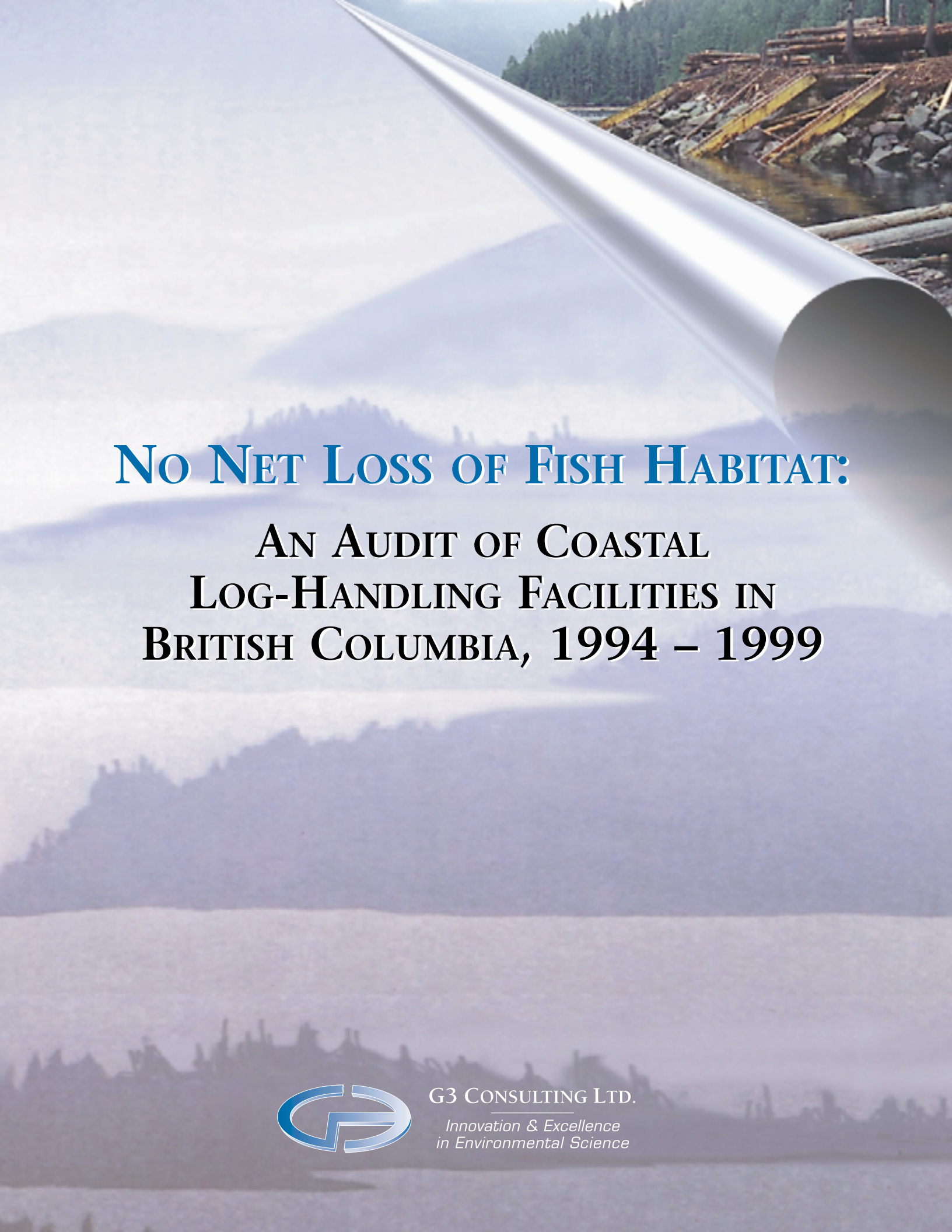

No Net Loss of Fish Habitat:

An Audit of Coastal Log-Handling Facilities in British Columbia, 1994 – 1999

G3 Consulting Ltd.

Innovation & Excellence in Environmental Science

No Net Loss of Fish Habitat: An Audit of Coastal Log-Handling Facilities in British Columbia, 1994-1999

Prepared for

The Habitat Assessment and Land Stewardship Unit (HALS)
of the Habitat and Enhancement Branch
Fisheries and Oceans Canada, Pacific Region,

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Cover Photograph:

Active log dump at Knox Bay, West Thurlow Island, November 1999.
(Discussed in Section 4.2.13).

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Abstract

Environmental management measures implemented 1994 to 1999 at log-handling facilities along coastal BC were audited to evaluate success of DFO objectives for No-Net-Loss (NNL) of fish habitat, and compare effectiveness of *Letters of Advice* to that of *Authorizations for Harmful Alteration, Disruption and Destruction* of fish habitat (HADD Authorizations). Of 35 files reviewed in detail (pertaining to 45 sites), 14 received field assessment. Habitat compensation sites available for field visits were limited to terrestrial sites, as dive surveys were beyond project scope.

NNL was achieved at only a few locations investigated. Temporary habitat loss was deemed acceptable by DFO staff in certain cases; other sites were anticipated to recover former levels of functionality following decommissioning and site rehabilitation. At a limited number of sites visited, prescribed compensation measures had failed to achieve initial objectives, or had created new habitat at the expense of other habitat types. In a few cases, it was not possible to state whether site-specific NNL had been achieved, as no post-implementation monitoring had been conducted. Further, environmental assessment and monitoring reports examined were of inconsistent quality and usability, as no standard reporting requirements or formats had been applied.

Procedural differences between DFO North and South Coast HEB Areas were evident. North Coast DFO tended to advise proponents to avoid the necessity for HADD Authorizations through strict siting criteria and limiting footprints of their facilities. Authorizations were more common on the South Coast, as many applications pertained to modifying existing facilities or to areas where compensatory habitat banks had been established. Notable difficulties were encountered with inconsistent file quality and management. It is recommended that DFO develop and implement a practical, convenient system that staff can follow and employ consistently.

Overall, compensation projects that aimed to restore habitat historically degraded by industrial activities appeared to provide greater benefit to ecological resources than creation of like-for-like habitat.

Key recommendations include that HADD Authorizations be applied consistently; that compensatory habitat be demonstrated as functional before habitat loss is incurred; and that environmental management initiatives of various levels of government, and within levels, be better integrated to address cumulative impacts. Other recommendations pertain to appropriate siting of log dumps; research on and use of artificial reefs; habitat rehabilitation and restoration vs. creation; habitat banking; appropriate compensation ratios and areal multipliers; standardizing procedures and record keeping, standardizing monitoring programs and making them mandatory, to be conducted by impartial parties; and locations for future site audits.

At several sites it developed, MOF Small Business Program appeared to be in non-compliant with DFO objectives. It is suggested that MOF work with DFO in developing Best Management Practices for coastal log-handling facilities.

Key Words: environmental audit; no-net-loss; log-handling facilities; artificial reefs; compensation ratios; habitat banking

Résumé

On a effectué un contrôle de l'efficacité des mesures de protection de l'environnement mises en oeuvre entre 1994 et 1999 par les industries de manutention du bois situées le long de la côte de la Colombie-Britannique, afin de déterminer si l'on avait atteint l'objectif du MPO de « 0 perte nette » d'habitat piscicole, et de comparer l'efficacité des *Lettres d'avis* à celle des *Autorisations de détérioration, destruction ou perturbation de l'habitat du poisson.* Des 35 dossiers étudiés (concernant 45 sites), 14 ont fait l'objet d'évaluations *in situ*. Les sites de remplacement de l'habitat qui étaient susceptibles d'être visités se sont limités aux sites des terres émergées puisque le projet ne prévoyait pas d'inspections en plongée.

L'objectif de 0 perte nette a été atteint dans quelques-uns seulement des sites visités. Les déperditions temporaires d'habitat ont été jugées acceptables par le personnel du MPO dans certains cas; d'autres sites devraient recouvrer leurs niveaux antérieurs de productivité après la cessation des activités perturbatrices et la remise en état des lieux. Dans un certain nombre d'endroits visités, les mesures de substitution prescrites n'ont pas donné les résultats escomptés ou ont eu pour effet de créer de nouveaux milieux aux dépens d'autres types d'habitats. Dans plusieurs cas, il n'était pas possible d'établir si l'objectif 0 perte nette pour le site en question avait été atteint, aucune surveillance à posteriori n'ayant été effectuée. Par ailleurs, l'évaluation environnementale et les rapports de surveillance étudiés se sont avérés de qualité et d'utilité inégales du fait qu'aucun critère standard de présentation ou de rapport n'avait été appliqué.

On a constaté des écarts de procédure entre les zones de la côte nord et de la côte sud de la DMVH. Dans la zone de la côte nord, on a tendance à recommander aux promoteurs de projets d'éviter de demander des *Autorisations de détérioration, destruction ou perturbation* dès lors qu'on respecte des critères très sévères d'implantation et qu'on limite les « empreintes » laissés sur le terrain. En revanche, dans la zone sud, les demandes d'autorisation sont plus nombreuses du fait qu'il s'agit souvent de modifier des installations existantes ou qu'il s'agit de sites où des banques d'habitats de substitution ont déjà été constituées. Des difficultés considérables ont été rencontrées pour ce qui est de la régularité de la qualité et de la gestion des dossiers. Il est recommandé que le MPO crée et mette en oeuvre un système commode et pratique, que le personnel pourra suivre et employer de manière systématique.

Dans l'ensemble, les projets de substitution visant à restaurer des habitats dégradés depuis longtemps par les activités industrielles semblent donner de meilleurs résultats que la compensation en nature.

Plusieurs recommandations importantes peuvent être faites : que la méthode des Autorisations de détérioration, destruction ou perturbation soit appliquée avec davantage de rigueur; que les habitats de compensation aient fait la preuve de leur productivité avant que ne survienne la déperdition d'habitat; que les initiatives de gestion de l'environnement des divers paliers de gouvernement, entre ceux-ci et au sein de ceux-ci, soient mieux intégrées, de manière à résoudre les impacts cumulatifs. Les autres recommandations concernent le choix de l'emplacement des dépôts de grumes; l'étude et l'exploitation des récifs artificiels; la formule consistant à réhabiliter et à restaurer l'habitat plutôt qu'à créer de nouveaux habitats; la formule consistant à constituer des « banques d'habitats »; l'établissement de ratios de compensation et de multiplicateurs surfaciques; la standardisation des méthodes et de la gestion des données; la standardisation des programmes de surveillance (et faire en sorte qu'ils soient obligatoires et qu'ils soient assurés par des parties impartiales); l'emplacement des futurs sites vérifiés.

Dans plusieurs sites qu'il a développés, le Programme de promotion des PME a semblé ne pas se conformer aux objectifs du MPO. Il est recommandé que ce ministère travaille de concert avec le MPO pour établir des pratiques de meilleure gestion concernant les installations côtières de manipulation des grumes.

Mots clés : AUDIT ENVIRONNEMENTAL; « 0 PERTE NETTE »; INSTALLATIONS DE MANIPULATION DES GRUMES; RÉCIFS ARTIFICIELS; RATIOS DE COMPENSATION; BANQUES D'HABITATS.

EXECUTIVE SUMMARY

G3 Consulting Ltd. was requested to conduct an audit of environmental management measures implemented at coastal log-handling facilities on behalf of Fisheries and Oceans Canada (Department of Fisheries and Oceans; DFO), Pacific Region. The purpose of the review was to investigate the success of DFO objectives for No-Net-Loss (NNL) of fish habitat, and to compare the effectiveness of mitigation measures suggested in *Letters of Advice* to that of Habitat Compensation Agreements pursuant to *Authorizations for Harmful Alteration, Disruption and Destruction* of fish habitat (HADD Authorizations). Project scope, as defined by DFO, included:

- brief review and synthesis of literature pertaining to impacts of log-handling facilities on coastal fish habitat, recovery from impacts, and best management practices;
- collecting referrals issued by DFO Nanaimo and Prince Rupert offices after January 1994 regarding log-handling facilities, including Letters of Advice, HADD Authorizations, compensation agreements, and monitoring reports;
- compiling and reviewing Letters of Advice and Authorizations with associated compensation agreements and monitoring reports;
- on-site NNL auditing of a subset of log-handling facilities in the North and South Coast HEB Areas; and,
- a written report summarizing the findings of both paper and field audits.

Good communications were maintained between G3 and the DFO Scientific Authority throughout this project, including four project review meetings. Report drafts underwent department review and subsequently review by eight members of the Marine Estuarine Working Group. Comments received from these reviewers were addressed to the extent possible within project scope.

Files on sixteen log-handling facilities in the North Coast HEB Area were reviewed in detail. Of these, eight received field assessment. Nineteen files on South Coast log-handling facilities were reviewed in detail, pertaining to 29 sites. Given that many sites in this region were subject to HADD Authorizations that required building compensatory reef habitat, the number available for non-dive surveys was limited to six; under terms of project scope, sites that required dive surveys were excluded from on-site audits of compensatory habitat. Several sites audited had been developed by the BC Ministry of Forests' Small Business Program.

Typical mitigation measures applied to the design of log-handling facilities included siting to avoid sensitive habitat, minimizing the "footprint" of the operation, and contouring the site to minimize risk of sedimentation of marine waters or contamination by fuel spills. Construction measures included timing "windows" to avoid critical fish spawning or migration periods, or use of clean rock fill. During operations, potential adverse impacts may have been minimized by ensuring log booming took place at a distance sufficiently offshore to avoid grounding of logs, containing fuels and other potential pollutants properly, and intercepting silt-bearing runoff water. Finally, decommissioning or deactivation included returning the site to a condition resembling adjacent natural areas, with a goal of achieving temporal no-net-loss of fish habitat.

When adverse impacts could not otherwise be mitigated, DFO may have issued HADD Authorizations accompanied by site-specific plans for habitat compensation, often developed in co-operation with the proponent. Compensation plans applied to projects reviewed during this program included replacing lost rocky intertidal habitat with the face of new rock fill, constructing intertidal marsh habitat, and creating artificial reefs.

NNL was achieved at only a few locations investigated. Temporary habitat loss was deemed acceptable by DFO staff in certain cases; e.g., some sites visited had suffered temporal habitat loss initially, but new habitat had eventually become established; other sites were anticipated to recover former levels of functionality following decommissioning and site rehabilitation. At a limited number of sites visited, prescribed compensation measures had failed to achieve initial

objectives (e.g., Knox Bay, West Thurlow Island; Campbell River Fibre, Menzies Bay), or had created new habitat at the expense of other habitat types (e.g., Brand Creek, Effingham Inlet; MacMillan Bloedel, Menzies Bay). In a few cases, it was not possible to state whether site-specific NNL had been achieved, as no post-implementation monitoring had been conducted to evaluate mitigation and compensation measures requested.

Procedural differences between DFO North and South Coast HEB Areas were evident. North Coast habitat management staff appeared more likely to advise proponents to avoid the necessity for HADD Authorizations through strict siting criteria and limiting footprints of their facilities. Authorizations were more common on the South Coast, as many applications pertained to modifying existing facilities or to areas where compensatory habitat banks had been established.

Notable difficulties were encountered during this audit program with inconsistent file quality and management. It is recommended that DFO develop and implement a practical, convenient system that staff can follow and employ consistently. Although possibly requiring additional office support resources, the quality and reliability of information obtained, reviewed and stored would be greatly enhanced.

Reports on environmental assessment and monitoring programs examined during this audit were of inconsistent quality and usability. It was evident that no standard reporting requirements or formats had been applied.

Several lessons were learnt during this audit pertaining to habitat protection, and what management practices are most advisable. Overall, compensation projects that aimed to restore habitat historically degraded by industrial activities appeared to provide the greatest benefit to ecological resources.

Based on this NNL audit of log-handling facilities, G3 Consulting Ltd. offers the following recommendations:

1. Apply HADD Authorizations to all applications for foreshore leases related to log-handling facilities on the BC coast expected to result in habitat loss.
2. Avoid temporal loss of habitat by ensuring that compensatory habitat is functioning before habitat loss is incurred.
3. Site log dumps on rocky foreshores with steeply sloping shorelines whenever possible, avoid excessive drop height, and compensate for habitat loss with rocky intertidal and subtidal structures.
4. Continue compensating for lost rocky intertidal habitat by constructing artificial reefs, provided that greater attention is paid to matching design with management objectives for target species.
5. In co-operation with an educational institution, establish a research reef along the BC coast that would enable longitudinal studies and habitat manipulation to test specific hypotheses relating reef ecology to their use as habitat management tools.
6. When using wetlands as compensatory habitat, emphasize the environmental management objectives of habitat rehabilitation and restoration, over that of habitat creation.
7. Conduct further and more comprehensive reviews of available literature on compensatory habitat reefs and saltmarsh rehabilitation, creation and management, and make this information available to regional managers.
8. Continue using artificial reefs as habitat banks, provided that habitat management goals are first identified and then met by reef design.
9. Research and develop a policy for habitat banking, using practices in other jurisdictions (e.g., US) as models.

10. Integrate DFO habitat protection and rehabilitation programs with other federal and provincial initiatives, such as the BC Watershed Restoration Program, Fisheries Renewal BC, and regional planning processes.
11. Place greater emphasis on addressing adverse cumulative impacts of all shore-based industries in a given region, rather than addressing adverse impacts piecemeal and project-by-project.
12. Develop a process that facilitates freer exchange of information among government departments, divisions within departments, and different levels of government to enable integrated planning and assessment of cumulative impacts (e.g., a central geographically keyed database accessible to all levels of government).
13. Apply a minimum ratio of compensatory habitat to lost habitat of 1:1 only when replacement habitat of a similar or superior type is already available and functioning within 1 km, thereby avoiding temporal habitat loss. In all other cases, apply a ratio greater than 1:1.
14. Use a multiplier of twice the footprint to determine the amount of habitat provided by artificial reefs.
15. Wherever practical, relocate fauna before dumping fill and move them to appropriate habitat nearby or use them to "seed" compensatory habitat.
16. Develop standardized guidelines and procedures for the consulting community to apply when conducting environmental assessments and preparing reports.
17. Implement formal, standardized environmental monitoring programs at log-handling facilities under DFO jurisdiction.
18. Make project approval contingent on the ability to monitor a site.
19. Develop a monitoring guidance manual for DFO staff that includes a process of keeping it updated.
20. Ensure that monitoring is conducted by independent, impartial parties.
21. In co-operation with the consulting community, develop monitoring and reporting procedures, and implement training programs to help ensure consistency.
22. Base monitoring duration and frequency on site-specific ecological attributes and the type of compensatory habitat, and adapt the schedule in response to monitoring results; a general guideline would be to monitor artificial reefs annually for three years and created marshes in years 1, 2, 5 and 10.
23. Retain performance bonds or letters of credit until a minimum of two years of monitoring have been completed.
24. Establish and implement efficient record-keeping and filing procedures that staff will understand and use.
25. Conduct additional site audits in 2000-2001 at the Queen Charlotte Islands, Bute Inlet, Broughton Archipelago and the Lower Mainland, to include, at minimum, evaluation of one large habitat banking reef, such as that located at Charlotte Point, and possibly freshwater sites.

Forest companies applying for Crown Land leases have expressed frustration with inconsistent process and expectations on the part of DFO. Establishing a clear, easy to follow set of internal procedures, and a standard format for environmental assessment and monitoring reports, would significantly assist applicants. At several sites it developed, MOF appeared to be non-compliant with DFO objectives. It is suggested that MOF work with DFO to develop Best Management Practices that can be applied consistently.

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1.0 INTRODUCTION

G3 Consulting Ltd. (G3) conducted this audit of environmental management measures implemented at coastal log-handling facilities on behalf of Fisheries and Oceans Canada (Department of Fisheries and Oceans; DFO), Pacific Region. The purpose of the program was to investigate the success of DFO objectives for No-Net-Loss (NNL) of fish habitat, and to compare the effectiveness of mitigation measures suggested in *Letters of Advice* to that of Habitat Compensation Agreements pursuant to *Authorizations for Harmful Alteration, Disruption and Destruction* of fish habitat (HADD Authorizations). Intended to provide DFO habitat management staff with guidance in developing a consistent approach for applying the national *Policy for the Management of Fish Habitat* (1986), recommendations made in this report include ones related to:

- best management practices for protecting fish habitat values at log-handling sites;
- guidelines for conducting pre- and post-construction assessments;
- compensation ratios for affected habitat;
- timeframes for monitoring compensatory habitat; and,
- siting of log-handling facilities to minimize potential deleterious impacts.

NNL is a national guiding principle of the conservation goal of the habitat policy. Challenges in determining whether DFO NNL objectives are being met comprise three categories: 1) proponent-related; 2) scientific authority-related; and 3) receiving environment-related. Questions the audit was intended to answer on a site-specific basis may be nested within a decision-tree and included:

Under successful mitigation or compensation:

Was this due to correct implementation of Letter of Advice or Compensation Plan?

- If so, can this be replicated?
- If not, what occurred?

Under unsuccessful mitigation or compensation:

- Was the Letter of Advice or Compensation Plan implemented correctly?
- If so, was the advice given appropriate?
- If so, did any receiving-environment factors or unforeseen events interfere?
- If not, can this failure be prevented by policy change?
- If not, was the reason a lack of due diligence that could be prevented through policy change (e.g., more policing or fines), or insufficient direction or capability that may be prevented through a change in policy (e.g., increased education, supervision, or communication)?
- If not, would procedural changes prevent similar scenarios in the future (e.g., ways in which files are handled, additional site visits and adaptive management)?

1.1 Audit Terms of Reference

Project scope, as defined by DFO, included:

- brief review and synthesis of literature pertaining to impacts of log-handling facilities on coastal fish habitat, recovery from impacts, and best management practices;
- collecting referrals issued by DFO Nanaimo and Prince Rupert offices after January 1994 regarding log-handling facilities, including Letters of Advice, HADD Authorizations, compensation agreements, and monitoring reports;

- compiling and reviewing Letters of Advice and Authorizations with associated compensation agreements and monitoring reports;
- on-site NNL auditing of a subset of log-handling facilities (approximately 10% to 15%), including equal representation of Letters of Advice and HADD Authorizations, an equal number for the South Coast Habitat and Enhancement Branch (HEB) Area and North Coast HEB Area, and sites of different ages; and,
- a written report summarizing the findings of both paper and field audits.

A draft of this report was reviewed by eight members of the DFO Marine Estuarine Working Group. Comments received have been addressed to the extent possible within the project scope.

1.2 Application & Limitations

This audit was intended to benefit DFO Habitat Management staff, industry, the Canadian public, and the natural environment in several ways by evaluating:

- consistency of DFO processes for applying the National Habitat Policy;
- whether the goal of no-net-loss of fish habitat is being achieved;
- whether improvements may be made in decision-making criteria provided to DFO staff;
- ways to reduce uncertainty among industry as requirements become standardized in time and space, rather than differing among DFO jurisdictions; and,
- ways to achieve greater qualitative and quantitative efficiency in mitigating harmful industrial impacts and compensating habitat losses.

It is intended that this report constitute part of ongoing review of DFO policy and process, and compliment other reports contributing to standardization at regional and national levels (e.g., a recent report by KPMG: Drodge *et al*., 2000).

Approximately 90 files were obtained from DFO regional offices in Nanaimo and Prince Rupert, and from sub-regional offices in Bella Coola, Queen Charlotte City, and Port Hardy. Of that total, 35 files, pertaining to 46 individual log-handling facilities, were given thorough review and “paper audit”. Remaining files were not audited as they pre-dated 1994, pertained to facilities proposed but not yet built, or contained insufficient information (e.g., no Letter or Authorization) and additional information could not be located by DFO.

Several constraints limited the ability to conduct on-site audits. Most important was that the available budget precluded dive surveys. Substantial components of habitat compensation projects at 24 log-handling sites involved creation of subtidal reefs or other structures that could not be assessed without diving. Attending those sites to examine other mitigation measures would not have likely provided meaningful information, as no assessment of NNL would have been possible. Furthermore, some reefs were created as “habitat banks” to compensate habitat losses at several sites, making visits to those sites to examine mitigation measures even less relevant to assessing success or failure of NNL policy.

Additional constraints to field audits were season and attendant safety concerns. As the project began in August 1999, and delays were experienced obtaining and reviewing a sufficient number of files, fieldwork could not begin until late autumn. Weather conditions restricted travel to some North Coast sites that might have been better accessible in summer.

Given the limited number of files reviewed and on-site audits conducted, caution must be applied when extending site-specific findings to draw general conclusions. Statistical inference should also be avoided. For example, as the total number of dumpsites constructed since 1994 is unknown, the proportion reviewed is also uncertain. Also

unknown is the number of applications that either were not approved, or did not proceed for some other reason, such as changes in proponent operating plans. Comments made with respect to a particular piece of created habitat apply only at that location and time.

1.3 Study Area

Log-handling facilities investigated during this program were situated within the North Coast and South Coast HEB Areas.

1.3.1 North & Central Coast

The North Coast HEB Area includes the north coast of British Columbia, portions of the central coast north of Cape Caution, coastal islands, and the Queen Charlotte Islands. Files on sixteen log-handling facilities situated in this region were reviewed (Figure 1). Of these, nine were selected for field visits; weather, however, made one site (Ingram Bay) inaccessible during field audits. Table 1-1 summarizes site locations and type of audit conducted at each.

TABLE 1-1:
North & Central Coast No-Net-Loss Audit Sites

Site[1]	Name	Location	Category	Audit Type
N01	Fog Creek	King Island	Mitigation	Paper & Field
N02	Frenchman Creek	Dean Channel	Mitigation	Paper & Field
N03	Ingram Bay	Spiller Inlet	Mitigation	Paper
N04	Draney Inlet	Rivers Inlet	Mitigation	Paper
N05	Cousins Inlet	Dean Channel	Mitigation	Paper & Field
N06	Surf Inlet	Princess Royal Island	Not Approved	Paper
N07	Big Tillhorn River	Hawksbury Island	Unknown	Paper
N08	Lina Island	Queen Charlottes	Mitigation	Paper
N09	Chadsey Creek	Queen Charlottes	Mitigation	Paper
N10	Beattie Anchorage	Queen Charlottes	Mitigation	Paper
N11	Sandilands Island	Queen Charlottes	Mitigation	Paper
N12	East Gribbell Island	Ursula Channel	Mitigation	Paper & Field
N13	Goat Harbour	Ursula Channel, Mainland	Mitigation	Paper & Field
N14	Trip Creek	Triumph Bay, Mainland	Mitigation	Paper & Field
N15	Verney Passage	Mainland	Mitigation	Paper & Field
N16	Verney Pass Creek	Hawkesbury Island	Mitigation	Paper & Field

1. N = North Coast site number

1.3.2 South Coast

The South Coast HEB Area comprises portions of the BC mainland coast south of Cape Caution, coastal islands and Vancouver Island. For purposes of this study, only regions under jurisdiction of the Nanaimo regional office were included (including sub-regional offices in Port Alberni, Campbell River, Port Hardy, Bella Coola and Queen Charlotte City). Nineteen South Coast files on log-handling facilities were reviewed, pertaining to 29 sites (Figure 2). As many sites in this region were subject to HADD Authorizations that required building compensatory reef habitat, the number available for non-dive surveys was limited to six. Egerton log dump (Bute Inlet) has not yet been constructed.

South Coast files reviewed, and the type of audit conducted at associated sites, are listed in Table 1-2.

TABLE 1-2:
South Coast No-Net-Loss Audit Sites

Site1	Name	Location	Category	Audit Type
S01	London Point	Thompson Sound	Mitigation/Compensation	Paper
S02	Mount Connolly	Sutlej Channel	Mitigation/Compensation (habitat bank reef)	Paper
S03	Elaine Creek	Gilford Island	Mitigation/Compensation (habitat bank reef)	Paper
S04	Discovery Passage	Discovery Passage	Mitigation/Compensation	Paper
S05	Menzies Bay, MacMillan Bloedel	Vancouver Island	Mitigation/Compensation	Paper & Field
S06	Hovel Bay; Moh Creek; Bear Bay; Orford Bay	Bute Inlet	Mitigation/Compensation (habitat bank reef)	Paper
S07	Silverado Creek	Vancouver Island	Mitigation/Compensation	Paper
S08	Harbledown Island	Broughton Archipelago	Mitigation/Compensation (habitat bank reef)	Paper
S09	Kingcome Inlet	Broughton Archipelago	Mitigation/Compensation (habitat bank reef)	Paper
S10	Snowdrift; Cavern Cove; Skeene Bay; Sir Edmund Bay; Tribune Channel; Charlotte Point; Seymour Inlet; Salmon Arm; Frederick Sound	Broughton Archipelago	Mitigation/Compensation (habitat bank reef)	Paper
S11	Brand Creek	Vancouver Island	Mitigation/Compensation	Paper & Field
S12	Menzies Bay, Campbell River Fibre	Vancouver Island	Mitigation/Compensation	Paper & Field
S13	Knox Bay	West Thurlow Island	Mitigation/Compensation	Paper & Field
S14	Harmac Chip Mill	Vancouver Island	Mitigation/Compensation	Paper
S15	Rosewall/Mud Bay	Vancouver Island	Mitigation/Compensation	Paper & Field
S16	Egerton	Bute Inlet	Mitigation/Compensation	Paper
S17	Valdes Island	Strait of Georgia	Mitigation/Compensation	Paper
S18	Michelsen Point	Vancouver Island	Mitigation/Compensation	Paper & Field
S19	Kinnaird Island	South Coast	Mitigation/Compensation	Paper

1. S = South Coast site number

Figure 1: Approximate Locations of North Coast No-Net-Loss Audit *Sites*.

Figure 2: Approximate Locations of South Coast No-Net-Loss Audit Sites.

1.4 Background

This section describes the policy context in which this audit of log-handling facilities was conducted, and summarizes potential environmental effects of such operations.

1.4.1 No-Net-Loss Policy Context

DFO first proposed a policy of No-Net-Loss (NNL) of productive capacity of fish habitats in a 1983 discussion paper (cited by Langer, 1995). In 1986, NNL was adopted as part of the *Policy of the Management of Fish Habitat* (DFO, 1986). The policy objective of "net gain of habitat for Canada's fisheries resources" seeks to "increase the natural productive capacity of habitats for the nation's fisheries resources, to benefit present and future generations of Canadians." Net gain of habitat has three goals:

1. Fish Habitat Conservation;
2. Fish Habitat Restoration; and,
3. Fish Habitat Development.

The first goal, that of fish habitat conservation, has the guiding principle of NNL, to be achieved through such measures as:

- relocating proposed developments to alternative sites to avoid damage to habitats of higher value;
- reducing impacts of proposed development by applying mitigation measures, such as building around sensitive habitat; and,
- building compensation habitat where impacts would be unavoidable and the project is in the public interest.

The quantity of compensatory habitat that may be requested from a proponent is based on ratios determined from several criteria, including whether habitat is of the same type (like-for-like), different type (like-for-unlike), or of enhanced quality, and the estimated lag time before new habitat is considered productive. For example, DFO established a 2:1 replacement ratio for marshes in the Fraser River Estuary on the basis that newly created compensation marsh could be expected to take 5 to 10 years to become fully productive (Langer, 1995). On the other hand, a ratio of 0.5:1 was established for marsh habitat used to replace mudflats, as marshes were considered habitat of potentially higher value.

DFO has two procedures for ensuring proponents of log-handling facilities fulfill NNL policies. If habitat damage can be fully mitigated on-site, DFO outlines appropriate mitigation measures to the proponent in a Letter of Advice. If harmful habitat impacts cannot be fully mitigated, DFO requires proponents compensate for such damage. A Habitat Compensation Agreement is legally binding under an Authorization for Harmful Alteration, Disruption, or Destruction (HADD) of fish habitat, as defined by the federal *Fisheries Act*, Subsection 35 (2). DFO (1998) recently developed a decision framework for staff to use when determining magnitude and extent of HADD and authorizing such impacts.

Requirements under Letters of Advice and Habitat Compensation Agreements may vary among Pacific Region DFO offices, complicating assessment of whether the goal of NNL is being achieved. This audit is intended to aid DFO in developing an approach for applying the National Habitat Policy in a consistent manner.

1.4.2 Potential Environmental Effects of Log-Handling Facilities

Given the fjordic, mountainous coast with limited road accessibility, more than 90% of the annual log harvest in coastal BC is reliant on water-based transportation, storage and handling (Sloan, 1996). Coastal log-handling facilities have the potential to degrade nearshore and intertidal habitat. Invertebrate and plant communities may be subject to alienation of habitat by accumulation of wood debris, reduced light intensity, and such mechanical affects as compaction and scouring of soft substrates, and scouring and abrasion of hard substrates. Adverse water quality impacts may also result, including effects from decomposition of debris and spills of fuels and lubricants. Such degradation affects fish and other organisms at higher trophic levels.

Effects of log storage on habitat of juvenile salmonids in BC have been investigated by Levy *et al*. (1982) and Power and Northcote (1991). Sedell *et al.* (1991) provided a thorough summary of habitat disturbances caused by log handling along coastal BC. Sloan (1996) examined environmental impacts in the context of sustainability of fisheries values in the Strait of Georgia. Kirkpatrick *et al.* (1998) assessed effects of deep-water bark accumulation on benthos richness at log transfer and storage facilities off Prince of Wales Island, Alaska. A recent study by Williamson *et al*. (1999) assessed the biological effect of accumulated wood debris at log dumps along the BC north coast. Potential impacts reported by these investigators are briefly summarized in Table 1-3.

TABLE 1-3:
Summary of Potential Environmental Impacts of Coastal Log Handling

Impactor	Circumstance	Affected Ecosystem Component	Impact
accumulation of wood & bark debris	free-fall log watering; sorting in water; unbundled logs; poor site flushing.	substrate & sediments	intertidal scouring at low tide; compaction from log grounding & sinking; decreased oxygenation; high biochemical oxygen demand (BOD); generation of high H_2S and leachate levels.
		vegetation	decreased diversity & productivity.
		invertebrates	habitat loss; direct destruction; decreased diversity, biomass & fecundity.
		fish	reduced food supply
log storage	lengthy/extensive storage; decreased currents; breakwater effect; log manipulation; propeller wash.	substrate & water column	shading; greater sedimentation; enhanced leachate levels; intertidal compaction & sediment scouring.
		benthic infauna	restricted habitat due to compaction; anoxic horizon closer to sediment surface.
log storage & transport	coastal modifications	fish	loss of spawning & feeding habitat; pollution (litter, sewage, fuel spills).
		aquatic birds & mammals	loss of habitat for some species, gain for others, leading to altered species composition.

2.0 AUDIT METHODOLOGY

This section describes methodologies and approaches developed and employed during this NNL audit. G3 maintained good communication with the DFO Scientific Authority throughout this program. Liaison began with a startup meeting during August 1999, and continued by telephone and E-mail. Three additional progress-report meetings were also held at DFO, and a draft report underwent thorough review by the Marine Estuarine Working Group.

2.1 Literature Review

The program began with a search and review of available and relevant literature, previous studies and assessments pertaining to impacts of log-handling facilities on fish habitat, recovery from impacts, and best environmental management practices. Sources of information sought included educational institutions, industry, and government agencies (e.g., DFO, Environment Canada, BC Environment, Washington Department of Natural Resources, Oregon Department of Natural Resources, Alaska Department of Environmental Conservation, US Environmental Protection Agency, NOAA, and US Army Corps of Engineers). A thorough and comprehensive literature review was beyond the scope of this project.

2.2 Obtaining Referrals Files

During the period of literature review, G3 requested DFO offices in Nanaimo and Prince Rupert provide referrals files pertaining to log-handling facilities, including Letters of Advice, HADD Authorizations, compensation agreements and monitoring reports, issued since January 1994. Available materials were subsequently forwarded to G3 and relevant portions duplicated. Obtaining files was an involved process, given the varying status of files and inconsistent file management processes among DFO offices.

2.3 Compiling & Reviewing DFO Files

Once obtained from DFO offices, file contents were reviewed, and contents of Letters of Advice, HADD Authorizations, and associated compensation agreements and monitoring reports summarized. For each log-handling facility given on-site assessment, relevant information was compiled on standardized summary sheets, partly modelled on those of a previous NNL audit by Kistritz (1995). Completed No-Net-Loss Evaluation Summary sheets are provided in Appendix 1. For each facility, available information summarized included:

- project name and proponent;
- nature, scope and scale of project;
- location and UTM co-ordinates;
- fish habitat type and features affected, including vegetation type;
- fish habitat impacts;
- compensation requested and rationale for approach;
- features of mitigation measures and/or compensatory habitat;
- dates of impact, construction, and building of compensatory habitat, and any previous on-site inspections and monitoring program;
- list of documentation and contact persons;
- additional comments on site history and implementation of compensation;
- a Habitat Balance table summarizing habitat types and their areas lost to the project and gained through compensation, and net totals of each habitat type;

- identification of any requirement for remedial action; and,
- a statement of whether or not the NNL guideline was successfully achieved.

A fish habitat classification framework developed for DFO by Williams (1990) was applied where applicable during paper and on-site audits.

2.4 Design of On-Site NNL Audits

On-site NNL audits of selected log-handling facilities was to provide information not previously known with respect to implementation of mitigation and compensation measures, or to confirm or update previous audit information. Such information then facilitated completion of summary sheets (described in Section 2.3) and formed the basis of assessments of compliance and whether or not the NNL objective had been maintained.

2.4.1 Assessment Criteria

On-site audits included:

- a photographic record of projects and related fish habitat;
- where feasible, measurements of approved and actual footprints (dimensions) of log-handling facilities; and,
- physical and biological descriptions of affected habitat, compensatory habitat, and mitigation sites.

Level of functioning of compensatory habitat was determined from visual observation by biologists experienced in identifying habitat requirements. When available, nearby natural habitat of similar type was examined and compared as reference.

2.4.2 Site Selection Criteria & Screening Process

DFO specified that on-site NNL audits be conducted of representative log-handling facilities, based on the stipulations that:

- Letters of Advice and HADD Authorizations be equally represented;
- an equal number of audits be completed for the South Coast and North Coast HEB Areas to enable comparison of policies implemented by DFO offices in Nanaimo and Prince Rupert; and,
- sites of different ages be represented in the audit.

DFO initially estimated that 150 to 170 referrals files would be applicable to this program. Of these, a representative sample for site visits would be expected to constitute approximately 10 % to 15% of sites. It had been anticipated that a series of selection criteria would be applied in order to determine where to conduct field audits, and that statistical program design might be applied to minimize sampling bias and to establish defensible study endpoints. As fewer files were available, sites were selected for field audit on the basis of:

- whether they could be assessed without diving;
- whether they were accessible (e.g., prevailing weather)
- efficient use of time and budgetary resources; and;
- relevance and value of information to be obtained.

2.5 General Field Assessment Methodology

Fieldwork entailed visiting representative log-handling sites along coastal BC. South Coast sites visited were accessible by road and by floatplane, while North and Central Coast sites visited required float planes and helicopters.

As applicable, the following general activities were undertaken during field assessments:

- a series of photographs was taken of the log-handling facilities, habitat compensation site, and any applicable reference site;
- additional observations and data were recorded in field notebooks;
- relevant measurements were made with hip chain, measuring tape and range finder;
- general setting of any compensatory habitat and available reference sites were described, including flora and fauna observed;
- vegetation voucher samples were collected for later identification, as warranted; and,
- vegetation plot surveys (described below) of the compensatory habitat and a nearby reference location (if available) were conducted (where applicable).

2.5.1 Plot Survey Method

The general plot survey method was developed to be both systematic and site representative. Slight modifications are necessary when applying this method at given site, depending on local topography and shape of units to be assessed. This method was applied when assessing functionality of intertidal marsh created at the Brand Creek site:

- data were recorded on a “Vegetation Plot Survey” form (Appendix 2);
- dimensions of the compensatory site were measured;
- a straight line near the site perimeter was staked and flagged at intervals of 1/10 the total length, numbered 0 through 10 (including endpoints);
- along a straight line parallel to the long axis of the site, measuring tape was used to mark perpendicular transects from percentiles 20, 50 and 80;
- a 1 m X 1 m quadrat (constructed from metre sticks) was placed at 3 locations along the left edge of each transect (facing inland), one at or near the centre and one approximately equidistant between centre and each edge, or within apparent zonation patterns;
- an identifying number was placed in each plot and the plot photographed,
- total vegetation cover in each plot was estimated, using a standard reference diagram;
- the number of individuals or stems of each plant species was counted in each plot;
- plot substrates were described and categorized;
- the form was completed and a sketch plan of the site and plots locations was drawn.

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3.0 REVIEW OF RELEVANT ENVIRONMENTAL MANAGEMENT TECHNIQUES

This section provides a brief overview of the types of environmental management options available to address adverse impacts of log-handling facilities. Rather than being a comprehensive literature review, this section is intended to provide background with regard to techniques that have been applied in BC and the constraints and opportunities they present.

There is, as yet, no central repository of Best Management Practices (BMPs) specific to coastal log-handling facilities in BC. A similar situation exists in the US Pacific Northwest. Very little marine log handling is conducted in Oregon or Washington, as most log transport is by road or rail (J. McCauley, 2000, pers. comm.). In Alaska, the US Environmental Protection Agency and state Department of Environmental Conservation are currently implementing a renewed program to regulate and permit discharge of bark and wood debris from "log transfer facilities," but there are no BMPs specific to onshore aspects of log handling and habitat loss (D. Sturdevant, 2000, pers. comm.). If BMPs are developed for BC, "it may be a first" (H.B. Hill, 2000, pers. comm.).

3.1 Mitigation of Adverse Environmental Effects

Given the high potential for environmental sensitivity of coastal marine habitats, and resultant high level of potential public scrutiny, prudent mitigation programs are typically requested of proponents applying for foreshore leases to develop log-handling facilities. "Mitigation" refers to measures undertaken during design, construction, operations and decommissioning phases of development projects to minimize adverse environmental impacts and secure permit approvals.

Typical mitigation measures applied to design of BC log-handling facilities include siting to avoid sensitive habitat, minimizing the "footprint" of the operation, and contouring the site to minimize risk of sedimentation of marine waters or contamination by fuel spills. Construction measures may include timing "windows" that avoid critical fish spawning or migration periods, or use of clean rock fill to build the sortyard and running surface. During operations, potential adverse impacts may be minimized by ensuring log booming takes place at a distance sufficiently offshore to avoid grounding of logs, containing fuels and other potential pollutants properly, and intercepting silt-bearing runoff water. Finally, decommissioning or deactivation may include returning the site to a condition resembling adjacent natural areas, with a goal of achieving temporal no-net-loss of fish habitat.

In Alaska, log transfer facilities (LTF) guidelines and state and federal permits stipulate certain siting criteria to be followed (Kirkpatrick *et al*., 1998; D. Sturdevant, pers. comm.). Requirements include selecting sites with relatively unproductive intertidal and subtidal zones, minimizing speed of log bundle drop, limiting the zone of bark deposit (ZOD) to 1 acre, and annual monitoring for bark accumulation at all active LTFs. Monitoring requirements include establishment of permanent transects for measuring areal extent, thickness, and percent coverage of bark debris. No studies have yet been conducted to determine regional effectiveness of the guidelines in minimizing impacts on the marine environment (Kirkpatrick *et al*., 1998).

A document containing standard Environment Canada mitigation requests, often included in Canadian Environmental Assessment Act (CEAA) reviews, is provided in Appendix 3.

3.2 Compensation & Habitat Replacement

When adverse impacts cannot otherwise be mitigated, DFO may issue an HADD Authorization accompanied by a site-specific plan for mitigative compensation, often developed in co-operation with the proponent. Compensation plans applied to projects reviewed during this program included replacing lost rocky intertidal habitat with the face of new rock fill, constructing intertidal marsh habitat, and creating artificial reefs. These

methods are briefly described below, followed by discussions of applicable compensation ratios, functional habitat replacement, and habitat compensation banking. Particular attention has also been given to experience in adjoining US jurisdictions.

3.2.1 Rock-Fill Faces & Rocky Intertidal Habitat

Compensatory mitigation of the effects of many investigated log-handling facilities included habitat that was predicted to be supplied in the future by the rock fill itself. It was expected that the rock fill face would eventually function in a similar way to natural rocky intertidal habitat, and become substrate for algae (e.g., rockweed, *Fucus distichus*) and epifauna. At one site (Knox Bay, West Thurlow Island), additional intertidal rock fill was placed in the form of several finger-groynes adjacent to the dumpsite.

The balance sheet of compensatory habitat being created was calculated by subtracting the "footprint" of rock fill as lost habitat, and adding the surface area of deposited fill, multiplied by a factor that accounted for three dimensional structure and interstices among the rocks. In this way, the facility foundation itself would supply compensatory habitat during operations, and was expected in many cases to increase habitat functionality over time following decommissioning of the site.

Not accounted for by such compensatory mitigation is the time lag between HADD and development of functional habitat. Implicit is the assumption that "extra" surface area eventually supplied by rock fill and interstices at time "B" would compensate for habitat lost at time "A." Net loss can only be avoided by requiring compensatory habitat be in place before HADD occurs. Such issues are further discussed in Section 5.

3.2.2 Artificial Subtidal Reefs

Habitat compensation prescribed for a majority of log-handling facilities in the South Coast HEB Area investigated during this program consisted of constructing artificial subtidal reefs. Reefs were noted to be particularly favoured by some DFO jurisdictions as tools of habitat banking.

The practice of constructing artificial reefs to increase habitat complexity and vertical relief of relatively unproductive sandy sea bottoms and attract recreationally important bottomfish has long been an accepted and proven technique used throughout the world (Naito, 1991). It has been demonstrated (e.g., Jessee *et al*., 1985) that fish use high relief structures placed on generally featureless sandy seabottoms as focal points for orientation, food sources, and shelter from predators.

In late November 1987, Naito (1991) surveyed an artificial reef constructed in 1984 at French Creek, BC (near Parksville) by Public Works Canada to enhance marine fish habitat. The reef consisted of two subtidal riprap groynes projecting from the foreshore. In four years marine life on the reef had become well established, with an abundant fish community comprising individuals of all size classes. A large number of juvenile fish indicated that the reef may constitute a nursery area. Biodiversity and abundance of algae and invertebrates were also high. By comparison, biodiversity, density and biomass of fish on neighbouring sand seabed were lower. Naito (1991) cautioned that reef construction may bury benthic macroinvertebrates in substrate materials, and reefs placed along migration routes may increase exposure of juvenile salmonids to predators.

Research at experimental artificial reefs in the US (e.g., the San Luis Obispo County Artificial Reef [SLOCAR] along the coast of central California) has demonstrated that reef design may be manipulated in order to address a variety of management objectives. For example, for an artificial reef to support independent fish populations, Turner *et al*. (1969) and Jessee *et al*. (1985) recommended that reefs be placed a minimum of 600 m from existing habitats. If the goal of an artificial reef is to replace or enlarge portions of natural communities, then the reef should be placed within 600 m of existing natural habitats,

enhancing immigration of invertebrates and recruitment of algae and fish to both artificial and natural habitats (Danner *et al*., 1994). Artificial reefs situated in close proximity to areas that support diverse communities of flora and fauna may become extensions of the natural habitat and increase successful recruitment of fishes, rather than habitat islands that may concentrate fish in a marginally productive habitat (Carter *et al*., 1985). In the Florida Keys, artificial reefs placed within 25 m of natural reefs did not diminish the resident population, as most fish tended to recruit as juveniles (Stone *et al*., 1979).

It is suggested that an integrated approach to fisheries management that includes artificial reefs be cognizant of the efficacy of reef designs in meeting life history requirements of target species. There is, therefore, a need to thoroughly evaluate and provide requirements of juveniles (Bohnsack and Sutherland, 1985; West *et al*., 1994). Artificial reefs have tended to primarily provide habitat for large, adult fish, and, where this is the management objective, they have been successful in that adult populations may exceed those of natural habitats (e.g., rockfish in Puget Sound; Buckley and Hueckel, 1985; Hueckel and Buckley, 1989). As many target fish species are carnivorous, there is a potential for juveniles recruiting to artificial reefs to be subject to abnormally high predation unless suitable refuge habitat is provided (West *et al*., 1994).

Hixon and Beets (1989) demonstrated in the Caribbean that the number of fish a reef can shelter is directly related to the number of holes or crevices and inversely related to the size of the holes when the number of holes is kept constant. Investigations by West *et al*. (1994) suggested that low-relief artificial habitat attracts juvenile rockfish, independent of depth, and that they may avoid high-relief portions of a reef. Juvenile rockfish responded to characteristics of habitat structure similarly to adult rockfish, but on a much smaller scale. Anderson *et al*. (1989) investigated interrelationships of numerical density, biomass density, and body size and found that juveniles and small-bodied fish tend to have more-specialized habitat requirements, and, therefore a greater need for shelter, than do large-bodied or older life staged fish.

