Freshwater Atlas

Mesoscale Aquatic Assessment Watersheds

Technical Documentation

Prepared for
The Crown Registry and Geographic Base Branch
of the
Integrated Land Management Bureau

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REVISION HISTORY

Date	Version	Author	Description of Changes
August 25, 2009	1	Simon Norris	Initial draft.
September 29, 2009	1.1	George Eade	Added post processing tasks

CONTENTS

1 OVERVIEW

Mesoscale aquatic Assessment Watersheds were created to replace the widely used 3rd order 1:50k watershed product with a similar but improved product that is consistent with the Freshwater Atlas.

Creation of the Assessment Watersheds was based on the grouping of the Freshwater Atlas fundamental watersheds (average size 30ha) into larger watersheds, with a target size between 2,000ha and 10,000ha. Grouping was performed by manipulation of the hierarchical watershed codes associated with each fundamental watershed - the FWA_WATERSHED_CODE (abbreviated to WS_CODE in this document), and LOCAL_WATERSHED_CODE (abbreviated to LOCAL_CODE). Processing of the grouping was performed independently for each of British Columbia's 246 watershed groups.

This document outlines the methodology used to create the Assessment Watersheds. For an introduction to the concept and rational behind the Assessment Watersheds, please see *Overview of Assessment Watersheds.doc.*

2 METHODOLOGY

2.1 EXTRACT INPUT DATA

Assessment Watershed boundaries are created entirely from the Freshwater Atlas fundamental watershed polygons, held on ILMB's LRDW. This dataset is defined as *"all fundamental watershed polygons generated from principal watershed boundary lines, bank edges, delimiter edges, coastline edges, and administrative boundary edges, following the 1:50k data model."*

Dataset: WHSE_BASEMAPPING.FWA_WATERSHED_POLY

Metadata:
https://apps.gov.bc.ca/pub/geometadata/metadataDetail.do?recordUID=50652&recordSet=ISO19115

For each watershed group, all records from this dataset were extracted to a local copy. New fields were added to the local copy - an AW WS_CODE and an AW LOCAL_CODE. These are the Watershed Code and Local Code of the output Assessment Watersheds; grouping of the fundamental watersheds was accomplished by assigning common values to these codes.

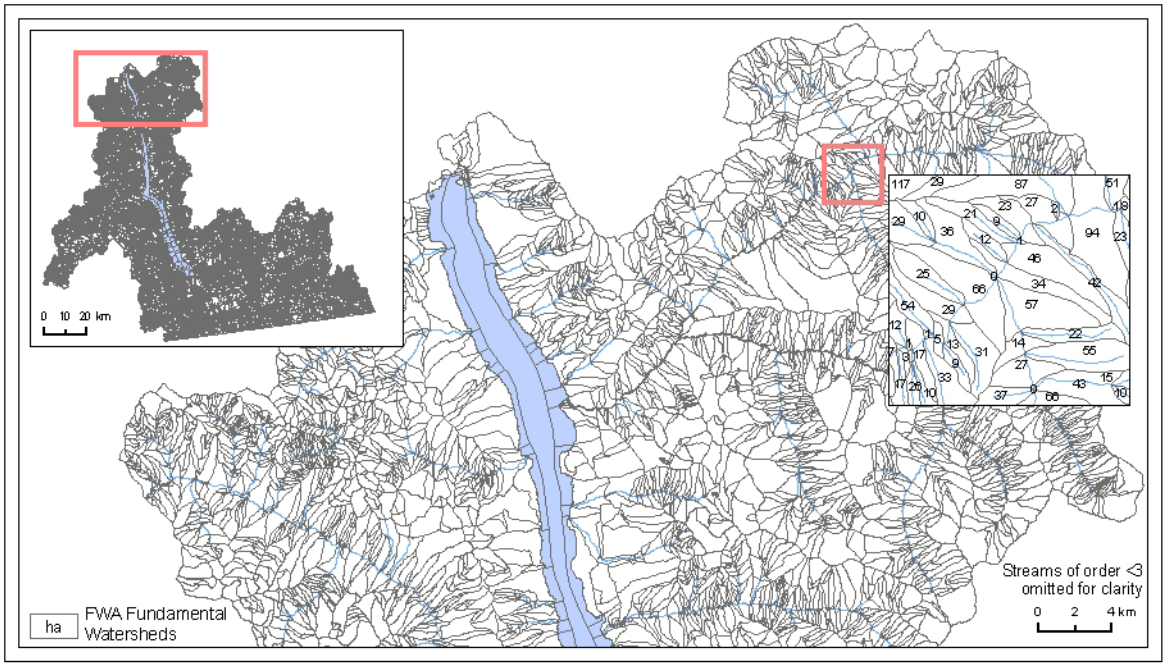

Figure 1. Input data - Fundamental Watersheds

2.2 CREATE PRELIMINARY ASSESSMENT WATERSHEDS

2.2.1 Create 'Large Lake' Assessment Watersheds

Lakes larger than 2,000ha are a special case within the Assessment Watersheds.

