

Fish Movement / Barrier Alteration

WWFMP Type: Special Measures (Habitat Enhancement)

Primary Mechanism: Removal of obstacles to permit fish and invertebrate passage

Related WWFMPs: May be a co-requirement of other measures to allow colonization of aquatic habitat to occur before effectiveness of other measures can be assessed.

Examples: Dam/barrier removal, bypass construction, flow modifications

Description: Barrier Alteration involves modification of the stream where abrupt changes in slope inhibit movement of stream inhabitants. Barrier alteration is typically used at old dams and weirs but has been applied at natural drops in bedrock streams. Passage can be accomplished by building a riffle downstream of the obstruction to 'ramp' the fish over the obstacle. If this technique cannot be used then a bypass is often provided. Bypasses options range from natural channels to concrete engineered structures. Barrier removal is also a potential solution where cultural and economic conditions permit.



Fish passage

Application Requirements: To be applied within the stream corridor. A site investigation and analyses of potential upstream and downstream impacts must be assessed.

Consideration must be given to access, maintenance, urgency and availability of materials.

Not generally modeled.

Proven Effectiveness/Experience Elsewhere:

- Very effective in restoring aquatic communities to reaches where they could otherwise exist;
- Can provide access to important habitat that otherwise would limit the ability of aquatic communities to exist in a stream.
- [Widespread use throughout Ontario and the Toronto Region CA](#)

Cost Considerations:

- Cost is dependent on the type of system, availability of materials and amount of excavation required;
- Typically does not result in a loss of developable land because the zone of application for these techniques exists within hazard lands and are protected by policies (e.g. Public Health and Safety, Policy 3.1, Stream and Valley Protection Policy);
- May require disposal of contaminated sediment off-site.

SPECIAL MEASURES (HABITAT ENHANCEMENT)

Objectives Addressed:

Technical Objectives (Terms of Ref.)	Measure Addresses
1. Achieve healthy aquatic communities	X
2. Reduce fish consumption advisories	
3. Reduce erosion impacts	X
4. Re-establish natural hydrologic process	
5. Re-establish natural features	X
6. Virtual elimination of toxic contaminants using pollution prevention at source	
7. Achieve water and sediment objectives in watercourses and waterfront	X
8. Eliminate sanitary discharges in SSO, CSOs, bypasses, cross connections and spills	
9. Improve body contact recreation in rivers and reduce beach closures	
10. Eliminate aesthetic nuisances	X
11. Reduce basement flooding	
12. Reduce sanitary sewer inflow and infiltration	
13. Protect life and property from flooding	

Opportunities Considerations:

- Opportunities identification based on:
 - Land and space requirements;
 - Fisheries objectives;
 - Economic and Cultural objectives;
 - Physical implementation criteria;

- Matrix-type Opportunities Considerations by watershed (Step 3B in Assessment Process)

References:

- Brookes, Andrew and F. D. Shields (Editors), 1996, *River Channel Restoration: Guiding Principles for Sustainable Projects*, 433 p., John Wiley & Sons Ltd, West Sussex, England.
- Federal Interagency Stream Restoration Working Group, 1998, *Stream Corridor Restoration: Principles, Processes, and Practices*, U.S.D.A.
- Rosgen, Dave, 1996, *Applied River Morphology*, Wildland Hydrology, Pagosa Springs, Colorado.

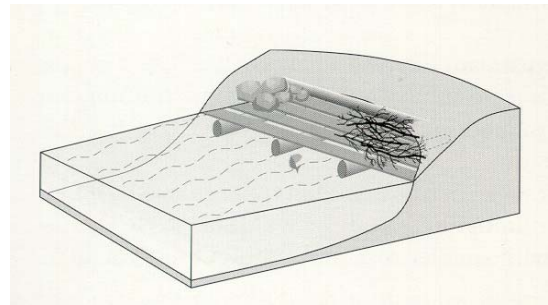
Aquatic Habitat Enhancement / Instream Practices

WWFMP Type: Special Measures (Habitat Enhancement)

Primary Mechanism: Modification of river function to better suit stream inhabitants through changes to streamflow conditions, physical structure of the channel, water quality, riparian zone and other living components

Related WWFMPs: System Rehabilitation, Softer Engineering Approach, Vegetative Buffer Strips, Tree Plantings/Urban Forests, Constructed Wetlands, Bank Protection, Stream Corridor Measures.

