RED MOUNTAIN UNDERGROUND GOLD PROJECT
VOLUME 3 | CHAPTER 23
ACCIDENTS AND MALFUNCTIONS

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23 ACCIDENTS AND MALFUNCTIONS

23.1 Introduction

23.1.1 Background

IDM Mining Ltd. (IDM) is proposing the development of the Red Mountain Underground Gold Project (the Project) in northwest British Columbia (BC), approximately 15 kilometres (km) from Stewart, BC. The Project comprises two main areas of activity with interconnecting access roads:

- The Mine Site, comprising an underground mine and dual portal access at the upper elevations of Red Mountain (1,950 metres above sea level (masl)); and,
- Bromley Humps, situated in the Bitter Creek valley (500 masl), comprising a Process Plant and a Tailings Management Facility (TMF).

The Project is within the Nass Area and the Nass Wildlife Area, as set out in the Nisga'a Final Agreement (NFA). Pursuant to the NFA, Nisga'a Nation, as represented by Nisga'a Lisims Government (NLG) has Treaty rights to the management and harvesting of fish, wildlife, and migratory birds within the Nass Wildlife Area and the larger Nass Area. The Project is also within the asserted traditional territory of Tsetsaut Skii km Lax Ha (TSKLH) and is within an area where Métis Nation BC (MNBC) claims Aboriginal rights.

IDM has prepared an Application for an Environmental Assessment Certificate / Environmental Impact Statement (Application/EIS) to identify and assess potential environmental, economic, social, heritage, and health effects resulting from the Project that meet the requirements outlined in the Application Information Requirements (AIR) issued for the Project by the BC Environmental Assessment Office (EAO) in March 2017 and the Guidelines for the Preparation of an Environmental Impact Statement pursuant to the *Canadian Environmental Assessment Act, 2012*, (the EIS Guidelines) issued by the Canadian Environmental Assessment Agency (the Agency) in January 2016.

It is IDM's intention to develop and operate the Project in a safe and environmentally-responsible manner, so that it is beneficial to all parties involved. In so doing, IDM will balance good stewardship in the protection of human health and the natural environment with the need for economic growth of the region and BC. Specifically, the Project will attract much needed training, employment, and commercial opportunities, as well as increased investment in services, to the people of Stewart and to the province of BC. The Feasibility Study, completed in June 2017, identified the positive economic viability and potential of the Project.

The production plan describes an estimated 6-year operating mine life, based on currently delineated resources, with a total ore feed of 1.8 million tonnes. Mining will be carried out throughout the year at a nominal 1,000 ore tonnes per day (i.e., average of 365,000 ore

tonnes per year). Continued exploration during the Operation Phase may increase the mineable resource; projected effects resulting from changes to the development plan and continued exploration of the resource are expected to require subsequent environmental assessment and regulatory overview.

Ore will be mined using conventional underground methods and trucked to the Process Plant located at the Bromley Humps facility for processing using standard recovery processes. Waste rock will be temporarily stored in several designated waste rock storage areas (WRSAs) on the surface or backfilled directly into mined-out workings. Tailings from the Process Plant will be stored permanently in the TMF located near the Process Plant. The life of the Project, from construction to post-closure monitoring, has been estimated to be approximately 23 years. It is expected that construction activities could begin as early as the Spring of 2018. The Operation Phase will continue for 6 years, based on the proposed mine plan and the current reserve base. IDM will continue exploration activities in the area and further discoveries may extend the mine's currently envisioned Operation Phase. Throughout the life of the Project, IDM will seek to recruit a stable workforce capable of operating the mine efficiently and safely. Efforts will be made to incorporate local residents into the workforce.

The mineral resources will ultimately be exhausted, whereupon the mine will enter a staged Closure and Reclamation Phase. During the first season, immediately at the cessation of production, the mine, equipment, and infrastructure will be decommissioned. Mine backfill and reclamation of mine rock storage facilities will have been mostly completed during operations; however, the final grading and reclamation will be completed upon closure. Final reclamation of the TMF will be completed two years after cessation of mining, and the Post-Closure phase will consist mostly of site monitoring until the site is returned to a stable condition with no adverse residual effects on the environment. Closure and post-closure monitoring will be conducted for a period of approximately fifteen years to ensure that the area remains both chemically and physically stable.

The management of risks and preparedness for unplanned events, such as accidents and/or malfunctions, are crucial elements of IDM's corporate policies. These policies and their associated management plans form the backbone in identifying causal mechanisms and eliminating or minimizing the risks of accidents and/or malfunctions.

The broad approach adopted by IDM with respect to Project risk is as follows:

- Proactively identify any major risks, commencing at the mine design phase, and continuing throughout all Project phases;

- Fully assess all material risks using a methodological analysis, including estimating the probability/likelihood, potential magnitude, and consequence(s) of accidents and/or malfunctions associated with the Project;

- Develop management plans, training, and education programs and facilitate a culture of risk awareness designed to prevent the above-mentioned accidents and/or malfunctions associated with the Project;

- Develop and maintain emergency preparedness and other management plans to ensure the protection of the environment, workers, and the public in case of accidents and/or malfunctions associated with the Project;

- Where elimination, avoidance, or transfer of risk is not possible, reduce the risk to as low as reasonably practicable by applying loss control and other strategies to minimize effects on the environment, workers, and public; and

- Employ adaptive management approaches and techniques to ensure continual assessment and enhancement for all risk awareness, management, mitigation and response plans, and training associated with the Project.

A systematic approach to the identification and assessment of risk is required to accomplish these objectives for a large and complex project.

23.1.2 Scope

This chapter of the Application/EIS addresses the accidents and/or malfunctions that would be associated with the Construction, Operation, Reclamation and Closure, and Post-Closure Phases of the Project that could potentially result in effects to the environment or to Aboriginal peoples, including effects to Nisga'a Nation interests and consideration of the components listed under section 5(1)(c) of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012), i.e.: changes to Aboriginal peoples' health and socio-economic conditions, physical and cultural heritage, current use of lands and resources for traditional purposes, and any structure, site, or thing that is of historical, archaeological, paleontological, or architectural significance resulting from changes to the environment. This assessment also addresses the potential effects of accidents and malfunctions that interact with *Canadian Environmental Assessment Act, 2012* (CEAA 2012) 5(1) components, including components of the natural environmental under federal jurisdiction (e.g., fish and migratory birds).

Section 9.0 of the Project's AIR (EAO 2017) states that the Application/EIS will include the following, with respect to accidents and/or malfunctions:

- Identify potential accidents and/or malfunctions;

- Provide the overall methodology for assessing the potential risk of an event (i.e., probability/likelihood and consequence);

- Define each category of probability/likelihood;

- Define each category of consequence;

- Assess the probability/likelihood of the event occurring, based on historical trends and predictive models (where appropriate);
- Identify and described proposed mitigation measures to reduce the probability/likelihood of a given event;
- Identify potential interactions between the identified events and Project Intermediate Components (ICs) and Valued Components (VCs);
- Assess the consequence of the event, in a manner consistent with the direct effects assessments outlined in this document;
- Identify measures to mitigate the risk consequences to VCs; and
- Conclude on the potential risk (probability/likelihood multiplied by consequence) of the accident and/or malfunction.

This part of the Application identifies potential accidents, malfunctions, and unplanned events that may occur in any phase of the Project. The circumstances under which these events could occur are described herein. Proposed risk mitigations and contingency plans are provided and cross-referenced with the environmental management and monitoring programs for the Project. Residual effects are defined in terms of risk and risk criteria and are used to evaluate the classification of residual effects based on the probability/likelihood that a specific severity of environmental or public consequence could occur.

Accidents and/or malfunction events assessed include, but are not limited to:

- Breach or failure of tailings dam or other containment structure;
- Spills of hazardous substances stored on site (e.g., reagents, fuels, contained liquid waste);
- Leakage or spill of materials with potential risks to the environment (including petroleum products, chemicals, and other materials) as a result of road transportation;
- Accidental release of sediments and contaminants from ore/waste rock stockpiles;
- Accidental discharge of off-specification effluent from treatment plants;
- Sediment releases into watercourses;
- Accidents related to construction and operation of underground facilities;
- Fires or explosions;
- Failure of permanent and temporary waste rock dumps or stockpiles;
- Safety to personnel resulting from in-rushes to the underground mine;

- Safety to personnel resulting from fly rock from blasting; and
- Failure of the lower adit plug, which will be installed upon closure of the mine.

Moreover, this part of the Application/EIS includes an analysis based on a Failure Modes and Effects Analysis (FMEA) approach to evaluating the probability/likelihood of a hypothetical failure of a TMF designed system and the potential consequences (effects) of that failure on selected VCs or ICs. The assessment:

- Describes key environmental and public health effects of such failures, including any effects on Nisga'a Nation interests and CEAA 2012 section 5(1) components;
- Identifies mitigation/controls incorporated into the proposed Project design to reduce risk; and
- Identifies contingency plans and response options to address residual risks.

In addition to the above-mentioned activities, IDM has specifically conducted a tailings dam breach and inundation assessment for dry and wet year events, which is summarized in this chapter, and is also presented in more detail in Volume 8, Appendix 23-A. An assessment of potential effects to Commercial, Recreational and Aboriginal (CRA) Fisheries is also presented in this chapter using results from the dam breach and inundation study.

23.1.2.1 Residual Effect Characterizations and Significance

The residual effect characterizations and significance determinations used for the VCs, ICs, Nisga'a Nation interests, and CEAA 2012 5(1)(c) components are the same as those defined in Volume 3, Chapter 6 (Effects Assessment Methodology).

The biophysical VCs and ICs discussed below include the components listed under CEAA 2012 Section 5(1)(a) and 5(1)(b):

- Fish and fish habitat as defined in subsection 2(1) of the Fisheries Act;
- Aquatic species as defined in subsection 2(1) of the Species at Risk Act;
- Migratory birds as defined in subsection 2(1) of the Migratory Birds Convention Act, 1994; and
- A change that may be caused to the environment that would occur on federal lands, in a province other than BC, or outside of Canada.

CEAA 2012 5(1)(c) components are discussed below.

23.1.2.2 Characterization of Effects to Nisga'a Nation Interests

The Nisga'a Nation interests considered for the accidents and malfunctions described below are the interests relevant to the assessments required under Chapter 10, paragraphs 8(e) and 8(f) of the NFA. These interests are:

- Nisga'a Nation Treaty right to harvest and manage Nass salmon, Nass steelhead, and eulachon;
- Nisga'a Nation Treaty right to harvest non-salmon fish, aquatic plants, and marine mammals for domestic purposes in the Nass Area;
- Nisga'a Nation Treaty right to manage and harvest wildlife for domestic purposes in the Nass Wildlife Area;
- Nisga'a Nation Treaty right to manage and harvest migratory birds for domestic purposes in the Nass Area;
- Nisga'a Nation Treaty right to access other lands;
- The economic well-being of Nisga'a citizens, including consideration of:
  - Nisga'a citizens' employment and income;
  - Nisga'a citizens' business activities;
  - Natural resource activities and related earnings or values; and
  - Future Nisga'a citizens' economic opportunities and economic development.
- The social well-being of Nisga'a citizens, including consideration of:
  - Migration and population effects in Nisga'a Nation communities;
  - Infrastructure and services in the Nisga'a Nation communities;
  - Occupational and non-occupational health and accident risks;
  - Crime; and
  - Family and community well-being.
- The cultural well-being of Nisga'a citizens', including consideration of:
  - Effects of environmental impacts on the cultural activities and practices of Nisga'a citizens;
  - Effects of changing work patterns on Nisga'a cultural activities and practices; and
  - Effects on Nisga'a language.

A characterization of potential effects to Nisga'a Nation interests are provided where potential residual effects to pathway VCs or ICs are identified; for example, Fish and Fish Habitat is a pathway VC for Nisga'a Nation Treaty right to harvest and manage fish.

23.1.2.3 Characterization of CEAA 2012 5(1)(c) Components

The CEAA 2012 5(1)(c) components have been considered for TSKLH and MNBC as Nisga'a Nation Treaty interests are discussed separately. The CEAA 2012 5(1)(c) components

considered for TSKLH and MNBC include an effect occurring in Canada of any change that may be caused to the environment on:

- Health and socio-economic conditions;
- Physical and cultural heritage;
- The current use of lands and resources for traditional purposes (CULRTP); and
- Any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

A characterization of potential effects to TSKLH's and MNBC's CEAA 2012 5(1)(c) components are provided where potential residual effects to pathway VCs or ICs are identified; for example, Fish and Fish Habitat is a pathway VC for TSKLH's and MNBC's CULRTP.

23.2 Risk Analysis Approach and Methodology

IDM's methodology for analyzing risks related to accidents and/or malfunctions consists of a four-step process:

1. Identify hazards: itemize all of the potential hazards (i.e., natural and human-made) that could affect the site of operations;
2. Evaluate frequency (probability/likelihood): the frequency of risk occurrence for each identified hazard (Table 23.2-1). Where possible, the evaluation of probability/likelihood was based on modelling or historical trends. In other instances, the evaluation was based on professional experience and expertise;
3. Evaluate consequences (severity): select the category that best describes the effects of a credible mishap on personnel, environment, and facilities, assuming that emergency planning and management controls are in place (Table 23.2-2); and
4. Evaluate risk: for each hazard, select a risk category based on probability/likelihood and consequences (Table 23.2-3).

Table 23.2-1: Probability/Likelihood Categories

Probability/Likelihood	Description in Context of Full Operating Life of the Facility	Definition
Almost Certain	The event will occur	90-100%
Likely	The event will probably occur in most circumstances	55-90%

Probability/Likelihood	Description in Context of Full Operating Life of the Facility	Definition
Possible	The event could occur at some time	30-55%
Unlikely	The event may occur at some time	5-30%
Rare	The event may occur only in exceptional circumstances	< 5%

Table 23.2-2: Consequence Severity Categories

Consequence	Definition
Critical	*Major uncontrolled event or inefficiency with uncertain and perhaps prohibitively costly remediation*. Health and Safety: Fatality. Production: More than six-month production loss or expenditure. Cost: >$50,000,000 damage or additional costs. Environmental Effect/Compliance: Very serious environmental effects with impairment on landscape/ marine ecology. Long-term, widespread, significant effects on environment. Corporate Image: Corporate image tarnished internationally. Community Affairs: Extreme and widespread community concerns with international exposure/influence.
Major	Significant event or inefficiency that can be addressed but with great effort. Health and Safety: Lost-time injury(s) potentially resulting in permanent disability. Production: Three to six months' production loss or expenditure. Cost: $20,000,000 to $50,000,000. Environmental Effect/Compliance: Serious environmental effects with impairment on ecosystems. Relatively widespread long-term effects. Corporate Image: Corporate image tarnished in North America. Community Affairs: High local community concerns with national exposure/influence.
Moderate	Moderate event or inefficiency that might need physical attention and certainly engineering review. Health and Safety: Lost-time injury (no permanent disability). Production: One to three months' production loss or expenditure. Cost: $1,000,000 to $20,000,000 damage or additional costs. Environmental Effect/Compliance: Some impairment on ecosystem function. Displacement of species. Moderate short-term widespread effects. Regulatory orders with significant cost implications. Corporate Image: Corporate image tarnished in British Columbia. Community Affairs: Moderate local community concern with potential permanent damage to relations.

Consequence	Definition
Minor	Minor incident or inefficiency that might require engineering review and is easily and predictably remediated. Health and Safety: Injury (no lost time). Production: Less than one month production loss or expenditure. Cost: $100,000 to $1,000,000 damage or additional costs. Environmental Effect/Compliance: Minor effects on biological or physical environment. Minor short-term damage to small areas. Corporate Image: Corporate image not affected; written complaint or concern dealt with internally. Community Affairs: Minimal local community concern with no lasting damage to relations.
Insignificant	Minor incident or inefficiency of little or no consequence. Health and Safety: No injury or lost time. Production: One to two weeks' production loss or expenditure. Cost: <$100,000 damage or additional costs. Environmental Effect/Compliance: No lasting effects. Low-level effects on environment. Limited damage to minimal area of low significance. Corporate Image: Corporate image not affected or verbal complaint dealt with internally. Community Affairs: No community concern

Table 23.2-3: Risk Matrix based on Probability/Likelihood vs. Consequence

Probability/Likelihood					
Consequence	**Rare**	**Unlikely**	**Possible**	**Likely**	**Almost Certain**
Critical	Moderate	Moderate	High	Extreme	Extreme
Major	Low	Moderate	Moderate	High	Extreme
Moderate	Low	Moderate	Moderate	Moderate	High
Minor	Very Low	Low	Moderate	Moderate	Moderate
Insignificant	Very Low	Very Low	Low	Low	Moderate

Risk was determined as the average of probability/likelihood and consequence. Risks in the highest categories (Table 23.2-3) would be considered as non-routine and would receive additional planning, employee training, and management scrutiny, as appropriate.

