Fisheries and Oceans Canada
Pêches et Océans Canada

PRACTITIONERS GUIDE

TO FISH PASSAGE FOR DFO HABITAT MANAGEMENT STAFF

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FISHERIES AND OCEANS CANADA

Canada

The *Practitioners Guide to Fish Passage* is one in a series of Practitioners guides which are intended to provide clear and nationally consistent guidance to Habitat Management practitioners making regulatory decisions related to the habitat protection provisions of the *Fisheries Act*. Together these guides support the objective of providing a predictable and coherent approach to regulatory review of works or undertakings that affect fish and fish habitat across Canada.

This guide provides guidance on assessing fish passage effects for new development proposals. It further identifies the regulatory tools that should be used to manage these effects. When applying this guide, it is important to note that effects on fish passage cannot be managed in isolation of the other habitat protection provisions of the *Fisheries Act*, namely impacts to fish habitat (Section 35) and the destruction of fish by means other than fishing (Section 32).

http://oceans.ncr.dfo-mpo.gc.ca/habitat/home_f.asp

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Cette publication est également disponible en français.

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1.0 INTRODUCTION

In order for fish to successfully fulfill their life processes they must have access to suitable areas in which to feed, seek refuge and spawn. In many cases these areas are represented by specific types of habitat which are often quite distinct and can be far removed from one another. The movement between these essential habitats is referred to as migration. For some species these migrations are quite localized, (e.g. some fish may live their entire life within the confines of a single pond or segment of a river) while for others they may involve spectacular journeys stretching many hundreds of kilometers.

The various types of migration are generally categorized as:

Trophic migrations involve movements to rearing or feeding habitats. The downstream migration of juvenile diadromous species, back to adult habitat is one example of a trophic migration. In some cases it may take several years for juvenile fish to return to the lake or ocean where they will grow into adults.

Refuge migrations are often required for fish to avoid extreme environmental conditions. Many species migrate to deeper pools or lakes to overwinter, or in response to changes in water levels. Other species such as brook trout may seek out groundwater upwellings during the summer to avoid excessively warm temperatures.

Reproductive migrations are those movements related to reaching spawning habitats. Anadromous fishes such as salmon, American shad, gaspereau, and striped bass must migrate from saltwater to spawn in freshwater, while catadromous species, such as the American eel, live in freshwater but must spawn in saltwater. Adfluvial fish, such as some trout, whitefish, and Arctic grayling, live in freshwater lakes and migrate into streams to spawn.

For the purpose of this guide, 'fish passage' is a general term used to represent all types of migration including the localized movements of fish within a given type of habitat. The term applies to all species defined as 'fish' as per the *Fisheries Act* which includes crustaceans and marine mammals.

Depending on the prevailing conditions, altering fish passage can result in habitat fragmentation, loss of genetic diversity, population declines, species replacement or even extirpation. There are also situations where restricting fish passage is required to achieve fisheries management objectives. Examples include the use of fish screens to prevent fish from becoming entrained, or the use of low-head dams or other specialized structures to prevent the spread of invasive species.

Many types of development proposals have the potential to affect fish passage.
The most obvious situations involve the construction of an obstruction through which fish cannot pass. Stream crossings for instance are a common type of development proposal which can easily become a barrier to fish passage if not designed properly. Dams are another obvious form of physical obstruction, which can directly affect fish passage. An obstruction is not necessarily a complete blockage to fish passage. Some obstructions are only temporary in nature and may only affect certain species or fish of a certain size. In other cases a reduction in fish passage may be a result from such things as disturbance due to noise, or as a result of mortality or other physical stress.

This guide builds on concepts presented in the *Practitioners Guide to the Risk Management Framework*, in which, fish passage is viewed as one of several main effects that could arise from activities associated with development proposals regularly reviewed by Habitat Management practitioners (Practitioners).

1.1 PURPOSE

The purpose of this guide is to:

- provide clarity around the application of the *Fisheries Act* to development proposals which have the potential to impact on fish passage,
- provide a structured approach to assessing the risk associated with fish passage effects, and
- offer guidance on the appropriate regulatory tools to be applied for managing risks to fish passage.

Figure 1 shows how the components of the Pathways of Effects diagrams (i.e. activities, stressors and effects) relate to one another.

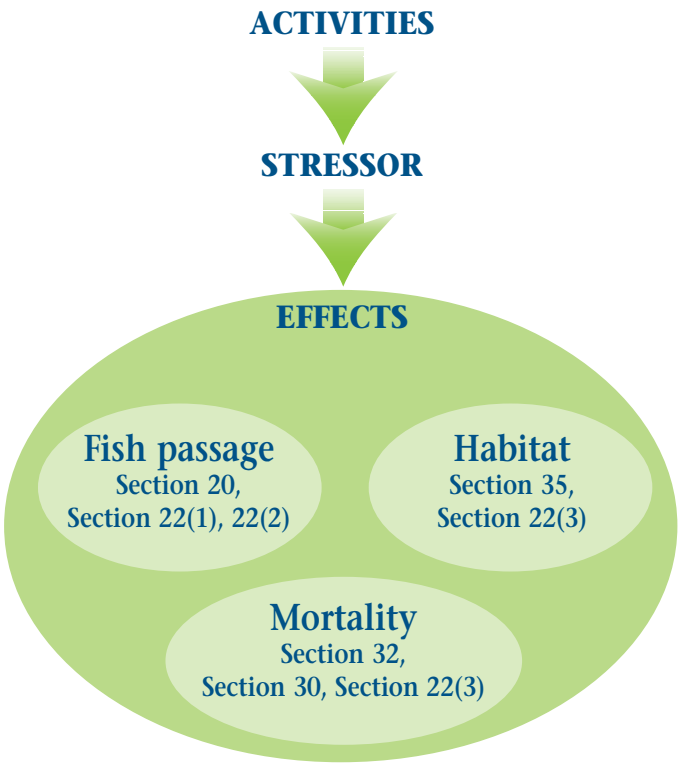

Figure 1: Conceptual diagram showing how effects are generally grouped and managed through the application of the habitat protection provisions of the *Fisheries Act*

