

# A Guide to Community-Based Compensatory Fish Habitat Monitoring



Pacific Salmon Foundation  
2010

Developed by Pacific Salmon Foundation in collaboration with Adamah Consultants



Vision: To achieve healthy, sustainable and naturally diverse Pacific salmon stocks.

Mission: To conserve and rebuild Pacific salmon populations through strategic and focused efforts where people and resources are mobilized to work together to achieve common goals.

<http://www.psf.ca/>



The word Adamah is rooted in the Hebrew language (Adam – man, Adamah – earth) and is interpreted as the “arable land from which man was made”. At its roots lies the recognition of our species intrinsic connection to the earth and the inherent responsibility to protect and sustain it.

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## PREFACE

British Columbia is endowed with some of the richest and most biodiverse aquatic ecosystems in the world, supporting one of the most iconic species: the Pacific salmon.

Pacific salmon are bioindicators and keystone species in our coastal watersheds. Their significant spiritual, cultural and economic value is recognized by the public and enshrined in law.

Hundreds of stewardship groups and tens of thousands of volunteers are actively involved in salmon enhancement and habitat conservation and rehabilitation in BC through the Fisheries and Oceans Canada (DFO) Salmon Enhancement Program.

Along with conservation and rehabilitation, monitoring is another critical activity of community-based watershed stewardship groups in BC.

The objectives and responsibilities of monitoring vary greatly.

A Guide to Community-Based Compensatory Fish Habitat Monitoring has been developed for community-based groups already working in partnership with DFO and or BC Ministry of Environment.

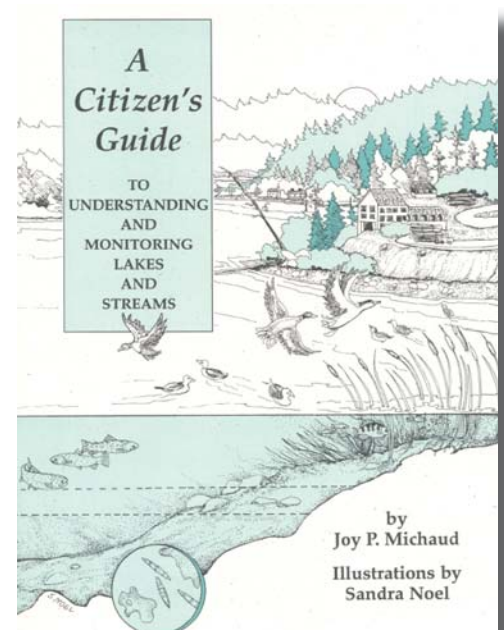
This guide will assist groups to determine if their organization possesses the skills, capacity and liability coverage to enter into a long-term agreement to undertake compensatory fish habitat monitoring.

Compensatory fish habitat monitoring is legally binding. A tri-partied agreement results when this activity occurs between the regulator, usually DFO, the project proponent and a community group.

Where early agreements were piloted important successes and challenges were noted that provided the catalyst for this guide.

This guide provides information on monitoring types and the roles of the three parties, and identifies some of the skills and project supports necessary for success to help a community-based group determine what level of involvement in compensatory fish habitat monitoring they could commit to.

This Guide is a living document which will evolve through its use and your comments and recommendations resulting from your experience with Community-Based Compensatory Fish Habitat Monitoring.



*A Citizen's Guide to Understanding and Monitoring Lakes and Streams is an excellent example of the resource developed for community use*

## INTRODUCTION

### WHY A GUIDE TO COMMUNITY-BASED FISH HABITAT MONITORING?

Senior agencies such as Fisheries and Oceans Canada (DFO), and other relevant federal and provincial ministries oversee a complex suite of acts, regulations and policies that govern fish and fish habitat management, conservation and protection.

Within this regulatory framework impacts to fish habitat can be authorized<sup>1</sup>. Such authorizations, taken after all measures to avoid or mitigate damage to habitat have been explored, may allow for harmful alteration, disruption or destruction (HADD) to fish habitat. Compensatory fish habitat flows out of these authorizations as a means to meet federal habitat management policy requirements such as the No Net Loss-Net Gain Guiding Principal.

When compensatory fish habitat is an outcome there is a need to ensure that it complies with the terms of the authorization in size and function. This may include replacing or substituting appropriate, suitable natural functions and services lost through the HADD.

A Guide to Community-Based Compensatory Fish Habitat Monitoring has been developed for existing experienced community-based groups who have been offered an opportunity to enter into a tri-partied compensatory fish habitat monitoring agreement.

This agreement would be between the group, DFO and the project proponent. The proponent could be a developer, road construction company, another level of government or a not for profit organization.

Ideally the monitoring project would be in the community group's watershed or geographic area of involvement.

The monitoring agreement would be offered to the community group only in situations where the proponent fully supports their involvement. The group would be contracted by or partnered with the proponent to undertake the monitoring activity. DFO, as the regulator issuing the authorization, will continue to play a role in the monitoring process that will be defined in the agreement.

There is a long history of successful partnerships between DFO and the stewardship community and between both of these parties and project proponents. Compensatory fish habitat monitoring is an emerging opportunity that brings together the regulator, the project proponents and the public in a way that builds upon past success while working to increase future watershed stewardship commitment through new opportunities.

This guide has been developed to provide information that will assist a community-based group to ask the necessary questions or to seek additional information to help them determine if they will enter into a monitoring agreement.



Where does our group fit into the compensatory fish habitat monitoring mosaic?

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<sup>1</sup> For a detailed breakdown of the regulatory framework governing fisheries habitat compensation please refer to APPENDIX 1

## THE GUIDE

The content of this guide has been designed to help established community-based stewardship groups determine if they have the capacity to enter into a regulatory induced monitoring agreement, and can take on the additional long-term responsibilities such an agreement would entail.

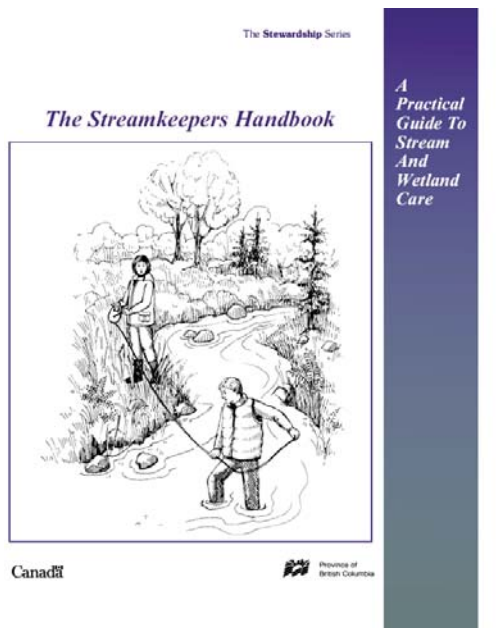
The goals and objectives of monitoring types vary greatly. This guide will highlight the similarities and differences between the routine monitoring you may already be engaged in and compensatory fish habitat monitoring. Primarily this guide will help you:

- ◆ Identify and evaluate the pros and cons of becoming a Community-based Monitor (CBM)
- ◆ Identify questions that need to be answered by a group to determine if they have the capacity, resources, commitment, expertise and longevity
- ◆ Understand the obligations, responsibilities and liability associated with an agreement
- ◆ Identify questions that need to be answered among monitoring agreement partners (e.g. scope of the works, documenting data, reporting, gear and equipment, timelines, budget, default or dispute resolution)

## BUILDING ON EXISTING RESOURCES

You are one of the hundreds of community volunteer groups throughout BC, actively engaged in watershed conservation and restoration. You have received training and are familiar with the key foundation pieces available to you through the “Keeper” series. You may already be involved in ‘routine’ watershed monitoring.

The Streamkeepers methodologies you are currently using in your monitoring are the starting point of this guide. These methodologies and the Streamkeepers Program have been developed and are supported by Fisheries and Oceans Canada and the Province of BC as repeatable, scientifically defensible protocols that have the necessary foundations for routine watershed monitoring.



Streamkeepers, Wetlandkeepers and Shorekeeper's handbooks and training modules are readily available

As such, your skills as a Streamkeeper are highly transferable to new challenges and opportunities, including compensatory fish habitat monitoring. Combined with local and traditional knowledge you possess the key components for undertaking the advanced activities compensatory fish habitat monitoring will require.

One of the first questions you may ask yourself is “why would I want to accept this additional work and responsibility?” The most important response to this question is that the fish, wildlife and the habitat they depend on will be the beneficiary.



## SECTION ONE

### MONITORING TYPES

There are different types of monitoring that are part of a typical monitoring program. Of these **Effectiveness**, **Compliance** and **Trend** monitoring form the bulk of compensatory fish habitat monitoring in relation to DFO's activities. Table 1 provides an overview of the range of opportunities where volunteer groups could bring their local knowledge and skills to a compensatory fish habitat monitoring project. Table 2 provides a more detailed breakdown of where and how community-based monitors can derive the greatest efficiency and effectiveness from their involvement.

**TABLE 1. Range of Monitoring 'Types'<sup>2</sup>**

MONITORING CATEGORY	INTENDED MEASURE	EXAMPLE ACTIVITY	ROLE OF COMMUNITY-BASED VOLUNTEER MONITORS (CBM)
<b>ROUTINE MONITORING</b>	Changes over time and current conditions - accurately with coarse precision	<ul style="list-style-type: none"> <li>◆ Basic water quality measurements: conductivity, pH, dissolved oxygen (DO), turbidity, temperature</li> <li>◆ Species presence/utilization: invertebrates, vegetation, fish and wildlife, invasive species</li> <li>◆ Habitat and stream assessments</li> </ul>	The CBM is the best fit for this role, groups usually have baseline, pre-project and long-term monitoring data
<b>EFFECTIVENESS MONITORING</b>	Changes over time	<ul style="list-style-type: none"> <li>◆ Characterize and document the conditions of the area or species present before compensation works commence</li> <li>◆ Look at changes beyond site specific level to the broader area over time</li> <li>◆ Measure and document possible indirect cause and effect relationships</li> </ul>	The CBM can work in partnership with agency staff and Qualified Environmental Professionals (QEP's) to undertake the routine monitoring in either the control watershed or the project watershed (additional resources or training may be required)
<b>TREND MONITORING</b>	<p>Changes over time prior to, during and after works are completed, and current conditions - accurately with coarse precision</p> <p>Usually overlaps with effectiveness and compliance monitoring</p>	<ul style="list-style-type: none"> <li>◆ Characterize and document the conditions of the area or species present before compensation works commence.</li> <li>◆ Look at changes not just at the site specific level but to the area over time.</li> <li>◆ Measure and document possible indirect cause and effect relationships.</li> </ul>	The CBM can undertake limited monitoring to assist agency staff and QEP as directed due to scale, accessibility and regulatory responsibilities
<b>COMPLIANCE MONITORING</b>	Current conditions, accurately with fine precision	<ul style="list-style-type: none"> <li>◆ Determine if the proposed or approved works were undertaken and completed in compliance with conditions of authorization or approvals</li> </ul>	The CBM can undertake limited monitoring to assist agency staff and QEP as directed, based on scale, accessibility and regulatory responsibilities