Evaluation criteria ratings (Table 23.4-3 and Table 23.4-6) were based on defined ratings for each specific risk as outlined in Volume 3, Chapter 24 (Effects of the Environment on the Project).

23.3 Risk Mitigation Measures

In order to address the risks (i.e., product of probability/likelihood and consequences) of any accidents and malfunctions, risk mitigation strategies and measures will be developed and implemented throughout the life of the Project.

These include:

- Reducing the probability/likelihood of occurrence of the event (e.g., reinforcement of structures, operating procedures);
- Reducing consequences of an event occurring (e.g., increased avoidance of sensitive periods or sites); and
- Developing system redundancies (e.g., back-up systems).

IDM will implement several mitigation actions to prevent accidents and malfunctions from occurring and to minimize the effects should such events occur.

23.3.1 Systematic Risk Assessment Approach

The results of hazard identification and risk assessment are the basis for establishing and documenting:

- Environmental, health, and safety objectives;
- Environmental, health, and safety performance targets; and
- Actions to achieve the established objectives and targets.

Each hazard classified as representing a priority risk requires an action plan with recommendations to control the risk. Recommendations include consideration for:

- Operational controls;
- Training and awareness; and
- Performance measurement and monitoring.

The action plan and recommendations are forwarded to the area manager responsible for the implementation and follow-up. In all cases, the action plan and recommendations are communicated to the interested and affected employees (and others as required). Typically, the recommendations are implemented in consultation with interested and affected employees (and others, as required).

23.3.2 Employee Training Programs

IDM will develop training programs to educate employees on Project-related risks and the associated mitigation measures and controls. As an example, employees involved in handling hazardous materials will receive specific training focused on handling procedures, spill prevention, and clean-up.

23.3.3 Inspection and Maintenance Program

IDM will implement a routine inspection and maintenance program for its equipment, facilities, and hazardous material storage facilities. Equipment containing hazardous materials will be kept in good repair. Worn or damaged transfer equipment (e.g., valves and hoses) will be replaced or repaired promptly.

23.3.4 Emergency Response

The Risk Management and Emergency Response Plan and Spill Contingency Plan will take into account the possible scenarios for major accidents and malfunctions. Suitable spill kits will be maintained at transfer points for hazardous materials.An on-site Emergency Response Team (ERT) will be established. The ERT will be trained to respond to likely spill scenarios. Field exercises and classroom training will be undertaken on an annual basis.Detailed procedures for handling and disposal of spill contaminated materials will be developed.

23.3.5 Environmental Monitoring

IDM will develop a comprehensive and adaptive Environmental Management System (EMS) for the life of the Project. Employees and contractors will receive a site induction program during which they will be made aware of the EMS, any relevant and site-specific environmental sensitivities, and reporting requirements for unsafe or hazardous situations. IDM will employ site-based environmental personnel throughout the Project's Construction, Operation, and Closure and Reclamation Phases to monitor contractor performance and to ensure that suitable environmental precautions and standards are being followed.

23.3.6 Adaptive Management

All incidents and accidents will be investigated and reported. Lessons learned from these investigations will inform revisions to work procedures and response techniques.

23.4 Risk Analysis Results

IDM has identified 15 major accidents and malfunctions: 8 of moderate risk (Table 23.4-1) and 7 of low (Table 23.4-2). No high or extreme risk accidents or malfunctions are expected to occur. IDM recognizes the importance of all risk categories, particularly health and safety.

23.4.1 Moderate Risk Accidents and Malfunctions

Eight moderate-risk accidents and/or malfunctions were identified and evaluated. Table 23.4-1 describes each of the events along with IDM's proposed control plans and response procedures. Table 23.4-2 summarizes the interactions between each event with the VCs and ICs selected for the Project's environmental assessment. Table 23.4-3 provides a brief assessment of residual risk and significance of the events on the Project's VCs and ICs.

Table 23.4-1: Moderate Risk Accidents and Malfunctions

Accident/Malfunction	Likelihood	Consequence	Risk	Controls and Plans	Response Procedures
Tailings dam breach	Rare	Critical	Moderate	Robust dam design to applicable standards, High safety factor; Emergency Response Plan; Erosion and Sediment Control Plan; Site Water Management Plan; Tailings Management Plan	• Regular monitoring will maximize probability of detecting geotechnical failures. • If geotechnical issues become apparent, proactive preventative measures will be implemented to enhance geotechnical stability • In the event of an unforeseen incident, Emergency Response Plan will be followed (including key communication procedures) and monitoring/assessment procedures will be initiated • Construction materials sufficient to repair structural damage will be available on site. • Follow-up monitoring will include assessment of incident causes and monitoring of all potentially affected ICs/VCs
Accidental discharge of sediment and metals from TMF and waste rock stockpile	Unlikely	Moderate	Moderate	Robust dam design applicable design standards; Aquatic Effects Management Plan; Emergency Response Plan; Erosion and Sediment Control Plan; Material Handling and Geochemistry Management Plan; Site Water Management Plan; Tailings Management Plan	• Regular monitoring will maximize probability of detecting geotechnical failures. • If geotechnical issues become apparent, proactive preventative measures will be implemented to enhance geotechnical stability • In the event of an unforeseen incident, Emergency Response Plan will be followed (including key communication procedures) and monitoring/assessment procedures will be initiated • Follow-up monitoring will include assessment of incident causes and monitoring of all potentially affected ICs/VCs
Minor fuel spills or hazardous materials release to water	Possible	Moderate	Moderate	Access Management Plan; Aquatic Effects Management Plan; Emergency Response Plan; Fuel Management Plan; Hazardous Materials Management Plan; Occupational Health and Safety Plan; Spill Contingency Plan; Waste Management Plan	• Identification and control of risk to human health and safety • Identification and control or risk to non-human ICs/VC • Identification and containment of spill • Notification of appropriate authorities • Recovery and remediation • Accident investigation • Follow-up monitoring will include assessment of incident causes and monitoring of all potentially affected ICs/VCs •
Minor fuel spills or hazardous materials release to land	Likely	Minor	Moderate	Access Management Plan; Emergency Response Plan; Fuel Management Plan; Hazardous Materials Management Plan; Occupational Health and Safety Plan; Spill Contingency Plan; Waste Management Plan	• Identification and control of risk to human health and safety • Identification and control or risk to non-human ICs/VC • Identification and containment of spill • Notification of appropriate authorities • Recovery and remediation • Accident investigation • Follow-up monitoring will include assessment of incident causes and monitoring of all potentially affected ICs/VCs

Accident/Malfunction	Likelihood	Consequence	Risk	Controls and Plans	Response Procedures
Explosive accident (accidental detonation of explosives, fly rock from blasting)	Rare	Major to Critical	Low to Moderate	Emergency Response Plan; Explosives Management Plan; Occupational Health and Safety Plan	• Initiate Emergency Response Plan • Identification and control of risk to human health and safety • When safe to do so, Identification and removal of additional flammable or explosive materials • Identification and control or risk to non-human ICs/VC • Notification of appropriate authorities • Recovery and remediation • Accident investigation • Follow-up monitoring will include assessment of incident causes and monitoring of all potentially affected ICs/VCs
Waste rock stockpile slope failure	Unlikely	Moderate	Moderate	Robust mine design to applicable standards; Emergency Response Plan; Occupational Health and Safety Plan; Tailings Management Plan	• Regular monitoring will maximize probability of detecting geotechnical failures • If geotechnical issues become apparent, proactive preventative measures will be implemented to enhance geotechnical stability • In the event of an unforeseen incident, Emergency Response Plan will be followed (including key communication procedures) and monitoring/assessment procedures will be initiated • Follow-up monitoring will include assessment of incident causes and monitoring of all potentially affected ICs/VCs
Failure of underground mine stability (including failure of lower adit plug)	Rare	Major to Critical	Low to Moderate	Robust mine design to applicable standards; Emergency Response Plan; Occupational Health and Safety Plan	• Regular monitoring will maximize probability of detecting geotechnical failures • If geotechnical issues become apparent, proactive preventative measures will be implemented to enhance geotechnical stability • In the event of an unforeseen incident, Emergency Response Plan will be followed (including key communication procedures) and monitoring/assessment procedures will be initiated • Identification and control of risk to human health and safety • Identification and control or risk to non-human ICs/VC • Notification of appropriate authorities • Recovery and remediation • Accident investigation • Follow-up monitoring will include assessment of incident causes and monitoring of all potentially affected ICs/VCs
Helicopter or vehicle accidents	Unlikely	Major to Critical	Moderate	Access Management Plan; Emergency Response Plan; Occupational Health and Safety Plan	• Initiation of Emergency Response Plan • Notification of appropriate authorities • Accident investigation • Follow-up monitoring will include assessment of incident causes and monitoring of all potentially affected ICs/VCs

Table 23.4-2: Summary of Moderate Risk Accidents and Malfunctions Interactions with Intermediate and Valued Components

IC/VC	Tailings dam breach	Accidental discharge from TMF or stockpile	Minor spill or release to water	Minor spill or release to land	Explosives accident	Waste rock stockpile failure	Failure of underground mine stability	Helicopter or vehicle accident
Air Quality					X			
Noise								
Soil Quantity	X							
Soil Quality	X	X		X				
Terrain Stability and Geohazards	X						X	
Hydrogeology								
Groundwater Quality								
Hydrology	X							
Surface Water Quality	X	X	X					
Sediment Quality	X	X	X					
Ecologically Valuable Soil	X			X				
Alpine and Parkland Ecosystems				X				
Old Growth and Mature Forest Ecosystems	X							
Floodplain and Wetland Ecosystems	X		X	X				
BC CDC Listed Ecosystems	X		X	X				
Rare Plants Lichens and Associated Habitats	X			X				
Mountain Goat								

IC/VC	Tailings dam breach	Accidental discharge from TMF or stockpile	Minor spill or release to water	Minor spill or release to land	Explosives accident	Waste rock stockpile failure	Failure of underground mine stability	Helicopter or vehicle accident
Grizzly Bear	X							
Moose								
Furbearers								
Bats								
Migratory Breeding Birds								
Listed Bird Species								
Raptors								
Non-migratory Game Birds								
Western Toads	X		X					
Periphyton	X	X	X					
Benthic Invertebrates	X	X	X					
Fish	X	X	X					
Fish Habitat	X	X	X					
Contemporary Land and Resource Use	X	X	X					
CRA Fisheries	X	X	X					
Project-related Employment								
Revenue to Local Economy	X							
Potential Social Issues Related to the Project								
Social and Health Services								
Housing								

IC/VC	Tailings dam breach	Accidental discharge from TMF or stockpile	Minor spill or release to water	Minor spill or release to land	Explosives accident	Waste rock stockpile failure	Failure of underground mine stability	Helicopter or vehicle accident
Infrastructure	X							
Recreational Values	X	X	X					
Project-related Traffic								
Visual Quality	X							
Cultural and Heritage Resources	X							
Human Health	X	X	X		X	X	X	X

Table 23.4-3: Assessment of Residual Risk and Significance of Moderate Risk Accidents and Malfunctions on Intermediate and Valued Components

IC/VC	Evaluation Criteria						Significance of Accident Producing Residual Effects
	Magnitude	Extent	Duration	Frequency	Reversibility	Context	
Tailings dam breach							
Soil Quantity	High	Regional	Long Term	One Time	Reversible	Neutral	Significant
Soil Quality	High	Regional	Long Term	One Time	Reversible	Neutral	Significant
Terrain Stability and Geohazards	Low	Regional	Long Term	One Time	Reversible	Neutral	Not Significant
Hydrology	High	Regional	Long Term	One Time	Permanent	High	Significant
Surface Water Quality	High	Regional	Long Term	One Time	Reversible	High	Significant
Sediment Quality	High	Regional	Long Term	One Time	Reversible	High	Significant
Ecologically Valuable Soil	High	Local	Long Term	One Time	Reversible	High	Significant
Old Growth and Mature Forest Ecosystems	High	Local	Long Term	One Time	Permanent	High	Significant
Floodplain and Wetland Ecosystems	High	Regional	Long Term	One Time	Reversible	High	Significant
BC CDC Listed Ecosystems	High	Local	Long Term	One Time	Reversible	High	Significant
Rare Plants, Lichens and Associated Habitats	High	Local	Long Term	One Time	Reversible to Permanent	High	Significant
Wildlife and Wildlife Habitat (excluding Western Toad)	Moderate	Local	Long Term	One Time	Reversible	Neutral	Not Significant
Western Toad	High	Local	Long Term	One Time	Permanent	High	Significant
Periphyton and Benthic Invertebrates	High	Regional	Long Term	One Time	Reversible	High	Significant

IC/VC	Evaluation Criteria						Significance of Accident Producing Residual Effects
	Magnitude	Extent	Duration	Frequency	Reversibility	Context	
Fish and Fish Habitat	High	Regional	Long Term	One Time	Reversible	High	Significant
Contemporary Land and Resource Use	High	Regional	Permanent	One Time	Reversible	High	Significant
CRA Fisheries	High	Regional	Long Term	One Time	Reversible	High	Significant
Revenue to Local Economy	High	Regional	Long Term	One Time	Reversible	High	Significant
Recreational Values	High	Regional	Long Term	One Time	Reversible	High	Significant
Visual Quality	High	Regional	Long Term	One Time	Reversible	High	Significant
Cultural and Heritage Resources	High	Regional	Long Term	One Time	Permanent	Low	Significant
Human Health	High	Regional	Long Term	One Time	Reversible	High	Significant
Accidental discharge from TMF or waste rock stockpile							
Soil Quality	High	Discrete	Long Term	Sporadic	Reversible	Neutral	Not Significant
Surface Water Quality	Moderate	Local	Short Term	Sporadic	Reversible	High	Not Significant
Sediment Quality	Moderate	Local	Short Term	Sporadic	Reversible	High	Not Significant
Periphyton and Benthic Invertebrates	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
Fish and Fish Habitat	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant
Contemporary Land and Resource Use	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant
CRA Fisheries	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant
Recreational Values	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant
Human Health	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant

IC/VC	Evaluation Criteria						Significance of Accident Producing Residual Effects
	Magnitude	Extent	Duration	Frequency	Reversibility	Context	
Minor Spill or Release to Water							
Surface Water Quality	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
Sediment Quality	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
Floodplain and Wetland Ecosystems	High	Discrete	Short Term	Sporadic	Reversible	High	Not Significant
BC CDC Listed Ecosystems	High	Discrete	Short Term	Sporadic	Reversible	High	Not Significant
Western Toad	High	Discrete	Long Term	Sporadic	Reversible (potentially Permanent if during breeding season)	High	Not Significant (Significant if during breeding season)
Periphyton and Benthic Invertebrates	High	Local	Short Term	Sporadic	Reversible	High	Not Significant
Fish and Fish Habitat	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
Contemporary Land and Resource Use	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
CRA Fisheries	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
Recreational Values	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
Human Health	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant
Minor Spill or Release to Land							
Soil Quality	High	Discrete	Short Term	Sporadic	Reversible	Neutral	Not Significant
Ecologically Valuable Soil	High	Discrete	Short Term	Sporadic	Reversible	Neutral	Not Significant
Alpine and Parkland Ecosystems	High	Discrete	Short Term	Sporadic	Reversible	High	Not Significant

IC/VC	Evaluation Criteria						Significance of Accident Producing Residual Effects
	Magnitude	Extent	Duration	Frequency	Reversibility	Context	
Old Growth and Mature Forest Ecosystems	High	Discrete	Short Term	Sporadic	Reversible	High	Not Significant
Floodplain and Wetland Ecosystems	High	Discrete	Short Term	Sporadic	Reversible	High	Not Significant
BC CDC Listed Ecosystems	High	Discrete	Short Term	Sporadic	Reversible	High	Not Significant
Rare Plants Lichens and Associated Habitats	High	Discrete	Short Term	Sporadic	Permanent	High	Not Significant
Explosives Accident							
Air Quality	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant
Human Health	High	Discrete	Short Term	Sporadic	Partially Reversible to Permanent	Low	Significant
Waste Rock Stockpile Failure							
Human Health	Moderate	Discrete	Short Term	Sporadic	Reversible	Low	Not Significant
Failure of Underground Stability							
Terrain Stability and Geohazards	Moderate	Discrete	Long Term	Sporadic	Permanent	Neutral	Significant
Human Health	High	Discrete	Long Term	Sporadic	Permanent	Neutral	Significant
Helicopter or Vehicle Accident							
Human Health	High	Discrete	Long Term	Sporadic	Permanent	Neutral	Significant

23.4.1.1 Tailings Dam Breach

Based on the Tailings Dam Breach Analysis (Volume 8, Appendix 23-A), which was based on a worst-case scenario predictive model, and considering the relatively small incremental effects during both the fair weather and flood-induced dam breach events, the hazard consequence classification of the Project TMF dams has been assessed to be Very High (per CDA 2013 Dam Safety Guidelines). The CDA 2013 Dam Safety Guidelines require that the determined dam hazard consequence classification be applied to the design criteria, specifically for the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) criteria. Based on the Very High dam hazard consequence classification and the applied design criteria, the design incorporates increased conservatism to reduce the likelihood of failure.