Effects can be grouped into three broad categories (i.e. Fish Passage, Fish Mortality and Fish Habitat) which are managed through the application of specific sections of the *Fisheries Act*.

While the discussion in this guide focuses on fish passage the final management decision and regulatory action needs to take into consideration potential effects on fish habitat and fish mortality as well. Effects on fish habitat or fish mortality which are unrelated to fish passage are not discussed in this Guide.

1.2 LEGAL AND POLICY CONTEXT

Several sections of the *Fisheries Act* make reference to fish passage. The sections which are most relevant to the review of new development proposals are Sections 20, 21, 22, 30, 32, and 35 (Appendix B). The proposed issuance of an authorization under sections 22 or 32 or subsection 35(2) of the *Fisheries Act* may require that DFO ensure that an environmental assessment on aspects of the development poposal is conducted under the *Canadian Environmental Assessment Act* (CEAA)[1].

Fish passage has long been recognized as an important requirement to manage Canada's fisheries resources. Section 20 of the *Fisheries Act*, for example, was first introduced in 1868. The introduction of the current Section 35 in 1977 included "migratory habitat" within the definition of fish habitat thus providing an additional regulatory mechanism to ensure fish passage. Where more than one section of the *Fisheries Act* applies to a particular development proposal, regulatory efficiencies can be achieved by including the various regulatory conditions into one authorization (Section 2.2.4). For example, where a harmful alteration, disruption or destruction (HADD) of fish habitat determination has been made, it would be unnecessary to exercise the Section 20 provisions as well. An authorization under subsection 35(2) could simply include mitigation measures and/or monitoring requirements related to fish passage.

1.2.1 Section 20 - Fish Passage at an Obstruction

Subsection 20(1) applies with respect to "obstructions". "Obstruction" is defined in the *Fisheries Act* as any "slide, dam or other obstruction impeding the free passage of fish". An obstruction does not have to amount to a complete barrier. Subsection 20(1) of the *Fisheries Act* provides the Minister of Fisheries and Oceans (Minister) with the power to order the owner or occupier of an obstruction to provide for the free passage of fish. The term "Minister" in this case is interpreted to mean a departmental employee working in a capacity appropriate to making such a decision.

If a subsection 20(1) order is made and not complied with, a charge may be laid under section 66.

The subsection 20(1) power is discretionary and any exercise of discretion must be reasonable. The exercise of the discretionary power must be based on the Minister's determination that it is necessary for the public interest to allow for the free passage of fish. This means it must be

[1] Note that in certain areas of Canada, other EA regimes may apply in addition to or instead of CEAA. Thus, where CEAA is mentioned, CEAA may apply alone, with another EA regime or may be replaced by another EA regime.

exercised for a legitimate, not arbitrary, purpose. While the section does not give the Minister authority to order the removal of the obstruction, due to the discretionary nature of the power, the Minister may choose to work proactively with the proponent to achieve fish passage by other means, such as redesigning of the development proposal. As a matter of practice, therefore, an order under subsection 20(1) would only be issued in the event that the owner/occupier was unwilling to cooperate.

By issuing a subsection 20(1) order, subsection 20(3) requires that Fisheries and Oceans Canada (DFO) review and approve the plans prior to construction. While a plain reading of the Act would suggest a written subsection 20(1) order be issued prior to a subsection 20(3) approval being given, it is possible to issue an approval without a written order, if done in cooperation with the proponent. In either case, the approval must include details of the place, form and capacity of the fish-way or canal. Once the fish-way is in operation DFO can require the owner to make changes to the structure to allow it to work properly.

1.2.2 Section 21 – Additional Powers Related to Fish Passage

Section 21 of the *Fisheries Act* contains several subsections that are rarely exercised. Subsection 21(1) provides that DFO may, if it wishes, pay up to one half of the costs of a fish-way. If such a power were exercised, paragraph 5(1) (b) of the CEAA may require that an environmental assessment be conducted before a federal authority "makes or authorizes payments … for the purpose of enabling the project to be carried out…".

Subsection 21(2) states "The owner or occupier of any obstruction shall make such provision as the Minister determines to be necessary for the free passage of both ascending and descending migratory fish during the period of construction thereof." Concerns regarding fish passage associated with the construction phase are generally addressed through the application of suitable mitigation measures.

Under subsection 21(3), DFO can order the removal of an unused obstruction (or a thing detrimental to fish) in circumstances where the owner/occupier fails to act after notice has been given, or the owner/occupier cannot be located. The Crown may recover the expense of the removal or destruction.

Subsection 21(4) provides DFO with the ability to require the owner/occupier of an obstruction to install and maintain such fish stops or diverters above or below the obstruction to prevent the destruction of fish or assist their ascent.

Since subsection 21(3) and 21(4) involve powers related to ensuring fish passage at existing facilities, they are not included within the scope of this guide.

