Workshop Proceedings

Working together for responsible erosion and sediment control

The Suncor Energy Fluvarium
5 Nagles Pl St, St John's, NL
June 6, 2014

Proceedings prepared by Corinna Favaro

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Representatives from the Fisheries and Oceans Canada; the Provincial Department of Environment and Conservation, Water Resources Management Division; AMEC; SNC Lavalin BAE Newplan; and Pennecon Ltd. presented at the event. APEX Construction Specialties Inc. provided demonstrations of techniques used for erosion and sediment control. Thank you to the presenters from industry and government who donated their time in an effort to improve strategies for controlling sedimentation and erosion in Newfoundland and Labrador.

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Introduction

The Northeast Avalon Peninsula has been undergoing rapid population growth and development in the last decade. In 2011, the population of the St. John's metropolitan area was approximately 197,000 inhabitants—a 9% increase from the previous five years (Statistics Canada 2012). As the growing population densifies and expands geographically, it is increasingly important that development activities are properly planned so they minimize stressors on the natural environment.

When development is improperly planned, freshwater habitats are susceptible to negative impacts. One impact is the excessive disruption and weathering of soils and fine sediments that become released and deposited in waterways (Gosse et al. 1998). The processes of erosion (release) and sedimentation (deposition) are both naturally occurring phenomena, but in excess may present a threat to the persistence of freshwater fish and their habitats. Various protective measures can be used to mitigate impacts on water ways, but proper implementation requires up-to-date knowledge of regulations and control measure practices.

Waterways in Newfoundland and Labrador are protected by regulations such as the *Federal Fisheries Act*, the *Provincial Water Resources Act*, and various municipal bylaws. However, these regulations are considered to provide "reactive" protection, i.e. they are activated after habitat damage may have already occurred. A proactive approach that implements current control measure technologies can provide greater success in mitigating impacts of development.

Work in the field of erosion and sediment control requires industries and governments to update their knowledge regularly. Otherwise, revisions to environmental legislation and advances in mitigation techniques may be overlooked. It is in the hands of planners, developers, contractors, and regulatory agencies to advance their knowledge of mitigation requirements and strategies.

The goal of this workshop was for experts to share current knowledge on regulations, theory, and practical applications of sedimentation and erosion control. The responsibility for proper erosion and sediment control is shared between all parties involved in the process. By sharing knowledge and working together proactively, parties can mitigate negative impacts of erosion and sedimentation on local waterways.

Format

The workshop was a half-day event hosted on June 6, 2014 at the Suncor Energy Fluvarium, St. John's, Newfoundland and Labrador. There were a total of 74 attendees from groups representing all three levels of government, industry, students, environmental organizations, and the general public. The event was opened by Hope Bennett, Chair of Northeast Avalon Atlantic Coastal Action Program, and formal welcome was given by Ted Lomond, Executive Director at Newfoundland and Labrador Environmental Industry Association. Six speakers from government and industry gave 25-30 minute presentations representing their perspectives and

experiences with sedimentation and erosion. Subsequently, a product overview showcased some of the control measures detailed in the presentations. Networking time was built into the agenda to allow for new connections to be formed. These proceedings summarize the presentations and concepts that were discussed.

Presentations

1. Does DFO need to review my project? Submitting my application

Bret Pilgrim and Michelle Roberge, Fisheries Protection Program, Fisheries and Oceans Canada

As of November 25, 2013 there are new changes to the federal *Fisheries Act* that have implications for the reviews of projects occurring in or near water (Figure 1). The purpose of the amendments is to concurrently streamline administrative processes and to strengthen environmental and fisheries protection. In the new *Fisheries Act*, three areas of focus are highlighted. 1) Protection is focused on real and significant threats to fisheries and supporting habitats, while routine low risk projects are guided by clear, consistent standards. 2) Management of threats to sustainability and productivity is focused on commercial, recreational, and Aboriginal fisheries in Canada. 3) Partnerships between agencies and organizations are enhanced so qualified groups are enabled to provide fisheries protection.

This presentation highlighted that the old principle "HADD" or the "harmful alteration, disruption or destruction of fish habitat" no longer applies to the *Fisheries Act*, and has been replaced with the principle of avoiding activities that cause "serious harm" to fish that contribute to fisheries (Figure 1).