<sup>2</sup> Derived from the California Environmental Protection Agency's State Water Resources Control Board State Monitoring Working Group [http://www.swrcb.ca.gov/rwqcb3/board\\_info/agendas/2004/dec/item31\\_attach9.pdf](http://www.swrcb.ca.gov/rwqcb3/board_info/agendas/2004/dec/item31_attach9.pdf)

**TABLE 2. Most Applicable Monitoring Types, Proficiency Areas and Links to Streamkeepers Modules**

MONITORING TYPE (from Table 1)	DESIRED PROFICIENCY AREA	STREAMKEEPERS HANDBOOK MODULE NUMBER
ROUTINE MONITORING	Ability to undertake baseline survey of habitat conditions, photo documentation, basic water quality measurements, invertebrate surveys, fish sampling and identification, wildlife and livestock interactions, native plant restoration, basic fish habitat enhancement techniques	1,2,3,4,11, 12 and 14
EFFECTIVENESS MONITORING	Ability to undertake baseline survey of habitat conditions, photo-point monitoring, fish sampling and identification, wildlife interactions, native plant restoration, basic fish habitat enhancement techniques, identification of invasive species	1,2,7,8,11,12,14,16 (if assisting agency staff or QEP)
TREND MONITORING	Ability to undertake baseline survey of habitat conditions, photo documentation, basic water quality parameters (dissolved oxygen, pH, turbidity), invertebrate surveys, fish sampling and identification, wildlife interactions, native plant restoration, basic fish habitat enhancement techniques	1,2,3,4,7,11,12,14 and 16 (if assisting agency staff or QEP)

Streamkeepers Program, training information and the handbook available at: <http://www.pskf.ca/>

**Module 1: Introductory Stream Habitat Survey:** <http://www.pskf.ca/mod01/index.html>

**Module 2: Advanced Stream Habitat Survey:** <http://www.pskf.ca/mod02/index.html>

**Module 3: Water Quality Survey:** <http://www.pskf.ca/mod03/index.html>

**Module 4: Stream Invertebrate Survey:** <http://www.pskf.ca/mod04/index.html>

**Module 7: Streamside Planting:** <http://www.pskf.ca/mod07/index.html>

**Module 8: Streamside Fencing:** <http://www.pskf.ca/mod08/index.html>

**Module 11: Juvenile Fish Trapping and Identification:** <http://www.pskf.ca/mod11/index.html>

**Module 12: Salmonid Spawner:** <http://www.pskf.ca/mod12/index.html>

**Module 14: Stream Channel Improvement:** <http://www.pskf.ca/mod14/index.html>

**Module 16: Controlling Beavers:** <http://www.pskf.ca/publications/beavers.html>

## **SECTION TWO**

### **ROLES AND RESPONSIBILITIES**

Each level of government has specific authority or responsibility to develop, enforce or oversee legislation and regulations, including bylaws, which affect land use and the environment.

Both the Federal and Provincial governments are moving toward ecosystem-based management which is reflected in the development, approval and monitoring of fish habitat compensation projects. Each are looking at the long-term impacts a project may have at the ecosystem level to other species such as small mammals, amphibians, reptiles and birds<sup>3</sup> and to processes such as flow regimes, surface and groundwater interactions and so on<sup>4</sup>.

#### **Federal Government**

DFO is the federal agency most often involved in the HADD approval process and the development of compensatory fish habitat. The Department receives this authority and responsibility through 14 acts, the most relevant to compensatory habitat being the Fisheries Act and the Species at Risk Act.

The Pacific Region has Salmon Enhancement Program (SEP) Community Advisors who are a community-based group's one window- first point of contact to the department and compensatory habitat monitoring opportunities.

#### **Provincial Government**

The Province of BC, usually represented by the Ministry of Environment, can also be part of the review and or approval process. Provincial authorities participate to ensure conflicts with provincial legislation and regulations are avoided such as provincial environmental, wildlife and water acts.

The provincial "Develop with Care" series and "Interim Standards and Best Practices for Instream Works" provide a comprehensive and detailed companion to DFO's resources<sup>5</sup>.

#### **Regional and Municipal Government**

Regional districts and municipal governments currently have the greatest influence on land use designations and zoning. These levels of government are key authorities in the review and permitting of land use activities on private land which generates the majority of fish habitat compensation projects.

Some municipalities have Environmental Review Committees (ERC's) that meet regularly with other levels of government, development proponents and their consultants and city staff to review and discuss land use issues and development proposals. Community groups may be asked to participate as a representative of local community and stewardship interests.

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3 [http://www.cielap.org/pub/pub\\_biodivlaw.php](http://www.cielap.org/pub/pub_biodivlaw.php)

4 [http://www.ec.gc.ca/WATER/en/policy/prov/e\\_prov.htm](http://www.ec.gc.ca/WATER/en/policy/prov/e_prov.htm)

5 [http://www.env.gov.bc.ca/wld/documents/bmp/devwithcare2006/develop\\_with\\_care\\_intro.html](http://www.env.gov.bc.ca/wld/documents/bmp/devwithcare2006/develop_with_care_intro.html), <http://www.env.gov.bc.ca/wld/BMP/standards.html>, <http://www.env.gov.bc.ca/wld/BMP/index.html>

## First Nations

First Nations (FN) have a constitutional right and a historic legal entitlement to access, use and trade of fish and other natural resources. They are also to be consulted on their use by others. When a group is approached to participate in community-based compensatory fish habitat monitoring they should ensure that the FN on whose traditional land the project is sited has been consulted. Monitoring projects can build strong relationships between stewardship groups and FN as it is an opportunity to share or combine FN traditional knowledge with community local knowledge to increase the effectiveness of the compensatory habitat for the long term.

## Qualified Environmental Professionals (QEP's)

Many community-based groups have worked with qualified environmental professionals (QEP's) for a number of years. They are professionals who are accredited by a professional body such as Registered Professional Biologists, Professional Engineers, Hydrologists, Geoscientists, Agrologists and Forestry Professionals.

In many cases QEP's may have been involved in the development of the compensatory fish habitat project to be monitored.

As professionals QEP's are insured for projects they are involved in. This is an important asset as liability can potentially be the limiting factor that determines if a community group will enter into a monitoring agreement or not.

QEPs can be a valuable project partner providing professional oversight, equipment and assisting in developing credible monitoring and reporting programs.

While a QEP often moves on once their requirements for project involvement concludes, a positive partnership between a community group and a QEP can leave an organizational legacy of new skills and competencies.

## Citizens

Community involvement in watershed stewardship is critically important for long-term conservation and protection of our watersheds. Senior agencies, land use decision makers and QEP's gain much from working with community groups and/or local specialists. They can provide a diligent and constant set of eyes and ears, frequent and long-term data collection as well as providing continuity and longevity for a project or place.

CBM's work hard to engage, inform and develop partnerships with others to increase the organization's and the public's capacity to understand and take action. This can reduce issue-based conflicts. Inclusion of traditional and local knowledge can be a vital source of information and increase the sense of ownership, understanding and support for conservation and restoration efforts among the broader community.

Training, concise and consistent standards, appropriate tools and new resources will enable community-based groups to be an effective, credible and complimentary monitoring resource.



## SECTION THREE

### YOUR MONITORING PROGRAM

#### What are We Monitoring?

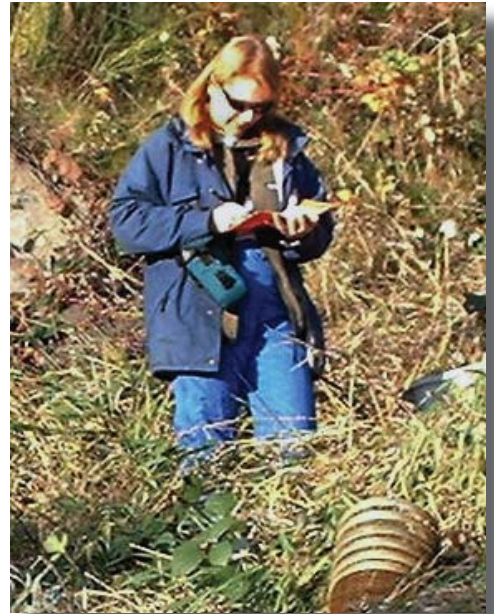
Monitoring programs consist of gathering data linked to pre-determined indicators. Monitoring compensatory fish habitat does this by monitoring indicators determined in the authorization. Monitoring and reporting the findings help ensure that over time the works provide productive replacement habitat for fish, to the degree of quality and quantity of habitat identified in the HADD approval. If it is found that the works do not achieve the required results, monitoring will result in these issues being identified and reported. This will then trigger efforts to remediate or 'fix' the problem.

Community-based monitoring of compensatory fish habitat goes beyond reporting on the indicators or attributes set out in a monitoring agreement, such as how many trees and shrubs survived their first year or how much woody debris was installed and whether it remained in place. Compensatory fish habitat monitoring will link to the routine watershed monitoring an organization is already engaged in and may provide information such as how other species, are interacting with the compensatory habitat. Ecosystems are dynamic living systems and there are many variables that can affect the success of compensatory habitat, as it is not isolated within a watershed.

Community-based monitors are engaged in a watershed beyond the project site. The compensatory habitat will be the beneficiary of this broader interest and local knowledge: the big picture effect. Thus compensation habitat, once the monitoring phase has ended, can be expanded or augmented as community stewardship groups consider them in their watershed scale land use plans, local and community values or social context (Kay 2001).

#### Monitoring Toolbox

To assist in answering the key questions of what you will need if you are considering entering into the role of community-based monitor there are core 'essentials' that need to be in place prior to undertaking any activities. Several resources and references cited in this guide provide excellent direction on the necessary materials, training and requirements monitoring activities require<sup>6</sup>. For the most part, this entails standard field equipment and practices that will be familiar to many stewardship or community based organizations; however, it also requires gathering background information and details about the project such as maps, schematics, photos and of course understanding the nature of the fish compensation habitat authorization and the approvals itself.



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<sup>6</sup> Examples include Module 1-4 and 14 of the Streamkeepers handbook, and the US Environmental Protection Agency's volunteer monitoring series at: <http://www.epa.gov/volunteer/>

The most frequently needed tools and resources for monitoring (and not just for compensatory fish habitat) can be broadly grouped under the following categories:

- ◆ Field observation and data gathering/recording
- ◆ Testing and sampling
- ◆ Reporting
- ◆ Safety

Each one of these categories has numerous components. A summary of necessary resources and a detailed monitoring toolkit checklist is provided in Appendix 2: Tables 5.



