# Appendix B - Summary of EFN-Setting Methods Used in Canada and Elsewhere

**Table B-1**
**Summary of the major categories of EFN-setting methods used in Canada and their strengths and weaknesses (adapted from Linnansaari et al. 2013).**

| Categories / Common Methods | General purpose | Scale and Scope | Suggested Uses | Strengths | Weaknesses |
|---|---|---|---|---|---|
| **Hydrological**<br>• BC Instream Flow<br>• Tennant and its derivatives (e.g. B.C.-Modified Tennant)<br>• Percentage of Flow (POF), Sustainability Boundary Approach (SBA) and Presumptive Standard<br>• Alberta Desktop<br>• DFO Framework | Examination of historic flow data to find levels that naturally occur and can be considered “safe” thresholds or within the range of natural variability patterns. | Whole rivers, applicable for regional-scale assessments.<br>Mainly based on discharge data. | Useful for situations where the potential risk of impacts to aquatic ecosystems is low.<br>Regionalization techniques can allow the transfer of data from gauged to un-gauged systems.<br>A “percent flow” method assumes the availability of data from a gauged reference system. | Easy to implement because require little to no field work. | Do not scale with stream size or type.<br>Risk that criteria will be applied across different geographic regions and river types, without sufficient understanding of their ecological implications. |
| **Hydraulic rating**<br>• Wetted Perimeter Inflection Point<br>• Flowing Perimeter<br>• R-2 Cross | Examination of change in a hydraulic variable, e.g. “wetted width”, as a function of discharge. The change is a proxy for the general quantity of fish habitat in a river. | Applied at a study site / river segment scale, up-scaling to whole river level based on the assumption of availability of “representative” sites.<br>Methodology is river specific.<br>Based on physical (hydraulic) characteristics.<br>Some consideration of biological characteristics. | Can be used to validate other statistical analyses (primarily for periods of low flow).<br>Can work well for site-specific, individual stream sections.<br>Generally designed to be used in rivers with well-defined single channels. | Requires some field work and data to derive relationships between flow and specified hydraulic variables (e.g. wetted perimeter, depth, average velocity).<br>Can be used for “low risk” situations when sufficient data exists for the river/site being assessed.<br>Can be used as an increased safety measure or a benchmark with other methods.<br>Inexpensive but river specific. | Not recommended as the sole method for studies requiring a high level of detail or which pose a significant ecological risk.<br>Difficult to identify appropriate transects at which to collect data in braided channels.<br>Criticized for lack of direct relationship with ecological processes and inability to quantify trade-offs between flow and ecological consequences.<br>Can lead to a stable (i.e. “flat-lined”) environmental flow regime, which may lead to degradation over time. |

## Appendix B - Summary of EFN-Setting Methods Used in Canada and Elsewhere

| Categories / Common Methods | General purpose | Scale and Scope | Suggested Uses | Strengths | Weaknesses |
|---|---|---|---|---|---|
| **Habitat simulation modelling**<br>• Instream Flow Incremental Methodology<br>• PHABSIM (Physical Habitat Simulation System)<br>• RYHABSIM (River Hydraulic and Habitat Simulation)<br>• EVHA (Evaluation de Habitat)<br>• RSS (River System Simulator)<br>• CASIMIR (Computer Aided Simulation of Habitat in Regulated streams)<br>• River2D<br>• MesoHABSIM<br>• MesoCASIMIR | Examination of change in the amount of physical habitat based on selected variables and target species, as a function of discharge. | Applied at a study site (micro) / river segment scale (meso).<br><br>Detailed assessment. | Useful for identifying trade-offs in physical habitat over a range of flows. | Can address river-specific issues in high-risk situations.<br>Can provide a better spatial estimate of the potential impact of the project, when compared with hydrological / hydraulic methods.<br>Can provide accurate estimates of flow regimes required to maintain physical integrity of habitat in river segments (i.e. wetted area, depth, discharge, and water velocity within that area).<br>Resulting habitat-discharge relationship can be used as negotiating tool | Considerable amount of field work and expertise required time consuming and relatively expensive.<br>Considerable modeling assumptions are made; not always validated and uncertainty is not often communicated.<br>Misapplication of the results is reportedly common.<br>May lead to uniform, stable ("flat-lined") prescriptions for the ecological flows required for fisheries.<br>Criticized for lack of ecological specificity and uncertainty for habitat vs. species abundance relationship. |
| **Holistic**<br>• Building Block Methodology (BBM)<br>• Downstream Response to Imposed Flow Transformation (DRIFT)<br>• Benchmarking<br>• Ecological Limits of Hydrologic Alteration (EOHA) | Examination of flows based on multiple data inputs including expert opinion, leading to recommendations of flow regimes for all components of the riverine ecosystem. May include consideration of socio-economic objectives. | Whole rivers, applicable for regional or river specific scales.<br><br>Flexible. | Useful for examining overall ecosystem function. | Encompasses physical, chemical, and biological variables.<br>Flow alteration prescriptions are based on ecological considerations.<br>Reliance on expert opinion, although this is viewed as a weakness by some.<br>Can use multiple inputs, including other assessment methods.<br>Each additional element adds incremental information and understanding. | Can be labour intensive, time consuming, and relatively expensive.<br>Each additional element included in an analysis adds additional uncertainty. |