

# **Freshwater Atlas**

## **Route Generation Technical Documentation**

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**Date:** December 2005

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# 1 FWA ROUTING DOCUMENTATION

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## **1.1 Introduction**

The routing process generates routes on all flows. Routes on primary flows are already defined by the mainstem process; they are collected and added to the secondary flow routes which are generated by the routing software.

This document outlines the process completed to generate routes on secondary flows and the post-processing completed to fix issues and add additional information. The appendix contains the documentation on the algorithm used to generate routes.

## **1.2 Routing Process**

The routing process has the following three steps:

1. Break up the secondary flows into connected groups, determine which mainstems (primary flows) interact with each connected group and flag pre-routes;
2. Generate routes for all secondary flow groups; and
3. Manually fix circular routes, add mainstems to generated routes and generate route information.

### 1.2.1 Break up Secondary Flows

This step groups together connected secondary flows. Each of the resulting connected secondary flow groups are processed separately.

This step also identifies pre-defined routes on secondary flows which are identified by named secondary flows and coding on edges. All named secondary flow edges must have a unique route for each gnis\_id; therefore, they generate a predefined route. Predefined routes are also identified by the coding on edges. The breaks of side-channels double line river polygons identify predefined routes.

#### Input:

- All secondary flow edges in the database.
- Mainstems

#### Output:

The *FWA\_secondary\_flow\_groups* table containing:

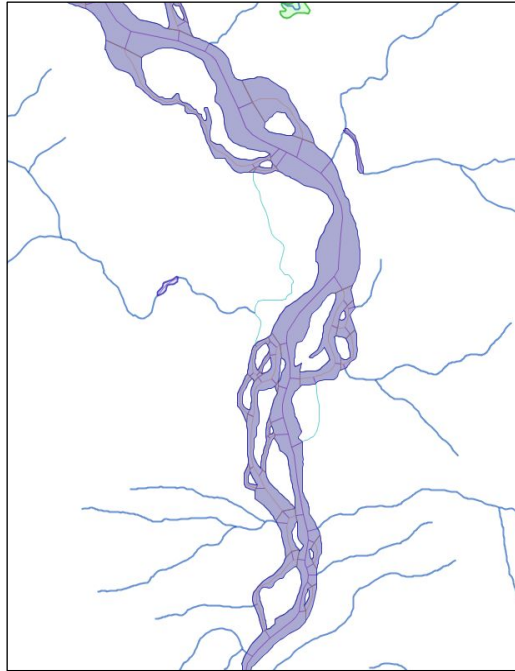
- Connected secondary flow groups
- Group code associated with each edge.
- Source and sink mainstem associated with each edge representing the mainstem\_id the edge sinks into of flows from.
- Subgroup generated from named secondary flows and edge codes that represent pre-routes.
- Unique group\_code value for each of the connected secondary flow groups.

#### Process:

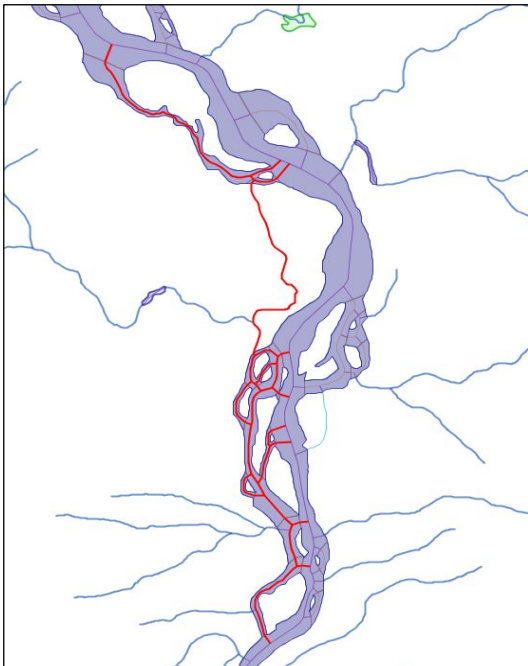
1. Load in all secondary flows.
2. Find all the connected groups.
3. Find all the mainstems each secondary flow edges flows from or sinks into.
4. Generate sub-groups for each of these connected groups based on the named secondary flows and coding associated with the edges.
5. Write the results to the database.
6. Assign each of these secondary groups to a single watershed group. The secondary flow connected groups will cross group boundaries, but for processing reasons we assign a single watershed group to each of the secondary flows. The actual watershed group is somewhat irrelevant.

