



# **AGNICO EAGLE**

**MELIADINE GOLD PROJECT**

**SD 2-14**

## **Explosives Management Plan**

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**APRIL 2014  
VERSION 3**

## TABLE OF CONTENTS

Tables and Figures .....	iii
Document Control .....	iv
Executive Summary .....	v
Acronyms .....	vii
 <b>Section 1 • Introduction .....</b>	<b>1</b>
1.1 Overview.....	1
1.2 Purpose and Scope .....	1
1.3 Related Documents .....	1
1.4 Applicable Legislation.....	1
<b>Section 2 • Manufacture of Explosives .....</b>	<b>4</b>
2.1 Infrastructures.....	4
2.2 Location .....	4
2.3 Products.....	5
2.4 Emulsion Plant Flow Sheet .....	6
2.5 Design Criteria .....	6
<b>Section 3 • Handling of Explosives .....</b>	<b>8</b>
3.1 Transport .....	8
3.2 Storage.....	8
3.3 Blasting Activities.....	8
3.4 Type of Explosives .....	9
3.5 Blast Monitoring for the Protection of Fish.....	9
3.6 Disposal .....	11
<b>Section 4 • Spills .....</b>	<b>12</b>
4.1 Spill Prevention.....	12
4.2 Intervention in Case of a Spill.....	12
<b>Section 5 • Personnel Training Program .....</b>	<b>14</b>

<b>Section 6 • Blasting Safety Measures .....</b>	<b>15</b>
6.1    Surface .....	15
6.2    Underground .....	16
<b>Section 7 • Internal Audit and Inspection.....</b>	<b>17</b>
<b>Section 8 • Emergency Response Plan.....</b>	<b>18</b>
References .....	19
 Appendix A • Guidelines for the Use of Explosives In or Near Canadian Fisheries Water.....	 20

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**TABLES AND FIGURES**

---

Table 1-1	Applicable Legislation to Explosives Management .....	2
Figure 2-1	Location of Cap magazine, Powder Magazine area and Emulsion Plant.....	5
Figure 2-2	Emulsion Plant Flow Sheet .....	6
Table 4-1	Procedures in Case of Leaks and Spills of Explosive Products.....	13

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**DOCUMENT CONTROL**

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Version	Date	Section	Page	Revision	Author
1	October 2012			First draft of the Explosives Management Plan	Blandine Arseneault, Env. Superintendent, AEM Ryan Vanengen, Biologist, AEM
2	March 2013			DEIS re-submission	No change; rebranding
3	April 2014	3.3-3.4	8-9	Added details on best practices and types of explosives	Josée Noël, Env. Coord. AEM
		3.5	10	Reduced instantaneous pressure change from 100 to 50 kPa	John Witteman, Env. Consultant, AEM

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## EXECUTIVE SUMMARY

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This Explosives Management Plan (SD 2-14) provides information on the manufacture, transport, storage, handling and use of explosives at Agnico Eagle Mines (AEM)'s Meliadine Project. Aspects related to marine shipping and marine mammals are presented in AEM's Shipping Management Plan (SD 8-1). Following are the main federal and territorial legislations which cover the control and use of explosives: Canada - *Explosives Act and Regulations; Transport of Dangerous Goods Act and Regulations; National Fire Code of Canada*; Nunavut - *Explosives Use Act and Regulations, Transportation of Dangerous Goods Act and Regulations; Mine Health and Safety Act and Regulations; Fire Prevention Act and Regulations; Safety Act and Regulations*.

Agnico Eagle Mines (AEM) intends to use emulsion-based explosives as well as ANFO (ammonium nitrate/fuel oil) for controlled blasting of overburden rock, waste rock, ore, construction rock and granular material on surface and underground during the development and operation phases of the Meliadine Project. All products required for blasting activities will be shipped from the south by vessel to Rankin Inlet, loaded on barges, and transported to Itivia area for temporary storage, if necessary, prior to be trucked to site. There will be a temporary material pad for raw products in Rankin Inlet. Explosives, boosters and caps will be transported directly to the mine site once unloaded from the barge. However, if these products require temporarily storage in Rankin Inlet, they will be according to applicable regulations.

General infrastructure on site related to explosives will include an Emulsion Plant (surface), Powder Magazines for storage of explosives such as boosters and ANFO (surface and underground), Cap Magazines (surface and underground), and storage of raw materials used in the preparation of emulsion. An explosives truck will be used on site to transport emulsion from the Emulsion Plant to mining operations. To minimize loss rate and optimize usage of explosives, emulsion will be mostly used since it is efficient regardless the presence of water in boreholes. Unused explosives that are still usable will be returned to storage. The blasting patterns will favor comminution which will reduce energy consumption related to the crushing at the mill therefore optimizing usage of explosives.

To assist in the safe and secure storage of fuels, hazardous materials and hazardous wastes, design criteria of the infrastructures will be in compliance with the various guidelines set by the regulatory bodies. The Emulsion Plant will contain no open drains and will be equipped of lined concrete berms so spills can be 100% contained within the building. All fuel and oil storage tanks will be contained according to the provisions of regulations, or have a double-walled tank. In the event of a spill, a plan will be implemented and appropriate equipment will be used to contain spilled materials. All preventive and breakdown maintenance will be carried out and recorded in accordance with standard operating procedures. A detailed Emergency Response Plan (ERP) will be provided by the explosives supplier and will be included in the next version of this Plan, which will address worst case scenarios such as an accidental explosion.

Blasting safety procedures on breaking rock and frozen material are described in the Plan for surface as well as underground operations. Only trained and certified persons will work with explosives. The explosives personnel will undertake formal training and on-the-job training to ensure compliance with legislation. Internal audits and inspections of all components related to the explosives management will be conducted on a regular basis by qualified personnel, and the results recorded according to quality and safety standard operating procedures. All recommendations and orders made by regulators and inspectors will be responded to and acted upon accordingly.

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**ACRONYMS**

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AEM	Agnico Eagle Mines Limited
ANFO	Ammonium Nitrate / Fuel Oil
CCME	Canadian Council of Ministers of the Environment
DFO	Department of Fisheries and Oceans
EIS	Environmental Impact Statement
IPC	Instantaneous Pressure Change
NRC	Natural Resources Canada
PPV	Peak Particle Velocity
PVS	Peak Vector Sum
SD	Support Document
TDG	Transportation of Dangerous Goods
WHMIS	Workplace Hazardous Materials Information System

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## SECTION 1 • INTRODUCTION

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### 1.1 Overview

Agnico Eagle Mines (AEM) intends to use explosives for controlled blasting of overburden rock, waste rock, ore, construction rock and granular material on surface and underground during the development and operation phases of the Meliadine Project. At this stage, the Explosives Management Plan (SD 2-14) is conceptual since mine construction has not started.

### 1.2 Purpose and Scope

This Plan provides information on explosives manufacture, transport, storage, handling and use at the Meliadine Project and is conform to Section 9.4.13 of the *NIRB Guidelines for the Preparation of an Environmental Impact Statement for Agnico Eagle Mines Ltd.'s Meliadine Project (NIRB File No. 11MN034)*.

Guidelines specific to marine shipping and marine mammals are tackled within the Shipping Management Plan (SD 8-1).

### 1.3 Related Documents

Environmental Impact Statement (EIS) documents containing information related to this Management Plan include:

- Environmental Management and Protection Plan (SD 2-5);
- Risk Management and Emergency Response Plan (SD 2-15);
- Spill Contingency Plan (SD 2-16);
- Landfill and Waste Management Plan (SD 2-11);
- Hazardous Materials Management Plan (SD 2-13);
- Borrow pits and Quarries Management Plan (SD 2-10);
- Surface Water Management Plan (SD 2-6);
- Occupational Health and Safety Plan (SD 9-6);
- Shipping Management Plan (SD 8-1); and
- Oil Pollution Emergency Plan (SD 8-2).

### 1.4 Applicable Legislation

The control and use of explosives within Canada and the Territorial area are covered by existing federal and territorial Acts and Regulations. Meliadine Project will put into place operational policies and procedures which meet or exceed the applicable legislation. Applicable Acts, Regulations and Guidelines are listed in the table below.

Table 1-1 Applicable Legislation to Explosives Management

Acts	Regulations	Guidelines
<b>Federal</b>		
<i>Canadian Environmental Protection Act (1999 c.33)</i>	<i>Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations (SOR/2008-197)</i>  <i>Environmental Emergency Regulations (SOR/2003-307)</i>  <i>Interprovincial Movement of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2002-301)</i>	<i>Canadian Council of the Ministers of Environment - Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products</i>  Notice with respect to substances in the National Pollutant Release Inventory  Canada-Wide Standards for Petroleum Hydrocarbons (PHC) In Soil
<i>Fisheries Act (R.S.C. c. F-14)</i>	<i>Metal Mining Effluent Regulations (SOR/ 2002-2222)</i>	Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters
<i>Explosives Act (1985 c.E-17)</i>	<i>Explosives Regulations (C.R.C., c. 599)</i>  <i>Ammonium Nitrate and Fuel Oil Order (C.R.C., c. 598)</i>	
<i>National Fire Code of Canada (2010)</i>		
<i>Transport of Dangerous Goods Act (1992, c.34)</i>	<i>Transportation of Dangerous Goods Regulations (SOR/2001-286)</i>	
<b>Territorial – Nunavut</b>		
<i>Environmental Protection Act (RSNWT (Nu) 1988, c E-7)</i>	<i>Spill Contingency Planning and Reporting Regulations (NWT Reg (Nu) 068-93)</i>  <i>Used Oil and Waste Fuel Management Regulations (NWT Reg 064-2003)</i>	Guideline for the General Management of Hazardous Waste in Nunavut  Guideline for Industrial Waste Discharges in Nunavut  Guideline for the Management of Waste
<i>Mine Health And Safety Act (SNWT (Nu) 1994, c 25)</i>	<i>Mine Health And Safety Regulations (NWT Reg (Nu) 125-95)</i>	
<i>Explosives Use Act (RSNWT (Nu) 1988, c E-10)</i>	<i>Explosives Regulations (RRNWT (Nu) 1990 c E-27)</i>	
<i>Fire Prevention Act (RSNWT (Nu) 1988, c F-6)</i>	<i>Fire Prevention Regulations (RRNWT (Nu) 1990 c F-12)</i>	
<i>Safety Act (RSNWT 1988, c.S-1)</i>	<i>General Safety Regulations (RRNWT (Nu) 1990 c S-1)</i>  <i>Work Site Hazardous Materials</i>	

Acts	Regulations	Guidelines
	<i>Information System Regulations</i> (RSNWT 1988, C 81 (Supp))	
<i>Transportation Of Dangerous Goods Act</i> (1990, RSNWT (Nu) 1988, c 81 (Supp))	<i>Transportation Of Dangerous Goods Regulations</i> (1991, NWT Reg (Nu) 095-91)	

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## SECTION 2 • MANUFACTURE OF EXPLOSIVES

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### 2.1 Infrastructures

In supporting the overall Meliadine Project development and mine operations, the use of emulsion based explosives as well as ANFO (ammonium nitrate/fuel oil) will be required, depending on the blasting conditions. ANFO will be used during the development phase until the Emulsion Plant becomes available for the manufacturing of emulsion. General infrastructures for the management of explosives at the mine site will include:

- Emulsion Plant (surface);
- Powder magazines for storage of explosives such as boosters and ANFO (surface and underground);
- Cap magazines (surface and underground); and
- Storage of raw materials used in the preparation of emulsion.

The Emulsion Plant will operate 7-days a week on a 12-h/day basis. The explosives truck(s) will be based at the Emulsion Plant. A garage will be included in the building for the maintenance and washing of trucks and equipment used to handle the explosives. The water used for the manufacturing of emulsion will be supplied from the site's fresh water tank using a heat-traced pipeline. Waste water generated by the Emulsion Plant will be re-used within the plant when feasible and excess used water will be evaporated (remaining solids will be disposed in the same manner as unusable emulsion such as described at Section 3.5).