Community based monitoring can start at an early age, youth can provide assistance in long-term monitoring and participants obtain valuable skills!

## SECTION FOUR

### DECISION MAKING

Undertaking a long-term commitment in the arena of legally required activities such as compensatory fish habitat monitoring may be a huge step beyond your group's traditional activity or role in a watershed. Many groups have most of the gear, some of the skills, but not quite enough capacity nor the proper insurance to accept all opportunities or all aspects of a full compensatory monitoring agreement; however, they may be able to carve off the portion that is appropriate for them and to enter into an agreement to do only that specific work. The other parties -DFO and the proponent - can contract separately for the project elements your group determines it does not want to take on.

The key issues for you and your organization are the need to understand and assess the scope, commitments and limits of community involvement in a long-term monitoring project. This includes:

- ◆ Insurance and advice regarding liability (may be a main determining factor)
- ◆ Skills and training your group will need or need to contract
- ◆ Equipment, maintenance and storage
- ◆ Capacity and level of commitment (individually or collectively)
- ◆ Resources to address commitments over the life of the project.

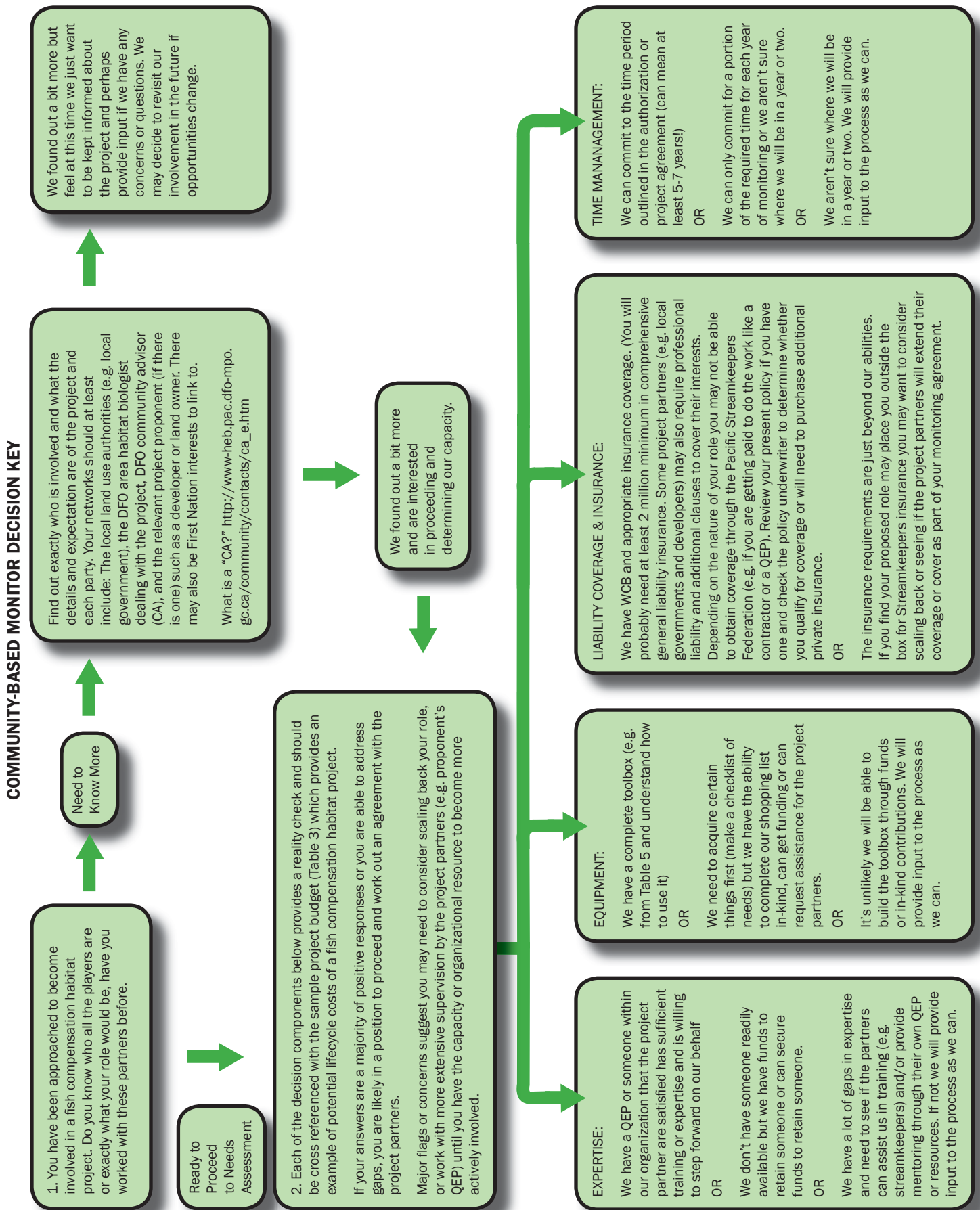
Identifying all the gaps, potential challenges, who is responsible for what and for how long needs to be determined up front. The necessary resources and skills need to be in place prior to commencement in order to ensure success.

Asking and answering these questions while also recognizing individual and organizational limits will be key to initiating a successful monitoring program. Figure 1 on the following page provides a sample decision key and gap analysis, typical expectations of costs and time commitments are provided in Table 3. But don't be daunted or overwhelmed when you see the long list of what is required – it isn't all or nothing!

Community-based monitoring is a collaborative venture within an organization as well as between the organization and a QEP or other assisting professional.



**FIGURE 1. Monitoring Decision Key and Gap Assessment Matrix**



**TABLE 3. Compensatory Fish Habitat Monitoring: Sample project lifecycle budget**

(Based on CBM providing expertise through Streamkeepers Methodology and Skills, partnered management and consulting QEP to set up monitoring plan)

DESCRIPTION OF WORKS (example)	Monitor and confirm degree/size of HADD, fish presence, soil/slope stability of the compensation works, wetted and upland planting survival and volunteer plant community, planting donor sites, remediation of site to improve effectiveness of fish habitat, invasive species			
EXPERTISE NEEDED	Expertise with Streamkeepers methodology, plant identification, fish identification, video/camera photo-monitoring, analysis and reporting			
SERVICES	Rate/Day (\$) Includes HST	Days per Annum	Term 5 year (\$)	In-Kind Volunteer
Management fee - Group fee per month for undertaking works, attending meetings and consultations, keeping abreast of changing methodologies, issues and opportunities	200	12	12000	
Biologist, Consultant, Monitoring Design Yr 1	900	3	2700	
Biologist, Consultant, Monitoring Design Yr 3, Monitoring Techniques Refresher	900	2	1800	
Engineer Confirm HADD Footprint Yr 1	1100	2	2200	
Analysis and Reporting, Biologist Consultant Yr 1	900	3	2700	
Videographer/photographer, first year to train community-based groups, volunteers	600	1	600	
Community-based group volunteer in-kind 4 persons per field days, valued at 15.00 per hour	120	12		28,800
Community-based groups, volunteers - In-kind 1 person - reporting	120	3	1800	
SUPPLIES AND MATERIALS				
Transportation/travel, volunteers	100	12	6000	
Communications and Documentation	1000		1000	
Field Gear - Volunteers 4	2500		2500	
Supplies and Materials	1000		1000	
<b>Project Insurance</b> (may be higher)	1500		7500	
STEWARDSHIP TRAINING				
Training and Mid Term Refresher - 4 persons	50		1000	
Total Estimate			35800	
Contingency 10%			3600	
Quote			<b>42,800</b>	<b>28,800</b>
QEP and Professional Rates: Range	HIGH (\$)	LOW (\$)		
Management	1120	700		
Biologist	1100	600		
Monitoring Design	1100	600		
Engineer	1550	750		
Reporting	1000	820		
Technician	500	400		
Labour	300	200		

This is an estimate intended to inform a community group of the potential costs to include in their quote to undertake monitoring

## WHERE DO I GO FROM HERE?

This guide has been developed to provide your community stewardship organization with the essential information to help inform your decision making process regarding a long-term commitment to monitor compensatory fish habitat.

There are a many resources referred to in this guide that are readily available, plus a range of training opportunities that can be arranged through organizations such as the Pacific Streamkeepers Federation, your DFO Community Advisor or local QEP.

Your roles and responsibilities as CBM's may extend for a lengthy period. Most HADD authorizations cover at least five years and often have options for additional years which may be required depending on the changing conditions and success of a compensation project. Invasive plants, wildlife damage, natural processes and unforeseen events can impact a project's success. However by documenting and reporting these issues you as the CBM provide an opportunity for timely remediation which will ultimately increase success of compensatory fish habitat in BC.

If you choose to extend your existing works to include regulatory monitoring it is best done, as are your other projects, as a collaborative partnership with other organizations, agencies and the private sector. This can expand your organization's skill sets, help to relieve volunteer exhaustion or burnout, increase your essential safety and reduce liability issues.

Your organization's experience and achievements will become part of the growing body of projects and case studies that inform other groups and demonstrate to agencies and the public that this is a natural next step for an experienced community-based watershed stewardship group.



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## GLOSSARY

The list below is derived from the Streamkeeper's Handbook and the "Glossary of Construction and Engineering Technology" developed by Al Jonsson of DFO.

**Acid rain:** rainwater carrying acidic atmospheric pollutants (nitrous or sulfuric oxides)

**Acid:** substance with pH less than 7.0; acidity is caused by high concentrations of hydrogen ions

**Aggrade:** to increase channel elevation by sediment accumulation.

**Aggregate:** sand, gravel etc mixed with cement to form concrete.

**Alevin:** newly hatched fish with yolk sac attached, larva

**Alkaline:** substance with pH greater than 7.0; alkalinity is caused by high concentrations of hydroxylions; basic

**Alluvial:** native aggregates deposited by water flow

**Anadromous fish:** fish that migrate from salt water to fresh water for spawning

**Apron:** a smooth (generally concrete) surface that is placed between culvert and channel to improve capacity and reduce erosion.

**Aquatic insect:** insect species whose larval stages live in water

**Aquatic:** refers to water

**Archimedes screw:** type of pump that looks like an angled corkscrew.

**Articulated rock truck:** a four-wheel drive dump truck with heavy duty tapered box and pivoting connection between cab and box.