1.2.3 Section 22 – Sufficient Flow of Water

Section 22 of the *Fisheries Act* provides the Minister with the authority to regulate downstream water flows at an obstruction to provide for the safe and unimpeded descent of fish and for the free passage of both ascending and descending migratory fish during the period of construction. The powers of Section 22 are implemented through the issuance of a Section 22 order. The Minister has issued Section 22 orders sparingly in the past and would do so only for obstructions that have already been built or are under modification or repair. A Section 22 order is discretionary and should only be issued where there is sufficient evidence to conclude that the free passage of fish is impeded due to insufficient water levels. As with Section 20, Section 22 orders are generally only applied after all opportunities for negotiating with proponents have failed. Since Section 22 orders tend to be used for resolving fish passage effects associated with ongoing activities, it is not discussed in any great detail in this guide.

1.2.4 Section 30 – Fish Guard or Screen

Section 30 is a discretionary power under the *Fisheries Act* and requires that, "every water intake, ditch, channel or canal in Canada constructed or adapted for conducting water from any Canadian fisheries waters must provide for a fish guard or a screen, covering or netting over the entrance or intake so as to prevent the passage of fish into such water intake, ditch, channel or canal". In most instances this requirement is associated with preventing fish from sustaining injury leading to death. This is particularly relevant to juvenile fish migrating downstream through the turbines of a hydroelectric facility as well as to juvenile fish entering irrigation ditches, pumps, and water extraction facilities for personal and commercial purposes.

In some cases preventing fish from becoming entrained is enough in and of itself to ensure safe passage around a potential obstruction. In other cases additional measures, (e.g. bypass channel) may also be required.

1.2.5 Section 32 – Destruction of Fish by Means Other than Fishing

Section 32 prohibits the destruction of fish by means other than fishing unless authorized by the Minister. In many cases fish passage and fish mortality are inextricably linked. For instance fish could be killed as a result of using explosives which in turn could reduce the number of fish able to complete their spawning migration. The downstream migration of juvenile fish could be seriously affected by incidental mortality due to entrainment or impingement on water intake structures such as hydroelectric canals or municipal water intakes. Low levels of dissolved oxygen, resulting either from contamination or the discharge of anoxic reservoir water can also result in fish kills leading to reduced migratory success.

Where fish passage is impaired due to fish mortality, Section 32 of the *Fisheries Act* would likely be the most appropriate section to be applied. As such, mortality related fish passage issues are not discussed in this guide.

Where the destruction of fish is associated with the construction and operation of a new development proposal which is also likely to result in a harmful alteration, disruption or destruction (HADD) of fish habitat, the conditions associated with a Section 32 authorization can be included within a Section 35(2) authorization to avoid two separate administrative mechanisms for the same development proposal (Section 2.2.4).

1.2.6 Section 35 – Fish Passage and Migration Areas

Section 35(1) is a prohibition against the HADD of fish habitat. It is prescriptive in its application and applies to works or undertakings which are to be undertaken. The definition of "fish habitat" as defined in Section 34 of the *Fisheries Act*, includes "migration areas". Therefore, an obstruction of fish passage, could also be considered a HADD of fish habitat, and be administered through a subsection 35(2) *Fisheries Act* authorization. The authorization could include mitigation, monitoring and contingency measures related to fish passage.

If fish passage is addressed through the application of Section 35, the issuance of a separate order under subsection 20(1) and approval under subsection 20(3) is not required. Subsection 20(1) orders should be reserved for resolving issues involving existing obstructions, especially where the owner/occupier is unwilling to cooperate.

APPLYING A RISK APPROACH TO ASSESSING FISH PASSAGE EFFECTS

2.0

Early notification and consultation with proponents is often the best means of managing effects on fish passage. Communication between DFO and the proponent is essential to ensure that sufficient information can be gathered, that there is a clear understanding of the fish passage objectives and that alternative designs can be considered. For larger, more complex development proposals, such as a new hydroelectric facility, detailed modeling may be used to test various designs, in order to determine the likelihood that the proposed development will achieve the fish passage objectives.

2.1 AQUATIC EFFECTS ASSESSMENT

Many development proposals have the potential to impact on fish passage. The effects may range from short-lived disruptions to complete blockages that persist indefinitely. Physical obstructions are the most obvious form of fish passage barrier, but other effects such as changes in water depth, velocity or water chemistry, can be just as significant. Pathways of Effects (PoE) provide a thorough process to analyze complex development proposals to ensure important cause and effect relationships are not overlooked.

PoE diagrams also offer a visual way of representing cause and effect relationships, which helps to describe to proponents the type of mitigation measures that would be required to address potential effects on fish and fish habitat. Short term disruptions to fish and fish habitat can generally be addressed through simple mitigation measures, such as timing work to avoid migration periods or through the implementation of sediment and erosion control plans to prevent the introduction of sediment or other contaminants into the water. More permanent effects to fish passage resulting from the creation of a dam, alterations to stream hydraulics, and effects related to ongoing fish mortality, generally require more elaborate mitigation measures, such as the application of fish screens, baffles or fish-ways.

Table 1 lists many of the common stressors, which could be represented on a PoE diagram, and that have the potential to effect fish passage.

