Explosives Management Plan

Doris North Gold Mine

Nunavut

Submitted to:

Miramar Hope Bay Limited

North Vancouver, British Columbia

Submitted by:

AMEC Earth & Environmental,
a division of AMEC Americas Limited

Burnaby, BC

October 2006

AMEC File: VM00259A-2100

TABLE OF CONTENTS

Page

LIST OF FIGURES

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF APPENDICES

IMPORTANT NOTICE

This report was prepared exclusively for Miramar Hope Bay Limited by AMEC Earth & Environmental, a wholly owned subsidiary of AMEC PLC. The quality of information, conclusions and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions and qualifications set forth in this report. This report is intended to be used by Miramar Hope Bay Limited, the Nunavut Water Board, the Kitikmeot Inuit Association and the regulatory agencies involved in reviewing the water license application for the Doris North Project only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any other third party is at that party's sole risk.

EXECUTIVE SUMMARY

This explosives management plan for the Doris North Gold Mine provides pre-construction information on explosives transport, storage and handling at the Mine. The plan is provided in support of a water licence application by Miramar Hope Bay Limited for gold mine operation.

The proposed gold mine will be located on Roberts Bay, an extension of Melville Sound about 110 km south of Cambridge Bay.

Explosives will be used at Doris North for blasting of the underground mine development headings and for production stope blasts. Explosives will also be used during the construction phase of mining to extract broken rock from the four quarry sites for construction of the site facilities (roads, airstrip, building pads, jetty, tailings dams, etc.).

The plan covers safe procedures for explosives handling and environmental management to minimize negative effects from explosives use. Doris North will be an underground mine and the quantity of explosives on hand and used on an annual basis will be relatively small (approximately 700 tonnes of ammonium nitrate manufactured into ANFO on site, and 38 tonnes of packaged high explosives). All explosives (and other bulk supplies) will be delivered annually in a marine sealift to Roberts Bay. Explosives and other hazardous supplies will be shipped in Seacans; Seacans will be offloaded from the barges and trucked to their storage locations at the mine site.

Manufacture of ANFO will be contracted out by the Mine to a qualified blasting contractor who will mix ammonium nitrate and fuel oil in a contractor-supplied mixing building and deliver the ANFO underground for use by certified mine personnel in mine development.

Use of explosives will be compliant with all pertinent regulations. Any spills of explosives will be clean up immediately, logged, and reported on the Nunavut spill line.

On closure, all unused explosives will be burned or removed from site.

1.0 INTRODUCTION

1.1 Overview

This explosives management plan provides pre-construction information on how explosives will be transported, stored and used in a safe and environmentally sound manner at the Miramar Hope Bay Limited (MHBL) Doris North Gold Mine (Doris North) in Nunavut. This plan was developed in support of MHBL's application for a water licence from the Nunavut Water Board (NWB) to operate Doris North.

Doris North is located on the Canadian mainland in the West Kitikmeot region of Nunavut approximately 110 km southwest of Cambridge Bay and 75 km northeast of Umingmaktok. The Project is located on Inuit Owned Land at 68 09' N x 106 40' W, 5 km south of the head of Roberts Bay, an extension of Melville Sound which connects with Bathurst Inlet about 80 km west of the Project.

Explosives will be used at Doris North for blasting of the underground mine development headings and for production stope blasts. Explosives will also be used during the construction phase of mining to extract broken rock from the four quarry sites for construction of the site facilities (roads, airstrip, building pads, jetty, tailings dams, etc.).

Doris North will be a 690 tonne per day underground mine and consequently explosives usage will be small. A contractor will be engaged to supply explosives and most usage will be ammonium nitrate-fuel oil mix (ANFO). Some specialty packaged explosives will be used for specific blasting needs such as controlled wall blasting where needed and for wet conditions, if they are encountered. All explosives and detonators will be transported, stored and used in an approved manner by trained and licensed personnel.

1.2 Cross Reference to MHBL Plans Cited in the Explosives Management Plan

The explosives management plan will be cross referenced in other plans developed for mine operation including:

- training manuals (where appropriate)
- MHBL Hazardous Materials Management Plan
- MHBL Emergency Response and Spill Contingency Plan
- mine operating procedures (where appropriate).

1.3 Regulations Governing Explosives Use

Control and use of explosives are covered by federal and Nunavut regulations:

- *Transportation of Dangerous Goods Act*
- *Canada Explosives Act and Regulations*
- *Canada Transportation Act, Ammonium Nitrate Storage Facilities Regulations*
- *Northwest Territories/Nunavut Mine Health and Safety Act and Regulations*

- *Nunavut Explosives Use Act*
- *Consolidation of Explosives Regulation.*

1.4 Location of Facilities

Explosives storage and handling facilities are listed in Table 1-1 together with their locations which are shown on Figures 1 and 2.

Table 1-1: Explosives Storage and Handling Facilities

Facility	Location
Initial Construction Period	
Ammonium Nitrate	In 1-tonne tote bags in Seacans on the temporary laydown
Diesel Fuel	Fuel laydown area; self-bermed day tank at the temporary explosives storage area
High Explosives Detonators	Detonator magazine at the temporary explosives storage area
Blasting Caps	Caps magazine at the temporary explosives storage area
Operation	
Ammonium Nitrate	In 1-tonne tote bags in Seacans at the permanent explosives storage area
Diesel Fuel	Fuel farm; self-bermed day tank at the explosives mixing building, permanent explosives storage area
High Explosives Detonators	Detonator magazine at the permanent explosives storage area
Blasting Caps	Caps magazine at the permanent explosives storage area

