

# Planning Sustainable Communities

*A focus on community mapping case studies from the Lower Mainland and Sunshine Coast of British Columbia*





# Planning Sustainable Communities

*A compilation of community mapping case studies from the Lower Mainland and Sunshine Coast of British Columbia, prepared for the Planning Sustainable Communities Workshops*

Sponsored by

The Township of Langley  
The Community Mapping Network  
(a partnership of community and government conservation agencies in British Columbia)  
Fisheries & Oceans Canada Habitat Conservation and Stewardship Program  
Sunshine Coast Regional District

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# Introduction

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## *Planning for sustainable communities*

### **The Environmental Setting**

The value of maintaining healthy functioning sensitive habitats in British Columbia — urban and rural watercourses, riparian areas, wetlands, foreshores and nearshores — is poorly understood. This means species at risk and sensitive habitats are under constant threat from urban and agricultural development. It may also mean that development proposals received by municipalities are often reviewed without adequate knowledge of the location or value of sensitive resources, either because the information has not been inventoried, or it may not be presented in the appropriate scale needed for land use planning.

We know that human activity and populations are increasing in British Columbia. More people increase the stress on sensitive ecosystems by bringing more houses, cars, industry and farm animals — but they cannot bring more land, air or water to our communities. We must understand that natural resources are finite, and that it is essential that community and land use planning efforts incorporate the value of sustainability — as it is the ecosystems of the earth and the services they provide that are the foundations of a healthy economy and social well being.

Population growth within the Georgia Basin of British Columbia is expected to double in the next 20 years. For this reason, ecologically sensitive areas such as floodplains, riparian corridors, small stream channels and wetlands may be severely affected by development unless there is strong commu-

nity stewardship, awareness and effective land use planning.

Streams and other freshwater watercourses are a critical component to the health, vitality and economies of the urban and rural landscapes of British Columbia. They not only contain the runoff for water downhill, but also provide critical habitats and corridors for fish and wildlife. In coastal B.C. small streams and watercourses provide critical spawning, rearing, over-wintering and feeding habitats for both adult and juvenile salmonids. These environments are also home to many other species of fish, aquatic invertebrates, benthic organisms, wildlife and plants, all of which function as a part of the freshwater community and the entire ecosystem.

Conditions in and adjacent to streams are easily disturbed, and changes in land use can adversely affect the overall health and state of the streams and watercourses and the plants and animals within them. Housing, industry and road development often result in disturbance to watercourses, leading to the decline and alteration of surface water runoff, stream channel stability, watershed-based nutrient cycles, other organic and inorganic constituents, riparian vegetation, in-stream vegetation, and water temperature and flow regimes. These forms of disturbance can cause dramatic changes in ecosystem biodiversity, population status and the form and function of watersheds and ecosystems. For example, in British Columbia's Georgia Basin, numerous coastal salmonid stocks and populations of 29 wildlife taxa are at risk of extinction (red or blue listed) and are rapidly declining in

abundance due to loss of sensitive habitats which are vital to sustaining populations.

Recent studies<sup>1</sup> reveal that at least 30% of small urban streams and watercourses in the Georgia Basin of British Columbia are not delineated on provincial or federal topographic maps and databases. This appears to be typical in many regions and local municipalities. Local cadastral and planning information can often be dated and not capture recent land use changes, while large-scale inventory maps of streams and adjacent habitats are often not available as a means to identify sensitive habitats for fish and wildlife. As a result, many plan-

ning and development decisions continue to be made in the absence of critical information.

Good land use planning and decision making require accurate, precise and recent spatial habitat information. Accurately inventoried and delineated small urban and rural watercourses, wetlands, and riparian areas will help improve current land use planning processes and promote decisions made through greater understanding, improved planning practices, heightened protection and clearer priorities for fish and wildlife habitat restoration and enhancement.



Figure 1. The Community Mapping Network data model

### The Community Mapping Network (CMN)

Over the last decade lower costs and accessibility of mapping technology have made it

possible for local conservation groups and local governments to develop map-based tools for sustainable land use planning. In British Columbia the Community Mapping Network (CMN) is being built by contribu-

tors and users interested in creating accurate resource data accessible through the internet. The CMN integrates data from government and non-government sources and makes it accessible through a user-friendly mapping system.

The CMN encourages building expertise locally, sharing ideas so as not to reinvent the wheel, and linking all community data across administrative boundaries to make it seamless. In this way CMN members build on each other's investments and are able to customize applications to meet individual communities' needs for mapping and inventory information. *Building local capacity and expertise, sharing ideas and linking all community data across administrative boundaries are the key objectives of the CMN.*

### **Who is the CMN?**

The Community Mapping Network is made up of a number of community groups, organizations and individuals that collect and map natural resource information. A steering committee responsible for managing the CMN includes representatives from the BC Conservation Foundation, Fisheries and Oceans Canada, Environment Canada (Canadian Wildlife Service), BC Ministry of Water, Land and Air Protection, BC Ministry of Agriculture, Food and Fisheries, Fraser Valley Regional District, Greater Vancouver Regional District, local governments, and community groups. *The CMN is a network of partners.*

### **What are the activities of the CMN?**

Integrated natural resource information is necessary to assist communities and local governments with land use planning, to promote conservation and protection of sensitive habitats, and to raise awareness and respect for ecological values. *The CMN is about integrating information.* The CMN promotes standard methods of collecting

and mapping community information (though in practice methods vary). The CMN does not have a master database.

### **The Community Mapping Network:**

- Builds capacity within communities to collect and manage resource information;
- Uses a network of servers to provide internet access to resource information, base maps and imagery;
- Develops common methods and standards for data collection;
- Links community-based mapping with larger agency databases such as the Canada/BC Fisheries Information Summary Systems (FISS) and the Coastal Resource Information System (CRIS);
- Shares ideas and project information locally and internationally;
- Provides information about watershed management, stream ecology, fish and wildlife habitat and restoration opportunities and promotes active stewardship;
- Creates an open forum for discussing the use and management of natural resources; and
- Promotes planning sustainable communities.

### **How Community Mapping Works**

The Community Mapping Network integrates community and agency natural resource information using an interactive geographic information system (GIS) called Autodesk MapGuide. A series of servers is utilized to share the workload of serving province-wide base maps, high resolution orthophotography and selected resource information (Fig. 1). Maps and natural re-

source information are “web-served” in an easy-to-use format.

Many types of information are provided through the CMN, such as fish and wildlife distribution, streams and wetlands, eagles and herons, rare and endangered species, and possible restoration sites.

Agency and community members with suitable qualifications and password clearances can be granted direct access to CMN maps and databases over the internet. On-line digitizing tools (Fig. 2) can then be used to update and edit existing resource information and to delineate the location of community mapping projects in British Columbia, Canada and around the world.

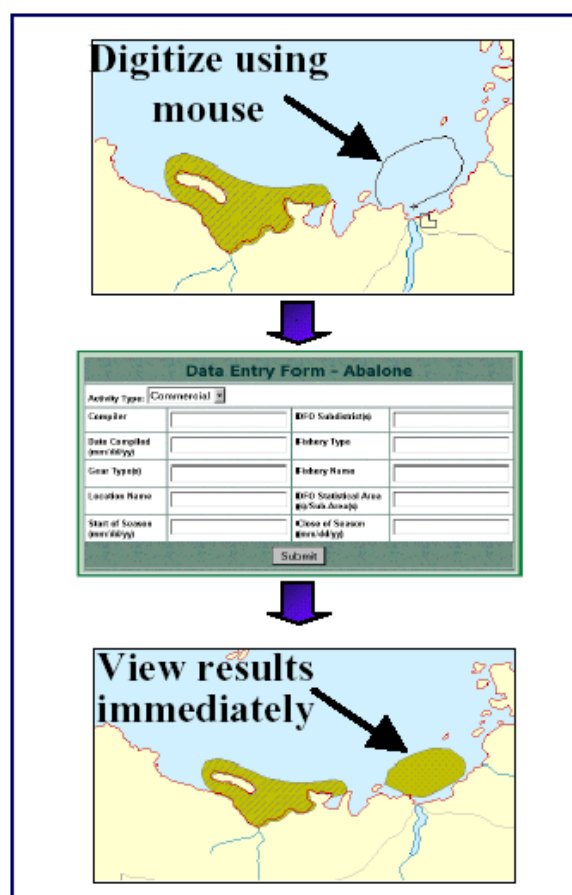


Figure 2. Digitizing features

### The scope of the CMN

Selected information and thematic maps are available at a scale of 1:5,000 for the Georgia Basin and Central Okanagan. Province-wide coverage is also available at smaller scales for watercourses, fish distribution, coastal resources and other themes. Several mapping projects exist for specific resources or for specific areas, for example the B.C. Wetlands Atlas, the Upper Skeena Atlas, and the Vancouver Island Wildlife Tree Atlas.

Four types of mapping projects can be accessed through the CMN, including:

- **Community projects:** Inner Coastal Natural Resource Centre, Comox Valley Project Watershed and Upper Skeena Streamkeepers, and The Georgia Strait Alliance;
- **British Columbia projects:** Sensitive Habitat Inventory and Mapping, BC Wetlands, Wildlife Observations, Coastal Resources, Natural Resources Information Network, Vancouver Island Wildlife Trees, Sensitive Ecosystems Inventory, BC Watersheds, South Coast Cutthroat;
- **National projects:** Stewardship Canada, FrogWatch
- **International projects:** Community Mapping Projects Directory.

A good example of a developing application on a provincial scale is agricultural GIS. GIS layers of information are used in agriculture for planning, regional drainage and water use efficiency.

### Concrete results

Methods provided through the CMN reflect a set of tools to explore and promote awareness of sensitive habitats by mapping their location and inventorying their attributes.

The awareness and commitment to local watercourses and other sensitive habitats is an important process created through co-operation of local communities, First Nations, municipalities, planners and managers. Community mapping methods comprise a set of tools and methods that can be used to help conserve fisheries, wildlife and aquatic habitat resources throughout British Columbia.

The time is right to share the results from successful community mapping projects completed over the last few years, and to demonstrate how the information is being used to make better resource management decisions. *The purpose of this document is to demonstrate by examples how better information results in better planning, leading to concrete results.*

### Case study themes

Given the large number of mapping projects that have been undertaken recently in British Columbia, it is possible to present only a small subset of them at this workshop. Case study criteria for inclusion in the workshop included:

1. concrete results have been achieved or are pending;
2. ample information is available and the cases can readily be presented in this forum;
3. they are examples of good methods that ought to be promoted.

Additionally, case studies were selected to be reflective of the following themes:

- **Planning Tools:** e.g., greenways and protected area mapping, community and neighbourhood planning, development permitting, watershed planning
- **Resource Mapping and Restoration Opportunities:** e.g., mapping invasive plants, rare and endangered species, riparian and aquatic areas, wildlife habitat, fish distribution and watercourses
- **Engineering Tools:** e.g., determining impervious surface cover, managing storm water drainage, ditch maintenance (for settled and agricultural areas)
- **Tools for Regulatory Compliance:** e.g., streamside protection regulations, local government zoning and development permit areas, watercourse classification, Land Covenant registry
- **Information Systems Support:** e.g., Community Mapping Network, Sensitive Habitat Inventory and Mapping methods [refer to Appendix 1: section on Sensitive Habitat Inventory and Mapping (SHIM)].

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1. Brown, T.G., L. Barton, and G. Langford. 1996. The use of a Geographic Information System to evaluate Terrain Resource Information Management (TRIM) maps and to measure land use patterns for Black Creek, Vancouver Island. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2395.



# Building Community Capacity: the Role of Local Inventory and Mapping Endeavours

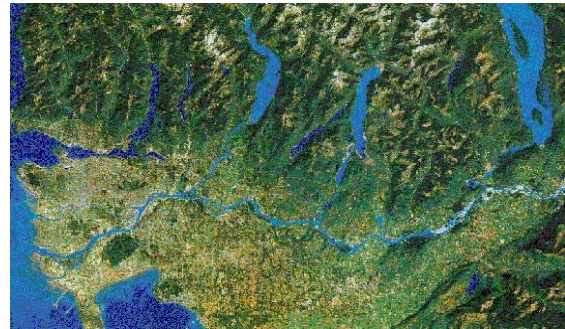
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*"Heroes are not grand statues framed against a red sky. They are people who say this is my community and it is my responsibility to make it better." Tom McCall (former Governor of Oregon), 1913-1983.*

The Lower Mainland represents one of the continent's most biologically diverse areas. In addition to its inherent richness, the Fraser River estuary is also part of an important flyway for migratory birds. The Fraser River and its tributaries support large and valuable salmon runs. Protecting the natural spaces that have generated this wealth of life is an issue of importance for conservation agencies and sections in all levels of government (federal, provincial, regional, and municipal). However, governments (at any level) do not have sufficient funds to buy all the sensitive natural areas in the Lower Mainland that need protection. Similarly, the ability of governments to regulate potentially detrimental activities on public or private lands is limited by a lack of staff, political mandate, conflicting policies, a large and confusing array of regulations, and many other social and economic impediments.

The real success of efforts to protect the environment in the Lower Mainland and elsewhere will depend on the individuals who actually live on or manage the land — e.g., landowners, developers, farmers, fishers, foresters and community volunteers. These are the people who actually touch and change the land, whose actions directly impact both land and water. These are the people who make everyday decisions that maintain, transform or deplete the landscape. Long-term conservation of our natural environments will depend on a conservation ethic with a

vation ethic with a respect for the land and water. As the Lower Mainland continues to grow it is essential local public stewardship of all natural habitats improves.

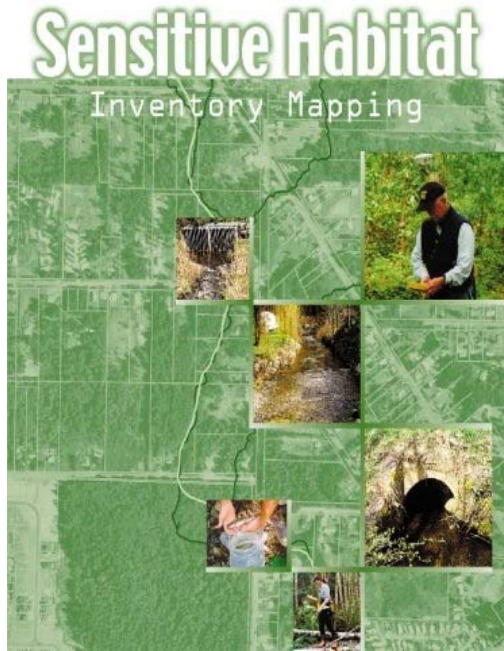


Traditionally, federal and provincial agencies have been responsible for environmental review of development projects through interagency referrals. This approach has been piecemeal, and a variety of staffing and financial constraints have often prevented comprehensive assessment and follow-up. But if sound environmental information is generated at the local level it reflects the commitment and ability of the community to shape and sustain their environment. When communities are involved in collecting and managing resource information they are better able to promote its use in local and regional planning initiatives.

There is a growing interest from communities and stewardship groups to take a more direct role in environmental planning and management. These communities are looking for encouragement, information, guidance and the tools to undertake the tasks. The growing number of Community Conservation Centres focusing on local natural resource knowledge are a step in this direction as are the Sensitive Habitat Inventory



and Mapping Procedures (SHIM), that assist suitably trained volunteers to inventory and accurately map existing natural areas within their communities.



This growth in community capacity also provides opportunities for education, skill development, public awareness and an expanded local economy. The long term viability of sustainable communities depends on processes that fully integrate environmental, economic and social considerations into all aspects of decision making.

The benefits of having accurate environmental information available to the communities and local governments are significant. They include:

- Consolidation of local resource knowledge for support of community-based management (information becomes more accessible and increasingly familiar to use)
- Seamless integration of environmental information with other municipal datasets
- Updated maps and environmental inventory (errors or omissions are identified and corrected at source)

- Reduced staff and turnaround time for habitat referrals by all reviewing agencies
- Improved cooperation between communities, local governments and senior government agencies
- Opportunities for training of community members, First Nations, and students in data collection, data analysis and data management skills.

Local habitat inventory and mapping projects have been undertaken throughout B.C. and many more are currently underway. Local resource atlases, customized for use by local government planners and developers, have been used to support Local Resource Management Plans, Official Community Plans, and Watershed Management Plans in a number of B.C. regional districts. The atlases have helped to define Development Permit Areas and have improved identification of candidate areas for protection, enhancement or restoration. The atlases have assisted local regulators in administering the Forest Practices Code, the Water Act, the Land Development Guidelines and the Local Government Act, and will assist in future implementation of the Streamside Protection Regulations. Essentially, a knowledgeable community that knows where their sensitive resources, lands and wetlands are situated, can more effectively care for them.



## ***Building Community Capacity: Role of Local Inventory and Mapping Endeavours***

### **Some examples of local inventory and mapping initiatives:**

- ***Sunshine Coast Habitat Atlas***

The Atlas is a locally created centralized data warehouse for the Sunshine Coast Regional District, consisting of over 40 GIS layers compiled from government and non-government sources.



#### **Benefits:**

- TRIM road and stream lines for the district have been and will be corrected
- Data has been converted into a single standard format and map projection
- All information existing for the Sunshine Coast Regional District has been integrated
- Accurate custom maps can be made for community groups and local businesses
- Has provided training and employment for a GIS specialist (full-time 3 year position) and seasonal employment for a small mapping crew in the field
- Has increased confidence in the information available for local planning purposes

- ***Langley Environmental Partners Society***

The Township of Langley supported the creation of the Langley Environmental Partners Society (LEPS) to carry out stream mapping and other conservation activities. LEPS now conducts the field component on

some Township projects, for example providing stream surveying for watercourse classification, and hosts educational and restoration activities.



#### **Benefits:**

- Has provided training for large numbers of university, college and high school students in use of high end GPS systems, GIS analysis and computer database programs
- Has provided local ecological data that have been used for research papers and presentations on stream dynamics and watershed ecology
- Information has been used to prioritize actions on habitat improvement and restoration in Langley
- Has increased community pride and sense of stewardship of the land



- ***Ucluelet Inlet Shoreline Atlas***

This atlas was created to provide inventory information on the inlet for agencies, regional and municipal planners and local stakeholders. It employed a pilot methodol-

## Planning Sustainable Communities

ogy for mapping coastal shorelines using GPS procedures developed by SHIM.



### Benefits:

- Provided direct employment for a field crew of displaced fisheries workers from the Ucluelet and Nuuchahnulth communities
- Provided training for the crew in use of high-end GPS systems, data collection and GIS analysis and mapping
- Provided accurate mapping of local coastal resources to assist regional government in protection, restoration and enhancement of habitats and resources native to the Inlet



### • *Comox Valley Project Watershed Society*

Established to operate in the watersheds of the Comox Valley, the Project Watershed

Society is a non-profit group that produces environmental reports and accurate mapping to promote community stewardship initiatives and facilitate local planning.



### Benefits:

- Products developed have been used by local environmental groups for public awareness-raising and enhancement project planning
- Information has been used by the Comox Regional District for development of their Official Community Plan, Development Permit Area designations, Liquid Waste Management Plans, Greenway Plans and Watershed Management Plans
- Has provided training in stream inventory and monitoring to over 200 local citizens
- Has provided regular seasonal employment to mapping field crews and associated training in use of GPS units
- Has provided full time employment for a GIS technician and project manager

## The Case Studies

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# Township of Langley: Stream Mapping for Better Local Water Resources Management

## Abstract

The Township of Langley initiated detailed mapping of streams and fish habitat in 1993. The stream survey data has been integrated into the Township's GIS, and watercourse classification maps have been produced. The mapping information will be used in the development of Water Management Plans.

## Objectives

The Township of Langley has adopted a Water Resources Management Strategy (WRMS) to protect and manage local water resources. The goals of the WRMS are:

- To provide a clean and sustainable supply of groundwater and surface water for domestic, agricultural and industrial use;
- To conserve and enhance water quality and quantity for aquatic habitat and recreational use; and
- To minimize flooding and erosion.

Within this context, watercourses are mapped and the data entered into the Township's geographic information system (GIS). The technical information and data collection are meant to feed into planning processes. This will be a proactive way of planning, avoiding the difficulties of the past in which decisions for developing a certain area, or for making designations in the Official Community Plan (OCP), might get made before appropriate studies were done.

## Actions

Detailed mapping of streams and fish habitat in the Township of Langley was initiated by the Township in 1993, predating the development of SHIM standards. The mapping was carried out by the Langley Environmental Partners Society (LEPS), which was instrumental in the development of SHIM standards.

Some 800 km of watercourses have been mapped (Fig. 1); this work is more or less completed. Over 17,000 points of features that were found along the creeks have been recorded, entered into a database, and displayed on GIS.

## Project Outcomes

The stream survey data has been integrated into the Township's GIS, and watercourse classification maps have been produced. These provide the Township with a useful planning tool. The information will help the Township of Langley to save staff time and costs in managing its watercourses and setting up agreements, and by streamlining environmental approval processes.

By the use of Sensitive Habitat Inventory and Mapping (SHIM) and earlier methodologies the Township now has accurate stream and fish habitat mapping, putting it in an advantageous position in dealing with surface water matters and in developing policy and bylaws. In implementing the WRMS Action Plan and watershed management plans (WMPs) in years to come, the Township will have a significant head start and will move ahead faster in those areas where work has been done.



**Figure 2:** Using a hand-held global positioning unit to map watercourses

Anticipated benefits of the watercourse mapping information include:

- More local management of water resources
- More detailed community planning
- Memoranda of agreement to be developed with senior environmental agencies
- Common ground between various players – community, local government, senior agencies, any other community groups – all using the same information
- Having the most up-to-date and accurate information

- Moving ahead on management decisions, agreements, water management plans, and streamside protection regulations
- Reduced costs to the Township of hiring consultants as it may be less necessary
- Reduced costs to landowners who may not have to hire a consultant to do a full environmental assessment if the appropriate agencies already accept creek coding as it is
- Decreased uncertainty for developers, who will know from the start if a stream is fish-bearing

Some streams were discovered in the course of mapping. Some surface water pollution problems were also found, raising concerns for groundwater. The quality of groundwater, a source of drinking water in the Township, is an identified public concern.

Landowner approval to access properties was anticipated to be a greater challenge than it turned out to be. The multi-partner nature of the project was an advantage in this respect, as crews were able to present a variety of objectives for the project, resulting in approval from most landowners.

The various partners who contributed a substantial portion of the project funding were able to meet their objectives in a more cost-effective manner than by doing it alone.

### Background<sup>1</sup>

The Township of Langley derives a large portion of its municipal drinking water supply from groundwater. Groundwater is also used as a water supply by many agricultural, aquacultural and industrial facili-

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<sup>1</sup> Much of the material in this section is from: Golder Associates Ltd. 2001. Draft final report.



## *Case Study: Langley Stream Mapping for Better Local Water Management*

ties, as well as by private well owners. Of the five most accessible and economical aquifers, four are shallow and unconfined, and therefore susceptible to contamination from surface sources. As well, declining water tables in some aquifers indicate that the current and future rates of groundwater extraction may not be sustainable.

The Township contains fourteen major surface watersheds that provide water for fish habitat, agricultural irrigation, and recreational uses. Urbanization in some of these watersheds has had an impact on water quality, peak flow and availability of fish habitat. As well, changing agricultural practices have increased surface water extraction rates and reduced floodplain areas (e.g. by dyking and filling) in many of the rural watersheds.

The Township is ideally suited for the development of a water resources management strategy, based on its dependence on groundwater as a source of water supply, the inherent vulnerability of its aquifers, the quality of its fisheries resources, and the threats to surface and groundwater quality and quantity from pressures related to agriculture and increased development.

In 1998 the Township of Langley initiated its WRMS with the following vision: to balance present and future water supply with demand for development, while maintaining and maximizing opportunities to enhance the quantity and quality of surface water and groundwater. The WRMS is intended to provide the township with a comprehensive and defensible approach to managing the quantity and quality of the local groundwater and surface water. The Township anticipates that by developing and implementing this strategy, it will move from a position of reacting to individual problems in an ad hoc manner, to a position of proactively managing issues.

The WRMS is an overall strategy for all surface and ground water in which mapping work (which is ongoing to the present time) forms an important component. The Township initiated the mapping of fish habitat and creeks in 1993, before the WRMS was embarked on, as a process of information gathering. The fact that eight years of mapping has already been done propels the Township forward to being able to use the information to make management decisions.

An Action Plan developed under the WRMS has been formally adopted by Langley Township council. This Action Plan will provide the Township with a 20-year schedule of projects to address water resources issues in four categories: groundwater quantity, groundwater quality, surface water quantity, and surface water quality.

### **Process and Partners**

Funding and support for habitat inventory mapping have been provided by a variety of agencies and organizations, including:

1. The Township of Langley
2. The Langley Environmental Partners Society (LEPS), which is itself a partnership. LEPS linked organizations and facilitated contacts. The relationship between the Township and LEPS has been close since the inception of LEPS.
3. Fisheries and Oceans Canada (DFO)
4. Human Resources Development Canada (HRDC), which provided funding for work crews. This funding provided training for unemployed fishermen, street kids, and youth at risk. While learning to do stream mapping, the trainees learned new life skills and at the same time learned the importance of streams and stream protection.

5. School District 35: school students helped in data collection as part of their career preparation program.
6. Community stewardship groups
7. The Real Estate Foundation
8. VanCity Savings
9. Environment Canada, through its Action 21 youth program
10. The Urban Salmon Habitat Program of the Ministry of Water, Land and Air Protection (MWLAP)
11. Fisheries Renewal BC, a former B.C. government agency
12. UBC, which helped develop GIS methods

### **Recommendations for the Community Mapping Network**

1. Plan your project before you start: what information you want to collect, how it will be used, what is the best way to collect it, how you will pay for it, what partners you will work with, etc.
2. Design your database/GIS.
3. Train your crews. The data is only as good as those collecting it.
4. Monitor the results as you go, instead of waiting until the field work or data entry has been completed.
5. Try to build in landowner education and encourage private stewardship.
6. Focus at the local government level: encourage partnerships.

### **Next Steps**

The next steps are to apply the information that has been collected in ways that will be directly useful to staff and to the public.

Mapping information will be used in the development of WMPs. As part of the WMPs, it is a goal to develop separate memoranda of agreement with senior environmental agencies for dealing with stream-side protection regulations, taking a flexible approach to produce long-term agreed-on plans. SHIM mapping provides a level of detail that gives the planning process a huge head start in defining clearly the objectives of those plans.

The Township aims to make use of the stream information to streamline procedures and protocols for landowners requiring the information, as well as for its own staff.