Project design considerations and the quick responsiveness afforded by key management and monitoring programs provided in Chapter 29 will be critical aspects of minimizing the likelihood of a tailings dam breach, including:

- Emergency Response Plan (e.g., pre-planning; regular emergency and safety drills; coordination with Stewart on warning and evacuation procedures);
- Erosion and Sedimentation Control Plan (e.g., ditch design, regular inspection);
- Site Water Management Plan (e.g., separation of contact and non-contact water); and
- Tailings Management Plan (e.g., runoff and seepage management, erosion and sediment control, visual monitoring).

23.4.1.1.1 Landforms and Natural Landscapes

Potential effects to Soil Quantity and Soil Quality resulting from a tailings dam breach include covering of soils with tailings, losses due to erosion, and alteration of soil chemistry. The magnitude of this effect is considered high (e.g., exceedances of applicable soil guidelines) and the effect is expected to be regional in scale. The effects will be felt long-term but are reversible as remediation efforts will augment natural recovery processes. The ecological context of soil quantity and quality is considered neutral. Based on this characterization, the effect of a tailings dam breach on Soil Quantity and Quality is expected to be significant.

Potential effects to Terrain Stability and Geohazards resulting from a tailings dam breach include slope destabilization along Bitter Creek, with increased erosion and mass wasting, and the attendant loss of streamside vegetation. Similar effects are expected along the Bear River but to a lesser extent given the less incised nature of the watercourse. The magnitude is considered low (the affected areas are already considered unstable) and the effect is expected to be regional in scale. The effects will be felt long-term, but are reversible as remediation efforts will augment natural recovery processes. The ecological context of Terrain Stability and Geohazards is considered neutral. Based on this characterization, the effect of a tailings dam breach on Terrain Stability and Geohazards is expected to be not significant.

23.4.1.1.2 Hydrology

The Tailings Dam Breach Analysis models predict substantial alteration of Bitter Creek morphology with less substantial alterations to Bear River; therefore, the magnitude is considered high and is regional in geographic extent. The effects will be felt long-term and are likely permanent. The ecological context of Hydrology is considered high. Based on this characterization, the effect of a tailings dam breach on Hydrology is expected to be significant.

23.4.1.1.3 Surface Water Quality and Sediment Quality

The potential effects of a tailing dam breach on Surface Water Quality and Sediment Quality are expected to have a high magnitude and regional geographic extent. A breach is expected to lead to multiple exceedance of applicable guidelines for the protection of aquatic life, in addition to increased sediment loads (i.e., from tailings and increased scouring). The effects will be felt long-term but are considered reversible. The ecological contexts of Surface Water Quality and Sediment Quality are considered high. Based on this characterization, the effect of a tailings dam breach on Surface Water Quality and Sediment Quality is considered significant.

23.4.1.1.4 Vegetation and Ecosystems

The potential effects of a tailings dam breach on Ecologically Valuable Soils downstream of the TMF include reductions in soil quantity and degradation of soil quality. The magnitude of this effect is considered high (e.g., exceedances of applicable soil guidelines) and the effect is expected to be local in scale. The effects will be felt long-term but are reversible, as remediation efforts will augment natural recovery processes. The ecological context of Ecologically Valuable Soils is considered neutral. Based on this characterization, the effect of a tailings dam breach Ecologically Valuable Soils is expected to be significant.

Vegetation and Ecosystem VC present downstream of the TMF (i.e., Old Growth and Mature Forested Ecosystems, Floodplain and Wetland Ecosystems, and BC CDC Listed Ecosystems) will be subjected to loss of ecosystem area and degradation of ecosystem function of a high magnitude. The bulk of these effects will be felt at a local geographic extent (i.e., within the LSA) with the possible exception of Floodplains and Wetlands (regional). The effects will persistent in the long-term and are considered reversible for some ecosystems (e.g., Floodplain and Wetland) and essentially permanent for others (e.g., Old Growth and Mature Forest). The ecological context of these ecosystem VCs is considered high. Based on this characterization, the effects of a tailings dam breach on ecosystem VC are considered significant.

The potential effects of a tailings dam breach on Rare Plants, Lichens, and Associated Habitats downstream of the TMF include the loss of rare plant occurrences in the flood zone and alteration of habitat suitability and quality (i.e., high magnitude). The geographic extent of this effect is considered regional and the effects will be felt long-term. The effects will likely be reversible for some occurrences and habitat but permanent for others (i.e., habitat conditions post-breach are substantially different from pre-breach conditions). The ecological context of these Rare Plants, Lichens, and Associated Habitats is considered high.

Based on this characterization, the effects of a tailings dam breach on Rare Plants, Lichens, and Associated Habitats are considered significant.

23.4.1.1.5 Wildlife and Wildlife Habitat

Wildlife VCs, with the exception of Western Toad, are unlikely to substantially affected in the short term by a tailings dam breach based on current knowledge of habitat preferences and distributions; however, some directly mortality is possible during the initial flood and inundation. The magnitude is considered moderate with a local geographic extent (i.e., the majority of the effects will be felt within the Wildlife LSA). Although direct mortality effect on an individual is permanent, the population-level effects are reversible in the long-term. The ecological context for Wildlife and Wildlife Habitat is neutral. Based on this characterization, the effects of a tailings dam breach on Wildlife and Wildlife Habitat (excluding Western Toad) are considered not significant.

A tailings dam breach would potentially eliminate Western Toad moderate-rated habitat along Bitter Creek. This high magnitude effect is local in geographic extent but has the potential to be permanent in duration. The ecological context for Western Toad is high. Based on this characterization, the effect of a tailings dam breach on Western Toad is considered significant.

23.4.1.1.6 Aquatic Resources

Based on the known resources in the Project area, as well as the likely scenarios from the hypothetical dam breach, the effect on Aquatic Resources could range between ‘High’ and ‘Very High’ (per CDA 2013 Dam Safety Guidelines; Appendix 23-A). There are two primary effect pathways for Aquatic Resources: habitat loss and alteration and reduction in periphyton and benthic invertebrate biomass.

The magnitude of the effect on Aquatic Resources (Periphyton and Benthic Invertebrates) is considered high with a regional geographic extent. In addition to habitat alteration resulting from scouring during the flood and the deposition of tailings and other debris into aquatic habitats will results in the alteration of surface water and sediment quality in both Bitter Creek and Bear River. The effects are expected to be long-term but reversible. The ecological context of Aquatic Resources is considered high. Based on this characterization, the effect of a tailings dam breach on Aquatic Resources is considered significant.

23.4.1.1.7 Fish and Fish Habitat

Based on the known resources in the Project area, as well as the likely scenarios from the hypothetical dam breach, the effect on Fish and Fish Habitat could range between ‘High’ and ‘Very High’ (per CDA 2013 Dam Safety Guidelines; Appendix 23-A). There are four primary effect pathways: habitat loss and alteration, reduction in periphyton and benthic invertebrate biomass, direct fish mortality, and fish exposure to contaminants.

There are no known endangered fish species that would be displaced from a hypothetical dam failure. Direct mortality of fish in the initial flood wave would likely be limited to the immediate downstream reaches of Bitter Creek, and be limited to one salmonid species (i.e., Dolly Varden).

The magnitude of the effect on Fish and Fish Habitat is considered high (primarily due to the potential exposure of fish to contaminants) and regional in geographic extent. The potential effects are considered reversible in the long-term. The ecological context of Fish and Fish Habitat is considered high. Based on this characterization, the effect of a tailings dam breach on Fish and Fish Habitat is considered significant.

23.4.1.1.8 Human Health

A flood from a fair-weather dam breach may damage or wash out the Highway 37A bridge crossing of Bitter Creek, near the Bear Creek confluence. Damage to the Highway 37A bridge crossing Bear River just north of Stewart is not expected. Flooding in the Stewart is not expected and, hence, no loss of life is predicted. However, limited loss of life may occur if industrial and recreational users are present on or near Bitter Creek during a flood. A flood-induced dam breach (i.e., a breach that occurs due to an extreme flood event) is predicted to wash out both bridges along Highway 37A and result in flooding in Stewart. The onset of flooding is predicted to occur over several hours or days, thereby allowing sufficient evacuation time; however, there remains a potential for loss of life. Secondary effects of the flooding include limited access to clean drinking water and sanitation concerns.

The magnitude of the potential effect on Human Health is considered High, with a Regional geographic extent. The effect will Long Term but reversible. The context is considered High. Based on this characterization, the effect of a tailings dam breach on Human Health is considered Significant.

23.4.1.1.9 Federal Lands, Lands Outside of BC, and Lands Outside of Canada

Based on the above biophysical and socio-economic assessments, a tailings dam breach is not anticipated to have effects on federal lands, lands outside of BC, or lands outside of Canada.

23.4.1.1.10 Effects to Nisga'a Interests

Right to Manage and Harvest Nass Salmon, Nass Steelhead, and Eulachon

A tailings dam breach has the potential to have significant, long-term, but reversible effects on CRA fisheries in the Bear River. Effects to Nisga'a citizens' health as a result of consuming Nass salmon, Nass steelhead, or eulachon from the Bear River following a tailings dam breach are unknown. Therefore, a tailings dam breach is predicted to have a high magnitude, regional extent, long-term, one-time, and reversible significant effect on Nisga'a Nation Treaty rights to harvest and manage Nass salmon, Nass steelhead, and eulachon. The context is high given the other areas with significant salmon, steelhead, and eulachon runs available to Nisga'a citizens. A tailings dam breach may have a moderate effect the NFA-defined Nisga'a allocation for Nass salmon, Nass steelhead, and eulachon for the time before the effect reverses.

Right to Harvest Aquatic Plants and Marine Mammals

As no pathway residual effect to aquatic plants or marine mammals has been identified, a tailings dam breach is unlikely to result in effects to Nisga'a Nation treaty rights to harvest aquatic plants and marine mammals.

Right to Harvest Non-Salmon Fish

Similar to effects on Nass salmon, Nass steelhead, and eulachon, a tailings dam breach is predicted to have a high magnitude, regional extent, long-term, one-time, and reversible significant effect on Nisga'a Nation Treaty rights to harvest non-salmon fish, such a Dolly Varden. The context is high given the other areas with significant fish stocks to Nisga'a citizens. A tailings dam breach may have a moderate effect the NFA-defined Nisga'a fish allocation for the time before the effect reverses.

Right to Manage and Harvest Wildlife and Migratory Birds

Based on the assessment of potential effects to Wildlife, a tailings dam breach is predicted to have a moderate magnitude, local, long-term, one-time, and reversible non-significant effect on Nisga'a Nation Treaty right to manage and harvest wildlife and migratory birds, including grizzly bears, moose, and mountain goats. The context is high given the significantly large area available to Nisga'a citizens for hunting and trapping. Effects to Nisga'a citizens' health as a result of consuming wildlife or migratory birds from the Bitter Creek or Bear River valley following a tailings dam breach are unknown. A tailings dam breach may have a low effect on the NFA-defined allocation for designated species for the time before the effect reverses.

A tailings dam breach may also have a moderate magnitude, local, long-term, one-time, and reversible non-significant effect on the Nisga'a Guide Outfitter license who may be unable to guide mountain goat hunts in the Bitter Creek valley for the time before the effect reverses. The context is high given the relatively large license area.

Right to Access Other Lands

As no pathway residual effect has been identified, a tailings dam breach is unlikely to result in effects on the ability of Nisga'a Nation representatives to access the Nass Wildlife Area to carry out their duties or on the ability of Nisga'a citizens to access Crown lands.

Nisga'a Citizens' Economic Well-being

Nisga'a citizens working at the Project and Nisga'a businesses with Project-related contracts may lose income as a result of Project activities being halted for the duration of the accident. However, this may be offset by additional employment and contracting opportunities relating to the remediation and recovery efforts.

Natural resource activities and related earnings or values are not likely to be affected.

Nisga'a Citizens' Social Well-being

As no pathway residual effect has been identified, a tailings dam breach is unlikely to result in effects to Nisga'a citizens' social well-being.

Nisga'a Citizens' Cultural Well-being

A tailings dam breach could have a positive effect on Nisga'a citizens employed at the Project as they would have more time for cultural activities and practices. Although, this might be offset by the negative effect of the tailings dam breach on hunting and fishing in the Project area.

A tailings dam breach is unlikely to affect the Nisga'a language.

23.4.1.1.11 CEAA 2012 5(1)(c) Components (TSKLH and MNBC)

Health and Socio-economic Conditions

It is IDM's understanding that TSKLH's members and MNBC's citizens reside in other communities in northwest BC, such as Terrace, Prince Rupert, and the Hazeltons. Based on this, it is unlikely that a tailings dam breach would affect TSKLH's or MNBC's health and socio-economic conditions. This includes considerations of TSKLH's and MNBC's navigable waters use; forestry and logging operations; commercial fishing, hunting, trapping, and gathering; guide outfitting; and recreational use as it is IDM's understanding that these activities are largely absent from the Project area or would be unaffected, in the case of TSKLH's trapline, by a tailings dam breach. However, the health effects of consuming fish, wildlife, or plants from the Project area following a tailings dam breach are unknown.

The socio-economic conditions of TSKLH members or MNBC citizens employed at the Project may be negatively affected by the cessation of Project operations, however this might be offset by the opportunity for work in remediation and recovery activities.

Physical and Cultural Heritage and Structures, Sites, or Things that are of Historical, Archaeological, Paleontological, or Architectural Significance

Based on the Heritage Effects Assessment (Volume 3, Chapter 21), there are no cultural or heritage resources or structures, sites, or things that are of historical, archaeological, paleontological, or architectural significance in the Project area. Therefore, they are unlikely to be affected by a tailings dam breach. A tailings dam breach may destroy unknown and unidentified cultural or heritage resources. It may also uncover previously unidentified resources.

Current Use of Lands and Resources for Traditional Purposes

Based on the above characterizations of effects to Vegetation and Ecosystems, Wildlife and Wildlife Habitat, and Fish and Fish Habitat, a tailings dam breach is likely to have a high magnitude, local, long-term, one-time, and reversible significant effect on TSKLH's and MNBC's current use of lands and resources for traditional purposes (CULRTP). The context is high given the relatively large areas utilized by both TSKLH and MNBC for their CULRTP.

23.4.1.2 Accidental Discharge of Sediment/Metals from Tailings and Waste Rock

There is the potential for accidental discharge of fine materials from tailings and waste rock to yield elevated total suspended solids (TSS) and metals to be transported into Bitter Creek and beyond, to other downstream receiving environments (e.g., Bear River). Screening of potential interactions indicates that several receptor VCs could potentially be affected by elevated TSS and metals to Bitter Creek and surface water bodies beyond: Surface Water Quality, Aquatic Resources, Fish, and Fish Habitat. The worst-case scenario for discharge would be a Tailings Dam breach (Section 23.4.1.1; Appendix 23-A). The assessment of probability and likelihood for this event was based on the authors experience with similar projects and historical trends.

A non-worst case discharge scenario would have a moderate consequence on Water Quality and Aquatic Resources, but is considered unlikely due to Project design considerations (which have been successful in minimizing risk at similar projects) and the quick responsiveness afforded by key management and monitoring programs provided in Chapter 29, including:

- Aquatic Effects Management and Response Plan (e.g., regular erosion and sediment control inspections);
- Emergency Response Plan (e.g., pre-planning and regular emergency and safety drills);
- Erosion and Sedimentation Control Plan (e.g., regular inspection, silt fencing);
- Material Handling & Geochemistry Management Plan (e.g., material segregation, waste rock characterization, runoff management);
- Site Water Management Plan (e.g., separation of contact and non-contact water); and

23.4.1.2.1 Tailings Management Plan (e.g., runoff and seepage management, erosion and sediment control, visual monitoring).Landforms and Natural Landscapes

The primary potential effect to Soil Quality resulting from the accidental discharge of sediment/metals from tailings and waste rock is the alteration of soil chemistry. The magnitude of this effect is considered high (e.g., exceedances of applicable soil guidelines) and the effect is expected to be discrete in scale. The frequency is predicted to be sporadic. The effects will be felt long-term but are reversible as remediation efforts will augment natural recovery processes. The ecological context of Soil Quality is considered neutral. Based on this characterization, the effect of a discharge on Soil Quality is expected to be not significant.