Working in Puget Sound, Hueckel and Buckley (1989) developed a methodology of using indicator species from natural reefs to predict future species assemblages on artificial reefs, as biota in a given area provide an analytical tool for translating complex biological and physicochemical parameters into a simple indicator of environmental quality. These researchers drew the analogy that biota of marine environments essentially perform *in situ* multivariate biological analyses of physicochemical parameters of their ecosystem.

Matthews (1985) and Samples and Sproul (1985) demonstrated that artificial reefs may attract and concentrate fish from marginally productive areas low in biomass, redistributing biomass and concentrating fish in one area and promoting removal by sport fishermen. Since the mid-1980s the issue of attraction-production has been the subject of much debate and research (Seaman, 1997). To what extent do artificial reefs concentrate existing populations, and to what extent do they increase net productivity? Critics argued that, if artificial reefs merely aggregate fish, then continuing to construct them would not serve a conservation ethic, and artificial reefs would best be viewed as fishing gear (Lindberg, 1997).

A series of papers published in the American Fisheries Society journal *Fisheries*, 1997 Vol. 22(4) and 1998 Vol. 23(3) reviewed the attraction-production debate in detail. Lindberg (1997) summarized the applicable scientific questions as follows.

(1) By what mechanisms or processes might artificial reefs enhance fish production (e.g., reduce habitat limitation on larval settlement, alleviate post-settlement demographic bottlenecks, enhance bottom-up production within reefs, or facilitate trophic coupling to off-reef production)? These constitute alternative, but not mutually exclusive, hypotheses.

(2) Are any of these mechanisms or processes affected by characteristics of artificial reefs (e.g., structural complexity, location, reef dimensions, densities or patchiness). The null hypothesis to be tested is “no effect” under conditions in which you would most expect an effect from specific processes.

(3) Can the rates of processes, confirmed under question 2, be shifted favorably (sic) relative to control conditions? Whereas question 2 can be answered by reef-to-reef comparisons, this question requires rate estimates and a contrast with productivity in appropriate natural habitat. The designation of what is appropriate deserves careful consideration.

(4) If the answers to questions 2 and 3 are “yes,” then is the gain in productivity or production sufficient to offset associated fishing mortality? Ultimately, this is the important question for *sustainable* reef fisheries.

As Seaman (1997) noted, other questions may be of greater significance than attraction-production. For example, how are specific life history requirements of individual target species met by artificial reefs? This question is an important one for DFO. Use of reefs for habitat banking, common at sites investigated during this audit, requires “generic” reef design and little opportunity for application of species-specific management strategies.

3.2.3 Intertidal Marshes

A small number of compensatory projects examined in this report involved creation of intertidal marshes to either replace lost marsh habitat or augment marshes adjacent to an area of adverse impact.

Mitigation through creation of compensatory wetland habitat is practiced more widely and intensively in the US than in Canada, to replace wetlands lost to a wide range of development projects (e.g., shopping centres, highways, suburban developments and coastline manipulation). The US Environmental Protection Agency (EPA) and the US Army Corps of Engineers signed a Memorandum of Agreement in 1990 endorsing a national goal of NNL of wetlands acreage and function, first recommended by the National Wetlands Policy Forum in 1989. In Washington State, the *Shoreline Management Act* is aimed at minimizing ecological damage of shoreline areas, the Hydraulic Code has the purpose of protecting fish and fish habitat, and the Puget Sound Water Quality Authority has adopted the NNL into the Wetlands Protection Element of their management plan. The state’s *Growth Management Act*, enacted in 1990, requires local governments to protect ecologically significant areas, including wetlands (Castelle *et al*., 1992). Through these mechanisms, NNL in Washington is enforced at the federal, state and local levels.

Controversy has been engendered by uncertainty as to how to create and restore these important ecosystems, and what constitutes “success” of new wetlands (Mitsch *et al*., 1998). Many wetland creation projects attempted in the US have failed, or have fallen well short of their objectives (Castelle *et al*., 1992; Roberts, 1993) for several reasons, including:

- inadequate designs and difficulty in mimicking natural systems and assembling a functioning ecosystem from its components;
- failure to implement the design and deviation by developers from plans filed with government agencies;
- lack of follow-up and supervision by regulators;
- site infestation by exotic species;
- grazing by geese and other animals;
- destruction by floods, erosion, fires or other catastrophic events;

- failure to adequately maintain water levels;
- failure to protect projects from on-site and off-site impacts (e.g., sedimentation, toxic spills and off-road vehicles); and,
- restoration becoming a shortcut to getting a development permit, increasing the number of mitigation projects that become economically and politically driven, i.e., political objectives may clash with ecosystem requirements, and insufficient time and resources are provided for thorough, biologically-based design, monitoring and remediation.

Techniques used to measure success or failure of mitigation projects include confirming that projects were completed according to plans, whether projects have achieved stated goals and objectives, or comparing functional equivalency through quantitative evaluations with natural control or reference sites. Follow-up studies summarized by Castelle *et al*. (1992; 1992a) indicate that the average rate of compliance with permit conditions was 50%.

When creating wetlands, it is important to have realistic expectations of the level of functionality (Roberts, 1993; Mitsch *et al*., 1998). An example of unrealistic expectations was that of a restored 12 ha wetland in San Diego Bay, within the Sweetwater Marsh National Wildlife Refuge. Imposed by the US federal court as part of a compensation deal allowing the California Department of Transportation to widen Interstate 5, the restored marsh was to replace damaged cordgrass marsh that jeopardized habitat of two endangered birds, the light-footed clapper rail and the least tern, and an endangered plant, the salt marsh bird's beak. After four years, the clapper rail was still not nesting in the new marsh, and by comparing the new marsh with a natural one nearby, investigators determined that one key factor was missing. The cordgrass had not achieved its full height, and the clapper rail requires tall grass so its nests can float on a rising tide. The problem was traced to inadequate nitrogen being supplied by sandy soils. The frequency of nitrogen fertilization was increased, but three years later the cordgrass was devastated by an insect outbreak, attributed to a missing predator. The predator, a beetle was then identified and imported. After ten years of this heuristic approach, the attempt to recreate habitat for endangered species was declared a failure (Malakoff, 1998; Zedler, 1998).

Mitsch *et al*. (1998) advocate an "ecological engineering" approach to creating and restoring ecosystems, through application of ecological theory of self-design and self-organization, similar to McHarg's (1970) concept of "design with nature," applied to urban planning and architecture. Working with paired created marshes, for example, Mitsch *et al*. (1998) demonstrated that a planted marsh and unplanted marsh would converge in biodiversity and ecosystem functionality after three years, provided sufficient sources of plant propagules were present.

An important factor to consider when assessing wetland habitat loss or gain is the losses that continue to occur over the full time it takes a replacement wetland to represent a fully functioning ecosystem. It is not possible to accurately estimate the time required to achieve functional equivalency, beyond general assumptions of years or decades, during which many generations of organisms may be lost (Castelle *et al*., 1992). Though the length of time depends, in part, on vegetation type, structural equivalency is not the same as functional equivalency, which may be unachievable.

G3 investigated four artificial wetlands during this audit (Sites S05, S11, S12 and S15) and found this compensatory strategy to be limited in applicability to log-handling facilities.

3.2.4 Compensation Ratios & Habitat Banking

Evaluation of what may constitute adequate mitigative compensation includes consideration of appropriate compensation or replacement ratios and how they would be applied, including whether or not, or in what relative proportions, habitat replacement

should be in-kind functionally (like-for-like), or defined by areal equivalence factors (i.e., hectare for hectare). Other considerations include the types of site-specific functional losses that should be mitigated, and, if mitigation or compensation is implemented off-site, whether and how to factor in distance from the affected area, and limiting this distance.

Two common techniques applied in the US to evaluating the functional value of wetlands affected by development and determining equivalent value of replacement wetlands are:

- Habitat Evaluation Procedures (HEP), first implemented by the US Fish and Wildlife Service (FWS) in 1976; and,
- Wetland Evaluation Technique (WET), developed jointly by the US Army Corps of Engineers and the Federal Highway Administration, implemented in 1983 (Dennison and Schmid, 1997).

The US FWS policy is focussed specifically on the "value" of affected wetlands, and recommends that damage to the most valued resources be avoided and degree of mitigation correspond to the value and scarcity of the habitat at risk (Dennison and Schmid, 1997). The HEP employ standard computer models to relate biological requirements and tolerances of certain indicator species to environmental variables applicable to the subject property, and to derive numerical values for habitat suitability, which can be used as objective measures of relative "quality" of wetland functional values.

If the potential exists for a proposed project to damage marine resources and habitats, the US National Marine Fisheries Service (NFS) also becomes involved early in the regulatory process to resolve potential conflicts and minimize adverse impacts. Under the *National Marine Fisheries Service Habitat Conservation Policy* (48 Fed. Reg. 53142; 1983), the NFS recommends mitigation measures for "essential public interest projects" when practical alternatives are unavailable, and recommends habitat enhancement measures (Dennison and Schmid, 1997).

Habitat managers administering wetland mitigation banks in the US commonly employ HEP to assess the relative functional values of affected wetlands and proposed replacement wetlands (Dennison and Schmid, 1997). HEP uses a Habitat Suitability Index (HSI) model to determine suitability of a wetland as habitat for indicator species selected, and what percentage of the wetland is optimal for that species. The number of habitat units (HUs) available as credits, and used as currency for the mitigation bank, is derived by multiplying HIS by the number of acres having the suitable type of vegetation cover. The total HUs of all cover types is the total number of credits in the bank.

The function-specific analysis of HEP, based on vegetation type, has been criticized as being too narrow, and other methodologies such as WET have been developed, and are often applied in concert to evaluate a wider range of wetland functions (Dennison and Schmid, 1997). WET requires an analyst to gather information on 80 different wetland characteristics or "indicators." Once evaluated, indicators are integrated to derive "low," "moderate" or "high" functional values for each of eleven different wetland functions:

1. groundwater recharge;
2. groundwater discharge;
3. flood-flow storage and desynchronization;
4. shoreline anchoring and dissipation of erosive forces;
5. sediment trapping;
6. nutrient retention and removal;
7. food chain support;

8. fisheries habitat;
9. wildlife habitat;
10. active recreation; and,
11. passive recreation and heritage value.

Three ratings are applied to each of the eleven functions: effectiveness (ability of the wetland to perform the function), opportunity (can the wetland be effective), and social significance (importance of the function to society).

The US Army Corps of Engineers Section 404 permit regime divides compensatory mitigation into restoration, creation, enhancement and preservation (Dennison and Schmid, 1997). Of these options, preservation, the protection of ecologically important wetlands or other aquatic resources in perpetuity, has been the most controversial when offered in the context of wetland mitigation banking. As preservation of one wetland area to justify destruction of another does not replace lost wetland values and function, and results in a net loss, awarding credits for preservation is discouraged.

Compensatory habitat is usually required to be like-for-like, in order to achieve in-kind replacement of aquatic resource function. Exceptions are made on a case-by-case basis if it is determined that out-of-kind compensation is practicable and environmentally preferable to in-kind compensation. For example, if the area of impact falls within the purview of a regional environmental management plan addressing specific resource objectives, several means of achieving the objective might be acceptable for addressing cumulative impacts.

In setting standards for the amount of created, restored or enhanced wetland a permittee would be required to provide as adequate compensation for habitat losses, regulators frequently establish compensation or replacement ratios. The ratio represents the area of habitat loss compared to the requested area of habitat gain. Development of consistent, fair, site-specific and ecologically defensible ratios depends on a number of factors in addition to area, including function, type, location and time (Castelle *et al*., 1992). Four important considerations were identified by Eliot (1985; cited by Castelle *et al*., 1992):

- the lag lime for complete habitat replacement;
- determination of a critical size to replace habitat;
- feasibility of fully restoring habitat; and,
- the difficulty of predicting success of a given project.

An additional consideration is the distance between lost and replacement areas.

Ratios vary with the type of compensatory mitigation being offered. A 1:1 ratio of mitigation area to affected area would only apply when compensatory habitat is available before construction, and there is no risk of even short-term habitat loss. Typical ratios are 1.5:1 for restoration of the same area, 2:1 for creation of new habitat, and 3:1 for enhancement of pre-existing habitat (Castelle *et al*., 1992; Dennison and Schmid, 1997). US EPA guidelines for mitigation banking use more conservative values of 2:1 for restoration, 3:1 for creation, 4:1 for enhancement, and 10:1 for preservation (i.e., protecting existing habitat instead of creating new habitat). Castelle *et al*. (1992; 1992a) conducted a comprehensive review of available literature pertaining to replacement ratios on behalf of the Washington Department of Ecology, including an examination of those applicable in other states and in Washington counties and municipalities.

Mitigation banks may have several advantages over individual mitigation projects, including (Castelle *et al*., 1992b; Dennison and Schmid, 1997):

- maintaining ecological integrity through consolidation into a single large parcel or contiguous parcels, where appropriate, making them more self-sustaining and providing habitat for more species, and more habitat niches that can better accommodate ecosystem succession, migration and change;
- bringing together financial resources, planning and scientific expertise not practical on a project-specific basis, increasing long-term management success and maximizing opportunities for contributing to biodiversity and ecological function;
- reducing permit processing times and mitigation design time;
- proving more cost-effective compensatory mitigation opportunities through economies of scale;
- implementing compensation prior to impact reduces temporal losses of aquatic functions and uncertainty as to success of mitigation;
- contributing to no-net-loss of habitat through authorized impacts; and,
- reducing the number of mitigation sites, allowing more efficient use of limited agency compliance staff.

Disadvantages of mitigation banking may include (Dennison and Stroud, 1997):

- difficulty in replicating site-specific habitat functions;
- a tendency to result in habitat types that are easiest and cheapest to create and maintain; and,
- a lack of technical expertise in both planning and monitoring of banking projects.

Brown and Lant (1999) conducted an analysis of whether the 68 wetland mitigation banks that existed in the US as of January 1996 were achieving no-net-loss of wetlands nationally and regionally. Though these researchers found that 74% of individual banks had achieved NNL by acreage, they projected that wetland mitigation banks would result in a net loss of 21,328 acres of wetlands nation-wide, amounting to 52% of total acreage banked. Wetlands already provided as credit were being converted to other uses, raising the point that habitat banks are of little use unless legal guarantees are applied to ensure NNL in perpetuity. A further difficulty was that most preservation and enhancement banks used minimum mitigation ratios of 1:1, much lower than ratios called for in current guidelines (described above). Brown and Lant (1999) concluded that wetland mitigation banking inevitably leads to geographic relocation of wetlands, and therefore changes, either positively or negatively, the functions they perform and ecosystem services they provide. This observation may be extended to artificial reef habitat banks as well.

Compensation ratios applied at log-handling facilities in BC, and habitat banking practices are described in Section 5. Section 6 includes recommended compensation ratios and circumstances under which they should be applied.

4.0 AUDIT RESULTS

This section presents results of field and paper audits, and includes detailed summaries of the contents of applicable DFO files. A chronology of correspondence between project proponents and government agencies is presented and, where relevant, consultant reports, environmental impact assessments and monitoring reports summarized. A section entitled “Field Audits” has been added to site summaries, as applicable.

4.1 North & Central Coast Sites

Sixteen applicable files were reviewed in detail pertaining to log-handling facilities along the North and Central Coast. Field audits were conducted at:

- three sites along the Central Coast, Fog Creek (Section 4.1.1), Frenchman Creek (Section 4.1.2) and Cousins Inlet (Section 4.1.5), all situated generally west of Bella Coola and northeast of Bella Bella; and,
- five sites along the North Coast, East Gribbell Island (Section 4.1.12), Goat Harbour (Section 4.1.13), Trip Creek (Section 4.1.14), Verney Passage (Section 4.1.15) and Verney Pass Creek (Section 4.1.16), all situated generally south-southwest of Kitimat in the vicinity of Hawkesbury Island.

4.1.1 Fog Creek (Site N01)

In September 1995, Interfor, Mid Coast Operations, applied to BC MOF for a Special Use Permit (SUP) to construct a log dumpsite, truck turnaround, fuel tank storage area and temporary shop on King Island. The site was located along the south shore of Dean Channel, immediately east of the mouth of Fog Creek, on Timber Licence TO 483, at the foot of the East Mainline road (Figure 1).

The DFO Bella Coola Habitat Technologist reviewed the application and issued a Letter of Advice to MOF for mitigation measures to be undertaken by the proponent. Facilities were to be constructed in ways that ensured sediments from roads and shop areas did not enter tidal waters, the maximum possible timbered buffer was to be retained along the foreshore, and no material not previously authorized in the foreshore lease was to be placed in the intertidal area. In addition, it was stipulated that fuel storage facilities include containment provisions that complied with the National Fire Code of Canada.

No documentation was available as to whether or not DFO subsequently inspected this site.

Field Audit

G3 conducted a field assessment of the Fog Creek log dump 1999-12-16. The site, located along Dean Channel on the north shore of King Island, was inactive at that time (Photo 1). Limited quantities of road building supplies were stored at the landing area (e.g., small bridge span sections, fuel, and a small covered storage shed; Photo 2). Piles of sediment and woodwaste observed adjacent to shore, covering approximately 3 m^2, were minimal potential sediment sources. This material was likely associated with site deactivation and did not appear related to site development.Most of the dumpsite had been blasted from steep bedrock adjacent to shore, and a majority of the footprint had been built on bedrock. Fill consisted of large boulders generally 0.5 m to 1.5 m in diameter that appeared to have been clean fill from the blasting site (Photo 3). The fill face extended approximately 60 m along the western edge of the site, with a width varying from 3 m to 10 m. Total developed intertidal footprint (i.e., created from blasted rock) was estimated to be 350 m^2 to 400 m^2, and total site area 1,600 m^2. The fill face had generally colonized with barnacles and green algae.

Photo 1: The inactive Fog Creek log dump, King Island, on the shore of Dean Channel (December 1999).

Photo 2: Fog Creek log dump, storage shed and fuel tank (December 1999).

Photo 3: The Fog Creek dump was blasted from steep bedrock, then shot rock used as fill (December 1999).

Fog Creek entered the foreshore approximately 250 m west of the site, separated by a natural riparian forest buffer dominated by western hemlock and western redcedar. The riparian buffer appeared to have been left undisturbed (Photo 4).

A beach, located in a small bay between rock outcrops at the site and adjacent to the mouth of Fog Creek, appeared well colonized with barnacles, rockweed (*Fucus distichus;* also known as *F. gardneri*), and grasses (e.g., tufted hair grass). Woody debris had accumulated on upper sections of the beach as was typical of the region (Photo 5).

Upslope from the beach, a treed buffer up to 75 m wide separated the beach from the dumpsite and associated road. A section of buffer extending approximately 20 m had been cleared, and several stumps remained. It was not determined when or why this section of trees had been cleared.

The site appeared to be well drained and erosion or sediment sources were not obvious. Though the dumpsite sloped toward the seashore, it was surrounded by a well-developed berm that appeared to effectively contain surface runoff, as no drainage channels were observed entering the ocean. Rather, runoff would percolate through the fill, which would act to filter sediment. A barge ramp built of smaller diameter fill (0.25 m to 0.4 m) also appeared stable and well drained. A small boat wharf was in disrepair at the time of assessment.

Audit Assessment

To the extent that could be discerned when the site was inactive, the field audit of the Fog Creek log dump (Section 4.1.1) indicated that requested mitigation measures had been applied during construction and operations. Equipment and fuels were not stored on the foreshore, and a minimal amount of rock fill (~350 m^2 to 400 m^2) appeared to have been placed in the intertidal region. Of greatest concern for potential adverse impact, the riparian buffer area between the site and Fog Creek appeared to have been unaffected.

The NNL objective was not met at this site. It was observed, however, that barnacles and algae had colonized the small amount of intertidal fill after a time lag had elapsed. Interstices and contours of the fill may provide a net habitat gain over time.

There may have been viable compensation options for addressing the time lag between construction and colonization of the rock fill. Cost and risk associated with assessing alternative compensation sites, implementing compensatory measures, and conducting a monitoring program at this remote site would have been high, in comparison to the relatively small scale of this operation. Decisions regarding project viability should be based on the ability to compensate for habitat loss, and the ability to monitor compensatory habitat and mitigative measures. Though this and other log-handling facilities examined were small, disregard for such habitat loss contributes to “destruction by insignificant increments.”

4.1.2 Frenchman Creek (Site N02)

Fletcher Challenge Canada (FCC), Bella Coola Operations, submitted an SUP application pertaining to a site west of the mouth of Frenchman Creek, in April 1990 (Figure 1). Frenchman Creek flows into Dean Channel from the north. The permit was to allow installation of a log dump apparatus and a small mechanical maintenance shop to facilitate harvesting timber from Forest Licence A-16842. MOF designated this application SUP 17710.

In a 1990-05-17 letter to MOF, the DFO Bella Coola Fishery Office (FO) indicated that he had discussed his concerns with FCC’s Divisional Engineer. Concerns were related to the proximity of the site of proposed facilities to the mouth of Frenchman Creek, a region known to be a major holding area for adult and juvenile salmon. (A 1999 FISS database search by G3 indicated presence of chum, coho and pink salmon, cutthroat and steelhead

Photo 4: Fog Creek and riparian forest (December 1999).

Photo 5: Fog Creek log dump, debris on foreshore (December 1999).

trout, and Dolly Varden char.) Recognizing this concern, FCC agreed to locate the log dump at the southern end of the proposed SUP, as far from the creek mouth as possible. Discussions were also to be undertaken to resolve placement of the float/barge ramp as far south as possible, possibly at the site of the log dump. It was preferred that the access point close to the creek mouth be limited to crewboat and aircraft tie-up only, to avoid accumulation of fuel, oil, garbage and other substances toxic to fish. DFO requested that provisions be made in the SUP that it be subject to agreement between DFO and FCC on final location of access points.

In June 1992, Interfor, Bella Coola Division, Mid Coast Operations, submitted an SUP application pertaining to replacing SUP 17710 (west of the creek mouth) with installation of a dryland log sort yard and small mechanical maintenance shop on a site immediately east of the mouth of Frenchman Creek, to facilitate harvesting timber from Forest Licence A-16850. Interfor had acquired FCC Bella Coola Operations in the interim, and requested that SUP 17710 be allowed to expire. MOF designated the new SUP as S19149.

In a 1992-07-08 letter to MOF, the FO indicated the new application had been reviewed with the Interfor Divisional Engineer. DFO requested that MOF include in the SUP formal recognition of a 30-metre treed buffer extending south and east from the point at which the western edge of the property met the creek to a point immediately north of a small rock islet. The FO noted that all parties had recognized the location of the SUP and associated landing and log watering area was highly environmentally sensitive.

In March 1995, Bella Coola Grizzly Holdings Ltd. (1995) conducted a dive survey of the site on behalf of the proponent. The stated purpose of this survey was “to provide the necessary data to determine the potential impact of the proposed development on associated habitat as well as recommend possible mitigative measures for the protection and conservation of fisheries resources as required by DFO policy.” No contextual information pertaining to this survey was on file, nor was there a response from DFO.

In December 1995 Interfor applied for an amendment to SUP S19149, which entailed a reduction in log dump size by replacing a portion of the area with a smaller piece of property further north. The new area was to be the site of a first aid trailer and temporary shop. The FO advised that DFO concerns would be addressed by applying BC Forest Practices Code provisions (e.g., riparian management area and reserve zone widths adjacent to fish-bearing streams). In addition, the FO specified that fuel and oil products be stored according to fire code, and that fuel spill containment and cleanup procedures be specified.

The file reviewed did not indicate whether or not DFO subsequently inspected this site.

Field Audit

The Frenchman Creek dumpsite was located along the north side of the Dean Channel, approximately 5 km northwest of Fog Creek site. G3 staff visited 1999-12-16. The site fronted on a minimal amount of exposed foreshore (Photo 6) and was situated approximately 150 m from the mouth of Frenchman Creek. A riparian buffer approximately 40 m wide remained intact adjacent to Frenchman Creek (Photo 7), while a treed buffer of 8 m to 20 m remained between cleared upland areas and the foreshore. Dominant tree species were mature western hemlock, western redcedar and red alder. Snow cover precluded thorough understory classification; however, it appeared typical for the region.

The site was designed so that log sorting and related activities would occur in a cleared area (~2,000 m^2) located approximately 60 m upslope of the foreshore (Photo 8). The only structures in place on the foreshore were a shotrock barge ramp and log dump skids (Photo 9). These structures were well colonized with rockweed and barnacles. Mussels were observed on the crib logs at the bottom of the log dump ramp. Brow logs remained in place at the bottom of the dump ramp to prevent debris from accumulating on the ramp

Photo 6: Frenchman Creek log dump, along the north side of Dean Channel (December 1999).

Photo 7: Frenchman Creek and riparian forest (December 1999).

Photo 8: Fenchman Creek log dump, sort yard ~60 m upslope of the foreshore (December 1999).

Photo 9: Frenchman Creek log dump, barge ramp and skids (December 1999).

structure. At medium tide, water depth at the bottom of the ramp was estimated to be 3 m, beyond which the ocean floor likely dropped off to greater depths.

The site appeared well drained, and no obvious drainage problems were observed. A minor sediment source observed at the eastern edge of the site (~6 m^2) was not likely attributable to initial site development, having likely formed more recently due to tree windthrow (or similar site disturbance).

Audit Assessment

The field audit (Section 4.1.2) suggested that the NNL objective was met at Frenchman Creek. Sensitive habitat areas associated with the mouth of the creek had been avoided, and, given that log sorting and related activities were restricted to areas upslope, minimal foreshore had been affected by the development. It is unlikely that compensation would have been an option at this site, or necessary, given the minimal foreshore impact.

Though this site appeared to be of little concern from an NNL perspective, it would have been advisable for DFO to visit this site during or following construction to ensure requested mitigation measures had been implemented. No such visit was documented.

4.1.3 Ingram Bay (Site N03)

In spring 1993, Doman Forest Products Limited applied for a licence to construct a dryland sort yard and log barge landing facility in Ingram Bay, located along the east side of Spiller Inlet, west of Ocean Falls (Figure 1). BC MELP forwarded the application to the DFO FO for comment. MELP also included a 1991 letter to MELP from the Heiltsuk Band Council objecting to log dumping and storage activities in Ingram Bay proposed by Doman, as they were not compatible with the Heiltsuk Fisheries Program (HFP). In his response to MELP, the FO noted that Ingram Bay had once been part of a proposal by the Heiltsuk Band for a sockeye enhancement facility. DFO had since evaluated the suitability of the area and found (unspecified) diseases to be present that would make the area unsuitable for sockeye enhancement. The FO suggested the proponent discuss the proposal with the Heiltsuk Band. In addition, the master of a DFO fisheries patrol vessel conducted a depthsounding and habitat survey of Ingram Bay.

In December 1993, Western Forest Products Limited (WFP), a Doman subsidiary, requested the DFO Bella Coola FO review a proposal for a biophysical site evaluation, to be conducted by the Heiltsuk Band pursuant to Band review of a WFP foreshore application for log dumping and storage in Spiller Inlet. This site was the same one originally applied for by the parent company. The intent was for WFP to provide Heiltsuk staff with experience conducting evaluations of this type, while ensuring that information requirements of resource agencies were met. DFO responded by recommending specific sites for investigation, and noting specific concerns regarding herring spawning in the region.

WFP forwarded a copy of the draft Heiltsuk report to DFO in May 1994. The FO had no objections to any recommendations made in the report, and emphasized that log storage be limited to an area west of a mapped mark along the northern shoreline of the Bay, to avoid eel grass beds to the east that constituted potential herring spawning habitat. The FO noted that a restricting timing window for the operation might be required, as herring spawn had been progressing steadily northward within Spiller Channel and Spiller Inlet. The FO also stipulated that, if WFP could design the booming area to permanently hold wood offshore, as recommended by the HFP, then DFO would not oppose extending the booming area throughout the top of the bay as delineated in the original application. The final report (Heiltsuk Fisheries Program, 1994), containing no substantive changes, was provided to the FO in July 1994.

MELP referred WFP's amended foreshore lease application to the DFO FO in December 1995. This application included facilities for log handling and storage and a float camp and dock. These facilities were to occupy three separate sites along the shoreline of Ingram Bay. Site 1, for log storage, was situated along the northwest shoreline adjacent to Spiller Inlet. Facilities siting avoided the eelgrass beds referred to above. Site 2, for log storage, occupied the southwestern shore of Ingram Bay and part of the Spiller Inlet shoreline, and Site 3, for the float camp, was located along the eastern shore of Ingram Bay.

The FO concluded that the proposed log-handling facilities would not result in HADD if mitigation measures specified were implemented, and, therefore, no authorization under Section 35(2) of the *Fisheries Act* would be necessary. General requests were that sites be selected and designed as indicated available diagrams, that the log dump and camp area be located a minimum of 125 m from shellfish beds, and that measures be taken to prevent surface runoff from the dryland sort from depositing sediment in tidal waters. Specific comments regarding Site 1 were that all log storage was to occur in water greater than 20 m deep and designed to ensure logs were kept floating at all tidal stages.

Comments specific to Site 2 were that all logs were to be stored in water greater than 20 m deep, except the area adjacent to the log watering site, and that logs be kept floating at all tidal stages. Any fill material placed in the intertidal area was required to be clean, large, well anchored riprap placed at the lowest angle possible (<1:1) so as to provide habitat for marine organisms and allow colonization of the rock by kelp. To prevent wood waste buildup being pushed off the surface of the sort or accumulating along the edge and sloughing into the water, a permanent rock berm of at least 1 m diameter was to be placed around the perimeter of the sort area. As the area designated as cross section A-A had been identified in the HFP report as shellfish habitat, no intertidal fill material was indicated in the plan or authorized by DFO.

Design of barge and camp facilities at Site 3 were to ensure sewage would not be discharged in shallow water or near shellfish populations, outfalls be located in water deeper than 10 fathoms (~18 m), and the camp be located at least 125 m from shellfish populations. Rock fill was not to be used at the camp barge site.

The file did not indicate whether DFO had inspected this sight during construction or operations.

Field Audit

G3 staff members attempted to fly into Spiller Inlet 1999-12-16, but were prevented by severe weather and waterspouts in the area.

Audit Assessment

If implemented as described, mitigation measures recommended for the Spiller Inlet facilities appear to have been adequate to avoid damaging sensitive habitat, and prescribed orientation of the rock fill would provide habitat over time. Placement of approximately 400 m^2 of rock fill did result in a significant net loss of habitat; the rock face was, however, expected to colonize with plants and invertebrates.

The spatial and temporal extent of net habitat loss is difficult to quantify, given the lack of monitoring information. In addition, as site plans did not specify the areal extent of rock fill, an estimate of 400 m^2 had to be derived from the drawings.

As with the Fog Creek site, compensatory habitat should have been provided and a monitoring program implemented. If a suitable location was not available nearby, compensation could have been provided off-site. For example, derelict log dumps suitable for site remediation and rehabilitation may have been available in the region.

4.1.4 Draney Inlet (Site N04)

Draney Inlet is a fjord whose waters enter the east side of Rivers Inlet on the Central Coast. Bella Coola Grizzly Holdings Ltd. (1996) conducted a foreshore dive survey at the proposed site of a log dump and storage area in Draney Inlet, on behalf of Interfor. The site was located on the north shore of the inlet, opposite the mouth of Robert Arm (Figure 1).

Interfor applied for a Foreshore Lease for the Draney Inlet site in January 1998, and the file was referred to the DFO Bella Coola Habitat Technologist (HT). DFO replied in March 1998 that Interfor had supplied insufficient information for informed proposal review, and requested full design plans indicating exact location and amount of intertidal disturbance expected, and such information as duration of operations, construction schedule, and amount of wood to be processed. In addition, review of the dive survey report indicated the log dump was proposed at the only rock outcrop in the vicinity, the most highly vegetated area within the site boundary. *Fucus distichus* growing on the rock would provide a feeding area for fish of many species. DFO also requested that Interfor also avoid Survey Transect # 4, located immediately west of the rock outcrop, as eelgrass and bull kelp were identified growing along it. For these reasons, DFO suggested the dumpsite be moved eastward. A notation on the Land Referral indicates the HT visited the site on May 20, 1998.

In June 1998, Interfor submitted an amended application for the Draney Inlet Dump, which met the DFO request to move the site eastward to avoid the rock outcrop and eelgrass bed. The application also included a review by an Interfor Habitat Specialist, who concurred with DFO on habitat sensitivity.

The DFO HT replied to Interfor July 15, 1998 (letter amended July 27). DFO concluded that the alternate site would not likely result in harmful alteration of fish habitat, but stressed that "the area to the West should be considered very sensitive and harmful alteration must be avoided." DFO requested a retaining berm be placed on the edge of the sort closest the eelgrass, and that the eelgrass bed also be protected with boom logs. DFO mitigation requests were as follows:

- it was mandatory that Interfor prevent sediment from upland portions of the site from entering the water by sloping the site landward and constructing ditches and catchment basins to allow sediment to settle from runoff water;
- the running surface should consist not of organic material but of rock of a size suitable to prevent buildup of mud and debris;
- logs were to be stored in water at least 20 m deep at low tide and not allowed to contact the shore, and not on the west side of the dump near the eelgrass bed and rock outcrop;
- the perimeter of the storage site was to be a double boomstick, and all escaped debris was regularly to be cleaned and removed to an upland disposal site;
- Interfor was to implement a herring monitoring program between March 1 and May 1 of each year to ensure that herring spawn not be harmed;
- if construction were to occur within the herring spawning time period, then any blasting on the rock outcrop must fall within accepted DFO blasting guideline standards;
- it would be necessary to properly deactivate the site when no longer in use, and DFO Habitat Branch should be contacted for comment at that time; and,
- dump and storage was not to be located within 125 m of harvestable shellfish populations; it would be Interfor's responsibility to determine such information and make any appropriate changes.

DFO files contained no information on any follow-up to these requests.

Audit Assessment

Despite DFO requests for clarification from Interfor, the areal extent of intertidal fill was not provided in the documents on file. This area has been estimated from site plans to be 300 m^2, constituting a net loss of habitat. Over time, this fill would likely be colonized, recovering its habitat value following a time lag.

Spatial and temporal mitigation measures were requested by which Interfor could avoid sensitive habitat areas identified, and avoid construction during herring spawning. Though implementation of these measures should have been the subject of DFO monitoring, no information was available on file.

Provision of compensatory habitat would have avoided temporal net loss of fish habitat. Options available off-site might have included rehabilitation and restoration of foreshore habitat at a derelict industrial site.

4.1.5 Cousins Inlet (Site N05)

In July 1998, Interfor submitted an application to MELP to operate a 2 ha log dump and 8 ha log storage and booming ground near the southern end of Cousins Inlet (Figure 1). Cousins Inlet is a north-south trending fjord that extends northward from the western end of Dean Channel. Ocean Falls is located at the head of Cousins Inlet. The log dump would be situated south of Wearing Point along the western shore of the inlet, while the booming area would be off the eastern shore in Wallace Bay, north of Benn Point. The application was referred to the DFO Habitat Technologist in Bella Coola.

Mid-Coast Aquatics (1998) had conducted a dive survey to classify marine foreshore habitat at the proposed site in April 1998. Of particular note related to the proposed log dump was a large stream entering Cousins Inlet at a point approximately 175 m south of the site. The stream was known to be fish-bearing, and the intertidal zone at the mouth, containing thick growth of rockweed (*Fucus distichus*) was rich habitat for shellfish (e.g., blue mussels, horse clams and butter clams) and other macroinvertebrates (e.g., sea cucumber). Much of the opposite shoreline, off which the log storage area would be located, had steep bedrock in intertidal and subtidal zones, and was low in numbers and diversity of marine life. The central section, however, located near the mouth of a small stream, had boulder-cobble substrates that supported dense rockweed growth and significant populations of California sea cucumber and red and green sea urchins. Herring were spawning there at the time of the survey.

The DFO Habitat Technologist issued a Letter of Advice to Interfor on 1998-12-14, requiring several mitigation measures be implemented.

With regard to the log dump, DFO requested the estimated 175 m waterfront and upland area between the dump site and stream mouth be restricted from any development. It was requested Interfor conduct a depth sounding investigation of the proposed bullpen site, and contact DFO if the site were found to be less than 20 m deep or to have vegetated areas. Total amount of intertidal fill was not to exceed the 100 m^2 indicated on the site plans.

The proposed road alignment crossed the fish-bearing creek twice as it descended toward the log dump. DFO preferred that the creek not be crossed if construction parameters would permit. Installation of any bridge structures and drainage ditches were not to cause harmful alteration of fish habitat, and ongoing operations were to ensure that ditches were designed to adequately control drainage and prevent sediment being discharged to either the creek or the ocean.

DFO agreed that Interfor's plans to situate the log storage areas outside the intertidal zone and 150 m to 170 m from shore would mitigate adverse impacts. Interfor was to ensure that logs were located in waters deeper than 20 m, that logs be kept from contacting the shore where they could damage herring spawning habitat, and that sunken wood debris did not

smother habitat of sea cucumbers and sea urchins. Logs were to be contained by a double boomstick perimeter and debris cleaned and properly disposed of daily well above the highest tide line. Transport of barged wood was to meet all requirements of the *Navigable Waters Act*.

No compensation package would be necessary, provided Interfor implement the following specific mitigation measures:

- design the dryland sort surface to slope away from the waters edge to control drainage to defined drainage ditches containing sediment traps;
- place the final slope of the filled intertidal area at an angle that would provide equivalent surface area to the area being covered;
- place only clean rock of sufficiently large size in the intertidal zone;
- blast in a way that limits the amount of overblast entering the water;
- conduct no water-based or intertidal activities in March or April of each year, as herring spawn during this period;
- conduct intertidal work at low tide, with machinery clean and free of leaks;
- construct skidways at locations where waters are sufficiently deep to ensure logs do not contact the bottom at any time during dumping operations; and,
- locate dump and storage facilities 125 m or more form harvestable shellfish populations, and ensure such issues are addressed directly with First Nations.

DFO also noted that it may require that a habitat assessment be conducted upon decommissioning to determine the level of any impact that has occurred, and any applicable mitigative measures for reclaiming altered habitat.

There is no indication in the file of whether DFO follow-up occurred.

Field Audit

G3 assessed the Cousins Inlet site 1999-12-16. The log dump was located along the west side of Cousins inlet immediately across from Wallace Bay. The site had been blasted from steep walled bedrock, and little fill placed in the intertidal zone (Photo 10). Total exposed foreshore was estimated to be 35 m, and 350 m^2 to 450 m^2 of fill material comprised the foreshore site footprint; approximately 100 m^2 of that total was intertidal fill (as per site plans), and the remainder had been deposited above the high tide mark. Fill was typically 0.5 m to 1.5 m diameter rock (presumably from the blasted site). A layer of small debris (woodwaste and bark) approximately 15 cm deep was observed covering the foreshore for an extent of approximately 150 m^2 near the bottom of the log dump ramp. The total area occupied was estimated to be 1,000 m^2.

A road led upslope from the dumpsite at a gradient of approximately 15% (Photo 11). A forested buffer 5 m to 35 m wide remained between the road and the foreshore. A stream entered the foreshore approximately 175 m south of the dumpsite and a riparian buffer remained adjacent to most portions of the channel. A utility line right-of-way crossed the road at a bend approximately 150 m from the dumpsite and subsequently crossed the stream, resulting in complete removal of trees from 50 m to 75 m of the riparian area. This cleared right-of-way was not associated with the logging activities, and was not mentioned in file information.

A fully enclosed fuel storage tank was present at the dumpsite as crews were actively building roads in the area. The site sloped away from the foreshore. A small ephemeral stream at the rock wall of the site was a potential sediment source that could be alleviated by placing additional large cobble in the channel to dissipate stream energy and allow

Photo 10: Cousins Inlet log dumpsite, blasted from steep walled bedrock (December 1999).

Photo 11: Road leading upslope from the Cousins Inlet dumpsite (December 1999).

sediment to settle. The stream was observed to percolate through the dumpsite fill and minimal sediment was being delivered to the ocean at the time of assessment.

Though the site was inactive when visited, boomsticks remained in place, delineating the approximate booming grounds. It was noted that boomsticks were in water sufficiently deep to allow them to float, and that they extended in an arc around the site foreshore a distance of approximately 115 m from shore.

Audit Assessment

The field audit of the Cousins Inlet log dump (Section 4.1.5) indicated that requested mitigation measures related to siting of log storage areas and onshore facilities had been met, and that potential impacts on sensitive habitat near the creek mouth had been avoided. An estimated net loss of 100 m^2 resulted from placement of intertidal fill. Though it is likely that interstices and contours of the intertidal rock fill provided adequate replacement of the footprint area following a time lag, eventually achieving the NNL objective, DFO files contained no record of follow-up. DFO follow-up might also have identified the need for regular removal of wood debris from the vicinity of the log dump.

It would be advisable following decommissioning for DFO to follow through with the habitat assessment noted in the Letter of Advice, to determine whether adverse impacts have occurred and applicable restoration measures. It would have been preferable, however, that a thorough assessment had been conducted prior to project approval, and a rehabilitation plan developed. Without a binding authorization and posting of a performance bond, there is little incentive for Interfor to take any rehabilitative action following site decommissioning.

4.1.6 Surf Inlet, Princess Royal Island (Site N06)

Interfor applied to BC Lands to locate a log dump and associated booming grounds and camp tie-up at the head of Surf Inlet, on the west coast of Princess Royal Island (Figure 1). Total area required for the project would be approximately 6.4 ha. The application was referred to DFO, Prince Rupert.

Two reports were subsequently issued on behalf of Interfor: an impact assessment report (White, 1999) and a draft report on compensation options (Triton Environmental Consultants Ltd., 1999).

The DFO Habitat Management Biologist (Prince Rupert) initiated a CEAA referral process in June 1999, but terminated the process in September 1999. A preponderance of evidence from DFO fisheries biologists and other sources had demonstrated the site of the proposed dumpsite to be critical herring spawning habitat to which compensation would not be applicable. This decision was facilitated by the recent internal DFO document, *Decision Framework for the Determination and Authorization of Harmful Alteration, Disruption or Destruction of Fish Habitat* (1998).

Audit Assessment

The NNL objective has unequivocally been met at this site by a decision that conservation objectives were incompatible with development as proposed. At this writing, the CEAA review process has been re-initiated and completed, as Interfor proposed an alternate site. Negotiations over terms of an Authorization are in progress.

4.1.7 Big Tillhorn River (Site N07)

West Fraser Mills Ltd. (WFM) Skeena Sawmills division is, at this writing, seeking to locate log dumping and booming facilities in Douglas Channel, on the west side of Hawksbury Island, adjacent to the Big Tillhorn River estuary (Figure 1).

A 1997-10-06 report by biologist Eric White assessed two optional sites previously identified by the proponent, on opposite sides of the river mouth. The southern site

comprised intertidal bedrock with a subtidal sand shelf, while the northern site was characterized by nearly vertical bedrock cliff. The southern site would require fill be placed, but would not require a bridge spanning the river. The northern site would require a bridge be placed at a point approximately 350 m from the river mouth. It was suggested that the increased impacts on the foreshore from locating the dump at the southern site would be offset to some extent by reduced impacts on the river.

An additional 1998-06-02 report by E. White discussed results of an assessment of foreshore habitat along Kitkiata Inlet, Douglas Channel. WFM proposed mooring a floating camp and storing log bundles at the site of an inactive log dump in the inlet. Several recommendations were made to mitigate potential damage to marine habitat.

In a 1999-07-23 letter to WFM, the Habitat Management Biologist informed them of the requirement that the project undergo a CEAA process, as an authorization for HADD of fish habitat would be necessary. It is of note that West Fraser Mills had previously expressed some dismay at the prospects of a CEAA review, given the delays that would result and that no previous applications had triggered this process.

Referrals were sent to the Hartley Bay Band Council and Haisla Fisheries Commission, the Canadian Coast Guard (CCG), Environment Canada (EC) and the Canadian Wildlife Service (CWS). The Haisla Fisheries Commission responded that they were opposed to the proposal as currently presented, and were pleased that DFO had invoked the CEAA process. CWS responded that the EC standard log-handling guidelines (Appendix 3) would apply in this instance. They also noted that, as estuaries such as those in the subject region provide important and limited habitat for shorebirds and waterfowl, any authorization must ensure the integrity of estuarine habitat not be compromised by poor waste management practices. No CCG response was on file.

Audit Assessment

At this writing, the proposed Big Tillhorn River facilities remain in the review process. The assessments by E. White appeared to provide sufficient information on which to base requests for mitigation measures. Further field investigations would be required pursuant to any proposed compensatory habitat, and to confirm the extent of potential habitat loss.

4.1.8 Lina Island Log Dump (Site N08)

The DFO Queen Charlotte City Habitat Technician (HT) sent correspondence 1993-09-03 to MELP (Smithers) in response to referral of an application by DSF Enterprises Ltd. to construct a log dump and barge landing site along the southern shoreline of Lina Island. The HT, Land Officer and proponent had conducted a low water survey of the shoreline 1993-06-03, and the HT again 1993-09-01. Eelgrass beds were observed extending along the entire intertidal and subtidal shoreline of the island. The proposal involved placing fill on the rock apron at the site to be used as a running surface to a log barge anchored offshore within the eelgrass bed. Activities associated with dumping and booming logs were expected to have deleterious impacts on eelgrass beds. Given the high likelihood of harmful impact on fish habitat, the HT objected to the application.

The proponent commissioned Archipelago Marine Research Ltd. (AMRL) to conduct a survey of habitat at the proposed site. The AMRL report (December 1993) made several recommendations for operational, temporal and spatial mitigation measures, and for impact assessment at the end of operations:

- all log bundles should be stored in a boom placed outside the eelgrass bed; it was suggested that log bundles dumped from the log crib be moved into the boom before they have the opportunity to dry on the eelgrass bed by creating a 60 m boom “alleyway” between the end of the log crib and the outside of the eelgrass bed;
- no log bundles should be allowed to dry at any time, particularly in the eelgrass habitat;

- minimize any potential for mortality of juvenile salmon by restricting log dumping to the period after June 1; if herring spawn at the log dump site in April or May, restrict any log dumping activity until after hatching;
- a marine biologist should discuss habitat issues and a habitat protection plan with the logging contractor prior to commencing operations; the marine biologist should also direct placement of boom anchors to ensure impact on eelgrass are avoided; and,
- after the logging operation is finished any impacts on the eelgrass bed should be assessed through a dive survey and underwater video; any necessary remediation, e.g., cleanup of log and bark debris and eelgrass planting, could then be undertaken.

The DFO HT responded to the AMRL report in a 1994-01-17 letter to the proponent. The HT noted that project redesign or relocation would not be acceptable options for avoiding impact. Instead, the proposed "alleyway" would restrict log-handling activities to a corridor approximately 21 m wide, accounting for approximately 625 m^2 of eelgrass habitat that would be vulnerable to debris accumulation and other physical deterioration. Given the other recommendations for minimizing disruption or disturbance of eelgrass, the HT waived any requirement that the proponent implement compensatory strategies.

DFO subsequently issued the proponent an *Authorization for Works or Undertakings Affecting Fish Habitat*, valid 1994-06-01 to 1994-12-31. Conditions are summarized below:

- foreshore filling and construction of the log crib was restricted to the intertidal bedrock shelf; clean fill was required of sufficient size to prevent erosion; on completion of log dumping activities, the beach face was to be restored by removing all foreshore works;
- an "alleyway" was to be constructed of logs, anchored between the end of the log crib and the farthest seaward edge of the eelgrass bed;
- logs were to be boomed and temporarily stored in the booming area beyond the eelgrass beds; booms were to be secured with anchors, and booming areas situated so that bundled logs do not dry during periods of low water;
- all logs watered from the log dump were to first be bundled on the upland; loose logs were not to be watered;
- log dumping and handling activities were restricted to the authorization period to protect spawning herring and allow two months for eelgrass rehabilitation before spring return of fish;
- a debris management plan was to be developed; and,
- immediately upon completion of site activities, a dive survey was to be conducted to assess any impacts on eelgrass beds and facilitate a rehabilitation plan.