Figures 1 – 3 below show the results of grouping secondary flows. Figure 1 shows the raw flow edges, figure 2 highlights a connected secondary flow group (red edges), and figure 3 shows the pre-defined secondary routes (each color represents a different predefined route; the cyan edges have no predefined routes).

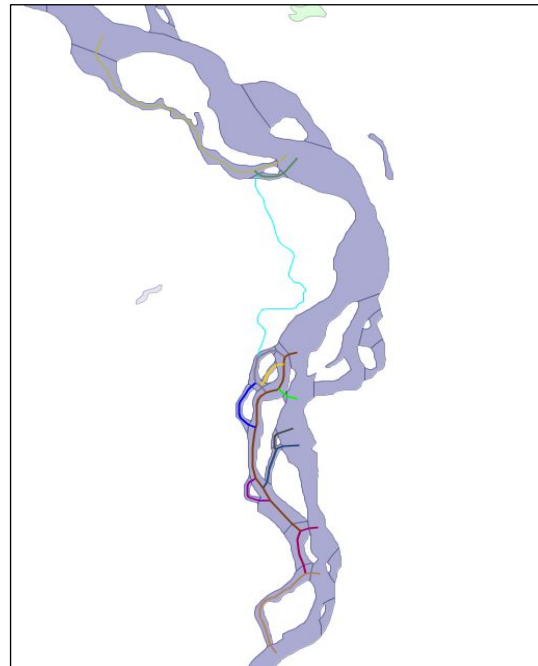
**Figure 1: Flow Edges**



**Figure 2: Secondary Flow Groups**



**Figure 3: Secondary Flow Groups**



### 1.2.2 Step 3: Generate Routes

This step generates the routes.

#### Input:

The routing program takes the following as input:

- A feature collection of edges to route that are noded at each intersection.
- A feature collection of pre-routes that are only noded at the start and end of the route.

#### Output:

The *fwa\_route\_edges* table populated with:

- the route\_id and edge\_id from every secondary flow edge

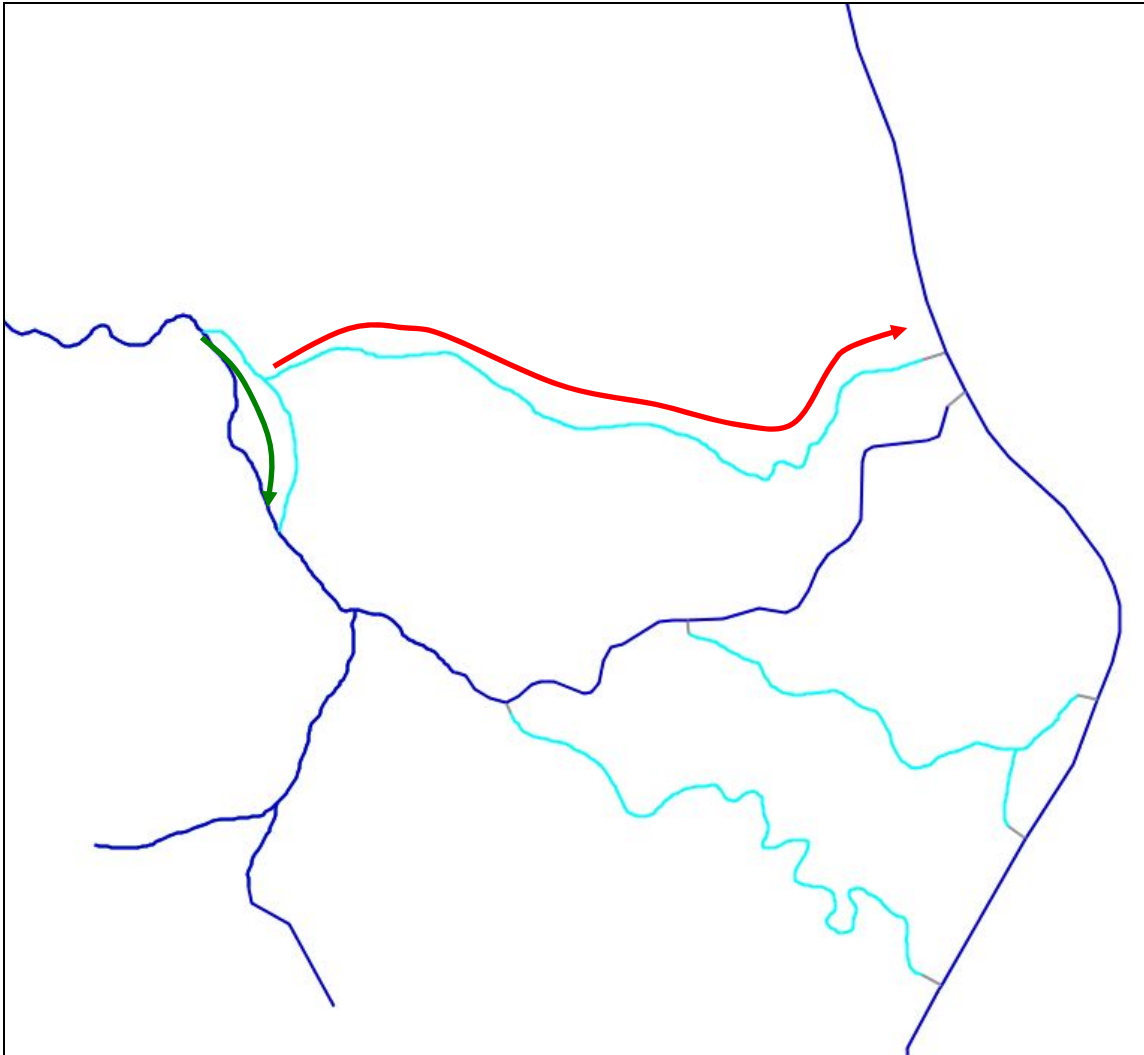
#### Process:

For each secondary flow group:

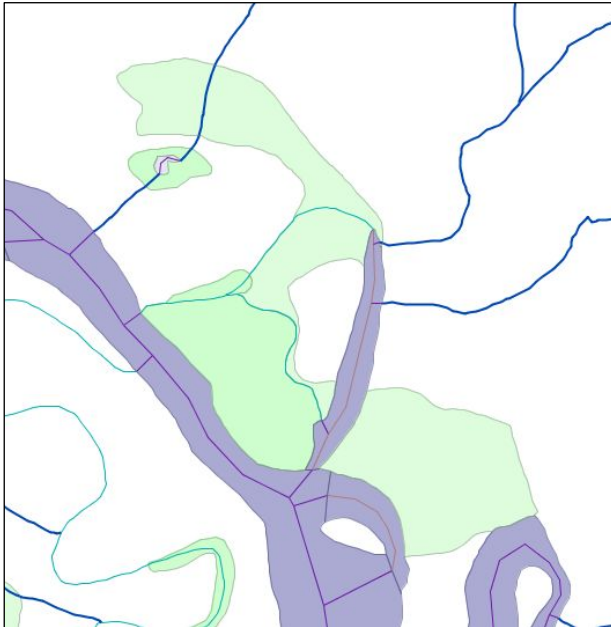
1. Load in all the secondary flow edges in the group and all the primary edges associated with the mainstems that interact with the secondary flow group.
2. Generate pre-routes for mainstems and other routes that are defined by the coding. Correctly node these generated pre-routes.
3. Check and remove duplicate edges (edges that have the same start and end nodes). These will cause the router to generate errors if they are not fixed. These are fixed by adding a node to the longer of the two edges. This results in edges added to the feature collection of edges to route and the feature collection of pre-routes to be updated.
4. Generate *side-channel* routes from source nodes.
5. Generate *tributary* routes from source nodes.
6. Generate *side-channel* routes that continue from pre-defined routes.
7. Generate *side-channel* routes that sink into pre-defined routes.
8. Generate *side-channel* routes (see figure below).
9. Generate *tributary* routes that continue from pre-defined routes.
10. Generate *tributary* routes that sink into pre-defined routes.
11. Generate *tributary* routes (see figure below).
12. Generate routes out of all single edges left.
13. Merge together routes that join at degree two nodes.
14. Save routes to database.

As shown in figure 4, when generating routes, side channels are generated before distributaries; therefore, the green route will be generated before the red route (Step 8 generates these side channel routes; Step 11 generates the distributary routes).

