The Case Studies

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 1: 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[1]

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-

[1] Much of the material in this section is from: Golder Associates Ltd. 2001. Draft final report.

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 streamside 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.

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

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 draf

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 farming 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 information 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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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).

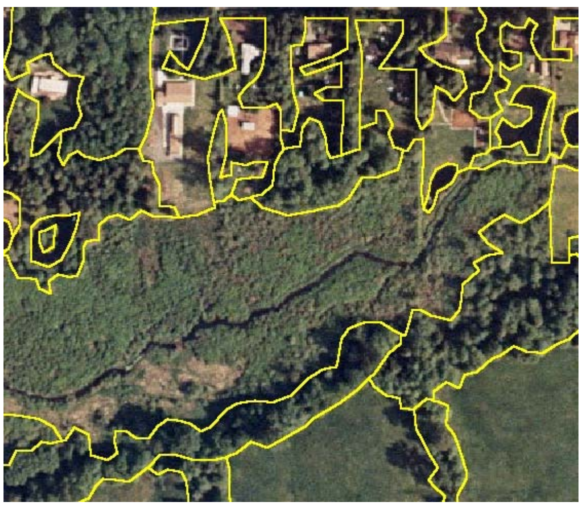

Figure 2: Example of photointerpretation—land cover and land use polygons

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. Co-operation 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 practices 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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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 section 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^2 area). Funding for the project was obtained from FsRBC. Information from previous years was made use of, including the Urban Salmon Habitat