**At grade:** at the local ground elevation.

**Axial flow:** type of pump that acts like an outboard motor in a casing.

**Backhoe:** a rubber tired vehicle with loader bucket in front and small excavator bucket at back.

**Backwater:** to place a culvert or use a weir such that there will always be some depth of water within the culvert.

**Ball & Burlap:** packaging method for field grown trees – root balls are wrapped in burlap and bound with string, wire etc.

**Bar scalping/skimming:** to remove a thin layer (1-5') from the top of gravel bars.

**Basic:** alkaline

**Batch plant:** local facility for preparation and distribution of concrete.

**Bedding:** fine gravel or crushed rock placed around culverts to evenly distribute load.

**Bedload:** coarse aggregates carried by flowing water (rolled or bounced, but not suspended)

**Bench mark:** an elevation reference point.

**Benthic macro-invertebrates:** spineless animals that inhabit the bottom of streams and lakes; visible to the eye; aquatic worms, snails, clams, immature stages of aquatic insects

**Benthic:** refers to the bottom of a body of water

**Biochemical oxygen demand (BOD):** the amount of oxygen used up in biological decomposition and chemical oxidation of sediment, water, or effluent

**Blast mat:** a large heavy mat made from rubber tires used to confine debris during rock blasting.

**Blow out:** rupture of concrete forms.

**Bob-cat:** trade name for a four wheeled skid steer loader.

**Bottomless:** a culvert consisting of an arch with an open bottom such that native streambed is exposed.

**Boulders:** rocks larger than 30 cm (12 inches) in diameter

**Box Culvert:** a culvert of rectangular cross section, commonly of precast concrete.

**Breaker:** hydraulic jackhammer, often mounted on an excavator.

**Bulldozer:** tracked vehicle with front mounted blade.

**C/C:** center to center – distance between plants.

**Caliper:** diameter of nursery tree at the butt.

**Canopy:** upper layer formed by trees

**Carrying capacity:** number of organisms a habitat can support throughout a year without damaging organisms or habitat

**Cast-in-place:** construction of forms and filling with concrete at final location.

**Cement:** aka Portland Cement - a dry powder consisting of burned limestone, gypsum and other chemicals - used in the manufacture of concrete, mortar, grout etc.

**Centrifugal:** type of pump that “flings” water outwards and into an exit pipe.

**Chainage:** linear distance.

**Clay:** grains of rock less than 0.001mm.

**Clear Crush:** crushed and screened rock that contains no fines – very porous

**CMP:** corrugated metal pipe, generally galvanized and/or tarred for corrosion resistance

**Coarse particulate organic matter (CPOM):** leaf and fine woody debris >1 mm in diameter

**Cobble:** rock from 7 to 30 cm (3 to 12 inches) in diameter; rubble

**Coir:** coarse fiber derived from outer husks of coconuts.

**Collectors:** aquatic invertebrates that feed on fine material

**Community:** the plants and animals that interact in a habitat; the community of people who influence a habitat

**Concrete:** a mixture of Portland cement, aggregate and water to form a stiff slurry that will chemically react and harden.

**Confluence:** the meeting of two streams.

**Conifer:** a tree or shrub (usually evergreen) with seed cones and resinous sap.

**Coniferous:** cone-bearing trees with needles

**Consumers:** organisms that depend on other organisms for their food

**Contour:** an imaginary line linking points of equal elevation.

**Cover:** vegetation or other features that provide shelter for wildlife

**Critical:** the flow condition at which point the water velocity equals the wave speed.

**Cut-off Wall:** a collar (metal, concrete etc) placed around a culvert to prevent piping.

**DBH:** diameter breast high – tree trunk diameter at 4-5’ off the ground.

**Debris torrent:** a mixture of water, soil, vegetation etc that flows with great speed and force down a channel.

**Deciduous:** trees that shed their leaves in fall

**Decomposition:** breakdown of organic materials

**Degrade:** to decrease channel elevation by sediment removal (erosion or extraction)

**Denil:** fishway that rectangular in cross section and has many backward facing vanes that cause water to flow back on itself and induce extreme turbulence.

**Deposition:** depositing of material by a stream, generally at points of reduced stream flow

**Depth of Cover:** depth of fill placed atop a culvert

**Dibble:** rod-like tool used to plant live stakes, plugs etc.

**Directional Drilling:** drilling sideways under structures/roadways/streams etc to place pipes, utility lines without excavation. Generally limited to less than 30cm diameter.

**Discharge:** the amount of water flowing past a given point on a stream; measured in cubic feet or cubic metres per second

**Dissolved oxygen:** oxygen dissolved in water; the amount depends on water temperature, plant photosynthesis, plant and animal respiration, and physical aeration

**Dissolved solids:** solid (generally inorganic) material in solution

**Diversity:** number of species in a particular community or habitat

**Drainage basin:** watershed

**Drainage maintenance:** to remove sediments and vegetation from ditches/ canals etc in order to improve conveyance.

**Dry /wet pit mining:** to isolate gravel extraction to a confined hole in a bar. Wet/dry refers to whether it goes below the water table at the time of extraction.

**D-X:** size that X% of an aggregate sample is smaller than.

**Dynamic head:** the total equivalent head drop due to the static head and all friction losses.

**Ecosystem:** the organisms, physical environment, and climate relationships that occur in a given area

**Effluent:** waste liquid from a house, industry, sewage treatment plant, etc.

**Engulfers:** predators that eat their prey whole

**Ephemeral streams:** ones that flow only during and shortly after extreme rainfall or snow-melt

**Erosion:** movement of soil by water and wind

**Evaporation:** conversion of water from liquid to vapour

**Evapotranspiration:** water lost from plants through evaporation and photosynthesis

**Excavator:** generally tracked vehicle with rotating body and front mounted digging arm.

**Exposed Aggregate:** decorative technique for driveways, walks etc that involves washing half set concrete so as to expose gravel aggregate.

**Fascine:** a bundle of live branches (generally willow or cottonwood) placed perpendicular to a slope to form a stable edge.

**Filter Layer:** cobble, gravel, etc placed under riprap to prevent native fines from washing out through the riprap. Geotextile may be used to supplement or replace this layer.

**Filtering collectors:** aquatic invertebrates that feed by filtering small organic particles from the water

**Fine particulate organic matter (FPOM):** organic material <1 mm in diameter

**First-order stream:** stream with no tributaries

**Fish ladder:** a stepped fishway with water flowing over it

**Flag:** a piece of survey ribbon.

**Flap Gate:** a passive “trap door” device placed on culvert outlets to prevent inflow. The hinge can be on the top or side of the culvert.

**Float switch:** float that can be set to turn pump on or off at set water level.

**Flood:** stream flow greater than the channel can contain

**Floodplain:** area along a stream or river subject to flooding; often the location of human development

**Floodplain:** the region flanking a river channel that is subject to periodic inundation.

**Forebay:** the inlet structure for a pump, often holds the trash rack.

**Form:** wood or metal structure that concrete is poured into.

**Free Board:** the vertical distance from water surface to top of channel, dike etc.

**Freshet:** a sharp rise in discharge or a flood event associated with rainfall or snow melt

**Fry:** recently emerged fish, after the yolk sac has been absorbed

Functional feeding groups: classification of aquatic invertebrates by their feeding method

**Gathering collectors:** aquatic invertebrates that feed on particles on the bottom of a stream

**Geodetic:** an elevation correlated to international standard.

**Geo-textile:** heavy weight fabric of generally synthetic material used to stabilize aggregates, soil etc., may be of woven or felted composition.

**Glacial:** aggregates deposited by or through glacial processes

**GPS:** Global Positioning System – a series of satellites and ground based hardware that allow precision location anywhere on the surface of the globe.

**Grader:** rubber tired vehicle with blade mounted between front and rear axles

**Gradient:** degree of slope, or steepness of a geographic feature

**Gravel:** crushed or alluvial rock of size between 2mm and 60mm

**Ground water:** water that sinks into the soil and collects over impermeable rock; it then flows laterally toward a stream, lake or ocean.

**Grout:** a concrete mixture that is made with fine aggregate to achieve a smooth surface or easily pumped mixture.

**Habitat:** an area that provides food, water, and shelter for an organism

**Hay:** cut and dried grass and legumes – often with seeds

**Headwall:** a wall built at top and sides of a culvert end to secure adjacent soil

**Headward erosion:** localized channel degradation that progresses upstream, often due to removal of bedload.

**Headwaters:** the uppermost collection area of a stream or watershed

**Herbaceous:** plants with soft rather than woody stems

**Hiab:** Flatbed truck with hydraulic crane for loading and unloading freight.

**Hog Fuel:** crushed, shattered or shredded bark, wood etc

**Humus:** decayed organic matter in or on the soil

**Hydraulic Jump:** an abrupt transition from super to sub critical – also know as a standing wave. Often used to dissipate energy

**Hydroseed:** to spray a mixture of seed (generally grass), fibre and tackifyer (glue) for rapid planting and erosion control.

**I/P:** abbreviation - iron pin (normally used to mark corners of property lots)

**Impeller:** the rotational element that actually contacts and moves the water.

**Incise:** downcutting of a channel, generally without a corresponding downcutting of the floodplain.

**Infiltration:** drainage of water through soil

**Inlet Limited:** a condition in which the maximum flow capacity of a culvert is determined by the hydraulic conditions of the inlet. Small changes to the inside of the culvert or outlet structure will have no effect on maximum capacity.

**Inlet Structure:** an arrangement of wing walls and apron that smoothes the hydraulic transition from open channel to culvert flow and increases maximum capacity, it may also be the mounting point for a trash rack

**Intermittent stream:** one that does not flow year-round

**Invasive:** plants or other species that invade or grow so aggressively that they will dominate an area - generally non-indigenous or non-native in origin.

**Invert:** the upstream entrance to the bottom of a culvert.

**Invertebrate:** an animal without a back bone

**Ion:** an electrically charged atom or molecule

**Jump height:** vertical distance between water surfaces of two pools

**Jump pool:** the “take-off” pool at the base of a fall. Generally must be a minimum of 1.25 x as deep as the jump height for leaping salmonids.

**Laminar:** flow condition with no waves, eddies etc., rarely encountered in open channel flow.

**Larva:** immature stage in a life cycle between egg and adult

**Legume:** a plant that hosts nitrogen fixing bacteria within its roots such as peas.

**Level:** horizontal, or: an optical/mechanical device that allows determination of horizontal.

**Light weight:** the addition of lightweight aggregates such as pumice.

**Limiting factors:** conditions that establish a population or range of a species

**Live drain:** a bundle of live branches buried within a slope to convey water down the slope and limit erosion

**Live whip/stake/pole:** dormant branches of a self-rooting woody species used to establish vegetation, stabilize slopes etc.