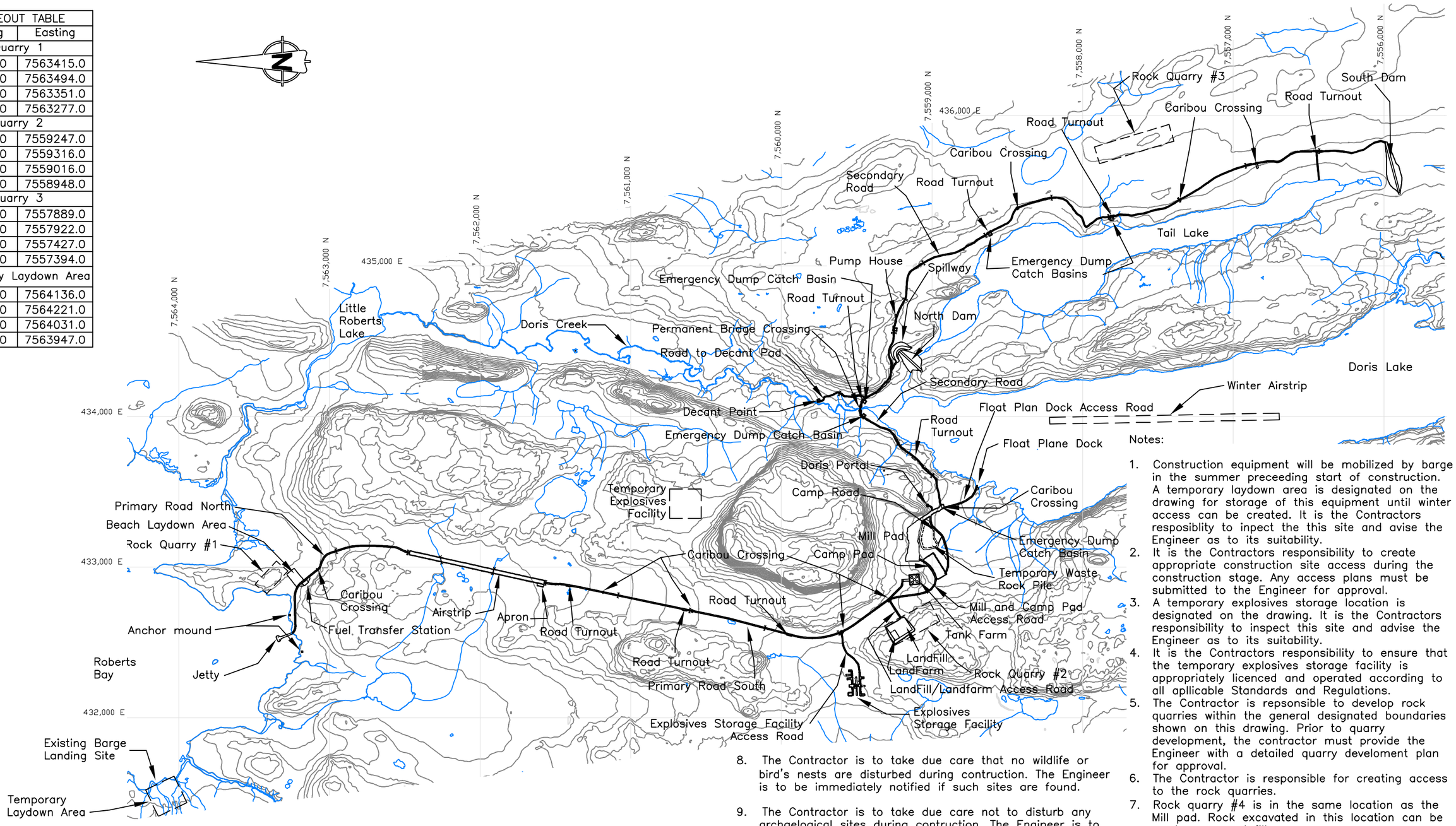
For the construction phase of the Project, a temporary explosives storage site will be developed east of the permanent airstrip. This temporary site will be accessed via a winter road and will be constructed as a snow laydown area built directly on the frozen tundra. It will be used during one winter season only with all explosives transferred to the permanent site by the end of the first winter season. Consequently this site will “disappear” at the end of the first winter season during the construction phase and is solely required to allow explosives to be securely stored for a short window of time while the permanent storage location is constructed of quarried rock.

Explosives will be permanently stored in separate Type 4 powder and detonator magazines 760 m northwest of the camp, and accessed by the main all-weather road coming from Roberts Bay. The detonator magazine will be 275 m off this road, which will ensure that it is tucked in behind a rock outcrop effectively shielding it from view to the mill and campsite. The powder magazine will be located on the same road 100 m beyond the detonator magazine.

1.5 Product Description

The explosive material categories, site handling and storage requirements, and personal protective equipment as recommended by the product manufacturers’ Material Safety Data Sheets (MSDS) are summarized in Tables 1-2 through 1-4.

STAKEOUT TABLE	
Northing	Easting
Quarry 1	
432825.0	7563415.0
432887.0	7563494.0
433040.0	7563351.0
432975.0	7563277.0
Quarry 2	
432482.0	7559247.0
432612.0	7559316.0
432772.0	7559016.0
432642.0	7558948.0
Quarry 3	
435680.0	7557889.0
435791.0	7557922.0
435939.0	7557427.0
435828.0	7557394.0
Temporary Laydown Area	
431346.0	7564136.0
431522.0	7564221.0
431613.0	7564031.0
431437.0	7563947.0



1:12500 0 200 400 600 800 1000 Metres

Note: Drawings plotted to half scale

8. The Contractor is to take due care that no wildlife or bird's nests are disturbed during contruction. The Engineer is to be immediately notified if such sites are found.

9. The Contractor is to take due care not to disturb any archaeological sites during contruction. The Engineer is to be immediately notified if such sites are found.

Notes:

1. Construction equipment will be mobilized by barge in the summer preceeding start of construction. A temporary laydown area is designated on the drawing for storage of this equipment until winter access can be created. It is the Contractors resposiblity to inpect the this site and avise the Engineer as to its suitability.
2. It is the Contractors responsibility to create appropriate construction site access during the construction stage. Any access plans must be submitted to the Engineer for approval.
3. A temporary explosives storage location is designated on the drawing. It is the Contractors responsibility to inspect this site and advise the Engineer as to its suitability.
4. It is the Contractors responsibility to ensure that the temporary explosives storage facility is appropriately licenced and operated according to all apllicable Standards and Regulations.
5. The Contractor is repsonsible to develop rock quarries within the general designated boundaries shown on this drawing. Prior to quarry development, the contractor must provide the Engineer with a detailed quarry develoment plan for approval.
6. The Contractor is responsible for creating access to the rock quarries.
7. Rock quarry #4 is in the same location as the Mill pad. Rock excavated in this location can be used as general fill.

DRAWING NO.	DRAWING TITLE	DRAWING NO.	DRAWING TITLE
REFERENCE DRAWINGS			

NO.	WATER LICENCE APPLICATION DESCRIPTION	CHK'D	APP'D	DATE
A				
REVISIONS				

Stamped, signed and dated originals submitted to the Nunavut Water Board

PROFESSIONAL ENGINEERS STAMP

SRK Consulting Engineers and Scientists Vancouver

DESIGN:	DRAWN:	REVIEWED:
AT	JJH	EMR
CHECKED:	APPROVED:	DATE:
AT	EMR	Oct. 2006

FILE NAME: PLAN VIEW.dwg

MIRAMAR HOPE BAY LTD.