**Figure 4: Generating Side Channels**



**Figure 5: Generating Routes - Overview**



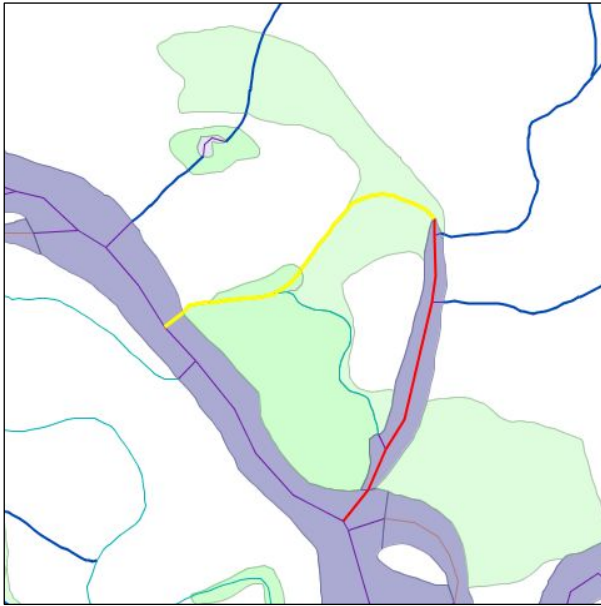
Generating routes that continue from predefined routes are generated before regular side channels to ensure routes are formed that correctly match the coding on the edges. This takes place during steps 6, 7, 9 and 10.

**Figure 6: Generating Routes - Side Channel Continuation**



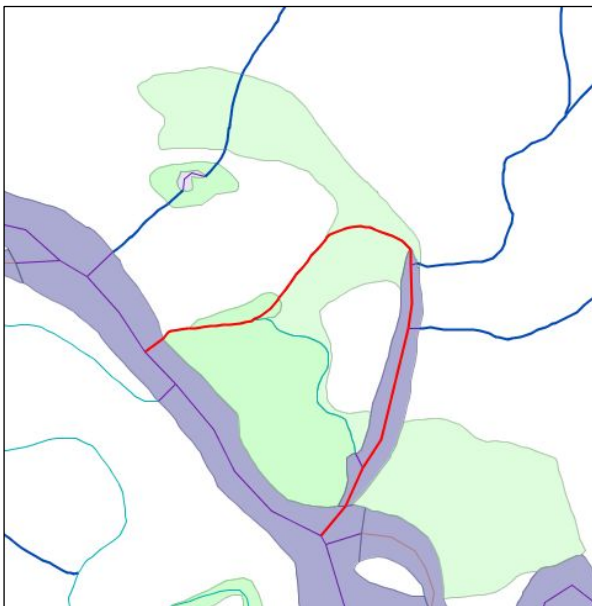
The red route is a predefined route. Thus the side channel route originating from this route is generated first. Then other routes are generated.

**Figure 7: Generating Routes – Merging Routes**



The result is two different routes that share a degree two node. These routes are merged in step 13.

**Figure 8: Generating Routes – Final Result**



This results in a single route being generated.

### 1.2.3 Step 4: Fix circular routes, add mainstem routes, and compute route information

This step completes all the post-processing required for route generation.

#### Inputs:

- All routed secondary flows in *fwa\_route\_edges* table.
- All mainstem edges in *fwa\_mainstem\_edges* table.

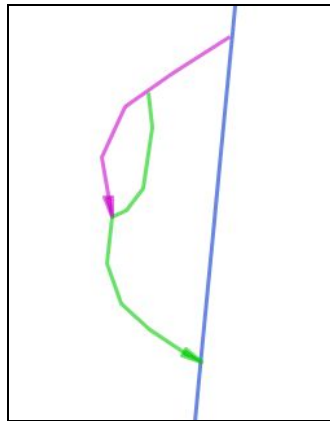
#### Outputs:

- All flow edges associated with a route (in *fwa\_route\_edges* table).
- Mainstems added to the *fwa\_route\_edges* table.
- Source and sink routes associated with each route (-1 for routes with no source or sink route).
- the *fwa\_routes* table populated