### **Project Contacts**

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### **References**

Golder Associates Ltd. 2001. Draft final report.

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Thanks are due to all the funders and partners. Special thanks go to Brad Mason of DFO and Rob Knight of MWLAP for their ongoing support.

The Township of Langley provided all the necessary equipment and system updates plus GIS expertise and technical support.



## ***Case Study: Langley Stream Mapping for Better Local Water Management***

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LEPS not only conducted the work, but championed the project. Special thanks to the stream survey coordinator for ongoing dedication, and to the stream survey crews for taking on any challenge!

Thanks to the landowners who allowed crews on to their property.

Community stewardship groups played a helpful supportive role in community education.

Hans Schreier of UBC set up the GIS system.

Marina Stjepovic was interviewed for the preparation of this Case Study, and reviewed a draft



# Ministry of Agriculture, Food and Fisheries Land Use Coding

## *Sustainable Agriculture (1): Planning for Agriculture*

### **Abstract**

The Ministry of Agriculture, Food and Fisheries (MAFF) has partnered with various B.C. local governments to develop agricultural GIS systems as a basis for agricultural land use planning, urban-rural interface planning and strengthening farming. A pilot project has been completed in the District of Pitt Meadows; additional projects have been completed or are ongoing elsewhere.

### **Objectives**

In an effort to improve links between local governments, provincial agencies and the farm community, the Ministry of Agriculture, Food and Fisheries introduced the Strengthening Farming Program. This program has initiated several projects to improve these linkages and foster agricultural awareness.

A key project that was successfully completed under the program was the Pitt Meadows GIS Pilot Project, undertaken in partnership with the District of Pitt Meadows to explore the benefits of adding agricultural data and tools to a geographic information system (GIS). This was done with a view to supporting local governments in the development of official community plans (OCPs), bylaws, and agricultural area plans; developing and evaluating various planning scenarios for the urban-rural interface; evaluating the availability and usefulness of resource information and land use data regarding opportunities and constraints for agricultural industry development; and evaluating the usefulness of the technology in terms of strengthening farm-

ing and applicability to other areas of the province.

An ongoing project in the City of Richmond will involve the local government updating its land use inventory within its farming areas while examining inventory methodology. Other important objectives of this project are to ensure that methodologies are compatible with local governments' technical capabilities and to document the findings in order to share the results with other local governments that may wish to undertake land use inventory work in their agricultural areas.

### **Actions**

In 1996, MAFF and the District of Pitt Meadows joined together to work on an agricultural GIS pilot project. It was felt that GIS held considerable promise not only to enhance the understanding of farming areas, but also to help identify issues important to strengthening, sustaining and promoting agricultural development.

MAFF is also working with the City of Richmond on a land use inventory project. Other projects have been or are being considered in municipalities in various regions of the province, including Creston, Peace River, Comox, the Capital Regional District, and Kelowna.

A lot of the original Pitt Meadows survey was done in 1995 and 1996. Richmond has been surveyed twice as have Surrey, Langley and the Matsqui area of Abbotsford. Pitt Meadows intends to re-do its survey this summer.

(Information will out-date over time, so keeping up to date is a challenge. Updating is actually fast and efficient. An interval of three years between surveys is probably reasonable; this is a question of available resources and time.)

The inventory method developed by MAFF involves a team of two surveyors using a combination of drive-by observations and aerial photographic interpretation. Each legal parcel in the study area is examined, and both the land covers (e.g. buildings, crops and vegetated areas) and the land use activities (e.g. agricultural, residential and industrial use) are recorded. The survey work can be done quickly – about 100 ha per day. The information is coded into data tables in a computer, which are then linked to a GIS layer of the survey area's legal parcels. A GIS user can then query and map the land use inventory information.

### **Project Outcomes**

The Pitt Meadows GIS Pilot Project enabled the District and MAFF to explore the benefits of adding agriculture data and tools to the District's GIS. The agricultural GIS is proving to be a cost-effective, user-friendly planning tool. The District now has a system that will:

- Increase access to local farm sector information;
- Act as a tool to enhance decision-making; and
- assist in the promotion of farming in the community.

More specifically, applying GIS to the District's farming area can provide information that is useful in future updates of the District's Official Community Plan (OCP) and bylaws. Some of the tools that were developed can be used to demonstrate the effects of setback distances and commodity restrictions on the agriculture industry. Other

tools can help investigate the possibilities of starting or expanding a farm business and provide information that can assist an operator in making management decisions. Additional features of the agricultural GIS include its ability to identify land use patterns along the farm edge and help determine the need for buffering.

The project also provided an opportunity to test approaches to undertaking land use inventories in farm areas and to examine the applicability of a variety of different information layers and sources. The intent from the outset was to ensure that the experience gained in working with Pitt meadows would be available to other local governments. Since the completion of the pilot project, MAFF has worked with several local governments, helping them to conduct agricultural land use inventories and incorporate the data into their GIS.

Two documents have been produced and one is in draft form. A booklet (MAFF 2001(a)) based on the Pitt Meadows Pilot Project outlines the agricultural GIS tools and describes the pilot project. A related brochure (MAFF 2001(b)) provides a brief synopsis of what an agricultural GIS is capable of. A draft manual for agricultural land use inventory is in preparation; it will serve as a guide for communities interested in undertaking an inventory of their agricultural land base.

A future consideration is public access to municipal GIS information by means of the internet. At least on municipality has plans to provide public access to some of this information via the Web.

### **Discussion**

GIS technology provides a new way to connect with agriculture (Fig. 1).

From a local government perspective, the end product is a database of land use infor-

mation tied to the GIS parcel boundaries. From this a variety of different maps can be made, at varying levels of detail according to need. The GIS resides with the local government, making it easy to prepare maps or do calculations.



**Figure 1:** Agricultural GIS: Possible data layers

GIS information may be used in *many ways* by *many users*. Examples of GIS uses related to agriculture include agricultural area plans, ditch maintenance, watercourse classification, irrigation studies, drainage studies, agriculture development options, bylaw reviews, farm bylaw development, and tools for regulatory compliance.

A key way GIS can aid in the development of plans and bylaws that affect agricultural areas is by demonstrating the impacts of proposed policy or regulation on farm activities. An example would be assessing the effects of setback distances or commodity restrictions. A GIS can be queried for all

properties meeting specified criteria. The results of such examinations can then guide the updates of plans or bylaws—e.g. official community plans, agricultural area plans, zoning and farm bylaws.

Urban land use data within a specific distance from the farm edge can also be identified with GIS. The data can then be used to help select the most appropriate setback distances, building standards and farm management practices within a specified area from urban edge.

Another way in which an agricultural GIS can be used is in the assessment of development and rezoning proposals next to farmland. Information gained through the assessment can be used to determine the suitability of urban development proposals near the Agricultural Land Reserve (ALR) boundary.

Other example uses would include identifying patterns of disease outbreaks, or determining how many animal barns are within or near a disease quarantine area.

### Process and Partners

Partners include local governments and Agriculture and Agri-Food Canada. Generally, MAFF has simply partnered with the local government. Local governments provide labour, expertise and technical support.

### Recommendations for the Community Mapping Network

When planning an inventory project, first find out what inventories have already been done. Contact local government or MAFF first, rather than starting from scratch. Talk to other groups and find out what their information needs are—see if something can be done jointly. Partners can do a project together that meets the needs of each, sharing the work.

### Next Steps

Given the success of the pilot project, MAFF is interested in pursuing further work with other local governments. It is anticipated that future projects will include building GIS tools to identify marketing and employment opportunities, as well as trends in land use and ownership patterns. The opportunity for employing GIS to help in the application of buffers along the urban/rural edges will also be examined further.

MAFF will continue to work with the District of Pitt Meadows to implement the existing tools of the project, evaluate new scenarios and provide support as required. MAFF is also interested in working with and supporting other local governments wishing to use GIS to undertake inventory work in their farming areas, develop agricultural area plans, update bylaws and generally promote and plan for agriculture as a part of more comprehensive sustainability programs. Several local government planning departments throughout B.C. have expressed an interest in using GIS to improve their knowledge of the local agriculture industry.

A project is anticipated that will involve several provincial and federal agencies. This project will help the different agencies to better understand each other's land and water inventory needs and allow the exchange of information more readily. The objective will be to explore inventory methodologies that will accommodate the needs

of several users and ensure that the most cost-effective means are used to collect, store and share information through the application of GIS.

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Ministry of Agriculture, Food and Fisheries. 2001(b). AgFocus, An Agricultural GIS Overview: the Pitt Meadows pilot project (brochure).

### Acknowledgements

Ted Van der Gulik, Janine Nyvall, Karen Thomas and Stacy Meech, all of MAFF, were interviewed and provided resource materials in the preparation of this Case Study. Karen Thomas and Ted Van der Gulik reviewed a draft.

Portions of this Case Study are drawn from MAFF 2001(a) and MAFF 2001(b), as well as from the MAFF leaflet *Growing Together: the rural-urban connection*.

# Langley Environmental Partners Society Wildlife Strategy

## *A wildlife strategy for the Township of Langley*

### **Abstract**

The Langley Environmental Partners Society, the Township of Langley and other agency and community partners have joined together to develop and implement a comprehensive wildlife strategy for the Township of Langley. SHIM techniques and data are used to generate a GIS database of land cover and land use information within the Township to aid in the establishment of habitat objectives within the strategy.

### **Objectives**

The lack of comprehensive information on the quantity and quality of available habitats, and the absence of defined and achievable habitat objectives against which community partners and government agencies can measure their progress, are two major obstacles to adequately conserving wildlife habitat.

The purpose of this project is to address and overcome these obstacles within the Township of Langley, and in so doing, to provide a blueprint for success that can be replicated by other municipalities in the region. To this end, LEPS and the Township of Langley are working together to produce a comprehensive Wildlife Strategy.

The project is complex, involving several major initiatives over a two to three year period. The principal objectives are:

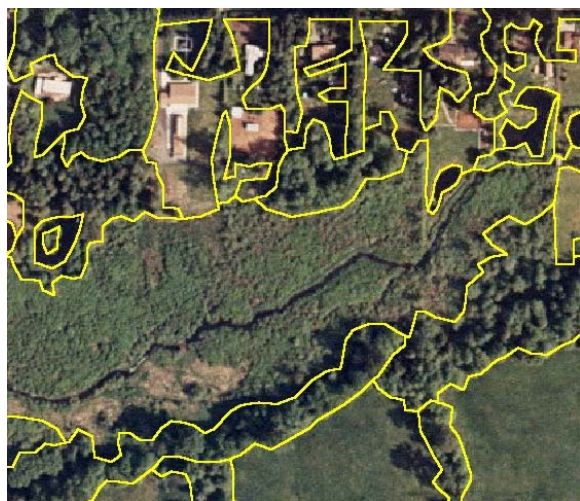
1. to assess the quality and quantity of available habitat in the municipality, using Geographic Information Systems (GIS) to delineate land cover polygons;
2. to work with municipal staff, Council, senior agencies and the community to establish specific and quantifiable habitat objectives that would conserve a healthy diversity of wildlife species;
3. to develop and implement a strategy for incorporating these objectives into municipal policies and practices, as well as stewardship efforts by community groups;
4. to initiate a reasonable and consistent monitoring program for use by non-governmental organizations to evaluate progress on achieving the habitat objectives;
5. to cooperate with recovery teams to protect and restore habitat for local wildlife species that are endangered, with particular emphasis on the Oregon Spotted Frog and the Pacific Water Shrew;
6. to develop and implement an invasive species control strategy, with particular emphasis on the American Bullfrog;
7. to establish a comprehensive and practical program of volunteer-conducted inventory and monitoring of habitat quality and use by wildlife species in Langley;
8. to develop and implement protocols for incorporating terrestrial wildlife values into local aquatic and riparian habitat restoration projects; and
9. to conduct educational activities in local schools, focusing on wildlife habitat issues.



### SHIM-Related Actions

The objectives of the Wildlife Strategy are wide-ranging, so only those actions related to the use of Sensitive Habitat Inventory and Mapping (SHIM) are described here.

Mapping by LEPS of land cover and land use within the Township of Langley is underway, using modified SHIM land cover classes. Orthophoto imagery is being photointerpreted at a 1:5,000 scale, with a minimum polygon size for most land cover classes of 0.01 hectares (Fig. 1).



**Figure 3:** Example of photointerpretation—land cover and land use polygons

Ground-truthing of the mapping data involves random sampling, stratified by confidence level in the photointerpretation of each land cover polygon. Along with field verification of land cover and land use, supplementary information will be collected on structural conditions, habitat elements, type and extent of disturbance, etc., during the ground-truthing process.

In addition, previously-collected SHIM data will be used to verify the accuracy of photointerpretation in riparian areas.

The mapping data will be analysed to generate a coarse-level habitat status report. Combined with supplemental field data and

scientific information on species habitat requirements, a series of habitat objectives for selected focal species will be established.

### Results and Status

The anticipated results and status to date for each of the nine project objectives are as follows:

1. A GIS database with polygons delineating the type and extent of vegetation cover and land use (scale 1:5,000) will be produced. Using existing data and information from the land cover database, a Habitat Status Report will be prepared. The mapping at present is just over 25% complete; ground-truthing and field data collection will start shortly.
2. A series of habitat objectives for the Township of Langley will be developed. Selection of the focal species that will be used to establish the habitat objectives is currently in progress.
3. Achieving the habitat objectives will require a joint effort by the municipal government and community partners. The planning, engineering and parks departments of the municipality expect to contribute through innovative policies and practices. The stewardship community will assist by restoring critical habitats and promoting private land stewardship.
4. A reasonable and consistent monitoring program will be developed that non-governmental organizations can use to evaluate progress on achieving habitat objectives. Once the methods have been tested and baselines have been established, a monitoring manual will be produced. This will be initiated after the objectives have been established. .



5. It is hoped that the project will contribute to a significant improvement in the local status of endangered species. Cooperation with the Oregon Spotted Frog Recovery Team is ongoing; no other recovery teams are currently in place for species at risk in Langley.
6. A long-term strategy involving local landowners and the public will be developed for controlling the spread of non-native, invasive plant and animal species within the municipality. Research is nearly complete. Mapping is ongoing, and will feed the prioritization of sites and species. The first priority will be the American Bullfrog.
7. Protocols for volunteer-conducted surveys of the quality of available habitats and their use by wildlife species will be produced and distributed. Volunteer-conducted inventory and monitoring are currently in the initial stages.
8. A handbook or manual for community groups and other organizations involved in habitat restoration programs will be produced. This will assist groups involved in aquatic and riparian habitat restoration to incorporate terrestrial wildlife values into their projects. The research for this is nearly complete; draft protocols should be ready by April or May of this year.
10. Several wildlife-focused education programs, targeted at both the kindergarten to grade 3 and the grades 4 to 7 age groups, will be created and presented. Some have now been developed.

### **Project Outcomes**

The principal outcome of this project is a comprehensive long-term strategy for conserving and restoring wildlife habitat throughout the Township of Langley. The

municipal government expects to incorporate the objectives into its planning processes, engineering policies and practices, and parks planning. The stewardship community will use the strategy to guide their efforts in private land stewardship, monitoring and assessment and habitat restoration.

Direct benefits include:

1. the identification of critical habitats for protection and restoration;
2. the control of invasive plant and animal species (Fig. 2), which will help restore the ecological integrity and diversity of local habitats;



**Figure 2:** Controlling Himalayan blackberry

3. the incorporation of wildlife considerations into aquatic and riparian habitat restoration projects;
4. the exposure of hundreds of elementary students to the importance of wildlife habitat and the threat of invasive exotic species; and
5. the opportunity for secondary and post-secondary students and community groups to get involved in assessing and monitoring the quality of habitats.

Some of the many indirect benefits to habitat include:

1. an expansion in the quantity of available habitat as a result of defining and achieving habitat objectives;
2. an improvement in the quality of available habitat as a result of incorporating habitat inventory and assessment data into the habitat objectives; and
3. an increase in community efforts to protect and restore habitat as a result of public awareness and education initiatives related to many of the project objectives.



**Figure 3:** Oregon Spotted Frog

It is anticipated that this project will serve as a blueprint or model for other communities across the country. The products and results will be disseminated to other municipalities in the region in an effort to encourage replication of this project's success.

In addition, the methods defined in several of the project components can be used by community groups or government staff to conduct inventory, monitoring or restoration projects in other regions. The resulting data will prove invaluable for community partners, municipal staff and senior agencies, as they each pursue their independent objectives.

## Background

The rate of urban growth and the impacts of intensifying agriculture are threatening one of the most sensitive and productive ecosystems in North America: the Lower Fraser Valley of British Columbia (Langer 1997). This region, which includes the Township of Langley, has been identified as containing wildlife habitat at high risk (Wildlife Habitat Canada 2000).

The Oregon Spotted Frog (Fig. 3), recently designated "endangered" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), is at risk in Langley because of habitat fragmentation and predation by the invasive, non-native American Bullfrog (Fig. 4). Habitat fragmentation and the spread of invasive plant and wildlife species must be addressed if the integrity of local habitats is to be protected and restored.



**Figure 4:** American Bullfrog

Federal and provincial legislation do not fully protect terrestrial species, while local government has considerable influence over wildlife habitat.

This influence presents a unique opportunity to incorporate wildlife values into every aspect of the decision-making process of local governments, from the preservation of habitat corridors in urban developments to the use of stormwater management prac-

tices to improve the quantity and quality of available wildlife habitat (Wilson *et al.* 1998, Stephens 1999).

While municipalities' action on the issue of habitat protection is critically important, there is recognition that adequate habitat stewardship requires a combination of municipal activities (e.g. land use regulation and appropriate investment in parks and public works) and private activities (e.g. public awareness and voluntary conservation practices by landowners) (Government of British Columbia 1997).

Many municipalities in Canada have initiated environment-focused programs. Some municipalities produce State of the Environment reports (e.g. Calgary, Kelowna), while others adopt environmentally focused by-laws (e.g. North Vancouver, Surrey). The Township of Langley, among others, commissioned an assessment of Environmentally Sensitive Areas in the municipality. However, the lack of defined and quantifiable objectives against which progress can be measured limits the effectiveness of such practices (Wildlife Habitat Canada 2000).

As of 1995, fewer than half of local governments in the Lower Fraser Valley had established objectives and implemented sufficient regulatory measures to protect riparian and aquatic habitats (Quadra Planning Consultants 1995). No municipalities could be identified that had objectives or measures for terrestrial habitats.

There are examples, however (Wildlife Habitat Canada 2000), of programs using specific and feasible habitat objectives. There are also many inventory and monitoring programs for particular species groups, e.g. the North American Bird Conservation Initiative (NABCI) on which the project partners plan to base their habitat objectives.

### Process and Partners

A Steering Committee has been established for the Wildlife Conservation Strategy for the Township of Langley, with representatives from three departments of the municipal government, local naturalists and stewardship organizations, the Greater Vancouver Regional District (GVRD) and senior government agencies. SHIM is well-represented on the committee through provincial and federal agency staff. All partners, including the Community Mapping Network, are providing in-kind support to the project. Funding is being provided by Wildlife Habitat Canada, Environment Canada and the Township of Langley.

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### **Acknowledgements**

Leanne Leith provided resource materials for the preparation of this Case Study and contributed revisions to the draft.

# Squamish River Watershed Society Mapping, Restoration & Enhancement

## Abstract

Using SHIM methodology, the Squamish River Watershed Society GPS-mapped the Little Stawamus River watershed with a view to identifying restoration opportunities and producing an easy-to-use end product for planners. The information is to be added to the municipality's GIS. Some restoration work has been undertaken and more is planned. It is anticipated that the accurate stream location mapping will prove very useful in planning future developments within the watershed.

## Objectives

The objectives for the project were:

- To map the Little Stawamus watershed accurately in its entirety, from the headwaters down to the confluence with the Stawamus River (and to include the tributary Magnolia Creek), by means of GPS
- To identify restoration opportunities and add them to the District of Squamish's GIS
- To provide an easy-to-use end product for planners within the District, the Squamish-Lillooet Regional District, and any interested user group, in electronic or hard copy.

## Actions

Over a two month period in 2000, a team trained in SHIM practices digitally mapped the entire Little Stawamus watershed using a Trimble Pathfinder GPS unit. Approximately 16.5 km of stream and 6 hectares of wetland were mapped. The information is

in the process of being transferred into GIS format for future use.

## Project Outcomes

Some restoration projects have been undertaken in the lower portion of the watershed – the removal of collapsed bridges and some riparian planting. A larger project that is being considered is to meander a channelized portion of the Little Stawamus.

The SHIM mapping will be very useful in the not-yet-developed headwater reaches of the watershed. The District will be able to use the information in pre-planning for future development. When development proposals eventually come forward, accurate stream location information will be available to developers in advance.

Resources Inventory Committee (RIC) markers have been placed in the lower reaches of the creek for the purpose of spatially tying in future enhancement work to the GIS.

The deliverables, consisting of a final report with accompanying digital GIS files for all stream and feature data, provide an easy-to-use end product for use by planners within the District, the Regional District and any other interested groups. The report includes a description of the project, methodology, results, recommendations, and a series of 11" x 17" maps (Fig. 1). The series of maps generated for the report provides an overview of the watershed with respect to land use, stream and wetland location, and enhancement opportunities. The GIS product establishes a framework for future data collection, mapping and data entry.



At present, the intent is to provide a digital copy of the map to the District of Squamish planning and engineering departments to be included in any future land use decisions (i.e. Official Community Plans (OCPs)).

### Background

The Squamish River Watershed Society has been actively involved with restoration works since 1995 when the Society first undertook Forest Renewal BC (FRBC)-funded projects working with the Ministry of Environment, Lands and Parks (MELP). The intention of the Watershed Society was to undertake a holistic approach towards managing the watershed working with the local, regional, and provincial governments and bodies. At present, the Watershed Society has representation from the local, regional, and provincial governments, local community groups, public and private industrial, commercial and retail organizations, as well as Squamish Nation participation.

In recent years, the Watershed Society acted as the administrative body for Fisheries Renewal BC (FsRBC) on behalf of the Squamish/Lillooet Rivers Watershed Partnership Group. The direction that the Watershed Society brought to this group and the projects that were given funding were part of an overall strategic plan that was initiated in 1999 to prioritize restoration opportunities, identify information gaps, develop a resource centre, and secure long term funding.

A need was recognized early on for proper mapping of the watercourses and the watershed and emphasis has been placed on developing digital mapping on the major watercourses. Bit by bit, this is being accomplished and the information is being utilized locally in OCPs and provincially.

This case study highlights the GPS mapping of one of the watercourses in an urban sec-

tion of Squamish: Little Stawamus Creek. This watercourse was once a spawning bed for pink salmon (*Oncorhynchus gorbuscha*) but has been rechannelled, rerouted, and dramatically altered with the construction of housing in the area.

Little Stawamus Creek and its tributaries (Magnolia Creek) are still heavily utilized by spawning coho salmon (*Oncorhynchus kisutch*) and chum salmon (*Oncorhynchus keta*). The Creek does not appear on many of the provincial maps and some of the headwaters and ephemeral streams and wetlands did not appear on any map prior to it being mapped by GPS.

Squamish Nation annually undertakes spawner surveys and includes this stream. In addition, smolt surveys and enumeration have been undertaken by Fisheries and Oceans Canada.

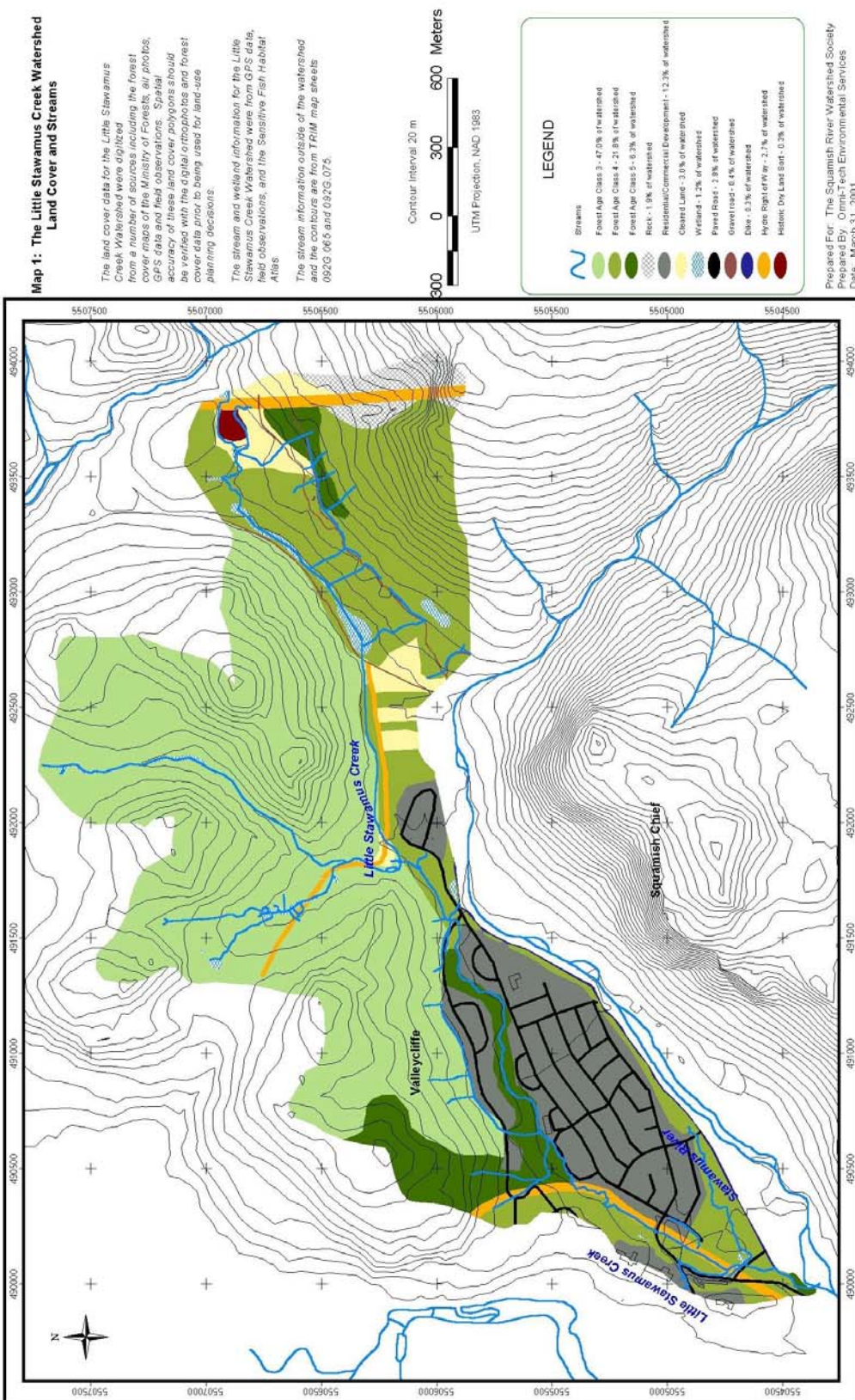
### Process and Partners

This project is a component of a larger watershed plan for the lower sections of the Stawamus River.

