BACK RIVER PROJECT
Hazardous Materials Management Plan

October 2017

BACK RIVER PROJECT
HAZARDOUS MATERIALS MANAGEMENT PLAN

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Revision Log

Version	Date	Section	Page	Revision
1	October 2017	All	All	Supporting Document for Type A Water Licence Application, submitted to Nunavut Water Board for review and approval

Acronyms

AN	Ammonium Nitrate
ANFO	Ammonium Nitrate / Fuel Oil
CCME	Canadian Council of Ministers of the Environment
FEIS	Final Environmental Impact Statement
FO	Fuel Oil
GN	Government of Nunavut
HMMP or Plan	Hazardous Materials Management Plan
ISO	International Organization for Standardization
MAD	Main Application Document
MLA	Marine Laydown Area
NIRB	Nunavut Impact Review Board
NRC	Natural Resources Canada
NWB	Nunavut Water Board
OPEP	Oil Pollution Emergency Plan
Project	Back River Project
Sabina	Sabina Gold & Silver Corp.
SCP	Spill Contingency Plan
SDS	Safety Data Sheets
SOP	Standard Operating Procedures
TDG	Transportation of Dangerous Goods
WHMIS	Workplace Hazardous Materials Information System
WIR	Winter Ice Road

1. Introduction

The Back River Project (the Project) is a proposed gold project owned by Sabina Gold & Silver Corp. (Sabina) within the West Kitikmeot region of southwestern Nunavut. It is situated approximately 400 kilometres (km) southwest of Cambridge Bay, 95 km southeast of the southern end of Bathurst Inlet, and 520 km northeast of Yellowknife, Northwest Territories. The Project is located predominantly within the Queen Maud Gulf Watershed (Nunavut Water Regulations, Schedule 4).

The Project is comprised of two main areas with interconnecting winter ice roads (WIR) (Main Application Document [MAD] Appendix A, base Figure 2): Goose Property (MAD Appendix A, base Figure 3) and the Marine Laydown Area (MLA) (MAD Appendix A, base Figure 4) situated along the western shore of southern Bathurst Inlet. The majority of annual resupply will be completed using the MLA, and an approximately 160 km long WIR will interconnect these sites. Refer to the MAD Appendix A, base Figures 1 to 5 for general site layout and locations. A detailed project description is provided in the MAD.

This Hazardous Materials Management Plan (HMMP or Plan) outlines the approach planned for managing hazardous materials at the Project including safe handling, storage, transport, and disposal. The HMMP and other management plans are intended to support the Type A Water Licence Application for the Project.

The Plan was prepared following the requirements of the Supplementary Information Guidelines (SIG) for Mining and Milling MM3 and Water Works M1, issued by Nunavut Water Board (NWB 2010 a, b) and the Environmental Impact Statement (EIS) Guidelines issued by the Nunavut Impact Review Board (NIRB) to Sabina (NIRB 2013) and in accordance with best management practices and in conformance with current Federal and Territorial statutory requirements (see Applicable legislation and Guidelines Section 3).

This plan is a living document to be updated upon changes in related regulatory requirements, management reviews, incident investigations, changes to facility operation or maintenance, and environmental monitoring results, best practice updates or other Project specific protocols once construction starts through to Project closure activities. Any updates will be filed with the Annual Report submitted under the Type A Water Licence.

The information presented herein is current as of September 2017. An update will be initiated prior to the start of construction. The Plan will be reviewed as needed for changes in operation and technology and as directed by the NWB in the Type A Water Licence or other regulatory authorization where appropriate. Completion of the updated Plan will be documented through signatures of the personnel responsible for reviewing, updating, and approving the Plan.

A record will document all significant changes that have been incorporated in the Plan subsequent to the latest review. The record will include the names of the persons who made and approved the change, as well as the date of the approval.

Sabina will maintain a distribution list providing contact details for all parties to receive the Plan including key personnel, contractors, organizations, and external agencies.

2. Scope and Objectives

The Hazardous Materials Management Plan is one of the documents that forms part of Sabina's overall Waste Management Program for the Project. This plan has been written to meet requirements of a Type A Water Licence and applies to all Sabina projects in the Kitikmeot region.

This plan is divided into the following components:

- Applicable Legislation and Guidelines (Section 3);
- Planning and Implementation (Section 4);
- Roles and Responsibilities (Section 5);
- Hazardous Materials and Management (Section 6);
- Storage, Handling, and Contingency (Section 7);
- Environmental Protection Measures (Section 8);
- Monitoring Program (Section 9);
- Environmental Reporting (Section 10);
- Adaptive Management (Section 11); and
- Reclamation (Section 12).

The HMMP provides information on hazardous material management including the environmental hazards and safe handling, transportation, storage, and disposal requirements at the Project. Sabina intends to use, generate and dispose of hazardous materials as part of the development, Operations, and Closure phases of the Project.

Sabina's Safety and Environmental Policy relates specifically to waste management by:

- Recognizing that environmental quality is vital to the Corporation's existence, progress, and continued development.
- Committing to high environmental standards, conserving natural resources, and minimizing the impact of its activities through the diligent application of appropriate technology and responsible conduct.
- Providing a framework to measure performance.
- Ensuring compliance with applicable legislation, regulations, and guidelines.

The main objectives of Sabina's HMMP are summarized as follows:

1. Identify hazardous materials types potentially used and or generated during the Construction, Operations, and reclamation and Closure phases.
2. Characterize the potential environmental hazards associated with the proposed materials.
3. Assign responsibilities for the management of hazardous materials.

4. Identify practices for handling, storing, and disposal of hazardous materials at the Back River mine site that are safe, secure, and environmentally sound.
5. Identify required training for all staff and contractors related to hazardous materials.
6. Implement waste monitoring and mitigation measures.
7. Confirm conformance with applicable Federal and Territorial regulations.
8. Conform with Section 9.4.8 of NIRB (2013).

The current Plan is conceptual and under development given the proposed Project is pending regulatory approvals and direct suppliers have not been identified. From development to closure, transport of hazardous material from site and disposal will be contracted to licensed contractor(s) who will have adequate certification for the transportation, handling, and disposal of hazardous materials. Hazardous material volumes have been estimated based on the current mine plan size.

This plan has been aligned to conform to the general strategies to be used to achieve the waste management objectives presented in Sabina's Landfill and Waste Management Plan (Supporting Document [SD]-10). This includes strategies to reduce waste through a proactive procurement policy, material and chemical substitution and waste segregation, as well as application of the 4 'R's (reduction, reuse, recycling, and recovery).

In addition, a Cyanide Management Plan has been developed as a sub-plan to the HMMP (Appendix A) and is in accordance with the International Cyanide Management Code (International Cyanide Management Institute 2015).

The Cyanide Management Plan provides a description of the engineering designs and operations procedures that will be implemented to contain and manage cyanide on-site and thereby minimize risk to on-site employees and the environment.

2.1 RELATED DOCUMENTS

Documents within the Application for the Type A Water Licence, which support this plan include the following:

- Landfill and Waste Management Plan (SD-10);
- Fuel Management Plan (SD-16);
- Spill Contingency Plan (SD-17);
- Oil Pollution Emergency Plan (SD-18);
- Risk Management and Emergency Response Plan (SD-15);
- Landfarm Management Plan (SD-12);
- Incineration Management Plan (SD-11);
- Environmental Management and Protection Plan (SD-20);
- Occupational Health and Safety Plan (FEIS Volume 10, Chapter 25);
- Shipping Management Plan (FEIS Volume 10, Chapter 15); and
- Explosives Management Plan (FEIS Volume 10, Chapter 13).

3. Applicable Legislation and Guidelines

The generation, storage, transport, and disposal of hazardous materials within Canada and specific to Nunavut are covered by existing federal and territorial Acts and Regulations. Sabina is also bound by the terms and conditions of its land use permits to be issued by Indigenous and Northern Affairs Canada for Crown Land and the Kitikmeot Inuit Association for Inuit Owned Land, and its Type A Water Licence to be issued by the Nunavut Water Board (NWB).

Sabina will put into place operational policies and procedures (e.g., Standard Operating Procedures [SOPs]) which meet or exceed the requirements of the applicable legislation and authorizations. Applicable Acts, Regulations and Guidelines related to hazardous material management, which are summarized in Table 3-1. Hazardous material management practices will also follow to the guidelines and operational policies and procedures developed by suppliers.

The Cyanide Management Plan (Appendix A) was prepared with reference to the following codes and standards:

- International Cyanide Code
- Transportation Canada
- United Nations Handling of Dangerous Goods

The *International Cyanide Management Code For the Manufacture, Transport, and Use of Cyanide In the Production of Gold* (Cyanide Code) was developed by a multi-stakeholder Steering Committee under the guidance of the United Nations Environmental Program and the then-International Council on Metals and the Environment. Signatories of the Cyanide Code commit to follow the Cyanide Code's Principles and Standards in the use of cyanide. The Standards of Practice listed under each Principle in the Cyanide Code set performance goals and objectives that an operation must achieve in order to be certified as compliant with the Cyanide Code.

Table 3-1. Applicable Legislation to the Hazardous Material Management Plan

Acts	Regulations	Guidelines
Federal		
Canadian Environmental Protection Act (CEPA)	Interprovincial Movement of Hazardous Waste and Hazardous Recyclable Material Regulations Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations	Canadian Council of the Ministers of Environment (CCME) - Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products Canada-Wide Standards for Petroleum Hydrocarbons in Soil CCME Environmental Quality Guidelines Canada – Wide Standards for Dioxins and Furans
Fisheries Act (1985, c. F-14)	Metal Mining Effluent Regulations (SOR/2002-2222)	
Hazardous Products Act	Controlled Products Regulations	Workplace Hazardous Materials Information System (WHMIS)

(continued)

Table 3-1. Applicable Legislation to the Hazardous Material Management Plan (completed)

Acts	Regulations	Guidelines
National Fire Code of Canada (2010)		
International Maritime Organization (IMO)	International Maritime Dangerous Goods Code (IMDG)	
Transport of Dangerous Goods Act	Transportation of Dangerous Goods Regulations	2016 Emergency Response Guidebook (Transport Canada and U.S. Department of Transportation, 2016).
Explosives Act (R.S.C, 1985, C E-17)	Explosive Regulations 2013 (SOR/2013-211)	Note: for Manufacture and Storage not use
International Air Transport Association (IATA)	International Air Transport Association (IATA) Dangerous Goods Regulations	International Civil Aviation Organization Technical Instructions
Territorial – Nunavut		
Environmental Protection Act	Spill Contingency Planning and Reporting Regulations Used Oil and Waste Fuel Management Regulations The removal of hazardous materials will require the registration with the Government of Nunavut, Department of Environment (DOE) as a waste generator as well as carrier (if applicable) prior to transport	Government of Nunavut (GN) Environmental Guidelines for the Management of: o General Management of Hazardous Waste in Nunavut (GN, 2010a) o Waste Paint (GN, 2010b) o Mercury-Containing Products and Waste Mercury (GN, 2010c) o Industrial Waste Discharges into Municipal Solid Waste and Sewage Disposal Facilities (GN, 2011a) o Waste Batteries (GN, 2011b) o Waste Solvent (GN, 2011c) o Waste Antifreeze (GN, 2011d) o Used Oil and Waste Fuel (GN, 2012) o Biomedical and Pharmaceutical Waste (GN, 2014) Canada-Wide Standards for Petroleum Hydrocarbons In Soil (CCME, 2008)
Mine Health And Safety Act	Mine Health And Safety Regulations	
Explosives Use Act (RSNWT (Nu) 1988, c E-10)	Explosives Regulations (RRNWT (Nu) 1990 c E-27)	
Fire Prevention Act	Fire Prevention Regulations	
Safety Act	General Safety Regulations Work Site Hazardous Materials Information System Regulations	
Transportation Of Dangerous Goods Act	Transportation Of Dangerous Goods Regulations	

4. Planning and Implementation

The HMMP considers existing (baseline) conditions, assessed potential impacts of the Project, developed conceptual mitigation strategies, and developed specific mitigation measures to execute these strategies. Conceptual strategies and plans will continue to be elaborated and executed throughout the all phases of the Project.

Monitoring will be the principal mechanism to provide feedback to continually gauge the effectiveness of environmental performance. Operational control is facilitated through the contractor job-specific SOPs work instructions, on-the-job instruction, tailgate meetings where required, contract requirements, and service agreements. The effectiveness of physical operational controls will be reviewed according to preventative maintenance and review procedures and schedules.

5. Roles and Responsibilities

The General Manager will be ultimately responsible for the success of this plan and approves all relevant policies and documents, auditing, action planning and the verification process.

The Mine Manager, Plant Manager, and Safety Superintendent, along with their direct reports will be responsible for the implementation of this plan including overall management of the Plan and internal reporting.

All other Project personnel involved with hazardous materials management activities will be responsible for the effective implementation of this plan including: completion of required training, maintain compliance with training requirements as set out by this plan or by Sabina's SOPs, and Best Management Practices. All employees are to work in compliance with Health and Safety Laws and Regulations.

5.1 TRAINING AND CERTIFICATION REQUIREMENTS

All personnel working on the Project will undertake formal training, to ensure compliance with legislation and Sabina's SOPs. The training requirement for all staff and contractors may include:

- Site-specific Orientation.
- Workplace Hazardous Materials Information System (WHMIS).
- Emergency and Spill Response Training.
- Blasting Certificate (specific to handling of explosives).
- Additional site-specific procedures (such as SOPs).

Only trained personnel will be assigned to work with and around hazardous materials. Personnel working with hazardous materials will undertake formal training, including on-the-job training to ensure safety, compliance with legislation, and SOPs. The additional training requirements for staff handling hazardous materials or fuel may include:

- First Aid.
- Transportation of Dangerous Goods (TDG).
- Workplace Hazardous Materials Information System (WHMIS)
- Emergency and Spill Response Team Training.
- Additional site-specific procedures (such as SOPs pertaining to fuel handling, waste oil incineration, oily liquid treatment plant, reagent loading and transfer, and job specific training).

The training requirements for contractors and other visiting personnel will be the same as for Sabina employees. It is expected that contractors will have been provided adequate training from their employer. Contractors may be requested to provide copies of any current certificates of requested individuals, such as First Aid, WHIMS, and TDG. Site-specific training will be provided by Sabina and renewed as required according to SOPs and legislative requirements.

Records for training will be maintained for employees and contractors.

As a contractual condition with penalties, Contractors will be obliged to comply with Sabina's approvals and environmental management plans, including this plan.

6. Hazardous Materials and Management

For the purpose of the HMMP, a hazardous material is defined as a material that, as a result of its physical, chemical, or other properties, poses a hazard to human health or the environment when improperly handled, used, stored, disposed of or otherwise managed. Hazardous materials may include products procured for use on-site, as well as wastes generated on-site that can no longer be used for their intended purpose or reused.

The hazardous materials classifications under the *Transportation of Dangerous Goods Act* are as follows:

- Class 1 – Explosives (discussed in the Explosives Management Plan [FEIS Volume 10, Chapter 13]).
- Class 2 – Gases.
- Class 3 – Flammable liquids.
- Class 4 – Flammable solids.
- Class 5 – Oxidizing substances and organic products.
- Class 6 – Poisonous (toxic) and infectious substances.
- Class 8 – Corrosives.
- Class 9 – Miscellaneous products or substances.

A hazardous material does not include substances that are:

- Household in origin.
- Included in Class 1 - Explosives or class 7 - Radioactive materials.
- An empty container (GN 2010a).
- Intended for disposal in a sewage system or by landfilling.

6.1 MATERIALS

The typical types of hazardous materials that will be located at the Project include:

- Petroleum products – used or new fuel/lubricants/oils/greases.
- Contaminated snow/water/soil.
- Used oil and fuel filters.
- Used sorbents and rags.
- Empty petroleum hydrocarbon containers and drums.
- Glycol.
- Sodium cyanide and other process reagents.
- Laboratory reagents.
- Solvents.
- Paints.

- Fluorescent light tubes.
- Electronics and electrical waste.
- Waste equipment batteries.
- Hazardous medical waste.
- Propane tanks.
- Aerosol cans.

A number of the above materials will be handled as products before being used, and subsequently as wastes following their use.

The Project phase(s) and location(s) of use, potential environmental effects, and proposed handling and disposal measures, and estimated quantities for the above hazardous materials are presented in Table 8-1.

6.1.1 Petroleum Products (Fuel/Lubricants/Oils/Greases)

The use of and regular preventive maintenance of Project vehicles and machinery will require the use and periodic replacement of products such as fuel, lubricants, oils and greases at the MLA and the Goose Property. The types of waste generated within this category may include:

- Fuel for machinery.
- Lubricants.
- Hydraulic fluid.
- Waste oil from vehicles/equipment.
- Waste oil from oily water separators.

6.1.2 Contaminated Snow/Water/Soil (Oil/Fuel)

All spills will be contained and cleaned-up in accordance with the Spill Contingency Plan (SCP; SD-17) and Oil Pollution Emergency Plan (OPEP; SD-18). The materials that are contaminated and the materials that are used for the clean-up will require handling under this HMMP, and remediation or final disposal according to the Landfill and Waste Management Plan (SD-10) and/or Landfarm Management Plan (SD-12).

6.1.3 Oil and Fuel Filters

Regular preventive maintenance of vehicles and machinery will require the periodic replacement of oil and fuel filters in the maintenance facilities at the MLA and the Goose Property. The used filters will be stored in secondary containment and backhauled (refer to Section 7.2.6 for additional information).

6.1.4 Used Sorbents and Rags

Used sorbents and rags will be generated from regular maintenance, and may be generated from occasional spill response activities. All spill materials will be contained and cleaned up in accordance with the SCP (SD-17) and OPEP (SD-18). Hydrocarbon-contaminated materials, including the materials used for the clean-up will require handling under this HMMP, and remediation or final disposal according to the Incinerator Management Plan (SD-11) or Landfill and Waste Management Plan (SD-10).

6.1.5 Glycol

Glycol will be used in Project Operations, and spent or contaminated glycol will be generated. All glycol spills will be contained and cleaned up in accordance with the SCP (SD-17). Spent or contaminated glycols will require disposal under this HMMP. The types of waste generated within this category will include (GN 2011c):

- Glycol solutions from heat recovery and building HVAC.
- Waste antifreeze from vehicles.
- Waste antifreeze from equipment.
- Airport de-icing solutions.
- Used glycol products.