**Loader:** wheeled or tracked vehicle with wide front mounted bucket to scrape and load trucks.

**Loc-Bloc:** large precast concrete brick (2.5' x 2.5' x 5') placed to interlock with others

**Low bed:** Truck tractor and low semi-trailer used to transport large excavators, dozers etc.

**Meander:** the tendency of a channel to move laterally.

**Mg/l:** milligrams of a substance per liter of water, parts per million (ppm)

**Midreaches:** streams carrying the water from several tributaries

**Milt:** sperm-filled milky substance released by male fish to fertilize eggs

**Monitor:** track a characteristic over time, using uniform methods to evaluate change

**Mulch:** raw or semi composted wood chips, leaves etc

**Multi-plate:** a large culvert made up of segments bolted together on site.

**Non-point source pollution:** pollutants that enter waterways from broad land areas as a result of the way the land is used (e.g. sedimentation, runoff)

**Nymph:** immature form of insects such as stoneflies and mayflies that do not pupate

**O/S:** abbreviation – offset (generally used when a survey stake cannot be placed on the exact point of interest).

**Obvert:** interior top of a culvert, equal to the invert plus the culvert diameter

**Off set baffles:** beams, logs, curbs etc placed on either side of a culvert, flume etc so as to create turbulent flow and ease fish passage.

**Orifice:** a fishway consisting of stepped pools connected by submerged holes.

**Outlet Structure:** An arrangement of apron, wing walls and sometimes energy absorption structure at the end of a culvert.

**Overburden:** native soils overlying aggregate to be mined or subsoils to be constructed upon.

**Overland flow:** river flow outside of defined channel.

**Overs:** oversized rocks, boulders etc

**Perennial streams:** ones that flow throughout the year

**Periphyton:** algae growing on surfaces in a stream, lake, or ocean

**pH:** measure of the hydrogen ion activity; measures the acidity or alkalinity of a solution: the pH scale ranges from 1 (strong acid) to 14 (strong base), with 7.0 as neutral

**Piercers:** predators that feed by sucking fluids out of their prey

**Pipe Arch:** a “squished” CMP culvert that has greater invert width.

**Pipe Jacking:** a process by which a culvert is pushed horizontally through the ground to allow placement of a culvert without excavation.

**Piping:** water flowing along the outside of a culvert. This can lead to erosion and failure.

**Pit Run:** unscreened alluvial aggregates as extracted from a pit.

**Plankton:** microscopic plants and animals suspended in the water

**Plug:** small (2-6”) plant grown in a multi-celled tray.

**Point bar:** accumulation of bedload on the inside of a curve

**Point source pollution:** air or water pollutants entering the environment from a specific source

**Pool and weir:** a fishway consisting of stepped pools connected by small falls.

**Pool:** a localized increase in water depth, generally formed by scour processes

**Population:** group of individuals of a specific kind, in a given area, at a given time

**Porosity:** the percentage of open spaces between pieces of gravel cobble etc.

**Pot Size:** standard nursery stock sizes expressed in inches diameter or gallons volume.

**ppm:** parts per million or milligrams per liter (mg/l)

**Precast:** concrete products cast at a site remote from the final installation.

**Precipitation:** rain, snow, hail, or sleet falling to the ground

**Predator:** an animal that hunts and kills other animals for food

**Primary production:** organic material produced by plants from inorganic material and sunlight

**Procter Test:** a method to determine the maximum density that can be achieved through wetting and packing for a given aggregate.

**Producers:** plants that manufacture food from inorganic nutrients

**Pump:** to use a pump to transport wet concrete from truck to form; or in the case of grout, to fill voids by pressure.

**Pupa:** stage of a life cycle between larva and adult

**ROW:** abbreviation – right of way

**Reach:** a stream section with fairly homogenous characteristics / distance that an excavator arm can extend.

**Rearing habitat:** places in a stream that provide food, resting places, and shelter for young fish

**Re-bar:** ribbed steel bars of various sizes used to give concrete strength in tension

**Redd:** a nest in the streambed in which salmon and trout lay their eggs; the eggs incubate, then hatch in the gravel

**Riffle:** reach of river channel characterized by shallow medium velocity flow over cobble or small boulder.

**Rip rap:** coarse angular rock, generally blasted or crushed. Also known as shot rock - used to protect stream banks from erosion

**Riparian area of influence:** transition area between riparian area and upland vegetation

**Riparian area:** the border of the stream above its banks; wet soil areas influenced by the water of a stream, lake, or wetland

**River continuum:** a conceptual model explaining changes in composition of aquatic invertebrate communities in streams and rivers

**Road Base:** a mixture of gravel, sand and fines that compacts well

**Rod:** measurement stick used with a level or theodolite.

**Roughness:** a way of quantifying the degree of drag on flowing water by a surface. Most commonly expressed as a dimensionless Manning's number.

**Run:** a part of the stream with smooth, slow to moderate flow, deeper than a riffle

**Salmonid:** a fish of the Salmonidae family (salmon, trout, char)

**Sand:** grains of rock between 0.06mm and 2mm

**Scour:** localized erosion of substrate and banks by river flow.

**Scrapers:** aquatic invertebrates that feed by scraping the surface of rocks for algae

**Secondary production:** material that is transformed by consumers (eaten or decomposed)

**Sediment budget:** annual volume of sediment transported by a river.

**Shock:** dehydration of plants and trees due to transplanting.

**Shredders:** aquatic invertebrates that feed on leaves or twigs that fall into a stream

**Shrub:** small to medium plant of woody character generally with multiple stems.

**Silt:** grains of rock between 0.002mm and 0.06mm

**Silt:** tiny, fine particles suspended in or deposited by water

**Siltation:** the process of becoming clogged by fine sediments

**Sinuosity:** ratio of total stream length to straight line distance.

**Slope:** measurement of the change in elevation with distance.

**Slot:** a fishway consisting of stepped pools connected by vertical slots.

**Sluice Gate:** a manually or automatically operated sliding or rotating panel to restrict flow into or out of a culvert

**Slump:** the “sloppiness” of wet concrete, generally more slump equals less strength.

**Smolt:** a juvenile anadromous fish that has undergone physical changes to prepare for life in saltwater

**Snag:** standing dead tree

**Soil wrap:** geotextile used to enclose topsoil as a means of slope stabilization

**Spawning habitat:** parts of a stream or lake that provide suitable areas for fish to spawn; usually gravel beds

**Spawning:** laying and fertilizing eggs

**Spider:** specialized excavator with four legs that can negotiate steep slopes and rivers with minimal impact.

**Stake:** wood stake used to mark point of interest.

**Static head:** vertical distance from inlet water elevation to discharge elevation.

**Steep-pass:** simplified design of Denil fishway

**Stone slinger:** conveyor belt equipped dump truck than can precision place or “throw” gravel.

**Straw:** coarse stalks (generally of grain) without seeds.

**Stream flow:** volume of water carried by a stream

**Stream order:** a system used to classify (and analyze) streams

**Streambed:** part of the stream over which water moves; substrate

**Substrate:** inorganic material that forms the streambed

**Sump:** deep water filled hole that the pump inlet is placed into. Constructed to increase water depth in order to reduce vortex formation and air entrainment.

**Surcharge:** a condition in which the water elevation at the upstream end of a culvert exceeds the culvert obvert.

**Suspended sediments:** particles carried in water without being dissolved

**Swamp pad:** large wood pad used to distribute excavator weight in soft conditions.

**Swing:** the space required for an excavator to rotate.

**Tail out:** riffle at downstream end of pool

**Tandem:** tandem axle (rear) dump truck.



**Terrestrial:** living on land

**Theodolite:** survey instrument with vertical and horizontal degree gradations.

**Thumb:** metal beam located opposite an excavator's bucket, used to grip rocks etc.

**Tilt-up:** a method of building construction whereby concrete walls are cast in horizontal forms on site and then tilted to the final vertical position.

**Topsoil:** native or manufactured soil with 15-40% organic content

**Trash Rack:** a metal grate placed at the upstream end of a culvert to prevent woody debris, rocks etc from entering the culvert.

**Traverse:** survey circuit.

**Tree spade:** specialized truck mounted device used to dig and transport large trees.

**Tree:** medium to large plant of woody character, generally with a single stem.

**Tributary:** smaller stream that contributes to flow of larger stream.

**Turbidity:** degree to which light penetration is blocked because water is cloudy; measure of sediment suspended in water

**Turbulent:** flow condition with waves, eddies etc

**Undercut:** a portion of stream channel underneath an overhanging bank, log, rock etc.

**UTM:** Universal Transverse Mercator – standard map projection.

**Velocity Profile:** variation in water velocity vertically and horizontally due to roughness effects.

**Vibrate:** to use a mechanical device to vibrate wet concrete within forms to cause it to flow more easily and flow around re-bar etc.

**Water table:** upper level at which the soil is saturated with water

**Watershed:** all the land area that drains into a particular body of water

**Wattle:** low retaining wall of live whips/stakes placed on a slope to form a terrace and limit erosion.

**Weir:** structure that spans a channel and controls the local streambed elevation.

**Well Graded:** coarse grained soil with an even distribution of sizes.

**Wildlife tree:** tree that is topped/killed but much of the trunk left standing (man-made snag)

**Wildlife:** any animal that is not tamed or domesticated

**Wind throw:** tree blowdown, often due to removal of adjacent trees

**Wing Wall:** a flaring vertical wall on either side of a culvert

## APPENDIX 1

### FISHERIES LEGISLATION IN CANADA

The Federal Fisheries Act is one of the oldest pieces of legislation in Canada (1868). It has been updated several times since and is often referred to as Canada's strongest environmental legislation. Created to manage and protect Canada's fisheries resources, it applies to all fishing zones, territorial seas and inland waters and is binding to federal, provincial and territorial governments.

While DFO is perhaps the best known agency involved in the conservation and protection of fish and fish habitat, it is not the only agency or government with that responsibility.

Many other provincial and federal agencies have, as part of their mandate or authority, related acts and regulations that also manage and conserve fish and fish habitat through approvals and permitting that relates to activities or uses affecting fish habitat.

Many of these acts and regulations are complimented and supported by policies. One of the best known to community-based volunteers is the Policy for the Management of Fish Habitat (1986) which has as its main objective the achievement of an overall net gain of the productive capacity of fish habitats.

Achievement of this principal is attained by meeting three goals:

#### 1 Fish Habitat Conservation

Maintain the current productive capacity of fish habitats supporting Canada's fisheries resources, such that fish suitable for human consumption may be produced.