The project included the resources of Fisheries and Oceans Canada staff and background information as well as involvement from the District of Squamish. The Watershed Society has worked over the years with the Squamish Trails Society, who were interested in obtaining the maps in order to incorporate them with their trails system. As well, the information was made available to Squamish Nation who provided background information on fish densities and distribution and suggested restoration opportunities.

Three people were hired to map the 3 km of stream (over a 15 km<sup>2</sup> area). Funding for the project was obtained from FsRBC. Information from previous years was made use of, including the Urban Salmon Habitat

## Case Study: Squamish R. Watershed Society Restoration & Enhancement



**Figure 1:** The Little Stawamus Creek watershed land cover and streams. This map is an outcome of the SHIM mapping project.

Program (USHP)-funded Inventory of Squamish Nation Territorial Lands, and DFO-funded fisheries data.

The project to meander the stream section would be a joint project between Squamish Nation and the District of Squamish.

### **Next Steps**

Funding has been applied for to meander the channel of the Little Stawamus and to build a new crossing. As funding becomes available, the Watershed Society hopes to continue to map the watercourses within the developed portion of Squamish.

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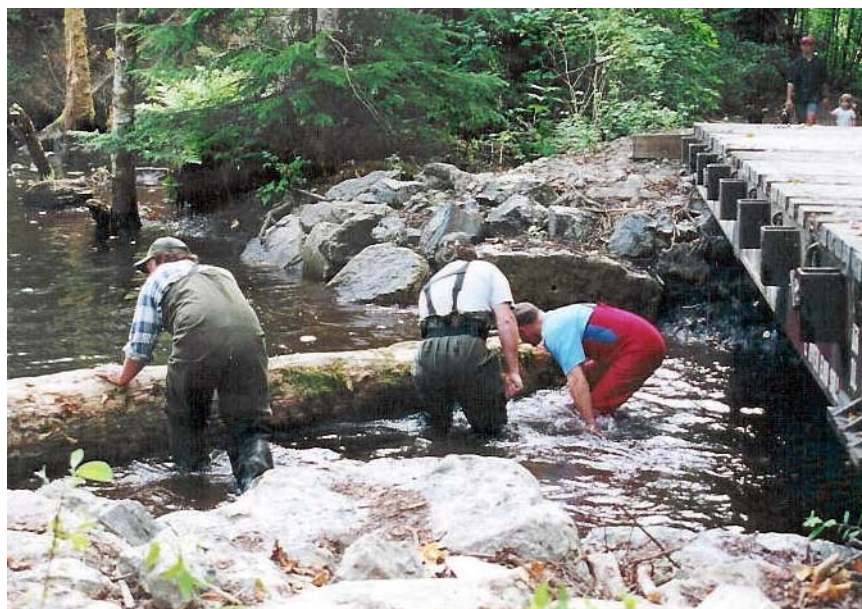
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This Case Study was contributed by Edith Tobe. Jas Michalski provided additional information.



Stream enhancement by the Squamish Streamkeepers: building a "beaver baffle" on the Little Stawamus River



# Vancouver Island Small Streams

## *Stream lines on a map: a critical first step in protecting fish habitat*

### Objectives

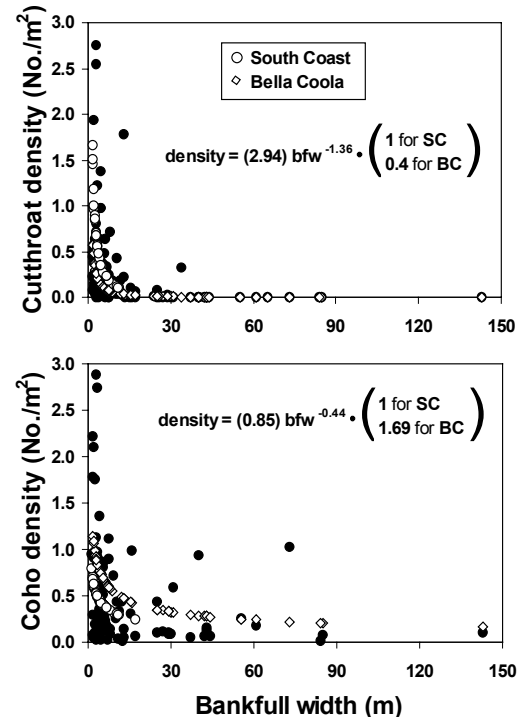
BC Fisheries Research, in partnership with the Community Mapping Network, undertook a project to assess how well the most commonly used regional topographic map series delineate small stream networks in different coastal landscapes. The primary objectives were:

- to walk, measure and map the total lengths of all streams located within a variety of west coast watersheds; and
- to determine the extent of streams missing from these drainages on government 1:50,000 and 1:20,000 topographic maps.

### Background

Traditionally, fisheries research efforts and conservation strategies have focused on large rivers and lakes, and not on the types of fish habitat prevalent in low gradient landscapes like that of the Fraser Valley, i.e., wide and dispersed networks of small tributary streams and ditches (Paish 1997). Only in the last few years has there been a recognition that smaller scale streams – the aquatic systems most likely affected by unregulated urban development – are probably critical components in maintaining the health of many important fish stocks. Recent research has shown that small streams contribute a disproportionate amount of total rearing habitat for anadromous cutthroat trout and coho salmon (Fig.1), and has highlighted the need for riparian regulations and land-use management plans that adequately protect small streams (Rosenfeld *et al.* 2000). This is becoming increasingly urgent for many areas of the Pacific North-

west, as continued urbanization, agriculture and logging in low-gradient valleys is exerting growing pressure on small stream habitat and their associated fish stocks (Murphy 1995, Reeves *et al.* 1997). Small streams and wetlands are important not only for their intrinsic ability to contribute to specific fish stocks, but also because these habitats can provide other components of value to urban dwellers. Biodiversity, green areas, and natural recreation opportunities are all recognized by public groups and municipal governments as valuable community assets that should be retained (Paish



**Fig. 1.** Highest densities of cutthroat trout and coho salmon occur in small streams (< 5m bankfull width) (from Rosenfeld *et al.* 2000).

Small fish bearing streams are, have been, and/or will be protected to varying degrees within British Columbia by Federal Land Development Guidelines, the now defunct Forest Practices Code, the proposed B.C. Fish Protection Act and assorted municipal bylaws. The key element of this protection most commonly takes the form of leave strips, areas of the land and vegetation adjacent to watercourses that are to remain in an undisturbed state, throughout and after any development process. Leave strips are intended to protect both the watercourse itself and the adjoining riparian areas, a varying width of land designated as the Fisheries Sensitive Zone (FSZ). Theoretically, leave strips are intended to apply to all watercourses that flow into or contain fish and fish habitat. This could include wetlands, ponds, swampy areas or other intermittently wetted areas, small streams, side channels and ditches. Leave strips are intended not only to directly protect fish and fish habitat, but also to avoid wasteful loss of land due to stream erosion and instability.

The absence of leave strips from many small streams in B.C. is likely a combination of inconsistencies within the regulatory mechanisms and a failure to accurately delineate the presence of many of these small systems in regional or municipal plans. Topographic maps (such as NTS and TRIM) used for planning purposes at multiple scales are digitized from air photographs, where stream drainages are usually most apparent in high gradient topographies with incised channels, and least obvious in low gradient landscapes. The number of streams missed on any given projection will likely vary both with the underlying topography, the scale of the coverage and the skills of the individual cartographer who digitized the air photos. Research by Brown *et al.* (1999), for example, found that 48% of linear stream length was omitted on

1:20,000 TRIM maps of the Black Creek drainage on the east coast of Vancouver Island, which included an estimated 12% of coho and 20% of cutthroat rearing habitat. Underestimation of small streams on published topographic maps may be a general feature of wetter coastal areas with extensive forest cover or high wetted stream density. This could present significant problems for stream protection during industrial development or urbanization, since streams that are not identified will not be accommodated during development plans, and are less likely to be protected during resource extraction or urbanization (Rosenfeld 2000).

### Process and Partners

Funding was provided by Forest Renewal BC (FRBC) to the B.C. Ministry of Water, Land and Air Protection, Fisheries Research Section to support an extensive study on habitat use and requirements for coastal cutthroat trout.

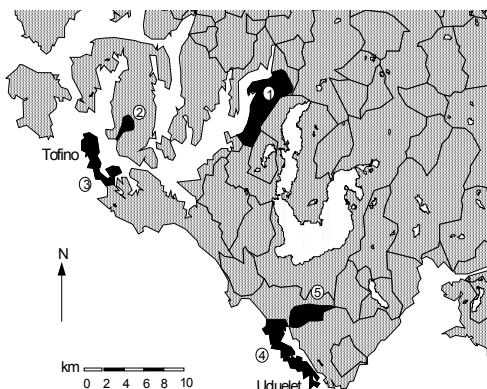
Funding was also provided by Human Resources Development Canada (HRDC) to the Regional Aquatic Management Society (RAMS) and the District of Ucluelet to finance retraining for displaced fisheries workers in the Ucluelet District and Nuuchah-nulth territory .

Logistical support for SHIM methods, crew training and maps were provided by staff at Fisheries and Oceans Canada, Pacific Region (Brad Mason and Louise Porteau).

### Actions

In order to estimate the proportion of streams missing on 1:50,000 and 1:20,000 topographic maps, streams were walked on foot and channel lengths and widths systematically measured in discrete drainages (Fig. 2). All streams were identified by carefully inspecting shorelines by boat or on

foot. Stream channel widths and lengths were measured with a tape for streams in Tofino Inlet and Meares Creek (BC Fisheries protocol). Stream measurements within drainages of the Tofino and Ucluelet peninsulas and Smith Creek followed standard SHIM protocols employing a Trimble Pro XLR GPS georeferenced daily with an accuracy of  $\pm 5\text{m}$ .

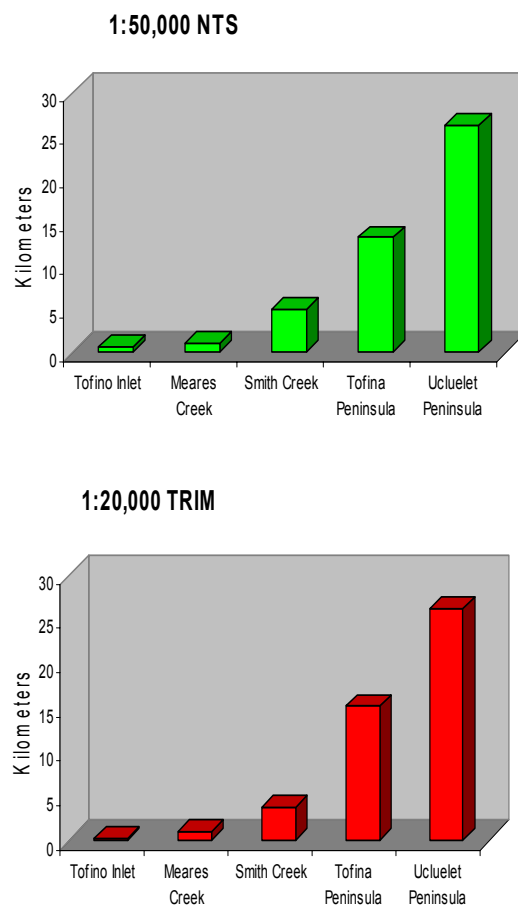


**Fig. 2.** Locations of the areas (shaded in black) where stream habitat was surveyed on the West Coast of Vancouver Island, British Columbia. 1=steep Tofino Inlet streams, 2=Meares Creek, 3=Tofino Peninsula streams, 4=Ucluelet Peninsula streams, and 5=Smith Creek (from Rosenfeld 2000)

The percentage of streams that were missing on 1:50,000 and 1:20,000 topographic maps was calculated by comparing lengths of streams digitized from maps to lengths of streams measured in the field. The proportion missing was calculated for total stream length (all gradients) as well as assumed fish-bearing reaches (gradient less than 20%).

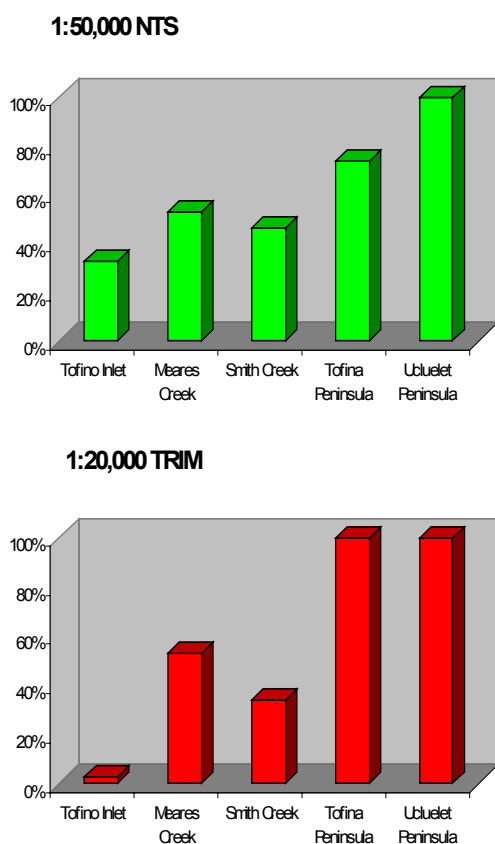
A surprisingly high proportion of streams was absent from the topographic maps (Fig. 3).

Many kilometres of anadromous fish habitat were absent even on 1:20,000 TRIM maps, particularly in low gradient drainages. Underestimation of total stream length within the watersheds varied from 13.2% to 100%. Underestimation of streams



**Fig. 3.** Total length of stream missed in topographic mapping of Vancouver Island drainages.

was least pronounced in the high gradient Tofino Inlet region, although a full 33% of anadromous stream length was missed at the 1:50,000 scale, dropping to 3.1% at 1:20,000. Underestimation was most pronounced on the low gradient Ucluelet peninsula, where virtually none of the 26 km of measured stream channel (including approximately 9.4 km of potentially fish bearing stream) appeared on either the 1:50,000 or 1:20,000 topographic maps. Although the 1:20,000 TRIM maps tended to show more streams than 1:50,000 maps, underestimation of fish-bearing stream length at this scale still ranged from 34% to 100% across the lower gradient drainages (Fig. 4).



**Fig. 4.** Proportions of fish-bearing streams missing from topographic mapping of Vancouver Island streams.

The results of this analysis indicate that there is no real substitute for careful and accurate field surveys to document location and extent of streams and other aquatic habitats where development is planned (Rosenfeld 2000). Although detailed interpretation of localized high resolution air photographs will likely identify a significant number of small streams that are not present on standard topographic maps, even these photogrammetric techniques are unlikely to discern small stream systems obscured by overhanging canopy or without well defined stream corridors (see accompanying Case Study: *Delineation of Streams and Top of Bank in Mission, B.C.*). From a regional planning and habitat protection perspective, data accuracy and

credibility are key factors. The legality of Stream Protection laws and bylaws can be challenged and overturned if the baseline information is in error. Projects can be unnecessarily delayed, emotions can be ignited, planners and regulatory agencies can be made to look foolish and unprepared, and general acceptance of the process is weakened.

## Challenges

The assessment presented here focused on the often unrecognized contribution of small fish-bearing streams from the perspective of their direct contribution to fish habitat. It should also be noted that small fishless streams also serve less directly quantifiable ecosystem functions that affect downstream fish habitat, including the storage, retention and processing of organic matter, and production of both terrestrial and aquatic invertebrates. In the interests of multispecies management, it is also important to recognize that small fishless streams can provide habitat for potentially unique invertebrate communities as well as a diversity of amphibians. The universal geometry of drainage networks is such that small streams are always more abundant than larger ones, and the connectivity of aquatic systems dictates that small streams cannot be lost without compromising the integrity of downstream reaches and wetlands (Rosenfeld 2000). The challenge is quite broad – a greater understanding and awareness of the value of these smaller streams and wetlands, and a concerted effort to identify and accurately map these systems prior to the onset of inevitable development pressures. If economic issues should override our concerns for habitat protection then we shall have to deal with that as a society, but at least the choices should be based on the best information we can provide.



### Project Outcomes

Analysis based predominantly on the SHIM collected data contributed to a chapter in a recently published BC Fisheries research report (Rosenfeld 2000).

This analysis will also soon be released as a scientific article in the North American Journal of Fisheries Management (Rosenfeld, J., S. MacDonald, D. Foster, S. Amrhein, B. Bales, T. Williams, F. Race, and T. Livingstone. 2002. NAJFM 22: 177-187).

The SHIM mapping project provided direct field training for seven displaced fisheries workers from the Ucluelet area in the use of high end Trimble GPS units and ArcView GIS mapping technologies.

The District of Ucluelet now has access to highly accurate and complete stream mapping and inventory information for the area, obtained using the SHIM procedures. This information should aid all future planning activities within the regional district.

### Recommendations for Community Mapping Network

The results of this project clearly illustrate the importance of the detailed habitat map-

ping achievable under SHIM protocols. They also should serve as an example of the very need for the integrated data sets being created through the community mapping network. No single government map layer could presently capture all the pertinent fish and fish habitat information necessary for planning purposes, as important inventory and landscape information is often linked to maps and images created at different spatial scales. For local decision makers traditional approaches for bringing all these data sources together, and then merging and extracting the best quality information have generally been difficult and time consuming. The Community Mapping Network has an important role to play by continuing to build and expand on its role as a centralized hub for environmental information, integrating existing map and inventory datasets and encouraging the acquisition of new data at spatial scales relevant to community planners.

### Next Steps

The focus of the Community Mapping Network on small stream aquatic habitats puts it at the forefront of an awakening realization of the valuable role these systems play in overall watershed functioning. Research and habitat protection groups within environmental organizations are putting increased emphasis on the importance of small streams and the development of methods to mitigate impacts to these systems. Witness ongoing federal research programs like that of Fisheries and Oceans Canada's "Managing land-use impacts on streams to protect fish habitat: evaluation of small-stream and managed riparian buffers for mitigating forestry operations", and a recent symposium at UBC this February entitled "Small stream channels and their riparian zones: their form, function and ecological importance in a watershed context". The Community Mapping Network

needs to continue with its mapping of these small aquatic systems, to contribute the real data that can be used in these evaluations and provide the actual spatial context for their protection and management. Ultimately, it won't be sufficient to recognize the importance of these small streams if nobody even knows where they are.

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This Case Study was prepared by Marc Porter.



# Fraser Valley Regional District Habitat Atlas

*A partnership towards accessible habitat information for Fraser Valley residents*

## Bringing Project Partners Together

With funding provided by Fisheries and Oceans Canada, the Fraser Valley Regional District (FVRD) is participating in a proactive land use planning initiative through shared mapping products of local and senior governments. This information will be used to publish atlases of habitat information for all the local government areas in the FVRD. Each municipality will have access to this watercourse inventory for land use and operations planning.

Through extensive data sharing, new SHIM data for these habitats will be integrated with the existing map data of local, regional and senior governments to produce user-friendly, accurate and up to date maps. The FVRD recognizes a need for mapping work of this scale and atlases as part of its long range planning, to ensure that development is socially, environmentally, and economically healthy. This information will assist local governments in coordinating their Official Community Plans with the Regional District.

## A Proven Success

Similar atlas products have been published by Fisheries and Oceans for Squamish and other communities on Vancouver Island. These are proven products used extensively by local governments. They have been effective tools for informed land use planning and revising OCPs. Squamish is now revising their atlas and the Sunshine Coast Regional District and the Capital Regional District are now building new atlases for their planning needs. Similarly, the B.C.

Conservation Foundation (BCCF) and the SHIM partnership are building on this proven method by providing map products to all local governments in the FVRD.

SHIM data, acquired through community partnerships, will be captured and integrated with the maps of local governments and the FVRD. The habitat atlas will be published in limited numbers as 11"x17" binders at project completion in April, 2002. Watercourse classification will be included in the second edition of habitat atlases for high priority areas and agricultural lands, based on available field data.



All of these data including integrated local government data and new SHIM data about watercourse alignment, fish presence and riparian habitat will be made available to the public via the SHIM web site on an ongoing basis, long after the term of this project.



## Who will benefit from the Habitat Atlas Project?

A variety of uses may be derived from this Regional Atlas project, including public information and planning processes. Because the users will range from highly trained technical staff to concerned members of the public, there is a need to make this information as user-friendly as possible. Smaller communities without GIS departments will also benefit from easily accessible information.

For planning purposes, local governments and communities in the FVRD will be greatly assisted by these atlases of sensitive habitats, based on best available information. They will help to flag the lands around watercourses and wetlands that require special attention during land use planning and operations planning. Accuracy is important, but it is important also to recognize that the product is intended to be used as a planning tool, not a legal document. Its limitations must be explicitly recognized by the project partners.

Because these mapping products are both user-friendly and easily accessible through the SHIM website, they will be of tremendous benefit to diverse users. This point is especially relevant for smaller communities, which may be best served by the user-friendly format of the web site service included as part of this project.

## How will the Atlas Work?

By compiling and integrating existing data, the atlas will provide one of the best and most accessible sources of information for fish-bearing streams, storm water systems, watercourse data, local government contour lines, wildlife inventory, and any ecosystem inventory. However, this project will also

improve existing information by using SoftCopy Photogrammetry. A unique software program that allows for 3D viewing and ortho interpretation via a computer monitor, SoftCopy is useful for improving the existing data set. It is being used in parts of the FVRD as a quality assurance tool to redefine misaligned streams and rivers where necessary, and is also being used to collect missing ditches and streams. This new technology offers the advantage of 3D viewing for quality assurance, where the image and the line data are superimposed directly into the stereo image.

## Project Outcomes

Paper versions of the Fraser Valley Habitat Atlas will be available at public libraries and local government offices within the Fraser Valley Regional District. FVRD municipalities will each have customized versions reflecting their jurisdictional boundaries. These will be available for public review.

Although most of the mapping sources will be at a 1:5000 scale, hardcopy versions of this atlas, printed on 11"x17" sheets, will be shown at 1:11,000 to 1:12,000 scale.

The Atlas will also be available in an electronic version, which will be revised to incorporate new information as it becomes available. This will be accessible through the Community Mapping Network Website at [www.shim.bc.ca](http://www.shim.bc.ca). The CMN will continue to post the most recent data. Partners of course must continue collecting data.

## Process and Partners

Supporting partners include:

- B.C. Conservation Foundation (BCCF)
- Environment Canada/Canadian Wildlife Service (CWS)

## Case Study: Fraser Valley Regional District Habitat Atlas

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## Acknowledgements

This Project Summary is a reworking of information in the pamphlet: *Newsletter # 1, Habitat Atlas, A partnership towards accessible habitat information for all B.C. residents*, prepared by Diana Hall and published by the FVRD.

Shannon Sigurdson of the FVRD provided information used in the preparation of this Project Summary. Katrina Roger of the Cascade Institute provided the graphic of the map.

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# Riparian Buffer Effectiveness Assessment

## Abstract

An integrated index that rates the effectiveness of a riparian buffer at protecting fish habitat and water quality is being developed for the Lower Fraser Valley, B.C. The project was initiated to help establish protection and restoration priorities. The index is based on using four indicators (riparian integrity, land use, slope and surficial materials) to estimate the capability of the buffer to maintain five functions (contributing large woody debris, stabilizing stream-banks, capturing nutrient and sediment runoff, moderating water quantity, and moderating stream temperature). An index has been developed for each function. These individual indices will be integrated into one overall rating. An example of the assessment is provided for one of the functions, moderating stream temperature. This assessment uses percent stream shading and presence of groundwater to rate how well stream temperature is being moderated. The application and verification of the moderating stream temperature section of the assessment is demonstrated using four sites in the Elk Creek Watershed. The two sites rated as poor have higher daily temperatures and greater temperature fluctuations than the two sites rated as excellent. Further work is currently being conducted to edit and integrate the assessment, to test the assessment in three watersheds, as well as, to incorporate more in-stream data to allow a rigorous verification of the assessment.

## Objectives

The characteristics a buffer must have to protect water quality and fish habitat are fairly well documented and researched

(Castelle et al., 1994; Hachmoller et al., 1991; Millar et al., 1997; Osborne & Kovacic, 1993; Wegner, 1999). It is often difficult, however, for managers to select which areas should be protected and/or restored. The impetus for this study comes from the need to develop a methodology to help determine these priorities. This project has two main objectives:

1. To develop and test assessment procedures for determining the effectiveness of a riparian buffer at protecting fish habitat and water quality from land use impacts.
  - a) Select a suite of indicators to represent buffer functions. Develop these indicators into an integrative index to rate the effectiveness of the buffer at protecting fish habitat and water quality.
  - b) Apply this index to three watersheds in the Lower Fraser Valley: Elk Creek, Salmon River and Miami River Watersheds.
  - c) Verify the index with water quality and physical stream habitat data.
2. To develop a framework for setting restoration & protection priorities from the riparian buffer effectiveness assessment.
  - a) Develop a framework to establish protection and restoration priorities.
  - b) Set restoration and protection priorities for one of the test watersheds using the framework.

## Background

The Elk Creek, Salmon River and Miami River Watersheds are predominantly agricultural with some large lot residential areas. All three areas face agricultural intensi-

fication and increasing residential development. By the year 2021 the population of the Lower Mainland is expected to be over 3, 300, 000 people (B.C. Statistics, 2001). With an increasing population comes the intensification of urban and agriculture areas. This intensification could possibly result in threats to water quality from eutrophication, ammonia toxicity, nitrate contamination and increased storm water runoff (Schueler, 1994; Arnold & Gibbons, 1996; Cook, 1994). Riparian buffers can potentially help to mitigate the threats associated with land use intensification.

Current B.C. buffer width regulations are fixed widths with some provisional conditions applied to increase the buffer width under certain circumstances (BCMELP, 2001; BCMAFF, 2001; BCMoF, 1995). Provisional conditions are typically fish presence, presence of community watershed, stream width and width of existing or potential vegetation. Conditions such as slope, land use and surficial materials can alter the effectiveness of a buffer, but are complex to incorporate into buffer width regulations and are not usually included (Wegner, 1999). This project aims to develop a method to more easily incorporate these conditions into habitat protection and restoration priorities. This has the potential to provide greater protection to sensitive areas and give more flexibility to landowners.