6.1.6 Empty Petroleum Hydrocarbon Containers and Drums

Empty petroleum hydrocarbon containers and drums will be stored and returned for recycling and disposal. When possible, Sabina will bring supplies in bulk to limit the number of empty containers generated. Empty containers will also be used for the containment of spent or used products such as oil, glycol, and hydraulic fluid.

6.1.7 Process Reagents

Process reagents to be stored on-site include hydrated lime, sodium cyanide, activated carbon, sodium hydroxide, hydrochloric acid, sulphur, copper sulphate, sodium metabisulphite, flocculant, lead nitrate, and antiscalant. Best practices will be in place to reduce or eliminate the generation of hazardous waste from the mill process (i.e., use all reagents within the process circuits). Process reagents identified as hazardous waste will require disposal under this HMMP except cyanide-containing products and wastes, which will be managed according to the Cyanide Management Plan (Appendix A). All reagent spills will be contained and cleaned-up in accordance with the SCP (SD-17).

6.1.8 Laboratory Reagents

Laboratory reagents will be stored on-site for use during operations. Best practices will be in place to reduce or eliminate the generation of hazardous waste from laboratory processes. Laboratory reagents identified as hazardous waste will require disposal under this HMMP. All reagent spills will be contained and cleaned in accordance with the SCP (SD-17).

6.1.9 Solvents

Solvents will be used and waste solvents generated as a result of maintenance and operations. All solvent spills will be contained and cleaned-up in accordance with the SCP (SD-17). Spent or contaminated solvents will require disposal under this HMMP. The types of waste generated within this category may include (GN 2011c):

- Cleaning agents (degreasers).
- Oil-based paints.
- Paint thinner.
- Industrial glues.
- Other solvents.

6.1.10 Paints

Paints will be used by the Project, and used paints will likely require disposal if not entirely consumed. All paint spills will be contained and cleaned-up in accordance with the SCP (SD-17). The materials that are spent or contaminated will require disposal under this HMMP. When feasible, water-based paints will be used on-site. Waste water-based paints under 5 litres should be collected in a covered area and opened to dry. After they have been dried, the paint and cans can be landfilled (GN 2010a).

Unused full containers of paint will be returned to the manufacturer when possible. Paint containing hazardous materials over 5 litres that cannot be used will be sealed and shipped off-site to a registered hazardous waste receiver.

6.1.11 Fluorescent Light Tubes

Florescent light tubes are expected to be used by the Project. Both new and used tubes will be collected in the original boxes and stored for disposal. If the used fluorescent tubes are not broken and are packaged in their original shipping box, no special requirements are needed for transport purposes and transport, as a hazardous waste is not necessary. If tubes are broken, compliance with the hazardous waste regulations will be required (GN 2010a).

6.1.12 Equipment Batteries

Batteries will be used by the Project, and waste batteries will require disposal. Waste batteries will be landfilled or collected and shipped off-site to a recycling facility or a registered hazardous waste receiver as appropriate. Types of batteries that might be used during all Project phases and recommended disposal methods are summarized in Table 6.1-1 (GN 2011b).

Table 6.1-1. Battery Type and Recommended Disposal Methods

Battery Type	Sizes Available	Disposal Method
Alkaline	AAA, AA, C, D, 6V and 9V	Landfill or return to a licensed recycler
Carbon-Zinc	AAA, AA, C, D, 6V and 9V	Landfill or return to a licensed recycler
Button Cell – Silver Oxide, Lithium, Alkaline, Zinc-Air	Various sizes	Alkaline – landfill or return to a licensed recycler. All other types – return to a licensed recycler.
Vehicle Lead-Acid	6V and 12V	Return to a licensed recycler
Sealed Lead-Acid	2V, 6V and 12V	Return to a licensed recycler
Nickel-Cadmium (NiCd)	AAA, AA, C, D, 6V and 9V	Return to a licensed recycler
Nickel-Metal-Hydride (NiMH)	AAA, AA, C, D, 6V and 9V	Return to a licensed recycler
Lithium-Ion	Various sizes	Return to a licensed recycler

Source: GN (2011b).

6.1.13 Electronics and Electrical Materials

Electrical devices from the Project that cannot be repaired or recycled will be collected for disposal. Sabina's environment staff will determine the risk of electronic devices and classify them as hazardous or non-hazardous waste and determine the appropriate method of recycling/disposal.

6.1.14 Hazardous Medical Waste / Biomedical Waste

Hazardous medical waste/biomedical waste originates from human health care and personal health requirements on-site, such as First Aid rooms. A portion of that waste stream may be infectious or potentially infectious and presents a potential hazard to the public health and the environment.

All hazardous medical waste/biomedical waste will be handled, transported and disposed of according to the Guidelines for the Management of Biomedical Waste in Canada, Environment Canada (1992) (CCME-EPC-WM-42E). Additional guidelines pertaining to northern environmental conditions are found in the Government of Nunavut Environmental Guideline for Biomedical and Pharmaceutical Waste.

6.1.15 Ammonium Nitrate

Ammonium nitrate is the oxidiser component of the Ammonium Nitrate and Fuel Oil (ANFO) explosive. It is a stable, inorganic, solid compound. It must be kept dry to remain effective if it is to be used in blasting. Ammonium Nitrate (AN) is completely soluble in water and also readily absorbs water from air. AN products vary in composition, blend, and surface treatment. AN prill (pellets) produced for use in ANFO explosives are intentionally porous to permit the fuel oil to be absorbed. Prill are generally white or off-white, and their shelf life in a tightly closed container is unlimited.

AN is not an explosive, but rather it is an oxidiser which 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 oils or waxes;
- Contamination with inorganic materials such as chlorides and metals (e.g., chromium, copper, cobalt and nickel); and
- Exposure to strong shock waves from other explosions.

AN is not combustible; however, 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. For additional information refer to the Explosives Management Plan (FEIS Volume 10, Chapter 13).

6.1.16 Ammonium Nitrate and Fuel Oil

Ammonium Nitrate and Fuel Oil is a mixture of ammonium nitrate and fuel oil and is the main explosive to be used for mining at the Project. ANFO is formulated of approximately 94% AN and 6% fuel oil (FO) by weight. ANFO requires a booster of primary and / or secondary explosives to ensure reliable detonation. ANFO is placed in boreholes for efficient detonation and brisance.

The mixture of AN and FO when activated using a detonator reacts to form nitrogen (N_2), carbon dioxide (CO_2) and Water (H_2O) when complete combustion occurs, and some carbon monoxide (CO) and nitrogen oxides (NO_x) during incomplete combustion.

Water can interfere with the explosive function and the combustion reaction of ANFO. However, given the relatively dry climatic conditions, a water-resistant ANFO / emulsion blend is currently not anticipated to be used for surface blasting at the Project. Underground, ANFO is planned to be used as the main explosive for development and stoping. Packaged emulsion would be used as a primer and for

loading lifter holes in development headings (JDS 2015). For additional information refer to the Explosives Management Plan (FEIS Volume 10, Chapter 13).

6.2 GENERAL SAFETY REQUIREMENTS

Each chemical component will be handled and disposed of in accordance with information found within its respective Safety Data Sheet (SDS). An SDS is a source of health and safety information for workers and emergency personnel. Information found within the SDS includes the following:

- Identification of the material.
- Hazard Information.
- Composition / Ingredients.
- First Aid Measures.
- Fire Fighting Measures.
- Accidental Release Measures.
- Handling and Storage.
- Exposure Controls / Personal Protective Equipment.
- Physical and Chemical Properties.
- Stability and Reactivity.
- Toxicological Information.
- Ecological Information.
- Disposal Considerations.
- Transport Information.
- Regulatory Information.
- Other Information.

SDSs will be available for hazardous material products to be stored on-site. This information will be available at various designated Project locations such as the maintenance areas and hazardous material generation and storage areas.

Safety procedures for the use, handling, and storage of hazardous materials will be developed based on best practices and SDS guidelines. As an example, a summary of the minimum product safe handling measures is listed in Table 7.2-3. It must be emphasized that these are protection measures against the materials themselves. They are not a substitute for the safe handling and use of explosives. See Section 7.2.7 for more information on the handling of explosives.

7. Storage, Handling, and Contingency

One of Sabina's main priorities (see Section 2) is to identify practices for handling, storing, and disposal of hazardous materials for the mine site that are safe, secure, and environmentally sound. Sabina's goal is, through proper management, to implement policies and controls to reduce impacts to the environment, and reduce the overall quantities required.

7.1 STORAGE LOCATIONS

The majority of hazardous materials will be stored at the hazardous materials storage facility located at the MLA or the hazardous materials storage area at the Goose Property. The facilities established during the Construction Phase will be used through the Operations and Closure phases of the Project. Hazardous waste that is generated onboard cargo ships will remain on board the ship, stored, and labelled in accordance with carrier specific plans.

7.1.1 Marine Laydown Area

A 5,000 m² dedicated lined storage pad will be constructed at the MLA to receive and temporarily store hazardous wastes until the backhaul sealift can transport it from the site. Additional temporary hazardous materials storage areas may be used for short-term storage during the Construction and initial Operations phases. The storage facility will be located proximal to the landfarm will be secured and identified with appropriate signage (Figure 7.1-1). The hazardous material storage pad at the MLA will be constructed to prevent pooling of water; this will be achieved by grading the base of the storage area to collect contact water and snow melt in sumps.

Additional temporary hazardous materials storage areas may be used for short-term storage during the Construction, Operations, and Closure phases. Refer to Table 7.3-1 Hazardous material inventory for delivery form, typical volumes and storage vessels. As the Project moves through each development phase the types and estimated numbers of containers on-site will vary throughout project development. Sabina will provide updated information with the Annual Report or as otherwise required by authorization.

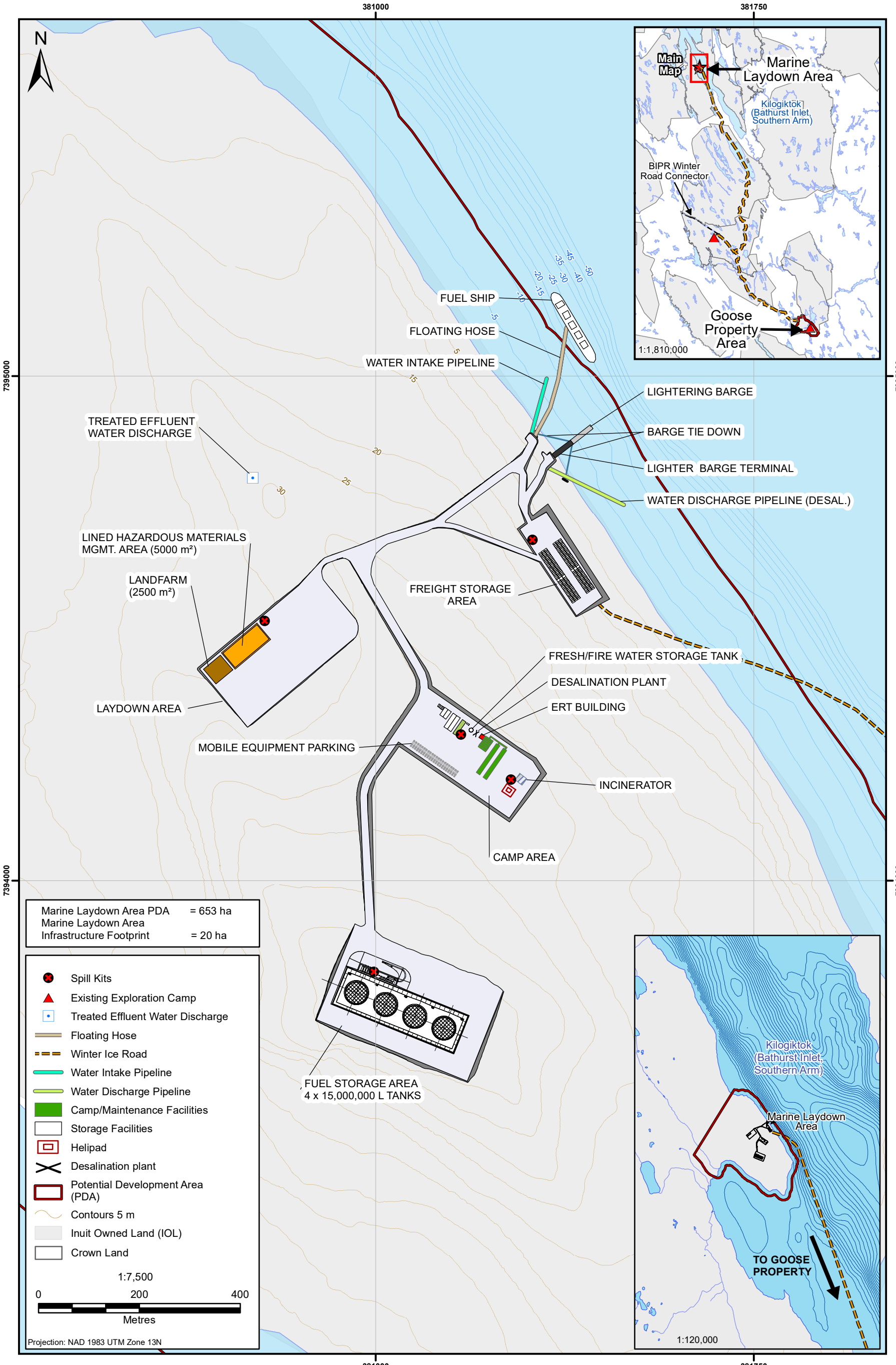
In addition, there will be a laydown pad at the MLA for inert materials. The laydown pad will receive up to 3,900 tonnes of inert AN within seacans that provide secondary containment. The seacans will be placed on an unlined laydown pad for transport to the Goose site. During Operations, AN will not be sourced from the seacans at the MLA.

Roads and pads will be designed so runoff is dispersed as sheet flow and to minimize channelized flow. Refer to the Water Management Plan (SD-05) for additional details related to contact water associated with the hazardous waste storage facility and laydown pads. Detailed plans for containment of hazardous materials will be developed as a part of detailed design and will be provided to the NWB 60 days prior to construction.

During the construction of the MLA, there will be temporary storage and use of packaged explosives. These explosives will be stored using the magazines that will be permanently installed at Goose later during the operational phase.

During operations, packaged explosives and blasting related products will be shipped by air directly to the Goose Property and will not be stored at the MLA.

GIS # BR_NA_tab_MLASiteLayoutERT_WL_A W:\BackRiver\04_Exploration\BackRiverRegion\GIS_Products\ESRI_MXD\Water_Permitting\FINAL FIGURES\BR_NA_tab_MLASiteLayoutERT_WL_A.mxd September 25 2017



NOTE: All roads at the MLA are service roads

Sabina GOLD & SILVER CORP.

Figure 7.1-1

Marine Laydown Area
General Arrangement Plan with Spill Kit Locations

7.1.2 Goose Property

During Construction Phase of the Project, the existing hazardous material storage area associated with the exploration camp will be used initially until the permanent/temporary hazardous materials storage area to support mine development is constructed in Year -1. This existing facility is an HDPE lined system with a combination of gravel and wood support walls, and a sloped base and sump. The exploration camp area is regulated under NWB Water Licence No. 2BE-GOO1520.

The permanent hazardous materials storage area at the Goose Property will be predominantly outdoors on a 3,000 m² lined pad at the mine site development area (Figure 7.1-2). Additional temporary hazardous materials storage areas may be used for short-term storage during the Construction and initial Operations phases. Sabina will, where appropriate:

- use sea containers for storage of materials;
- identify and label sites within buildings;
- regularly inspect materials and containers to confirm for proper storage as part of regular environmental site inspections; and
- identify a secure area for hazardous materials such as mill reagents.

Detailed plans for containment of hazardous materials will be developed as a part of detailed design and will be provided to the NWB 60 days prior to construction. At the Goose Property, there will be a laydown and storage area for up to 3,900 tonnes of inert AN, as well as an AN Facility, a magazine capable of holding 32 t of explosives, and a cap magazine capable of holding approximately 600 cases of detonators (Figure 7.1-3). Explosives magazines for short-term use may be placed in proximity to the pits or construction areas, subject to quantity/distance regulations, and re-supplied from the explosives storage area.