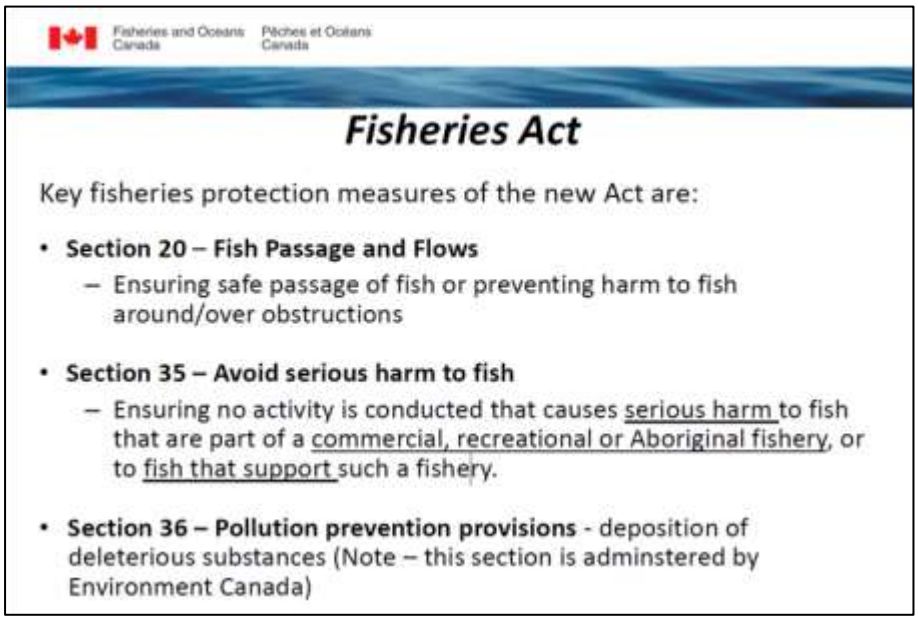


Figure 1. New changes to the *Fisheries Act*.

The revised legislation has consequences for projects in/near water. Now, not all projects will require a review by Fisheries and Oceans Canada (DFO, Figure 2). To determine whether a project will require review by DFO, proponents must use a two-step process to *self-assess*.

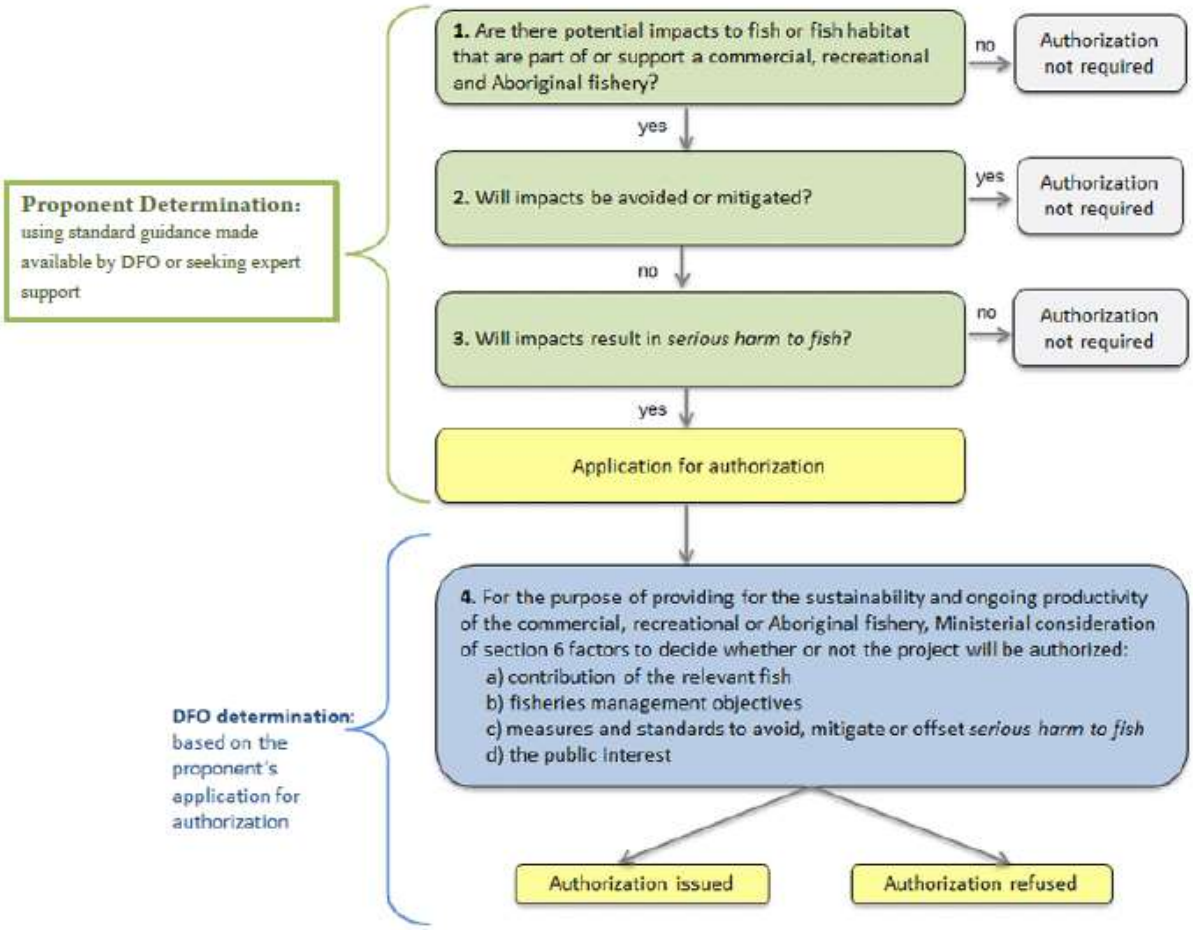


Figure 2. Overview of the DFO project referral process.

