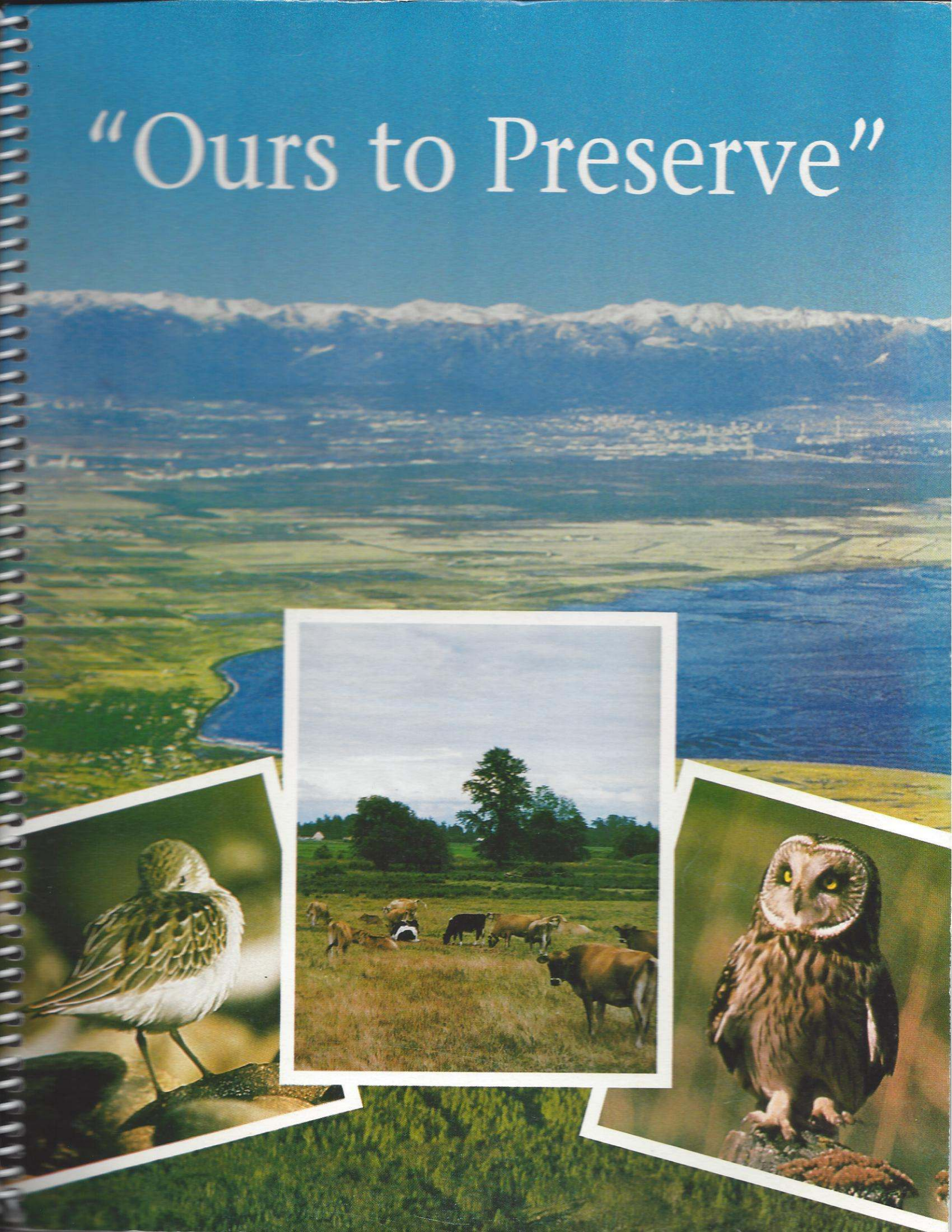
"Ours to Preserve"



"Ours to Preserve"

Boundary Bay Biosphere Reserve

BRITISH COLUMBIA, CANADA
WASHINGTON U.S.A.

(Incorporating Boundary Bay, Mud Bay,
Semiahmoo Bay, Burns Bog,
Roberts Bank, Point Roberts, and Drayton Harbour)

PREPARED BY THE
Boundary Bay Conservation Committee
August, 1992

Acknowledgements

This proposal was prepared by the Boundary Bay Conservation Committee and edited by Anne Murray and Dr Mary Taitt.

The following groups have contributed to and endorsed the proposal "OURS TO PRESERVE" - A BOUNDARY BAY BIOSPHERE RESERVE:

BOUNDARY BAY CONSERVATION COMMITTEE
BC FEDERATION OF NATURALISTS
BC GREAT BLUE HERON SOCIETY
BC WILDLIFE FEDERATION
BURNS BOG CONSERVATION SOCIETY
DELTA NATURALISTS
FRASER FOR LIFE
FRASER WETLAND HABITAT COMMITTEE
FRASER RIVER COALITION
FRIENDS OF BOUNDARY BAY
HERITAGE FOREST SOCIETY
INDEPENDENT DELTA ELECTORS ASSOCIATION
PEOPLE FOR PUGET SOUND
POINT ROBERTS HERON PRESERVATION COMMITTEE
SIERRA CLUB OF CANADA
SOCIETY PROMOTING ENVIRONMENTAL CONSERVATION
TSAWWASSEN HOMEOWNERS ASSOCIATION
TSAWWASSEN NATURE PARK SOCIETY
VANCOUVER NATURAL HISTORY SOCIETY
WESTERN CANADA WILDERNESS COMMITTEE
WESTERN CANADA WILDERNESS COMMITTEE: WHITE ROCK BRANCH
WHITE ROCK AND SURREY NATURALISTS

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Executive Summary

Boundary Bay, British Columbia, is a shallow marine bay, located near the mouth of the Fraser River, on the Pacific coast of Canada, close to the United States border. Boundary Bay and its adjacent uplands support a rich, globally significant, delta ecosystem. It is a migratory bird habitat unrivalled along the Pacific Coast between Alaska and California.

The area has a wide variety of aquatic, wetland and upland habitats: from salt to fresh water, salt marsh to domed bog, and fields and hedgerows to woodlands. These habitats are a vital link on the Pacific flyway for an estimated 1.5 million migratory shorebirds and waterfowl. The wetlands far exceed the Ramsar Convention criteria for a wetland of international importance. The largest density and diversity of wintering raptors in Canada roost and feed on the shores and fields of Boundary Bay. Burns Bog, located between the bay and the Fraser River, is the largest domed bog in the Pacific northwest. It is home to subarctic plant and insect species, as well as a variety of vertebrates. The Boundary Bay ecosystem warrants protection.

The original wetlands of the Fraser River delta supported aboriginal communities from 9000 years ago. In the late nineteenth century, European settlers dyked, drained and developed the delta for agriculture. The abundance of salmon and other fish gave rise to the British Columbia fishing industry. Agriculture and fishing continue to be among the foremost industries in the Fraser delta. The Fraser Valley farmland is recognised as the best in Canada, because of the temperate climate and fertile soils. Low-lying agricultural lands flood in winter and provide important habitat for migrating and wintering waterfowl, shorebirds and birds of prey. The farmland of the Boundary Bay ecosystem, therefore, fulfills a dual role as an agricultural resource and as wildlife habitat.

In recent years land use in the Fraser delta has changed dramatically.

The integrity of the Boundary Bay ecosystem is threatened by non-agricultural use of farmland, urban-sprawl, deterioration of water quality and loss of wetlands.

The integrity of the Boundary Bay ecosystem is threatened by non-agricultural use of farmland, urban-sprawl, deterioration of water quality and loss of wetlands.

There is constant pressure on land for industrial and airport expansion, ports, highways, golf courses and residential sub-divisions. Expectations of land use change within the Agricultural Land Reserve jeopardise the stability of the farming industry.

Increasing water pollution from agricultural and urban run-off, from marine traffic, and from landfills in Burns Bog, is a current and potential problem. Water pollution has an impact on life throughout the food-chain: from marine invertebrates to fish, waterfowl, seals and whales. Even human use of beaches for recreation may be curtailed as a result of pollution.

The destruction of agricultural land and development of the foreshore wetlands lead inevitably to loss of wildlife habitat. Much of the Fraser delta habitat has already been destroyed and only about 1% has been protected for wildlife use. Further destruction of habitat will result in the loss of some resident wildlife species and could also threaten populations of some migratory species that feed, rest, and roost at this vital stop-over.

Current studies on agriculture and wildlife are confirming the importance of protecting these resources. The Boundary Bay ecosystem has no overall protection despite qualifying under numerous conservation schemes. Immediate action is imperative to prevent the loss of this vital international site.

"Ours to Preserve" presents the biosphere reserve concept as a means of protecting the Boundary Bay ecosystem, while recognising that people and their activities are an integral part of the environment.

"Biosphere reserve" is a United Nations designation that is in use in 71 countries. It is a "multi-purpose protected area established to conserve species and natural communities, and to find ways to use environments without degrading them" (UNESCO 1987). There are only six in Canada and none in British Columbia.

Biosphere reserves work on the principles of co-ordination and co-operation.

Creation of the Boundary Bay biosphere reserve will provide a framework for achieving the following goals for the Boundary Bay ecosystem:

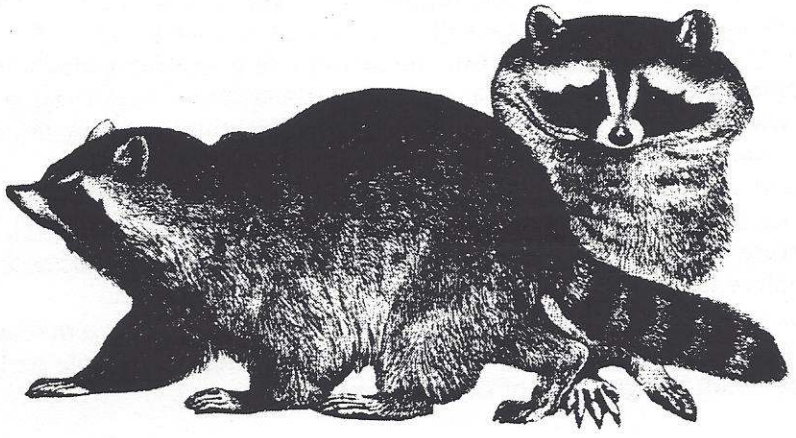
- Conservation of wildlife habitat
- Preservation of the farming industry
- Public education on the importance of living and working in the ecosystem
- Improved land use planning
- Research initiatives

Biosphere reserves work on the principles of co-ordination and co-operation. In the Boundary Bay ecosystem a biosphere reserve could provide:

- Co-ordination of all conservation plans, at all levels of government;
- Co-operation in ecosystem management by means of the biosphere reserve management committee, which includes representation of all interested parties;
- International recognition and interest in the ecosystem;
- A focus for the funding of conservation initiatives, such as farmland stewardship schemes;
- A focus for the creation of new, stronger legislation to protect wildlife habitat;
- A focus for public education and involvement in the environment;
- A forum for discussion and implementation of specific goals and objectives associated with the Boundary Bay ecosystem.

A biosphere reserve has CORE areas which receive maximum protection (eg. vital wetland habitats), BUFFER areas which are clearly delineated and managed to protect the core (eg. agricultural regions) and a ZONE OF COOPERATION which is a transition area that can be developed for business, recreation and industry that is in keeping with the core and buffer areas. In all three areas strong public participation in the goals of the biosphere reserve is encouraged.

Specific recommendations are given in the proposal for the implementation of the above objectives. Co-ordinated, co-operative action is needed immediately to save the Boundary Bay ecosystem.



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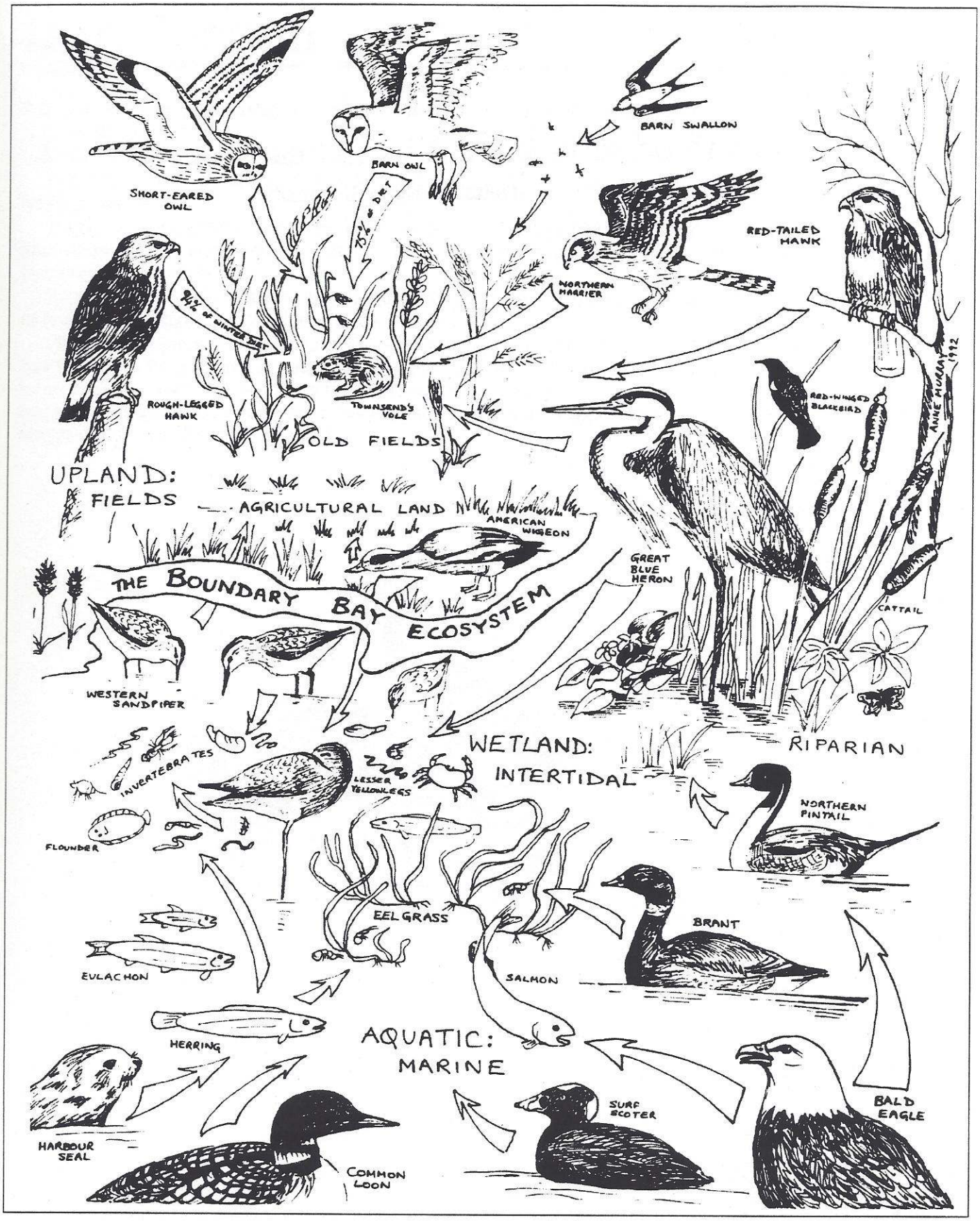

THE BOUNDARY BAY ECOSYSTEM
UPLAND:
FIELDS
AGRICULTURAL LAND
OLD FIELDS
SHORT-EARED OWL
BARN OWL
BARN SWALLOW
75% of DIET
24% of WINTER DIET
NORTHERN HARRIER
RED-TAILED HAWK
ROUGH-LEGGED HAWK
TOWNSEND'S VOLE
RED-WINGED BLACKBIRD
ANNE MURRAY 1992
AMERICAN WIGEON
GREAT BLUE HERON
CATTAIL
WESTERN SANDPIPER
WETLAND:
INTERTIDAL
RIPARIAN
INVERTEBRATES
LESSER YELLOWLEGS
NORTHERN PINTAIL
FLOUNDER
EELGRASS
BRANT
EULACHON
SALMON
HERRING
AQUATIC:
MARINE
HARBOUR SEAL
SURF SCOTER
BALD EAGLE
COMMON LOON

"Ours to preserve by hand and heart"

-Delta Municipality motto

Introduction

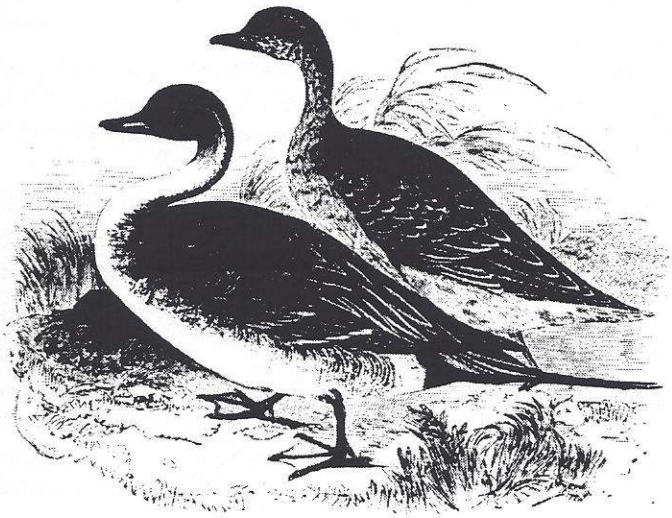
This proposal presents an overview of the land use issues pertaining to the Boundary Bay ecosystem in British Columbia, Canada, with the intention of formulating a framework for ecosystem protection.

It outlines the importance of Boundary Bay for its wildlife, agricultural and heritage values.

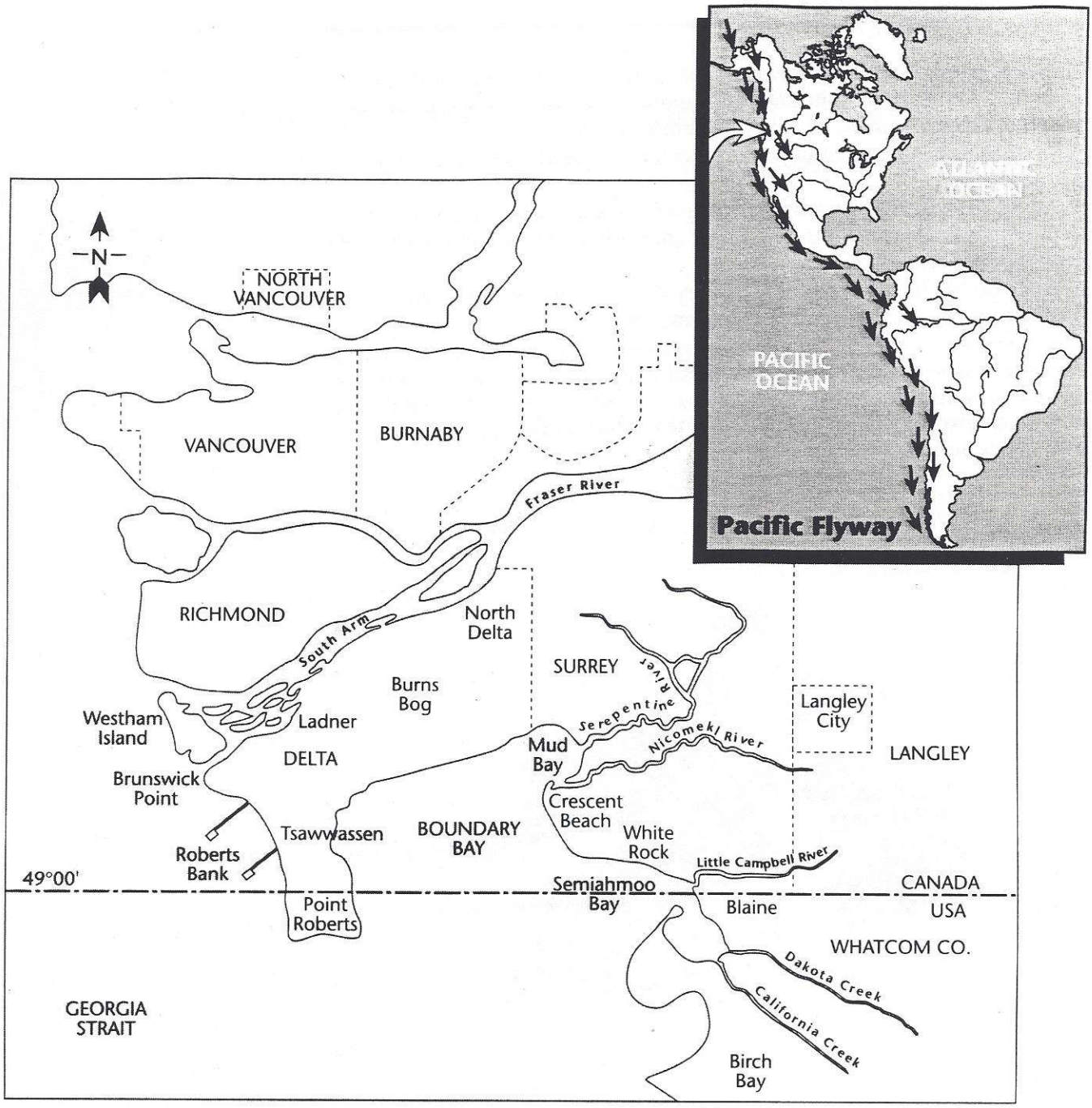
It examines the threats facing the integrity of the Boundary Bay ecosystem and the problems encountered in adequately addressing habitat conservation and farmland preservation.