425050 430050 435050

7270500

N

Goose PDA = 5,358 ha
Goose Infrastructure Footprint = 560 ha

Culvert
Spill Kits
Existing Exploration Camp
FEIS_Infrastructure_Points
Underground Portal
10 m Contour Interval
Service Road
Haul Road
Water Diversion Structure
Winter Ice Road
Water Intake Pipeline
Water Discharge Pipeline
Airstrip
Laydown Area
Other Infrastructure
Open Pit
Camp/Plant Site
Ore Stockpile
TSF Containment Dam
TSF South Dyke
Tailings Storage Facility/ Waste Rock Storage Area
Water Management Structure
Landfarm
Tailings Emergency Pond
Flow Direction
Potential Development Area (PDA)
Inuit Owned Land (IOL)
IOL and Crown Land Border
Crown Land

1:32,500
0 0.5 1
Kilometres

Projection: NAD 1983 UTM Zone 13N

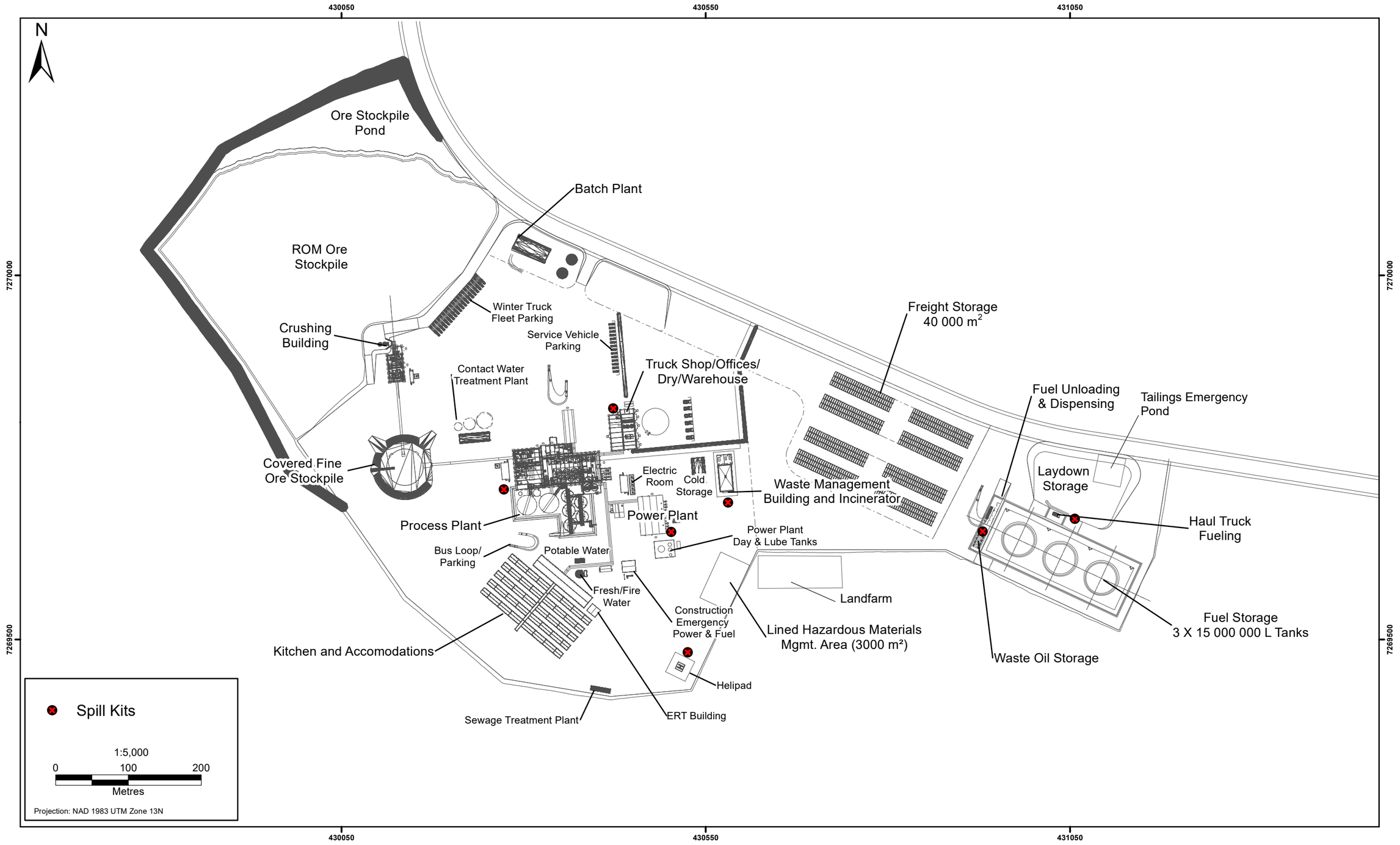
Mam Lake
Llama Lake
Llama Pit
Llama WRSA
Llama Portal
Primary Pond
Umwelt WRSA
Umwelt Pit
Pipeline and Access Trail
Saline Water Pond
Water Intake Pipeline
Umwelt Portal
Ore Stockpile
Tahikyuak (Big Lake)
Landfarm
Goose Plant Site
ERT Building
Treated Effluent Water Discharge
AN Storage and AN Facility
Cap Magazine
Powder Magazine
Effluent Discharge Pipeline
Giraffe Lake
Giraffe Outflow
Attituq (Goose Lake)
Goose Outflow
Tahikafalok Nahik (Propeller Lake)
Water Intake Pipeline
Goose Portal
Goose Main Pit
Echo WRSA
Gander Pond
Airstrip
Echo Outflow
Echo Portal
Echo Pit
Echo Lake
IOL
CROWN LAND
TSF WRSA Pond
TSF/TSF WRSA
Fox Lake
Rascal Lake
IOL
CROWN LAND

TO MARINE LAYDOWN AREA
Goose Property Area
IOL
CROWN LAND
1:270,000

Sabina GOLD & SILVER CORP.

Goose Property
General Arrangement with Spill Kit Locations
Type A Water Licence

Figure 7.1-2



Sabina
GOLD & SILVER CORP.

Goose Plant Site Layout with Spill Kit Locations Type A Water Licence

Figure 7.1-3

Bulk AN prill will be shipped to site in 1-t tote bags within 20-ft seacans that provide secondary containment for transport and storage. The AN storage area is sized to allow for a maximum of 3,900 t of AN within seacans.

The seacans will be placed on a laydown pad at the AN Facility. Diversion berms will direct any runoff water to a sump at the AN Facility pad. Collected runoff from the AN Facility area will be treated as contact water as described in the Water Management Plan (SD-05). Water from the AN facility truck wash will be transported to a water management pond for treatment or discharge as appropriate, or will be collected and treated in an evaporator. The explosives storage magazines are located on separate pads.

In each underground operation, two underground bays are planned for the storage of explosive products. One bay will be designated for the storage of explosives; while the other bay will be designated for the storage of detonators. Day boxes would be used as temporary storage for daily consumption. The magazines would be equipped with fire extinguishers, wooden shelves, and concrete flooring.

Hazardous wastes originating from the Goose Property will be temporarily stored on-site until it can be packaged in appropriate containers for transportation to the hazardous waste storage area at the MLA to be backhauled by barge for off-site disposal. Alternatively, hazardous wastes may be shipped off-site by air directly from Goose Property.

7.2 HANDLING REQUIREMENTS

All waste material will be handled in accordance with applicable federal and territorial legislation and regulations (see Table 3.1). Handling requirements will also adhere to the Government of Nunavut's Environmental Guides and take into account SDSs requirements. A summary of the safe handling requirements is provided subsections below (Section 7.2.1 to 7.2.7). All waste manifests will be completed according to applicable legislation and retained for the required time periods. When possible, materials will reused.

7.2.1 Hazardous Materials Inventory

An accurate and detailed inventory of hazardous materials and dangerous goods is required to implement best materials management practices at the site. A hazardous materials inventory will list all chemicals on the site, and include additional information on the products applicable for use by mine personnel including specific spill response considerations and procedures.

As the Project moves through each development phase the types and estimated numbers of containers on-site will vary throughout project development. Sabina will provide updated information in the Annual Report to regulators or as otherwise required by authorization.

A typical list of hazardous materials to be utilized at the mine site is provided in Table 7.2-1. The inventory is based on planned Process Plant hazardous materials and consumption rates.

Table 7.2-1. Typical Process Plant Hazardous Materials Inventory

Substance (by area)	Use	Delivered Form, Typical Volume in Site Storage	Storage Vessels
Goose Process Plant			
Sodium Metabisulphite	CN destruction	1,000 kg bags, granular,1,360 t/a via MLA	Seacan
Lead Nitrate	Process - Leaching	Granular, 44 t/a via MLA	Seacan
Sodium Cyanide	Process - Leaching	1,000 kg bags, granular, 3,132 t/a via MLA	Seacan
Flocculant	Thickening	750 kg bags, granular, 44 t/a via MLA	Seacan
Copper Sulphate	CN destruction	2,500 kg bags, granular, 51 t/a	Seacan
Lime	Process – Grinding	1,700 kg bags, granular, 4,380 t/a	Seacan
Sodium Hydroxide	Elution – Regeneration	1,000 kg bags, granular, 469 t/a	Seacan
Antiscalant	Mill	Granular, 92 t/a	Seacan
Hydrochloric Acid	Elution - Regeneration	Bulk Liquid, 72 t/a	Seacan

Table 7.2-2 shows volumes of select hazardous materials; it includes both annual totals and Life of Mine volumes.

Table 7.2-2. Anticipated Consumption of select of Hazardous Materials

Material	Area of Use	Construction Consumption Estimate (t)	Production Consumption Estimate (t)
Ammonium Nitrate	Goose Site	3,900 t/a	3,900 t/a
Packaged Explosives	Goose Site	1,000 t	2,100 t
Packaged Explosives	MLA	700 t	0
Sodium Metabisulphite	Process Plant	0	1,360 t/a
Lead Nitrate	Process Plant	0	44 t/a
Sodium Cyanide	Process Plant	0	3,132 t/a
Flocculant	Process Plant	0	44 t/a
Copper Sulphate	Process Plant	0	51 t/a
Lime	Process Plant	0	4,380 t/a
Sodium Hydroxide	Process Plant	0	469 t/a
Antiscalant	Process Plant	0	92 t/a
Hydrochloric Acid	Process Plant	0	72 t/a
Process Reagents Total	**Process Plant**	**0**	**9,709 t/a**

The Project phase(s) and location(s) of use, potential environmental effects, and proposed handling and disposal measures, and estimated quantities for the above hazardous materials are presented in Table 8-1.

7.2.2 Containment and Labelling

All hazardous materials will be contained in designated containers appropriate for their WHMIS hazard classification, and in accordance with any other information contained in their respective SDS to prevent chemical reactions or corrosion that could result in spills or emergency situations (i.e., fire and explosions). When possible, original containers will be used for storage (e.g., fuel drums and reagent containers). All containers should be sealable and in good condition, void of cracks or potential for leaks. Containers will be kept closed except when adding or removing product.

Hazardous materials that cannot get wet (or may result in adverse quality runoff) will be stored in the original containers, and if necessary, will be stored in shipping containers or indoors.

Liquid hazardous materials will be stored in lined secondary containment areas; water that collects in these lined containment areas will be tested prior to discharge, as described in the Water Management Plan (SD-05) and Environmental Management and Protection Plan (SD-20).

7.2.3 On-site Collection and Transport

Collection sites for hazardous waste within the buildings and around the Project will be identified and labelled. Collection sites will be managed to minimize interaction with the environment and human health. Hazardous wastes will be collected from these areas at regular intervals and transported to the temporary hazardous waste storage areas.

During winter road access, such materials will be transported to the main storage facility at the MLA. All transportation of goods will be in accordance with on-site best management practices (e.g., speed limits and shipping hours), SOPs (e.g., truck spill kit requirements and communication procedures) and required laws and regulations including the *TDG Act* and Regulations.

7.2.4 Storage

Sabina expects hazardous materials may be stored on-site for greater than 180 days; therefore, Sabina will be registered with Nunavut's DOE as a Hazardous Waste Management Facility. Detailed designs of hazardous materials storage facilities will be provided no later than sixty (60) days prior to construction.

To assist in the safe and secure storage of fuels, hazardous materials and hazardous wastes, the following general guidelines for storage areas/facilities will be applied:

- All hazardous material storage areas will be adequately signed indicating that hazardous materials/wastes are stored therein.
- All hazardous material storage areas will be clearly defined and designed to protect containers from physical damage, such as barriers or fencing.
- Storage areas will be designed to comply with the National Fire Code, where appropriate.
- Hazardous materials will be segregated by chemical compatibility within the storage area to prevent contact of incompatible materials in the event of a release.
- Storage areas will be maintained in an organized fashion to make them accessible for firefighting and other emergency procedures.
- Adequate ventilation will be provided to prevent the build-up of noxious or toxic vapours.

- Containment of liquid hazardous materials (including fuel, oils as well as other liquid hazardous materials) with capacity equal to the greater of the volume of the largest tank plus 10 % of the volume of the remaining tanks or 110 % of the volume of the largest tank within the containment area
- Drums containing hazardous materials or wastes will be placed on pallets or on a well-drained storage area to prevent rusting.
- All containers containing product shall be stored in the upright position to prevent leaking.
- Containers shall be arranged within the storage area in a manner as to prevent damage from falling or dislodging.
- Containers shall be arranged to allow for easy access and inspections.
- All wastes should be stored in conditions recommended by the SDS, such as temperature requirements.

The identified hazardous materials storage areas for the MLA and Goose Property identified in Section 7.1 will be subject to geotechnical investigations, if required, to confirm that the ground conditions are stable and suitable for use as storage.

7.2.5 Transport

All hazardous materials will be transported to and from site by commercial carriers in accordance with the applicable legislation for transport by air, road/rail, or marine (Table 3-1). Consistent with regulatory requirements, all carriers will be registered with Nunavut DOE as a hazardous waste carrier.

Nearly all hazardous materials will be transported to the MLA via sealift, and materials required at the Goose Property will be transported over the WIR. A preliminary estimate of the annual consumption of key hazardous materials is provided in Table 7.2-2, and a more detailed inventory of the types and quantities of hazardous materials is provided in Table 8-1. The quantities presented in these tables provide some indication of what will be delivered to the MLA by sealift and to the Goose Property by winter road.

Hazardous waste and hazardous materials, if no longer required, will be transported by truck on the WIR from Goose Property to the MLA. At all times, hazardous materials will be transported in compliance with the safety standard prescribed by the TDG Regulations. All containers used to transport hazardous materials will be designed, constructed, filled, closed, secured and maintained so that under normal conditions of transport, including handling, there will be no accidental release of dangerous goods that could endanger public safety.

A large number of the hazardous materials delivered to site will be consumed at site, including fuel and both process and lab reagents. Therefore, the volume of hazardous wastes requiring transport to an off-site licensed disposal facility will be relatively limited. Hazardous wastes, such as biomedical waste or spent solvents, will likely be transported to Yellowknife as backhaul during regular scheduled flights. Larger quantities such as waste oil, oil and fuel filters, etc. will be stored in drums within secondary containment and will be delivered to the MLA hazardous waste storage facility over the winter road, prior to backhaul to the south on sealifts.

Carriers will be licensed and inspected as required by the Department of Transportation. All required permits, licenses, and certificates of compliance will be the responsibility of the carrier. The Project will not be managing any shipping waste from sealift vessels or tankers delivering supplies to the MLA.

To assist in the safe and secure transport of hazardous materials and hazardous wastes, the following general guidelines for carrier storage areas/facilities will include:

- The hazardous materials will be shipped in approved containers.
- All shipments will be properly identified and labelled, such as placarding and labeling all transport vehicles and containers in accordance with the appropriate legalisation.
- Shipping papers and waste manifests will be filled in completely and accessible during transport.
- Each transportation company will have a spill prevention, control, and counter measures plan to address the materials they are importing / exporting. In the event of a release during transport, the commercial transportation company is responsible for first response and cleanup. Sabina will periodically review this plan for Sabina requirements.
- Hazardous waste will only be transported to a registered receiver or hazardous waste management facility.
- An inventory of the types and predicted volumes/quantities of hazardous wastes to be generated or produced by the Project activities.

7.2.6 Off-Site Disposal

Sabina will ensure that all hazardous materials will be shipped to approved hazardous waste disposal facilities. This means the hazardous waste receiver has been registered and approved by the jurisdiction in which it is located to accept and dispose of the specified hazardous wastes. Hazardous wastes will be backhauled by ocean going vessel from the MLA or may be shipped off-site by air directly from Goose Property.

7.2.7 Explosives Transport, Handling, and Disposal

During the Construction and Operations phases of the Project, explosives and inert materials (AN and FO) will be received at the MLA during the annual sealift. Bulk AN prill will be shipped to site in 1-t tote bags within 20-ft seacans. Other supplies, including prepackaged explosives, caps, boosters, and detonating cord will be received by air freight. Upon arrival of the explosives products on-site, the authorized mine blasting personnel will sign to confirm their delivery. It is then the responsibility of the authorized mine blasting personnel to transport the explosives to the designated magazines immediately.

All on-site transportation will be done in accordance with Section 14 of the *Mines Act* and Regulations as well as with the *Transportation of Dangerous Goods Act*. The handling of explosives on-site will be carried out by certified Sabina employees or certified contractors. All explosives shall be handled according to the manufacturer's specifications. In addition to the manufacturer's specifications, all applicable WSCC regulations will be complied with. Table 7.2-3 outlines the minimum safe handling procedures for ammonium nitrate and fuel oil.

Table 7.2-3. Summary of Minimum Safe Handling Procedures for Ammonium Nitrate and Fuel Oil

Product	Handling Procedures
Ammonium Nitrate	• Protective clothing and impervious gloves must be worn during handling. • Do not ingest. • Do not smoke while handling. • Keep away from combustible or reducing agents. • Prevent dispersion of dust.
Fuel Oil	• Avoid contact with eyes, on skin or clothing. • Avoid breathing vapours, mist, fumes. • Do not ingest. • Wear protective equipment and/or garments if exposure conditions warrant. • Wash thoroughly after handling. • Launder contaminated clothing before reuse. • Use in areas with adequate ventilation. • Keep away from heat, sparks, and flames. • Store in a closed container in a well-ventilated area. • Bond and ground during transfer.

Sabina, the explosives supplier, and the shipping contractors will have or will develop detailed manuals for the transportation, storage, handling and use of explosives and will be responsible for explosives management including employee training, hazardous operations analysis, and quality control.

Bulk AN will be transported on flatbed trucks from the MLA to the AN Facility at Goose Property on the WIR. During transport AN will be contained in 1-t tote bags within 20-ft seacans. Inspections will be conducted prior transport to ensure there has not been a leak or that conditions in the area will not result in an accident. These inspections will include the transport equipment, the containers being moved, winter road conditions, and weather conditions.

Packaged explosives will be flown into the Goose Property, and transported to the explosives storage magazines in approved vehicles. Bulk AN will be transported to open pit blast patterns in the bulk ANFO truck. For underground use, ANFO will be mixed on surface and bagged at the AN Facility and transported underground within 1-t tote bags in approved vehicles by qualified personnel.

Blasting will be required in the open pits and underground operations. Only trained and certified personnel will be assigned to work with and around explosives. Blasting, including preparation of blast sites before blasting and securing of blast sites after blasting, will be carried out in strict compliance with the applicable WSCC regulations.

Explosives that have been identified as deteriorated or damaged will be removed from site or destroyed. The supplier will be consulted on the appropriate handling and disposal of deteriorated or damaged explosives.

If the quantities of deteriorated or damaged explosives are small, then they would be added to blast holes in a production blast. This will safely destroy them, since the area will have been evacuated and guarded under normal blasting procedures.

If larger quantities require disposal or destruction, the explosives supplier would be asked to recommend the appropriate method of disposal and subsequent course of action to be followed.

Prior to Construction, Sabina will complete the following forms and submit them to the relevant authorities:

- Natural Resources Canada (NRC) Form 10 Magazine License Application (if it not a mine site, this federal form needs to be filled out).
- NRC Form 1 Application for Explosives Manufacture.
- NRC Form 4 Plant, Buildings and Equipment.
- NRC Form 5 Authorized Explosives Manufacture and Storage.
- NRC Form 6 Authorized Operations and Processes.
- NRC Form 7 Distances To Be Maintained Between the Buildings and Process Units of the Site(s) and Other Buildings and Works Outside the Site or Operations.