On 1994-07-24 the HT (Queen Charlotte City) conducted a low water survey of the Lina Island site, and observed more than six log bundles grounded on the eelgrass bed within the intertidal zone along the "alleyway", and that eelgrass had been uprooted. The HT indicated the Authorization would be revoked unless the situation was rectified immediately. A handwritten notation on this correspondence indicated the proponent had corrected the problem.

Pursuant to the final item in the HADD Authorization, AMRL assessed the site on completion of log-handling operations. The most notable impact was the uprooting of eelgrass from a portion of the "alleyway," approximately 70 m^2 in area (10 m x 7 m). As the area was relatively free of bark debris, the eelgrass was expected to regenerate from rhizomes within 2 years.

Audit Assessment

The NNL target was not met at the Lina Island site, as a portion of the eelgrass bed in the "alleyway" was uprooted during operations, and log bundles had been allowed to run aground. The AMRL assessments appear to have downplayed potential risks to eelgrass habitat. Given its importance for herring spawning habitat, a 2-year time lag for regeneration of eelgrass from rhizomes should not be considered acceptable. DFO might have been well advised to include an eelgrass "nursery" and transplantation program and regular monitoring in the HADD Authorization, and to have requested the project proponent post a compliance bond.

4.1.9 Chadsey Creek (Site N09)

In a 1995-09-27 letter to MacMillan Bloedel (MB), the DFO Habitat Technician (HT) expressed concern over a proposed truck-barge landing site at Chadsey Creek, Queen Charlotte Islands (Figure 1). Site 1, originally proposed, had been the option preferred in the draft EIA (White, 1995), as it would least affect fisheries habitat values; however, the upland area at the site was of unique cultural and spiritual value for the Haida.

An optional site, Site 5, was situated north of the Chadsey Creek estuary. A narrow corridor traversed the moderately sloping cobble and boulder beach, cleared during past harvesting activities. Adjacent shoreline areas supported luxuriant rockweed and several species of marine invertebrates, whereas the cleared path was relatively unpopulated. The MB intention was to use the existing corridor as an all-tide truck-barge landing site. Some additional foreshore contouring and placement of crushed rock was requested, requiring approximately 240 m^2 of fill. An additional issue was that a major bridge would be necessary to serve Site 5, crossing the lower reach of Chadsey Creek, which contained salmon habitat. The HT agreed to E. White (1995) conducting an EIA, as this firm had prepared others for several nearby MB sites.

The HT concluded from review of the EIA that there existed little option of relocating the landing site to a less sensitive marine location and that no Class 1 habitat would be impacted upon by the project as proposed. As only a small area of intertidal shoreline would be affected, the duration would be short-term, and options were available for rehabilitating the shoreline upon completion of harvesting, fish habitat compensation would not be required. The HT described a number of mitigation measures that would minimize impact on Class 2 habitat, and concurred with rehabilitation proposals in the EIA.

Audit Assessment

An estimated net loss of 240 m^2 of foreshore habitat resulted from this project, and NNL was not achieved. Though the fill might colonize with algae and invertebrates following a time lag, mitigating this habitat loss, it would have been preferable that options for compensatory projects had been investigated and recommended to avoid temporal habitat loss.

4.1.10 Beattie Anchorage Log Dump, Louise Island (Site N10)

In a 1996-04-30 letter to MacMillan Bloedel (MB), the DFO Habitat Technician (HT) described how, in 1996, MB commissioned an assessment of selected locations along the shoreline of Beattie Anchorage. Beattie Anchorage is situated on Louise Island, in the Queen Charlotte Islands (Figure 1). MB had proposed constructing a truck-barge landing site as the companion to the one proposed at Chadsey Creek.

Construction of the original log-handling facility at Beattie Anchorage had been approved in 1975, though the shoreline was recognized as an important herring spawning location. The HT noted that such an approval would be unlikely in 1996.

When MB sought to renew its foreshore lease in 1985, DFO was concerned about spread of negative impacts from the log watering area, attributable to poor debris management. Clam and eelgrass beds were now "devoid of fisheries resource values." In addition, the barge landing facility had been constructed on the foreshore approximately 500 m east of the log sort, creating two point sources of impact. The trend by 1996 was to concentrate foreshore facilities at one location to minimize the extent of disturbance of adjacent shorelines.

By 1996, the barge landing facility was in disrepair, and would require rebuilding if the site were to be reused. It appeared from the assessment that MB intended to build the new truck-barge facility at the site of the existing barge landing, perhaps affecting an additional 500 m^2 of foreshore habitat. The HT suggested MB explore the option of rebuilding at the location of the log sort, an area already impacted upon by log-handling activities, so as not to damage additional habitat. The HT further suggested MB apply a design similar to that of the Chadsey Creek facility (Site N09).

On 1997-09-09, MB submitted plans to build a causeway and spillway over the tidal zone. The HT replied 1997-09-15 that the proposed causeway was a positive measure that would minimize deleterious foreshore and subtidal impacts associated with log watering activities by restricting machine access to an established corridor. Previous site visits had made the HT aware that fish habitat values were limited at the site as the beach substrate had been highly compacted. As the proposed causeway was viewed by DFO as an upgrade of log-handling facilities previously approved, no Section 35(2) Authorization would be required. The HT requested construction be completed by mid-March (1998) to allow time for the site to stabilize before arrival in the inlet of herring schools.

The HT requested a dive assessment of the lower intertidal and subtidal regions along the proposed causeway corridor, as the location had been an historic herring-spawning site. A consultant assessed the site (MTE Inc., 1997) and noted no foreshore or subtidal benthic organisms within the footprint of the proposed causeway. The assessment recommended that large, clean, loosely piled boulders be used for intertidal fill to provide habitat for benthic and pelagic organisms, and that, following completion of the causeway, efforts be made to boom logs away from the foreshore so logs would float at most tides, reducing scour. MB submitted the MTE report to DFO 1997-11-25, along with a letter requesting permission to proceed with the work.

A letter to MB from the HT gave permission for construction to begin. The HT concurred with the consultant recommendations and expressed DFO's continued concern regarding debris management at the site. The HT notified MB of the intent to request more comprehensive intertidal and subtidal foreshore assessment when MB seeks to renew the foreshore lease at the site.

Audit Assessment

The NNL objective appears to have been met, marginally, at the Beattie Anchorage log dumpsite, given that new construction would consolidate operations at a pre-existing site, and occupy a smaller footprint. It may be questioned, however, why the MTE report prescribed intertidal fill of a type that would provide habitat for benthic and pelagic organisms, then suggest that efforts be made to ensure logs would float at most tides, rather than at all tides (i.e., create conditions that would hinder development of new habitat). It is also surprising that MTE made note of no foreshore or subtidal benthic organisms in the footprint of the proposed causeway. MTE could have made alternative recommendations, and additional remediation or decommissioning of the former MB facilities might have been requested by DFO.

4.1.11 Sandilands Island, Skidegate Inlet (Site N11)

In a 1996-10-31 letter to the MELP Skeena Region Land Officer, the Habitat Techician expressed DFO positions regarding an application by TimberWest Forest Ltd. (TWFL) to install a truck-barge landing ramp and crew boat dock along the foreshore of Sandilands Island, Skidegate Inlet (Figure 1). The HT noted recent receipt of a report on a site assessment he had requested TWFL conduct. The barge ramp would be used for approximately five months on two occasions separated by an estimated five years. TWFL had committed to working with DFO to develop and implement any compensatory measures deemed appropriate.

Proposed foreshore works would require fill be placed over approximately 600 m^2 of intertidal habitat, characterized by boulder-cobble substrate overlying coarse gravel. The HT described the type of shoreline as typifying the common rockweed-barnacle community along the upper region of shore, with more diversification of plants and animals toward lower intertidal and subtidal regions. The barge ramp as proposed would avoid the highly sensitive eelgrass beds located to the east.

DFO could not assess the need for compensation of affected fish habitat at that time. The HT noted that, though the fill would replicate the natural shoreline substrate, the material would become compacted, resulting in loss of habitat for burrowing organisms.

The HT requested TWFL assess the foreshore habitat between periods of site use to determine the extent of natural recovery. Results would then be applied when prescribing any compensatory measures such as the artificial reef suggested in the EIA (Lindsay, 1996). The HT further suggested that it might not be appropriate for the proponent to remove fill materials from the foreshore on completion of the second use of the site.

The HT approved installation and operation of the facilities as described in the EIA, and specified additional mitigation measures be used to minimize harmful impacts. Briefly, the measures included that:

- fill material be derived from the upland of Sandilands Island or barged to the site, not materials from adjacent shorelines;
- floats be extended so that the dock would float on all tides, and that the floats and dock be removed between the two operating periods;
- dock stabilization anchors left in the subtidal region pose no navigational hazard; and,
- bulk fuel handling facilities not be installed on the upland area or the boat deck.

In a 1997-07-24 letter to the MELP Land Officer, the DFO HT noted that the Land Officer had informed DFO that the Haida Nation had identified the subject portion of the Sandilands Island shoreline as a traditional clam harvesting area. The HT subsequently assessed the proposed site shoreline and found it to have little bivalve harvesting potential; however, the HT identified productive areas nearby, including a clam beach approximately 350 m distant. It is also noted that DFO regulations prohibited harvesting of bivalve molluscs north of Cape Caution due to concerns about paralytic shellfish poisoning.

The HT also commented on an additional site assessment TWFL had conducted three days earlier. Of note was a narrow band of eelgrass identified that paralleled the shoreline at the lower intertidal/subtidal divide. Eelgrass had not been identified in the previous EIA. The HT requested the barge grid not extend seaward beyond the mid-intertidal zone, which would still allow its operation at all but the lowest tides. The HT informed TWFL of this request in a 1997-07-29 letter. The HT also requested the eelgrass bed near the barge and dock site be assessed and mapped, and again assessed upon closure of the facility.

Undersea Broadcast Services (1997) assessed the eelgrass bed, and its proximity to the barge grid, August 22-24, 1997. The HT took issue with some of the methodology the

consultant employed (e.g., poor documentation), but concurred that the videotape demonstrated the barge grid was separated from the eelgrass bed by a distance of approximately 15 m (~5 m difference in tidal elevation). Therefore, grounding of the truck barge or scouring effects from the support tug would not be expected.

Audit Assessment

A net 600 m^2 of foreshore habitat was lost at the Sandilands Island barge ramp facility. A portion of this loss may be recovered in time through colonization of the rock fill, and further compensated for by construction of a rock reef, as proposed. It was an unusual procedure for DFO to request a proponent monitor a site and assess the need for compensatory habitat without requiring a formal Authorization and performance bond.

4.1.12 East Gribbell Island (Site N12)

In February 1997 MELP forwarded a Lands Referral to DFO Prince Rupert pertaining to a proposal by West Fraser Mills, Skeena Sawmills Division, to construct log-handling facilities along Ursula Channel, on the eastern coast of Gribbell Island. The facilities would consist of a log dump, storage area, and float camp. Gribbell Island is situated approximately 60 km southwest of Kitimat.

Archipelago Marine Research Ltd. (AMRL) had conducted a dive survey 1995-05-30 (Burger and Thuringer, 1995). AMRL reported that the proposed facilities would entail placing riprap fill over approximately 2,400 m^2 of intertidal and shallow subtidal bedrock habitat vegetated by *Verrucaria*, *Fucus* and various other algae. The riprap face would provide approximately 1,910 m^2 of new habitat, reducing net loss of foreshore habitat to approximately 490 m^2. In addition, a bed of horse clams (*Tresus sp*.) lay within subtidal sand at the location of the base of the proposed skid. The proposed float camp, to be held offshore, would not be expected to affect nearshore habitat. The log booming area, proposed to lie along the steep-sided bedrock shoreline south of the camp, would be anchored to keep log bundles away from the shoreline.

AMRL suggested mitigating adverse effects on of bark debris and sediment run-off from the sort and dump by installing appropriate ditching and drainage, incorporating sediment traps or filter material, and using metal skids to minimise sloughing of bark and wood debris from log bundles.

In a 1997-04-22 Letter of Advice, the DFO Habitat Biologist noted that the log dump and barge ramp would result in a net loss of approximately 80 m^2 of intertidal and subtidal shoreline habitat, consisting mainly of bedrock covered by rockweed and barnacles. Proponent plans had been modified in response to the AMRL report. Given that further design modifications would not be possible and the short operational period of 3 to 4 years, the HB requested that habitat loss be mitigated by partial or complete “debuilding” of the intertidal fill at the log dump. The barge ramp would remain intact following operations to facilitate silviculture. The HB also requested that the tidal portion of the outer surface of fill be built of large, clean shot rock that would maximise available surface area.

Field Audit

The East Gribbell Island log dump, located along Ursula Passage on the eastern shore of Gribbell Island, was active when visited by G3 March 14, 2000 (Photos 12 and 13). Logs were being removed from trucks by loader and bundled logs being dumped into the ocean. No boom boat was present and log bundles appeared free to impact on the foreshore under wave or wind influence (Photo 14). Log bundles were temporarily stored at this location before being boomed to Goat Harbour (Site N-13) for loading onto log barges.

Much of the site had been blasted from the existing bedrock wall and shot rock 0.75 m to 1.5 m in diameter then used to enlarge the area (Photo 12). The bedrock shoreline flanking the site remained undisturbed (Photo 15). The 8 m to 18 m wide cleared and levelled area

Photo 12: East Gribbell Island log dump (March 2000).

Photo 13: Loader and logging truck operating at the East Gribbell Island dumpsite (March 2000).

Photo 14: East Gribbell Island log dump, logs in close proximity to the foreshore (March 2000).

Photo 15: Undisturbed bedrock shoreline immediately south of the East Gribbell Island log dump (March 2000).

extended parallel to the foreshore approximately 51 m, comprising an estimated 600 m^2, of which approximately 180 m^2 appeared to be intertidal fill. The remaining cleared area was developed above tidal influence or from areas blasted from bedrock. A majority of the filled intertidal area facilitated placement of the log dump ramp and barge ramp. Fill on northern portions of the site (near the road and dock) appeared to have been placed above tidal regions, and natural bedrock remained exposed (Photo 16).

The running surface, consisting of mixed gravel and sand, appeared well drained, and pooling of residual water was minimal (Photo 17). A road with a slope of approximately 18% extended from the north end of the site. A steel log dump-ramp was in place and other equipment and fuel associated with daily operation of the site appeared to be stored in an adequate manner.

Fill had become well colonized with barnacles, rockweed, and other algae. Site activities precluded detailed observations of flora and fauna on intertidal fill surfaces. Upslope areas were predominantly vegetated by cedar-hemlock forest.

Audit Assessment

As described above, the DFO Letter of Advice estimated net habitat loss to be 80 m^2 at the East Gribbell Island site, based on redesign of the facilities in response to the AMRL report. No detail was provided by AMRL as to how they derived the original loss of 490 m^2 and calculated that 1,910 m^2 of riprap face would provide habitat. The final figure of 80 m^2 appeared to have been exceeded, given field observations of approximately 180 m^2 of intertidal fill. Though the NNL goal was not achieved, the temporal loss of habitat was partially mitigated by colonization of the rock fill by barnacles and algae.

4.1.13 Goat Harbour (Site N13)

Goat Harbour is a fjord extending approximately 3 km eastward from Ursula Channel, from a point directly opposite the site of the East Gribbell Island log-handling facility (Figure 1). The inflow of Goat Creek has created an estuary at the head of the inlet, approximately 25 ha in extent.

In August 1993, alternative sites for log-handling facilities in Goat Harbour were assessed on behalf of Coast Forest Management Ltd. (White, 1993). The estuary was observed to constitute very productive marine habitat, comprising tidal mud flats (60% to 70%), eelgrass beds (20% to 25%) and emergent marsh (10% to 15%). Other intertidal habitat along the flanks of the inlet consisted mainly of rock beaches and cliffs, with some pockets of sand beach at the head. The inlet was observed to be quite clean, but for a small amount of sunken log debris along the south shore, attributable to previous logging and booming operations. It was suggested that, given the confined nature of the inlet, its flushing rate would be quite low, and accumulation of garbage and debris a potential hazard.

White (1993) recommended against siting facilities along the south shore of the inlet, as an access road would necessarily impinge on the estuary and produce adverse impacts. Two alternative sites were selected along the north shore: Site 1, immediately adjacent to the estuary, and Site 2, several hundred metres west of Site 1. Facilities at either site would alienate rock beach intertidal habitat and a horse clam bed, though density of horse clams was lower at Site 1.

It was recommended that operations associated with log harvesting be conducted in ways that would minimize introduction of logging debris, construction debris or general refuse to the harbour, and that there be daily cleanup throughout the operational period.

In a 1994-01-14 letter to the MOF Small Business Planner (Prince Rupert), the DFO Central Coast Habitat Biologist (HB) commented on the Goat Harbour development plan in the context of Section 35(2) of the *Fisheries Act*:

Photo 16: East Gribbell Island log dump, fill upslope of bedrock along foreshore; logs in contact with shoreline (March 2000).

Photo 17: East Gribbell Island log dump, running surface with little pooled water (March 2000).

a site inspection of the log dump, road and bridge locations would be required before approval;

- further information was required regarding road construction difficulties alluded to in the plan (not available for review); and,
- further information was requested concerning location of and sequencing of proposed cutblocks and the watershed development plan.

The HB inspected the site 1994-03-24 and forwarded comments in a 1994-05-13 letter. DFO agreed that Site 1 was preferable. As planned, approximately 200 m^2 of *Fucus*-covered shoreline habitat would suffer net loss, and require HADD Authorization. DFO's preferred option was to redesign the site to eliminate fill extending below the top elevation of *Fucus*, or by installing a lift system for watering log bundles. It was recommended the outer facing of fill consist of materials the same size range as those of the natural shoreline.

The HB approved the proposed road alignment and bridge location. The bridge would cross Class B habitat along Goat Harbour Creek; Class A habitat was known to extend as far as the base of falls below the bridge. As bridge construction would displace approximately 30 m of backchannel habitat, however, DFO would require it be rebuilt at a location upstream of the approach embankment. Construction timing would be restricted to the period June 15 to August 15 during any year to avoid spawning periods.

MOF addressed issues identified by DFO in a 1994-06-28 letter. MOF had had the dump redesigned to reduce the amount of fill that would potentially impact upon *Fucus*-covered shoreline below the high-water-mark to that necessary to securing the skidway at the west end of the dump. Excess bank material not used as fill would be end-hauled to a suitable spoil site "elsewhere." Given delays in initiating construction of the road and bridge, MOF would be unable to meet DFO restrictions regarding timing of in-stream work. Rather, MOF proposed that their Contract Officer monitor construction, that activities be suspended during periods of continuous or intense precipitation, and that a videotape be made to document procedures during all critical phases of work.

The DFO HB issued a Letter of Advice 1994-07-06, in which three measures were specified for mitigating HADD, and to avoid the necessity of an HADD Authorization:

1. hillside runoff from the fan above the log dump was to be routed away from the working area through perimeter ditches;
2. clean rock was to be used for fill, particularly along the edge adjacent to Goat Harbour, and skids removed at the close of operations; and,
3. logs were not to ground during any phase of the operation, and any becoming free-floating during operations were to be retrieved and properly secured.

The file also contained the cover sheet of a 1996-03-12 fax from the HB to BC Lands, but no following pages.

Field Audit

The Goat Harbour log dump was located approximately 0.5 km from the mouth and estuary of the Goat River (Photo 18), and active at the time of field assessment (March 14, 2000; Photos 18 and 19).

The operating surface at the site occupied an area of approximately 1,800 m^2, with approximately 100 m frontage (Photo 20). The largely mineral soil was very muddy as percolation of water appeared inhibited. The upslope cutbank had a gradient of approximately 55%, exposing an estimated 1,200 m^2 of mineral soil and boulder till, but

Photo 18: Goat Harbour booming operations and Goat River estuary (March 2000).

Photo 19: Goat Harbour log dump (March 2000).

Photo 20: Goat Harbour log dump, shoreline and running surface (March 2000).

little or no bedrock (Photo 21). A potential existed to hydroseed the cutbank to reduce erosion.

Situated at the west side of the site (as requested by DFO), the log dump was unique in being elevated a vertical distance of approximately 10 m above mean high tide, a configuration that reduced the amount of intertidal fill required for construction (Photo 19). A majority of intertidal fill appeared to be associated with placement of the log dump ramp, presumably to direct logs toward deeper water (Photo 22). Operators onsite indicated, however, that the long drop (~27 m at low tide) increased loss of wood and potential for bottom disturbance as logs moved down the ramp. Sediment plumes were observed by G3 personnel as logs were dumped at moderately low tide, suggesting logs contacted the substrate below the dump ramp (Photo 23).

While the intertidal foreshore had been partially filled, portions of the site (eastern and western edges) were located upslope of tidal influence. Fill that had been placed in the intertidal region had become colonized with rockweed and barnacles, similar to surfaces of the surrounding boulder beach habitat (Photo 24). Natural substrate of adjacent foreshore was boulder approximately the same size as that used for fill. As the site was operational, detailed observations of fill in the intertidal zone were limited. The site was relatively free of debris and fuel was stored in a mobile tank truck.

Audit Assessment

The NNL objective was not met at the Goat Harbour log dump, as it resulted in a loss of approximately 200 m^2 of intertidal *Fucus* habitat, though some rock fill has become colonized by barnacles and *Fucus* over time. As the site was in operation at the time of the field visit, it was not possible to verify whether or not backchannel habitat along Goat Harbour Creek had been restored. Of greatest concern was the excessive drop distance at the log dump, and the risk of logs striking the subtidal seafloor and bundles breaking apart. Such operations had continuous deleterious effects on fish habitat. MOF did not appear to be exercising due diligence in monitoring this site, and maintaining industry standards. The issue of excessive drop height may occur at other locations and should be included in all assessments and monitoring.

4.1.14 Trip Creek (Site N14)

In the mid-1990s, West Fraser Mills, Skeena Sawmills Division (WFM) proposed constructing a log dumping and booming facility and attendant barge moorage at the Trip Creek site (Figure 1). DFO received a 1995-03-24 Land Referral from MELP, indicating 1.6 ha to be the parcel size proposed. The Trip Creek site is situated approximately 66 km south of Kitimat and 53 km west of Kemano, on the BC mainland. The site fronts on the west side of Triumph Bay, an inlet of the Gardner Canal, at a point approximately 2 km north of the inflow of the Triumph River and 1 km south of the inflow of Trip Creek.

WFM engaged Archipelago Marine Research Ltd. (AMRL; report undated) to assess impacts of the proposed facilities on marine habitat. AMRL conducted a dive survey along two transects 1995-05-31. No critical fish habitat, such as eelgrass or kelp beds, were identified along either transect. Rather, both transects exhibited intertidal and subtidal zonation beginning at the higher-high-water line:

- an upper intertidal zone of the black lichen *Verrucaria* growing on the steep bedrock slope;
- an intertidal zone of *Fucus distichus* (rockweed) and small barnacles on a bedrock substrate; and,
- a lower intertidal/shallow subtidal zone of mixed red and green filamentous and foliose algae, sparsely growing on sloping bedrock.

Photo 21: Exposed till on cutbank face, upslope of Goat Harbour dumpsite (March 2000).

Photo 22: Goat Harbour log dump, fill used in construction of the dump ramp (March 2000).

Photo 23: Goat Harbour log dump, log bundle recently dumped and resultant sediment plume (March 2000).

Photo 24: Rockweed and barnacles adhering to intertidal fill; Goat Harbour log dump (March 2000).

Further depths were characterized by steeply sloping sand shelves and intervening bedrock slopes.

AMRL speculated that juvenile salmon would shelter and forage in estuary marsh habitat at the mouth of the Triumph River, and that Trip Creek was also salmon-bearing. Given its distance from either stream, operational impacts of the proposed facilities on salmon habitat were expected to be minimal.

Site plans indicated that construction of the log dump would result in loss of approximately 1,380 m^2 of nearshore marine habitat. AMRL estimated that 623 m^2 would be replaced by rock fill available for recolonization by *Fucus distichus* and other algae, resulting in a net habitat loss of 757 m^2. AMRL also recommended design modifications, based on its examination of topography and potentially unstable substrates.

A 1996-05-15 letter to the DFO Prince Rupert HB from WFM indicated WFM had revised its plans in response to the AMRL report and DFO concerns previously communicated (but not on file):

- the width of the running surface had been reduced from approximately 30 m to 20 m, and would require significantly less rock fill; and,
- a larger portion of the dumpsite would be constructed by cutting into upland bedrock, rather than by placing fill below the high-tide-mark, resulting in approximately 5,100 m^3 of cut material and 2,150 m^3 of rock fill, and a net 2,950 m^3 of material to be hauled to a spoil site.

Rock fill was now to be restricted mainly to the intertidal *Fucus* zone, with some portions of toe extending into the lower intertidal/shallow subtidal mixed algae zone. Subtidal sand substrates would be unaffected.

In the 1996-10-02 Letter of Advice, the HB noted that the footprint of the log dump and barge ramp would occupy approximately 200 m^2 of intertidal and subtidal shoreline habitat. Recognizing that terrain constraints meant the design could not be further modified, and the relatively short period of operation (three to four years), DFO would consider partial or complete “debuilding” of the intertidal fill after active life to be a viable habitat mitigation measure. The barge ramp could remain intact for a longer period to facilitate silviculture. Further measures were that the tidal portion of the outer surface of required fill be composed of clean shot rock that would provide as large and rough a surface area as possible to partially compensate for the fill footprint. No HADD Authorization was deemed necessary.

Field Audit

The Trip Creek dumpsite was inactive when visited by G3 March 14, 2000, though it appeared to have been operated recently. A steel log dump ramp and boat dock remained in place and small amounts of operational debris (tires, wire rope, steel straps, etc.) remained on-site (Photos 25 and 26).

A majority of the site had been blasted from bedrock, providing a total surface area of approximately 900 m^2. Total foreshore area filled was approximately 125 m^2, of which an estimated 70 m^2 of fill lay within the intertidal area (Photo 27). Appearing to have originated from site blasting, fill boulders were 0.5 m to 1.5 m in diameter and colonized with rockweed, other algae, barnacles and mussels (Photo 28).

A road sloping 5% to 8% upward toward the north appeared to be well surfaced and not a sediment source. Though road construction had not required intertidal fill, some fill had been placed above tidal influence, and some trees had been removed (Photo 29). Upslope, blasted sections of the site appeared to have erosion potential and be sediment sources as mineral soil partially overlay exposed bedrock (Photo 30). An erosion channel extending

Photo 25: Trip Creek log dump, Triumph Bay (March 2000).

Photo 26: Steel log dump ramp and boat dock; Trip Creek dumpsite (March 2000).

Photo 27: Foreshore and intertidal fill; Trip Creek dumpsite (March 2000).

Photo 28: Intertidal fill colonized by rockweed, other algae, barnacles and mussels (1 m square quadrat); Trip Creek dumpsite (March 2000).

Photo 29: Intertidal fill and upslope area, showing tree stumps and rockweed; Trip Creek dumpsite (March 2000).

Photo 30: Trip Creek log dump, running surface and blasted slope (March 2000).

from the cutslope was observed to be transporting sediment and debris to the intertidal area (3-16). A drainage ditch along the toe of the slope had either not been properly installed or had subsequently filled with debris, and required maintenance. A better ditch would likely have prevented erosion across the site.

Given the steep sloping bedrock shores of Triumph Bay and that the site was located approximately 1.5 m to 2 m above mean high tide, water depth at the bottom of the log ramp was likely sufficient to prevent logs from having contacted the substrate during dumping.

Wildlife appear to inhabit the area as otter scat was observed on the boat dock.

Audit Assessment

Approximately 125 m^2 of intertidal habitat was lost at the Trip Creek log dump; over time, however, fill has become colonized by algae and invertebrates, mitigating the habitat loss. Partial "debuilding" following operational life would repeat this loss of habitat. It is suggested that the rock fill be left in place to be acted upon by natural processes. A monitoring program would have identified the fill colonization and enabled habitat managers to re-evaluate the mitigation plan (i.e., adaptive management). In addition, the excessive erosion of the running surface would have been identified and instructions issued for corrective action.

4.1.15 Verney Passage (Site N15)

The Ministry of Forests (MOF) Small Business Forest Enterprise Program proposed constructing a log dump, barge facility, and storage area on the BC mainland, along the south shore of Verney Passage, opposite Eva Point, Hawksbury Island (Figure 1). The MELP Land Referral, dated 1997-10-09, pertained to a parcel size of 1.6 ha.

Approximately 100,000 m^3 of timber was to be cut over an eight-year period commencing 1997. Typically, each timber sale would average 15,000 m^3 to 25,000 m^3 to be logged over a two-year term, with only one operator usually in the drainage at any one time (Thuringer, 1996). MOF engaged Archipelago Marine Research Ltd. (AMRL) to evaluate candidate sites for the log dumping facilities.

AMRL assessed three potential log dump locations, and two potential sites for the barge ramp, in late August, 1996 (Thuringer, 1996). Dive surveys were conducted along two transects extending from each alternative dumpsite and one transect from each alternative barge ramp site. A transect was also surveyed across the intertidal delta of an unnamed creek, located at the western end of the proposed development area.

The three alternative log dumpsites were each free of marsh habitat, including eelgrass, and none had been identified as herring habitat. Bull kelp grew on hard boulder, bedrock and cobble substrate along a nearshore band at each site. Site 1 (preferred by MOF) was situated approximately 500 m from the creek mouth, Site 2 at 340 m, and Site 3 at 610 m. Without specific plans, AMRL could not calculate a habitat balance. AMR deemed it likely that, as loss of *Fucus* habitat on hard substrate would be minimal were facilities built of fill of large size, net habitat loss would be restricted to soft bottom habitat.

The barge ramp was intended to facilitate offloading of construction equipment. During operations, barges would tie directly to the log dump. Barge ramp Site 1 was situated approximately 415 m from the creek mouth, and Site 2 (preferred by MOF) at 415 m. Thuringer (1996) stated that a sparse upper intertidal marsh grew at Site 1.

AMRL did not favour any site for the log dump, deeming all three suitable, subject to specified siting constraints. AMRL preferred barge ramp Site 1 "due to a more favourable slope angle and the absence of intertidal marsh vegetation (Thuringer, 1996)." The AMR report appears inconsistent with respect to location of eelgrass.

The DFO Prince Rupert HB issued MOF a Letter of Advice 1997-11-11 reiterating DFO comments provided to MOF 1997-07-15 (letter not on file). As the log dump would necessitate filling a 20 m^2 portion of a *Fucus*-barnacle-mussel zone, DFO recommended that:

- clean riprap be used, consisting of pieces at least 0.5 m in diameter to provide a structure for *Fucus* attachment, and interstices among which may be used by fish as refuge;
- logs be watered at depths greater than 3 m to 4 m to prevent grounding of logs or scouring the soft, bivalve-contained substrate;
- metal skids be used to minimize bark and woody debris from watering logs, and skids be placed to the east to avoid clam habitat;
- logs not be stored in the vicinity of bull kelp beds east and west of the site, to protect them from log handling and vessel traffic;
- fill be placed at low tide;
- appropriate drainage and sediment control measures be initiated to minimize potential adverse impacts on water quality;
- wood debris be cleaned up regularly and disposed of off-site in a manner acceptable to DFO and Provincial agencies;
- the float camp be equipped with a septic tank to provide 48-hour waste retention prior to discharge, and the discharge line extend to a minimum depth of 10 m and be located at least 125 m from shellfish beds; and,
- fuel be stored and handled according to Canadian and BC Fire Code Regulations, and requirements in “Environmental Standards for Fuel Handling.”

Though the MELP Land Referral included an application for a log storage site, such a facility had not been included in the MOF 5-Year Development Plan reviewed by DFO. As the location had not been cross-referenced to the AMRL report, DFO estimated from a chart in the referral package that the log storage area would be located approximately 70 m east of the proposed dumpsite. That location had been described by AMRL (Thuringer, 1996) as a sand/boulder/shell substrate with a subtidal bull kelp bed. With reference to the log storage location, DFO recommended that:

- logs be stored a minimum of 41 m from the high-water-mark so as to be located in 3 m of water at low tide, and the storage area held away from the intertidal area to prevent log bundles from grounding and be configured to avoid the kelp bed;
- alternatively, the storage area could be re-situated to the northeast to avoid a majority of the kelp bed and provide a deeper location; and,
- given the relatively close proximity to the estuary, wood debris be cleaned up regularly and disposed of at a location and in a manner acceptable to DFO and Provincial agencies.

Field Audit

The Verney Passage log dump was situated on a prominent bedrock outcrop along the eastern shore of Verney Passage on the BC mainland, approximately 2 km southwest of Staniforth Point (Photo 31). G3 visited the site March 14, 2000. The dump appeared to have been constructed to service one cutblock located a few kilometres up the valley of an unnamed creek flowing into Verney Passage near the site (Photo 32). The site and upslope road leading to the cutblock had been deactivated, as evident from cross ditches, though culverts remaining in place along the road indicated deactivation to be temporary

Photo 31: Verney Passage log dump (March 2000).

Photo 32: Cutblock likely serviced by the Verney Passage log dump (March 2000).

(Photo 33). The dump ramp, constructed of logs, had been removed from the water and stored on-site. Large deposits of mussel shells were noted amongst the ramp logs, indicating mussels to have colonized them while in the water. The ramp had been located on the southwestern edge of the site, as evident from abandoned fastening hardware anchored to the rock.

Construction of the barge ramp, located at the western point of rock, had required a minimal amount of fill. The site had been partially deactivated and recontoured, as evident from a pile of rock and fill debris on site. It appeared likely that the site was only accessible to barges at high or near-high tide (Photo 34).

Though the operating area adjacent to the foreshore was estimated to be 150 m^2, with a larger operating areas (~1,800 m^2) located slightly upslope, less than 25 m^2 of intertidal zone had been filled (as per the plan; Photo 31). The upslope operating area was separated from the foreshore area by a water bar, fitted with a sediment control pond and geotextile (Photo 35).

Mussels, barnacles, rockweed, and other green algae had colonized surfaces of intertidal fill (Photo 36). Adjacent foreshore regions, composed predominantly of bedrock, were densely covered with similar species (Photo 37). Sea stars and sun stars were observed on bedrock substrate below the approximate mean low tide level (Photo 38), and bull kelp in waters surrounding the site.

Upslope forest, dominated by western redcedar and western hemlock was typical of the region, and riparian buffers appeared to have been retained along streams. The stream and estuary foreshore habitat west of the site appeared to have been undisturbed during site operation.

Audit Assessment

The relatively minimal amount of habitat (~20 m^2) lost at this site appeared to have been quickly regained, as fill surfaces had been colonized by a variety of algae and invertebrates. Nevertheless, a temporal habitat loss occurred at this site.

4.1.16 Verney Pass Creek, Hawkesbury Island (Site N16)

[*NOTE: The DFO Prince Rupert file list labelled this site "Cheenis Creek". A FISS search indicated Cheenis Creek to be an alias for an unnamed creek (Watershed Code 91044810000) in the Bella Bella region (Statistical Area 7). Verney Passage Creek is an alias for a different unnamed creek (WC 9155673754000) that flows into Verney Passage.*]

White (1993a) described a 1993-08-06 assessment of the foreshore site of a proposed log dump. The site was located between Fishtrap Bay and Danube Bay on the south shore of Hawkesbury Island, along Verney Passage near its confluence with Ursula Channel (Figure 1).

The estuary of an unnamed creek adjacent to the site had a total intertidal area of approximately 2 ha, and was situated between granodiorite cliffs. The estuary contained a small emergent marsh and a small eelgrass bed. The creek appeared to be well used by anadromous fish, as salmonid fry were observed in the creek and adults leaping at the falls. The foreshore was characterized by a steeply sloping rock-boulder mid-to-high intertidal substrate that merged into gently sloping sand-silt foreshore flats. The foreshore was rich in vegetation and invertebrates, including dense beds of mussels on rock-boulder substrates. The subtidal slope of the estuary consisted of a nearly vertical rock cliff on the east and a steeply sloping face of rock, sand and silt in front of the creek mouth. Intertidal areas also supported a rich community of flora and fauna. The unnamed creek is referred

Photo 33: Cross bar installed during partial deactiviation of Verney Passage log dump (March 2000).

Photo 34: Steep shoreline of Verney Passage dumpsite restricted barge access to times of higher tides (March 2000).

Photo 35: Water bar, fitted with geotexile, separating foreshore from operating surface; Verney Passage dumpsite (March 2000).

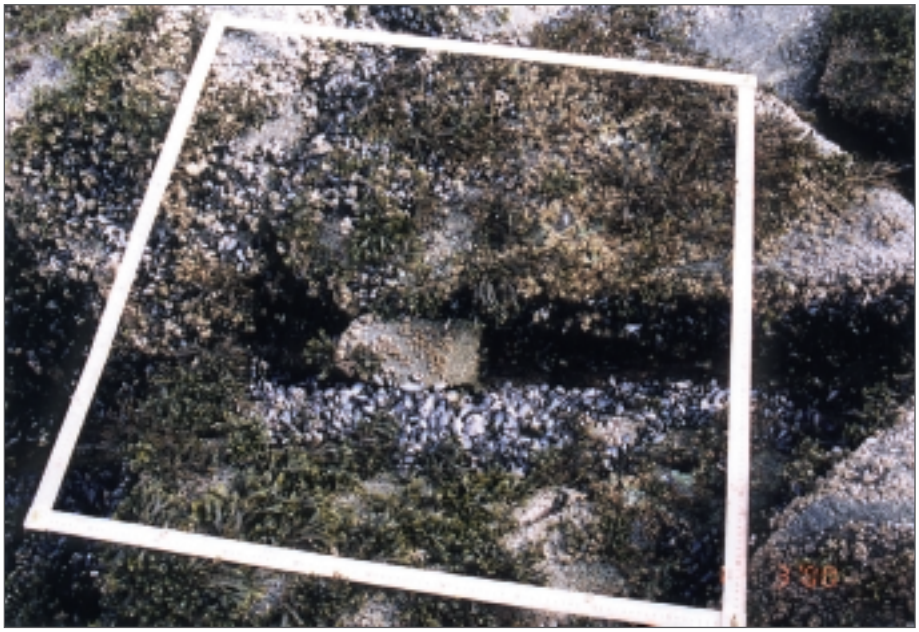

Photo 36: Intertidal fill colonized by rockweek, other algae, barnacles and mussels (1 m square quadrat); Verney Passage dumpsite (March 2000).

Photo 37: Habitat on bedrock foreshore adjacent to Verney Passage Dumpsite (March 2000).

Photo 38: Sunstars and sea stars on bedrock substrate below low tide level; Verney Passage Dumpsite (March 2000).

to by White (1993a), and in later related correspondence, as Verney Passage (or Pass) Creek.

White (1993a) recommended the proposed log dump be located east of the creek mouth on a prominent rock point assessed as having a nearly vertical cliff greater than 26 m deep. It was also suggested that booming operations be restricted to waters directly in front of the dumpsite. This location would avoid direct adverse impacts on the estuary.

A Land Referral was issued to DFO by MELP 1994-01-13 for use of a 4.8 ha parcel for log dumping and storage. The applicant was the MOF North Coast Forest District. Facilities would be used by small business operations for 10 years, with each operator required to obtain a permit prior to use.

MOF had earlier provided DFO with a Development Plan (not on file), on which the Central Coast Habitat Biologist commented in a 1994-01-14 letter. Among HB comments were that:

- a site inspection would be required prior to approval;
- the proposed road alignment, adjacent to a Class B section of Verney Pass Creek, presented concerns regarding fish resident in a nearby swamp, water quality during construction, and stability of the subgrade;
- constructing a road across silt-clay terrain might cause long-term water quality problems;
- the bridge location was suitable, subject to inspection; and,
- details of proposed cutblock locations and sequencing would be required.

Operations were to be designed and carried out in consideration of the *Coastal Fish/Forestry Guidelines* and the North Coast Harvesting Guidelines.

Following a 1994-04-22 field review, the DFO issued a Letter of Advice and HADD Authorization 1994-05-04. The required area of fill would be above the *Fucus* covered shoreline habitat, with the exception of areas on each flank of the fill face, totalling 40 m^2 to 50 m^2. The fill was expected to provide approximately the same area for regrowth of *Fucus*. The Letter of Advice included recommendations that:

- a lift system be considered for watering the log bundles;
- the bridge deck be built at a higher elevation, and the bridge be armoured with riprap for flood protection;
- bridge construction be restricted to the period June 15 to August 15 to reduce or eliminate potential siltation during spawning periods;
- road and logging plans for areas east of the site be reconsidered and evaluated by a geotechnical specialist, given the extensive, gullied clay outcrop in the area had the potential to be a major sediment source.

Stipulations in the Section 35(2) Authorization were that:

- the log dump be built as per the location and design shown in the plans;
- fill material be clean riprap that would be stable under wave action and not cover *Fucus* beds except at the two authorized areas totalling 50 m^2;
- logs not be allowed to ground out during any phase of operations, and any becoming free-floating be retrieved and properly secured;
- log storage and booming not take place within 100 m of the low tide mark of any stream mouth, and logs be stored only where all would float freely at all tidal stages; and,

- fuels be stored according to the Canada and BC Fire Code Regulations for Fuel Storage Tanks, as outlined in the *Coastal Fish/Forestry Guidelines*.

DFO personnel inspected the Verney Pass Creek dumpsite 1994-09-28, during construction. Comments the HB provided to MOF in a 1994-10-11 letter are summarized below:

- the quarry was generating a considerable quantity of fine sediment and, though a series of bermed sediment ponds were catching most of the material the day of the field inspection, two days later a DFO patrolman observed a sediment plume in the bay, originating from Verney Pass Creek; DFO recommended the quarry be closed or a more rigorous sediment control plan be implemented;
- as the log dump appeared to be larger than shown in authorized plans, DFO requested an as-built survey;
- the area bermed for temporary placement of fuel tanks during construction should be sealed with an impermeable liner;
- as the road from the log dump to the sort was already slumping along a sand escarpment, DFO recommended implementation of stabilization measures (e.g., grass seeding or rock fill buttressing of the toe) as determined by a geotechnical engineer;
- as the log sort and drainage ditch along the adjacent road had been built in sand, the ditch and log sort surface were highly erodible and required lining with gravel and rock for erosion control; and,
- though examination of the area surrounding the log dump revealed the terrain to be underlain by deep glaciomarine or glaciolacustrine sand, terrain mapping in the Development Plan indicated morainal blanket overlying rock; as such, DFO recommended against building a road (letter of 1994-05-04).

This letter was copied to the Prince Rupert Forest Region Geomorphologist and MELP.

No additional file information was available to indicate whether there were subsequent inspections.

Field Audit

G3 scientists inspected the Verney Pass Creek log dump March 15, 2000. The dumpsite was located on the southern shore of Hawkesbury Island along Verney Passage, on a rocky promontory approximately 2 km southwest of Danube Bay (Photo 39). Ground truthing and comparison of available pre- and post-development photos indicated fill had been placed on approximately 90 m^2 of intertidal foreshore surrounding portions of the natural bedrock peninsula, with a majority (~80 m^2) on the southeast edge of the point to develop a flat working area. Fill appeared to have originated from clean angular blast rock, and ranged in diameter from 0.75 m to 1.25 m (Photo 40). Limited amounts of fill had been placed along the western edge of the site, mainly above the high tide mark, to increase the surface area of the landing (Photo 41). The remaining, smaller-sized fill (~10 m^2) had been used to construct a barge ramp extending southward from the tip of the peninsula (Photo 42).

A gravel road extended approximately 80 m north from the site, at an estimated slope of 15%, to the previous location of a camp or work area (Photo 43). Though flagging tape prescribed waterbar placement, they had not yet been installed, and there was little other evidence of road deactivation (Photo 44). The log dump area sloped slightly towards the ocean. The site was inactive when visited and no erosion or sediment sources were observed. Fill used for site development appeared to be of a type that would allow adequate percolation of water. The site was free of accumulated woody debris and the ramp had been removed and stored on-site.

Photo 39: Verney Pass Creek log dump, Hawkesbury Island (March 2000).

Photo 40: Verney Pass Creek dumpsite, fill face along southeastern shore (March 2000).

Photo 41: Verney Pass Creek dumpsite, fill on western edge placed mainly above high tidal mark (March 2000).

Photo 42: Verney Pass Creek dumpsite, smaller-sized fill used to extend barge ramp (March 2000).

Photo 43: Verney Pass Creek dumpsite, road and site of former camp or work area (March 2000).

Photo 44: Presscribed deactivation water bar; Verney Pass Creek dumpsite (March 2000).

Barnacles and rockweed had colonized both bedrock and intertidal fill (Photo 45). Western redcedar and western hemlock dominated the upslope forest, and a minimal number of trees appeared to have been cleared during site development.

Audit Assessment

Development of the dumpsite on a bedrock peninsula appeared to require less fill be placed in intertidal regions to create the working area. The amount of fill (~90 m^2) exceeded the 50 m^2 specified in the Authorization, and represents a net loss. As expected, however, this loss was mitigated over time by colonizing algae and invertebrates. Covering of foreshore areas with fill and construction of the running surface may have resulted in loss of some unique terrestrial habitat (e.g., wildlife trees), a topic deserving further assessment at log-handling facilities proposed in the future.

It is notable that, despite DFO scrutiny inspecting this site, MOF violated the Authorization.

4.2 South Coast Sites

Nineteen applicable files were reviewed pertaining to 29 log-handling facilities along the BC South Coast (Figure 2). Field audits were conducted at six sites: Menzies Bay, MacMillan Bloedel (Section 4.2.5), Brand Creek (Section 4.2.11), Menzies Bay, Campbell River Fibre (Section 4.2.12), Knox Bay (Section 4.2.13), Rosewall (Section 4.2.15) and Michelson Point (Section 4.2.18).

4.2.1 London Point Log Dump (Site S01)

On October 10, 1997, Interfor applied to BC MELP to situate a 10.5 ha log dumping, booming and storing facility on the foreshore at London Point, Thompson Sound (Figure 2). The region is located along the BC mainland coast, east of Gilford Island and north of Knight Inlet. The application was subsequently referred to DFO Habitat and Enhancement Branch, Campbell River.

DFO issued an HADD Authorization pertaining to the London Point site. The period of construction authorized was from September 1, 1999 to February 15, 2000. Harmful alteration of 320 m^2 of intertidal and subtidal marine habitat was expected, associated with construction and operation of the log dumping site with a skidway into the ocean. It is noted that a report on an underwater survey, associated with the application, and referred to by DFO, was not available on file for review.

Mitigative conditions in the Authorization relating to the log dump were as follows:

- all machinery was to be in good working condition, no fuels, lubricants or construction wastes were to enter marine waters, and all work on the foreshore was to occur when the site was not wetted by the tide;
- log handling and storage were to be directed away from the intertidal foreshore to waters at least 10 m deep at chart datum;
- the surface of the log dump site was to be sloped away from the foreshore, and wood debris, sediment and petroleum pollutants (potentially) generated by log-handling activities were to be collected and disposed of at an approved off-site location; brow logs or other devices were to be installed to prevent wood waste and debris entering the marine foreshore; and,
- clean fill, free from sediment, and clean, blasted rock free from pollutants were to be used to construct the log dump; no native materials, boulders or beach gravel were to be used.

A minimum of 320 m^2 of compensatory subtidal rock reef habitat was to be constructed on the south (i.e., opposite) side of Thompson Sound before or during log dump construction. The Authorization prescribes a monitoring program to be undertaken by a consultant

Photo 45: Intertidal fill colonized by rockweed and barnacles; Verney Pass Creek dumpsite (March 2000).

approved by DFO until it is deemed the habitat is functioning as intended. As construction was to begin in autumn 1999, no monitoring has been initiated to date.

Audit Assessment

The NNL objective appears to have been met at this site, assuming successful implementation of the compensatory reef habitat. Temporal habitat loss was reduced by the requirement to construct the reef before or during construction of the log dump. It may have been advisable to use a replacement ratio higher than 1:1 (e.g., 1.5:1), given compensation was not like-for-like. Lost habitat was intertidal and subtidal, whereas compensatory habitat was entirely subtidal.

The Authorization contained no prescriptions or instructions for constructing the replacement habitat required. It is assumed that Interfor was issued some guidance, or employed the services of a consultant. An opportunity exists to review the Interfor project plans.

4.2.2 Mount Connolly Dump, Sutlej Channel (Site S02)

The Mount Connolly Dump was proposed by Interfor for a site located along Sutlej Channel, north of North Broughton Island, on the BC mainland coast (Figure 2). In November 1998 Interfor applied to BC MELP for a 15 year foreshore lease to construct and operate a log storage area, heli-drop zone, log dump (with fill) and barge camp with wharf. Total area indicated as requiring fill was 400 m^2.

