Information Note

The BC Freshwater Atlas

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The quality of British Columbia's water is a barometer that reflects the environmental, economic, and social well-being of our province. British Columbia's burgeoning population, industrial and agricultural growth, and the potential impacts of climate change are only increasing the value of our water resources. The Freshwater Atlas has been developed as a freely and publicly available tool to ensure freshwater resources in this province are sustained for future generations.

What is the Freshwater Atlas?

The Freshwater Atlas is a standardized dataset for mapping the province's hydrological features. It represents a significant improvement over the previous 1:50 000 scale Watershed Atlas because it is derived from the province's more detailed 1:20 000 scale topographic base maps (TRIM). Another major improvement is the specific coding of all stream segments and corresponding watersheds (30 ha average size) establishing an unambiguous upstream-downstream relationship for all features. The atlas defines watershed boundaries by height of land and provides a connected three-dimensional network of streams, lakes, and wetlands.

Each stream in the province has its own watershed (the land drained by that stream), but it is also linked to other streams and watersheds that it flows from and to. The Freshwater Atlas allows you to connect a stream to both its tributaries and the watersheds associated with them (Figure 1).

The atlas was designed to be the authoritative source for mapping freshwater features in British Columbia. It provides a consistent coding system that ensures the province's various freshwater-related inventories are tied to a common base. Watersheds are bounded by heights of land, which provide the authoritative reference for many administrative boundaries and land tenures. The Freshwater Atlas offers a connected network that serves as the foundation for sophisticated analysis and modelling.

How was the Freshwater Atlas developed?

The basic source data for the Freshwater Atlas were the rivers, streams, lakes, wetlands, and man-made waterbodies as identified on the 1:20 000 scale TRIM base map. This input information, while very consistent, well-specified, and quality-assured (QA), was only available on a map sheet basis (7027 tiles to cover BC). In addition, most features in TRIM were simple line work and did not form complex features such as lake polygons or stream networks. In the Freshwater Atlas, the stream network is connected through lakes, double line rivers, and wetlands allowing water flow to be mapped. The stream network is connected through glaciers, but glaciers are not as tightly integrated with the stream network as are lakes, wetlands, or double line rivers.

TRIM 1 base mapping (air photo date: late 1980s) was used to develop the atlas to ensure a consistent scale across the province. TRIM 2 data were not used because the greater detail (1:10 000 scale) only exists for half of British Columbia. As some attributes (e.g., stream order and magnitude) are scale-dependent, combining the two TRIM scales would have introduced inconsistencies in the atlas. In addition, scale differences across map sheet boundaries would result in a lack of continuity and connectedness for streams.

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While the level of detail available is more than adequate for the majority

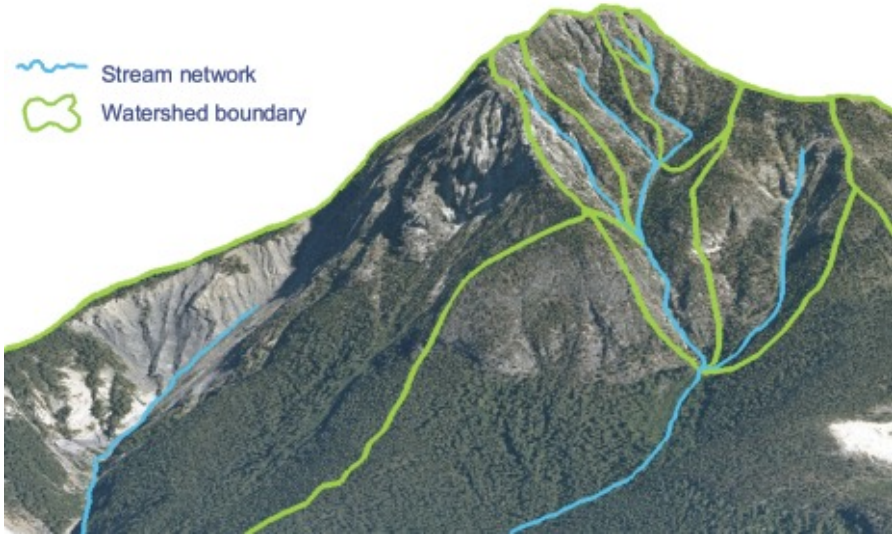

Figure 1. Conceptualization of watershed atlas mapping units.