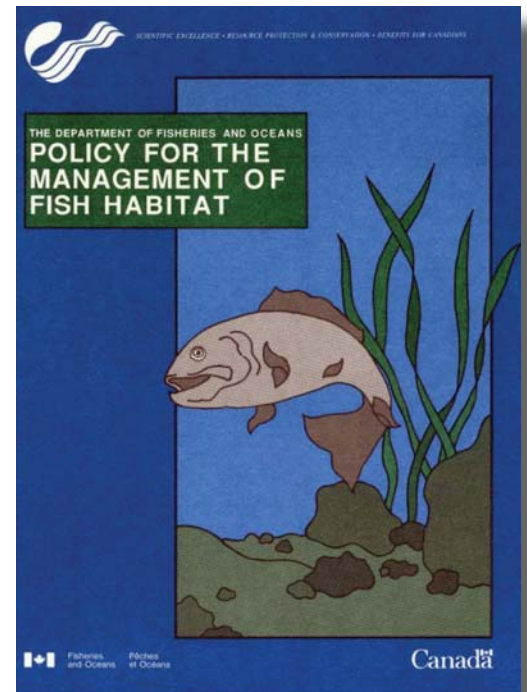
#### 2 Fish Habitat Restoration

Rehabilitate the productive capacity of fish habitats in selected areas where economic or social benefits can be achieved through the fisheries resource.

#### 3 Fish Habitat Development

Improve and create fish habitats in selected areas where the production of fisheries resources can be increased for the social or economic benefit of Canadians.

However, the Fisheries Act allows The Minister of Fisheries and Oceans to authorize harm to fish habitat if all steps to avoid or mitigate damage do not achieve this. This usually results in compensatory fish habitat.



The Policy for the Management of Fish Habitat is considered one of the pillars of habitat protection in Canada.

## WHAT IS A HADD?

Under DFO's Habitat Policy productive capacity lost to harmful alteration, disruption, or destruction of habitat (HADD) is compensated for through proponent funded creation, restoration or enhancement of fish habitats (Pearson & Quigley et al 2005). Described under Section 34 and 35 of the FFA, the review, approval and subsequent compensatory requirements associated with a HADD represent one of the most common arenas where community stewardship of fish and fish habitat interacts with senior agency and local authority decision making.

All the habitat protection provisions found in the FFA must be considered when reviewing the potential impacts, effects or outcomes a project or activities may have or has had to fish habitat. Additional sections of the FFA may also link to community monitoring efforts.

**Subsection 34(1), defines fish habitat; and Subsection 35(2), allows a HADD of fish habitat when authorized by the Minister or by regulations made under the Act. Habitat compensation is required when a Fisheries Act subsection 35(2) Authorization will be issued. The habitat compensation contained as part of that Authorization is needed to meet the Habitat Policy guiding principle of "No Net Loss" (NNL) in the productive capacity of fish habitat.**

Source: The "Guide to Habitat Compensation for DFO Habitat Management Staff Practitioners (Version 1.1)

There are other federal and provincial legislative components<sup>7</sup> and acts governing fish habitat and watershed integrity such as the provincial Fish Protection Act and the Riparian Area Regulations, Federal and Provincial Environmental Assessment Acts, Species At Risk Act. Plus numerous other related acts, regulations and policies that govern activities outside of fisheries.

Each of these pieces of legislation with its respective regulations and policies not only has a relationship to fish and fish habitat but other issues beyond fish that must often be satisfied prior to any authorization being issued.

Decisions regarding how and where compensation is to be achieved are often made between the levels of government responsible for the implementation of these acts and their corresponding regulations and policies.

The use of compensation to achieve No Net Loss is only to be considered after all avenues to avoid a HADD are exhausted (e.g. project relocation, redesign, or mitigation). DFO has the discretion to not issue an Authorization in situations where adverse impacts to fish habitat are deemed unacceptable.

There is limited flexibility in respect to interpretation and application of the legislation as part of approving HADD's. However DFO has the authority to employ professional discretion about how collaborative the process will be, including the integration of local and traditional knowledge into processes involving the assessment, management and monitoring of environmental resources (Engel 2002, Gayton 2004, Gilchrist 2005). As more citizens and community organizations advocate for a greater voice in land use decisions affecting the health and integrity of natural capital their role as "citizen scientists" is growing.

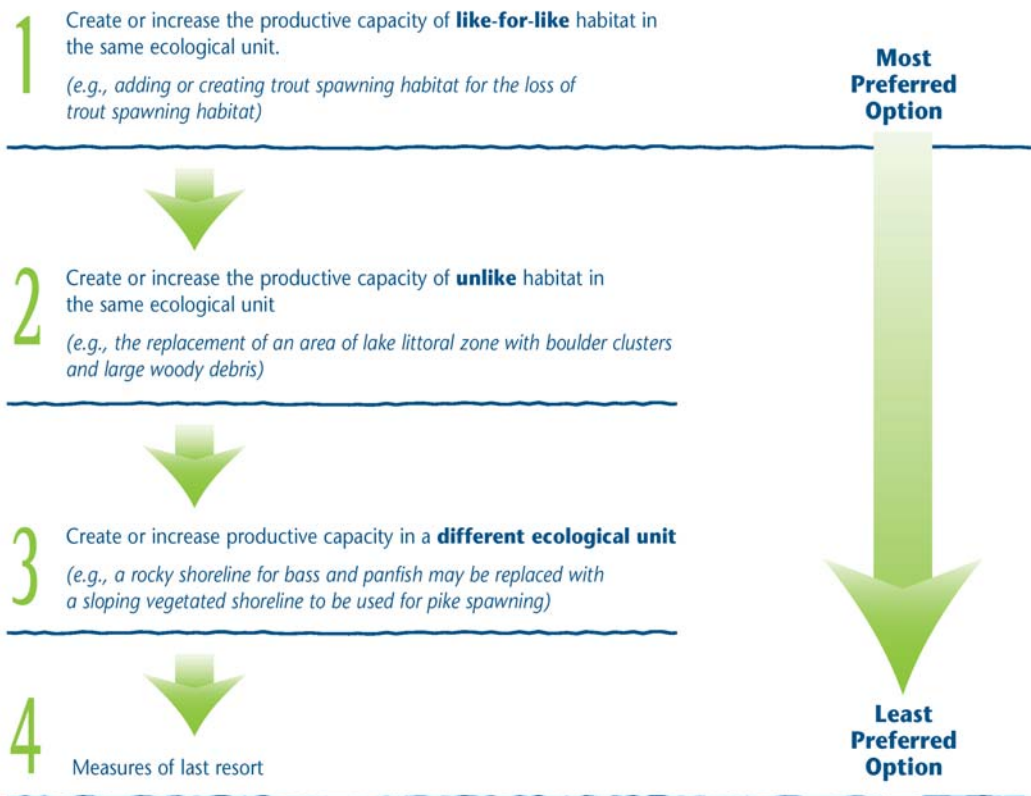
<sup>7</sup> [http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/policies-politique/index\\_e.asp](http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/policies-politique/index_e.asp),  
<http://www.leg.bc.ca/legislation/index.htm>

## THE COMPENSATORY HEIRARCHY

Though the legislative environment for compensatory fish habitat may seem complicated there has already been substantial work by senior agencies and community based organizations to simplify and streamline the process for regulators and non regulators .

The “Guide to Habitat Compensation for DFO Habitat Management Staff Practitioners (Version 1.1) is available via the Salmon Enhancement and Habitat Advisory Board<sup>8</sup> (SEHAB) or as individual downloadable sections through DFO’s website<sup>9</sup>.

As previously described, at the core of providing compensation is the requirement for actions that maintain the net production potential of fish habitat. When compensation is required a “Hierarchy of Compensation Options” is used. For each step in the hierarchy, with the exception of step four, compensation should be completed on site before moving off-site.



**Exceptions to the Compensation Hierarchy:** While the Hierarchy of Compensation Options should normally be followed, there are circumstances where site-specific issues are well understood and may include circumstances where limitations to productive capacity are known, and local management plans containing clear objectives for the fishery may have been prepared. Available information should support the effectiveness of an alternative compensation approach to achieve both “NNL” and ecological objectives. This information could be used to justify moving down the hierarchy. (From the “Guide to Habitat Compensation for DFO Habitat Management Staff Practitioners (Version 1.1)

<sup>8</sup> The “Guide to Habitat Compensation for DFO Habitat Management Staff Practitioners (Version 1.1) was developed to assist in ensuring a consistent agency approach to reviewing and authorizing fish habitat compensation <http://www.sehab.org/epmp/resources/8E%20Habitat%20Comp%20ENG%20v4.pdf>  
<sup>9</sup> [http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/policies-politique/operating-operation/compensation/index\\_e.asp](http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/policies-politique/operating-operation/compensation/index_e.asp)

## TYPICAL GENERIC TEXT OF DFO HADD AUTHORIZATIONS<sup>10</sup>

There is no one authorization template to cover all situations, and the format, as with any policy or regulation, is subject to change. The wordings in the following template reflect some of the most common section 35 (2) authorization language which you may experience when invited to participate in community based compensatory monitoring. There are always differences in the conditions and site specific requirements. Community-based monitors will need to obtain a copy of the authorization from DFO and/or the proponent as part of their initial capacity assessment. Care needs to be taken to ensure that all parties interpret the terms, conditions and requirements the same and the agreement is understood thoroughly before making long-term commitments.

### Conditions that Relate to the Compensatory Habitat (fish compensation habitat)

The Monitoring Program shall consist of In Stream Monitoring; Vegetation Monitoring; Monitoring of Authorized Works; and Drainage Monitoring, all as more fully described below, and consistent with the Schedule 'A' authorization.

1. The Proponent Shall construct the following habitat compensation works.....

◆ Invasive species management and riparian revegetation of a total area of x m<sup>2</sup> on the xx River corridor at the following sites:

- a. 200 m<sup>2</sup> on the east bank of xxx....
- b. 364 m<sup>2</sup> at xxx...
- c. etc.

The invasive species management and riparian revegetation management plan shall include measures to address sediment, erosion and runoff control, which must be implemented and maintained adequately to control all discharges from the site until no longer applicable to site conditions.

The plan shall also include regular maintenance treatments, which will be carried out for the duration of the monitoring program.