Step 1.

The first step of a self-assessment is to understand the project by gathering basic information and answering the following questions:

- What is the plan? (e.g. private wharf, culvert, bridge installation/replacement)
- How will the plan be executed? (e.g. wharf: floating, post dock, crib wharf, concrete)
- What activities will be associated with the project? (e.g. dredging, infilling, fording, stream realignment)
- What is the size of the project?
- Where is the project taking place? (e.g. freshwater, marine, shoreline above/below the high-water mark, pond, lake, river)

Step 2.

Once all of the above information is obtained, the second step is to access the *DFO Projects Near Water Website*: **http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html.** This website will provide information on *types of water bodies,* or *project activities as well as the associated criteria* for which the project does not require a DFO review. Even if the project does not require a DFO review, the proponent must follow best practices to reduce harm to fish and fish habitat by using measures that include: project planning, erosion and sediment control, re-vegetation and stabilization, fish protection, and operation of machinery. For projects and water bodies that are not listed as exempt from a DFO review, a *Request for Review* should be submitted. During this process DFO will conduct a review to determine if the project will cause serious harm to fish. If the project is determined to cause "serious harm to fish that are part of or support a commercial, recreational, or Aboriginal fishery", an *Application for Authorization* may be required.

During the question period following the presentation, the presenters were asked whether self-assessments would need to be documented in writing, which they do not. However, the proponent must follow best practices and stages such as project planning and mitigation measures will require documentation. When asked the consequences of mis-assessing a project, the presenters noted that potential issues may be reported to DFO. The idea of whether the process of guidelines and standard development should be a public process was brought up as a potential consideration for the future.

For further information on application submissions visit:
http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html

Email:
Fisheries Protection Program: FPP-NL@dfo-mpo.gc.ca.

2. Why erosion and sedimentation control is important: a fish's point of view

Jody Roach, Fisheries Protection Program, Fisheries and Oceans Canada

Sediments are soil particles of varying size and composition that can be deposited in lakes and streams through the process of erosion. Both sedimentation and erosion occur naturally, but in excess these processes may cause detrimental effects to fish.

Sedimentation differs from siltation in that sedimentation refers to deposition of *particles of all sizes* on the bottom of a water body. Conversely, siltation refers to the input *of fine sized particles* (i.e. < 0.063 mm) to a water body which can often remain in suspension and contribute to turbidity. Sources of sedimentation include land disturbing activities that lead to exposed soils (Figure 3).

Figure 3. Examples of exposed soils.

Excessive suspended sediments, or those that are deposited in water bodies, can have damaging impacts *on all life stages* of fish, in particular for salmonids. Depending on their life stage, salmonids have various specific requirements for the condition of stream substrates. For spawning, female salmonids construct redds (nests) in gravels usually found at the heads of riffles. At these sites, gravels must allow through-flow of fresh oxygenated stream water to promote the development of fertilized eggs. After hatching, salmonid eggs enter the alevin stage. Alevins remain in the spawning gravels with oxygenated through-flowing water surviving on nutrients from their attached yolk sacs (Figure 4). Once the yolk sac is depleted, the alevins enter the fry stage where they leave the spawning gravels and continue to grow in nearby nursery areas. After a year they become parr and stay in the stream for 2-4 years where they camouflage with bottom substrate. Eventually, they leave the stream to go to sea.

Figure 4. Alevins in gravel.

The effect to which sediments will have detrimental effects on fish and fish habitat depends on duration, extent, and intensity of exposure, as well as the sediment type (suspended vs deposited).

In excess, sediments can have effects on habitat, fish physiology, trophic patterns, and indirect impacts, as described below.

Habitat effects: Excess sediments can degrade the quality of spawning grounds, and high amounts of sediments can cause aversion by adults. Additionally, sediments can clog spaces between gravels thus restricting water circulation, restricting oxygenation and preventing flushing of wastes excreted by embryos. These factors lead to reduced egg survival, delayed fry emergence or trapping within gravels, premature hatching, or smaller fry.

Physiological effects: Excess sediments are associated with increased mortality, depending on a variety of factors (e.g. life stage, time of year, fish size, sediment composition) and exposure. Additionally, gills may become damaged due to abrasion by sediment particles, leading to infection and death. Other effects include traumas and deformities.

Trophic effects: Excess sediments may alter feeding patterns. Because salmonids are visual predators, suspended sediments may influence their feeding success. Additionally, aquatic insects, a type of prey for salmonids, may become smothered, dislodged or impaired by sediments, or their habitat quality may be reduced thereby affecting food chains by lessening the availability of food for species such as fish

Indirect impacts: Sediments may reduce primary production by increasing the turbidity which thereby decreases the amount of light that reaches primary producers (plants and algae). Reduced light leads to less plant matter and therefore less oxygenation and poorer water quality. The morphology of rivers may also be altered if erosion removes bottom sediments and creates pools, or if erosion washes out the undercut banks that provide important fish habitat. The suspended sediments carried away may be deposited in other areas and change the stream profile by creating new structures such as sandbars (Figure 5).