### 2.2 Location

The Emulsion Plant, raw material storage and magazines will be safely located away from vulnerable facilities, as stipulated by the federal and territorial *Explosives Use Act* and regulations.

The Emulsion Plant will be located 1.5 km north-west of the mine site as shown on Figure 2-1. The Surface Powder Magazine area will be next to the Emulsion Plant. Caps will be stored in sea cans which will be located 250 m west of the Emulsion Plant.

Underground facilities will include a Powder Magazine and a Cap magazine. These areas will be constructed as stipulated in the applicable regulations.

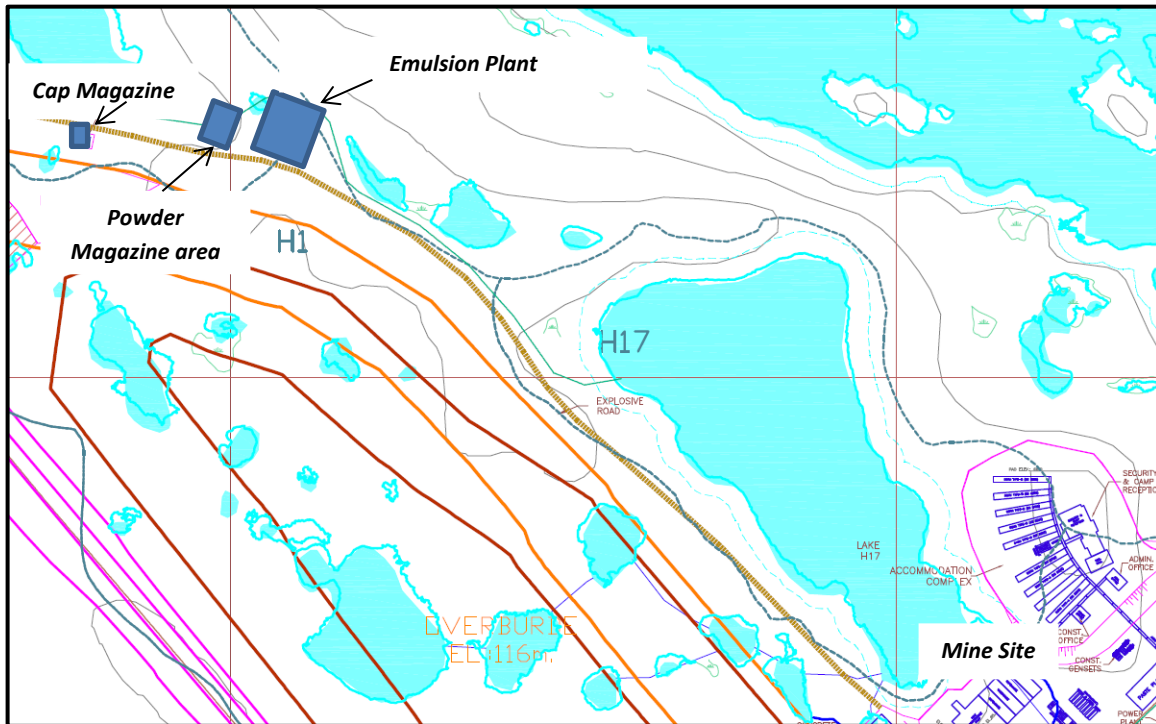


Figure 2-1 Location of Cap magazine, Powder Magazine area and Emulsion Plant

### 2.3 Products

The following products will be required for the mixing of emulsion:

- Fuel oil;
- Ammonium nitrate;
- Sodium nitrite;
- Emulsifier; and
- Water.

The following products will be required to achieve blasting activities:

- Explosives;
- Caps; and
- Boosters.

## 2.4 Emulsion Plant Flow Sheet

The flow sheet of the Emulsion Plant is presented in Figure 2-2. Briefly, the main steps of emulsion preparation are as follows:

1. Mixing ammonium nitrate with water (Mix #1 / Oxidising Melt Solution).
2. Mixing fuel and emulsifier (Mix #2 / Fuel Blend).
3. Mixing Mix#1 and Mix#2.
4. Emulsion ready to be loaded in explosives truck.

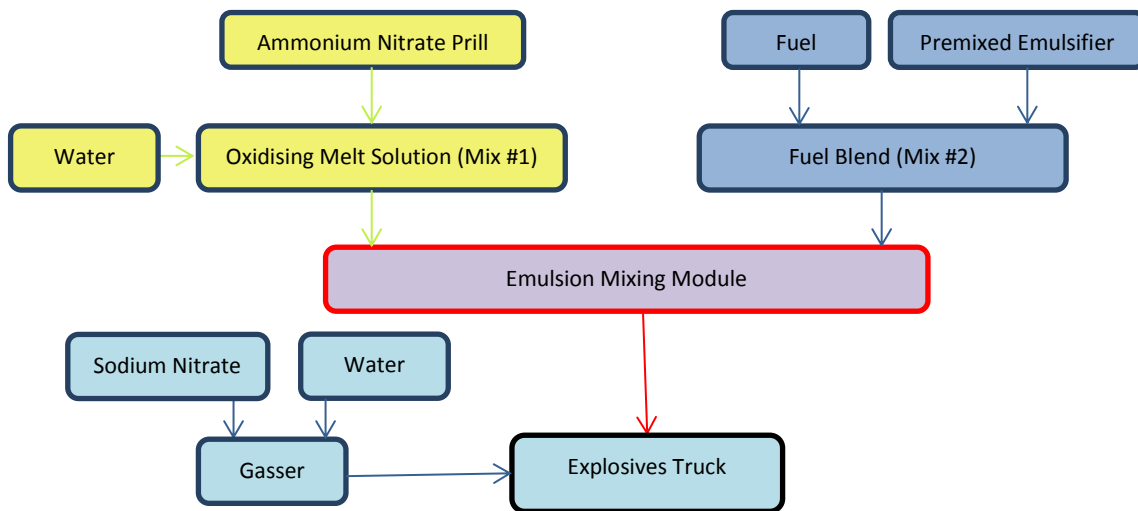


Figure 2-2 Emulsion Plant Flow Sheet

## 2.5 Design Criteria

To assist in the safe and secure storage of fuels, hazardous materials and hazardous wastes, general design criteria for storage areas and facilities related to explosives will be followed:

- Design will be in compliance with the *National Fire Code*, where appropriate.
- Compliance with the Canadian Council of Ministers of the Environment (CCME) publication, *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products (2003)* will be followed. This CCME code deals with inventory control, inspections, corrosion protection, records and

monitoring. Environment Canada's *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations* outline registration and documentation requirements for storage tanks.

- Emulsion Plant will be adequately signed indicating that hazardous materials/wastes are stored therein.
- Storage locations will be clearly defined and marked to prevent damage to storage drums and containers in the event they are covered by snow.
- Incompatible materials will be segregated by chemical compatibility within the storage area to prevent contact between materials in the event of a release.
- Emulsion Plant will be located at least 31 m from surface water.
- Emulsion Plant will be readily accessible for firefighting and other emergency procedures.
- Emulsion Plant will be adequately ventilated to prevent the build-up of noxious or toxic vapours.
- Secondary containment will be installed to allow for the containment of at least 110 % of the largest container or tank volume of any chemical within the contained area.
- Emulsion Plant will be constructed, or provided with barriers, to protect containers from physical damage.
- Adequate spill and emergency response equipment will be installed at each storage area (i.e. spill control, fire protection, etc.).

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**SECTION 3 • HANDLING OF EXPLOSIVES**

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**3.1 Transport**

All products required for blasting activities will be shipped from the South by vessel to Rankin Inlet and loaded on barges and transported to Itivia area for temporary storage, if necessary, prior to be trucked to site. Delivery to Rankin Inlet details and related mitigation measures are provided in the Shipping Management Plan (SD 8-1).

The handling of explosives on site will be carried out by the supplier under a license to conduct such work.

An explosives truck (capacity of 25,000 L) will be used on site to transport emulsion from the Emulsion Plant to the mining operations (surface and underground).

**3.2 Storage**

There will be a temporary material pad for raw products in Rankin Inlet. Sensitive products such as explosives, boosters and caps will be transported directly to the mine site. However, in the eventuality of a delay in their transit to the mine site, these products will be temporarily stored in Rankin Inlet according to applicable regulations, which imply locked storage under constant surveillance.

On the mine site, raw materials such as ammonium nitrate used in the preparation of emulsion will be stored in sea cans (capacity of approximately 20,000 kg each) within the Emulsion Plant area. Raw materials of different and incompatible types will be stored in separate sea cans to prevent their mixing. Raw materials will also be stored away from any other products as required by explosive regulations. The explosive caps will be stored in enclosed Cap Magazines (surface and underground). The boosters and ANFO will be stored in an enclosed Powder Magazine. Surface and underground mining activities will require in total approximately 10 to 20 magazines which will be managed according to the explosive regulations.

**3.3 Blasting Activities**

Blast frequency will be between two (2) and four (4) blasts per day, including underground and surface activities. The quarries, and possibly the borrow pits in some instances, will also require the use of explosives.

The primary blasthole drills on surface will be diesel-powered rigs whereas underground rigs will be electric. A number of operating procedures will be implemented in order to adapt blasting to factors that can affect the operations, including, notably, weather (pit operation). These may include minimizing the sleep time for loaded holes, ensuring that cuttings will be mounded around the hole's collar after loading to prevent snow drifting into the holes, and utilizing blasthole covers.

Emulsion is efficient regardless the presence of water which contributes to minimizing loss rate. Unused explosives that are still usable will be returned to storage.

Blasting will likely be by electric initiation and will feature current technology with down-the-hole delays to minimize the energy per delay to single hole loads. This will minimize backbreak, fly rock, vibration levels and will optimize fragmentation and minimize excavation problems. The blasting patterns will favor comminution, which will reduce energy consumption related to the crushing at the mill. Usage of explosives will therefore be optimized.

Blasting will be carried out by certified blasters following blasting regulations and safe practices. The responsibility for blasting will be split between appropriately trained mine personnel and the explosives supplier.

Finally, there is often a relationship between ammonia and nitrate levels in water and the amount of undetonated explosives. Well planned blasts and strict control of spillage are keys to reducing ammonia losses. For safety, environmental and economic reasons, blast designs will be optimized and include measures that favor complete detonation of all explosives. Drill patterns, explosive loads, and initiation methods will be designed and performed by experienced professionals, and will be adaptively managed to make necessary adjustments should any problems be observed. Also, having a single explosives supplier and trained certified blasters loading the holes and performing blasting activities will ensure consistency and efficiency of the activity. Blasters who are conscientious and aware can prevent most spills by adjusting their loading practices.

### **3.4 Type of Explosives**

The explosive composition can also influence ammonia and nitrate leaching rates which ultimately can have an influence on loss rates. ANFO is less costly than other explosives, but it dissolves readily in water. It is thus an obvious choice for economical, operational, and environmental reasons not to use ANFO when there is anticipated presence of water. Emulsion will release ammonia and nitrates much more slowly than ANFO, mainly because the ammonium nitrate is contained in an aqueous phase that is surrounded by an oil fuel phase. This is in part why, when planning the operation, emulsion explosives will be favoured over ANFO whenever possible.

### **3.5 Blast Monitoring for the Protection of Fish**

#### **Objectives**

Monitoring to evaluate blast related peak particle velocity (PPV) and overpressure to protect nearby fish bearing waters will be conducted to ensure blast operations meet the requirements of specific charge weight/delay/set.