Before processing any other portion of a watershed group, fundamental watersheds delineating lakes greater than 2,000ha were grouped to form Assessment Watersheds equivalent to the extent of each lake.

The steps to identify 'large lake' Assessment Watersheds were:

- Find lakes greater than 2,000ha within the watershed group by querying the FWA_LAKES_POLY table. Return the WATERBODY_KEY(s) of the large lake(s).
- For each distinct WATERBODY_KEY returned, assign AW WS_CODEs to all fundamental watersheds defining the lake (ie. all fundamental watersheds with this WATERBODY_KEY)
    - Assign an AW WS_CODE equivalent to the WS_CODE of the lake.
    - Assign an AW LOCAL_CODE equivalent to the minimum LOCAL_CODE found within the lake.

2.2.2 Aggregate Fundamental Watersheds into preliminary Assessment Watersheds

The fundamental watersheds' WS_CODE and LOCAL_CODE are hierarchical codes which place a given fundamental watershed in its correct upstream/downstream relationship with all other fundamental watersheds. For more information regarding the structure of the watershed code, see http://www.env.gov.bc.ca/fish/pdf/guide2_hierarchical_watershed_coding_system4BC.pdf.

Using these codes it is possible to aggregate the fundamental watersheds into larger watersheds of a given size or stream order. The aggregation is based on common code prefixes.

The steps to perform the aggregation were:

- Sort the fundamental watershed table in descending order of WS_CODE (this orders the records with the largest stream at the top, followed by the first tributary (with its tributaries), then the second tributary (plus its tributaries) and so on.)
- Starting from the top, sequentially consider the area drained by each and every fundamental watershed
- For each WS_CODE that drains an area greater than 2,000ha., assign all upstream records an AW WS_CODE equal to this WS_CODE, and note the area drained. Overwrite previous assignments when working through the table.

This produces a conceptual set of nested watersheds, all at least 2,000ha in size. These are preliminary Assessment Watersheds, each with an AW WS_CODE equivalent to the WS_CODE of the most downstream fundamental watershed within the preliminary Assessment Watershed.

