

Burns Bog Ecological Conservancy Area Management Plan May 2007



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Metro Vancouver Residents

Re: Burns Bog Ecological Conservancy Area Management Plan

Burns Bog is a unique wetland of ecological significance not only for the region but indeed for the world. To guide its restoration and ongoing management, the Burns Bog Ecological Conservancy Area Management Plan has been adopted by the Government of Canada, the Province of BC, the Corporation of Delta and Metro Vancouver.

The plan was produced by a team led by Metro Vancouver and including representatives from the Government of Canada, Province of BC and Municipality of Delta. The planning team was supported by advice from a Scientific Advisory Panel of distinguished scientists with specialties relevant to bog ecosystems.

The plan sets out policy direction and actions that are designed to maintain the Bog's ecological integrity. Metro Vancouver will oversee implementation of the plan with overall responsibility for bog management and the Municipality of Delta has specific responsibility for water regime and fire management.

Metro Vancouver Board adopted the Burns Bog Ecological Conservancy Area Management Plan on May 25, 2007. I want to thank everyone who was involved in the planning process.

Yours truly,

Lois E. Jackson
Chair, Metro Vancouver Board
LEJ/EA/mlt/ldm

BURNS BOG ECOLOGICAL CONSERVANCY AREA MANAGEMENT PLAN

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1.0 INTRODUCTION

Burns Bog is a 5000-year-old raised bog located near the mouth of the Fraser River in the Municipality of Delta, British Columbia (Canada). The Bog is an area of global ecological significance based on its chemistry, form, flora and large size, exhibiting typical raised bog ecosystem characteristics. While there are many bogs in Canada, raised or domed bogs are less common. Raised peat bogs occur in areas where the water table is at or near the ground surface for most of the year, and water drainage is inhibited by relatively flat topography. When bog plants die, they decompose very slowly because the high water table excludes air that accelerates the decomposition process. Over time, a mound of peat slowly accumulates as the plants grow, decline and slowly decompose. The mound or dome grows fastest at the center of a raised bog. The water table follows the domed shape of the bog. The vegetation is mostly sphagnum mosses and the few other plant species that can tolerate the very acidic and wet bog conditions.

Historically, Burns Bog covered about 4,800 hectares (11,860 acres). However, it is about half that size today with the encroachment of agriculture and industrial land uses. The surrounding rural and urban development affects the vegetation and wildlife within the Bog and isolates the Bog from other natural areas. The hydrology and ecology of the remaining Bog has been further disrupted by peat extraction and related activities. At present, about twenty-nine percent (29%) of the Bog remains relatively undisturbed.

Burns Bog is one of Canada's largest undeveloped land masses within an urban area. It supports distinctive bog vegetation communities and recognized rare and endangered plant and wildlife species. While not pristine, the Bog is believed to maintain enough of its ecological integrity (wholeness) to allow its restoration over time.

1.1 Public Acquisition and Management of the Lands

In March 2004, 2,042 hectares (5,045 acres) of Burns Bog were purchased by Canada, British Columbia, GVRD and Delta. These lands are now owned by the Province, GVRD, and Delta. The three levels of government committed to Canada, in a Conservation Covenant, to manage these lands as a functional raised bog ecosystem. This covenant is registered on land title.

GVRD committed to prepare a management plan for the lands in collaboration with the other purchasing agencies to guide the protection and management of the hydrologic regime, plant and wildlife communities, access, habitat enhancement and restoration requirements.

1.2 Planning Process

In August 2004, a Planning Team was established with representatives of the four purchasing agencies to guide the preparation of the management plan. Mr. Bob Peart was hired by GVRD to facilitate and coordinate the preparation of the Management Plan.

A Scientific Advisory Panel (SAP) was established in January 2005 to provide technical advice to the Planning Team on hydrology and bog ecology based on the best science of the time. SAP members included Allan Dakin, Richard Hebda, John Jeglum, Hamish Kimmins, Geoff Scudder, and Paul Whitfield, with David Bellamy and Bert Brink as honorary members. The activities of the Scientific Advisory Panel included:

- Identification of short-term and long-term management strategies to protect the ecological assets of the bog lands;
- Review of existing and new information on the Bog, and identification of information gaps and critical issues needing short term action; and
- Review of work plans for the bog lands provided by the managing agencies.

The Facilitator and Planning Team communicated with the Tsawwassen, Semiahmoo and Musqueam First Nations, the public, interest groups and societies, adjoining landowners and agencies during the management planning process. Public information meetings were held in Delta and included displays, presentations and opportunities for questions. A Burns Bog website was established at www.gvrd.bc.ca/burnsbog to provide readily available information on the lands, their acquisition, short-term management actions, the management planning process and electronic access to the Facilitator. SAP meeting notes are available on the Burns Bog website.

2.0 BACKGROUND

2.1 Formation of Burns Bog

The stage was set for the development of Burns Bog about 11,000 years ago during the formation of the Fraser River delta. The sediments carried by the melt-waters of receding glaciers were deposited as their flow slowed upon meeting the waters of the Strait of Georgia. Over time the delta was formed with successive deposits of sediments.

Subsequently, the delta-building process continued with the regular deposition of sediments in the spring high river flows. Smaller lighter sediments were carried further and deposited in the lowest lying areas where the water table was at or near the ground surface throughout the year. These fine silt and clay sediments formed layers that became relatively impermeable to water. Eventually, the annual floodwaters stopped reaching the outlying areas leaving shallow basins that were sealed by clay sediments. Subsequently the main source of water to these basins was nutrient-poor precipitation. Abundant annual precipitation kept the water table at or near the ground surface throughout the year. The nutrient-poor environment favoured the growth of sphagnum mosses and a few other bog species. Bog water became more acidic as sphagnum mosses proliferated, further favouring the bog plant species.

As plants died and sank to the bottom of the basin they turned into peat. Over time, a domed bog was formed with a living layer of sphagnum mosses at the surface called the acrotelm (top 50 cm layer) and a thicker decomposing layer of peat below called the catotelm. Water drains outward from the bog into its lagg or transition zone before moving into the flat neighbouring lowlands.

The four bogs that exist today on the delta deposits of the Fraser River are the Greater and Lesser Lulu Island Bogs in Richmond, the Big Bend Bog in Burnaby and Burns Bog in Delta (Attachment 1, map). These four bogs may once have been joined but now they each exist in delicate ecological balance with their urban and rural surroundings.

2.2 Significance of Burns Bog

Burns Bog is one of the southernmost raised bogs in western North America and represents the southernmost extension of sphagnum-dominated domed bogs in Canada. Due to the influence of oceanic precipitation, coastal bogs are chemically different from those found further inland. Coastal bogs also support a different vegetative community than continental bogs.

Burns Bog is also unique because of its size. It is significantly larger than other bogs in the region. As well, there are a number of plant species that are regionally unique to Burns Bog.

2.3 Cultural History

Human use of Burns Bog dates back many years. The Bog is within the traditional use areas of the Tsawwassen, Semiahmoo, Musqueam and other First Nations. First Nations peoples hunted large mammals and waterfowl and gathered berries, leaves and sphagnum moss for household, ceremonial and medicinal purposes. Summer village sites have been documented along the Fraser River in the vicinity of Burns Bog. The St. Mungo archaeological site is located near the Alex Fraser Bridge at the north end of Highway 91. The Bog may have served as a canoe portage route between the Fraser River and Boundary Bay.

European settlers began farming in this area as early as the 1870's and farms were well-established by the 1900's. The outer edges of the Bog, particularly to the south and west, were drained and filled for farmland. The Bog is believed to be named for Dominic Burns who purchased the Great Delta Bog in the early 1900's for \$26,000. Peat was gathered in the war years to provide a sterile wound dressing material.

Peat extraction in Burns Bog began in the 1940's and continued into the 1980's. Ditches were built to drain the Bog and to facilitate peat removal. The peat was used primarily as a soil ingredient and amendment in the horticultural and greenhouse industry.

2.4 Recent Bog History

In the 1980's and 1990's a variety of land use proposals for Burns Bog were floated in the community, including housing, industry, port, racetrack, golf course and theme park/exhibition. Throughout this time the Delta community and others effectively expressed their view that the Bog should be protected in its natural state. In 1988 the Burns Bog Conservation Society was formed to raise community awareness about the natural values of the Bog through education. In 1999 a referendum in Delta found seventy-five percent (75%) of respondents in favour of their Municipality participating in the purchase of Burns Bog for its long-term protection.