The detonation of explosives in or near water produces compressive shock waves that can cause significant impacts to the swim bladders of fish, rupture other internal organs and/or damage or kill

fish eggs and larvae. In addition, the effects of the shock waves can be intensified in the presence of ice. DFO guidelines developed in 1998 to protect fish and fish habitat from works or undertakings that involve explosives in or near fisheries waters (Wright and Hopky 1998; see Appendix A) have, in part, been superseded by research carried out by Godard et al. 2008. In particular, the recommended maximum instantaneous pressure change has been reduced from 100 to 50 kPa. As a result, AEM will adhere to the following guidelines:

- No explosive is to be detonated in or near fish habitat that produces an instantaneous pressure change (IPC) greater than 50 kPa in the swim bladder of a fish; and
- No explosive is to be detonated that produces a PPV greater than 13 mm/s in a spawning bed during the period of egg incubation (for lakes near the Meliadine Project, the fisheries window is from August 15 to June 30).

Peak particle velocity and overpressure monitoring data will be recorded at a minimum of two locations at the Meliadine Project. The data will be routinely reviewed, evaluated as compared to the guidelines and compiled at the end of the year during annual reporting.

#### Methods

Blasts will be monitored using an Instantel Minimate Blaster (or another compliant monitoring system) which is fully compliant with the international Society of Explosives and Engineers performance specification for blasting seismographs. The Minimate Blaster has three main parts: a monitor, a standard transducer (geophone) and a microphone. The monitor contains the battery and electronic components of the instrument. It also checks the two sensors to be sure that they work properly. The transducer measures ground vibration with a mechanism called a geophone.

They measure transverse, vertical and longitudinal ground vibrations. Transverse ground vibrations agitate particles in a side to side motion. Vertical ground vibrations agitate particles in an up and down motion. Longitudinal ground vibrations agitate particles in a back and forth motion progressing outward from the event site. The Minimate Blaster calculates the PPV for each geophone and calculates the vector sum of the three axes. The final result is the Peak Vector Sum (PVS) and is the resultant particle velocity magnitude of the event:

$$PVS = \sqrt{T^2 + V^2 + L^2}$$

Where:

T = particle velocity along the transverse plane

V = particle velocity along the vertical plane

L = particle velocity along the longitudinal plane

The transducer will be installed as per the model specifications.

### 3.6 Disposal

Disposal of regular waste will follow the AEM's Landfill and Waste Management Plan (SD 2-11).

Any hazardous material that requires to be disposed of will be according the AEM's Hazardous Materials Management Plan (SD 2-13).

Used water generated at the Emulsion Plant will be re-used within the plant when feasible, and excess used water will be evaporated (remaining solids will be disposed of in the same manner as unusable emulsion).

Any unusable/unused emulsion waste as well as other explosive products which expiry date is passed will be taken to the mines blast pattern for disposal down the bore holes.

The empty explosive containers that cannot be reused will be burned on site according to applicable regulation.

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## SECTION 4 • SPILLS

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### 4.1 Spill Prevention

The Emulsion Plant will contain no open drains and will be equipped of lined concrete berms so spills can be 100 % contained within the building. All facilities related to explosives handling on site will be secured (locked), regularly inspected by site security and maintained.

More details regarding spill preventive methods are provided in AEM's Spill Contingency Plan (SD 2-16). Following is a summary of the main aspects:

- All fuel/oil storage tanks will be contained according to the provisions of regulations (e.g. National Fire Code, *Environmental Protection Act*), or have a double-walled tank;
- In case of a spill, a plan will be implemented and appropriate equipment will be used to contain liquids;
- All preventive and breakdown maintenance will be carried out and recorded in accordance with standard operating procedures.

### 4.2 Intervention in Case of a Spill

The following table summarizes procedures to be applied in case of a leak or a spill of a product used in the manufacture of emulsion. Means of disposal of waste are also included. More details regarding hazardous materials and spill management are provided in AEM's Hazardous Materials Management Plan (SD 2-13) and Spill Contingency Plan (SD 2-16).

Table 4-1 Procedures in Case of Leaks and Spills of Explosive Products

Product	Description	Spill and Leak Procedures	Waste Disposal
Ammonium Nitrate Prill	Odorless white to light tan crystalline solid.	Remove source of heat and ignition. Sweep or shovel spill into a clean, non-combustible container. Wash remaining trace residues with water. Wear rubber gloves and safety glasses to prevent contact with skin and eyes.	Dispose of as-is in approved containers. Remove as much as possible the spilled material as a solid.
Fuel Oil	Dyed or pale yellow liquid with petroleum odor.	Eliminate any source of ignition. Prevent spills from entering watercourses or drainage systems. Contain with sand or earth. Recover with pump or inert absorbent material into clean container. Wear safety glasses and rubber gloves to prevent contact with the eyes and skin.	Dispose as specified in the Hazardous Material Management Plan (SD 2-13).
Emulsion	Blasting agent.	Remove all sources of heat and ignition. Prevent spills from entering watercourses or drainage systems. If large amount of emulsion is involved, contain spill with earth or sand. Recover spilled material with a diaphragm pump. Use of a diaphragm pump also requires an air compressor. Limitation of the pump suction is approximately 2.5 m, pump discharge is approximately 8 m. Use a screening device on pump suction hose. Out of area spills will require taking two pumps and extra hose. Transfer the product into a tanker trailer or clean 200 L drums. If small amount of emulsion is involved, transfer material into a clean plastic container with a plastic shovel. Label tanker trailer or drums. Wear rubber gloves and rubber boots.	Recycle product, if possible. If not practical, explode it inside a borehole or if large amount is involved, demulsify it with liquid detergent.
Sodium Nitrite	Oxydizing agent; white to light yellow crystals, faint odour.	In the event of a spill or leak, contact the vendor for advice. Wear respirator, protective clothing and gloves. Vacuuming is the recommended method to clean up spills. Do not sweep or use compressed air for clean up. Recover spilled material of non-combustible material, such as vermiculite. Use non-sparking tools and place in covered containers for disposal. Any recovered material may be used for its intended purpose, depending on contamination.	Dispose of the waste material at an approved hazardous waste treatment/disposal facility.

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**SECTION 5 • PERSONNEL TRAINING PROGRAM**

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Only trained and certified persons will work with explosives. The explosives personnel will undertake formal training and on-the-job training to ensure compliance with legislation. Training requirements will include (but not be limited to):

- Specific fire procedures as per the *Federal Explosives Act*;
- First Aid;
- Transportation of Dangerous Goods (TDG);
- Blasting Certificate; and
- Workplace Hazardous Materials Information System (WHMIS).

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**SECTION 6 • BLASTING SAFETY MEASURES**

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**6.1 Surface**

Blasting safety procedures on breaking rock and frozen material are described below for blasting on the surface (open pit and quarry operations):

- No unauthorized person is allowed inside a posted blast area whether the holes have been loaded or not;
- The blasting supervisor and the blaster are responsible for the safe handling, loading and connection of a blast;
- The shift supervisor is responsible for the evacuation of all personnel and equipment from the blast area and the guarding of the blast;
- The general supervisor is responsible for notifying the appropriate personnel, and other departments and personnel who may be affected by a particular blast;
- Guards will be posted prior to blast time, and must remain guarding until they are told verbally by the shift supervisor that they can leave their position;
- Once guards are posted, the blast area must be inspected by the shift supervisor to ensure that no personnel or equipment remain inside the blast area;
- A blast-warning siren will be sounded for one (1) minute; three (3) minutes after this, the blast will be fired;
- The blaster will only fire the blast when given a direct verbal order to do so by the shift supervisor;
- Before firing a shot, the blaster must ensure the immediate area is clear (i.e. aircraft, etc.);
- The shift supervisor and blaster will inspect the fired shot for indications of any problems such as misfires or cut-offs;
- Areas in which charged holes are awaiting firing shall be guarded or posted against unauthorized entry;
- Vehicles containing explosives shall not be taken to the repair shop or any other building for any purpose; no open flames or welding are to be used for field repairs unless explosives are first removed;
- Downhole initiation lines must be attached to a stake planted in the cuttings on all holes;
- All loaded patterns, in addition to being marked with blasting signs, shall be clearly delineated to outline the pattern;
- Redrills shall be marked with a plastic cone and be designated by a member of the blasting crew; the plastic drill cone shall be firmly implanted in the cuttings of the hole to be redrilled; the cone should be removed by the driller before drilling and inverted in the hole after drilling for pickup by the blasting crew;
- Where redrills are required on loaded patterns, the drill must be guided by the blasting supervisor or blaster or a responsible person designated by them; and

- Service vehicles and fuel trucks are not allowed on a loaded pattern; the drill must pull well clear of the loaded holes before work be done on it; where the drill cannot be moved and service is required, it may be done only under the direct supervision of the blast supervisor or designate and all loaded holes must be covered.

## **6.2 Underground**

Blasting safety procedures on breaking rock and frozen material are described below for underground operations:

- Underground blasts will occur at approximately the same time during the day;
- All employees working underground have to be back on surface and have removed their badges on presences board; and
- Before blasting, the responsible makes sure that there is no badge on the presences boards.

**SECTION 7 • INTERNAL AUDIT AND INSPECTION**

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Internal audits and inspections of all components related to the Explosives Management Plan will be conducted as required by the regulation. Inspections will be done on a regular basis by qualified personnel for physical condition and serviceability, and the results recorded according to quality and safety standard operating procedures. Qualified personnel will perform regular inspections of the Emulsion Plant and of the sea cans storing the boosters, caps and explosives to ensure that inventory is documented.

All recommendations and orders made by Natural Resources Canada (NRC) Explosives Branch Inspectors, Fire Marshals and Insurance Inspectors will be responded to and acted upon accordingly.

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**SECTION 8 • EMERGENCY RESPONSE PLAN**

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A detailed Emergency Response Plan (ERP) will be prepared by the explosives supplier which will address potential incidents involving manufacturing, transport, handling and storage of explosives and related products. The supplier's ERP will be provided in Appendix in the next version of this Plan. It will prescribe actions that supplier's and AEM's employees must take to ensure employee and public safety in the event of an emergency.

The following situations (worse case scenarios) will be addressed relatively to explosives in this ERP:

- Fire/explosion;
- Storage tank failure;
- Spills from product delivery trucks;
- Spills from raw material delivery trucks;
- Process spills;
- Shut down due to weather, floods, lightning, fires, explosions and other threats to the security and operation of supplier's facilities, equipment and material;
- Bomb threats; and
- Quantities of spills and reportable to the supplier and authorities.

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## REFERENCES

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**APPENDIX A • GUIDELINES FOR THE USE OF EXPLOSIVES IN OR NEAR CANADIAN FISHERIES WATER**

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# **Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters**

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## TABLE OF CONTENTS

ABSTRACT/RÉSUMÉ ANALYTIQUE .....	iv
SCOPE AND RATIONALE .....	1
APPLICABLE LEGISLATION AND POLICY.....	1
<i>Fisheries Act</i> .....	1
<i>Canadian Environmental Assessment Act</i> .....	3
IMPACTS.....	3
Effects on Fish.....	3
Effects on Fish Habitat.....	4
GUIDELINES, AND APPLICATION AND REVIEW PROCESSES .....	4
GUIDELINES.....	4
APPLICATION AND REVIEW PROCESSES.....	6
Application Procedures .....	7
Review and Decision-making Process.....	10
UPDATING 13	
ACKNOWLEDGEMENTS.....	13
REFERENCES .....	13

## LIST OF TABLES

Table 1.	Setback distance (m) from centre of detonation of a confined explosive to fish habitat to achieve 100 kPa guideline criteria for various substrates.....	15
Table 2.	Setback distance (m) from centre of detonation of a confined explosive to spawning habitat to achieve 13mm•sec <sup>-1</sup> guideline criteria for all types of substrate.....	15

## LIST OF APPENDICES

Appendix I.	DFO Regional/Area authorities .....	16
Appendix II.	General equations to determine setback distance for confined explosives to meet guideline criteria of 100 kPa.....	18
Appendix III.	Sample calculations and examples for confined explosives .....	20
Appendix IV.	Application form for Authorization to destroy fish by means other than fishing .....	27
Appendix V.	Application form for Authorization to harmfully alter, disrupt or destroy fish habitat. ....	31

## ABSTRACT

Wright, D.G., and G.E. Hopky. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Can. Tech. Rep. Fish. Aquat. Sci. 2107: iv + 34p.

