The Watershed Evaluation Tool (WET v3); A Watershed Atlas based tool to rank British Columbia's fish values and watershed sensitivity[5]

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Abstract

British Columbia's fisheries resources, including the watersheds on which they rely, are an important social, economic, and ecological feature of the Province's landscape. Historically, there have been various fisheries management initiatives aimed at evaluating watershed sensitivity and protecting fish values. Typically, these were targeted at site specific stocks or locations, and identified areas in an ad hoc fashion with little consideration for assessing higher fish values at the watershed scale and over the broader landscape. Recognizing the weaknesses of this method, under the new *Forest Practices and Range Act*, and using the Government Actions Regulation (GAR) to legally designate areas of land as 'fisheries sensitive watersheds' (FSW), Government has developed a prototype model called the Watershed Evaluation Tool (WET) to assess in a comparative fashion watersheds across selected landscapes.

The WET is GIS (vector) based tool that has been designed to evaluate and numerically 'rank' 1:50,000 scale third order (and larger) watersheds. The tool uses a consistent methodology that can be applied to a variety of predefined geographic areas ranging in size from the entire province down to a sub-regional scale. The model uses an assortment of consistently available indicators to evaluate each watershed's inherent physical sensitivity and fish values. These indicators are derived from various sources including: interpolations of TRIM data, Watershed Statistics, Base Line Thematic Mapping, modeling, and inventories. The WET is structured such that the indicators are combined in a series of systematic, normalized, and linear process steps to determine a single relative score or rank for each watershed within a predetermined geographic population of watersheds. While the tool was designed to help legally designate FSWs for the purposes of GAR (s14), it has other important applications including prioritizing watersheds for restoration, compliance monitoring, and has been successfully used to prioritize watersheds for fish passage (culvert) assessment and improvements.

Using the WET to select

For the purposes of the GAR (s.14), the WET will be applied at two separate scales, or steps. The first is at the provincial scale, where it will be used to rank all watersheds in BC using data consistently available for the entire extent of the Province. This step will help determine the suitability of the small proportion of watersheds appearing at the top percentile of the (ranked) provincial WET list. Watersheds meeting this criteria are assumed to host values of "provincial importance". The second step will focus on "evaluation-units" (see map in centre of poster). In this step, where improved data exists that can be augmented to the WET, the WET will utilize this information to help better differentiate the relative distribution of ranked watersheds evaluation-unit (EU). The second step will help better inform the consultation process, a legal requirement under GAR (s.3), and provide greater confidence to the WET results for any specific EU.

FISHERIES VALUES

Fisheries values are characterized by evaluating and selecting the highest single value of three components: 1. Biodiversity, 2. Socioeconomic, and 3. Socioeconomic Concentration Values.

1. Biodiversity Value

Biodiversity value is a function of the number and status of native fish species listed by the BC Conservation Data Center. The probability of a species being present in a watershed is based on ~140,000 observations. Three groups of species are recognized based on the method used to estimate their probability of occurrence:

- For 37 species, probability of occurrence was predicted from logistic regressions of known species occurrence as functions of watershed characteristics.
- For anadromous species, the probability of access to a watershed is estimated from the presence of known barriers to fish migration and the presence of another obligate anadromous species.
- For 24 species where there are too few records (<50) to generate a habitat model, probabilities were based on expert opinion.
- For 15 species or populations that are thought to be restricted to <10 watersheds, probabilities were set to either 0 or 1 based on known occurrences.

Each species is weighted by an estimate of relative sensitivity to forest harvesting based on 11 life history traits. This weighting is high for bull trout (cold-water, stream-resident) and much lower for more lake dependent species (lake trout, most minnows). The three components of Biodiversity Value are: 1) Native Species Richness, 2) Endanger Species Score, and 3) Regionally Important Stocks, which will be augmented to the WET data set at the evaluation-unit level, are those not captured in the CDC data base (e.g. summer steelhead).

2. Socioeconomic Value

Relative **sport fisheries** values are measured in terms of current angler activity. **First Nations** Value**:** currently all watersheds are assumed to be of equally high value to First Nations. We hope to work with First Nations at the evaluation-unit level to develop a database which will reflect important First Nations values such as food and ceremonial use values. Relative **commercial fishery** values are calculated by assuming that: the average 1985-2005 escapement represents optimal escapement; estimated MSY harvest rates for each species are the same for all stocks within a species; market value is the average 2000-2005 landed value per individual.

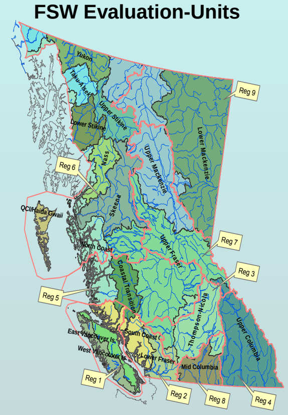
3. Socioeconomic Concentration Value

Socioeconomic concentration values is calculated similarly to the above value except for the addition of an important final step. This step involves dividing watershed's socioeconomic score by its area (km^2). This step highlights small watersheds with high relative productivity.

CONTINUOUS IMPROVEMENT

The FSW program is committed to continuous improvement of the WET and the procedure used to select and designate FSWs. Accordingly, a group of hydrogeomorphologists and fish scientists met recently to examine several aspects of the sensitivity side of the tool. The resulting recommendations from this meeting lead to important improvements which are currently being implemented. These changes are not reflected in this poster, however the essence of the model and procedure described here remain the same.

FSW Evaluation-Units



Coloured areas = evaluation-units; red lines = MOE regional boundaries.

WATERSHED SENSITIVITY

Watershed sensitivity in the WET is an index of likelihood that development (forest management) activities will significantly decrease the geomorphic stability of a watershed adversely impacting fish habitat. Sensitivity has been defined by the three components listed below, each of which addresses different mechanisms that can compromise fish habitat.