2. The habitat compensation works described above shall be constructed as described in the following:

a. Memo of July X, 200X, to xx Re: xxx. From xxx (usually correspondence between DFO and the proponent or other party involved in the authorization)

b. Drawing entitled Figure 1. xxx July 200X. xxx

#### **Success of Compensatory Works**

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<sup>10</sup> CBM's are urged to work with partners or proponents to ensure that the language of the authorization is clearly understood or simplified if possible. For further information: [http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/policies-politique/operating-operation/authorization-autorisations/page05\\_e.asp](http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/policies-politique/operating-operation/authorization-autorisations/page05_e.asp)

3. The Proponent shall ensure that the compensatory habitat is functioning as intended pursuant to this Authorization.

The compensatory habitat will be deemed to be functioning as intended if, in the opinion of DFO, the habitat is physically stable, invasive species have been eliminated from the site, and riparian planting has met the intended survivorship. Following the initial monitoring period, and any extensions thereof, DFO will assess the success of the compensatory habitat and determine whether or not it is functioning as intended, and choose the appropriate course of action as outlined below:

- a. The compensatory habitat is functioning as intended and will be self-sustaining without further major remedial work. The Monitoring Program will be terminated;
  - b. The compensatory habitat is not functioning as intended, the Proponent shall extend the Monitoring Program, including remedial work, for an additional two years to allow more time for the habitat to become adequately established; or,
  - c. The compensatory habitat is not functioning as intended and further remedial work is not likely to rectify the situation, the Proponent shall then carry out alternative compensatory works of similar habitat value within the same watershed.
  - d. If, after the monitoring period is over, it becomes apparent that the compensatory habitat is not functioning as intended, for example by reason of poor vegetation survival, the Proponent shall carry out any works which are necessary to enable the compensatory habitat to function as designed.
4. If the Proponent wishes to transfer its interest in the enhancement area, and the transferee assumes the obligations in this paragraph in a form satisfactory to DFO, the Proponent shall thereafter be relieved of these obligations.

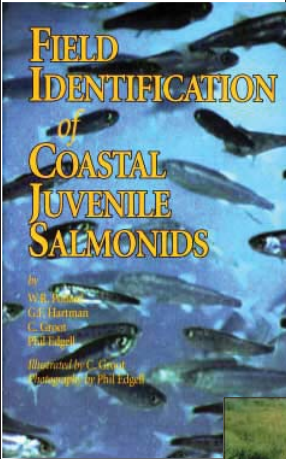


#### **Conditions that Relate to Monitoring**

5. The Proponent shall carry out a monitoring program (the "Monitoring Program"), for five (5) growing seasons post construction from 200X to 20XX, which includes the following:
  - a. A date stamped photographic assessment of the work and compensation showing before, during, and after conditions of the worksite within 60 days of the completion of the project;
  - b. An annual assessment of the riparian vegetation in and around the compensatory habitat will be conducted. Plant survival must be at least 80% for ground cover, forbs and shrubs, and 100% for trees for the duration of the Monitoring Program. Should plant survival not meet this requirement during the Monitoring Program, replacement planting must be undertaken during the first planting season following the assessment. Monitoring will consist of, at least, one visit to the site in August/September of each year of the monitoring program;



- c. A minimum twice yearly assessment of invasive species, including maintenance treatment for invasive species management to achieve a presence of 0%, in the compensation sites.
- d. In Stream Monitoring and review of the depth, stability, water quality and fish usage of the compensation works
- e. The Monitoring Program shall be conducted by a qualified environmental monitor who has experience in this area, and who is acceptable to DFO;
- f. The submission to DFO of the annual results of the Monitoring Program in a written report, and any other relevant documents and photographs, by the first of December of each year of the Monitoring Program. DFO will provide a written response to the annual monitoring report within 6 months of its receipt if any aspect of the project design, maintenance, operation or performance is considered unsatisfactory;
- g. The final report shall provide the results of the final year's monitoring and shall summarize the findings of the annual monitoring. The final report will provide a functional assessment of the performance of the compensatory habitat and will include photographs of the constructed compensatory works.

**APPENDIX 2 MONITORING PROGRAM ESSENTIALS**

**TABLE 4. Summary of Key Monitoring Program Components**

COMPONENTS	RESOURCES REQUIRED	WHAT ITS FOR
<p><b>FIELD DATA</b></p>   	<ul style="list-style-type: none"> <li>◆ Field Notes/ Notebook</li> <li>◆ Field Forms</li> <li>◆ Field Guides - Fish, Plants</li> <li>◆ Maps</li> <li>◆ Camera</li> </ul>	<p><b>Field Notes:</b> Taking good field notes is important. Field notes can form part of evidence for a legal investigation by a legal authority or can be the only back up if digital records are lost or damaged. When recording data in the field use a standard field form or similar template (e.g. like the assessment field forms record sheets used for Module 4 of the Streamkeepers Handbook) or if you are using a standard field notebook (usually a 6 ring 5x7 binder with “Rite in the Rain” or “DuksBack” waterproof paper) use standard note section headers for each set of notes – and set up your pages before going out in the field. Examples of field notes and templates are provided in Appendix 4</p> <p>Best resources: Streamkeepers Manual, Modules 1-4</p> <p><b>Field Guides:</b> Bring and refer to field guides for plant, fish, wildlife etc. identification - accurate identification is essential.</p> <p><b>Photo Point Monitoring:</b> Photo point monitoring is applying a set of repeat benchmarks to your project site from which you record and document pre and post changes of the fish habitat compensation. It is a quick and effective documentation of the nature of a site and any changes in characteristics or disturbance (e.g. vegetation, damage from natural events, people or wildlife, changes to stream channels or habitat features and installations). Whether you use a high end single lens reflex, point and shoot digital or disposable camera, setting up a rigorous photo point monitoring program is the foundation for monitoring your project site. It will be your main visual history evidence to pair with your field notes.</p> <p>Best resources: USDA Forest Services Photo Point Monitoring Handbook Series or A User Guide to Photo Point Monitoring Techniques for Riparian Areas-Field Test Edition</p>



COMPONENTS	RESOURCES REQUIRED	WHAT ITS FOR
<p><b>TESTING/SAMPLING</b></p>  	<ul style="list-style-type: none"> <li>◆ Chemical Analysis Kits/Digital Meters</li> <li>◆ Sterile Containers</li> <li>◆ Gloves, Boots, Waders</li> <li>◆ Gee Traps, Seine and Dip Nets</li> <li>◆ Bait</li> <li>◆ Sampling Buckets</li> </ul>	<p><b>Water Quality Monitoring:</b> dissolved oxygen (DO), pH and turbidity are usually monitored. Additional monitoring if required will be clearly identified in the agreement. Many of these can be measured with chemical kits. Digital meters are field ready and can last a long time though require regular calibration and batteries.</p> <p><b>Fish Species Monitoring:</b> presence, abundance, distribution and diversity of fish species. In many cases determining whether the fish compensation habitat you are monitoring is actually providing a benefit for fish may be hard to quantify. Showing fish use the habitat doesn't necessarily prove No Net Loss; however it may be useful to document changes over time in fish use, diversity or distribution as part of monitoring. You will need a permit from DFO/Prov. to undertake any form of fish sampling, care needs to be taken to avoid amphibians and small mammals and species of conservation concern.</p> <p>Best resources: Streamkeepers Handbook – Module 11 and Province of BC Resource Information Standards Committee.</p> <p><b>Vegetation Monitoring:</b> Requirements will be clearly identified in the monitoring agreement. Usually you are required to monitor survival of planted specimens and presence of alien/invasive species. As a community-based monitor who will be stewarding the habitat long term you will want to look beyond plant survival and presence/absence of alien/invasive species to vegetation cover and composition. For this you can use line or grid point surveys or fixed plot as they are accurate and also give enough data to assess wildlife habitat and potential for erosion.</p> <p>Partnerships with QEP's, government and other groups can reduce the need to purchase equipment.</p>

COMPONENTS	RESOURCES REQUIRED	WHAT ITS FOR
<p><b>REPORTING/ ARCHIVING</b></p>	<ul style="list-style-type: none"> <li>◆ Project Authorization(S)</li> <li>◆ Project Files &amp; Archives</li> <li>◆ Maps And Air Photos</li> <li>◆ Report Template(S)</li> <li>◆ Computer, Software, Internet</li> <li>◆ Digital Storage And Backup</li> </ul>	<p>There are numerous ways to compile all your field observations, data records and photo documentation. Each HADD authorization includes a set of authorization reporting requirements which must be adhered to (a sample is found in Appendix 1). An example of a monitoring report template is provided in Appendix 3.</p> <p>Generally reports follow a standard technical reporting format, e.g. Executive Summary, Table of Contents, Introduction or Background, Location, Methods, Results or Outcomes and Discussion, Summary and Conclusions, Recommendations, Appendices (monitoring agreement, approvals, field data, permits, additional photos).</p> <p>Notify project partners that something has ceased working or there is a problem as directed, usually as soon a possible.</p>



COMPONENTS	RESOURCES REQUIRED	WHAT ITS FOR
<p><b>SAFETY/LIABILITY</b></p>	<ul style="list-style-type: none"> <li>◆ First Aid Kit</li> <li>◆ Mobile Phone (cell/satellite)</li> <li>◆ Wildlife deterrents (bear spray/bangers)</li> <li>◆ Liability coverage (comprehensive general, Worksafe BC etc.)</li> <li>◆ Worksafe BC compliant Gear and Clothing</li> </ul>	<p>No activity should be undertaken without thinking safety first, whether it involves professionals or volunteers. All modules of the Streamkeepers Handbook give detailed information on safety equipment.</p> <p>The basics are first aid training, first aid kit, cell phone (check service), area knowledge and a field buddy.</p> <p>Before heading out prepare and file an itinerary and wherever possible notify the property owner. You may require wildlife/aggressive dog deterrent. Carry and know how to use bear bangers, air horns and bear spray. Learn how to avoid or deter potentially dangerous and aggressive wildlife. Unexpected interactions with people can also be an issue even in remote areas.</p> <p>Best resources: WorkSafe BC, Streamkeeper’s Handbook safety portion from each module.</p> <p>Another facet of safety is insurance coverage and an understanding of liability coverage. This has been highlighted as a one of the main factors that can effect your role as a community-based monitor. The Pacific Streamkeepers Federation offers comprehensive general liability insurance for a nominal fee for members doing volunteer work. This does not cover paid work. Members should contact PSkF. Non-member, consultants or employees need to discuss insurance needs with their insurer, employer or client.</p> <p>Whatever your role, you will need to have adequate and appropriate insurance coverage.</p> <p>The liability issue isn’t an insurmountable one. You may be able to acquire the necessary coverage through your project partners. Some municipalities have volunteer insurance to cover authorized activities on municipal lands; some QEP’s or other project partners may be able to cover a community partner under their WCB and/or liability coverage.</p> <p>QEP’s also have professional insurance which covers the physical data, reports and potentially the opinions they may provide.</p>