7.3 SPILLS

Adequate emergency and spill response equipment will be located at all hazardous materials storage areas. Figures 7.1-1, 7.1-2, and 7.1-3 show proposed spill kit locations and hazardous materials storage facilities. For all phases of mine operation from Construction to Closure, all spills will be contained and cleaned up according to the SCP (SD-17), the OPEP (SD-18), and the Shipboard Oil Pollution Emergency Plan, as appropriate. All spills of hazardous waste over the reporting requirements will be reported immediately to the NWT/Nunavut Spill Report Line at (867) 920-8130 as per the SCP (SD-17). Spill reports will include details such as date and time of the spill, type and amount of product discharged, photographic records, location and approximate size of the spill, actions already taken to stop and contain the spill, meteorological conditions and any perceived threat to human health or the environment.

Spills of hazardous materials at the MLA, Goose Property, or on the WIR may result from any of the following situations:

- Leaks or ruptures in tanks, drums or containers;
- Equipment failure including valves, hoses, piping or containment structures;
- Overfilling containers;
- Improper handling and storage;
- Spills during transfer; and
- Accidents during transportation.

All site personnel will be briefed on the procedures to be followed to report a spill and initiate spill response. The following summarizes the steps to be taken in the event of a spill: source control, control of free product, protection, clean up the spill, report the spill. Local spill kits will contain, at a minimum:

- Sufficient hydrophobic absorbent material (e.g., oil absorbent booms and absorbent socks) to contain and cleanup potential drips, leaks, or spills.
- Gloves and heavy plastic bags to contain oily absorbent materials and contaminated soils or wastes.
- Barrier tape to keep personnel out of contaminated areas.
- Sorbent granular materials to soak up free oil.
- Other appropriate PPE such as disposal coveralls, rubber gloves and safety goggles.

Emergency response procedures are described in more detail in the Risk Management and Emergency Response Plan (SD-15). Procedures will vary seasonally and be based on the nature of the hazardous material spilled. The applicable SDS will be consulted to ensure that the materials are being handled safely and appropriately.

Additional details on responding to spills on land, water, snow and ice, and for specific materials (i.e., fuel, ammonium nitrate, chemicals, etc.) are provided in the SCP (SD-17) and OPEP (SD-18). The SCP (SD-17) describes Nunavut spill reporting requirements, as well as TDG Regulations reporting requirements (both immediate and follow-up reporting) applicable to spills that occur during transport.

7.4 SECURITY

Security measures for the management of hazardous materials include design and procedural measures. All hazardous material storage areas will have controlled access and only authorized personnel will have access/permission to enter hazardous materials management areas.

8. Environmental Protection Measures

Sabina has an ongoing commitment to implementing environmental protection measures in all aspects of its operations. Sabina is committed to undertaking waste collection, storage, transportation, and disposal in a safe, efficient, and environmentally compliant manner, by actively encouraging and implementing the four 'R's of waste management, namely: waste reduction, reuse, recycling, and recovery.

Sabina will implement monitoring programs to satisfy regulatory requirements and achieve environmental protection from hazardous materials contamination. Refer to Section 9 and the Environmental Management and Protection Plan (SD-20).

Liquid hazardous materials will be stored within secondary containment to prevent possible spills or leaching of hazardous materials products into the environment. Where appropriate, hazardous materials will be stored in a covered building or sea cans to prevent exposure to the influences of weather.

Environment Protection measures will be implemented in all aspects of the hazardous materials management program, from waste segregation and waste handling to ultimate storage and disposal. The Environmental Protection measures will be implemented from Project design and Construction through Operations and into the Closure Phase (Table 8-1).

Table 8-1. Hazardous Material Types, Source, Quantities Generated, Potential Environment Effects, and Waste Management and Pollution Prevention Strategies

Type	Source	Estimated Quantity Used/Generated by Project Phase	Project Location Generated	Potential Environmental Effects	Waste Management and Pollution Prevention Strategies
Fuels and both new and used Petroleum Products (oils / lubricants / greases / hydraulic fluids)	Vehicles and equipment including generators and pumps	Construction 167 t/a Operations 627 t/a Closure 63 t/a	Goose Property and MLA	Petroleum products can accumulate on the surface of waterbodies or may sink to the bottom. Fish can uptake hydrocarbons in the environment. Feeding and reproduction of aquatic life (e.g., fish, plants, and insects) may be affected. Micro-organisms in soil degrade hydrocarbons, sometimes at the expense of plant nutrition. Petroleum products can damage the respiratory system if aspirated and be toxic if ingested.	Spill Response Procedures (safety procedures, initial assessment, spill report, containment, storage, and disposal) will be employed. When possible, waste oil will be used in incinerators or designated used-oil heaters. Waste oil may be collected and stored in empty bulk lubricant cubes to be stored in the designated hazardous waste section of the waste storage facility with secondary containment. Contaminated snow/water will be stored in clearly-marked, sound, sealed containers in the laydown yard and may be shipped off-site to an appropriate facility. Bioremediation may be considered for contaminated soil.
Used Oil and Fuel Filters	Vehicles and equipment	Construction 13 t/a Operations 39 t/a Closure 4 t/a	Goose Property and MLA	Petroleum products can accumulate on the surface of waterbodies or may sink to the bottom. Fish can uptake petroleum hydrocarbons once it is in their environment. Feeding and reproduction of aquatic life (e.g., fish, plants, and insects) may be affected. Micro-organisms in soil degrade hydrocarbons, sometimes at the expense of plant nutrition. Petroleum products can damage the respiratory system if aspirated and be toxic if ingested.	Waste oil and fuel filters will be drained in a heated and ventilated section of the maintenance shop. Filters will then be crushed to minimize volume and release any additional oil. This area of the maintenance shop will adhere to Sabina's Spill contingency plan and have a liner or tray to catch any spills or splashes. The filters will be placed in sealed containers and labelled and stored at the waste management facility. These containers may be shipped off-site to a registered hazardous waste receiver. Bioremediation of contaminated soils and treatment of contaminated water, snow and ice (see LWMP [SD-10]).
Used Sorbents and Rags	Used in the maintenance of vehicles, equipment and spill control	Construction 2 t/a Operations 6 t/a Closure <1 t/a	Goose Property and MLA	Petroleum products can accumulate on the surface of waterbodies or may sink to the bottom. Fish can uptake petroleum hydrocarbons once it is in their environment. Feeding and reproduction of aquatic life (e.g., fish, plants, and insects) may be affected. Micro-organisms in soil degrade hydrocarbons, sometimes at the expense of plant nutrition. Petroleum products can damage the respiratory system if aspirated and be toxic if ingested.	Where possible, used rags and sorbents will be incinerated on-site. If incineration is not practical, used sorbents and rags will be stored in clearly-marked, sound, sealed containers in the laydown yard and then shipped off-site to a registered hazardous waste receiver.
Empty Petroleum Hydrocarbon Containers and Drums	Packaging for oils, solvents and penetrating oils	Construction 8 t/a Operations 28 t/a Closure 3 t/a	Goose Property and MLA	Petroleum products may accumulate on the surface of waterbodies or may sink to the bottom. Fish can uptake petroleum hydrocarbons once in the environment. Feeding and reproduction of aquatic life (e.g., fish, plants, and insects) may be affected. Micro-organisms in soil degrade hydrocarbons, sometimes at the expense of plant nutrition. Petroleum products can damage the respiratory system if aspirated and be toxic if ingested.	Sabina and its contractors will purchase these items in bulk to minimize the amount of packaging. Empty containers will be backhauled to the original supplier or a licensed recycling facility.
Glycol	Used as a coolant, capturing waste heat from generators, and antifreeze in equipment	Construction 9 t/a Operations 33 t/a Closure 3 t/a	Goose Property and MLA	Glycol's odour is a known wildlife attractant. Glycol can have toxic effects on aquatic organisms and wildlife.	Environmentally benign glycols will be used where practical. Equipment will be regularly maintained to prevent spills from ruptured glycol lines. Waste glycol will be stored within secondary containment within the waste storage facility in clearly marked, sound, sealed containers. These containers may be shipped off-site to a registered hazardous waste receiver. Unused glycol in the original containers may be returned to the manufacture for disposal or reuse at closure.

(continued)

Table 8-1. Hazardous Material Types, Source, Quantities Generated, Potential Environment Effects, and Waste Management and Pollution Prevention Strategies (continued)

Type	Source	Estimated Quantity Used/Generated by Project Phase	Project Location Generated	Potential Environmental Effects	Waste Management and Pollution Prevention Strategies
Ammonium nitrate	Stored in seacans	Construction and Operations 3,900 t/a (consumed)	Goose Property and MLA	If mixed with water, the resultant runoff may be acutely toxic to fish. Will also cause harm to vegetation if spilled.	**Transport** Certified and authorized Sabina employees or contractors will mix AN with FO at the on-site AN Facility or on a bulk ANFO truck at the blast hole. All explosives will be transported to site in dedicated containers; secondary containment will be used as required. Only qualified personnel holding valid blasting certificates shall handle these materials. Spills will be contained, cleaned up, and placed in suitable containers for use or disposal. All reportable spills will be reported to the spill response coordinator. Containers and equipment shall be inspected prior to use transporting explosives products on or between Project sites **Storage** All explosives will be stored only at safe distances from facilities or personnel. Explosives will be stored in a designated location within the explosives storage area and away from the explosive caps / detonator storage magazines. The magazines will be dedicated to storing high energy explosives and blasting caps. Explosives will be handled and managed only by suitably qualified employees trained in safe handling procedures and applicable legislation and regulations. Mine personnel involved in explosives spill response will have explosives training. Explosives stored in magazines will be clearly labelled. Spills shall be contained and placed in suitable containers for use or disposal. All reportable spills will be reported to a spill response coordinator. Access will be controlled to the AN Facility and explosives storage locations. Access to the explosives plant will be restricted to authorized personnel and log books shall be kept in each magazine for tracking purposes. **Blasting** Only certified and authorized mine employees or contractors will charge the holes, place the detonators and boosters, and tie-in the patterns. All blasting will follow applicable legislation such as DFO Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (DFO 1998). The Air Quality Monitoring and Management Plan will be followed to reduce or eliminate impacts from air. Wet blast holes will be lined with plastic liners prior to being loaded with ANFO. Packaged explosives will be used as a backup to ANFO for situations when blast holes cannot be lined. Sleep time in loaded blast holes will be limited to minimize contact between ANFO and water Spills shall be contained, cleaned up, and placed in suitable containers for use or disposal. All spills will be reported to a spill response coordinator. The mine shall record daily use of explosives. Records will be checked and reconciled on a regular basis. Explosives identified as deteriorated or damaged will be destroyed or disposed of; the supplier shall be consulted on the appropriate handling and disposal. Contact water will be managed in accordance with the Site Water Monitoring and Management Plan. **Disposal** All explosives will be removed from site or disposed of at closure. Explosives will be secured and stored safely or disposed of in case of temporary closure. All explosives will be disposed of according to the SDS or manufacture. Spills will be contained, cleaned up, and placed in suitable containers for use or disposal. All spills will be reported to the spill response coordinator.

(continued)

Table 8-1. Hazardous Material Types, Source, Quantities Generated, Potential Environment Effects, and Waste Management and Pollution Prevention Strategies (completed)

Type	Source	Estimated Quantity Used/Generated by Project Phase	Project Location Generated	Potential Environmental Effects	Waste Management and Pollution Prevention Strategies
Reagents	Additives required for mine processing and laboratory testing	Operations ~9,700 t/a (consumed) Closure <100 kg/a	Goose Property and MLA	Lab and processing reagents (hydrated lime, sodium cyanide, activated carbon, sodium hydroxide, hydrochloric acid, sulphur, copper sulphate, MBS, flocculant, and antiscalant) may enter the environment from spills and leaks from containers, process equipment or from improper storage. Once in the environment, some may cause harm to the terrestrial and aquatic ecosystem by entry of deleterious and other polluting substances (e.g., cyanide).	Spill prevention procedures will be developed. Spill Response Procedures to respond to the spill (safety procedures, initial assessment, spill report, containment, storage, and disposal). Spent reagents will be collected and stored in clearly-marked, sound, sealed empty bulk containers. Containers will be stored in the designated hazardous waste section of the waste storage facility. Reagents may be shipped off-site to a registered hazardous waste receiver Unused reagents will be sent back to the manufacture as required in original containers at closure. Management of cyanide-containing materials (sodium cyanide reagent, residual cyanide in process water) described in stand-alone management plan, presented as Appendix A of the HMMP.
Solvents	Used to degrease machinery in the maintenance shop	2000 L/a Construction / Operations / Closure	Goose Property and MLA	Petroleum fuels can accumulate on the surface of waterbodies or may sink to the bottom. Fish can uptake petroleum hydrocarbons once it is in their environment. Feeding and reproduction of aquatic life (e.g., fish, plants, and insects) may be affected. Petroleum products can damage the respiratory system if aspirated and be toxic if ingested.	Low toxicity solvents and physical cleaning (e.g., steam jet) will be used where practical. Petroleum-based solvents will not be allowed into the environment and will be subject to the spill response plan. Waste or excess solvents will be stored in the waste storage facility in clearly marked, sound, sealed containers. These containers may be shipped off-site to a registered hazardous waste receiver. Unused solvents in the original containers may be returned to the manufacturer for disposal or reuse at closure.
Paints		100 L/a Construction /Operations /Closure	Goose Property and MLA		When feasible, latex paints will be used on-site. Latex paints should be collected in a covered area and opened to dry. Unused full containers of paint will be returned to the manufacturer, if possible. Paint containing hazardous materials, that cannot be used will be sealed and shipped off site to a registered hazardous waste receiver.
Fluorescent Light Tubes	Indoor lighting	<1 t/a Construction / Operations /Closure	Goose Property and MLA	Fluorescent tubes contain mercury phosphor powder and traces of lead and cadmium.	Lights should be equipped with motion sensors to reduce usage where practical. Discarded fluorescent lights will be consolidated together and stored indoors in the waste storage facility in their original packaging. Fluorescent light tubes may be shipped off-site to a registered hazardous waste receiver.
Electronics and Electrical Materials	Electrical devices that cannot be repaired and cannot be recycled	<1 t/a Construction /Operations /Closure	Goose Property and MLA	Electrical waste and devices may or may not contain polluting substances (such as mercury, lead, arsenic, cadmium, and polyvinyl chloride (PVC) that could enter the ecosystem.	Sabina's environment staff will determine the risk of electronic devices and classify them as hazardous or non-hazardous waste and determine the appropriate method of recycling/ disposal.
Equipment Batteries	Equipment batteries	4 t/a Construction/ Operations /Closure	Goose Property and MLA	Lead batteries (i.e., vehicle batteries) contain sulphuric acid and lead harmful to environmental receptors. Rechargeable batteries (i.e., industrial forklift, radio and transmitter batteries) usually contain either potassium hydroxide or nickel cadmium with toxic effects.	Protect and service batteries to prevent damage and loss of charge. Test batteries prior to disposal to confirm the battery is spent. All batteries will be shipped off-site to a recycling facility or a registered hazardous waste receiver.
Biomedical Waste	Small amounts of medical waste from First Aid (e.g., syringes, used medical supplies)	<100 kg/a Construction /Operations /Closure	Goose Property and MLA	May be sharp or may contain bacteria and viruses which can be a risk to human or wildlife health.	Written procedures will be developed and implemented regarding the handling, storage, transport and disposal of biomedical waste, consistent with the Nunavut guideline (GN, 2014). Pollution prevention strategies include training staff in the adopted procedures for handling of biomedical waste; permitting only trained workers to handle biomedical waste; appropriate segregation and disposal of biomedical wastes separate from generate garbage and according to the type of biomedical waste; using appropriate containers for safe storage of biomedical wastes (e.g., sharps containers for used needles and other sharps); appropriately labelling biomedical waste in accordance with WHMIS requirements; record keeping; use of appropriate personal protective equipment; waste transport in accordance with applicable regulations; and final disposal at a registered hazardous biological waste receiver. Medical waste will not be incinerated on-site as it poses a handling risk from sharps for the incinerator operator and workers collecting waste.
Aerosol Cans		<100 kg/a Construction /Operations /Closure	Goose Property and MLA		Pressurized aerosol cans will be punctured on-site and landfilled.
Kitchen grease	Camp kitchens	40 t/a Construction /Operations /Closure	Goose Property and MLA		Collected in sealed containers and incinerated or shipped off-site for disposal.

Notes: Goose = Goose Property, MLA = Marine Laydown Area

9. Monitoring Program

Monitoring programs for the HMMP will include inventory checking and visual inspections of hazardous materials storage facilities and conveyance facilities. Any materials that are reported as excess will be reported to purchasing in an effort to adaptively manage future hazardous waste generation. Secondary containment for hazardous materials storage areas will be inspected, and repaired if needed. The hazardous material storage areas will be constructed to prevent pooling of water. Any ponding or contaminated water will be tested as appropriate and discharged or collected for off-site disposal.

Environmental monitoring locations are described in the Environmental Management and Protection Plan (SD-20) and Water Management Plan (SD-05).

The monitoring and the checking and corrective measures described and adaptive management measures identified in Section 11 form the basis of the Quality Assurance (QA) and Quality Control (QC) program relating to hazardous materials management. For specific QA/QC measures related to environmental sampling refer to the QA/QC Plan (SD-24).

10. Environmental Reporting

Any spills or releases of hazardous materials will be reported as part of this plan and will follow the incident response procedures identified in Sabina's SCP (SD-17), OPEP (SD-18), and Fuel Management Plan (SD-16). All information about the spill or release will be documented according to the requirements of the SCP (SD-17), OPEP (SD-18), and Fuel Management Plan (SD-16).

11. Adaptive Management

Sabina will implement a series of checking and corrective action measures to ensure the effectiveness of this plan. Effectiveness evaluation is one of the tools used as part of an adaptive management approach. Best management practices will be implemented and may include:

- Hazardous material inventory accounting.
- Internal inspections and audits.
- External inspection and audits.