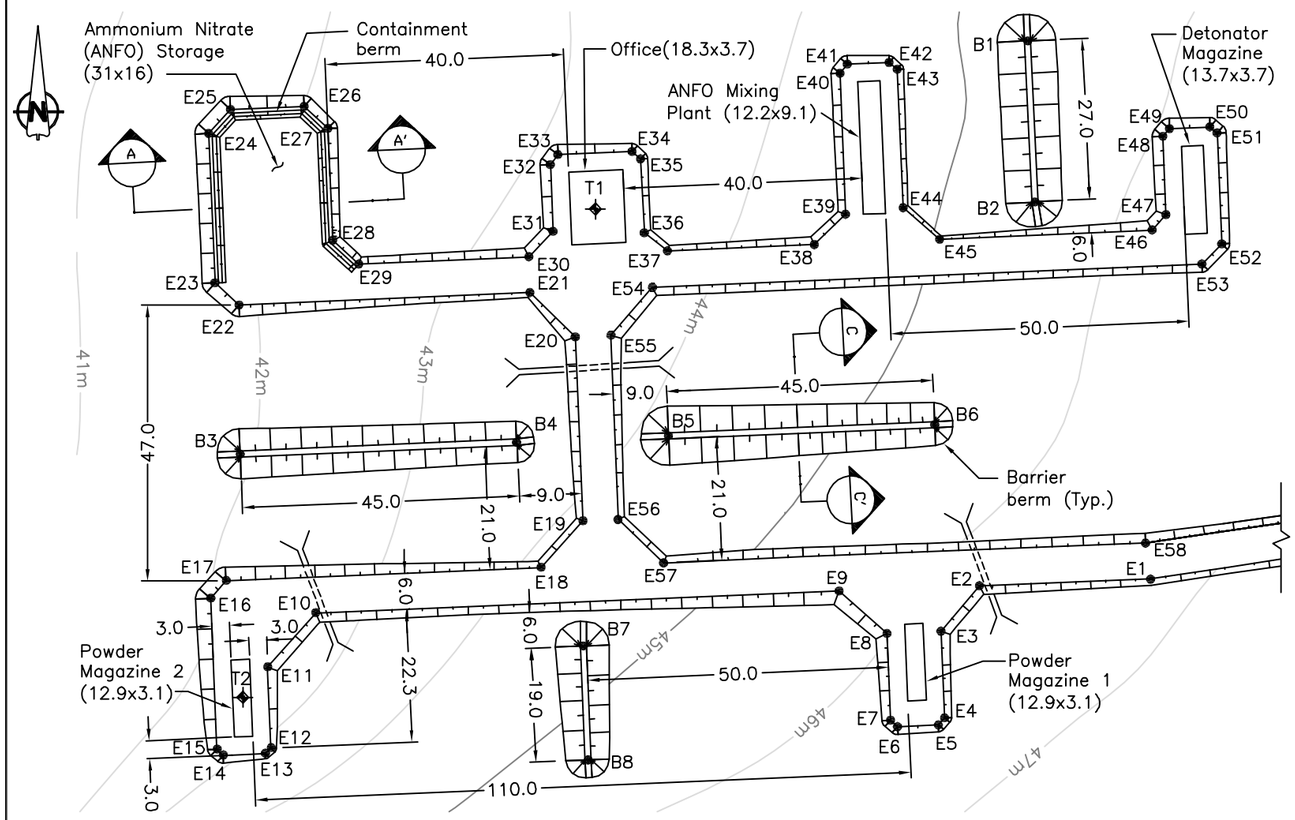
DORIS NORTH PROJECT
DETAILED DESIGN

SRK JOB NO.: 1CM014.008

Doris North Project

DRAWING TITLE: FIGURE 1

DRAWING NO.	SHEET	REVISION NO.
G-02	2 OF 48	A



EXPLOSIVES FACILITY PLAN LAYOUT

1:500 0 5 10 15 20 25 Metres

Legend:

- Surfacing Material
- Select Subgrade
- Run of Quarry
- Natural Ground
- Thermistors

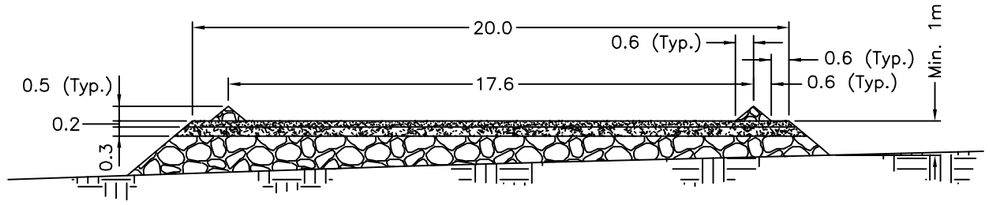
STAKE OUT TABLE			
Explosives Storage Facility			
Point	Easting	Northing	Elev.
E1	432305.5	7559478.8	48.0
E2	432276.9	7559476.7	47.5
E3	432270.5	7559469.0	47.5
E4	432271.1	7559454.5	47.5
E5	432270.0	7559453.3	47.5
E6	432263.2	7559453.0	47.5
E7	432262.0	7559454.1	47.5
E8	432261.4	7559468.7	47.5
E9	432253.4	7559475.8	47.5
E10	432165.6	7559472.1	44.0
E11	432157.6	7559463.0	44.0
E12	432158.1	7559449.5	44.0
E13	432157.2	7559448.5	44.0
E14	432150.1	7559448.2	44.0
E15	432149.1	7559449.3	44.0
E16	432148.0	7559474.5	44.0
E17	432150.6	7559477.5	44.0
E18	432203.4	7559479.7	45.0
E19	432210.5	7559487.5	45.0
E20	432209.2	7559518.3	45.0
E21	432201.6	7559525.8	44.0
E22	432152.8	7559523.7	43.5
E23	432148.8	7559527.4	43.5
E24	432147.7	7559552.4	43.5
E25	432151.4	7559556.4	43.5
E26	432163.7	7559556.9	43.5
E27	432167.7	7559553.2	43.5
E28	432168.5	7559534.5	43.5
E29	432172.9	7559530.5	43.5