A 14 December 1998 letter from Interfor to the DFO Habitat Technologist in Port Hardy included maps and specifications, and briefly summarized results of a dive survey of marine habitat at the proposed location. The dumpsite was to be situated on a relatively steep bedrock foreshore, with bedrock substrate changing to sand at depths of approximately 6 m to 7 m. Biota observed included rockweed, starfish and yellow perch. Based on observations from two dive transects, Interfor concluded the depth profiles to have indicated the site was suitable for dumping logs.

To comply with DFO NNL policy, Interfor suggested a compensatory artificial reef to replace the 400 m^2 estimated to be adversely impacted upon by the development. An equivalent area would be added to the Interfor Port Hardy Operation's Charlotte Point Compensatory Reef.

Correspondence between DFO and Canadian Coast Guard (CCG) indicated that the Charlotte Point reef had already been constructed in Drury Inlet/Actress Passage and had been used as a compensation bank for various Interfor projects for a number of years.

As the proposal would require placement of intertidal fill, which constitutes HADD, DFO concluded that a *Fisheries Act* authorization would be required. As such an authorization constitutes a CEAA law list trigger, DFO declared itself a Responsible Authority (RA) for the proposed project, requiring a screening level environmental assessment be conducted. The CEAA Referral was sent to CCG, Environment Canada (EC), MELP, Canadian Wildlife Service (CWS), Public Works and Government Services Canada (PWGSC), and the Chief of the Gwawaenuk First Nation (GFN). Referee responses are summarized in Table 4-1.

A memo to DFO from Interfor indicated Interfor discussed the proposal with the GFN Chief by telephone 17 May 1999. Interfor stressed that it did not intend to restrict access to the area. Interfor felt the area was sound for a dumpsite and would not adversely affect the quality of GFN food resources or interfere with GFN food gathering activities.

TABLE 4-1:
Responses to Sutlej Channel CEAA Referral

Referee	Response
CCG	No environmental assessment required
EC	EC has a role as a Federal Authority (FA); project had been previously referred to EC by MELP, Lands Division and reviewed by the EC Shellfish Section and CWS; requested that Interfor implement a list of mitigatory measures, and contact EC directly.
MELP	No objections, provided a list of mitigatory conditions are implemented; MELP had previously reviewed the proposal through the BC Assets and Land Corporation
CWS	Included with EC response
PWGSC	Response not on file.
GFN	GFN opposed for jurisdictional reasons; site subject to strong southeasterly winter winds; federal/provincial approval should be conditional on the log dump not affecting the high quality of GFN food resources and not interfering with GFN food gathering activities.

DFO issued an HADD Authorization pertaining to the Sutlej site, June 7, 1999. The authorized period of construction was from July 1, 1999 to March 1, 2000. Harmful alteration of 400 m^2 of rocky intertidal and subtidal marine habitat was expected, associated with construction and operation of the log dumping site with a skidway into the ocean.

Mitigative conditions in the Authorization relating to the log dump were as follows:

- all machinery was to be in good working condition, no fuels, lubricants or construction wastes were to enter marine waters, and all work on the foreshore was to occur when the site was not wetted by the tide;
- log handling and storage were to be directed away from the intertidal foreshore to waters at least 10 m deep at chart datum;
- the surface of the log dump site was to be sloped away from the foreshore, and wood debris, sediment and petroleum pollutants (potentially) generated by log-handling activities were to be collected and disposed of at an approved off-site location; brow logs or other devices were to be installed to prevent wood waste and debris entering the marine foreshore; and,
- clean fill, free from sediment, and clean, blasted rock free from pollutants were to be used to construct the log dump.

A minimum of 400 m^2 of new intertidal and subtidal rocky marine foreshore habitat was to be provided at the compensatory reef recently constructed at Charlotte Pont. Given the reef was already functioning habitat, credits were to be removed from the 1,706 m^2 banked habitat, leaving 1,306 m^2 remaining. The Authorization prescribed an annual monitoring program to be undertaken by a consultant acceptable to DFO until habitat were deemed to be functioning as intended. As construction was to begin late summer 1999, no monitoring has been initiated to date.

Other stipulations provided to Interfor in a separate letter were that:

- the float camp be anchored in water at least 10 m deep chart datum;

- sewage from the float camp must be retained in a septic tank 48 hours prior to release to well-flushed waters deeper than 10 m chart datum;
- Interfor survey the site following construction of the log dump facility to determine the actual amount of habitat lost, and advise DFO of the necessary adjustment of the habitat balance at Charlotte Point Reef; and,
- with respect to the heli-drop site,
  - all operations were to be maintained in waters deeper than 25 m, with anchors and stiff legs; no logs or boon sticks were to be allowed to collapse onto the shoreline;
  - to avoid adverse impacts on the commercial prawn fishery, commercial fishers should be advised in order to avoid conflict, and debris management would be of utmost concern, with all woody debris to be contained and either flown back into the setting or disposed of at an upland site; and,
  - to protect pink salmon stocks, operations were not to be permitted during July and August in even-numbered years.

An opportunity exists to examine the Charlotte Point reef and any pertinent designs Interfor may have.

Interfor was also provided with the EC CEAA response, which recommended Interfor adhere to the EC set of guidelines for maintaining water quality, protecting shellfish resources, and protecting migratory bird resources in the area. EC mitigation standards are provided in Appendix 3.

Audit Assessment

The Mt. Connolly project met the NNL objective, as temporal habitat loss was avoided through use of an already functional habitat bank reef. The 1:1 replacement ratio was appropriate, given compensation was like-for-like (rocky intertidal and subtidal habitat) and replacement habitat was already available. In addition, rock fill at the log dump would provide additional habitat over time. It may have been advisable to require the proponent to post a bond, guaranteeing adherence to the planned amount of habitat loss, until as-built inspection could be carried out. Additional withdrawals from the habitat bank may be too ready a solution.

4.2.3 Elaine Creek, Tribune Channel (Site S03)

In June 1994, BC Lands referred to DFO an Interfor application for a foreshore lease pertaining to construction and operation of a log dump and log storage facility, occupying an estimated 4.6 ha. The facility would be located along Tribune Channel, at the eastern end of Gilford Island (Figure 2). The northwestern edge of the lease would be a point approximately 50 m southeast of the mouth of Elaine Creek. The following month, Interfor amended its application to include short-term helicopter log drops. Interfor supplied DFO with videotape and a 1993-08-02 report prepared by Peter Bruce & Associates (PBA 1993), on behalf of Interfor, evaluating five proposed dumpsites in the region.

In a 1994-05-27 report on four dumpsites, PBA (1994a) noted Tribune Channel to be the most biologically productive site. It was recommended that habitat mitigation be provided in the form of like-for-like compensatory habitat, and proposed that a rock reef be constructed.

A third report prepared by PBA (1994b) on behalf of Interfor summarized results of August 1994 field visits to sites of six proposed log dumps. The purpose of the report was to aid development of a plan for habitat compensation projects to satisfy DFO NNL policy. Surveyors of the Tribune Channel site identified no suitable habitat compensation site, and it was recommended that mitigation for this site be tied in with projects at other sites. This

report also included assessment of an artificial reef being constructed at Charlotte Point to serve as compensation for a number of sites, including the Charlotte Point dump. Specifications for the Charlotte Point reef are discussed in Section 4.2.10.

Status of several proposed log-handling facilities and associated compensation programs was discussed at a 1994-10-27 meeting among representatives of DFO, Interfor and PBA. In his 1994-11-23 letter to Interfor, the DFO Habitat Biologist described the Charlotte Point site as a log dump and compensatory rock reef habitat approved and built during summer 1994. Additional reef habitat was to be added at Charlotte Point to compensate for three additional projects (Snowdrift, Seymour and Salmon Arm) at locations with little opportunity to create on-site rock reef habitat. At that time, Interfor proposed the Tribune Channel site be compensated with rock reef habitat built at one of three possible sites at Sir Edmund Bay. DFO requested that, once complete, Interfor accurately measure the Charlotte Point Reef to allow accounting of habitat losses and gains on a balance sheet.

Interfor provided an accounting 1995-01-18, and the DFO Habitat Biologist confirmed the status of several sites 1995-01-24. 605 m^2 of rocky foreshore had been filled or altered at Charlotte Point, while 5,437 m^2 of compensatory rocky reef habitat had been created. After applying the 4,832 m^2 "banked" habitat to compensation owing at Snowdrift, Seymour and Salmon Arm, a net habitat gain of 1,908 m^2 would result. The proposed Tribune Channel site (i.e., Elaine Creek) would affect an estimated 708 m^2 of fish habitat. DFO issued authorizations for the Seymour and Salmon Arm sites with this set of correspondence.

On 13 May 1998, Interfor confirmed earlier telephone discussions with DFO that it would prefer to compensate habitat losses at Elaine Creek, now estimated to be 150 m^2 by applying them to the surplus available at Charlotte Point.

On 8 January 1999, Interfor applied to BC MELP and DFO to revise its development plan for the Elaine Creek site, relocating the position of the log dump approximately 100 m east of the approved location within the foreshore lease area. After construction had begun at the original location, it was apparent that the site was too steep and too high for dumping bundles at any time other than high tide. It was also estimated that 200 m^2 of foreshore area would be required for construction, to be compensated for at Charlotte Point.

The 2 February 1999 Letter of Advice from DFO to Interfor contained provisions that:

- construction occur before 99-02-15 or between 99-07-01 and 00-02-14; any construction between 99-02-15 and 99-06-30 would require implementation of an approved biological monitoring program to protect salmon fry;
- all machinery be in good working condition and that no fuels, lubricants or construction wastes were to enter marine waters; all work on the foreshore was to occur when the site was not wetted by the tide;
- log handling and storage be directed away from the intertidal foreshore to waters at least 10 m deep at chart datum;
- log dump and sort surfaces be sloped away from the foreshore, and wood debris, sediment and (potential) petroleum pollutants generated by logging activities be collected and disposed of at an approved off-site location; brow logs or other devices were to be installed to prevent wood waste and debris from entering the marine foreshore at both the log dump and grid locations;
- clean fill free form sediment, and clean, blasted rock free from pollutants be used to construct the log dump and barge grids;
- a total of 200 m^2 be subtracted from habitat credits at Charlotte Point, leaving a balance of +1,706 m^2; and,

- Interfor survey the site post-construction and advise DFO of the accurate amount of habitat loss.

Additional DFO conditions recommended in a 1999-02-17 letter were that:

- the float camp be anchored in water at least 10 m deep chart datum; and,
- sewage from the float camp be retained in a septic tank for 48 hours prior to release to well-flushed waters deeper than 10 m chart datum.

Audit Assessment

The NNL objective appears to have been met at the Elaine Creek site, though a higher replacement ratio than 1:1 would appear to have been more appropriate. Lost intertidal habitat was compensated for at an intertidal and subtidal reef. It is expected that additional intertidal habitat, however, will eventually develop on the filled area of the log dumpsite.

DFO's request that Interfor conduct a self audit of the amount of habitat loss at its site following construction, rather than requiring an independent site audit, appears inappropriate.

4.2.4 Discovery Passage, Merrill & Ring (Site S04)

On June 1, 1995, Merrill & Ring Canadian Properties Inc. applied to BC Lands for a foreshore lease pertaining to a log barge loading facility. The site, approximately 0.25 ha (2,500 m^2) in area, was located on the eastern shore of Vancouver Island, along Discovery Passage, south of McMullen Point (Figure 2). The application was referred to the DFO Referral Co-ordinator in Nanaimo. The DFO file obtained by G3 contained no plan of proposed works, other than location maps.

It was noted in the application that a small watercourse along the proposed road cut corridor would be enclosed in a culvert in the roadway; as the stream gradient was estimated at 20%, fish were not expected to be present. In addition, the existing beach was described as narrow and steeply sloping, and the area was to be used for log loading at high tides.

The South Coast Division Habitat Biologist responded 4 July 1995 that DFO would require a detailed environmental assessment of the proposed log-handling site before proceeding further. The report was to include photographs, video, description of environmental resources at and in the immediate vicinity of the site, and mitigative and compensatory measures intended to satisfy DFO NNL policy.

A 1995 draft letter on file from the Habitat Biologist to the proponent acknowledges receipt of a report and video prepared by Discovery Diving Ltd. of Campbell River. As the site of the proposed log-handling facility was apparently productive kelp bed habitat, DFO would require it be replaced in kind, preferably on-site. As the proponent was required to submit a detailed plan of the project and compensation measures, the Habitat Biologist enclosed a list of qualified consultants.

According to the Habitat Compensation Agreement, an assessment of potential impact of the project on fish habitat and compensation measures required were documented in a report by Alby Systems Ltd. of Alert Bay, dated 14 December 1995. An annotation on the file indicates this report is missing, but the video is available.

In an 18 January 1996 letter to the engineer representing the proponent, the Habitat Biologist reiterated project information provided in an 11 January 1996 letter (not on file). The proponent indicated the fill at the proposed facilities would cover 555 m^2 to 600 m^2 of intertidal foreshore, to be compensated for by construction of an intertidal rock bench, as described by Alby Systems Ltd. DFO approved the compensation design, and attached a Habitat Compensation Agreement for review and signature. Construction of the project

would be restricted to the period May 1 to February 15, and subject to standard mitigation measures concerning machinery, blasting, and potential pollutants. A Section 35(2) Authorization was subsequently issued.

The Habitat Compensation Agreement was dated 16 January 1996. Merrill & Ring was "committed to a habitat compensation program, and in particular to constructing a subtidal rock reef with the same dimensions as the footprint of the intertidal fill required for the log load-out facility." The proponent was to set up a monitoring system to include an assessment between April and June for 2 years and report within one month of each assessment. An additional requirement was that, though the artificial reef was expected to revegetate naturally, if any eelgrass were altered, disrupted or destroyed, the proponent would create a new eelgrass meadow of at least twice the area as the meadow destroyed.

A 5 July 1996 letter from the Habitat Biologist to the engineer representing the proponent described deficiencies noted by DFO during construction:

- the contractor had built a road to the site of the barge load-out on a steep incline from a point on the foreshore of a small bay north of the site known to be productive fish habitat and containing abundant eelgrass, rockweed and bull kelp;
- the contractor was observed off-loading heavy equipment at a time when the tide was too low, given the proximity of marine vegetation, and may have damaged fish habitat;
- small patches of rockweed had been scraped off intertidal rocks in the small bay, and salmon smolts were observed flipping in the bay;
- a significant area of soil was exposed along the road cut without any sediment abatement work apparently having been installed;
- there was a danger that this sediment would wash into the bay during the next heavy rainfall and smother productive marine vegetation, resulting in charges under the Fisheries Act; and,
- sediment abatement was also of concern where an excavator was operating above the high water mark at the north end of the barge load-out site.

The proponent was advised to work closely with the contractor to ensure that appropriate sediment abatement works were installed throughout the construction site and access road. The Habitat Biologist requested a copy of a site plan of the sediment abatement works, and recommended effectiveness be monitored. The HB also requested the access road be deactivated and seeded following construction.

A 6 December 1996 letter from the engineer to the proponent reported on a site visit he made with the DFO Habitat Officer 15 November to review compliance with 7 November road deactivation instructions given the contractor. No previous correspondence was on file concerning this topic.

A 23 July 1997 DFO internal memorandum listed species of fish, invertebrates and algae observed during a dive survey conducted at the barge unloading area that day.

Audit Assessment

Though the NNL objective appears to have been met at the Discovery Passage site, several deficiencies were noted by the Habitat Biologist during construction. The proponent did not comply with the mitigation measures required in the Authorization. In addition, as compensation was not like-for-like, but replaced intertidal habitat with subtidal habitat, a replacement ratio of 1.5:1 or higher should likely have been used rather than a ratio of 1:1. The 2:1 ratio requested for any necessary like-for-like replacement of eelgrass habitat was appropriate, given the time lag for establishment of such habitat.

4.2.5 Menzies Bay, MacMillan Bloedel (Site S05)

In a 1994-10-05 letter to the MacMillan Bloedel Ltd. (MB) Menzies Bay Division Engineer, the DFO South Coast Division Habitat Biologist described results of a site visit made the previous day to the Dryland Sort Expansion Project at Menzies Bay (Figure 2). DFO would not be opposed to the plan, provided an equal area of intertidal marine fish habitat were created to offset the area of proposed intertidal fill. It was noted that several site options existed within Menzies Bay. The work window for foreshore construction would be 1994-12-01 to 1995-02-15.

A 1994-10-31 letter to MB from Peter Bruce & Associates (PBA, 1994) described options available for creating compensatory habitat to fulfill DFO NNL objectives at a new dry land sort at Menzies Bay. Approximately 0.5 acres (~2,023 m^2) of intertidal area was to be filled during construction, at a relatively unproductive site covered by a layer of finely ground wood particles 0.3 m to 0.6 m deep. An additional area of approximately 0.25 acres (~1,012 m^2) where the bank was failing, also highly disturbed by past log handling, was to be armoured with riprap. As the consultant noted, "Although it can be argued that the habitat of the fill areas is very poor, in general this will not mitigate or minimize the area required to meet the 'No Net Loss' Policy. Thus the total area of fill, and the area for which compensation must be provided by habitat creation will be about .75 acre or about 3000 m^2 (sic)." The consultant considered options for creating intertidal marsh or pond habitat at three nearby locations; each option would require several habitat units be constructed to achieve 1:1 compensation.

In a 1994-12-09 letter to DFO, MB provided a habitat compensation proposal. The area to be filled at the dryland sort was now given as 1,350 m^2, as indicated in drawings prepared by G.F. Yule & Associates. A minimum of 1,000 m^2 intertidal area was to be created at this site, with a plan to replace the entire 1,350 m^2. Any shortfall would be made up at the Trout Lake site, described in a second consultant report (PBA, 1994a). Waters from Trout Lake flow into Menzies Bay via Trout Creek.

The consultant had visited Trout Creek (also known as Mohun Creek) 1994-11-25 to review a potential habitat enhancement project, consisting of replacing a culvert with a bridge to improve fish passage into a large pond (i.e., Trout Lake) draining southward into Trout Creek. The U-shaped pond, located on the south side of Trout Creek approximately 0.5 km upstream of the estuary, was estimated to be 350 m long and 20 m to 30 m wide. No assessment of fish presence in the pond or the capability of fish to pass through the culvert had been conducted. Back channel areas and the pond were identified as prime areas for use by overwintering coho fry. Replacing the existing culvert with a bridge would improve access by fry to the pond. Some excavation of the channel between the pond and the culvert site might also be warranted, including low, flow-controlling weirs. A FISS database search by G3 (September 1999) indicated Trout Creek to support significant sport fisheries for pink salmon and anadromous cutthroat trout. Upper stream sections were noted to contain good spawning and rearing habitat, while lower sections had been subject to heavy silt and clay deposits.

DFO issued a Habitat Compensation Agreement 94-12-12. The Agreement committed MB to creating 1,000 m^2 to 1,350 m^2 of intertidal salmon rearing habitat in Menzies Bay by excavating upland forest, and to making up any deficit area owing by opening access to a rearing pond from Trout Creek. The existing culvert was to be removed and replaced with a bridge and weirs. Work was to be completed by 1995-09-01. MB was also to set up a monitoring system to assess effectiveness of the habitat compensation project every July for 3 years, and to undertake any necessary remedial action. A $11,800.00 performance bond was required.

The DFO 94-12-16 Section 35(2) Authorization required:

- any foreshore construction to occur 05-15 to 09-15 and 11-01 to 02-15 in any year;
- construction equipment to be in good working condition and to deposit no fuels or construction wastes in marine waters;
- clean fill and rock riprap armour to be used for construction;
- fish habitat compensation as per the Agreement; and,
- appropriate waste interceptors be installed and wood debris prevented from spilling onto the foreshore.

BC Lands also issued an Authorization 1994-12-12, amended 1995-01-12. A further Lands authorization was issued 1995-02-06 pursuant to MB placing a small amount of fill to facilitate construction of a crane at the dryland sort facility.

A 1995-02-23 letter to MB from Peter Bruce & Associates (1995) reported on construction of the intertidal habitat compensation project January 23 to 27, 1995. The new pond, with two inlet/outlet channels for tidal exchange, was built north of an old A-frame dump at Menzies Bay. It was intended that marsh vegetation would establish itself over time, contributing to productivity of the shoreline. Total habitat created, including areas subject to edge effect above the normal high tide elevation, was estimated at 1,237 m^2. Features to diversify habitat included several small islands protected with old logs and covered with organic soil to provide a seedbed. A habitat deficit of 113 m^2 thereby remained. MB was to monitor the site annually for three years.

DFO requested (though not documented) that MB pull back a minimum of 120 m^2 of foreshore immediately north of the dryland paved area to provide additional fish habitat. MB complied by pulling back more than 140 m^2. In a 1995-08-21 letter to MB, DFO acknowledged that MB had satisfied all its compensatory requirements, and returned the performance bond. As requirements had been met elsewhere, proposed Trout Lake remediation was not implemented.

It is of note that the DFO file on this project contained an HRTS Referral Baseline Detail Report on this project, a database of pertinent contact persons and correspondence on file.

It is also of note that the file contained no information regarding monitoring of this site in subsequent years.

Field Audit

G3 scientists examined the compensatory habitat pond at low tide 1999-12-01. An arc-shaped channel, approximately 61 m long, had been excavated from the foreshore, isolating a treed island at high tide. The natural beach adjacent to the compensatory site consisted of cobbles and boulders. Clumps of tufted hairgrass (*Deschampsia cespitosa* ssp. *beringensis*) were scattered along the beach, at and below the high water mark (Photo 46).

The artificial channel, with an average bankfull width of approximately 10 m, had been designed to be inundated to an average wetted with of approximately 7 m at tides exceeding approximately 3.3 m (11 feet; Photo 47). A stream entering the channel near its north end provided an additional 27 m channel extension.

Natural mixed woodland on the created island and adjacent foreshore was characterized by western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), western redcedar (*Thuja plicata*), Sitka spruce (*Picea sitchensis*), black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), and red alder (*Alnus rubra*). The new bank behind the excavation had been hydroseeded to promote growth of grasses and other herbs, and small alders had also cloned from underground stems. Scattered vegetation within the channel consisted of lilaeopsis (*Lilaeopsis occidentalis*), grasses (e.g., *Bromus sitchensis*),

Photo 46: Natural beach adjacent to MacMillan Bloedel (now Weyerhaeuser) Menzies Bay compensation site (December 1999).

Photo 47: Artificial channel, MacMillan Bloedel (now Weyerhaeuser) Menzies Bay compensation site (December 1999).

sedges (*Carex sp*.), and bulrushes (*Scirpus sp*.). Hummocks, with organic soil supporting grasses, vetch, and other herbs typical of a hydroseed mixture, had been placed in the channel near its north end to increase habitat complexity.

Channel substrate consisted predominantly of sand, covered in places with thin patches of wood fibre (Photos 48 and 49). Leaf litter was abundant. Standing water in the channel was approximately 5 cm deep at low tide. The channel contained scattered woody debris, but no pieces exceeded 30 cm in diameter. Boulders up to 1 m in diameter had been placed across both the north and south channel entrances, apparently intended to form gateways blocking large debris (e.g., floating logs) from entering the channel. Large boomsticks had washed up near both channel entrances. Channel banks appeared stable.

Invertebrate observations consisted of sparse barnacles on rocks at the north channel entrance, and small infaunal snails in woody debris along the channel. No epifauna were observed elsewhere along the channel. The channel of a small stream entering the foreshore at a point approximately 85 m south of the compensatory site was also devoid of epifauna, possibly indicating a general impoverishment of the area.

Audit Assessment

The field audit (Section 4.2.5) of the MacMillan Bloedel compensation site at Menzies Bay indicated that created habitat was functioning as intended, and that marsh vegetation was gradually colonizing the shore of the artificial channel. Woody debris along the channel was likely transient and insufficient to impair habitat function. Though the HADD Authorization required site monitoring and the HRTS database system had been employed, the DFO file contained no report of monitoring during the five years following implementation.

The merits of excavating an artificial channel from an otherwise unaffected area of shoreline forest should be reviewed as an advisable compensatory option. It is not obvious what was achieved by increasing the size of Menzies Bay by approximately 1,237 m^2, given that this water body has long been subject to relatively high levels of industrial activity. In addition, compensation for the equivalent area of excavated forest should also be factored into the review of this type of compensatory option. The second option originally explored, that of opening fish access from Trout (Mohun) Creek to an available rearing pond, would likely have been more effective. This option would have complemented large-scale fish habitat mitigation works constructed concurrently in the region as part of the Island Highway project.

4.2.6 Bute Inlet, Coast Mountain Hardwoods Inc. (Site S06)

In 1998, Coast Mountain Hardwoods Inc. (CMHI) considered several sites for a series of temporary log dumps in Bute Inlet, along the mainland coast of BC (Figure 2). Each site was surveyed by Peter Bruce & Associates (PBA; 1998, 1998a, 1998b, 1998c, 1998d), on behalf of the proponent. Surveyed sites at Hovel Bay, Moh Creek, Bear Bay and Orford Bay were generally situated on steep bedrock faces or bouldery shores deemed to be of marginal habitat value. PBA reports were provided to DFO along with BC Lands referrals.

In a 1998-07-07 letter to CMHI regarding the first application, the DFO Habitat Biologist suggested that CMHI work with PBA to establish a habitat bank of rocky reef habitat to offset habitat losses pertaining to this and other future log dump applications. Assessment information would then become part of a CEAA referral.

A 1998-12-08 letter to the Habitat Biologist from CMHI summarized the proposed compensation plan. Potential habitat losses, estimated to total 1,030 m^2, were generally attributed to temporary skidways, and minimal amounts of fill would be required. CMHI expected little permanent habitat loss, as the log dumps would be temporary. The compensation bank was proposed for Orford Bay, adjacent to a proposed log dump.

Photo 48: Sandy substrate of artificial channel, MacMillan Bloedel (now Weyerhaeuser) Menzies Bay compensation site (December 1999).

Photo 49: Wood fibre overlying portions of substrate of artificial channel, MacMillan Bloedel (now Weyerhaeuserr) Menzies Bay compensation site (December 1999).

The plan was to “debuild” a portion of the running surface and use this material to increase the size of the original apron; the entire area except the portion of running surface not “debuilt” would become compensatory habitat. 787 m^2 of combined intertidal and subtidal habitat would result.

In a 1999-01-18 reply to CMHI, the Habitat Biologist objected to this plan. CMHI had assumed that there would be no loss of fish habitat at Hovel Bay, Moh Creek, or the two Bear Bay sites. In DFO’s consideration, activities would, in fact, destroy marine animals and plants and result in lost fish habitat for a considerable time. In addition, the “debuilding” of the Orford Bay log dump would occur following operations, and well after habitat destruction at the other four sites. As proposed, the five sites would actually affect 1,315 m^2 to 1,456 m^2 of intertidal and subtidal rocky reef habitat.

Instead, the Habitat Biologist suggested that CMHI commit to constructing a rock reek in Orford Bay to account for the Hovel Bay, Moh Creek and Bear Bay sites (1,030 m^2 of rocky reef habitat), and for the Orford Bay site until decommissioned. Any area exceeding losses determined by later surveys would be banked as habitat credits against future CMHI activities in Bute Inlet.

A 1999-02-05 letter from CMHI followed up on a meeting between CMHI, PBA and the Habitat Biologist. An attached table summarized compensation required at each site. Steel skidways to be used at each site would cause “low” impact, and CMHI agreed only to compensate for areas filled at each site. Total compensation would amount to 265 m^2, as described and illustrated in a 1999-02-01 PBA report. CMHI committed to monitoring the dumpsites and to providing additional compensation at Orford Bay, if warranted.

In a 1999-02-15 letter, the Habitat Biologist informed CMHI of DFO’s intent that the Orford Bay compensation project undergo a CEAA referral process. CEAA referees were the Canadian Coast Guard (CCG), Environment Canada (EC), and the Canadian Wildlife Service (CWS). Floating steel pipe skidways were expected to result in little or no negative impact, and bundled alder to undergo little bark loss at the sites. CMHI was authorized to proceed with development at the Hovel Bay, Moh Creek and Bear Bay sites during the period of 1999-05-15 to 1999-12. The Habitat Biologist also specified a number of standard mitigation measures to be followed.

Results of the CEAA referral were summarized in a *Screening Recommendation and Decision Summary*” document. EC and CWS had no specific concerns, but provided a copy of their Guidelines for Log Storage and Handling to be given to the proponent (Appendix 3). CCG commented that the project would not trigger their CEAA involvement.

DFO subsequently issued an *Authorization for Works or Undertakings Affecting Fish Habitat*, valid 1999-05-15 to 2000-02-15, and CMHI posted a $5,000.00 performance bond. The Authorization included standard conditions relating to mitigation measures at the Orford Bay log dump. Among conditions relating to compensatory habitat were that:

- CMHI build a subtidal rock reef a minimum of 265 m^2 in area, according to the PBA design, prior to or during construction of the log dump;
- CMHI conduct a monitoring program to include an annual underwater assessment and video of the reef, immediately following construction (to confirm surface area) and each of the following two summers;
- DFO be provided with monitoring results, assess whether or not the compensatory habitat it is functioning as intended, and either terminate the monitoring program or request additional remedial work and a two year monitoring extension;
- CMHI ensure the continued functioning of the compensatory habitat and carry out any necessary remedial action (e.g., clearing wood waste); and,

- CMHI leave the compensatory habitat undisturbed.

The DFO file contained no information as to the progress of this project following issue of the Authorization.

Audit Assessment

The NNL objective appeared to have been met at the Bute Inlet sites. The decision to compensate habitat loss at 5 sites with a single reef, rather than in a piecemeal fashion, appears to have been well founded. A higher replacement ratio than 1:1 (e.g., 1.5:1) may have been advisable, as lost intertidal habitat was replaced with a subtidal reef. It is expected, however, that habitat loss will be regained during and following operations, as the log dumps are temporary.

A noteworthy aspect of compensation negotiations was the significant reduction in predicted adverse impact following design modifications in response to DFO concerns. The proponent elected to use "low impact" steel skids, reducing habitat loss to 265 m^2 from an initial 1,315 m^2 to 1,456 m^2. This reaction on the part of the proponent is a clear benefit of the Authorization process.

4.2.7 Silverado Creek, Muchalat Inlet (Site S07)

In a 1996-01-11 letter to the DFO Habitat Management Technologist (HT, Campbell River), Pacific Forest Products Ltd. (PFPL) requested DFO permission to construct an equipment barge grid immediately east of the mouth of Silverado Creek. Silverado Creek enters Muchalat Inlet from the south at a point approximately 9 km west of the town of Gold River. The design included a log crib and filling an area of foreshore with blasted rock to create a roadway. The HT replied that, as the information and photographs submitted by PFPL indicated a potential for destruction of fish habitat, further information would be required, and that DFO (Nanaimo) would be responsible for determining applicable compensation.

Peter Bruce & Associates (PBA, 1996) conducted a dive survey of the barge grid site 1996-02-14 on behalf of PFPL. The PBA report recommended reorienting the barge ramp to avoid impinging on eelgrass beds in the bay.

PBA conducted a second dive survey 1996-04-10, to investigate the site of a proposed log dump adjacent to the barge grid. The assessment concluded that each of two skidways would affect 150 to 200 m^2 of habitat. PBA (1996a) also investigated the site proposed for construction of a compensatory rock reef.

DFO authorized construction of the equipment barge grid in a 1996-06-05 letter. The Habitat Biologist wrote, "The entire ramp/grid will remain intertidal (below High High Water), negating the requirement for replacement fish habitat. Log handling at the site is not part of this application." Construction was approved between 1996-06-15 and 1996-08-31 or between 1996-12-01 and 1997-02-15. Machinery was to be in good working condition, no fuels, lubricants or construction wastes were to enter marine waters, and all fill was to be clean. No foreshore fill, dredging or blasting was authorized.

A 1996-06-26 letter from the BC MELP Lands Officer to PFPL stated that Lands had been copied the DFO authorization for the barge grid, but that PFPL had yet to apply for a Land Act tenure.

On 1996-08-26 PFPL submitted a "preliminary final site plan" for the proposed Silverado Creek Log dump. The plan included cutting the bedrock edge and installing fill to support steel pipe skidways. Most fill was to be placed on existing rock and the narrow boulder slope at the toe of the bedrock shore. PFPL suggested an on-site inspection with DFO to review the plans.

A 1996-09-16 letter to DFO from PFPL indicated that, during a joint site visit with DFO 1996-09-04, footprints of 72 m^2 for the equipment barge ramp and 200 m^2 for each of two

steel skidways on rock fill were derived. From this information, PFPL and PBA determined a compensatory reef 2 m to 3 m high, 12 m wide at the base, and 27 m long would be appropriate. Interstices in the reef were assumed to provide 30% additional surface area. Cost of the reef was estimated to be $25,000. The reef might be split into two separate parts to fit onto the relatively narrow offshore benches.

The DFO Habitat Biologist (Nanaimo) approved the compensation plan as stated above, and enclosed a Habitat Compensation Agreement with a 1996-09-20 Section 35(2) Letter of Authorization (sic), in which on-site impact mitigation measures were also described. PFPL was to monitor the artificial reef, and provide DFO with a report, each summer for three years. A $25,000 performance bond required by the Agreement was waived in the Authorization as the reef would be constructed prior to the log-handling facilities.

The Final Amended Application for Foreshore Licence of Occupation was referred to DFO and the Canadian Coast Guard (CCG) in November 1996. DFO approved the application, subject to the Habitat Compensation Agreement. CCG determined that, as the work would not interfere substantially with navigation, authorization under Section 5 of the Navigable Waters Protection Act would not be required.

Audit Assessment

The NNL objective appears to have been met at the Silverado Creek site; however, no monitoring report was available for verification. Three issues were unclear:

- how did the consultant derive a 30% multiplier for reef surface area?
- why was the barge grid deemed to cause no adverse impact? and,
- why was the bond requirement waived before any monitoring was conducted?

4.2.8 Harbledown Island (Site S08)

In the mid-1990s, MacMillan Bloedel Ltd. (MBL), Port McNeill Division, developed plans to construct a log dump and associated booming grounds on a 4.5 ha site on the northeast shore of Harbledown Island, along Beware Passage. The area would include the site of an old, disused log dump. The BC MELP Log Handling and Storage Prospectus noted the lifetime of the project would exceed 20 years. The BC Lands Foreshore Lease Application was filed 1996-01-31.

Peter Bruce & Associates (PBA) conducted an underwater survey 1995-10-12, reported in a 1996-01-05 letter to the proponent. The diversity of flora and fauna was reported to be low along the two transects investigated. PBA concluded that the most feasible way of meeting DFO NNL policy at this location would be construct a reef from clean shot rock placed 10 m to 15 m below zero tide.

On 1997-03-06 MBL applied to the Canadian Coast Guard (CCG) Navigable Waters Division for approval. CCG determined that the work would not interfere with navigation, and that no authorization was required under Section 5 of the Navigable Waters Protection Act. The application was then referred to DFO Habitat Management Unit, Nanaimo.

In a 1997-03-20 Letter of Advice to MBL, the DFO (Port Hardy) Habitat Management Technologist recommended for the Harbledown Island site a set of mitigation measures, including that:

- any overburden, brush, trees and/or other debris be disposed of at an upland site;
- no filling, dredging or blasting occur below the high water mark, unauthorized by DFO;
- all sewage, garbage and wood waste be properly disposed of;
- fuel storage meet current standards;

- the log-handling area be sloped away from the water and proper ditches be constructed;
- settling ponds and an oil-water separator be established; and,
- the February 15 to May 15 herring spawning period be avoided or that, if the log dump must be used, a herring monitoring program be instituted.

PBA (1997) proposed the location and specifications of a habitat compensation structure. The best available site identified was situated immediately south of the old dumpsite. The footprint of the proposed skidway, the only area requiring fill, was estimated 400 m^2. The fill would be placed on intertidal and shallow subtidal marine foreshore. It was suggested that a rock reef approximately 2 rocks deep, 5 m wide and 25 m to 30 m long would have an equivalent surface area, when crevices were included in the calculation. The DFO file contained no response to the PBA report.

DFO issued MBL an Authorization for Works or Undertakings Affecting Fish Habitat 1997-09-11. Valid until 1998-03-15, the Authorization applied to 1) placement of fill and rock armour over 400 m^2 of intertidal and shallow subtidal marine foreshore at a log dump site on Harbledown Island, and 2) to placement of fill and rock armour over 250 m^2 of intertidal marine foreshore at a barge grid site at the head of Kingcome Inlet. Conditional mitigation measures relating to both sites were that:

- machinery be in good working condition and that no fuels, lubricants or construction wastes were to enter marine waters; all work on the foreshore was to occur when the site was not wetted by the tide;
- log handling and storage be directed away from the intertidal foreshore and occur in water at least 10 m deep;
- the log dump and sort be sloped away from the foreshore and wood debris, sediment and (potential) petroleum pollutants be collected and dispose of at an approved location off-site;
- brow logs or other devices be installed to prevent wood waste and debris from entering the marine foreshore; and,
- clean fill and blasted rock be used in construction.

For compensation, MBL was to create replacement fish habitat at the Harbledown site by depositing clean, blasted rock in water 5 m to 10 m deep to form a three dimensional rocky reed measuring a minimum of 650 m^2 in surface area. The PBA specifications were approved. Work was to be completed prior to or during construction of the Harbledown Island log dump. MBL was to have a qualified biologist carry out a monitoring program, including summer site visits 1998 through 2000.

A 1997-09-12 fax from MBL to DFO clarified costs for 400 m^2 mitigation and compensation at Harbledown Island and 259 m^2 at Kingcome inlet. A total of 650 m^2 at \$42.00/m^2 would cost \$27,300.00. A performance bond cheque for that sum was provided to DFO with the signed Authorization.

In a 1997-09-24 letter to DFO, MBL sought permission to construct the Kingcome barge grid immediately, as road building equipment was on site. Construction at Harbledown Island was to be deferred until at least 1998 due to a downturn in the hemlock market.

DFO authorized MBL to proceed with the Kingcome project, though construction at Harbledown, including the compensatory reef, would be deferred. If the market did not permit Harbledown construction within approximately one year, DFO would instruct MBL to proceed with the compensatory reef or discuss other compensatory arrangements. DFO signed-off the 1996-06-14 Land Referral/Response Form 1997-09-30.

Construction of the Harbledown reef indeed proceeded in fall 1997. On 1998-06-23 MBL submitted the first monitoring report by PBA. The rock reef measured approximately 60 m long by 12 m wide by 2 m high, providing a total habitat area of 720 m^2, exceeding the minimum requirement of 650 m^2. PBA suggested the extra habitat be banked against future MBL projects. PBA made recommendations that the southern end of the booming ground be moved north to prevent woody debris accumulating on the reef, and that marker buoys be placed on the reef to help prevent encroachment.

In an additional 1998-06-23 letter, MBL informed DFO that the Harbledown Island foreshore lease area previously applied for was not large enough to accommodate the final design and layout. An additional 60 m would be required to be added to the southern boundary. An attached map showed the site now occupying waters over approximately one third of the compensatory reef.

A 1998-07-28 letter to MBL from DFO confirmed the amount of banked habitat MBL would be credited toward future projects in the Broughton Archipelago area, as follows:

rocky intertidal/subtidal habitat altered/destroyed =	(650 m^2)
rocky subtidal reef created, multiplied by 3 for crevice habitat provided =	+2,160 m^2
footprint area of subtidal reef habitat created =	(720 m^2)
net surplus rocky reef habitat to be banked =	+790 m^2

The DFO HB recommended release of the performance bond in a letter the same day.

On 1999-02-24, DFO signed-off the 1999-02-11 Land Referral/ Response Form pertaining to the additional 0.63 ha at Harbledown, recommending approval without conditions. Plans indicated that no booming grounds would overlie the compensatory reef.

Audit Assessment

Though the NNL objective appears to have been met at this site, a 1:1 replacement ratio may have been insufficient, as intertidal foreshore habitat was replaced by a subtidal reef. A ratio of 1.5:1 may have been more appropriate. In addition, it is unclear how MBL or their consultant derived the multiplier of 3 for crevice habitat provided by the reef. It would be desirable that clear rationale be given for the ratio and multiplier, given the calculated 790 m^2 of habitat credit to be applied to future projects.

4.2.9 Kingcome Inlet (Site S09)

In a 1991-10-02 internal DFO memo, the Habitat Management Biologist (Nanaimo) reported on a dive survey made at the head of Kingcome Inlet, pursuant to a MacMillan-Bloedel Ltd. (MBL) log dump proposal. The site was found unsuitable for a log dump as:

- the site was a highly productive estuarine habitat located within 500 m of the mouth of the Kingcome River, known to be habitat for populations of five salmon species and steelhead trout;
- herring spawn annually on the intertidal and shallow subtidal vegetation;
- the dropoff was shallow and would result in log bundles grounding onto the loose substrate, disrupting finfish and crab populations; and,
- another MBL log dumpsite was located less than 1 km away, for which compensation habitat was built, but remained unevaluated.

The DFO biologist noted that the loss of habitat area during establishment of marine vegetation on the compensation reef at the existing log dump had not been accounted for, and that 3 to 4 seasons are typically required before newly established marine vegetation becomes fully functioning fish habitat.

Biological consultants Peter Bruce & Associates (PBA, 1997a) reported to MBL 1997-05-18 results of a field review of the location of a proposed road in the Kingcome River estuary. The road would provide access to a barge ramp and service a First Nations village located upstream. A steep rock face bordering the estuary and floodplain would necessitate building the road along the edge of the floodplain.

PBA estimated the amount of various habitat types that would be covered or filled by construction of the road and associated bridges and culverts as follows:

- Mainly freshwater draining onto estuarine meadow of sedge and grass, or into an intertidal channel: 90 m^2
- intertidal channel with sedge and grass: 149 m^2
- upper floodplain sedge and grass habitat: 50 m^2

PBA suggested that MBL provide compensation by excavating additional channels in the floodplain to create equivalent intertidal channel and sedge habitat areas.

In a 1999-05-19 letter to MBL, PBA also reported on an underwater survey at the proposed site of a barge grid on the east shore of Kingcome Inlet, approximately 1 km south of the estuary. The footprint area of rock fill would cover approximately 350 m^2, but the north side of the fill would contribute an estimated 100 m^2 of habitat on which rockweed would quickly establish. Net habitat loss was therefore estimated to be 250 m^2. PBA suggested that compensation be provided by scattering shot rock atop the muddy bed material to provide more stable sub-tidal habitat suitable for algal production.

The DFO Habitat Management Technologist (Port Hardy) provided a Letter of Advice to MBL 1997-08-28 concerning the Kingcome Inlet project. The following mitigation measures were recommended:

- no construction below the high water mark was to occur between February 15 and June 30 of any year, the period of herring spawn and out migration of salmon fry;
- any overburden, brush, trees and other debris must be disposed of at an upland site;
- no filling, dredging or blasting may occur below the high water mark, unless authorized by the DFO Nanaimo Habitat Biologist;
- waste management concerns were to be addressed for disposal of all sewage, garbage and wood waste;
- fuel was to be stored in ways meeting current standards;
- the site was to be sloped away from the water and proper ditches constructed; and,
- settling ponds and an oil-water separator were to be established to prevent discharge of sit or petrochemicals onto the foreshore.

The letter also referred to an agreement made between DFO and MBL that compensation for the barge ramp would be provided at the Harbledown Island site.

In a 1997-09-12 letter to MBL, the DFO HB confirmed the preparation of an Authorization for 250 m^2 of compensatory habitat to be provided in the form of a shallow subtidal rocky reef at the Harbledown Island log-handling site. DFO stipulated that compensatory habitat be constructed prior to or during construction of the Kingcome facility.

The Harbledown file (Site S08) indicates that compensatory habitat was constructed shortly after Kingcome construction was initiated. The Kingcome file makes no specific mention of whether compensation was provided in relation to road construction. No records of monitoring were provided.

Audit Assessment

The NNL objective was not met at the Kingcome Inlet site. 350 m^2 of lost intertidal foreshore habitat was compensated for by a withdrawal of 250 m^2 from the Harbledown Island site. It is unclear why an exception was made here that allowed temporal habitat loss of 100 m^2 during colonization of rock fill. In other South Coast applications described earlier, future colonization of rock fill did not enter habitat balance calculations. It is also unclear why a 1:1 ratio was applied, given unlike replacement habitat.

4.2.10 Broughton Archipelago, Interfor Area 12 (Site S10)

This section describes a group of South Coast HEB Area log dumps for which joint habitat compensation projects were implemented at Charlotte Point and Sir Edmund Bay.

Snowdrift, Frederick Sound, Seymour Inlet

A 1993-07-16 report by Peter Bruce & Associates (PBA; 1993) described a 1993-07-08 underwater reconnaissance of the site of a log dump proposed by Interfor at Snowdrift, Frederick Sound, Seymour Inlet. The site was located on the northeast side of Frederick Sound, a fjord separated from Seymour Inlet by Eclipse Narrows.

Foreshore substrates at the site (sandy/mud, silty gravel, and bouldery/mud) exhibited an impoverished faunal community. Potential for habitat impact was deemed low, though it was suggested measures be taken to prevent grounding of log bundles.

The DFO Port Hardy Habitat Management Technologist issued a Letter of Advice 1995-06-26 pertaining to this site. The letter advised Interfor to implement a set of standard mitigation measures. It had been agreed at a 1995-06-07 meeting that compensatory habitat would be provided at the Charlotte Point reef.

Cavern Cove, Drury Inlet

PBA (1993a) conducted an underwater survey 1993-07-09 of the site of a log dump proposed by Interfor at Cavern Cove, Drury Inlet. The 1993-07-20 report describes the site as located immediately north of a small rock island, connected to the east shore by a narrow isthmus flooded only at higher tides. Cavern Cove is situated at the head of Drury Inlet, on the east side of Actress Passage and south of Charters Point. Charlotte Point is located to the south along the east shore of Actress Passage.

The substrate at the first dive transect consisted of bedrock through the upper-to-mid intertidal zone, then becoming predominantly bouldery to a depth of approximately 26 ft. below zero tide. These regions were found to be biologically productive. Habitat at Transect 2 was less productive, owing to the more concave profile that offered a narrower band of boulder habitat. It was suggested that site characteristics at the location of Transect 2 would make impacts of development less adverse.

Skeene Bay, Drury Inlet

A 1993-07-09 underwater survey of the site of a log dump and boom storage area proposed by Interfor in Skeene Bay was the subject of a 1993-07-20 report by PBA (1993b). Skeene Bay is small, shallow inlet at the head of Drury Inlet, north of Actress Passage. The shoreline at both survey transects 1 and 2 was characterized by bedrock outcrops and large pieces of fractured rock or boulders. Transect 2 was more gently sloping. Areas beyond the shoreline had a sandy mud substrate. Algal growth at the site was patchy and scattered, and few macroinvertebrates or finfish were observed. Bouldery areas appeared to be the most productive. It was suggested that, as the shallow profile presented a liklihood that log bundles would become grounded, booms be stored toward to centre of the bay. Shading of algae growing on boulders nearer shore would also be avoided.

Sir Edmund Bay, Broughton Island

In a 1993-07-23 report, PBA (1993c) discussed a dive survey conducted 1993-07-09 at the site of a log dump Interfor had proposed at Sir Edmund Bay, on the northeast corner of Broughton Island. Transect 1 was situated along a steep bedrock/boulder slope that extended to a depth of 25 ft to 30 ft below zero tide. Substrate at Transect 2 was similar, but the depth profile was shallower. The region was relatively high in biological productivity and biodiversity. PBA suggested that the bed profile at Transect 1 was suitable for a log dumpsite. It was suggested that Short Cove, located between the two transects, and containing large numbers of horse clams and juvenile Dungeness crabs, be protected from impacts of any development by a chain of boomsticks or other applicable measures.

Tribune Channel, Northeast Gilford Island

A 1993-07-23 report by PBA (1993d) described a 1993-07-10 dive survey of the site of a log dump Interfor proposed building along Tribune Channel, on the northeast corner of Gilford Island. The site consisted of the shallow Noel Bay, on the south side of which the remains of an old log dump were located on a rock headland. The site of the pre-existing log dump was deemed the best site for a new facility. Given that it provided the steepest drop, and narrowest band of algae, this site would be subject to fewer adverse impacts. PBA noted that the site had recovered from past log-handling activity, as there was no evidence of logging debris or denuded habitat.