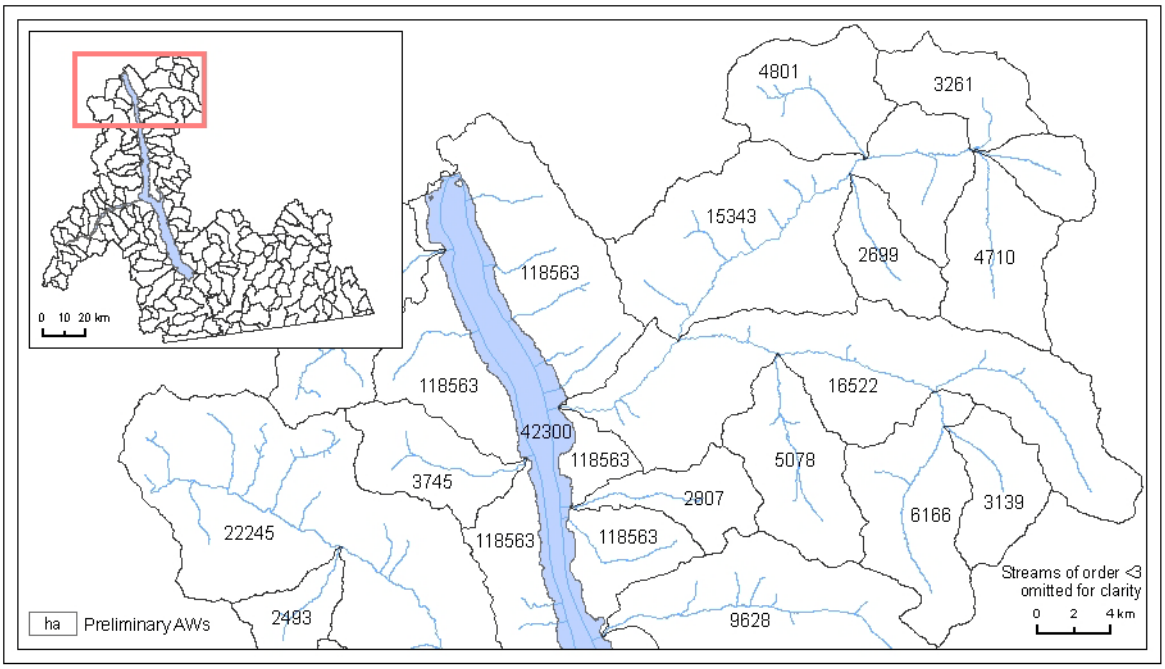

Figure 2 - Preliminary Assessment Watersheds

2.3 SPLIT PRELIMINARY ASSESSMENT WATERSHEDS

Polygons defining the preliminary Assessment Watersheds range in size from the minimum 2,000ha to many tens of thousands of hectares. As a maximum size of approximately 10,000ha was desired, preliminary Assessment Watersheds greater than this size were split into smaller upstream and downstream components. Splits were accomplished by assigning distinct AW LOCAL_CODEs to component parts of the preliminary Assessment Watersheds. Two rounds of splitting were run in order to fully break down large preliminary Assessment Watershed to meet area targets.

2.3.1 First Split

Each preliminary Assessment Watershed greater than 10,000 was considered as follows:

- Identify all tributaries of the preliminary Assessment Watershed greater than 2,000ha (ie, other preliminary Assessment Watersheds draining into the large preliminary Assessment Watershed). Confluences with these tributaries are candidate locations for splitting the preliminary Assessment Watershed under consideration into separate upstream/downstream components.

- Starting at the most upstream candidate splitting location, working downstream, consider each candidate splitting point. If the area of the large preliminary Assessment Watershed upstream of this confluence (and downstream of any previous splits) is greater than 3,000ha, split the preliminary Assessment Watershed at this candidate location by assigning an AW LOCAL_CODE equivalent to the LOCAL_CODE at the candidate location to the portion of the large preliminary Assessment Watershed upstream of the candidate location (that hasn't already been assigned an AW LOCAL_CODE).

- After considering all candidate splitting locations, consider the remaining area between the final candidate splitting location and the mouth of the preliminary Assessment Watershed. Assign this remaining area an AW LOCAL_CODE equivalent to the AW WS_CODE of the preliminary Assessment Watershed. If the area of the remainder is less than 3,000ha, group the remainder with the portion of the preliminary Assessment Watershed immediately upstream. Do this by re-assigning the AW LOCAL_CODE of this area to also equal the AW WS_CODE of the preliminary Assessment Watershed.

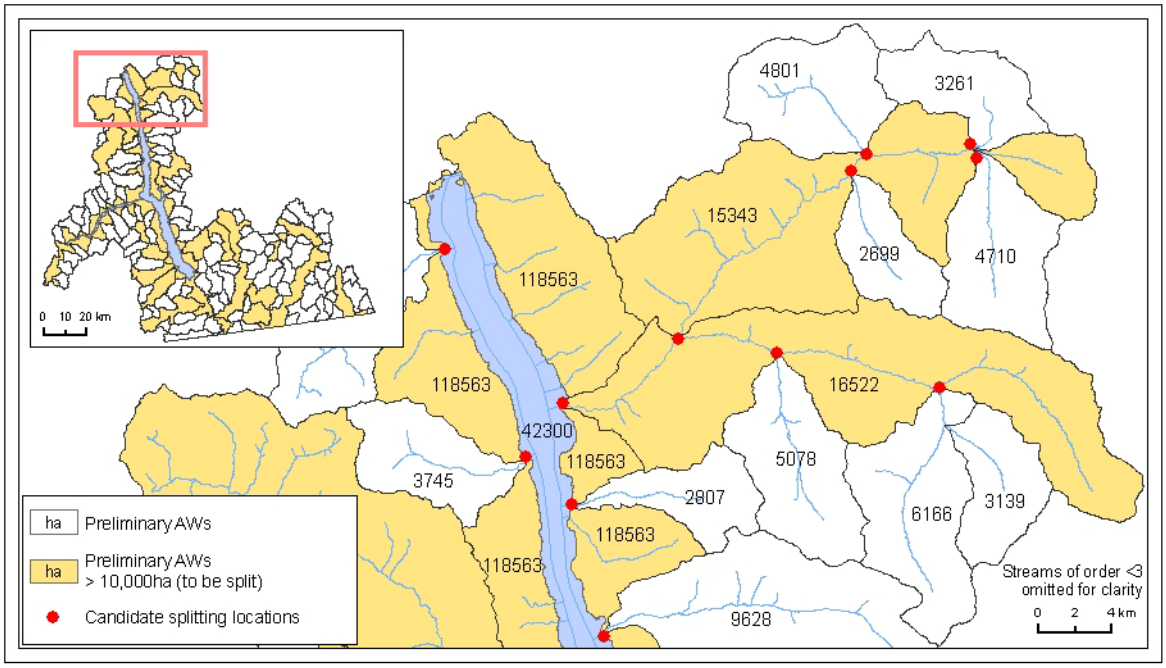

Figure 3 - Preliminary Assessment Watersheds to be considered for splitting and candidate splitting locations for first round.