STAKE OUT TABLE (Cont.)			
Explosives Storage Facility			
Point	Easting	Northing	Elev.
E30	432201.4	7559531.7	44.5
E31	432205.4	7559536.0	44.5
E32	432205.0	7559547.2	44.5
E33	432206.3	7559548.9	44.5
E34	432218.7	7559549.4	44.5
E35	432220.1	7559548.1	44.5
E36	432220.8	7559535.8	44.5
E37	432224.7	7559532.7	44.5
E38	432249.3	7559533.8	45.5
E39	432254.5	7559538.9	45.5
E40	432253.6	7559562.5	45.5
E41	432254.8	7559564.0	45.5
E42	432261.8	7559564.3	45.5
E43	432263.2	7559563.1	45.5
E44	432264.1	7559540.0	45.5
E45	432270.3	7559534.7	45.5
E46	432305.9	7559536.2	47.5
E47	432308.2	7559538.8	47.5
E48	432307.7	7559551.9	47.5
E49	432308.8	7559553.2	47.5
E50	432315.6	7559553.5	47.5
E51	432316.8	7559552.5	47.5
E52	432317.6	7559533.9	47.5
E53	432314.2	7559530.5	47.5
E54	432225.6	7559526.8	47.5
E55	432215.3	7559515.7	45.0
E56	432216.3	7559487.7	45.0
E57	432223.9	7559480.4	45.0
E58	432304.8	7559483.8	48.0

STAKE OUT TABLE		
Barrier Berm		
Point	Easting	Northing
B1	432285.0	7559567.9
B2	432286.3	7559540.9
B3	432153.1	7559498.7
B4	432199.2	7559500.6
B5	432224.8	7559501.8
B6	432269.4	7559503.8
B7	432210.5	7559466.5
B8	432211.4	7559447.5
Thermistors		
T1	432212.6	7559539.7
T2	432153.5	7559458.0

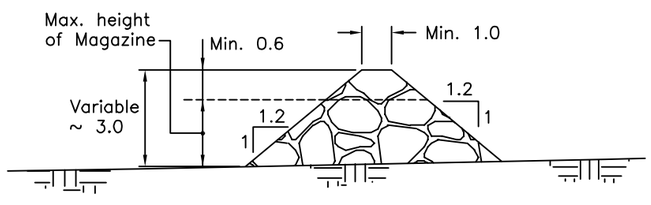
Notes:

1. The Contractor is to strictly adhere to the minimum layout distances on the drawing, since they are based on minimum design standards for operation of the facility.
2. The minimum distances applicable to this facility, as defined by the appropriate regulations are as follows:
   a. D1 = Not Applicable
   b. D2 = 50 m
   c. D3 = Not Applicable
   d. D4 = 170 m
   e. D5 = Not Applicable
   f. D6 = Not Applicable
   g. D7 = 465 m
   h. D8 = Not Applicable
3. The Owner will supply the Powder Magazines, Detonator Magazines, Explosives Mixing Facility and Portable Office Complex. The Contractor will be responsible for the installation of these facilities according to the details shown on these drawings.
4. The Powder Magazine, detonator Magazine, Explosives Mixing Facility and Portable Office construction pads must be a minimum 1.0 m thick, and must be at level. Connecting roads between these structures will vary in grade, but shall be at least 1.0 m in thickness.



TYPICAL SECTION A–A'

1:100 0 1 2 3 4 5 Metres



BARRIER BERM – TYPICAL CROSS SECTION C–C'

1:100 0 1 2 3 4 5 Metres

Note: Drawings plotted to half scale

DRAWING NO.	DRAWING TITLE	DRAWING NO.	DRAWING TITLE

REFERENCE DRAWINGS

NO.	DESCRIPTION	CHK'D	APP'D	DATE
A	WATER LICENCE APPLICATION			

REVISIONS

Stamped, signed and dated originals submitted to the Nunavut Water Board

PROFESSIONAL ENGINEERS STAMP

SRK Consulting Engineers and Scientists Vancouver

DESIGN:	DRAWN:	REVIEWED:
AT	JJH	EMR
CHECKED:	APPROVED:	DATE:
AT	EMR	October 2006

FILE NAME: EXPLOSIVE FACILITY.dwg

MIRAMAR HOPE BAY LTD.

DORIS NORTH PROJECT
DETAILED DESIGN

SRK JOB NO.: 1CM014.008

Doris North Project

DRAWING TITLE:
Explosives Storage Facility Plan, Typical Sections, Details

DRAWING NO.	SHEET	REVISION NO.
FIGURE 2	12 OF 48	A

Table 1-2: Hazard Classes and Potential Impacts

Material	Class	Potential Impact
Ammonium nitrate	5.1	Water contamination
High explosives detonators	1	Negligible with proper handling
Blasting caps	1	Negligible with proper handling

Table 1-3: On-Hand Quantities & Safe Handling Procedures

Product	Approximate On-Hand Quantities	Handling Procedure
Ammonium nitrate	700 tonnes packaged in 1-tonne tote bags	Avoid eye and skin contact; avoid breathing dust. Do not swallow. Separate from all organic materials or other possible contaminants that are not compatible. Store in well-ventilated location, away from all sources of heat, fire, or explosion.
High explosive detonators	38 tonnes as stick powder	Store under dry conditions in a well-ventilated magazine. Keep away from heat, sparks, and flames. Keep containers closed.
Blasting caps	To be determined	Store in a cool, well-ventilated area in an approved magazine.

Table 1-4: Personal Protective Equipment

Product	Eyes	Skin	Respiration
Ammonium nitrate	Safety glasses or goggles	Non-absorbent rubber or equivalent gloves	NIOSH/MSHA approved respirator, if required
High explosive detonators	Safety glasses or goggles	Rubber gloves and protective clothing made from cotton	NIOSH/MSHA approved respirator
Blasting caps	Safety glasses or goggles	Rubber gloves and protective clothing made from cotton	NIOSH/MSHA approved respirator

1.6 Doris Mine Blast Management Organization

The proposed blast management organization at Doris North (top to bottom) will be:

- mine manager – overall responsibility for the Doris North Mine
- mine engineer – responsible for mine design and operation
- mine supervisor – responsible for day to day operations supervision
- blast supervisor – responsible for all blasting activities and explosives
- blasters – certified mine personnel who carry out blasting

2.0 EXPLOSIVES MANAGEMENT

Explosives management at Doris North will focus on two goals, both equally important:

- safety
- environmental stewardship.

All explosives manufacturing, storage and product delivery systems will be approved and subject to inspection under *Part IV – Explosives at Mines* of the *Northwest Territories/Nunavut Mines Health and Safety Act and Regulations* and under federal regulations administered by Natural Resources Canada, Explosives Division. The explosives supplier and on-site contractor will be licensed and permitted to operate at the Doris Mine.

MHBL personnel or third-party consultants will perform periodic safety and environmental audits. Doris North mine management will have the overall responsibility for planning, use and management of explosives at the mine site.

2.1 Safety

2.1.1 Safe Distances

The explosives magazines must be a minimum distance from camp. To address this requirement, the temporary explosives magazine layout will have a setback distance of 1,436 m from the camp and the permanent explosives magazine pad will have a setback of 760 m from the camp. In both cases a significant rock outcrop is in the direct line of site between the explosives magazine area and the camp and other plant site buildings, providing additional safety buffering. MHBL has consulted with Natural Resources Canada over these setback distances and is of the opinion that they meet all appropriate guidelines and regulations.