Mitigation & Compensation Proposals for Five Sites

In a 1993-08-02 letter, PBA advised Interfor of mitigation/compensation options available for the above five sites. With the exception of Skeene Bay, habitat subject to adverse impacts would consist of bouldery substrates with associated growth of large algae. Such habitat would generally be replaced by dumping pieces of large, clean material such as shot rock from a barge at specific locations. Skeene Bay, with its mainly sandy mud substrate and shallow profile, would be more difficult to compensate. PBA recommended that the Snowdrift site be compensated for elsewhere (e.g., a site toward the mouth of Seymour Inlet), given the comparatively low productivity there compared to more exposed locations with greater tidal circulation.

Charlotte Point, Drury Inlet

PBA (1994) reported to Interfor 1994-01-22 findings of fieldwork 1994-01-19 at the location of a proposed log dump at Charlotte Point, on the east side of Actress Passage, Drury Inlet. The purpose of the visit was to review potential site impacts and determine an appropriate mitigation plan.

PBA had conducted an underwater survey in July 1993 (no report on file). The intertidal area was predominantly bedrock, becoming bouldery at the lower intertidal/upper subtidal transition zone, to a depth of approximately 3 m below zero tide, where the substrate became a moderately steep slope of sandy mud. Algae were observed only on the rocky/bouldery substrate, and faunal observations were few. The depth profile was suitable for a log dump.

PBA estimated the area that would be affected by foreshore works to be 2,000 m^2 to 2,400 m^2, and proposed a compensatory reef habitat be built of shot rock placed from a barge. Two parallel, overlapping rows could be laid down to create a reef several pieces of rock deep. PBA also suggested mitigation measures to be implemented at the site, including constructing the road as far from shore as possible and leaving a treed buffer along the bay to avoid adverse impacts on shellfish resources.

Application Processing (Charlotte Point & Snowdrift)

In a 1994-04-21 letter, the DFO Nanaimo Habitat Biologist (HB) advised Interfor that, though Interfor had provided copies of PBA reports on the Charlotte Point and Sir Edmund

Bay sites, no formal application or plans had been submitted on which to base a compensation agreement and Section 35(2) Authorization. The following day Interfor forwarded plans for Charlotte Point to DFO.

The HB issued Interfor a Letter of Advice pertaining to Charlotte Point 1994-04-29. DFO would not object to the project, provided Interfor and DFO sign a Habitat Compensation Agreement (Draft enclosed). DFO would then issue the Authorization. DFO also listed a set of mitigation measures to be followed, including a work window of May 15 to February 15 in any year. Interfor returned an annotated draft Agreement 1994-05-05, and the Agreement was made final 1994-05-13.

The Habitat Compensation Agreement committed Interfor to creating a subtidal rock reef, adjacent to the Charlotte Point facilities, equivalent in area to those of lost productivity at the Charlotte Point and Snowdrift log-handling facilities. The reef, with a surface area between 2,000 m^2 and 2,400 m^2 as per the PBA report, was to be constructed of clean, blasted rock before or during construction of the Charlotte Point facilities, between 1994-09-01 and 1995-02-15.

Interfor was required to institute a program to monitor effectiveness of the compensatory habitat, whereby videography and reporting would be undertaken each summer for two years following construction, and be responsible for making any necessary modifications for a period of 3 years. Interfor posted a performance bond for $20,000.00.

Seymour Inlet, Salmon Arm, Frederick Sound, & Tribune Channel

PBA (1994a) reported to Interfor 1994-05-27 results of recent underwater surveys at sites of proposed log dumps in along Seymour Inlet (Site 1), Salmon Arm (Site 2), Frederick Sound (Site 3), and Tribune Channel (Site 4). Tidal range at sites 1, 2 and 3 was approximately 1.5 m; low tidal exchange at sites 2 and 3 was attributable to a glacial sill at Eclipse Narrows at the mouth of the sound. Inflows of fresh water, and low mixing, appeared to have a limiting effect on establishment of large algae and diverse biota found along shores that are more open. The west end of Site 2 had been affected by a landslide, and Site 3 had evidently been a log storage area in the past. Site 1, though less impoverished biologically than sites 2 and 3, did not have the species richness characteristic of less protected shores. Notable, however, was the presence of large numbers of female Dungeness crabs carrying their eggs. Site 4 exhibited the greatest productivity and species richness among these sites, with large kelps extending to 30-foot depths.

Given bathymetric character and low productivity, PBA (1994a) recommended sites 1, 2, and 3 be compensated for in a combined project elsewhere in the Interfor operating area, and that a rock reef be created as compensation for Site 4.

Crown Lands applications for the Seymour Inlet and Salmon Arm sites were referred to DFO 1994-06-09. The Seymour Inlet site would occupy 3.7 ha, and the Salmon Arm site 8.5 ha. On 1995-01-23, DFO issued Authorizations for Works or Undertakings Affecting Fish Habitat for Seymour Inlet (R # 2241) and Salmon Arm (R # 2242), each valid 1993-01-23 to 1995-02-15 and 1995-05-01 to 1996-02-15. The Authorizations stated that compensatory fish habitat had already been provided at Charlotte Point, for approximately 707 m^2 of fill at Seymour Inlet and 1,108 m^2 of fill at Salmon Arm.

Proposed Habitat Compensation Projects

PBA (1994b) surveyed six sites of proposed log dumps between August 25 and 28, 1994, with the objective of developing a list of projects and sites where habitat compensation could be carried out. The six sites were Tribune Channel, Sir Edmund Bay, Charlotte Point, Frederick Sound, Salmon Arm, and Seymour Inlet. The survey outcome is summarized in Table 4-2.

TABLE 4-2:
Habitat Compensation at Six Proposed Log Dumps

Site	Impact Area (m^2)	Compensation Proposal
Tribune Channel	~900	no suitable on-site location; combine with mitigation projects for other sites
Sir Edmund Bay	~1,200	three suitable sites for rock reefs that could also be used to compensate for other projects
Charlotte Point	~2,400	reef construction already underway to compensate for this and a number of other projects
Frederick Sound	~800	excavate an intertidal channel and/or pond to increase site productivity
Salmon Arm	500 to 800	little suitable foreshore; apply habitat compensation at another site
Seymour Inlet	500 to 800	no suitable on-site location; combine with mitigation projects for other sites

In a 1994-11-23 letter to Interfor, the DFO HB described the status of seven proposed log dumps, based on a 1994-10-27 meeting. This letter is summarized in Table 4-3.

A 1994-12-10 PBA letter (1994d) to Interfor reported on a dive survey the previous day that had the objective to measure the Charlotte Point reef. The total footprint area of the reef was calculated to exceed 3,625 m^2 (using a conservative estimate of a 25 m average width). A factor of 1.5 applied to account for crevice habitat yielded a surface area estimate of 5,437 m^2. Total area of impact by the log-handling facilities was calculated to be 605 m^2, leaving 4,832 m^2 of habitat to be applied against other foreshore developments. The performance bond was returned to Interfor 1994-12-14.

TABLE 4-3:
Status of Seven Proposed Log Dumps

Site	Status	Impact Area (m^2)	Compensation Progress	DFO Requests from Interfor
Tribune Channel	Proposed	~900	compensation proposed at Sir Edmund Bay	no requests
Sir Edmund Bay	Proposed (at least 3 years)	~1,200	3 potential sites of reefs nearby; opportunity to create additional banked habitat	accurate drawing of facilities & compensatory project; cost estimate; habitat banking balance sheet
Charlotte Point	Approved	~2,400	dump & compensatory reef habitat built in summer 1994	accurate measurement of reef, and banked habitat balance sheet
Frederick Sound	Proposed	~800	proposal to excavate intertidal channel/pond	accurate drawing of facilities & compensatory project; cost estimate
Salmon Arm	Proposed	500 to 800	compensatory habitat likely to be provided at Charlotte Point	no requests
Seymour Inlet	Proposed	500 to 800	compensatory habitat to be provided at Charlotte Point	no requests
Snowdrift	Proposed[1]	800	dump built and operating; compensatory habitat provided at Charlotte Point	no requests

1. Operating without formal approval

In a 1995-01-18 package sent to the DFO HB, Interfor included a table and calculation of habitat loss and compensation, maps showing locations of the seven log dump sites and foreshore alterations at each, and relevant PBA reports. Table 4-4 summarizes the habitat impact and compensation calculations.

Based on the information provided for the above seven dumpsites, the DFO HB again updated status of the applications in a 1995-01-24 letter. At this time, DFO issued Authorizations for construction of the Seymour Inlet and Salmon Arm sites. The HB also provided a draft Habitat Compensation Agreement for the Sir Edmund Bay site, committing Interfor to construct new rocky reef habitat with a minimum surface area of 708 m^2. DFO still required details of Frederick Sound compensation plans. Those plans were not present in files reviewed. A 1997-06-03 letter from Interfor indicated compensation for Frederick Sound was eventually deducted from the Charlotte Point habitat bank (Table 4-5).

In a 1995-02-02, Interfor informed the HB that Skeene Bay habitat loss would now be provided at the Charlotte Point rocky reef rather than that at Sir Edmund Bay. After construction of all proposed log dumps and compensation projects, Interfor projected net habitat gains to be 1,208 m^2 at Charlotte Point, 1,584 m^2 at Sir Edmund Bay, and 692 m^2 at Frederick Sound.

TABLE 4-4:
Summary of Disturbance & Compensation at Eight Dumpsites

Site	Total Disturbance Area (m^2)	On-Site Compensation	Area Available for Compensation (m^2)	Areas Compensated For
Tribune Channel	708	no	0	na
Sir Edmund Bay	708	yes	3,000	Tribune Channel Skeene Bay Sir Edmund Bay
Charlotte Point[1]	605	yes	5,437	Seymour Inlet Salmon Arm Snowdrift Charlotte Point
Frederick Sound	1,108	yes	1,800	Frederick Sound
Salmon Arm	1,108	no	0	na
Seymour Inlet	708	no	0	na
Snowdrift	1,108	no	0	na
Skeene Bay	708	no	0	na
TOTALS:	**6,761 m^2 disturbed**		**10,237 m^2 habitat created**	

1. Areas stated were based on actual field measurements

Subsequent Monitoring & Habitat Balance Accounting

In a 1996-01-11 letter, Interfor informed the HB (Nanaimo) of a brief site inspection conducted at the Charlotte Point reef. Noted to inhabit the reef were a small school of perch, green sea cucumbers, Dungeness crab, bottom kelp, plumose anemones, prawns, and several starfish species.

A 1997-06-03 letter from Interfor provided brief project updates and results of January and May 1997 site assessments. The information is summarized in Table 4-5.

In a 1997-06-11 letter to the DFO Port Hardy Habitat Management Technologist, Interfor applied to alter the skid system at Scott Cove, Gilford Island. The consequent filling of 55 m^2 of foreshore would be accounted for at Charlotte Point. A 1997-07-28 letter from the HB confirmed a remaining habitat bank of 2,336 m^2.

Additional habitat "banked" at Charlotte Point was later "withdrawn" by Interfor to compensate impacts of other log dumps:

- 1998, Elaine Creek, 150 m^2 (balance 2,186 m^2);
- 1998, Hare Creek and Alpha Bluff, Bute Inlet (Interfor Campbell River Operations), 430 m^2 (balance 1,756 m^2);
- 1999, relocated Elaine Creek, additional 50 m^2 (balance 1,706 m^2);
- 1999, Sutlej Channel, Mount Connolly, 400 m^2 (balance 1,306 m^2); and,
- 1999, 2:1 compensation at Stakawus River site, Jervis Inlet (Interfor Campbell River Operations), 197 m^2 (2 x 98.3 m^2; balance 1,109 m^2).

As of July 12, 1999, a balance of 1,109 m^2 rocky reef habitat remained at Charlotte Point.

TABLE 4-5:
Habitat Compensation at Seven Proposed Log Dumps

Site	Status	Impact Area (m^2)	Comments
Seymour Inlet	operations complete	~878	area was mainly rocky bedrock/boulder substrate due to construction of the landing; deposited wood waste had remained localized due to low current flow
Snowdrift	operations complete	170	some woody debris was scattered along the bottom substrate; influenced by substantial freshwater flows that limit growth of marine vegetation
Salmon Arm	operations complete	573	woody debris scattered to 15 m offshore along ~30 m of landing zone; outer zone influenced by freshwater that limits growth of marine vegetation
Frederick Sound	active	~540	woody debris expected to remain localized due to low currents and tidal influences
Sir Edmund Bay	operations complete	170	very little debris within 12 m off shore; some small debris & 12 small logs were observed scattered12 m to 30 m offshore
Crab Bay	not provided	110	new barge ramp, compensated at Charlotte Point
Charlotte Point	not provided	605	**Summary of Habitat Compensation (m^2):**
			Seymour Inlet (878)
			Snowdrift (170)
			Salmon Arm (573)
			Frederick Sound (540)
			Sir Edmund Bay (170)
			Crab Bay (110)
			Charlotte Point (605)
			Charlotte Point 5,437
			Total Compensation Remaining: 2,391 m^2

Audit Assessment

It is questionable whether the habitat bank reef at Charlotte Point successfully met NNL objectives. The footprint of the reef, approximately 3,625 m^2, was not deducted from the calculation of total compensation remaining (Table 4-5). Had the reef footprint been deducted, the habitat balance would be a deficit of –1,234 m^2. This discrepancy may have been accounted for in the conservative reef surface area multiplier of 1.5, though derivation of this multiplier is unclear. Multipliers as high as 3 were applied elsewhere in the South Coast HEB Area.

4.2.11 Brand Creek, Effingham Inlet (Site S11)

The BC Ministry of Forests (MOF) Small Business Program proposed building an access road to service a small log dump adjacent to the Brand Creek estuary in Effingham Inlet, on the west coast of Vancouver Island (Figure 2). In a 1997-01-20 letter to MOF, Port Alberni, the DFO Port Alberni Habitat Management Technologist (HT) reiterated objections made 1995-08-10 to an earlier proposal for the same site. MOF had amended the earlier plan, as it was not achievable. The amended plan was to cover a portion of the estuary to relocate the centre line of the road seaward from the original alignment, and for equipment access across the estuary. An artificial reef had been proposed to compensate loss of fish habitat. DFO objected to this proposal for the reasons that 1) estuaries and riparian areas are Class 1 habitats, and 2) an artificial reef would not qualify as “like for like” compensation.

Peter Bruce & Associates Biological Consultants (PBA 1997c) to MOF described an underwater survey undertaken at Brand Creek. The mouth of Brand Creek, located approximately 1 km east of the Effingham River estuary, was characterized by a gravel delta. The purpose of the survey was to identify and discuss subtidal features of the site. The access road would follow the steep shoreline west of the delta. PBA assessed the intertidal area of the delta as extensive and productive, and noted that it would be difficult to replace lost habitat on site.

In a 1997-12-22 letter to MOF, the DFO Habitat Biologist (Nanaimo) summarized findings from PBA and DFO surveys of assessed habitat losses and gains at four sites:

- loss of intertidal saltmarsh to road building at Brand Creek: ~60 m^2
- alienation of rocky intertidal and subtidal reef habitat to Brand Creek skidway/log dump: 200 m^2 to 250 m^2
- alienation of intertidal and subtidal habitat at the Skull Lake log dump: ~600 m^2
- alienation of subtidal habitat at the Skull Lake log storage area: ~1,200 m^2
- alienation of intertidal and subtidal rocky reef and gravelly habitat at Cataract Lake: ~600 m^2
- net gain of compensatory rocky reef habitat at Tzartus Island: ~150 m^2

Net loss at existing and proposed log dumping sites totalled approximately 2,450 m^2 of rocky intertidal and subtidal habitat and 60 m^2 of saltmarsh. DFO and MOF had agreed that a minimum of 120 m^2 compensatory saltmarsh be constructed at Brand Creek by excavating forested upland. In addition, the 200 m^2 to 250 m^2 of rocky intertidal and subtidal habitat would be replaced by constructing a rocky reef off site, possibly near Cataract Lake in Barkley Sound, as proposed by PBA. The Habitat Biologist suggested that MOF formalize a proposal.

G.L. Williams and Associates Ltd. (Williams, 1998) assessed intertidal habitat of the Brand Creek estuary and developed a compensation prescription. Total intertidal encroachment area was calculated at 47 m^2, including 18 m^2 of saltmarsh and 29 m^2 of gravel/rock

substrate. An upland area measuring 150 m^2 was identified as suitable for construction of replacement saltmarsh. The DFO habitat compensation ratio of 2:1 (replacement area to area impacted upon) was applied, requiring compensation of approximately 100 m^2. The excess area of approximately 50 m^2 could be banked as compensation for future projects.

A 1998-02-24 letter to the DFO Habitat Biologist from the MOF Small Business Forester made reference to DFO accounting of habitat owed by MOF. MOF was prepared to meet its liabilities, but was requesting clarification of agreements between the agencies, and obligations under the *Fisheries Act*.

The DFO Habitat Biologist initiated a CEAA process, and received a response from Environment Canada (EC). (The CEAA referral form was not on file.) EC determined that no aspects of the proposal would make it a Responsible Authority under CEAA. EC noted that existing habitat values associated with the proposed compensation site had not been discussed in the proposal, and that it was difficult to ascertain the impacts of destroying existing forest habitat to create compensatory marsh habitat. EC did not favour destroying one habitat type to create another habitat type, and suggested the road design or compensation proposal be changed. In a 1998-06-02 letter to MOF, the Habitat Biologist suggested MOF contact EC regarding its concerns.

With a 1998-07-02 letter to the DFO Habitat Biologist, MOF enclosed a signed Authorization agreement for alteration of intertidal salt marsh and unvegetated rock at Brand Creek. The cover letter stated that road building would begin in August 1998 and compensatory habitat work in September 1998. The road would be completed by 1998-12-01. MOF was working within timing constraints from the BC MELP to protect wildlife trees, and urged DFO to expedite approval. It was the intention of MOF to create 150 m^2 compensatory salt marsh under the supervision of G.L. Williams & Associates Ltd. (GLW), and to create rock reef compensatory habitat at the Cataract Lake site, as proposed by PBA. It is noted that the DFO file contained no record of discussions among MOF, MELP and EC.

The harmful alteration authorized was placing fill and rock armour over 60 m^2 of high intertidal salt marsh and 250 m^2 of rocky intertidal and subtidal marine foreshore at Brand Creek, to create an access haul road and A-frame log dump.

Standard mitigation conditions in the Authorization were that:

- machinery be in good working condition and that no fuels, lubricants or construction wastes enter marine waters;
- log handling and storage be directed away from the intertidal foreshore and occur in water at least 10 m deep; and,
- the log dump and sort be sloped away from the foreshore, debris, sediment and (potential) petroleum pollutants be collected and disposed of at an approved off-site location, and brow logs or other devices be installed to prevent wood waste and debris from entering the marine foreshore.

Conditions relating to compensatory habitat were that:

- MOF create 120 m^2 of new salt marsh habitat to offset loss of 60 m^2 of salt marsh;
- loss of 250 m^2 of intertidal and subtidal rock habitat be replaced by rocky reef habitat, at minimum equivalent in area, constructed in Barkley Sound at an appropriate site identified by Peter Bruce (PBA);
- compensatory works be completed as described in the reports by Peter Bruce (1997c) and Gary Williams (January 1998);
- compensatory works be constructed between 1998-05-15 and 1998-09-15; and,

- MOF Port Alberni carry out a monitoring program, to include summer assessments 1998 through 2000.

A PBA report to MOF, 1998-09-02, described proposed construction of the compensatory reef in Barkley Sound. MOF would barge 400 m^3 of rock to the site to create a reef at least 2,450 m^2 in area, compensating for the Brand Creek, Cataract, Tzartus and Skull log dumps and dryland sorts.

A 1998-09-11 letter from the DFO Habitat Biologist to MOF described findings of a visit to the Brand Creek site two days earlier. The contractor building the barge landing site had destroyed 25 m^2 of salt marsh by surfacing it with crushed blasted rock. MOF would be required to replace the additional area of marsh. MOF replied 1998-09-15 that they would investigate the site 1998-09-17, and asked whether the Habitat Biologist would prefer rock be pulled out of the disturbed area, the area be replanted, the compensatory habitat be enlarged, or a combination of these options. On 1998-09-16, the Habitat Biologist replied that the preference would be to restore the affected area of marsh, but that additional compensation of 50 m^2 may be an option.

A report by PBA (erroneously dated 2 Sept. 1998) reported on construction of the compensatory reef September 10 and 11, 1998. The reef was situated in Barkley Sound approximately 50 m to 70 m west of the booming ground associated with the Cataract log dump. Observations made during a preliminary dive examination, made shortly after the rock had been dumped to form the reef, estimated the footprint of the reef to be a minimum of 850 m^2, and that, given the large size of rock used and extensive crevice habitat created, the surface area would be 2 to 3 times greater. The minimum requirement was 2,450 m^2, and the new reef appeared to be "in this general realm."

The first annual monitoring report was prepared by GLW 1998-10-05 (Williams, 1998a), summarizing and discussing construction of the compensatory salt marsh. Approximately 350 plugs of tufted hairgrass (*Deschampsia cespitosa* ssp*. beringensis*) were transplanted from the existing salt marsh to create a compensatory marsh approximately 200 m^2 in area, exceeding the design target of 170 m^2.

The second annual monitoring report, prepared by GLW 1998-08-06 (Williams, 1999), indicated the compensatory marsh to be approximately 235 m^2 in area, stable, and estimated core survival to have been 97%. Colonization by other species had begun between the cores of tufted hairgrass.

Field Audit

G3 scientists visited the Brand Creek site 1999-12-02 at low tide. Log-handling operations were inactive, with only the boat dock and ramp remaining (Photo 50). The site running surface was free of debris and potential sources of contamination (Photo 51). Riparian forest along Brand Creek (Photo 52), immediately east of the log dump site, was dominated by western redcedar, western hemlock, Douglas-fir and salal. Red alder had colonized the margins of the roadbed. A large snag stood adjacent to the compensatory habitat, providing potential wildlife habitat.

Immediately offshore, along the subtidal-intertidal boundary was an extensive oyster bed (Photo 53). Swans were observed in the inlet, in addition to other waterfowl.

As tide was low, the compensatory marsh study area and foreshore could be assessed when visited. The excavation was wedge-shaped, tapering from approximately 14.2 m wide at its opening to approximately 12 m wide at the rear, through a length of approximately 20 m (Photo 54). Compensatory area was estimated to be 260 m^2, somewhat larger than previous estimates. The substrate was gravel dominant with cobble subdominant, and the slope approximately 1.5% toward the inlet. Based on the high water mark, it was estimated that the site would be partially inundated by 2.5 m to 0.5 m of water at high tides.

Photo 50: Brand Creek log dump, Effingham Inlet; “reference” foreshore in foreground, dock and upslope running surface in background (December 1999).

Photo 51: Running surface of Brand Creek log dump, Effingham Inlet (December 1999).

Photo 52: Mouth of Brand Creek (December 1999).

Photo 53: Foreshore west of Brand Creek mouth, with oysters visible underwater (December 1999).

Photo 54: Brand Creek habitat compensation site (December 1999).

Photo 55: Vegetation plot survey methodology, Brand Creek habitat compensation site (December 1999).

Cores of tufted hairgrass (*Deschampsia cespitosa* ssp*. beringensis*) had been planted in a grid pattern approximately 10 tufts wide and 24 tufts long. The total number estimated was 240 to 250, lower than the 350 reported by Williams (1998a). Significant mortality was not observed and did not appear to account for the entire difference in counts.

Nine 1 m^2 vegetation plots were laid out with a quadrat and assessed in the compensation area (three along each of three transects) and three along a transect on the adjacent reference foreshore. Each plot was photographed, vegetation species identified (per Pojar and MacKinnon, 1994) and stems tallied by species, plot substrate categorized, and total percent cover estimated (Photo 55; data tabulated in Appendix 2).

As expected, tufted hairgrass was, by far, the dominant species in the compensatory habitat, and appeared healthy. Plots contained 1 to 4 cores, each approximately 30 cm in diameter (Photo 56). Tufted hairgrass had also vigorously colonized by runner, with 33 new stems tallied in one plot. Other higher-plant species commonly found in the compensatory habitat were Lyngby's sedge (*Carex lyngbyei*), silverweed (*Potentilla anserina* spp*. pacifica*), Canadian sand-spurry (*Spergularia canadensis*) and yarrow (*Achillea millefolium*). Less common species (1 to 7 individuals) included salt marsh starwort (*Stellaria humifusa*), small hop-clover (*Trifolium dubium*), Alaska plantain (*Plantago macrocarpa*), red alder (*Alnus rubra*) seedlings, small-leaved montia (*Montia parvifolia*), and beach carrot (*Glehnia littoralis* spp. *leiocarpa*). Mosses included a clump of lanky moss (*Rhytidiadelphus loreus*) that appeared to have been windblown into the area, and red roof moss (*Ceratodon purureus*), covering 1% to 2% of surface area in most plots. Total percent vegetation cover in plots ranged from approximately 3% to 60%, and all substrates were rock/cobble. A small number of additional plants could not be identified as they were in poor condition (given the season) or not it flower.

The reference site on the adjacent foreshore had been the donor area for transplanted cores of tufted hairgrass (Photo 57). Vegetation cover in the three sample plots was dense (40% to 60%), dominated by four species: tufted hairgrass, silverweed, small hop-clover and Alaska plantain.

Dominant vegetation species identified were the same ones identified by Williams (1999), who also conducted plot surveys in July 1999. Less common species identified differed somewhat between the two surveys, attributable to random plot placement. Williams (1999) identified seven species in each of two reference plots and three to seven species in each compensatory plot. G3 identified three to four species in reference plots and five to eight species in compensatory plots. Some colonizing species were foreshore species common in the region, while others were opportunistic and cosmopolitan (e.g., yarrow and red roof moss).

The compensatory habitat appeared to be functioning as intended, with tufted hairgrass gradually spreading by runner throughout the area to create additional saltmarsh habitat similar to that on the adjacent foreshore (reference and donor site).

Audit Assessment

Field audit results (Section 4.2.11) indicated that intertidal marsh created as compensatory habitat at the Brand Creek log dump was becoming established, and would eventually function as intended. This compensation site, together with offshore artificial reef habitat, appeared to achieve the NNL objective.

As noted by Environment Canada in its response to the CEAA referral, existing habitat values of the compensation site had not been discussed in the proposal, and it was difficult to justify removal of existing forest habitat to create compensatory marsh habitat. DFO and BC MOF (the project proponent) did not appear to have responded to EC's opinion in this matter.

Photo 56: Typical vegetation survey plot, Brand Creek habitat compensation site (December 1999).

Photo 57: One of three vegetation survey plots, Brand Creek habitat reference site (December 1999).

Another type of option that could have been considered may have been to request MOF contribute to a larger-scale habitat restoration effort off-site. An available area for such an effort would be Alberni Inlet, which has been adversely affected by log booming and transport operations over many decades.

With regard to the compensatory reef in Barkley Sound, the reef surface area multiplier of "2 to 3" ascribed by PBA is overly qualitative. In addition, application of a higher replacement ratio than 1:1 (e.g., 1.5:1 or 2:1) may have been advisable, given intertidal and subtidal habitat losses were being replaced by an entirely subtidal reef.

4.2.12 Menzies Bay Crane De-Watering Site (Site S12)

In a 1994-12-09 letter to DFO, and with reference to an earlier telephone conversation, Campbell River Fibre Ltd. (CRF) requested DFO evaluate the CRF request to dewater pulp logs at their Menzies Bay site near Campbell River (Figure 2).

A 1995-01-10 letter from consultants Peter Bruce & Associates (PBA, 1995a) to CRF advised CRF of expected fish habitat losses and possible compensatory measures. The likely method of constructing the crane would be to use cribbing or drive sheet pile and fill with clean rock to a height of 1 m to 2 m greater than the existing armouring. A total footprint between 45 m^2 and 75 m^2 was expected. It was suggested that compensatory habitat be constructed at a site immediately south of the conveyor. As the shoreline at that site had not been armoured, the foreshore could be pulled back to create upper intertidal or marsh habitat. The 1995-01-19 fax cover sheet from CRF to the DFO Habitat Biologist (Nanaimo) indicated the PBA report and drawings were attached, and that the Habitat Biologist had visited the site 1995-01-12. CRF subsequently forwarded blueprints.

With a 1995-01-20 letter to CRF, the Habitat Biologist enclosed a Habitat Compensation Agreement for CFR signature before commencement of work. Other conditions listed in the letter were that:

- DFO issue CFR with an Authorization for Works or Undertakings Affecting Fish Habitat prior to commencement of work;
- foreshore construction occur May 15 to August 31 and November 1 to February 15 in any year, to protect vital fisheries resources; and,
- construction equipment was to be in good working condition, no fuels, lubricants or construction wastes enter the marine environment, and all fill used for the dewatering ramp be clean coarse gravel or shot rock and all fill excavated from the fish habitat compensation site be disposed of in an approved upland location.

Under the agreement, CRF was to compensate for 3,000 ft^2 of intertidal and subtidal marine foreshore filled during construction by excavating 3,000 ft^2 of intertidal marine foreshore at the south end of its site. Tides of 12 ft and higher were to inundate the site. Construction was to begin before or coincident with construction of the dewatering crane. As rapid natural colonization of the new intertidal area was expected, no detailed monitoring was deemed necessary; however, photographs were to be provided, taken during the first low tide following construction. CRF was given the responsibility of ensuring that the habitat continued to function properly for a period of 3 years. CRF posted a $2,000.00 letter of credit.

The DFO Habitat Biologist provided the necessary Authorization for Works or Undertakings Affecting Fish Habitat 1995-01-30.

A 1995-05-03 letter from PBA to CRF reported on construction of the compensatory habitat. Approximately 330 m^2 of foreshore covered by fill during construction was compensated by approximately 390 m^2 of new intertidal habitat created by pulling back the

upper beach south of the dewatering site. The Habitat Biologist returned the CRF letter of credit 1995-09-29.

It is noted that the DFO file for this project contains a "Referral Baseline Detail Report" that contains an Action Log summarizing letters, faxes and other paperwork. This appears to be a convenient record format. Other items, such as site visits, could be added.

Field Audit

G3 evaluated the compensation site 1999-11-30. The intertidal pool, an estimated 15 m wide, extended approximately 25 m along the beach (Photo 58). A log retaining wall was situated behind the pond along the bank, which supported alder-dominated forest. The tide was rising during assessment, and the pool filling rapidly, approaching a high of approximately 4.27 m (14 feet).

The pond was relatively devoid of vegetation (Photo 59), with the exception of scattered rockweed (*Fucus distichus*) and western lilaeopsis (*Lilaeopsis occidentalis*), in contrast with adjacent beach areas (Photo 60), densely vegetated with grasses (e.g., Alaska brome, *Bromus sitchensis* and meadow barley, *Hordeum brachyantherum*) and bulrushes (*Scirpus sp*.). A layer of wood fibre and other organic debris approximately 5 cm thick overlay the sandy substrate. A narrow band of rockweed (<1 m) had colonized the opening of the pond, whereas colonization of the pond edges by vegetation was minimal. No fauna were observed.

Campbell River Fibre operations were active during the field visit, precluding detailed site measurements (Photo 61). The crane dewatering site and conveyor were located approximately 70 m northward along the waterfront.

Audit Assessment

As described in Section 4.2.12, the intertidal pool excavated in spring 1995 as compensation for expansion of the sortyard did not appear, during the site audit, to be functioning as intended, though appearing to meet design specifications. Though failure of this site may not have been predictable, shortcomings might have been discerned and corrected had a monitoring program been required in the Authorization. It is suggested that HADD Authorizations include provisions for site monitoring a minimum of once annually for three years, with additional requirements defined on a site-specific basis.

Pulling back the vegetated beach to create an intertidal pool appeared to have been an ineffective option. Presence of abundant vegetation on the remaining beach flanking the compensation site suggests the site to have been well vegetated before implementation, helping to stabilize the beach and prevent erosion by wave action.

Alternative compensation sites were available nearby, and may have been preferrable options had they been investigated. For example, Trout (Mohun) Creek habitat rehabilitation, suggested concurrently as compensation for the Menzies Bay MacMillan Bloedel facilities (Section 5.3.1), might have been applicable. Benefits to fish habitat would likely have been more desirable.

The existing compensatory pond might benefit from increasing its complexity; for example, large boulders, coarse substrate or rootwads could be placed within it to provide habitat for epifauna and rockweed, similar to the large boulders observed in the intertidal area nearer the Mohun Creek estuary.

Photo 58: Habitat compensation site with crane dewatering and conveyer facilities in background, Campbell River Fibre, Menzies Bay (November 1999).

Photo 59: Substrate of compensation site, Campbell River Fibre, Menzies Bay (November 1999).

Photo 60: Typical beach vegetation adjacent to compensation site, Campbell River Fibre, Menzies Bay (November 1999).

Photo 61: Crane dewatering site, Campbell River Fibre, Menzies Bay (November 1999).

4.2.13 Knox Bay (Site S13)

The site of a log dump proposed for Knox Bay, West Thurlow Island (Figure 2), by Discovery Hardwoods Ltd. (DHL) was visited by the DFO Fisheries Officer (Quathiaski Subdistrict) (FO) and the DFO Habitat Biologist (Nanaimo) (HB) 1989-05-23. In a 1989-06-08 letter to DHL, the FO provided a series of mitigation measures conditional to approval. He also cautioned DHL that any damage to the adjacent eelgrass bed would require creation of compensatory habitat.

A 1994-03-22 memo to the HB from the DFO Habitat Technologist (HT) (Campbell River) described the configuration of a dryland sort proposed by TimberWest Forest Limited (TFL) for Knox Bay that would require placement of fill. A site plan and photographs were also supplied. The HB replied that, as the beach appeared to have little commercial shellfish value, the primary DFO concern would be associated with loss of intertidal habitat to fill and impact of watering and handling logs on intertidal and shallow subtidal areas. The HB's preferred compensatory option was to cut back an upland area to create more intertidal habitat. Other options would include building a rock reef with an intertidal breakwater component.

A 1994-11-21 letter to DFO from TFL described results of a dive survey undertaken to address concerns of the DFO HT that:

- the float camp might be killing some eelgrass by shading;
- a barge ramp built into the intertidal zone without DFO consultation had impacted on fish habitat to an unknown extent; and,
- a mitigation and compensation plan would require defining.

In addition, TFL desired to assess the feasibility of enlarging the dryland sort area with the least impact on fish habitat and to plan to compensate for any habitat destroyed. The surveyors found that the float camp was not shading any eelgrass, but that the barge ramp had covered a portion of eelgrass bed. Accurate measurements would later be taken, and a plan developed for 2:1 areal replacement. In addition, it was suggested that the cobble beach south of the barge ramp be filled to allow the facilities expansion, and that a compensatory rock reef be created.

In a 1995-05-02 letter to the HB, the TFL Fish and Wildlife Technician advised of a plan to pull back rock from the barge ramp, install fill, and plant compensatory eelgrass. A 1995-11-27 letter from TFL described the eelgrass transplanting program undertaken by Archipelago Marine Resources on behalf of TFL. A dense eelgrass bed located approximately 100 m south served as the donor site. The affected area of eelgrass measured 30 m^2, and the plan was to replace it 1:1. As a 40 m^2 plantable bench was created with an excavator, a 40 m^2 of eelgrass bed was created by tying approximately 200 eelgrass rhizomes to 30 cm long, 0.6 cm diameter steel bars used for anchoring. The file did not indicate why a 2:1 ratio was not applied in this instance.

A 1996-06-04 letter from the TFL Fish and Wildlife Technician to the DFO HB provided photographs and a plan for expansion of the Knox Bay dryland sort. The footprint would be approximately 250 m^2, with a face composed of angular shot rock (1.5:1 slope) that would yield approximately 70 m^2 of intertidal rocky habitat. Net habitat loss would therefore be approximately 180 m^2 of gently sloping upper intertidal cobble beach. The compensation proposal was that 12 rock "fingers" be constructed of angular shot rock placed perpendicular to the expansion site. Each finger would be 10 m long, 2 m wide at the base, and 1.5 m high, yielding 1.6 m^2 of net gain per metre, or approximately 192 m^2 of net habitat gain. Total compensation would amount to 262 m^2 of rocky intertidal habitat. In a 1996-06-18 fax, TFL indicated the cost was estimated to be $7,200.00.

In a 1996-06-18 letter to TFL, the DFO HB approved the plan, provided that TFL sign a Habitat Compensation Agreement. The HB would then issue a Letter of Authorization permitting the project to proceed, subject to mitigation conditions that:

- foreshore construction occur June 18, 1996 to February 15, 1997;
- all machinery be in good working condition, no fuels, lubricants or construction wastes enter marine waters, and every attempt be made to minimize disturbance of the adjacent natural beach; and,
- operations not result in deposit of wood waste or other contaminants on the marine foreshore, and brow logs and fuel and oil catchment devices be deployed as required.

The Habitat Compensation Agreement stipulated that TFL provide 262 m^2 of rocky intertidal habitat, as described above, between June 18, 1996 and February 15, 1997. TFL was to monitor effectiveness of the compensation program for two years.

TFL provided a performance bond in the amount of $7,200.00 1996-07-12, and DFO subsequently issued a Section 35(2) Letter of Authorization stipulating requirements of the Habitat Compensation Agreement and the HB's 1996-06-18 letter.

Field Audit

G3 assessed the Knox Bay log dump and compensation site 1999-11-30, mid-afternoon on an ebbing tide (Photo 62). As the log dump was in active operations, detailed measurements of the footprint could not safely be made (Photo 63).

High late-fall tide levels prevented non-dive assessment of the eelgrass bed adjacent to the dumpsite. The boomstick perimeter (Photo 62) appeared to lie outside the barge ramp transplanted area, as indicated on site plans.

Twelve fingers had been constructed of shot rock along the intertidal foreshore south of the dumpsite (numbered 1 to 12 with increasing distance from the fill toe). The fill slope had encroached on the compensation area (probably gradually during operations), and fingers 1, 2 and 3 were nearly to partially covered (Photo 64). Large amounts of logging debris had been washed up between and atop the fingers, along with bull kelp and various flotsam (e.g., large pieces of styrofoam and other plastic refuse). The amount of such material decreased with distance from the fill toe, and fingers 11 and 12 were relatively exposed (Photo 65). The fingers had effectively formed a debris trap.

Little vegetation appeared to have colonized rock surfaces on the fingers, and faunal observations were limited to occasional limpets (*Lottia pelta*) adhering to fingers 10 through 12 (Photo 66). By contrast, abundant rockweed (*Fucus distichus*) was observed southwest of the fingers, adhering to the natural rock face and adjacent intertidal and subtidal shore. This compensatory habitat is further discussed in Section 5.3.4.

Limpets were also present in higher numbers along the shore beyond the compensation site, and a sunstar of undetermined species was observed offshore Finger 3.

As stated above, twelve fingers, each 10 m long, 2 m wide at the base, and 1.5 m high, were designed to yield 1.6 m^2 surface area per linear metre, or a total of 192 m^2 of net habitat gain. As-built measurements of selected fingers, taken during the site audit, are provided in Table 4-6.

Table 4-6 data demonstrate the measured rock fingers (as-built) met or exceeded design specifications. Though 192 m^2 or more net habitat gain was potentially achieved, the condition of the site when visited, by a combination of debris and encroachment, was not conducive to colonization by epifauna or vegetation.

TABLE 4-6:
Measured Dimensions of Selected Compensatory Rock Fingers; Knox Bay Log Dump, West Thurlow Island

Finger Number	Length (m)	Average Basal Width (m)	Average Height (m)	D90[1] Rock Size (m)
5	9.6	3	1.4	0.7
6	12.7	2.8	2.0	1.0
9	10.5	2.9	1.4	0.7
12	12.4	3.5	1.4	0.7

1. Intermediate diameter of rocks of a nintieth percentile size

Audit Assessment

The shot rock fingers constructed adjacent to the Knox Bay log dump, West Thurlow Island, assessed during the field audit did not appear to be functioning as intended (Section 4.2.13). The fingers trapped large amounts of flotsam and debris, and were being gradually encroached upon by the apron of the log dump. Scouring of rock surfaces by waves moving the debris likely contributed to a lack of colonization by *Fucus* and epifauna.

Though this compensatory habitat would potentially provide like-for-like habitat, and was designed to have a large available surface area, siting appears to have been ineffective. A preferable location, where debris would not accumulate to such a degree, may have been selected by giving due consideration to tidal and current flow direction and water depth. It would also have been advisable to isolate the compensatory habitat from continued effects of the log dump and associated activities.

Shortcomings of the Knox Bay compensatory habitat would almost certainly have been identified earlier had independent monitoring been conducted. DFO files contained no information as to whether the proponent followed through with monitoring requirements of the HADD Authorization, or whether the performance bond has been returned.

The existing rock fingers would benefit from frequent cleaning (e.g., following storms), and educating the licensee's employees and contractors as to the purpose of this compensatory habitat, to make them mindful of encroachment. Cleaning might enable vegetation and epifauna to gain a foothold in more sheltered microsites. Cleaning would likely be labour-intensive and expensive.

It is suggested that measures to rehabilitate the rock finger habitat be investigated, and implemented if deemed effective and feasible. Such measures might include extending each finger approximately 5m to 10 m further from shore into the subtidal zone, and placing a protective breakwater, constructed of boomlogs, to divert and disperse debris and reduce accumulation.

Photo 62: Knox Bay log dump and compensation site (centre of frame; December 1999).

Photo 63: Active operations, Knox Bay log dump (November 1999).

Photo 64: Debris washed up on compensatory rock “fingers”, Knox Bay log dump (November 1999).

Photo 65: Debris on compensatory rock “fingers” decreased with distance from the Knox Bay dumpsite (November 1999).

Photo 66: Occasional limpets adhered to compensatory rock “fingers”, Knox Bay log dump (November 1999).

Photo 67: Active operations at Rosewell Dryland Sort (December 1999).

4.2.14 Harmac Chip Mill (Site S14)

In the mid-1990s, Harmac Pacific Inc. proposed constructing a new chipping plant and chip scow unloading facility at its existing property on Duke Point, along Northumberland Channel, south of Nanaimo, BC. The DFO Habitat Biologist (HB) attended a meeting and site tour 1996-09-17. It was noted that the HB would like to see the area of fill impact minimized, and that blasting would be restricted to the period between November 15 and December 15.

Biological consultants Peter Bruce & Associates (PBA, 1997d) reported on an underwater habitat assessment of the site. PBA observed the booming ground to have been highly impacted upon by deposition of wood debris generated by log handling, rendering the area uninhabitable by infauna. Only one crab was observed, and the only fish was one sculpin, observed in the intertidal zone. PBA concluded that proposed changes would result in fewer sunken logs at the site, and improvement in conditions of subtidal habitat.

PBA (1997d) assessed a bay located west of the Harmac outfall as having good potential for habitat compensation projects. PBA suggested that two major habitat features were lacking in the bay: substrate sufficiently stable for attachment of large kelps, and rocky habitat with crevices. Creation of two types of rocky habitat were therefore recommended: 1) an apron of shot rock along the toe of the armoured slope in the upper subtidal zone; and 2) one or more reefs made of shot rock, located 10 feet (~3.0 m) to 35 feet (~10.7 m) below zero tide. Total area requiring compensatory habitat was estimated to be 3,700 m^2, the area of the fill footprint, less the peripheral armoured fill slopes below the high water mark that would contribute habitat.

In a 1997-06-10 letter, Harmac informed the BC MELP Land Officer of the timing and status of the project. The revision of the Harmac foreshore lease would be contingent upon completion of the landfill and a legal survey of the developed upland.

The Gisborne Group (TGG) prepared detailed engineering specifications for the proposed chipmill and barge unloading facility, and also for the habitat compensation project. These projects, and related schedules, were described in two 1997-06-10 letters. The compensation project would consist of three linear rock groynes placed in the bay west of the pulp dock, between 5 m and 10 m below low water elevation. The structures would run parallel to the contours of the sea bottom and shoreline, and be approximately 10 m wide, 3 m high, and 80 m long. The material, similar to riprap and with a minimum diameter of 0.5 m, would be end dumped from a spud barge to create a loosely piled configuration with many crevices. At that time, it was anticipated that the blasting timing window would be insufficient, and mitigatory measures were suggested that would be implemented should the period require extension, including placement of a berm and fish exclusion netting.

DFO, Habitat Enhancement Branch, determined that CEAA assessment requirements were applicable to the proposed project, and DFO was a Responsible Authority. Table 4-7 summarizes responses to the 1997-06-17 referral.

In a 1997-09-25 letter to DFO, the Harmac Engineering Superintendent outlined changes in project scope. "Becker Hammer" soils testing had revealed less rock to be present at the site than expected, and presence of more overburden. In addition, in reviewing its fibre supply requirements, Harmac had concluded that it would proceed first with the barge unloading facility and a minimum breakwater, rather than marine fill for the chipping plant as originally planned. Blasting requirements would be, therefore, less, and the size of marine fill reduced from 75,700 ft^2 (~7,032 m^2) to approximately 30,200 ft^2 (~2,806 m^2).

In a 1997-09-30 letter, the MELP Regional Land and Water Manager authorized Harmac to proceed with the amended proposal after 1997-10-15, subject to the Habitat Authorization agreement and to preparation of a survey plan revised post-construction.

TABLE 4-7:
CEAA Referral Responses,
Harmac Chipmill & Barge Unloading Facility

Referree	Date	Comments
Environment Canada	1997-06-27	not a CEAA Responsible Authority; referred to CWS re migratory birds
	1997-07-24	CWS advised the Harmac foreshore was rated as 3M by Canada Land Inventory, important migration stopover and overwintering habitat for waterfowl; however, given the highly disturbed nature of the site, it is unlikely that significant bird habitat exists; given the rock groynes would be colonized by molluscs and crustaceans, they would provide foraging habitat for migratory diving waterfowl; as the greatest numbers of overwintering waterfowl are present in Northumberland Channel during January and February, CWS would not support blasting/excavating activities beyond December
Canada Coast Guard	1997-08-29	formal approval under the Navigable Waters Protection Act, subject to mitigation measures, including debris containment and safety lighting
Nanaimo First Nation	NA	no response to referral
BC MELP	1997-09-03	no objections, provided mitigation/compensation plans take into account means of addressing impacts of wood waste accumulations at the booming grounds, and the design includes detailed stormwater and contaminant control plans

A 1997-10-08 memo from EC's Ocean Disposal Control Program acknowledged receipt of an Application for Ocean Disposal from Evans Professional Engineering Services Ltd., on behalf of Harmac. Dredgate was to consist of approximately 50% wood wastes and the remainder, sand and gravel. Disposal would be at either the Five Finger or Porlier Pass sites. EC would undertake analysis of archived bore-hole samples for substances regulated under the Canadian Environmental Protection Act (including trace metals, PAH, PCP, PCB and dioxins/furans) and circulate the results for comment if concentrations were found to exceed levels identified in the Interim Contaminant Testing Guidelines.

In a 1997-10-23 memo, Harmac informed DFO of its plans to commence dredging 1997-10-27, around the Phipps Landing area of the foreshore, and that 13,000 m^3 to 15,000 m^3 of overburden would be removed by mid-November. Blasting would then take place mid-November to November 30. The DFO Habitat Biologist advised Harmac to proceed with this schedule, in a 1997-10-25 memo.

The Authorization of Works or Undertakings Affecting Fish Habitat (No. 96-000382) was amended to reflect these changes in project scope and schedule. Changes were handwritten and initialed by the Harmac Production Supervisor.

Conditions in the Authorization related to blasting at the barge unloading facility included on-site monitoring by a qualified marine biological consultant with the authority to stop all work if he or she deemed fish or marine mammals to be harmed by blasting.

Mitigation measures during construction included that:

- foreshore construction occur between 1997-10-15 and 1998-02-15;
- machinery be in good working condition and no fuels, lubricants or construction wastes enter marine waters;
- blasted rock and marine sediments be excavated from the blasting area and placed as fill to facilitate construction of the breakwater;

- the breakwater be armoured with appropriately sized blasted rock to prevent erosion and care be taken during construction to ensure minimal sedimentation of the foreshore;
- asphalt, cement wastes or other substances deleterious to fish not be allowed to enter the marine foreshore;
- existing dolphins and tie-ups be used wherever practical, and new pilings or dolphins be constructed of steel pipe to reduce potential toxicity; and,
- sunken logs, rope and other debris collected during site preparation be disposed of at an approved ocean disposal location or in a approved landfill.