Figure 5. Changes in river morphology due to sedimentation.

There are several steps that can be undertaken to reduce sedimentation and erosion. First, *have a plan* to minimize sedimentation through all stages of the project and *implement* them before starting work. *Maintain* the control measures until disturbed ground has been permanently stabilized, suspended sediment has resettled, and runoff water is clear. Finally, *decommission* once the site is stabilized.

After the presentation, workshop attendees discussed work timeframes that minimize impacts to fish. In Newfoundland rivers, that timeframe is between June 1 and September 30, and in Labrador rivers it is between June 15 to September 15.

To report sedimentation events contact:

Fisheries Protection Program (Mon. – Fri.)
Triage Line
709-772-4140 or FPP-NL@dfo-mpo.gc.ca

Canadian Coast Guard – Regional Ops Center (24/7)
709-772-2083
1-800-563-2444

3. Water Investigations

Susan George, Water Investigations Section, Water Resources Management Division, NL Department of Environment & Conservation

The Water Investigations Section is one of five Sections in the Water Resources Management Division in the Department of Environment & Conservation. The mandate of the Water Investigation Section is to minimize impacts of developments on the province's water resources and to respond to water related concerns. One engineer and one water resource technician work in the Water Investigation Section to provide coverage for the province of Newfoundland and Labrador. Various policies and regulations guide the activities of the Water Investigation Section (Figure 6). The core activities include referrals, permitting, investigations of complaints, follow up visits, and floodplain management.

Figure 6. Water Investigation Section tools.

***Permits*:** According to Section 48 of the *Water Resources Act*, permits are needed for projects such as bridges, culverts, stream alterations (modification or diversion), work in flood risk mapped areas, and miscellaneous work in water bodies. Permit processing takes 4-6 weeks.

***Investigations of complaints*:** The Water Investigation Section handles issues and problems raised by concerned citizens, provincial, federal or municipal agencies on works that are occurring near a water body and may be impacting water quality and infilling (Figure 7).

Figure 7. Investigated sites.

The Water Investigation Section oversees a large geographic area due to its province-wide mandate. With the ongoing economic growth, there is more pressure for development. By strengthening partnerships between all levels of government and non-governmental

organizations enhanced environmental oversight can occur. Education and public awareness will also aid in achieving the mandate of minimizing impacts of development.

In a discussion after the presentation, Ms. George expanded on the follow up that occurs after an investigation. The intensity of the follow-up depends on the number of complaints, and typically includes contacting the parties that are included in the investigation, and conducting site visits together. A related question pertained to the potential consequences of investigation, and Ms. George outlined that the Water Resources Management Division can take action by, for example, issuing stop work orders. During a discussion about the potential for more Water Investigations Officers, the importance of good relationships between with municipalities was brought up, and that monitoring and oversight is a group effort. Another question presented was regarding the timelines for recovering disturbed lands. Ms. George clarified that timelines for remediation depends on the conditions of the permit, and that timelines can range from 2-5 years. The remediation work is expected to be done on the completion of permit reporting. The length of time left on a permit may soon be able to be viewed online. Ms. George also highlighted the importance of preventable measures when working in or near water bodies.

4. Effective planning for erosion prevention and sedimentation control
Andrew Peach, SNC-Lavalin

Development accelerates erosion rates, but by eliminating the source of sediments, or preventing erosion at the source, impacts can be controlled. Erosion prevention is a more effective measure than a reactive measure such as controlling sediments. Costs and effort increase as the project moves from the stages of prevention, to intervention and to restoration. Costs also increase as sediments move further away from the source. Although disruption of land during development is unavoidable, negative impacts may be mitigated in a cost-effective manner through proper planning that uses prevention and control measures, through all stages of construction.

There are several key planning principals for erosion prevention and sediment control: 1) Choose an appropriate site. 2) Create a schedule that will minimize erosion and sedimentation effects. 3) Minimize impacted area and duration of exposure. 4) Keep runoff velocities and erosive energies low. 5) Apply erosion control techniques and retain sediments at the site. 6) Carry out maintenance and monitoring.

1) Choose an appropriate site.

Costs can be minimized if a site is selected based on its intrinsic suitability, meaning it requires minimal modifications to land. There are many tools to aid in site selection, such as: topographical maps, surficial geology/landform maps, aerial photography, LiDAR imagery, watershed and drainage mapping. A location map will reveal proximity of the site to surface water bodies, watercourses, buffer zones, roads, and other areas of concern. Areas requiring grading should be restricted to use in the most level portions of the site, while steep slopes and areas subject to flooding should be avoided.

2) Create a schedule that will minimize erosion and sedimentation effects.

Select a favourable time of year for activities, and avoid stripping or grading when there is a high potential for erosion. Additionally, avoid ecologically sensitive times such as when spawning occurs.

3) Minimize impacted area and duration of exposure.