**TABLE 5. Monitoring program toolkit checklist and applications**

<b>COMPONENT</b>	<b>OBSERVATION</b>	<b>SAMPLING</b>	<b>REPORTING</b>	<b>SAFETY</b>	<b>APPLICATIONS AND OPTIONS</b>
Batteries	X	X		X	Rechargeable batteries are recommended and can last years – needed for all your electronic monitoring equipment.
Binoculars	X			X	A small pair of field binoculars is useful for assessing distant points in your project site, as well as wildlife identification.
Camera	X	X	X		A camera is a core necessity in any monitoring program. Digital point and shoot waterproof cameras are relatively inexpensive (under \$200.00) and widely used by professionals and volunteers, and they allow for quick transfer of information from the field to other digital storage devices. Alternatives are film-based cameras. Disposable cameras can also be used. An added feature for photo documentation is date and time stamping, valuable for trend and compliance monitoring. Video cameras are also options that provide both audio and visual records.
Cell phone	X		X	X	Most volunteer groups have cellular phones, which can double as a backup digital camera. They are important as a communications tool in the event of an accident/injury or to report a violation/incident
Computer/Laptop			X		Most information is stored, compiled, analyzed and transferred in digital format; a basic computer system with the ability to create documents and tables is a necessity.
Dissoved Oxygen & pH meter					Not all projects will require water quality sampling as part of the monitoring; however, they are handy to have for your routine, trend or compliance monitoring.
Eslon tape or chain	X	X			Eslon or plastic measuring tapes come in lengths of 30 meters or more and are useful for creating benchmarks and measuring stream characteristics. Chains (also known as hip chains) are a spool of fine cotton line on a continuous roll that are useful for measuring distances longer than 50 metres. Remember to collect the thread and dispose of it as it is a deadly snare for birds and small mammals if left strung on vegetation.
Field ID guides (fish, wildlife and plants)	X	X	X		A necessity: There are many readily available guides including Field Identification of Coastal Juvenile Salmonids (W.R. Pollard et al), Trees, Shrubs & Flowers to Know in BC and Washington (Lyons & Merilees), Plants of Coastal BC (Pojar & Mackinnon) Birds of Western North America (National Geographic Society), plus a range of Peterson's Field Guides and Lone Pine Guides.
Field note-book and waterproof paper	X	X	X		There are range of field notebook sizes and paper types, some are number pages and bound (can be used as evidence in court), or spiral bound or loose leaf. While using waterproof books and notepaper is not required, it is very smart given field conditions in BC. Field notes may be needed for evidence later in the event of a violation. If using waterproof paper, remember, use pencil-ink fades and can run.

COMPONENT	OBSERVATION	SAMPLING	REPORTING	SAFETY	APPLICATIONS AND OPTIONS
First aid kit				X	Never leave home without it, whether you are on your own or part of a team - a WCB level one first aid kit or similar must accompany you while you are in the field.
Flagging tape	X	X		X	Flagging tape is another necessity, comes in a range of sizes, colours and some have pre-printed messaging (e.g. tree falling zone, danger area etc.) Most can be written upon by a permanent marker. It is used to mark points or delineate boundaries. If your flag points do not have to remain in place for a long period of time, photo/biodegradable flagging tape is available.
Minnow Traps (refer to page 13)					Minnow traps come in various shapes and sizes, designed for different life stages. The most common type used is the Gee type funnel trap made of galvanized steel. Bait can range from fish cat food to processed fish chunks or processed salmon roe.
Planting plan and habitat					These are necessary documentation that you will require as part of the Compensatory Monitoring Agreement implementation. As-builds are the final surveyor's drawings of the works after they have been completed. The planting plan will help you determine if planting was completed as authorized and the as-built will help you measure the compensation habitat to ensure it also is in compliance.
Polarized glasses	X	X		X	Along with the meters and GPS unit, you do not have to have polarized sunglasses; however, they are invaluable for being able to observe aquatic conditions and see beneath the water's surface. They range in price from inexpensive to very expensive- note they can scratch easily
Pre-project photo	X		X		Essential background information which should have been undertaken as part of the original request for a HADD authorization and are useful when setting up photo point monitoring sites.
Reflector vest				X	Essential part of your safety kit, reflector gear comes in lightweight vests, shirts and as part of heavier rain gear. Helps to identify and locate you on the site especially in dense vegetation.
Remote sensing imagery	X	X		X	Ortho or satellite imagery or standard aerial photographs are integral to monitoring, especially to assess changes over time and provide site context and mapping information for your report. Basic imagery in black and white or colour is available through a range of sources such as Landsat, Google Earth and the Community Mapping Network.
Steel toes					Part of every monitors gear, whether as gumboots, work boots, hikers or even waders, steel toes are a general safety component along with a first aid kit and reflector vest.

## APPENDIX 3

### SAMPLE MONITORING REPORT TEMPLATE

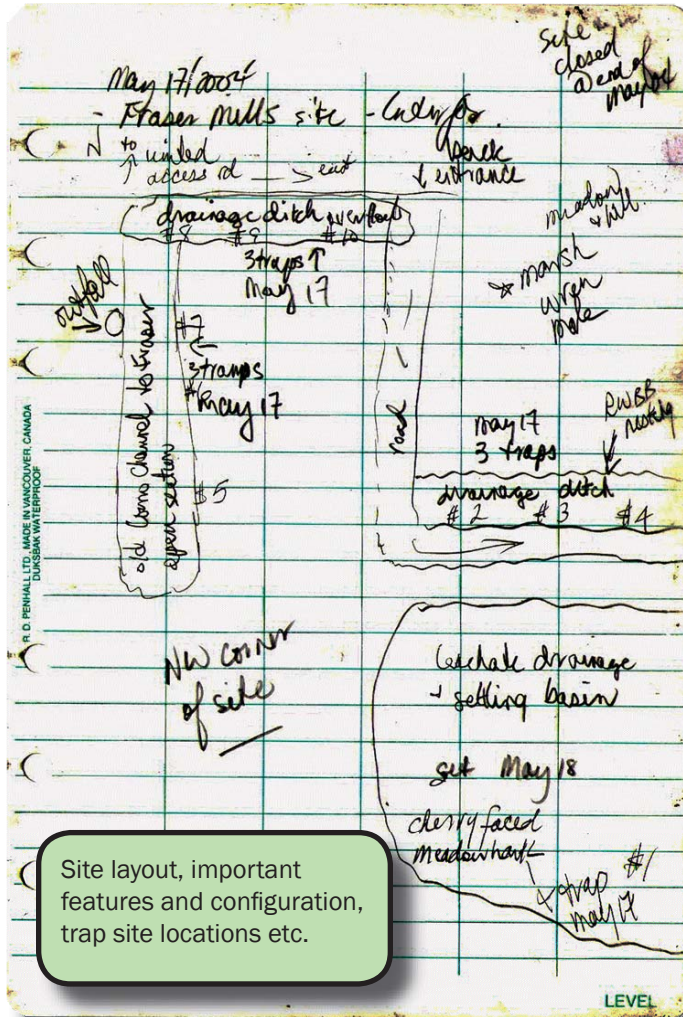
As with the HADD authorization, exact reporting requirements will depend on the nature of the project and the terms of the monitoring agreement. The following template may be useful.

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1.3 Primary Objectives .....	3
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Authorization, Monitoring Agreement, Data Sheets, Additional Photos, As-builds, Planting plan	

**APPENDIX 4**

**SAMPLE FIELD NOTES AND FIELD FORM TEMPLATES**



Standard information:

- ◆ Date & general location
- ◆ Legal names, addresses or accepted aliases or nick names of waterbody or feature(s)
- ◆ Specific locations of key elements or activities (record latitude/longitude or UTM's to provide accurate geo-referencing information. Use accepted names and/or codes for fish and wildlife (e.g. standard common names or scientific names)

May 17 - species notes  
 Fraser Mills site

- spotted sand piper - old Como channel ( )
- RW BB ( )
- barn + tree swallow ( )
- mallard + grebe wing (catchment pond) ( )
- kingfisher nesting on site
- marsh wren in NE meadow ( )
- broadwing water beetle ( )
- dragonfly + damselfly in pond ( )
- red + white - blue + black ( )

May 18th

- Trap #1 - large pond - ac
- dragonfly larvae + lots of backswimmers, filamentous algae (green) + tubifex worms.
- no egg masses or tadpoles noted.
- #2 - 3 ciliates diving beetles. Ditch.
- #3 - n/c
- #4 1 bullfrog morph tadpole ( )
- \* several pacific fantail damselflies
- \* cherry faced meadowhawk
- aquatic snails - right fold - check "Q" ( )
- #5 n/c Old Como Chnl. (type grass/sterile)
- #6 12 TBSB - gravid females, male in breeding condition

Sample field notes from a fish and wildlife baseline study (Adamah Consultants 2004). The page at top shows the simple ways that key site components or landmarks can be sketched to provide contextual information. This is important because some time can pass before notes are used for reporting. As well by showing the location and associations on a particular site changes can be identified over time. The page to the right shows actual detailed records pertaining to the data being gathered (in this case fish trapping results and wildlife observations). These represent attributes for the site that can be detailed in the report or may become part of an information database. Your notes may become evidence for a violation charge, so should be detailed and legible so that they can be adequately reviewed by you in the future or by an authority.

\*Notes are on "DuksBak" paper (lined) for a standard 6 ring binder.

**FIGURE 2:**  
**Sample Template: Field Reconnaissance Data Sheet (source Streamkeepers Handbook Module 1)**

## Stream Reconnaissance Field Data Sheet

... Additional Feature Information

**Module 1**

Stream Name/Nearest Town:	Date
Organization Name:	Watershed code
Contact Name:	Phone #
Stream Segment #	
Stream Section #	

### Feature Information

Feature #	Photo #	m upstream of last feature	Feature Description and Size (see App. 3)	Stream-bank (L or R)	Adjacent Land Use *	Actions/Comments/Water Quality Concerns
* Adjacent Land Use Codes: <i>Undisturbed, Agriculture, Forestry, Residential, Parks, Commercial, Industrial</i>						

Note whether feature is on the left or right bank (facing *downstream*)





## APPENDIX 5

### USER COMMENT AND FEEDBACK FORM

The Pacific Salmon Foundation wants to hear from you! Now that you have gone through and started to use and apply the resources in this guide, what do you think? How useful was this guide, what have been your experiences as an evolving CBM and how can future resources better suite your needs and experiences.

E-mail, fax or mail to:                   The Pacific Salmon Foundation  
#300 - 1682 West 7th Avenue Vancouver BC V6J, 4S6  
Tel. (604) 664-7664, Fax. (604) 664-7665  
salmon@psf.ca

Name (CBM or Organization): \_\_\_\_\_

Contact information (address, phone, e-mail):  
\_\_\_\_\_  
\_\_\_\_\_

1. Overall, how useful was the information in this guide in helping you determine if you would monitor compensatory habitat?

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2. How can future editions of the guide be improved?

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3. As a Community-based Monitor what do you feel are your greatest challenges / successes?

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4. Do you have a project or experience that you think could be profiled for other CBM's and organizations to learn from? If so please let us know!

**A Guide to Community-Based Compensatory  
Fish Habitat Monitoring**

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**Pacific Salmon Foundation 2010**