11.1 INVENTORY ACCOUNTING

Hazardous material inventory accounting will be verified against purchasing requirements and waste manifests to identify waste generation amounts and ensure all materials are removed from site.

Hazardous material inventories, waste manifest libraries, spill reports (as per the SCP; SD-17) will be completed to track the volume, hazardous material type and hazardous material source for all hazardous materials that are generated. The transportation of hazardous waste to the on-site hazardous material management facilities will be tracked and recorded. Specifically, site records will include:

1. Dates of hazardous waste collection
2. Date, description, volume and generator of wastes placed in compound
3. Method of storage
4. Name of carrier removing wastes from the compound
5. Copies of the forms for Transportation of Dangerous Goods from persons removing wastes from site

Sabina will retain all raw data records and annual reporting for at least two years. The updated HMMP, raw data and annual reporting will be made available by Sabina at all times for review by the regulatory inspectors.

All internal and external inspections and audits will be documented and stored digitally and available for review by on-site personnel and regulatory agencies as part of the annual review process.

Staff training records will be filed per safety SOPs and made available for review with this plan.

11.2 INTERNAL INSPECTIONS AND AUDITS

Internal audits and inspections will be conducted on a regular basis and adapted to each phase of the mine life. Inspections will be completed by qualified personnel on a regular basis for physical condition and serviceability, and the results recorded according to quality and safety standard operating procedures. In addition, qualified personnel will perform inspections to ensure that each inventory is documented.

Inspections will be required and reported for:

- Waste manifests.
- Inspection of all hazardous waste collection areas.
- Storage areas.
- Storage containers.
- Transportation containers.
- Fuel management areas.
- Waste oil collection systems.

11.3 EXTERNAL INSPECTIONS AND AUDITS

On occasion, external inspections and audits may be required by regulatory authorities. All recommendations and orders made by regulatory authorities, Fire Marshals, and Insurance Inspectors will be responded to and acted upon accordingly.

11.4 PLAN REVIEW

The HMMP will be reviewed and updated periodically to incorporate any lessons learned, and records outlined in Section 11.

All employees will be informed of relevant updates and the updated HMMP will be stored at designated Project sites. A record will document all significant changes that have been incorporated in the HMMP subsequent to the latest annual review. The record will include the names of the persons who made and approved the change, as well as the date of the approval.

12. Reclamation

Hazardous wastes will be shipped off site periodically to reduce the amount of waste requiring removal at the end of Operations. At Closure, remaining hazardous wastes will be collected for off-site disposal at an approved facility. Periodic off-site shipments will continue throughout Closure.

After removal of all remediated material from each hazardous materials storage area, the berm and base will be sampled to determine if these soils are free from contamination. If the soils meet the required criteria, the area would then be regraded to confirm positive surface drainage. If soil does not meet the required criteria, it will be collected for off-site disposal at an approved facility. Additional details pertaining to reclamation and closure are provided in the Interim Closure and Reclamation Plan (SD-26).

13. References

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NIRB (Nunavut Impact Review Board). 2013. *Guidelines for the Preparation of an Environmental Impact Statement for Sabina Gold & Silver Corp.'s Back River Project*. NIRB File No. 12MN036).

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NWB. 2010b. Miscellaneous Supplemental Information Guideline (SIG) for General Water Works (including crossings, flood control, diversions, and flow alterations) (M1). February 2010.

Transportation of Dangerous Goods (TDG) Transport Canada and the U.S. Department of Transportation. 2016. *2016 Emergency Response Guidebook: A guidebook for intended for use by first responders during the initial phase of a transportation incident involving dangerous goods/hazardous materials.*

Workplace Hazardous Materials Information System (WHMIS)

Appendix A. Cyanide Management Plan

Plan

Cyanide Management Plan

H347084-0000-05-126-0001

2015-08-24	0	Approved for Use	K. Lee	G. Schwab	G. Schwab	J. Eng
DATE	REV.	STATUS	PREPARED BY	CHECKED BY	APPROVED BY	APPROVED BY
				Discipline Lead	Functional Manager	Client

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1. Introduction

This Cyanide Management Plan provides a description of the engineering designs and operations procedures that will be implemented to contain and manage cyanide at Sabina Gold and Silver Corporation's Back River site and thereby minimize risk to on-site employees and the environment. Standard operating procedures (SOPs), which will detail the procedures for safe handling of the entire lifecycle of cyanide, will be developed during the execution phase of the project.

Gold ores require cyanide to efficiently extract gold interlocked within gangue minerals. Gold ore is first liberated by means of comminution, or size reduction, to expose gold surfaces. Gold is then subject to cyanidation for dissolution of gold particles into solution; gold in solution is adsorbed onto carbon for final gold production. The tailings in cyanide solution are then detoxified prior to disposal to tailings storage facilities. Cyanide is a potentially hazardous chemical which requires careful management and control.

The cyanide life-cycle consists of the items listed below:

- Worker Training
- Dialogue
- Cyanide Production
- Cyanide Transportation
- Cyanide Handling and Storage
- Cyanide Use in Operations
- Site Decommissioning
- Worker Safety
- Emergency Response

This plan addresses the necessary elements of design, construction, and operation of facilities for unloading and storage of cyanide, its use in the gold recovery process, and the detoxification process for safe disposal into the environment.

1.1 Codes and Standards

This document was prepared with reference to the codes and standards listed below:

- International Cyanide Code – Cyanidecode.org
- Transportation Canada – https://www.tc.gc.ca/
- United Nations Handling of Dangerous Goods – http://www.unece.org/trans/danger/danger.html

1.2 Standard Operating Procedures (SOPs)

Sabina will develop a suite of SOPs that encompass the safe handling of cyanide. Below is a list of example SOPs from other operating mine sites using cyanide:

- Unloading and Storage of Reagent Cyanide
- Cyanide Leach and Carbon-in-Pulp Facility Operation
- Inspections of Cyanide Tanks, Pipelines, and other Cyanide Facilities
- Maintenance and Calibration of Hydrogen Cyanide Monitoring Equipment
- Decontamination of Cyanide Handling Equipment
- Emergency Power Generation for Cyanide Handling Equipment
- Emergency Response Preparedness
- Alcohol Testing for Drivers/Equipment Operators
- Hazardous Material Storage and Transfer Operations
- Environmental and Social Management Training.
- Emergency Response Preparedness
- Operations Start-up
- Normal Operating Procedures- Tailings Deposition
- Tailings Management Facility- Operations Inspection
- Tailings Management Facility- Operations Reporting
- Tailings Management Facility- Emergency Maintenance/ Inspection
- Tailings Management Facility- Emergency Response Action
- Tailings Management Facility- Emergency Notification Requirement
- Tailings Management Facility- Health and Safety
- Tailings Management Facility- Health and Safety Monitoring

2. Cyanide Management Plan

2.1 Cyanide Production

Sabina is an end-user of sodium cyanide and does not control the production of cyanide. Sabina will purchase cyanide in solid form and from producers who are committed to limiting exposure of cyanide to their workforce and for preventing and controlling release of cyanide into the environment, or signatories to the International Cyanide Code.

2.2 Cyanide Transportation

Sodium cyanide briquettes will be transported from the point of manufacture to Vancouver, then to the Marine Laydown Area (MLA) at Bathurst Inlet. The sodium cyanide briquettes will be packaged in 2 tonne bags contained within wooden boxes. The boxes will be properly labelled by UN standards. It is expected that the boxes will be loaded into standard 20 foot steel shipping containers ('sea cans') at the point of manufacture. No other materials or equipment will be loaded into the cyanide shipping containers.

Although Sabina may not be directly responsible for the transport from the manufacturing/ production facility to the MLA Sabina will establish responsibility for safety, security, release prevention, training and emergency response in written agreements with producers, distributors and transporters.

Sabina will require that cyanide transporters implement appropriate emergency response plans and capabilities, and employ adequate measures for cyanide management.

From the MLA, cyanide will be transported to the Goose site storage area where cyanide will be stored in original shipping containers until used in ore processing. The cyanide boxes will only be removed from the shipping containers at the make-up facility within the process plant.

2.3 Cyanide Handling and Storage

2.3.1 Cyanide Storage on Site

All cyanide brought on site for use at the Back River mine site will be recorded in an Inventory Register which is updated (as materials arrive on site) and available for inspection by the appropriate authorities. Material Safety Data Sheets (MSDSs) for solid sodium cyanide, sodium cyanide solution and HCN gas will also be included in the Inventory Register. The MSDSs are provided in Appendix B. The purpose of the Inventory Register is to facilitate efficient audit functions as well as to conform to best practice for environmental and safety management.

Cyanide shipping containers will be separated from shipping containers for other equipment and materials. The cyanide shipping containers will be appropriately labelled and tracked with the Inventory Register.

2.3.2 Cyanide Handling

To ensure safe storage, the following requirements for storage and handling of cyanide in bulk are listed below:

- design and construction requirements for containers
- bunds and compounds

Although Sabina will not be directly handling cyanide at the MLA, the above provisions are for handling bulk solid cyanide within storage containers at their respective locations.

The drainage provision for the storage area will slope away from the tanks to a sump. A pump will be fitted at the sump and will transfer any rainfall, hose down or spilt liquid collected to the leach tanks, or alternatively back into the cyanide solution tanks in the event that spillage does occur within the bunded area. Storage areas, tanks, pipelines, pumps and valves will have high visibility labelling and will be inspected regularly for signs of leakage, presence of solution outside of the tanks in the bunded areas and integrity of the containment. Any aspects requiring maintenance or repair will be addressed immediately and records documenting the inspection and corrective measures will be kept and presented when required.

2.3.3 Cyanide Packaging Disposal

All cyanide packaging will be incinerated at the Goose site with a proper burning permit obtained from the appropriate authorities.

2.4 Cyanide in Operations

2.4.1 Overview of Cyanide Use in Operations

Solid cyanide will be dissolved in water, in a mixing tank, to prepare a solution for use in the processing plant. Bulk cyanide supersacs will be lowered onto a bag-breaker located on top of the mixing tank. Fume hood(s) will be installed over the mixing tank to capture any cyanide dust particles to be properly disposed. Carmoisine dye is added to the mix to give the solution a highly visible red colour.

After dissolution, the sodium cyanide solution in the mixing vessel is transferred into the cyanide storage tank. From the cyanide storage tank, the sodium cyanide solution is distributed to the leach tanks, elution circuits, and intensive leach reactor within a cyanide reagent solution loop.

The cyanide destruction system is based on the well proven SO_2 air process to oxidize cyanide to the compound, cyanate, (OCN^-). The process uses sodium metabisulphite as the source of SO_2, copper sulphate as a soluble copper catalyst and lime for pH control.

Oxygen is required for the reaction and is supplied by sparging air into the reaction vessels. The reaction is optimally carried out at a pH level between 8 and 9, and lime is added to neutralize the acid generated by the reaction to maintain the required pH range.

The cyanide concentration of the solution discharged to the tailings storage facility must comply with, at minimum, the limits and specifications imposed by the local environmental permitting regulations in Nunavut.

2.4.2 *Process Plant*

Cyanide will be contained within the Back River processing plant utilizing the following measures:

- Cyanide mixing tank with dust extraction system, and all personnel handling bulk cyanide issued with the requisite personal protective equipment (PPE) including face masks and respirators.
- Cyanide mixing tanks, cyanide storage tanks, and process tanks utilizing cyanide are located within concrete bunded areas having a capacity to contain 110% of the volume of the largest tank.
- A spillage pump, located within the bunded area, will be operated under direct operator supervision to ensure the solution is safely disposed.
- The storage tank is required to be located in a well ventilated area or have a forced air ventilation system.
- Integrated cyanide destruction circuit to treat the leaching plant residue process stream before discharge to tailings.
- A back-up power supply system / generators is provided for key equipment related to the cyanide make-up and cyanide addition.
- Further cyanide destruction occurs at the tailings storage facility through oxidation and volatilization.
- Piping containing cyanide in solution will be routed away from any acidic solution and will be self draining. All cyanide piping lines will also be properly labelled within the process plant.

2.4.3 *Cyanide Detoxification Circuit*

At a minimum, the detoxification plant influent and effluent will be monitored for the following parameters, at the frequencies indicated in Table 2-1.

Table 2-1 Detoxification Influent/Effluent Parameters

Parameter	Frequency
pH	Continuous monitor and alarm
WAD cyanide	During each shift
Total cyanide	During each shift
Copper	During each shift
Thiocyanate (SCN) concentrations	Weekly
Selected metals and other parameters that may be required	Monthly

A continuous sample will be taken from both sample streams throughout the day and will be tested in the assay lab for the above parameters once per shift as there are no cyanide on-stream analyzers. Slurry pH will be monitored continuously through the use of a pH probe in the cyanide detoxification tanks.

2.4.4 Tailings and Reclaim

The tailings stream will be pumped to the tailings storage facility. Cyanide detoxification will reduce CN_{WAD} levels at the discharge point at the tailings storage facilities to <1 ppm. Solution reclaimed from the tailings storage facility will be re-used in the processing plant. It is expected that the amount of cyanide returning to the processing plant from the tailings storage facility will be negligible due to the natural degradation process and from dilution from other sources.

Solution decanted from the tailings in the TSF is exposed to ultraviolet radiation (sunlight) and atmospheric air, resulting in natural degradation (oxidation) of cyanide. Degradation and retention processes also take place in the anaerobic zone of the tailings.

2.4.5 On-site Laboratory

Cyanide in solution (CN_{WAD} and CN_{TOTAL}) will be closely monitored in the tailing slurry stream, tailings storage facility, reclaim water, effluent treatment discharge, and process water streams. The following monitoring programs will be established on site:

- The on-site assay laboratory will determine CN_{WAD} levels in the tailings stream, discharge at the tailings storage facility, in the reclaim water, and effluent treatment plant discharge.

An off-site laboratory will be used to confirm the results.

2.5 Site Decommissioning

Sabina will decommission the mine site and ensure the proper closure of cyanide facilities. This will entail the removal or detoxification of unused reagent cyanide and the cleanup of cyanide-containing residues in process tanks and equipment.

2.6 Worker Safety

Sabina will conduct routine safety meetings and regularly scheduled formal safety meetings of which cyanide management will be the key topic to solicit worker input to safety issues and to insure that employees perform their tasks in a manner that is protective of their health and safety and that of their co-workers. At each meeting, employees will have the opportunity to ask questions and identify health and safety concerns. Sabina will also establish a suggestion box that employees may use to identify concerns with health and safety issues.

2.6.1 Safety Equipment for (HCN Exposure)

Hydrogen cyanide is a hazardous gas compound. When inhaled, the gas will cause restriction in air intake causing asphyxiation, and in large enough quantities, death. Hydrogen cyanide evolution occurs when cyanide solution comes into contact with acidic solutions.

In the case of cyanide poisoning, safety kits with cyanide antidote, resuscitator, and other medical necessities can be utilized to reverse cyanide poisoning when exposure occurs. Cyanide safety kits will be located in the following areas: MLA, Goose sit storage, and the processing plant. Routine check-ups on the safety kits will be completed to ensure the kit is up to date.

All workers that may be exposed to cyanide will be provided guidelines and safety protocols on how to respond to hydrogen cyanide exposure. Standard operating procedures will be easily accessible to workers.

Administration of cyanide antidotes are restricted to qualified medical personnel. The emergency response team will be trained in the use of the antidote.

2.6.2 Monitoring

2.6.2.1 Monitoring Locations

Sabina will remotely monitor HCN levels at locations where employees are operating. Audible and visual local alarms will also be installed where required. In the event that an emergency brings employees into contact with HCN, the appropriate emergency response will be initiated.

HCN, CN_{WAD} and CN_{TOTAL} levels will be monitored in the processing plant and associated storage facilities to provide information relevant to process control and/or cyanide detoxification.

The on-line monitoring of HCN gas will be carried out at the cyanide sparging and storage area and in the processing plant, at the following locations:

- Grinding area
- Pre-leach thickener
- Carbon-in-Column tanks
- Intensive leach reactor
- Cyanidation leach tanks

- Carbon-in-pulp tanks
- Tailings thickener
- Cyanide detoxification tanks
- Cyanide mix and storage tanks
- Elution circuit
- Electrowinning room

CN_{WAD} and CN_{TOTAL} will be measured where process samples are taken.

The optimum location of alarms will be determined during detailed engineering. The alarm units will continuously monitor for hydrogen cyanide (HCN) and provide the readings directly to the operating control centre. Operators/ Maintenance personnel may be required to carry personal monitoring units in special circumstances, i.e. maintenance of the leach tanks. Sabina will ensure that the appropriate personnel are trained and that the required equipment and resources are provided.

2.7 Cyanide Emergency Response

2.7.1 Alarms and Procedures

If excessive HCN gas (>10ppm) is detected within the processing plant, the following steps will be undertaken:

- An alarm will activate notifying all personnel in the area: a siren and flashing lights will be activated and HCN levels will be displayed in the process control centre.
- All personnel in the process plant will evacuate from the area and into the designated evacuation zone. The process plant will then be off-limits to all personnel until HCN levels decrease to acceptable levels or unless wearing proper PPE to investigate and apply appropriate measures to correct the situation.
- Once acceptable HCN levels are achieved and after all alarms have been reset and the “all-clear” has been communicated, the operation will resume.

The procedures will be periodically reviewed by appropriate stakeholders and will be revised when required.

2.7.2 Safety Measures

The following events will trigger contingency measures at the Back River site:

- HCN levels within the process plant above 10ppm.
- CN levels within the tailings stream are higher than acceptable environmental limits.
- CN levels within the tailings pond are higher than acceptable environmental limits.

If any of the safety measures are triggered, the following steps will be implemented to correct the events that occurred.

- Increase cyanide detoxification reagent dosage, SO_2 and lime, to increase chemical reactivity.
- Decrease cyanide addition rate.
- Decrease mill feed rate.
- Change the ratio of the ore blend.
- Addition of dilution water to the tailings stream to reduce cyanide concentrations.

In the event that one or more safety measures are implemented, regular monitoring of the effectiveness of the safety measures will be undertaken. It is expected that the list above will be refined as methods to improve are identified.

Appendix A
International Cyanide Code

http://www.cyanidecode.org/about-cyanide-code/cyanide-code

PRINCIPLES AND STANDARDS OF PRACTICE

1. PRODUCTION Encourage responsible cyanide manufacturing by purchasing from manufacturers who operate in a safe and environmentally protective manner.