### Actions

Four indicators: riparian integrity, land use, slope and surficial materials, have been selected to measure buffer effectiveness. An assessment has been developed based on the relationship between these four indicators and five key buffer functions. The five key riparian buffer functions being used are: contributing large woody debris, stabilizing streambanks, capturing nutrient and sediment runoff, moderating water quan-

tity, and moderating stream temperature. Each index by function will be amalgamated into an overall rating for the buffer zone. An example of the index for stream temperature is given in Figure 1.

**Figure 1. Example of rating system for stream temperature**

	≥ 60% of upstream area is shaded	< 60% of upstream area is shaded
Groundwater present	Excellent	Excellent
Groundwater absent	Excellent	Poor

Riparian vegetation controls stream temperature by intercepting short-wave radiation during the day and insulating the stream from long-wave radiation loss at night (LeBlanc et al., 1997). Knutson & Naef (1997) noted that a stream surface should have 60-80% shade through out the day in order to moderate water temperatures. A range of buffer widths from 10-30m has been shown to moderate stream temperature (Osborne & Kovacic, 1993). Percent shading will be measured within the 10m buffer. The minimum buffer size of 10m was chosen because of the westcoast's mild climate and commonly overcast skies (Beschta et al., 1987). Stream temperature is moderated with the inflow of cool groundwater (Schreier et al., 1997; Moore and Story, 2001). Summer stream temperatures are kept lower and winter temperatures higher.

The assessment will be applied in each of the three watersheds. Data layers for use in the assessment are in the process of being collected and organized for each of the watersheds. The data layers have been compiled by the Langley Environmental Partners Society using Sensitive Habitat Inventory Mapping (SHIM) techniques; by Mu-

municipal Governments, such as the Township of Langley and the City of Chilliwack; by the Ministry of Forest and by project members digitizing from air photos.

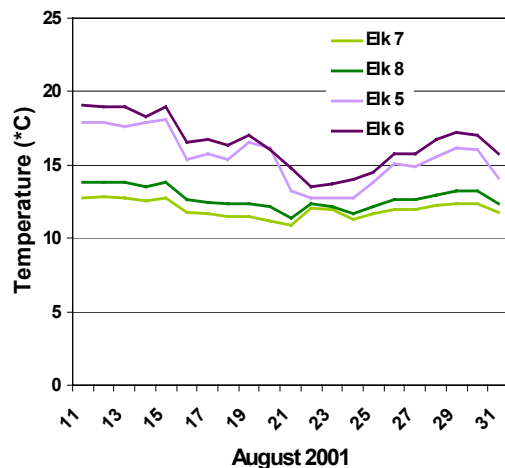
Most of the in-stream data that will be used to verify the assessment has been collected. Water quality data has been sampled at 36 sites in the three watersheds. Twelve temperature loggers have been placed in the three watersheds. They have been recording stream temperature each hour since August 2001. An example of how the in-stream data could be used to verify the applied assessment is given in Figure 2 for stream temperature in the Elk Creek Watershed.

**Figure 2. Comparison between moderating stream temperature rating and actual in-stream temperature data sampled in Elk Creek.**

**a. Stream temperature rating of 4 sites in Elk Creek.**

Site	Rating
Elk 7	Excellent
Elk 8	Excellent
Elk 5	Poor
Elk 6	Poor

**b. Daily high temperature (\*C) for August 11<sup>th</sup> to 31<sup>st</sup>, 2002 at 4 sites in Elk Creek.**



rated as poor, Elk 5 and 6. Increased sample sizes and the incorporation of other in-stream parameters will add rigour to this verification process.

### Process and Partners

This project was initiated by Lea Elliott, MSc. Candidate and Dr. Hans Schreier, project supervisor, at the Institute for Resources and Environment, University of British Columbia.

Funding for the project was from Fisheries Renewal B.C. – Urban Salmon Habitat Program. Data layers have been provided by the City of Chilliwack, Township of Langley, Langley Environmental Partners Society and the District of Kent. Ministry of Forestry provided forest age data for each of the watersheds. In-stream invertebrate data has been provided by Environment Canada. Water quality data was collected and analyzed in co-operation with Dr. Ken Hall and Jody Addah. Equipment, maps and training have been provided by the Community Mapping Network, Shortreid Terrain Data and B.C. Conservation Foundation.

### Next Steps

The next step in the process is to review the riparian buffer effectiveness assessment by individual function and develop a method to integrate the assessment into one rating. When the data layers for the watersheds are finalized the assessment will be applied to each of the watersheds. Physical habitat parameter data will be collected to further verify the assessment. In-stream data will be compared with the applied riparian buffer effectiveness assessment. The final step will be to develop a framework for establishing restoration and protection priorities that can be applied to one of the three

watersheds. This project should be completed during this year, 2002.

### Project Contacts

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# Hatzic Valley Watercourse Inventory

## *Developing Community Capacity*

### **Abstract**

Watercourses in the Hatzic Valley were mapped using a Global Positioning System (GPS). The information collected will be used to enhance regional land use planning initiatives for issues such as flood control, drainage, ditch maintenance, runoff management, habitat enhancement, and channel stability. The data will supplement and validate existing databases and maps. The project is currently underway, projected to finish near the end of March 2002. Some of the results have already been submitted to a regional atlas project.

### **Objectives**

Information collected from this project will be used to enhance regional land use planning initiatives for issues such as flood control, drainage, ditch maintenance, runoff management, habitat enhancement, and channel stability. The data will supplement and validate existing databases and maps.

Previous projects utilized aerial photo interpretation or hand-drawn maps, resulting in watercourses that are presently mapped at 1:20,000 scale, often only to 1:50,000. At that scale features can be up to 20 metres off and many features are not captured at all. This project will map all watercourse features to within 1 to 5 metres of their actual location.

Previous studies of the Hatzic Valley watersheds provide a wealth of useful information. However, there has been no inventory of the biophysical features and habitats of the watercourses that make up the watershed. The watercourse inventory and mapping, along with the existing information,

will enable balanced decision-making that takes into account stream hydrology, functions, and habitat.

The information will be used to:

- support drainage and flooding prevention programs;
- identify enhancement opportunities such as riparian planting;
- aid applications for in-stream works;
- inform watershed planning efforts;
- protect resources; and,
- assist in community planning.

The information should also reduce or eliminate costs to landowners for habitat surveys associated with applications to the province for works in or about a watercourse.

### **Actions**

Watercourses in the Hatzic Valley (streams, creeks, ditches, and tributaries) were mapped by field staff using a Trimble ProXR GPS with a TDS Ranger datalogger.

Obtaining landowner permission proved more difficult than first anticipated. In the Hatzic Prairie many of the properties are very large, and any exclusion affects a large portion of the area to be mapped. Some landowners have been slow to respond, and of those who have replied, approximately 10% have declined permission to access watercourses on their property.

Once property access permission was gained, efforts were made to co-ordinate with landowners. Many had dogs or bulls that they wished to contain while the field

crew was on the property. Assurances were also made that no liability could be incurred by the landowner during stream mapping on the landowner's property.



**Photo:** Stream mapping

### Project Outcomes

This project is currently underway, projected to finish near the end of March 2002. Some of the results have already been submitted to a regional atlas project (see accompanying Case Study: *Fraser Valley Regional District Habitat Atlas*).

A main drive during this project has been to develop community capacity. This begins with training staff and ensuring that software, data-collection devices, and computer hardware are up to the task. This challenge, although greater than first anticipated, is nearly overcome. This method of mapping, including the technology, is user-friendly enough to allow for this to happen.

### Background

The Fraser Valley Regional District provides services such as fire protection, sewer, water, storm drainage, building inspection, bylaw enforcement, planning, zoning and development to electoral areas. The Regional District also provides services common to both municipal and electoral areas such as regional parks, emergency 911 telephone service, fire department dispatch,

regional planning for air quality and solid waste reduction, and growth management.

Located within the FVRD is the Hatzic Valley, a picturesque area east of Mission just north of the Lougheed highway. The valley contains two distinct watersheds, Stave and Hatzic. Many properties are owned by families who have been in the valley for many generations.

Records indicate that this area was utilized by salmon, and to a certain extent it still is. Landowner and salmon issues don't mix, and in recent years these two factors have collided head-on. Heavy sediment loads have caused many of the watercourses in the valley to "fill up". This poses significant problems for both landowners and salmon.

Sediment, particularly in the lower reaches, adjacent to farmland, has drastically reduced the drainage capacity in the area. This has led to increased pressure for watercourse maintenance, an activity that is costly, both fiscally and environmentally.

The frequent threat of flood is exacerbated by complicated ditch maintenance regulations and the farmers' perceived inability to help themselves. Old ways of doing things that used to work to the landowners' liking are now not allowed.

In late 2000 and early 2001, two proposals were submitted to the USHP on behalf of the Hatzic Valley Community. One proposal was submitted by the FVRD, the other by the Hatzic Valley Watersheds Committee. Both proposals were well received, and grants were awarded.

### Process and Partners

Partners include the FVRD, the Urban Salmon Habitat Program (USHP), Fisheries Renewal BC (FRBC), the Hatzic Valley Watersheds Committee, and the Community Mapping Network.

### **Recommendations for the Community Mapping Network**

Begin well in advance of the project in notifying the public, and try to notify them through several complementary means. For example, send a formal mail-out, then follow up with phone calls, an information newsletter, and information handouts at residences where contact has not been established.

In many cases permission is not necessary in order to access watercourses, even on private land. However, it is definitely a good gesture and helps in respect to the interest in the project and the good will towards it. Landowners who do not at first grant permission often change their minds upon receiving more information. For those who don't change their minds, it is often enough to look into the watercourse from the edge of the property and make notes on what is there.

### **Next Steps**

Once the Hatzic Valley mapping project is completed, there will be initiatives to use the data gathered to assist in the design and implementation of sediment control projects. It is hoped that local residents will use

the data to determine appropriate watercourse maintenance procedures (e.g. observing fisheries windows and guidelines pertaining to their particular watercourse classification).

From the outset one of the main goals of this project was to develop community capacity. In keeping with this, FVRD staff will be working with other community groups to continue mapping areas within the FVRD. At present FVRD staff are working with the Seabird Island Band to map their reserve. In this situation they will provide training, support, and the opportunity for lower cost GPS rental.

### **Project Contacts**

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### **Acknowledgements**

Brad Mason of DFO and Rob Knight of MWLAP helped in obtaining funding for this project, and in getting it up and running.

This Case Study was submitted by Dirk Lewis.





# Sensitive Habitat Mapping by the Cheam Band

## *First Nations SHIM*

### Objectives

The SHIM mapping project was initiated with a view to involving young members of the Cheam First Nations band with the watershed, in line with the inherent First Nations relationship with all streams and water, to reaffirm and rebuild an old relationship with the land.

### Actions

The majority of the Cheam Lake watershed was mapped with SHIM methodology using a Trimble Pathfinder GPS unit, employing members of the Cheam band. The data was entered into a database.

Following the SHIM mapping, some further mapping was done to produce a jurisdictional map of the watershed.

### Project outcomes

The SHIM watershed mapping verified the existence of some streams and found some tributaries that did not appear on existing maps.

The SHIM mapping led to riparian planting, stock assessment, and spawning bed development work, and to relating the numbers of fish to different parts of the watershed.

The jurisdictional map shows the areas of the watershed that are under the jurisdiction of different agencies, including DFO, MWLAP, MAFF, and the Ministry of Forests.

An important benefit for the band is information sharing with SHIM partners, e.g. neighbouring municipalities and cities.

Mapping information has been transferred into the Stó:lō Nation GIS.

### Background

The Cheam band is one of 19 Stó:lō Bands. The traditional Cheam territory includes the Cheam Lake watershed, located between Mount Cheam and the Fraser River.

The band has undertaken two habitat mapping and inventory projects:

1. An *Overview Study* of the entire watershed was undertaken in partnership with MELP, DFO, and the regional district. Within the watershed boundaries, the project collected information from elders, biologists, governments and other stakeholders. However, the project lacked a mechanism to involve all stakeholders and user groups in all relevant issues, and generated too much information for the band to deal with.
2. A *Mapping and Inventory Project* included:
  - spatial mapping, including SHIM mapping
  - a downstream fish trap for collecting out-migrant coho
  - water quality testing with a general water quality test kit over a period of one month

### Process and partners

The mapping crews took training from the Langley Environmental Partners Society, which also provided the data entry templates. DFO and MWLAP also provided

support. Information is shared with other CMN partners.

### Next Steps

The GIS information will be updated regularly with data collected by partners, as the Cheam band has no plans to do additional SHIM mapping. Information will also be shared with other bands that do not have access to the GIS.

### Project Contacts

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### Acknowledgements

Ernie Victor provided information used in the preparation of this Case Study.

Information from the Community Mapping Network web site at <http://www.shim.bc.ca/Stolo.htm> was also incorporated into this write-up.



A male coho salmon (*Oncorhynchus kisutch*) in spawning colouration (photograph by Ernest Keeley)

# SHIM in Chilliwack: Ford, Marble, Patterson and Calkins Creeks

## Introduction

With intentions of developing a Master Drainage Plan, the City of Chilliwack is currently conducting a survey of all of its watercourses. Beginning with a proposal from The University College of the Fraser Valley (UCFV) in April 2001, a grant was provided from the Real Estate Foundation of B.C. to conduct SHIM for the watersheds of Chilliwack's Eastern Hillside. Since the initial funding of the project, the City has taken over the funding.

The success of the project has been accomplished through a partnership involving Fisheries and Oceans Canada, B.C. Ministry of Water, Land and Air Protection, UCFV's Cascade Institute, and MCC Ecoworks. The City has provided transportation, a cellular phone and a micro-computer to the team. The GPS unit used for the mapping has been provided by Fisheries and Oceans Canada. UCFV's Cascade Institute in Chilliwack has provided work space for the team which is used for the GIS data interpretation of the watercourses. MCC Ecoworks has been contracted to provide the members of the team conducting SHIM on the Eastern Hillside.

## Objectives

The purpose of this survey is to determine the following information for the City:

- accurate watercourse location
- channel dimensions (cross sections)
- watercourse elevations
- channel flow volumes
- presence of fish or potential to provide fish habitat

- obstacles to fish passages (culverts, falls etc.)

Because the previous watercourses on the Eastern Hillside are not accurately depicted, the streams are being mapped, using a GPS, to determine their accurate locations. Sensitive Habitat Inventory and Mapping (SHIM) mapping standards are being recognized which makes the data collected useful to multiple organizations including Fisheries and Oceans Canada. This information will be used by the City to determine appropriate development zones, especially in regard to stream presence. The watercourses mapped will also be available to the public on the SHIM website as the data is processed.



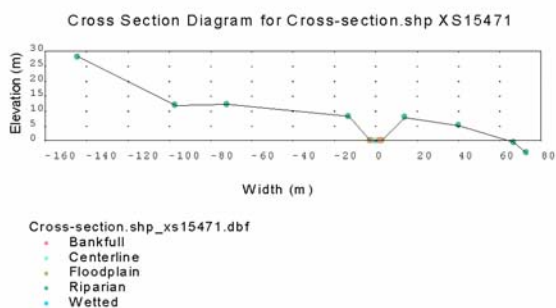
## Methods

The landowners of the Eastern Hillside containing property where watercourses flow are contacted before inventory begins to keep them informed about the project and surveyors entering their land.

The stream inventory has been collected using a Trimble Pathfinder GPS. As the team of two walks through a stream, satellites record the user's path, recording a spe-

cific point every second. Using version 24 of the data dictionary associated with the GPS, the team records an array of data for every segment of the stream. The collection of data includes measurements about specific water levels, substrate of the creek, vegetation covering and riparian zone classifications, as well as the tops of the riparian zone banks. Specific features are also recorded such as fish habitat location, waterbody presence such as tributaries, and man-made modifications such as culverts, to name a few.

The City has also required the collection of cross-section data to be recorded when there is a significant change in the slope or riparian vegetation of the stream. These cross sections (Fig. 1) will be valuable to the City as they determine where suitable areas to develop are located, including the tops of banks. Data is collected for each band in a cross-section including specific types of vegetation as well as the bearings and gradients.



**Figure 1:** Example stream cross-section diagram

The data that is collected in the field is brought back to the office at the Cascade Institute and interpreted using the ArcView GIS. This program enables the user to clean up the raw data and to create an accurate streamline that may be usable by the City. This data will be applied to Chilliwack's older maps.

## Partnerships

Partners in this project included the City of Chilliwack, UCFV's Cascade Institute, Fisheries and Oceans Canada, Ministry of Water, Land and Air Protection, and MCC Ecoworks.

## Results and Status

Since April 2001, four watersheds have been mapped including Elk, Ford, Marble and Patterson Creeks. Calkins Creek is currently being mapped but will not be completed in this phase of the project.

There has been a lot of important data collected in the field from this project which will be valuable to both the City of Chilliwack and Fisheries and Oceans Canada. Many tributaries as well as other waterbodies have been found on the hillside which have not been recognized on recent Chilliwack maps. There have also been a number of areas noted which contain obstructions directly related to the streams as well as developments relative to them. Some of these include banks with high degrees of erosion, roads and culverts which have collapsed over time and are obstructing water flow, areas which have been clear-cut and where vegetative buffer zones for the stream have been ignored, and even areas where the stream has been completely ploughed over. Many sites have also been encountered which contain the presence of fish. All of these points which have been nested with the GPS may be returned to in the future. Areas which have not been completed, including the remainder of Calkins Creek, must be revisited in the future, as this project continues.

## Recommendations

There are a few recommendations in regard to the enhancement of the data dictionary. Features such as 'barbed wire fence' or

'pond' would be useful to have because we ran across many of these. It may also be useful to create a feature in the data dictionary to write or estimate the distance of the top of bank for each segment instead of only asking if the top of bank is in the band or not.

### **Contacts**

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### **Acknowledgements**

This Case Study was submitted by Ryan Klassen.





# Chilliwack Master Drainage Plan

## Abstract

The City of Chilliwack is developing a comprehensive Master Drainage Plan to ensure sustainable development and provide future infrastructure savings. Watercourses were mapped using SHIM techniques. By this means, accurate stream locations are now known, and useful stream cross-sections were derived.

## Objectives

The City of Chilliwack aims to become a leader in the province with a state-of-the-art integrated drainage system which is technically sound, fiscally responsible and environmentally commendable. To achieve this goal, the City requires a Master Drainage Plan (MDP).

The MDP is expected to provide flood protection, erosion control, water quality improvements, habitat enhancement and ground water protection. As well, it will facilitate prior approval of development projects from senior agencies and minimize costs of future storm infrastructure by economic design of drainage systems based on accurate hydraulic and hydrological data.

The MDP will contribute to the sustainable development of the Eastern Hillside area of Chilliwack, where conventional drainage practices would be unaffordable and could lead to deleterious consequences for the agricultural lowlands downstream.

The goals and objectives are:

- to route urban runoff from upland areas through the agricultural lowland to the Fraser River without impacting the lowland community;

- to alleviate all existing and potential drainage, erosion and flooding concerns due to the past and future growth in the City of Chilliwack;
- to protect streamside resources, including riparian and aquatic habitats by policies and bylaws;
- to remediate existing and potential stormwater quality and quantity problems prior to its discharge to a natural body of water; and
- to provide infrastructure savings in the future by superior hydrotechnical analysis and by adopting site specific modelling.

Council authorized the MDP in 1998. There will actually be three MDPs; it is anticipated that by 2004 the first of these will be done. A Draft Action Plan has been completed. The MDP will be integrated into the Official Community Plan (OCP).

## SHIM-Related Actions

The objectives of the MDP are wide-ranging, so only those actions related to the use of Sensitive Habitat Inventory and Mapping (SHIM) are described here.

SHIM methods and standards were used to map watercourses in the City of Chilliwack. Working with the City, SHIM methods for stream profile cross-sections were refined to produce an acceptable level of detail.

Mapping is still being carried out under contract to the City of Chilliwack.

### Project Outcomes

The MDP is halfway done. A Policy and Design Criteria Manual for Surface Water Management will be completed this spring.

SHIM mapping provided accurate stream locations, important because accurate knowledge of stream centrelines is essential. Useful stream cross-sections, used to model flow, were interpreted from the SHIM data.

Some endangered species were found and mapped (Pacific Giant Salamander).



**Photo:** Ford Creek

### Discussion

SHIM provides:

- information regarding stream truthing, i.e. legally locating the streams
- stream cross-sections
- riparian forest information
- stream classification
- information on top of bank
- information on in-stream work that may be required
- water quality data – temperature, dissolved oxygen, suspended solids
- streambank condition information
- substrate information

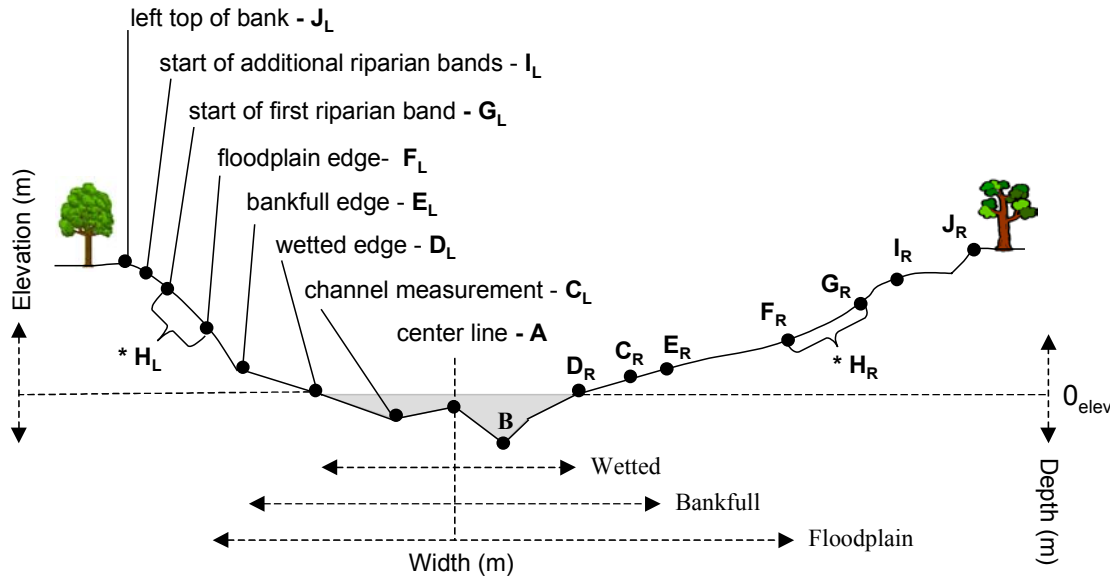
A point to be noted is that a SHIM cross-section is not a hydraulic cross-section. SHIM procedures using GPS technology cannot provide centimetre-level precision. Although SHIM procedures do not provide the level of accuracy of an engineering survey, useful stream cross-sections were interpreted from the SHIM data.

The standard SHIM procedure involves collection of stream channel wetted, bank-full and floodplain widths and depths. In terms of providing a general description of stream conditions at different points along the stream channel this is considered sufficient. However, more detailed SHIM field procedures and accompanying mapping software tools have also been developed to capture greater details of stream channel complexity, to aid in development of hydraulic models used for regional flood planning.



**Photo:** Lefferson Creek

Required cross-sectional measurements of stream channel widths, depths and elevations as well as upland riparian features are based on the survey points as shown in Figure 1. The ArcView Cross-Sectional tool is used to graphically display the collected data.



**Figure 1.** Cross-sectional measurement points for SHIM stream surveys.

## Process and Partners

The source of SHIM funding was Fisheries Renewal BC; this source has been lost with the cancellation of that agency.

Other partners include:

- B.C. Ministry of Environment, Lands and Parks
- Fisheries and Oceans Canada
- Environment Canada
- Human Resources Development Canada
- Pacific Initiatives
- City of Chilliwack
- Real Estate Foundation of B.C.
- Cascade Institute
- University College of the Fraser Valley
- Ecoworks

## Recommendations for the Community Mapping Network

It is important to involve all participants, to maintain contact, and to ensure common objectives by maintaining the flow of communication.

In future partnership projects of this sort it will be desirable to ensure that biologists and engineers have the same understanding of the required watercourse parameters.

## Next Steps

Any new SHIM mapping will require new sources of funding to be secured.

## Project Contacts

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## Acknowledgements

Dipak Basu, Peter O'Byrne and John Wiley, all of the City of Chilliwack, and Katrina Roger of the Cascade Institute were interviewed for the preparation of this Case Study. Dipak Basu reviewed a draft.



# Delineation of Streams and Top of Bank in Mission, B.C.

## Objectives

The Community Mapping Network, in partnership with the District of Mission, undertook a project to assess the accuracy of photogrammetry at delineating watercourses and top of bank (ToB) in a selected test area: the Cedar Valley Comprehensive Development Plan (CVCDP) area of Mission, B.C. The primary objectives of the project were to:

1. select a representative sub-drainage (project area) from within the CVCDP where the top of bank boundary was delineated using photogrammetric techniques (Method One);
2. ground truth the project area to locate the top of banks and watercourses using Global Positioning System (GPS) technology (Method Two);
3. compare the top of bank boundaries and watercourse locations as determined by the two methods;
4. provide recommendations for delineating the boundaries of Fisheries Sensitive Zones (FSZs) in British Columbia using the results of this assessment;
5. establish accurate “natural open space” boundaries for Cedar Valley so that the District of Mission can proceed with their Development Plan for the area.

## Background

Determining the correct location of watercourses and their associated top of banks (ToB) is a necessary prerequisite for delineating the boundaries of Fisheries Sensitive Zones (FSZs). FSZs are comprised of both

instream aquatic habitat and the adjacent riparian areas above the normal high water line of the stream or wetland. Defining FSZs is an essential planning component for establishing the minimum setbacks required for development adjacent to a stream. Setbacks are areas of land and vegetation adjacent to watercourses that are to remain in an undisturbed state, throughout and after the development process (Chillibeck *et al.* 1992). The location and extent of these setbacks will be determined by the presence and proximity of a watercourse on or adjacent to a development site, by the presence or absence of fish in the watercourse and by the nature of the watercourse and surrounding vegetation. Provision of these setbacks may be a primary component of streamside protection regulations being developed under Section 12 of British Columbia’s *Fish Protection Act* (FPA).