Phase the development, i.e. expose the smallest practical area of land at a time for the shortest duration. This practice preserves existing vegetation and reduces erosion. The use of grading plans for each phase will aid in identifying changing drainage patterns. Once grading has begun, complete it as quickly as possible and keep areas protected with temporary or permanent cover (e.g. gravel, mesh, blanket, vegetation, seeding; Figure 8).

4) Keep runoff velocities and erosive energies low.

To reduce the impacts of overland flow, minimize the length and steepness of slopes and provide protection by using gabions, matting, or riprap. If a long or steep slope is unavoidable, use divisive measures such as benching, terracing, or build diversion structures. Remaining runoff should be directed away from environmentally sensitive or erodible areas. Ditches can be equipped with check dams to break up flow velocity.

Figure 8. Methods for reducing runoff velocities and volumes.

5) Apply erosion control techniques and retain sediments at the site.

To *prevent* excessive sediment from being produced and to reduce costs and complexity of mitigation, use the following measures:

- slope roughening (Figure 9)
- rolling and compacting soils to make them less erodible
- broad based dips (channels that collect water from gravel roads and carry it across)
- inside ditches (i.e. along inside edge of road, paired with a cross-culvert), or take-off (ditch that deposits water in area where sediments can settle)
- waterbars (structures to control drainage on seasonal or recreational roads; Figure 9)

Methods to *retain* sediments at the source include:

- filter fabric dam
- brush barriers
- sediment ponds

Figure 9. Rough grading (left) and waterbars (right).

6) Carry out maintenance and monitoring.

Using a proactive approach (rather than reactive) will be more cost-effective in the long run. Examples of proactive behaviours include checking weather forecasts on a daily basis, and maintaining an inventory of erosion and sedimentation control materials such as straw bales, silt fences, filter fabric, gravel, and riprap. Budgets should account for costs of the updating and reviewing stormwater and runoff management plans, and inspection and maintenance of erosion and sedimentation control devices. Maintenance and monitoring should be carried out in construction, operation, and decommissioning phases.

There are several common deficiencies in planning and implementation that should be avoided. Specifically, development phasing is often absent from projects (i.e. the process of clearing and grading only a portion of a construction site at a time). Additionally, there may be unnecessary clearing of sensitive areas such as stream riparian buffers, steep slopes and wetlands. Another common deficiency is to introduce a long temporal lag between soil disturbance and stabilization. Finally, poor installation of sediment and erosion control structures as well as poor inspection and enforcement practices can decrease the quality of controls.

The above-discussed principles can be integrated into an *Erosion and Sedimentation Control Plan* (ESC Plan) to guide project practices. Each ESC Plan should contain the elements described in Table 1.

After the presentation, the workshop participants discussed the need for knowledge of proper choice of materials to use in remediation, as there are many choices. For example, some species of vegetation may be better than others to promote features like soil stability. Additionally, sediment control blankets may be made up of different materials (e.g. synthetic or biodegradeable). One participant raised the question of whether an ESC Plan is submitted with a development plan. Mr. Peach expanded that an ESC Plan may not necessarily be submitted at the same time as the development plan, however it is usually a municipal or provincial requirement

at some stage of the development; in addition it is a best practice which may have been specified by a landowner. Another participant clarified that some Environmental Assessments require and ESC component. Professional responsibility, responsibility towards the public, and ethical issues were discussed in the context of ESC.

Table 1. Essential elements for an erosion and sedimentation control plan (ESC Plan).

Element	Description
1. General project statement	– Brief description of the development, project dates, schedule, location, size
2. Topographic and relevant features	– Project location relative to highways, water supplies, property boundaries, critical environmental areas
3. Information on the site soils	– Description of each soil type including texture, thickness, erodibility, surface area
4. The proposed alteration of the area	– Boundary limits and area, limits of clearing and grading, areas of cut and fill and proposed side slopes, location of stockpiles – Phasing (or staging) of land disturbing activities and site stabilization to minimize the extent of exposed areas.
5. Stormwater/runoff management plan	– Amount of runoff from the project area, upstream watershed, runoff producing factors and methods of calculation – Problems posed by runoff on downstream areas. – Analysis of local drainage factors which may contribute to on-site and off-site problems
6. Temporary ESC measures (during construction)	– Types and purpose, location, length of service, dimensions, design considerations and calculations
7. Permanent ESC measures (long-term protection)	– Types and purpose, location, length of service, dimensions, design considerations and calculations, landscaping or vegetation details (seeding, sodding)
8. Maintenance and follow-up program details	– Frequency and schedule of inspections and maintenance of ESC, method and frequency of removal and disposal of sediment, disposal method for temporary control measures. – Review of existing ESC plan for effectiveness and the need for updates due to changing conditions during construction, operation, decommissioning or abandonment.

5. Practical application of sediment and erosion control during fish habitat enhancement

Shaun Garland, AMEC Environment and Infrastructure

Fish habitat offsetting compensates for the *serious harm to fish* that can occur due to a project, and is one process that is carried out through the Biology Group at AMEC Environment and Infrastructure. The process of fish habitat offsetting and the associated construction activities are shown in Figure 10. The steps pertaining to sedimentation are detailed below.