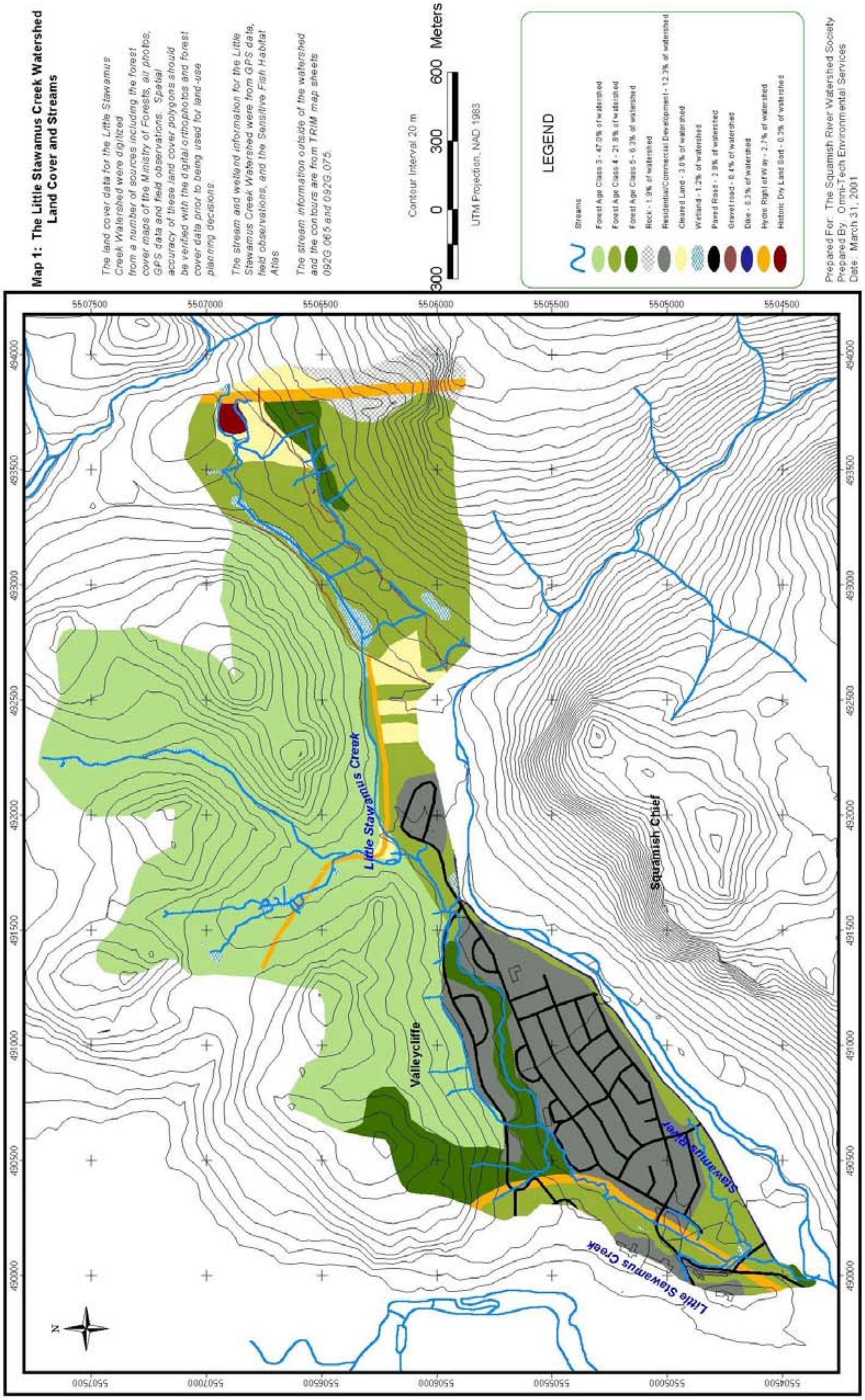

Figure 1: The Little Stawamus Creek watershed land cover and streams. This map is an outcome of the SHIM mapping project.

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

Stream enhancement by the Squamish Streamkeepers: building a “beaver baffler” 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 becomingly increasingly urgent for many areas of the Pacific Northwest, 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

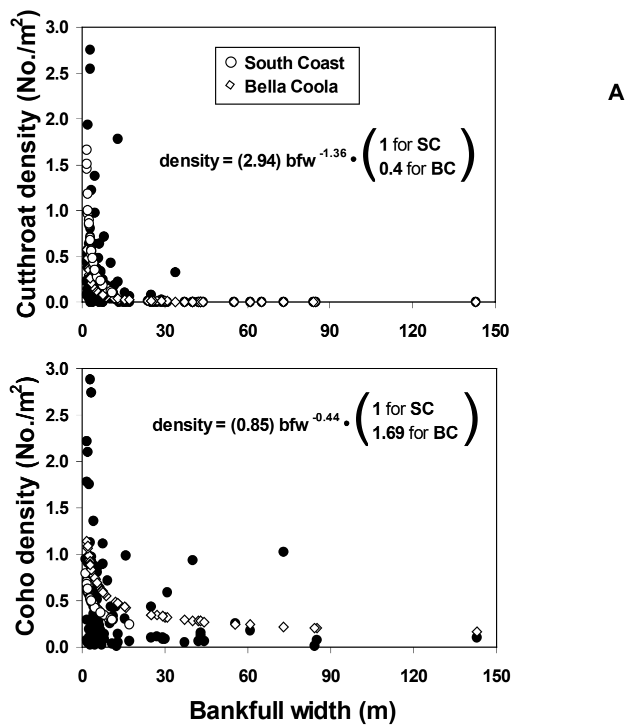


Fig. 1. Highest densities of cutthroat trout and coho salmon occur in small streams (< 5m bankfull width) (from Rosenfeld et al. 2000).

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 Nuu-chah-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 ± 5m.

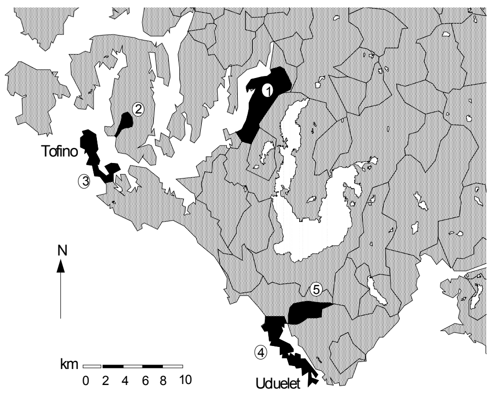
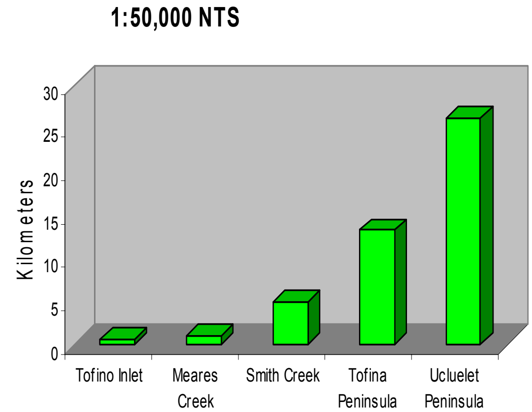