In the 1990's significant studies of Burns Bog were undertaken. The assessment of Burns Bog by Catherine Berris and Associates found that the Bog had high potential as a protected area. An ecosystem review of Burns Bog was undertaken by the Province and the landowner to determine the factors crucial to preserving the Bog as a viable ecosystem. The BC Environmental Assessment Office managed the ecosystem review under the direction of Richard Hebda. Gregory McDade facilitated First Nations, stakeholder and public consultation for the review. Consulting scientists were retained to conduct technical investigations. The Burns Bog Ecosystem Review was completed in March 2000.

In March 2004 Canada, British Columbia, GVRD and Delta purchased 2042 hectares (5,045 acres) of Burns Bog for \$73 million. The purchase contributions were Canada (38.5%), BC (39%), GVRD (14.3%) and Delta (8.2%).

3.0 MANAGEMENT CONTEXT

The 2,042 hectares (5,045 acres) of Burns Bog are owned by British Columbia, Delta and GVRD. The Province owns 888 hectares (2,193 acres), referred to as the Provincial Lands, located in south-central part of the Lands (Attachment 2). Delta and GVRD jointly own 1,154 hectares (2,852 acres), referred to as the Local Government Lands, surrounding the Provincial Lands. GVRD and Delta manage both the Local Government Lands and the Provincial Lands as an Ecological Conservancy Area. GVRD has overall

management responsibility for the Lands and Delta has specific responsibility for drainage management in and around the Lands and for fire management.

The Conservation Covenant registered on the land titles provides the following guiding management principles:

To the greatest extent possible:

- Maintain in perpetuity a large contiguous undeveloped natural area for the purpose of protecting the flora and fauna that depend on the Bog;
- Manage the Bog as a functional raised bog ecosystem as understood by the best science of the time;
- Maintain the extent and integrity of the water mound and the peat that encloses it, and in particular the upper porous acrotelm upon which the persistence of the bog ecosystem depends; and
- Prevent any occupation or use of the Bog that will impair or interfere with the current state of the Bog or the natural, scientific, environmental, wildlife or plant life values relating to the Bog.

Two additional properties are included in this management plan: Parcel 2 owned by the City of Vancouver, and Delta Nature Reserve owned by Delta (Attachment 2). Parcel 2 adjoins the south-west corner of the Local Government Lands, and Delta Nature Reserve is located east of Highway 91. The owners of these properties intend to transfer them to the joint ownership of Delta and GVRD in the future. On transfer, conservation covenants will be registered on the land titles.

Existing recreational use in Delta Nature Reserve will be recognized in this conservation covenant. GVRD will assume overall management responsibility for the lands and Delta will be responsible for drainage management and fire management. For purposes of this management plan, the Provincial Lands, the Local Government Lands, Parcel 2 and Delta Nature Reserve are collectively referred to as the 'Bog Lands'.

4.0 THE BOG LANDS AND THE GVRD

The Bog Lands form part of the Region's Green Zone for purposes of the GVRD Growth Management Plan. The Green Zone identifies important watersheds, major parks, farmlands, wildlife habitat and wetlands in the Region. Burns Bog lands were acquired to protect this important component of the Green Zone in perpetuity.

The GVRD Regional Parks and Greenways Plan (RPGP) was adopted in September 2005 and established the direction and priorities for park and greenways programs and services over the coming decade. The goals of the RPGP illustrate the importance of acquiring the Bog Lands and the expectations for their management. The first goal of the RPGP identifies the protection and enhancement of regional landscapes, biodiversity and heritage features. The strategies associated with this goal include securing and enhancing regionally significant landscapes and critical habitats, and managing conservation lands and habitats to protect their biodiversity and environmental and cultural integrity.

The Bog Lands will be designated as an Ecological Conservancy Area (ECA) by GVRD to clearly identify these lands as a specially protected area for purposes of their management. The ECA designation identifies the clear priority for conservation and protection of the Bog Lands.

5.0 VISION AND OBJECTIVES FOR BURNS BOG ECA

The Vision, Mission and Management Objectives provide direction and guidance for the management of the Bog Lands and have been adopted by the purchasing agencies. They are to be followed to the greatest extent possible, subject only to fiscal affordability.

5.1 Vision – 100 Year Timeframe

Burns Bog is an internationally recognized restored bog that is naturally evolving over time into a self-sustaining raised bog ecosystem that is appreciated regionally for its public and education programs and scientific research.

5.2 Mission

To restore the raised bog ecosystem and maintain its integrity in accordance with the best scientific principles and stewardship practices of the time, in collaboration with the community, offering opportunities for education/interpretation, sustainable recreation and scientific research.

5.3 Management Objectives

The management objectives build on the Vision and Mission. In their application, management objectives must be consistent with the Conservation Covenant.

A. Ecological Management Objectives

- Protect and restore raised bog processes, recognizing the limitations that regional urbanization and anticipated climate change may impose;
- Implement monitoring systems that track the bog's hydrology and water regime in addition to other biological processes;
- Support scientific research on raised bog ecology and restoration, to further the understanding and recognition of bogs;
- Control wildfires;
- Protect and manage threatened or endangered species, as appropriate;
- Minimize or eliminate, if possible, introduced and invasive plant and animal species;
- Support efforts to establish wildlife corridors outward from the Bog Lands to natural areas (e.g. Fraser River, Boundary Bay, and Panorama Ridge); and
- Recognize the rights and need to maintain, repair and/or replace existing utilities in the Bog.

B. Social Management Objectives

- Implement a collaborative outreach stewardship program with adjacent landowners and neighbours;
- Control encroachment and unauthorized access and use;
- Provide opportunities for public education and sustainable recreation as community amenities;
- Encourage on-going community involvement in the long-term management of the Bog Lands including community stewardship and education services;

- Respect First Nations rights that may exist to access Provincial Lands for ceremonial and traditional uses; and
- Apply best environmental management practices in the design, construction and operation of potential future facilities.

C. Fiscal Management Objectives

- Encourage private, non-government organization and public philanthropy through the Pacific Parkland Foundation to assist in achieving the long-term management and education objectives of Burns Bog;
- Explore initiatives to off-set restoration and operating costs; and
- Manage and operate the Bog within a fiscally affordable framework through partnered collaboration of resources and expertise.

5.4 Scientific Guidelines

The Scientific Advisory Panel and the Facilitator recommended the following guidelines to focus discussions about the science of bog protection and restoration:

- Return Burns Bog to an ecological condition shaped by raised bog processes, buffered from disruptive or disturbing adjacent processes on the landscape, within a timeframe of 100 years;
- Achieve this ecological condition by maintaining characteristic ecological processes, structure and biota interacting over time, while recognizing the directional forces of urbanization, adjacent land uses and climate change;
- Measure and analyze the ecological condition using the following indicators:
 - Characteristic ecological processes: hydrological systems and water chemistry, peat accumulation, trophic interactions (exchange of energy) and connection with adjacent ecosystems and landscapes;
 - Structure and composition: the set of plant species or communities that define the bryophyte dominated shrubby structure and function of the bog habitat;
 - Biota: the set of key, rare and/or critical acidophilic species (plants, vertebrates and invertebrates) that is collectively capable of natural or progressive evolution into other related bog ecosystem(s) with ecological integrity.

The Scientific Advisory Panel believes that a focus on maintenance and restoration of healthy ecological processes is fundamental to the sustainable management of Burns Bog.

6.0 NATURAL RESOURCE MANAGEMENT

6.1 Ecosystem Perspective

The management focus of the Bog Lands is the maintenance of ecological integrity and the preservation of the lands as a healthy and viable ecosystem. Maintaining functioning ecosystems requires the adoption of management principles focused on retaining ecosystem elements and processes. Conservation efforts focused on the preservation of a single species may run the risk of losing the ecosystem that supports the target species. Instead, an ecosystem approach focuses on the essential processes, functions and interactions among organisms and their environment and recognizes the interconnectivity of the elements within an ecosystem. This approach also addresses the vulnerabilities and limitations of ecosystems and recognizes cumulative effects and response thresholds within ecosystems.

Management activities for the Bog Lands must focus on sustaining and restoring the raised bog processes. While many aspects of the Bog are still functional and key elements persist, the constituent ecosystems are in a degraded and fragile state. Such a condition threatens the Bog's ecological integrity.

With an ecosystem approach, management is based on best available scientific knowledge about the ecosystem and its dynamics. While managing the Bog Lands will require human intervention at least in the short-term, the goal is a return to an ecological condition shaped by raised bog processes.

The Bog Ecosystem

A bog is a mossy, peat-covered or peat-filled wetland that develops on open terrain where the water drainage is restricted. The water supply for a bog comes almost

exclusively from precipitation, resulting in a nutrient-poor acidic ecosystem. With limited drainage, the surface of a bog is frequently covered with small ponds.