The federal *Fisheries Act* includes provisions for the protection of fish, shellfish, crustaceans, marine mammals and their habitats. The detonation of explosives in or adjacent to fish habitat has been demonstrated to cause disturbance, injury and/or death to fish and marine mammals, and/or the harmful alteration, disruption or destruction of their habitats, sometimes at a considerable distance from the point of detonation.

Within the context of the guidelines and procedures outlined in this report, an explosive is defined as a chemical compound which, when detonated, creates a compressional wave having an almost instantaneous rise time to a very high peak pressure followed by a decay to below ambient pressure by either rapid oxidation or the breaking of high-energy chemical bonds.

The purpose of this report is to provide information to proponents who are proposing works or undertakings that involve the use of confined or unconfined explosives in or near Canadian fisheries waters, and to which the *Fisheries Act*, Sections 32 and 35 in particular, may apply. Guidelines are provided on methods and practices for the conservation and protection of fish, marine mammals, and fish habitat from impacts arising from the destructive forces of explosives. The report describes the suggested application and review procedures and processes for proponents whose use of explosives may result in the destruction of fish, or the harmful alteration, disruption or destruction of fish habitat.

## RÉSUMÉ ANALYTIQUE

Wright, D.G. et G.E. Hopky. *Lignes directrices concernant l'utilisation d'explosifs à l'intérieur ou à proximité des eaux de pêche canadiennes*, rapport technique canadien des sciences halieutiques et aquatiques 2107, 1998, iv + 34 p.

La *Loi sur les pêches* fédérale renferme des dispositions relatives à la protection du poisson, des mollusques, des crustacés, des mammifères marins et de leur habitat. Il a été prouvé que la détonation d'explosifs dans l'habitat du poisson ou à proximité perturbe, blesse ou tue des poissons et des mammifères marins ou encore entraîne la détérioration, la destruction ou la perturbation de leur habitat. Il arrive parfois que les dommages se fassent sentir à une distance considérable du point de détonation.

Aux fins des lignes directrices et des procédures énoncées dans le présent rapport, on entend par explosif un composé chimique qui, lorsqu'il explose, crée une vague de compression entraînant presque instantanément un pic de pression extrêmement élevé suivi d'une décroissance sous la pression ambiante soit par oxydation rapide ou par la rupture des liaisons chimiques à haute énergie.

Le présent rapport a pour but de fournir de l'information aux promoteurs qui proposent des ouvrages ou des entreprises nécessitant l'utilisation d'explosifs confinés ou non confinés à l'intérieur ou à proximité des eaux de pêche canadiennes et auxquels la *Loi sur les pêches*, plus précisément les articles 32 et 35, pourraient s'appliquer. Il renferme des lignes directrices concernant les méthodes et pratiques de conservation et de protection du poisson, des mammifères marins et de leur habitat contre les effets découlant de la force destructrice des explosifs. On y décrit les procédures de présentation des demandes et d'examen pour les promoteurs qui prévoient l'utilisation d'explosifs de nature à entraîner la destruction du poisson ou la détérioration, la perturbation ou la destruction de son habitat.

## SCOPE AND RATIONALE

The federal *Fisheries Act* includes provisions for the protection of fish, shellfish, crustaceans, marine mammals and their habitats. The detonation of explosives in or adjacent to fish habitat has been demonstrated to cause disturbance, injury and/or death to fish and marine mammals, and/or the harmful alteration, disruption or destruction of their habitats, sometimes at a considerable distance from the point of detonation. Therefore, the Department of Fisheries and Oceans (DFO) has prepared this document to provide information to proponents on the conservation and protection of fish, marine mammals, and their habitat from impacts arising from the use of confined or unconfined explosives in or near Canadian fisheries waters. The guidelines, and application and review procedures and processes outlined in this document apply in the context of the legislative and policy framework summarized below.

## APPLICABLE LEGISLATION AND POLICY

### *Fisheries Act*

A number of sections of the *Fisheries Act* and its attendant regulations are applicable to the conservation and protection of fish and fish habitat from the destructive forces of explosives.

- Section 2 defines "Canadian fisheries waters" as meaning all waters in the fishing zones of Canada, all waters in the territorial sea of Canada and all internal waters of Canada.
- Section 2 defines "fish" as including shellfish, crustaceans, marine animals and the eggs, sperm, spawn, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.
- Section 32 prohibits the destruction of fish by any means other than fishing, except as authorized by the Minister of Fisheries and Oceans or under regulations made by the Governor in Council under the *Fisheries Act*.
- Subsection 34(1) defines "fish habitat" as meaning spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes.
- Subsection 35(1) prohibits any person from carrying on any work or undertaking that results in the Harmful Alteration, Disruption or Destruction (HADD) of fish habitat.
- Subsection 35(2) provides for the alteration, disruption or destruction of fish habitat by any means or under any conditions authorized by the Minister of Fisheries and Oceans or under regulations made by the Governor in Council under the *Fisheries Act*.

- Subsection 36(3) prohibits the deposit of a deleterious substance into waters frequented by fish, unless otherwise permitted by regulation.
- Subsection 58(1) of the *Fishery (General) Regulations* provides for anyone proposing to carry on any work or undertaking likely to result in the HADD of fish habitat, to apply to have the means or conditions of that work or undertaking authorized by the Minister under Subsection 35(2) of the *Fisheries Act*, using the form set out in Schedule VI. Schedule VI includes a section for the applicant to provide details on the proposed use of explosives.
- Subsection 58(2) of the *Fishery (General) Regulations* provides the means for the Department of Fisheries and Oceans to issue Authorizations under Subsection 35(2) of the *Fisheries Act*, using the form set out in Schedule VII.
- Section 7 of the *Marine Mammal Regulations* prohibits disturbance of marine mammals except when fishing for them.

In addition, the Department of Fisheries and Oceans has developed a policy framework to assist in the interpretation and application of the applicable legislation. The most relevant documents are as follows:

- The **Policy for the Management of Fish Habitat** (1986) provides policy direction for interpreting the broad powers mandated in the *Fisheries Act* in a way that is consistent with the concept of sustainable development. To achieve the Policy's goal of fish habitat conservation when reviewing project proposals with the potential to affect fish habitat, DFO's habitat managers apply the No Net Loss (NNL) guiding principle. Under this principle, the Department strives to maintain the existing productive capacity of fish habitats, such that the fish habitat is able to sustain the production of fish suitable for fisheries purposes.

In summary, in order to meet the NNL guiding principle, the habitat manager's first preference is to avoid or reduce the project's potential for a HADD of fish habitat through the application of appropriate mitigation measures. Avoidance measures, such as project relocation or redesign, can be effectively applied at the project design stage. Failing that, impacts may be further reduced by application of specific mitigation measures, such as use of timing windows during the construction phase. If a HADD is still expected to occur, unavoidable - i.e. residual - losses in habitat productive capacity may be compensated on a case-by-case basis if the manager concludes that compensation is acceptable and feasible.

- The **Directive on the Issuance of Subsection 35(2) Authorizations** (1995) clarifies the circumstances when an Authorization under Subsection 35(2) may be issued, and on providing proponents with letters of advice suggesting means of avoiding HADD of fish habitat.

- The **Habitat Conservation and Protection Guidelines** (1998) is a document for use by DFO's staff in administering the habitat provisions of the *Fisheries Act*. It outlines a standard approach to habitat conservation and protection through the application of the NNL guiding principle.

### **Canadian Environmental Assessment Act**

A decision to issue an Authorization under Section 32 or Subsection 35(2) of the *Fisheries Act* triggers an environmental assessment under the *Canadian Environmental Assessment Act* (CEAA).

## **IMPACTS**

The use of explosives may result in a number of adverse impacts on fish and marine mammals, and their habitats.

### **Effects on Fish**

The detonation of explosives in or near water produces post-detonation compressive shock waves characterized by a rapid rise to a high peak pressure followed by a rapid decay to below ambient hydrostatic pressure. The latter pressure deficit causes most impacts on fish.

The primary site of damage in finfish is the swimbladder, the gas-filled organ that permits most pelagic fish to maintain neutral buoyancy. The kidney, liver, spleen, and sinus venous also may rupture and haemorrhage. Fish eggs and larvae also may be killed or damaged (Wright 1982).

Studies (Wright 1982) show that an overpressure in excess of 100 kPa will result in these effects. The degree of damage is related to type of explosive, size and pattern of the charge(s), method of detonation, distance from the point of detonation, water depth, and species, size and life stage of fish.

Vibrations from the detonation of explosives may cause damage to incubating eggs (Wright 1982, Wright in prep.). Sublethal effects, such as changes in behaviour of fish, have been observed on several occasions as a result of noise produced by explosives. The effects may be intensified in the presence of ice and in areas of hard substrate (Wright 1982, Wright in prep.).

The detonation of explosives may be lethal to marine mammals and may cause auditory damage under certain conditions. The detonation of explosives in the proximity of marine mammals also has been demonstrated to induce changes in behaviour (Wright in prep.).

The number of shellfish and crustaceans killed by the detonation of explosives is believed to be negligible, however, few data are available. Sublethal effects of explosives on

shellfish and crustaceans including behavioural modifications are little known or understood (Wright 1982, Wright in prep.).

### **Effects on Fish Habitat**

The use of explosives in and near fish habitat may also result in the physical and/or chemical alteration of that habitat. For example, sedimentation resulting from the use of explosives may cover spawning areas or may reduce or eliminate bottom-dwelling life forms that fish use for food. By-products from the detonation of explosives may include ammonia or similar compounds and may be toxic to fish and other aquatic biota (Wright in prep.).

## **GUIDELINES, AND APPLICATION AND REVIEW PROCESSES**

The following sections have been prepared to guide proponents proposing works or undertakings that involve the use of confined or unconfined explosives in or near Canadian fisheries waters, and to which the *Fisheries Act*, Sections 32 and 35 in particular, may apply. Confined explosives are those that would be used within a substrate, including ice, while unconfined explosives are those that would be used in open water, or not within a substrate.

Note that the information and guidance provided in these sections pertains to the conservation and protection of fish and fish habitat in the context of the *Fisheries Act*, and to the CEAA requirements that may result. There is no intent to relieve the proponent of responsibilities under any other federal, provincial or municipal legislation. Proponents are encouraged to contact other appropriate regulatory agencies to ensure that the proposed work or undertaking is carried out according to their requirements.

### **GUIDELINES**

This section provides guidelines on methods and practices which, if incorporated into a project proposal, are intended to prevent or avoid the destruction of fish, or any potentially harmful effects to fish habitat that could result from the use of explosives. Implementation of these measures, for this purpose, is at the discretion of the proponent. Use of these guidelines should not be taken to imply approval of the proposed project in accordance with the *Fisheries Act*. Note that should the proponent proceed with the project and the use of explosives results in the destruction of fish and/or the HADD of fish habitat as a result of a change in plans, or failure to implement the measures, contravention of Section 32 and/or Subsection 35(1) of the *Fisheries Act* could occur.

1. Proponents considering the use of explosives are encouraged to consult the appropriate DFO Regional/Area authorities (Appendix I) as early as possible in their planning process to identify possible alternatives to the use of explosives, the biological resources and their habitats at risk, and/or effective mitigation measures.

2. Where provincial or territorial resource management agencies, or aboriginal resource management boards undertake the administration of fisheries, the proponent is encouraged to consult with the relevant authorities.
3. The use of confined or, in particular, unconfined explosives in or near Canadian fisheries waters is discouraged, and proponents are encouraged to utilize other potentially less destructive methods wherever possible.
4. No use of ammonium nitrate-fuel oil mixtures occurs in or near water due to the production of toxic by-products (ammonia).