2.1.2 Restricted Access

Access to the magazines will be restricted to authorized personnel only and log books will be kept in each magazine for tracking purposes. The magazines will be supplied and permitted by the explosives supplier. Authorized personnel will be persons holding a Blasting Certificate or Provisional Blasting Certificate that is issued in accordance with *Part VII* of the *Mine Health and Safety Act and Regulations.*

2.1.3 Notification

Blasting for construction will take place approximately daily when rock is quarried. The blasting supervisor will advise the mine manager at the daily morning management meeting if a blast will occur that day. Warning signs will be placed appropriately on access roads indicating the time of the blast. A warning will be transmitted on the mine radio watch frequency one hour, 30 minutes and 15 minutes before the blast. Prior to detonation, the blast supervisor will ensure the area is cleared of people and animals to a distance of 600 m from the blast centre and guards placed on access roads. A warning siren will be sounded 2 minutes before the blast. Following the blast, the blasting superintendent will inspect the blast area to ensure all explosives have detonated. Once the superintendent is satisfied the blast site is safe the all clear will be sounded and transmitted on the mine radio watch frequency.

For underground blasting, the procedure will be similar except that underground mine workings will be inspected for personnel prior to the blast and all underground personnel accounted for prior to detonation. An underground tag system will be in place to ensure that no one goes underground without notification.

2.1.4 Adverse Weather

Adverse weather precautions will apply to quarry blasting. During adverse weather conditions the blast supervisor will notify the mine supervisor of the precautions to be taken. In the event of electrical storms, the blast site will be evacuated and no blasting connections will be made.

Except in extreme weather conditions, underground blasting operations are not anticipated to be affected.

2.1.5 Misfires

Reporting and handling of misfires is defined in Section 14.56 of the *NWT/Nunavut Mines Health and Safety Act* and *Regulations*. All misfires will be documented in a logbook kept for the purpose by the blasting supervisor and periodically reviewed by the engineer.

When a misfire has been identified it will be treated as a loaded hole until made safe. A blast sign and markers will be placed at the hole as required by the *Regulations.* The misfire will be made safe by an authorized person and the misfire and follow up logged. The authorized person will date and sign the log book. The engineer will use the survey location and log book information to correlate the incident to ground conditions, blast design or product quality issues.

2.2 Environmental Management

2.2.1 Permanent Explosives Storage Pad

The permanent explosives storage area pad will be constructed of sized fill and include a berm surrounding the ammonium nitrate storage area.

2.2.2 Ammonium Nitrate

2.2.2.1 Properties

Ammonium nitrate (AN) is a stable, inorganic, solid compound. It is completely soluble in water and must be kept dry to remain effective for its intended purpose. AN products vary in composition, blend, and surface treatment. For instance, granular fertilizer products are coated with various materials to seal the particles from moisture contamination, whereas AN prills (pellets) produced for use in ANFO explosives are intentionally porous to permit the oil to be absorbed. The prills are generally white or off-white, and shelf life in a tightly closed container is unlimited.

AN itself is not an explosive, but it is an oxidizer and can explode or decompose under specific conditions, such as: high temperature (between 160°C and 200°C); bulk storage in a confined space; contamination with organic substances such as oil or waxes; contamination with inorganic materials such as chlorides and metals (chromium, copper, cobalt, nickel); and exposure to strong shock waves from other explosions. Similarly, AN is not combustible in itself, but as an oxidizing agent it increases fire hazard when in contact with other combustible materials, even in the absence of air. AN must be stored in a dry, well-ventilated area away from all possible sources of heat, fire, or explosion.

AN is odourless under normal conditions but releases toxic nitrous and ammonia fumes on explosion, decomposition, or involvement in a fire. Direct, unprotected contact with dry AN can cause discomfort and inflammation of eyes, skin, and respiratory membranes. Its oral toxicity is slight to moderate, although swallowing large amounts can have serious, if not fatal, effects from the ammonia and nitrate salts. It has no known chronic effects, however, and repeated or prolonged exposure is not known to aggravate pre-existing medical conditions.

AN is of low toxicity to aquatic life but may promote eutrophication in waterways (water becomes pollution rich in dissolved nutrients). AN dissociates to ammonia in water and ammonia at high enough concentrations (dependent on temperature and pH) is toxic to fish. For more information on ammonium nitrate, see the MSDS in Appendix A and recommended handling procedures summarized in Appendix B.

2.2.2.2 Handling and Storage

Although AN is classified as a hazardous product, its storage and handling at Doris North is not considered to be a significant risk activity. AN will be delivered to site in heavy-duty, one-tonne tote-bags. At site, explosives will be handled and managed by MHBL personnel qualified and trained in safe handling procedures and in accordance with applicable legislation and regulations.

The proposed AN storage pad is not located near any water bodies and runoff, not absorbed by the storage pad, will be absorbed by the tundra. In the event runoff transports sediment, temporary silt curtains can be placed in the water path to screen sediment.

AN bags will be stored within seagoing containers within the designated storage area at the permanent explosives storage area away from water bodies and from the explosive caps/detonator storage magazines. The bags will be handled individually when needed for the preparation of batches of explosive.

Any spills will be swept up and placed in suitable containers for use or disposal. Typically empty bags are not considered to be hazardous waste. However to prevent the uncontrolled release of fine AN material (that may be coating the inside of the bags) into nearby water courses, the empty bags will be shaken clean at the point of use and then burned in a burning pit at the site non-hazardous landfill area in a similar manner as other empty reagent bulk bags. This will prevent the empty bags from being used for other purposes.

All personnel exposed to AN will wear suitable personal protective equipment.

2.2.3 High Explosives Detonators and Blasting Caps

The permanent explosives magazines will be located on 2.0 m thick pad with surface areas of approximately 600 m^2 and 430 m^2 for the detonator and powder magazines, respectively. Both magazines will be designed to Type 4 magazine standards, as outlined in "*Storage Standards for Industrial Explosives*" (NRCan 1995). The magazines will be separated by berms that meet the "donor-receiver" conditions of safe storage.

Features of the Type 4 magazines are:

- steel exterior shell
- inside each magazine all walls and floors are covered with 20 mm plywood fastened with counter-sunk non-sparking fasteners

- interiors are marked with stacking limit lines
- access is by a laminated door with high security locking hardware.

The magazines will be dedicated to storing high energy explosives and blasting caps. Caps and high explosives will be stored in separate magazines as required by the regulations.