Factors governing land use in the Boundary Bay area are identified, and a list of goals for protection of the ecosystem is formulated.

Finally, a proposal is presented recommending the formation of a Boundary Bay Biosphere Reserve, as a means to resolve differing land allocation needs and to promote a sustainable economy for the area. The Biosphere Reserve would become the framework to provide a co-ordinated, co-operative approach to ecosystem protection and management.



Map 1: Boundary Bay and the Fraser Delta



Geographical Location

BOUNDARY BAY is a shallow marine bay in the Fraser River estuary, British Columbia, Canada. It is bordered by fertile farmland, and partially intersected by the USA/Canada border. The Boundary Bay marine ecosystem encompasses Boundary Bay, Mud Bay and Semiahmoo Bay, and the adjacent uplands in the municipalities of Delta, Surrey and White Rock in British Columbia, Canada, and Whatcom County, Washington, USA. This ecosystem is inter-related with Burns Bog, to the north and the estuarine ecosystem of the Fraser River delta, to the west.

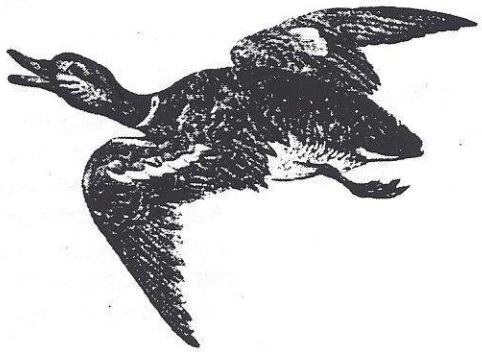
1. Attributes of the Boundary Bay Ecosystem

Wildlife

Boundary Bay is a vital link for birds migrating on the Pacific Flyway. Its fish habitat is an essential part of the Fraser River estuary ecosystem. Large wintering populations of waterfowl, shorebirds and birds of prey are supported by the Boundary Bay ecosystem. Some of the highlights are:

- Boundary Bay exceeds the recognised criteria for a wetland of international importance (Butler & Campbell 1987).
- 1.5 million birds on the Pacific flyway migrate through the Fraser delta. Tens of thousands of waterfowl of many species - swans, geese, ducks, loons and grebes, and hundreds of thousands of shorebirds - use Boundary Bay as a winter range and during migration. The bay and its adjacent uplands, including the floodplains of the Nicomekl and Serpentine Rivers, are the most important migratory waterfowl and shorebird habitat on the Canadian Pacific coast (Butler & Cannings 1989).
- The waters of Boundary Bay are crucial to the life cycle of herring, salmon, coastal cut-throat trout, and bottom fish. In the past, the bay supported a commercial shell-fishery.
- A total of 50 species of shorebird has been observed in the bay (Price 1990). Most of the world's population of western sandpipers rest and feed in Boundary Bay as they travel between Alaska and Suriname (Butler, Kaiser & Smith 1987)
- The largest density of wintering birds of prey in Canada roost and feed on the shores and uplands of Boundary Bay. Townsend's voles, abundant in oldfield habitat, are the principal prey for many of these species.
- Burns Bog is the largest deltaic raised bog remaining on the Pacific coast of America.
- The Point Roberts great blue heron colony is one of the three largest in the Pacific north-west, (384 nests in 1991). The heronry is located in Point Roberts, USA, and the herons use feeding areas on Boundary Bay, Roberts Bank, and uplands in Canada (Kelsall 1991).
- The last Canadian nesting population of barn owls, listed by the Committee on the Status of Endangered Wildlife in Canada as a "vulnerable" species, is in the Fraser delta (COSEWIC 1991). Cooper's hawk, also listed by COSEWIC as "vulnerable", is resident in wooded areas and hedgerows in Boundary Bay.
- The highest number of wintering bird species in Canada (144) was recorded in the Ladner Christmas Bird Count of 1990; (the count area includes Boundary Bay).

Most of the world's population of western sandpipers rest and feed in Boundary Bay as they travel between Alaska and Suriname



Habitats

The diversity of wildlife is supported by three major types of habitat: aquatic, wetland and upland.

Aquatic

MARINE

Boundary Bay is a shallow, marine bay where 1.5km of mudflats are exposed between high and low tides. The deep water areas beyond the low water mark provide feeding areas for harbour seals, diving ducks, loons and grebes. Other important species of this marine zone are crabs, sturgeon, herring and salmon fingerlings.

ESTUARINE

The mouth of the South Arm of the Fraser River, around the islands of the South Arm marshes, the shores of Westham Island and Brunswick Point, and the mouths of the Serpentine, Nicomekl, and Little Campbell Rivers are all estuarine habitat, where salt and fresh water mix. These areas are very rich biologically and are habitat for many wildlife species.

The Fraser River is renowned for its sockeye run, the largest in the world.

RIVERINE

The fresh water of all four rivers has a vital role in the life cycle of the salmon species which must travel upstream to their spawning grounds. The Fraser River is renowned for its sockeye run, the largest in the world. The Fraser Basin produces nearly 14 million Pacific salmon a year (Dorcey 1991). The fishing industry is extremely important to the British Columbia economy. The rivers also provide valuable habitat for other wildlife species.

Wetland

INTERTIDAL

The beach and very extensive mudflats are used by large numbers of shorebirds, ducks, gulls, herons and birds of prey for feeding, roosting and loafing. The shallow water at high tide attracts numerous dabbling ducks and geese. This habitat includes the very important eelgrass beds which are a source of amphipods and small crustaceans as well as a feeding area for brant and great blue heron.

There are two important foreshore areas, seaward of the dykes: on stabilised Boundary Bay, the salt marsh is in transition to riparian habitat, while on the active western front of the Fraser estuary there are bullrush and cattail marshes.

RIPARIAN

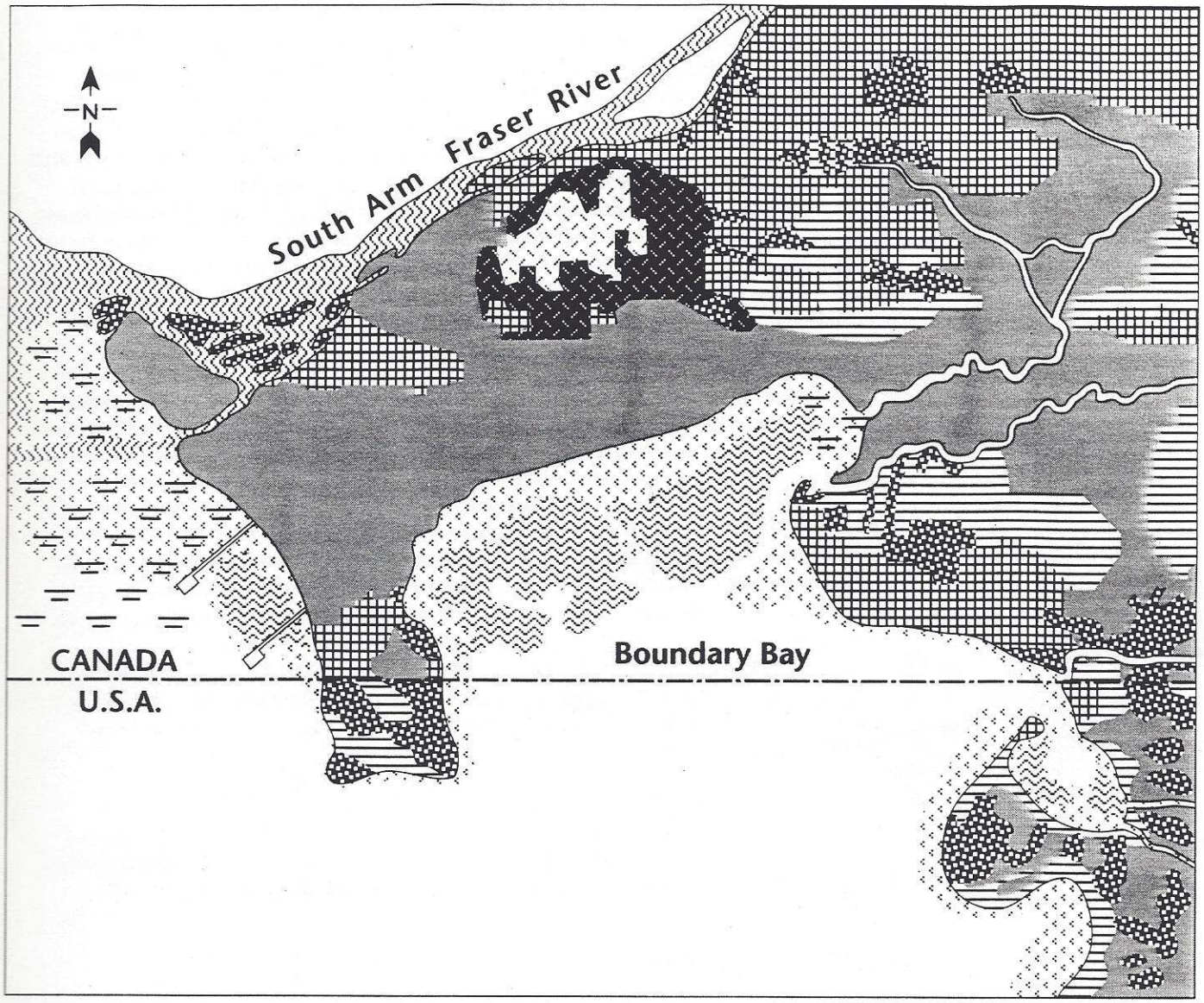
Ditches around fields and along the sea dykes provide quiet water channels for fish nurseries and the banks and hedgerows give cover to small mammals and songbirds. Butterflies, such as the anise swallowtail and red admiral breed where suitable food plants grow.

Burns Bog possesses plant species which are unusual at this latitude

BOG

Burns Bog encompasses 4000 ha and its southern perimeter is approximately 1km north of Boundary Bay. The bog is a circular organic deposit overlying dense silts and clays, and it is believed to be the largest domed bog in western North America. Burns Bog possesses plant species which are unusual at this latitude, eg. cloudberry, bog rosemary, Labrador tea and sundew. The bog also provides habitat for some of the few remaining black bear and sandhill crane in the Lower Mainland (Hebda & Biggs 1980).

Map 2: Land use and habitats of the Boundary Bay ecosystem



AQUATIC
- Marine
- Estuarine
- Riverine

WETLAND
- Intertidal
- Eelgrass
- Bog incl. Woodlot
- Bog–Peat Extraction

UPLAND
- Agricultural
- Woodland & Riparian
- Semi–Urban
- Urban & Industrial

Data:
1. Abs et al (1990)
2. Butler and Campbell (1987)
3. Agriculture Land Commission
4. Moore (1990)

Upland

FIELDS

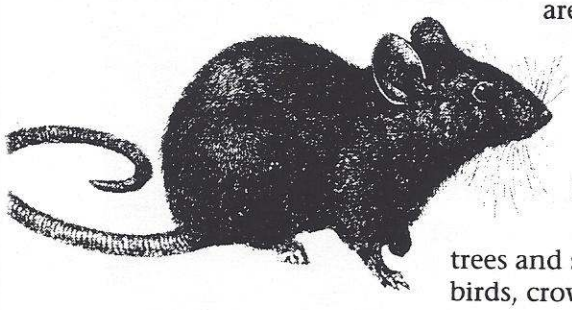
Agricultural land has replaced the prairie grasslands and marshes which covered much of the Fraser delta prior to the mid 1800s. However the farm fields continue to provide many types of habitat. Townsend's vole becomes established in rough grasslands which have lain fallow for a few years (old–fields).and "sustains the highest average densities of any North American vole species" (Taitt and Krebs, 1985). Townsend's vole is a principal food source for hawks, owls, great blue herons and northern harriers. Stubble fields provide grazing for swans, geese and ducks. Wintering waterfowl are particularly attracted to cover crops on farmland at night and during high tides (Jury, 1981). Shorebirds are abundant on fields (Fry, 1981). These waterbird flocks attract predators such as peregrine falcon, merlin and bald eagle.

HEDGEROWS

Some of the most valuable wildlife habitat in the Boundary Bay ecosystem is found between fields, along ditches and on roadsides. Trees, shrubs, bushes and grass edges provide perches, cover, nest sites, roost sites, food and dispersal corridors for a wide variety of wildlife.

WOODLAND

Coniferous woodland now occurs on parts of Burns Bog and on the highland regions which were formed by glacial moraines: North Delta, White Rock, parts of North and South Surrey and the Tsawwassen/Point Roberts peninsula. There are also a few small mixed or deciduous tree woodlots, eg. Ladner Harbour Park, Beach Grove. Woodlots provide habitat for many species of songbird and a variety of mammals. Great blue heron colonies in Point Roberts and on the Nicomekl River depend on mature woodland.



SEMI-URBAN

Some older subdivisions with large lot sizes, and a good variety of trees and shrubs, provide habitat for bird and mammal species, including songbirds, crows, hawks, woodpeckers, hummingbirds, raccoons and opossums.

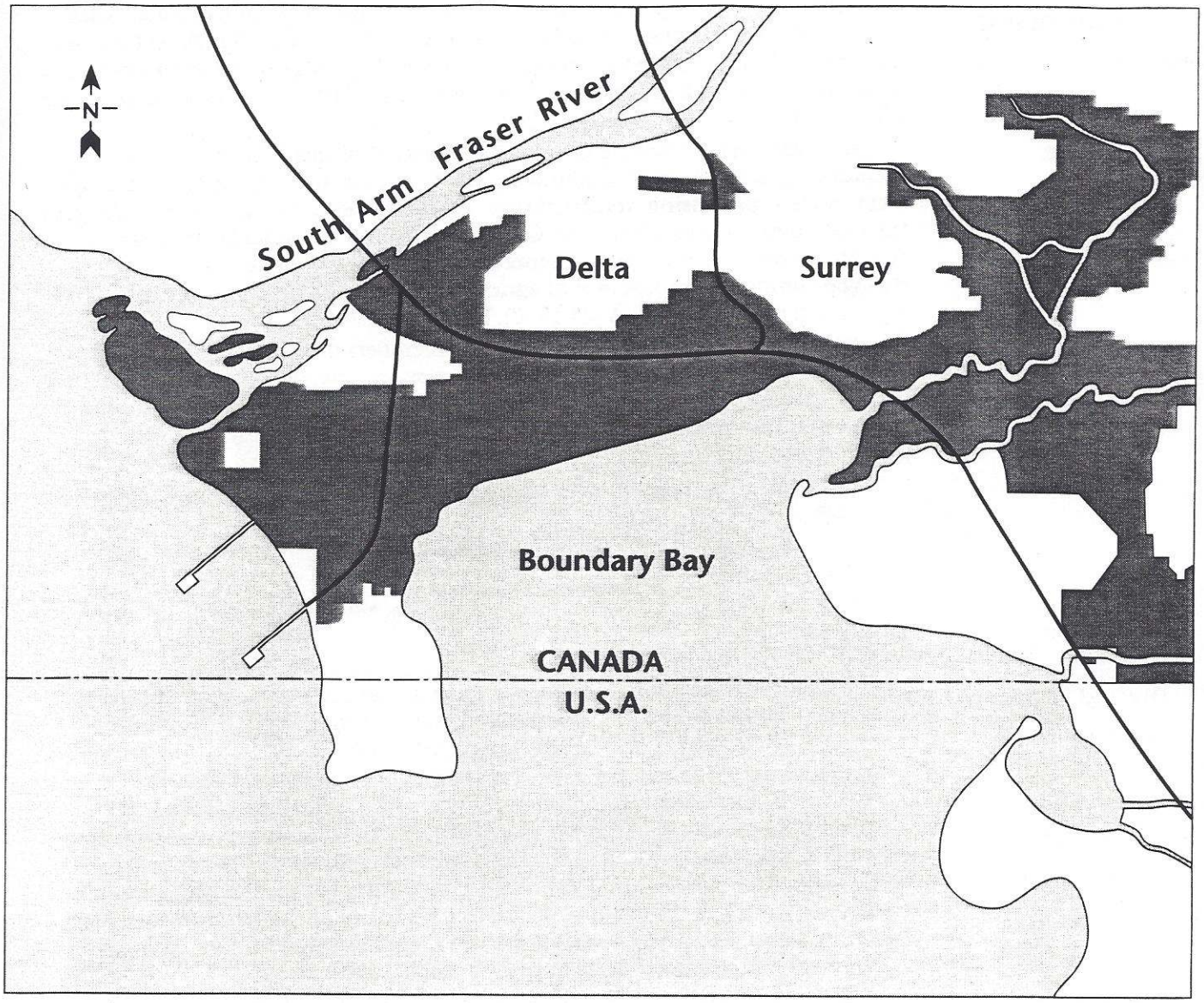
Agriculture

More than 10,000 ha of agricultural land surrounds Boundary Bay forming a belt of farmland from Roberts Bank and Westham Island in the west to the watershed of the Serpentine and Nicomekl Rivers in the east. This land is frequently referred to as the "uplands". Much of it is actively farmed and most of it is in the British Columbia Agricultural Land Reserve (ALR).This reserve was created by the Agricultural Land Commission Act in 1973.

Farmland is an important, finite resource. As global populations increase (and as global warming and desertification continue) farmland will be increasingly important for food production, but will also be under increased pressure to become urbanised. The ability to grow food is historically a key element in national stability and security.

> *"Without the ability to grow our own food, we leave our children and grandchildren held to ransom to buy food on the world market from whatever source, of whatever quality, at whatever price."*
>
> Gary Runka, former Head of the Agricultural Land Commission (Runka 1991)

Map 3: Agricultural Land Reserve in the Boundary Bay ecosystem



Agriculture Land Reserve
(APPROXIMATE BOUNDARIES)

Data: Agricultural Land Commission

The Fraser valley farmland is recognised as the best in Canada.

The Canada Land Inventory shows that only 11% of Canada's land area is suitable for agriculture and in B.C only 4% is arable.