Standard of Practice

1.1 Purchase cyanide from manufacturers employing appropriate practices and procedures to limit exposure of their workforce to cyanide and to prevent releases of cyanide to the environment.

2. TRANSPORTATION Protect communities and the environment during cyanide transport.

Standards of Practice

2.1 Establish clear lines of responsibility for safety, security, release prevention, training and emergency response in written agreements with producers, distributors and transporters.

2.2 Require that cyanide transporters implement appropriate emergency response plans and capabilities, and employ adequate measures for cyanide management.

3. HANDLING AND STORAGE Protect workers and the environment during cyanide handling and storage.

Standards of Practice

3.1 Design and construct unloading, storage and mixing facilities consistent with sound, accepted engineering practices and quality control and quality assurance procedures, spill prevention and spill containment measures.

3.2 Operate unloading, storage and mixing facilities using inspections, preventive maintenance and contingency plans to prevent or contain releases and control and respond to worker exposures.

4. OPERATIONS Manage cyanide process solutions and waste streams to protect human health and the environment.

Standards of Practice

4.1 Implement management and operating systems designed to protect human health and the environment including contingency planning and inspection and preventive maintenance procedures.

4.2 Introduce management and operating systems to minimize cyanide use, thereby limiting concentrations of cyanide in mill tailings.

4.3 Implement a comprehensive water management program to protect against unintentional releases.

4.4 Implement measures to protect birds, other wildlife and livestock from adverse effects of cyanide process solutions.

4.5 Implement measures to protect fish and wildlife from direct and indirect discharges of cyanide process solutions to surface water.

4.6 Implement measures designed to manage seepage from cyanide facilities to protect the beneficial uses of ground water.

4.7 Provide spill prevention or containment measures for process tanks and pipelines.

4.8 Implement quality control/quality assurance procedures to confirm that cyanide facilities are constructed according to accepted engineering standards and specifications.

4.9 Implement monitoring programs to evaluate the effects of cyanide use on wildlife, surface and ground water quality.

5. DECOMMISSIONING Protect communities and the environment from cyanide through development and implementation of decommissioning plans for cyanide facilities.

Standards of Practice

5.1 Plan and implement procedures for effective decommissioning of cyanide facilities to protect human health, wildlife and livestock.

5.2 Establish an assurance mechanism capable of fully funding cyanide-related decommissioning activities.

6. WORKER SAFETY Protect workers' health and safety from exposure to cyanide.

Standards of Practice

6.1 Identify potential cyanide exposure scenarios and take measures as necessary to eliminate, reduce and control them.

6.2 Operate and monitor cyanide facilities to protect worker health and safety and periodically evaluate the effectiveness of health and safety measures.

6.3 Develop and implement emergency response plans and procedures to respond to worker exposure to cyanide.

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7. EMERGENCY RESPONSE Protect communities and the environment through the development of emergency response strategies and capabilities.

Standards of Practice
7.1 Prepare detailed emergency response plans for potential cyanide releases.

7.2 Involve site personnel and stakeholders in the planning process.

7.3 Designate appropriate personnel and commit necessary equipment and resources for emergency response.

7.4 Develop procedures for internal and external emergency notification and reporting.

7.5 Incorporate into response plans monitoring elements and remediation measures that account for the additional hazards of using cyanide treatment chemicals.

7.6 Periodically evaluate response procedures and capabilities and revise them as needed.

8. TRAINING Train workers and emergency response personnel to manage cyanide in a safe and environmentally protective manner.

Standards of Practice
8.1 Train workers to understand the hazards associated with cyanide use.

8.2 Train appropriate personnel to operate the facility according to systems and procedures that protect human health, the community and the environment.

8.3 Train appropriate workers and personnel to respond to worker exposures and environmental releases of cyanide.

9. DIALOGUE Engage in public consultation and disclosure.

Standards of Practice
9.1 Provide stakeholders the opportunity to communicate issues of concern.

9.2 Initiate dialogue describing cyanide management procedures and responsively address identified concerns.

9.3 Make appropriate operational and environmental information regarding cyanide available to stakeholders

- See more at: http://www.cyanidecode.org/about-cyanide-code/cyanide-code#sthash.ER5NiUwm.dpuf

Appendix B
Cyanide Material Safety Data Sheets (MSDS)

Material Safety Data Sheet

This material is hazardous according to criteria of NOHSC.
Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for Transport by Road and Rail.

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product Name: **SODIUM CYANIDE**

Supplier: Orica Australia Pty Ltd
ABN: 004 117 828
Street Address: 1 Nicholson Street,
Melbourne 3000
Australia
Telephone Number: +61 3 9665 7111
Facsimile: +61 3 9665 7937

Emergency Telephone: **1 800 033 111 (ALL HOURS)**

2. COMPOSITION/INFORMATION ON INGREDIENTS

Product Description: Uses: Extraction of gold and silver from ores; electroplating; heat treatment of metals; chemical intermediate.

Components / CAS Number	Proportion	Risk Phrases
Sodium cyanide	>60%	R26/27/28, R32
143-33-9		

3. HAZARDS IDENTIFICATION

Risk Phrases: Very toxic by inhalation, in contact with skin and if swallowed. Contact with acids liberates very toxic gas.

Poisons Schedule: S7 Dangerous Poison.

4. FIRST AID MEASURES

For advice, contact a Poisons Information Centre (Phone eg. Australia 131 126; New Zealand 0 800 764766) or a doctor at once. Urgent hospital treatment is likely to be needed.

Inhalation: Take precautions to ensure rescuer is not overcome. Remove victim from area of exposure - avoid becoming a casualty. Remove contaminated clothing and loosen remaining clothing. Allow patient to assume most comfortable position and keep warm. Keep at rest until fully recovered. If patient finds breathing difficult and develops a bluish discolouration of the skin (which suggests a lack of oxygen in the blood - cyanosis), ensure airways are clear of any obstruction and have a qualified person give oxygen through a face mask. Apply artificial respiration if patient is not breathing. Seek

immediate medical advice.

Skin Contact: If skin contact occurs, remove contaminated clothing and wash skin with running water. If irritation occurs seek medical advice.

Eye Contact: If in eyes, wash out immediately with water. In all cases of eye contamination it is a sensible precaution to seek medical advice.

Ingestion: Immediately rinse mouth with water. If swallowed, remove from contaminated area. Apply artificial respiration if not breathing. Do not give direct mouth-to-mouth resuscitation. To protect rescuer, use air-viva, oxy-viva or one-way mask. Resuscitate in a well-ventilated area. Never give anything by the mouth to an unconscious patient. Get to a doctor or hospital quickly.

Notes to physician: May be fatal if inhaled, swallowed or absorbed through skin. At all places where there is a risk of cyanide poisoning, the following items should be kept in an accessible and convenient location: An oxygen resuscitator and a source of oxygen; a clearly marked CYANIDE ANTIDOTE box containing an approved airway, elasticised tournequet, disposable in dwelling intravenous cannulae, 20ml sterile disposable syringes and needles, fluoride heparinised blood sample tubes, skin prep swabs, dressings and adhesive tape, and ampoules of kelocyanor (dicobalt edetate), including the prescribing information outlining side effects and precautions (a copy of the appropriate Material Safety Data Sheet and a copy of the Worksafe Australia Guide, 'Cyanide Poisoning'). antidote for cyanide poisoning is the intravenous administration of dicobalt edetate. Due to adverse reactions which can occur in the absence of poisoning, this should be administered when absorption of cyanide is beyond doubt. Cyanide poisoning occurs apidly after exposure. If the patient is conscious after the usual time taken to reach hospital then exposure to cyanide either from inhalation, ingestion or skin contamination is unlikely to have resulted in a significant amount of cyanide being absorbed. In these circumstances the patient should be observed carefully with particular attention being given to the state of consciousness. Over zealous administration of the antidote is contraindicated and may result in serious adverse reactions of an anaphylactic (allergic) nature. Adverse reactions reported include gross oedema of the face and neck, urticaria, palpitations, hypotension, convulsions, vomiting, chest pains, difficulty in breathing, and collapse. If after clinical assessment the patient is considered to require the antidote, that is, the patient is known to have been exposed to cyanide and is unconscious or lapsing into unconsciousness, administer one ampoule containing 300 mg Dicobalt edetate in 20 mL glucose solution (Kelocyanor) intravenously by slow injection. The initial effect is a fall in blood pressure, rise in pulse rate, and sometimes retching. Immediately after this phase, lasting about one minute, the patient should recover. The injection should be discontinued if allergic adverse effects are noted. A second dose may be given if the response is inadequate and allergic adverse effects are absent.

5. FIRE FIGHTING MEASURES

Specific Hazards: Non-combustible material.

Fire-fighting advice: Decomposes on heating emitting toxic fumes, including those of hydrogen cyanide , and ammonia . If safe to do so, remove containers from path of fire. Fire fighters to wear self-contained breathing apparatus and suitable protective clothing if risk of exposure to products of decomposition.

Suitable Extinguishing Media: Not combustible, however, if material is involved in a fire use: Water fog (or if unavailable fine water spray), foam, dry chemical powder.

Unsuitable Extinguishing Media: DO NOT USE the following as extinguishing media: Carbon dioxide.

6. ACCIDENTAL RELEASE MEASURES

Clear area of all unprotected personnel. Avoid breathing in dust. Work up wind or increase ventilation. Wear protective equipment to prevent skin and eye contact and breathing in vapours/dust. DO NOT allow material to get wet. Contain - prevent run off into drains and waterways. Spillage area and contaminated solids can be detoxified by treatment with an excess of dilute sodium hypochlorite, calcium hypochlorite, or ferrous sulfate after the addition of soda ash or lime to raise the pH to greater than 10.5. Allow 1 hour for complete decomposition before washing spillage area down with large quantities of water to ensure maximum dilution. Collect and seal in properly labelled containers or drums for disposal. If contamination of sewers or waterways has occurred advise local emergency services.

7. HANDLING AND STORAGE

Handling advice: Avoid skin and eye contact and breathing in dust. Avoid handling which leads to dust formation.

Storage advice: Store in a cool, dry, well ventilated place and out of direct sunlight. Keep dry - reacts with water. Protect from moisture. Store away from foodstuffs. Store away from incompatible materials described in Section 10. Keep containers closed when not in use - check regularly for spills.

This material is a Scheduled Poison S7 and must be stored, maintained and used in accordance with the relevant regulations.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits:
No value assigned for this specific material by the National Occupational Health and Safety Commission. However, Exposure Standard(s) for constituent(s):

Cyanides (as CN): 8hr TWA = 5 mg/m3, Sk
Decomposition product(s): Hydrogen cyanide: Peak Limitation = 11 mg/m3 (10 ppm), Sk

As published by the National Occupational Health and Safety Commission.

TWA - The time-weighted average airborne concentration over an eight-hour working day, for a five-day working week over an entire working life.

`Sk' Notice – absorption through the skin may be a significant source of exposure. The exposure standard is invalidated if such contact should occur.

Peak Limitation - a ceiling concentration which should not be exceeded over a measurement period which should be as short as possible but not exceeding 15 minutes.

These Exposure Standards are guides to be used in the control of occupational health hazards. All atmospheric contamination should be kept to as low a level as is workable. These exposure standards should not be used as fine dividing lines between safe and dangerous concentrations of chemicals. They are not a measure of relative toxicity.

Engineering Control Measures:
Ensure ventilation is adequate and that air concentrations of components are controlled below quoted Exposure

Standards. Avoid generating and breathing in dusts. If inhalation risk exists: Use with local exhaust ventilation or while wearing air supplied mask. Keep containers closed when not in use.

Personal Protective Equipment:
Orica Personal Protection Guide No. 1, 1998: J - OVERALLS, RUBBER BOOTS, AIR MASK , GLOVES (Long), APRON.

Wear overalls, full face shield, elbow-length impervious gloves, splash apron and rubber boots. Use with adequate ventilation. If inhalation risk exists, wear air-supplied mask meeting the requirements of AS/NZS 1715 and AS/NZS 1716. Always wash hands before smoking, eating, drinking or using the toilet. Wash contaminated clothing and other protective equipment before storage or re-use.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state:	Solid
Colour:	White
Odour:	Faint 'Bitter almonds'
Molecular Formula:	NaCN
Solubility:	Soluble in water.
Specific Gravity:	1.6-1.62 @20°C
Relative Vapour Density (air=1):	Not available
Vapour Pressure (20 °C):	Not available
Flash Point (°C):	Not applicable
Flammability Limits (%):	Not applicable
Autoignition Temperature (°C):	Not applicable
Melting Point/Range (°C):	ca. 560
pH:	Not available

10. STABILITY AND REACTIVITY

Stability: Incompatible with acids , moisture , metals , oxidising agents , and halogens . Hazardous polymerization will not occur. Reacts with water liberating toxic hydrogen cyanide gas.

11. TOXICOLOGICAL INFORMATION

No adverse health effects expected if the product is handled in accordance with this Safety Data Sheet and the product label. Symptoms or effects that may arise if the product is mishandled and overexposure occurs are:

Ingestion: Swallowing can result in nausea, vomiting, diarrhoea, abdominal pain, convulsions and loss of consciousness. Collapse and possible death may occur.

Eye contact: May be an eye irritant. Exposure to the dust may cause discomfort due to particulate nature. May cause physical irritation to the eyes.

Skin contact: Contact with skin may result in irritation. Can be absorbed through the skin. Effects can include those described for 'INGESTION'.

Inhalation: Breathing in high concentrations may result in the same symptoms described for 'INGESTION'. High inhaled concentrations may lead to a feeling of suffocation and cause difficulty in breathing, headaches, dizziness and loss of consciousness. Can cause suffocation.

Long Term Effects:

Repeated or prolonged skin contact may lead to irritant contact dermatitis - 'cyanide rash' - characterised by itching and skin eruptions. (1)

Toxicological Data:

Oral LD50 (rat): 6440 ug/kg. (2)
Dermal LD50 (rabbit): 10400 ug/kg. (2)

12. ECOTOXICOLOGICAL INFORMATION

Avoid contaminating waterways.

13. DISPOSAL CONSIDERATIONS

Refer to Waste Management Authority. Dispose of material through a licensed waste contractor. Empty containers must be decontaminated and destroyed.

14. TRANSPORT INFORMATION

Road and Rail Transport
Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for Transport by Road and Rail.

UN No: 1689
Class-primary 6.1 Toxic
Packing Group: I
Proper Shipping Name: SODIUM CYANIDE

Hazchem Code: 2X

Marine Transport
Classified as Dangerous Goods by the criteria of the International Maritime Dangerous Goods Code (IMDG Code) for transport by sea.
This material is classified as a Marine Pollutant (P) according to the International Maritime Dangerous Goods Code.

UN No: 1689
Class-primary: 6.1 Toxic
Packing Group: I
Proper Shipping Name: SODIUM CYANIDE, SOLID

Air Transport
Classified as Dangerous Goods by the criteria of the International Air Transport Association (IATA) Dangerous Goods Regulations for transport by air.

UN No: 1689
Class-primary: 6.1 Toxic
Packing Group: I
Proper Shipping Name: SODIUM CYANIDE, SOLID

15. REGULATORY INFORMATION

Classification: This material is hazardous according to criteria of NOHSC.
T+ : Very Toxic

Risk Phrase(s): R26/27/28: Very toxic by inhalation, in contact with skin and if swallowed.
R32: Contact with acids liberates very toxic gas.

Safety Phrase(s): S7: Keep container tightly closed.
S22: Do not breathe dust.
S29: Do not empty into drains.
S45: In case of accident or if you feel unwell, seek medical advice immediately (show the label whenever possible).

Poisons Schedule: S7 Dangerous Poison.

This material is listed on the Australian Inventory of Chemical Substances (AICS).

16. OTHER INFORMATION

(1) Worksafe Australia Cyanide Poisoning; National Occupational Health and Safety Commission; Australian Government Publishing Service, 1989.
(2) `Registry of Toxic Effects of Chemical Substances'. Ed. D. Sweet, US Dept. of Health & Human Services: Cincinatti, 2005.

This material safety data sheet has been prepared by SH&E Shared Services, Orica.

Reason(s) for Issue:
5 Yearly Revised Primary MSDS

This MSDS summarises to our best knowledge at the date of issue, the chemical health and safety hazards of the material and general guidance on how to safely handle the material in the workplace. Since Orica Limited cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, assess and control the risks arising from its use of the material.

If clarification or further information is needed, the user should contact their Orica representative or Orica Limited at the contact details on page 1.

Orica Limited's responsibility for the material as sold is subject to the terms and conditions of sale, a copy of which is available upon request.

Material Safety Data Sheet

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

Product name: Sodium Cyanide Solution - (30% w/w)

Synonyms: Cyanide of Sodium Solution - (30% w/w)

CAS-No.:

Molecular Formula:

Supplier: Orica Australia Pty Ltd
ACN: 004 117 828
Street Address: 1 Nicholson Street
Melbourne 3000
Australia
Telephone: + 61 3 9665 7111
Facsimile: + 61 3 9665 7937

Emergency telephone number: **1 800 033 111 (ALL HOURS)**

2. COMPOSITION/INFORMATION ON INGREDIENTS

Recommended use: Extraction of gold and silver from ores; electroplating; heat treatment of metals; chemical intermediate.

Appearance: Colourless to straw-coloured liquid with a faint, 'bitter almonds' odour.

CHEMICAL ENTITY	CAS NO.	PROPORTION (% weight per weight)
Water	7732-18-5	70
Sodium cyanide	143-33-9	30
		100%

All the constituents of this material are listed on the Australian Inventory of Chemical Substances (AICS).

3. HAZARDS IDENTIFICATION

Hazardous according to criteria of Worksafe Australia.

Hazard Category
T+ Very toxic

R-phrase(s)
R26/27/28 Very toxic by inhalation, in contact with skin and if swallowed.

R32 Contact with acids liberates very toxic gas.

Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for transport by road or rail.
Class: 6.1 Toxic

Poisons Schedule (Aust)/Toxic Substance (NZ): S7

This material is a Scheduled Poison S7 and must be stored, maintained and used in accordance with the relevant regulations.