Table 1: List of activities, stressors, and mitigation measures which could be used to address effects on fish passage

Activity	Stressor	Description	Mitigation Measures
Water Extraction	Water chemistry	Alteration of chemical properties (e.g. salinity, dissolved oxygen, temperature etc.) can disrupt migration cues or in extreme situations result in fish mortality.	Where applicable follow provincial or federal water quality standards.
	Alteration of water flow	See 'Alteration of Water Flow'.	

Alteration of Water Flow	Reduced water depth	Reduction of flow may reduce ability of certain species to migrate past natural obstructions.	Management of water taking or water diversions to maintain Instream Flow Needs requirements.
	Change to channel form and function	Disruption of bedload movement (i.e. transport and deposition patterns), may lead to changes in channel form and function.	Management of water taking or water diversions to maintain Instream Flow Needs requirements.
	Alteration of attraction flows	Migrating fish may be drawn away from natural migration paths or fish passage structures due to the competing flows generated from water extraction or diversions.	Proper orientation and location of fish-ways and management of flows to meet Instream Flow Needs requirements.
	Alteration of migration cues	The migration patterns of many fish species are closely associated with water flow. Smolts migrating downstream may cease migration when reaching a large reservoir instead of continuing to the ocean. Alteration of flood peaks may affect the spawning migrations of adult fish.	Management of flows to meet Instream Flow Needs requirements.
Placement of Material in Water	Increased water velocity	Can be caused by the constriction of the channel or floodplain, change in channel slope, or reduction in channel roughness. Shallow stream margins provide a zone of reduced water velocity used for migration, particularly for smaller species.	Selection of designs which don't constrict the channel and retain shallow stream margins (i.e. stream simulation). Construction of fish-ways, baffled culverts or other velocity refuge such as boulders, off-channel pools or multi-staged channels.
	Vertical drop	Obstruction created that exceeds fishes jumping/crawling ability. Examples would include perched culverts, dams, causeways, cofferdams, pipelines on seabed etc.	Proper design to prevent undermining of culverts or providing pool conditions (flows, depths) suitable for jumping species. Fish-ways or fish bypass structures to allow fish to pass permanent obstructions such as dams. Crawling platforms or tunnels to permit crustaceans to pass structures such a pipelines laid on the seabed.

Activity	Stressor	Description	Mitigation Measures
	Diffuse flow	Interstitial or subsurface flow caused by water flowing through voids in coarse granular materials or debris. If coarse rock material was used to line a culvert or create a riffle, water might flow through the rocks, rather than over them, if finer grained materials were not included into the mixture to fill voids. Similarly, water flowing through debris jams, may not provide enough concentrated flow to allow fish to pass.	Additions of finer materials within an otherwise coarser mixture; further improved, through compaction techniques.
	Change in channel form and function	Disruption of bedload movement (i.e. transport and deposition patterns), may lead to changes in channel form and function. Increased erosion may lead to bank failure and widening of a stream channel, resulting in reduced water depth.	Best addressed through proper design to prevent offsetting the natural erosion and bedload transport processes.
	Darkened corridor	Certain species of fish are hesitant to migrate through long darkened corridors. (e.g. long culverts on major highways).	Use of lighted portholes, or use of designs with wide openings and shorter spans.
	Turbulence	Generally only associated with high gradient systems. Can be aggravated due to the application of baffles or fish passage structures.	Ensuring adequate pool volume to dissipate water energy. Proper embedment of water conveyance structures or construction of gradient control structures.
Industrial Equipment / Dredging / Grading / etc.	Change in sediment concentrations	Increased turbidity arising from erosion or the re-suspension of sediments.	Sediment and erosion control devices, silt curtains, timing work to avoid migration/refuge periods, use of clean materials etc.
Explosives / Pile Driving / Seismic	Disturbance due to noise	Can result in lethal and sub-lethal effects.	Operate within specific parameters set by prevailing conditions (i.e. open water vs ice cover, confined vs unconfined). Time work to avoid migration periods.
Wastewater Management	Change in water quality	Changes in nutrients, pathogens, contaminants, dissolved oxygen, temperature etc. can cause varying levels of effect on fish, ranging from behavioral to lethal.	Where applicable follow provincial or federal water quality standards.

PoE diagrams are an excellent way to show how stressors can be addressed through the application of mitigation measures in order to offset impacts to fish passage. The list of mitigation included in Table 1, highlights some of the more common measures used to address specific stressor(s), but by no means is it meant to capture the full range of possible options. By clearly communicating the key concerns, PoE's support a performance-based approach to achieving compliance with the *Fisheries Act*, and empower proponents to devise ways of avoiding effects which are economically and technically feasible.

In some situations mitigation measures may only partially alleviate a stressor, in which case the resultant effect(s) would be carried forward to the risk assessment phase (Section 2.2). A development proposal which avoids residual effects either through appropriate design and/or the application of mitigation measures, would rank low on the Scale of Negative Effect and by extension generally be considered Low Risk.

Effects on fish passage are not always negative. Restricting passage of certain species of fish may be necessary to prevent the spread of invasive species or to reduce competition between resident stocks. Similarly, preventing fish from entering a turbine or water intake would also be considered a positive residual effect.

FISH-WAYS AS MITIGATION

While fish-ways are included within the list of likely mitigation, construction of fish-ways or baffled culverts are generally considered a measure of last resort due to ongoing maintenance requirements and the level of expertise and monitoring required to ensure optimal performance. It is important that a professional engineer who is familiar with the design and operation of fish-ways be involved in reviewing these structures. This includes any design which involves the use of baffles, fish stops or diverters. Certain designs may only function well under a narrow range of flows and may be susceptible to debris accumulation, or sedimentation. In most cases monitoring and repeated modifications are required to ensure optimal effectiveness.