Watercourse and ToB locations can be determined directly in the field using high precision GPS survey units or else interpreted remotely through photogrammetric analysis of high-resolution aerial photographs. The use of photogrammetry represents a potentially lower cost and time saving approach for delineating stream and riparian corridors over larger geographic areas. However, the accuracy of the existing photogrammetric methodology is presently untested and it is uncertain whether the technique has broad reliability.

## Project Actions

Black and white aerial photos of the project area were captured in two flight lines during leaf-free conditions using a 305-mm focal length camera (Method 1). A digital



1:10,000 base map depicting hydrographic and top of bank information within the entire CVCDP area was subsequently produced.

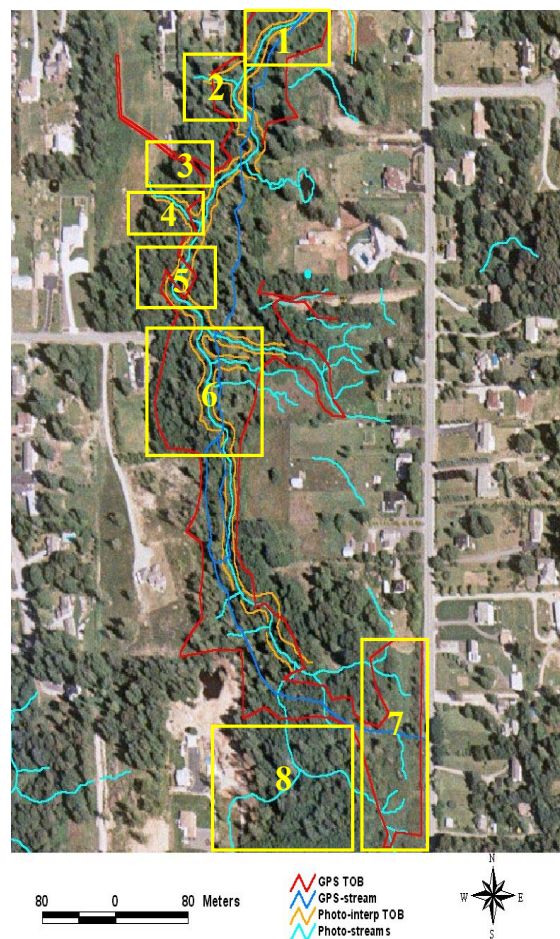
Ground-truthing (Method 2) of ToB was accomplished by placing numbered flags along the top of bank boundary approximately 15 m to 20 m apart. The flag locations were then confirmed using GPS technology (i.e., Trimble Pathfinder Pro-XR with a precision of  $\pm 5$  m with 95% accuracy). Ground-truthing of stream centreline locations was established by walking all watercourses present within the project area.

Eight study plots were selected for detailed comparisons of the two methods used for delineating watercourses and ToB within the project area. Within each site, major habitat and terrain features were described and any observed discrepancies between the two methods in determining streams and ToB were identified. Apparent reasons for these discrepancies were deduced from an integration of information obtained from the field (i.e., relative habitat and terrain conditions) and detailed examination of the aerial photo overlays. Differences between the two methods in depicting stream location and right and left ToB were determined for each site by measuring the horizontal distance between respective linework at 20 approximately equidistant intervals.

### Project Outcomes

Top of bank and watercourse locations determined by photogrammetry (Method 1) differed considerably from ground-truthing with GPS (Method 2) (see Fig. 3). Within study sites for which streams were correctly identified by both survey methods, photogrammetry misplaced stream locations by 7.6 to 11.6m (on average) and maximum stream displacement relative to GPS location was as much as 25.5m. Location of site ToB boundaries depicted by the two meth-

ods varied on average from 8.3 to 35.2m, and maximum displacements were in the range of 18.4 to 70.2m.



**Fig. 1.** Comparison of photogrammetrically interpreted streams (light blue) and ToB (gold) versus GPS field-surveyed streams (dark blue) and ToB (red) in Cedar Valley. Boxed areas (1-8) represent individual site assessments.

Serious photogrammetric errors in mapping for the study area included:

- failing to sufficiently extend ToB to the edges of low gradient floodplains along the creek corridor
- incorrectly mapping the actual locations of watercourses
- mapping watercourses that were not actually present (see Fig. 2)



- missing several watercourses altogether.

A direct objective of the mapping work undertaken for this project was to establish “natural open space” boundaries for the Cedar Valley Comprehensive Development Plan (CVCDP). These boundaries are intended to form the basis of a Memorandum



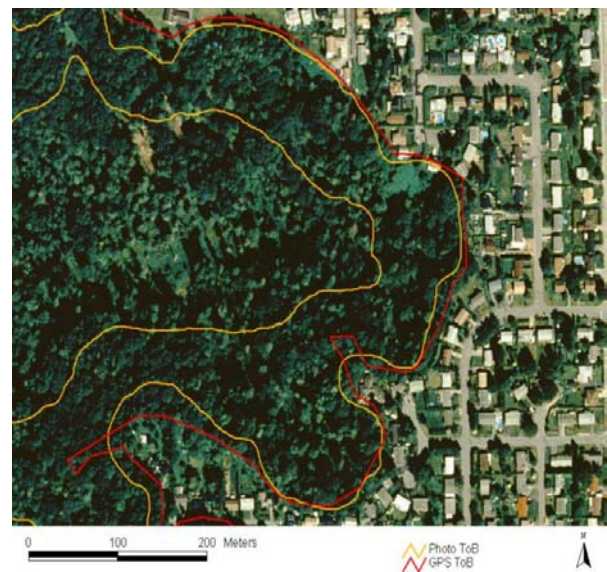
**Fig. 2.** Photo of a walking trail through a salmonberry dominated thicket. The trail was incorrectly identified as a creek channel by air photo interpretation.

of Understanding between the District of Mission, B.C. Ministries and DFO that will chart the course for development in the area for at least 10 years and possibly longer. Previous efforts to map the CVCDP had generated public concerns that the indicated boundaries were not accurate and were, in some cases, inappropriate. Now that the streams and area boundaries for the CVDCP have been mapped in an accurate and comprehensive manner using field based GPS, the District can proceed with the Memorandum, and the public can be assured that the job has been done using the best available technology.

### Recommendations for Community Mapping Network

Photogrammetry displayed considerable difficulties with correctly mapping streams and ToB boundaries within the study area across a range of different terrain condi-

tions. However, the technique may be sufficient under certain limited conditions. These might include areas where a clear demarcation between a narrow forested ravine and urban landscape allows an easy assessment of stream location and associated ToB (Fig. 3). Alternatively, open non-forested areas should also allow relatively easy interpretation of watercourse locations and ToB. Further work may suggest situations where photogrammetry could play an effective role in defining Fisheries Sensitive Zones.



**Fig. 3.** ToB determined for an area with a clearly defined forest-urban boundary, using photogrammetry versus ground-based GPS surveying.

At present, however, there is no indication that photogrammetric interpretation displays the general requisite level of accuracy necessary for use as a detailed inventory tool. Streamside protection setbacks based solely on photogrammetry would likely be seriously erroneous, and require considerable readjustment by ground based measurement. Ground-based GPS surveying for stream locations and ToB represents a much more reliable method than photogrammetry. In addition, besides establishing stream locations and the boundaries of top

of banks, field assessments can provide information about important biological, chemical or physical features of a watershed.

Results from this project suggest that map interpretations based upon photogrammetry (even using very high resolution imagery) may fail to accurately capture and delineate small streams and wetlands, and may seriously misrepresent Fisheries Sensitive Zones. However, high quality air photography (especially in the form of digitally rectified ortho-photos) is increasingly becoming an accessible and attractive tool for urban planners. As such, landbase interpretations based on photogrammetry and other remote sensing techniques are likely to play a major role within regional planning exercises in the future. Low level aerial photography will provide significant detail over large areas, more quickly and perhaps more cheaply than intensive ground based surveys over the same area. As such it represents an important element in capturing some types of information required for sustainable community planning. However, in terms of aquatic habitats the work here suggests that although high resolution photography represents an improved starting point for identifying potentially sensitive areas, it should not be used as the sole method to delineate stream centre lines, top of banks or Fisheries Sensitive Zones.

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### **References**

Chillibeck B., G. Chislett, and G. Norris.  
1992. Land development guidelines for the protection of aquatic habitat. Department of Fisheries and Oceans Canada. Pacific Region. Vancouver, B.C., and B.C. Ministry of Environment, Lands and Parks, Integrated Management Branch, Victoria, B.C.

This Project Summary was prepared by  
Marc Porter.

# Ministry of Agriculture, Food and Fisheries Watercourse Classification and Agricultural Ditch Maintenance

## *Sustainable Agriculture (2): Regional Drainage*

### **Abstract**

Watercourse classification and fish presence information are useful for landowners, local governments and agencies as planning resources to assist in habitat improvements, watercourse maintenance and conservation. Used in conjunction with Agricultural Watercourse Maintenance Guides and Riparian Self Audit Handbooks, this information can be used to establish watercourse protection and ditch maintenance practices. Watercourse classification uses data acquired by Sensitive Habitat Inventory and Mapping (SHIM) methods and incorporated into local GIS databases.

### **Objectives**

The objective is to provide for adequate drainage and irrigation of productive agricultural lands while protecting valuable fishery resources. The Agricultural Watercourse Maintenance Guide is intended to provide farmers and municipalities with clear direction on how to proceed with maintenance works under various conditions. At the same time the Guide will reduce the need for the Ministry of Water, Land and Air Protection (MWLAP) and Fisheries and Oceans Canada (DFO) to issue approvals, authorizations and/or letters of advice for routine maintenance of constructed agricultural drainage ditches. This is accomplished by streamlining contact requirements for constructed ditches through processes outlined in the Guide, and the development of protocol agreements between proponents and the environmental agencies.

### **Actions**

The definitions of natural streams, channelized streams and constructed ditches have been used to classify watercourse channels in the Fraser Valley Regional District Habitat Atlas (see FVRD Habitat Atlas Case Study). Natural streams and constructed ditches were classified first. The remaining watercourses were then classified as channelized streams.

The Habitat Atlas has used the best available data to locate, map and classify watercourses. Techniques used include aerial photo interpretation, on-the-ground Global Positioning System (GPS) information using the SHIM method, contact with landowners and/or visual inspection of the areas in question.

The Agricultural Ditch Maintenance Guide project has been in progress for four years. It was piloted in the Fraser Valley first, in 1999 and 2000; it will be extended in 2002 to Vancouver Island, and eventually over the rest of the province.

### **Project Outcomes**

Watercourse classification and fish presence information are used by landowners, local governments and agencies as planning resources to assist in habitat improvements, watercourse maintenance and conservation. Used in conjunction with Agricultural Watercourse Maintenance Guides and Riparian Self Audit Handbooks, this information can be used to establish what riparian assessments may be required for habitat protec-

tion, implementing the ditch maintenance guidelines and determining building set-backs.

The Agricultural Watercourse Maintenance Guide uses the classifications to determine agency requirements for contact when doing work in and about watercourses (i.e. ditch maintenance), and in the riparian audit to develop watercourse protection measures for channels in agricultural areas.

Watercourse classification and the Agricultural Watercourse Maintenance Guides are ongoing projects.

The watercourse classification initiative contributes to the integration of multiple kinds of land and resource data in GIS systems, where it helps build a comprehensive database of information that can be accessed by a variety of users for different purposes.

### Discussion

In 1995, Fisheries and Oceans Canada (DFO) changed its way of managing for habitat, requiring authorization to clean ditches. A committee was struck to find ways to do maintenance. This process led to the recognition of three categories: natural streams, channelized streams and constructed ditches.

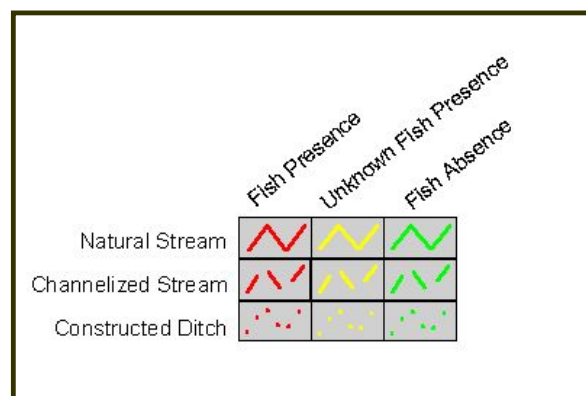
**Natural streams** are historic watercourses that have not been channelized or have not recently been altered. Often characterized by a meandering channel, they may only flow seasonally and may have intermittent or subsurface flows.

**Channelized streams** are permanent or relocated streams that have been diverted, dredged, straightened and/or dyked. They often carry water from more than one property, upland areas or wetlands.

**Constructed ditches** are watercourses that drain individual properties or local areas. They have been constructed by landowners for the purpose of removing excess storm-water and runoff, and may be a source of irrigation water in summer.

DFO authorization is required for maintenance work on constructed ditches if the work is expected to result in the harmful alteration, disruption or destruction of fish habitat (as determined by a habitat biologist). Guidelines are provided, depending on the condition of the ditch, so work can be done with minimum red tape. The benefit for agriculture and agencies is fewer approvals required. The process is thoroughly outlined in the Agricultural Watercourse Maintenance Guide.

Once the type of watercourse has been defined, the presence or absence of fish must also be determined. There are three categories that can be used: fish presence, fish absence and unknown fish presence. The watercourse classification system is then mapped using a combination of line types and colours (Fig. 1).



**Figure 1.** Watercourse classification system in agricultural areas

The watercourse classification system is often incorporated into a GIS. Figure 2 shows data layers that could be incorporated into a GIS system for agricultural areas. Different information collected by other agencies can



also be incorporated into the various layers. The watercourse classification system would be part of the water features layer. Figure 3 is an example of the watercourse classification and fish presence layer as presented on a cadastre map. Figure 4 shows the same information as presented on an orthophoto.



Figure 2. Agricultural GIS: Possible data layers



Figure 3. Cadastre map

## Process and Partners

The Partnership Committee on Agriculture and Environment is:

- Fisheries and Oceans Canada
- Ministry of Agriculture, Food and Fisheries
- Ministry of Water, Land and Air Protection
- Ministry of Sustainable Resource Management
- B.C. Agriculture Council
- Union of British Columbia Municipalities
- Canadian Wildlife Service
- Environment Canada
- Agriculture Canada

The Partnership Committee struck the Ditch Maintenance Task Group, which is the first six agencies listed above.



Figure 4. Orthophoto

## Recommendations for the Community Mapping Network

Users want different things from the same data. When the data is collected, therefore, collect it all at once, to facilitate use of the database by different users. Open up the vision to ensure collection of information for use by all. It has to be collected by local governments, since they have the need and the resources — i.e. the vision. Collect a common datasheet and share it.

### **Project Contacts**

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the Environment. 2001. Agricultural Water-  
course Maintenance Guide. Lower Fraser  
Valley and Vancouver Island. Ministry of  
Agriculture, Food and Fisheries and Minis-  
try of Water, Land and Air Protection.

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draft.



# Terminal Forest Products Ltd.: Mapping Applications for Integrated Resource Management Planning

## Abstract

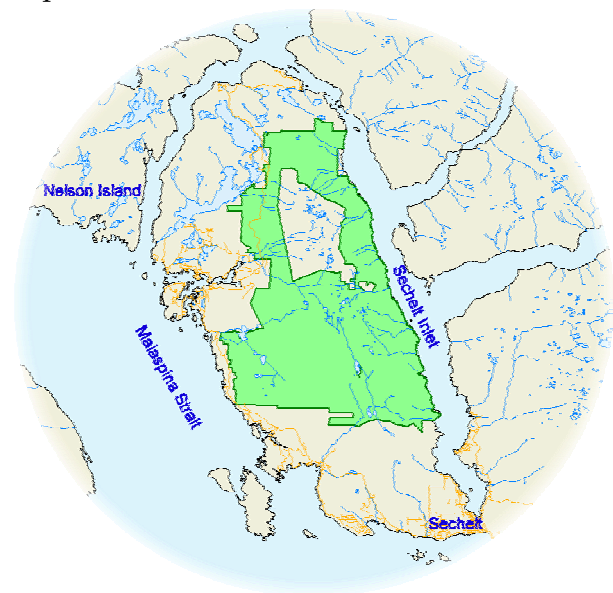
Integrated Resource Management Planning (IRMP) is an operationally based planning tool that allows the forest manager to direct development within a planning area. An operational plan will normally “nest” within a higher level strategic plan. The planning area is generally a watershed or a landscape unit, but can also be an operational area usually ranging between 10,000 and 100,000 hectares. An IRMP amalgamates all known resource values and inventory information within a planning unit. Aerial photos and maps are used to identify critical resource values and topographic constraints for road and bridge locations in the planning unit. Once the road infrastructure has been designed, a preliminary harvest plan can be developed for the entire planning area over time. This process reviews the entire area, not just available timber for harvest. Critical to the process is the inclusion of knowledgeable field staff that has a working sense of the area and on the ground expertise.

Harvest sequence, timing of operations and design pattern is based on available operational and inventory timber information. Following design, detailed field reconnaissance is completed for the area, ground verifying critical control points and operational constraints. Once the main road systems and harvest patterns are determined, other resource values are over-laid to determine potential conflicts. Where resource conflicts exist, a detailed strategy is developed. When all known resource information has been collected, interpreted and strategies developed, the final plan can be created. In addition to the

amalgamation of digital resource information and mapping, a comprehensive resource values database is created to assist resource managers and stakeholders, that allows for sustainable management of the planning area. further projects of this nature.

## Background

Terminal Forest Products has been granted logging rights to a large area (approximately 15,000 hectares) of the Sunshine Coast peninsula ranging from Sechelt to Egmont. To manage their operations economically and on a sustainable basis, Terminal uses a sophisticated process of long and short range planning. Digital resource information is analyzed to develop future harvest plans that includes timing of the harvest and the type of logging methods to be used, while minimizing environmental impacts.



**Figure 1.** Map illustrating area of Terminal's logging rights on the Sunshine Coast Peninsula

### **Objectives**

To achieve sustainable and integrated forest management through economically viable forestry practices.

### **Process, Partners, Costs**

Terminal participates as a supportive partner in numerous projects. For example, it has made financial contributions to the Sensitive Ecosystems Inventory on the Sunshine Coast and a Marbled Murrelet Research Project currently being conducted by Simon Fraser University. Terminal endeavours to be a good corporate citizen through its practices and participation in many projects and stakeholder groups, including the sharing of resource information.

Accessing and utilizing enhanced technologies like GIS has required the commitment of financial resources by the company. However, this is considered an investment in the continued economic viability of the company as well as being indicative of a strong continued commitment to environmentally sensitive and sustainable forest management practices.

### **Actions**

To achieve sustainable forestry management practices and environmental standards, Terminal has become third party certified under both the International Standards Organization (ISO) 14001 Environmental Management System and the American Forest and Paper Association's (AF&PA) Sustainable Forest Initiative (SFI<sup>SM</sup>) Standard. Terminal adheres to tough standards of practice that often exceed those established by law and are routinely subjected to internal and external auditing. To maintain certification, Terminal has developed environmental programs and standard operating practices to ensure

sustainability and minimize the likelihood of environmental risks and hazards (e.g. road failures). Loggers and field staff are trained in standard operating procedures that help to recognize and prevent potential environmental problems thus avoiding environmental impacts. Detailed operational maps (1:5,000) and aerial photographs provide vital information necessary to complete planning and assist in the identification of potential risk or hazard areas. Every logger is required to carry a copy of the map and understand critical issues involved when working on the block.

Strategic plans are developed to ensure sustainability and that other resource values are adequately protected for a planning unit. This type of planning utilizes 1:5,000 and 1:20,000 TRIM base maps and inventory information including the forest cover, visual quality objectives, recreation sites, terrain and wildlife.

Utilizing base TRIM map information each polygon has a site index that is analyzed and drives all cut levels. Digital inventory information is constantly being revised and updated as new information becomes available and is added to the database. Analyzing the various layers of information permits sustainable development in an area that takes into consideration numerous factors including protection of fisheries riparian zones, ecologically sensitive sites, old growth and other sensitive habitat site preservation.

Terminal has recently upgraded their mapping capabilities and have recently produced a new series of 1:5,000 scale maps using the latest information and technology. This has provided much greater detail than was previously provided by any other source. The increased level of detail and accuracy in the mapping allows for better

forward planning and decision making prior to any harvesting taking place.

## **Results**

Utilizing GIS has allowed Terminal to strategically plan and commit to environmentally sustainable forestry practices while still remaining economically viable. Through this planning process, Terminal has established good relations and communication with all levels of government and various groups and organizations. Recently, delegations from the United Kingdom, Russia and Germany have visited forestry sites to view the exemplary forest practices that Terminal engages in.

## **Challenges**

Creating a collaborative approach that sees all stakeholders working together, sharing information with a common goal. Standardization of collection methods, reliability and validity remain challenges for all user groups whether they represent industry, government or community groups.

## **Project Outcomes**

Using GIS technology has provided Terminal with greater decision making tools that allow the company to make good “economical” business decisions. This same technology has enabled the company to engage in better forestry practices that are sustainable and environmentally sensitive. A detailed map of the whole region with several layers of detailed information provides the opportunity to plan with a “big picture” and long range future in mind. As well, any polygon area can be analyzed in minute detail to ensure that the best possible decisions are being made and implemented.

## **Recommendations for the Community Mapping Network**

As per the challenges identified, an overall “champion” for community mapping would be ideal in terms of helping to standardize the work and ensure that the continuity and efficiencies are in place particularly at a point in time where human and financial resources are in scarce supply. Enhanced communication strategies between the various user groups would help ensure economies of scale and avoid unnecessary duplication of projects, fieldwork, etc.

## **Next Steps**

Terminal is committed to an ongoing process of enhancing forest management practices and being an open and contributing partner to projects of this nature.

## **Project Contacts**

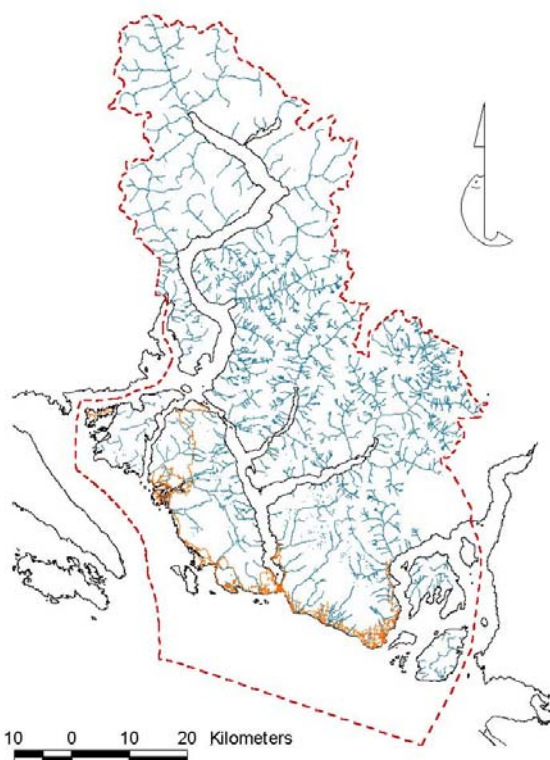
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# Sunshine Coast Regional District: Sunshine Coast Habitat Atlas

## Abstract

The Sunshine Coast Habitat Atlas is a Geographic Information Systems (GIS) database containing an inventory and mapping of natural areas and fish habitat for the SCRD; from Langdale to Egmont and north past the top of Jervis Inlet. The Habitat Atlas will provide comprehensive information that can be used by planners, developers, government agencies, non-government organisations, First Nations, local businesses and individual property owners. The information will assist these groups in making informed land use planning and stewardship decisions that will help protect, enhance and restore fish habitat. This three-year project will conclude in April 2003.



**Figure 1.** Sunshine Coast Habitat Atlas study area

The Habitat Atlas will contain forty different layers or categories of information. Currently, thirty-six layers of information have been collected and processed. Four layers are still being processed while two remain unavailable. A complete listing and status of these layers can be found at <http://www.user.dccnet.com/ctrent/>. All of these layers are stored at the SCRD office in Sechelt and will be made available as an Internet mapping website. Seven of these layers will be included in the published Habitat Atlas mapbook. Each page of the mapbook will contain a map illustrating features that include streams, roads, trails, land parcels, fish and wildlife habitat, parks and protected areas and aerial photographs.

Prior to the initiation of this project, this type of information was not included in the various maps that were used to make important land use decisions. This project will provide land use decision-makers with vital information that should be taken into consideration.

## Background

The SCRD determined that there was a need to have more comprehensive and accurate environmental information to make land use and planning decisions. This data could be used to inform and educate the community about natural resource assets, revise and develop new Official Community Plans, develop new Local Resource Management Plans, revise or develop new Watershed Management Plans and implement the Streamside Protection Regulations.

Fisheries and Oceans Canada (F&OC) Habitat Conservation & Stewardship Program (HCSP) provided examples of how and where other Habitat Atlases were ful-

filling similar data requirements. The SCRDC determined to proceed with the Sunshine Coast Habitat Atlas project. A partnership was formed through the F&OC Habitat Conservation and Stewardship Program. Funding was secured and a qualified consultant was hired to lead the project and liaise with all interested groups.

The project is now into its third year and the first draft of the Habitat Atlas was circulated in March 2002 for review. The final Sunshine Coast Habitat Atlas will be complete and available by March 31, 2003.

### **Objectives**

The project was funded to achieve the following objectives:

- Produce and publish the Sunshine Coast Habitat Atlas with current and accurate maps and an inventory of aquatic and terrestrial habitat and fish species.
- Develop, strengthen and maintain partnerships with government organizations, land developers, First Nations, community organizations and local businesses.
- Compile existing data, identify gaps in the information and collect new data to fill these gaps.
- Engage in public outreach efforts to solicit input from interested parties, to generate project support from the community and to foster data sharing.
- Provide a knowledge resource to assist with the enforcement of local government regulations to protect and maintain fish and wildlife habitat.

### **Process, Partners, Costs**

Funding for this project was made available through Fisheries and Oceans Canada, Habitat Conservation and Stewardship Program. Other agencies that provided fund-

ing include Fisheries Renewal BC, Sunshine Coast Regional District and the Urban Salmon Habitat Program. The SCRDC also provides office space, various supplies and significant in-kind staff time. The Ministry of Water, Land and Air Protection also provides in-kind staff time and has donated a significant amount of data to the project.

Many community partners provided a source of support, expert knowledge, information, tools and funding. See Acknowledgement section for details.

### **Actions**

The first step taken was to create a detailed work plan for the project, which was and approved by the SCRDC and F&OC. Soon after, a Technical Steering Committee of 17 individuals was formed to enhance communication between key parties. The committee continues to meet three or four times per year.