Agriculture has long been one of the foremost industries in the Fraser delta. Much of the agricultural land is biophysical class 1 to 4, which means the temperate climate and fertile soils combine to provide ideal growing conditions for a wide range of crops and products. The Fraser valley farmland is recognised as the best in Canada.

Farm cash receipts for the Greater Vancouver Regional District (which includes Delta and Surrey) amounted to $300 million in 1989. Added value services, such as processing, transportation and food industries, accounted for a further $3 billion (Runka 1990). The Greater Vancouver Regional District report, "Creating Our Future, Steps to a More Liveable Region", identifies in the strongest terms the importance of agriculture in the "Green Zone", both for the region and the Province (GVRD 1990).

Agriculture is a sustainable industry. All members of society can benefit from local high quality food sources and the open spaces, healthy lifestyle and wildlife habitat that the farmlands provide. The employment opportunities offered by the agricultural industry contribute significantly to the economy of both the province and the country.

> *"We must come to the point where we think that the highest use for agricultural land is agriculture."*
>
> Senator Herb Sparrow (Sparrow, 1984)

Heritage

The high ground of the escarpments at White Rock, Tsawwassen and North Delta are particularly rich in archaeological remains.

The history of the aboriginal people in the Fraser delta dates back at least 9,000 years. Middens and archaeological remains of the early tool users, for example, the Glenrose Cannery Site, Delta, have been dated at about 7,000 BC.

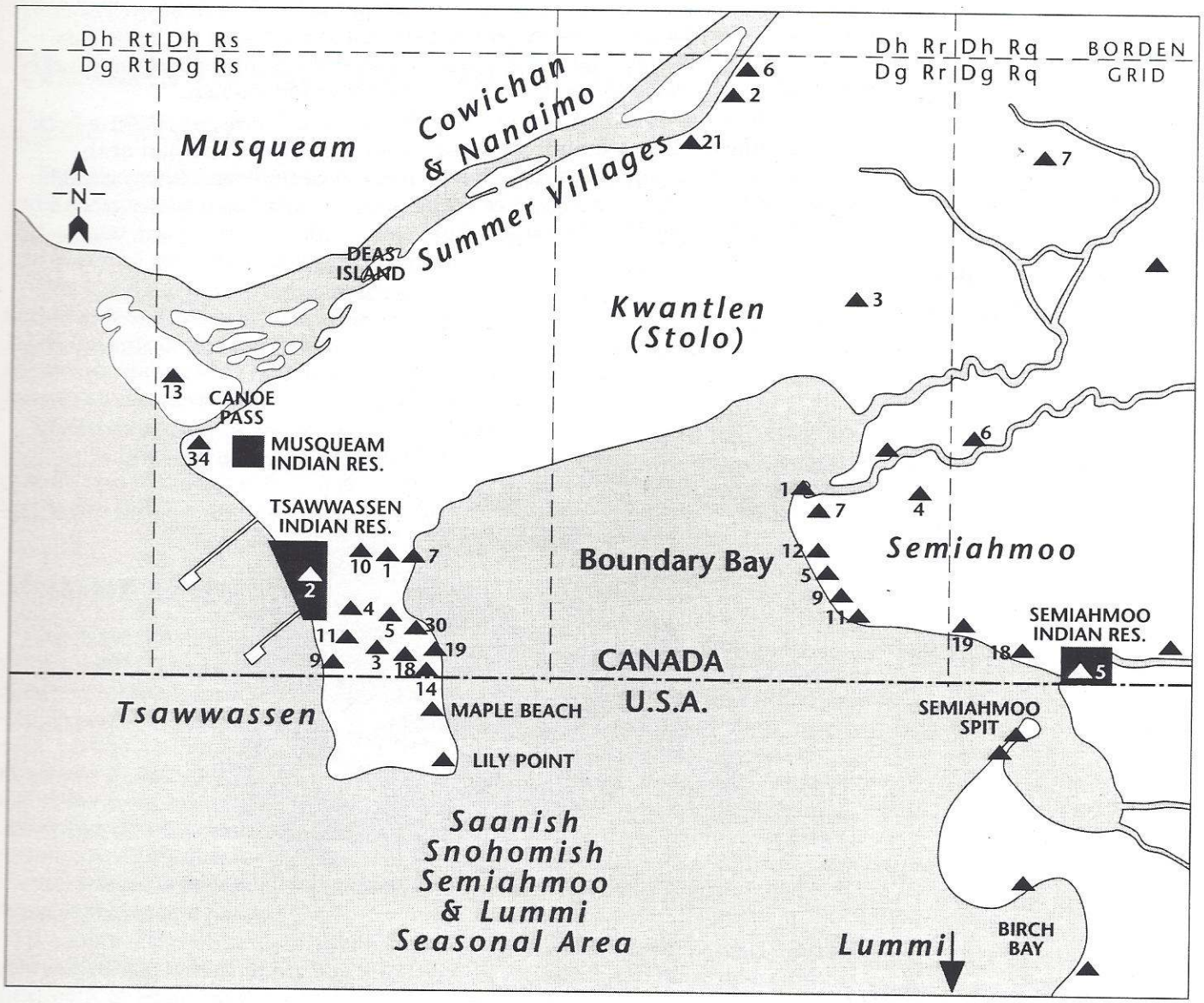
In the centuries following, tribes came and went, harvesting the rich bounty of marsh and sea. Vast swamps covered the land around the Fraser river, including present day Burns Bog, Pitt Meadows and much of Surrey, which comprised the great Sumas Lake basin (Leach 1982). The high ground of the escarpments at White Rock, Tsawwassen and North Delta are particularly rich in archaeological remains. Historically the estuary has been the domain of the Halkomelem-speaking Coast Salish, including Stalo, Cowichan, Nanaimo, Semiahmoo, Lummi, Tsawwassen and Saanich. Many of these occupied summer villages on the Fraser River and in Point Roberts, to take advantage of the annual salmon runs (Duff 1952). Semiahmoo, Tsawwassen and Musqueam bands now live on reserve lands near Boundary Bay.

The first Europeans to sight the floodplain of the Fraser Delta were Spanish explorers in 1791. The Spaniards, Galiano and Valdez, together with the English explorer, George Vancouver, travelled further in the following summer. Captain Vancouver described the delta as

> *" a swampy flat...very much inundated,..[with] stumps of trees innumeable"*
> (Ross 1979)

He named Point Roberts after his friend Captain Henry Roberts . In 1868 the Ladner family pre-empted 320 acres (133 ha) along the Chilukthan Slough in Ladner, near the mouth of the South Arm of the Fraser. This was the beginning of a large wave of settlement and by 1880 most of the Boundary Bay region was pre-empted. The dyke along the Boundary Bay shore was built in 1892 to protect this area which was very vulnerable to flooding. Other areas of the delta were dyked subsequent to the great flood of 1894 (Philips 1988).

Map 4: Archaeological sites in the Boundary Bay ecosystem

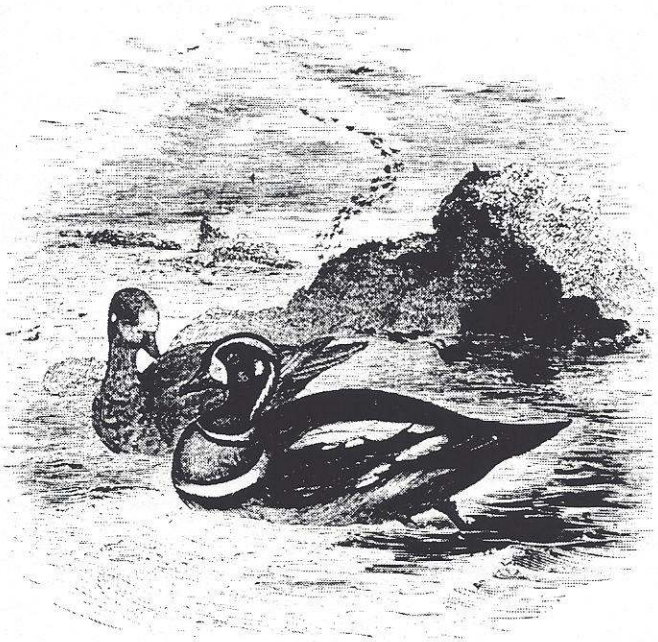


▲ Archaeological Site
(WITH CANADIAN BORDEN NO.)

Data:
1. Archaeology Branch, Ministry of Municipal Affairs
2. Parson (1981)
3. Duff (1952)
4. Gaston (1975)
5. Clark (1980)

Japanese and Chinese immigrants arrived in the mid 1800s and the region soon developed a cosmopolitan ethnic mix, with farming and fishing being the main industries. Salmon canneries sprang up along the South Arm of the Fraser in the 1870s to capitalise on the extremely plentiful salmon runs at Canoe Pass, Lily Point and in the mouth of the South Arm. Deas Island (now a Regional Park) is named after John Sullivan Deas, one of the early cannery owners.

The communities of Ladner, Tsawwassen, North Delta, Surrey and White Rock are now satellite towns, commuting distance from Vancouver, and part of the Greater Vancouver Regional District. Major crossings of the Fraser River, notably the George Massey tunnel and the Alex Fraser Bridge, contributed to the growth of urban centres in the Boundary Bay region.



2. Land Use Issues

Threats to the Boundary Bay Ecosystem

The integrity of the Boundary Bay ecosystem is now at risk. There is no formal protection for the water and foreshore of the bay itself. Chemical pollution from agricultural and urban run-off, oil spills from tanker traffic in the Georgia Strait, and bacterial contamination are current or potential problems.

There is no formal protection for the water and foreshore of the bay

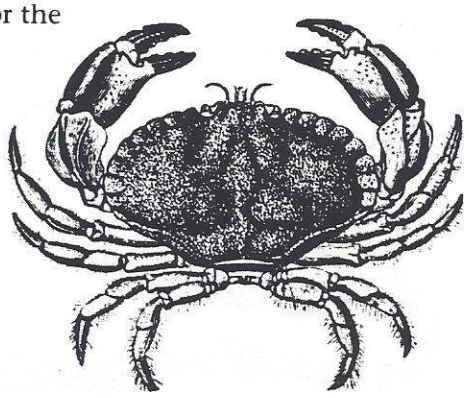
The farmland which forms much of the upland habitat is in the Agricultural Land Reserve. However there is constant pressure for non-agricultural developments on this land; these include golf courses, airport and industrial expansion, highways, and residential sub-divisions. In contrast, very little land is set aside for long-term conservation or public parks.

Archaeological sites are being covered by urban developments. Heritage buildings are falling into disrepair. New developments often lack sympathy with the natural and historical values of the region and cause feelings of alienation and distress to the community.

Water Quality

The water quality of the Fraser has declined in recent decades (Dorcey & Griggs, 1991). The Fraser River estuary monitoring program, of the BC Ministry of the Environment, indicates that contamination problems may exist in Boundary Bay (Swain & Walton, 1991). Tests for arsenic, cadmium, chromium, lead, mercury, carbon and toxicity all showed higher than average readings for the offshore site in Boundary Bay. The Serpentine and Nicomekl Rivers which feed the bay suffer from severe pollution problems associated with upstream agricultural and urban developments. Poor flushing at the mouth of these rivers contributes to toxicity. Groundwater contamination, mainly from pesticides and stock-piled animal wastes, is potentially a problem in the Fraser delta as it is elsewhere in North America and Europe.

A proposal has been made to the Greater Vancouver Regional District, to convert mined portions of Burns Bog into lagoons, reed-beds and marshes for the treatment of waste-water from the nearby Annacis Island Sewage Treatment plant (Fraser Wetland Habitat Committee, 1991). Other water quality issues in the area include:



- The loss of the commercial shellfish harvest in Boundary Bay, due to bacterial contamination (Taylor 1970). The bay supported over 50% of the BC oyster harvest before contamination closed the fishery in the early 1960s. Crabs and shrimp were also harvested.
- The continued dumping of chemical pollutants at the Burns Bog landfill and at unregulated dumpsites around the bog has a detrimental impact on the water which irrigates neighbouring arable land and which ultimately flows into the bay.
- The presence of the Cherry Point oil refinery in the USA portion of Semiahmoo Bay and the oil tanker routes through the Georgia Strait are potential sources of oil spills. A US/Canadian coordinated response to an oil spill in Boundary Bay is lacking. According to a recent report, one third of

ships travelling to Cherry Point, carrying crude oil, do not meet North American safety standards (Anderson 1989).

- Swimming beaches at White Rock and Boundary Bay suffer from closures due to high fecal coliform counts.

Loss of Wetlands

Since the arrival of European settlers,

> *"about 75% of the flooded portion of the delta has been diked, drained and cultivated ... only about 1% of the Fraser River delta has been protected by government legislation for the primary use of wildlife"*
>
> (Butler & Campbell 1987).

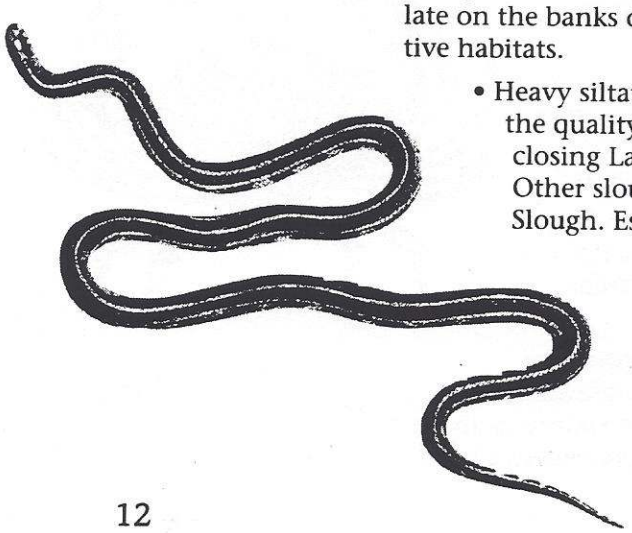
The Fraser River Estuary Management Program (FREMP) has categorized shoreline habitats along all coastal regions linked to the Fraser estuary, including Boundary Bay. Three designations are given: high, medium and low habitat value. Development of the shorelines is expected to follow these guidelines. However, in practice there appear to be many problems in the implementation of this strategy.

There is increasing pressure for industrial developments along the edge of the rivers, on Roberts Bank and its backup lands, and on Burns Bog.

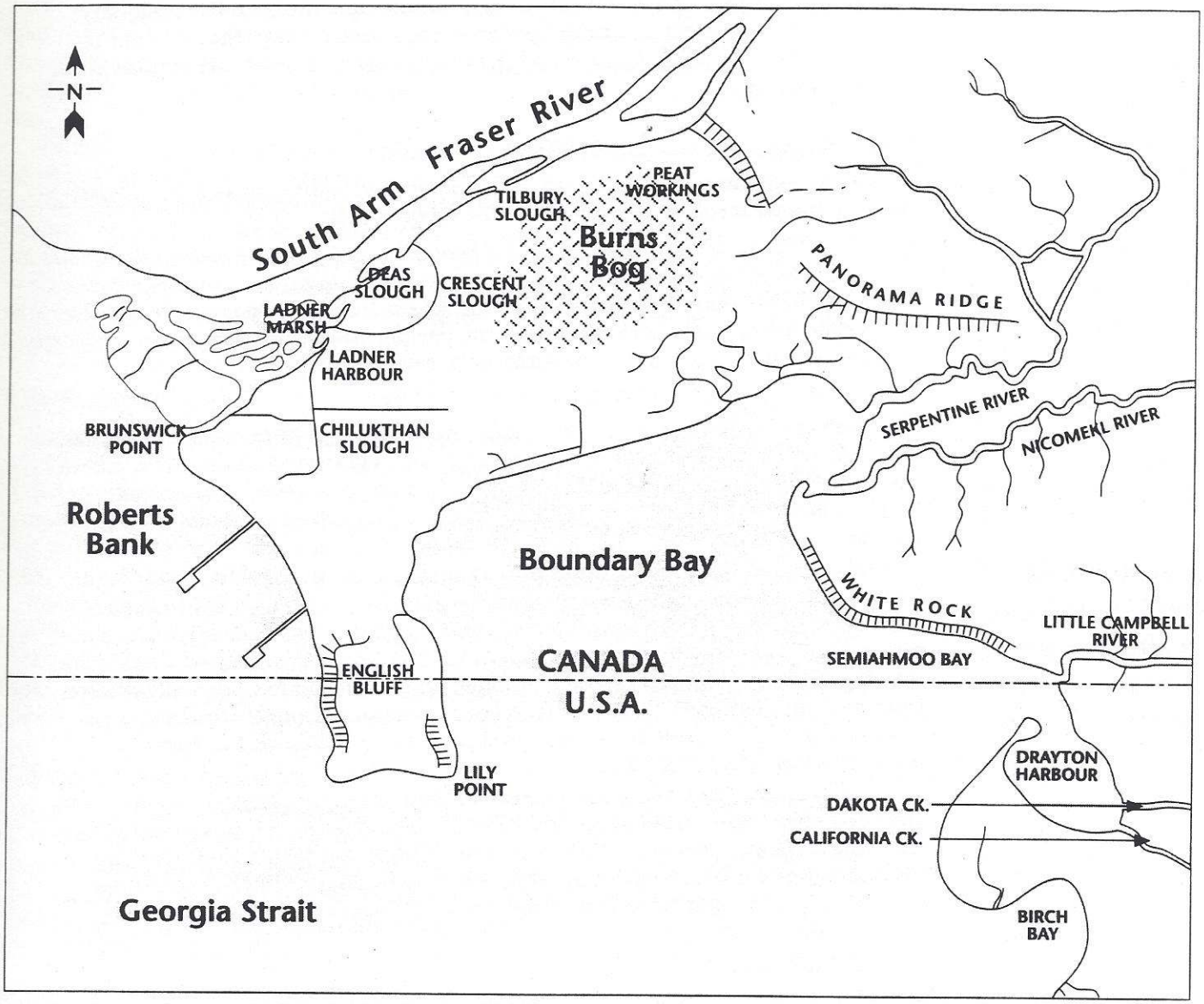
There is increasing pressure for industrial developments along the edge of the rivers, on Roberts Bank and its backup lands, and on Burns Bog. The Westshore coal terminal, on the foreshore at Roberts Bank, has affected the flow of water across that portion of the estuary. This has put an end to the Dungeness crab fishery in that area, according to local fishermen. Vancouver Port Corporation are planning to expand the terminal operations to include containers and other commodities, by the year 1995. The Port of Vancouver and other industrial concerns also plan to expand operations onto the Roberts Bank backup lands (FREMP 1990). The B.C Ferry Terminal Expansion at Tsawwassen in 1990/91 affected an area of mudflats and eelgrass beds adjacent to Tsawwassen Beach. Experiments to transplant eelgrass are currently in progress on the north side of the jetty.

Some other wetland development issues are:

- Logs and other debris brought down by the Fraser River accumulate in Boundary Bay and along the estuarine front. A program in the winter of 1984/85 by Ducks Unlimited and BC Environment cleaned up a number of logs on the Boundary Bay foreshore, thus restoring the saltmarsh (Wilson 1985). A debris control trap at Agassiz annually collects 100,000 cubic metres of floating material from the Fraser River, preventing the foreshore from being inundated. However, river debris , including logs, continue to accumulate on the banks of much of the South Arm of the Fraser, smothering sensitive habitats.
- Heavy siltation of slough channels as a result of dyking has degraded the quality of these aquatic habitats. Heavy sediment deposition is closing Ladner Harbour channel, Chilukthan and Crescent Sloughs. Other sloughs are surrounded by industrial lands, eg. Tilbury Slough. Estuarine management for some of these areas has been proposed (Dorcey et al. 1983).
- Proposed marinas and house boat moorages.
- Sewage disposal from house boats and other vessels.
- Commercial seaweed harvesting.