Attracting fish to upstream fish-ways or guiding them to downstream passage facilities are probably the most important design considerations for fish passage effectiveness. Flow management above and below obstructions is the key to attracting and guiding fish, particularly in larger rivers. For example, flow releases near a fish-way entrance are used to help migrants heading upstream to locate the facility. Providing directional flows can guide downstream migrants towards bypasses.

Structures, such as walls and louvers upstream or downstream of an obstruction, may also assist fish to locate passage systems. Several fish-ways, bypasses or multiple fish entrances for upstream or downstream movements, possibly at different locations in the horizontal or vertical directions, offer increased opportunities for fish to find upstream or downstream facilities at various water levels and flow patterns.

In some cases a large proportion of a weir or low head dam may be fish-navigable by design, making it more likely that fish will be able to locate the passable area without delay.

Based on the required expertise and the habitat impacts that are also likely associated with development proposals requiring fish ways, these mitigation options are generally reserved for larger development proposals such as dams or where fish-ways are being considered as a solution to problems associated with ongoing operations.

2.1.1 Establishing Fish Passage Objectives

Determining the species and life stage(s) of fish, for which passage is required, is often the most challenging and important aspects of risk managing effects. Fisheries management plans are generally considered the best source of information for both identifying target species and ratifying the various, and often competing, socio-economic interests which must be taken into account when setting fisheries management objectives. Some fisheries management plans may also provide specific policy guidance which relates directly to improving fish passage, or in some cases, maintaining barriers to prevent competition between native and non-native species.

In the absence of local fisheries management plans it is the Practitioner that is ultimately responsible for establishing fish passage objectives which make sense, and which can be supported by a reasonable explanation. In most cases this rationale should be developed in consultation with local fisheries management agencies.

Where data on fish communities is limited it is the proponent's responsibility to undertake inventories to determine what species and habitats are likely to be affected. Sampling may need to be done over an extended time period to accurately reflect seasonal use by migratory species.

An understanding of the species characteristics and their specific passage requirements at various lifestages (Table 2) is essential to set appropriate design criteria for any given development proposal.

Table 2: Species characteristics and their relevance in establishing specific fish passage design criteria

Species Characteristic	Description
Physical ability	Swimming capabilities such as burst, sustained and prolonged swimming speeds.
	Jumping ability enables a species to pass vertical barriers.
	Minimum water depth required to move past an obstruction.
	Crawling abilities of migratory crustaceans such as lobster and crab. Certain obstacles on the seabed may prevent the species from migrating between habitats.
	Requirement for damp surfaces to climb up and over barriers such as dams (e.g. juvenile American eel).
Migration times	Defined periods of time when the species is known to migrate. May reflect both daily and seasonal cycles of fish movement.
Behavioural limitations	Avoidance of darkened corridors.
	Reliance on sensory cues to find natal streams and spawning areas.
	Behavioural responses of marine mammals to such things as sound.

Species characteristics can in turn be used to set design criteria for such things as:

- the size of openings on fish screens,
- the velocity of water flowing across or through a screen or culvert,
- the minimum water depth flowing through or over a structure,
- the distance required between resting areas (e.g. culvert length, baffle spacing),
- the maximum height of a physical obstruction (e.g. sea lamprey barrier, pipeline lying on the seabed), and
- the timing and intensity of sound waves.

An alternative to setting fish passage objectives for specific species or lifestages of fish is to establish objectives which more generally apply to maintaining or simulating natural conditions. To use watercourse crossings as an example, one could assume, that by maintaining natural channel form and function throughout the crossing (i.e. the same substrates, channel profile, streambed roughness, low flow channel, and shallow stream margins), that the ability for all species of fish to pass will remain consistent with the pre-disturbance condition. This approach alleviates the need for intensive inventory data, flow predications or modeling to determine if specific thresholds (e.g. depth, distance, turbulence, velocity etc.) will be met.

2.2 RISK ASSESSMENT

The *Practitioners Guide to the Risk Management Framework* describes an approach for conducting Risk Assessments for residual effects affecting fish and fish habitat. This process characterizes the effects relative to their expected impact on productive capacity. The same process can be used to characterize fish passage effects as well. Rather than specifically trying to quantify productive capacity, fish passage objectives (Section 2.1.1) are generally used as a surrogate measure, to help rationalize decisions. For example, a development proposal which has a high likelihood of meeting the fish passage objectives would be characterized as Low Risk. An inability to meet the fish passage objectives would elevate the level of risk, and form the basis for requesting relocation or redesign. The level of risk may also increase due to a high level of uncertainty associated with predicting either the residual effects or in determining the sensitivity of fish and fish habitat. Depending on the nature of the impacts, it may be possible to authorize certain high risk development proposals conditional on monitoring and a commitment by the proponent to undertake any upgrades or modifications that might be required. This is often the case when approving fish-ways since monitoring and modification is often required to ensure optimal efficiency.

The Risk Assessment Matrix (Figure 2) is used to visually represent the concept of risk, using the two key variables of Sensitivity of Fish and Fish Habitat (x-axis) and Scale of Negative Effect (y-axis) as a basis for regulatory decision making.