23.4.1.2.2 Surface Water Quality and Sediment Quality

Surface Water Quality and Sediment Quality in the receiving environment (surface waters) below the TMF is characterized by a relatively high degree of natural variation; this is due to the dynamic hydrological regime of watershed, with large variability, both seasonally and annually. Potential effect(s) on Surface Water Quality and Sediment Quality are considered moderate in magnitude. The majority of the parameters have a negligible to low magnitude

rating with up to 50% of parameters in Goldslide Creek having a moderate magnitude for certain months at the predicted maximum concentrations in the P50 case. The majority of these parameters had a moderate rating in only certain months and in many cases the moderate rating was due to parameters that already exceeded guidelines at background concentrations. The geographic extent will be limited to the near-field receiving environment of Bitter Creek (i.e., local geographical extent) given the natural flow and turbidity regime of Bitter Creek; it is expected that incremental concentrations of TSS and metals would be unlikely to persist along the length of Bitter Creek until the confluence with Bear River. These elevated concentrations in lower Bitter Creek would become indistinguishable from the background TSS load originating from upstream glaciers. A malfunction of the tailings system (indicated by elevated TSS levels) will be detected fairly rapidly, as a result of daily outflow water quality monitoring. This will allow for contingency measures to be rapidly put in place. Once contingency measures are fully implemented, TSS and total metals concentrations would reflect typical operating levels within days (i.e., short-term and reversible). The ecological context of Surface Water Quality and Sediment Quality are considered high. Based on this characterization, the effect of an accidental discharge on Surface Water Quality and Sediment Quality is considered not significant.

23.4.1.2.3 Aquatic Resources

Potential effects on aquatic resources (e.g., periphyton, benthic invertebrates) will result mainly from increased TSS and metals loadings into Bitter Creek; these increases could yield both direct and indirect effects from sediment and direct toxic effects from elevated metals concentrations. Increased sediment loads (i.e., high TSS) have the potential to smother aquatic organisms (i.e., benthic invertebrates), interfere with light availability for aquatic primary production (i.e., periphyton and phytoplankton), inhibit oxygen diffusion in the benthic environment, increase scour in stream habitats, and vary sediment particle size distributions. Elevated metal concentrations from tailings discharge could potentially result in acute and chronic toxic effects on aquatic organisms (i.e., benthic invertebrates). As with potential effects to surface water quality, the duration of elevated TSS and metals will be limited; therefore, the duration of effects to Aquatic Resources will also be limited. Periphyton and benthic invertebrates tend to have relatively short generation times and are resilient to environmental variability in the above-mentioned parameters.

The magnitude of the effect is considered high, with a local geographic extent. The sporadic occurrences will have a long-term duration but are reversible. The ecological context of Aquatic Resources is considered high. Based on this characterization, the effect of an accidental discharge on Aquatic Resources is considered not significant.

23.4.1.2.4 Fish and Fish Habitat

The potential effect of an accidental discharge on Fish and Fish Habitat is considered to have a low magnitude as the nearest fish-bearing waters are at least 0.5 km from the location at which there may be a potential release. Any increase in TSS or metals originating from the TMF is not expected to be distinguishable from background sources beyond Hartley Gulch, due to the dynamic hydrological regime of watershed, with large variability both seasonally and annually. The geographic extent of the effect will be local with sporadic frequency. The effects are expected to be short-term and reversible. The ecological context of Fish and Fish

Habitat is high. Based on this characterization, the effect of an accidental discharge on Fish and Fish Habitat is considered not significant.

23.4.1.2.5 Economic

Two Economic VCs are potentially affected by an accidental discharge: Contemporary Land and Resource Use and CRA Fisheries. The potential effect of an accidental discharge on both VCs is considered to have a low magnitude as the nearest fish-bearing waters are at least 0.5 km from the location at which there may be a potential release. Any increase in TSS or metals originating from the TMF is not expected to be distinguishable from background sources beyond Hartley Gulch, due to the dynamic hydrological regime of watershed, with large variability both seasonally and annually. The geographic extent of the effect will be local with sporadic frequency. The effects are expected to be short-term and reversible. The context of the two affected Economic VCs is high. Based on this characterization, the effect of an accidental discharge on Economic VCs is considered not significant.

23.4.1.2.6 Social

The potential effect of an accidental discharge on Recreational Values is mediated through fishing opportunities. This effect is considered to have a low magnitude, as the nearest fish-bearing waters are at least 0.5 km from the location at which there may be a potential release. Any increase in TSS or metals originating from the TMF is not expected to be distinguishable from background sources beyond Hartley Gulch, due to the dynamic hydrological regime of watershed, with large variability both seasonally and annually. The geographic extent of the effect will be local with sporadic frequency. The effects are expected to be short-term and reversible. The context is high. Based on this characterization, the effect of an accidental discharge on Recreational Values is considered not significant.

23.4.1.2.7 Human Health

Human Health may be affected by an accidental discharge into the receiving environment if individuals ate fish contaminated by the discharge. Given the mitigation measures proposed by IDM (e.g., access restrictions, community notification of accidents), it is expected that this potential effect will be low in magnitude and local in geographic extent. The effects are considered short-term and reversible. The context is considered high. Based on this characterization, the effect of an accidental discharge on Human Health is considered not significant.

23.4.1.2.8 Federal Lands, Lands Outside of BC, and Lands Outside of Canada

Based on the above biophysical and socio-economic assessments, an accidental discharge of fine materials from tailings and waste rock is not anticipated to have effects on federal lands, lands outside of BC, or lands outside of Canada.

23.4.1.2.9 Effects to Nisga'a Interests

Right to Manage and Harvest Nass Salmon, Nass Steelhead, and Eulachon

Based on the above assessment of potential residual effects on Fish and Fish Habitat, an accidental discharge of fine materials from tailings and waste rock has the potential to have a low magnitude, short-term, local, sporadic, and reversible non-significant effect on Nisga'a Nation Treaty rights to harvest and manage Nass salmon, Nass steelhead, and eulachon. The context is high given the other areas with significant salmon, steelhead, and eulachon runs available to Nisga'a citizens. Given the high context and short-term, local nature of the effect, it is unlikely to have an effect on the NFA-defined Nisga'a allocation for Nass salmon, Nass steelhead, and eulachon.

Right to Harvest Aquatic Plants and Marine Mammals

As no pathway residual effect to aquatic plants or marine mammals has been identified, an accidental discharge of fine materials from tailings and waste rock is unlikely to result in effects to Nisga'a Nation treaty rights to harvest aquatic plants and marine mammals.

Right to Harvest Non-Salmon Fish

Similar to effects on Nass salmon, Nass steelhead, and eulachon, an accidental discharge of fine materials from tailings and waste rock is predicted to have a low magnitude, local extent, short-term, sporadic, and reversible non-significant effect on Nisga'a Nation Treaty rights to harvest non-salmon fish, such a Dolly Varden. The context is high given the other areas with significant fish stocks to Nisga'a citizens. An accidental discharge of fine materials from tailings and waste rock is unlikely to have an effect the NFA-defined Nisga'a fish allocation.

Right to Manage and Harvest Wildlife and Migratory Birds

As no pathway residual effect to Wildlife and Wildlife Habitat has been identified, an accidental discharge of fine materials from tailings and waste rock is unlikely to result in effects to Nisga'a Nation treaty rights to harvest aquatic plants and marine mammals.

Right to Access Other Lands

As no pathway residual effect has been identified, an accidental discharge of fine materials from tailings and waste rock is unlikely to result in effects on the ability of Nisga'a Nation representatives to access the Nass Wildlife Area to carry out their duties or on the ability of Nisga'a citizens to access Crown lands.

Nisga'a Citizens' Economic Well-being

As no pathway residual effect has been identified, it is unlikely that an accidental discharge of fine materials from tailings and waste rock would result in effects to Nisga'a citizens' economic well-being.

Nisga'a Citizens' Social Well-being

As no pathway residual effect has been identified, it is unlikely that an accidental discharge of fine materials from tailings and waste rock would result in effects to Nisga'a citizens' social well-being.

Nisga'a Citizens' Cultural Well-being

The potential low magnitude effect to Nisga'a Nation Treaty right to harvest and manage fish, including Nass salmon, Nass steelhead, eulachon, and non-salmon fish, may have a low magnitude, local, short-term, sporadic, and reversible non-significant effect on Nisga'a citizens' cultural well-being. The context is high considering the relatively large area available to Nisga'a citizens for cultural activities and practices.

23.4.1.2.10 CEAA 2012 5(1)(c) Components (TSKLH and MNBC)

Health and Socio-economic Conditions

Based on the assessment above of potential effects to social and economic VCs and considering IDM's understanding that TSKLH's members and MNBC's citizens reside in other communities in northwest BC, such as Terrace, Prince Rupert, and the Hazeltons, an accidental discharge of fine materials from tailings and waste rock is unlikely to affect TSKLH's and MNBC's socio-economic conditions.

Physical and Cultural Heritage and Structures, Sites, or Things that are of Historical, Archaeological, Paleontological, or Architectural Significance

Based on the Heritage Effects Assessment (Volume 3, Chapter 21), there are no cultural or heritage resources or structures, sites, or things that are of historical, archaeological, paleontological, or architectural significance in the Project area. Therefore, they are unlikely to be affected by an accidental discharge of fine materials from tailings and waste rock.

Current Use of Lands and Resources for Traditional Purposes

Based on the above characterizations of effects to Fish and Fish Habitat, an accidental discharge of fine materials from tailings and waste rock is likely to have a low magnitude, local, short-term, sporadic, and reversible non-significant effect on TSKLH's and MNBC's CULRTP. The context is high given the relatively large areas utilized by both TSKLH and MNBC for their CULRTP.

23.4.1.3 Minor Fuel Spills or Hazardous Material Releases to Land and Water

There are many potential pathways for a minor fuel spill or hazardous material release to land or water, including vehicle accidents, containment leaks or ruptures, or poor storage and handling. The assessment of probability and likelihood for this event was based on the authors experience with similar projects and historical trends. Key risk mitigation measures to minimize the probability and consequence of fuel spills and hazardous material releases to land and water include:

- The development and implementation of key Chapter 29 environmental management plans (see Volume 5, Chapter 29) related to spill response and material handling:
  - Aquatic Effects Management Plan (e.g., monitoring);
  - Fuel Management Plan (e.g., lined and bermed containment of fuel storage areas);
  - Hazardous Materials Management Plan (e.g., material-specific containment measures);
  - Spill Contingency Plan (e.g., staff training; containment design, spill response plans); and
  - Waste Management Plan (e.g., waste separation and containment, recycling and landfill diversion).
- The development and implementation of key management plans related to safe operation and emergency response:
  - Access Management Plan (e.g., limiting traffic on Access Road by using buses to transport personnel from Stewart);
  - Emergency Response Plan (e.g., pre-planning and regular emergency and safety drills); and
  - Occupational Health and Safety Plan (e.g., staff training and awareness; hazard assessment).

Based on standard practice, extremely hazardous materials (e.g., certain chemical reagents and explosives) are packaged in such a manner that a traffic accident-related spill would be quite rare. The shipped quantities of other, less hazardous materials are relatively small or of low relatively toxicity.

The consequence is higher for a spill or release to water (Moderate) than it is for a spill or release to land (Minor), as aquatic systems tend to be more sensitive to the effects of spills/releases than are terrestrial systems. However, the likelihood of a spill/release to water was considered to be lower (Possible) than a potential spill/release to land (Likely) given Project design criteria and the implementation of multiple management plans designed to minimize the potential for adverse effects to water quality. Both consequence-likelihood combinations lead to a risk rating of Moderate for both scenarios.

The worst-case scenario for a large fuel spill is provided in Section 23.4.2.1.

The screening of potential interactions indicated the VCs and ICs that could potentially be affected are Soil Quality, Surface Water and Sediment Quality, Vegetation and Ecosystems, Aquatic Resources, Fish and Fish Habitat (including CRA Fisheries), Economic, Social, and Human Health. The most likely locations for accidents and malfunctions of this class will be terrestrial and/or aquatic environments adjacent to the 26 km Access Road from Highway 37A to the mine. Adjacent waters include Bitter Creek, Bear River, and smaller-order tributaries of these aquatic ecosystems. A number of these ecosystems are fish-bearing streams. Wetlands located adjacent to the Access Road could also be affected by fuel spills. However, based on ecological baseline studies in and around the LSA, it has been determined that the only wetland areas near the Access Road would be the outlet of Clements Lake.

23.4.1.3.1 Landforms and Natural Landscapes

Potential direct effects on Soil Quality include changes in electrical conductivity and soil pH, and the introduction of diesel fuel, gasoline, or other materials to the spill/release location. Spills and releases will be managed by both containment and rapid recovery of materials using state-of-the-art methods (e.g., spill kits and absorbents). Although the magnitude of these potential effects could be high (e.g., exceedances of applicable soil guidelines), the rapid detection of and response to the spill or release at the time of the accident will limit the geographic extent (discrete) and duration (short-term) of any effect. The frequency is predicted to be sporadic. The effects are considered reversible. The ecological context of Soil Quality is considered neutral. Based on this characterization, the effect of a minor spill or release on Soil Quality is expected to be not significant.

23.4.1.3.2 Surface Water Quality and Sediment Quality

Potential effects of minor spills to water on Surface Water Quality and Sediment Quality will be direct and are considered high in magnitude, as they could result in elevated concentrations of hydrocarbons, among other substances, above permitted discharge limits or applicable guidelines. The geographic extent will be limited to the near-field receiving environment the spill or release (i.e., local). Lighter fuel components will likely remain on the water surface where they will volatilize and become diluted. Compounds such as benzene, toluene, ethylbenzene, and xylenes (BTEX), although toxic, volatilize relatively rapidly. Methyl tert butyl ether (MTBE) and other additives will dissolve in the water but will continue to evaporate from surfaces. In general, lighter fuels, such as gasoline, volatize more rapidly than heavier diesel fuels; these latter fuels tend to persist in the environment. Finally, compounds such as polycyclic aromatic hydrocarbons (PAHs) will persist, requiring several years to degrade. Therefore, the duration of the potential effect is considered long-term. Given the proposed implementation of detailed management plans (e.g., Spill Contingency Plan), detection of the fuel spill will be immediate and will be followed by a rapid response. Containment will be implemented using booms and temporary diversions for small waterways and rapid recovery of materials. Once contained, IDM will immediately implement appropriate site remediation activities, contributing to a reversible potential effect. The ecological context of Surface Water Quality and Sediment Quality are considered

high. Based on this characterization, the effect of a minor spill or release to water on Surface Water Quality and Sediment Quality is considered not significant.

23.4.1.3.3 Vegetation and Ecosystems

Minor spills and releases onto land or water have the potential to effect Vegetation and Ecosystems through the alteration of soil or water quality or direct damage to plants. The magnitude of these effects is considered high (i.e., exceedance of applicable guidelines) but with a discrete geographic extent (i.e. limited to the location of the spill or release). Rapid and detection of a spill or release will limit the duration of the effects (short-term) and effects are expected to be reversible. Should a minor spill or release occur in the vicinity of a rare plant occurrence such that the occurrence itself is directly affected, the duration of the effect on Rare Plants, Lichens, and Associated Habitat would be permanent. The ecological context of Ecologically Valuable Soils is considered neutral, with the other Vegetation and Ecosystem VCs having high contexts. Based on this characterization, the effect of a minor spill or release on Vegetation and Ecosystems is considered not significant.

23.4.1.3.4 Wildlife and Wildlife Habitat

The potential effects of a minor spill or release on Wildlife and Wildlife Habitat will likely be restricted to effects on Western Toads given their discrete distribution and narrow ecological niche. If a minor spill occurs in the vicinity of Western Toad habitat, the effect could have a high magnitude effect with a discrete geographic extent. The duration of the effect would be long-term and, depending on the timing of the spill, the effect will be reversible. The ecological context for Western Toad is high. Based on this characterization, the effect of most minor spills or release to water on Western Toad is considered not significant. If the spill or release occurred directly into a breeding pond during the breeding season (i.e., when fertilized eggs or tadpoles are present), the effect could be considered significant.