Map 5: Water drainage in the Boundary Bay ecosystem



Escarpment

Data: 1. Dorcey et al (1983)
2. TERA (1988)

Agriculture

The issues affecting the viability of agricultural operations in the Boundary Bay area are the subject of a recent government-funded study (Klohn Leonoff, Holm and Runka, 1992). Issues which have implication for wildlife conservation are discussed here.

Urbanisation of farmland

A 1990 Agricultural Land Commission report highlights the lack of a conservation ethic with respect to farmland. The report states:

> *"In spite of the program having been in place for nearly two decades an attitude continues to persist that the agricultural landscape is simply awaiting non-farm development. Continuing expectations of land use change within the ALR represents a fundamental threat to the preservation of the resource and the agricultural industry upon which it is based".*
>
> B.C Agricultural Land Commission, 1990

Urban uses (golf courses, playing fields, hospitals, race tracks) have a complex effect on farmland. This type of land speculation is perceived as the "thin end of the wedge" of development and causes great instability in the farming community. High land prices make it difficult for farmers to purchase land and are a great incentive to sell out.

The intrusion of urban facilities into agricultural areas creates a series of conflicts.

The intrusion of urban facilities into agricultural areas creates a series of conflicts. Roads become inadequate where they must be shared with slow moving farm vehicles, which need space to manoeuvre. Ditches and hedgerows are then removed to make way for wider pavements. Vandalism (eg. garbage dumping and interference with animals) can be a problem where farmland is not well buffered from new sub-divisions. Parcels of land become isolated from the main agricultural region and are then under increased pressure to be rezoned as part of an urban shadow effect (Runka 1990).

Farmers in the Lower Mainland must compete in today's markets. They need a large and stable land base so that there is sufficient acreage of crops to justify capital outlays on equipment and so that the processors can justify their working costs. A large land base is also important for crop rotations which help prevent pests, diseases and soil erosion, and reduce the reliance on chemicals.

Land leasing

Soil production capabilities are less likely to be maintained on leased land than on land which is farmer owned and worked. There has been a significant increase in leased farmland in the Lower Mainland. In the Greater Vancouver Regional District, farm ownership decreased from 81.5% to 74% of properties between 1971 and 1986 (Runka 1990). In Delta only 35% of farmland is owned by the farmer (Klohn Leonoff, Holm and Runka, 1992). 43% of leased land is owned by the government and 57% is privately held. A considerable amount of privately-owned land is managed by corporations acting as agents; the owner's residency status is often not known. A 1989 study showed over 50% of privately-owned farmland in the Boundary Bay area, is registered under trust numbers and is presumably being held for speculative purposes (Southlands 1989).

One of the major land use constraints identified in recent studies, is the leasing program for the provincially-owned Roberts Bank backup lands (Odermatt 1984, Klohn Leonoff, Holm, Runka, 1992). Policy strategies in keeping with agricultural priorities, and standardization and lengthening of leases on crown-owned land are desired aims for the agricultural community.

Infrastructure

Farmers in the Boundary Bay area have frequently expressed a need for investment to enhance land quality and maintain soil productivity by better water control. Without adequate water control soil becomes more susceptible to degradation processes such as erosion, compaction, structural cloddiness and the formation of plow pans. High salt levels are also a problem in some fields around the bay.

Irrigation requirements are complex; a better system of controlling already abundant ditch water for farm use is a common goal. In some places water control equipment and structures already exist, but properly trained water control officers, on 24 hour call, are lacking. Other requirements include extra water for annual use or for use during infrequent drought periods. A reliable mains or well water supply is a goal for other owners. The proposal for the use of waste-water mentioned above may have some application here. Fresh water irrigation is also necessary to combat salinity problems.

Crop damage

Although the majority of bird species using the Boundary Bay ecosystem are not a problem, the presence of some wildfowl can be a pest, causing crop losses. Species of particular concern to the farming community include feral Canada goose, American wigeon and European starling. Numbers of feral, non-migratory Canada geese have increased in the Boundary Bay area following an unfortunate management program by the British Columbia Wildlife Branch (Leach 1982).

Regulated hunting on farmlands is a possible management tool. Non-destructive methods of control are being studied; for example the Greenfields Project is trying to identify ways of controlling wigeon grazing to sustain cropland production (Duynstee 1992). It is believed that in some cases better irrigation could reduce crop damage by American wigeon.

Retirement Options

For many farmers retirement options are a priority. They believe they should have the right to sell their land to developers and retire on the proceeds. Uncertainty in the future of farming in the Boundary Bay region and the high costs of urban-edge land result in few young farmers coming into the industry. These issues must be addressed if Boundary Bay's farmland is to survive into the next century.

Greenhouses and turf farms

Greenhouses have become a successful agricultural option for some landowners. The many hours of sunshine in the southern Lower Mainland make it an ideal location. However greenhouse operations are not soil-based and they alienate the land both for soil-based farming and for wildlife habitat. There is currently little zoning control to co-ordinate greenhouse development. Locations should be found which do not conflict with prime farmland or wildlife habitat.

A Ministry of Agriculture report on farming in Delta suggests that the market potential for greenhouse operations is a limited one (Odermatt 1984). However individual operations in the Lower Fraser Valley are very successful.

Turf farms are another agricultural option but result in severe degradation of the soil and also offer minimal wildlife habitat.

Land Ownership

Land ownership in the Boundary Bay ecosystem falls into a number of categories:

a) Federal crown:	Boundary Bay airport (512 ha),
	Alaksen National Wildlife Area (which includes the Reifel Migratory Bird Sanctuary)(648 ha)
	Robertson Farm (Transport Canada)
	some foreshore areas
b) Provincial crown:	Roberts Bank backup lands (1700 ha)
	Farm Program properties (330 ha)
	Greenbelts and parcels managed in conjunction with them (193 ha)
	Boundary and Mud Bay foreshore (4500 ha)
c) GVRD parks:	Deas Island
	Boundary Bay
	Campbell Valley Park
	Tynehead
d) Municipal lands:	in the municipalities of Delta, Surrey and White Rock
e) Native lands:	Semiahmoo
	Tsawwassen
	Musqueam
f) Private:	encompassing urban, industrial, and agricultural properties and Burns Bog.

The large number of jurisdictions owning the land base makes integrated resource planning particularly complex.

The large number of jurisdictions owning the land base makes integrated resource planning particularly complex. Some areas of publicly-owned property are discussed below:

Upland Greenbelt Properties

The Greenbelt properties consist of four parcels located on the east end of Boundary and Mud Bays. The parcels were acquired under the Greenbelt Protection Funds Act. There are a further three parcels which are managed in conjunction with the greenbelt parcels but which are not officially greenbelt (two of these are owned by the Ministry of Highways).

Farm Program Properties

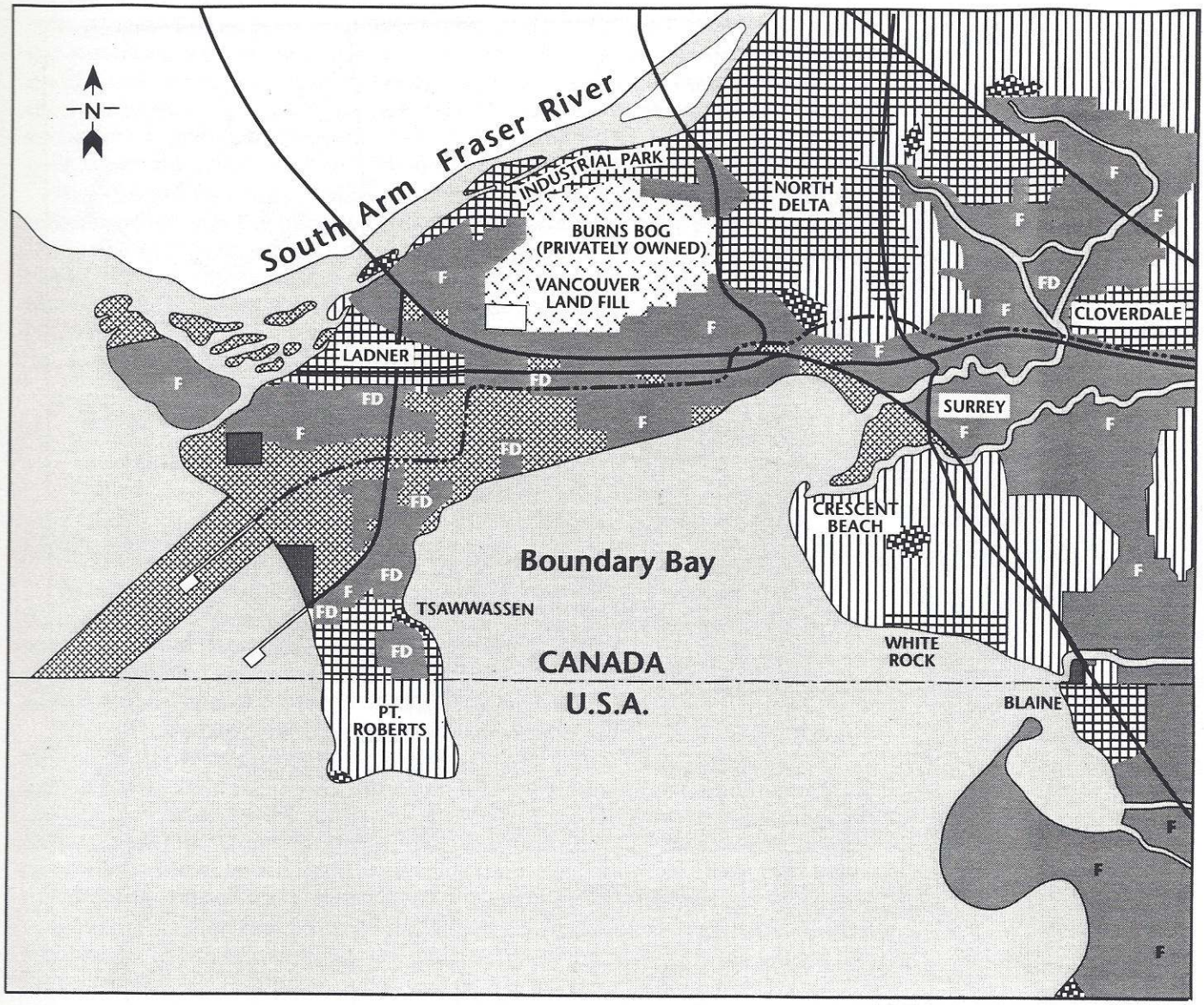
There are a total of 13 crown-owned Farm Program Properties in the vicinity of Boundary Bay, excluding the Greenbelt parcels.

These are: the Hanson and Embree farms adjacent to the dyke on Boundary Bay (76 ha); six parcels owned by the Ministry of Transportation and Highways (38 ha); and five other parcels (216 ha).

Boundary Bay and Mud Bay Foreshore Areas

These foreshore areas comprise some 4500 hectares. They are currently the subject of negotiations between the Provincial Ministries of Environment and Crown Lands. A proposed transfer of jurisdiction to the Ministry of Environment would create a Wildlife Management Area on the bay. Small parcels are owned by Nature Trust and Environment Canada.

Map 6: Land ownership in the Boundary Bay ecosystem



F Agriculture Land

FD Agriculture Land (DEVELOPER OWNED OR DEVELOPMENT PROPOSED–1992)

Indian Reserve

Urban Centres

Semi Urban

Crown Property

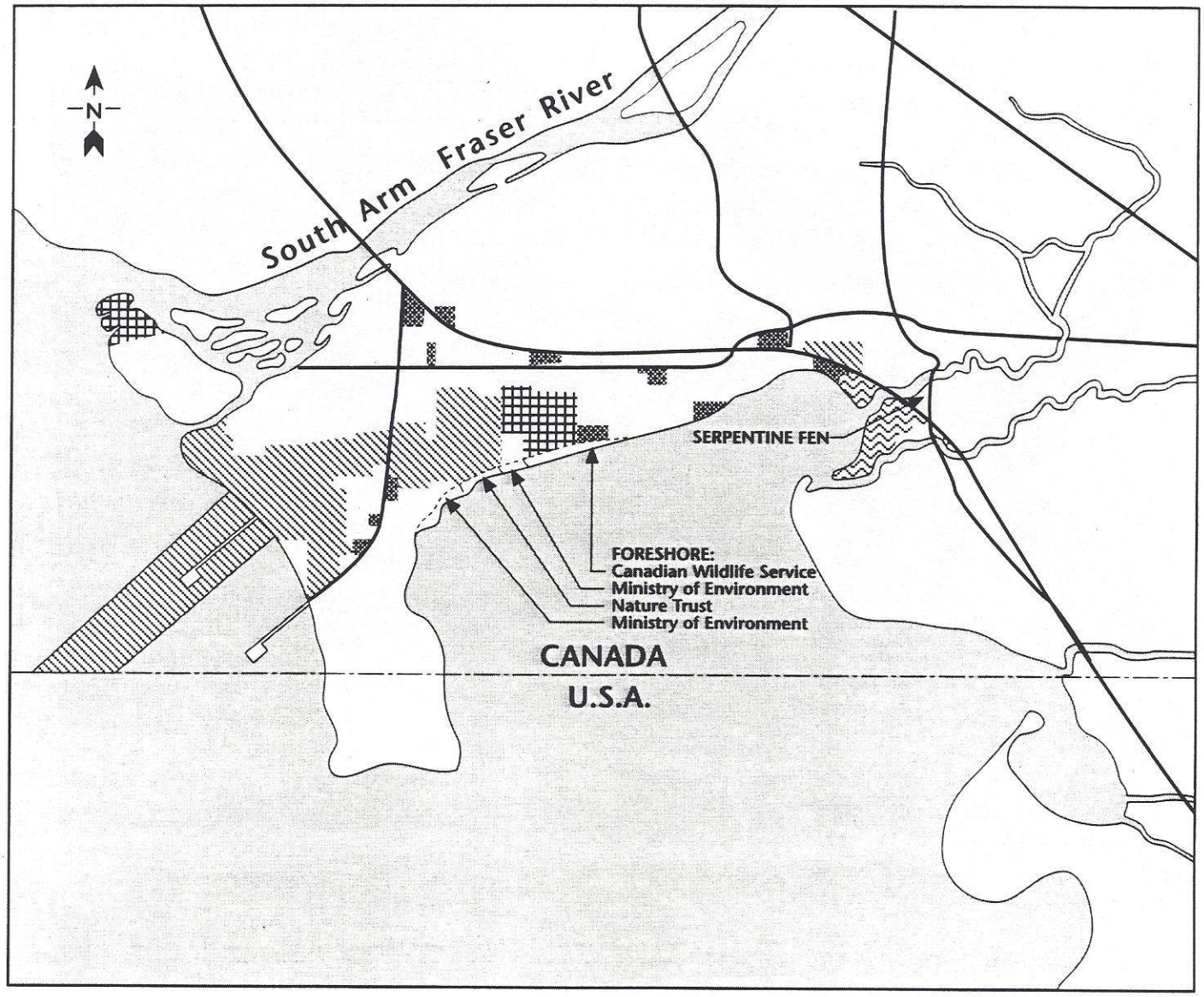
Park

Roads

Railway

Data:
1. Corporation of Delta
2. District of Surrey
3. Whatcom County
4. Southlands (1989)

Map 7: Crown land in the Boundary Bay ecosystem



Greenbelt

Roberts Bank
(INDUSTRIAL BACKUP PROPERTIES)

Federal Crown Land

Farm Program Lands

Data: British Columbia Ministry of Crown Lands

Roberts Bank

The Roberts Bank lands break into two sub-categories, namely the foreshore and uplands. The foreshore is administered under the Federal government and the Port of Vancouver, with B.C Rail. The upland component consists of approximately 1700 ha extending from Roberts Bank to the dyke at Boundary Bay. They were expropriated originally for port-related industrial development and access and utility corridors to the port. They are presently leased for farming and have been under the jurisdiction of Ministry of Crown Lands since 1988.

The Roberts Bank lands were expropriated originally for port-related industrial development

The Greater Vancouver Regional District 1990 report "Creating Our Future" recommended that the Roberts Bank uplands form part of the proposed Green Zone, and that their jurisdiction be transferred to the Ministry of Agriculture (GVRD 1990). The Agricultural Study, a component of the Boundary Bay Study initiated by Delta Municipality in 1989, also recommends that future planning strategies should

> *"recognise that the use for which these lands were originally expropriated is no longer valid and restrict the development of these lands to that which is fully consistent with Delta's long term agricultural priorities."*
>
> (Klohn Leonoff, Holm, Runka, 1992).

Recreation

The demand for outdoor recreation is a major land use issue associated with Boundary Bay. Tourism is one of British Columbia's growth industries and much of the perceived demand for golf courses originates with the pressure from tourism interests. Ecotourism, on the other hand, has not been significantly explored as an option for the Boundary Bay area.

Wildlife viewing is rapidly becoming a popular recreational activity.

Prior to June 1988 golf courses were only allowed on the Agricultural Land Reserve at the discretion of the Agricultural Land Commission. However, between June 1988 and December 1991, following a Provincial Cabinet order-in-council, golf courses were allowed as an outright use. This order-in-council generated a spate of development proposals in the Boundary Bay area, which would have resulted in at least 35 golf courses in Delta and Surrey. In December 1991 this order-in-council was rescinded, after the change in provincial government.

A recent Greater Vancouver Regional District study of the regional demand for golf courses found that at most 15% of the population were golfers (defined as someone who played at least one round of golf per year) (Argyle 1991). Regional figures for other outdoor activities include 83% participation in visiting the beach, 63% for swimming, 42% for camping, and 36% for fishing (GVRD 1991).

Wildlife viewing is rapidly becoming a popular recreational activity. It may have unexpected economic benefits. A 1983 provincial survey showed that over 87% of B.C residents are interested in wildlife, which translates into a gross economic value of $1.2 billion for wildlife-related activities in the province (Province of B.C, 1985). Each year there are no fewer than 200,000 visitors to the Boundary Bay/South Arm Fraser area to watch birds and other wildlife; (the Reifel Bird Sanctuary alone hosted 56,000 visits in 1992). Allowing for the fact that North Americans spend an average of $15 a day when birdwatching this means a minimum of $3 million for the local economy. Much of this activity is in the "off" season.

The potential is far greater given that:

a) Birdwatching is rapidly gaining in popularity,

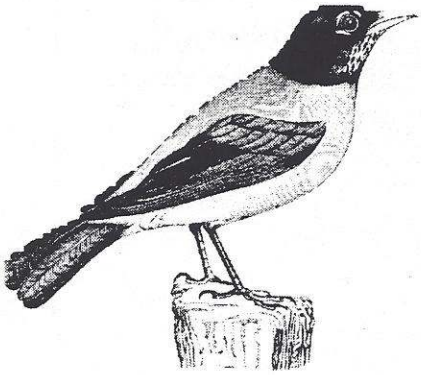
b) There is virtually no promotion of Boundary Bay as a destination for birdwatching,

c) There has been little enhancement of birdwatching facilities.

There are about 2 million committed birders in North America who each spend an average of more than $2000 per year while pursuing their hobby (Wiedner & Kerlinger 1989). Many more of them could be visiting the Fraser delta. The delta has only slightly fewer species than Point Pelee, Ontario, where in May alone, birdwatchers spend more than $2.1 million dollars in the local business community (Hvenegaard et al. 1989).