Figure 10. Processes required for fish habitat offsetting.

Fish habitat offsetting construction

1) *Pre-project planning*

First, plan to conduct work during seasons that are not excessively wet. Next, determine suitable access routes that avoid sensitive areas, and do not require extensive cut/fill operations. In areas where there is a risk of erosion, plan and undertake mitigation. For example, ensure a vegetated buffer zone is maintained between access routes and watercourses. For dewatering operations, begin by identifying the extent of areas to be dewatered and the pumping requirements. Select a suitable location where water can be pumped (e.g. into vegetated areas where sediments may naturally be filtered out before entering watercourses). Pre-project planning should encompass all aspects of the project (early pre-project activities, project construction, and project completion and closeout).

2) ***Access construction***

The construction of site access should use the least invasive methods possible and should incorporate the minimum clearances necessary to reduce its environmental footprint (e.g. wooden boardwalk, Figure 11). Overburden (topsoil) materials should be kept in shallow elongated piles along the access for easy replacement upon work completion, and to allow the soils to remain biologically active. The overburden contains nutrients and natural seeds which play an important role in the re-vegetation. Materials free of fines should be used in close proximity (<15 m) of a stream.

In sensitive areas, separation layers (e.g. geotextiles) can be used to allow efficient and less damaging removal of road bed upon completion of the project (Figure 11). Large substrates along the base of the road promote easy removal with minimal disturbance to soils. Control site water with mitigations such as ditching, silt fence check dams, hay bale dams, and silt fencing (Figure 11).

Figure 11. Some mitigation strategies for access roads: wooden boardwalk to minimize impact of access to sensitive areas (left), geotextile layer (centre), silt fence check dam (right).

3) ***Water diversion***

Water can be diverted from a worksite though isolation and pumping or cofferdam placement. 'Dirty' water and seepage is pumped into a natural vegetated area to allow filtration.

4) ***Access removal***

Materials used in building an access should be removed and the road bed should be re-contoured to match original grade and scarified. The stockpiled overburden should be reapplied with woody debris and rocks to promote natural revegetation. All layers of the road should be removed including the top layer, the base layer of large sediments, and geotextile fabric.

5) ***Rehabilitation***

Long term sediment erosion and control planning requires revegetation. Various strategies for revegetation exist and are documented in Table 2. On slopes, erosion control mats made of

biodegradeable wood fibers (e.g. Curlex), layers of loose hay or rows of hay bales may be used to reduce runoff of sediment laden water and promote revegetation.

Table 2. Revegetation strategies.

Strategy	Description
1. "Leave it to nature"	With time, a disturbed area will revegetate through natural stages of succession. Applying organic matter, nutrients and seed can accelerate this process.
2. Commercial seed mixtures	Commercial mixtures typically contain grasses and legumes and can be easily applied by hand. However, these seed mixtures typically contain non-native species.
3. Hydroseeding	Hydroseed contains a mixture of seed, fertilizer, mulch and tactifyer. Application is costly for large areas and requires specialized equipment. Hydroseed mixtures can introduce non-native species.
4. Collection and sowing of seed from native plants	Seeds are collected and sowed by hand. This can be time consuming. One good candidate is alder due to its high seed production, ease of seed collection and processing, and straightforward sowing.
5. Transplanting	Collect small donor plants (usually less than30 cm tall) with soil attached to roots for transplanting.
6. Rootstock	Rootstocks are grown in a nursery and have a well-established rootball. They are easy to plant.
7. Live staking	This method works for species such as willow, red osier dogwood and sweetgale. Whips collected when dormant (i.e. no leaves) and are driven into the ground to 80% of their length.

In conclusion, pre-project planning which includes the use of proactive measures is critical to reducing sedimentation and erosion. A notable strategy described by Mr. Garland is to maintain a stockpile of mitigation materials such as silt fencing and hay bales to greatly reduce negative impacts. For longer term sediment and erosion control, revegetation of exposed soils is essential.

After the presentation, a discussion began with a question from a participant about the availability of a model of risk to fish if allowable suspended solids are exceeded; AMEC does not have such a model. Next, the timing of vegetation planting was discussed and Mr. Garland pointed out that vegetation can be established while other control measures (such as silt fencing, and spread hay) are still in place. Participants also discussed that there are currently no regulations regarding the use and spread of non-native plants for revegetation.

6. Erosion and sediment control: an industry perspective
Deidre Puddister, Pennecon Limited

Erosion and sediment control are necessary in areas near water bodies, wetlands, and at watercourse crossings. Erosion and sediment control are carried out in accordance with the law as a protective measure for the environment, to avoid financial losses, and to reduce liability through regulatory compliance. When selecting a measure, it is important to consider the source of water, whether marine water will be encountered, and whether groundwater will be impacted.