There are three types of bogs: flat or sloped bogs, blanket bogs and raised bogs. Burns Bog is a raised bog, also known as a domed bog. Raised bogs are a special type of bog that form in mild, wet climates. The estuarine (river) and coastal location, in combination with its large size, make Burns Bog unique. Burns Bog exhibits the classic characteristics of a raised bog ecosystem: (Attachment 3)

- An internal water mound surrounded and enclosed by peat;
- Acidic nutrient-poor water from precipitation as its water source;
- A two-layered composition; and
- Widespread peat-forming plant communities dominated by sphagnum mosses and members of the Heather family.

The essential characteristic of a raised or domed bog is its water mound. The water mound consists of:

- The upper layer or acrotelm (top 50 cm layer): The acrotelm is the living layer of the bog where the sphagnum mosses grow, driving the peat-forming process. The acrotelm is vital to the persistence of the water mound. Its porous structure plays a key role in water management by regulating the storage and release of water to reduce the variation in the level of the water table.
- The lower layer or catotelm: The catotelm is the bottom layer of very dense peat that is permanently below the water table. The catotelm and the impermeable clay soils below restrict the movement of water out of the water mound.
- The rand: The rand refers to the sloping sides of the dome;
- The perimeter transition zone or lagg: The lagg is located at the perimeter of the bog and is also referred to as the discharge zone. Excess water from the bog collects at the lagg and drains away into the surroundings. The lagg acts as a buffer between the nutrient-poor waters of the bog and the higher nutrient waters surrounding the bog.

The ecological viability of the Bog is directly dependent upon the extent and integrity of the water mound and the peat that encloses it.

6.2 Hydrology

Water is the single most important factor in the raised bog environment. Water inflow/outflow (balance) and water storage are essential factors determining the viability of the ecosystem. A high water table is critical to all peat communities. Burns Bog depends entirely upon precipitation for its water supply. To survive, the amount of incoming water from precipitation must be greater than the water loss from evaporation, transpiration and drainage outflow.

Two issues currently threaten the hydrology of Burns Bog:

- Reduced bog area: About twenty-nine percent (29%) of the original surface of the bog's water mound remains intact; and
- Ditching: Water from the Bog flows outward from the water mound through an extensive network of man-made ditches.

Originally, excess water traveled through natural channels to the lagg. Extensive networks of ditches were built in Burns Bog to create drier conditions to support peat extraction and cranberry farming. About 110 kilometres of ditches drained nearly forty percent (40%) of the Bog. In the future, climate change may become a threat to Burns Bog if drier summers prevail.

Peat extraction removed the upper acrotelm layer and the peat located in the catotelm layer. In addition, ditching compromised the acrotelm's water storage and regulation capability over a broader area. Ditches increase the volume and speed at which water leaves the bog. Peat decomposes faster in the drier ditched environment. Several feet of peat have been lost over the last 100 years due to accelerated decomposition caused by lower water table levels.

The drier growing conditions support the establishment of woody shrubs and trees like Shore Pine. As woody plants grow, their transpiration rates increase significantly and

the overall water loss from the bog increases. Over time, the extent of woody shrubs and trees in Burns Bog has increased significantly.

Burns Bog has a small overall annual water surplus (precipitation greater than outflows) estimated at about 200 mm. However, the Bog experiences water deficits in the summer months, particularly in July when it may lose 80-90 mm more water than it receives. The seasonal water table variation in Burns Bog is greater than in an un-ditched bog.

The Scientific Advisory Panel recommended that water inflow and outflows from the Bog be identified and tracked in a water balance model, to monitor the macro-health of the bog ecosystem. Problematic outflows could be identified and addressed, where possible. A weather station is being installed in the western part of the Bog Lands. Climatic data will be regularly recorded to provide seasonal and annual records specific to the Bog Lands.

The 2000 Burns Bog Ecosystem Review concluded that a number of features strongly favour successful restoration of the Bog, including its large size, the existence of many relatively large patches of undisturbed bog vegetation, a large zone of natural vegetation surrounding the disturbed zone and the central (versus peripheral) location of most of the historic peat extraction sites.

With the advice of the Scientific Advisory Panel, a pilot ditch-blocking program was undertaken in 2005 in the south-west area of the Bog Lands in an effort to control water outflow and raise water levels (Attachments 4 and 5). The pilot program included the installation of piezometers (in-ground instruments for the on-going measuring and monitoring of water table levels) and the establishment of vegetation plots to monitor vegetation response to rising water levels.

In the past, piezometers were installed by various parties to measure water table and study the hydrology of the Bog. These piezometers are being re-established where possible and mapped (Attachment 6). Water measurements are being taken regularly and studied with the Scientific Advisory Panel, to better understand water level and

movement, both seasonally and over time. Bog water samples are being analyzed periodically to monitor any changes in characteristics like acidity (pH). Recently two sets of piezometers were installed on the Bog Lands and adjoining lands by the BC Ministry of Transportation and Highways and by an adjoining landowner with the approval of the managing agencies. Hydrological information will be shared from a network of measuring instruments on and adjoining the Bog Lands.

Resident beaver in the Bog Lands also create blockages. Beaver structures have raised water levels locally, and in some cases these structures have been associated with flooding of adjacent properties. The flooding has generally been addressed by controlling the height of the beaver structures. The locations of beaver structures will be integrated into hydrological management programs.

Recommended Actions:

- Develop a water balance model for the Bog Lands to better understand and monitor its hydrology and the amount of water retained by the Bog;
- Continue to monitor the water and vegetation response to the pilot ditch-blocking program in the south-western part of the Bog Lands; and
- Develop an overall ditch-blocking program for the Bog Lands, including implementation timing and monitoring as required, considering the needs of adjoining land owners, perimeter drainage engineering works and the activities of resident beavers.

6.3 The Lagg

The lagg lies at the edge of the bog beside the adjoining non-bog lands and usually supports vegetation like sedges and other wetland species. It receives excess water from the bog before it flows outward. The lagg buffers the bog from mineral-rich waters from the surrounding lands. It is an essential component of a healthy raised bog. However, the Scientific Advisory Panel has confirmed that our scientific understanding of

lagg is rudimentary at this time. Refer to the SAP Workshop Notes on Lagg on the Burns Bog website.

Much of the Bog's original lagg has been lost to other land uses. Some sections of the lagg remain today but are located outside of the Bog Lands. Restoration of lagg is required to achieve and maintain fully functioning raised bog processes and bog integrity. The existing portions of Burns Bog lagg need to be protected and studied to understand their functions and characteristics. The lags of other bogs also need to be studied to identify their physical, hydrological, hydro-chemical and biological characteristics (i.e. flow, gradients, vegetation), forming the knowledge base on which lagg for the Bog Lands can be designed, modeled, built, tested and evaluated.

Recommended Actions:

- Identify remnant pieces of Burns Bog lagg and develop strategies for their protection and management in collaboration with property owners where possible;
- Study remnant pieces of Burns Bog lagg, as well as the lagg of other representative bogs to understand their distinctive physical, hydrological, hydro-chemical, and biological characteristics; and
- Develop strategies for the design, modeling, building, testing and on-going management of lagg for the Bog Lands in collaboration with adjoining property owners where possible.

6.4 Vegetation

Peat-Forming Plant Communities

The Bog Lands have a wide variety of plant associations. Some associations have persisted since the early days of the Bog, and some have evolved in response to more recent changes in bog conditions like lower water levels and peat extraction. Refer to the 2000 Burns Bog Ecosystem Review for more discussion about vegetation.

Peat-forming plant communities (sphagnum mosses) are a defining characteristic of bogs. Peat deposit classification is based on the hydrological structure of bog layers. As

peat-forming aerobic bacteria decompose the sphagnum mosses at the bottom of the acrotelm, the material is gradually incorporated into the catotelm. The water table rises and the bog grows higher. The acrotelm controls water retention and is essential for the continued existence and growth of the bog.

About 800 hectares (1,975 acres) of the original peat-forming plant communities remain in the southern periphery and the northwest sections of the Bog Lands. The Bog Lands support at least twelve species of sphagnum moss, constituting about eighty-six percent (86%) of the region's sphagnum flora. These communities provide examples of original bog habitat and potential re-colonizing stock for other parts of the Bog Lands in the future. If water levels fall, the composition of these remaining bog communities will change. Peat-forming species will recede and species adapted to drier conditions will advance (refer to 6.2 Hydrology and 6.3 Lagg).

The currently lower water table conditions in the Bog Lands support the broader establishment of woody shrubs and trees, like Shore Pine. As water levels rise, the growth and spread of Pines will likely moderate and be controlled. However, these Pine communities have extensive well-established root systems that will likely compromise the re-establishment of peat-forming plant communities. The Scientific Advisory Panel has advised that investigation into the management of the woody shrub and tree communities will be required to develop effective strategies for supporting the re-establishment of peat-forming communities in these areas of the Bog Lands.