All of the explosives that are stored in the magazines will be clearly labelled. Inventory will be used on a first-in, first-out basis to ensure quality control and prevent degradation due to cold weather storage.

2.2.4 Transportation to Site

All explosives will be sea lifted to site (initially the barge landing and, when constructed, the jetty) with the annual resupply for Doris North. Mine construction phase explosives will be shipped to site in the first sealift and stored in the temporary explosives magazines. The mixing plant will come to site pre-built inside a shipping container, also on the first sealift.

2.2.5 On-Site Handling

Most usage will be ANFO which will be batch mixed by the explosives contractor on surface in a mixing plant to be located in a Seacan at the explosives storage magazine. The ammonium nitrate and fuel oil will be batch mixed and then placed back into 25 kg bags which will then be stored inside the ANFO storage magazine at the explosives storage site. The 25 kg bags of ANFO will be moved underground by a service vehicle on a daily basis to meet daily needs. Mixing will be by the explosives contractor.

2.2.6 Spills

2.2.6.1 Marine Resupply

Marine transporters are required to have spill response plans; MHBL will verify that valid spill and emergency response plans are in place for contract marine transportation companies used by Doris North.

2.2.6.2 Explosives Spills at Doris North

At Doris North spills could potentially occur and will be responded to as indicated in Table 2-1.

Table 2-1: Potential Explosives Spills at Doris North and Response

Product	Location of Potential Spill	Potential Size of Spill	Response
Ammonium nitrate	Broken bags in the explosives storage area	1000 kg or more depending on the number of bags damaged	Qualified mine personnel will clean up and salvage or burn prills; damaged bags will be emptied into new bags and damaged bags burned.
	Broken tote bags in the mixing plant	Part of 1000 kg	The blasting contractor will clean up and salvage prills; damaged bags will be emptied into new bags and damaged bags burned.
ANFO	Broken transport bags in the mixing plant	Up to 25 kg	The blasting contractor will clean up and salvage ANFO; the plant area will be completely cleaned of ANFO and damaged bags will be burned.
	Spilled transport bags on the underground delivery vehicle	25 kg or more depending on the number of bags spilled	The blasting contractor will clean up and salvage ANFO. The spill area will be cleaned up and the spilled ANFO burned by the blasting contractor. The delivery truck will be clean if required.
Detonators and blasting caps	Transport underground	One or more containers of products	As above.

Mine personnel involved in explosives spill response will have explosives training. All spills of explosives will be reported on the NWT/Nunavut 24-hour spill line **(867) 920-8130** and to INAC Water Resource Inspector at **(867) 975-4298** and logged by the Doris North spill response coordinator.

2.2.7 Housekeeping

The magazines and mixing plant will be kept free of empty tote bags and boxes and swept clean on a regular basis. Similarly the blasters' vehicles will be kept tidy with any empty packaging taken to the dump daily to be burned. No explosives will be allowed to be stored in the vehicles when not in use. The blasting superintendent will conduct a weekly inspection and any deficiencies will be immediately remedied.

2.2.8 Inventory Management

MHBL will record daily use of ammonium nitrate and high explosives. The blasting superintendent will check the records weekly and complete a monthly reconciliation. Blasters will be responsible to ensure that all accessories and explosives are accounted for. Blasting accessories that are not used during the workday will be returned to their respective magazine and signed in. Magazine inventories will be regularly audited for accuracy. Missing or found explosives will be reported to the blasting supervisor.

2.2.9 Inspection

Access to and use of explosives will be under the exclusive control of the blasting superintendent. The blasting superintendent will be responsible for inspection of all explosives facilities, including the ammonium nitrate storage area, the magazine for high explosive detonators and blasting caps, and the explosives manufacturing plant.

2.2.10 Records

The Federal Explosives Act requires that the following records be kept with regard to explosives products:

- annual quantity of each explosive issued to the mine site from the factory, including the dates of shipments; and
- annual quantity of each explosive present at the site.

MHBL will maintain weekly records of the following relating to the handling and preparation of explosives through the explosives plant:

- staffing;
- safety concerns or incidents;
- total explosives consumption;
- the amount of ammonium nitrate remaining on site ; and
- inventory of other explosives and accessories to be audited for fiscal month-end balances.

Daily reports (including the misfire log book discussed under safety above) will be kept by blasters and the blast supervisors. The blaster in charge will sign in and sign out blasting accessories from the magazines, conduct and record magazine inspections and inventory audits, acknowledge receipt of bulk product delivered under underground and complete a blast report.

The blast report will include:

- deviations from the engineered design
- date and time of the blast
- name of the blaster and helpers
- description of weather conditions (for quarry blasting)
- surveyed location and number of holes (including the pattern for quarry blasting)
- accessories used, if any, e.g. number and times of delays.

The mine engineer will keep files on all blasts and only the mine manager, mine engineer and blast supervisor will have access to the files.

2.2.11 Disposal

Explosives identified as deteriorated or damaged will be destroyed; the supplier will be consulted on the appropriate handling and disposal. Only qualified personnel holding valid blasting certificates will handle these materials. Typically, such explosives are either burned or detonated under controlled conditions. In either case, only small quantities will be disposed of in a remote location. The site will be dependent on the mining stage and will be chosen by the blasting supervisor in consultation with the mine manager. Normal safety precautions for blasting operations will apply.

At mine closure (except short-term closure when a sub-compliment of personnel will remain on site), all unused explosives will be removed from site or safely burned or detonated if small quantities.

3.0 POTENTIAL EFFECTS ON FISH

Reference to Figure 1 shows that Quarry 1 is adjacent to Roberts Bay and thus blasting may produce shock wave effects on fish. Shock waves cause "a rapid rise to a high peak pressure followed by a rapid decay to below ambient hydrostatic pressure" (Wright and Hopkey 1998). The drop below ambient hydrostatic pressure causes most of the negative effects on fish, which can range from damage to the swim bladder or other organs to the disruption of development and mortality of fish eggs; small fish are more susceptible than larger fish (Wright and Hopkey 1998).

There are a number of mitigative measures available to reduce the magnitude of the shock waves produced by the explosion. The most appropriate mitigation would be to reduce the total weight of explosives, or separate the total explosion into a series of smaller explosions (and weights) by increasing the detonation delay period between charges. Wright and Hopkey (1998) recommend a minimum detonation delay period of 25 milliseconds. To reduce the potential effects of explosives in Quarry 1, MHBL will implement the following measures:

- introduce a detonation delay of 500 ms between rows of explosives
- introduce a detonation delay of 25 ms between each charge within each row.

Based on these mitigative measures, which correspond to the guidelines outlined in Wright and Hopkey (1998), the maximum weight of explosive will be limited below levels that may potentially affect fish.