Compensatory habitat to be constructed was to consist of three blasted rock reefs located at 7 m to 10 m depths within the Harmac lease site, west of the main mill and parallel to the shoreline. Total surface area of the reefs would be 2,500 m^2, and each would measure approximately 3 m high by 70 m long. An additional 3,256 m^2 compensatory habitat would be provided by the portion of rock armour surrounding the breakwater below the high water mark. As this project would therefore result in no net loss of habitat, compensatory habitat constructed was to be considered a credit applicable to future projects. Harmac was to carry out a monitoring program, included in federal Environmental Effects Monitoring.

In a 1997-11-14 memo to the Marine Mammals Department, DFO Marine Biological Station, Nanaimo, PBA described the blasting program and potential impacts on the estimated 200 sea lions inhabiting log booms near the construction site. A 1997-11-20 letter from the DFO Habitat Biologist authorized use of seal bombs to encourage sea lions to move away from the site.

Audit Assessment

Though Harmac subsequently suspended plans to build the chip mill, the company constructed an artificial reef west of its diffuser outfall, as materials were available on-site. G3 Consulting Ltd. has reviewed a video assessment that indicated the reef to be populated by several fish and macroinvertebrate species. Assuming it was built to the original specifications, this reef represents a net habitat gain of approximately 2,500 m^2.

4.2.15 Rosewall Dryland Sort (Site S15)

DFO Nanaimo logged an application for the Rosewall dryland sortyard at Mud Bay, near Campbell River, 1995-06-26 (Figure 2). The application, from Stonecroft Project Engineering of Black Creek, on behalf of BCF Shake Mill Ltd. was for proposed modifications to an existing facility. The proponent requested written authorization from DFO to expedite MELP and BC Lands approvals.

In a 1995-06-26 reply to the proponent, the DFO Habitat Biologist (HB) referred to a joint site visit made 1995-06-20. The proponent would require a legal agreement with DFO prior to construction.

A Habitat Compensation Agreement was made 1995-07-04. BCF Shake agreed to compensate for filling 2,754 m^2 of intertidal mudflat currently used for log handling by:

- removing 485 m^2 of fill then used at the log sort;
- creating 642 m^2 of intertidal wetland adjacent to a settling pond to be built on the southwestern part of the property; and,
- by removing all woodwaste from the booming off area of mudflat measuring a minimum of 4,895 m^2, then returning this area of former leased land to the Crown.

It was the responsibility of BCF Shake to ensure that compensatory habitat continued to function properly for three years, and to make any necessary modifications.

In a 1995-07-05 Letter of Advice to the proponent, the HB added a series of site-specific mitigatory conditions to DFO approval:

- foreshore construction at the site was to be limited to the periods July 1 to August 31 and December 1 to February 15, in any year;
- all construction equipment was to be in good working condition and no fuels, lubricants or construction wastes were to enter the marine environment;
- all fill was to be clean and free from contaminants;
- dredgeate piles and woodwaste on the site and within the foreshore lease area to be returned to the Crown were to be disposed of at an approved upland location;
- the side slopes of the new dryland sort were to be armoured with rock riprap or other material that would prevent erosion;
- the new dryland sort surface was to be sloped and drained so as to deposit water and sort wastes into a settling basin prior to discharge to the log pocket on the foreshore;
- the surface of the new dryland sort was to be paved and curbed so that woodwaste did not enter the marine foreshore from the sides of the sort;
- fuel handling and equipment maintenance were to conform to industry standards; and,
- the portion of intertidal foreshore returned to the Crown as fish habitat was to be isolated from industrial activity through installation of a double row of boomsticks and any other measures that would prevent woodwaste from settling on this area.

The Authorization for Works or Undertakings Affecting Fish Habitat was conditional on the Letter of Advice, and initially effective 1995-07-05 to 1995-08-31 and 1995-12-01 to 1996-02-15. A later amendment made the Authorization effective 1996-07-01 to 1996-08-31 and 1996-12-01 to 1997-02-15, as construction was deferred until July 1996.

As work proceeded, the DFO HB issued additional Letters of Advice pertaining to project components, including:

- 1996-07-11, a letter pertaining to construction of a temporary bridge over a tributary of Waterloo Creek to facilitate trucking of gravel to the construction site from a nearby pit;
- 1997-09-11, a letter pertaining to cleaning of the shoreward end of the log pocket by the line loader to get more depth to handle log bundles; and,
- 1998-05-07, a letter pertaining to installation of approximately 25 steel piles between the skidways at the log sort to support log cribbing that would hold back riprap that was eroding from the sort face.

A 1999-06-30 letter from McElhanney Associates engineers, on behalf of BCF Shake Mill, informed DFO of intended amendments to the area of the Rosewall Creek foreshore lease, and requested written confirmation that foreshore works previously authorized had been satisfactorily completed. The DFO HB confirmed 1999-07-19 that BCF Shake Mill Ltd. had completed the works to DFO satisfaction, and that it had continued to make improvements to the sort maintenance and drainage as and when required. Additional letters on file dealt with maintenance and cleaning issues arising in summer 1999. No further information was available pertaining to lease amendments.

It is noted that this file contained a “Referral Baseline Detail Report,” containing an action log of project correspondence.

Field Audit

G3 scientists visited the Rosewall Dryland Sort site 1999-12-02 at low tide. Operations were active at the time of the visit (Photo 67). The compensatory mudflat habitat was located adjacent to the southern edge of the dryland sort surface (Photo 68). Facilities occupying that edge of the site included a shed, pumphouse, and settling pond.

The created mudflat, roughly square in shape, extended approximately 40 m inland and was approximately 36 m wide. It was estimated that overburden to a depth of 1.5 m had been excavated to create the mudflat. A cattail stand separated the mudflat from the dryland sort to the north and from the forested area westward. Lands to the south were wooded, dominated by Douglas-fir, western redcedar and red alder. Natural mudflat beach lay between Mud Bay waters and the site.

The mudflat lagoon consisted of a layer of homogeneous mud, composed of fine silt, coarser fragments and organic matter, approximately 15 cm deep throughout most of the site, overlying gravel basement substrate. The mud layer was deeper along the northern perimeter, exceeding 1 m. Small amounts of fresh water entered the lagoon from two point sources along the western edge, a small creek and a drainage culvert.

An area of approximately 2 m^2 in the north-central portion of the mudflat had been colonized by widgeon grass (Photo 69). Approximately 60% cover was provided by perhaps two rooted stems, each with a maze of runners. Denser brome grass and sedge had colonized a band approximately 2 m wide between the lagoon and the natural beach (Photo 70).

This compensatory habitat appeared to be functioning as intended, and would be inundated by tidal waters twice daily to a depth of approximately 0.5 m.

Audit Assessment

The field audit (Section 4.2.15) of the Rosewall sortyard compensatory mudflat habitat suggested that it was functioning as intended, and achieved the NNL objective. Woodwaste had been removed from approximately 0.5 ha of mudflat formerly leased as booming area, then returned to the Crown, and approximately 500 m^2 of fill had been removed and mudflat restored.

This compensation project appeared to have been well founded, as the aim was to restore, in kind, functionality of local habitat that had long been alienated by industrial activity. No existing natural habitat was disrupted in order to create different habitat. It was evident from G3's discussions with BCF Shake Mill management that the project contributed to a sense of pride on the part of staff with regard to company compliance with DFO and MELP Waste Management Branch regulations, an important factor that helped ensure project success.

4.2.16 Egerton Dryland Sort (Site S16)

On 1998-01-21, TimberWest Forest Limited, Integrated Resource Analysis Section, sent the Nanaimo DFO Habitat Biologist (HB) plans for a "pared back" version of the Egerton Dryland Sort proposal. The site was located in Bute Inlet. An initial plan to fill 2,300 m^2 of beach had been reconfigured to require 1,500 m^2. Within that area, a portion of habitat approximately 550 m^2 in size would be isolated by a causeway, but could otherwise be left intact. It was proposed a culvert, 1.5 m in diameter, be installed to allow tidal rise and fall.

DFO Habitat and Enhancement Branch determined this project to require CEAA referral, and that DFO was a Responsible Authority (RA). Referees were Canadian Coast Guard Navigable Waters Protection Division (NWPD), Environment Canada (EC), and Canadian Wildlife Service (CWS). Included in the referrals were copies of a letter report by Sea-mount Consulting (1998a). The report included a compensation plan whereby the gravel area behind the beachline would be excavated to create sheltered lagoon habitat, and result in no-net-loss of fish habitat.

Photo 68: Compensatory mudflate adjacent to Rosewell Dryland Sort (December 1999).

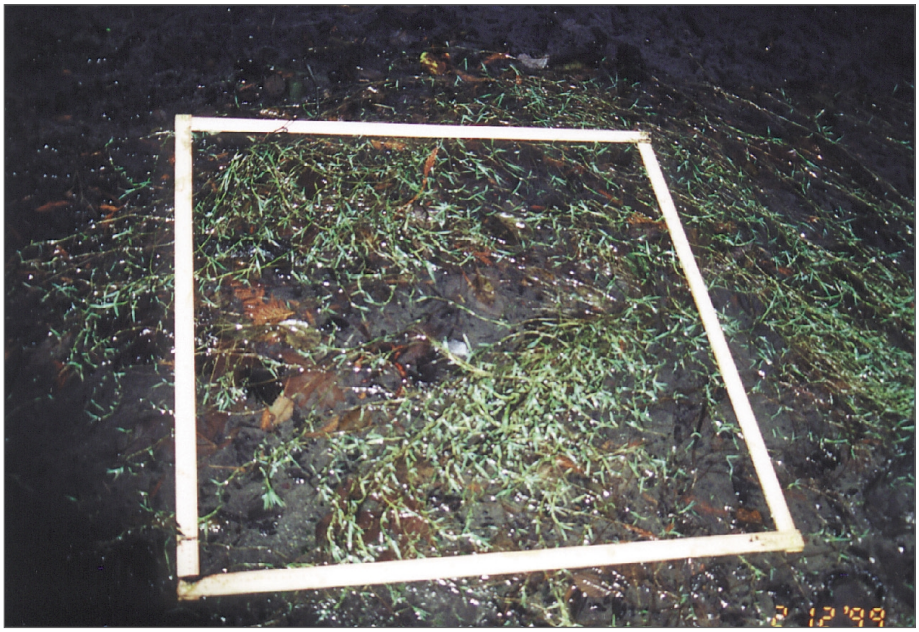

Photo 69: Widgeon grass had colonized a small area (~2 m^2) in the compensatory mudflat; Rosewell Dryland Sort (December 1999).

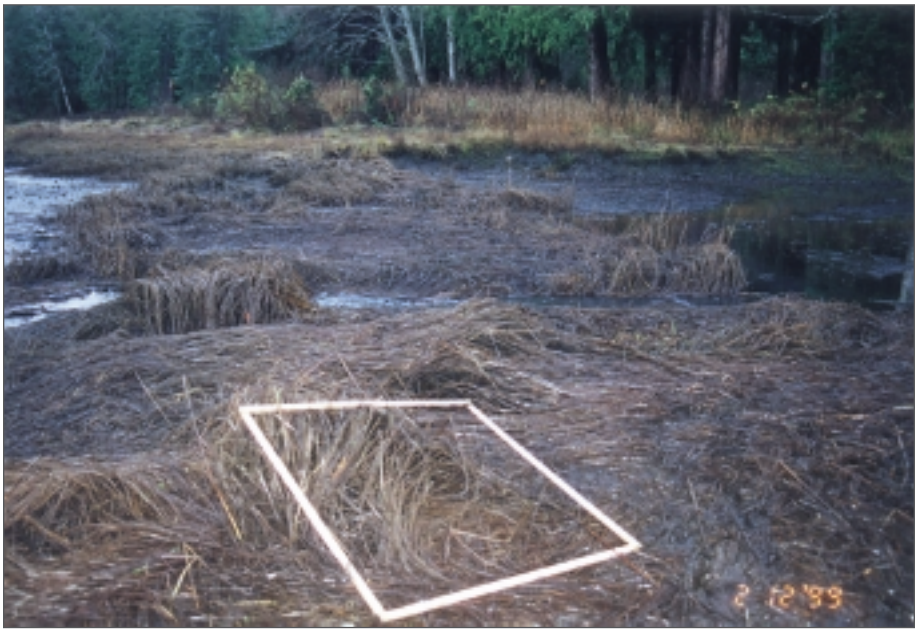

Photo 70: A band of brome grass and sedge had colonized a band between the compensatory mudflat and the natural beach; Rosewell Dryland Sort (December 1999).

NWPD advised the DFO HB (letter, 1998-06-12) that the project would require authorization under Section 5(1) of the Navigable Waters Protection Act, and that NWPD, as an RA, would have an obligation to ensure an environmental assessment be conducted.

EC responded 1998-06-19 that the proposal did not trigger their responsibility under CEAA. EC recommended its set of log-handling mitigation measures be applied. There was no separate CWS response.

The 1998-11-17 DFO Habitat and Enhancement Branch "Screening Recommendation and Decision Summary" outlined the referral process and outcome. DFO concluded that the project would be unlikely to cause significant adverse environmental effects, provided that mitigation measures specified in the approval document be implemented.

An Authorization for Works or Undertakings Affecting Fish Habitat (number 1998-000176) was issued to TimberWest 1998-11-18, and proponent provided a letter of credit in the amount of $5,000.00. Mitigatory conditions relating to the log dump were that:

- machinery be in good working condition and that no fuels, lubricants or construction wastes enter marine waters;
- log handling and storage be directed away from the intertidal foreshore and occur in water at least 10 m deep;
- the log dump and sort be sloped away from the foreshore, and debris, sediment and potential petroleum pollutants be collected and disposed of at an approved location off site; and,
- brow logs or other devices be installed to prevent wood waste and debris from entering the marine foreshore.

Conditions relating to the compensatory habitat were that:

- new intertidal marine foreshore habitat be created by facing the dryland sort facility with large blasted rock (773 m^2) to promote attachment of marine algae and invertebrates;
- a tidal lagoon be excavated from 950 m^2 of adjacent upland and by removing 72 m^2 of old intertidal fill;
- Timberwest undertake culvert maintenance to maintain access to the lagoon by juvenile fish and protect the compensation site from industrial activities; and,
- specifications be as described in the Sea-mount Consulting report.

Work was to be conducted 1998-12-01 to 1999-02-28 or 1999-05-15 to 1999-07-31, and compensatory habitat was to be created prior to or during construction of the log dump. The proponent was to undertake a Monitoring Program, consisting of annual assessment of compensatory habitat during August 1999, 2000, and 2001.

It was noted that the DFO project file did not include a report on 1999 monitoring.

Audit Assessment

Subsequent to file review, while planning fieldwork, G3 determined from discussions with the proponent that construction of the Egerton site had been deferred. Therefore, habitat loss or gain was not factored into the calculation of habitat balance (Table 5-2).

4.2.17 Valdes Island Log Dump (Site S17)

An internal MacMillan Bloedel Limited (MBL) report (1995-03-30) from the Corporate Forestry—Sustainable Forestry Land Use Planning Advisory Team described a preliminary engineering investigation undertaken on Valdes Island (Figure 2). The purpose was to assess the suitability of Blackberry Point (Site A) and an alternate site (Site B), approximately 650 m northward, as potential sites for a proposed log dump and terminal. Both sites had been used in the past as sites of log-handling facilities. Terrain analysis and marine water depth profiles favoured Site B, as regulatory requirements were now more stringent than when these sites had first been used.

Results of a 1995-05-08 dive survey by biological consultants Peter Bruce & Associates (PBA, 1995b) also favoured the northern site (referred to as Site 1), as the other site was too shallow to prevent grounding of logs. A rock point extending into the Site 1 bay could be incorporated into the causeway. It was suggested that a rock reef be created as compensatory habitat.

MBL filed a foreshore lease application with BC MELP (Lands) 1995-08-29, and DFO logged the referral 1995-10-30. The lease would occupy an area of approximately 2.70 ha.

An internal MBL memo (1995-11-08) updated information on terminal design options, and a "final" Valdes Log Dump Site Plan, prepared by Associated Engineering, was provided to the DFO HB 1995-12-14. MBL "spent considerable time and effort reviewing the option to include a ten-metre bridge to facilitate the passage of small fish. The estimates for a bridge structure would add approximately $40,000 to the rock fill – increasing the cost by nearly 50%. The bridge option [was] not included in this plan." The plan called for approximately 13,000m^3 of fill with a footprint area of 4,100 m^2.

On 1995-12-19, MBL provided the Associated Engineering plan and a PBA "Review of Fisheries Aspects of Proposed Log Dump at Valdes Island" (1995-12-15). PBA calculated that sandstone fill would cover 5,585 m^2 of fish habitat, including the footprint area, toe berm, bullpen area and boom storage. A planimetric conversion, based on a slope of 2:1, resulted in a calculation of approximately 4,410 m^2 of potential habitat created by the structure. PBA applied two "void factors" to account for crevice habitat: 25% would result in 5,512 m^2 being created, and 30% in 5,733 m^2 being created. PBA concluded that potential habitat created by the structure would equal the area covered by fill. Impact would be further mitigated by the intermittent use of the log dump, approximately 5 years per decade.

In a 1996-01-05 Letter of Advice, the DFO HB agreed with the PBA interpretation that the project would result in no net loss of fish habitat. Once MBL signed a Habitat Compensation Agreement, they would be issued a Section 35(2) Authorization. Construction mitigation conditions were that:

- foreshore construction occur May 1 to February 15 in any year;
- all construction equipment be in good working condition and no fuels, lubricants or construction wastes enter the marine environment;
- the project be built according to plans and specifications submitted and approved and there be no dredging, blasting or foreshore filling (other than construction of the rock groyne);
- logging debris be regularly cleaned off-site and disposed of on land, and wood waste and debris not be allowed to enter the marine foreshore; and,
- fuel storage and handling comply with Petroleum Industry Specifications.

The 1996-01-08 Habitat Compensation Agreement confirmed the PBA calculations of habitat losses and gains. MBL was required to institute a monitoring program such that, for two summers following construction:

- the groyne structure be assessed as to physical stability of the re-created habitat by using underwater photography and/or ground surveys;
- a biological evaluation be conducted to determine the level of success of establishment of marine vegetation; and,
- a written report be prepared, including all relevant documents, data and photographs, within one month of each assessment.

MBL was responsible for ensuring that created habitat functions properly for the duration of the log-handling tenure, and for carrying out any necessary modifications.

DFO issued Authorization R#3804 on 1996-02-06.

On 1997-08-05, PBA reported on a 1997-07-11 dive survey it conducted to assess whether rock slopes of the causeway were being colonized. The causeway had been completed in August 1996, and log-dumping activities conducted mid-September through November 1996. Dumping was to resume in July 1997. The survey found diverse and prolific growth of algae in the lower intertidal/subtidal area around the perimeter of the causeway. Attached fauna were colonizing more slowly. Abundant crevice habitat was being used, and had the potential to support fauna in greater numbers and diversity. A 1997-09-08 internal memo indicates DFO also conducted a dive survey that day. Four plant species, at least six macroinvertebrate species, and at least nine fish species were identified.

Audit Assessment

The NNL objective appears to have been met at the Valdes Island site, though DFO accepted a short time lag (<1 year) before compensatory habitat became functional. Similar to the Barkley Sound compensatory reef described above (Section 4.2.11), the consultant (PBA) appeared to be overly qualitative in deriving a rock crevice multiplier of 25% to 30%.

4.2.18 Michelsen Point Log Dump (Site S18)

On 1994-08-29, Western Forest Products Limited (WFP) submitted an Application for Crown Land to BC MELP, pertaining to reactivation of a log dump and associated booming and storage facilities at Michelsen Point, Holberg Inlet (Figure 2). Holberg Inlet is situated at the northwestern end of Vancouver Island. The licence of occupation would cover an area of 16.72 ha. DFO Nanaimo logged the referral 1995-02-02.

In a 1995-04-25 letter to WFP, the DFO (Port Hardy) Habitat Management Technologist requested that results of a dive survey of the prospective site be submitted to DFO of allow it to assess potential impacts of the proposal. A Section 35(2) Authorization and compensatory plan would be required should habitat losses occur.

On 1995-07-06, WFP's consultant biologist (S. Lacasse) provided DFO with a copy of Environment Canada's (EC's) response to the BC Lands referral. EC registered its objection to the proposal as it appeared that the proposed location of the barge ramp and boat tie-up would necessitate closure of an existing commercial clam beach under the *Fisheries Act*, Management of Contaminated Fisheries Regulations. EC also provided its standard list of applicable mitigation measures (Appendix 3). The biologist requested DFO provide a letter confirming that no commercial clamming operations exist in the area.

In a 1995-07-21 letter to EC, the WFP Resident Engineer explained WFP's intent to have a marine biologist survey and inventory the site of the proposed facilities and provide a detailed written assessment and recommendations. With reference to the commercial clam beach, WFPL agreed to relocate the barge ramp and boat tie-up wharf a minimum of 125 m east of the edge of the intertidal zone at Michelsen Point.

On 1995-08-09, WFPL provided DFO a copy of the 1995-07-12 survey report by S. Lacasse (1995). The consultant found the potential for adverse project impacts on benthic

areas to be low because of the great depths of the inlet. Logs or bundles would have no opportunity for grounding. The Lewis Creek estuary would be avoided, and displayed little deposition from previous log-handling activities. The intertidal area at Michelsen Point exhibited a variety of plants and animals, including populations of little neck clams and butter clams. The small size of the beach would not allow a profitable commercial clamming operation, and discussions with local fisheries officials confirmed that none was occurring. By moving the barge ramp and boat tie-up dock to a point immediately adjacent to the dump site, this relatively productive and undisturbed area would be protected by a minimum 200 m buffer. There would be minimal debris associated with the operation, as logs would be sorted at an existing dryland sort some distance away. Cleanup of the existing facilities would also be addressed, including the spilling of fill onto the beach caused by erosion of the existing cribbing. Construction of a new cribbing on the spilt flow would allow adequate depth to prevent grounding when bundles were placed in the water.

In a 1996-10-09 letter to the DFO HB, the WFP Field Engineer summarized project impacts and proposed a compensation package. The proposed dump would require landfill of approximately 0.1 ha. During a previous meeting with DFO, WFP had agreed in principle to reclamation of an unnamed creek near Michelsen Point. WFP now proposed to use a log loader or road excavator to remove undesired wood waste from the stream channel, and that WFP and DFO conduct a joint inspection on-site. In a second letter 1996-10-17, with reference to a meeting between themselves and DFO, WFP proposed that two distinct channels of the stream be enhanced to provide desired intertidal habitat. The cost was estimated at $9,000.00, for which WFP proposed to establish a performance security.

The DFO HB subsequently issued a Letter of Advice (1996-10-23) and Habitat Compensation Agreement. Mitigation measures requested were that:

- foreshore construction occur only 1996-10-23 to 1997-02-15;
- all fill be free from contaminants and rock armour clean;
- machinery be in good working condition and no fuels, lubricants or construction wastes enter marine waters;
- log handling and storage be directed away from the intertidal foreshore and occur in waters at least 10 m deep;
- the log dump and sort be sloped away from the foreshore, and debris, sediment and [potential] petroleum pollutants be collected and disposed of at an approved offsite location; and,
- brow logs or other devices be installed to prevent woodwaste and debris entering the marine foreshore.

The Habitat Compensation Agreement required that WFP compensate for placing fill and rock armour over 0.074 ha of intertidal marine foreshore at Michelsen Point by creating new intertidal marine foreshore habitat by excavating openings in two tidal channels (0.064 ha and 0.08 ha, respectively) associated with an unnamed salmon stream (Lewis Creek). WFP would be responsible for ensuring proper functioning of the compensatory habitat for the lifetime of the log dump, and undertake any necessary modifications. WFP posted a bond in the amount of $9,000.00.

DFO subsequently issued an Authorization for Works or Undertakings Affecting Fish Habitat (no. 1996-2). In addition to the above considerations, WFP was required to institute a monitoring program to include annual assessment during August of 1997, 1998 and 1999. Legal discourse ensued between the Department of Justice and the WFP lawyer regarding precise wording of this document.

A memo from FishFor Contracting Ltd. to WFP documented a 1997-05-13 site visit by their representatives, together with personnel from DFO, MELP and MOF. A large amount of woody debris at the mouth of Lewis Creek was observed that would impede fish access and reduce availability of juvenile rearing habitat. It was planned that a majority of the wood would be removed with a backhoe and cast to higher ground. Large pieces would be left for fish cover. Channel "B" of the river had not been open for several years, and conifers were growing in the former streambed. No attempt would be made to reopen the channel. Channel "A" exhibited underground flow to the estuary, and it was planned that the backhoe be used to clear debris from the channel. A later memo (1997-09-18) reported the successful implementation of these plans.

A 1998-01-14 memo from FishFor Contracting Ltd. to WFP reported on a 1997-10-22 site visit their representative made with the DFO HB to review the work done at Lewis Creek. Heavy precipitation between completion of work and the review had resulted in Channel "A" increasing substantially in size. The debris in the Lewis Creek outlet had settled and the estuary had been successfully opened up to offer more habitat to fish. It was suggested that further monitoring be conducted to document the benefits or detriments of this type of habitat enhancement.

Field Audit

G3 conducted a site audit 1999-11-29. The log dump was active when visited, with bundled logs being delivered by truck to the A-frame assembly, and a boom boat operating (Photo 71). Two metal fuel barrels stood alongside the top of the barge ramp. The shoreline of Holberg Inlet at this location appeared to drop off steeply, likely eliminating any possibility of logs grounding. A steady, light rain was falling, facilitating observations of site drainage. The unpaved running surface and road appeared well-drained, sloping toward a ditch running along the toe of the adjacent embankment and away from the inlet. A culvert extended from the ditch to the edge of the inlet, conveying surface runoff into the marine waters. A sediment plume was observed extending from the outfall, within the booming area (Photo 72). No sediment traps were observed.

Observations were made during low tide at the Lewis Creek compensation site, and were consistent with site descriptions provided by FishFor Contracting Ltd. Downstream of the Michelson Main logging road Lewis Creek flowed through a coniferous-dominated forest of Douglas-fir, western redcedar, western hemlock, Sitka spruce and red alder trees (Photo 73). Sword fern, deer fern, bracken, red huckleberry and devil's club characteristic of the understory. Salal grew on drier microsites, such as atop stumps.

A short excavation extending from the right bank (facing downstream) of Lewis Creek at a point approximately 30 m upstream of the high tide mark had re-created a connection with Channel "A". The Lewis Creek mainstem and Channel "A" flowed into Holberg Inlet across an intertidal marsh, dominated by tufted hairgrass, Alaska plantain and meadow barley growing on a substrate of cobble, gravel and boulders (Photo 74). Scattered blue mussels, clams and rockweed were attached to intertidal rocks, and whips of bull kelp had washed up onto the shore. Between the two wetted channels was an accumulation of wood debris where it was evident Channel "B" had once flowed (Photo 75). Many hemlock seedlings were scattered above the high water mark throughout the old channel, and a vigorous cluster of juvenile spruce grew just above the intertidal zone.

Flow in the Lewis Creek mainstem was considerably faster than that in Channel "A", and of greater volume. At a location approximately 135 m from the mouth, and immediately above the upper tidal limit, the left stream bank was eroding along an outside bend. A narrow riparian leavestrip, approximately four tree-widths in extent, separated the creek from an adjacent cutblock. Two trees of approximately 0.3 m DBH (diameter at breast height) had fallen into the channel. Bankfull width at this location was estimated to be 12 m, and wetted

Photo 71 : Michelson Point dump, running surface, view westward (November 1999).

Photo 72: Michelson Point log dump, drainage waters entering boomed area from culvert under the large log (November 1999).

Photo 73: Lewis Creek flowing through coniferous forest; Michelson Point log dump compensatory site (November 1999).

Photo 74: Mouth of Lewis Creek flowing across intertidal marsh; Michelson Point log dump compensatory site (November 1999).

Photo 75: Wood debris in former “Channel B”, between Lewis Creek mainstem and “Channel A”; Michelson Point log dump compensatory site (November 1999).

width 9 m. Average water depth was approximately 0.35 m. Channel gradient was approximately 1.5 % to 2 %.

Fish habitat was quite functional in both mainstem and side-channel. The cobble-boulder substrate of the intertidal section of Lewis Creek created ripple-cascade channel morphology that would likely become a glide at high tide levels. A primary pool alongside the eroding bank and a secondary pool below the high water mark would be suitable fish holding habitat during migration. Both channels were well "complexed" with LWD (large woody debris), and pools that formed under debris piles would constitute good salmonid rearing habitat (Photo 73).

Audit Assessment

Field audit investigations (Section 4.2.18) indicated that the channel cleaning and fish habitat restoration project had achieved its goal of restoring fish habitat functions of the lower portion of Lewis Creek and a principal side-channel. Though this project diverged from general like-for-like compensation, it appeared to have been a cost-effective and creative solution, supplying funding and human effort necessary to address adverse, direct impacts on fish habitat of past log-handling activities in the vicinity.

The decision not to clean Channel "B" as originally planned was an example of "adaptive management" principles being well applied, in that regenerating trees and fish cover habitat would have been lost during these efforts, thereby destroying one type of habitat to create another.

It is unfortunate that no baseline data appear to have been collected pertaining to fish use of lower Lewis Creek and their distribution within the channels, as such data would have enabled quantitative evaluation of potential habitat gain. When feasible, collection of baseline information should be encouraged for other such projects before implementation.

4.2.19 Kinnaird Island (Site S19)

Kinnaird Island is situated along the BC central coast, near the junction of Wells Passage, Stuart Narrows and Sutlej Channel. In the late 1990s, the BC Ministry of Forests (MOF) Port McNeill Forest District Small Business Forest Enterprise Program planned to harvest timber from two cutblocks within TSL A55678. Construction of log dumping and booming facilities were planned for the north side of the island, facing Grappler Sound, between August 1998 and January 1999. Plans called for the site to sit idle for 15 years following harvest, then be reactivated for an additional harvest. The site might also be used by MacMillan Bloedel Ltd. (North Island Biological Consultants, 1998).

North Island Biological Consultants (1998) submitted a site assessment to MOF dated 1998-03-10. Purposes of the survey were to determine appropriate sites for log dumping and storage, assess potential impacts on the adjacent marine environment, provide bathymetric profiles, and recommend applicable mitigation and compensation measures. The proposed dumping and storage sites were deemed suitable for those activities, as no specific or potential environmental concerns were identified along surveyed transects. The shoreline consisted of steep bedrock outcrops. Extremely low biological diversity was attributed to inhibitory effects of inflow of freshwater from several small streams, and to the depth of the subtidal zone being below the strong photic zone.

Potential impacts identified were associated with migratory finfish, including use of the sites by Pacific salmon as staging areas for migration up nearby rivers, and use by spawning herring. The relative lack of marine vegetation, however, reduced the likely significance of these sites for such uses. Surveyors expected the impact of organic debris, such as bark and fibre, to be limited and localized, given the low biodiversity and low current flows. Little evidence remained of past use of the sites for logging operations.

A net loss of 400 m^2 of boulder/bedrock habitat was projected. As opportunities to create compensatory habitat nearby were limited, it was recommended that habitat be provided at a more appropriate location with higher marine productivity. Mitigation measures recommended included a construction window outside the March to June spawning period, and storage of logs in waters at least 10 m deep.

In a 1998-04-22 letter to the DFO Habitat Biologist (HB), the MOF Small Business Officer requested that the impacts of the Kinnaird Island facilities be compensated at an underwater reef a few kilometres distant at Turnbull Cove. This reef had been built to compensate for log dumps at Strachan Bay and Turnbull Cove, and was four times the required size. A 2,899 m^2 area was available against which to credit the 400 m^2 habitat loss at Kinnaird Island.

The DFO HB replied 1998-06-02 with a new calculation of the available "habitat bank." The HB cited a 1997 report prepared by Sandwell Engineering for Defense Construction Canada. Sandwell estimated that interstices afforded by a 1 m thick, 1,000 m^2 rock reef provided an area of 4,600 m^2. Assuming 75% biological productivity would result in a habitat efficiency factor of 4.6, 3,457 m^2 of interstitial habitat would be provided. Added to the surface area of the reef, 4,457 m^2 of habitat would be available. North Island Biological had used the Sandwell method to calculate 3,787 m^2 habitat had been provided by the 1,134 m^2 Turnbull Cove reef.

Discussions with other biologists had led the HB to conclude a ratio of 1:3 surface area to total surface area including interstices to be more realistic; i.e., a 1,000 m^2 reef would provide approximately 3,000 m^2 of habitat to fish. DFO's opinion of surface area resulted in an estimate of 3,402 m^2 of compensatory habitat at Turnbull Cove. The HB conceded to "split the difference" and concluded that MOF had provided a reef with a habitat area of 3,600 m^2. As 888 m^2 was required to satisfy no-net-loss of fish habitat from Strachan Bay and Turnbull Cove, MOF now had a 2,712 m^2 habitat bank of rocky reef from which to draw for other similar projects.

DFO Habitat and Enhancement Branch (HEB) determined that a CEAA referral process would apply to the Kinnaird Island project, and that DFO was a Responsible Authority. Referees consisted of the Canadian Coast Guard (CCG), Environment Canada (EC), and the Canadian Wildlife Service (CWS). The referral was dated 1998-06-09. A joint response from EC and CWS 1998-07-21 indicated that they were not Responsible Authorities under CEAA. They provided the standard set of mitigation measures applicable, and suggested the proponent contact them directly. No response from CCG was on file. In its CEAA "Screening Recommendation and Decision Summary," DFO HEB concluded that the project would require a Section 35(2) Authorization.

The Authorization (No. 98-000179) was provided to MOF 1999-02-26. Standard mitigation measures were applicable. As the Turnbull Cove reef was already a functioning habitat, 400 m^2 (i.e., 1:1 ratio) was removed from the banked habitat of 2,712 m^2, leaving MOF a remainder of 2,312 m^2. Annual monitoring of the compensatory habitat was to continue until it be deemed self-sustaining, or for two years following any remedial work. No monitoring has yet been applicable at this writing.

Audit Assessment

The Kinnaird Island site fulfilled the NNL objective, as 1:1 compensation was provided as a withdrawal from an existing reef habitat bank located in a more highly productive region.

The Sandwell Engineering calculation of 3-dimensional reef habitat described above is of questionable validity, given it is unclear how the "habitat efficiency factor" was derived or defined.

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5.0 SUMMARY & DISCUSSION

Findings of this NNL Audit are summarized in this section, followed by a discussion of mitigation and compensation measures applied, and monitoring and follow-up, and general comments regarding process and documentation.

5.1 Summary of Audit Findings

Audit results presented in Section 4 are summarized in Tables 5-1 (North Coast) and 5-2 (South Coast).

Of 16 files examined pertaining to log-handling facilities in the North Coast HEB Area, the NNL objective was not met at 12. Of those remaining:

- one site (Frenchman Creek) required only impact mitigation as there was little or no placement of intertidal fill;
- two sites (Surf Inlet and Big Tillhorn River) remain in the review process; and,
- habitat impacts at one site (Beattie Anchorage) were restricted to areas already affected by previous activities.

Total net habitat loss at North Coast HEB Area sites investigated was approximately 2,575 m^2, or 0.2575 ha.

In the South Coast HEB Area, NNL appeared to have been met at 20 sites documented in 12 files (i.e., S10, Broughton Archipelago, included 9 log dumps). Of those remaining:

- NNL had not been met at two sites (Kingcome Inlet and Menzies Bay, CRF);
- two sites (London Point and Mount Connolly) were too recent to have undergone monitoring;
- facilities had not yet been constructed at one site (Egerton); and,
- project status was unknown at four sites documented in one file (Bute Inlet).

Total net habitat gain at South Coast HEB Area sites investigated was approximately 6,939 m^2, or 0.6939 ha. A large proportion of this surplus, however, was accounted for at 3 sites:

- surplus banked reef habitat (~1,109 m^2) at Charlotte Point, which may be expected to be entirely "withdrawn" as additional log dumps are constructed;
- an artificial reef constructed at Harmac (~2,500 m^2), though the project for which it was designed to compensate was shelved; and,
- a large surplus at Mud Bay (~3,268 m^2) was accounted for by habitat rehabilitation that consisted of cleaning wood debris from an extensive mudflat.

5.2 Interregional Comparison

There were clear differences in application of NNL policies by DFO habitat management staff in the North Coast and South Coast HEB Areas.

In the North Coast, an emphasis was placed on mitigating project impacts through:

- siting criteria aimed at avoiding sensitive habitat (e.g., avoiding eelgrass habitat by relocating facilities to deepwater, rocky shorelines);
- design considerations that minimize time lag between impact and ecosystem recovery (e.g., use of large rock for foreshore fill to encourage re-establishment of the rockweed-barnacle community);
- construction and operational measures aimed at preventing or minimizing siltation and other forms of aquatic contamination; and,
- post-operational decommissioning, expected to replace habitat over time.

Authorizations and the attendant CEAA referral process were seldom invoked in the North (three times among files examined). As the DFO Queen Charlotte Island Habitat Technician observed (pers. comm., 1999-09-24), the major licensees already have large log-handling facilities in place, and a majority of recent foreshore projects fell under the auspices of the MOF Small Business Program. As such, new sites tend to be small in scale, with operators watering a limited volume of wood over a period of a few months. The main DFO objective in such instances was to prevent permanent alienation of mid- to high intertidal habitat. In most cases, the Queen Charlotte Islands HT attempted to dissuade proponents from installing log-handling facilities that would require a Section 35(2) HADD Authorization. In the North Coast HEB Area, there was a tacit acceptance of temporal habitat loss, with the aim of mitigation measures to minimize time lag between habitat loss and habitat restoration.

By contrast, a majority of South Coast HEB Area log-handling facilities examined had been subject to HADD Authorizations. Reasons for the regional difference may include:

- larger scale and longer operating period of many South Coast operations compared to North Coast;
- fewer siting options on the South Coast, given that many applications pertained to modifications to, and enlargement of existing facilities;
- application of artificial rock reef habitat banks to sites clustered in close proximity to one another along the South Coast; and,
- better access to South Coast than North Coast sites, given differences in climatic and geographical setting, making site visits by DFO and industry consultants to South Coast sites more feasible for purposes of designing, implementing and monitoring compensatory mitigative habitat.

Drodge *et al.* (2000), in their preliminary examination of DFO operations Canada-wide also noted that, though habitat staff in different DFO regions largely perform similar duties, regional differences frequently occur, leading to questions surrounding national consistency of the Habitat Referrals Process. These authors identified six impediments to national standardization:

- legal framework, i.e., the “patchwork quilt” of federal, provincial and municipal laws and jurisdictions, and the resultant roles and responsibilities assumed by other government agencies;
- geographic realities, e.g., accessibility of sites, geological complexity of the terrain, availability of detailed data, range of species, and weather;

TABLE 5-1: Summary of No-Net-Loss Site Audits, North & Central Coast Log Handling Facilities

Site	Name	Letter of Advice or Authorization	Compliance (Y/N)		Compen-sation Ratio Applied	Surface Area Multiplier (Reefs)	Temporal Habitat Loss? (Y/N)	Monitoring				Bonding/Letter of Credit		Field Visit by DFO? (Y/N)	Habitat Balance (m^2) (approx.)	NNL Met? (Y/N)[1]	Comments
			Mit.	Comp.				Duration (Years)	Frequency	Compliance	Self (Y/N)	Required	Retained				
N01	Fog Creek	Letter	Y	N/A	N/A	N/A	Y	N/A	N/A	N/A	N/A	N	N/A	unknown	(350)	N	eventual fill habitat
N02	Frenchman Creek	Letter	Y	N/A	N/A	N/A	N	N/A	N/A	N/A	N/A	N	N/A	unknown	0	Y	no intertidal fill
N03	Ingram Bay	Letter	unknown	N/A	N/A	N/A	Y	N/A	N/A	N/A	N/A	N	N/A	unknown	(400)	N	fill area estimated[2]
N04	Draney Inlet	Letter	unknown	N/A	N/A	N/A	Y	N/A	N/A	N/A	N/A	N	N/A	unknown	(300)	N	fill area estimated[2]
N05	Cousins Inlet	Letter	Y	N/A	N/A	N/A	Y	N/A	N/A	N/A	N/A	N	N/A	unknown	(100)	N	eventual fill habitat
N06	Surf Inlet	N/A	N/A	N/A	N/A	N/A	N	N/A	N/A	N/A	N/A	N/A	N/A	N	0	Y	not approved
N07	Big Tillhorn R.	application in progress	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Y	N/A	N/A	CEAA review in progress
N08	Lina Island	Authorization	N	N/A	N/A	N/A	Y	N/A	N/A	N/A	N/A	N	N/A	Y	(70)	N	eelgrass bed loss
N09	Chadsey Creek	Letter	unknown	N/A	N/A	N/A	Y	N/A	N/A	N/A	N/A	N	N/A	unknown	(240)	N	eventual fill habitat
N10	Beattie Anchorage	Letter	Y	N/A	N/A	N/A	N	N/A	N/A	N/A	N/A	N	N/A	Y	0	Y	restricted to area o 1980s impacts
N11	Sandilands Island	Letter	unknown	N	N/A	N/A	Y	N/A	N/A	N/A	N/A	N	N/A	unknown	(600)	N	compensation reef not yet implemented
N12	East Gribbell Island	Letter	N	N	N/A	N/A	Y	N/A	N/A	N/A	N/A	N	N/A	unknown	(80)	N	to be partially “debuilt” as compensation
N13	Goat Harbour	Letter	N	N/A	N/A	N/A	Y	N/A	N/A	N/A	N/A	N	N/A	Y	(200)	N	impacts not fully mitigated
N14	Trip Creek	Letter	Y	N	N/A	N/A	Y	N/A	N/A	N/A	N/A	N	N/A	unknown	(125)	N	to be partially “debuilt” as compensation
N15	Verney Passage	Letter	Y	N/A	N/A	N/A	Y	N/A	N/A	N/A	N/A	N/A	N/A	unknown	(20)	N	minimal impact; fill provided habitat
N16	Verney Pass Creek	Letter & Authorization	N	N/A	N/A	N/A	Y	N/A	N/A	N/A	N/A	N	N/A	Y	(90)	N	fill area ~2X size authorized
														TOTAL	(2,575)	N	

1. Determination of whether or not NNL has been achieved at each site is based primarily on available file information, unless directly verified in the field.
2. Areas of intertidal fill at Ingram Bay and Draney Inlet were estimated from plan drawings, as no areal measurement was provided in file documents.

N/A = Not Applicable; no monitoring programs were requested or implemented at north and central coast sites.

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TABLE 5-2: Summary of No-Net-Loss Site Audits, South Coast Log Handling Facilities

Site	Name	Letter of Advice or Authorization	Compliance (Y/N)		Compen-sation Ratio Applied	Surface Area Multiplier (Reefs)	Temporal Habitat Loss? (Y/N)	Monitoring				Bonding/Letter of Credit		Field Visit by DFO? (Y/N)	Habitat Balance (m^2) (approx.)	NNL Met? (Y/N)1	Comments
			Mit.	Comp.				Duration (Years)	Frequency	Compliance	Self (Y/N)	Required	Retained				
S01	London Point	Authorization	unknown	unknown	1:1	none	Y	3	annual	unknown	Y	N	N/A	unknown	0	unknown	no monitoring yet complete
S02	Mt. Connolly	Authorization	unknown	unknown	1:1	none	Y	open	annual	unknown	Y	N	N/A	unknown	0	unknown	no monitoring yet complete
S03	Elaine Creek	Letter	unknown	Y	1:1	none	N	N/A	N/A	N/A	N/A	N	N/A	unknown	0	Y	withdrawal from habitat bank
S04	Discovery Passage	Authorization	N	unknown	1:1; 2:1 eelgrass	none	Y	2	annual	unknown	Y	N	N/A	Y	0	unknown	no monitoring report on file
S05	Menzies Bay, Mac Blo	Authorization	Y	Y	1:1	N/A	Y	3	annual	Y	Y	Y	N	Y	27	Y	compensatory habitat constructed as specified
S06	Bute Inlet	Authorization	unknown	unknown	1:1	none	Y	2	annual	unknown	Y	Y	Y	unknown	0	unknown	project status unknown
S07	Silverado Cr.	Authorization	unknown	unknown	1:1	1.3	N	3	annual	unknown	Y	N	N/A	Y	0	unknown	no monitoring report on file
S08	Harbledown Island	Authorization	Y	Y	1:1	3	Y	3	annual	Y	Y	Y	N	unknown	790	Y	net habitat gain to be banked
S09	Kingcome Inlet	Letter	unknown	Y	1:1	none	Y	N/A	N/A	N/A	N/A	N	N/A	unknown	(250)	Y	compensation withdrawn from Harbledown reef bank
S10	Broughton Archipelago	Letter	unknown	Y	1:1	1.5	N	2	annual	Y	Y	Y	N	unknown	1,109	Y	July 12, 1999 balance at Charlotte Point reef bank
S11	Brand Creek	Authorization	Y	Y	2:1	2 to 3	Y	3	annual	Y	Y	N	N/A	Y	85	Y	compensatory habitat constructed as specified
S12	Menzies Bay, CRF	Authorization	Y	Y	1:1	N/A	Y	3 (informal)	not specified	Y	Y	Y	N	unknown	(330)	N	compensatory habitat not functioning as intended
S13	Knox Bay	Authorization	N	Y	~1:1	none	Y	2	annual	Y	Y	Y	unknown	unknown	(250)	N	compensatory habitat not functioning as intended
S14	Harmac	Authorization	N/A	N/A	1:1	not specified	N	3	not specified	Y	Y	N	N/A	unknown	2,500[2]	Y	though facilities not constructed, a reef was constructed
S15	Mud Bay	Authorization	Y	Y	~2:1	N/A	N	3	not specified	Y	Y	N	N/A	Y	3,268	Y	compensatory habitat functioning as intended
S16	Egerton	Authorization	N/A	N/A	1:1	N/A	N	3	annual	unknown	Y	Y	unknown	unknown	0	unknown	facilities not yet constructed
S17	Valdes Island	Authorization	Y	Y	1:1	1.25–1.3	Y	2	annual	Y	Y	N	N/A	Y	0	Y	compensatory habitat functional
S18	Michelsen Pt.	Authorization	Y	Y	1:1	N/A	Y	3	annual	Y	Y	Y	unknown	Y	0	Y	compensatory habitat functional
S19	Kinnaird Is.	Authorization	unknown	Y	1:1	~3	N	open	annual	unknown	Y	N	N/A	unknown	0[3]	Y	habitat reef bank withdrawal[2]
														TOTAL	6,949	Y	

1. Determination of whether or not NNL has been achieved at each site is based primarily on available file information, unless directly verified in the field.
2. Net gain at Harmac tends to bias overall habitat balance, as the reef was provided in compensation for a project that did not proceed.
3. 400 m^2 was withdrawn from the Turnbull Cove reef, not included in the balance calculation.

N/A = Not Applicable

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- activities of prevalent industrial sectors;
- economic realities and resultant public scrutiny of actions and decisions;
- status of First Nations land claims; and,
- such other factors as political imperatives at any one time.

As noted by Drodge *et al.* (2000), habitat staff in local DFO offices often set up informal agreements with representatives of provincial agencies or other levels of government, arrangements that may not reflect formal agreements negotiated between government levels. Such partnership efforts, while demonstrating a recognition among field staff that mutually beneficial arrangements with other agencies can be an effective means of coping with heavy workloads and minimizing duplication of effort, can lead to regional differences in how policies are applied and enforced.

Overall, HADD Authorizations, coupled with Letters of Advice pertaining to mitigative measures, appeared to be more effective in achieving NNL than Letters of Advice alone. As described above, however, there were some advantages to Letters of Advice when applied alone, including greater scrutiny in avoiding sensitive habitat and mitigative measures aimed at minimizing temporal net loss and achieving net habitat gain over time. Authorizations, on the other hand, in some cases led to construction of ill-conceived compensatory habitat and monitoring requirements that were not followed up.

5.3 Evaluation of No-Net-Loss Policy as Applied

As summarized in Tables 5-1 and 5-2, NNL could be demonstrated at two of 16 (12.5%) North Coast HEB Area sites investigated, and at 20 of 30 South Coast HEB Area sites investigated (66.6%).