Rare and Endangered Species

The Bog Lands continue to support rare plants and plant associations, including lichens and fungi that only grow in bog environments. Several plant species including cloudberry, bog-rosemary, crowberry and velvet-leaf blueberry are isolated populations (i.e. 'islands') located at the southern limit of their North American range.

The Lodgepole Pine-Sphagnum, Western Red Cedar-Douglas Fir-Oregon Beaked Moss, and Grand Fir-Foamflower Associations are provincially red-listed and are considered endangered or threatened. The Red Alder-Skunk Cabbage Association is provincially

blue-listed and considered sensitive or vulnerable. Rice Cutgrass is provincially blue-listed. The Bog also supports a rare moss called *Sphagnum fuscum*. The potential impact of bog restoration on rare and endangered species and associations will need to be studied and evaluated.

Invasive Species

The acidic nature of healthy bogs discourages the establishment of non-bog plant species. However, non-bog species have moved into the Bog Lands in response to changing conditions like lower water table levels and to disturbances like service road building. The invasive plants include ornamental, cultivated and indigenous species from surrounding landscapes including cranberries from adjoining farms.

Some of these non-bog species are considered invasive because they can become dominant by quickly propagating, spreading and out-competing bog species and thereby changing the bog vegetation structure. Species like European Birch, Evergreen Blackberry, High-bush Blueberry, Tawny Cotton-grass, Brown Fruit-rush and Large Cranberry have become well-established in parts of the Bog Lands. Some species may be controlled as efforts to raise and stabilize water table levels proceed.

Recommended Actions:

- As bog restoration proceeds, undertake investigations of woody shrub and tree communities to identify the rate and extent of re-establishment of peat-forming communities; develop strategies to support the re-establishment of peat-forming plant communities as required;
- Identify and monitor areas of rare and endangered species as bog restoration initiatives are planned and implemented; develop management strategies as required; and
- Monitor areas of invasive species as bog restoration proceeds; develop management strategies for their control as required.

6.5 Wildlife

Burns Bog is a rare environment in the Lower Mainland, supporting a diverse array of birds (175 species), mammals (41), amphibians (11) and reptiles (6). About 4,000 invertebrate species have been identified. The Bog's overall size and variety of habitats, from forests to heath land to open water, contribute to the abundance and diversity of wildlife species. Fish species have been found in the periphery of the Bog and associated watercourses, but fish populations are limited by temperature, low pH (acidity), low levels of dissolved oxygen and isolation from fish-bearing streams. The nearby-forested areas on the margins of the Bog Lands are important habitat for small mammals and raptors. Refer to the 2000 Burns Bog Ecosystem Review for more discussion about wildlife.

In the past, the abundance and diversity of wildlife species likely changed in response to changing water and vegetation conditions. These adjustments will likely continue as bog restoration efforts proceed. Restoration of the Bog will likely support most wildlife species associated with the Bog. However, the adjustments in conditions for wildlife, and in particular species-at-risk need to be studied and monitored.

Rare and Endangered Species

The provincially red-listed (endangered or threatened) Peregrine Falcon is believed to occur in the Bog along with thirteen blue-listed (sensitive or vulnerable) bird species. The Bog also provides important breeding and staging habitat for the Greater Sandhill Crane (White Beak-rush–Sphagnum Association) and is one of two nesting sites in the Lower Mainland. The Bog's peripheral forests provide roosting habitat for the Barn Owl. The Great Blue Heron is believed to forage in the Bog.

While systematic study of mammals in Burns Bog is limited, some rare and endangered species are known to reside in the Bog, including the Southern Red-backed Vole (provincially red-listed), the Pacific Water Shrew (provincially red-listed), and the Trowbridge's Shrew (provincially blue-listed). The forested habitats at and around the margins of the Bog provide habitat for the Trowbridge's Shrew.

The permanent ponds and riparian conifer forest in the Bog are believed to provide breeding and dispersal habitat for a variety of amphibian and reptile species. The Red-Legged Frog (provincially red-listed) and the Painted Turtle (provincially blue-listed) have been reported in the Bog.

The Bog Lands will be managed to re-establish and maintain raised bog processes and the species supported by these ecological conditions. Management strategies to support other species may be considered.

Invasive Species

Five non-indigenous animal species have been reported in the Bog, including American Bullfrog, Green Frog, North American Opossum, Eastern Grey Squirrel, and Eastern Cottontail (rabbit). The impacts of these populations will be monitored during bog restoration and management strategies will be developed, if required.

Recommended Actions

- Identify and monitor areas of rare and endangered species as bog restoration initiatives are planned and implemented;
- Develop management strategies to address rare and endangered species as required; and
- Monitor areas of invasive species as bog restoration proceeds and develop management strategies for their control as required.

6.6 Wildfire

Wildfires need to be controlled to protect the Bog and its surroundings. Wildfire can destroy the peat-forming plant communities at the surface of the Bog and take decades to recover. In addition, wildfires release unwanted nutrients into the nutrient-poor bog environment. Wildfires threaten wildlife, people and the properties surrounding the Bog, and impact air quality for the residents of the Region.

The two most recent significant wildfires in the Bog Lands occurred in 1996 and September 2005. The 1996 fire covered a 170 hectare (420 acres) area west of Highway 91 and north of 72nd Avenue. This wildfire is believed to have started in the Bog by a discarded cigarette. The September 2005 wildfire covered about 200 hectares (500 acres) in the south-east area of the Bog, bounded by the alignments of 72nd and 64th Avenues and 104th and 96th Streets. This wildfire is believed to have started on a neighbouring property bordering the Bog Lands.

The inconsistent ground conditions in the Bog Lands pose a significant challenge for firefighters and equipment. The Delta Fire Department and the Scientific Advisory Panel have discussed the issues and trade-offs around the use of fresh water and salt water for fire-fighting and the use of fire retardants containing unwanted nutrients. The Delta Fire Department is leading the development of wildfire control procedures which address fire monitoring and response; the identification of municipal, regional and provincial resources to address wildfires; access within the Bog Lands for fire-fighting personnel and equipment; and water supply to fight wildfires. On the advice of the Scientific Advisory Panel, vegetation monitoring will be extended to include a small number of plots in the 2005 wildfire burn area to monitor vegetation recovery.

Recommended Actions

- Control wildfire in the Bog Lands employing practices that minimize impacts to the Bog environment where practical; and
- Monitor vegetation recovery in the 2005 wildfire burn area to better understand bog recovery and any observable impacts from suppressing the fire.

7.0 HABITAT CONNECTIVITY WITH ADJACENT LANDS

Historically, Burns Bog covered about 4,800 hectares (11,860 acres) and was ecologically connected with adjacent ecosystems. Today the Bog Lands are largely isolated from other natural areas by the intervening agricultural, residential and industrial land uses.

The Scientific Advisory Panel identified the desirability of applying the Bog Lands management approach to some of the near-by lands that were once part of Burns Bog. Some of these lands are owned by public agencies (Attachment 7). Strategies for integrating the management of these lands with the Bog Lands will be considered in the future.

The Scientific Advisory Panel also identified the desirability of re-establishing wildlife corridors to the Fraser River, Panorama Ridge and Boundary Bay.

- Connection to the Fraser River (north): This link would connect the Bog's perimeter aquatic habitat to the Fraser River allowing fish to use these waterways and provide a corridor for other wildlife. Future investigation is required to study the appropriate locations and characteristics of habitat connectors to the Fraser River;
- Connection to Panorama Ridge and Delta's Watershed Park (east): Highway 91 is a significant barrier for connections to the upland habitats to the east. Future investigation is required to study the appropriate locations and characteristics of connectors to Panorama Ridge and Watershed Park;
- Connection to Boundary Bay (south): Highway 99 and the railway pose significant obstacles for connections to Boundary Bay. While future investigation is desirable, connections to Boundary Bay are considered a lower priority.

Recommended Actions

- Assess the value and feasibility of integrating the management of adjacent bog land with the Bog Lands; develop appropriate management strategies; and
- Explore opportunities to re-establish wildlife corridors to the Fraser River, Panorama Ridge and Boundary Bay with other agencies and landowners.

8.0 LAND INTERESTS

8.1 Bog Land Interests

First Nations

Historically, the First Nations peoples visited Burns Bog for plant gathering and for hunting. Cranberries and blueberries were harvested and traded and Labrador tea was collected for medicinal purposes. Sphagnum mosses were useful for their absorptive properties. The open bog provided hunting grounds for deer, moose, bear and birds.

Access to the Provincial Lands by First Nations for ceremonial and traditional uses may be considered. Activities associated with aboriginal or treaty rights would need to be consistent with the Conservation Covenant. Prior to access, gathering plans prepared by First Nations may be required. Access to suitable near-by alternative sites outside of the Bog Lands would be considered for these activities.