The most common types of control measures are:

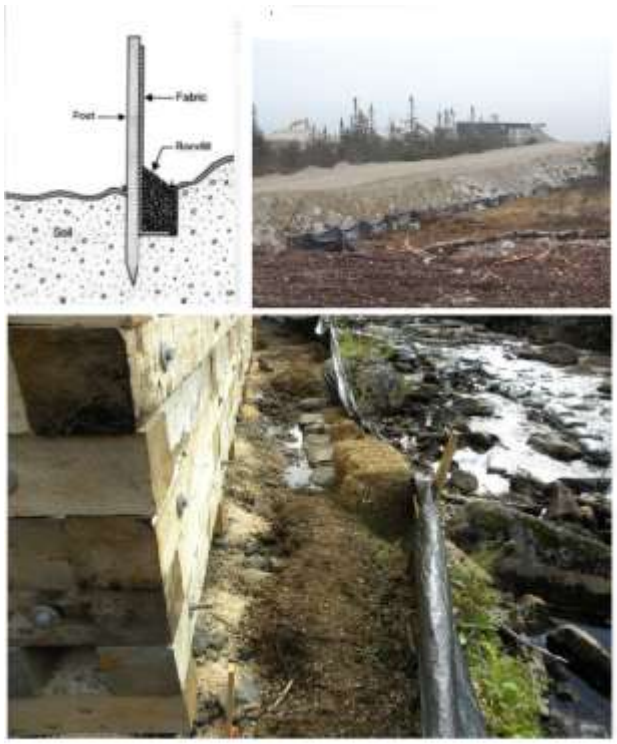
- Settling ponds, sediment control ponds or traps, storm water interceptors
- Silt fencing and hay bales
- Check-dams, dykes, gravel berms
- Turbidity curtains

Some of the above-mentioned control measures are discussed in more detail below.

1) *Settling ponds*

Settling ponds retain water so that sediments can settle out (Figure 12). The size of the particle will determine how long it takes sediments to settle (with smaller particles taking longer to settle). The construction of a settling pond requires consideration of materials to be used, geotextiles, and use of baffles or turbidity curtains. Water to be discharged from sediments must meet water quality criteria defined by Environmental Control Water and Sewage Regulations and the Canadian Council of Ministers of the Environment. Ponds must be cleaned of sediments and a plan must exist for the removed sediments.

Figure 12. Settling pools within a diversion ditch (left), settling pond (right).



2) Silt fencing

Silt fencing consists of synthetic fabric that is mounted between wooden stakes (Figure 13). The fabric is trenched into the soil and the stakes are placed downhill of the fabric. This design allows water to pass through the fence and deposit sediments on the uphill side. Silt fences require frequent inspection and accumulated sediment must be removed and properly disposed of in an area where it will not be able to re-enter a water body.

Figure 13. A schematic depicting the construction of a silt fence (top left), silt fence along a new access (top right), silt fence with hay bales (bottom).

3) Turbidity curtains

Turbidity curtains are flexible barriers for sediment control that are placed in water bodies such as lakes. They hang vertically in the water column due to flotation materials along the top cable and a chain along the bottom (Figure 14).

There are various types of sediment control to select from, and Ms. Puddister highlighted that it is essential to have a strategy and implement it before work begins. Erosion and sediment control measures must also be regularly inspected, maintained, or replaced.

A discussion after the presentation touched on the issue of climate change and the risk of 1:50 year flood levels occurring more frequently. The general consensus was that increased planning is necessary in light of this.

Figure 14. Turbidity curtain.

Product Overviews
Ken Walsh, APEX Construction Specialties

Mr. Walsh provided product demonstrations of sediment and erosion control technologies. This session provided workshop attendees the opportunity to view several products and ask questions throughout the remainder of the session. Mr. Walsh demonstrated several products, some of which are noted below. A turbidity curtain, also described in presentation #6, was shown and it was noted that it must be left off the bottom. Other products were a sediment bag which can hold sediments bigger than dust particles, followed by a floating silter, which is similar to a turbidity curtain but slightly smaller. Next, a modified silt fence reinforced with wire was demonstrated and noted to be stronger than a traditional mesh silt fence. Lastly, Mr. Walsh demonstrated a roll of dredge mat shown which is used to prevent erosion.

Conclusion

Erosion and sedimentation occurs when lands are disturbed due to developmental activities such as clearing and grading. When soils are loosed and removed (erosion) they can enter into water ways (sedimentation). The excessive disruption of natural sediments within waterways can drastically change water quality and river morphology thereby impairing biological processes of fish. The use of erosion and sedimentation control (ESC) measures is necessary when projects are at risk of inputting sediment-laden waters into waterways.

One of the main achievements of the workshop, as determined by participant feedback (see Appendix), was that it clarified the theory and regulations that pertain to erosion and sedimentation. The new *Fisheries Act* provides regulatory context for the requirement for ESC because it ensures that "no activity is conducted that causes serious harm to fish that are part of a commercial, recreational, or Aboriginal fishery, or to fish that support such a fishery". Non-compliers may be reported and/or investigated by federal fisheries officers or the provincial Water Investigations Section. Industry presenters knowledgeable in ESC measures provided insight into the practical approaches for ESC planning and implementation and highlighted the importance of carrying out ESC through all phases of construction.