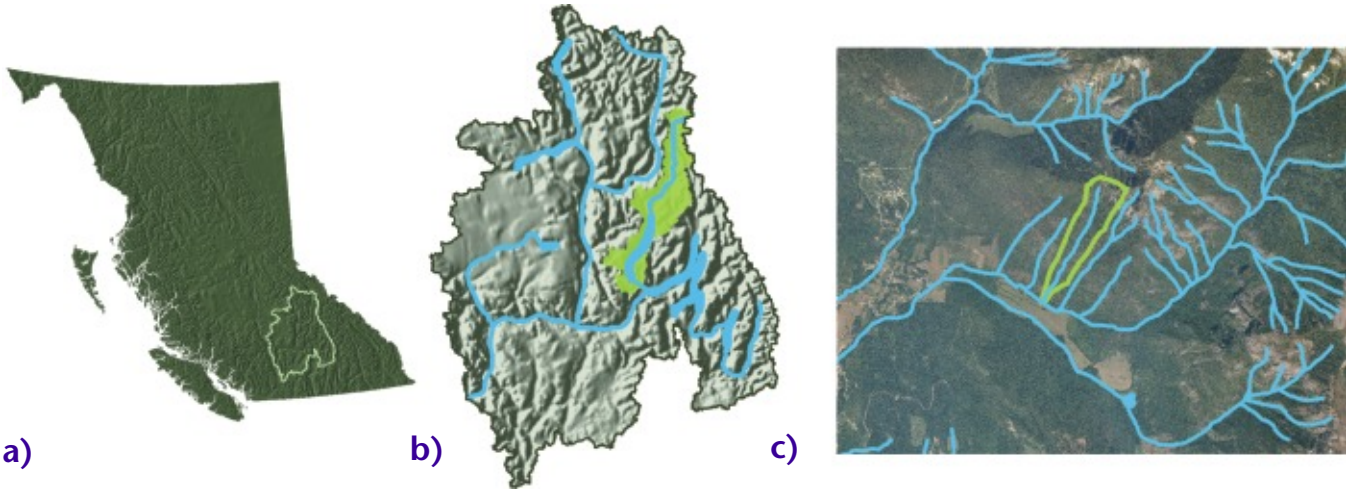

Figure 2. Scales of application of the Freshwater Atlas. The outline of (a) the Thompson River watershed within the Province of BC, (b) sub-basins of the Thompson River watershed including the Adams River in green and, (c) a sub-basin of the Adams River watershed.

of applications (BC is divided into 3 million watersheds), GeoBC is continuing to improve the product through the development of a method to add the greater detail available in TRIM 2. However, the current codes will be the standard index for linking inventory information both now and in the future.

One challenge for GeoBC is to quantify on-the-ground changes, mapped between the TRIM 1 and TRIM 2 products. Some features, such as glaciers, are known to have undergone significant change, and other hydrologic features undergo continual change (i.e., sand bars and islands in large rivers). GeoBC will be addressing this during 2009/10, beginning with an evaluation of the amount of change over time. The expectation is that from a provincial perspective, at the 1:10 000 scale, there is very little change, but this remains to be determined.

Creating the atlas involved many years of effort. Mappers had to ensure continuity across map sheet boundaries, construct "skeleton" lines through waterbodies to explicitly connect the hydrologic network, infer the hydrologic connections for isolated waterbodies, and repeatedly create and QA the hydrologic flow through the network. This last step involved knowledgeable staff conducting a major manual checking process of the hydrologic network to resolve flow contradictions.

How many lakes are there in the province?
386 049

What is the total area of lakes in the province?
22 434 km^2

What is the length of the province's coastline?
37 902 km

What is the total length of streams and rivers in the province?
1 955 540 km

How many wetlands are there in the province?
378 426

What is the total area of wetlands in the province?
41 143 km^2

In developing the atlas, watershed codes were assigned to every stream segment following a method that built upon, and improved, the existing 1:50 000 Watershed Atlas coding system. In addition to the traditional code, a second code was generated at every confluence for both the tributary and mainstem. The watershed codes alone, allow the correct upstream/downstream relationship for all stream segments and associated features to be determined without complicated spatial analysis (i.e., independent of a geographic information system [GIS]).