23.4.1.3.5 Aquatic Resources

Potential effects on Aquatic Resources due to a minor spill or release scenario are direct toxicity from the fuel hydrocarbon compounds and indirect effects from the accumulation of hydrocarbons in sediments. The consequence of these effects will depend on the environmental conditions at the spill location and could be confounded by the environmental fates of various fuel constituents. Streamflow mixing or waves can increase exposure of the fuel compounds to aquatic organisms and consequently increase the magnitude of toxicity. The persistence of chemical constituents of the fuel is related to physical, chemical, and biological factors, such as temperature, oxygen concentration, and microbial activity. Although spill response and volatilization will help to minimize the exposure of periphyton and benthic invertebrates to the majority of the fuel, some of the constituents can be persistent in alpine environments and accumulate in the receiving benthic environment.

The magnitude of the effect is considered high (e.g., exceedance of applicable guidelines) and local in geographic extent. The effects of these sporadic incidents are predicted to have a short-term duration as Periphyton and Benthic Invertebrates have relatively short generation times and the spill/release response would be rapid. The potential effects are

considered reversible. The ecological context is considered high. Based on this characterization, the effect of a minor spill or release to water on Aquatic Resources is considered not significant.

23.4.1.3.6 Fish and Fish Habitat

Effects of a minor fuel spill or release on the Fish and Fish Habitat will be via a number of pathways: direct chemical toxicity via the water column, physical effects on fish coming into contact with spilled fuel, and indirectly, via ingestion by fish of primary and secondary producers. The consequence is considered to be Moderate since petroleum compounds have the potential to be toxic to fish and aquatic organisms; these compounds can cause mortality at high concentrations. In addition, adverse effects on fish health and/or altered behaviour at sublethal concentrations are also possible. The toxicity of petroleum-derived compounds occurs via their water-soluble constituents, and toxicity increases in low dissolved oxygen conditions. Fish behaviour (avoidance) can change after exposure to sublethal concentrations of spilled petroleum constituents in response to the physiological changes caused by the toxins. Fish populations and habitats further downstream of a spill may experience measureable effects; however, IDM has implemented plans and systems that will allow for rapid spill detection and response.

The magnitude of the effects is considered high and local in geographic extent. The effects of these sporadic incidents could have long-term duration but are considered reversible. The ecological context is considered high. Based on this characterization, the effect of a minor spill or release to water on Fish and Fish Habitat is considered not significant.

23.4.1.3.7 Economic

Two Economic VCs are potentially affected by a minor spill or release to water: Contemporary Land and Resource Use and CRA Fisheries. Effects of a minor fuel spill or release on these Economic VCs will be via a number of pathways: direct chemical toxicity via the water column, physical effects on fish coming into contact with spilled fuel, and indirectly, via ingestion by fish of primary and secondary producers. The consequence is considered to be Moderate since petroleum compounds have the potential to be toxic to fish and aquatic organisms; these compounds can cause mortality at high concentrations. In addition, adverse effects on fish health and/or altered behaviour at sublethal concentrations are also possible. The toxicity of petroleum-derived compounds occurs via their water-soluble constituents, and toxicity increases in low dissolved oxygen conditions. Fish behaviour (avoidance) can change after exposure to sublethal concentrations of spilled petroleum constituents in response to the physiological changes caused by the toxins. Fish populations and habitats further downstream of a spill may experience measureable effects; however, IDM has implemented plans and systems that will allow for rapid spill detection and response.

The magnitude of the effects is considered high and local in geographic extent. The effects of these sporadic incidents could have long-term duration but are considered reversible. The context is considered high. Based on this characterization, the effect of a minor spill or release to water on Fish and Fish Habitat is considered not significant.

These Economic VCs are not expected to interact with a minor spill or release to land.

23.4.1.3.8 Social

The potential effect of minor spill or release on Recreational Values is mediated through fishing opportunities along three pathways: direct chemical toxicity via the water column, physical effects on fish coming into contact with spilled fuel, and indirectly, via ingestion by fish of primary and secondary producers. The consequence is considered to be Moderate since petroleum compounds have the potential to be toxic to fish and aquatic organisms; these compounds can cause mortality at high concentrations. In addition, adverse effects on fish health and/or altered behaviour at sublethal concentrations are also possible. The toxicity of petroleum-derived compounds occurs via their water-soluble constituents, and toxicity increases in low dissolved oxygen conditions. Fish behaviour (avoidance) can change after exposure to sublethal concentrations of spilled petroleum constituents in response to the physiological changes caused by the toxins. Fish populations and habitats further downstream of a spill may experience measureable effects; however, IDM has implemented plans and systems that will allow for rapid spill detection and response.

This effect is considered to have a low magnitude as the nearest fish-bearing waters are at least 0.5 km from the location at which there may be a potential release. Any increase in TSS or metals originating from the TMF is not expected to be distinguishable from background sources beyond Hartley Gulch, due to the dynamic hydrological regime of watershed, with large variability both seasonally and annually. The geographic extent of the effect will be local with sporadic frequency. The effects are expected to be short-term and reversible. The context is considered high. Based on this characterization, the effect of minor spill or release on Recreational Values is considered not significant.

23.4.1.3.9 Human Health

Human Health may be affected by a minor spill to land or water if individuals ate fish or plants contaminated by the spill. Given the mitigation measures proposed by IDM (e.g., access restrictions; community notification of accidents), it is expected that this potential effect will be low in magnitude and local in geographic extent. The effects are considered short-term and reversible. The context is considered high. Based on this characterization, the effect of minor spill on Human Health is considered not significant.

23.4.1.3.10 Federal Lands, Lands Outside of BC, and Lands Outside of Canada

Based on the above biophysical and socio-economic assessments, a minor release of fuel or hazardous materials to land or water is not anticipated to have effects on federal lands, lands outside of BC, or lands outside of Canada.

23.4.1.3.11 Effects to Nisga'a Interests

Right to Manage and Harvest Nass Salmon, Nass Steelhead, and Eulachon

A minor release of fuel or hazardous materials to land is unlikely to affect Nisga'a Nation Treaty rights to harvest and manage Nass salmon, Nass steelhead, and eulachon due to lack of pathway effect.

Based on the above assessment of potential residual effects on Fish and Fish Habitat due to a minor release of fuel or hazardous materials to water, such an event has the potential to have a high magnitude, long-term, local, sporadic, and reversible non-significant effect on Nisga'a Nation Treaty rights to harvest and manage Nass salmon, Nass steelhead, and eulachon. The context is high given the other areas with significant salmon, steelhead, and eulachon runs available to Nisga'a citizens. Given the high context and local extent but long-term duration, such an event may have a low magnitude effect on the NFA-defined Nisga'a allocation for Nass salmon, Nass steelhead, and eulachon.

Right to Harvest Aquatic Plants and Marine Mammals

As no pathway residual effect to aquatic plants or marine mammals has been identified, a minor release of fuel or hazardous materials to water or land is unlikely to result in effects to Nisga'a Nation treaty rights to harvest aquatic plants and marine mammals.

Right to Harvest Non-Salmon Fish

Similar to effects on Nass salmon, Nass steelhead, and eulachon, a minor release of fuel or hazardous materials to land is unlikely to affect Nisga'a Nation Treaty rights to harvest non-salmon fish due to lack of pathway effect.

A minor release of fuel or hazardous materials to water is predicted to have a high magnitude, local extent, long-term, sporadic, and reversible non-significant effect on Nisga'a Nation Treaty rights to harvest non-salmon fish, such a Dolly Varden. The context is high given the other areas with significant fish stocks to Nisga'a citizens. A minor release of fuel or hazardous materials to water may have a low magnitude effect the NFA-defined Nisga'a fish allocation.

Right to Manage and Harvest Wildlife and Migratory Birds

As no pathway residual effect to Wildlife and Wildlife Habitat has been identified, a minor release of fuel or hazardous materials to water or land is unlikely to result in effects to Nisga'a Nation right to manage and harvest wildlife and migratory birds.

Right to Access Other Lands

As no pathway residual effect has been identified, a minor release of fuel or hazardous materials to water or land is unlikely to result in effects to the ability of Nisga'a Nation representatives to access the Nass Wildlife Area to carry out their duties or on the ability of Nisga'a citizens to access Crown lands.

Nisga'a Citizens' Economic Well-being

As no pathway residual effect has been identified, a minor release of fuel or hazardous materials to water or land is unlikely to result in effects to Nisga'a citizens' economic well-being.

Nisga'a Citizens' Social Well-being

As no pathway residual effect has been identified, a minor release of fuel or hazardous materials to water or land is unlikely to result in effects to Nisga'a citizens' social well-being.

Nisga'a Citizens' Cultural Well-being

The potential effect to Nisga'a Nation Treaty right to harvest and manage fish, including Nass salmon, Nass steelhead, eulachon, and non-salmon fish, may have a low magnitude, local, short-term, sporadic, and reversible non-significant effect on Nisga'a citizens' cultural well-being. The context is high considering the relatively large area available to Nisga'a citizens for cultural activities and practices.

23.4.1.3.12 CEAA 2012 5(1)(c) Components (TSKLH and MNBC)

Health and Socio-economic Conditions

Based on the assessment above of potential effects to social and economic VCs and considering IDM's understanding that TSKLH's members and MNBC's citizens reside in other communities in northwest BC, such as Terrace, Prince Rupert, and the Hazeltons, a minor release of fuel or hazardous materials to water or land is unlikely to affect TSKLH's and MNBC's socio-economic conditions.

Physical and Cultural Heritage and Structures, Sites, or Things that are of Historical, Archaeological, Paleontological, or Architectural Significance

Based on the Heritage Effects Assessment (Volume 3, Chapter 21), there are no cultural or heritage resources or structures, sites, or things that are of historical, archaeological, paleontological, or architectural significance in the Project area. Therefore, they are unlikely to be affected by a minor release of fuel or hazardous materials to water or land.

Current Use of Lands and Resources for Traditional Purposes

Based on the above characterizations of effects to Fish and Fish Habitat and Vegetation and Ecosystems, a minor release of fuel or hazardous materials to water or land is likely to have a high magnitude, local, long-term, sporadic, and reversible non-significant effect on TSKLH's and MNBC's CULRTP. The context is high given the relatively large areas utilized by both TSKLH and MNBC for their CULRTP.

23.4.1.4 Explosives Accident

The type of explosives proposed for use on the Project is quite common and is used by mining companies throughout Canada and internationally. IDM's focus on safety will ensure that appropriate procedures are in place and strictly followed. Potential accidents resulting from the use of explosives include injury to personnel resulting from fly rock during blasting activities and the accidental detonation of the explosive magazine. The assessment of probability and likelihood for this event was based on historical trends. Explosives mishaps account for 5.8% of incidents reports to the BC Ministry of Energy and Mines over the

period of 2010-2015[1]. Based on this, the likelihood of an accident or malfunction related to explosives use has been assessed as Rare.

For the purpose of addressing the AIR requirements regarding accidents and malfunctions, the worst-case scenario for explosives is considered to be the detonation of a full Operation Phase explosives magazine. The explosives magazine will be located near the Mine Site Waste Rock Storage Area, which is at a sufficient distance from other facilities prescribed as by federal regulations (i.e., the *Explosives Act*) to ensure that the safety of personnel and facilities is preserved in the Rare event of an accident or malfunction. The Explosives Management Plan includes actions that serve to minimize accidents of all sizes (e.g., use of blast mats to minimize spread of fly rock).

There will be short-term Air Quality effects from the resulting fire and smoke, but limited to no release of materials to the receiving environment, as it assumed that the explosion would result in complete combustion of materials. The magnitude of a potential effect of an explosion on Air Quality is considered low, with a local geographic extent. The effect would be short-term and reversible. The ecological context for Air Quality is neutral. Based on this characterization, the potential effect of an explosives accident on Air Quality is considered not significant.

A worst-case scenario would involve the detonation of a recently stocked explosives magazine (surface: 20,000 kilogram (kg); underground 36,000 kg). The principal effects will be health- and safety-related, and it is expected that a worst-case scenario would result in one or more injuries or fatalities as an accident or malfunction is most likely to be human-caused and a consequence ranking of Major to Critical. An Emergency Response Plan will be in place to address explosives-related incidents; key features of this plan include pre-planning and regular emergency and safety drills. The Project will have comprehensive first aid facilities and qualified first aid attendants equipped to handle major incidents. Moreover, there will be an ambulance and rapid access to a helicopter for transportation of injured persons to the nearest hospital. Given the isolated location of the explosives magazine (both surface and underground), very few fatalities and injuries would be expected in the worst-case scenario and should not overly burden local health facilities and infrastructure.

The magnitude of a potential effect of explosions on Human Health is high, with a discrete geographic extent. The duration of the effect would be long-Term and partially reversible (in the case of human injury) or permanent (in the unlikely event of a human fatality). The context is considered low. Based on this characterization, the potential effect of an explosive accident on Human Health is considered significant.No other biophysical or socio-economic effects are anticipated.

23.4.1.4.1 Federal Lands, Lands Outside of BC, and Lands Outside of Canada

Based on the above assessment, an explosives accident is not anticipated to have effects on federal lands, lands outside of BC, or lands outside of Canada.

[1] http://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/further-information/reports-publications/chief-inspector-s-annual-reports

23.4.1.4.2 Effects to Nisga'a Interests

As no biophysical pathway residual effects have been identified, an explosives accident is unlikely to result in effects to Nisga'a Nation Treaty right to manage and harvest Nass salmon, Nass steelhead, and eulachon; to harvest aquatic plants and marine mammals; to harvest non-salmon fish; to manage and harvest wildlife and migratory birds; or to access other lands.

As no pathway residual effects have been identified, an explosives accident is unlikely to result in changes to Nisga'a citizens' economic or cultural well-being.

In the event of injuries or fatalities resulting from an explosives accident, a high magnitude effect on Nisga'a citizens' social well-being may occur as a result of grieving the loss of a colleague and/or relative. The effect would have a regional geographic extent if one or more of the individuals involved were Nisga'a citizens with a long-term effect that would be partially reversible. The context would be low. The effect may be significant.

23.4.1.4.3 CEAA 2012 5(1)(c) Components (TSKLH and MNBC)

As no pathway residual effects have been identified, an explosives accident is unlikely to result in effects to TSKLH's and MNBC's health and socio-economic conditions; physical or cultural heritage; structures, sites, or things that are of historical, archaeological, paleontological, or architectural significance; or CULRTP.

23.4.1.5 Failure of Waste Rock Dumps or Stockpiles

The risk analysis identified potential accidents/malfunctions associated with the failure of the waste rock dump or stockpiles associated with health and safety and cost. The assessment of probability and likelihood for this event was based on the authors experience with similar projects and historical trends. The analysis did not identify any environmental effects of this failure, as the current design standards incorporate the potential for stockpile failure at maximum capacity. Human injury may occur if employees are on or in the vicinity of the waste rock pile when a slump or failure occurs.

The magnitude of this potential effect on Human Health is considered moderate, with a discrete geographic extent. The duration of the effect is short-term and reversible. The context is low. Based on this characterization, the potential effect of the failure of the waste rock stockpile is considered not significant.

The worst-case scenario for a failure of the waste rock pile at peak storage capacity of 76,000 tonnes. This scenario is considered Unlikely based on conservative design standards, the geological stability of the location (Volume 7, Appendix 1-A), implementation of best management practices for waste rock pile construction methodologies, and a frequent, proactive monitoring of pile stability.

23.4.1.5.1 Federal Lands, Lands Outside of BC, and Lands Outside of Canada

Based on the above assessment, a failure of the waste rock dump or stockpiles is not anticipated to have effects on federal lands, lands outside of BC, or lands outside of Canada.

23.4.1.5.2 Effects to Nisga'a Interests

As no biophysical pathway residual effects have been identified, a failure of the waste rock dump or stockpiles is unlikely to result in effects to Nisga'a Nation Treaty right to manage and harvest Nass salmon, Nass steelhead, and eulachon; to harvest aquatic plants and marine mammals; to harvest non-salmon fish; to manage and harvest wildlife and migratory birds; or to access other lands.

As no pathway residual effects have been identified, a failure of the waste rock dump or stockpiles is unlikely to result in changes to Nisga'a citizens' economic or cultural well-being.

In the event of injuries resulting from a failure of the waste rock dump or stockpiles, a moderate to magnitude effect on Nisga'a citizens' social well-being may occur. The effect would have a regional geographic extent if one or more of the individuals involved were Nisga'a citizens with a long-term effect that would be partially reversible to irreversible, depending on the type of injury. The context would be low. The effect may be significant.

23.4.1.5.3 CEAA 2012 5(1)(c) Components (TSKLH and MNBC)

As no pathway residual effects have been identified, a failure of the waste rock dump or stockpiles is unlikely to result in effects to TSKLH's and MNBC's health and socio-economic conditions; physical or cultural heritage; structures, sites, or things that are of historical, archaeological, paleontological, or architectural significance; or CULRTP.