Fig. 2. Locations of the areas (shaded in black) where stream habitat was surveyed on the West Coast of Vancouver Island, British Columbia. 1=steep Tofino Inlet streams, 2=Meares Creek, 3=Tofino Peninsula streams, 4=Ucluelet Peninsula streams, and 5=Smith Creek (from Rosenfeld 2000)

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



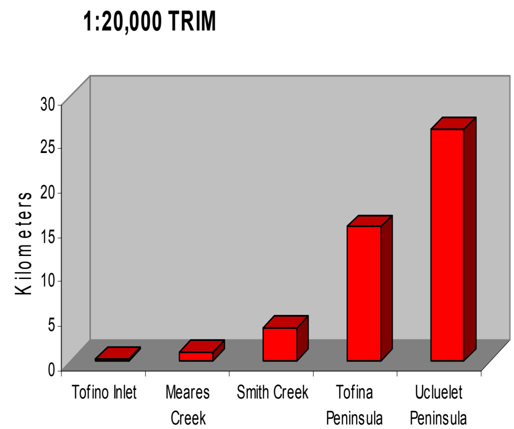


Fig. 3. Total length of stream missed in topographic mapping of Vancouver Island drainages.

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).

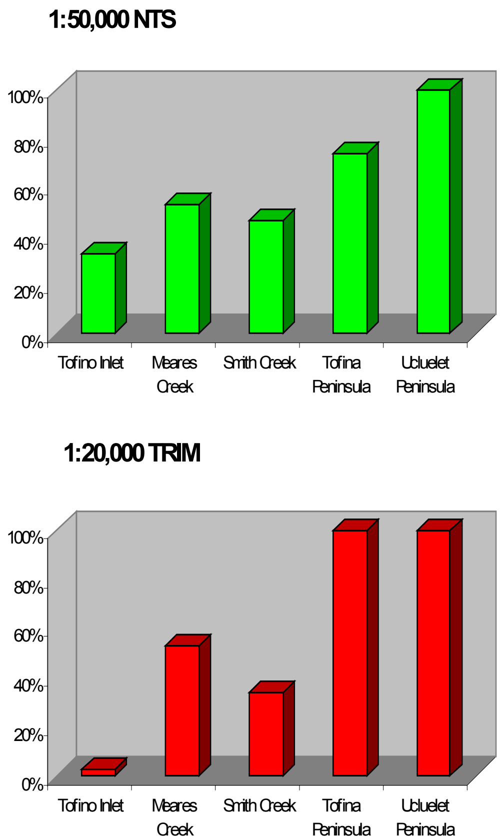


Fig. 4. Proportions of fish-bearing streams missing from topographic mapping of Vancouver Island streams.

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 mapping 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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Special thanks to Scott McDonald of RAMS for leading the SHIM field crews and coordinating GPS data collection.

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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. 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)

- Fisheries and Oceans Canada (DFO)
- Fraser Valley Regional District (FVRD) and member municipalities
- Fraser Valley Regional Watershed Coalition (FVRWC)
- Ministry of Agriculture, Food & Fisheries (MAFF)
- Ministry of Water, Land, and Air Protection, Urban Salmon Habitat Program (USHP)
- Sensitive Habitat Inventory & Mapping Partnership (SHIM)
- University College of the Fraser Valley (UCFV)

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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.

A page from the Habitat Atlas

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 streambanks, 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 intensification 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 quantity, 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.