Note:

- The deposit of deleterious substances into waters frequented by fish is prohibited under Section 36(3) of the *Fisheries Act*, unless otherwise permitted by regulation. There is no regulation pursuant to the *Fisheries Act* that permits the deposit of by-products resulting from the use of ammonium nitrate-fuel oil mixtures.
5. After loading a charge in a hole, the hole is to be back-filled (stemmed) with angular gravel to the level of the substrate/water interface or the hole collapsed to confine the force of the explosion to the formation being fractured. The angular gravel is to have a particle size of approximately 1/12th the diameter of the borehole.
  6. All "shock-tubes" and detonation wires are to be recovered and removed after each blast.
  7. No explosive is to be knowingly detonated within 500 m of any marine mammal (or no visual contact from an observer using 7x35-power binocular).

Note:

- Upon review of a proposal, the DFO Regional/Area authority may impose a greater avoidance distance, depending on the size of the charge or other project specific or fishery resource conditions.
8. No explosive is to be detonated in or near fish habitat that produces, or is likely to produce, an instantaneous pressure change (i.e., overpressure) greater than 100 kPa (14.5 psi) in the swimbladder of a fish.

Notes:

- For confined explosives, setback distances from the land-water interface (e.g., the shoreline), or burial depths from fish habitat (e.g., from under the riverbed) that will ensure that explosive charges meet the 100 kPa overpressure

guideline are shown in Table 1. Equations to derive these relationships have been adapted from Nicholls et al. (1971) and Anon (1980). The equations are described in Appendix II, and should be used for weights of explosives not covered in Table 1. Sample calculations and examples are illustrated in Appendix III.

- If a confined explosive is to be detonated close to the substrate-water interface (such as in trenching or demolition), the set-back distance closely approximates the theoretical lethal range within which 50% of the fish may be killed or injured. Consequently, the 100 kPa guideline is not likely to be met in those situations where, because of the design constraint's of the project, it is also likely not possible or practical to 'adjust' the setback distance as a means to meet the 100 kPa guideline. For example, preparation of a trench for a pipeline crossing typically requires no more than a below grade burial depth of about 2m. Therefore, the weight of explosive charge per delay will have to be adjusted in an effort to meet the 100 kPa guideline. A sample calculation to illustrate a trenching example is given in Appendix III.
  - For unconfined explosives, proponents are encouraged to contact the appropriate DFO Regional/Area authorities (Appendix I) for further guidance.
9. No explosive is to be detonated that produces, or is likely to produce, a peak particle velocity greater than  $13 \text{ mm}\cdot\text{s}^{-1}$  in a spawning bed during the period of egg incubation.

Note:

- For confined explosives, setback distances or burial depths from spawning beds that will ensure that explosive charges meet the  $13 \text{ mm}\cdot\text{s}^{-1}$  guideline criteria are shown in Table 2. Equations to derive these relationships have been adapted from Nicholls et al. (1971) and Anon (1980) and are described in Appendix II. Sample calculations and examples are illustrated in Appendix III.
- For unconfined explosives, proponents are encouraged to contact the appropriate DFO Regional/Area authorities (Appendix I) for further guidance.

## APPLICATION AND REVIEW PROCESSES

Proponents planning to use an explosive that is likely to destroy fish and/or cause a HADD of fish habitat are subject to certain legal obligations under the *Fisheries Act*, as identified in the preceding 'Applicable Legislation and Policy' section. This section discusses these obligations with respect to the proposed use of explosives, and suggests to proponents how to fulfil them.

Proponents should contact the DFO Regional/Area authorities (Appendix I) as early as possible in their planning process. The purpose is to find out whether the proposed use of

explosives is likely to affect a Canadian fisheries water and whether its use is likely to destroy fish and/or cause a HADD of fish habitat. Depending on the outcome, DFO may also discuss potential issues, specific information requirements, or the next steps and possible outcomes in a further review of the proposal. For example, as summarized in the subsequent 'Review and Decision-making Process' section, possible next steps could include a request for further information, or a recommendation that the proponent seek an authorization pursuant to Section 32 and/or Subsection 35(2). Possible outcomes may include the provision of written advice, the issuance of (an) authorization(s) subject to completion of a CEAA review, or, refusal to issue (an) authorization(s).

Proponents should contact DFO before irrevocable commitments (such as contracts for equipment/services) are made, in order to avoid any unnecessary delays in the application and review process. Note that DFO may become aware of your proposed project through its participation in co-operative arrangements with other governments, agencies, boards, etc.

The following 'Application Procedures' section provides information to assist the proponent in deciding if it should seek Authorization to destroy fish by means other than fishing, and/or Authorization to harmfully alter, disrupt or destroy fish habitat, through the use of explosives and, if so, provides information on procedures for filing, etc.

Note that application for Authorization under Section 32 and/or Subsection 35(2) is voluntary. Proponents are not prohibited from going ahead with their use of explosives without Authorization. But, if as a result of the use of explosives, fish are destroyed and/or there is a HADD of fish habitat, contravention of Section 32 and/or Subsection 35(1) of the *Fisheries Act* could occur and the proponent is liable to prosecution.

### **Application Procedures**

1. Proponents unable to meet the overpressure or peak particle velocity guideline values identified, respectively, in measures 8 or 9 of the preceding 'Guidelines' section, should complete and submit an application for Authorization under Section 32 of the *Fisheries Act*, to destroy fish by means other than fishing. The recommended application form is shown in Appendix IV. However, the proponent should contact the appropriate DFO Regional/Area authority (Appendix I) to verify that this is the appropriate application form to use and/or to identify information requirements.
2. Proponents who wish to file for Authorization under Subsection 35(2) of the *Fisheries Act* should complete and submit a separate application in accordance with the form prescribed pursuant to Subsection 58(1) of the *Fishery (General) Regulations* (Appendix V). Assistance on filing the application form, and related procedures, may be obtained by contacting the appropriate DFO Regional/Area authorities (Appendix I).

3. Proponents seeking Authorization under both Section 32 and Subsection 35(2) should complete and submit both Section 32 (Appendix IV) and Subsection 35(2) (Appendix V) applications. However, to minimize duplication, the proponent may choose to cross-reference those sections that are the same in each application form, and is expected to only submit one set of the documents requested in the forms, unless otherwise requested by the DFO Regional/Area authority. Contact the appropriate DFO Regional/Area authorities (Appendix I) for further information and assistance.
4. In seeking Authorization, the proponent will be expected to provide the information requested in the application forms. Doing so will expedite the review process.

In general, the proponent is expected to provide all plans, specifications, studies, procedures, samples or other information required to permit an assessment of the potential impact of the proposed use of explosives on fish and fish habitat, and the mitigation and/or compensation measures proposed to alleviate impacts and/or to compensate for any loss of productive capacity of habitat to produce fish. Typically, the fish and/or fish habitat information requirements include, but may not necessarily be limited to the items summarized below:

- a) A description of the project and the expected effects resulting from the use of explosives on the fisheries resources (including marine mammals) and/or fish habitat, including:
  - i) A description of fish and marine mammal species and their habitats likely to be affected by the detonation;
  - ii) A description of whether the fish, marine mammals and their habitats contribute, or have the potential to contribute, directly or indirectly, to a fishery - subsistence, commercial or recreational;
  - iii) The timing of any seasonal migration of fish and marine mammals;
  - iv) The theoretical lethal range (i.e., the range, or distance, over which the overpressure exceeds 100 kPa) of the explosives to be used (from equations provided in Appendix II);
  - v) An assessment of potential impacts arising from the proposed use of explosives and a description of proposed mitigation and/or compensation measures; and
  - vi) Other matters, such as the proposed contingency plan and monitoring and follow-up program.
- b) The proponent's mitigation plan should include discussion of the following measures that are particularly relevant to alleviating the potential impacts of explosives:
  - i) The work or undertaking should be undertaken at the time of least biological activity or biological sensitivity. Proponents should consult with DFO Regional/Area authorities to determine the appropriate timing;

- ii) If multiple charges are required, time-delay detonation initiators (blasting caps) should be used to reduce the overall detonation to a series of discrete explosions. Time delays for discrete explosions should be greater than 25 ms; and,
- iii) If possible, large charges should be subdivided into a series of smaller discrete detonations or explosions using time-delay detonation initiators (a procedure known as decking) to reduce the overall detonation to a series of smaller discrete detonations or explosions.

In addition to these measures, the proponent should also consider additional mitigation measures including, but not limited to the following:

- iv) Deployment of bubble curtains/air curtains to disrupt the shock wave;
  - v) Deployment of noise generating devices, such as an air compressor discharge line, to scare fish away from the site; or,
  - vi) Removal or exclusion of fish from the work area before the blast occurs.
5. Proponents should be aware that subsequent to filing the application, DFO may request additional information concerning fish and fish habitat, the mitigation and/or compensation plans, the contingency and monitoring and follow-up programs, and other matters as required to complete the *Fisheries Act* review. If the appropriate information is not already available, it is the proponent's responsibility to provide it and, also, to assure DFO that the proposed mitigation and/or compensation measures will be effective. Should it be necessary to conduct an environmental assessment of the project pursuant to the CEAA, then additional information will be required in order to meet the requirements of the CEAA.
  6. The Department of Fisheries and Oceans will undertake to: respond to requests for review, or to referrals, of project proposals or activities; issue Authorizations or provide advice; and/or complete environmental assessments in a manner consistent with Departmental service standards. Generally, DFO will respond to requests for review or to referrals within 30 working days of notification. Timeframes required for the issuance of Authorizations or advice will be discussed with proponents. Proponents should be aware that the length of time required to complete a review can vary greatly, often depending on the type and complexity of project proposed, the fish and fish habitat issues involved, and whether or not an environmental assessment under the CEAA is required. Once again, proponents are encouraged to contact the appropriate DFO Regional/Area authorities (Appendix I) to discuss these issues.
  7. If an unforeseen need to use explosives arises, Departmental service standards may be waived and a review completed as expeditiously as possible so as not to unduly delay a project. Further, Departmental service standards are waived in the event of an emergency where lives and/or property are threatened. In such cases, the amount of information required may be reduced due to the urgency of the

situation. Any verbal request for an emergency Authorization will be accepted only on the condition that it is followed by a written confirmation of the project details.

8. If applicable, proponents may be required by the Department of Fisheries and Oceans, Canadian Coast Guard, to issue a "Notice to Mariners" and/or a "Notice to Fishers". The appropriate DFO Area/Regional authorities (Appendix I) are prepared to assist the proponent with contacting the Canadian Coast Guard.
9. Resource management agencies of other governments, departments, or boards that have been established under some aboriginal land claim settlements, may have aquatic resource review requirements and service standards that are different than those described in this document. Proponents should contact those agencies to ensure compliance with any requirements they may have.

### **Review and Decision-making Process**

This section summarizes the approach taken by the Department of Fisheries and Oceans in the review of referrals and of applications for Authorization. Included is a description of the key decisions possible from a review, and the criteria used in making decisions. There is also a brief summary of the linkage between Section 32 and/or Subsection 35(2) Authorizations and the responsibilities of the Department of Fisheries and Oceans to undertake environmental assessments pursuant to the *Canadian Environmental Assessment Act* (CEAA).

#### **Fisheries Act**

DFO will review the proponent's application in accordance with the *Fisheries Act* and its supporting policy framework, including this document. Upon receipt of information, notice, a referral, or application for Authorization concerning works or undertakings where the use of explosives is proposed, DFO will normally take the following steps in its review of the proposal:

1. Determine the adequacy of the information provided by the proponent.
2. Using the information provided, assess the extent of risk or potential damage to fish and marine mammals and/or fish habitat and the acceptability of this level of damage in context with the level of protection required.
3. Determine the probable success of proposed mitigation and/or compensation measures and, as appropriate the acceptability of any residual impacts.
4. Where relevant, consult with the appropriate provincial or territorial resource management agencies, and/or aboriginal resource management boards.
5. Note that prior to finalizing its review of the proposal DFO may, among other matters, advise the proponent of the need for more information, re-assess a revised project proposal, suggest that the proponent seek authorization, etc. The

review of a proposal is often an iterative process depending on a number of factors, such as the type of referral received by DFO, its completeness, its potential impacts on fish and/or fish habitat and the potential to mitigate and/or compensate for such impacts. Proponents should discuss this and related aspects of the review process with the relevant DFO/Regional area authority (Appendix I).