Utility Rights-of-Way Holders

BC Transmission Corporation and Terasen Gas hold utility rights-of-way in the northern and western parts of the Bog Lands. Terasen Gas operates twin pipelines supplying natural gas to the Greater Vancouver Area. The Conservation Covenant for the Bog Lands recognizes these rights-of-way and the operating, maintenance and replacement requirements associated with these utilities. Bog Land managers will continue to work with utility managers to address their operational and security needs to ensure minimum disruption to the Bog Lands.

8.2 Adjoining Land Interests

The land uses adjoining the Bog Lands are varied and include agriculture, industry, municipal landfill and transportation corridors. These lands were once part of Burns Bog.

The Vancouver Landfill adjoins the south-west corner of the Bog Lands. The City of Vancouver has operated this landfill since 1966, serving the residents of Vancouver, Richmond, Delta, White Rock and parts of Surrey. Impacts of the landfill operation on

the Bog Lands are considered minimal. Parallel ditches at the perimeter of the Landfill collect and contain landfill groundwater that is sent to the Annacis Treatment Plant for processing. On the north side of the Landfill (beside the Bog Lands), landfill groundwater collects in the southern ditch, and bog groundwater collects in the northern ditch. The water level in the northern ditch is kept higher to contain the contents of the southern ditch. This complements the natural outward groundwater flow from the Bog. A series of dams (weirs) along the northern ditch slows the groundwater outflow from the Bog Lands.

Much of the land to the west and south-east of the Bog Land is agricultural. Cranberries and blueberries are grown on the farms to the west. In the past, farms were able to draw water from the Bog for irrigation purposes. Farms are being switched to other water sources (e.g. Fraser River) to reduce the amount of water drawn from the Bog Lands.

Transportation corridors like Highway 91 and the proposed South Fraser Perimeter Road can impact bog water movement, and interrupt wildlife movements and natural plant dispersal. In addition, roadways can be a source of run-off and air-borne particulates that are unwanted in a bog environment. The Scientific Advisory Panel advises that a lagg at the perimeter of the Bog Lands needs to be established. Managing agencies will work with roadway engineers and managers to minimize the impacts of their development and operation on the Bog Lands.

Relationship-building with the surrounding landowners will continue. Regular contact by managing agency staff provides a personal forum to discuss bog protection, monitoring and restoration activities, as well as landowner issues. Landowners may be able to assist staff in addressing issues such as illegal dumping and access to the Bog Lands.

Recommended Actions

- Complete negotiations with member municipalities for the transfer of Parcel 2 and Delta Nature Reserve to the joint ownership of Delta and GVRD (refer to 3.0 Management Context);

- Finalize arrangements with the Tsawwassen First Nation for near-by off-site gathering of Labrador Tea;
- Work with the utilities to address their needs with minimum disruption to the Bog Lands; and
- Work with the adjoining landowners and managers to address issues arising from ditch-blocking and rising water levels in the Bog Lands.

9.0 ACCESS TO BOG LANDS

9.1 Public Access and Education

As an Ecological Conservancy Area, protection and conservation of the Bog Lands is of paramount priority. The Conservation Covenant states that activities that may negatively affect or alter the Bog Lands must not be allowed. The obligation is to show that an activity will not negatively affect or alter the Bog Lands. Bogs are very sensitive to human disturbance, and ground instability poses a safety issue.

The focus of public access and education will be the Delta Nature Reserve (DNR) and the Delta South Surrey Greenway. The DNR is a 60-hectare (150 acre) property on the east side of Highway 91 that is owned by Delta. The Burns Bog Conservation Society (BBCS) has worked with Delta to develop two boardwalk trails through the DNR. In addition, BBCS regularly offers educational / interpretive programs at DNR and at other venues to raise awareness about Burns Bog and its values. BBCS has developed a variety of educational and interpretive materials on Burns Bog for its bog tours, school programs and community events.

The DNR trails connect with the GVRD Delta South Surrey Greenway (DSSG) on the eastern boundary of DNR (Attachment 8). DSSG is a recreational corridor that is being developed on a regional utility right-of-way / transportation corridor. The Greenway will eventually extend from the Fraser River to Boundary Bay, connecting natural areas along its route like DNR and Delta's Watershed Park.

Entry points to the Bog Lands west of Highway 91 were fenced and gated by previous landowners. Since 2004 key portions of property boundary have been identified by survey and posted. Signs have been installed identifying the Ecological Conservancy Area and explaining that there is no public access. In addition, these messages have been posted on the Burns Bog website and in other publications. Monitoring and staff patrols are on-going.

Investigations will be required to determine the impacts of potential access in the Bog Lands west of Highway 91. Ground and soil conditions, vegetation sensitivity, wildlife activity patterns, bog restoration activities, and research and monitoring sites will need to be considered. In addition, safety issues will be fully assessed.

9.2 Access for Research and Monitoring

The focus of research and monitoring in the Bog Lands will be bog protection and the re-establishment of raised bog processes, including bog hydrology and hydrochemistry, lagg, rare and endangered species, and invasive species. An on-going role for a Scientific Advisory Panel is envisioned, particularly in the areas of providing advice on scientific research and the interpretation of results and monitoring information related to bog management.

GVRD will establish the scientific research and monitoring program required to restore and protect the Bog Lands, with input from Delta, the other purchasing agencies and the Scientific Advisory Panel. Qualified researchers will be retained to undertake the various components of this program. Guidelines will be established for proposal submission, criteria for proposal evaluation, access for research and timelines for completion, and the timing and form for submission of research and monitoring results.

Research proposals will be reviewed, evaluated and approved by GVRD with the guidance of specialist scientific advisors. The implementation of research and monitoring projects will be coordinated by the managing agencies to ensure that the impact of research-related activities and potential conflicts between research projects are minimized and well-managed. Research and monitoring results will be submitted in

a form ready for inclusion in an appropriate database for use in bog management and future research.

The naming of the Bog Lands as part of an international convention (treaty) like the 'Convention on Wetlands of International Importance (Ramsar, Iran, 1971)' would likely raise the profile of the Bog Lands in terms of global conservation and research efforts. Environment Canada's Alaksen National Wildlife Management Area in Delta is a designated Ramsar site. The options and benefits of the designation of the Bog Lands as a Ramsar or other site of international significance and the associated requirements will be explored.

Recommended Actions

- Focus and manage Bog Lands-related public access at Delta Nature Reserve and the Delta South Surrey Greenway;
- Develop a bog education program for delivery at Delta Nature Reserve and the Delta South Surrey Greenway including web-based and off-site components;
- Maintain 'no access' elsewhere using the required tools: Engineering (fencing and gates, entry monitoring), Educational (signage, website, patrols, programs), and Enforcement (staff patrols);
- Undertake investigations required to determine the impacts of potential public access in the Bog Lands west of Highway 91;
- Establish the scientific research and monitoring program required to restore and protect the Bog Lands; retain qualified researchers to undertake the work; and
- Explore the options and benefits of an international designation for the Bog Lands and the associated requirements; apply for a designation if appropriate.

10.0 PRIORITIES AND BUDGETING

10.1 Priorities and Actions

The following tables organize the Management Actions into three timeframes.

Management Actions considered most important are High Priority and occur in the first 5 years, second in importance in the 6 to 15 year time-frame are Medium Priority, and longer term needs are post 16 years and are Low Priority.

High Priority Actions (within 5 years)

	Category	Actions
1	Hydrology	Develop a water balance model for the Bog Lands to better understand and monitor its hydrology and the amount of water retained by the Bog Lands
2	“	Continue to monitor the water and vegetation responses to the pilot ditch-blocking program in the south-western part of the Bog Lands
3	“	Develop an overall ditch-blocking program for the Bog Lands, including implementation timing and monitoring as required, considering the needs of adjoining land owners, perimeter drainage engineering works and the activities of resident beavers
4	Lagg	Identify remnant pieces of Burns Bog lagg and develop strategies for their protection and management in collaboration with property owners where possible
5	“	Study remnant pieces of Burns Bog lagg as well as the lagg of other representative bogs to understand their distinctive physical, hydrological, hydro-chemical, and biological characteristics
6	“	Develop strategies for the design, modeling, building, testing and on-going management of lagg for the Bog Lands in collaboration with adjoining property owners, where possible
7	Wildfire	Control wildfire in the Bog Lands employing practices that minimize impacts to the Bog environment where practical
8	“	Monitor vegetation recovery in the 2005 wildfire burn area to better understand bog recovery and any observable impacts from suppressing the fire
9	Land Interests	Complete negotiations with member municipalities for the transfer of Parcel 2 and Delta Nature Reserve to the joint ownership of Delta and GVRD
10	“	Finalize arrangements with the Tsawwassen First Nation for near-by off-site gathering of Labrador Tea
11	“	Work with the utilities to address their needs with minimum disruption to the Bog Lands
12	“	Work with the adjoining land owners and managers to address issues arising from ditch-blocking and rising water levels in the Bog Lands
13	Access to Bog Lands	Focus and manage Bog Lands-related public access at Delta Nature Reserve and the Delta South Surrey Greenway
14	“	Maintain ‘no access’ elsewhere using the required management tools: Engineering (fencing & gates, entry monitoring), Educational (signage, website, patrols, programs) and Enforcement (staff patrols)
15	“	Establish the scientific research and monitoring program required to restore and protect the Bog Lands; retain qualified researchers to undertake the work