23.4.1.6 Failure of Underground Mine Stability

The risk analysis conducted identified four potential accidents/malfunctions associated with underground mine emergencies, including roof fall. The assessment of probability and likelihood for this event was based on modeling and the authors experience with similar projects and historical trends. These were associated with potential effects to health and safety, production, cost, and reputation.

The crown pillar will be mined using a combination of drift-and-fill and longhole stoping to mine in close proximity to the surface. The crown pillar will be mined at the end of the mine life to minimize the effects of subsidence on the operation. The planned drift-and-fill excavations have a minimum pillar thickness of 12.5 metres (m) and longhole stoping will create a 20 m thick crown pillar. The crown pillar falls within the Red Domain, based on the geotechnical domain classification (Volume 7, Appendix 1-E, Section 6.1). The crown pillar was assessed using the Scaled Crown Pillar method to determine the short and long term stability. The crown pillar falls within Classes A to C (Figure 7.12, Appendix 1-E) indicating limited stand-up time. In order to achieve long-term crown pillar stability, crushed rock fill will be used to tightly backfill the drift-and-fill and long-hole excavations. Based on the current mine design, the crown pillar is expected to be temporarily stable and long-term stability will be achieved through tight backfilling of excavations.

Lower adit plug failure would result in either a gradual or sudden release of groundwater. A sudden release would result in increased flow to Goldslide Creek. The portal plug has been designed for a 250+ year useful life and is very unlikely to fail based on design safety factor of safety and ongoing inspection.

Volume 7, Appendix 1-F assesses the underlying geology of the Project, mine plan, and other site-specific conditions that support the Rare likelihood assessment. It is expected that a worst-case scenario would result in one or more injuries or fatalities as an accident or malfunction is most likely to be human-caused and a consequence ranking of Major to Critical. An Emergency Response Plan will be in place to address mine collapse incidents. The Project will have comprehensive first aid facilities and qualified first aid attendants equipped to handle major incidents. Moreover, there will be an ambulance and rapid access to a helicopter for transportation of injured persons to the nearest hospital. The Emergency Response Plan will include contingencies to distributing injured persons to multiple hospitals (including Terrace and Smithers) to minimize the potential for overloading local health infrastructure.

The analysis identified one potential environmental effect to Terrain Stability and Geohazards. The magnitude of this effect would be moderate with a discrete geographic extent. The effect would be long-term and permanent. The ecological context is considered neutral. Based on this characterization, the potential effect of failure in underground mine stability on Terrain and Geohazards is considered significant.

The magnitude of a potential effect on Human Health is considered high due to the possibility of human injury or fatality. The geographic extent is discrete, the duration is long-term, and is partially reversible (in the case of injury) or permanent (in the case of a fatality). The context is considered low. Based on this characterization, the potential effect of failure in underground mine stability on Human Health is considered significant.

23.4.1.6.1 Federal Lands, Lands Outside of BC, and Lands Outside of Canada

Based on the above assessment, a failure of underground mine stability is not anticipated to have effects on federal lands, lands outside of BC, or lands outside of Canada.

23.4.1.6.2 Effects to Nisga'a Interests

As no biophysical pathway residual effects have been identified, a failure of underground mine stability is unlikely to result in effects to Nisga'a Nation Treaty right to manage and harvest Nass salmon, Nass steelhead, and eulachon; to harvest aquatic plants and marine mammals; to harvest non-salmon fish; to manage and harvest wildlife and migratory birds; or to access other lands.

As no pathway residual effects have been identified, a failure of underground mine stability is unlikely to result in changes to Nisga'a citizens' economic or cultural well-being.

In the event of injuries or fatalities resulting from a failure of underground mine stability, a high magnitude effect on Nisga'a citizens' social well-being may occur as a result of grieving the loss of a colleague and/or relative. The effect would have a regional geographic extent if one or more of the individuals involved were Nisga'a citizens with a long-term effect that would be partially reversible. The context would be low. The effect may be significant.

23.4.1.6.3 CEAA 2012 5(1)(c) Components (TSKLH and MNBC)

As no pathway residual effects have been identified, a failure of underground mine stability is unlikely to result in effects to TSKLH's and MNBC's health and socio-economic conditions; physical or cultural heritage; structures, sites, or things that are of historical, archaeological, paleontological, or architectural significance; or CULRTP.

23.4.1.7 Helicopter or Vehicle Accident

The use of helicopters is not expected to be large part of construction and operations of the Project (i.e., less than 10 flights per year). The likelihood of a worst-case accident scenario involving loss of life is highly unlikely based on existing weather monitoring, safety, and preventative maintenance programs that follow federal requirements. Vehicle collisions are also possible. The assessment of probability and likelihood for this event was based on modeling and the authors experience with similar projects and historical trends.

Project-related traffic is predicted to increase the overall vehicle collision rate along Highway 37A by 0.5% during operations (Volume 7, Appendix 1-C). Minor collisions at the Project site itself are considered Likely given the number of vehicles potentially on site at any given time. IDM will implement standard procedures for limiting the human health and safety effects (i.e., lowering the consequence) of minor collisions (e.g., low speed limits on site, seatbelt requirements, rollover protection, radio communication procedures). The potential for and consequence of major accidents will be further minimized through the implementation of key management plans (e.g., traffic controls within the Access Management Plan, staff training within the Occupational Health and Safety Plan).

The worst-case scenario vehicle accident would be one involving a bus transporting personnel during shift changes. During operations, there will likely be four one-ways trips per day up or down the Access Road) with a full passenger load (Appendix 1-C). This frequency is low enough to allow for the focused implementation of a range of preventative measures, including access and haul road design and maintenance, and strict adherence to speed limits, communication protocols, and driver codes of conduct.

The Project will have comprehensive first aid facilities and qualified first aid attendants equipped to handle major incidents. Moreover, there will be an ambulance and rapid access to a helicopter for transportation of injured persons to the nearest hospital.

The magnitude of a potential effect on Human Health is considered high due to the possibility of human injury or fatality. The geographic extent is discrete, the duration is long-term, and is partially reversible (in the case of injury) or permanent (in the case of a fatality). The context is considered low. Based on this characterization, the potential effect of a helicopter or vehicle accident on Human Health is considered significant.

No other biophysical or socio-economic effects are anticipated.

23.4.1.7.1 Federal Lands, Lands Outside of BC, and Lands Outside of Canada

Based on the above assessment, a helicopter or vehicle accident is not anticipated to have effects on federal lands, lands outside of BC, or lands outside of Canada.

23.4.1.7.2 Effects to Nisga'a Interests

As no biophysical pathway residual effects have been identified, a helicopter or vehicle accident is unlikely to result in effects to Nisga'a Nation Treaty right to manage and harvest Nass salmon, Nass steelhead, and eulachon; to harvest aquatic plants and marine mammals; to harvest non-salmon fish; to manage and harvest wildlife and migratory birds; or to access other lands.

As no pathway residual effects have been identified, a helicopter or vehicle accident is unlikely to result in changes to Nisga'a citizens' economic or cultural well-being.

In the event of injuries or fatalities resulting from a helicopter or vehicle accident, a high magnitude effect on Nisga'a citizens' social well-being may occur as a result of grieving the loss of a colleague and/or relative. The effect would have a regional geographic extent if one or more of the individuals involved were Nisga'a citizens with a long-term effect that would be partially reversible. The context would be low. The effect may be significant.

23.4.1.7.3 CEAA 2012 5(1)(c) Components (TSKLH and MNBC)

As no pathway residual effects have been identified, a helicopter or vehicle accident is unlikely to result in effects to TSKLH's and MNBC's health and socio-economic conditions; physical or cultural heritage; structures, sites, or things that are of historical, archaeological, paleontological, or architectural significance; or CULRTP.

23.4.2 Low-Risk Accidents and Malfunctions

Seven low-risk accidents and/or malfunctions were identified and evaluated (Table 23.4-4 to Table 23.4-6).

Table 23.4-4: Low Risk Accidents and Malfunctions

Accident/Malfunction	Likelihood	Consequence	Risk	Controls/Plans	Response/Contingency
Large spill resulting from vehicle accident (e.g., accident involving loaded fuel truck)	Rare	Major	Low	Access Management Plan; Aquatic Effects Management Plan; Emergency Response Plan; Fuel Management Plan; Hazardous Materials Management Plan; Occupational Health and Safety Plan; Spill Contingency Plan; Waste Management Plan	• Identification and control of risk to human health and safety • Identification and control or risk to non-human ICs/VC • Identification and containment of spill • Notification of appropriate authorities • Recovery and remediation • Accident investigation • Follow-up monitoring will include assessment of incident causes and monitoring of all potentially affected ICs/VCs
Vehicle-wildlife collisions	Unlikely	Minor	Low	Access Management Plan; Occupational Health and Safety Plan; Skills, Training and Employment Plan; Vegetation and Ecosystems Management Plan; Wildlife Management Plan	• Identification and control of risk to human health and safety • Identification and control or risk to non-human ICs/VC • Notification of appropriate authorities • Follow-up monitoring will include the tracking of the locations of vehicle-wildlife collisions to evaluate collision risk profile of the Access Road to facilitate mitigation measures (e.g., vegetation management to improve sight lines).

Accident/Malfunction	Likelihood	Consequence	Risk	Controls/Plans	Response/Contingency
Inability to manage water inflow into underground mine works	Unlikely	Minor	Low	Emergency Response Plan; Site Water Management Plan	• Implement appropriate Emergency Response Plan • Identification and control of risk to human health and safety • Identify, isolate and repair cause of water management issues
Failure of waste water treatment plant (WWTP)	Unlikely	Minor	Low	Emergency Response Plan; Site Water Management Plan	• Implement appropriate Emergency Response Plan • Identification and control of risk to human health and safety • Identification and control or risk to non-human ICs/VC • Engage back-up generators • Identify, isolate and repair cause of water management issues
Fire	Unlikely	Minor to Major	Low	Emergency Response Plan; Occupational Health and Safety Plan	• Implement appropriate Emergency Response Plan • Identification and control of risk to human health and safety • Identify, isolate and repair cause of power failure
Failure of power supply	Rare	Major	Low	Emergency Response Plan	• Implement appropriate Emergency Response Plan • Engage back-up generators • Identify, isolate and repair cause of power failure

Accident/Malfunction	Likelihood	Consequence	Risk	Controls/Plans	Response/Contingency
Weather-related stranding of personnel	Rare	Moderate	Low	Emergency Response Plan; Occupational Health and Safety Plan	• Implement appropriate Emergency Response Plan • Identification and control of risk to human health and safety • Identify, isolate and repair cause of stranding • Development additional safeguards to minimize potential recurrence of incident

Table 23.4-5: Summary of Low Risk Accidents and Malfunctions Interactions with Intermediate and Valued Components

IC/VC	Large Fuel Spill from Vehicle Accident	Vehicle-wildlife Collisions	Inability to Manage Water Flow into Unground Mine Works	Failure of Wastewater Treatment Plant	Temporary Failure of Power Supply	Fire	Weather-related Stranding of Personnel
Air Quality					X	X	
Noise							
Soil Quantity							
Soil Quality				X			
Terrain Stability and Geohazards							
Hydrogeology							
Groundwater Quality							
Hydrology							
Surface Water Quality	X			X			
Sediment Quality	X			X			
Ecologically Valuable Soil	X						
Alpine and Parkland Ecosystems							
Old Growth and Mature Forest Ecosystems	X						
Floodplain and Wetland Ecosystems	X						
BC CDC Listed Ecosystems	X						
Rare Plants Lichens and Associated Habitats	X						

IC/VC	Large Fuel Spill from Vehicle Accident	Vehicle-wildlife Collisions	Inability to Manage Water Flow into Unground Mine Works	Failure of Wastewater Treatment Plant	Temporary Failure of Power Supply	Fire	Weather-related Stranding of Personnel
Mountain Goat		X					
Grizzly Bear		X					
Moose		X					
Furbearers		X					
Bats							
Migratory Breeding Birds							
Listed Bird Species		X					
Raptors							
Non-migratory Game Birds		X					
Western Toads	X	X		X			
Periphyton	X			X			
Benthic Invertebrates	X			X			
Fish	X			X			
Fish Habitat	X			X			
Contemporary Land and Resource Use	X			X			
CRA Fisheries	X			X			
Project-related Employment							
Revenue to Local Economy							
Potential Social Issues Related to the Project							

IC/VC	Large Fuel Spill from Vehicle Accident	Vehicle-wildlife Collisions	Inability to Manage Water Flow into Unground Mine Works	Failure of Wastewater Treatment Plant	Temporary Failure of Power Supply	Fire	Weather-related Stranding of Personnel
Social and Health Services							
Housing							
Infrastructure							
Recreational Values	X			X			
Project-related Traffic							
Visual Quality							
Cultural and Heritage Resources							
Human Health	X	X	X	X	X	X	X

Table 23.4-6: Assessment of Residual Risk and Significance of Low Risk Accidents and Malfunctions on Intermediate and Valued Components

IC/VC	Evaluation Criteria						Significance of Accident Producing Residual Effects
	Magnitude	Extent	Duration	Frequency	Reversibility	Context	
Large Fuel Spill from Vehicle							
Soil Quality	High	Discrete	Short Term	Sporadic	Reversible	Neutral	Not Significant
Surface Water Quality	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
Sediment Quality	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
Ecologically Valuable Soil	High	Discrete	Short Term	Sporadic	Reversible	Neutral	Not Significant
Old Growth and Mature Forest Ecosystems	High	Discrete	Short Term	Sporadic	Reversible	High	Not Significant
Floodplain and Wetland Ecosystems	High	Discrete	Short Term	Sporadic	Reversible	High	Not Significant
BC CDC Listed Ecosystems	High	Discrete	Short Term	Sporadic	Reversible	High	Not Significant
Western Toad	High	Discrete	Long Term	Sporadic	Partially Reversible (potentially Permanent if during breeding season)	High	Not Significant (Significant if during breeding season)
Periphyton and Benthic Invertebrates	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
Fish and Fish Habitat	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
Contemporary Land and Resource Use	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
CRA Fisheries	High	Local	Long Term	Sporadic	Reversible	High	Not Significant

IC/VC	Evaluation Criteria						Significance of Accident Producing Residual Effects
	Magnitude	Extent	Duration	Frequency	Reversibility	Context	
Recreational Values	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
Human Health	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant
Vehicle-Wildlife Collisions							
Mountain Goat	Low	Regional	Long Term	Sporadic	Reversible	High	Not Significant
Grizzly Bear	Low	Regional	Long Term	Sporadic	Reversible	High	Not Significant
Moose	Low	Regional	Long Term	Sporadic	Reversible	High	Not Significant
Furbearers	Low	Regional	Long Term	Sporadic	Reversible	High	Not Significant
Listed Bird Species	Low	Regional	Long Term	Sporadic	Reversible	High	Not Significant
Non-migratory Game Birds	Low	Regional	Long Term	Sporadic	Reversible	High	Not Significant
Western Toads	Low	Regional	Long Term	Sporadic	Reversible	High	Not Significant
Human Health	Low	Regional	Short Term	Sporadic	Reversible	High	Not Significant
Inability to Manage Water Inflow into Underground Mine Works							
Human Health	Low	Discrete	Short Term	Sporadic	Reversible	Neutral	Not Significant
Failure of Wastewater Treatment Plant							
Soil Quality	High	Discrete	Long Term	Sporadic	Reversible	Neutral	Not Significant
Surface Water Quality	Moderate	Local	Short Term	Sporadic	Reversible	High	Not Significant
Sediment Quality	Moderate	Local	Short Term	Sporadic	Reversible	High	Not Significant
Periphyton and Benthic Invertebrates	High	Local	Long Term	Sporadic	Reversible	High	Not Significant
Fish and Fish Habitat	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant
Contemporary Land and Resource Use	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant

IC/VC	Evaluation Criteria						Significance of Accident Producing Residual Effects
	Magnitude	Extent	Duration	Frequency	Reversibility	Context	
CRA Fisheries	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant
Recreational Values	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant
Human Health	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant
Temporary Failure of Power Supply							
Human Health	Low	Local	Short Term	Sporadic	Reversible	High	Not Significant
Fire							
Air Quality	Low	Local	Short Term	One Time	Reversible	High	Not Significant
Human Health	High	Discrete	Short Term	Sporadic	Partially Reversible to Permanent	Low	Significant
Weather-related Stranding of Personnel							
Human Health	Moderate	Discrete	Short Term	Sporadic	Reversible to Partially Reversible	Low	Not Significant

23.4.2.1 Large Fuel Spill to Land and Water

The worst-case fuel spill scenario would involve an accident/collision with a 20,000 L fuel truck, which may cause a rupture of the fuel tank superstructure resulting in a spill of gasoline or diesel fuel load onto the adjacent environment. The assessment of probability and likelihood for this event was based on modeling and the authors experience with similar projects and historical trends.