Three-dimensional elevations were assigned to the hydrologic network and conditioned to be monotonically decreasing downstream. This was more than just smoothing out the +/–5 m vertical measurement difference in TRIM as many large lakes have a surface-elevation difference of tens of metres, the result of photography taken in different seasons and years.

Once a complete and consistent hydrologic network was developed, the topography (constrained by the hydrologic network) was used to delineate the watershed of each stream segment. These watersheds are small, on average 30 ha, with every confluence having its local watersheds determined. The local watersheds allow the troublesome long and narrow watershed polygons present in the 1:50 000 scale version to be subdivided and eliminated.

The hydrologic network was repeatedly quality assured throughout its production. Extensive consistency checks were conducted for all components (e.g., watersheds, waterbodies, and place names). The end result is a consistent, province-wide, three-dimensional, freshwater network, mapping the hydrological features of BC at a scale of 1:20 000.

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What information does the Freshwater Atlas contain?

The Freshwater Atlas has the following features:

- Coastline, major rivers, streams, and all tributaries mapped at 1:20 000 scale
- Obstructions: dams, waterfalls, and rapids
- Waterbodies: lakes, wetlands, and glaciers
- Coastal bays and inlets
- 20 000 named features (from the BC Gazetteer)
- 3 million watersheds, average size 30 ha
- Watershed code giving upstream/downstream relationships for all features

Names of many water features are accessible and coding within the data allows you to identify connected features and map upstream and downstream relationships. As there have been changes to the size of some glaciers since the original mapping in the 1980s, there will be some error in glacier extent. The magnitude of glacier errors and the potential for updating will be assessed in 2009/10.

What can you do with the Freshwater Atlas?

The Freshwater Atlas also allows you to:

- map water features and their associated watersheds;
- conduct analyses at a province-wide level;
- identify connected watersheds, streams, rivers and lakes at regional levels; and/or
- examine an individual stream's watershed for local planning.

What types of questions can be answered?

The Freshwater Atlas can be used to answer questions such as:

- How many lakes, wetlands, glaciers, and reservoirs are in my study area, and what size are they?
- Which streams, lakes, and wetlands are either downstream or upstream of a development that is planned for a particular local area?
- How many watersheds occur in a regional planning unit, what are their areas, and what is the total area of the land base they occupy?

These types of questions can be answered for the whole province, a region, or a single watershed.

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How can the Freshwater Atlas's stream network be used?

The Atlas lets you link environmental information to the province's network of streams, lakes, and rivers by location for applications such as:

- Water management and water-use planning
- Display of fisheries data
- Hydrological modelling
- Locating water features by name
- Emergency preparedness: Identify communities downstream of a dam or resources in the path of a chemical spill

The Freshwater Atlas provides a foundation for studying factors that influence salmon habitat in British Columbia. It facilitates the integration of the following types of information:

- Spawning habitat maps
- Locations of salmon-bearing streams and lakes
- Water-quality monitoring stations and stream flow data
- Upstream and downstream land uses
- Obstructions blocking fish passage
- Recreational and commercial harvest statistics
- Salmon-escapement statistics

How can the Freshwater Atlas help our understanding of the land base?

Information from a variety of disciplines can also be linked or summarized by the watersheds within the atlas. This lets us examine the potential impacts of both human activities and natural phenomena on the landscape.

Statistics for each watershed can be generated to quantify land-use types or density values. These can provide useful indicators that help us to monitor the conditions within either an individual watershed or to compare watersheds within either a region or throughout the entire province.

How do I find out more information?

To find out more information about the Freshwater Atlas or to download this public dataset go online at: *http://aardvark.gov.bc.ca/apps/dwds/home.so* and search on the Freshwater Atlas' old acronym "CWB" (searching on Freshwater Atlas will work soon, the name change is being implemented March 2009).

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