1. Peak Flow Potential (PFP)

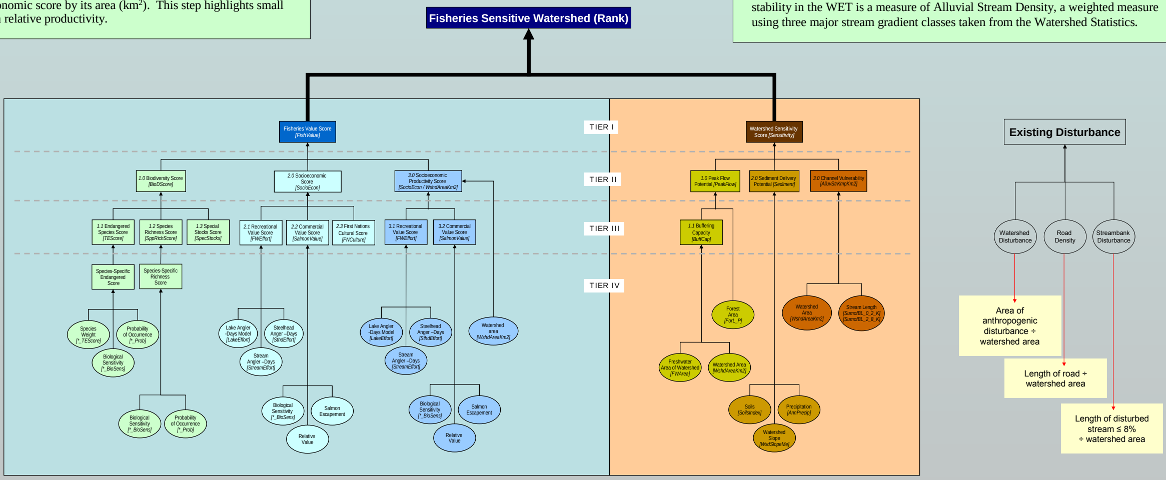
Peak (flood) flows shape stream channel morphology and influence the condition of fish habitat, including distribution of LWD. Anthropogenic activities (e.g. forest harvesting) can cause detrimental increases in these events by either exceeding their typical range of natural variability or return frequency. In the WET, the PFP component provides an indication of forest management related activities to affect the hydrological buffering capacity of a watershed (i.e. moderate peak flows). Mature vegetation, lakes, wetlands, and reservoirs are all used to indicate buffering capacity.

2. Sediment Yield Potential

This component recognizes that sediment can be delivered to watercourses via a number of mass-wasting mechanisms. These mechanisms have been grouped in two predominant geomorphic categories: 1) Terrain Stability and 2) chronic Fine Sediment Production. **Terrain Stability:** under a variety of conditions, parent and surficial materials can be transported to a stream channel (e.g. landslides, etc.). In the absence of large scale terrain stability mapping covering the province, the product of two broad surrogates influencing terrain stability is used: 1) slope and 2) precipitation. Slope, or terrain roughness, is clearly linked to terrain stability as more failures are found on steeper slopes. Melton's Ratio is used here to define this factor for each watershed. Precipitation (annual) is also strongly correlated to slope instability. An index of precipitation is taken from the Ecological Aquatic Unit (EAU) mapping to represent this factor. **Fine Sediment Production:** when disturbed, fine textured materials can be a significant source of deleterious sediment, even in areas of low topographic relief. In the absence of provincial terrain mapping, the best available data is 1:1 million-scale National Land and Water Information Service's data. Using attributes describing soil polygon characteristics, analysis was conducted to rank soils with high-erosion potential. The soil characteristics used to calculate sediment production potential include parent material, coarse fragment content, soil drainage class, and local surface form.

3. Channel Vulnerability

Geomorphic instability within a watershed can cause rapid or unnatural changes in stream channel dynamics and morphology which, when coupled to the channel, are known to have an adverse effect on fish and fish habitat. Alluvial channels are know to be most sensitive to these changes. The surrogate used to indicate channel stability in the WET is a measure of Alluvial Stream Density, a weighted measure using three major stream gradient classes taken from the Watershed Statistics.



Final Tasks Leading to the Launch of the FSW Program[6]

✓ **Completion of the FRPA Bulletin intended to provide guidance surrounding the definitions of "special management" and 'cumulative hydrological effect' with respect to FSWs and the use of these terms in GAR.**

✓ **Completion and executive approval of the FSW Procedures document.**

✓ **Training workshops to familiarize forest managers (industry) and Regional FSW leads in FSW designation procedures and interpretation of the WET results.**

✓ **Creation and implementation of the FSW Effectiveness (& Adaptive Management) Monitoring Framework and Program**

WET Data Sources

- GIS based
- Uses Watershed Atlas boundaries and codes
- Input data derived from:
  - TRIM,
  - Fish Distribution and other modeling,
  - TRIM/DEM,
  - Baseline Thematic Mapping (BTM),
  - Watershed Statistics,
  - Provincial & Regional Inventories,
  - Research, and
  - Others (in progress)

Acknowledgements

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[5] Martian Carver (MOE) and Greg Utzig (Kutenai Nature Investigations Ltd.) are developing a GIS DEM based model to evaluate watershed influences on channel stability – once this model has been completed and validated it may be incorporated into the WET.

[6] Please contact Lars Reese-Hansen (250-387-3980) with any questions and comments you may have regarding the FSW program, the WET, or FSW monitoring.

British Columbia — Ministry of Environment

Poster prepared by Lars Reese-Hansen September 20th, 2007 v1.3.2

Fisheries Sensitive Watersheds Website: http://www.env.gov.bc.ca/wld/frpa/fsw/index.html