4.0 LIMITATIONS AND CLOSURE

This report was prepared exclusively for Miramar Hope Bay Limited by AMEC Earth & Environmental, a division of AMEC Americas Limited. The quality of information, conclusions and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions and qualifications set forth in this report. This report is intended to be used by Miramar Hope Bay Limited, the Nunavut Water Board, the Kitikmeot Inuit Association and the regulatory agencies involved in reviewing the water license application for the Doris North Project only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any other third party is at that party's sole risk.

REFERENCES

Wright, D.G., and G.E. Hopkey. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Canadian Tech. Report of Fisheries and Aquatic Sciences 2107.

APPENDIX A : MSDS

Material Safety Data Sheet for #2 Diesel

Definition of terms

1. Chemical Product

MSDS Number: U7770

MSDS Date: 01-31-99

Product Name: #2 Diesel Fuel

24 Hour Emergency Phone: (210) 979-8346
Transportation Emergencies: Call Chemtrec at 1-800-424-9300
MSDS Assistance: (210) 592-4593

Distributors Name and Address:

T.W. Brown Oil Co., Inc.
1857 Knoll Drive
Ventura, California 93003

Chemical Name: #2 Diesel Fuel **Cas Number:** 68476-34-6

Synonyms/Common Names: This Material Safety Data Sheet applies to the following product descriptions for Hazard Communication purposes only. Technical specifications vary greatly depending on the product, and are not reflected in this document. Consult specification sheets for technical information.

California Air Resources Board (Carb) Diesel Fuel- On-road, Off-Road, Tax Exempt blends
Premium Diesel Fuel- Low-Sulfur, High-sulfur, On-Road, Off-Road, Tax Exempt blends
#2 Distillate- Low-Sulfur, High-sulfur, On-Road, Off-Road, Tax Exempt blends
#2 Diesel Fuel- Low-Sulfur, High-sulfur, On-Road, Off-Road, Tax Exempt blends
#2 Fuel Oil- Low-Sulfur, High-sulfur, On-Road, Off-Road, Tax Exempt blends

2. Composition, Information On Ingredients

Product Use: This product is intended for use as a fuel in engines and heaters designed for diesel fuels, and for use in engineered processes. Use in other applicatiions may result in higher exposures and require additional controls, such as local exhaust ventilation and personal protective equipment.

Description: #2 Diesel is a complex mixture of hydrocarbons from a variety of chemical processes blended to meet standardized product specifications. Composition varies greatly and includes C9 to C20 hydrocarbons with a boiling range of about 325-675 degrees F. The following is a non-exhaustive list of common components, typical percentage ranges in product, and occupational exposure limits for each.

Material Safety Data Sheet for #2 Diesel

Component or Material Name	%	CAS Number	ACGIH Limits TLV -- STEL -- Units	OSHA Exposure Limits PEL -- STEL -- C/P -- Units
Cat cracked distillate, light	0-100	64741-59-9	100 -- NA -- mg/m3	N/A -- N/A -- N/A -- N/A
Hydrotreated distillate, middle	0-100	64742-46-7	100 -- NA -- mg/m3	N/A -- N/A -- N/A -- N/A
Hydrotreated distillate, light	0-100	64742-47-8	100 -- NA -- mg/m3	N/A -- N/A -- N/A -- N/A
Gas oil, light	0-100	64741-44-2	100 -- NA -- mg/m3	N/A -- N/A -- N/A -- N/A

3. Hazards Identification

Health Hazard Data:

1. The major effect of exposure to this product is giddiness, headache, central nervous system depression; possible irritation of eyes, nose, and lungs; and dermal irritation. Signs of kidney and liver damage may be delayed. Pulmonary irritation secondary to exhalation fo solvent.

2. NIOSH recommends that whole diesel engine exhaust be regarded as a potential occupational carcinogen. Follow OSHA and NSHA rules where diesel engine exhaust fumes may be generated.

3. A life time skin painting study by the American Petroleum Institute has shown that similar naphtha products with a boiling range of 350-700 degrees F usually produce skin tumors and/ or skin cancers in laboratory mice. Only a weak to moderate response occurred. The effect to humans has not been determined.

4. Positive results at 2.0 ml/kg and 6.0 ml/kg noted in mutagenesis studies via in-vivo bone marrow cytogenetics assay in rats.

5. Kerosene is classified as a severe skin irritant. Mutation data has been reported for kerosene products. Hydrotreated kerosene is listed as being probably carcinogenic to humans with limited evidence in humans and sufficient evidence in experimental animals.

Hazards of Combustion Products: Carbon monoxide and carbon dioxide can be found in the combustion products of this product and other forms of hydrocarbon combustion. Carbon monoxide in moderate concentrations can cause symptoms of headache, nausea, vomiting, increased cardiac output, and confusion. Exposure to higher concentrations of carbon monoxide can cause loss of consciousness, heart damage, brain damage, and/or death. Exposure to high concentrations of carbon dioxide can cause simple asphyxiation by displacing available oxygen. Combustion of this and other similar materials should only be carried out in well ventilated areas.

MSDS Number: **A6048** * * * * * *Effective Date:* ***07/21/04*** * * * * * *Supercedes:* ***11/02/01***

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS | J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

AMMONIUM NITRATE

1. Product Identification

Synonyms: Nitric acid, ammonium salt
CAS No.: 6484-52-2
Molecular Weight: 80.04
Chemical Formula: NH4NO3
Product Codes:
J.T. Baker: 0729, 0731
Mallinckrodt: 3436

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Ammonium Nitrate	6484-52-2	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE OR EXPLOSION. MAY BE HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 1 - Slight
Reactivity Rating: 3 - Severe (Oxidizer)
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Yellow (Reactive)

Potential Health Effects

Inhalation:
May cause irritation to the respiratory tract; symptoms may include coughing, sore throat, and shortness of breath. At high temperatures, exposure to toxic nitrogen oxides decomposition products can quickly cause acute respiratory problems. Inhalation of large amounts causes systemic acidosis and abnormal hemoglobin.

Ingestion:
Large oral doses of nitrates may cause dizziness, abdominal pain, vomiting, bloody diarrhea, weakness, convulsions, and collapse. Harmful if swallowed. May cause methemoglobinemia resulting in cyanosis.

Skin Contact:
Causes irritation to skin. Symptoms include redness, itching, and pain.

Eye Contact:
Causes irritation, redness, and pain.

Chronic Exposure:
Small repeated oral doses of nitrates may cause weakness, depression, headache, and mental impairment.