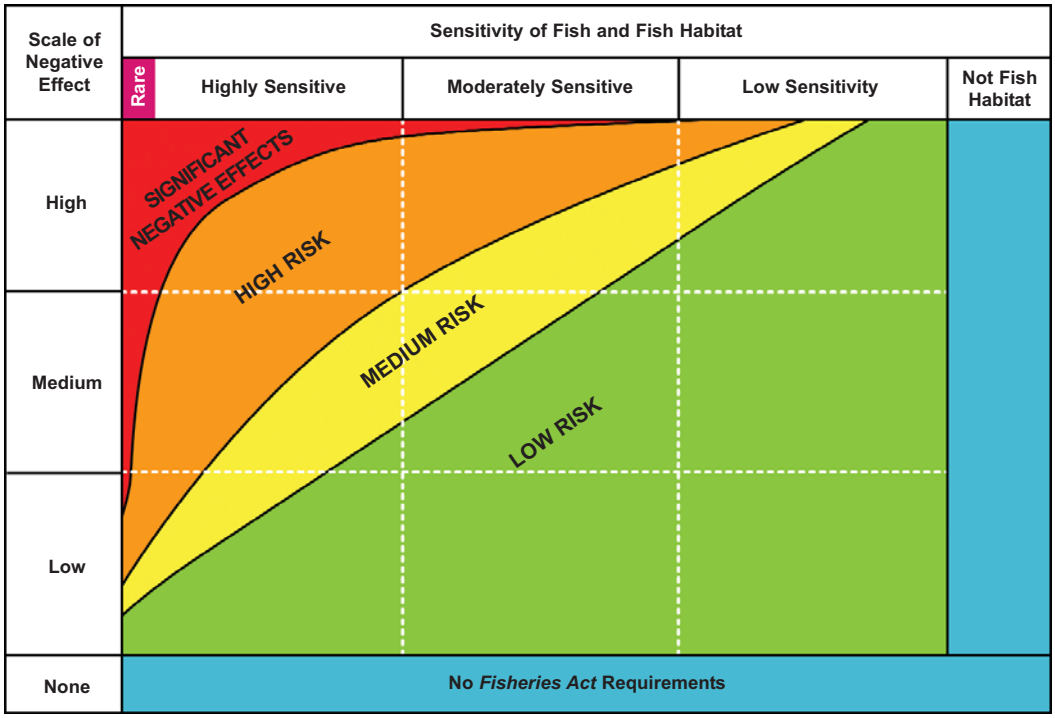

Figure 2: Risk Assessment Matrix

2.2.1 Scale of Negative Effect

The Scale of Negative Effect represents the outcome of the Pathways of Effects (PoE) analysis. The attributes listed in Table 3 can be used as a guide to help standardize the language used to describe effects on fish passage.

Table 3: Attributes used to describe the Scale of Negative Effect as it relates to fish passage

Attribute	Description to qualify the attributes	Examples of scales used (in increasing order)
Geographic Extent	The geographic extent represents the area of habitat being affected. This refers to the area upstream or downstream of an obstruction that fish fish may no longer be able to access.	Site or segment – localized effect Channel reach or lake region Entire watershed or lake
Duration	This can be used to describe how long the fish passage effect may persist. For example, fish passage effects associated with the construction phase of a development proposal, may only last for a few days, while certain structures (e.g. a dam, culverts etc.) may persist indefinitely.	Short term (days) Medium term (weeks-months) Long term (multiple years – permanent)
Intensity	The intensity of the effect should be described according to the type of species, life stage(s) and potentially, as in the case of entrainment, the size range of the fish affected. The potential duration of a migration delay. The total number of fish affected.	Days Weeks Months Tens (individuals) Hundreds Thousands (populations)

MIGRATION DELAY

A 3-day delay during a 1 in 10 year flow event is a threshold commonly used for establishing design criteria for watercourse crossings in certain parts of the country. The attribute 'Duration' describes the life expectancy of the proposal. In this case we could assume that the watercourse crossing will remain in place for an indefinite period of time (i.e. permanent). A 3-day delay once every 10 years describes the 'Intensity' of the effect. The 'Geographic Extent' refers to the amount of habitat upstream of the crossing that will be affected by the reduction in fish passage. Generally speaking this approach is reserved for situations where fisheries management objectives (i.e. fish passage objectives) focus on one or two key fish species. This approach also requires data on local fish populations, in order to establish the timing, lifestage(s) and corresponding size(s) of fish for which passage is required.

2.2.2 Sensitivity of Fish and Fish Habitat

The *Practitioners Guide to the Risk Management Framework* defines a series of attributes to describe fish and fish habitat sensitivities which include:

1. Species Sensitivity
2. Species' Dependence on Habitat
3. Rarity
4. Habitat Resiliency

By isolating specific considerations, that are generally accepted as being important to decision making, these attributes form the basis for describing Sensitivity of Fish and Fish Habitat in a consistent way. A great deal of professional judgment is often required to interpret what these attributes mean in terms of characterizing this axis, which again emphasizes the need for clear fish passage objectives (Section 2.1.1) in order to inform and support the ultimate conclusion.

2.2.3 Risk Assessment Matrix

The Risk Assessment Matrix uses the outcome of the Scale of Negative Effect and the Sensitivity of Fish and Fish Habitat analysis to characterize the level of risk the development proposal represents to fish and fish habitat. The Risk Assessment Matrix is an important communication tool, in that it helps proponents understand how decisions are made, and helps to illustrate how the level of risk can be reduced through relocation or redesign.

In some situations it may be necessary to assess fish passage risks in isolation of other effects such as fish mortality and impacts to fish habitat. However, final risk determinations for the proposed development can only be done once all fish and fish habitat effects have been considered.