#### Process:

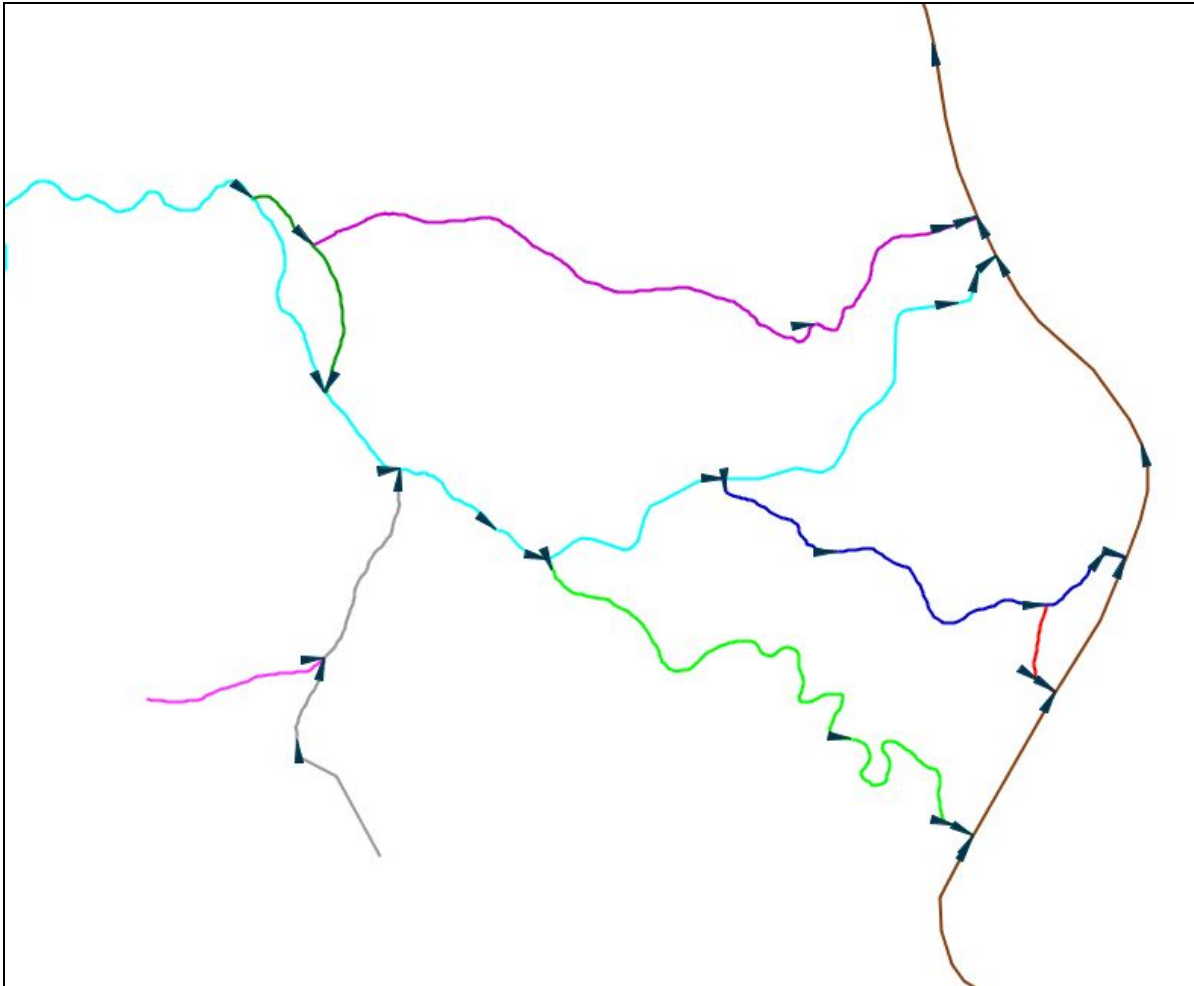
1. Manually fix circular routes. In a few cases the routes are generated such that Route A (green) flows from Route B (pink) and Route B flows into Route A, as shown in Figure 8. Such relationships create problems when defining a hierarchy on the routes and must be fixed manually.

**Figure 9: Circular Route Example**



2. Add mainstems to the routes tables. Add each edge from the *cwb\_mainstem\_edges* table to the *cwb\_route\_edges* table assigning each mainstem a unique route.
3. Compute Route Information. This involves computing the source and sink routes for each route as well as the main source and sink route. The main source and sink routes are the primary flow (or mainstem) the current route flows from or flows into.

**Figure 10: Route Info**



| Route | Color      | Source Route | Sink Route | Main Source | Main Sink | Mainstem |
|-------|------------|--------------|------------|-------------|-----------|----------|
| A     | Cyan       | ?            | B          | ?           | B         | 1        |
| B     | Brown      | ?            | ?          | ?           | ?         | 2        |
| C     | Dark Green | A            | A          | A           | A         | -1       |
| D     | Purple     | C            | B          | A           | B         | -1       |
| E     | Gray       | -1           | A          | -1          | A         | 3        |
| F     | Pink       | -1           | E          | -1          | E         | 4        |
| G     | Lime Green | A            | B          | A           | B         | -1       |
| H     | Blue       | A            | B          | A           | B         | -1       |
| I     | Red        | H            | B          | A           | B         | -1       |

? = (unknown)

-1 = no source/sink route or secondary flow

## **2 APPENDIX A: ROUTE GENERATION TECHNICAL DOCUMENTATION**

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See: "Routing Algorithm.doc"