The planning of ESC was identified as a key determinant of mitigation success. Of the three presentations that discussed practical techniques to ESC, all three presenters emphasized the importance of pre-project planning and a proactive approach. Specifically, it is essential to select mitigation strategies and implement them before work is started. Secondly, two of the three presenters on ESC techniques emphasized the importance of ESC maintenance and explained that measures must be followed up on with regular inspection, maintenance and even replacement.

While the use of ESC measures is an essential practice with important benefits, they may not mitigate damages entirely. Nearby waterways may continue to experience impacts such as decreased health of biotic communities, despite use of best management practices (Hogan et al. 2013). Non-structural ESC measures (i.e. those that reduce initial movement of sediments) can provide additional benefits to structural measures such as settling ponds and silt fences. For example, management actions such as maintaining riparian buffer zones and limiting impervious cover in watersheds can provide non-structural protective measures (Nietch et al. 2005, Hogan et al 2013). For more information on ESC measures, please see Gosse et al. 1998.

This workshop identified a need and desire for collaborative meetings where players in the environmental industry may exchange current information and ideas. All respondents to the post-workshop survey indicated that events of this nature should be hosted regularly. Interestingly, a public interest in ESC was also demonstrated by the workshop attendance of members of the general public. Indeed, previous studies have demonstrated the public's valuation and

willingness to contribute to the preservation of rivers (e.g. Loomis et al. 2000). It is hoped that after this workshop ESC awareness is heightened and use of protective measures is refined.

References

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Appendix

A. Agenda

WORKSHOP AGENDA

8:45 - 9:00	Registration
9:00 - 9:05	**Event Introduction** *Hope Bennett, Chair* *Northeast Avalon ACAP*
	Welcome from NEIA *Ted Lomond, Executive Director* *Newfoundland and Labrador Environmental Industry Association*
9:05 - 9:30	**Does DFO need to Review My Project?** *Bret Pilgrim, Fisheries Protection Program* *Department of Fisheries and Oceans*
9:30- 9:55	**Why Erosion and Sediment Control is Important: A Fish's Point of View** *Jody Roach, Fisheries Protection Program* *Department of Fisheries and Oceans*
9:55 - 10:20	**Water Investigations** *Susan George, Water Resources Technician* *Department of Environment and Conservation*
10:20 - 10:35	Break
10:35 - 11:05	**Effective Planning for Erosion Prevention and Sedimentation Control** *Andrew Peach, Geotechnical Engineering Manager* *SNC Lavalin - BAE Newplan*
11:05 - 11:35	**Practical Application of Sediment and Erosion Control for Fish Habitat Enhancement** *Shaun Garland, Environmental Biologist* *AMEC*
11:35 - 12:05	**Industry Experience: Silt Fencing and Settling Ponds** *Deidre Puddister, Environmental Manager* *Pennecon*
12:05 - 12:15	**Product Overviews** *Ken Walsh* *APEX Construction Specialties*
12:15 - 1:00	Lunch & Networking

EVENT PARTNERS

Walmart

EVERGREEN

Northeast Avalon ACAP | Atlantic Coastal Action Program

neia.org
Newfoundland and Labrador Environmental Industry Association

amec

PENNECON LIMITED

SNC·LAVALIN BAE-Newplan

Kelligrews Ecological Enhancement Program

B. Summary of participant feedback

A short survey was distributed after the event, and 30 responses were returned. The questions and summarized feedback from the survey is presented below. The number in brackets indicates the number of respondents that provided a similar answer.

1) What did you learn from this event?

- *The various types of sedimentation and erosion control measures (14)*
- *Details regarding the changes to the Fisheries Act and other regulatory issues (9)*
- *The general importance of erosion and sedimentation control plans (6)*

2) Is there any component of the workshop that you plan to use directly in your day to day operations?

- *The types of erosion and sedimentation controls available and the planning outline (11)*
- *The DFO regulation presentation was relevant to my work (3)*
- *"no", "maybe" or no response (9)*

3) a. Do you think that an event of this nature should be hosted regularly?

- *Yes (30)*
- *No (0)*

b. On the same topic?

- *Yes (13)*
- *No (6)*
- *Maybe (2)*
- *No response (9)*

c. Please suggest any other topics you would like to see covered.

- *Sustainable construction and construction management (3)*
- *Similar topic with greater depth (3)*
- *Climate change (e.g. its impacts on development activities or on coastal erosion) (2)*
- *Other topics of industry or regulatory concern (2)*
- *Renewable energy (1)*
- *Habitat protection (1)*
- *Environmental monitoring and compliance (1)*
- *Importance of environmental stewardship (1)*
- *Costing (1)*

4) Any further comments?

- *Informative, great, and worthwhile workshop (13)*
- *Good location (2)*
- *Industry should not be left to "honour system" to follow sustainable practices (2)*
- *Good networking opportunity (1)*
- *Great that the workshop was free (1)*
- *Consider partnering with Professional Engineers and Geoscientists Newfoundland and Labrador (PEGNL) or conservation associations to generate exposure (1)*
- *Would like to see more diverse industries other than fisheries and development*