Wildlife viewing and other outdoor recreation activities could enhance the economy of the Boundary Bay area. Clearly defined areas for wildlife viewing and thoughtfully located facilities are required to minimize conflict with farming operations and other land uses. Some studies have been made of potential wildlife viewing facilities in Boundary Bay, eg. by April Maurer (Maurer 1989) and by the Fraser Wetland Habitat Committee (Leach 1972, 1987). A nature park was proposed at Blackie Spit in a 1966 report. The recreation potential of the extensive dyke system and recommendations for the enhancement and protection of the Beach Grove archaeological site, were the subject of a Municipality of Delta study in 1989 (Phillips 1989).

The tourist potential of the area has not been recognised. For example, the road-side map beside the Provincial Information Centre at the Douglas International border crossing does not show the Reifel Migratory Bird Sanctuary, Alaksen National Wildlife Area, Boundary Bay or the Serpentine Fen. It does however show the coal loading harbour at Roberts Bank! Tourism should be sensitively handled to prevent damage to the resource base. The preferred type of tourism is ecotourism, which is defined as "travelling to relatively undisturbed natural areas with the specific objective of studying, admiring and enjoying the scenery and its wild plants and animals, as well as any cultural manifestations found in this area" (Canadian Environmental Council, 1991). It is biocentric rather than homocentric in philosophy and does not degrade the resource. Ecotourism can be directed towards residents or non-residents of British Columbia, and is particularly valuable when combined with educational programs, interpretation facilities for schools and research centres for scientists.



Birdwatching, however, is only one of many outdoor activities which include walking/hiking (with over 67% participation), cycling, jogging, sightseeing, fishing, boating, hunting and golfing. Nearly all outdoor recreationists cite natural beauty as a vital part of their activity (Province of B.C 1985).

The natural beauty, open space, wildlife and quiet of the Boundary Bay area all contribute to a quality of life that is difficult to measure in dollar terms.

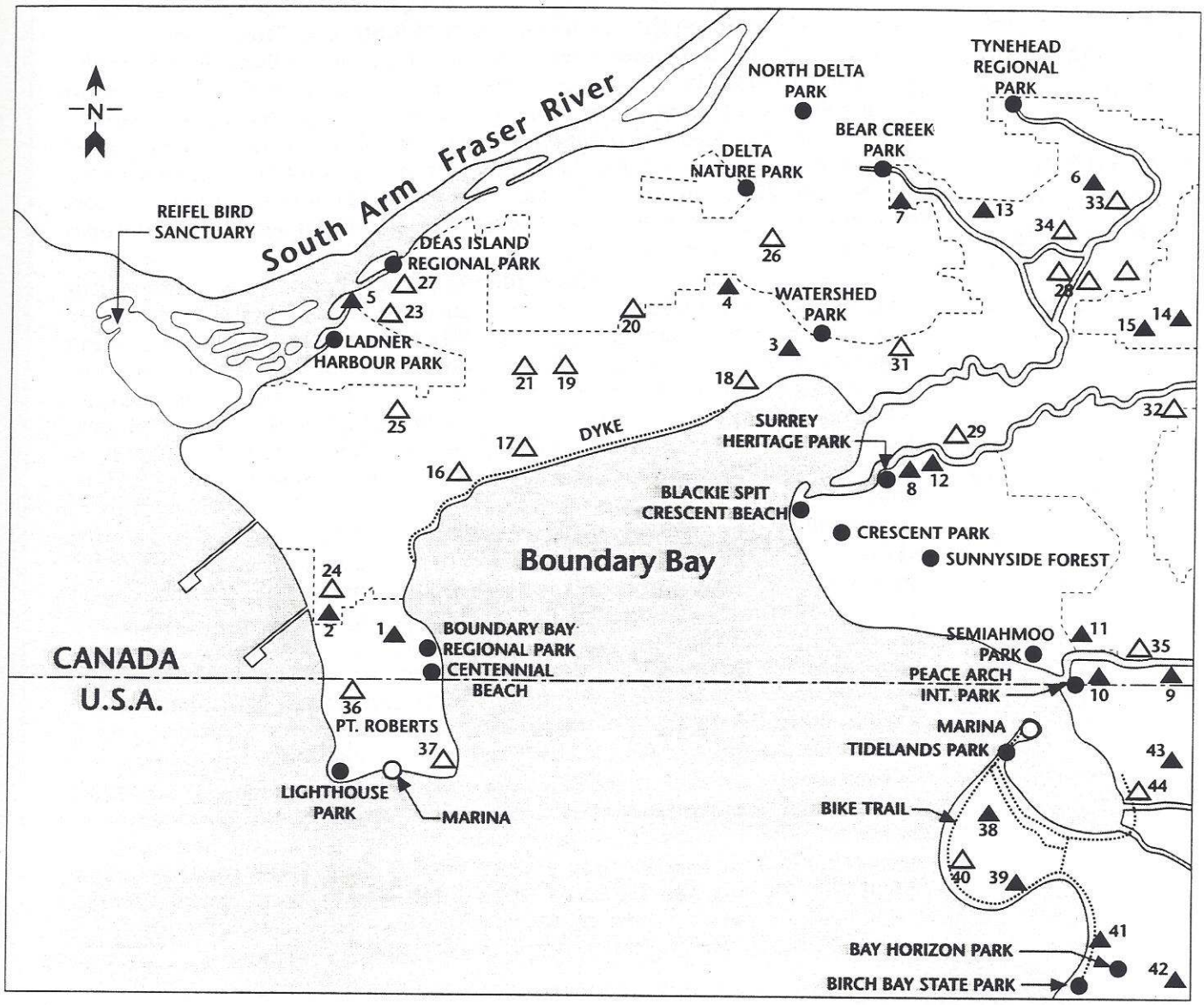
Transportation

Transportation corridors in the Boundary Bay ecosystem include railways, hydro-lines and provincial and municipal roads. There are airfields in the area, including the Boundary Bay airport. Public concerns regarding transportation centre around freedom of movement, noise and safety. Wildlife-related issues include road and hydro-wire kills, air strikes and the removal of habitat. Agricultural concerns include fragmentation of the land base and difficulties of moving farm machinery.

The British Columbia Ferry Corporation operates a ferry crossing from Tsawwassen to Victoria and Nanaimo, on Vancouver Island. The terminal at Tsawwassen is undergoing considerable expansion in response to the increased number and size of ferries. Plans for the expansion of the Westshore terminal by Vancouver Port Corporation include the construction of additional road links for truck access. Road traffic is increasing rapidly and feeder roads are becoming severely congested. Access to areas south of the South Arm of the Fraser is already limited by the "bottleneck" of the George Massey Tunnel beneath the river.

Transportation is recognised as a major concern of residents in the Boundary

Map 8: Recreation in the Boundary Bay ecosystem



- Parks
- Public Access Dykes
- Agriculture Land Reserve Boundary (approx.)
- Golf Courses (existing)
- Golf Courses (proposed–1991) (see Appendix 3 for list of names)

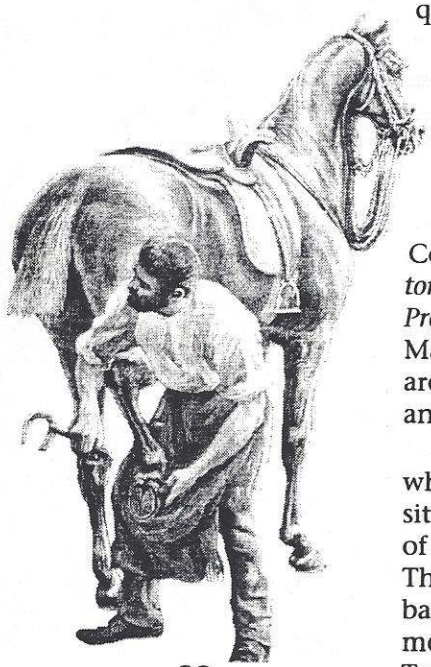
Regional planning generally disregards the environmental impacts, the disruption to the agricultural community, and the problems of commuting residents.

Bay ecosystem. Regional planning generally disregards the environmental impacts, the disruption to the agricultural community, and the problems of commuting residents. The new Annacis Island Bridge construction caused several hectares of tree kills in the north east corner of Burns Bog. There have been rumours of additional Fraser River bridges and roads across Burns Bog. Farmers are unable to move their machinery from one site to another. Commuters short-cutting down farm roads compound the problem. Roads dissect the farmland into ever smaller portions, and use many hectares of land in the process. Some communities are experiencing difficulties with heavy traffic flows at peak times, for example, along Highway 10 in East Ladner. The resolution of transportation problems in a manner which does not destroy agricultural and ecological values is a challenge to the whole region.

Boundary Bay has two airfields bordering the bay: Boundary Bay Airport and Delta Air Park. It is unclear yet whether Transport Canada is going to require greater use from Boundary Bay airport in the future, or direct that growth to less ecologically sensitive areas. Airport development in Boundary Bay threatens the ecological integrity of the area. It could affect over 2600 hectares of agricultural land through cropping restrictions, as well as increasing noise levels for adjacent homeowners. Future highway improvements to service an expanding airport industry would cause further loss and fragmentation of wildlife habitat and farmland.

The 1983 Environmental Assessment and Review Panel Hearings, that preceded the reactivation of Boundary Bay airport (in 1988), recognised the ecological sensitivity of the area, particularly the potential for bird strikes. The panel made a number of recommendations, notably on the type and weight of the airplanes and the permitted flight paths (FEARP 1979,1987). The recommendations were accepted by the Minister of Transport for both environmental and safety reasons. The large raptor population in the vicinity of the airport, the daily flights of seagulls, as well as the flight of tens of thousands of migrating waterfowl, pose a considerable risk to pilot safety, particularly at dusk and during the night.

Transportation corridors use hundreds of hectares of land. Only a small proportion of this area remains as potential wildlife habitat, eg. the grass verges alongside major highways. They prove to be attractive habitat for many small mammals and hence for the raptors which prey on them. Sadly, road kills are frequent both for birds and mammals. Large numbers of birds also perish after hitting hydro-lines. The tightly co-ordinated flocks of dunlin and other shorebirds are particularly susceptible to collisions with wires.

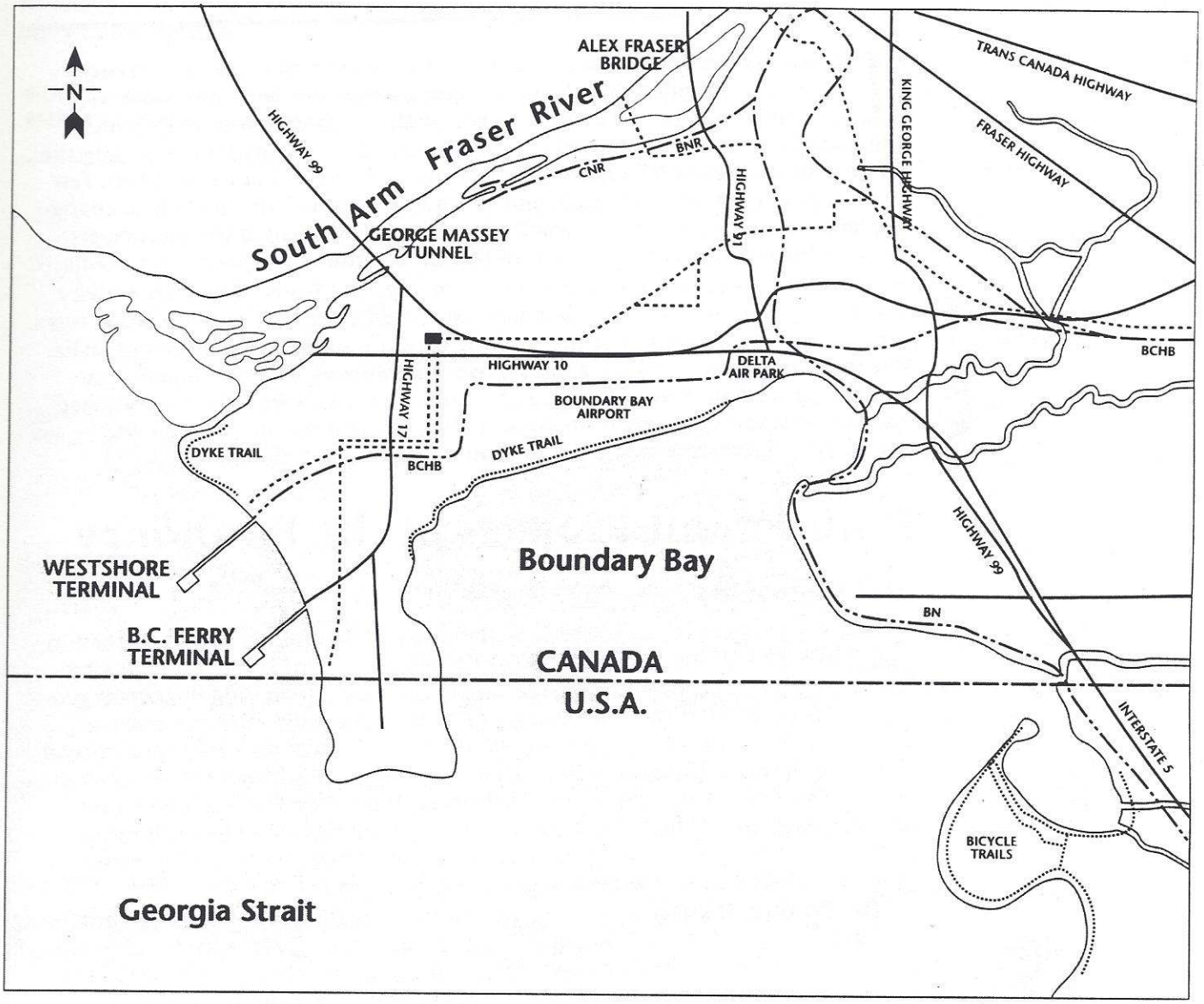


Heritage Sites

Archaeological and heritage sites are protected under the Heritage Conservation Act. In fact "heritage" in this context can mean any site with *"historic, architectural, archaeological, palaeontological or scenic significance to the Province or a municipality"*. However, enforcement seems to present difficulties. Many heritage sites, whether farm buildings, native burial sites or historic forests, are privately owned. The upkeep of traditional barns and farmhouses is expensive and few incentives exist to defray costs.

Archaeological sites are concentrated in upland areas around Boundary Bay, which have been the areas targeted for urban development in the past. Many sites have already been hard-topped. Sunnyside Urban Forest on the eastern side of Boundary Bay was preserved by the concerted efforts of citizens in White Rock. The fate of the privately-owned Tsawwassen Forest, on the western side of the bay, is yet to be decided. The surviving 30 ha of the Tsawwassen Forest is a fragment of the mixed woodland which once covered all the high ground on the Tsawwassen peninsula. It contains numerous plant and animal species and is the location of one of the most important and scientifically valuable archaeological sites in the area (Ham 1989).

Map 9: Transportation in the Boundary Bay ecosystem



Roads Railways Power Transmission Lines

3. Current Studies

There have been over 400 studies on the socio-economic and bio-physical aspects of Boundary Bay. Some of these studies have been evaluated in a 1991 literature review commissioned by the Corporation of Delta which concluded that a number of gaps exist in the literature, particularly regarding the effect of development on adjacent ecosystems (Corporation of Delta, 1991). Few or no studies exist on agricultural and storm water run-off, the impacts of changing land uses on water quality, wildlife habitat management at the municipal level, or the environmental impacts of present or future transportation systems.

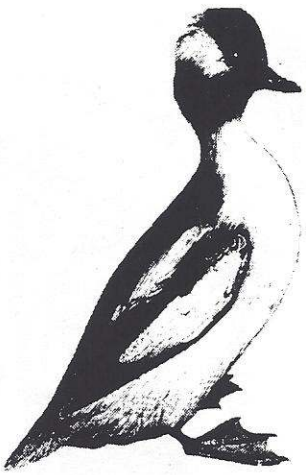
The literature review was carried out as part of the "Study of Human Activity and the Environment around Boundary Bay". This integrated resource study was initiated in 1989 as a result of the land use conflicts in the Municipality of Delta. The terms of reference are for a multi-government study with components on wildlife, agriculture, foreshore and Delta rural land use. Surrey Municipality had already undertaken a study of its environmentally sensitive areas and it was decided to include this as one component of the five-part study.

Component Projects of the Boundary Bay Study

The Surrey Environmentally Sensitive Areas (ESAs) Study, was published in April 1990. This study attempted to identify which areas of Surrey Municipality had ecological value, based on a wide variety of criteria, including important geological, biological and cultural features. An environmentally sensitive area was defined as *"a significant landscape or area which forms part of the natural and cultural heritage of the municipality and which requires planning and management measures to protect it from adverse human impacts"* (Abs et al.,1990). The ESA study also gave a rating to each area of high, medium or low. These ratings could be misleading, particularly since the internationally important waterfowl habitat of the floodplain is described in part as "low".

The Wildlife Habitat Study, a project of the Canadian Wildlife Service and BC Environment, was issued in May, 1992 (see figure 1). This study looked at the distribution of species of waterfowl, shorebirds, birds of prey and songbirds in the vicinity of Boundary Bay and attempted to formulate the amount of land required to support these populations, (Butler, R.W., editor, 1992). The conclusions and recommendations are:

- Agricultural land be maintained in the Agricultural Land Reserve.
- The inter-tidal beaches and mudflats for the Boundary Bay and Roberts Bank area be secured for wildlife.
- 300ha of farmland and 600ha of old-field habitat be secured for birds, adjacent to Boundary Bay.



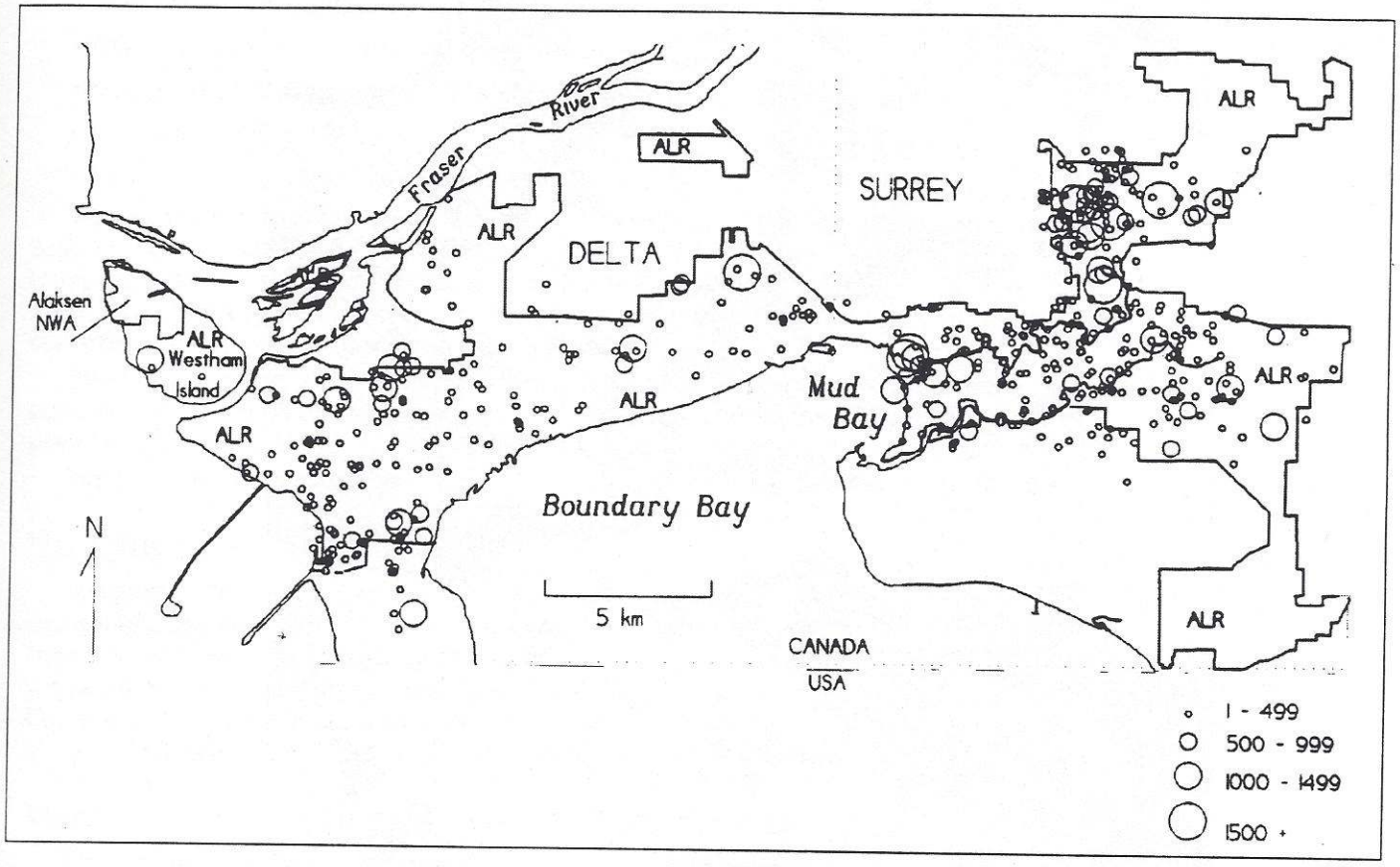
The Delta Agricultural Study, a joint provincial and municipal project, was published in January 1992 (Klohn Leonoff, Holm & Runka).This study presented an analysis of Delta farmer surveys and a discussion of agricultural issues. Strategies to address these issues are recommended.