4. FIRST AID MEASURES

* Poison Information Centres in each State Capital City can provide additional assistance for scheduled poisons.
* CONCURRENTLY WITH THE FOLLOWING FIRST AID PROCEDURES, TRANSFER PATIENT IMMEDIATELY TO HOSPITAL OR MEDICAL CENTRE, ACCOMPANIED BY AN ATTENDANT WITH THE CYANIDE EMERGENCY KIT.
For all routes of exposure, remove patient from contaminated area and ensure rescuers avoid contamination. Give oxygen and if necessary, artificial respiration. If giving mouth-to-mouth resuscitation wash out patient's mouth and lips - do not inhale patient's expired air. Remove contaminated clothing and wash contaminated skin thoroughly. Get to ahospital or doctor quickly.

Ingestion: * IF THE PATIENT IS CONSCIOUS:
- Do not give anything by mouth.
- Rest and reassure the patient who may become agitated.
- If available, oxygen should be administered by a qualified person.
* IF THE PATIENT IS UNCONSCIOUS AND BREATHING:
- Do not give anything by mouth.
- Lie the patient on their side, ensuring the airway is clear. If available, oxygen should be administered by aqualified person.
* IF THE PATIENT IS NOT BREATHING:
- Ensure airway is clear.
- Commence expired air resuscitation using a pocket mask with a one-way valve. If available, oxygen should be administered by a qualified person. Take care to prevent contamination of the rescuer by removing all contaminated clothing and if giving mouth-to-mask recuscitation wash out patient's mouth and lips - do not inhale patient's air.
- If cardiac arrest occurs (no pulse present), commence cardiopulmonary resuscitation (CPR).

Eye contact: * Immediately irrigate with copious quantities of water for at least 15 minutes. Eyelids to be held open. Remove clothing if contaminated and wash skin. Treat as for 'INGESTION'.

Skin contact: * If skin contact occurs, remove contaminated clothing and wash skin thoroughly. Can be absorbed through the skin with resultant toxic effects. Treat as for 'INGESTION'.

Inhalation: * Remove victim from exposure - avoid becoming a casualty. Treat as for 'INGESTION'.
EMERGENCY KIT FOR CYANIDE POISONING:
At all places where there is a risk of cyanide poisoning, the following items should be kept in an accessible andconvenient location:
. an oxygen resuscitator and a source of oxygen;
. a clearly marked CYANIDE ANTIDOTE box containing:
- an approved airway,
- elasticised tournequet,

- disposable in dwelling intravenous cannulae,
- 20 ml sterile disposable syringes and needles,
- fluoride heparinised blood sample tubes,
- skin prep swabs, dressings and adhesive tape, and
- ampoules of kelocyanor (dicobalt edetate), including the prescribing information outlining side effects andprecautions;

. a copy of the appropriate Material Safety Data Sheet and
. a copy of the Worksafe Australia Guide, 'Cyanide Poisoning'.

Notes to physician: The antidote for cyanide poisoning is the intravenous administration of dicobalt edetate (trade name - Kelocyanor). Due to adverse reactions which can occur in the absence of poisoning, this should only be administered when absorption of cyanide is beyond doubt. The antidote should only be administered by a suitably qualified professional health attendant (3).
Cyanide poisoning occurs rapidly after exposure. If the patient is conscious after the usual time taken to reach hospital then exposure to cyanide either from inhalation, ingestion or skin contamination is unlikely to have resulted in a significant amount of cyanide being absorbed. In these circumstances the patient should be observed carefully with particular attention being given to the state of consciousness.
Over zealous administration of the antidote is contraindicated and may result in serious adverse reactions of an anaphylactic (allergic) nature. Adverse reactions reported include gross oedema of the face and neck, urticaria, palpitations, hypotension, convulsions, vomiting, chest pains, difficulty in breathing, and collapse (3).
If, after clinical assessment the patient is considered to require the antidote, ie. the patient is known to have been exposed to cyanide and is unconscious or lapsing into unconsciousness, administer one ampoule containing 300 mg Dicobalt edetate in 20 ml glucose solution (Kelocyanor) intravenously by slow injection. The initial effect is a fall in blood pressure, rise in pulse rate, and sometimes retching. Immediately after this phase, lasting about one minute, the patient should recover. The injection should be discontinued if allergic adverse effects are noted. A second dose may be given if the response is inadequate and allergic adverse effects are absent.

5. FIRE-FIGHTING MEASURES

Specific hazards: Non-combustible material.

Fire fighting further advice: Not combustible. Can decompose on heating or on contact with acidic media emitting highly toxic fumes including those of hydrogen cyanide, ammonia, oxides of carbon, and oxides of nitrogen. If safe to do so, remove containers from path of fire. Fire fighters to wear self-contained breathing apparatus if risk of exposure to products of decomposition.

Suitable extinguishing media: Not combustible, however, if material is involved in a fire use water fog (or if unavailable fine water spray), foam, dry agent (carbon dioxide, dry chemical powder).

6. ACCIDENTAL RELEASE MEASURES

Immediate action required. Avoid inhalation of mists. Work up wind or increase ventilation. Clear area of all unprotected personnel to a minimum of 20 metres. Vacate completely if spill occurs in a confined area. Wear protective equipment to prevent skin and eye contamination and inhalation of highly toxic hydrogen cyanide gas. Contain - prevent run off into drains andwaterways.
FOR SMALL SPILLS TO SOIL Remove a conservative amount of soil, collect all contaminated soil and seal in clean, dry, properly labelled drums.
FOR LARGE SPILLS TO SOIL
Remove top layers of contaminated soil for treatment or treat in situ. Contact supplier for expert advice required for this treatment.
DO NOT wash to drain. If contamination of sewers or waterways has occurred advise local emergency services.
Spillage area and contaminated soils can be detoxified by treatment with an excess of dilute sodium hypochlorite or calcium hypochlorite. Expert advice is required for this treatment. Take care to avoid contact with detoxification solutions which are corrosive.
SPILLS TO WATERWAYS Seek advice from emergency services and local authorities prior to treating spills to waterways.
Spills to waterways can be detoxified with ferrous sulphate or sodium hypochlorite, however expert advice is required for this treatment.
Note: The detoxification procedure converts the cyanide ion to the cyanate ion which on continued reaction breaks down to carbon dioxide and nitrogen.

7. HANDLING AND STORAGE

Storage: Not to be available except to authorised or licensed persons. Sodium cyanide solution is only available in bulk and should be stored in mild steel or stainless steel tanks; the solution is corrosive to zinc and aluminium. Tanks should be vented to a safe atmosphere as they may develop a build-up of highly toxic hydrogen cyanide gas. The storage area must be fully bunded and facilities available to detoxify any spillage. Check tanks regularly for leaks. A safety shower and eye wash facility must be available at the discharge point. Store away from acids, oxidising agents and foodstuffs.

This material is a Scheduled Poison S7 and must be stored, maintained and used in accordance with the relevant regulations.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

National occupational exposure limits
No value assigned for this specific material by the National Occupational Health and Safety Commission (Worksafe Australia).

However, Exposure Standards for constituent and decomposition product:

	TWA		STEL		NOTICES
	ppm	mg/m3	ppm	mg/m3	
Cyanides (as CN)	-	5	-	-	Sk
Hydrogen cyanide **	10	11	(Peak limitation)		Sk

** (decomposition product).
As published by the National Occupational Health and Safety Commission

(Worksafe Australia).
Peak Limitation - a ceiling concentration which should not be exceeded over a measurement period which should be as short as possible but not exceeding 15 minutes.
'Sk' notice - absorption through the skin may be a significant source of exposure. The exposure standard is invalidated if such contact should occur.
TWA - the Time-Weighted Average airborne concentrations over an eight-hour working day, for a five-day working week over an entire working life.
STEL (Short Term Exposure Limit) - the average airborne concentration over a 15 minute period which should not be exceeded at any time during a normal eight-hour work day. According to current knowledge these concentrations should neither impair the health of, nor cause undue discomfort to, nearly all workers.
These Exposure Standards are guides to be used in the control of occupational health hazards. All atmospheric contamination should be kept to as low a level as is workable. Exposure Standards should not be used as fine dividing lines between safe and dangerous concentrations of chemicals. They are not a measure of relative toxicity.

Engineering measures: Ensure ventilation is adequate and that air concentrations of components and decomposition products are controlled below quoted Exposure Standards. Use with local exhaust ventilation or while wearing respirator (see PERSONAL PROTECTION section below) or air supplied mask.

Personal protection equipment: Orica Personal Protection Guide No.1, 1998: J - OVERALLS, RUBBER BOOTS, FACE SHIELD OR AIR MASK, GLOVES (L), APRON.

Avoid all contact. Wear overalls, full face shield, elbow-length impervious gloves, splash apron and rubber boots. Use with adequate ventilation. If inhalation risk exists wear full-face respirator (Type B2 or B3 gas filter combined with Class P3 particulate filter) or air supplied mask meeting the requirements of AS/NZS 1715 and AS/NZS 1716. Always wash hands before smoking, eating, drinking or using the toilet. Wash clothing and other protective equipment before storage or re-use.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form / Colour / Odour: Colourless to straw-coloured liquid with a faint, 'bitter almonds' odour.

Solubility: Miscible with water. Insoluble in organic solvents.

Specific Gravity (20 C)	: 1.170	Freezing Point (C)	: ca. 1
Rel Vapour Density (air=1)	: N Av	Boiling Point (C)	: ca. 111
Vapour Pressure (20 C)	: 1.73 kPa	Decomp. Point (C)	: N Av
Flash Point (C)	: N App	Sublimation Point	: N App
Flammability Limits (%)	: N App	pH	: >12
Autoignition Temp (C)	: N App	Viscosity	: N Av
% Volatile by volume	: 70	Evaporation Rate	: N Av
Solubility in water (15 C)	: Miscible	(n-Butyl acetate=1)	

(Typical values only - consult specification sheet)
(N Av = Not available N App = Not applicable)

10. STABILITY AND REACTIVITY

Stability: Will liberate highly toxic hydrogen cyanide gas upon contact with acids or acidic media. Incompatible with oxidising agents. Will decompose when heated generating toxic ammonia gas and hydrogen cyanide gas. For hydrogen cyanide gas (decomposition product): Rel Vapour Density (air=1): 0.94; Explosive Limits (%): 5.6-40; Flash Point (C): -17.

11. TOXICOLOGICAL INFORMATION

No adverse health effects expected if the product is handled in accordance with this Safety Data Sheet and the product label. Symptoms that may arise if the product is mishandled are:
Short term exposure by all routes is considered to be highly toxic. May be fatal if inhaled, swallowed or absorbed through skin.
Possible exposure routes are (1,2):
- Breathing hydrogen cyanide gas from decomposing solid or solutions, or by breathing cyanide dust.
- Swallowing solid or solutions.
- By absorption through skin or eyes as a result of contact with solutions, dust or solid material.

Early symptoms of exposure (1,2,3):
- Irritation of mucous membranes in eyes, nose and throat. Burning sensation of the the tongue.
- Salivation.
- Irritation of skin or eyes with discomfort or burning sensation.
- Headaches.
- Unusual behaviour.
- Nausea.
- General weakness, and heaviness in arms and legs.
- Rapid pulse.
- Increased difficulty in breathing.

Signs of severe poisoning (1,2,3):
- Cherry-red complexion.
- Feeling of suffocation, gasping for breath.
- Vomiting.
- Convulsions and collapse.
- Decreasing consciousness.
- Cessation of breathing.

Acute Effects
Ingestion: See Main symptoms above.

Eye contact: See Main symptoms above.

Skin contact: See Main symptoms above.

Inhalation: See Main symptoms above.

Long Term Effects:
Repeated or prolonged skin contact may lead to irritant contact dermatitis - 'cyanide rash' - characterised by itching and skin eruptions (3).

Acute toxicity / Chronic toxicity
No LD50 data available for the product.

For Sodium Cyanide (solid):
Oral LD50 (rat): 6.4 mg/kg; Oral Lowest Lethal Dose (human): 2.9 mg/kg (4)
Ocular LD50 (rabbit): 5.0 mg/kg (4)
For Hydrogen Cyanide (gas) -
Oral LD50 (mouse): 3.7 mg/kg (4)
Inhalation LC50 (rat): 160 ppm/30 min (4)
Inhalation Lowest Lethal Concentration (human): 120 mg/m3/1 hr (4)
Inhalation Lowest Lethal Concentration (human): 200 mg/m3/10 min (4)
Inhalation Lowest Lethal Concentration (human): 400 mg/m3/2 min (4)
Ocular LD50 (rabbit): 1.0 mg/kg (4)
No signs of cyanide toxicity were observed in a 2 year feeding study in rats given food containing 100 and 300 ppm of hydrogen cyanide. (5)
The high toxicity of cyanide compounds results from their ability to interfere with the body's utilisation of oxygen at the cellular level by inhibiting the cytochrome oxidase enzyme system (1,3)
In a study of the effect of chronic cyanide exposure at up to twice the current recommended exposure standard (ie 6.4 to 10.4 ppm) (6)

. No signs of hypo- or hyperthyroidism.
. 56% of the workers had thyroid enlargement to a mild or moderate degree.
. Workers were exposed to other chemicals.
. There was no association between the period of exposure and the incidence of enlargement or size of the thyroid.

12. ECOLOGICAL INFORMATION

Avoid contaminating waterways. Very toxic to aquatic organisms.
For Hydrogen Cyanide - (7)
96 hr LC50 (rainbow trout): 57 ug/L
TLm 24 (sunfish): 0.18 mg/L
TLm 24 (pinperch): 0.05 mg/L in sea water
TLm 24: Median Tolerance Limit - the concentration of toxicant or substance at which 50% of the test organisms survive over a 24 hour test period.

13. DISPOSAL CONSIDERATIONS

Refer to State/Territory Land Waste Management Authority. Waste treatment is essential. Empty containers must be decontaminated and destroyed. Dispose of material through a licensed waste contractor.

14. TRANSPORT INFORMATION

Classified as Dangerous Goods by the criteria of the Australian Dangerous Goods Code (ADG Code) for transport by road or rail.

UN-No: 1935
Class: 6.1 Toxic

Hazchem code: 2X
EPG: 6.0.009
Packing group: Packing Group 1

Proper shipping name: CYANIDE SOLUTIONS

Segregation Dangerous Goods: Not to be loaded with explosives (Class 1), nitromethane, acids of Class 8, food and food packaging in any quantity, however exemptions may apply.

15. REGULATORY INFORMATION

Hazardous according to criteria of Worksafe Australia.

Hazard Category	
T+	Very toxic

R-phrase(s)	
R26/27/28	Very toxic by inhalation, in contact with skin and if swallowed.
R32	Contact with acids liberates very toxic gas.

S-phrase(s)	
S 7	Keep container tightly closed.
S23	Do not breathe spray.
S24	Avoid contact with the skin.
S28	After contact with skin, wash immediately with plenty of water.
S29	Do not empty into drains.
S45	In case of accident or if you feel unwell, seek medical advice immediately (show label where possible).

Poisons Schedule (Aust)/Toxic Substance (NZ): S7

16. OTHER INFORMATION

Literary reference

(1), 'Various authors', In 'Patty's Industrial Hygiene and Toxicology Vol.IID 4th Edition' (Ed. Clayton, G.D., Clayton, F.E.), p 3119-3136, (John Wiley and Sons: New York 1994).
(2), Toxicology Profile for Cyanide; Agency for Toxic Substances and Disease Registry; US Department of Health and Human Services; 08/95
(3) Worksafe Australia Cyanide Poisoning; National Occupational Health and Safety Commission; Australian Government Publishing Service; 1989.
(4), On 'CC Info Disc No. C2 ' (Canadian Centre for Occupational Health and Safety; Ontario 1996)
(5), Howard, J. W. and Hanzal, R. F., J. Agric. Food Chemistry, April 1955, 3(4), 325-329.
(6), El Gwhawabi, S. H. et al, Br, J. Ind. Med., 1975, 3, 215-219.
(7), In 'Handbook of Environmental Data on Organic Chemicals Second

Edition' (Ed Verschveren, Karel), (Van Nostrand Reinhold Company: New York 1983).
This Material Safety Data Sheet has been prepared by SHE Pacific Pty Ltd on behalf of Orica Ltd and its subsidiary companies.
Contact Point: SHE Pacific Pty Ltd, MSDS Services

Within Australia:	Telephone	1 800 624 132
	Facsimile	(03) 9665 7929
Outside Australia:	Telephone	+61 3 9665 7500
	Facsimile	+61 3 9665 7929

Reason(s) For Issue: Change to Dangerous Goods requirements.

Safety Data Sheets are updated frequently. Please ensure that you have a current copy.

This MSDS summarises at the date of issue our best knowledge of the health and safety hazard information of the product, and in particular how to safely handle and use the product in the workplace. Since Orica Limited and its subsidiaries cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, review this MSDS in the context of how the user intends to handle and use the product in the workplace.

If clarification or further information is needed to ensure that an appropriate assessment can be made, the user should contact this company.

Our responsibility for product as sold is subject to our standard terms and conditions, a copy of which is sent to our customers and is also available upon request.

Material Safety Data Sheet

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

Product name: HYDROGEN CYANIDE GAS

Synonyms: HYDROGEN CYANIDE GAS (DECOMPOSITION PRODUCT OF SODIUM CYANIDE), Hydrocyanic acid gas

CAS-No.: 74-90-8

Molecular Formula: H-C-N

Supplier: Orica Australia Pty Ltd
ACN: 004 117 828
Street Address: 1 Nicholson Street
Melbourne 3000
Australia
Telephone: + 61 3 9665 7111
Facsimile: + 61 3 9665 7937

Emergency telephone number: **1 800 033 111 (ALL HOURS)**

2. COMPOSITION/INFORMATION ON INGREDIENTS

Recommended use: Decomposition product of sodium cyanide. Hydrogen cyanide will be encountered as a gas associated with the spillage of sodium cyanide liquid or solid.

Appearance: Colourless gas with a distinctive 'bitter almonds' odour.

3. HAZARDS IDENTIFICATION

Hazardous according to criteria of Worksafe Australia.

Hazard Category
T+ Very toxic

R-phrase(s)
R26 Very toxic by inhalation.

Classified as Dangerous Goods for the purpose of transport by road or rail. Refer to relevant regulations for storage and transport requirements.
Class: 6.1 Toxic
Subsidiary Risk 1: 2.1 Flammable Gas

Poisons Schedule (Aust)/Toxic Substance (NZ): S7

This material is a Scheduled Poison S7 and must be stored, maintained and used in accordance with the relevant regulations.