2.3.2 Second Split

Preliminary Assessment Watersheds greater than the maximum target of 10,000ha exist after the first round of splitting. A second round of splitting is applied to break these into smaller units.

Candidates locations for the second round of splitting are tributaries draining more than 1,000ha within the preliminary Assessment Watersheds. After defining the candidate splitting locations, the logic and methods in this round of splitting are exactly the same as in the first.

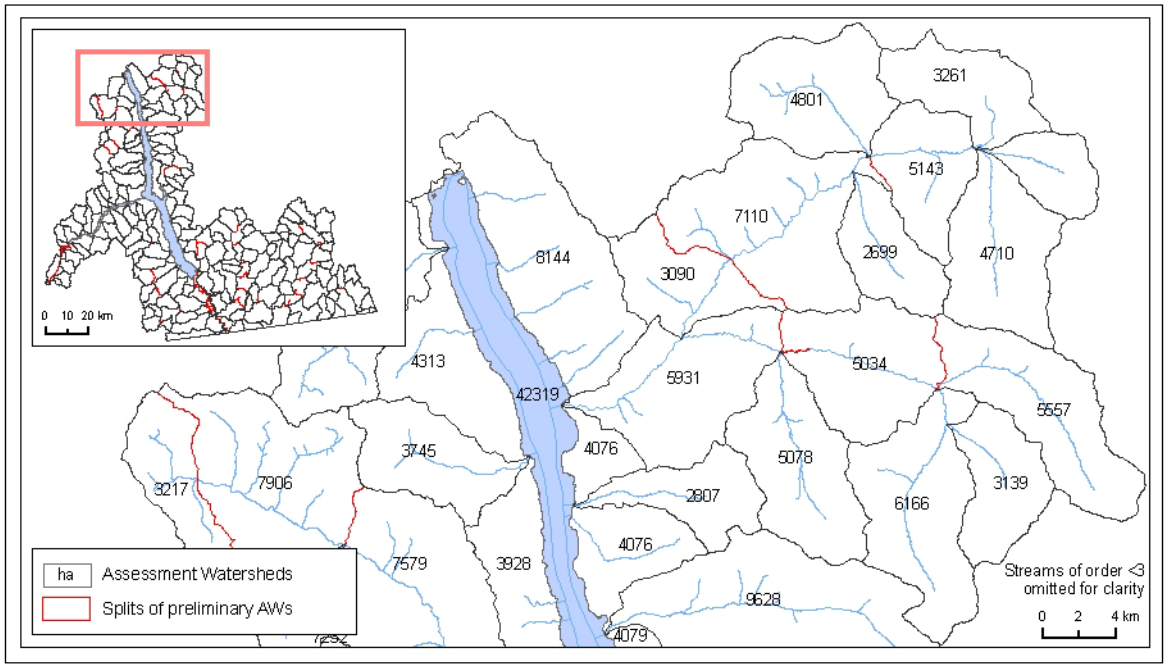

Figure 4 - Output Assessment Watersheds, with split preliminary AWs highlighted.

2.3.3 Special Cases - Large Lakes and Large Rivers

The first and second rounds of splitting the large preliminary Assessment Watersheds into smaller components was performed the same way on all large preliminary Assessment Watersheds, with two exceptions:

- Preliminary Assessment Watersheds containing lakes greater than 2,000ha
- Preliminary Assessment Watersheds containing rivers of order 7 or greater.

As with the other large preliminary Assessment Watersheds, two rounds of splitting to produce units greater than 3,000ha were applied. The same parameters of 2,000ha and 1,000ha were used for selecting candidate splitting tributaries in the respective rounds.

However, to prevent output Assessment Watersheds from spanning both sides of these potentially very wide lakes and rivers, the part of these preliminary Assessment Watersheds along the large lake or large river was split by grouping only fundamental watersheds that drained into a common side of the large lake or river. Candidates were derived, areas summarized, and splits applied by moving downstream independently along each bank of the feature. This modified splitting behaviour was accomplished by identifying immediate tributaries to the large preliminary Assessment Watersheds that had common LEFT_RIGHT_TRIBUTARY values.