6. After examination of the proposal, DFO will make a decision regarding the proponent's application.

- **With respect to Section 32, DFO will either,**

⇒ upon determining that implementation of mitigation measures by the proponent is expected to prevent or avoid the destruction of fish, advise the proponent by letter that if such measures are incorporated into the project, Section 32 is not expected to be contravened. A letter of advice should not be taken to imply approval of the project pursuant to the habitat provisions of the *Fisheries Act*, or any other legislation. Note, if the destruction of fish occurs as a result of a change in the plans for the proposed project, or failure to implement the measures identified in the letter of advice, contravention of Section 32 of the *Fisheries Act* could occur.

**OR**

⇒ upon determining that even with the implementation of mitigation measures the destruction of fish is still expected to occur **and**, because this mortality is acceptable within the context of the fisheries resource, issue a Section 32 Authorization using a letter format.

**OR**

⇒ upon determining that even with the implementation of mitigation measures the destruction of fish is still expected to occur **but**, because this mortality is not acceptable within the context of the fisheries resource, reject the proposal, and notify the proponent that DFO will not issue a Section 32 Authorization and that a contravention of the *Fisheries Act* could occur should the proponent still choose to proceed as proposed.

- **With respect to Section 35, DFO will either,**

⇒ upon determining that implementation of mitigation measures by the proponent is expected to prevent or avoid a HADD of fish habitat, advise the proponent by letter that if such measures are incorporated into the project, Subsection 35(1) is not expected to be contravened. A letter of advice should not be taken to imply approval of the project pursuant to the habitat provisions of the *Fisheries Act*, or any other legislation. Note, if a

HADD of fish habitat occurs as a result of a change in the plans for the proposed project, or failure to implement the measures identified in the letter of advice, contravention of Subsection 35(1) of the *Fisheries Act* could occur.

**OR**

⇒ upon determining that even with the implementation of mitigation measures a HADD of fish habitat is still expected to occur **and**, because the proposed compensation for the unavoidable net loss of productive capacity of fish habitat is acceptable to DFO, issue a Subsection 35(2) authorization using the form provided in Schedule VII of Subsection 58(2) of the *Fishery (General) Regulations*.

**OR**

⇒ upon determining that even with the implementation of mitigation measures a HADD of fish habitat is still expected to occur **but**, because the proposed compensation for the unavoidable net loss of fish habitat productive capacity is not acceptable, reject the proposal, and notify the proponent that DFO will not issue a Subsection 35(2) Authorization and that a violation of the *Fisheries Act* could occur should the proponent still choose to proceed as proposed.

Notes:

- The Department of Fisheries and Oceans, in arriving at one of the above noted determinations, will also consider the following criteria:
  - Whether the use of explosives is the only technically feasible means by which to attain the desired objective; and
  - Whether the use of explosives is required to alleviate an emergency situation threatening human safety and/or property.
- Section 32 and/or Subsection 35(2) authorizations come with conditions attached, which among others may include:
  - The proponent may be required to develop, undertake and report on a monitoring program at its expense, typically, to monitor compliance and evaluate effectiveness of the mitigation and/or compensation measures.
  - If, during the course of the works or undertakings, the adverse effects of the explosives were significantly greater than anticipated, the proponent may be required to immediately cease all further use of explosives,

pending review of the situation with Department of Fisheries and Oceans personnel.

- Additional, site-specific terms and conditions as may be required in order to satisfy fishery resource and/or fish habitat protection requirements. For example, the conditions may be more stringent than the measures identified in the preceding 'Guidelines' section.

#### Canadian Environmental Assessment Act

Section 32 and Subsection 35(2) are included in the *Law List Regulation* of the *Canadian Environmental Assessment Act* (CEAA). Consequently, the Department of Fisheries and Oceans as the Responsible Authority must conduct an environmental assessment of the relevant proposed works or undertakings before an Authorization can be issued. If the result of the environmental assessment is that the work or undertaking will, after taking into account the appropriate measures, not likely result in significant impact that cannot be justified, then authorization(s) will normally be issued pursuant to Section 32 and/or Subsection 35(2) of the *Fisheries Act*. Procedures for coordinating the CEAA review with provincial and aboriginal government review processes vary. Proponents are strongly advised to contact the DFO Regional/Area authorities (Appendix I) to obtain additional information on environmental assessment procedures and requirements.

### **UPDATING**

These guidelines will be reviewed and updated as necessary.

### **ACKNOWLEDGEMENTS**

Many individuals and governmental and non-governmental organizations were consulted in the development of these guidelines. We gratefully acknowledge their interest and contributions. In particular, input from D. Haché, K. Fisher, K. Broughton and R. Drolet, from DFO, and L. Macanuf (Golder-VME) and R. Morin (Explotec Engineering Ltd) is appreciated.

### **REFERENCES**

Anonymous. 1980. Blasters handbook. 16<sup>th</sup> edition. Explosives Products Division, E.I. DuPont de Nemours & Co. Wilmington, Delaware. 494 p.

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- Wright, D.G. 1982. A discussion paper on the effects of explosives on fish and marine mammals in the waters of the Northwest Territories. Can. Tech. Rep. Fish. Aquat. Sci. 1052: v + 16 p.
- Wright, D.G., in prep. The effects of the use of explosives on fish and marine mammals, including models to predict their impact and mitigation strategies to reduce the effect on fish and marine mammals. Can. Tech. Rep. Fish. Aquat. Sci. xxxx: xx + xx p.

Table 1. Setback distance (m) from centre of detonation of a confined explosive to fish habitat to achieve 100 kPa guideline criteria for various substrates.

The data in this table is incorrect and should not be used.

Substrate Type	Weight of Explosive Charge (kg)							
	0.5	1	2	5	10	25	50	100
Rock	3.6	5.0	7.1	11.0	15.9	25.0	35.6	50.3
Frozen Soil	2.3	3.2	4.5	7.2	14.3	16	22.6	32
Ice	1.5	2.1	3.0	4.7	6.6	10.5	14.8	21
Saturated Soil	1.5	2.1	3.0	4.8	6.7	10.0	15.1	21.3
Unsaturated Soil	0.7	1.0	1.4	2.2	3.1	4.9	6.9	9.8

**Erratum:**

Wright, D.G., and G.E. Hopky. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Can Tech. Rep. Fish. Aquat. Sci. 2107: iv + 34p.

Page 15: Table 1 should be replaced by the following Table:

Table 1. Setback distance (m) from centre of detonation of a confined explosive to fish habitat to achieve 100 kPa guideline criteria for various substrates.

Substrate Type	Weight of Explosive Charge (kg)							
	0.5	1	2	5	10	25	50	100
Rock	3.6	5.0	7.1	11.0	15.9	25.0	35.6	50.3
Frozen Soil	3.3	4.7	6.5	10.4	14.7	23.2	32.9	46.5
Ice	3.0	4.2	5.9	9.3	13.2	20.9	29.5	41.8
Saturated Soil	3.0	4.2	5.9	9.3	13.2	20.9	29.5	41.8
Unsaturated Soil	2.0	2.9	4.1	6.5	9.2	14.5	20.5	29.0

Table 2. Setback distance (m) from centre of detonation of a confined explosive to spawning habitat to achieve  $13 \text{ mm} \cdot \text{sec}^{-1}$  guideline criteria for all types of substrate.

	Weight of Explosive Charge (kg)						
	0.5	1	5	10	25	50	100
Setback distance (m)	10.7	15.1	33.7	47.8	75.5	106.7	150.9

## Appendix I

### DFO Regional/Area Authorities

#### **Newfoundland Region**

Habitat Evaluation Engineer,  
Habitat Management Division  
Fisheries and Habitat Management Branch  
PO Box 5667  
St. John's, NF A1C 5X1  
Voice: (709) 772-6157  
Fax: (709) 772-4525

#### **Maritime Region**

##### New Brunswick and Prince Edward Island

Denis Haché, P. Eng.  
Habitat Evaluation Engineer  
PO Box 5030  
Moncton, NB E1C 9B6  
Voice: (506) 851-6252  
Fax: (506) 851-6579

##### Nova Scotia

Brian Jollymore, P. Eng.  
Habitat Evaluation Engineer  
PO Box 550  
Halifax, NS B3J 2S7  
Voice: (902) 426-2549  
Fax: (902) 426-1489

#### **Laurentian Region**

Manager, Fish Habitat  
Fish Habitat and Environmental Science  
Maurice-Lamontagne Institute  
PO Box 1000  
Mont-Joli, QC G5H 3Z4  
Voice: (418) 775-0577  
Fax: (418) 775-0658

#### **Central and Arctic Region**

##### Ontario

Area Manager, Ontario Area  
Fisheries Management Branch  
PO Box 5050, 867 Lakeshore Road  
Burlington, ON L7R 4A6  
Voice: (905) 336-4567  
Fax: (905) 336-6437

##### Manitoba, Saskatchewan and Alberta

Manager, Habitat Management Division  
Fisheries Science Branch  
501 University Crescent  
Winnipeg, MB R3T 2N6  
Voice: (204) 983-5164  
Fax: (204) 984-2402

## Appendix I (concluded) DFO Regional/Area Authorities

### Central and Arctic Region (continued)

#### Nunavut

Area Manager, Nunavut Area  
Fisheries Management Branch  
PO Box 358  
Iqaluit, NWT X0A 0H0  
Voice: (867) 979-8002  
Fax: (867) 979-8039

#### Western Arctic

Area Manager, NWT West Area  
Fisheries Management Branch  
PO Box 2310  
Yellowknife, NWT X1A 2P7  
Voice: (867) 920-6636  
Fax: (867) 873-8871

### Pacific Region

#### North Coast

Chief,  
Habitat and Enhancement Branch  
North Coast Division  
South 417 - 2<sup>nd</sup> Ave. W.  
Prince Rupert, BC V8J 1G8  
Voice: (250) 627-3453  
Fax: (250) 627-3480

#### South Coast

Chief,  
Habitat and Enhancement Branch  
South Coast Division  
3225 Stephenson Pt. Road  
Nanaimo, BC V9T 1K3  
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Fax: (250) 756-7162

#### Fraser River

Chief,  
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Fraser River Division  
610 Derwent Way  
Annacis Island  
New Westminster, BC V3M 5P8  
Voice: (604) 666-0315  
Fax: (604) 666-6627

#### Yukon

Chief,  
Habitat and Enhancement Branch  
Yukon Division  
122 Industrial Road  
Whitehorse, YT Y1A 2T9  
Voice: (867) 393-6725  
Fax: (867) 393-6738

#### Northeastern and Southeastern B.C.

Chief, Major Projects Unit  
Habitat and Enhancement Branch  
327 – 555 Hastings Street  
Vancouver, BC V6B 5G3  
Voice: (604) 666-2057  
Fax: (604) 666-7907

## Appendix II

### General Equations to Determine Setback Distance for Confined Explosives to Meet Guideline Criteria of 100 kPa

#### Equation (A)

Equation (A) describes the transfer of shock pressure from the substrate to the water.

$$P_W = \frac{2(Z_W / Z_R)P_R}{1 + (Z_W / Z_R)}$$

where:

$P_W$	=	pressure (kPa) in water
$P_R$	=	pressure (kPa) in substrate
$Z_W$	=	acoustic impedance of water
$Z_R$	=	acoustic impedance of substrate

#### Equation (B)

Equation (B) describes the relationship between acoustic impedance and the density and velocity of the medium through which the compressional wave travels.

$$Z_W/Z_R = \frac{D_W C_W}{D_R C_R}$$

where:

$D_W$	=	density of water = $1 \text{ g}\cdot\text{cm}^{-3}$
$D_R$	=	density of the substrate in $\text{g}\cdot\text{cm}^{-3}$
$C_W$	=	compressional wave velocity in water
	=	$146,300 \text{ cm}\cdot\text{s}^{-1}$
$C_R$	=	compressional wave velocity in substrate
	=	in $\text{cm}\cdot\text{s}^{-1}$

**Appendix II (concluded)**  
**General Equations to Determine Setback Distance for Confined**  
**Explosives to Meet Guideline Criteria of 100 kPa**

Equation (B) (continued):

The following values are used for  $D_R$  and  $C_R$  for various substrates:

Substrate	$D_R$ (g•cm <sup>-3</sup> )	$C_R$ (cm•s <sup>-1</sup> )
Rock	2.64	457,200
Frozen Soil	1.92	304,800
Ice	0.98	304,800
Saturated soil	2.08	146,300
Unsaturated soil	1.92	45,700

Equation (C)

Equation (C) describes the relationship between the peak particle velocity ( $V_R$ ) and the pressure, density and compressional wave velocity in the substrate.

$$V_R = \frac{2P_R}{D_R C_R}$$

Equation (D)

Equation (D) represents the scaled distance relationship and is used to equate the peak particle velocity to charge weight and distance.

$$V_R = 100 (R/W^{.5})^{-1.6}$$

where:

$V_R$	=	peak particle velocity in cm•s <sup>-1</sup>
$R$	=	distance to the detonation point in m
$W$	=	charge weight per delay in kg

### Appendix III

#### Sample Calculations and Examples for Confined Explosives

#### SAMPLE CALCULATIONS

##### Sample Calculation 1: Calculation of Setback Distance Required for a 100 kg Charge Set in Rock to Meet the 100 kPa Guideline.

1. From Equation (B):

$$\begin{aligned}
 Z_W/Z_R &= \frac{D_W C_W}{D_R C_R} \\
 &= \frac{(1\text{g} \cdot \text{cm}^{-3})(146,300\text{cm} \cdot \text{s}^{-1})}{(2.64\text{g} \cdot \text{cm}^{-3})(457,200\text{cm} \cdot \text{s}^{-1})} \\
 &= 0.1212
 \end{aligned}$$

2. From Equation (A):

$$P_W = \frac{2(Z_W / Z_R)P_R}{1 + (Z_W / Z_R)}$$

$$P_W = \frac{2(0.1212)P_R}{1 + (0.1212)}$$

$$P_W = 0.22 P_R$$

3. To limit  $P_W$  to 100 kPa ( $\text{kg} \cdot \text{m} \cdot \text{s}^{-2} \cdot \text{m}^{-2}$ ):

$$P_R = \frac{P_W}{0.22}$$

$$P_R = \frac{100 \text{ kPa}}{0.22}$$

$$P_R = 455 \text{ kPa}$$

$$P_R = 4.55 \times 10^2 \text{ kPa}$$

**Appendix III (continued)**  
**Sample Calculations and Examples for Confined Explosives**

4. Convert kPa to dynes ( $\text{g}\cdot\text{cm}\cdot\text{s}^{-2}$ ):

$$\text{dynes} = \text{kPa} \times 10^4$$

$$P_R = 4.55 \times 10^2 \times 10^4$$

$$P_R = 4.55 \times 10^6 \text{ dynes } (\text{g}\cdot\text{cm}\cdot\text{s}^{-2})$$

5. From Equation (C):

$$V_R = \frac{2P_R}{D_R C_R}$$

$$V_R = \frac{(2) (4.55 \cdot 10^6 \text{ g}\cdot\text{cm}\cdot\text{s}^{-2})}{(2.64 \text{ g}\cdot\text{cm}^{-3})(457,200 \text{ cm}\cdot\text{s}^{-1})}$$

$$V_R = 7.54 \text{ cm}\cdot\text{s}^{-1}$$

6. From Equation (D):

$$V_R = 100(R/W^{.5})^{-1.6}$$

$$R = (W^{.5})(V_R/100)^{-0.625}$$

$$R = (100\text{kg})^{.5}(7.54\text{cm}\cdot\text{s}^{-1}/100\text{kg}\cdot\text{cm}\cdot\text{s}^{-1}\cdot\text{m})^{-0.625}$$

$$R = 50.3 \text{ m}$$

Therefore, a 100 kg charge of explosives detonated in rock requires a setback of 50.3 m from fish habitat in order to reduce the overpressure produced by the detonation to less than 100 kPa.

Now, the calculation of the set-back distance required for a 100 kg charge set in rock to meet the peak particle velocity guideline of  $13 \text{ mm}\cdot\text{sec}^{-1}$  is as follows:

### Appendix III (continued)

#### Sample Calculations and Examples for Confined Explosives

From Equation (D):

$$R = (W^{.5})(V_R/100)^{-0.625}$$

When

$$V_R = 13 \text{ mm} \cdot \text{sec}^{-1} = 1.3 \text{ cm} \cdot \text{sec}^{-1}$$

and  $W = 100 \text{ kg}$

$$R = (100^{.5})(1.3/100)^{-0.625}$$

$$R = 150.9 \text{ m}$$

Therefore, a 100 kg charge of explosives detonated in rock requires a setback of 150.9 m from a spawning area in order to reduce the peak particle velocity produced by the detonation to less than 13 mm•sec<sup>-1</sup>.

#### **Sample Calculation 2: Simplified Calculation of Setback Distance from Fish Habitat.**

The calculations to determine the required setback distance to meet the 100 kPa guideline may be simplified. Since the weight of the charge and the distance from the charge to fish habitat are the only variables in the equations, a factor can be developed for substitution in Equation (D).

From Equation (D):

$$V_R = 100(R/W^{.5})^{-1.6}$$

$$R = (W^{.5})(V_R/100)^{-0.625}$$

Therefore:

$$R = W^{.5}(K)$$

By working through the equations of Appendix II and solving for  $V_R$  for each substrate

**Appendix III (continued)**  
**Sample Calculations and Examples for Confined Explosives**

type, the following results are obtained:

<b>SUBSTRATE TYPE</b>	<b>K</b>
Rock	5.03
Frozen Soil	3.2
Ice	2.1
Saturated Soil	2.13
Unsaturated Soil	0.98

Therefore, to determine the setback distance required to meet the peak pressure guideline of 100 kPa, multiply the square root of the charge weight by the appropriate “K” factor.

**Sample Calculation 3: Simplified Calculation of Setback Distance from Fish Spawning Habitat.**

Similarly, to determine the set-back distance required to meet the peak particle velocity ( $V_R$ ) guideline of  $13 \text{ mm} \cdot \text{sec}^{-1}$ , a constant can be developed for substitution in Equation (D):

From Equation (D):

$$V_R = 100(R/W^{.5})^{-1.6}$$

$$R = (W^{.5})(V_R/100)^{-0.625}$$

where:

$$V_R = 13 \text{ mm} \cdot \text{sec}^{-1} = 1.3 \text{ cm} \cdot \text{sec}^{-1}$$

$$R = (W^{.5})(1.3/100)^{-0.625}$$

$$R = (W^{.5})(15.09)$$

Therefore, to determine the setback distance required to meet the peak particle velocity ( $V_R$ ) guideline of  $13 \text{ mm} \cdot \text{sec}^{-1}$ , multiply the square root of the charge weight by a factor of 15.09.

### Appendix III (continued)

#### Sample Calculations and Examples for Confined Explosives

#### EXAMPLES

##### **Example 1: On-shore Setback Distance from Fish Habitat.**

A proponent wishes to use explosives to break rock in a quarry near a stream. What is the minimum setback distance from the stream required in order to limit the overpressure in the stream to less than 100 kPa?

Calculate the required set back distance for a 35 kg charges set in rock.

$$\begin{aligned}
 W &= 35 \text{ kg} \\
 K_{(\text{rock})} &= 6.75 \\
 R &= (W^{.5})(K) \\
 R &= (35^{.5})(5.03) \\
 R &= 29.8 \text{ m}
 \end{aligned}$$

Note: It is assumed that the rock formation being quarried extends under the stream. Therefore the K factor for rock is used.

Therefore, the proponent would be required to maintain a set back distance of at least 29.8 m in order to meet the DFO guideline criteria of 100 kPa.

##### **Example 2: Buried Charges for Geophysical Exploration.**

A proponent wishes to conduct a geophysical survey beneath a shallow lake. Because of the shallow depth of the lake, it is not possible to use an air gun or other similar non-explosive energy source. To what depth must explosive charges (5 kg) be buried in order to limit the overpressure to less than 100 kPa?

$$\begin{aligned}
 W &= 5 \text{ kg} \\
 K_{(\text{sat. soil})} &= 2.13 \\
 R &= (W^{.5})(K) \\
 R &= (5^{.5})(2.13) \\
 R &= 4.8 \text{ m}
 \end{aligned}$$

Note: It is assumed that the charges are buried in un-consolidated sediments. Therefore the K factor for saturated soil is used.

Therefore the proponent would be required to bury the charges to a depth of at least 4.8 m below the substrate-water interface in order to limit the overpressure at the interface to less than 100 kPa.

### Appendix III (continued)

#### Sample Calculations and Examples for Confined Explosives

##### **Example 3: In-stream Trench Excavation.**

A proponent wishes to use explosives to assist in the excavation of a trench for a pipeline across a trout stream. The right-of-way is located in a cobble bottom riffle area that is used as a feeding area. There is a potential spawning bed located 75 m upstream of the right-of-way. The explosives' parameters are as follows:

Weight of individual charges:	15 kg
# of holes detonated/delay:	5
Weight of charge/delay:	75 kg

Does the proposal meet the DFO guideline criteria for overpressure and peak particle velocity?

##### **a) For the Overpressure Criteria:**

$$\begin{aligned}
 W &= 75 \text{ kg} \\
 K_{(\text{rock})} &= 5.03 \\
 R &= (W^{.5})(K) \\
 R &= (75^{.5})(5.03) \\
 R &= 43.6 \text{ m}
 \end{aligned}$$

Note: Since explosives must be used to excavate the trench, it is assumed that the substrate consists of rock or strongly consolidated sediments. Therefore the K factor for rock is used.

Therefore the detonation of 75 kg of explosives could kill or injure fish within a radius of 43.6 m of the right-of-way.

##### **b) For the Peak Particle Velocity Criteria:**

To determine the setback distance required to meet the peak particle velocity ( $V_R$ ) guideline of  $13 \text{ mm} \cdot \text{sec}^{-1}$  in a spawning area, multiply the square root of the charge weight by a factor of 15.09.

$$\begin{aligned}
 R &= (W^{.5})(15.09) \\
 R &= (75^{.5})(15.09) \\
 R &= 130.7 \text{ m}
 \end{aligned}$$

Therefore, the detonation of 75 kg of explosives would exceed the DFO Guideline for peak particle velocity of  $13 \text{ mm} \cdot \text{sec}^{-1}$  in a spawning bed.

### Appendix III (concluded)

#### Sample Calculations and Examples for Confined Explosives

Therefore, the application for an authorization to use explosives would be denied and major changes in the explosives program would be required in order for the project to be acceptable to DFO.

For example:

If the weight of explosive/delay were reduced to 5 kg by increasing the number of holes in the pattern and detonating each hole separately with 25 msec delays between each hole, the zone of overpressure exceeding 100 kPa would be:

$$\begin{aligned}
 W &= 5 \text{ kg} \\
 K_{(\text{rock})} &= 5.03 \\
 R &= (W^{-5})(K) \\
 R &= (5^{-5})(5.03) \\
 R &= 11.2 \text{ m}
 \end{aligned}$$

Similarly, the distance at which the peak particle velocity in the substrate would not exceed  $13 \text{ mm} \cdot \text{sec}^{-1}$  would be:

$$\begin{aligned}
 R &= (W^{-5})(15.09) \\
 R &= (5^{-5})(15.09) \\
 R &= 33.7 \text{ m}
 \end{aligned}$$

Therefore, if the weight of explosives per delay were reduced to 5 kg, the spawning area would be protected, as it is further than 33.7m from the detonation area. However, the detonation would still produce over-pressures exceeding 100 kPa to a distance of 11.2 m. Additional mitigation such as undertaking the project at a time of least fish activity or by removing/excluding fish from the area by either physical exclusion or scare tactics may be required.