2.2.4 Risk Management

Residual negative effects can be grouped into three broad categories - Fish Passage, Fish Mortality and Fish Habitat. These effects are managed through the application of specific sections of the *Fisheries Act* as outlined in Section 1.3. Table 4 summarizes which section of the *Fisheries Act* is to be used to manage effects on fish and fish habitat. Where more than one section of the *Fisheries Act* applies to a particular development proposal, regulatory efficiencies can be achieved by including the various regulatory conditions into one authorization.

Table 4: Sections of the *Fisheries Act* used to manage effects on fish and fish habitat

Type of Impact	EFFECTS			Appropriate *Fisheries Act* Section to manage effects
	Fish Habitat Sec 35	Fish Passage Sec 20, 21, 22 & 35	Fish Mortality Sec 21, 22, 30 & 32	
Destruction of Fish Habitat (e.g. large infilling)	✓			subsection 35(2)
Destruction of Fish Habitat and Impacts to Fish Passage (e.g. dam)	✓	✓		subsection 35(2)
Destruction of Fish Habitat and Impacts to Fish Passage and Mortality of Fish (e.g. hydroelectric facility)	✓	✓	✓	subsection 35(2)
Effects on Fish Passage Associated with Fish Mortality (e.g. hydroelectric turbine)		✓	✓	subsection 32
Fish Mortality Without Effects on Fish Passage or Habitat (e.g. use of explosives)			✓	Section 32
Ongoing Effects on Fish Passage Associated with a Dam, Perched Culvert or other Permanent Obstruction		✓		Section 20
Ongoing Fish Mortality Associated with Entrainment of Fish			✓	Section 30 or 32

APPENDIX A

3.0 DEFINITIONS

Anadromous refers to fish that spend most of their life in saltwater but migrate to freshwater to spawn. Salmon, trout and Arctic char that live in the ocean are prime examples of anadromous species.

Catadromous refers to fish that spend most of their life in freshwater but return to saltwater to spawn. The only North American catadromous species is the American eel.

Compensation refers to the replacement of natural habitat, increase in the productivity of existing habitat, or maintenance of fish production by artificial means in circumstances dictated by social and economic conditions, where mitigation techniques and other measures are not adequate to maintain habitats for Canada's fisheries resources (Policy for the Management of Fish Habitat, 1986).

Diadromous refers to those fish species that migrate between freshwater and saltwater. This category includes both anadromous and catadromous fishes.

Entrainment occurs when a fish is drawn into a water intake and cannot escape.

Fish includes "parts of fish, shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals." (*Fisheries Act*, Section 2)

Fish Passage is defined as the free transit of fish, upstream and downstream, associated with migration or localized movements that are necessary to complete their life cycle. Depending on the context, fish passage is also a route for fish to move between habitat types.

Fish-ways provide the means to enable fish to pass around or through an obstruction. This definition encompasses a wide variety of methods or activities for conveying fish including conventional fish ladders, fish locks, fish conveyors, trapping and trucking operations, culverts, and bypasses. A fish-way does not necessarily refer to a physical structure and could also include a channel or any passage used by fish to pass over or around an obstruction.

Fish Habitat means spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes (*Fisheries Act*, Section 34(1)(e)).

Impingement occurs when an entrapped fish is held in contact with a structure like a trashrack or an intake screen and is unable to free itself.

Migration is the spatial and temporal movement between spawning, feeding, and refuge habitats in response to genetic or environmental stimuli.

Mitigation includes actions taken during the planning, design, construction and operation of works or undertakings to alleviate potential adverse effects on the productive capacity of fish habitats (Policy for the Management of Fish Habitat, 1986).

APPENDIX B

4.0 SECTIONS OF THE *FISHERIES ACT* THAT PERTAIN TO FISH PASSAGE

Section 20(1) (1868)

Every obstruction across or in any stream where the Minister determines it to be necessary for the public interest that a fish-pass should exist shall be provided by the owner or occupier with a durable and efficient fish-way or canal around the obstruction, which shall be maintained in a good and effective condition by the owner or occupier, in such place and of such form and capacity as will in the opinion of the Minister satisfactorily permit the free passage of fish through it.

Section 20(2) (1932)

Where it is determined by the Minister in any case that the provision of an efficient fish-way or canal around the obstruction is not feasible, or that the spawning areas above the obstruction are destroyed, the Minister may require the owner or occupier of the obstruction to pay to him from time to time such sum or sums of money as he may require to construct, operate and maintain such complete fish hatchery establishment as will in his opinion meet the requirements for maintaining the annual return of migratory fish.

Section 20(3) (1868)

The place, form and capacity of the fish-way or canal to be provided pursuant to subsection (1) must be approved by the Minister before construction thereof is begun and, immediately after the fish-way is completed and in operation, the owner or occupier of any obstruction shall make such changes and adjustments at his own cost as will in the opinion of the Minister be necessary for its efficient operation under actual working conditions.

Section 20(4) (1868)

The owner or occupier of every fish-way or canal shall keep it open and unobstructed and shall keep it supplied with such sufficient quantity of water as the Minister considers necessary to enable the fish frequenting the waters in which the fish-way or canal is placed to pass through it during such times as are specified by any fishery officer, and, where leaks in a dam cause a fish-way therein to be inefficient, the Minister may require the owner or occupier of the dam to prevent the leaks therein.