Medium Priority Actions (6 to 15 years)

	Category	Actions
1	Vegetation and Wildlife	As bog restoration proceeds, undertake investigations of existing woody shrub and tree communities to identify the rate and extent of re-establishment of peat-forming plant communities; decide if strategies need to be developed to support the re-establishment of peat-forming plant communities
2	“	Identify and monitor areas of rare and endangered species as bog restoration initiatives are planned and implemented; develop management strategies as required
3	“	Monitor areas of invasive species as bog restoration proceeds; develop management strategies for their control as required
4	Habitat Connectivity with Adjacent Lands	Assess the value and feasibility of integrating the management of adjacent bog land with the Bog Lands; develop appropriate management strategies
5	Public Education	Develop a bog education program for delivery at Delta Nature Reserve and the Delta South Surrey Greenway including web-based and off-site components
6	Access to Bog Lands	Explore the options and benefits of an international designation for the Bog Lands and the associated requirements; apply for designation if appropriate

Low Priority Actions (16 years and beyond)

	Category	Actions
1	Habitat Connectivity with Adjacent Lands	Explore opportunities to re-establish wildlife corridors to the Fraser River, Panorama Ridge and Boundary Bay with other agencies and land owners
2	Access to Bog Lands	Undertake investigations required to determine the impacts of potential public access in the Bog Lands west of Highway 91

10.2 Budgets

Preliminary funding requirements associated with High Priority Actions are addressed by operating, capital and research categories. GVRD is responsible for overall management of the Bog Lands and Delta is responsible for drainage in and around the Bog Lands and for fire management. Cost-sharing arrangements between Delta and GVRD will be established in an Operating Agreement to be developed by the two agencies.

Preliminary Operating Funding Estimates

Category	Average annual costs over first 5 years
Resource Management staff (annually)	\$110,000
Field Operations staff (annually)	\$130,000
Contract Services (annually) (Hydrological and vegetation monitoring; Scientific Advisory Panel administration)	\$75,000
Total	\$315,000

Preliminary Capital Funding Requirements

An estimated \$150,000 in capital funds is required to implement the ditch-blocking program.

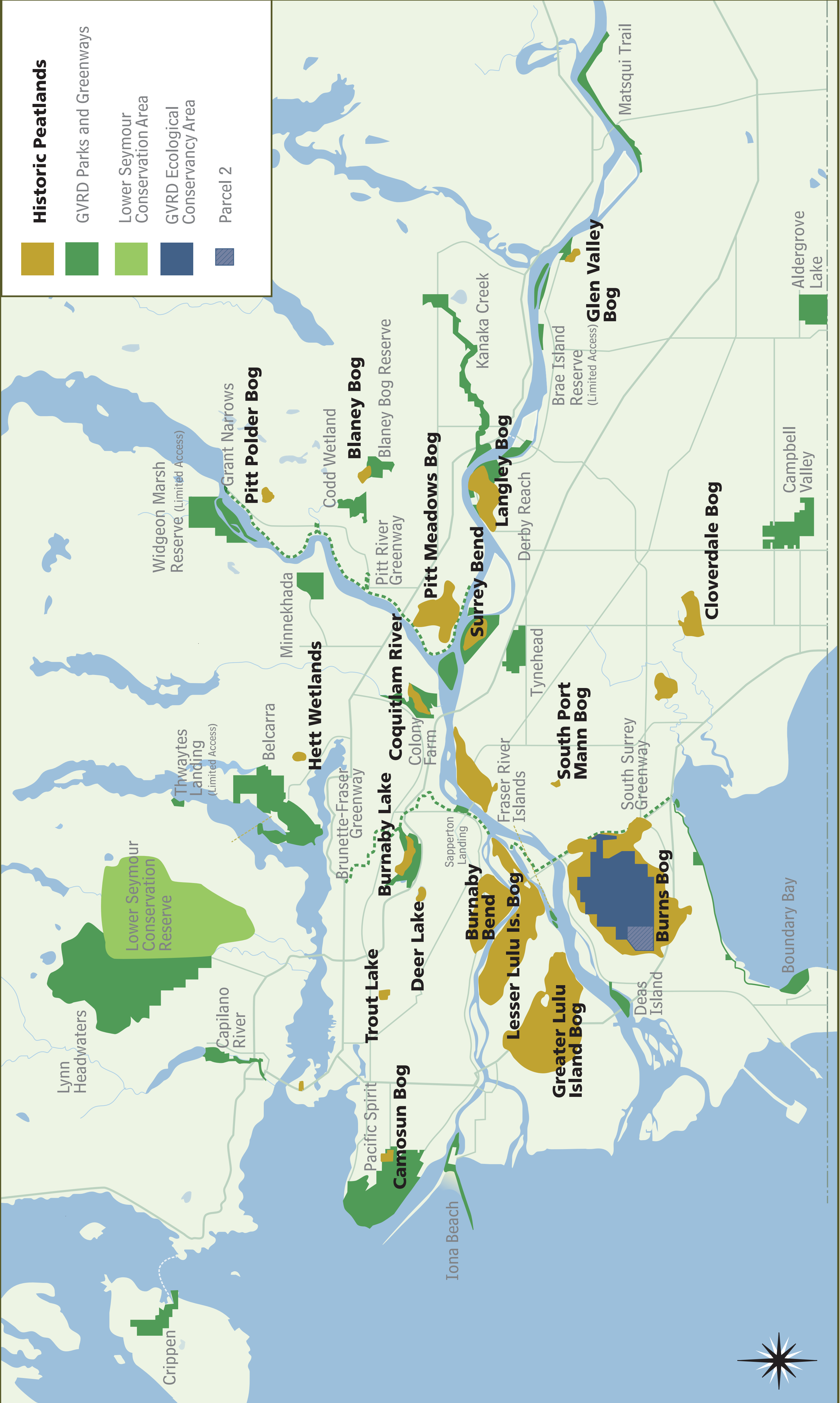
Funding for Research

A Research Budget will be developed as part of the Scientific Research and Monitoring Program (refer to line 15 of High Priority Actions) with input from Delta, the other purchasing agencies and the Scientific Advisory Panel. The Research Budget will be brought back to the GVRD Board for its consideration. The Program Budget will address the research and monitoring required for restoring and protecting the Bog Lands and the associated costs of investigations for water balance modeling, lagg development, wildfire control, vegetation management, rare and endangered species protection and invasive species management. Opportunities for research grants and cost-sharing with educational institutions and other agencies will be explored.