Next, an exhaustive and extensive search was done to compile the existing information that was available for the Sunshine coast. With much of the data located at numerous sites under the jurisdiction of many levels of government, this process was time consuming. Accessing the information was challenging due to licensing issues, prohibitive costs and confidentiality clauses.

During the process of data compilation, missing information has been documented and prioritized for future data collection.

Funding proposals were submitted to several funding agencies that secured approximately \$60,000:



Fisheries Renewal BC	\$25,000
Urban Salmon Habitat Program	\$20,000
F&OC Sunshine Coast	\$10,000

These funds were used for collecting new data to fill the gaps identified during the data compilation phase. A two-person field crew was hired to map streams with a GPS receiver in selected areas. A Trimble Pathfinder GPS capable of centimeter accuracy was rented from Terra-Pro GPS Survey Ltd., who provided commendable service and support. This fieldwork was completed using provincial Resource Inventory Committee (RIC) GPS data standards and followed the Sensitive Habitat Inventory and Mapping (SHIM) guidelines. This mapping is still ongoing but funding cuts will make it difficult to continue.



**Figure 2.** SHIM stream mapping in Anderson Creek

A significant amount of “outreach” has been done over the past two years. Presentations have been made to local government planning committees, schools and numerous community groups in an effort to ensure the Atlas meets the needs of these groups.

The objectives of these outreach efforts are:

- To foster data sharing between organizations,
- To avoid duplication of effort,

- To increase public awareness,
- To solicit input from the community,
- To generate project support, and
- To ensure information is up-to-date.

A Habitat Atlas website has been developed and is kept up-to-date and an article has been published in a local conservation newsletter.

## Results

The Sunshine Coast will soon have access to the Habitat Atlas. A draft format has recently been circulated for review. April 2003 is the target completion date for the final hard copy 200-page Sunshine Coast Habitat Atlas. Copies will be available for viewing/use at the SCRD, government offices, and the libraries.

As a large “warehouse” containing forty layers of information, the SCRD and various community groups are already using the data. A new website is under development to provide easy access to all of this data. The maps can be created and printed from a home computer. Numerous applications present themselves such as tourism oriented maps that accurately detail trails, bike paths, areas of interest, etc.

## Challenges

Some of the challenges faced include:

- Obtaining existing digital data through data sharing agreements
- Negotiating “free” access to maps and data. Negotiating various exchanges for data.
- Investigating funding sources and writing grant proposals and obtaining the funding. Three of seven proposals written were successful. Each grant application proposal was unique and requested a complex array of information

that made this a time consuming process. Funding criteria varied making it impossible to simply develop a grant application template that could be used.

### **Project Outcomes**

The project resulted in many positive outcomes. The consultative process resulted in enhanced information sharing and less duplication of effort by those involved in similar efforts. Meetings served to enhance the awareness between numerous community groups who work on similar projects in distinct areas.

The SCRD is utilizing this enhanced information to make more informed land use planning decisions. Questions about various land parcels can be answered with more confidence and in more detail. The map information serves as a benchmark to help in the review of applications for building permits, development permits, and bylaw amendments.

The project has assisted in the identification of areas that have been restored and need preservation and those that will need restorative action and protection in the future. The overall map provides an opportunity to assess what is happening in the entire area whereas previously, only one segment could be viewed at a time. This is useful when assessing land use proposals providing an opportunity to see what the impacts would be on adjacent lands.

Stream data information can be used to find efficient and expedient solutions to various water problems, environmental disasters and other potential emergency situations.

From an economic development perspective, the Habitat Atlas provides prospective buyers with detailed information that can be utilized for development permits, plan-

ning, zoning etc. and identify "green" tourism opportunities.

The quality maps can form the basis for promotional materials to be used by tourism umbrella organizations as well as individual business operators. The information may serve to make planning more cost-effective by preventing costly development errors, e.g. where NOT to locate buildings, roads etc.

### **Recommendations for the Community Mapping Network**

The project is proving to be a "priceless" endeavor providing information that all local communities need. This type of information should be readily available at local repositories in addition to government offices since so much of the land use planning decisions occur at the local government level.

A long term source of funding to assist with these initiatives would provide the resources required to map sensitive habitat areas before irreversible damage may be done as might be the case when land use decisions are made in the absence of vital environmental information.

### **Next Steps**

- Completion of the Habitat Atlas by April 2003
- Completion of a mapping web-site for the Habitat Atlas
- Initiate further "outreach" including presentations to various communities and groups on the coast to inform them about the Atlas, the information it contains and how it can be used.
- Host an open house training session in the winter of 2002-03.

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### Acknowledgements

The Sunshine Coast Habitat Atlas initiative is made possible through the key financial and in-kind support of the following organizations:

- F&OC Habitat Conservation and Stewardship Program
- Sunshine Coast Regional District
- Ministry of Water, Land and Air Protection.
- Urban Salmon Habitat Program
- Fisheries Renewal BC

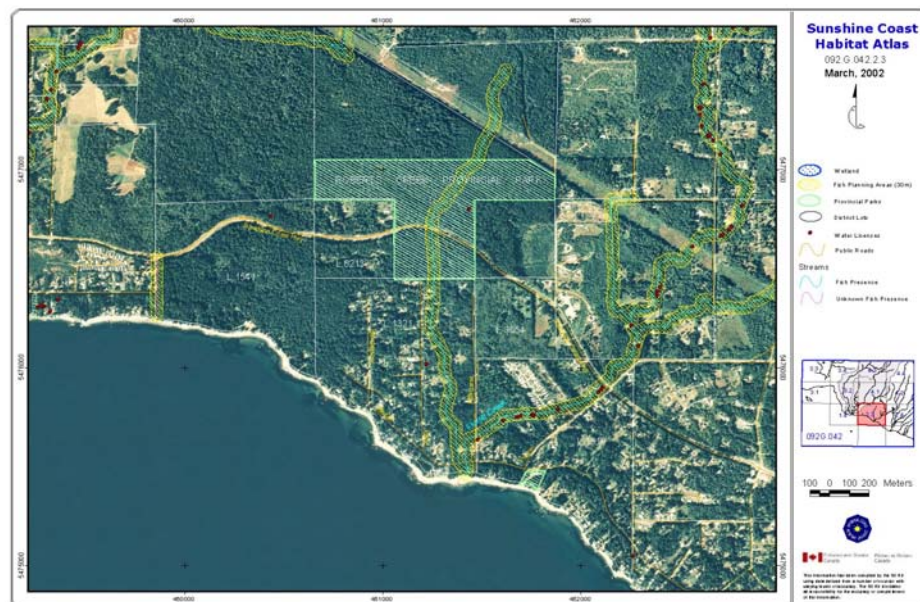


Figure 3. Sample page from the Habitat Atlas



# Gambier Island Conservancy : Streamkeepers and Watershed Mapping Projects

## Abstract

The Gambier Island Conservancy (the Conservancy) was formed by a group of local citizens who wanted to ensure that land use planning decisions were made based on accurate environmental information. Government maps that were being used did not include any detailed information with respect to streams, wetlands, trails, old growth ecosystems or other ecologically significant areas. Grant applications were submitted to secure funds for local resource mapping projects that would provide accurate information and maps with which to make objective, environmentally sensitive land use decisions. A number of projects have been successfully completed and many local residents are adopting a community stewardship attitude towards future development.

This case study is an excellent example of how a group of concerned residents can work together to access the funding and technical expertise to create a comprehensive and sophisticated environmental database for use in official community land use planning.

## Background

The Conservancy was formed in 1995 by a group of residents concerned about the increasing human pressures on the natural habitats on Gambier Island and who believed that increased environmental knowledge and public awareness are the foundations of sustainable land use. A number of different projects have been completed resulting in maps being included in the newly revised Gambier Island Official Community

Plan (OCP) with detailed and accurate environmental information that now serves as a basis for land use decisions. Prior to the Conservancy's projects, OCP maps contained no environmental information and development applications were approved without consideration of the potential damage to sensitive ecosystems.

## Objectives

The Conservancy is dedicated to enhancing and sharing knowledge of Gambier Island's ecosystems and to developing appropriate management strategies to preserve and restore its biological diversity.

To accomplish these objectives it was recognised that current and accurate environmental information is necessary to inform those making land use decisions. Such environmental data will provide key information necessary for restoration, preservation and future land use planning for the Gambier Island community.

## Actions

The Conservancy has initiated and overseen the following projects:

**Streamkeepers Project:** This project began with the detailed description and mapping of fish habitat in six known fish-bearing streams and included other biophysical inventories such as water quality, spawner surveys and species presence. Desmond Paine transcribed the field notes and measurements into maps and attribute tables. There was significant local volunteer efforts and several residents were sponsored to do their Streamkeeper's training. More de-



tailed mapping (overview maps) and fish habitat assessments (FHAPs) were completed later on all stream reaches that were candidates for rehabilitation or habitat enhancement work. Significant effort was given to increase local volunteer participation through public information and awareness activities. Because of the demographics of Gambier Island, however, there was an increasing reliance on grant-funded stream technicians and biologists to do this work. To date, detailed fish habitat assessments and stream mapping, as well as habitat enhancement and stream rehabilitation work have been done for seven streams on Gambier. The project Coordinator is Lois Kennedy.



**Figure 1.** Stream restoration on Manion Creek, Gambier Island

### Geographic Information Systems

**(GIS)Computer Mapping Project:** All existing environmental information for Gambier Island was collected and digitized into the computer. These maps included TRIM, terrain hazards, forest cover, cadastral, and a 1998 color orthophoto created from aerial photographs. Updated information can be added to this baseline data in layers to show various ecological and environmental data. This project was funded with the USHP

Streamkeepers grant. Maria Van Dyk was the GIS Project Coordinator.

**Trails Project:** Existing roads and trails are being marked, upgraded and sometimes re-routed to protect sensitive areas, and then included in the GIS database. The focus is upon public properties given that 60% of Gambier's landmass is Crown Lands. The Conservancy is hopeful that eventually a network of environmentally sensitive trails will provide walking access throughout Gambier. This network will not only provide land links between isolated communities on different parts of the Island, it will be a strong physical example of the community's recreational and ecological preservationist values. Accurate and detailed trail maps help keep people on proper trails rather than getting lost, keep the public from venturing onto private property or into hazardous areas, and assist Search and Rescue groups to more easily access remote areas. Wolf Weideman is the Trails Project Coordinator.

As a result of this information and further community planning, CANFOR, who have been given logging rights to Gambier's Crown Lands, have agreed to respect the local community's conservation and recreation values. For example, in bays where kayakers and campers use the beach areas, or where cutblocks are in close proximity to trails, CANFOR will leave buffers and adequate green spaces.

In addition, when developers are submitting subdivision applications, public access trails and parks will be dedicated, which will connect into the trail network. These strategies are viewed by some developers as adding value to their subdivision proposals since many people appreciate the recreational value of trails and parks as a desired lifestyle component. Developers are also required to ensure that there are green



space corridors providing connectivity for wildlife.

### Environmentally Sensitive Areas Project:

Capilano College Environmental Sciences Students have joined with the Conservancy in a unique partnership to complete a number of valuable projects which have been funded by the Real Estate Foundation. Capilano College Faculty member Victoria Troupe, who initiated these partnerships has since passed away, but these joint projects are being continued in her memory. A total of four sets of students have worked with the Conservancy on a variety of projects. All phases of the project have provided information vital in the consideration of any land use proposals that may impact sensitive ecological systems. The students' enthusiasm and expertise has been a great inspiration for the Conservancy. A number of projects coordinated by Maria Van Dyk and Wolf Weideman, have been completed during the past four years:

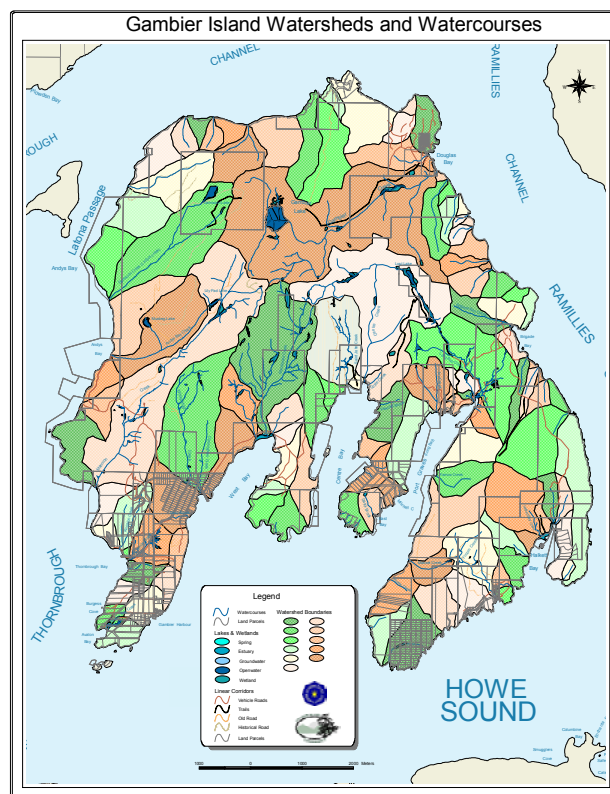
Year One: Students conducted a broad-brush study of Gambier Island to locate and survey the various types of ecosystems through ground-truthing, inventories and the use of aerial photos.

Year Two: Students completed a detailed analysis of the riparian zones of five lakes. This included the identification of plant species, heavily used/impacted areas, and recommendations for protective buffer zones and re-routing of trails.

Year Three: Students identified, inventoried and located the remaining intact old growth ecosystems on Gambier. Coring samples identified trees up to 1400 years old. These students subsequently continued on for two years to work with the Streamkeepers on the Watershed Mapping Project.

Year Four: This phase is “in the works”, with the objective being the beginning of a sensitive plant species inventory.

**Watershed Mapping Project:** This project involved the mapping of streams, tributaries and wetlands in fourteen watersheds and included the documentation of existing human impacts. Ground-truthing was done by GPS (global positioning system) and integrated with the digitized TRIM and orthophoto maps. All watersheds, sub-basins, streams and tributaries on Gambier have now been delineated and enumerated according to provincial code. All environmental information in the existing GIS/computer mapping system was reorganized on a watershed basis and previous Streamkeepers' spatial and attribute data was included.



**Figure 3.** Gambier Island watersheds  
Watershed reports have been produced which document this information for eight

major streams. This project has made it possible to analyze existing and potential human impacts on a watershed basis. The Project Coordinator is Lois Kennedy.

**Data Sharing Project:** The various project reports can be obtained from the Project Coordinators in hard copy. The digital data is available upon signing a limited use contract with the Conservancy. Islands Trust and SCRD have already used this database for the production of new maps for the Gambier Island OCP and Habitat Atlas for the Sunshine Coast. Hard copies of the watershed reports will be distributed to all government agencies involved in land development issues such as provincial Ministries of Transportation, Water, Land and Air Protection, Federal Fisheries and Oceans, and to private individuals and corporations as requested.

### Results

When the Conservancy was formed there was no accurate environmental information available for making environmentally sensitive land use decisions. The Conservancy members all share a great love of the outdoors and treasure the natural beauty of Gambier Island. The resulting maps and data have helped create a benchmark of information to help preserve and protect the environment for future generations.

Conservancy members remain active and vigilant as members of the local Advisory Planning Commissions (APC) for the Island Trust, the SCRD Recreation and Parks Committee, West Howe Sound Stakeholders Association, Sunshine Coast Watershed Stewardship Society, the Sunshine Coast Salmon Enhancement Partner Group and Sunshine Coast Conservation Association to ensure that any land use planning and decisions respect the natural

habitat and environmentally sensitive areas on Gambier Island.

### Challenges

**Vigilance:** Remaining forever alert in the face of on-going human pressures for development on Gambier.

**Funding:** Support for future and on-going projects is a major challenge and requires significant time and effort by Conservancy members.

**Patience, Endurance and Faith:** At several times the Conservancy activities have been met with hostility and suspicion by some members of the community. To help defuse the misinformation, misunderstandings and resolve conflicting points of view issues, the Conservancy has hosted open houses to display and discuss projects, posts all meeting agendas and minutes and writes frequent articles in the Gambier Island newsletter. The benefits of the work are becoming increasingly clear to everyone with the publication of the new OCP and the consultations with CANFOR regarding the impending logging on Gambier's Crown Lands.

The Streamkeepers have been surprised and dismayed by F&OC's reluctance to enforce the Federal *Fisheries Act* in spite of detailed documentation and evidence of severe and deliberate destruction of fish habitat.

### Project Outcomes

Gambier Island now has one of the most sophisticated and comprehensive tools possible for environmentally-sensitive land use planning and an informed and vigilant community to make good use of it. The Conservancy is increasingly being recognized and respected for its contribution to the community and to the Island. People

now recognize the incredible value of the work that has been completed. The mapping work has made it easier for various government departments, forestry companies, land developers and local residents to work together to make informed decisions. The data facilitates informed and objective land use planning based on the shared and integrated values of wildlife and habitat conservation, aesthetics, economic/industrial activity, recreation, and settlement.

Companies like CANFOR are utilizing the information in their planning. The Official Community Plan has a very strong environmental policy statement and detailed supporting maps. Through sharing of information and resources, strong networks of people have been created throughout B.C. to assist other similar projects achieve their success.

On a qualitative basis, the Streamkeepers can already see the results of their efforts to enhance fish habitat and rehabilitate streams. New log shelters and other fish habitat features have resulted in the return of fish to these areas. They are observing the fish now using these areas and how the streams are starting to “heal themselves”. Once streams were mapped, people came to realize that streams had “legal rights”. As another example of progress, the Fircom camp had been running people through a nearby stream in an obstacle race. With the encouragement from the Streamkeepers they are now looking at using the stream as an educational project.

The Conservancy has faced many challenges and has worked hard at community building. It is gaining widespread recognition as a model of community stewardship. For example, a recent bank slide into a small roadside stream brought together the Ministry of Transportation’s maintenance per-

son, a F&OC stream technician, the Streamkeeper’s Coordinator, a local excavator operator, a contractor and a private property owner. They engaged in a consultative process to resolve how to repair the road while protecting and even enhancing the stream. This type of consultation would have been politically impossible until now. It is an extremely gratifying example of building healthy communities and healthy watersheds through public awareness.

### **Recommendations for the Community Mapping Network**

The Conservancy hopes that their projects and other similar projects maintain their momentum to continue the work. Funding for these worthwhile stewardship projects is vital. Connections to the technical expertise of the various resource management individuals are also a vital component of success. They are the “glue” that helps hold these projects together and their input is gratefully acknowledged.

### **Next Steps**

Now that the information has been collected there is a need to facilitate the ongoing local stewardship, expand the volunteer base and help the local communities take ownership of the land around them. The information must now be managed. Knowledge is a source of empowerment, influence, and of community pride in “taking ownership”.

The Conservancy hopes that their work will help to identify, preserve and protect the delicate environmental balances that are present on Gambier.

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### **Acknowledgements**

Generous funding has been received from the Urban Salmon Habitat Program (USHP) and from Fisheries Renewal B.C. (FsRBC) in support of the Streamkeepers, GIS (computer) Mapping and Watershed Mapping projects. The Real Estate Foundation provided funds in support of the Capilano College/Conservancy Environmentally Sensitive Areas project. The Sunshine Coast Regional District (SCRD) has contributed to the Trails Mapping and Marking Project. ESRI donated the ArcView computer software and BC Hydro's Corporate Donations Department donated a much-needed computer to the Streamkeepers to facilitate the data organization for the Watershed Mapping project. The funds secured were used primarily to hire biologists, technicians and other qualified individuals to complete the technical work. The Conservancy Project Coordinators became a sort of "command central" for the various projects.

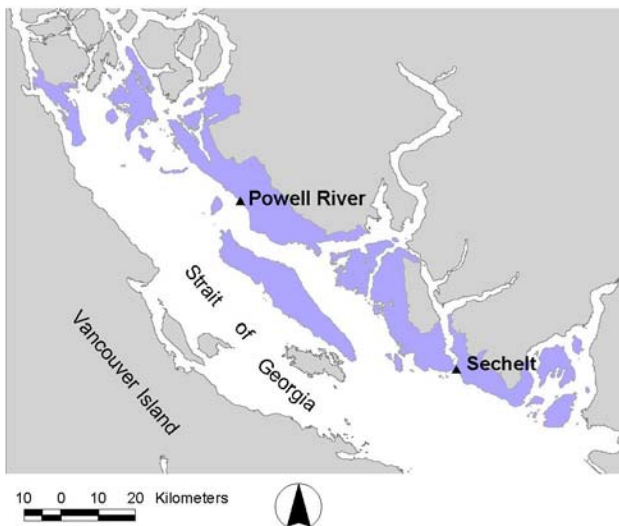
In addition, Grant McBain, the Community Advisor for the Fisheries and Oceans Canada (F&OC) provided the necessary technical support, equipment and some crew for the stream rehabilitation projects. Cheryl Trent, the Habitat Steward for the SCRCD regularly provides maps that are needed for land-use planning. The Islands Trust generated the official maps for the new Gambier Island OCP. Several local businessmen including Ken Sneddon of Sechelt Creek Contracting, John Cosoluch of Rivtow and Barry Proknow have provided much appreciated on-site support for the stream projects. Dr. Bob Newbury provided valuable advice at the beginning of the Watershed Mapping Project. Most property owners of large and small tracts of land have been generous in permitting access.

The Conservancy also extends its thanks and appreciation to Rob Knight (USHP), Marion Towne and Angus McKay (FsRBC), Victoria Troupe (Capilano College) and Margaret Lamarche (CFDC) for their support of this work.

# Sensitive Ecosystem Inventory of the Georgia Lowland and Islands in the Northern Strait of Georgia

## Abstract

April 2002 marks the commencement of the fourth year of the Sunshine Coast Sensitive Ecosystems Inventory (SEI) which will identify and map rare and fragile terrestrial ecosystems. The SEI study area is approximately 1,800 square kilometres and comprises the mainland portion of Georgia Basin Lowland, between Desolation Sound and Howe Sound, and includes adjacent islands within the Strait of Georgia Ecoregion, such as Texada, Harwood, Hernando, Savary, Cortes and the southern part of Quadra Island. Biogeoclimatic Units included in the study area are Coastal Douglas-fir Moist Maritime (CDFmm), Coastal Western Hemlock Very Dry (CWHxm1) and Coastal Western Hemlock Dry Maritime (CWHdm).



**Figure 1.** Sunshine Coast SEI study area boundary

The inventory data was derived from aerial photography (photo-interpretation) at scales between 1:10,000 and 1:16,000 and

verified using selective field checks (ground-truthing). The information is being captured using Arc/Info GIS (Geographical Information System). The maps will be available in both hard copy (1:20,000) and digital formats by March 2003.

This project has led to the identification of numerous unique and sensitive ecosystems. Unlike the Vancouver Island study where only 7.9% of the entire landscape contained rare and fragile ecosystems, preliminary findings suggest that the percentage is higher on the Sunshine Coast thus providing an opportunity to maintain and preserve these sites for future generations.

## Background

The mild climate and long growing season of the Sunshine Coast supports many rare plants, animals and plant communities – including several “at risk” species. Rapid development along the coast is resulting in the fragmentation and degradation of terrestrial ecosystems. The Sensitive Ecosystems Inventory is a “flagging” tool that identifies these systems and provides scientific information and support to local governments and others who are trying to maintain biodiversity.

The Sunshine Coast project builds on the success of the East Vancouver Island SEI. Vancouver Island and Gulf Islands mapping was completed in 1997 and a variety of support materials and services were developed over the following few years, including one-on-one user support, a 300-page Conservation Manual, pamphlets and workshops. Local governments on east Vancouver Island and adjacent Gulf Islands

are now using the SEI data in regional growth strategies, official community plans and greenways/parks plans. The information also assists in making site-specific decisions on land use planning issues. The Vancouver Island SEI can be seen at <http://srmwww.gov.bc.ca/cdc/sei> or at [www.pyr.ec.gc.ca/wildlife/sei](http://www.pyr.ec.gc.ca/wildlife/sei).

### Objectives

Through the completion of a systematic, scientific inventory of the remaining sensitive (rare and fragile) terrestrial<sup>2</sup> ecosystems the project will identify, classify, evaluate and map remnant native wildlife habitats including those supporting species at risk. The SEI will help increase the understanding of and respect for the ecological values of these sensitive ecosystems and encourage land use decisions that will conserve the sensitive ecosystems. The SEI information will provide mapped data for use by local government, environmental and other community and economic groups with an interest in land use, conservation and preservation. Once completed the maps and information will be available for use and presented in "Community Outreach" educational programs that would assist others in using the data and communicate the value and uses of this information by the community.

### Process, Partners, Costs

Major funding for the SEI is provided by the Georgia Basin Ecosystem Initiative (GBEI), with contributions from the Habitat Conservation Trust Fund, the Sunshine Coast Regional District, Comox-Strathcona Re-

gional District and Terminal Forest Products Ltd. The project is jointly managed by Environment Canada (Canadian Wildlife Service) and the B.C. Ministry of Sustainable Resource Management, with assistance from a multi-agency steering committee that includes federal and provincial agencies, local governments, First Nations and industry. A total of \$400,071 was secured over the first four years of the project with approximately 875 days of "in-kind" labor contributions.

A "Memorandum of Understanding" (MOU) is in the process of being signed by various partners involved in the use of the Sensitive Ecosystems Inventory of the Georgia Lowland and adjacent islands. The MOU is between Environment Canada and the following parties to the agreement: BC Ministries of Sustainable Resource Management and Water, Land and Air Protection, Sechelt Indian Band, Sunshine Coast Regional District, Powell River Regional District, Regional District of Comox-Strathcona, Terminal Forest Products Ltd., and the BC Conservation Foundation. The MOU is a demonstration of interest and of intention to co-operate on matters related to the use of the data. It is an acknowledgment by all parties of the value of the information for land use planning.

### Actions

Year 1(1999-2000): Startup and Air Photo Interpretation - A Steering committee was created with joint partners to oversee the direction of the project and ensure good communication. The classification criteria and inventory methodologies were developed. Air photo interpretation was conducted for most of the study area.

Year 2 (2000-2001): Air photo interpretation was completed, identifying 5,511 sites. Groundtruthing field visits, with high qual-

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<sup>2</sup> Wetlands (bog, fen, marsh, swamp, shallow water, wet meadow), Riparian ecosystems, Woodlands, Older coastal forests (structural stages 6 & 7), Herbaceous ecosystems, Cliffs and Seasonally flooded agricultural fields.



ity assurance strategies in place, were conducted for selected sites identified during air photo interpretation. Field data was entered into attribute files. Lack of full funding prevented the completion of groundtruthing this year.