The Delta Rural Land Use Study will identify the environmentally sensitive areas in Delta and consider the impact of transportation, recreation and urban and industrial development on the rural landscape of Delta.

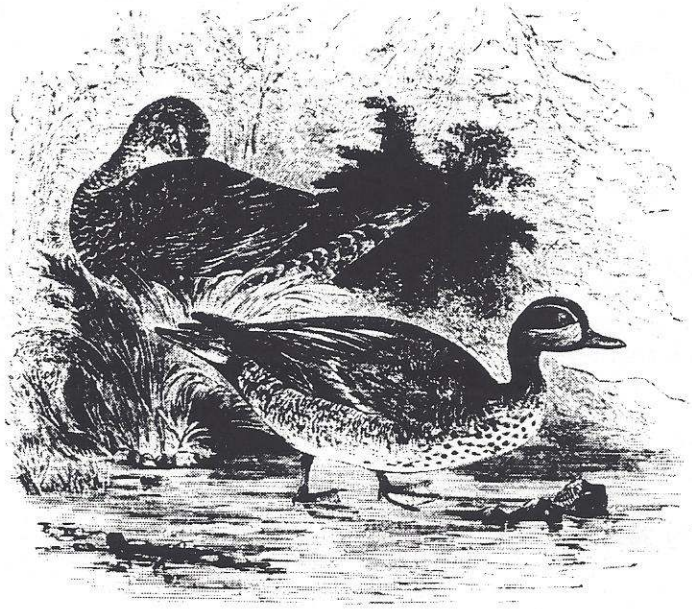
The Foreshore Planning Study is a project co-ordinated jointly by the provincial Ministry of Crown Lands and the Fraser River Estuary Management Program (FREMP).

The Boundary Bay Study will identify the most significant ecological sites in the Boundary Bay ecosystem and the quantity of habitat needed to maintain wildlife populations. It will also determine the requirements for agricultural viability in the uplands.

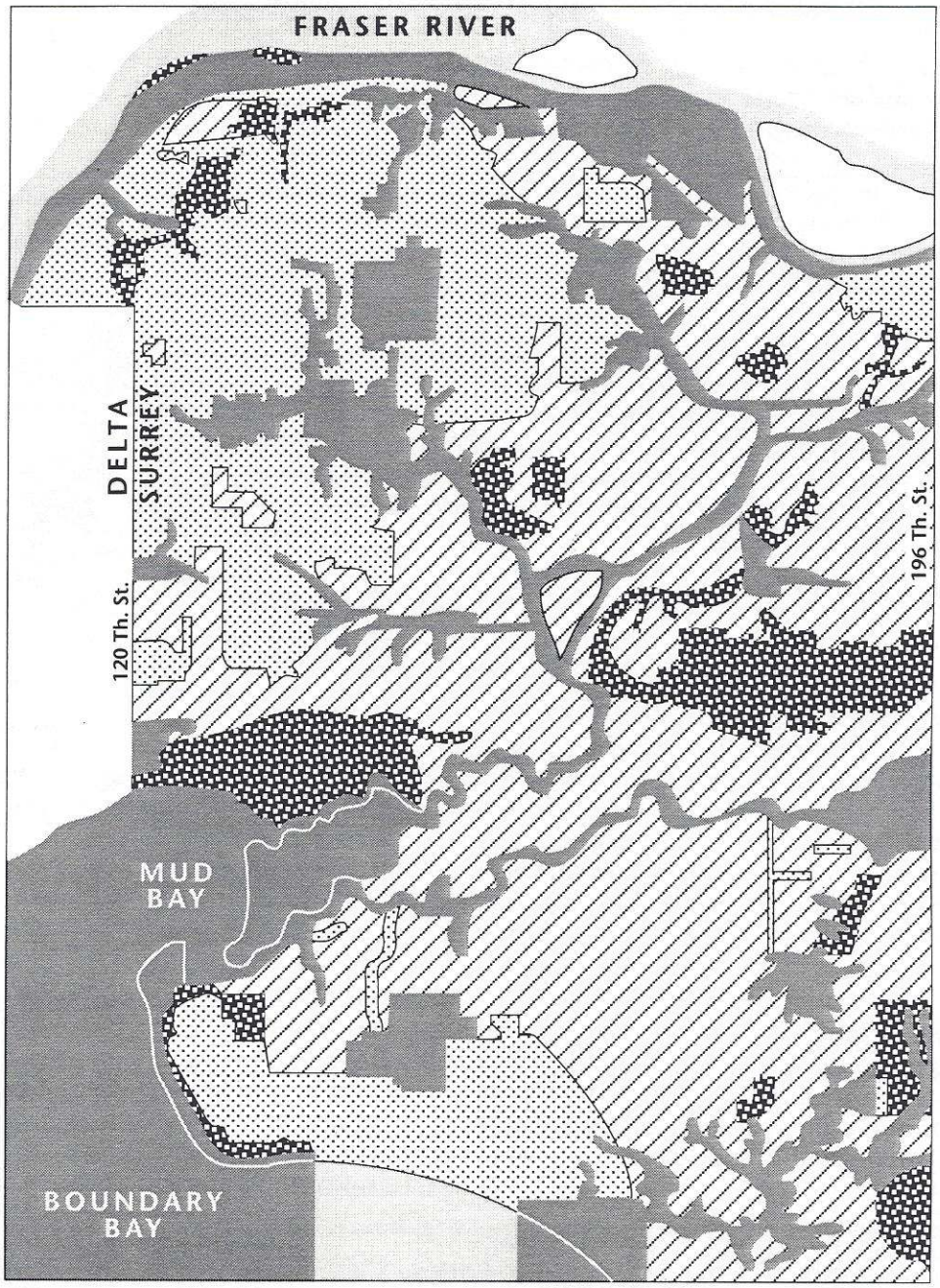
FIGURE 1. Distribution and abundance of flocks of ducks seen on 10 aerial surveys of entire farmlands between Jan. 23 and Apr. 6 1990



Source: Abundance, distribution and conservation of birds in the vicinity of Boundary Bay, British Columbia: R.W.Butler (ed)1992



Map 10: Environmentally sensitive areas in the Boundary Bay ecosystem



High Category
FULFILLS CRITERIA FOR:
- UNIQUENESS
- FRAGILITY
- DIVERSITY

Medium Category
FULFILLS CRITERIA FOR:
- GEOLOGICAL STABILITY
- IMPORTANT FEATURES

Low Category
FULFILLS CRITERIA FOR:
- REPRESENTATIVE LANDSCAPE
- ECOLOGICAL SIGNIFICANCE

eg. seasonal site

Urban Land

Data: District of Surrey, 1990

4. Current Protection and Future Imperatives

The Boundary Bay ecosystem is largely unprotected. Only four areas have wildlife habitat designations:

- Alaksen National Wildlife Area (648ha)
- South Arm Marshes Wildlife Management Area (811ha)
- Serpentine Fen (112ha)
- Parts of the Boundary Bay foreshore.

The Agricultural Land Reserve Act, 1973, slowed the conversion of farmland to non-agricultural use. However, it did not prevent 4354 ha from being removed from the Agricultural Land Reserve in the Lower Fraser Valley between 1980 and 1987. The recent spate of golf course construction on farmland is an indication of the vulnerability of the Agricultural Land Reserve.

The Boundary Bay ecosystem qualifies under numerous protective plans and schemes, all of which address different aspects of the ecosystem (the waterfowl population, the farmland, the intertidal portion of Boundary Bay itself, etc.).

For example, Boundary Bay has been recognised under the following plans:

Ramsar Site

A Ramsar Site is a UNESCO designation recognising important wetlands worldwide, as defined at the Convention on Wetlands of International Importance held at Ramsar, Iran in 1970. Member countries of the Convention are required to list and protect their important wetland habitats (Environment Canada 1987). Canada became signatory to the Convention in 1981. Alaksen National Wildlife Area is the only Ramsar site, at present, in British Columbia.

A Ramsar Site is a UNESCO designation recognising important wetlands worldwide

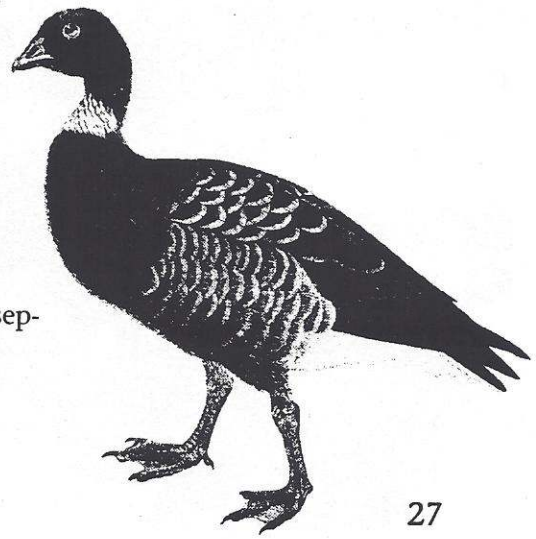
Western Hemispheric Shorebird Reserve Network Site

This international conservation strategy links important shorebird migration stop-overs. It was launched in 1985 through the collaborative efforts of the International Association of Fish and Wildlife Agencies (IAFWA), the World Wildlife Fund (WWF), and Canadian and United States federal, provincial and state agencies.

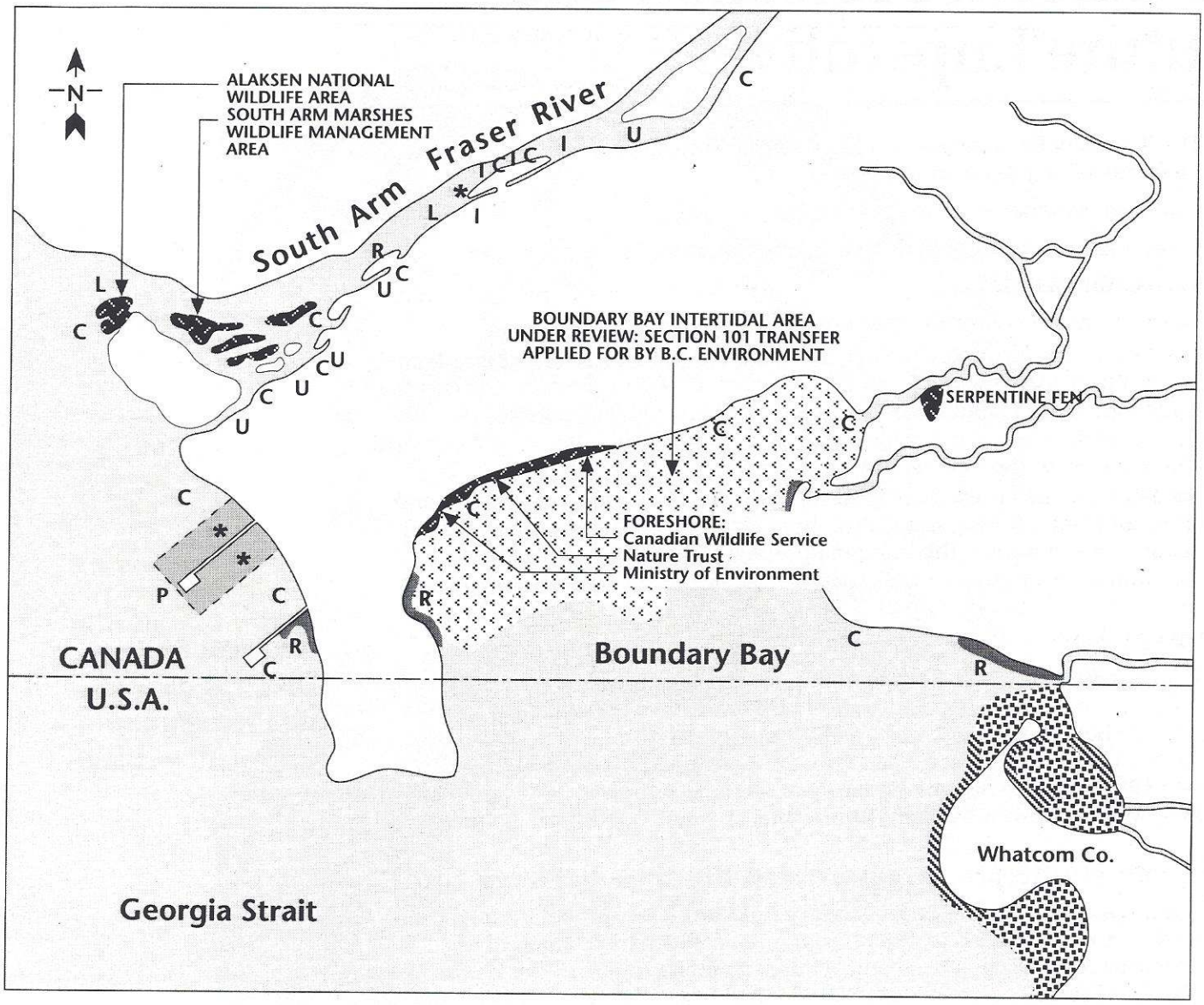
Boundary Bay and the Fraser delta are recognised as a site of major importance but have not yet been designated as a shorebird network site: they are the missing link on the Pacific coast.

Wildlife Management Area

A Wildlife Managment Area has been proposed for 4500 ha of crown owned intertidal land on Boundary Bay. It has been awaiting provincial government endorsement for eleven years. A Wildlife Management Area would afford some protection for the intertidal wildlife habitat, being effective only if followed by the designation of separate wildlife viewing, hunting and sanctuary areas within the bay.



Map 11: Protected areas and designations in the Boundary Bay ecosystem



Fraser River Estuary Program Designations (in Canada)
(UNDER REVIEW 1992)

C	Conservation	U	Urban
P	Port/Terminal	I	Industry
R	Recreation/Park	L	Log Storage
		*	Undetermined

Conservation Areas

Park

Whatcom County Designations (in USA)

Important Faunal Area—Birds

Critical Faunal Area—Pacific Herring

Data
1. Fraser River Estuary Managment Program
2. Whatcom County Planning Department
3. Greater Vancouver Regional District

Fremp Conservation and Recreation Area Designation

The Fraser River Estuary Management Program has mapped and classified all coastal regions in the Fraser estuary. Shoreline designations include: conservation, recreation, urban, industry, log storage and port or terminal. Boundary and Mud Bays are classified as conservation and recreation; the Roberts Bank/South Arm area includes classifications for conservation, port, recreation, urban and log storage. There is also an undetermined category associated with the Westshore Coal Terminal.

GVRD "Green Zone"

The upland Delta area has been proposed as a "Green Zone" by the Greater Vancouver Regional District in its document: "Creating Our Future; the liveable region" (GVRD 1990). A conference held in November 1991 to discuss the Green Zone, focussed on greater protection for open space because of its agricultural, recreational and habitat values. Boundary Bay was identified as a key area requiring protection.

Pacific Coast Joint Venture

The North American Waterfowl Management Plan has recently established the Pacific Coast Joint Venture, funded by United States and Canadian Federal and Provincial/State agencies and non-government conservation organisations, such as the Nature Trust, Nature Conservancy, Wildlife Habitat Canada, and Ducks Unlimited. The aim of this venture is to protect wildfowl habitat on the Pacific Flyway (Pacific Coast Joint Venture,1990). The Greenfields Project, studying the effect of American Wigeon grazing on farm fields, is being funded by the Pacific Coast Joint Venture (Duynstee, 1992).

Fraser River Basin Action Plan

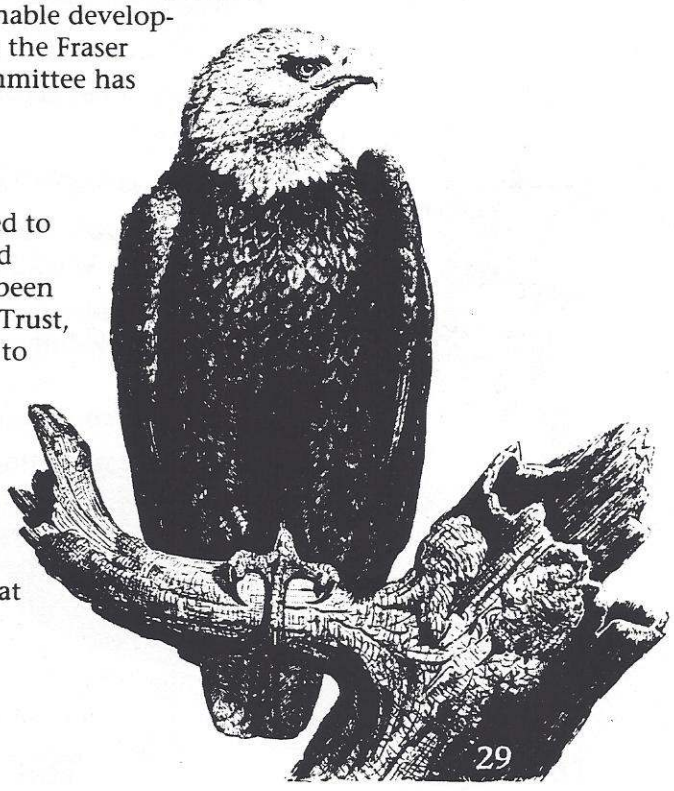
The Canadian Federal Green Plan allocated $100 million for environmental protection and enhancement of the Fraser River estuary. The goals of the Fraser River Basin Action Plan are to create partnerships in sustainable development, enhance and restore wildlife habitat and to clean up the Fraser River (Fraser River Basin Action Plan, 1991). A steering committee has been appointed and public input solicited.

Pacific Estuary Conservation Program

A consortium of agencies led by Nature Trust was formed to preserve and protect wetlands through acquisition and land stewardship. A portion of the Boundary Bay foreshore has been acquired, which includes 39 hectares purchased by Nature Trust, and two similar-sized parcels transferred from crown lands to the Ministry of the Environment for wildlife habitat designation.

Washington State Programs

The United States, Washington State, and Whatcom County have in place or are formulating protective plans for the Strait of Georgia which affect the proposed Reserve at the mouth of Boundary Bay. (See Appendix 4)



5. A Proposal For A Boundary Bay Biosphere Reserve

General

The Boundary Bay ecosystem has ecological, agricultural, and historical importance. Its integrity is threatened by rapid, poorly planned development. Goals for protection of the values which characterise the Boundary Bay area are:

Create Legislation to Achieve Long–term Habitat Protection

Site protection must be extended to all significant wildlife habitat and the designations must come from provincial and federal legislation and international convention.