The low overall traffic rates along the Access and Haul Road, enhanced traffic control measures when fuel trucks are on the roads, greater regulations/restrictions, and the safety features of fuel trucks reduce the likelihood of a worst-case scenario accident to a likelihood classification of Rare (250 trips per year during construction, 166 trips per year during operation; Volume 7, Appendix 1-C), thereby resulting in a Low risk rating, despite the Major consequence ranking. All of the design, mitigation, and response measures discussed in the previous fuel spill discussion (Section 23.3) apply here including, if necessary, the removal and off-site remediation of contaminated soils.

23.4.2.1.1 Landforms and Natural Landscapes

Potential direct effects on Soil Quality include changes in electrical conductivity and soil pH and the introduction of diesel fuel, gasoline, or other materials to the spill/release location. Spills and releases will be managed by both containment and rapid recovery of materials using state-of-the-art methods (e.g., spill kits and absorbents). Although the magnitude of these potential effects could be high (e.g., exceedances of applicable soil guidelines), the rapid detection of and response to the spill or release at the time of the accident will limit the geographic extent (discrete) and duration (short-team) of any effect. The frequency is predicted to be sporadic. The effects are considered reversible. The ecological context of Soil Quality is considered neutral. Based on this characterization, the effect of a large fuel spill on Soil Quality is expected to be not significant.

23.4.2.1.2 Surface Water Quality and Sediment Quality

Potential effects of a large spill on the Surface Water Quality and Sediment Quality will be direct are considered high in magnitude, as it could result in elevated concentrations of hydrocarbons, among other substances, above permitted discharge limits or applicable guidelines. The geographic extent will be limited to the near-field receiving environment the spill or release (i.e., local). Lighter fuel components will likely remain on the water surface where they will volatilize and become diluted. Compounds such as benzene, toluene, ethylbenzene, and xylenes (BTEX), although toxic, volatilize relatively rapidly. Methyl tert butyl ether (MTBE) and other additives will dissolve in the water, but will continue to evaporate from surfaces. In general, lighter fuels such as gasoline volatize more rapidly than heavier diesel fuels; these latter fuels tend to persist in the environment. Finally, compounds such as polycyclic aromatic hydrocarbons (PAHs) will persist, requiring several years to degrade. Therefore, the duration of the potential effect is considered long-term. Given the proposed implementation of detailed management plans (e.g., Spill Contingency Plan), detection of the fuel spill will be immediate and will be followed by a rapid response. Containment will be implemented using booms and temporary diversions for small waterways and rapid recovery of materials. Once contained, IDM will immediately

implement appropriate site remediation activities, contributing to a reversible potential effect. The ecological context of Surface Water Quality and Sediment Quality are considered high. Based on this characterization, the effect of a large spill to water on Surface Water Quality and Sediment Quality is considered not significant.

23.4.2.1.3 Vegetation and Ecosystems

A large spill onto land or water has the potential to effect Vegetation and Ecosystems through the alteration or soil or water quality or direct damage to plants. The magnitude of these effects is considered high (i.e., exceedance of applicable guidelines) but with a discrete geographic extent (i.e. limited to the location of the spill or release). Rapid and detection of a spill or release will limit the duration of the effects (short-term) and effects are expected to be reversible. Should a spill occur in the vicinity of a rare plant occurrence such that the occurrence itself is directly affected, the duration of the effect on Rare Plants, Lichens, and Associated Habitat would be permanent. The ecological context of Ecologically Valuable Soils is considered neutral, with the other Vegetation and Ecosystem VCs having high contexts. Based on this characterization, the effect of a minor spill or release on Vegetation and Ecosystems is considered not significant.

23.4.2.1.4 Wildlife and Wildlife Habitat

The potential effects of a large spill on Wildlife and Wildlife Habitat will likely be restricted to effects on Western Toads, given their discrete distribution and narrow ecological niche. If a spill occurs in the vicinity of Western Toad habitat, the effect could have a high magnitude effect with a discrete geographic extent. The duration of the effect would be long-term and, depending on the timing of the spill, the effect will be partially reversible. The ecological context for Western Toad is high. Based on this characterization, the effect of a large spill to water on Western Toad is considered not significant. If the spill or release occurred directly into a breeding pond during the breeding season (i.e., when fertilized eggs or tadpoles are present), the effect could be considered significant.

23.4.2.1.5 Aquatic Resources

Potential effects on Aquatic Resources due to a large fuel spill are direct toxicity from the fuel hydrocarbon compounds and indirect effects from the accumulation of hydrocarbons in sediments. The consequence of these effects will depend on the environmental conditions at the spill location and could be confounded by the environmental fates of various fuel constituents. Streamflow mixing or waves can increase exposure of the fuel compounds to aquatic organisms and consequently increase the magnitude of toxicity. The persistence of chemical constituents of the fuel is related to physical, chemical, and biological factors, such as temperature, oxygen concentration, and microbial activity. Although spill response and volatilization will help to minimize the exposure of periphyton and benthic invertebrates to the majority of the fuel, some of the constituents can be persistent in alpine environments and accumulate in the receiving benthic environment.

The magnitude of the effect is considered high (e.g., exceedance of applicable guidelines) and local in geographic extent. The effects of these sporadic incidents are predicted to have a long-term duration but are considered reversible with appropriate spill response and

recovery efforts. The ecological context is considered high. Based on this characterization, the effect of a large spill to water on Aquatic Resources is considered not significant.

23.4.2.1.6 Fish and Fish Habitat

Effects of a large spill on Fish and Fish Habitat will be via a number of pathways: direct chemical toxicity via the water column, physical effects on fish coming into contact with spilled fuel, and indirectly via ingestion by fish of primary and secondary producers. The consequence is considered to be Moderate since petroleum compounds have the potential to be toxic to fish and aquatic organisms; these compounds can cause mortality at high concentrations. In addition, adverse effects on fish health and/or altered behaviour at sublethal concentrations are also possible. The toxicity of petroleum-derived compounds occurs via their water-soluble constituents, and toxicity increases in low dissolved oxygen conditions. Fish behaviour (avoidance) can change after exposure to sublethal concentrations of spilled petroleum constituents in response to the physiological changes caused by the toxins. Fish populations and habitats further downstream of a spill may experience measurable effects; however, IDM has implemented plans and systems that will allow for rapid spill detection and response.

The magnitude of the effects is considered high and local in geographic extent. The effects of these sporadic incidents could have long-term duration but are considered reversible. The ecological context is considered high. Based on this characterization, the effect of a large spill to water on Fish and Fish Habitat is considered not significant.

23.4.2.1.7 Economic

Two Economic VCs are potentially affected by a large spill or release to water: Contemporary Land and Resource Use and CRA Fisheries.

Contemporary Land and Resource Use

A large spill could affect Contemporary Land and Resource Use if the location of the spill interferes with or limits access to important resources (e.g., temporary closure of Access Road). The magnitude of the potential effects is considered high and local in geographic extent. The effects of these sporadic incidents could have long-term duration but are considered reversible. The context is considered high. Based on this characterization, the effect of a large spill to water on Contemporary Land and Resource Use is considered not significant.

CRA Fisheries

A large spill could affect CRA Fisheries along a number of pathways: direct chemical toxicity via the water column, physical effects on fish coming into contact with spilled fuel, and indirectly via ingestion by fish of primary and secondary producers. The consequence is considered to be Moderate since petroleum compounds have the potential to be toxic to fish and aquatic organisms; these compounds can cause mortality at high concentrations. In addition, adverse effects on fish health and/or altered behaviour at sublethal concentrations are also possible. The toxicity of petroleum-derived compounds occurs via their water-soluble constituents, and toxicity increases in low dissolved oxygen conditions. Fish

behaviour (avoidance) can change after exposure to sublethal concentrations of spilled petroleum constituents in response to the physiological changes caused by the toxins. Fish populations and habitats further downstream of a spill may experience measurable effects; however, IDM has implemented plans and systems that will allow for rapid spill detection and response.

The magnitude of the potential effects is considered high and local in geographic extent. The effects of these sporadic incidents could have long-term duration but are considered reversible. The context is considered high. Based on this characterization, the effect of a large spill to water on CRA Fisheries is considered not significant.

23.4.2.1.8 Social

The potential effect of minor spill or release on Recreational Values is mediated through fishing opportunities along several pathways: direct chemical toxicity via the water column, physical effects on fish coming into contact with spilled fuel, and indirectly via ingestion by fish of primary and secondary producers. The consequence is considered to be Moderate since petroleum compounds have the potential to be toxic to fish and aquatic organisms; these compounds can cause mortality at high concentrations. In addition, adverse effects on fish health and/or altered behaviour at sublethal concentrations are also possible. The toxicity of petroleum-derived compounds occurs via their water-soluble constituents, and toxicity increases in low dissolved oxygen conditions. Fish behaviour (avoidance) can change after exposure to sublethal concentrations of spilled petroleum constituents in response to the physiological changes caused by the toxins. Fish populations and habitats further downstream of a spill may experience measurable effects; however, IDM has implemented plans and systems that will allow for rapid spill detection and response.

The magnitude of the potential effects is considered high and local in geographic extent. The effects of these sporadic incidents could have long-term duration but are considered reversible. The context is considered high. Based on this characterization, the effect of a large spill to water on Recreational Values is considered not significant.

23.4.2.1.9 Human Health

A large fuel spill to land or water could have indirect effects to Human Health, depending on the location of the spill, and only if not properly contained or remediated. In this instance, IDM will inform the local communities of resources users of the potential contamination issues, thereby minimizing any potential effects.

Given the mitigation measures proposed by IDM (e.g., access restrictions, community notification of accidents), it is expected that this potential effect will be low in magnitude and local in geographic extent. The effects are considered short-term and reversible. The context is considered high. Based on this characterization, the effect of large spill on Human Health is considered not significant.

23.4.2.1.10 Federal Lands, Lands Outside of BC, and Lands Outside of Canada

Based on the above biophysical and socio-economic assessments, a large fuel spill to land or water is not anticipated to have effects on federal lands, lands outside of BC, or lands outside of Canada.

23.4.2.1.11 Effects to Nisga'a Interests

Right to Manage and Harvest Nass Salmon, Nass Steelhead, and Eulachon

A large fuel spill to land is unlikely to affect Nisga'a Nation Treaty rights to harvest and manage Nass salmon, Nass steelhead, and eulachon due to lack of pathway effect.

Based on the above assessment of potential residual effects on Fish and Fish Habitat due to a large fuel spill to water, such an event has the potential to have a high magnitude, long-term, local, sporadic, and reversible non-significant effect on Nisga'a Nation Treaty rights to harvest and manage Nass salmon, Nass steelhead, and eulachon. The context is high given the other areas with significant salmon, steelhead, and eulachon runs available to Nisga'a citizens. Given the high context and local extent but long-term duration, such an event may have a low magnitude effect on the NFA-defined Nisga'a allocation for Nass salmon, Nass steelhead, and eulachon.

Right to Harvest Aquatic Plants and Marine Mammals

As no pathway residual effect to aquatic plants or marine mammals has been identified, a large fuel spill to water or land is unlikely to result in effects to Nisga'a Nation treaty rights to harvest aquatic plants and marine mammals.

Right to Harvest Non-Salmon Fish

Similar to effects on Nass salmon, Nass steelhead, and eulachon, a large fuel spill to land is unlikely to affect Nisga'a Nation Treaty rights to harvest non-salmon fish due to lack of pathway effect.

A large fuel spill to water is predicted to have a high magnitude, local extent, long-term, sporadic, and reversible non-significant effect on Nisga'a Nation Treaty rights to harvest non-salmon fish, such a Dolly Varden. The context is high given the other areas with significant fish stocks to Nisga'a citizens. A large fuel spill to water may have a low magnitude effect the NFA-defined Nisga'a fish allocation.

Right to Manage and Harvest Wildlife and Migratory Birds

As no pathway residual effect to Wildlife and Wildlife Habitat has been identified, a large fuel spill to water or land is unlikely to result in effects to Nisga'a Nation right to manage and harvest wildlife and migratory birds.

Right to Access Other Lands

As no pathway residual effect has been identified, a large fuel spill to water or land is unlikely to result in effects to the ability of Nisga'a Nation representatives to access the Nass Wildlife Area to carry out their duties or on the ability of Nisga'a citizens to access Crown lands.

Nisga'a Citizens' Economic Well-being

As no pathway residual effect has been identified, a large fuel spill to water or land is unlikely to result in effects to Nisga'a citizens' economic well-being.

Nisga'a Citizens' Social Well-being

As no pathway residual effect has been identified, a large fuel spill to water or land is unlikely to result in effects to Nisga'a citizens' social well-being.

Nisga'a Citizens' Cultural Well-being

The potential effect to Nisga'a Nation Treaty right to harvest and manage fish, including Nass salmon, Nass steelhead, eulachon, and non-salmon fish, may have a low magnitude, local, short-term, sporadic, and reversible non-significant effect on Nisga'a citizens' cultural well-being. The context is high considering the relatively large area available to Nisga'a citizens for cultural activities and practices.

23.4.2.1.12 CEAA 2012 5(1)(c) Components (TSKLH and MNBC)

Health and Socio-economic Conditions

Based on the assessment above of potential effects to social and economic VCs and considering IDM's understanding that TSKLH's members and MNBC's citizens reside in other communities in northwest BC, such as Terrace, Prince Rupert, and the Hazeltons, large fuel spill to water or land is unlikely to affect TSKLH's and MNBC's socio-economic conditions.

Physical and Cultural Heritage and Structures, Sites, or Things that are of Historical, Archaeological, Paleontological, or Architectural Significance

Based on the Heritage Effects Assessment (Volume 3, Chapter 21), there are no cultural or heritage resources or structures, sites, or things that are of historical, archaeological, paleontological, or architectural significance in the Project area. Therefore, they are unlikely to be affected by a large fuel spill to water or land.

Current Use of Lands and Resources for Traditional Purposes

Based on the above characterizations of effects to Fish and Fish Habitat and Vegetation and Ecosystems, a large fuel spill to water or land is likely to have a high magnitude, local, long-term, sporadic, and reversible non-significant effect on TSKLH's and MNBC's CULRTP. The context is high given the relatively large areas utilized by both TSKLH and MNBC for their CULRTP.

23.4.2.2 Vehicle-Wildlife Collisions

Wildlife collisions with vehicles are a potential causal factor of collisions. The assessment of probability and likelihood for this event was based on modeling and the authors experience with similar projects and historical trends.

In 2007, 1 out of 25 vehicle accidents in BC were caused by collisions with wildlife[2]. In addition to health and safety concerns (i.e., injury to the driver and/or passengers), these collisions can be a source of wildlife injury and mortality[3].

Vehicle-wildlife collisions resulting from Project activities can potential occur along Highway 37 and Highway 37A, as well as along the Access and Haul roads. The Traffic Impact Study conducted as part of this Application/EIS states that, based on available data, Project-related traffic is expected to have a maximum of a 3% increase in overall traffic rates along the two highways and the bulk of this traffic increase will be experienced during the Project's Operation Phase along Highway 37A between Stewart and the mine Access Road. This same study states that there could be a 1% increase in vehicle collisions. The low expected increase in highway traffic along already busy routes is unlikely to appreciably increase the risk of vehicle-wildlife collisions. Hence, this assessment focuses on vehicle-wildlife collisions on the mine access and haul roads.

Based on baseline studies and modeled habitat suitability, most identified Wildlife VCs are at risk of collisions with vehicles. However, the consequence is expected to be Minor (i.e., individual fatalities not expected to have population-level effects) and the likelihood Unlikely due to staff training and awareness and the implementation of key management plans (Chapter 29), including the Access Management Plan, which include such measures as limiting traffic on Access Road by using buses to transport personnel from Stewart and setting low speed limits. These measures have been shown to be very successful at lowering the likelihood of vehicle-wildlife collisions (e.g., Teck Coal Limited 2011).

The worst case scenario for vehicle-wildlife collisions has a Moderate consequence: post-breeding migration of Western Toads across the Access Road. In the unlikely event that the Access Road transects a post-breeding dispersal pathway for Western Toads, there is a potential for mass toad fatalities on the road if Project drivers are not aware of the potential risks. IDM will be implementing a wildlife monitoring program as part of the Wildlife Management Plan that will be able to help predict the occurrence of this ecological phenomenon in time to alert Project staff.

The magnitude of these effects to Wildlife are considered low (i.e., within the range of natural variability), regional in geographic extent, and sporadic in frequency. Although the direct mortality effect on an individual is permanent, the population-level effects are reversible in the long-term. The ecological context for Wildlife is neutral. Based on this characterization, the effects of vehicle-wildlife collisions for most Wildlife species are considered not significant.