Where NNL was not achieved, some sites had suffered habitat loss initially, but new habitat became established over time. Other sites were expected to recover former levels of functionality following decommissioning and site rehabilitation. At a small number of sites, prescribed habitat compensation projects, when implemented, had failed to achieve initial objectives, or had created new habitat to the detriment of another type of habitat.

Compensatory projects tended to fall into one of two categories: creation of intertidal marshes or creation of intertidal or subtidal rocky reef habitat. Literature reviewed in Section 3.2.2 indicated that artificial reefs must be designed to achieve specific management objectives, and may concentrate existing populations rather than increasing productivity. There was little evidence among files reviewed of careful, site-specific attention having been given to ecologically effective reef design. And as described in Section 3.2.3, created wetlands often fail due to a combination of several factors, including poor design and a lack of attention to site ecology, lack of follow-up by regulators, and time lag. Marsh creation projects examined either failed outright, or were created at the expense of other pre-existing habitat.

In several cases, it was not possible to state definitely whether site-specific NNL had been achieved, as no post-implementation monitoring had been conducted to evaluate requested mitigation and compensation measures. As Drodge *et al*. (2000) also noted, a lack of resources often meant DFO staff members were unable to carry out necessary site visits. Staff commented to KPMG (Drodge *et al*., 2000) that it is sometimes difficult to communicate ideas to proponents when not meeting face-to-face. This lack of personal contact likely increases the risk of inappropriate guidance by DFO if decisions must be made based solely on written text, photos, maps and other information, instead of in conjunction with in-person site investigations. There may also be a perception among industry that NNL issues are not important enough to warrant face-to-face meetings.

During field audits, and particularly when flying to sites in the North Coast HEB Area, it was evident that the terms of reference for this audit applied to a very small proportion of the total number of log-handling facilities along the BC coast. The cumulative impacts of the large number of these operations warrant investigation by DFO. NNL cannot be evaluated on a site-by-site basis, while not addressing the combined ecosystem implications of older sites nearby. Neither should log handling be examined in isolation. Investigations should consider integration of other types of coastal developments, where relevant. Drodge *et al*. (2000) determined that DFO staff lack access to information on cumulative impacts, and that this situation is aggravated by a tendency to review files in isolation without adequate central tracking that might facilitate recognition of patterns and trends.

5.3.1 Habitat Protection, Replacement & Creation

Habitat compensation projects were implemented at several sites in the South Coast HEB Area. Overall, projects that aimed at restoring habitat degraded by past activities appeared to provide the greatest benefit to ecological resources. At Michelson Point, simultaneous restoration of fish habitat in a nearby stream while altering existing log-handling facilities mitigated the usual time lag between impact and recovery, and also provided the impetus to address existing adverse impacts that might otherwise have remained had creation of other compensatory habitat been prescribed. At the Rosewall Log Sort, requesting restoration of mudflat habitat as compensation for realignment of existing facilities was also an effective approach.

Creation of new or replacement fish habitat was of mixed success. The tufted hairgrass marsh at Brand Creek and the artificial channel at the MacMillan Bloedel Menzies Bay site both appeared to have the potential to function as intended; however, other foreshore habitat had been destroyed in the construction process, confounding the resultant habitat balance. The attempt to create an intertidal pool in association with the Campbell River Fibre site at Menzies Bay failed due to inappropriate design and lack of a monitoring program. The rock fingers at Knox Bay were ineffective, as insufficient attention was given to siting criteria and there was little follow-up. Overall, viability of artificial subtidal reefs appeared to be most predictable and consistent, though it must be emphasized that no reefs underwent a field audit under the terms of this work.

5.3.2 Habitat Compensation Banking Reefs

In the DFO South Coast HEB Area, subtidal rock reefs were prescribed and constructed as compensation for losses of intertidal habitat at a majority of post-1994 log-handling facilities investigated. None were prescribed in the North Coast HEB Area. Of particular note is that rock reefs comprised large habitat banks in at least three locations: Charlotte Point (Broughton Archipelago), Bute Inlet and Barkley Sound.

Given differences in legal frameworks, including those concerning property tenure, habitat banking has not been practiced as widely in Canada as it has in the United States. The US experience with habitat banking has revealed benefits and shortcomings (refer to Section 3.2.4), suggesting prudence when applying the concept to compensating habitat losses due to log-handling facilities.

Assuming created rock reefs function well as compensatory habitat, large rock reef habitat banks would be supported by well-established ecological and biogeographical principles (e.g., MacArthur, 1972). A single, large area of habitat generally has a higher carrying capacity and supports greater populations and biodiversity than several smaller “habitat island” units with an equivalent total area. In a terrestrial context, biodiversity and its link to habitat connectivity has been established as a principle by the BC Forest Practices Code.

Habitat banking also offers economic and practical benefits to DFO habitat managers. Economies-of-scale would suggest building large habitat reefs to be more cost-effective than building several small ones. Given the high costs of site surveys, they would also be

more cost-effective to monitor, as fewer sites need be visited to demonstrate proper implementation and effectiveness over time. It is, therefore, more likely that monitoring would occur and NNL compliance demonstrated.

Habitat banking also has several shortcomings. Existence of habitat banks may enable a licensee to be less vigilant during project development. A more cavalier attitude toward unauthorized habitat disruption and destruction may be engendered if a licensee knew that a further withdrawal from the habitat bank would be the only consequence. Encouraging such an attitude is the general tendency of rock reefs to be overbuilt, exceeding design specifications and providing habitat "credit" at little incremental cost to a licensee. Such "black ink" may be seen as implied grounds for pre-approved "debits."

Another shortcoming of habitat banks is determining the party responsible for maintenance, given that two or more forest licensees and the Ministry of Forests may draw upon one habitat bank. A solution would be to establish a maintenance fund as part of compensation requirements, proportional to the amount of habitat credited to each party. A contractor would then conduct maintenance.

An additional issue concerning long-term viability of banked habitat is ensuring NNL in perpetuity (see Section 3.2.4; Brown and Lant, 1999). A regulatory mechanism, such as a conservation covenant, might be applicable to artificial reefs to prevent encroachment by other foreshore industries or nearshore activities (e.g., booming operations).

5.3.3 Compensation Ratios

Compensation ratios applied at coastal log-handling facilities tended to be minimal. A 1:1 ratio was applied in each case where lost rocky intertidal habitat was replaced with rocky intertidal habitat or subtidal reefs, for marsh creation (e.g., Menzies Bay, MacMillan Bloedel), and for out-of-kind compensation (Michelson Point). As described in Section 3.2.3, the general consensus in the habitat management scientific community is that a 1:1 ratio should only be applied when compensatory habitat is available before construction, and there is no risk of even short-term habitat loss. DFO applied a 1:1 ratio when habitat was available in advance (e.g., Broughton Archipelago sites), when it was not available in advance (e.g., Bute Inlet), and when no monitoring had been conducted to demonstrate available habitat to be functional (e.g., Knox Bay).

A 2:1 ratio was applied at two South Coast sites (Brand Creek and Mud Bay), where compensatory habitat consisted of created marshes, to account for the time lag before habitat became substantially functional. This ratio was also applied to potential loss of eelgrass habitat at Discovery Passage and to replacement of eelgrass habitat at Knox Bay. At Knox Bay, however, the 2:1 ratio was not enforced during habitat construction, and only 1:1 was achieved.

As a majority of log-handling facilities (particularly log dumps) operate temporarily, and foreshore rock fill on-site becomes colonized during operations within one to two years by algae and invertebrates, supplying compensatory habitat often results in a net habitat gain over time. It is therefore reasonable to apply a 1:1 ratio for like-for-like replacement of rocky intertidal and subtidal habitat, but only when the compensatory habitat has been demonstrated to be functional by a monitoring program. In other circumstances, ratios should be set at 1.5:1 or higher. Suggested ratios are presented in Section 6.2.4.

5.3.4 Reef Surface Multipliers

Surface area multipliers used to determine areal equivalency of compensatory rocky reef habitat were inconsistent, and justified and derived in different ways at different sites. Multipliers applied ranged from a low of 1.25 (Valdes Island) to a high of 3 (Harbledown Island and Kinnaird Island), and it was sometimes unclear whether, in making the calculation, the footprint of the compensatory reef had been subtracted from total habitat

created. Though attempts have been made to apply mathematical formulae (e.g., Kinnaird Island, Section 4.2.19), site-specific ecological considerations (e.g., territoriality of fish) and physicochemical characteristics (e.g., rock size and nutrient availability) make such attempts questionable. A better approach would be to establish a standard multiplier of twice the footprint in all cases, thereby accounting for habitat loss due to the footprint. A relatively low multiplier of two would reflect the precautionary principle, while ensuring fairness and predictability of the process.

5.3.5 Direct Loss of Biota

A final issue concerning habitat loss is the implicit direct killing of biota during construction of log-handling facilities. Though efforts are made in most cases to avoid highly productive shorelines, there is a routine acceptance that certain losses are unavoidable during such practices as placing intertidal fill. In appears incongruous that sea stars, sea cucumbers, sea urchins, anemones, shellfish, and rockweed and other aquatic vegetation are arbitrarily destroyed, while costly efforts are made to recreate or restore their habitat elsewhere.

5.4 Monitoring & Follow-Up

File review repeatedly revealed a lack of monitoring and follow-up. With few exceptions, information on file did not extend past issuance of Letters of Advice or HADD Authorizations. In many cases, there was no evidence on file that DFO staff visited log-handling facilities during construction or operations. Though most Authorizations clearly set out requirements for monitoring programs, few annual monitoring reports were on file. It was often impossible to determine from file information whether facilities had been built, or, if so, whether they were still operating.

In one case (Menzies Bay, Campbell River Fibre), an Authorization specifically excluded a monitoring requirement, under the assumption that the created intertidal habitat would be quickly colonized by vegetation. As discussed above, this site remained as an empty excavation several years following construction.

There was a tendency for Authorizations to require annual monitoring for a period of two or three years, while also placing a vague and unenforceable onus on proponents to ensure the long-term viability of compensatory habitat. Monitoring periods and frequency should be ecologically-based, according to the time frame during which different habitat types become substantially functional. Annual monitoring for three years may suffice for artificial reefs, whereas it may be prudent to monitor created marshes in years 1, 2, 5, and 10. Monitoring schedules should be adaptable to findings presented in monitoring reports.

In many cases, Authorizations stipulated monitoring be conducted by the same consultant who had designed the compensatory mitigation project, rather than by an independent reviewer. This practice introduces unacceptable bias into monitoring reports. While there may be no intent to mislead, it is very difficult to be objectively critical of one’s own work.

It is an unfortunate reality that, despite all best intentions, regular site visits by representatives of regulatory agencies, and implementation of a monitoring program, are the only ways to ensure sites are properly maintained and that project proponents are compliant with mitigation and compensation measures. Regular follow-up visits also ensure timely adaptive management to address shortcomings in design of these measures, shortcomings that may not be immediately obvious to non-specialists.

5.5 Assessment & Monitoring Reports

Consultant reports examined during this project were of two main types: reports on pre-construction site assessments, conducted on behalf of the proponent, supporting foreshore lease applications submitted to BC Lands; and reports on post-construction implementation or compliance monitoring. Few reports were available on effectiveness monitoring conducted later, following years 1, 2 and 3 of the monitoring program (e.g., Williams, 1999).

Of the assessment and monitoring reports available for review, no standardization had been applied to format or methodology, leading to a range of quality and usability, even among reports prepared by the same company. Site assessments tended to emphasize physical characteristics and biotic inventory, while providing insufficient information regarding habitat function, regional significance, or cumulative impacts. “Options” for compensatory habitat tended to pertain to alternative locations rather than alternative habitat types or compensation strategies. Monitoring reports tended to be brief and descriptive, qualitative not quantitative. Little detail was provided regarding methodology, an important factor in judging scientific validity. Enough detain should be provided to enable repeatability by auditors or other consultants in later monitoring phases. DFO and project proponents would benefit from development and application of reporting standards. DFO would be more readily able to verify compliance and respond to adaptive management requirements, while proponents would have better assurance of work quality and that legal responsibilities are being met.

5.6 Record Keeping & File Condition

As evident from detailed file review in Section 4, contents of DFO files on log-handling referrals were inconsistent. Some files were quite comprehensive, enabling an effective audit of the review and approval process from initial application through at least one monitoring report. Others contained little more than a site map, initial environmental evaluation by a consultant, and an indication of project status. Quantity and quality of information in most files was between these extremes. It could often be discerned that field visits had been conducted but not documented, that certain letters were missing, or that temporal gaps were present in the paper trail.

Difficulties were encountered in obtaining files from DFO. In some cases, staff work priorities precluded their giving attention to the matter for an extended period. In other cases files had been misplaced or stored by former staff members, and current staff located them only after lengthy searches.

As noted in Section 4, a small number of files reviewed included Referral Baseline Detail Reports, part of the Habitat Referral Tracking System (HRTS). This data tracking format facilitates records of project progress, including correspondence and other communication among DFO, project proponents and other agencies, and reporting stages, field assessments and compliance and effectiveness monitoring. Though HRTS databases may exist for additional files, regional DFO staff members appear to have underutilized this tool. In surveys of DFO staff, Drodge *et al*. (2000) determined that, though several avid users were satisfied with HRTS, a larger number of field staff found the system in its current form time-consuming, and the level of effort required to be disproportionate to any direct benefit to their day-to day work. Many users considered the system cumbersome, slow and not user-friendly or intuitive, and commented that insufficient training had been provided. HRTS reports in files review during this audit tended to be incomplete and to not extend beyond issuance of HADD Authorizations.

5.7 Performance Bonds & Letters of Credit

Several HADD Authorizations examined included a requirement that proponents post performance bonds or provide letters of credit in amounts equivalent to estimated costs of implementing habitat compensation measures. It was intended that bonds or letters of credit be held in trust in an effort to guarantee compliance by proponents with terms and conditions set forth in Authorizations. As few DFO files examined contained correspondence or other information pertaining to events following issuance of Authorizations, it was difficult in many cases to discern how long DFO retained the surety. Where documented, proponents tended to be refunded immediately upon completion of habitat compensation projects. In only one case (Menzies Bay, MacMillan Bloedel) was it clearly documented that the proponent was required to demonstrate habitat functionality before the bond was returned. That DFO procedures for managing such guarantees from proponents were inadequate was evidenced by an un-negotiated cheque, in the amount of $5,000.00, G3 found in a file provided for audit.

6.0 CONCLUSIONS & RECOMMENDATIONS

Conclusions made from these investigations and recommendations for future DFO investigations, policies and procedures are presented in this section.

6.1 Regional Differences in Achieving No-Net-Loss of Fish Habitat

Audit results summarized in Tables 5-1 and 5-2 demonstrate that, when expressed in purely habitat balance terms, overall NNL was not achieved at sites examined in the North Coast HEB Area, and was achieved at sites in the South Coast HEB Area.

In the North, temporal habitat loss has been accepted, under conditions that facilities be sited along relatively unproductive shores, and designed with minimal footprint to specifications that enabled relatively rapid colonization by vegetation and invertebrates. Level of compliance with these and other mitigation measures provided in Letters of Advice was high at most sites visited during this audit. It may be said that, although NNL was not achieved, the NNL policy appears to be an effective management tool.

In the South, where log-handling facilities tended to be larger and more concentrated, and, in some cases, associated with extensive industrialized foreshores, the NNL policy was more strictly applied. HADD Authorizations and CEAA referrals were routine. Though direct habitat loss at individual sites was often more extensive in the South than in the North, there was less temporal loss of habitat as compensatory habitat, usually an artificial reef, was available before construction. Authorizations have the advantage of bringing the full weight of the *Fisheries Act* to bear. It is noted, however, that DFO has not fully evaluated the habitat value of artificial reefs.

Recommendation 1: Apply HADD Authorizations to all applications for foreshore leases related to log-handling facilities on the BC coast expected to result in habitat loss.

Recommendation 2: Avoid temporal loss of habitat by ensuring that compensatory habitat is functioning before habitat loss is incurred (where practical).

6.2 Best Management Practices for Achieving NNL

Several lessons may be learnt from this audit pertaining to habitat protection, and what are the Best Management Practices (BMPs) applicable.

6.2.1 Siting of Log-Handling Facilities

It was evident from DFO file information and site visits that log dumps are best situated on rocky foreshores. These sites tended to have steeply sloping shorelines that would be less subject to mechanical damage from logs and debris than shorelines with gentle slopes. Pre-construction site assessments must include consideration of whether the log drop height would be excessive, causing logs to contact the substrate.

Fill placed on rocky shores tended to readily colonize with algae and invertebrates, thereby reducing temporal habitat loss, as it assumed form and function of adjacent natural habitat. Rocky intertidal and subtidal habitat is also relatively simple to create in compensation.

Recommendation 3: Site log dumps on rocky foreshores with steeply sloping shorelines whenever possible, avoid excessive drop height, and compensate for habitat loss with rocky intertidal and subtidal structures.

6.2.2 Habitat Compensation

Literature reviewed (Section 3.2.2) supports the efficacy of artificial reefs as compensatory fish habitat, provided design parameters are consistent with management objectives.

Careful, site-specific attention must be given to an ecologically effective reef design. Artificial reefs must not be used as habitat banks at the expense of on-site mitigation and enforcement.

It is suggested that DFO develop procedures and design and siting criteria for the development of rock reef habitat to address various management objectives, and particularly for placement of large reefs employed as habitat banks. One necessary step in the procedure would be consultation with staff in other divisions of DFO and at other federal departments (e.g., EC), and among other levels of government (e.g., BC MELP, MOF and municipalities) to determine fully data and information that exist concerning proposed sites.

Little scientific research of artificial reefs appears to have been conducted along the BC coast. Research elsewhere, notably at research reefs in Puget Sound and southern California, has been valuable in identifying how management objectives can be effectively matched to reef design, and how design elements may be used to benefit target species or age classes of fish. Such research findings may not be directly applicable in northern Canadian waters or under the Canadian regulatory regime.

Recommendation 4: Continue compensating for lost rocky intertidal habitat by constructing artificial reefs, provided that greater attention is paid to matching design with management objectives for target species.

Recommendation 5: In co-operation with an educational institution, establish a research reef along the BC coast that would enable longitudinal studies and habitat manipulation to test specific hypotheses relating reef ecology to their use as habitat management tools.

Creating wetlands was a less viable option for habitat replacement, owing to several factors, including poor design, lack of attention to site ecology and hydrology, lack of follow-up by DFO and the time lag before reaching a substantial level of functionality. Review of literature suggested that wetland compensation projects are more successful when the objectives are to rehabilitate or restore existing, degraded wetlands rather than attempting to create new wetlands where none previously existed.

Recommendation 6: When using wetlands as compensatory habitat, emphasize the environmental management objectives of habitat rehabilitation and restoration, over that of habitat creation.

The type of compensatory habitat associated with Authorizations and prescribed at South Coast log-handling facilities often tended to directly reflect the experience of those conducting initial site evaluations. It is suggested that a broader range of options be explored when evaluating proposals for compensatory mitigation.

Recommendation 7: Conduct further and more comprehensive reviews of available literature on compensatory habitat reefs and saltmarsh rehabilitation, creation and management, and make this information available to regional managers.

Habitat banking, particularly using artificial reefs, was a useful management tool applicable to log-handling facilities for two main reasons. First, large reefs are better than small reefs for avoiding habitat fragmentation and ensuring that a variety of ecological niches become available over time. Second, having, pre-existing reef habitat available ensures that no time lag is incurred between habitat loss and establishment of ecological functionality of a compensatory habitat.

Recommendation 8: Continue using artificial reefs as habitat banks, provided that habitat management goals are first identified and then met by reef design.

DFO has established habitat-banking agreements with other agencies, for example, the North Fraser Port Authority (1999). Agreements of this type help ensure banked habitat already applied as compensation is conserved in perpetuity.

Certain issues remain unresolved, notably that of establishing a mechanism for funding ongoing maintenance of habitat banks drawn on by two or more forest licensees.

Recommendation 9: Research and develop a policy for habitat banking, using practices in other jurisdictions (e.g., US) as models.

DFO NNL objectives might be better met through integration of habitat protection and rehabilitation programs with other fisheries-based initiatives, such as the BC Watershed Restoration Program. For example, it might be more ecologically effective to compensate for a log dump by requiring the same licensee to replant a riparian area in the same watershed, than to provide on-site compensatory habitat. A funding formula could be based on volume cut by the licensee in that watershed, and proportional to the areal impact of the log dump.

Ecological benefits might be derived from applying compensation funding to large-scale, integrated restoration projects. For example, numerous bays and estuaries along the coast have been subject to severe adverse cumulative impacts that can only be addressed by integrated planning and a large commitment of resources (e.g., Alberni Inlet, Menzies Bay and the Nanaimo River estuary). Reducing the number of sites or concentrating them geographically would facilitate monitoring and site visits.

Recommendation 10: Integrate DFO habitat protection and rehabilitation programs with other federal and provincial initiatives, such as the BC Watershed Restoration Program, Fisheries Renewal BC, and regional planning processes.

6.2.3 Cumulative Impacts

Review of the process of issuing Letters of Advice and HADD Authorizations revealed a tendency to evaluate habitat referrals in isolation and not consider cumulative impacts of nearby log-handling facilities and other industrial sites. This process has led to an inefficient, piecemeal approach to mitigation and compensation. Patterns and trends in ecological degradation may be missed without dedicated effort to identify them.

It is suggested that environmental management of log-handling facilities and other coastal industrial activities be placed in the context of DFO regional planning and its larger objectives. Such an approach would bring greater creativity to compensatory mitigation, provided the like-for-like criterion were less strictly applied, and applicable compensation ratios fully explored.

Recommendation 11: Place greater emphasis on addressing adverse cumulative impacts of all shore-based industries in a given region, rather than addressing adverse impacts piecemeal and project-by-project.

Recommendation 12: Develop a process that facilitates freer exchange of information among government departments, divisions within departments, and different levels of government to enable integrated planning and assessment of cumulative impacts (e.g., a central geographically keyed database accessible to all levels of government).

6.2.4 Compensation Ratios & Reef Surface Multipliers

A consistent set of compensation ratios applicable in differing scenarios would enable better habitat management by DFO staff, and help ensure that policies are applied equally among jurisdictions.

Implementing NNL policy and evaluating its success by measuring area lost versus area gained may be expeditious, but is not an ecologically sound approach. Habitat functionality must be factored in, particularly with reference to regional habitat management objectives for target species, species at risk, and conservation of rarer habitat types.

A policy that favours like-for-like compensation has benefits and shortcomings. The main benefit is avoidance of incremental, cumulative loss of particular habitat types, particularly if lost habitat is difficult to replace in kind, and creation or restoration of an alternative type of habitat has achieved a high success rate. The main shortcoming is that creation of certain habitat types (e.g., wetlands) is notoriously difficult, and replacement in kind might necessitate further habitat destruction, as occurred with forested land adjacent to the Brand Creek and Menzies Bay (MacMillan Bloedel) sites. Identifying the better option at a given site requires an integrated, region-wide approach, and application of compensation ratios appropriate for differing scenarios.

Appropriate ratios of compensatory habitat to lost habitat are suggested in Table 6-1. It is recognized that a certain degree of arbitrariness is necessary in standardizing ratios.

TABLE 6-1:
Suggested Compensation Ratios for Coastal Habitat

Circumstance	Ratio
in-kind or superior habitat is available nearby (<1 km) before construction; no risk of temporal habitat loss	1:1
in-kind or superior habitat is available at a distance greater than 1 km	2:1
an opportunity to restore additional compensatory habitat is available in conjunction with restoring the subject site	2:1
in-kind mudflat is to be rehabilitated or created nearby	2:1
marsh habitat is to be created nearby	3:1
pre-existing habitat requires enhancement to increase its carrying capacity	4:1
lost coastal habitat is to be compensated by improving fish habitat in a nearby stream (e.g, riparian planting or creation of side channels)	5:1
pre-existing habitat of high ecological value nearby is to be preserved through land tenure measures (e.g., donated by proponent as an ecological reserve)	10:1

Recommendation 13: Apply a minimum ratio of compensatory habitat to lost habitat of 1:1 only when replacement habitat of a similar or superior type is already available and functioning within 1 km, thereby avoiding temporal habitat loss. In all other cases, apply a ratio greater than 1:1.

Multipliers used to determine the amount of habitat available in the three dimensional structure of artificial reefs have been inconsistent and *ad hoc*. It is suggested that a conservative approach be taken, and that a standard multiplier of twice the reef footprint be applied in all cases, thereby accounting for habitat loss due to the footprint.

Recommendation 14: Use a multiplier of twice the footprint to determine the amount of habitat provided by artificial reefs.

6.2.5 Direct Destruction of Biota

An aspect of foreshore construction often overlooked is the direct destruction of biota by placement of intertidal fill.

Recommendation 15: Wherever practical, relocate fauna before dumping fill and move them to appropriate habitat nearby or use them to "seed" compensatory habitat.

6.3 Environmental Assessment, Monitoring & Follow-Up

Environmental assessments pursuant to BC Lands foreshore lease applications were of inconsistent quality and scope, and reports were often of limited usability. It was evident that no standard reporting requirements or formats were applied.

Recommendation 16: Develop standardized guidelines and procedures for the consulting community to apply when conducting environmental assessments and preparing reports.

A key finding of this audit is that there is little history of a formal, systematic process being applied to evaluate mitigation measures or remediation projects. Drodge *et al.* (2000) identified this lack of compliance or effectiveness monitoring to be a problem associated with the DFO referral process nationwide. These authors calculated that DFO habitat staff members typically spend less than 2% of their time monitoring compliance with Letters of Advice and HADD Authorizations, or assessing effectiveness of proffered advice. KPMG (Drodge *et al*., 2000) recommended the DFO Habitat Management Program gradually decrease "reactive" activities (e.g., processing of referrals) and increase "proactive" activities (e.g., early intervention and monitoring).

A monitoring program serves two distinct purposes (Bankes and Thompson, 1980) – those of providing essential information for 1) regulatory management, and 2) adaptive environmental management. Development of a monitoring program must be integral to project planning, not just an "add-on". Systematic monitoring of individual remediation projects provides an essential adaptive planning tool by which to further the understanding of ecosystems and improve both site-specific mitigation and compensation activities and the process in general.

Recommendation 17: Implement formal, standardized environmental monitoring programs at log-handling facilities under DFO jurisdiction.

The ability to monitor mitigation or compensation measures at a given site, as a means of justifying a particular course of action, must be viewed as a core component of the decision to proceed with the work. Inability to implement a monitoring program, whether due to accessibility or funding constraints, should lead to an application not being approved. Refusal by a habitat manager to authorize HADD on the grounds that funding was insufficient to enable a monitoring program, thereby risking shutdown of a local logging operation, would provide political capital to help ensure adequate funding and staffing were put in place.

Recommendation 18: Make project approval contingent on the ability to monitor a site.

Development of a comprehensive assessment and monitoring framework would help ensure program success can be demonstrated and quantified. Evaluation of individual projects is essential to improving program effectiveness, and to demonstrating program effectiveness or "wise spending" in the long term. Administration of DFO NNL policy would benefit from standardizing approaches among DFO offices, and from development of general procedures and training programs. A standardized process for environmental assessments and follow-up would also benefit proponents, as they would know what to expect and be able to budget accordingly.

Recommendation 19: Develop a monitoring guidance manual for DFO staff that includes standard operating procedures (SOPs) and an updating process.

Monitoring conducted by those responsible for initial assessments, and design and implementation of compensatory mitigation programs, introduces bias.

Recommendation 20: Ensure that monitoring is conducted by independent, impartial parties.

It is suggested that workshops and meetings be held among consultants and DFO staff to solicit input into development of monitoring and reporting procedures. Best management practices should be developed with input from all concerned parties. Workshops for consultants and DFO staff would also help ensure consistency of policy application within and among regions.

Once procedures are developed, it may be advisable to conduct training programs for consultants, and a certification process that establishes eligibility. Guidelines and training programs developed by the BC Resources Inventory Committee and Watershed Restoration Program may serve as appropriate models.

Recommendation 21: In co-operation with the consulting community, develop monitoring and reporting procedures, and implement training programs to help ensure consistency.

Required duration and frequency of monitoring should be site-specific and based on the length of time required for a particular habitat type to become substantially functional and not require further manipulation.

Recommendation 22: Base monitoring duration and frequency on site-specific ecological attributes and the type of compensatory habitat, and adapt the schedule in response to monitoring results; a general guideline would be to monitor artificial reefs annually for three years and created marshes in years 1, 2, 5 and 10.

Use of performance bonds or other mechanisms to ensure compliance is of limited value if the surety is returned before functionality of compensatory habitat is demonstrated through monitoring. A more formal system (e.g., trust accounts) would be advisable for handling such funds.

Recommendation 23: Retain performance bonds or letters of credit until a minimum of two years of monitoring have been completed.

6.4 File Management & Project Tracking

A major difficulty encountered during this audit program was the inconsistent quality of file management. It is recommended that DFO develop and implement, with reference to current information on what works and what does not work, a practical, convenient system that staff can employ consistently. Additional documentation would increase quality of data and the paper trail, increasing overall operational efficiency.

Recommendation 24: Establish and implement efficient record-keeping and filing procedures that staff will understand and use.

6.5 Additional Log-handling Audits

It is suggested that additional site audits be conducted in 2000-2001, at the following locations:

- Queen Charlotte Islands;
- Bute Inlet;
- Broughton Archipelago; and,
- the Lower Mainland.

The audit should include, at minimum, evaluation of one large habitat banking reef, such as that located at Charlotte Point. Audits of freshwater log-handling operations are also highly advisable.

Recommendation 25: Conduct additional site audits in 2000-2001 at the Queen Charlotte Islands, Bute Inlet, Broughton Archipelago and the Lower Mainland, to include, at minimum, evaluation of one large habitat banking reef, such as that located at Charlotte Point, and possibly freshwater sites.

6.6 Synopsis of Recommendations

Based on this NNL audit of log-handling facilities, G3 Consulting Ltd. recommends the following measures to DFO:

1. Apply HADD Authorizations to all applications for foreshore leases related to log-handling facilities on the BC coast expected to result in habitat loss.
2. Avoid temporal loss of habitat by ensuring that compensatory habitat is functioning before habitat loss is incurred (where practical).
3. Site log dumps on rocky foreshores with steeply sloping shorelines whenever possible, avoid excessive drop height, and compensate for habitat loss with rocky intertidal and subtidal structures.
4. Continue compensating for lost rocky intertidal habitat by constructing artificial reefs, provided that greater attention is paid to matching design with management objectives for target species.
5. In co-operation with an educational institution, establish a research reef along the BC coast that would enable longitudinal studies and habitat manipulation to test specific hypotheses relating reef ecology to their use as habitat management tools.
6. When using wetlands as compensatory habitat, emphasize the environmental management objectives of habitat rehabilitation and restoration, over that of habitat creation.
7. Conduct further and more comprehensive reviews of available literature on compensatory habitat reefs and saltmarsh rehabilitation, creation and management, and make this information available to regional managers.
8. Continue using artificial reefs as habitat banks, provided that habitat management goals are first identified and then met by reef design.
9. Research and develop a policy for habitat banking, using practices in other jurisdictions (e.g., US) as models.
10. Integrate DFO habitat protection and rehabilitation programs with other federal and provincial initiatives, such as the BC Watershed Restoration Program, Fisheries Renewal BC, and regional planning processes.
11. Place greater emphasis on addressing adverse cumulative impacts of all shore-based industries in a given region, rather than addressing adverse impacts piecemeal and project-by-project.
12. Develop a process that facilitates freer exchange of information among government departments, divisions within departments, and different levels of government to enable integrated planning and assessment of cumulative impacts (e.g., a central geographically keyed database accessible to all levels of government).
13. Apply a minimum ratio of compensatory habitat to lost habitat of 1:1 only when replacement habitat of a similar or superior type is already available and functioning

within 1 km, thereby avoiding temporal habitat loss. In all other cases, apply a ratio greater than 1:1.

14. Use a multiplier of twice the footprint to determine the amount of habitat provided by artificial reefs.
15. Wherever practical, relocate fauna before dumping fill and move them to appropriate habitat nearby or use them to "seed" compensatory habitat.
16. Develop standardized guidelines and procedures for the consulting community to apply when conducting environmental assessments and preparing reports.
17. Implement formal, standardized environmental monitoring programs at log-handling facilities under DFO jurisdiction.
18. Make project approval contingent on the ability to monitor a site.
19. Develop a monitoring guidance manual for DFO staff that includes standard operating procedures (SOPs) and an updating process.
20. Ensure that monitoring is conducted by independent, impartial parties.
21. In co-operation with the consulting community, develop monitoring and reporting procedures, and implement training programs to help ensure consistency.
22. Base monitoring duration and frequency on site-specific ecological attributes and the type of compensatory habitat, and adapt the schedule in response to monitoring results; a general guideline would be to monitor artificial reefs annually for three years and created marshes in years 1, 2, 5 and 10.
23. Retain performance bonds or letters of credit until a minimum of two years of monitoring have been completed.
24. Establish and implement efficient record-keeping and filing procedures that staff will understand and use.
25. Conduct additional site audits in 2000-2001 at the Queen Charlotte Islands, Bute Inlet, Broughton Archipelago and the Lower Mainland, to include, at minimum, evaluation of one large habitat banking reef, such as that located at Charlotte Point, and possibly freshwater sites.

7.0 LITERATURE SOURCES

Literature sources have been divided into three sections for the convenience of the reader: project-specific consultant reports, general references, and personal communications.

7.1 Site Assessment & Monitoring Reports

Archipelago Marine Research Ltd. 1993. A habitat survey of a foreshore lease application site at Lina Island. Prepared for Smith, Younger & Assoc. Victoria, BC.

Archipelago Marine Research Ltd. undated. A marine habitat impact assessment of a proposed barge moorage, log dumping and booming facility: Trip Creek, Triumph Bay, BC. Prepared for Skeena Sawmills. Victoria, BC; 16 pp.

Bella Coola Grizzly Holdings Ltd. 1995. Frenchman Creek Development Area, marine habitat survey. Prepared for International Forest Products Ltd., Mid-Coast Forest District. Bella Coola, BC; 5 pp.

Bella Coola Grizzly Holdings Ltd. 1996. Marine foreshore habitat assessment and classification, Draney Inlet Log Dump & Storage Area. Prepared for International Forest Products Ltd., Mid-Coast Forest District. Bella Coola, BC; 15 pp.

Bruce, Peter & Associates Biological Consultants. 1993. Habitat mitigation at five proposed log dumps. Prepared for Interfor, Port Hardy Operations. Ladysmith, BC; 3 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1993a. Underwater reconnaissance of a proposed log dump at Snowdrift, Frederick Sound, Seymour Inlet. Prepared for Interfor, Port Hardy Operations. Ladysmith, BC; 3 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1993b. An underwater survey of a proposed log dump at Cavern Cove, Drury Inlet. Prepared for Interfor, Port Hardy Operations. Ladysmith, BC; 3 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1993c. An underwater survey of a proposed log dump at Skeene Bay, Drury Inlet. Prepared for Interfor Operations, Port Hardy. Ladysmith, BC; 3 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1993d. An underwater survey of a proposed log dump at Sir Edmund Bay, Broughton Island. Prepared for Interfor, Port Hardy Operations. Ladysmith, BC; 3 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1993e. An underwater survey of a proposed log dump on Tribune Channel, North-East Gilford Island. Prepared for Interfor, Port Hardy Operations. Ladysmith, BC; 3 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1994. Habitat compensation projects at Menzies Bay. Letter report to MacMillan Bloedel, Menzies Bay Division, Campbell River, BC. Ladysmith, BC; 5 pp.

Bruce, Peter & Associates Biological Consultants. 1994a. Potential habitat enhancement project on Trout Creek. Letter report to MacMillan Bloedel, Menzies Bay Division, Campbell River, BC. Ladysmith, BC; 5 pp.

Bruce, Peter & Associates Biological Consultants. 1994b. Review of a proposed log dump at Charlotte Pt., Drury Inlet. Prepared for Interfor, Port Hardy Operations. Ladysmith, BC; 4 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1994c. Underwater surveys of proposed log dumps in Seymour Inlet, Salmon Arm, Frederick Sound, and Tribune Channel. Prepared for Interfor, Port Hardy Operations. Ladysmith, BC; 2 pp.

Bruce, Peter & Associates Biological Consultants. 1994d. Habitat compensation projects at six proposed log dumps at: Seymour Inlet, Broughton Island, Gilford Island and Drury Inlet. Prepared for Interfor, Port Hardy Operations. Ladysmith, BC; 6 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1994e. Measurement of reef constructed at Charlotte Point. Prepared for Interfor, Port Hardy. Ladysmith, BC; 3 pp.

Bruce, Peter & Associates Biological Consultants. 1995. Construction of an intertidal area for habitat compensation. Letter report to MacMillan Bloedel, Menzies Bay Division, Campbell River, BC. Ladysmith, BC; 3 pp.

Bruce, Peter & Associates Biological Consultants. 1995a. De-watering site at Menzies Bay. Letter report to Campbell River Fibre, Campbell River, BC. Ladysmith, BC; 4 pp.

Bruce, Peter & Associates Biological Consultants. 1995b. Underwater survey of two proposed sites for a log dump – Valdes Island. Prepared for MacMillan Bloedel Ltd., South Island Woodlands Division, Cassidy, BC. Ladysmith, BC; 3 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1996. Underwater survey of a proposed barge grid, and the sub tidal slope below a proposed road location at Silverado, Muchalat Inlet. Prepared for Pacific Forest Products, Ltd., Gold River Operations. Ladysmith, BC; 4 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1996a. Underwater survey of a proposed log dump at Silverado, Muchalat Inlet. Prepared for Pacific Forest Products, Ltd., Gold River Operations. Ladysmith, BC; 3 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1997. Underwater survey of potential habitat compensation sites at the Harbledown Island log dump. Prepared for MacMillan Bloedel Ltd., Port McNeill Division. Ladysmith, BC; 4 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1997a. Road location on Kingcome River estuary. Prepared for MacMillan Bloedel Ltd., Port McNeill Division. Ladysmith, BC; 3 pp.

Bruce, Peter & Associates Biological Consultants. 1997b. Barge grid at Kingcome Inlet. Prepared for MacMillan Bloedel Ltd., Port McNeill Division. Ladysmith, BC; 6 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1997c. Underwater survey of shoreline below proposed log dump and access road at Brand Creek, Effingham Inlet. Letter report to BC MOF, Port Alberni Forest District. Ladysmith, BC; 6 pp. + app.

Bruce, Peter & Associates Biological Consultants. 1997d. Underwater survey at Harmac 14 April 1997. Prepared for Harmac Pacific Inc., Nanaimo, BC. Ladysmith, BC; 4 pp. + app.

Bruce, Peter & Associates. 1998. Underwater survey of a proposed log dump (560-4), Orford Bay, Bute Inlet. Prepared for Coast Mountain Hardwoods Inc. Delta, BC. Ladysmith, BC; 6 pp. + apps.

Bruce, Peter & Associates. 1998a. Underwater survey of a log dump site, BLK 561-3, Hovel Bay, Bute Inlet. Prepared for Coast Mountain Hardwoods Inc. Delta, BC. Ladysmith, BC; 3 pp. + app.

Bruce, Peter & Associates. 1998b. Underwater survey of a log dump site, BLK 561-1, Hovel Bay, Bute Inlet. Prepared for Coast Mountain Hardwoods Inc. Delta, BC. Ladysmith, BC; 3 pp. + app.

Bruce, Peter & Associates. 1998c. Underwater survey of a proposed log dump (554-7), Bear Bay, Bute Inlet. Prepared for Coast Mountain Hardwoods Inc. Delta, BC. Ladysmith, BC; 2 pp. + app.

Bruce, Peter & Associates. 1998d. Underwater survey of a proposed log dump (554-3), Bear Bay, Bute Inlet. Prepared for Coast Mountain Hardwoods Inc. Delta, BC. Ladysmith, BC; 4 pp. + app.

Bruce, Peter & Associates. 1998e. Underwater survey of a habitat compensation project, Sechart Channel, Barclay Sound. MOF, South Island Forest District, Port Alberni, BC. Ladysmith, BC; 3 pp.

Bruce, Peter & Associates. 1999. Habitat compensation reef at Orford Bay, Bute Inlet. Letter report to Coast Mountain Hardwoods, Delta, BC. Ladysmith, BC; 5 pp.

Burger, L. and P. Thuringer. 1995. Marine habitat impact assessment of a proposed barge moorage, log dumping and booming facility: East Gribbell, Ursula Channel, B.C. Prepared for Skeena Sawmills Ltd., Terrace, by Archipelago Marine Research Ltd., Victoria, BC; 11 pp.

Heiltsuk Fisheries Program. 1994. Report for land logging site SCUBA dive surveys. Prepared for MOF Mid-Coast Forest District, Hagensborg, BC. Waglisla, BC; 12 pp. + app.

Lacasse, S. 1995. Michelson Point log dump and containment area survey. Prepared for Western Forest Products.

Lindsay, D.J. 1996. Sandilands Island dock and barge ramp proposal, environmental impact assessment. TimberWest Forest Limited, Integrated Resource Analysis Section. 7 pp.

MTE Inc. 1997. Summary report for Beattie Anchourage Dryland Sort proposed causeway. Prepared for MacMillan Bloedel Ltd., Juskatla, BC. Tlell, BC; 6 pp.

Mid-Coast Aquatics. 1998. Marine foreshore habitat assessment and classification. Cousins Inlet Log Dump & Log Storage. Prepared for International Forest Products. Bella Coola, BC; 10 pp. + app.

North Island Biological Consultants. 1998. Underwater survey and assessment of a proposed log dump and booming area at Kinnaird Island. Prepared for MOF, Port McNeill Forest District. Port Hardy, BC; 16 pp.

Sea-mount Consulting. 1998. Marine habitat assessments for proposed log dumping facilities on West Cracroft Island. Prepared for TimberWest Forest Ltd. [no publishing location given]. 38 pp.

Sea-mount Consulting. 1998a. Letter regarding TemberWest Egerton dryland sort. Prepared for DFO, Nanaimo; Lake Cowichan, BC; 9 pp.

Thuringer, P. 1996. Marine habitat assessment for a proposed log dumping and storage facility in Verney Passage, B.C. Prepared by Archipelago Marine Research Ltd. for MOF Small Business Forest Enterprise Program. Victoria, BC; 16 pp.

Triton Environmental Consultants Ltd. 1999 (July Draft). Preliminary compensation options for log handling and storage facilities near the head of Surf Inlet, Princess Royal Island, British Columbia. Prepared for International Forest Products Limited. Terrace, BC; 47 pp.

Undersea Broadcast Services. 1997. Sandilands Island (Queen Charlotte Island) Barge Dump environmental assessment, August 22, 1997 - August 24, 1997. Prepared for TimberWest Forest Ltd. Victoria, BC; 10 pp.

White, E.R. 1993. Goat harbour foreshore assessment. Prepared for Coast Forest Management Ltd., Prince Rupert. Nelson, BC; 13 pp.

White, E.R. 1993a. Verney Passage Creek foreshore assessment. Prepared for Coast Forest Management Ltd., Prince Rupert, BC. Nelson, BC; 11 pp.

White, E. 1995. Fisheries resource assessment of lower Chadsey Creek and foreshore. Prepared for Queen Charlotte Division, MacMillan Bloedel Limited, Juskatla, BC. Nelson, BC; 18 pp.

White, E. 1997. Foreshore habitat assessment for Big Tillhorn River, Douglas Channel. Prepared for Skeena Sawmills, A Division of West Fraser Mills Ltd., Terrace, BC. Nelson, BC; 34 pp. + app.

White, E. 1998. Foreshore habitat assessment for Kitkiata Inlet, Douglas Channel. Prepared for Skeena Sawmills division of West Fraser Mills Ltd., Terrace, BC. Nelson, BC; 20 pp. + app.

White, E. 1999. Assessment of impacts to foreshore fish habitats near the head of Surf Inlet, Princess Royal Island. Prepared for International Forest Products Limited, Terrace, BC. Nelson, BC; 29 pp.

Williams, G.L. 1998. Brand Creek estuary intertidal habitat assessment & compensation prescription. Prepared for MOF South Island Forest District, Port Alberni, BC. G. L. Williams and Associates Ltd., Coquitlam, BC; 9 pp.

Williams, G.L. 1998. Brand Creek estuary saltmarsh compensation 1998 monitoring report. Prepared for MOF South Island Forest District, Port Alberni, BC. G. L. Williams and Associates Ltd., Coquitlam, BC; 8 pp.

Williams, G.L., & Associates Ltd. 1999. Brand Creek compensation marsh 1999 monitoring results. Coquitlam, BC; 9 pp.

7.2 General References

Anderson, T.W., E.E. DeMartini, and D.A. Roberts. 1989. The relationship between habitat structure, body size and distribution of fishes at a temperate artificial reef. Bull. Mar. Sci. 44:681-697.

Bankes, N., and A.R. Thompson. 1980. Monitoring for impact assessment and management. Westwater Research Centre, University of British Columbia. Vancouver; 45 pp.

Bohnsack, J.A., and D.L. Sutherland. 1985. Artificial reef research: a review with recommendations for future priorities. Bull. Mar. Sci. 37:11-39.

Brown, P.H., and C.L. Lant. 1999. The effect of wetland mitigation banking on the achievement of no-net-loss. Environmental Management 23:222-345.

Brownlee, M.J., E.R. Mattice, and C.D. Levings. 1984. The Campbell River estuary: A report on the design, construction and preliminary follow-up study findings of intertidal marsh islands created for purposes of estuarine rehabilitation. Can. Manu. Rep. Fish. Aquat. Sci. 1789. 212 pp.

Buckley, R.M., and G.J. Hueckel. 1985. Biological processes and ecological development on an artificial reef in Puget Sound, Washington. Bull. Mar. Sci. 37:50-69.

Carter, J.W., W.N. Jessee, M.S. Foster, and A.L. Carpenter. 1985. Management of artificial reefs designed to support natural communities. Bull. Mar. Sci. 37:114-128.

Castelle, A.J., C. Conolly, M. Emers, E.D. Metz, S.Meyer, M. Witter, S. Mauermann, M. Bentley, D. Sheldon, and D. Dole. 1992. Wetland mitigation replacement ratios: defining equivalency. Adolfson Associates, Inc., for Shorelands and Coastal Zone Management Program, Washington State Dept. of Ecology, Olympia. Publication No. 92-08. 112 pp.

Castelle, A.J., C. Conolly, M. Emers, E.D. Metz, S.Meyer, and M. Witter. 1992a. Wetland mitigation replacement ratios: an annotated bibliography. Adolfson Associates, Inc., for Shorelands and Coastal Zone Management Program, Washington State Dept. of Ecology, Olympia. Publication No. 92-09. 40 pp.

Castelle, A.J., S. Luchessa, C. Conolly, M. Emers, E.D. Metz, S.Meyer, and M. Witter. 1992b. Wetlands mitigation banking. Adolfson Associates, Inc., for Shorelands and Coastal Zone Management Program, Washington State Dept. of Ecology, Olympia. Publication No. 92-12. 45 pp.

Danner, E.M., T.C. Wilson, and R.E. Schlotterbeck. 1994. Comparison of rockfish recruitment of nearshore artificial and natural reefs off the coast of central California. Bull. Mar. Sci. 55:333-343.

Dennison, M.S., and J.A. Schmid. 1997. Wetland mitigation. Mitigation banking and other strategies for development and compliance. Government Institutes, Inc. Rockville, Maryland; 305 pp.

DFO. 1983. Towards a fish habitat management policy for DFO – A discussion paper. Ottawa.

DFO. 1986. Policy for the management of fish habitat. Fish Habitat Management Branch. Ottawa; 28 pp.

DFO. 1995. Fish habitat conservation and protection. Guidelines for attaining no net loss. Ottawa. http://www.dfo-mpo.gc.ca/habitat/GuideLin/english/Index_e.htm.

DFO. 1995a. Fish habitat conservation and protection. What the law requires. Ottawa. http://www.ncr.dfo.ca/habitat/Law_Req/english/index_e.htm.

DFO. 1998. Decision framework for the determination and authorization of harmful alteration, disruption or destruction of fish habitat. Habitat Management and Environmental Science, Habitat Management Branch. Ottawa; 22 pp.

DFO and Province of British Columbia. 1980. Nanaimo Estuary Fish Habitat & Log Management Task Force, report to the Log Management Sub-Committee to the Steering Committee. Victoria; 67 pp.