Achieve an Inter–agency, Co–ordinated, Ecosystem Approach to Land Use Planning

> *"The planning process at all levels must regard agricultural land and wildlife habitat as much more than mere developable open space. Instead they must be recognised as vital components of this region."*
>
> (Moore 1990)

Maintain Aquatic and Upland Wildlife Habitat

> *"The key is more holistic and global planning of resources and a commitment by managers to work towards no net loss of important habitats"*
>
> (Savard, 1991)

- Permit no net loss of wildlife habitat in the ecosystem
- Preserve Burns Bog
- Implement FREMP conservation designations
- Develop incentive schemes to encourage farmers to save wildlife habitat where possible.

Protect the Integrity of the Agricultural Land Reserve

Encourage Public Awareness and Appreciation for the Boundary Bay Ecosystem: Its Wildlife, Agriculture and Heritage Values

- Promote understanding of the importance of the local farming industry, both in providing food and in maintaining landscape and ecological attributes.
- Promote a conservation ethic for wise use of resources
- Encourage recreation and tourism in keeping with the ecological and agricultural importance of the bay.

The Biosphere Reserve Concept

Biosphere Reserves are *"multiple purpose protected areas established to conserve species and natural communities and to use environments without degrading them"* (UNESCO 1987). At present there are 280 Biosphere Reserves in 71 countries, including six in Canada - in Alberta, Manitoba, and two each in Ontario and Quebec (MAB 1990).

Biosphere Reserves offer a co-operative approach to planning and enhancement of economic opportunities, while preserving environmental values. They are established under the Man and the Biosphere Program (MAB) of the United Nations Educational, Scientific and Cultural Organisation (UNESCO). Canada has participated in MAB since its inception in 1971.

A Biosphere Reserve is a geographical area designated to:

- conserve a natural ecosystem
- recognise people and their activities as an integral part of the environment
- encourage the monitoring, research, education, training and demonstration of natural and managed ecosystems
- be an example of voluntary cooperation in resource management
- be a place where local people form the management committee.

Biosphere Reserves are *"multiple purpose protected areas established to conserve species and natural communities and to use environments without degrading them"*

Structure of a Biosphere Reserve

A Biosphere Reserve comprises:

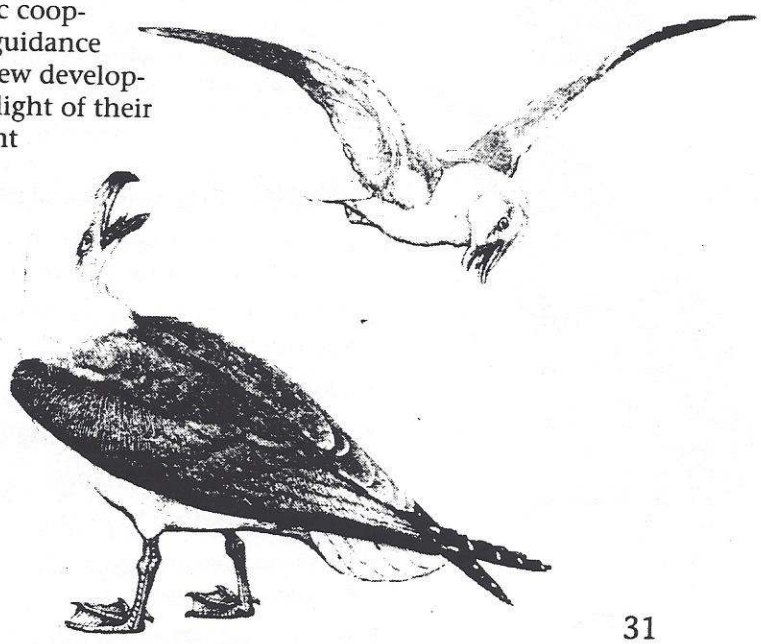
- A CORE AREA(S) which must be strongly protected,
- A BUFFER ZONE managed and protected to conserve the core, and
- A ZONE OF COOPERATION in which developments compatible with the core and buffer are permitted.

The core area(s) cover the regions of highest ecological significance and will often be areas that are already protected or designated, for example a National Park.

The buffer zone has moderate ecological significance and some human influence. Agricultural areas can make excellent buffer zones.

The zone of cooperation involves extensive public cooperation by all sections of the community under the guidance of the Biosphere Reserve management committee. New developments and potential land uses are considered in the light of their impact on the core and buffer areas. The management committee has members from the local community.

Education and research are important components of a Biosphere Reserve. In addition to their educational value, the creation of centres for these activities enhances the economic life of the community.



It is proposed that the Boundary Bay Biosphere Reserve encompass the Boundary Bay ecosystem together with portions of the South Arm of the Fraser River and Burns Bog.

The Boundary Bay Biosphere Reserve

It is proposed that a Boundary Bay Biosphere Reserve be created for the purposes of:

- Securing the wildlife habitat of the bay and its uplands for future generations of Canadians
- Securing a vital Canadian link in the Pacific migratory bird flyway as a responsibility to the international community
- Maintaining agriculture as the primary industry on the floodplains of the Boundary Bay ecosystem, and
- Enhancing the heritage values of the reserve area.

It is proposed that the Boundary Bay Biosphere Reserve encompass the Boundary Bay ecosystem together with portions of the South Arm of the Fraser River and Burns Bog.

A Boundary Bay Biosphere Reserve would satisfy the need for an inter-agency, co-ordinated approach to the management of the ecosystem. Combined with the appropriate legislation, essential wildlife habitat would be protected in core and buffer areas. The proposed Boundary Bay buffer zone is compatible with the existing Agricultural Land Reserve. Public awareness and appreciation for the Boundary Bay ecosystem would be increased by the international recognition afforded the area and by the research and education components of the biosphere reserve.

The Biosphere Reserve Management Committee may be legally incorporated. It would raise issues of common concern, priorities for management, research, education, etc. This Management Committee could be composed of a Working Group of local residents and stakeholders and a Technical Group of people from government agencies and universities.

Goals for The Boundary Bay Biosphere Reserve

Some goals for each zone of the Biosphere Reserve are suggested.

Obviously specific goals and an action plan to implement them would be developed by the management committee. The goals listed here are chosen to illustrate the way in which a Boundary Bay Biosphere Reserve could achieve solutions to the conflicting land use issues outlined in the earlier chapters of this proposal.

Goals for the Core Area

- Maintain existing populations of migratory and wintering birds by preserving and protecting the bay, foreshore and upland habitats.
- Secure Boundary Bay as the most important site in Canada for wintering birds of prey.
- Provide a permanent supply of old field habitat.
- Restore shellfish harvesting potential in Boundary Bay.
- Enhance songbird habitat, eg. by hedgerow protection.
- Protect breeding barn owls and Cooper's hawk.
- Preserve Burns Bog, possibly as an Ecological Reserve (as defined under the Ecological Reserves Act).
- Implement FREMP water quality objectives.

Actions for Achieving These Goals

The core areas should cover most of the wetland habitats of Boundary Bay and related ecosystems. This would include the aquatic habitats of Boundary, Mud and Semiahmoo Bays, Roberts Bank and the South Arm marshes, together with the key habitats of Burns Bog. In addition, the core would include critical supplies of old field habitat and upland areas, as determined by the Boundary Bay study. "Set-aside" farmland could be leased on a rotational basis to ensure these supplies, as in parts of Europe. Management of old-field habitat must concentrate on enhancement to maximize small mammal populations as suggested in Taitt (1991).

A provincial policy of no net loss of critical wildlife habitat must be established

A provincial policy of no net loss of critical wildlife habitat must be established, with the long term goal of net gain, via enhancement and restoration. The "precautionary principle" should be applied to new developments.

A clean water act on the "polluter pays" principle, as proposed by the West Coast Environmental Law Association, would help meet water quality objectives (Sandborn 1989).

Goals for the Buffer Zone

- Protect the integrity of the Agricultural Land Reserve within the Boundary Bay Biosphere Reserve.
- Retain crown lands and normalise their leases, within the Agricultural Land Reserve, in the Boundary Bay Biosphere Reserve. These lands should be recognised and designated for their agricultural, ecological and greenbelt values.
- Establish land owner incentive mechanisms, such as "retire with dignity" programs and tax incentives.
- Encourage conservation-oriented farming techniques, eg. soil-based agriculture, retention of hedgerows and shelter belts.
- Promote goals for farm viability, for example, irrigation, drainage, suitable land lease arrangements, and freedom of movement for farm vehicles.
- Promote public appreciation of the role played by local farmers in producing good quality, accessible food supplies.
- Promote public appreciation of local heritage.

Actions to Achieve the Buffer Zone Goals

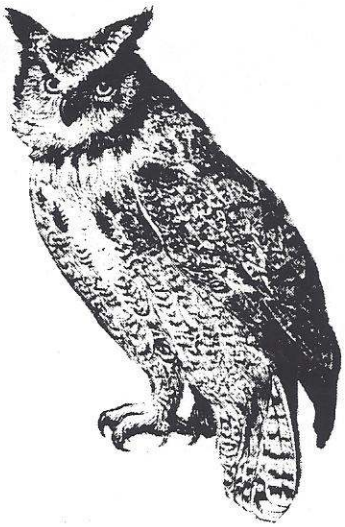
Provincially, the Agricultural Land Reserve must be upheld and strengthened, and the role of agriculture as the highest use of farmland must be acknowledged.

The Greater Vancouver Regional District's Liveable Region Plan 1990 suggests the formation of a "Green Zone" and transfer of the Roberts Bank backup lands to the Ministry of Agriculture with their future use as agricultural land secured. Implementation of this plan would be compatible with Buffer Zone objectives.

Landowner incentive mechanisms for protecting important habitat areas, while maintaining farming viability, are in use elsewhere in North America and Europe (Wildlife Habitat Canada 1987). The Pacific Coast Joint Venture, of the North American Waterfowl Management Plan, could be the vehicle for implementation of this goal, together with the encouragement of conservation-oriented farming techniques. The suggested goals of the Buffer Zone fit in well with the stated aims of the Venture (Pacific Coast Joint Venture 1990).

Amendments to the Assessment Act, the Land Title Act and the Ecological Reserves Act might be useful in promoting the concept of conservation easements (Sandborn 1989).

Heritage objectives could be achieved with such schemes as a National Heritage Area or a Community Pride Program.



Transfer the Roberts Bank back-up lands to the Ministry of Agriculture with their future use as agricultural land secured.

Goals of the Zone of Cooperation

- Promote public interest in the Biosphere Reserve concept and belief in the benefits of good environmental planning.
- Enact stronger pollution/toxic waste dumping controls.
- Restrict waterside locations in industrially-zoned areas to those industries that are intensively water dependent.
- Attract centres or facilities for scientific and educational research.
- Develop an ecotourism policy and strategic plan for the Biosphere Reserve.
- Restrict Boundary Bay airport to recreational and small plane use only.
- Develop a visitor interpretation centre for the bay.

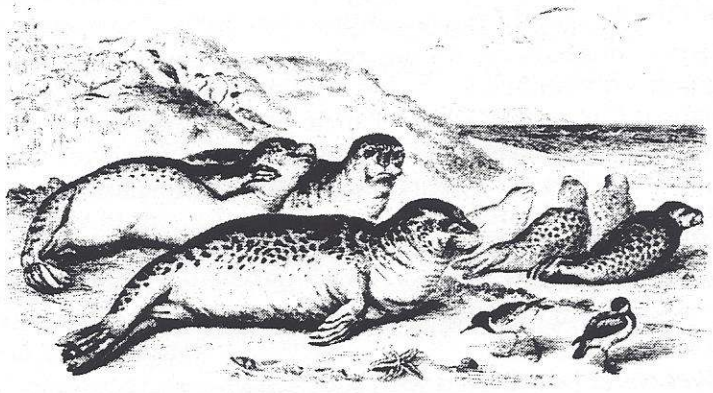
Actions to Achieve These Goals

An exciting aspect of the Boundary Bay Biosphere Reserve is the expansion of the scientific and educational opportunities associated with the bay's ecosystem. The Zone of Cooperation should include, under MAB guidelines, either study centres, university facilities or research centres. Some examples of the type of research topics are:

- Migratory bird studies on the importance of Boundary Bay on the Pacific Flyway.
- Ecology of wetlands, benefitting from the combination of marine, estuarine and riverine habitats within the Reserve and its location on the greatest sockeye salmon river in the world.
- Archaeological studies and heritage restoration projects.
- Studies of/for indigenous peoples, leading to the formation of a native heritage centre.
- Experimental farms and modern agriculture techniques, and rare farm breed conservation, as suggested by the Tsawwassen Nature Park Society proposal, "Our Country Connection" (TNPS 1989).
- Waste water treatment in marshes and water meadows, as suggested by the Fraser Wetlands Habitat Committee Proposal (FWHC 1991).

Studies on recreation needs and potentials will have to be undertaken and strategies evolved to incorporate recreation and tourism into the zone of cooperation. These activities should be handled in such a way that minimal impact occurs to the core and buffer zones.

The British Columbia Society of Landscape Architects Environmental Committee is presently working on a multiple use plan for a Boundary Bay Biosphere Reserve.



6. Recommendations

Creation of the Boundary Bay Biosphere Reserve will require a strong commitment from all levels of government and the involvement of the whole community. The following recommendations summarise some of the necessary steps towards implementation of the biosphere reserve goals.

Creation of the Boundary Bay Biosphere Reserve will require a strong commitment from all levels of government

Recommendation 1

Protect the CORE wetland areas by legislation.

- Create new, site-specific legislation to ensure that vital wetland habitat in the Boundary Bay ecosystem is protected in perpetuity.

  [Federal/Provincial]

- Implement all designations that have been suggested for the core:

  Ramsar Site (Boundary Bay and Roberts Bank foreshore)

  Western Hemispheric Shorebird Reserve Network Site (Boundary Bay foreshore)

  Provincial Wildlife Management Area (Boundary Bay and Roberts Bank foreshore)

  Ecological Reserve (Burns Bog)

  [Federal/Provincial]

- Enact water quality protection and waste management legislation.

  [Federal/Provincial]

Recommendation 2

Protect the BUFFER upland areas

- Maintain the integrity of agricultural areas in the Boundary Bay ecosystem, by reducing land speculation.

  [Provincial/Municipal]

- Make the Agricultural Land Reserve stronger and recognise this in local area planning and municipal zoning.

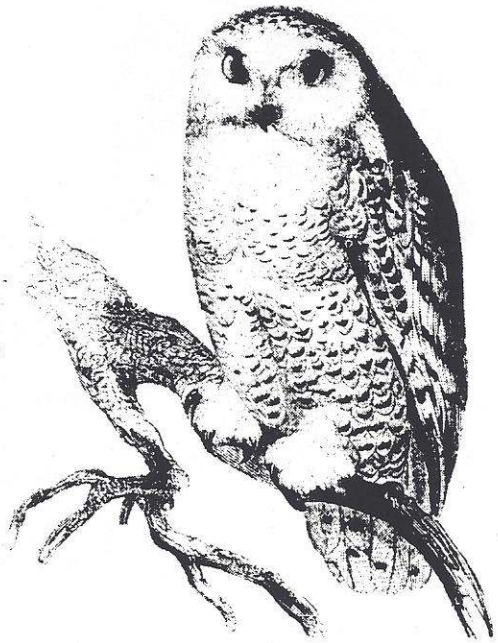
  [Provincial/Municipal]

- Transfer jurisdiction of the Roberts Bank backup lands to the B.C Ministry of Agriculture and restrict the uses of these lands to those which are consistent with agriculture.

  [Provincial]

- Preserve farmland by preserving the farmer: enact policies which will permit agriculture to be a viable industry in the Boundary Bay area.

  [Federal/Provincial/Municipal]



Recommendation 3

Co-operate with agricultural land owners to ensure a supply of upland wildlife habitat.

- Establish a Steering Committee of local farmers and wildlife interests who can explore co-operative schemes for conservation easements, covenants, tax incentives, and transfer of development rights to encourage and fund conservation of wildlife habitat.
- Create a "Boundary Bay Conservation Program" which will fund the aims of the Buffer Zone. This program could be linked with existing agencies, eg. Nature Trust, and could be managed by the Biosphere Reserve Management Committee/farming-wildlife steering committee.

  [Federal/Provincial/Municipal/Public]
- Ensure a supply of oldfield habitat close to core areas by implementing a rotational leasing scheme, based on those used elsewhere in North America and Europe, whereby farmers are paid to leave fields uncultivated.

  [Federal/Provincial]

- Implement and fund the Pacific Coast Joint Venture farm stewardship schemes.

  [Federal/Provincial/Non-government organisations]
- Promote and fund ecologically sustainable farming techniques and stewardship schemes to counteract wildlife depradation.

  [Federal/Provincial]
- Promote and fund the retention of hedgerows and ditch vegetation to both protect farm fields from litter and provide important wildlife habitat. Fund and plant shelter belts and hedgerows as buffers at the urban/rural interface.

  [Federal/Provincial/Municipal]

Recommendation 4

Purchase land for parks within the Boundary Bay ecosystem.

- Boundary Bay Regional Park should be expanded and possibly upgraded to Provincial or National Park status.

  [Regional and/or Provincial/Federal]
- Blackie Spit should be formally recognised as a nature park

  [Municipal]
- Linear parks should be secured to enhance corridor habitats and to allow for increased demand from walkers and wildlife viewers.

  [Regional/Municipal]
- Parks and vehicular access must be sited in co-operation with the agricultural community so that they do not conflict with agricultural operations.

  [Regional/Municipal]

Recommendation 5

Policies and strategies for tourism and recreation use of the Zone of Co-operation of the Biosphere Reserve should be determined cooperatively.

- The increasing interest in wildlife-related outdoor pursuits should be recognised and reflected in planning goals.

[Provincial/Municipal]

- Research and educational establishments should be encouraged.

[Federal/Provincial/Municipal]

Recommendation 6

Designate a lead agency or agencies to implement the goals of the Biosphere Reserve.

- This lead agency could be a government ministry or agency, a joint venture agency, eg. Nature Trust, or an independent trust or foundation established for this purpose.
- The lead agency should seek the co-operation of all stakeholders and apply for UNESCO status as a Biosphere Reserve.
- The lead agency should oversee the formation of a Local Steering Committee and a Biosphere Reserve Management Committee, and initiate funding methods.

Recommendation 7

Implement a Community Pride program to increase public awareness of heritage values within the Boundary Bay ecosystem.

[Municipal]

Recommendation 8

Set up a Commission to examine transborder environmental issues in the Georgia Strait/Boundary Bay/Puget Sound area.

- Establish a Georgia Basin Commission

[Provincial]

Recommendation 9

Encourage and fund research, ecological inventories and monitoring

- Investigate the ecological requirements for migratory birds that use the delta for staging.
- Investigate the ecological requirements for populations of shorebirds, waterfowl and birds of prey that use the delta for wintering.
- Investigate the distribution and abundance of riparian bird communities in the Boundary Bay ecosystem.