Aggravation of Pre-existing Conditions:
No information found.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.
Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Remove any contaminated clothing. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.
Eye Contact:
Wash thoroughly with running water. Get medical advice if irritation develops.

---

5. Fire Fighting Measures

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. May support combustion in an existing fire.
Explosion:
Contact with oxidizable substances may cause extremely violent combustion. Sealed containers may rupture when heated. Sensitive to mechanical impact.
Fire Extinguishing Media:
Use flooding amounts of water in early stages of fire involving ammonium nitrate. Use any means suitable for extinguishing surrounding fire.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

6. Accidental Release Measures

Remove sources of heat and ignition.
Collected waste may be transferred to a closed, preferably metal, container and sent to a RCRA approved waste disposal facility.
Alternatively, sweep spill into noncombustible container and dissolve in large amount of water. Add soda ash. Mix and neutralize with 6M-HCl. Neutralized sludge may be sent to an approved waste disposal facility.

---

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Protect against physical damage. Store in a dry location separate from combustible, organic or other readily oxidizable materials. Avoid storage on wood floors. Remove and dispose of any spilled dichromates; do not return to original containers. Do not store above 54C (130F) preferably below 30C (86F). Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
None established.
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures as low as possible. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
For conditions of use where exposure to dust or mist is apparent and engineering controls are not feasible, a particulate respirator (NIOSH type N95 or better filters) may be worn. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Colorless crystals.
Odor:
Odorless.
Solubility:
118g/100g water @ 0C (32F).
Specific Gravity:
1.73 @ 23C (77F)
pH:
5.4

% Volatiles by volume @ 21C (70F):
0
Boiling Point:
210C (410F) Decomposes.
Melting Point:
170C (338F)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Hygroscopic.
Hazardous Decomposition Products:
Emits nitrous oxides when heated to decomposition. Liberates ammonia in reaction with strong alkalis.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Aluminum, antimony, chromium, copper, iron, lead, magnesium, manganese, nickel, zinc, brass, oil, charcoal, organic material, acetic acid, ammonium chloride, bismuth, cadmium, chlorides, cobalt, phosphorus, potassium and ammonium sulfate, sodium, sodium hypochlorite, sodium perchlorate, sodium-potassium alloy, and sulfure.
Conditions to Avoid:
Heat, flame, ignition sources, dusting and incompatibles. Moisture and combustible materials. Shock sensitive.

---

11. Toxicological Information

Oral rat LD50: 2217 mg/kg.

--------\Cancer Lists\----------

Ingredient	NTP Carcinogen - Known	NTP Carcinogen - Anticipated	IARC Category
Ammonium Nitrate (6484-52-2)	No	No	None

---

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is not expected to evaporate significantly. When released into water, this material is expected to readily biodegrade.
Environmental Toxicity:
No information found.

---

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: AMMONIUM NITRATE
Hazard Class: 5.1
UN/NA: UN1942
Packing Group: III
Information reported for product/size: 300LB

International (Water, I.M.O.)

Proper Shipping Name: AMMONIUM NITRATE
Hazard Class: 5.1
UN/NA: UN1942
Packing Group: III
Information reported for product/size: 300LB

---

15. Regulatory Information

```
  --------\Chemical Inventory Status - Part 1\------------------------
--------
  Ingredient                                        TSCA  EC   Japan
Australia
```

```
  ---------------------------------------------  ----  ---  -----  --
-------
  Ammonium Nitrate (6484-52-2)                    Yes  Yes   Yes
Yes

  --------\Chemical Inventory Status - Part 2\-------------------------
--------
                                                          --Canada--
  Ingredient                                       Korea  DSL   NDSL
Phil.
  ---------------------------------------------  -----  ---   ----  -
----
  Ammonium Nitrate (6484-52-2)                     Yes   Yes   No
Yes

  --------\Federal, State & International Regulations - Part 1\--------
--------
                                           -SARA 302-    ------SARA
313------
  Ingredient                               RQ    TPQ     List
Chemical Catg.
  ---------------------------------------  ---   -----   ----  ------
--------
  Ammonium Nitrate (6484-52-2)             No    No      No
Nitrate cmpd

  --------\Federal, State & International Regulations - Part 2\--------
--------
                                                        -RCRA-    -
TSCA-
  Ingredient                               CERCLA     261.33     8(d)
  ---------------------------------------  ------     ------    -----
-
  Ammonium Nitrate (6484-52-2)             No         No         No


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: No   Fire: No  Pressure: No
Reactivity: Yes         (Pure / Solid)
```

Australian Hazchem Code: 1[S]
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **0** Flammability: **0** Reactivity: **3** Other: **Oxidizer**
Label Hazard Warning:
DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY

CAUSE FIRE OR EXPLOSION. MAY BE HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.

Label Precautions:

Keep from contact with clothing and other combustible materials.
Do not store near combustible materials.
Store in a tightly closed container.
Avoid breathing dust.
Avoid contact with eyes, skin and clothing.
Remove and wash contaminated clothing promptly.
Use only with adequate ventilation.
Wash thoroughly after handling.
Store preferably below 30C

Label First Aid:

If inhaled, remove to fresh air. Get medical attention for any breathing difficulty. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. In all cases, get medical attention.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 3, 16.

Disclaimer:

APPENDIX B

SPILL PROCEDURES FOR AMMONIUM NITRATE – FUEL MIXTURE

CONSIDER ACTION ONLY IF SAFETY PERMITS!
ELIMINATE IGNITION SOURCES
If safe stop the source of spill

On land	• Block entry into waterways • Do not flush into sewer/drainage system • Contained fuel will float to surface, use absorbent • Contain spill by dyking with earth or other barrier • If liquid, remove minor spills with sorbents, large spills with pumps or vacuum equipment • Prills /granules can be shovelled or removed mechanically
On snow and ice	• Block entry into waterways and contain with snow or other barrier • Remove ammonium nitrate and contaminated snow with shovels or other mechanical means
On tundra	• Do not deploy personnel and equipment on marsh or vegetation • Remove ammonium nitrate and contaminated snow with shovels or other mechanical means if feasible • Burning is not feasible • Flushing with low pressure water can be tried if feasible • Minor spill amounts can be left in place to serve as fertilizer • Minimize damage caused by equipment and excavation
On water	• Ammonium nitrate sinks and mixes with water; contain spill by isolating contaminated water through damming or diversion • Flushing with water can be tried, if spill area cannot be isolated
Streams	Ammonium nitrate is completely soluble in water and is difficult to recover. Water flushing can be tried do disperse spill
Storage and transfer	Store closed, labelled containers in cool, ventilated areas away from incompatible materials
Disposal	• Segregate waste types • Place contaminated materials into marked containers • Consult with environmental authorities during final disposal