Drodge, G., M.-H. Beauchesne, and G. Feltham. 2000 (Draft February 12). National habitat referral study. Prepared for DFO Habitat Management and Environmental Science, Ottawa, by KPMG. Ottawa.

Eliot, W. 1985. Implementing mitigation policies in San Francisco Bay: a critique. Prepared for the California State Coastal Conservancy.

Hixon, M.A., and J.P. Beets. 1989. Shelter characteristics and Caribbean fish assemblages: experiments with artificial reefs. Bull. Mar. Sci. 44:873-880.

Hueckel, G.J., and R.M. Buckley. 1989. Predicting fish species on artificial reefs using indicatory biota from natural reefs. Bull. Mar. Sci. 44:873-880.

Jessee, W.N., A.L. Carpenter, and J.W. Carter. 1985. Distribution patterns and density estimates of fishes on a southern California artificial reef with comparisons to natural reef habitats. Bull. Mar. Sci. 37:214-226.

Kennish, M.J. (ed.). 2000. Estuary restoration and maintenance. The National Estuary Program. CRC Press. Boca Raton, Florida; 359 pp.

Kirkpatrick, B., T.C. Shirley, and C.E. O'Clair. 1998. Deep-water bark accumulation and benthos richness at log transfer and storage facilities. Alaska Fish. Res. Bull 5(2):103-115.

Kistritz, R.U. 1995. Habitat compensation, restoration and creation in the Fraser River Estuary. Are we achieving a no-net-loss of fish habitat? Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2349. 70 pp. + 43 pp. appendices.

Langer, O.E. c. 1995. Evaluating an application of the concept of not net loss to Fraser River Estuary wetlands. http://www.bcwetlands.com/Wetnet_News/conference/langer.html.\

Levy, D.A., T.G. Northcote, and R.M. Barr. 1982. Effects of estuarine log storage on juvenile salmon. Tech. Rep. No. 26, Westwater Research Centre, University of British Columbia. Vancouver; 102 pp.

Lindberg, W.J. 1997. Can science resolve the attraction-production issue? Fisheries 22(4):10-13.

MacArthur, R.H. 1972. Geographical ecology. Patterns in the distribution of species. New York; Harper & Row, Publishers. 269 pp.

Malakoff, D. 1998. Restored wetlands flunk real-world test. Science 280:371-372.

Maser, C., and J.R. Sedell. 1994. From the forest to the sea. The ecology of wood in streams, rivers, estuaries, and oceans. St. Lucie Press. Delray Beach, Florida; 200 pp.

Matthews, R.M. 1985. Species similarity and movement of fishes on natural and artificial reefs in Monterey Bay, California. Bull. Mar. Sci. 37:252-270.

McHarg, I.L. 1970. Design with Nature. John Wiley & Sons. New York; 208 pp.

Mitsch, W.J., X.Y. Wu, R.W. Nairn, P.E. Weihe, N.M. Wang, R. Deal, and C.E. Boucher. Creating and restoring wetlands. A whole-ecosystem experiment in self-design. Bioscience 48(12):1019-1030.

Ministry of Lands, Parks and Housing. 1982. Guidelines for the review and processing of coastal log handling applications. Lands Division. Victoria; 52 pp.

Naito, B.G. 1991. A biological survey of an artificial reef at French Creek, British Columbia. Can. Manuscr. Rept. Fish. Aquat. Sci. 2100. 48 pp.

North Fraser Port Authority. 1999. North Fraser Harbour Habitat Compensation Bank. http://www.nfpa.ca/English/03fras/03habitat.html

Pearson, T.H., and R. Rosenberg. 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. Oceanogr. Mar. Biol. Ann. Rev. 16:229-311.

Pojar, J., and A. MacKinnon (eds.). 1994. Plants of coastal British Columbia including Washington, Oregon & Alaska. BC Forest Service and Lone Pine Publishing. Vancouver; 527 pp.

Power, E.A., and T.G. Northcote. 1991. Effects of log storage on the food supply and diet of juvenile sockeye salmon. North Am. J. Fish. Manage. 11:413-423.

Roberts, L. 1993. Wetlands trading is a loser's game, say ecologists. Science 260:1890-1892.

Samples, K.C., and J.T. Sproul. 1985. Fish aggregating devices and open-access commercial fisheries: a theoretical enquiry. Bull. Mar. Sci. 37:305-317.

Seaman, W.J. 1997. What if everyone thought about reefs? Fisheries 22(4):4-8.

Sedell, J.R., F.N. Leone, and W.S. Duvall. 1991. Water transportation and storage of logs. American Fisheries Society Special Publication 19. Bethesda, Maryland, USA; 325-368.

Sloan, N.A. 1996. Review of log transportation and handling impacts and dredged material disposal. *In:* D.A. Levy, L.U. Young, and L.W. Dwernychuk (eds.). Strait of Georgia fisheries sustainability review. Hatfield Consultants, Ltd., West Vancouver, BC; pp. 225-344.

Sneath, P.H.A., and R.R. Sokal. 1973. Numerical taxonomy: the principles and practice of numerical classification. W.H. Freeman, San Francisco, CA; 573 pp.

Stone, R.B., H.L. Pratt, R.O. Parker, Jr., and G.E. Davis. 1979. A comparison of fish populations on an artificial and natural reef in the Florida Keys. Mar. Fish. Ref. 41(9):1-11.

Toews, D.A.A., and M.J. Brownlee. A handbook for fish habitat protection on forest lands in British Columbia. DFO, Land Use Unit, Habitat Protection Division. Vancouver; 101 pp.

Turner, C.H., E.E. Ebert, and R.R. Given. 1969. Mana-made reef ecology. Calif. Dept. Fish Game, Fish Bull. 146. 221 pp.

West, J.E., R.M. Buckley, and D.C. Doty. 1994. Ecology and habitat use of juvenile rockfishes (Sebastes spp.) associated with artificial reefs in Puget Sound, Washington. Bull. Mar. Sci. 55:344-350.

Williams, G.L. 1990 revision. Coastal/estuarine fish habitat description and assessment manual. Part II, habitat description procedures. Prepared by G.L. Williams & Associates for DFO. Vancouver.

Williamson, C.J., C.D. Levings, J.S. Macdonald, and T. Pendray. 1999 (Review Draft). A preliminary assessment of the biological effect of wood debris accumulation at log dumps on the north coast of British Columbia. Can. Tech. Rep. Fish. Aquat. Sci. (in press).

Zedler, J.B. 1998. Replacing endangered species habitat: the acid test of wetland ecology. Chapter 15 *in*: P.L. Fiedler and P.M. Kareiva (eds). Conservation biology for the coming age. Chapman and Hall, New York; pp. 364-379.

7.3 Personal Communications

Hill, H. Burney. 2000. Aquatic Environment Scientist, NPDES Permits Unit, USEPA, Alaska. via E-mail.

McCauley, J. 2000. Oregon Forest Industries Council. via E-mail.

Sturdevant, D. 2000. Log Transfer Facility Program, Alaska Department of Environmental Conservation.

Appendices

Appendix 1: No-Net-Loss Evaluation Summary forms

Appendix 2: No-Net-Loss Field Audit Vegetation Plot Survey form (Brand Creek)

Appendix 3: Environment Canada Guidelines for Log Storage and Handling

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Appendix 1:
No-Net-Loss Evaluation Summary Forms

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	Fog Creek	HEB REGION:	North	DFO FILE NO:	7824-50
PROPONENT:	Interfor			CATEGORY (mit/comp):	mitigation
SITE NO:	N01	FILE REVIEW DATE:	99-09-08	SITE AUDIT DATE:	99-12-16
DESCRIPTION:	log dumpsite, truck turnaround, shop, fuel storage			STATUS:	SUP S21522
LOCATION:	King Island, shore of Dean Channel, E of Fog Creek mouth			UTM REF:	09.602954.5797013
IMPACTS:	MELP review indicates minimal impact expected on fish, wildlife and habitat, provided mitigation measures are followed.				
DFO MIT/COMP REQUESTS:	"All site construction should be done to ensure that sedimentation from roads and shop areas does not enter tidal waters. As much timbered buffer as possible should be left along the foreshore area, and no additional material is to be placed in the intertidal area from what was previously authorized in the foreshore lease. Fuel storage facilities must comply with the National Fire Code of Canada to ensure proper containment facilities exist." David Flegel, Habitat Technologist				
CONSTRUCTED MIT/COMP FEATURES:	MELP requested riparian management areas be established as per Forest Practices Code, and that any fuel storage comply with MELP standards; No documentation on file as to what mitigation measures were implemented.				
MONITORING HISTORY:	No documentation on file.				

IMPACT YR:	c. 1996	CONSTRUCTION YR:	c. 1996	LAST INSPECTED:	unknown

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)	RIPARIAN (linear m)
LOST:	~350			
GAINED:	0			
NET:	-350			

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R9 4-15

CHARACTERISTIC PLANT SPECIES:	algae had colonized the rock fill face; riparian buffer dominated by western hemlock and western redcedar
ON-SITE FAUNAL OBSERVATIONS:	Barnacles had colonized the rock fill face
CONTACT PERSONS:	(Owner) Bruce Brekke, Area Engineer (DFO) Brad Koroluk, Bella Coola
DOCUMENTATION:	SUP Application 95-09-25; MOF acknowledgement letter 95-10-03; DFO letter 95-10-06; MELP letter 96-04-03 (mitigation requests)
RATIONALE FOR AUDIT LEVEL:	Site did not appear to have been inspected since constructed accessible via float plane

ADDITIONAL COMMENTS & RECOMMENDATIONS: No file information as to whether DFO undertook site inspection during construction or operations; Fog Creek not found in FISS database; dumpsite inactive when visited; Habitat loss was temporal & colonization of rock fill face has occurred over time

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WAS NNL ACHIEVED?	**No**	**IS REMEDIAL ACTION REQUIRED?**	**No**

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	Frenchman Creek	HEB REGION:	North	DFO FILE NO:	7830-50-6
PROPONENT:	Interfor (Fletcher Challenge site)			CATEGORY (mit/comp):	mitigation
SITE NO:	N02	FILE REVIEW DATE:	99-09-08	SITE AUDIT DATE:	99-12-16
DESCRIPTION:	log dump; dryland sort yard; mechanical maintenance shop			STATUS:	SUP S19149
LOCATION:	E of Frenchman Creek mouth, along Dean Channel			UTM REF:	09.598748.5798118

IMPACTS:	potential to adversely impact on estuary foreshore near creek mouth; area known to be a major holding area for adult and juvenile salmon. FISS database for Frenchman Creek includes chum, coho & pink salmon, cutthroat & steelhead trout; Dolly Varden
DFO MIT/COMP REQUESTS:	DFO (D. Flegel) requested formal recognition in the 1992 SUP of a 30 m buffer extending from where the western edge of the lot meets the creek, south to the mouth, and eastward along the beach to a point immediately north of the rock. Requests pertaining to 1996 amendment included application of Forest Practices Code riparian buffer provisions, oil and fuel storage according to fire code, and clear spill containment and cleanup procedures.
CONSTRUCTED MIT/COMP FEATURES:	a riparian buffer had been retained between the facilities and Frenchman Creek.
MONITORING HISTORY:	D. Flegel inspected site pursuant to 1992 application. No other documentation on file.

IMPACT YR:	c. 1996	CONSTRUCTION YR:	c. 1996	LAST INSPECTED:	unknown

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)	RIPARIAN (linear m)
LOST:	0			
GAINED:	0			
NET:	0			

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R4 24-25; R5 1-16

CHARACTERISTIC PLANT SPECIES:	*Fucus* had colonized the barge ramp and log dump skids; riparian buffer dominated by western hemlock, western redcedar, red alder
ON-SITE FAUNAL OBSERVATIONS:	barnacles had colonized the barge ramp and log dump skids; mussels had colonized crib logs at the bottom of the log dump ramp.
CONTACT PERSONS:	(Owner) R.L. Lenci, Divisional Engineer (DFO) Brad Koroluk, Bella Coola
DOCUMENTATION:	Bella Coola Grizzly Holdings Ltd. 1995. Frenchman Creek Development Area, marine habitat survey. Prepared for Interfor, Mid-Coast District. Bella Coola SUP Application 1992-06-08; MOF acknowledgement letter 1992-06-16; DFO letter 1992-07-08 (mitigation requests); SUP Amendment Application 1995-12-07; 1996-02-08 letter from MPF to DFO; DFO letter 1996-02-26 (mitigaiton requests)
RATIONALE FOR AUDIT LEVEL:	Site did not appear to have been inspected since constructed accessible via float plane

ADDITIONAL COMMENTS & RECOMMENDATIONS: 1990 SUP application by Fletcher Challenge for a log dump and shop site west of the Frenchman Creek mouth was withdrawn. New 1992 application by Interfor. Amendment requested 1995 to reduce size of SUP and add a site for a first aid trailer and temporary shop. A very small amount of intertidal fill may have been placed, but the amount was negligible (<50 m^2)

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WAS NNL ACHIEVED?	Yes	IS REMEDIAL ACTION REQUIRED?	No

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	Cousins Inlet	HEB REGION:	North	DFO FILE NO:	INTCSN98
PROPONENT:	Interfor			CATEGORY (mit/comp):	mitigation
SITE NO:	N05	FILE REVIEW DATE:	99-09-10	SITE AUDIT DATE:	99-12-16
DESCRIPTION:	log dump, storage and booming ground			STATUS:	approved
LOCATION:	Dean Channel, Central Coast			UTM REF:	NA
IMPACTS:	Potential for impact on adjacent fish-bearing stream, particularly from proposed road alignment				
DFO MIT/COMP REQUESTS:	slope surface of dryland sort away from water's edge to confine drainage to ditches containing sediment traps; place final slope of fill at an angle that will provide equivalent surface area to footprint; use only clean rock; limit any overblast entering the water; no water-based or intertidal activities during March/April herring spawning period; conduct intertidal work at low tide; ensure logs do not contact bottom during dumping operations; locate facilities ≥125 m from harvestable shellfish populations				
CONSTRUCTED MIT/COMP FEATURES:	no documentation on file; a riparian buffer had been retained between the facilities and the stream				
MONITORING HISTORY:	No documentation on file.				

IMPACT YR:	1999	CONSTRUCTION YR:	1999	LAST INSPECTED:	unknown

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	INTERTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)
LOST:		~100		
GAINED:		0		
NET:		-100		

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R9 18-23

CHARACTERISTIC PLANT SPECIES:	not recorded; few plants had colonized the rock fill, as insufficient time had elapsed since construction.
ON-SITE FAUNAL OBSERVATIONS:	not recorded
CONTACT PERSONS:	(Interfor) Bruce Brekke, Logging Engineer (DFO) Brad Koroluk, Bella Coola
DOCUMENTATION:	Mid-Coast Aquatics. 1998. Marine foreshore habitat assessment and classification, Cousings Inlet log dump & log storage. Prepared for Interfor; Bella Coola
RATIONALE FOR AUDIT LEVEL:	Site did not appear to have been inspected since constructed; accessible via float plane

ADDITIONAL COMMENTS & RECOMMENDATIONS:

Approximately 150 m up the road from the dumpsite a utility line crossed the stream and ~50 m to 75 m of riparian forest had been cleared for the right-of-way (unrelated to logging activities);
boomsticks appeared to delineate a booming area in sufficiently deep water.

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WAS NNL ACHIEVED?	**Yes**	**IS REMEDIAL ACTION REQUIRED?**	**No**

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	E. Gribbell I.	HEB REGION:	North	DFO FILE NO:	NA
PROPONENT:	West Fraser Mills, Skeena Sawmills Div.			CATEGORY (mit/comp):	mitigation
SITE NO:	N12	FILE REVIEW DATE:	99-12-06	SITE AUDIT DATE:	2000-03-14
DESCRIPTION:	log dumpsite, storage area, float camp			STATUS:	active
LOCATION:	eastern coast of Gribbell Island, along Ursula Channel			UTM REF:	09.504899.5911101
IMPACTS:	fill to be placed on intertidal and subtidal shoreline habitat.				
DFO MIT/COMP REQUESTS:	Mitigate habitat loss of 80 m^2 by partial or complete "debuilding" following operations; build outer surface of fill from large, clean shot rock to maximise available surface area.				
CONSTRUCTED MIT/COMP FEATURES:	No documentation on file as to what mitigation measures were implemented.				
MONITORING HISTORY:	No documentation on file.				

IMPACT YR:	1997	CONSTRUCTION YR:	1997	LAST INSPECTED:	unknown

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	INTERTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)
LOST:		~80		
GAINED:		0		
NET:		-80		

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R2 18-28

CHARACTERISTIC PLANT SPECIES:	algae (e.g., *Fucus distichus*) had colonized the rock fill face; adjacent forest dominated by western hemlock and western redcedar
ON-SITE FAUNAL OBSERVATIONS:	Barnacles had colonized the rock fill face
CONTACT PERSONS:	Shawn Kenmuir, Skeena Sawmills (DFO) Chris Picard, Prince Rupert
DOCUMENTATION:	Burger, L. and P. Thuringer. 1995. Marine habitat impact assessment of a proposed barge moorage, log dumping and booming facility: East Gribbell, Ursula Channel, B.C. Prepared by Archipelago Marine Research Ltd., Victoria, BC Land Referral 6406274; DFO Letter of Advice 1997-04-22
RATIONALE FOR AUDIT LEVEL:	Site did not appear to have been inspected since constructed accessible via float plane

ADDITIONAL COMMENTS & RECOMMENDATIONS:

No file information as to whether DFO undertook site inspection during construction or operations; dumpsite active when visited; actual habitat loss appeared to be ~180 m^2; habitat loss was temporal & colonization of rock fill face has occurred over time

Auditor Initials
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WAS NNL ACHIEVED?	**No**	**IS REMEDIAL ACTION REQUIRED?**	**No**

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	Goat Harbour	HEB REGION:	North	DFO FILE NO:	NA
PROPONENT:	BC Ministry of Forests			CATEGORY (mit/comp):	mitigation
SITE NO:	N13	FILE REVIEW DATE:	99-12-06	SITE AUDIT DATE:	2000-03-14
DESCRIPTION:	log dumpsite			STATUS:	active
LOCATION:	off Ursula Channel			UTM REF:	09.509566.5912821
IMPACTS:	fill to be placed on intertidal and subtidal shoreline habitat.				
DFO MIT/COMP REQUESTS:	route hillside runoff through perimeter ditches; us clean shot rock; remove skids at close of operations; logs not to ground during any phase of operations				
CONSTRUCTED MIT/COMP FEATURES:	No documentation on file as to what mitigation measures were implemented; poor site drainage indicated that runoff had not been adequately directed through ditches; logs dumped from too great a height				
MONITORING HISTORY:	No documentation on file.				

IMPACT YR:	1994	CONSTRUCTION YR:	1994	LAST INSPECTED:	unknown

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	INTERTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)
LOST:		~200		
GAINED:		0		
NET:		-200		

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R2 29-37; R3 1-11

CHARACTERISTIC PLANT SPECIES:	algae (e.g., *Fucus distichus*) had colonized the rock fill face; adjacent forest dominated by western hemlock and western redcedar
ON-SITE FAUNAL OBSERVATIONS:	Barnacles had colonized the rock fill face
CONTACT PERSONS:	Don Bouzane, BC MOF (DFO) Chris Picard, Prince Rupert
DOCUMENTATION:	White, E.R. 1993. Goat harbour foreshore assessment. Prepared for Coast Forest Management Ltd., Prince Rupert. Nelson, BC; Land Referral 64056526; Letter of Advice 1994-07-06
RATIONALE FOR AUDIT LEVEL:	Site did not appear to have been inspected since constructed accessible via float plane

ADDITIONAL COMMENTS & RECOMMENDATIONS:

No file information as to whether DFO undertook site inspection during construction or operations; dumpsite active when visited; habitat loss was temporal & colonization of rock fill face has occurred over time; logs were being dumped from an excessive (and unacceptable) height

Auditor Initials
JN

WAS NNL ACHIEVED?	No	IS REMEDIAL ACTION REQUIRED?	Yes

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	Trip Creek	HEB REGION:	North	DFO FILE NO:	NA
PROPONENT:	West Fraser Mills, Skeena Sawmills Div.			CATEGORY (mit/comp):	mitigation
SITE NO:	N14	FILE REVIEW DATE:	99-12-07	SITE AUDIT DATE:	2000-03-14
DESCRIPTION:	log dumpsite; log booming; barge moorage			STATUS:	inactive
LOCATION:	Triumph Bay, BC mainland			UTM REF:	09.519953.5923797
IMPACTS:	fill to be placed on intertidal and subtidal *Fucus* habitat				
DFO MIT/COMP REQUESTS:	Mitigate habitat loss of ~200 m^2 by partial or complete "debuilding" following operations; fill to consist of large pieces of clean shot rock.				
CONSTRUCTED MIT/COMP FEATURES:	No documentation on file as to what mitigation measures were implemented; as built shoreline footprint appeared to be smaller (~125 m^2); large boulders (0.5 to 1.5 m diameter) used as fill.				
MONITORING HISTORY:	No documentation on file.				

IMPACT YR:	c. 1997	CONSTRUCTION YR:	c. 1997	LAST INSPECTED:	unknown

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	INTERTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)
LOST:		~125		
GAINED:		0		
NET:		-125		

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R3 12-35

CHARACTERISTIC PLANT SPECIES:	algae (e.g., *Fucus distichus*) had colonized the rock fill face; adjacent forest dominated by western hemlock and western redcedar
ON-SITE FAUNAL OBSERVATIONS:	barnacles and mussels had colonized the rock fill face; otter scat observed
CONTACT PERSONS:	Shawn Kenmuir, Skeena Sawmills (DFO) Chris Picard, Prince Rupert
DOCUMENTATION:	Archipelago Marine Research Ltd. undated. A marine habitat impact assessment of a proposed barge moorage, log dumping and booming facility: Trip Creek, Triumph Bay, BC. Prepared for Skeena Sawmills; Land Referral 6405844; Letter of Advice 1996-10-02
RATIONALE FOR AUDIT LEVEL:	Site did not appear to have been inspected since constructed accessible via float plane

ADDITIONAL COMMENTS & RECOMMENDATIONS:

No file information as to whether DFO undertook site inspection during construction or operations; dumpsite inactive when visited; habitat loss was temporal & colonization of rock fill face has occurred over time; excessive erosion occurring on running surface

Auditor Initials
JN

WAS NNL ACHIEVED?	**No**	**IS REMEDIAL ACTION REQUIRED?**	**Yes**

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	Verney Passage	HEB REGION:	North	DFO FILE NO:	NA
PROPONENT:	BC MOF			CATEGORY (mit/comp):	mitigation
SITE NO:	N15	FILE REVIEW DATE:	99-12-07	SITE AUDIT DATE:	2000-03-14
DESCRIPTION:	log dumpsite; log booming; barge moorage			STATUS:	deactivated
LOCATION:	South shore of Verney Passage, BC mainland			UTM REF:	09.509933.5932533
IMPACTS:	fill to be placed on intertidal and subtidal *Fucus*-barnacle-mussel habitat				
DFO MIT/COMP REQUESTS:	Mitigate habitat loss of ~20 m^2 by using large pieces of clean riprap; water logs at depths >4 m; use metal skids; avoid kelp beds; place fill at low tide; appropriate drainage; clean up wood debris regularly; sanitary precautions at float camp; proper fuel storage and handling.				
CONSTRUCTED MIT/COMP FEATURES:	No documentation on file as to what mitigation measures were implemented; minimal fill had been used (<25 m^2)				
MONITORING HISTORY:	No documentation on file.				

IMPACT YR:	1998	CONSTRUCTION YR:	1998	LAST INSPECTED:	unknown

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	INTERTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)
LOST:		~20		
GAINED:		0		
NET:		-20		

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R1 1-37

CHARACTERISTIC PLANT SPECIES:	algae (e.g., *Fucus distichus*) had colonized the rock fill face; adjacent forest dominated by western hemlock and western redcedar
ON-SITE FAUNAL OBSERVATIONS:	barnacles had colonized the rock fill face; sea stars and sun stars on rocks in subtidal zone
CONTACT PERSONS:	no MOF contact name on file (DFO) Chris Picard, Prince Rupert
DOCUMENTATION:	Thuringer, P. 1996. Marine habitat assessment for a porposed log dumping and storage facility in Verney Passage, B.C. Prepared by Archipelago Marine Research Ltd. for MOF Small Business Forest Enterprise Program; Land Referral 6406351; Letter of Advice 1997-11-11
RATIONALE FOR AUDIT LEVEL:	Site did not appear to have been inspected since constructed accessible via float plane

ADDITIONAL COMMENTS & RECOMMENDATIONS:

No file information as to whether DFO undertook site inspection during construction or operations; dumpsite had been deactivated; habitat loss on minimal footprint was temporal & colonization of rock fill face has occurred over time

Auditor Initials: JN

WAS NNL ACHIEVED?	**No**	**IS REMEDIAL ACTION REQUIRED?**	**No**

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	Verney Pass Creek	HEB REGION:	North	DFO FILE NO:	NA
PROPONENT:	BC MOF			CATEGORY (mit/comp):	mitigation
SITE NO:	N16	FILE REVIEW DATE:	99-12-08	SITE AUDIT DATE:	2000-03-14
DESCRIPTION:	log dumpsite and storage area			STATUS:	inactive
LOCATION:	Hawkesbury Island, west of Danube Bay			UTM REF:	09.500462.5935591
IMPACTS:	fill to be placed on intertidal and subtidal *Fucus* habitat				
DFO MIT/COMP REQUESTS:	Mitigate habitat loss of ~50 m^2 by using clean riprap; logs not to ground during operations; no log booming and storage within 100 m of low tide mark of any estuary; proper fuel storage and handling.				
CONSTRUCTED MIT/COMP FEATURES:	No documentation on file as to what mitigation measures were implemented; approximately twice as much fill was used as authorized (~90 m^2)				
MONITORING HISTORY:	Inspection by DFO during construction; no records of further monitoring				

IMPACT YR:	1994	CONSTRUCTION YR:	1994	LAST INSPECTED:	1994-09-28

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	INTERTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)
LOST:		~90		
GAINED:		0		
NET:		-90		

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R2 1-17

CHARACTERISTIC PLANT SPECIES:	algae (e.g., *Fucus distichus*) had colonized bedrock and intertidal fill; adjacent forest dominated by western hemlock and western redcedar
ON-SITE FAUNAL OBSERVATIONS:	barnacles had colonized bedrock and intertidal fill
CONTACT PERSONS:	Don Bouzane, MOF (DFO) Chris Picard, Prince Rupert
DOCUMENTATION:	White, E.R. 1993a. Verney Passage Creek foreshore assessment. Prepared for Coast Forest Management Ltd., Prince Rupert, BC; Land Referral 6405651; Letter of Advice and HADD Authorization 1994-05-04
RATIONALE FOR AUDIT LEVEL:	Site did not appear to have been inspected since constructed accessible via float plane

ADDITIONAL COMMENTS & RECOMMENDATIONS:

No file information as to whether DFO inspected the site during operations; dumpsite was inactive; habitat loss on minimal footprint was temporal & colonization of rock fill face has occurred over time

Auditor Initials
JN

WAS NNL ACHIEVED?	No	IS REMEDIAL ACTION REQUIRED?	No

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	Menzies Bay	HEB REGION:	South	DFO FILE NO:	2859
PROPONENT:	MacMillan Bloedel Ltd. (now Weyerhauser)			CATEGORY (mit/comp):	compensation
SITE NO:	S05	FILE REVIEW DATE:	99-10-04	SITE AUDIT DATE:	99-12-01
DESCRIPTION:	dryland sort expansion			STATUS:	approved
LOCATION:	Vancouver Island, north of Campbell River			UTM REF:	NA
IMPACTS:	filling of 1,350 m^2 of relatively unproductive intertidal area, already covered by a layer of wood particles.				
DFO MIT/COMP REQUESTS:	creation of 1,000 m^2 to 1,350 m^2 of intertidal salmon rearing habitat by excavating upland forest, and making up any deficit area owing by opening access to a rearing pond from Trout Creek; construction to occur May 15 to September 15 and November 1 to February 15; construction equipment to be in good working condition; use of clean fill and riprap; installation of appropriate waste interceptors.				
CONSTRUCTED MIT/COMP FEATURES:	~1,237 m^2 of intertidal habitat was initially constructed by excavating forested upland; DFO requested the deficit be made up, and an additional 140 was added; there was no requirement to conduct work in Trout Creek.				
MONITORING HISTORY:	no documentation on file.				

IMPACT YR:	1994-1995	CONSTRUCTION YR:	1994-1995	LAST INSPECTED:	unknown

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	INTERTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)
LOST:		1,350		
GAINED:		1,377		
NET:		27		

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R6 17-25; R7 1-18

CHARACTERISTIC PLANT SPECIES:	adjacent forest of western hemlock, Douglas-fir, western redcedar, Sitka spruce, red alder; emergent aquatics (sedges, rushes, Alaska brome grass, lilaeopsis)
ON-SITE FAUNAL OBSERVATIONS:	benthic infaunal snails
CONTACT PERSONS:	(Weyerhauser) Ally Gibson (DFO) Rob Russell, Nanaimo
DOCUMENTATION:	Peter Bruce & Associates. 1994. Habitat compensation projects at Menzies Bay. Letter to MacMillan Bloedel, Menzies Bay Division Peter Bruce & Associates. 1994. Potential habitat enhancement project on Trout Creek. Letter to MacMillan Bloedel, Menzies Bay Division
RATIONALE FOR AUDIT LEVEL:	long intervening period since last monitored; easily accessible by road and foot.

ADDITIONAL COMMENTS & RECOMMENDATIONS: Artificial channel appeared to be functioning as intended; known to Weyerhauser staff as “The Duckpond”; hydroseeded bank vegetation was well established

Auditor Initials
JN

WAS NNL ACHIEVED?	**Yes**	**IS REMEDIAL ACTION REQUIRED?**	**No**

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	Brand Creek	HEB REGION:	South	DFO FILE NO:	4191-3
PROPONENT:	BC Ministry of Forests Small Business Program			CATEGORY (mit/comp):	compensation
SITE NO:	S11	FILE REVIEW DATE:	99-10-12	SITE AUDIT DATE:	99-12-02
DESCRIPTION:	log dump and access road			STATUS:	approved
LOCATION:	West Vancouver Island, Effingham Inlet			UTM REF:	10.340204.5440098
IMPACTS:	loss of intertidal saltmarsh to road building, and alienation of rocky intertidal and subtidal reef habitat to skidway and log dump.				
DFO MIT/COMP REQUESTS:	all machinery to be in good working condition; no potential pollutants to enter marine waters; log handling/storage to be confined to waters ≥10 m deep; log dump and sort to be sloped away from the foreshore; create 170 m^2 of new salt marsh to offset loss of 85 m^2 of salt marsh; replace 250 m^2 intertidal/ subtidal rock habitat with ≥250 m^2 rocky reef habitat				
CONSTRUCTED MIT/COMP FEATURES:	~260 m^2 compensatory marsh; ~2,450 m^2 rocky reef habitat to compensate for same amount of combined habitat lost at four log dumps and dryland sorts.				
MONITORING HISTORY:	Peter Bruce & Associates (1998a) rocky reef implementation monitoring report; Williams (1998a; 1999) assessments of compensatory marsh				

IMPACT YR:	1998	CONSTRUCTION YR:	1998	LAST INSPECTED:	1999

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	INTERTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)
LOST:	0	250		85
GAINED:	250			260
NET:	250	-250		175

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R7 16-25; R8 1-24

CHARACTERISTIC PLANT SPECIES:	tufted hairgrass, Lyngby's sedge, silverweed, Canadian sand-spurry, yarrow; adjacent riparian forest along Brand Creek dominated by western redcedar, Douglas-fir, western hemlock, salal
ON-SITE FAUNAL OBSERVATIONS:	oyster beds; swans; other waterfowl abundant offshore
CONTACT PERSONS:	(Ministry of Forests) Greg Cawston (DFO) Rob Russell, Nanaimo
DOCUMENTATION:	G.L. Williams & Associates Ltd. 1998. Brand Creek estuary intertidal habitat assessment & compensation prescription. Prepared for Ministry of Forests. Coquitlam. - 1998a. Brand Creek estuary saltmarsh compensation 1998 monitoring report. Prepared for MOF. - 1999. Brand Creek compensation marsh 1999 monitoring results. Prepared for MOF. - 1997. Underwater survey of shoreline below proposed log dump and access road at Brand Creek, Effingham Inlet. Letter to MOF. Peter Bruce & Associates. 1998. Proposed construction of a habitat compensation reef in Barclay Sound. Letter to MOF. -1998a. Underwater survey of a habitat compensation project, Sechart Channel. Prepared for MOF.
RATIONALE FOR AUDIT LEVEL:	Verification of monitoring report; accessible via float plane

ADDITIONAL COMMENTS & RECOMMENDATIONS: This site should be regularly monitored as a case study, demonstrating rate of regeneration, and applicability elsewhere.

Auditor Initials: JN

WAS NNL ACHIEVED?	Yes	IS REMEDIAL ACTION REQUIRED?	No

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	Menzies Bay Crane Dewatering	HEB REGION:	South	DFO FILE NO:	3130
PROPONENT:	Campbell River Fibre Ltd.			CATEGORY (mit/comp):	compensation
SITE NO:	S12	FILE REVIEW DATE:	99-10-11	SITE AUDIT DATE:	99-11-30
DESCRIPTION:	addition of crane de-watering site to existing facilities			STATUS:	approved
LOCATION:	Vancouver Island, Menzies Bay, near Campbell River			UTM REF:	10.330259.5553922
IMPACTS:	filling of ~330 m^2 of previously armoured intertidal area.				
DFO MIT/COMP REQUESTS:	compensate for ~3,000 ft^2 (323 m^2) of filled intertidal and subtidal marine foreshore by excavating an equivalent area of intertidal marine foreshore at the south end of the site; construction to occur May 15 to September 15 and November 1 to February 15; construction equipment to be in good working condition; use of clean fill and riprap; all fill excavated from the compensation site to be disposed of in an approved upland location.				
CONSTRUCTED MIT/COMP FEATURES:	~330 m^2 of foreshore covered by fill during construction was compensated by ~390 m^2 of new intertidal habitat created by pulling back the upper beach south of the de-watering site.				
MONITORING HISTORY:	As natural colonization of the new intertidal area was expected to be rapid, no detailed monitoring was deemed necessary; a consultant conducted implementation monitoring immediately following construction (1995).				

IMPACT YR:	1995	CONSTRUCTION YR:	1995	LAST INSPECTED:	1995

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	INTERTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)
LOST:		330		
GAINED:		0		
NET:		330		

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R2 1-13; R3 1-11

CHARACTERISTIC PLANT SPECIES:	western lilaeopsis, rockweed; created habitat nearly barren; adjacent foreshore densely vegetated with Alaska brome, meadow barley, and bulrushes
ON-SITE FAUNAL OBSERVATIONS:	waterfowl offshore
CONTACT PERSONS:	(Campbell River Fibre) Frances Lake (DFO) Rob Russell, Nanaimo
DOCUMENTATION:	Peter Bruce & Associates. 1995 (January). Proposed construction of crane de-watering site on foreshore. Letter to Campbell River Fibre. - 1995 (May). De-watering site at Menzies Bay. Letter to Campbell River Fibre.
RATIONALE FOR AUDIT LEVEL:	No monitoring had been documented; accessible by road

ADDITIONAL COMMENTS & RECOMMENDATIONS: Created intertidal habitat had colonized with much less vegetation than expected during four years; option of transplanting vegetation from nearby donor sites and adding rocks might be investigated; It is suggested that compensation agreements always include a monitoring plan and that it be fully implemented

Auditor Initials
JN

WAS NNL ACHIEVED?	**No**	**IS REMEDIAL ACTION REQUIRED?**	**Yes**

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	Knox Bay	HEB REGION:	South	DFO FILE NO:	1983
PROPONENT:	TimberWest Forest Limited			CATEGORY (mit/comp):	compensation
SITE NO:	S13	FILE REVIEW DATE:	99-10-22	SITE AUDIT DATE:	99-11-30
DESCRIPTION:	dryland sort and subsequent expansion			STATUS:	approved
LOCATION:	West Thurlow Island			UTM REF:	NA
IMPACTS:	encroachment on eelgrass bed and intertidal cobble beach area.				
DFO MIT/COMP REQUESTS:	compensate for loss of eelgrass habitat by 2:1 areal replacement; compensate for net loss by filling of ~250 m^2 of intertidal cobble beach with ~70 m^2 of fill rock face and ~192 m^2 shot rock spurs extending into the intertidal zone; construction to occur June 18, 1996 to February 15, 1997; construction equipment to be in good working condition; minimal disturbance of adjacent natural beach; no deposit of wood waste or other contaminants on foreshore; deployment of brow logs and fuel and oil catchment devices as required.				
CONSTRUCTED MIT/COMP FEATURES:	in 1994, ~30 m^2 lost eelgrass bed replaced with ~40 m^2 eelgrass transplanted onto excavated bench (only a 1.33:1 ratio); in 1997, 12 rock spurs constructed that totalled ~192 m^2				
MONITORING HISTORY:	Agreement called for two years' monitoring; no records on file				

IMPACT YR:	1994 & 1997	CONSTRUCTION YR:	1995; 1996-1997	LAST INSPECTED:	unknown

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	INTERTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)
LOST:		250		(eelgrass) 30
GAINED:		0		40
NET:		-250		10

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R3 12-25; R4 1-2; R5 1-16

CHARACTERISTIC PLANT SPECIES:	*Fucus*
ON-SITE FAUNAL OBSERVATIONS:	limpets (*Lottia pelta*)
CONTACT PERSONS:	(TimberWest) Steve Voller, F&W tech. (DFO) Rob Russell, Nanaimo
DOCUMENTATION:	Voller, S.N. 1995. Eelgrass transplant at Knox Bay, West Thurlow Island. Letter from TimberWest to DFO, November 27. Voller, S.N. 1996. Knox Bay dray land sort expansion proposal. Letter from TimberWest to DFO, June 4.
RATIONALE FOR AUDIT LEVEL:	No reports of monitoring or follow-up; assessible by float plane

ADDITIONAL COMMENTS & RECOMMENDATIONS: Though the rock finger compensatory habitat appeared to have been implemeneted as designed, siting appeared to have been inappropriate and no record exists of maintenance or monitoring programs. It is suggested that such programs be implemented.

Auditor Initials
JN

WAS NNL ACHIEVED?	No	IS REMEDIAL ACTION REQUIRED?	Yes

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	Rosewall Dryland Sort	HEB REGION:	South	DFO FILE NO:	3500
PROPONENT:	BCF Shake Mill Ltd.			CATEGORY (mit/comp):	compensation
SITE NO:	S15	FILE REVIEW DATE:	99-10-22	SITE AUDIT DATE:	1999-12-02
DESCRIPTION:	modification of existing dryland sortyard			STATUS:	complete
LOCATION:	Mud Bay, near Campbell River			UTM REF:	10.370058.540508
IMPACTS:	pre-existing fill placed on 2,754 m^2 of intertidal mudflat.				
DFO MIT/COMP REQUESTS:	compensate for loss of 2,754 m^2 of intertidal mudflat by removing 485 m^2 of existing fill; creating 642 m^2 of intertidal wetland adjacent to a settling pond to be built on the SW part of the property; and removing all woodwaste from at least 4,895 m^2 of formerly leased mudflat and returning it to the Crown; construction limited to July 1 to August 31 and December 1 to February 15; construction equipment to be in good working order; no fuels, lubricants, construction wastes to enter marine environment; dredgeate and woodwaste to be disposed of at an approved upland location; side slopes of new dryland sort to be armoured with rock riprap; surface to be sloped and drained so as to deposit water/sort wastes into a settling basin; fuel handling and equipment maintenance to conform to industry standards; portion of intertidal foreshore returned to the Crown as fish habitat to be isolated from industrial activity.				
CONSTRUCTED MIT/COMP FEATURES:	as above.				
MONITORING HISTORY:	DFO Habitat Biologist inspected the site several times during and since construction.				

IMPACT YR:	1994 and 1997	CONSTRUCTION YR:	1995; 1996-1997	LAST INSPECTED:	August 1999

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	INTERTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)
LOST:			2,754	
GAINED:			5,380	642
NET:			2,626	642

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R6 20-25; R7 1-15

CHARACTERISTIC PLANT SPECIES:	adjacent woodland dominated by Douglas-fir, western redcedar; red alder; mudflat colonizing with widgeon grass, brome grass, sedges; cattails adjacent
ON-SITE FAUNAL OBSERVATIONS:	none observed
CONTACT PERSONS:	(BCF Shake) Jim Lennox (DFO) Rob Russell, Nanaimo
DOCUMENTATION:	no habitat assessment reports on file.
RATIONALE FOR AUDIT LEVEL:	assess whether this compensatory technique is applicable elsewhere; accessible by road

ADDITIONAL COMMENTS & RECOMMENDATIONS:

Mudflat creation and waste removal have combined to restore a significant net gain of habitat.

Auditor Initials: JN

WAS NNL ACHIEVED?	**Yes**	**IS REMEDIAL ACTION REQUIRED?**	**No**

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NO-NET-LOSS EVALUATION SUMMARY

SITE NAME:	Michelsen Point	HEB REGION:	South	DFO FILE NO:	HRTS 98-000408
PROPONENT:	Western Forest Products Limited			CATEGORY (mit/comp):	compensation
SITE NO:	S18	FILE REVIEW DATE:	99-10-20	SITE AUDIT DATE:	99-11-29
DESCRIPTION:	log dump and booming and storage facilities			STATUS:	approved
LOCATION:	Holberg Inlet, northwestern end of Vancouver Island			UTM REF:	09.592654.5604114
IMPACTS:	placement of ~740 m^2 fill and rock armour over intertidal foreshore.				
DFO MIT/COMP REQUESTS:	create new intertidal marine foreshore habitat by excavating openings in 2 tidal channels (Ch. A, 640 m^2 & Ch. B, 800 m^2); construction window to be 1996-10-23, to 1997-02-15; fill to be free of contaminants, rock armour clean; machinery to be in good working order; no fuels, lubricants, construction wastes to enter marine waters; log handling/storage to be directed away from foreshore and occur in water ≥10 m deep; facilities to be sloped away from the foreshore; debris, sediment, potential petroleum pollutants to be collected and disposed of at an approved location off-site; brow logs or other devices to be installed to prevent encroachment of wood waste.				
CONSTRUCTED MIT/COMP FEATURES:	A large amount of wood debris was cleared from the mouth of Lewis Creek; large pieces of wood were left to provide fish cover; Channel A exhibited underground flow to the estuary and debris was cleared with a backhoe; no attempt was made to reopen Channel B, as conifers had begun regenerating in the former streambed				
MONITORING HISTORY:	1997-10-22 visit by DFO Habitat Biologist and consultant; heavy precipitation since construction had caused substantially increased size of Channel A; Lewis Creek had been successfully opened; further monitoring was recommended.				

IMPACT YR:	1996-1997	CONSTRUCTION YR:	1996-1997	LAST INSPECTED:	1997(?)

HABITAT BALANCE TABLE

HABITAT:	SUBTIDAL (m^2)	INTERTIDAL (m^2)	MUD/SANDFLAT (m^2)	MARSH (m^2)
LOST:		740		
GAINED:		more than 640		
NET:		0 to -100		

MAP/CHART REF:	not used	AIR PHOTOS:	not used	PHOTOGRAPHS:	R1 1-25

CHARACTERISTIC PLANT SPECIES:	adjecent forest dominated by Douglas-fir, western redcedar, western hemlock, Sitka spruce, red alder; intertidal marsh dominated by tufted hairgrass, Alaska plantain, meadow barley
ON-SITE FAUNAL OBSERVATIONS:	bear scat and salmon operculum in creek riparian area; blue mussels and clams in intertidal/subtidal area
CONTACT PERSONS:	(Western Forest Products) Ken Seabloom (DFO) Rob Russell, Nanaimo
DOCUMENTATION:	Lacasse, S. 1995. Michelson Point Log Dump and Containment Area Survey. Prepared for WFP. Broekhuizen, L. 1997. Memo re site inspection with DFO, MELP, WFP, and MOF representatives. Prepared for WFP by FishFor Contracting Ltd., Port McNeill, BC. Hannah, C. 1997. Memo re implementation of Lewis Creek enhancement. Prepared for WFP by FishFor Contracting Ltd., Port McNeill, BC. Hannah, C. 1998. Memo re on-site review of work with DFO Habitat Biologist. Prepared for WFP by FishFor Contracting Ltd., Port McNeill, BC.
RATIONALE FOR AUDIT LEVEL:	Assess whether habitat compensation strategy is applicable elsewhere; accessible by road

ADDITIONAL COMMENTS & RECOMMENDATIONS: Habitat balance sheet does not include the benefits of clearing the mouth of the Lewis Creek mainstem of wood debris, as the total area cleared was not available; this was a creative application of habitat compensation and appeared to have achieved its goals.

Auditor Initials: JN

WAS NNL ACHIEVED?	**Yes**	**IS REMEDIAL ACTION REQUIRED?**	**No**

Appendix 2:
No-Net-Loss Field Audit Vegetation Plot Survey Form (Brand Creek)

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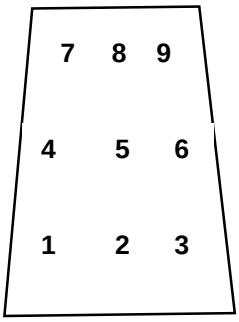
NO-NET-LOSS FIELD AUDIT
VEGETATION PLOT SURVEY

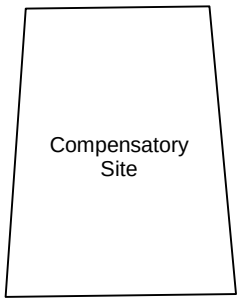
SITE NAME:	Brand Creek, Effingham Inlet			**SITE AUDIT DATE (YY-MM-DD):**	99-12-02	**SURVEYOR INITIALS:**	JN
SITE NO:	S11	**PLOT SIZE:**	1 m^2	**LOCATION OF REFERENCE SITE:**	adjacent shore		

PLANT SPECIES	NUMBER OF STEMS PER PLOT											
	COMPENSATORY SITE									REFERENCE		
	1	2	3	4	5	6	7	8	9	1	2	3
Deschampsia cespitosa spp. *beringensis* (transplanted)	1	3	2	1	1	4	1	2	2	36	22	26
Deschampsia cespitosa spp. *beringensis* (regenerating)	-	33	-	10	14	23	11	9	7	-	-	-
Achillea millefolium	1	5	-	2	-	-	-	-	-	-	-	-
Potentilla anserina spp. *pacifica*	-	-	-	3	1	3	2	-	1	8	-	3
Carex lyngbyei	42	14	1	1	2	-	1	2	2	-	-	-
Stellaria humifusa	7	-	-	-	-	1	-	-	-	-	-	-
Spergularia canadensis	7	6	1	4	1	1	1	-	-	-	-	-
Trifolium dubium	2	-	-	2	-	-	-	-	3	8	3	2
Plantago macrocarpa	-	-	-	-	-	1	-	-	2	many	many	-
Alnus rubra	-	-	-	-	-	-	2	-	-	-	-	-
Montia parvifolia	-	-	-	-	-	-	-	1	-	-	-	-
Glehnia littoralis spp. *leiocarpa*	-	-	2	-	-	1	-	2	-	-	-	-
Rhytidiadelphus loreus	-	-	-	-	-	-	-	-	clump	-	-	-
Ceratodon purpureus (% cover)	<1%	<1%	<1%	<1%	<1%	<1%	2%	2%	-	-	-	-
PERCENT COVER:	40	20	15	5	3	20	5	3	60	60	50	40
PLOT SUBSTRATE: (mud=1; rock/cobble=2; sand=3)	2	2	2	2	2	2	2	2	2	2	2	2

SKETCH OF COMPENSTORY HABITAT & PLOT LOCATIONS



SKETCH OF REFERENCE SITE & PLOT LOCATIONS



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Appendix 3:
Environment Canada Guidelines for Log Storage and Handling

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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 eggs/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 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 off-set.

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

(c) Logs should not be dumped or stored where grounding, 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 (DFO) should be consulted prior to removal of submerged wood debris.

With respect to helicopter log 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. 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, Lands and Parks; and
   - Emergency Standards for Industry -- A National Standard for Canada, Canadian Standards Association (CAN/CSA-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 1T5
   Telephone: (204) 945-4664; 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.