Section 21(1)

The Minister may authorize the payment of one-half of the expense incurred by an owner or occupier in constructing and maintaining any fish-way or canal and, after a fish-way or canal that has been duly approved by the Minister has been built at the cost of the owner or occupier of any obstruction, or after the owner or occupier has paid one-half the cost thereof and the fish-way or canal thereafter proves to be ineffective, the total cost of any change in the fish-way or canal or any new fish-way or canal required to enable the fish to pass by the obstruction shall, except as provided in subsection 20(3), be paid by Her Majesty.

Section 21(2)

The Minister, in order to procure the construction of any fish-way or canal, pending proceedings against any owner or occupier for the punishment imposed by this Act, may make and complete the construction forthwith, and may authorize any person to enter on the premises with the necessary workmen, means and materials for that purpose and may recover from the owner or occupier the whole expense so incurred by action in the name of Her Majesty.

Section 21(3)

Where an unused obstruction or a thing detrimental to fish exists and the owner or occupier thereof does not after notice given by the Minister remove it, or if the owner is not resident in Canada, or his exact place of residence is unknown to the Minister, the Minister may, without being liable to damages, or in any way to indemnify the owner or occupier, cause the obstruction or thing detrimental to fish to be removed or destroyed and, where notice has been given to the owner or occupier, may recover from the owner or occupier the expense of the removal or destruction.

Section 21(4) (1932)

The Minister may require the owner or occupier of any obstruction to install and maintain such fish stops or diverters, both above and below the obstruction, as will in his opinion be adequate to prevent the destruction of fish or to assist in providing for their ascent.

Section 22(1)[1]

At every obstruction, where the Minister determines it to be necessary, the owner or occupier thereof shall, when required by the Minister, provide a sufficient flow of water over the spill-way or crest, with connecting sluices into the river below, to permit the safe and unimpeded descent of fish.

Section 22(2)[1] (1932)

The owner or occupier of any obstruction shall make such provision as the Minister determines to be necessary for the free passage of both ascending and descending migratory fish during the period of construction thereof.

Section 22(3)[1]

The owner or occupier of any obstruction shall permit the escape into the river-bed below the obstruction of such quantity of water, at all times, as will, in the opinion of the Minister, be sufficient for the safety of fish and for the flooding of the spawning grounds to such depth as will, in the opinion of the Minister, be necessary for the safety of the ova deposited thereon.

Section 30(1) (1886)

Every water intake, ditch, channel or canal in Canada constructed or adapted for conducting water from any Canadian fisheries waters for irrigating, manufacturing, power generation, domestic or other purposes shall, if the Minister deems it necessary in the public interest, be provided at its entrance or intake with a fish guard or a screen, covering or netting so fixed as to prevent the passage of fish from any Canadian fisheries waters into the water intake, ditch, channel or canal.

Section 30(2) (1886)

The fish guard, screen, covering or netting referred to in subsection (1) shall
(a) have meshes or holes of such dimensions as the Minister may prescribe; and
(b) be built and maintained by the owner or occupier of the water intake, ditch, channel or canal referred to in subsection (1), subject to the approval of the Minister or of such officer as the Minister may appoint to examine it.

Section 30(3) (1886)

The owner or occupier of the water intake, ditch, channel or canal referred to in subsection (1) shall maintain the fish guard, screen, covering or netting referred to in that subsection in a good and efficient state of repair and shall not permit its removal except for renewal or repair.

Section 30(4) (1886)

During the time in which a renewal or repair referred to in subsection (1) is being effected, the sluice or gate at the intake or entrance of the water intake, ditch, channel or canal shall be closed in order to prevent the passage of fish into the water intake, ditch, channel or canal.

Section 32[1]

No person shall destroy fish by any means other than fishing except as authorized by the Minister or under regulations made by the Governor in Council under this Act.

Section 35(1) (1976)

No person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat.

Section 35(2)[1] (1976)

No person contravenes subsection (1) by causing the alteration, disruption or destruction of fish habitat by any means or under any conditions authorized by the Minister or under regulations made by the Governor in Council under this Act.

Section 66

Every owner or occupier of an obstruction across or in any stream who refuses or neglects to provide and maintain a fish-way or canal in accordance with section 20, to install and maintain fish stops or diverters in accordance with subsection 21(4) or to provide for a sufficient flow of water and the free passage of fish in accordance with section 22 is guilty of an offence punishable on summary conviction and liable, for a first offence, to a fine not exceeding two hundred thousand dollars and, for any subsequent offence, to a fine not exceeding two hundred thousand dollars or to imprisonment for a term not exceeding six months, or to both.

Section 67(1)

Where the Minister determines that the provision, which he deems necessary for the public interest, of an efficient fish-way or canal around any obstruction is not feasible or that the spawning areas above the obstruction are destroyed by reason of the obstruction, the owner or occupier of the obstruction shall from time to time pay to the Receiver General such lump sum or annual sum of money as may be assessed against the owner or occupier by the Minister for the purpose of constructing, operating and maintaining such complete hatchery establishment as will, in the opinion of the Minister, meet the requirements for maintaining the annual return of migratory fish.

Section 67(2)

The lump sum or annual sum referred to in subsection (1) shall be payable at such time or times as the Minister may direct and may be sued for and recovered with full costs of suit in the Federal Court.

[1] This section of the *Fisheries Act* is on the Law List Regulations of *Canadian Environmental Assessment Act*. Generally DFO is required to ensure that an environmental assessment is conducted before considering exercising this provision.