Year 3 (2001-2002): Groundtruthing was completed, although due to a lack of funding, only a limited number of field visits were conducted on Texada Island. Map and database development: Digitizing of 5,511 polygons was completed, but database linking, plotting and quality control was postponed until Year 4.

Year 4 CURRENT (2002-2003): Map and database development: Digitized polygons will be linked to an attribute file and draft maps will be produced. All maps and databases will be subject to thorough quality assurance.

Map production and distribution: digital and hardcopy maps will be published and distributed to all local governments and resource agencies.

Extension Materials: A report will be prepared and published describing inventory methods, ecological characteristics, and summarizing/analyzing inventory results. The report will also present management guidelines and conservation tools. Further outreach products such as pamphlets, display materials and workshops will be dependent on the availability of funding.

## Results

Not all of the data is ready yet for analysis or publication. When the data is processed, it will be possible to tell what percentage of Sunshine Coast land is considered to be ecologically sensitive. They have accumulated significant scientific data that supports an accurate interpretation.

## Challenges

Most challenges were financially related. Due to funding shortages the amount of groundtruthing for Texada Island was reduced. Ensuring good communication between the various agencies and partners was time consuming but there was good support and cooperation.

Coordinating with other studies and sources of data presented some challenges. For example, the SEI information will be included as a single layer of the Habitat Atlas mapbook, causing some users to think that SEI information is limited to what is presented in the Habitat Atlas. Users need to be made aware of the depth of additional SEI information available to them, including secondary and tertiary ecosystem components, and detailed ecosystem information on plant communities, stand structure, and site condition. Our experience has shown that many users think they “have it all” once they have looked at the atlas maps. For the Sunshine Coast Habitat Atlas, this will be explained in the report accompanying the mapbook.

Another challenge faced is that terrestrial inventories require specialized scientific expertise to identify in the field. The SEI data records plant communities and this ecological data is incorporated into the Conservation Data Center databases where it contributes to the development of the “red” and “blue” conservation lists for plant communities.

## Project Outcomes

Once completed, this information will serve to alert local governments, resource agencies, First Nations, landowners and other citizens as to the existence and importance of these remnant ecosystems. It will encourage land use decisions that will help

conserve these systems. This project is considered to be an essential component of the Georgia Basin Ecosystem Initiative that is fully supported by both Provincial and Federal governments in their efforts to assist local governments and communities in preserving and improving the quality of the environment.

Due to increasing development pressures throughout the Sunshine Coast and adjacent islands, as in most areas of the Georgia Basin lowlands, there has been a loss and fragmentation of the natural ecosystems upon which many species and communities depend. Further habitat loss is expected unless Official Community Plans, Growth Management Strategies and various day-to-day land-use decisions can direct growth and development away from these sensitive areas.

The combination of a broad ecosystem approach and plant community identification used by the SEI is new to most land use decision-makers. As a result, an outreach educational strategy is a vital component of the project that will help to ensure wise use of the inventory data.

The SEI website contains some descriptive material about the Sunshine Coast SEI, but it primarily describes the Vancouver Island SEI project, presents ecological information on the ecosystems of concern, and provides access to its publications. Once the Sunshine Coast SEI is completed, more comprehensive information will be posted on that site.

Currently, the SEI maps for Vancouver Island and Gulf Islands can only be accessed through the Internet on the Community Mapping Network (CMN) website at <http://www.shim.bc.ca/sei/seimain.html>. However, the B.C. Ministry of Sustainable Resource Management is currently devel-

oping an interactive mapping site that will include the SEI data layer.

A final report is being written which will detail the findings of the inventory, describe the values of the plant communities in detail and will provide management guidelines. A "conservation tools" section will provide details with various models or sample clauses that could be used in Official Community Plans and Development Permit Area Guidelines. While the information is of significance to all levels of government it is at the local government levels that many of the land use decisions are taking place, so these guidelines will be of extreme importance to these user groups. The target date for completion of this manual is April 2003.

### **Recommendations for the Community Mapping Network**

There is a need to ensure that all data can be overlaid on top of one another on the various maps. Compatibility of data from one map to another is important to allow for comparisons and other analysis of data.

Mapped information should be readily available to anyone. The maps are relatively inexpensive and the digital information can be accessed by those with GIS capability.

It is important that groups who are considering mapping projects assess what has already been done and adhere to standard and approved methodology as opposed to "seat of the pants" mapping. Some data generated simply cannot be used since there is no scientific level of confidence in the methodology and protocols as dictated by the province.

### Next Steps

See year four of “Actions” section. Once the maps are produced a report will be prepared and the various community outreach projects will be initiated, pending funding. The target audience for these workshops will be the local government staff and politicians, community groups, resource agencies and other entities including private business groups like logging companies, land developers etc.

### Project Contacts

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Contact project contacts (Carmen Cadrin) for further details.

### Acknowledgements

The Sensitive Ecosystems Inventory for the Sunshine Coast has the support of the following partners:

- Georgia Basin Ecosystem Initiative
- Habitat Conservation Trust Fund
- Sunshine Coast Regional District
- Comox-Strathcona Regional District
- Terminal Forest Products Ltd.
- Environment Canada (Canadian Wildlife Service)
- Ministry of Water, Land and Air Protection,
- Sechelt Indian Band,
- Powell-River Regional District,
- Ministry of Sustainable Resource Management.



# Sechelt Indian Band Mapping: Vancouver River Spawning and Rearing Channel Development

## Abstract

The Sechelt Indian Band (SIB) successfully undertook a three year project to increase the number of fish spawning and rearing in the off-channels of the Vancouver River located in Jervis Inlet on the Sunshine Coast. A total of eight channels consisting of approximately 7,000 meters, were excavated. Water flow was connected through the channels and fish habitat features were added. Fish returned almost immediately to these sites. Using a Leica GS50 GPS backpack unit, the channels were mapped and are now available as a resource to ensure that any subsequent logging or development does not destroy the rehabilitated fish habitat. The site is now an excellent place to study fish biology.

Construction of a town site and access roads had destroyed or cut off many of the channels from the river system. As a result, most of the channels were dry and void of fish habitat. The three-phase project undertaken in this area is likely one of the largest rehabilitative projects done in B.C. It has helped establish a track record of success and protocol for further projects of this nature.

## Background

The Vancouver River watershed had at one time sustained large populations of fish. Fish stock monitoring done over the past ten years at the Vancouver River site indicated drastically falling numbers of fish. In recent years, Vancouver Bay fish populations were almost extinct, down from approximately 8,000 chums in 1973, 13,000 pinks in 1987, 5,000 coho in 1979 and 24

sockeye in 1985. The cause was readily identified. Logging and ancillary development had led to the destruction of most of the off-channels of the river that are such a necessary component of healthy fish habitat.

The water level in the Vancouver River fluctuates severely. Without off-channels, the fish stock had no refuge from the torrent waters that result during periods of high rainfall and thaws and there were no sites to give young fry a place to develop.

SIB determined that drastic measures were needed to rehabilitate the Vancouver River to bring back the fish stocks.



Figure 1. Vancouver River

## Objectives

The objective of the project was to increase the fish populations in the Vancouver River Watershed. Achieving the objective would result in increased fish stocks for community enjoyment, harvesting and to correct

for the past physical decimation of the watershed.

### **Process, Partners, Costs**

The SIB Resource Management Department in conjunction with the Community Fisheries Development Center and Fisheries & Oceans Canada (F&OC) applied for funds for this extensive project. Funding was secured through the F&OC Habitat Restoration and Salmon Enhancement Program (HRSEP), Fisheries Renewal BC, and International Forest Products (Interfor). In addition, “in-kind” contributions were made by SIB in the form of providing labour, boats, trucks, office and administrative support. This project was a joint venture between SIB and F&OC HRSEP.

### **Actions**

The project work was conducted in three phases, as funding became available.

Phase I (1998): Previous channels of the Vancouver River that had been cut off from the river and had either been filled in or had dried up, were re-excavated. The channels were connected with the main river through flow pipes that had control valves. A total of eight channels representing some 7,000 meters of new stream were dug deep enough for ground water feed and river water to flow into them. Once dug, the water flow was reconnected and small logs/wood was put in place to provide shade and shelter for returning fish. This phase took approximately five weeks and provided employment opportunities for eight people.

Phase II (1999): A berm was constructed that allowed for water to be piped through it so it did not interfere with the main river flow yet kept the river from eventually eating into the channels that had been recon-

structed. A large excavation cut through the logging road and provided a feed to Jitco Creek. The river had previously shifted and cut off the water supply to Jitco Creek which was nearly void of water.

Phase III (2000): Two parallel channels were excavated on either side of the main logging road near the Vancouver Bay Lodge. A culvert was added to connect the two channels that fed another 1000 meters of channels that eventually drain back into the main Vancouver River.

During Phase III mapping was completed. Using a backpack GPS unit the channels were walked and mapped. This was converted into digital format on 1:20,000 scale TRIM maps. Maps now show all the reconstructed and rehabilitated channels along the Vancouver River area.

The work for all three phases included the use of excavators and backhoes with fill being provided by dump trucks. Some minor access roads were created. Native vegetation re-planting was done. Throughout the construction the process was designed to minimize siltation and further damage to the areas.

### **Results**

The project is considered to be a great success. “If you build it, they will come.” Adult fish have returned to all the channels. Juvenile salmon came in faster than the channels could be constructed, apparently just waiting for the off-channels to be finished to provide shelter and a place to hide. Numbers of fish have been recorded through foot surveys, trapping programs and the assessment of smolt migration patterns.

The area now provides an excellent outdoor laboratory to study fish biology, water



chemistry, logging impacts and soil analysis. It is a controlled environment that allows for the mimicking of the natural processes in a watershed. There are facilities on-site that make it easier for crews to study and monitor the river system as well as do repairs and maintenance.

Interfor is actively logging in the valley and contributed to the funding for the project. They have been very supportive of the project and are sensitive to maintaining the rehabilitated area.



**Figure 2.** Coastal Cutthroat Trout in intake pool.

### Challenges

**Funding** securing ongoing funding was the biggest challenge. The project was run on a phased basis since there were no guarantees that funding would be provided from one phase to the next. The application process was time consuming and cumbersome.

**Remote Location:** To access the site requires approximately 30 nautical miles of travel (or approximately 25 minutes from Egmont) by water. However, SIB owns the Vancouver Bay Lodge located at the mouth of the Vancouver River that provides overnight accommodation and shelter during foul weather.

**Weather/seasons:** The ideal time for channeling was during the “low flow” months of

summer that restricted work on the project to mostly late August and September.

**Equipment:** The GPS unit back pack (Leica GS 50) was found to be superior in mapping capability especially when under tree canopy cover.

**Natural Destruction:** Ongoing problems included some siltation, pools and channels filling in from natural run-off or collapsing banks.

**Ongoing resources** to provide monitoring and maintenance remains a challenge.

### Project Outcomes

The Vancouver River and the off-channels have now been mapped. The information has been layered onto existing SIB maps. Developers are required to consult with SIB, Resource Management Department, before proceeding with any development in an effort to help ensure there will be no negative environmental impacts in the area. Prior to the updated mapping, there was no official record of where the various channels existed and development of logging roads and actual logging practices were done with minimal regard for the ultimate damage to the surrounding eco-systems.

Reports are being written to identify the various project results and will be submitted to the funding agencies. SIB may eventually publish the project details in appropriate publications or on a web-site.

SIB keeps the newly mapped stream data available in digital format and F&OC also has this as part of its HRSEP program.

Most importantly, fish are back to the Vancouver River site and off-channels in increasing numbers. The site is now a place to study and provides a legacy for future

generations. The experience gained by the project workers and supervisors can be used to expedite and complete future projects of this nature in other watershed areas that are in need of rehabilitation.

### **Recommendations for the Community Mapping Network**

The updated maps provide some form of insurance that any development in the area will not damage the restored fish habitat areas. Mapping has provided a historical benchmark that can be used to track river system changes in the decades to follow. Any development in the area will now have access to the information to ensure that plans are developed in accordance with preservation standards.

If funding had been available it would have been ideal to map the river and channels prior to the reconstruction work. This would have provided information that would have made it easier to do a cost-analysis and to plan the project in more detail in advance. This may have resulted in more cost-effective procedures. In the absence of maps the work proceeded using an “eye ball” method to determine what should be done.

### **Next Steps**

Phase III reports are being completed. Access to funding will determine what “next

steps” can be taken. Ideally SIB would like to “turn the clock back” on a number of watershed areas with a process similar to that used on the Vancouver River area. There are five major watershed areas in the region; all of which have sustained various degrees of damage as a result of previous logging practices.

### **Project Contacts**

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### **Acknowledgements**

The Sechelt Indian Band would like to thank the funders and supporters of the Vancouver River spawning and rearing channel development initiative:

- Fisheries & Oceans Canada Habitat Restoration and Salmon Enhancement Program
- Fisheries Renewal BC
- International Forest Products
- Community Fisheries Development Center

# Capilano College, Sechelt Campus: Training, Data Collection and Interaction with Community Mapping Projects

## Abstract

For fourteen years Capilano College has been training students through a variety of programs on Fisheries and Community Stewardship like the Streamkeepers program. As part of the training, students have conducted a wide range of streamkeeping mapping and restorative projects in local watershed areas. Streamkeepers students have provided a "volunteer" labour force to map many of the local streams and tributaries and participate in restorative activities. The data collected has been shared with relevant agencies and has formed the basis of many further studies and projects. The College (Dave Bates) continues to serve on a number of advisory committees in the community and as a consultant to various projects including significant involvement in the various Sechelt Indian Band Resource Management Department projects. Graduates from the program are now working with a number of different agencies, providing technical and academic skills in the field of fish habitat stream enhancement, restoration and conservation. This case study is an excellent example of academic institutions working with community partners on projects that enhance the overall preservation and conservation of fish habitat.

Dr. Bates developed the delivery model and parts of the content of the Streamkeepers program that is now used throughout BC and is being adapted for use in other countries.



Figure 1. Capilano College, Sechelt Campus

## Background

Capilano College located on the Sunshine Coast in Sechelt, B.C., through the Department of Applied Fisheries and Forestry Science offers a Watershed Restoration Technician Certificate Program and Stewardship Training (Streamkeepers) programs. Students registered in these programs have participated in numerous local initiatives that involve stream mapping, restoration, enhancement, and collection of fish data. The projects and data collected have been shared with relevant agencies and have been used in other projects, such as the Sunshine Coast Habitat Atlas. Many skilled technicians who have graduated from the various programs are now working in the field. Those working in the Resource Management offices of the Sechelt Indian Band have received their training through the College and continue to work together closely on various watershed projects.

Watersheds of the Sunshine Coast offer world class "real life" laboratories that provide practical excellent "hands-on" training options for the program participants. Since

the College coordinates its projects with various community groups, the projects undertaken by the students and the program in general provide valuable data and work that assists these other agencies. The high standards and quality of work ensures that the project data is “useable” in the scientific community and meets high standards and quality assurance measures.

### **Objectives**

The objectives of the program are to provide skilled technical people who can collect reliable and reproducible information. The data collection process and methodology used will help ensure the conservation and protection of local salmonid populations and resources.

### **Process, Partners, Costs**

The College has developed a close working relationship with the Sechelt Indian Band. They have partnered on numerous projects where the College students have provided the labour and technical expertise while SIB has provided access, equipment and other associated project costs. The College also maintains an excellent working relationship with Fisheries and Oceans Canada.

### **Actions**

During the course of the various programs offered by the College, students have taken on a number of field projects under the supervision of Dave Bates. Some of the projects that have been undertaken include:

- Stream assessments: fish population surveys, students or graduates have surveyed almost every Anadromous stream on SIB lands;
- Two students (graduates) completed the early SHIM surveys and trained SHIM crews in Powell River;

- Developing field programs, field work into student exercises;
- RIC approved watershed restoration surveys;
- Watershed or stream assessments to identify, rehabilitate and restore fish habitat;
- Establish goals and project design for various projects ;
- Adult and juvenile salmon and trout assessments – annually enumerate and survey Chum salmon returns in Anderson Creek and Pender Harbour (Information forward to F&OC);
- Mapping projects is a large part of the Streamkeepers Program that involves students using tapes, compasses and other assessment programs to map various streams, channels and tributaries;
- Completion of small demonstrative restoration projects. E.g. Ouellett Creek;
- Assisting with the writing of funding proposals;
- Assisting with the writing of Technical reports; and,
- Finding employment opportunities for trained Applied Fisheries graduates.

### **Results**

Significant data and mapping information has been compiled and shared with local government, the SIB, and resource management organizations. The “real life” training exercises have helped train world class technicians, many of whom are working with various projects and agencies. The projects completed have provided much needed data that have been used for the planning and initiation of a variety of watershed restoration projects.

### **Challenges**

Challenges for the program include securing sufficient students and funding. Al-

though the local outdoor classroom settings provide an excellent learning environment, potential students may not want to temporarily relocate to the Sunshine Coast. Finding local year round employment opportunities has been frustrating to program graduates forcing many to relocate for work. Cooperation between the College and local groups has been excellent and has proven to be a long lasting mutually beneficial arrangement.

### **Project Outcomes**

The College's Streamkeepers Workshop has formed the basis of the model being used by numerous training institutes. The work of the College and its students has led to numerous publications and distribution of information that is relevant and important to the protection of local watershed resources. Dave Bates has taught and delivered many workshops in Canada and internationally. In the spring of 2002 he will be traveling to Malaysia where they want to adapt the Streamkeepers model to meet their local environmental needs.

### **Recommendations for the Community Mapping Network**

Groups or organizations engaged in Community Mapping projects should consider the possibility of partnering with College's and other educational institutes. The collaboration can be mutually beneficial and rewarding. Communication amongst these various groups can lead to new ideas, projects and possible collaborative efforts.

Efforts to diffuse quality control controversies by assisting with the standardization of techniques and methodology would be welcome. There have not been a lot of standards developed for foreshores and up-slope terrain.

### **Next Steps**

The program is somewhat at risk due to funding uncertainties and enrolment issues. The College hopes to continue the program to supply the technically qualified personnel who can then form the basis of a reliable labour pool to work on projects in BC, Canada, and internationally. Without well-qualified individuals, many community mapping and stewardship programs would be at risk.

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### **Acknowledgements**

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## Appendices

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## Appendix 1. Internet Sources of Environmental Data for Community Groups and Regional Planners in British Columbia

The following is only a small selection from an ever-growing list of organizations assembling and distributing environmental datasets for easy access by the public. Many of the following groups employ (or are moving towards) web sites with interactive GIS map interfaces that provide an understandable geographic context for their data, and allow the information to be used within formal planning exercises. Additionally, some of the organizations presently accessed through the umbrella of the Community Mapping Network now promote mapping functions that allow community members (with the appropriate qualifications and password access) to directly contribute to developing databases by entering new spatially-linked information directly over the internet. A fuller listing of informative environmental websites can be accessed at:

<http://www.shim.bc.ca/links2.html>.

The listing of supporting partners provided for each group is generally only a sample of the players involved in these undertakings. The full partnerships are more fully detailed within the individual websites.

### 1) Community Mapping Network

URL: <http://www.shim.bc.ca/>

**Supporting Partners:** Fisheries and Oceans Canada, Environment Canada (Canadian Wildlife Service), B.C. Ministry of Water, Land and Air Protection, Ministry of Energy and Mines, Habitat Conservation Trust Fund, Fraser Valley Regional District, Inner Coast Natural Resource Centre, The Real Estate Foundation of British Columbia,

Langley Environmental Protection Society, B.C. Conservation Foundation, Integrated Mapping Technologies Inc., Fraser River Estuary Management Program, Comox Valley Project Watershed Society, City of Surrey

**Abstract:** The Community Mapping Network was created to display and describe watershed-based community mapping projects that are either in progress or have been completed, and to make this valuable information available to both local and international communities. This information has been and will continue to be used for land use planning purposes as well as a vehicle for empowering community conservation and stewardship of natural resources.

A community mapping network is made up of a number of groups, organizations, and/or individuals that collect and map similar information about their community. Although standard methods of collecting and mapping community information are promoted, all community mapping projects, regardless of methodology, are welcome to become part of the community mapping network. The aim of many of the mapping projects is to collect inventory information for fish presence and habitat, wildlife, mapped and unmapped streams and wetlands, sensitive areas, and possible restoration sites. Mapping typically takes place in rural and urban communities where humans land use may influence the riparian areas. For each project the geographic location, and in some cases specific features, of the project sites are shown on an interactive map. A detailed description of each project is also available, and outlines the project's

goals, methods, and status. Contact information for the organization(s) responsible for each project is also provided, and interested viewers are encouraged to contact the organization to ask questions or find out how they can get involved. Since many of the community mapping projects are ongoing, information found in this atlas is constantly being updated. Inventory and mapping projects currently accessible through the Community Mapping Network include:

- Sensitive Habitat Inventory and Mapping Project (SHIM)
- Wild, Threatened, Endangered and Lost Streams of the Lower Fraser Valley
- Frogwatch Sighting Mapping Tool
- Wildlife Observations Mapping Tool
- Sensitive Ecosystems Inventory
- Inner Coast Natural Resource Centre (ICNRC) Stream Observation Mapping Tool
- B.C. Wetlands Atlas
- Pacific Coastal Resources Atlas
- Upper Skeena Atlas
- Watersheds B.C. Atlas
- South Coast Cutthroat Atlas
- Bald Eagle and Heron Atlas
- Comox Valley Project Watershed
- Community Mapping Network Directory

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## 2) Sensitive Ecosystems Inventory Project (SEI)

### URL:

<http://www.shim.bc.ca/sei/seimain.html>

**Supporting Partners:** Fisheries and Oceans Canada, Environment Canada (Canadian Wildlife Service), B.C. Ministry of Water, Land and Air Protection, B.C. Ministry of Sustainable Resource Management, Sunshine Coast Regional District, Regional District of Central Okanagan, Habitat Conservation Trust Fund

**Abstract:** The purpose of the Sensitive Ecosystems Inventory (SEI) project is to identify remnants of rare and fragile terrestrial ecosystems and to encourage land-use decisions that will ensure the continued integrity of these ecosystems. It is intended for use in a variety of land-use planning processes.

Sensitive ecosystems are first identified on aerial photographs. Identified sites are then field checked to verify boundaries, classify, photograph and evaluate present conditions. This information is placed into a GIS (Geographic Information System) database, and the maps are made available both in hard copy and digital formats. Maps will be at a 1:20,000 scale on the TRIM map base.

SEI project staff work with local governments, landowners, developers and others to use existing tools and mechanisms to protect and conserve the sites identified. Every one of these sites is potentially a valuable component of the area's natural landscape. The SEI is a "flagging" tool that identifies sensitive ecosystems and provides scientific information and support to local

governments and others who are trying to maintain biodiversity.

### Contacts:

- Southeast Vancouver Island and Gulf Islands:  
<http://srmwww.gov.bc.ca/cdc/sei/vancouverisland/information.htm>
- Sunshine Coast:  
<http://srmwww.gov.bc.ca/cdc/sei/sunshinecoast/contacts.htm>
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### 3) Sensitive Habitat Inventory and Mapping (SHIM)

#### URL:

<http://www.shim.bc.ca/method2.html>

**Supporting Partners:** Fisheries and Oceans Canada, Environment Canada (Canadian Wildlife Service), B.C. Ministry of Water, Land and Air Protection, Ministry of Energy and Mines, Habitat Conservation Trust Fund, Fraser Valley Regional District, Inner Coast Natural Resource Centre, The Real Estate Foundation of British Columbia, Langley Environmental Protection Society, B.C. Conservation Foundation, Fraser River Estuary Management Program, Comox Valley Project Watershed Society

**Abstract:** The Sensitive Habitat Inventory and Mapping (SHIM) method is intended as a standard for fish and aquatic mapping in urban and rural watersheds in British Columbia. The principal objective is to identify, inventory and map all watercourses, their associated riparian habitats and important fish and wildlife habitat features at a scale of approximately 1:5000. SHIM methodology involves field collection of

aquatic information using high-end global positioning systems (GPS) and subsequent data incorporation into geographic information systems (GIS).

This method attempts to ensure the collection and mapping of reliable, high quality, current and spatially accurate information about local freshwater habitats and watercourses. Watercourses in residential, commercial, agricultural, industrial and recreational land use areas in coastal British Columbia are the primary focus of this standard, but these methods can be applied for use across all areas of British Columbia. These methods have been designed to capture information not currently identified or acknowledged in local/regional plans and maps. SHIM is designed to provide the basis for accurately mapped baseline data that can be integrated into local mapping and planning initiatives. The mapping information collected is intended to augment and potentially enhance local land use planning maps and/or specific site or detailed planning surveys.

SHIM information can be applied to:

- Identify sensitive habitats for fish and wildlife along watercourses;
- Assist in determining setbacks and fish/wildlife-sensitive zones;
- Help guide management decisions and priorities with respect to habitat restoration and enhancement projects;
- Assist in the design of storm water or runoff management plans;
- Monitor for changes in habitat resulting from known disturbance;
- Provide a means of highlighting areas that may have problems with channel stability or water quality, and require more detailed study;
- Identify and map point and non-point sources of pollution;

- Provide current information, not previously available to urban planners, to allow more informed planning decisions and provide inventory information for Official Community Plans;
- Provide baseline mapping data for future monitoring activities;
- Map and identify the extent of riparian vegetation available and used by wildlife and fisheries resources;
- Provide preliminary data for analyses which can be used to indicate potential trends in resources that may require further study;
- Integrate new map information with existing TRIM and municipal planning maps;
- Contribute information towards an inventory of fish distribution and limiting factors to watershed based fish production;
- Assist in understanding urban water runoff patterns and help determine areas of impervious surfaces in urban watersheds.

During the past five years local communities have performed trials and reviews of SHIM methods to collect and integrate accurate and precise watercourse information. At least 30 separate community SHIM based mapping projects have been completed throughout the Georgia Basin and west coast Vancouver Island. Two workshops have also been held in Nanaimo and Abbotsford to review the status of all SHIM mapping projects, consider potential data gaps, review and improve methods, and provide recommendation for future method development.