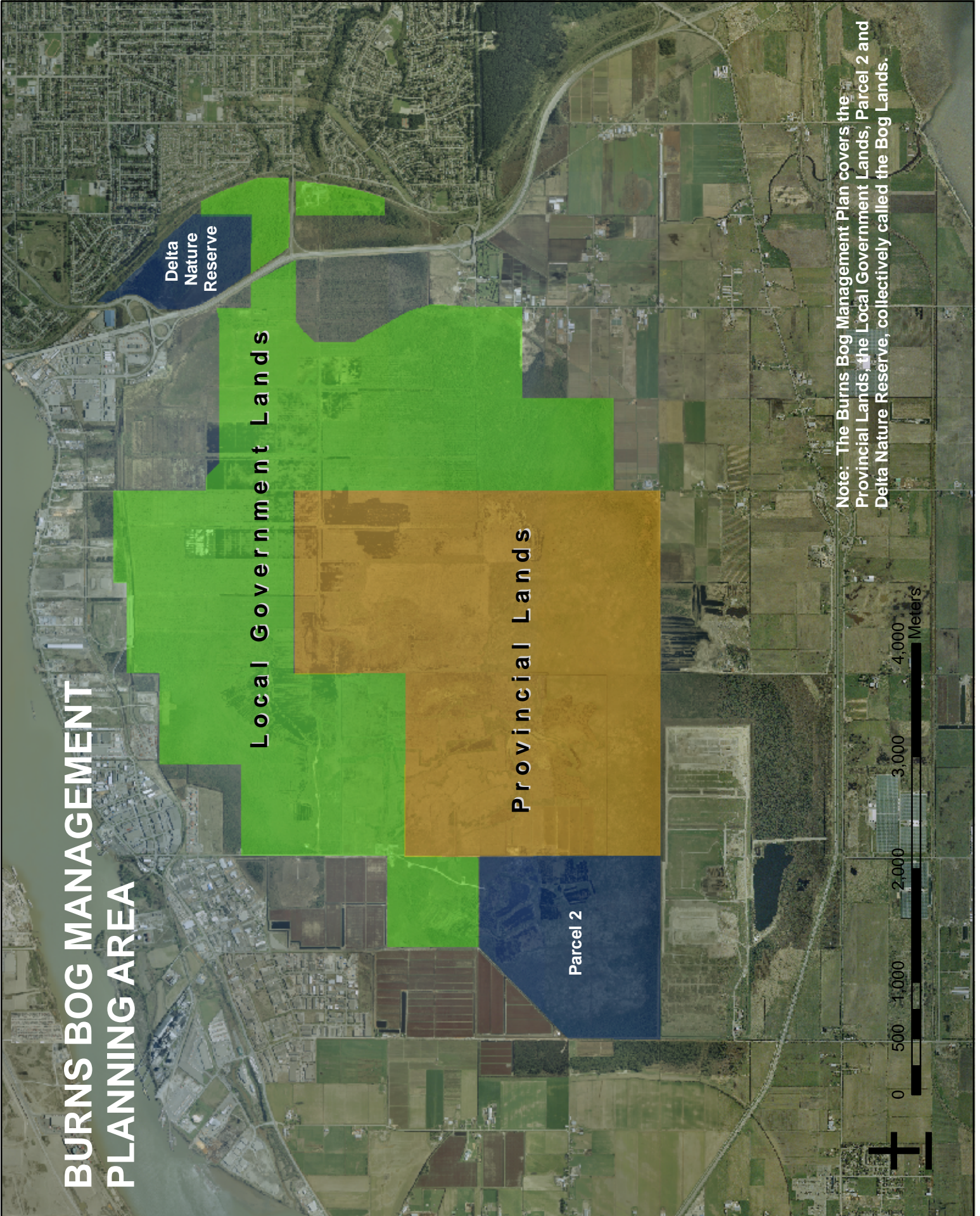
**BURNS BOG ECOLOGICAL CONSERVANCY AREA
MANAGEMENT PLAN**

Attachments 1-8

Historic Peatlands

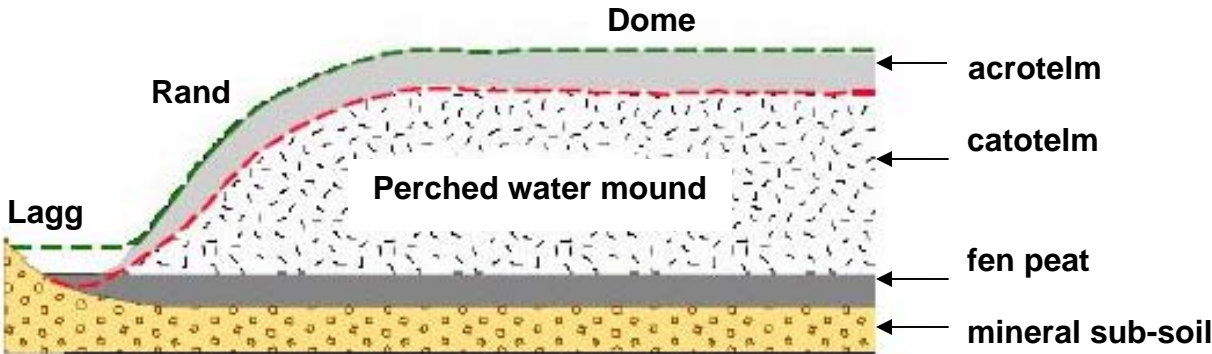


BURNS BOG MANAGEMENT PLANNING AREA

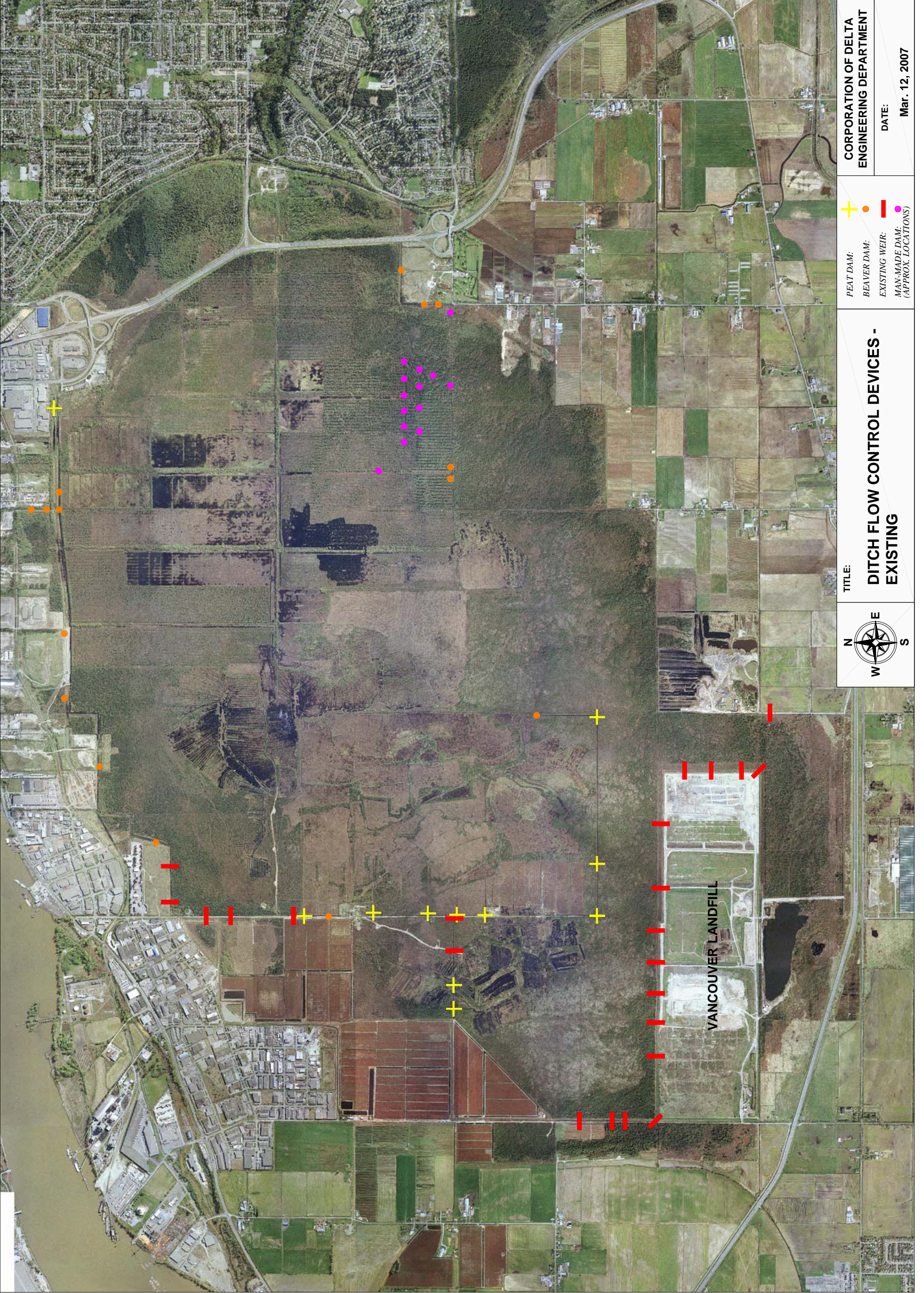


Note: The Burns Bog Management Plan covers the Provincial Lands, the Local Government Lands, Parcel 2 and Delta Nature Reserve, collectively called the Bog Lands.