Page 1

I, the undersigned, hereby request authorization to carry out the works or undertakings described on this application form. I understand that the approval of this application, if granted, is from the Department of Fisheries and Oceans standpoint only and does not release me from my obligation to obtain permission from other concerned regulatory agencies.

If an authorization is granted as a result of this application, I hereby agree to carry out all activities relating to the project within the designated time frames and conditions specified in the authorization.

**Applicant's Name (Please Print)** \_\_\_\_\_

**Applicant's Business Address** \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Applicant's Telephone Number

**Applicant's Facsimile Number**

**Applicant's E-Mail Number** \_\_\_\_\_

Date of Application

I solemnly declare that the information provided and facts set out in this application are true, complete and correct, and I make this solemn declaration conscientiously believing it to be true and knowing that it is of the same force and effect as if made under oath. This declaration applies to all material submitted as part of this application.

**Applicant's Signature** \_\_\_\_\_

Page 2

[illegible]

Page 3

## Schedule of Operations

Proposed starting date (D/M/Y) \_\_\_\_\_

Proposed completion date (D/M/Y) \_\_\_\_\_

**The following documents will assist in assessing your application and help expedite its approval. Please check which documents you have attached.**

Map indicating location of project [ ]

Engineering specifications [ ]

Dimensional drawings [ ]

Assessment of fish and marine mammal resources [ ]

Assessment of potential effects of project on fish and marine mammals [ ]

Measures proposed to mitigate potential damage to fish and marine mammals [ ]

Other [ ]

Page 4

Method of detonation \_\_\_\_\_

## APPENDIX V

## Application Form to Harmfully Alter, Disrupt or Destroy Fish Habitat

## SCHEDULE VI / ANNEXE VI

(Subsection 58(1)/paragraphe 58(1))

Fisheries and Oceans



Pêches et Océans

Page 1

Application No./N° de la demande

APPLICATION FOR AUTHORIZATION FOR WORKS OR UNDERTAKINGS AFFECTING FISH HABITAT  
DEMANDE D'AUTORISATION POUR DES OUVRAGES OU ENTREPRISES MODIFIANT L'HABITAT DU POISSON

I, the undersigned, hereby request authorization to carry out the works or undertakings described on this application form. I understand that the approval of this application, if granted, is from the Minister of Fisheries and Oceans standpoint only and does not release me from my obligation to obtain permission from other concerned regulatory agencies.

Je soussigné, demande par les présentes l'autorisation d'exploiter les ouvrages ou entreprises décrits dans la formule. Je comprends que l'approbation de cette demande, le cas échéant, porte sur ce qui relève du ministre des Pêches et des Océans et ne me dispense pas d'obtenir la permission d'autres organismes réglementaires concernés.

If an authorization is granted as a result of this application, I hereby agree to carry out all activities relating to the project within the designated time frames and conditions specified in the authorization.

Si la demande est approuvée, je consens par les présentes à exécuter tous les travaux relatifs à ce projet selon les modalités et dans le laps de temps prescrits dans l'autorisation.

Applicant's Name (Please Print) \_\_\_\_\_ Nom du requérant (lettres moulées)

Applicant's Business Address \_\_\_\_\_ Adresse d'affaires du requérant

Applicant's Telephone No./ N° de téléphone du requérant \_\_\_\_\_ Date \_\_\_\_\_

I solemnly declare that the information provided and facts set out in this application are true, complete and correct, and I make this solemn declaration conscientiously believing it to be true and knowing that it is of the same force and effect as if made under oath. This declaration applies to all material submitted as part of this application.

Je déclare solennellement que les renseignements fournis et les faits énoncés dans cette demande sont véridiques, complets et exacts, et je fais cette déclaration solennelle, la croyant consciencieusement vraie et sachant qu'elle a la même force et le même effet que si elle était faite sous serment. Cette déclaration s'applique à tout document qui est présenté dans le cadre de cette demande.

\_\_\_\_\_  
Applicant's Signature (and corporate seal)

\_\_\_\_\_  
Signature du requérant (et sceau de la société)

Name of watercourse or waterbody (give coordinates)

Cours d'eau ou plan d'eau (donner les coordonnées) \_\_\_\_\_

This watercourse is a tributary of (where applicable)

Cours d'eau tribulaire de (le cas échéant)

Nearest community  
Localité la plus proche

County  
Comté

Province  
Province

## APPENDIX V

## Application Form to Harmfully Alter, Disrupt or Destroy Fish Habitat (continued)

SCHEDULE VI-Continued/ANNEXE VI (suite)

Fisheries and Oceans



Pêches et Océans

Page 2

Application No./N° de la demande

**APPLICATION FOR AUTHORIZATION FOR WORKS OR UNDERTAKINGS AFFECTING FISH HABITAT  
DEMANDE D'AUTORISATION POUR DES OUVRAGES OU ENTREPRISES MODIFIANT L'HABITAT DU POISSON**

## Type of Activity/Genre d'activité

<input type="checkbox"/> Bridge Pont	<input type="checkbox"/> Stream Realignment Alignement de cours d'eau	<input type="checkbox"/> Gravel Removal Enlèvement du gravier	<input type="checkbox"/> Stream Traverse Traversée de cours d'eau
<input type="checkbox"/> Culvert Ponceau	<input type="checkbox"/> Channelization Canalisation	<input type="checkbox"/> Obstruction Removal - Bypass Enlèvement ou contournement d'obstacle	<input type="checkbox"/> Seismic Survey Levé sismique
<input type="checkbox"/> Dam Barrage	<input type="checkbox"/> Wharf - Break water Quai - Brise-lames	<input type="checkbox"/> Stream Utilization - Recreation Utilisation récréative du cours d'eau	<input type="checkbox"/> Agriculture
<input type="checkbox"/> Stream Diversion Dérivation de cours d'eau	<input type="checkbox"/> Dewatering Assèchement	<input type="checkbox"/> Erosion Control Lutte contre l'érosion	<input type="checkbox"/> Other (specify) Autres (préciser)
<input type="checkbox"/> Mining Activité minière	<input type="checkbox"/> Aquaculture	<input type="checkbox"/> Flood Protection Protection contre les inondations	

**List of Agencies (Federal, Provincial or Municipal) contacted or notified, or who have initiated contact with the applicant.**

**Liste des organismes (fédéraux, provinciaux ou municipaux) contactés ou qui ont pris contact avec le requérant.**

**PROVIDE DETAILS OF PROPOSED ACTIVITY INCLUDING REASONS FOR THE PROJECT AND TYPES OF EQUIPMENT TO BE USED  
DONNER DES PRÉCISIONS SUR LES TRAVAUX PROJETÉS Y COMPRIS LA JUSTIFICATION DU PROJET ET  
LE TYPE D'ÉQUIPEMENT À UTILISER**

## APPENDIX V

## Application Form to Harmfully Alter, Disrupt or Destroy Fish Habitat (continued)

SCHEDULE VI-Continued/ANNEXE VI (suite)

Fisheries and Oceans



Pêches et Océans

Page 3

Application No./N° de la demande

APPLICATION FOR AUTHORIZATION FOR WORKS OR UNDERTAKINGS AFFECTING FISH HABITAT  
DEMANDE D'AUTORISATION POUR DES OUVRAGES OU ENTREPRISES MODIFIANT L'HABITAT DU POISSON

## SCHEDULE/CALENDRIER

	D/J	MM	Y/A
Proposed Starting Date Date prévue du début des travaux	_____	_____	_____
Proposed Completion Date Date prévue de l'achèvement des travaux	_____	_____	_____
Approximate Timing of Work in shoreline, foreshore, tidal zone, or underwater areas. Période approximative des travaux sur le rivage et les estrans ainsi que dans les zones à marées et les zones sous-marines.			
	D/J	MM	Y/A
From/De	_____	_____	To/A _____

**The following documents will assist in assessing your application and help expedite its approval. Please check which documents you have attached.**

**Les documents suivants faciliteront l'évaluation de votre demande et permettront d'accélérer son approbation. Veuillez cocher les documents vous avez joints à votre demande.**

Map indicating location of project	<input type="checkbox"/> Carte indiquant l'emplacement du projet
Engineering Specifications	<input type="checkbox"/> Spécifications techniques
Scale Drawings	<input type="checkbox"/> Dessins à l'échelle
Dimensional Drawings	<input type="checkbox"/> Plans cotés
Assessment of Existing Fish Habitat Characteristics	<input type="checkbox"/> Évaluation des caractéristiques existantes de l'habitat du poisson
Assessment of Potential Effects of Project on Fish Habitat	<input type="checkbox"/> Évaluation des répercussions possibles sur l'habitat du poisson
Measures Proposed to Offset Potential Damage to Fish Habitat	<input type="checkbox"/> Mesures proposées pour compenser les ventuels dommages à l'habitat du poisson
Other	<input type="checkbox"/> Autres

ENVIRONMENTAL ASSESSMENT AND REVIEW PROCESS  
CONSIDERATIONSCONSIDÉRATIONS CONCERNANT LE PROCESSUS  
D'ÉVALUATION ET D'EXAMEN EN MATIÈRE  
D'ENVIRONNEMENT

NOTE: All applications pursuant to section 35 of the Fisheries Act will be assessed in accordance with applicable federal environmental assessment requirements.

REMARQUE : Toute demande en vertu l'article 35 de la Loi sur les pêches sera soumise aux exigences fédérales applicables à l'évaluation environnementale.

## APPENDIX V

## Application Form to Harmfully Alter, Disrupt or Destroy Fish Habitat (concluded)

SCHEDULE VI-Concluded/ANNEXE VI (fin)



Fisheries and Oceans

Pêches et Océans

Page 4

Application No./N° de la demande

**APPLICATION FOR AUTHORIZATION FOR WORKS OR UNDERTAKINGS AFFECTING FISH HABITAT  
DEMANDE D'AUTORISATION POUR DES OUVRAGES OU ENTREPRISES MODIFIANT L'HABITAT DU POISSON**

COMPLETE ONLY IF USE OF EXPLOSIVES IS INTENDED  
A REMPLIR SEULEMENT EN CAS D'UTILISATION D'EXPLOSIFS

EXPLOSIVES CONTRACTOR (IF DIFFERENT FROM APPLICANT)/RESPONSABLE DES EXPLOSIFS (SI AUTRE QUE LE REQUIRANT)

Name/Nom : \_\_\_\_\_

Address/Adresse : \_\_\_\_\_

Telephone No./N° de téléphone : \_\_\_\_\_

	D/J	M/M	Y/A		D/J	M/M	Y/Y
Anticipated Starting Date				Completion Date			
Date prévue du début des travaux	_____	_____	_____	Date d'achèvement	_____	_____	_____

**DETAILS OF EXPLOSIVES/PRÉCISIONS SUR LES EXPLOSIFS**

Type (including trade name) \_\_\_\_\_  
Genre (y compris la marque) \_\_\_\_\_

Weight and configuration (where applicable) \_\_\_\_\_  
Poids et forme (le cas échéant) \_\_\_\_\_

Weight of individual shots and shot pattern where multiple charges are used  
Poids des coups individuels et déploiement des coups, en cas de charges multiples

Detonation depth (in the rock; note also the depth of water, if applicable)  
Profondeur de détonation (dans le roc; indiquer aussi, la profondeur de l'eau, s'il y a lieu)

Method of detonation \_\_\_\_\_  
Méthode de détonation \_\_\_\_\_