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## 4) Sensitive Habitat Atlases

### URLs:

- [http://www.shim.bc.ca/sens\\_hab\\_atlases.htm](http://www.shim.bc.ca/sens_hab_atlases.htm)
- <http://www.user.dccnet.com/ctrent/>
- <http://www.naturalareasatlas.ca>
- [http://www.fvrd.bc.ca/growth/RGS\\_Concepts/Habitat\\_Atlas/habitat\\_atlas.html](http://www.fvrd.bc.ca/growth/RGS_Concepts/Habitat_Atlas/habitat_atlas.html)

**Supporting Partners:** Fisheries and Oceans Canada, Ministry of Environment Lands and Parks, Comox-Strathcona Regional District, Sunshine Coast Regional District, Fisheries Renewal, Urban Salmon Habitat Program, Habitat Conservation and Stewardship Program, Real Estate Foundation of British Columbia, Veins of Life Watershed Society, South Island Aquatic Stewardship Society, Islands Trust, City of Victoria

**Abstract:** The Sensitive Habitat Atlases are land planning, computer-generated tools that identify sensitive aquatic and terrestrial habitats within a district. A Sensitive Habitat Atlas consists of several map layers: the backdrop consists of an up-to-date aerial photograph. This is overlaid with property boundaries, land parcels, and road networks. Additional overlays include land use information and the locations of sensitive resources compiled from existing information sources and through interpretation of



## *Appendix 1. Internet Data Sources for Community Groups and Planners*

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aerial photographs. Colour-coding of the resources facilitates their identification. By combining resource information from a variety of sources the Atlases provide a strong foundation for integrated resource management and planning in urban areas. The development of Habitat Atlases is the recognized initial step towards the protection of natural areas. These atlases are one of the primary tools used by local government planners and engineers who are responsible for making day-to-day decisions regarding land use and development in and around environmentally significant landscapes. An atlas can locate and describe natural areas in relation to property boundaries, road networks and other cadastral information. In this respect, natural areas atlases are excellent 'flagging devices' for planners, consultants, architects, engineers and the development community to inform them that further study of a proposed development or activity may be required. These atlases also provide essential background information for tasks such as defining setbacks on watercourses and can also be used to complement land use bylaws and Official Community Plans (OCPs).

In addition to resource and land use planning, government and non-government agencies and community groups are able to use the atlas to highlight and prioritize areas that may be in need of protection and/or restoration. By compiling information from a wide variety of sources and making it easily accessible, the Natural Areas Atlas will become an essential education and information tool for land use planning decision-makers and the public.

The Atlases may also be readily incorporated into habitat resource databases and used in geographic information systems. The first generation of Sensitive Habitat Atlases were produced in the late 1990's for the Comox-Strathcona, Nanaimo, Squamish

and Saanich Regional Districts. A new generation of Sensitive Habitat Atlases are currently being developed for the Sunshine Coast, Fraser Valley and Capital Regional Districts. These Habitat Atlases will be created as digital Geographic Information System (GIS) databases. The database will provide constantly up-dated information to planners, developers, government organizations, municipalities, First Nations, community organizations and local businesses, enabling them to make informed land use and stewardship decisions in support of the protection, enhancement, and restoration of fish habitat and sensitive ecosystems.

Some of the themes to be included in these new Atlases are: all water courses and associated information (enhancements, obstructions, artificial modifications), fish presence and species information, parks and protected areas, and land use. These themes will serve to identify the location of important habitat and its relation to other features. The Atlases will provide accurate mapping for enforcement of the Fish Protection Act (including the Streamside Protection Regulation), the Forest Practices Code, the Water Act, the Land Development Guidelines, and the Local Government Act.

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Email: [growth@fvrd.bc.ca](mailto:growth@fvrd.bc.ca)

### 5) Vancouver Island Wildlife Tree Atlas

URL:  
<http://www.shim.bc.ca/eagle/main.htm>

**Supporting Partners:** Community Mapping Network, Vancouver Island Region FBCN, Canadian Wildlife Service (CWS), Ministry of Water, Land, and Air Protection (MWLAP), BC Hydro, Cowichan Community Land Trust (CCLT), Land Trust Alliance of B.C. (LTABC).

**Abstract:** The Vancouver Wildlife Tree Atlas has been developed by the Wildlife Tree

Stewards (WITS), a stewardship initiative of the Vancouver Island Region of the Federation of B.C. Naturalists (FBCN). Volunteers document the location and monitor use of wildlife trees. Landowners provide access to, and information regarding, their trees. The Wildlife Tree database and interactive GIS display system are maintained by the Community Mapping Network. New and spatially accurate wildlife tree locations and associated information can be entered by qualified community members with appropriate password clearance. The goal is to conserve dwindling coastal wildlife tree habitats through volunteer monitoring, landowner agreements, and community education along the Strait of Georgia on Vancouver Island. Of particular concern are mature coastal trees and mixed tree stands with documented high levels of wildlife use. Volunteer wildlife tree stewards and cooperative landowners are crucial to this initiative. The WITS initiative is built on the results of a decade of fieldwork conducted on Great Blue Herons (a threatened species in B.C.) and on Bald Eagles by Vancouver Island naturalists and biologists. This new initiative is expanding to include trees and habitat important to other wildlife species.

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### 6) Fisheries Data Warehouse

URL:  
<http://www.shim.bc.ca/shim/main.htm>  
or  
<http://www.bcfisheries.gov.bc.ca/fishinv/>

**Supporting Partners:** B.C. Ministry of Sustainable Resource Management, Fisheries and Oceans Canada

**Abstract:** The Fisheries Data Warehouse provides access to federal-provincial fisheries datasets compiled under the Canada-B.C. Agreement on the Management of Pacific Salmon Fishery Issues. All data are linked to “active” maps and to standard tables and reports that allow you to choose detailed information from any location. The simple map-based interface allows easy access to the most recent information from government data sets that include:

- **Salmon Escapement:** data from Fisheries and Oceans Canada
- **B.C. Watershed Atlas:** detailed 1:50,000 maps of watersheds, stream networks and lakes
- **Fisheries Information Summary System (FISS):** summarized fish, fish habitat and resource use data for over 27,400 provincial streams and lakes
- **B.C. Lakes and Release Records:** physical, chemical, and fish data for over 3,500 lakes
- **Release Records:** hatchery fish stocking data
- **Lake Depth Maps:** for over 2,500 lakes.
- **FFHI Reports:** provincial fish and fish habitat reports and associated data files

**Contact:**

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### 7) Inner Coast Natural Resource Centre (ICNRC)

**URL:**

<http://www.shim.bc.ca/icnrc2/main.htm>

**Supporting Partners:** Fisheries and Oceans Canada, B.C. Ministry of Water, Land and Air Protection, Ministry of Forests, Namgis

First Nations, Kwakwaka'wakw Traditional Fisheries Commission, Sayward Chamber of Commerce, Town of Port McNeil, Village of Alert Bay, Village of Port Alice, District of Port Hardy, Ecotrust Canada, U'Mista Cultural Society, VINVA, Community Futures Development Corporation, Intergraph Canada

**Abstract:** The Inner Coast Natural Resource Centre (ICNRC) was created to provide a forum for North Island Communities to recognize, enhance and sustain social, cultural, economic, and environmental values. The ICNRC has gathered local information pertaining to the marine and watershed ecosystems of the region, including their geology and forests, fish and wildlife. This information has been built into an interactive on-line stream habitat data entry and mapping tool primarily for the use of Northern Vancouver Island Stewardship Groups. New information put into the ICNRC streams database is instantly viewable as points or zones on the maps and associated data reports. The stream habitat database is to be used as a tool in setting priorities for restoration projects in the Combined North Island Fisheries Center area and to catalogue new fisheries related information collected by local stewardship groups and individuals.

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### 8) B.C. Coastal Resources Atlas

**URL:**

<http://www.shim.bc.ca/coastal2/main.htm>

### Supporting Partners: Community Mapping Network

**Abstract:** The B.C. Coastal Resources Atlas has been designed to display the data from a series of inventories undertaken to identify the location of commercial and recreational fishing activity on the coast of British Columbia. The application is intended for general interest and land use planning purposes. Areas of activity for a given fishery are represented as a series of polygon themes with common data structures. Each polygon represents an area where a particular type of fishery operates, with timing and intensity of use specific to that location. The marine fisheries data were compiled through interviews with DFO Fisheries Officers and Biologists and were performed by several contractors.

The coastal resources covered by this data set include:

1. *marine invertebrates:* Abalone, crabs, geoduck, octopus, prawn, scallop, sea cucumber, shrimp, sea urchins, squid;
2. *marine fish:* anchovy, groundfish, herring;
3. *anadromous fish:* salmon
4. *recreational fisheries:* Abalone, crab, fishing, prawn, scallop, squid

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### 9) Wild, Threatened, Endangered and Lost Streams of the Lower Fraser Valley

**URL:**

<http://www.shim.bc.ca/shim/main.htm>

**Abstract:** This map and database product evaluated the condition of streams in the Lower Fraser Valley and classified them as lost, endangered, threatened, or wild, based on the number and types of impacts on the stream, including channelization, water diversion, removal or alteration of riparian vegetation, and pollution. Information on stream condition was derived from many sources — maps, airphotos, reports, various databases and interviews with field workers. The methodology also involved comparison of historical maps and surveyor field notes, circa the 1860's, with contemporary National Topographic System (NTS) maps (1:20,000 and 1:50,000) in order to identify streams that are no longer present in the lower Fraser Valley.

The assembled information can be used at a strategic level for determining needs for habitat protection and restoration for endangered and threatened streams which still have the potential to produce viable populations of salmon and other species of fish. Using the SHIM maps and data entry function on the CMN website, individual streams can be queried for watercourse classifications and downloading of either simple or detailed stream classification reports. Additionally, qualified individuals in the community (with appropriate password access) can enter the site directly over the internet, and update/edit the Lost Streams database and associated map linework with the most current information.

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### 10) B.C. FrogWatch

**URL:**

<http://www.shim.bc.ca/frog/main.htm>

or

<http://wlapwww.gov.bc.ca/wld/frogwatch/index.htm>

**Supporting Partners:** Habitat Conservation Trust Fund (HCTF), B.C. Ministry of Water, Land and Air Protection (MWLAP) Wildlife Branch, B.C. Ministry of Sustainable Resource Management (MSRM) Inventory Branches and Conservation Data Centre, Environmental Monitoring and Assessment Network (EMAN)

**Abstract:** BC FrogWatch is a program to collect information on frog and toad populations in British Columbia. The program will soon expand to include salamanders. The website contains lists of the amphibians to be found in each area of B.C. and this information is stored and accessed through an interactive GIS system. Information has been derived from museum collections and government records to determine the historical distributions of the species, but volunteer input is used to assess current range and species movements. The Ministry of Water, Land, Air and Water Protection maintains the Oracle database that stores the assembled information; the Community Mapping Network (CMN) maintains the GIS interface that allows display of the data and (with proper password access) updating of frog records directly over the internet. Government Supporting Partners re-

ceive this information and make it available for amphibian conservation. Biologists, naturalists, teachers and students are all working together, and sharing their information across B.C. and Canada.

**Contact:**

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Ministry of Water, Land and Air Protection  
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### 11) Conservation Data Centre (CDC)

**URL:**

<http://srmwww.gov.bc.ca/cdc/index.htm>

**Supporting Partners:** B.C. Ministry of Sustainable Resource Management, Nature-Serve

**Abstract:** The British Columbia Conservation Data Centre (CDC) systematically collects and disseminates information on the rare and endangered plants, animals and plant communities of British Columbia. This information is compiled and maintained in a computerized database that provides a centralized and scientific source of information on the status, locations and level of protection of these rare organisms and ecosystems. Information accessible through the CDC includes:

1. Species Tracking Lists (names, conservation status ranks and Red or Blue List status of animal/plant communities)
2. Element Occurrence Reports (individual, verified locations for rare species or plant communities in a requested geographic area)



3. Species/Plant Association Summary Reports (all verified locations in the province for an individual species, group of species or plant communities)

4. Detailed Individual Occurrence Records (all the information recorded for a single species or natural plant community occurrence)

5. Electronic files (DBase files and digital ArcView shapefiles)

**Contact:**

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### 12) Fisheries Project Registry (FPR)

**URL:** [http://www.canbcdw.pac.dfo-mpo.gc.ca/FPR/Qf\\_Welcome.asp](http://www.canbcdw.pac.dfo-mpo.gc.ca/FPR/Qf_Welcome.asp)

**Supporting Partners:** Fisheries and Oceans Canada, B.C. Ministry of Land, Air and Water Protection, B.C. Ministry of Sustainable Resource Management, Fisheries Renewal BC, Forest Renewal BC (Resource Inventory and Watershed Restoration Programs), Habitat Conservation Trust Fund, Urban Salmon Habitat Program, Habitat Restoration and Salmon Enhancement Program, Pacific Streamkeepers Federation, Columbia Basin Fish and Wildlife Compensation Program, Peace Williston Fish and Wildlife Compensation Program, BC Hydro

**Abstract:** The Fisheries Project Registry (FPR) is a map-enabled database management system, accessible on the Internet, which tracks minimum data about the existence, general nature, location and key contacts for specific categories of fisheries-related projects including: inventory, re-

search, restoration and enhancement, resource use planning, stewardship and economic development. The purposes of the Registry are: to identify who is doing what where, using which standards or methods; co-ordinate projects and activities; promote partnerships among organizations; and reduce project duplication. The Registry contains projects approved by funding Supporting Partners or sponsoring organizations, giving other individuals and groups the ability to quickly and easily identify and get basic information about projects in any watershed or within any stream, lake, wetland or marine statistical area/sub area. It is planned that the existing FPR will be merged into a consolidated Natural Resources Project registry in the coming year.

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### 13) Pacific Streamkeepers Federation (PSKF)

**URL:** <http://www.pskf.ca/>

**Supporting Partners:** Fisheries and Oceans Canada

**Abstract:** The Pacific Streamkeepers Federation (PSKF) is a non-profit society helping individuals take action through support, education and building partnerships. PSKF assists British Columbians in improving their communities by helping them become involved in their local streams and watersheds. Streamkeepers offers training on



procedures to assess, monitor and protect local streams. The Streamkeepers methodology is scientifically sound, and uses every day English, so non-professionals can understand it. The Streamkeepers Central Database allows information gathered using the Streamkeepers methodology to be uploaded and queried, and customized reports can generated, all via the Internet. The database works hand in hand with the Streamkeepers Handbook and Modules. The streamkeepers methods do not represent a direct mapping protocol *per se*, and have been designed primarily for use in inventory and monitoring. Coupling the existing information with a GIS system would be a useful dimension in future developments of the Streamkeeper database.

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### 14) Shorekeepers

**URL:** <http://www-sci.pac.dfo-mpo.gc.ca/protocol/shorekeepers/>

**Supporting Partners:** Fisheries and Oceans Canada

**Abstract:** Shorekeepers is a monitoring methodology designed specifically for community groups and for people who may not have a strong science background to be able to contribute to scientific data collection. Having local community groups and individuals take an active role in looking after their coastline fosters "local ownership" and interest. The Shorekeepers' Guide developed by Fisheries and Oceans Canada

presents an intertidal surveying methodology. The method is presented in a logical step-by-step manner starting from selecting a study area through each type of measurement to entering the field data into the database, to final map and report generation. To detect gradual changes to habitats and local biodiversity Shorekeepers generates long term datasets by collecting detailed data annually at the same site(s) for 3 or more years. Shorekeepers is a rigorous monitoring methodology using standard survey methods at all sites.

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### 15) Reefkeepers

**URL:** <http://www-sci.pac.dfo-mpo.gc.ca/protocol/reefkeepers/>

**Supporting Partners:** Fisheries and Oceans Canada, Royal British Columbia Museum, PADI Project AWARE

**Abstract:** Reefkeepers is a protocol for non-professionals, certified and experienced in scuba diving, to survey and monitor subtidal habitats. The data collected is intended for use by resource managers, environmental biologists, and marine researchers, who are monitoring and assessing long-term changes in marine communities. Reefkeepers is a rigorous subtidal survey methodology, with data collected in the same way at all sites over time. To detect gradual changes in subtidal habitats and local biodiversity. Reefkeepers is designed to collect detailed data at regular frequent in-

tervals at the same site for 5 or more years. The goal is to enable interested non-professional individuals and community groups to obtain standardized, credible data over time from a specific physical site – and use these data to document and evaluate the nature of change, if any, that is occurring. Once project data are entered into the Reefkeepers database, various summary reports can be created. Coastal stewardship involves the voluntary conservation of natural marine resources and habitat. Having local community groups and individuals take an active role in looking after their coastline fosters “local ownership” and interest.

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### 16) WetlandKeepers

**URL:**

<http://www.bcwf.bc.ca/programs/wetlands/wetlands.html>

**Supporting Partners:** B.C. Wildlife Federation

**Abstract:** WetlandKeepers is a program aimed at teaching individuals and community groups across British Columbia to inventory and monitor local habitats. Many of the participants in the Wetlandkeepers program are working towards wetland conservation in their communities and the program is planning to build a network of mentors throughout the province. The WetlandKeepers program outlines step by step procedures for conducting wetland inventories, cleaning-up saltwater marshes

and for raising awareness of wetlands. The intended steps are:

1. Initial Wetland Assessment
2. Survey of Wetland Plants
3. Survey of Wetland Birds
4. Developing and implementing a Public Education Program
5. Marsh Cleanup

**Contact:**

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Wetland Keepers

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### 17) Environmental Trends in British Columbia

**URL:**

<http://wlapwww.gov.bc.ca/soerpt/index.html>

**Supporting Partners:** Ministry of Water, Land and Air Protection

**Abstract:** Steady population growth in British Columbia, combined with high rates of consumption and waste generation, place stress on the environment. By incorporating environmental concerns into all decisions, we can reduce this stress and promote sustainability. The State of Environment Reporting Office provides timely, accurate, and easily understood information on environmental conditions and trends in B.C. that encourages better decision-making.

The objectives of the State of Environment Reporting Office are to provide a comprehensive analysis of environmental conditions and trends and to measure progress towards sustainability, and to contribute to informed and open decision-making. These objectives are served through the development and regular release of environmental

indicators and the production of periodic, comprehensive reports.

Information on the individual environmental indicators for the province, along with supporting data, can be accessed at the Internet site. Environmental indicators that are monitored for British Columbia include:

- protected areas
- water use
- air quality
- species at risk
- domestic waste
- greenhouse gases
- wildlife
- forest species
- fish
- climate change
- riparian ecosystems
- surface water quality
- groundwater
- toxic contaminants
- green economy

### 18) Environmental Indicators—Pacific and Yukon Region

**URL:**

[http://www.ecoinfo.org/env\\_ind/default.htm](http://www.ecoinfo.org/env_ind/default.htm)

**Supporting Partners:** Environment Canada

**Abstract:** Environmental Canada maintains information on a dynamic set of environmental indicators on priority issues for which Environment Canada maintains monitoring programs. The indicators describe the state of the environment for particular issues in a scientifically concise and easily understood manner. The indicators are described by answering the four state of the environment questions: what's happening, why is it happening, why is it significant and what is being done. All indicators will be updated on an on-going basis,

as more recent information becomes available. The key indicators that are tracked include:

- Marine ecosystems
- Biodiversity (selected species)
- Sensitive ecosystems
- Toxic contaminants
- Climate change
- Urban air quality
- Stratospheric ozone depletion
- Urban water use and wastewater treatment
- Freshwater quality

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### 19) Community Involvement Projects

**URL:**

<http://www-heb.pac.dfo-mpo.gc.ca/english/community/advisor.htm>

**Supporting Partners:** Fisheries and Oceans Canada

**Abstract:** The Community Involvement Division of the Habitat & Enhancement Branch was established by Fisheries and Oceans Canada to foster the expressed desire of the people of B.C. for stewardship over the resource. Specifically, people from communities throughout the province wanted locally based enhancement efforts in which they could participate directly. Many local groups are working to try to reverse the declines through enhancement, stream restoration, and protection of salmon streams from further damage. The Community Involvement site lists and describes related project proponents, loca-

tions, activities, dates, and targeted fish species.

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### 20) Bird Studies Canada

URL: <http://www.bsc-eoc.org/regional.html>

**Supporting Partners:** Ontario Trillium Foundation, Ontario Ministry of Natural Resources, Habitat Conservation Trust Fund, Vancouver Foundation, British Columbia Field Ornithologists

**Abstract:** Bird Studies Canada is recognized nation-wide as a leading and respected not-for-profit conservation organization dedicated to advancing the understanding, appreciation and conservation of wild birds and their habitats, in Canada and elsewhere, through studies that engage the skills, enthusiasm and support of its members, volunteers, staff and the interested public. Wherever possible, regional projects have a large, and very important, volunteer component. Current programs in British Columbia include the British Columbia Coastal Waterbird Survey and the British Columbia Nocturnal Owl Survey.

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### 21) Important Bird Areas of Canada (IBA)

URL: <http://www.ibacanada.com/>

**Supporting Partners:** Bird Studies Canada, Canadian Nature Federation (CNF-FCN)), Birdlife International, Weyerhaeuser, Wildlife Habitat Canada, Alberta Conservation Association

**Abstract:** The IBA process is designed to identify a network of sites that conserve the natural diversity of Canadian bird species and are critical for the long-term viability of naturally occurring bird populations. For each identified site protection or stewardship requirements are determined, and partnerships are developed with local stakeholders to implement appropriate on-the-ground conservation plans. Sites are identified using a set of standardized and internationally agreed upon criteria that have gained worldwide recognition. IBAs can be identified under four main categories: sites regularly holding significant numbers of threatened species; sites regularly holding endemic species or species with restricted ranges; sites regularly holding an assemblage of species largely restricted to a biome or a unique or threatened community type; and sites where birds congregate in significant numbers when breeding, in winter, or during migration.

The identification of important bird habitat is a necessary first step in establishing habitat-based priorities in bird conservation. The designation of a network of sites can help decision-makers focus their efforts and protect the most critical bird habitat. The program is inclusive and identifies important sites for all groups of birds. It integrates aquatic and terrestrial habitat conservation by protecting seabird, shorebird, landbird, and waterfowl habitat. Most importantly, the program is community-driven, and cooperative. It relies on grass-

roots involvement to develop and implement effective conservation plans. The program will also help generate widespread public awareness about birds and will help build partnerships at all levels: international, national, provincial, and local.

**Contacts:**

IBA Technical Coordinator  
Tel: 519-586-3531  
Email: [rchaundy@bsc-eoc.org](mailto:rchaundy@bsc-eoc.org)

### 22) Wormwatch

**URL:**

<http://www.naturewatch.ca/english/wormwatch/>

**Supporting Partners:** Environment Canada, Agriculture and Agri-Food Canada, Environmental Monitoring and Assessment Network (EMAN), Science Alberta Foundation, Lethbridge Research Centre, SCLINKS, Canadian Nature Federation (CNF-FCN)

**Abstract:** Worm Watch is part of a national volunteer monitoring program designed to help identify ecological changes that may be affecting our environment. Using monitoring methods created by scientists working with Environment Canada's Ecological Monitoring and Assessment Network (EMAN), it allows Canadians of all ages to participate in discovering how – and more importantly, why – our natural environment is changing. Worm Watch is designed to get everyone (gardeners, naturalists, farmers and schoolchildren etc.) contributing information about soil biodiversity. The data received from volunteers will be used to create a Canadian database of earthworm species and habitat distribution and may lead to the use of earthworms as indicators of soil changes. The information is entered into a national database for creation of interactive maps showing the species present at observation sites and the location of other Worm Watch volunteers across Canada.

**Contact:**

Ecological Monitoring and Assessment  
Network Coordinating Office  
Environment Canada  
Canada Centre for Inland Waters  
867 Lakeshore Road  
Burlington, Ontario, Canada  
L7R 4A6  
Tel: 905-336-4414  
Fax: 905-336-4499  
Email: [eman@ec.gc.ca](mailto:eman@ec.gc.ca)

### 23) The B.C. Stewardship Centre

**URL:** <http://www.stewardshipcentre.org>

**Supporting Partners:** Fisheries and Oceans Canada, Environment Canada, Ministry of Water, Land and Air Protection, Habitat Conservation Trust Fund, Ministry of Sustainable Resource Management, Ministry of Transportation, Ministry of Municipal Affairs, BC Hydro, Provincial Capital Commission

**Abstract:** There is an increasing awareness of the importance of stewardship. Better decisions require information and technical advice, and there is a need for improved access to information and advice on stewardship in British Columbia. Many people simply lack the information and the tools they need to carry on their activities sensitively. In B.C. over the last few years, a number of Supporting Partners and organizations have cooperated in creating the *Stewardship Series* – a world-class series of publications that offer such stewardship information to landowners, developers, volunteers, professionals, local governments and Supporting Partners. A large body of information has been gathered – not only in the *Stewardship Series* but also in other initiatives. But there is a need to bring all information together in one central place – and then to make sure that information is accessible and gets out to the right people. The Stewardship Centre endeavors

ours to get critical stewardship information and conservation tools into the hands of all people who touch the land.

**Contact:**

Stewardship Centre Administrator

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## Appendix 2. Guide to Acronyms Used

<b>CMN</b> .....	Community Mapping Network
<b>CVCDP</b> .....	Cedar Valley Comprehensive Development Plan
<b>DFO</b> .....	Fisheries and Oceans Canada
<b>FISS</b> .....	Fisheries Information Summary System
<b>FRBC</b> .....	Forest Renewal BC
<b>FsRBC</b> .....	Fisheries Renewal BC
<b>FSZ</b> .....	Fisheries Sensitive Zone
<b>FVRD</b> .....	Fraser Valley Regional District
<b>GIS</b> .....	geographic information system
<b>GPS</b> .....	global positioning system
<b>GVRD</b> .....	Greater Vancouver Regional District
<b>HRDC</b> .....	Human Resources Development Canada
<b>LEPS</b> .....	Langley Environmental Partners Society
<b>MAFF</b> .....	Ministry of Agriculture, Food and Fisheries
<b>MDP</b> .....	Master Drainage Plan
<b>MELP</b> .....	Ministry of Environment, Lands and Parks
<b>MWLAP</b> ...	Ministry of Water, Land and Air Protection
<b>NTS</b> .....	National Topographic System
<b>OCP</b> .....	Official Community Plan
<b>RAMS</b> .....	Regional Aquatic Management Society
<b>RIC</b> .....	Resources Inventory Committee
<b>SHIM</b> .....	Sensitive Habitat Inventory and Mapping
<b>ToB</b> .....	Top of Bank
<b>TRIM</b> .....	Terrain Resource Information Management
<b>UBC</b> .....	University of British Columbia
<b>UCFV</b> .....	University College of the Fraser Valley
<b>USHP</b> .....	Urban Salmon Habitat Program
<b>WMP</b> .....	Watershed Management Plan
<b>WRMS</b> .....	Water Resources Management Strategy