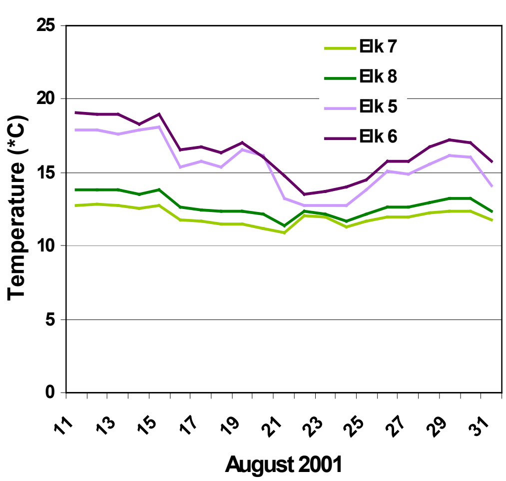
The assessment will be applied in each of the three watersheds. Data layers for use in the assessment are in the process of being collected and organized for each of the watersheds. The data layers have been compiled by the Langley Environmental Partners Society using Sensitive Habitat Inventory Mapping (SHIM) techniques; by 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 11th to 31st, 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.

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Acknowledgments

This project would not have been possible without the enthusiastic support of the following individuals and groups: Brad Mason, Fisheries and Oceans Canada; Rob Knight and Krista Payette, Ministry of Water, Air and Land Protection; Kathleen Moore, Canadian Wildlife Service; Darrin Heisler, Shortreid Terrain Data; Leanne and Lisa, Langley Environmental Partner Society; Marina Stepjovic and Bob Reiger, Township of Langley; Dipak Basu and John Wiley, City of Chilliwack; Katrina Roger, Elk Creek SHIM group; Stephanie Sylvestre, Environment Canada; George Derksen, Environment Canada; Bev Anderson, Ministry of Water, Air and Land Protection; Keith Paisley and Councillor Westlin, District of Kent; Ministry of Forest, Harry Gill; Dr. Hans Schreier, Dr. Ken Hall, Dr. Scott Hinch, Dr. Brian Klinkenberg, Gina Bestbier, Jody Addah, Trevor Davies, Nick Page, Kate Schendel, Stephanie von Westarp and Mike Pearson - UBC professors, staff and students.

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 that 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:lõ Nation GIS.

Background

The Cheam band is one of 19 Stó:lõ 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.

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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 Hillsides.

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 specific 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.

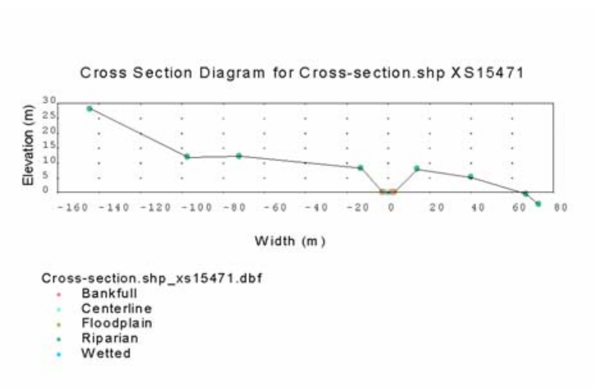

Figure 1: Example stream cross-section diagram

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 clearcut 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 Hillsides 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, bankfull 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.