4. FIRST AID MEASURES

Poison Information Centres in each State capital city can provide additional assistance for scheduled poisons.

CONCURRENTLY WITH THE FOLLOWING FRIST AID PROCEDUTRES, TRANSFER PATIENT IMMEDIATELY TO HSPITAL OR MEDICAL CENTRE, ACCOMPANIED BY AN ATTENDANT WITH THE CYANIDE EMERGENCY KIT.

For all routes of exposure, remove patient from source and ensure rescuers avoid contamination.

Ingestion: Not applicable.

Eye contact: Immediately irrigate with copious quantities of water for at least 15 minutes. Eyelids to be held open. Removeclothing if contaminated and wash skin. Treat as for 'INHALED'.

Skin contact: If skin contact occurs, remove contaminated clothing and wash skin thoroughly. Can be absorbed through the skinwith resultant toxic effects. Treat as for 'INHALED'.

Inhalation: Remove victim from exposure - avoid becoming a casualty.

IF THE PATIENT IS CONSCIOUS:
- Do not give anything by mouth.
- Rest and reassure the patient who may become agitated.
- If available, oxygen should be administered by a qualified person.

IF THE PATIENT IS UNCONSCIOUS AND BREATHING:
- Do not give anything by mouth.
- Lie the patient on their side, ensuring the airway is clear. If available, oxygen should be administered by a qualified person.

IF THE PATIENT IS NOT BREATHING:
- Ensure airway is lear.
- Commence expired air resuscitation using a pocket mask with one-way valve. If available, oxygen should be administered by a qualified person
- If cardiac arrest occurs (no pulse resent), commenc cardiopulmonary resuscitation (CPR).
- Take are to prevent contamination of the rescuer by removing all contaminated clothing and if giving mouth-to-mask resuscitation wash out patient's mouth and lips - do not inhale patient's air.

EMERGENCY KIT FOR CYANIDE POISONING:
At all places where there is a risk of cyanide poisoning, the following items should be kept in an accessible and convenient locatiation:

- an oxygen resuscitator and a source of oxygen;

- a clearly marked CYANIDE ANTIDOTE box containing:
- an approved airway,
- elasticised tournequet,

- disposable in dwelling intravenous cannulae,
- 20 ml sterile disposable syringes and needles,
- fluoride heparinised blood sample tubes,
- skin prep swabs, dressings and adhesive tape,
- ampoules of kelocyanor (dicobalt edetate), including the prescribing information outlining side effects and precautions;
- a copy of the appropriate Material Safety Data Sheet.
- a copy of the Worksafe Australia Guide, 'Cyanide Poisoning'.

Notes to physician: The antidote for cyanide poisoning is the intravenous administration of dicobalt edetate (trade name - Kelocyanor). Due to adverse reactions which can occur in the absence of poisoning, this should only be administered when absorption of cyanide is beyond doubt. The antidote should only be administered by a suitably qualified professional health attendant.
Cyanide poisoning occurs rapidly after exposure. If the patient is conscious after the usual time taken to reach hospital then exposure to cyanide either from inhalation, ingestion or skin contamination is unlikely to have resulted in a significant amount of cyanide being absorbed. In these circumstances the patient should be observed carefully with particular attention being given to the state of consciousness.
Over zealous administration of the antidote is contraindicated and may result in serious adverse reactions of an anaphylactic (allergic) nature. Adverse reactions reported include gross oedema of the face and neck, urticaria, palpitations, hypotension, convulsions, vomiting, chest pains, difficulty in breathing, and collapse.
If, after clinical assessment the patient is considered to require the antidote, ie. the patient is known to have been exposed to cyanide and is unconscious or lapsing into unconsciousness, administer one ampoule containing 300 mg Dicobalt edetate in 20 ml glucose solution (Kelocyanor) intravenously by slow injection. The initial effect is a fall in blood pressure, rise in pulse rate, and sometimes retching. Immediately after this phase, lasting about one minute, the patient should recover. The injection should be discontinued if allergic adverse effects are noted. A second dose may be given if the response is inadequate and allergic adverse effects are absent.

5. FIRE-FIGHTING MEASURES

Specific hazards: Highly flammable gas. Avoid all ignition sources. Flameproof equipment necessary in area where this chemical is present. Nearby equipment must be earthed.

Fire fighting further advice: Highly flammable gas. Do not spray sodium cyanide containers with water. Fire fighters to wear self-contained breathing apparatus

Suitable extinguishing media: Dry chemical powder. (DO NOT use carbon dioxide.)

6. ACCIDENTAL RELEASE MEASURES

NOTE: HCN is a decomposition product which may be released in a solid or liquid sodium cyanide spill.
For solid or liquid sodium cyanide spill see MSDS's for solid or liquid sodium cyanide (3,4).
Immediate action required. Clear area of all unprotected personnel and move upwind. Increase ventilation. Wearfull protective equipment (see PERSONAL PROTECTION above) to prevent skin and eye contamination and inhalation of highly toxic hydrogen cyanide gas (liberated upon contact with water).

7. HANDLING AND STORAGE

Storage: Not applicable as hydrogen cyanide is a decomposition product of sodium cyanide.

This material is a Scheduled Poison S7 and must be stored, maintained and used in accordance with the relevant regulations.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

National occupational exposure limits

Peak Limitation/ Ceiling Limit		STEL		Carcin-ogen Category	Notices
10 ppm	11 mg/m3				'Sk'

As published by National Occupational Health and Safety Commission (Worksafe Australia).

Exposure Standard (TWA) is the time-weighted average airborne concentration over an eight-hour working day, for afive-day working week over an entire working life. According to current knowledge this concentration should neither impair the health or, not cause undue discomfort to, nearly all workers.

Peak limitation - a ceiling concentration which should not be exceeded over a measurement period which should be as short as possible but not exceeding 15 minutes.

'Sk' Notice - absorption through the skin may be a significant source of exposure. The exposure standard is invalidated if such contact should occur.

These Exposure Standards are guides to be used in the control of occupational health hazards. All atmospheric contamination should be kept to as low a level as is workable. These Exposure Standards should not be used as fine dividing lines between safe and dangerous concentrations of chemicals. They are not a measure of relative toxicity.

Engineering measures: Ensure ventilation is adequate to maintain air concentrations below Exposure Standards. Hydrogen cyanide gas is lighter than air DO NOT enter confined spaces where gas may have collected. Refer to AS 2865 for requirements for entry to confinedspaces.

Personal protection equipment: Orica Personal Protection Guide No.1, 1998: J - OVERALLS, RUBBER BOOTS, FACE SHIELD OR AIR MASK, GLOVES (L), APRON.

Avoid all contact. Use with adequate ventilation. Wear polypropylene disposable overalls, elbow-length impervious gloves, enclosed rubber boots. Wear full-face respirator (Type B2 or B3 gas filter combined with Class P3 particulate filter) orair supplied mask meeting the requirements of AS 1715 and AS 1716. Always wash

hands before smoking, eating, drinking or using thetoilet. Wash clothing and other protective equipment before storing or re-using.
Where exposure to sodium cyanide solid or liquid is likely refer to the appropriate MSDS for personal protectionrequirements (3,4)

9. PHYSICAL AND CHEMICAL PROPERTIES

Form / Colour / Odour: Colourless gas with a distinctive 'bitter almonds' odour.

Solubility: Soluble in water and organic solvents.

Specific Gravity (4 C)	: N App	Melting Point (C)	: N App
Rel Vapour Density (air=1)	: 0.93 (26 C)	Boiling Point (C)	: N App
Vapour Pressure (20 C)	: 62 kPa	Decomp. Point (C)	: N Av
Flash Point (C) (CC)	: -17.8	Sublimation Point	: N Av
Flammability Limits (%)	: 6-41	pH	: N App
Autoignition Temp (C)	: 538	Viscosity	: N App
% Volatile by volume	: 100	Evaporation Rate	: N Av
Solubility in water	: N App	(n-Butyl acetate=1)	

(Typical values only - consult specification sheet)
(N Av = Not available N App = Not applicable)

10. STABILITY AND REACTIVITY

Stability: If not stabilised, can polymerise violently. Reacts with oxidising agents.

11. TOXICOLOGICAL INFORMATION

No adverse health effects expected if the product is handled in accordance with this Safety Data Sheet and the product label. Symptoms that may arise if the product is mishandled and overexposure occurs are:

Acute Effects
Short term exposure at concentrations greater than the TLV by all routes is considered to be highly toxic. Can kill by any exposure route. The adverse effects depend on concentration and duration of exposure.

Possible exposure routes are:
- Breathing hydrogen cyanide gas.
- By absorption through skin or eyes as a result of contact with gas in a confined area at high concentrations.

Early symptoms of exposure:
- Irritation of mocous membranes in eyes, nose and throat.
- Burning sensation of the tongue.
- Salivation
- Irritation of skin or eyes with discomfort or burning sensation.
- Headaches.
- Unusual behaviour.

- Nausea
- Cessation of breathing.
- General weakness, and heaviness in arms and legs.
- Rapid pulse
- Increased difficulty in breathing.

Signs of severe poisoning:
- Cherry-red complexion.
- Feeling of suffocation, gasping for breath.
- Vomiting.
- Convulsions and collapse.
- Decreasing consciousness.

Long Term Effects:
Repeated or prolonged skin contact may lead to irritant contact dermatitis - 'cyanide rash' - characterised by itching and skin eruptions.

Acute toxicity / Chronic toxicity
Inhalation (gaseous) LC50 (rat): 160 ppm/30 min (1)
Inhalation Lowest Lethal Concentration (human): 113 ppm/1 hr (1)
Inhalation Lowest Lethal Concentration (human): 188 ppm/10 min (1)
Inhalation Lowest Lethal Concentration (human): 376 ppm/2 min (1)
Ocular LD50 (rabbit): 1.0 mg/kg (1)
The high toxicity of cyanide compounds results from their ability to interfere with the body's utilisation of oxygen at the cellular level by inhibiting the cytochrome oxidase enzyme system.
In a study of the effect of chronic cyanide exposure at up to twice the current recommended exposure standard:
. No signs of hypo- or hyperthyroidism.
. 56% of the workers had thyroid enlargement to a mild or moderate degree. (2)

12. ECOLOGICAL INFORMATION

Highly toxic to aquatic life. Avoid contaminating waterways.
For Hydrogen Cyanide - (5)
96 hr LC50 (rainbow trout): 57 ug/L
TLm 24 (sunfish): 0.18 mg/L
TLm 24 (pinperch): 0.05 mg/L in sea water
TLm 24: Median Tolerance Limit - the concentration of toxicant or substance at which 50% of the test organisms survive over a 24 hour test period.

13. DISPOSAL CONSIDERATIONS

Refer to State Land Waste Management Authority. Waste treatment essential. Empty containers MUST BE decontaminated and destroyed.

14. TRANSPORT INFORMATION

Road and Rail Transport

Classified as Dangerous Goods for the purpose of transport by road or rail. Refer to relevant regulations for storage and transport requirements.

UN-No:	1051
Class:	6.1 Toxic
Hazchem code:	2WE Hazchem Code
EPG:	6C3
Packing group:	Packing Group 1
Subsidiary Risk 1:	2.1 Flammable Gas
Proper Shipping Name:	HYDROGEN CYANIDE

Segregation Dangerous Goods:
Dangerous goods segregation: Not applicable. HYDROGEN CYANIDE (HCN) GAS IS A DECOMPOSITION PRODUCT OF SODIUM CYANIDE. THE ABOVE DANGEROUS GOODS CLASSIFICATIONINDICATES THAT HCN IS A COMPRESSED GAS AND COULD BE PRESENT AS A LIQUID. HCN LIQUID OR COMPRESSED GAS ARE NOT SOLD OR USED BY ICI AUSTRALIA.

15. REGULATORY INFORMATION

Hazardous according to criteria of Worksafe Australia.

Hazard Category	
T+	Very toxic
R-phrase(s)	
R26	Very toxic by inhalation.
S-phrase(s)	
S16	Keep away from sources of ignition - No smoking.
S38	In case of insufficient ventilation, wear suitable respiratory equipment.
S45	In case of accident or if you feel unwell, seek medical advice immediately (show label where possible).

Poisons Schedule (Aust)/Toxic Substance (NZ): S7

16. OTHER INFORMATION

Literary reference

(1), In 'Worksafe Disc One' (94/1) - National Material Safety Data Sheet Repository (1994); RTECS (1994) National Institute for Occupational

Safety and Health of the Dept. of Health and Human Services, USA;
Australian Atmospheric Exposure Standards, Commonwealth of Australia
(1991).
(2), El Gwhawabi, S. H. et al, Br, J. Ind. Med., 1975, 3, 215-219.
(3) Safety Data Sheet - Solid Sodium Cyanide; CDS# 10197
ICI Australia Operations Pty Ltd; 07/94
(4) Safety Data Sheet - Liquid Sodium Cyanide; CDS# 36402
ICI Australia Operations Pty Ltd; 12/94
(5), In 'Handbook of Environmental Data on Organic Chemicals Second
Edition' (Ed Verschveren, Karel), (Van Nostrand Reinhold Company: New
York 1983).
This chemical is listed on the Australian Inventory of Chemical
Substances (AICS).
This Material Safety Data Sheet has been prepared by SHE Pacific Pty Ltd
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Issue Date: 18/SEP/96/JF Supersedes Issue Date: 01/95
Reason(s) For Issue: Change in Dangerous Goods Requirements. Change in
Physical Properties.
Safety Data Sheets are updated frequently. Please ensure that you have
a current copy.

This MSDS summarises at the date of issue our best knowledge of the health and safety hazard information of the product, and in particular how to safely handle and use the product in the workplace. Since Orica Limited and its subsidiaries cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, review this MSDS in the context of how the user intends to handle and use the product in the workplace.

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Appendix B. NWT-NU Spill Report Form

NT-NU SPILL REPORT

OIL, GASOLINE, CHEMICALS AND OTHER HAZARDOUS MATERIALS

NT-NU 24-HOUR SPILL REPORT LINE
TEL: (867) 920-8130
FAX: (867) 873-6924
EMAIL: spills@gov.nt.ca

REPORT LINE USE ONLY

A	REPORT DATE: MONTH – DAY – YEAR	REPORT TIME	☐ ORIGINAL SPILL REPORT, OR ☐ UPDATE # _____ TO THE ORIGINAL SPILL REPORT	REPORT NUMBER ____-_____
B	OCCURRENCE DATE: MONTH – DAY – YEAR	OCCURRENCE TIME		

C	LAND USE PERMIT NUMBER (IF APPLICABLE)	WATER LICENCE NUMBER (IF APPLICABLE)
D	GEOGRAPHIC PLACE NAME OR DISTANCE AND DIRECTION FROM NAMED LOCATION	REGION ☐ NWT ☐ NUNAVUT ☐ ADJACENT JURISDICTION OR OCEAN
E	LATITUDE DEGREES MINUTES SECONDS	LONGITUDE DEGREES MINUTES SECONDS

F	RESPONSIBLE PARTY OR VESSEL NAME	RESPONSIBLE PARTY ADDRESS OR OFFICE LOCATION	
G	ANY CONTRACTOR INVOLVED	CONTRACTOR ADDRESS OR OFFICE LOCATION	
H	PRODUCT SPILLED	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER
	SECOND PRODUCT SPILLED (IF APPLICABLE)	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER
I	SPILL SOURCE	SPILL CAUSE	AREA OF CONTAMINATION IN SQUARE METRES
J	FACTORS AFFECTING SPILL OR RECOVERY	DESCRIBE ANY ASSISTANCE REQUIRED	HAZARDS TO PERSONS, PROPERTY OR ENVIRONMENT
K	ADDITIONAL INFORMATION, COMMENTS, ACTIONS PROPOSED OR TAKEN TO CONTAIN, RECOVER OR DISPOSE OF SPILLED PRODUCT AND CONTAMINATED MATERIALS		

L	REPORTED TO SPILL LINE BY	POSITION	EMPLOYER	LOCATION CALLING FROM	TELEPHONE
M	ANY ALTERNATE CONTACT	POSITION	EMPLOYER	ALTERNATE CONTACT LOCATION	ALTERNATE TELEPHONE

REPORT LINE USE ONLY

N	RECEIVED AT SPILL LINE BY	POSITION STATION OPERATOR	EMPLOYER	LOCATION CALLED YELLOWKNIFE, NT	REPORT LINE NUMBER (867) 920-8130

LEAD AGENCY ☐ EC ☐ CCG ☐ GNWT ☐ GN ☐ ILA ☐ INAC ☐ NEB ☐ TC | SIGNIFICANCE ☐ MINOR ☐ MAJOR ☐ UNKNOWN | FILE STATUS ☐ OPEN ☐ CLOSED

AGENCY	CONTACT NAME	CONTACT TIME	REMARKS
LEAD AGENCY			
FIRST SUPPORT AGENCY			
SECOND SUPPORT AGENCY			
THIRD SUPPORT AGENCY			

Appendix C. Sabina Internal Report Form

SABINA INTERNAL SPILL REPORT FORM

This form is to be used for internal documentation of spills of any petroleum product, chemical, ethylene glycol (antifreeze), or other hazardous material. See recent Spill Contingency Plan for reporting thresholds and structure. Once complete file with the Operations Superintendent.

***Report Date and Time*:**	***Spill Date and Time*:** ☐ Spill occurred ☐ Spill observed
***Spill Location*:** ☐ Goose ☐ Marine Laydown Area ☐ George ☐ Other (e.g. Drill, Boulder Pond)	***Describe Location*:**
***Coordinates (Lat/Long or UTM)*:**	

***Product(s) Spilled*:**	Jet fuel	Diesel (P50)	Gasoline	AvGas	Oil (type)	Antifreeze	Other (describe)
***Quantity (L or kg)*:**							

Personnel Involved:	☐ Sabina	☐ Contractor	☐ Visitor	☐ Other

***Cause of Spill*:**
***Containment/Cleanup Measures Taken*:**
***Factors Affecting Spill or Recovery (weather, snow, ground conditions, etc.)*:**
***Additional Action Required*:**
***Additional Comments*:**

	Name	***Employer***	***Signature***
***Reported by*:**			
***Reported to*:**			