Typical Profile of a Raised Bog



SOURCE: Hebda et al. (2000) Burns Bog Ecosystem Review



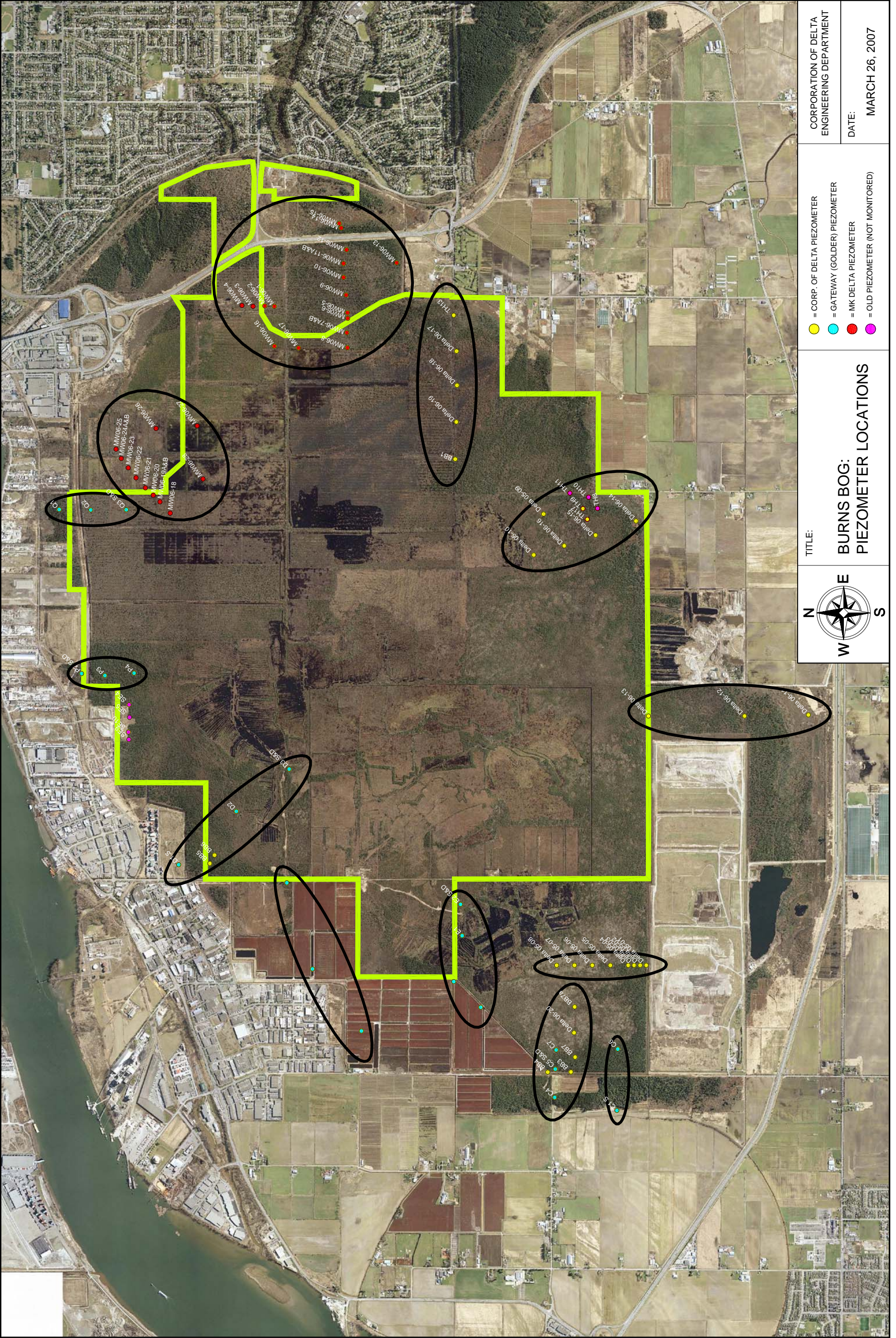
Ditch Blocking Devices



Weir



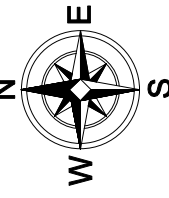
Peat Dam



CORPORATION OF DELTA
ENGINEERING DEPARTMENT

- = CORP. OF DELTA PIEZOMETER
- = GATEWAY (GOLDER) PIEZOMETER
- = MK DELTA PIEZOMETER
- = OLD PIEZOMETER (NOT MONITORED)

TITLE:
**BURNS BOG:
PIEZOMETER LOCATIONS**



DATE:
MARCH 26, 2007

MW06-15
MW06-12
MW06-11A&B
MW06-10
MW06-9
MW06-8
MW06-7A&B
MW06-17
MW06-16
MW06-4
MW06-3
MW06-2
MW06-1

MW06-25
MW06-24A&B
MW06-23
MW06-22
MW06-21
MW06-20
MW06-19A&B
MW06-18
MW06-28
MW06-27

TH13
Delta 06-17
Delta 06-18
Delta 06-19
BB1

Delta 05-10
Delta 05-16
Delta 05-09
TH10
TH11
TH12
TH13
Delta 06-14
Delta 06-15
Delta 06-16

Delta 06-12
Delta 06-13

Q1
Q2
C2 S&D

P1
P2
P3
P4
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10

D2
D3 S&D
BB1
BB2
BB3

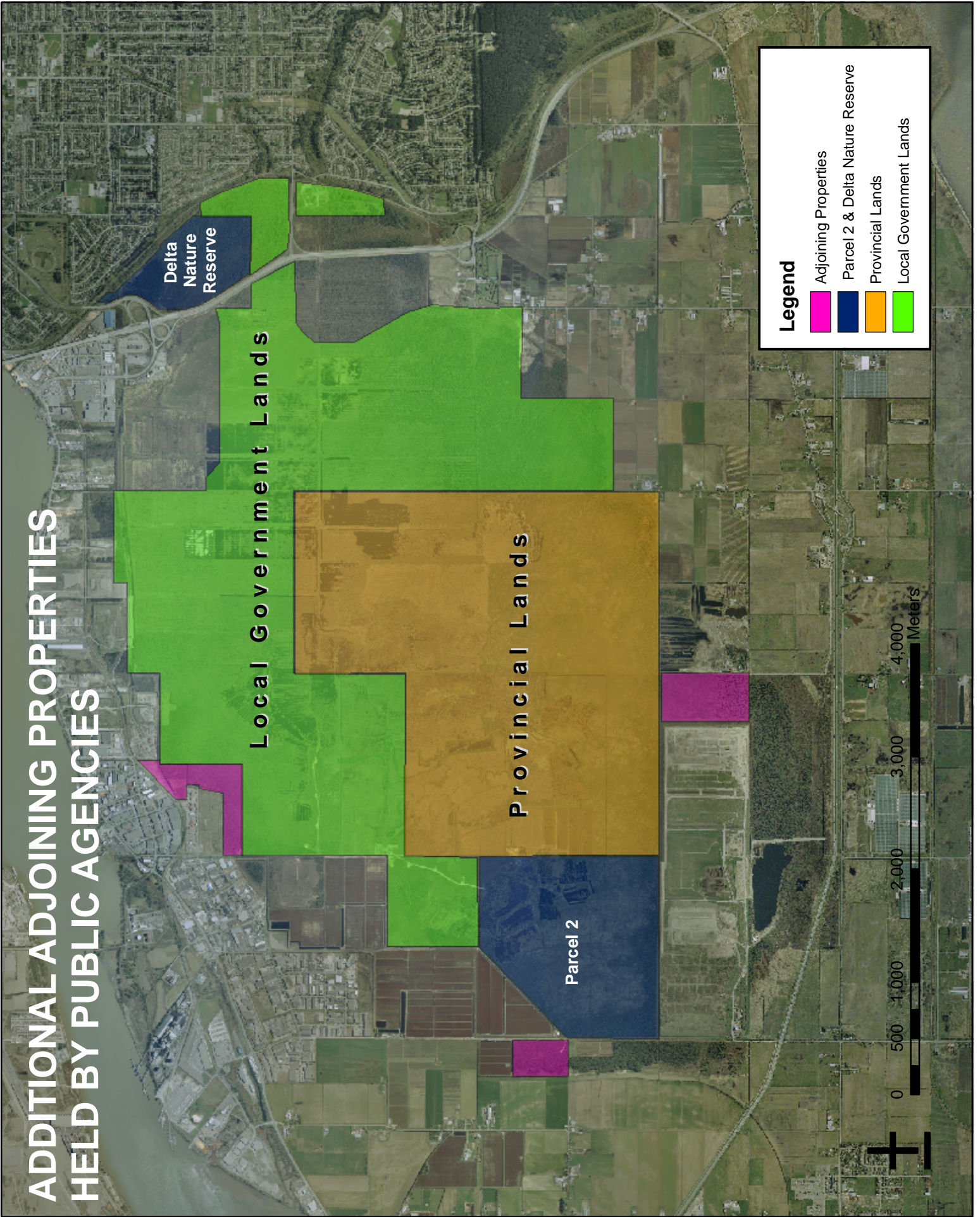
EX
C2 S&D
C3 S&D

Delta 05-08
Delta 05-07
Delta 05-06
Delta 05-05
Delta 05-04
Delta 05-03
Delta 05-02
Delta 05-01

BB1a
BB1b
BB2
BB3
C1 S&D
C2
C3
C4

C1 S
C8

ADDITIONAL ADJOINING PROPERTIES HELD BY PUBLIC AGENCIES



DELTA SOUTH SURREY GREENWAY