Examples: Boulder clusters, Weirs or sills, log/brush/rock shelters, lunger structures, migration barriers, tree cover, wing deflector, grade control measures, substrate enrichment, provision of woody debris.



Log/brush/rock shelter

Description: *Aquatic Habitat Enhancement* methods modify the stream environment increase the diversity of habitats upon which aquatic life depend on for survival. There are three general categories of physical habitat modification including **instream structures** or devices to impound or modify the flow, modification of the **substrate**, and devices which provide **cover**. *Instream structures* typically create areas of fast and slow water that create a variety of hydraulic conditions (velocity, depth, turbulence) across and along the channel. Examples include weirs, sills, riffles, pools and deflectors. *Substrate* placement can be done to increase diversity in stream form, to provide more food production, and to provide reproduction sites. Examples include boulder placements, gravel beds/bars, special materials for plant growth. Instream *cover* can be provided by introducing overhangs and obstructions which are attached to the channel, hanging or floating.

Application Requirements: To be applied within the stream corridor. A site investigation and analyses of river behaviour is required to determine the type of technique to be applied. The suitability of each technique must be weighed against the environment that is to be applied. For example, structures which are intended to modify the stream-bed (e.g. digger logs, knotted weirs) are not effective if insufficient energy is available to modify the stream-bed. High sediment load and energy streams (e.g. large rivers) preclude the use of many traditional instream habitat measures. A precondition of all measures is that the stream is in an equilibrium or stable condition. This may require application of other stream restoration works first.

Consideration must be given to access, maintenance, urgency and availability of materials. [These alternatives are not generally modeled during watershed / subwatershed planning activities.](#)

SPECIAL MEASURES (HABITAT ENHANCEMENT)

Proven Effectiveness/Experience Elsewhere: Engineered structures are less sustainable and rarely as effective as a stable channel. Techniques which mimic natural stream function are more successful than techniques which force a desired condition.

There are many examples of projects that have demonstrated ecological improvement but there are many examples of projects that are not sustainable in the long term.

These practices are generally in widespread use throughout Ontario and have proven effective at enhancing aquatic habitat when installed in stable stream systems with natural rates of erosion.

Cost Considerations:

- Cost is dependent on the type of system, availability of materials and amount of excavation required;
- Typically does not result in a loss of developable land because the zone of application for these techniques exists within hazard lands and are protected by policies (e.g. Public Health and Safety, Policy 3.1, Stream and Valley Protection Policy).

Objectives Addressed:

Technical Objectives (Terms of Ref.)	Measure Addresses
1. Achieve healthy aquatic communities	X
2. Reduce fish consumption advisories	
3. Reduce erosion impacts	X
4. Re-establish natural hydrologic process	X
5. Re-establish natural features	X
6. Virtual elimination of toxic contaminants using pollution prevention at source	
7. Achieve water and sediment objectives in watercourses and waterfront	X
8. Eliminate sanitary discharges in SSO, CSOs, bypasses, cross connections and spills	
9. Improve body contact recreation in rivers and reduce beach closures	
10. Eliminate aesthetic nuisances	X
11. Reduce basement flooding	
12. Reduce sanitary sewer inflow and infiltration	
13. Protect life and property from flooding	

Opportunities Considerations:

- Opportunities identification based on:
 - Land and space requirements;
 - Fisheries objectives;
 - Physical implementation criteria;
- Matrix-type Opportunities Considerations by watershed (Step 3B in Assessment Process)

References:

- Beak 1996. Fisheries Technical Manual. Prepared for the Ministry of Transportation, Environmental Policy Group.
- USFWS. 1980. Ecological Services Manual – habitat evaluation procedures (HEP). ESM 102. Washington, DC: US Department of the Interior, Fish and Wildlife Service.
- USFWS. 1980 (various years). Habitat Suitability Index Models for various fish species. Washington, DC: US Department of the Interior, Fish and Wildlife Service.

- Canadian Electrical Association. 1980. Comprehensive review of instream flow requirements for fish downstream of hydropower facilities in Canada. Methodologies for assessing instream flow requirements were evaluated with respect to hydroelectric requirements in Canada. A "users guide" was prepared for use in the selection of appropriate methodologies for managing a river use and protection of aquatic resources.
- Canadian Electrical Association. 1980. Review of the effectiveness of man-made spawning and rearing habitat for fish.