[2] http://www.wildlifecollisions.ca/thefacts.htm

[3] From 1996 to 2007, the British Columbia Ministry of Transportation and Infrastructure estimated that more than 200,000 animals were killed in collisions.

Vehicle-wildlife collisions can have an effect on Human Health if the collision occurs with a large mammal (e.g., Moose) and at high speeds. The low speed limits for the Access Road and Haul Roads, in combination with wildlife habitat preferences and distribution patterns, limit the potential for a collision to result in a human fatality. Therefore, the magnitude is considered low, the extent is regional, the duration is short-term, the frequency is sporadic, the effect is reversible, the context is high, and the overall effect is not significant.

23.4.2.2.1 Federal Lands, Lands Outside of BC, and Lands Outside of Canada

Based on the above assessment, a wildlife-vehicle collision is not anticipated to have effects on federal lands, lands outside of BC, or lands outside of Canada.

23.4.2.2.2 Effects to Nisga'a Interests

As no biophysical pathway residual effects have been identified, a wildlife-vehicle collision is unlikely to result in effects to Nisga'a Nation Treaty right to manage and harvest Nass salmon, Nass steelhead, and eulachon; to harvest aquatic plants and marine mammals; to harvest non-salmon fish; or to access other lands.

A low magnitude, regional, long-term, sporadic, and reversible non-significant effect to Nisga'a Nation Treaty right to manage and harvest wildlife and migratory birds due to a wildlife-vehicle collision may occur. The context is high given the significantly large area available to Nisga'a citizens for hunting and trapping. A wildlife-vehicle collision is unlikely to have an effect on the NFA-defined allocation for designated species.

As no pathway residual effects have been identified, a wildlife-vehicle collision is unlikely to result in changes to Nisga'a citizens' economic, social, or cultural well-being.

23.4.2.2.3 CEAA 2012 5(1)(c) Components (TSKLH and MNBC)

As no pathway residual effects have been identified, a wildlife-vehicle collision is unlikely to result in effects to TSKLH's and MNBC's health and socio-economic conditions; physical or cultural heritage; or structures, sites, or things that are of historical, archaeological, paleontological, or architectural significance.

A wildlife-vehicle collision may have a low magnitude, regional, long-term, sporadic, and reversible non-significant effect on TSKLH's and MNBC's CULRTP due to the pathway effect to Wildlife. The context is high given the relatively large areas utilized by both TSKLH and MNBC for their CULRTP.

23.4.2.3 Inability to Manage Water Inflow into Underground Mine Works

Inflow of water into underground mine works will be a part of the normal operations at Project. The assessment of probability and likelihood for this event was based on the authors experience with similar projects and historical trends. This event has the potential of degrading the air and water quality in the underground environment in the Unlikely worst case scenario of a failure in the pumping system. It has been determined, however, that these effects, while of concern for health and safety, production, and costs, will not have any consequence for environmental VCs or ICs. Proper design and effective management

and monitoring of water inflow into the underground works will be preventative measures to ensure health and safety and environmental protection. Back-up pumps will be stored on site. A variety of mitigation measures addressed through various policies, plans, monitoring procedures, and procedures for the entire mine operation will maintain the underground quality of air and water.

The magnitude of potential effects to Human Health is considered low with a discrete geographic extent. The effects are considered to be short-term and reversible. The context is considered neural (i.e., some individuals will be more robust to short term changes in air and water quality than others). Based on this characterization, the effect of the inability to manage water inflow on Human Health is considered not significant

23.4.2.3.1 Federal Lands, Lands Outside of BC, and Lands Outside of Canada

Based on the above assessment, inability to manage water inflow into the underground mine works is not anticipated to have effects on federal lands, lands outside of BC, or lands outside of Canada.

23.4.2.3.2 Effects to Nisga'a Interests

As no biophysical pathway residual effects have been identified, inability to manage water inflow into the underground mine works is unlikely to result in effects to Nisga'a Nation Treaty right to manage and harvest Nass salmon, Nass steelhead, and eulachon; to harvest aquatic plants and marine mammals; to harvest non-salmon fish; to manage and harvest wildlife and migratory birds; or to access other lands.

As no pathway residual effects have been identified, inability to manage water inflow into the underground mine works is unlikely to result in changes to Nisga'a citizens' economic, social, or cultural well-being.

23.4.2.3.3 CEAA 2012 5(1)(c) Components (TSKLH and MNBC)

As no pathway residual effects have been identified, inability to manage water inflow into the underground mine works is unlikely to result in effects to TSKLH's and MNBC's health and socio-economic conditions; physical or cultural heritage; structures, sites, or things that are of historical, archaeological, paleontological, or architectural significance; or CULRTP.

23.4.2.4 Potential Failure of the Water Treatment Plant

There is the potential for the capacity at the Water Treatment Plant to become nonoperational due to equipment failure. This would, in turn, create the potential for excess surface contact water that is diverted to the TMF to not be discharged, reducing the designed TMF supernatant pond freeboard. The TMF supernatant pond receives contact water from two sources: groundwater seepage into the underground workings and contact surface water that reports through interception ditches. In the event of the above-mentioned failure of the Water Treatment Plant, water would remain in the collection pond and underground inputs would cease. Water would not be released to surface. Thus, environmental effects on VCs and ICs are considered unlikely.

The worst-case scenario involves a failure of the Water Treatment Plant leading to a compromised ability to manage the TMF supernatant pond effectively, potentially resulting in a controlled release from the TMF to prevent overtopping. This scenario is considered Unlikely as it would require a 7-day equipment failure, coupled with a 1-in-50 year wet month, and the runoff from a 1-in-200 year precipitation event bypassing the non-contact water diversion system to create the need for a controlled release. In this scenario (i.e., 7 down days), 18,300 m^3 of water would be discharged with geochemical characteristics of pre-treatment conditions. Potential effects to ICs and VCs from this scenario are identical to those discussed in the Accidental Discharge scenario (Section 23.4.1.2). The assessment of probability and likelihood for this event was based on the authors experience with similar projects and historical trends.

23.4.2.5 Temporary Failure of Power Supply

Preventative measures to reduce power failures will include: routine maintenance on equipment; mitigating fire risks; installing lightning protection on buildings (e.g., roof top lightning rods to provide grounding protection); and permitting only authorized entry into electrical rooms. Stand-by generators will be maintained for system critical facilities (e.g., communications, heat, light, emergency response facilities, water treatment plant, and sewage treatment plant) in the event of shutdown for routine maintenance or mechanical failure. The assessment of probability and likelihood for this event was based on the authors experience with similar projects and historical trends.

Given the presence of back-up generators, the worst case scenario would be underground power failure where the main system of ventilation for a underground mine fails; all personnel working underground will be informed, and all diesel powered equipment will be shut down. Where a hazard to persons exists, all persons will be evacuated to the surface of the mine or to an approved refuge/muster station in accordance with the emergency procedures. The risk rating of a power outage is considered low.

No effects on environmental VCs were identified. The magnitude of potential effects to Human Health is considered low, with a discrete geographic extent. The effects are considered to be short-term and reversible. The context is considered neural (i.e., some individuals will be more robust to short term changes in air quality than others). Based on this characterization, the effect of a temporary failure of power supply on Human Health is considered not significant.

23.4.2.5.1 Federal Lands, Lands Outside of BC, and Lands Outside of Canada

Based on the above assessment, a temporary failure of power supply is not anticipated to have effects on federal lands, lands outside of BC, or lands outside of Canada.

23.4.2.5.2 Effects to Nisga’a Interests

As no biophysical pathway residual effects have been identified, a temporary failure of power supply is unlikely to result in effects to Nisga’a Nation Treaty right to manage and harvest Nass salmon, Nass steelhead, and eulachon; to harvest aquatic plants and marine mammals; to harvest non-salmon fish; to manage and harvest wildlife and migratory birds; or to access other lands.

As no pathway residual effects have been identified, a temporary failure of power supply is unlikely to result in changes to Nisga'a citizens' economic, social, or cultural well-being.

23.4.2.5.3 CEAA 2012 5(1)(c) Components (TSKLH and MNBC)

As no pathway residual effects have been identified, a temporary failure of power supply is unlikely to result in effects to TSKLH's and MNBC's health and socio-economic conditions; physical or cultural heritage; structures, sites, or things that are of historical, archaeological, paleontological, or architectural significance; or CULRTP.

23.4.2.6 Fires

Fires account for 7.2% of incidents reports to the BC Ministry of Energy and Mines over the period of 2010-2015[4]; none were reported to extend beyond a given Project area (i.e., no spread to surrounding areas). The assessment of probability and likelihood for this event was based on the authors experience with similar projects and historical trends.

The Project will be protected from fire in accordance with applicable codes and standards, at a minimum. The fire alarm system shall consist of manual pull stations at building exits and audible and visual notification devices throughout the work areas. In addition to fire detection devices and smoke detection alarms will be incorporated into the fire system. Fire alarm systems at various buildings will report to the plant control room, which will be manned 24 hours per day. All surface and underground mobile equipment will be fitted with fire extinguishers. Underground mobile equipment is heavily regulated and, except for underground personnel carriers, all of this equipment will have fitted fire suppression systems. All buildings and conveyors have fire extinguishers and some will have standpipe systems and fire truck apparatus. Fires will be addressed by the IDM's Emergency Response Team who will be trained in firefighting and equipment use. All employees will be trained in fire alarm procedures and the use of a standard fire extinguisher. The Emergency Response Plans will provide necessary detail for IDM's firefighting procedures (e.g., training requirements, equipment needs). Based on all of these factors, the likelihood of a fire at the Project is considered Unlikely.

The environmental consequences of a major fire that is restricted to the Project site include the potential release of fumes, smoke, and dust. It is anticipated that even a major fire would be contained to the Project site and would have at most a minor localized effect on the surrounding environment. The environmental consequence rating of a fire is considered Minor and the likelihood Unlikely because of engineered design features and the development and implementation of adequate emergency response procedures. There will be short-term air quality effects from the resulting fire and smoke. The magnitude of a potential effect of a fire on Air Quality is considered low with a local geographic extent. The effect would be short-term and reversible. The ecological context for Air Quality is neutral. Based on this characterization, the potential effect of a fire on Air Quality is considered not significant.

[4] http://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/further-information/reports-publications/chief-inspector-s-annual-reports

The environmental worst case scenario involves a major fire that is not restricted to the Project site and expands into the surrounding landscape. The magnitude and consequence of this Rare worst-case scenario is dependent on the cause of the fire, the location of the fire, and the time of year; the ultimate consequences are difficult to predict and quantify.

The human health and safety worst case scenario would an uncontrolled fire in an occupied building or in the underground portions of the mine. Given the proposed preventive measures, this worst case scenario is not predicted to result in loss of human life, although serious injury is possible. The Project will have comprehensive first aid facilities and qualified first aid attendants equipped to handle major incidents. Moreover, there will be an ambulance and rapid access to a helicopter for transportation of injured persons to the nearest hospital.

The magnitude of a potential effect of fire on Human Health is high with a discrete geographic extent. The duration of the effect would be long-term and partially reversible (in the case of human injury) or permanent (in the unlikely event of a human fatality). The context is considered low. Based on this characterization, the potential effect of a fire on Human Health is considered significant.

23.4.2.6.1 Federal Lands, Lands Outside of BC, and Lands Outside of Canada

Based on the above assessment, an uncontrolled fire in an occupied building is not anticipated to have effects on federal lands, lands outside of BC, or lands outside of Canada.

23.4.2.6.2 Effects to Nisga'a Interests

As no biophysical pathway residual effects have been identified, an uncontrolled fire in an occupied building is unlikely to result in effects to Nisga'a Nation Treaty right to manage and harvest Nass salmon, Nass steelhead, and eulachon; to harvest aquatic plants and marine mammals; to harvest non-salmon fish; to manage and harvest wildlife and migratory birds; or to access other lands.

As no pathway residual effects have been identified, an uncontrolled fire in an occupied building is unlikely to result in changes to Nisga'a citizens' economic or cultural well-being.

In the event of injuries or fatalities resulting from an uncontrolled fire in an occupied building, a high magnitude effect on Nisga'a citizens' social well-being may occur as a result of grieving the loss of a colleague and/or relative. The effect would have a regional geographic extent if one or more of the individuals involved were Nisga'a citizens with a long-term effect that would be partially reversible. The context would be low. The effect may be significant.

23.4.2.6.3 CEAA 2012 5(1)(c) Components (TSKLH and MNBC)

As no pathway residual effects have been identified, an uncontrolled fire in an occupied building is unlikely to result in effects to TSKLH's and MNBC's health and socio-economic conditions; physical or cultural heritage; structures, sites, or things that are of historical, archaeological, paleontological, or architectural significance; or CULRTP.

23.4.2.7 Weather-related Stranding

Inclement weather and rapidly changing conditions at the Project create the Rare potential for personnel stranding in vehicles along roadways, or when working on terrain away from Project infrastructure. IDM will implement multiple measures minimize the consequence of stranding, including working alone or in isolation safety procedures, communication protocols, real-time weather monitoring, winter safety kits in Project vehicles (e.g., shovels, blankets, fire starters). The assessment of probability and likelihood for this event was based on the authors experience with similar projects and historical trends.

The worst-case scenario would involve the stranding of a full personnel bus on the Access Road during an unexpected winter storm. However, IDM's commitment to real-time monitoring of weather conditions (and, hence, the ability to limit Access Road traffic when inclement weather is imminent), coupled with the relatively close proximity to emergency services at the Project and in Stewart, should limit both the likelihood and the consequence of such a stranding to minor exposure or injuries.

The magnitude of a potential effect of weather-related stranding on Human Health is moderate with a discrete geographic extent. The duration of the effect would be short-term and reversible to partially reversible (depending on the extent of injuries). The context is considered low. Based on this characterization, the potential effect of a weather-related stranding on Human Health is considered not significant.

No other biophysical or socio-economic effects are anticipated.

23.4.2.7.1 Federal Lands, Lands Outside of BC, and Lands Outside of Canada

Based on the above assessment, weather-related stranding of personnel is not anticipated to have effects on federal lands, lands outside of BC, or lands outside of Canada.

23.4.2.7.2 Effects to Nisga'a Interests

As no biophysical pathway residual effects have been identified, weather-related stranding of personnel is unlikely to result in effects to Nisga'a Nation Treaty right to manage and harvest Nass salmon, Nass steelhead, and eulachon; to harvest aquatic plants and marine mammals; to harvest non-salmon fish; to manage and harvest wildlife and migratory birds; or to access other lands.

As no pathway residual effects have been identified, weather-related stranding of personnel is unlikely to result in changes to Nisga'a citizens' economic, social, or cultural well-being.

23.4.2.7.3 CEAA 2012 5(1)(c) Components (TSKLH and MNBC)

As no pathway residual effects have been identified, weather-related stranding of personnel is unlikely to result in effects to TSKLH's and MNBC's health and socio-economic conditions; physical or cultural heritage; structures, sites, or things that are of historical, archaeological, paleontological, or architectural significance; or CULRTP.

23.5 Conclusions

The risk assessment in relation to accidents and malfunctions for the Project was addressed using a risk analysis methodology. The assessment of probability and likelihood for risks was based on modeling (where appropriate) and the authors experience with similar projects and historical trends. Control measures and management plans have been identified for each accident and malfunction that outline mitigating measures to reduce the likelihood of occurrence or severity of consequence. In addition, response plans and contingency measures have been described for each accident and malfunction in the event of an occurrence to minimize the effects and to document incident investigation results to reduce the likelihood of recurrence. None of identified accidents and malfunctions fell into the High- or Very High-risk category. Overall, the risk and consequence of accidents/malfunctions were assessed Moderate or Low. The confidence in the result ranged from medium to high for all intermediate components or receptor VCs.

Given that the most common potential accident/malfunction outcome involves the release of materials into water or on land, the most commonly affected sub-components were surface water quality and/or soil quality. The second most commonly affected sub-components were wetlands, aquatic resources, and fish and fish habitat. The key management measures were safe travel routes, vehicle maintenance, and driver training, and mitigation including rapid detection, containment, and recovery of spilled materials.

Numerous engineering controls have already been incorporated into the Project design as part of IDM's risk based approach to avoid risk exposure where possible or by reducing the likelihood and potential consequence of risks on Project ICs and VCs.

Through the risk assessment process implemented as part of the Application/EIS and incorporating the outcomes into the consideration of environmental risk effects, an evaluation of their implications for the viability of the Project has been possible. Environmental risks of relevance to decision-making regarding accidents and malfunctions have been demonstrated to be at an acceptable level.

23.6 References

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