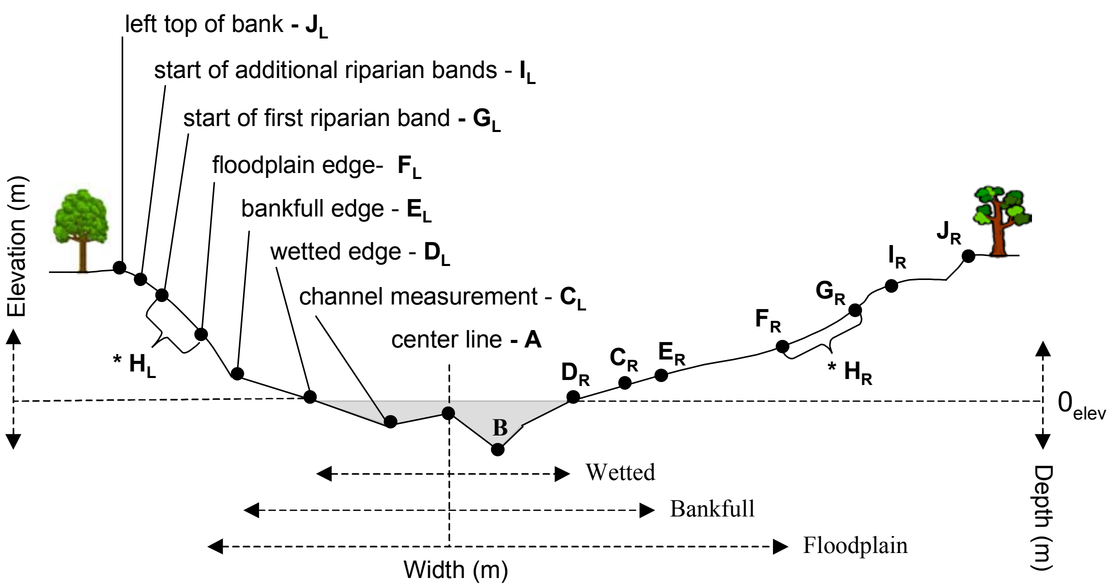

Figure 1. Cross-sectional measurement points for SHIM stream surveys.

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.

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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 ± 5m 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 methods varied on average from 8.3 to 35.2m, and maximum displacements were in the range of 18.4 to 70.2m.

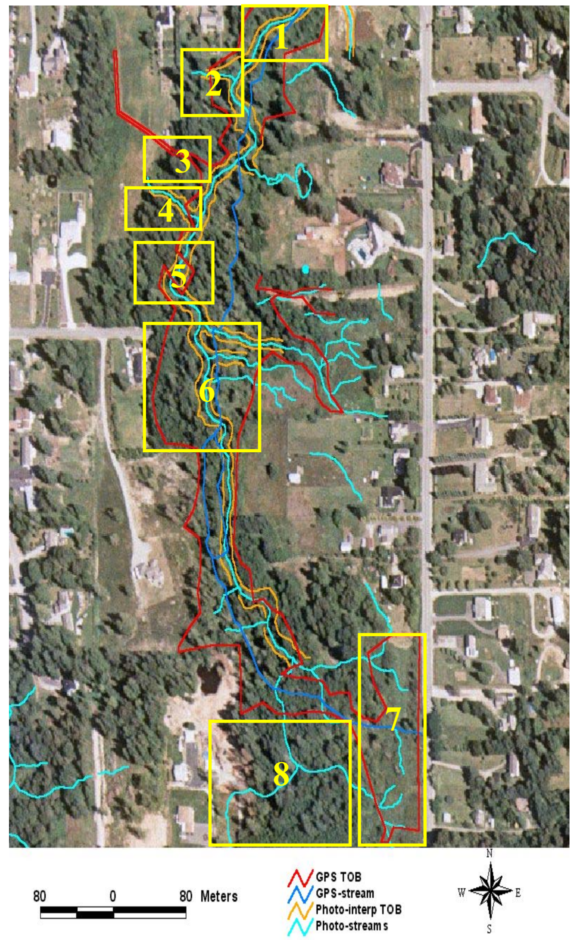

Fig. 1. Comparison of photogrammetrically interpreted streams (light blue) and ToB (gold) versus GPS field-surveyed streams (dark blue) and ToB (red) in Cedar Valley. Boxed areas (1-8) represent individual site assessments.

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 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.

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.

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 conditions. 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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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 protection, implementing the ditch maintenance guidelines and determining building setbacks.

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 stormwater 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).

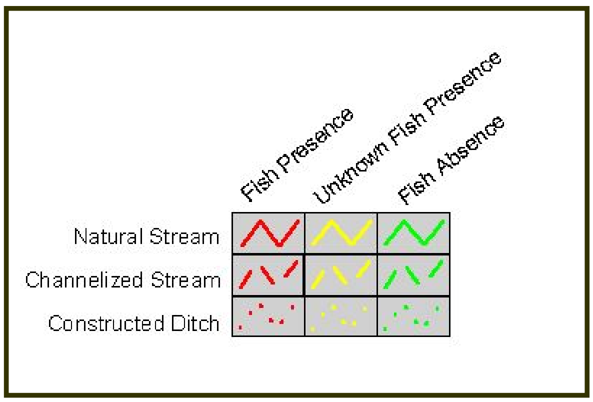

Figure 1. Watercourse classification system in agricultural areas

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.

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