This splitting behaviour began at the most upstream fundamental watershed along the large water feature and terminated at the most downstream fundamental watershed within the feature. As a result, a split was always applied at the inlet and outlet of a lake greater than

2,000ha. In instances where a seventh order or greater river ran through a lake greater than 2,000ha, splits were still applied at each end of the lake.

2.4 DISSOLVE FEATURES

Once all fundamental watersheds within a watershed group were assigned appropriate AW WS_CODEs and AW LOCAL_CODEs, the fundamental watersheds were dissolved based on distinct values for these codes. Up until this point all data manipulations were tabular, not spatial - the figures above are conceptual only. The output from this dissolve is the Assessment Watersheds.

2.5 IDENTIFY COMPLETE WATERSHEDS

When defining the rules for creation of the Assessment Watersheds, one of the goals was to maximize the area contained within 'complete' watersheds (Assessment Watershed polygons not fed by outside tributaries). However, when subdividing the landscape into distinct watersheds there is always some remainder. Further, the splitting of the preliminary Assessment Watersheds into smaller components also creates more 'incomplete' watershed polygons.

To record this, the WATERSHED_TYPE field was added. Complete (not fed by outside tributaries) and incomplete (fed by outside tributaries) Assessment Watersheds were noted in this field.

3 OUTPUT LAYER DATA SPECIFICATIONS

ATTRIBUTE NAME	DESCRIPTION
WATERSHED FEATURE ID	A unique identifier for each watershed in the layer.
FEATURE CODE	The MOEP standard numeric code to identify the type of feature represented by the spatial data.
AREA HA	Area of the assessment watershed, in hectares.
WATERBODY KEY	If the assessment watershed is derived entirely from a lake greater than 2,000ha, this field contains the waterbody key associated with the lake. Otherwise it is null.
FWA WATERSHED CODE	The 143 character watershed code associated with the assessment watershed polygon. This corresponds to the FWA_WATERSHED_CODE of the most downstream fundamental watershed within the assessment watershed.
LOCAL WATERSHED CODE	A 143 character code similar to the FWA watershed code that further subdivides remnant polygons to provide an approximate location along the mainstem. This corresponds to the LOCAL_WATERSHED_CODE of the most downstream fundamental watershed within the assessment watershed.
WATERSHED GROUP CODE	The watershed group code associated with the polygon.
WATERSHED GROUP ID	A unique numeric key representing the watershed group code.
WATERSHED_TYPE	The type of watershed. Possible values are 'C' - Complete (no external tributaries), 'I' - Incomplete (fed by external tributaries), 'L' - Lake (defined entirely by a lake waterbody).

4 POST PROCESSING TASKS

4.1 ELIMINATION OF SMALLER ASSESSMENT WATERSHEDS

During the QA processing of the Assessment Watershed (AW) layer it was determined that there were many (381) watersheds under 500ha. These were only land locked AWs, there are thousands of island AWs under 500ha. After much discussion it was decided that these AWs were not consistent with the underlying premise that drove the creation of the Assessment Watersheds. To this end the AWs under 500ha were eliminated and merged with adjacent AWs with the longest shared border. This was done on a watershed group by watershed group basis to ensure that watershed group boundaries were respected. All the attributes of the resulting merged AWs were derived from the original larger parent AW.

After the above process was complete a visual inspection of the AWs showed there where many (100) AWs that were still multipart, however, some of the parts were very small (less than 500ha) and were totally included within other AWs. It was again determined that these parts of AWs were not consistent with the intent of the AWs process. So these smaller parts of AWs were manually located and deleted.

4.2 ADDITION OF GNIS NAME, ORDER, AND MAGNITUDE

After the final production of the Assessment Watersheds it was determined that GNIS Name, Order and Magnitude would be useful attributes in the final production layer. A python script was written to add GNIS name, order, and magnitude to the Assessment Watershed polygons. GNIS name, order, and magnitude were assigned to the AWs using the FWA and local watershed code as matching criteria. GNIS names for the large lake AWs were assigned by matching on Waterbody Key.

4.3 ATTRIBUTE UPDATES

During GNIS name processing it was determined that six Assessment Watersheds (AWs) did not receive local watershed codes. These AWs were updated manually with the most downstream local watershed associated with the AWs watershed code. The following table lists the WATERSHED_FEATURE_IDs for the updated AWs.

WATERSHED_FEATURE_ID
1509
3239
7355

9438
9525
14965