Conclusion

The Boundary Bay ecosystem is proven to have internationally and nationally significant wildlife populations

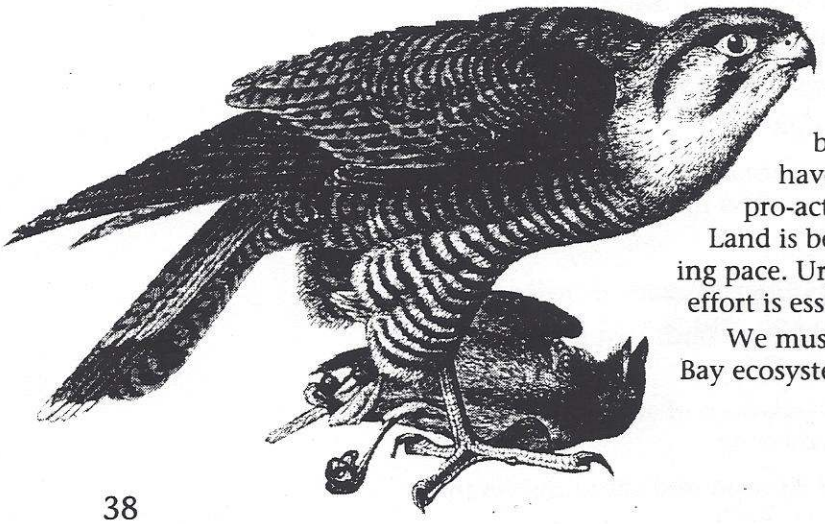
The Boundary Bay ecosystem is proven to have internationally and nationally significant wildlife populations. Waterfowl and shorebirds migrating on the Pacific flyway use the aquatic and upland habitats of the ecosystem as a vital stop-over. Many thousands of waterfowl also over-winter. Many species of raptor, in the largest densities in Canada, winter on the uplands, and are dependent on the Townsend's vole, waterfowl and wintering songbirds for prey. Cooper's hawk and barn owl, both vulnerable species in Canada, are resident species. Fish and shellfish species, including salmon, eulachon, cut-throat trout and Dungeness crab, are numerous and economically important. Biologically interesting species, such as the sub-arctic flora of Burns Bog, and the anise swallowtail butterfly of Boundary Bay, abound in the ecosystem.

Agriculture is the major industry and land use in the ecosystem, which also includes urban and industrial centres and a network of transportation corridors. Agricultural land is widely utilised by wildlife, particularly in the winter. Although there are some specific problems, such as crop depredation, agriculture and wildlife are able to co-exist.

The Boundary Bay ecosystem has important heritage and cultural aspects. Historically the area has been used by many native peoples and archaeological remains are plentiful on land above the floodplain. Pioneer families, who dyked and farmed the delta, built houses which are now considered heritage homes.

The wildlife of the Boundary Bay ecosystem are threatened by loss and degradation of their habitats. Urban and industrial expansion and competition for alternative land uses are reducing the land available for wildlife to near-critical levels. The wetland areas are also threatened by water pollution from urban and marine sources. Existing designations to protect agricultural land and wildlife habitat are proving to be weakly legislated.

The proposal for a Boundary Bay biosphere reserve is based on the broad scope needed for ecosystem management in this region. The biosphere reserve concept, already in use in 280 locations world-wide, allows for local involvement, international recognition and a co-operative and co-ordinated approach to land use planning. The program would gradually develop and evolve as the needs of the ecosystem were identified. For example in the Waterton Biosphere Reserve the program was initiated by the lead agency (Parks Canada) who set up a broad-based management committee and a technical group of experts. Public seminars played a vital role in making people aware of the issues while reinforcing the biosphere reserve concept: demonstrating the value of integrating conservation with development (Lieff, 1987).



The recommendations made in this proposal are preliminary actions for protection of the Boundary Bay ecosystem. The process is ongoing: public education will continue to be a key aspect. Governments at all levels will have to become conversant with the issues and pro-active in supporting the ecosystem approach. Land is being alienated for wildlife at an ever-increasing pace. Urgent action is required and a co-ordinated effort is essential.

We must act together now to protect the Boundary Bay ecosystem!

APPENDIX 1.

Plant and Animal Species Mentioned in the Text

Nomenclature from several recent references

Plants

Eelgrass	*Zostera marina*
Sundew	*Drosera rotundifolia*
Cloudberry	*Rubus chamaemorus*
Labrador tea	*Ledum palustre groenlandicum*
Bog rosemary	*Andromeda polifolia*
Bullrush	*Scirpus paludosus; scirpus americanus*
Cattail	*Typha latifolia*

Marine Invertebrates

Amphipod	*eg. Orchestia traskiana*
Dungeness crab	*Cancer magister*
Oyster	*eg. Ostrea lurida, Crassostrea gigas*

Butterflies

Anise swallowtail	*Papilio zelicaon*
Red admiral	*Vanessa atalanta*

Fish

White sturgeon	*Acipenser transmontanus*
Coastal cut-throat trout	*Salmo clarki*
Herring	*Clupea harengus pallasi*
"Pacific Salmon" include:	
Sockeye salmon	*Oncorhynchus nerka*
Coho salmon	*Oncorhynchus kisutch*
Chinook salmon	*Oncorhynchus tshawytscha*
Chum salmon	*Oncorhynchus keta*
Pink salmon	*Oncorhynchus gorbuscha*

Birds

Canada goose	*Branta canadiensis*
Brant	*Branta bernicla*
American wigeon	*Anas americana*
Cooper's hawk	*Accipiter cooperi*
Northern harrier	*Circus cyaneus*
Bald eagle	*Haliaeetus leucocephalus*
Peregrine falcon	*Falco peregrinus*
Merlin	*Falco columbarius*
Great blue heron	*Ardea herodius*
Sandhill crane	*Grus canadensis*
Dunlin	*Calidris alpina*
Western sandpiper	*Calidris mauri*
Barn owl	*Tyto alba*
Pileated woodpecker	*Dryocopus pileatus*
Warbling vireo	*Vireo gilvus*
European starling	*Sturnus vulgaris*

Mammals

Townsend's vole	*Microtus townsendii*
Black bear	*Ursa americanus*
Raccoon	*Procyon lotor*
Harbour seal	*Phoca vitulina*
Opossum	*Didelphis marsupialis*

Family names have also been used which include a number of species. These include:

Loons:

Red-throated loon	*Gavia stellata*
Pacific loon	*Gavia pacifica*
Common loon	*Gavia immer*
Yellow-billed loon	*Gavia adamsii*

Grebes:

Pied-billed grebe	*Podilymbus podiceps*
Horned grebe	*Podiceps auritus*
Red-necked grebe	*Podiceps grisegena*
Eared grebe	*Podiceps nigricollis*
Western grebe	*Aechmophorus occidentalis*

Herons:

Great blue heron	*Ardea herodias*
Cattle egret	*Bubulcus ibis*
Great egret	*Casmerodius albus*
Green-backed heron	*Butorides striatus*
Black-crowned night-heron	*Nycticorax nycticorax*

Swans:

Tundra swan	*Cygnus columbianus*
Trumpeter swan	*Cygnus buccinator*

Geese:

Greater white-fronted Goose	*Anser albifrons*
Snow goose	*Anser caerulescens*
Black brant	*Branta bernicla*
Canada goose	*Branta canadensis*

Ducks:

Wood duck	*Aix sponsa*
Green-winged teal	*Anas crecca carolinensis*
Mallard	*Anas platyrhynchos*
Northern pintail	*Anas acuta*
Blue-winged teal	*Anas discors*
Cinnamon teal	*Anas cyanoptera*
Northern shoveler	*Anas clypeata*
Gadwall	*Anas strepera*
Eurasian wigeon	*Anas penelope*
American wigeon	*Anas americana*
Canvasback	*Aythya valisineria*
Greater scaup	*Aythya marila*
Lesser scaup	*Aythya affinis*
Harlequin duck	*Histrionicus histrionicus*
Oldsquaw	*Clangula hyemalis*
Black scoter	*Melanitta nigra*
Surf scoter	*Melanitta perspicillata*
White-winged scoter	*Melanitta fusca*
Common goldeneye	*Bucephala clangula*
Barrow's goldeneye	*Bucephala islandica*
Bufflehead	*Bucephala albeola*
Hooded merganser	*Mergus cucullatus*
Common merganser	*Mergus merganser*
Red-breasted merganser	*Mergus serrator*
Ruddy duck	*Oxyura jamaicensis*

Birds of prey:

Turkey vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
Bald eagle	*Haliaeetus leucocephalus*
Northern harrier	*Circus cyaneus*
Sharp-shinned hawk	*Accipiter striatus*
Cooper's hawk	*Accipiter cooperi*
Northern goshawk	*Accipiter gentilis*
Red-tailed hawk	*Buteo jamaicensis*
Rough-legged hawk	*Buteo lagopus*
Golden eagle	*Aquila chrysaetos*
American kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine falcon	*Falco peregrinus*
Prairie falcon	*Falco mexicanus*
Gyrfalcon	*Falxo rusticolus*

Shorebirds:

Black-bellied plover	*Pluvialis squatarola*
Lesser golden plover	*Pluvialis dominica*
Semipalmated plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferus*
Greater yellowlegs	*Tringa melanoleuca*
Lesser yellowlegs	*Tringa flavipes*
Willet	*Catoptrophorus semipalmatus*
Spotted sandpiper	*Actitis macularia*
Whimbrel	*Numenius phaeopus*
Long-billed curlew	*Numenius americanus*
Marbled godwit	*Limosa fedoa*
Ruddy turnstone	*Arenaria interpres*
Black turnstone	*Arenaria melanocephala*
Red knot	*Calidris canutus*
Sanderling	*Calidris alba*
Semipalmated sandpiper	*Calidris pusilla*
Western sandpiper	*Calidris mauri*
Least sandpiper	*Calidris minutilla*
Baird's sandpiper	*Calidris bairdii*
Pectoral sandpiper	*Calidris melanotos*
Dunlin	*Calidris alpina*
Short-billed dowitcher	*Limnodromus griseus*
Long-billed dowitcher	*Limnodromus scolopaceus*
Common snipe	*Gallinago gallinago*
Red-necked phalarope	*Phalaropus lobatus*

Gulls:

Bonaparte's gull	*Larus philadelphia*
Mew gull	*Larus canus*
Ring-billed gull	*Larus delawarensis*
California gull	*Larus californicus*
Herring gull	*Larus argentatus*
Thayer's gull	*Larus thayeri*
Western gull	*Larus occidentalis*
Glaucous-winged gull	*Larus glaucescens*
Glaucous gull	*Larus hyperboreus*

Owls:

Western screech owl	*Otus kennicottii*
Great horned owl	*Bubo virginianus*
Snowy owl	*Nyctea scandiaca*
Long-eared owl	*Asio otus*
Short-eared owl	*Asio flammeus*
Northern saw-whet owl	*Ageolius acadicus*

Hummingbirds:

Anna's hummingbird	*Calypte anna*
Rufous hummingbird	*Selasphorus rufus*

Woodpeckers:

Red-breasted sapsucker	*Sphyrapicus ruber*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Picoides villosus*
Northern flicker	*Colaptes auratus*
Pileated woodpecker	*Dryocopus pileatus*

Crows:

Northwestern crow	*Corvus caurinus*
Common raven	*Corvus corax*

Songbirds:

This term is generally used to denote small passerine species, including those from the flycatcher, warbler, chickadee, kinglet, thrush, blackbird and finch families.

For a fuller species list for the Boundary Bay ecosystem, consult Butler, R. and R.W. Campbell, (1987). The Birds of the Fraser River delta: populations, ecology and international significance; Occasional Paper #65 Canadian Wildlife Service.

APPENDIX 2.

Great Blue Herons

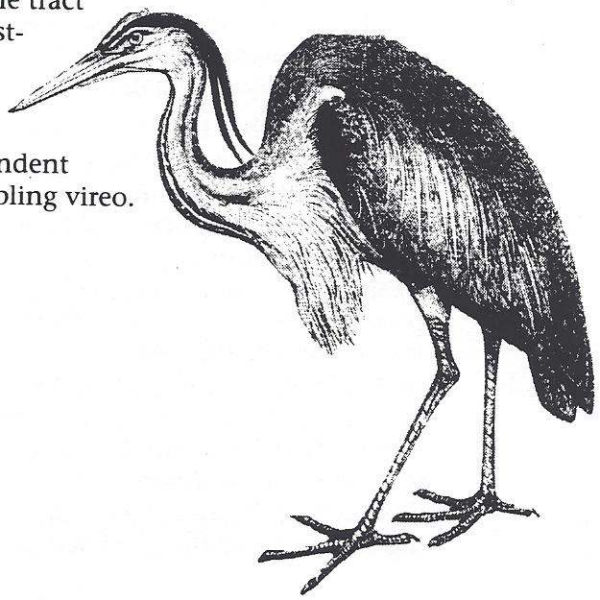
Point Roberts, Washington, and south Surrey each have a colony of great blue herons that feed in and around Boundary Bay. The herons are of a non-migratory subspecies, *Ardea herodias fannini*, peculiar to the Pacific Northwest. While nesting, they feed mostly on fish from extensive local tidal flats. At other seasons they disperse along the coast and in the Fraser delta's extensive agricultural areas. Inland, they prey on a variety of organisms including small mammals, particularly Townsend's vole in old field habitat.

The colony at Point Roberts, larger than any in British Columbia and one of the largest in Washington State, has had over 350 nesting pairs of herons. Having been driven out of Canada by forest clearing in South Delta, it is established in the last large block of suitable nesting forest near Boundary Bay. It is now jeopardised by an encroaching housing subdivision, by a golf course awaiting development, and because it is situated on land being privately held for development. The smaller south Surrey colony has several dozen nests in a successful year. It has moved location several times in the past 20 years, sometimes returning to previous sites as development and disturbance have made successive areas intolerable. Its present site is insecure and marginal at best.

Nesting herons are extremely and unpredictably sensitive to man-made disturbances. Most authorities recommend that a minimum 300 metre buffer zone surround colonies. That is a difficult requirement in an increasingly deforested and urbanised landscape. The present buffer zone around the Point Roberts colony is under constant threat of being compromised by land development. In additiion, protecting such a colony with a minimum buffer zone is adequate only in the short term. The birds need room to manoeuvre over long periods as the forest changes, and the Point Roberts forest is changing rapidly. Washington State has no overall plan to protect the colony. The south Surrey colony is confined to a small stand of conifers on a disturbed, privately-owned, rural holding, about its last refuge in an area where most nesting habitat has been destroyed. As in the case of Point Roberts, there is no overall plan to protect or improve the colony.

If great blue herons are to be maintained as a viable nesting population in the Boundary Bay area, efforts must be made to permanently secure suitable nesting habitat. In Point Roberts it might still be possible to save the colony's present nesting site, but at great cost. In south Surrey it might be impossible to find a genuinely suitable refuge within the urbanised stands of trees that remain locally. It might be simpler to start a new forest on a suitable tract of dedicated property with a view to supporting nesting herons in 30 or 40 years time.

It is worth noting that saving the large heron nesting forest in Point Roberts might result in the saving of local populations of other forest-dependent birds, such as the pileated woodpecker and the warbling vireo.



APPENDIX 3.

Golf Courses, Existing and Proposed in the Boundary Bay Area (numbers correspond to numbers on map 8)

EXISTING GOLF COURSES

DELTA, B.C	SURREY, B.C	WHATCOM CO.,WA.
1.Beach Grove	6.Surrey	38.Semiahmoo
2.Tsawwassen	7.Guilford	39.Birch Bay
3.Delta	8.Nico Wynd	41.Sea Links
4.Sunshine Hills	9.Hazelmere	42.Grand View
5.Captains Cove *	10.Peace Portal	43.Dakota Creek
	11.Meridian	
	12. Riverside	
	13.Coyote Creek	
	14.Greenside	
	15.Sunrise	

*Approved, not built

PROPOSED GOLF COURSES (1991)

DELTA, B.C	SURREY, B.C	WHATCOM CO, WA.
16.Bayview	28.Northview*	36.Pt.Roberts
17.Boundary Shores	29.Runeymede	Country Club
18.Dornoch Dunes	30.Hillside	37.Lily Pt.Resort
19.Pacific Lagoons	31.Pacific Panorama	40.Unnamed
20.Delta Pines	32.Westcraft	44.Unnamed
21.Delta Downs	33.Surrey extension	
22.Del Eden	34.Unnamed	
23.Crescent Island	35.Unnamed	
24.Tsawwassen extension**		
25.Genstar		
26.Western Lands		
27.Unnamed		

*Rezoning approved, Development permit pending
**Approved 1992

In November 1991 the Provincial government rescinded Order-in-Council 1141/88 which had allowed golf courses as an outright use on farm land within the Agricultural Land Reserve. A moratorium was placed on golf course development while the Agricultural Land Commission studied existing proposals: their decisions on individual courses was released in early 1992. This course of action by the Provincial government effectively put an end to most of the golf courses proposed for the Boundary Bay ecosystem. However Northview in Surrey (#28) was allowed to proceed, since it had received fourth reading of the zoning bylaw from the Municipality of Surrey. This 36-hole golf course is on good agricultural land in the floodplain of the Serpentine River, an area identified in the wildlife report of the Boundary Bay Study, as an important waterfowl habitat (Butler (ed.),1992). In addition Bayview golf course (#16), adjacent to the Boundary Bay dyke at 64th St, awaits a decision on bylaw approval by Delta Municipality, having also received the go-ahead from the Agricultural Land Commission. This site

is very important ecologically. Boundary Shores golf course (#17), adjacent to the Boundary Bay dyke at 72nd St, and also in an extremely sensitive ecological area, is still the subject of litigation at press time (June 1992). Tsawwassen golf and country club (#24) was successful in its application to build a further 9 hole golf course on land adjacent to the existing course. This site is also in the Agricultural Land Reserve and was much used by wildlife.

APPENDIX 4.

1991 Puget Sound Water Quality Management Plan

This is a comprehensive plan that includes action programs for cleaning up and preventing pollution of Puget Sound. Several of these action programs contain elements which protect fish and wildlife habitat, address public education and involvement, nonpoint source pollution, shellfish protection, municipal and industrial discharges, contaminated sediments and dredging, stormwater, wetlands protection, and spill prevention and response. Of special note is the watershed planning programs activated by the Plan, and in particular current planning underway for the Dakota Creek Watershed, which drains into Drayton Harbor.

Proposed Northwest Straits, Washington, National Marine Sanctuary

The National Marine Sanctuary Program seeks to protect unique marine and coastal resources through research, education, and conservation of ecological, historic and aesthetic values. The Northwest Straits study includes the water adjacent to the Canadian border, at the mouth of Boundary Bay. This program is in the planning/preliminary development stages and so far has not produced a complete management plan.

Whatcom County Shoreline Management Program

The Whatcom County Shoreline Management Program was adopted in 1976 and generally applies to large streams and lakes, the marine waters, and adjacent shorelines. The planning for and fostering all reasonable and appropriate uses to promote and enhance the public interest. The program protects against adverse effects to the public health as well as shoreline and aquatic vegetation and wildlife.

Whatcom County Critical Areas Protection

As part of a statewide growth management process, Whatcom County recently adopted a Temporary Critical Areas Ordinance, to be followed by a permanent ordinance in 1995. The Ordinance is designed to help protect the health, safety and welfare of the public by allowing careful development in and around wetlands, streams, fish and wildlife habitat, aquifer recharge, and geologically hazardous areas.

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The Boundary Bay Conservation Committee

The Boundary Bay Conservation Committee (BBCC) is a voluntary body comprising individual members and representatives of non-government organisations. The Committee believes in the preservation and the enhancement of Boundary Bay's ecological values. The Committee recognises the important role that the agricultural community plays in maintaining much of the wildlife habitat around the bay and seeks to develop links between agricultural and conservationist goals.

The BBCC is committed to the encouragement of all sectors of the public in the appreciation, protection, conservation and management of the Boundary Bay area, and to serving as a means of communication between government agencies and environmentally-concerned organisations and individuals.

For additional copies of this proposal contact:
The Boundary Bay Conservation Committee
Box 1251
Delta, British Columbia
V4M 3T3
Phone: (604) 943-6406