NWP Coal Canada Ltd

Chapter 21 - Accidents and Malfunctions Assessment

Crown Mountain Coking Coal Project
Application for an Environmental Assessment Certificate / Environmental Impact Statement

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21. Accidents and Malfunctions Assessment

21.1 Introduction

As outlined in Section 19(1)(a) of the Canadian Environmental Assessment Act, 2012, and the Application Information Requirements (AIR; Environmental Assessment Office [EAO], 2018), the environmental assessment of a designated project must take into consideration the potential environmental effects of accidents or malfunctions that may occur in relation to the designated project. Accidents or malfunctions refer to unplanned events or conditions that are not considered part of normal Project operations or activities as they are planned, which are associated with a loss or failure of Project components or processes. Previous chapters of the Application/Environmental Impact Statement (EIS) have assessed the effects of the Project as planned; this chapter is concerned with events that cannot necessarily be planned or foreseen, even with the best of planning. Much of the focus is on understanding the likelihood, consequences, and predicted risk of an accident, malfunction, or other unplanned event should one occur, and on identifying mitigation and emergency response measures that could be implemented in the event of an accident, malfunction, or unplanned event that cannot be avoided or mitigated prior to its occurrence.

This chapter of the Application/EIS includes an assessment of the potential effects of credible accidents or malfunctions associated with the Project that may result in adverse effects on one or more Valued Components (VCs). Credible accidents and scenarios were identified based on knowledge of the Project and past professional experience of NWP and the Project designers and engineers with similar types of projects and Project activities. Even with detailed planning and implementation of preventative measures, the potential exists for accidents or malfunctions to occur during any Project phase, and if they occur, for adverse environmental effects to result if these events are not addressed or responded to in an appropriate manner. However, many accidents or malfunctions are preventable and can be readily addressed or prevented through application of effective planning, design, emergency response planning, and mitigation implementation. By identifying and assessing the potential for these events to occur, NWP can also identify and put in place prevention and response procedures to minimize or eliminate the potential for significant adverse environmental effects, should an accident or malfunction occur.

21.2 Assessment Approach and Methodology

The approach used to identify and assess the potential effects of credible accidents or malfunctions associated with the Project is described in this section. The assessment approach was developed based on the AIR (EAO, 2018) and the Guidelines for the Preparation of an Environmental Impact Statement for the Crown Mountain Coking Coal Project (EIS Guidelines; Canadian Environmental Assessment Agency [CEAA], 2015).

The assessment approach consisted of the following key steps:

1. Identify the potential accidents or malfunctions that may occur during the life of the Project, including descriptions of the general Project activities or components that lead to the occurrences of each accident or malfunction. The focus was on credible accidents or malfunctions that had a reasonable probability of occurrence during the life of the Project; hypothetical (i.e., not credible) or low probability accidents or malfunctions were not discussed;
2. Assess the potential effects of each accident or malfunction, including the following:
    2.1. Identifying the potential interactions between the VCs that may be affected by the accident or malfunction, and the ways by which each VC may be affected;
    2.2. Describing the Project planning, design features, and safeguards that will be established to reduce or eliminate the potential for occurrence of each accident or malfunction;
    2.3. Describing the contingency and emergency response measures that could be implemented to manage to potential effects of each accident or malfunction, should it occur; and
    2.4. Characterizing the potential adverse residual effects (after safeguards and mitigation measures have been applied) on the VCs that may result from the occurrence of each accident or malfunction; and
3. Assess the residual risk (after safeguards and mitigation measures have been applied) of each accident or malfunction, based on the likelihood of the event occurring and the potential severity of consequences of the event.

It is noted that the characterization of adverse residual effects on VCs arising from accidents and malfunctions was focused on the consequences of an accident, malfunction, or unplanned event should one occur, as well as the related mitigation and response procedures that could be implemented, and not necessarily on the causes or mechanisms by which such an accident or malfunction might occur. For example, the consequences of a hazardous material spill on affected VCs and related mitigation and response, and not how the spill might occur during Project activities, were central to the assessment provided below.

A table of concordance between the requirements outlined in the AIR and EIS Guidelines, and the information provided in this chapter is presented in Table 21.2-1.

Table 21.2-1: Concordance between the AIR, EIS Guidelines and the Accidents and Malfunctions Assessment

AIR Requirements (Section 4.7, Page 129)	Corresponding Accidents and Malfunctions Assessment Section
Include an overall methodology for assessing the potential risk of an event (likelihood and consequence).	21.2 - Assessment Approach and Methodology

AIR Requirements (Section 4.7, Page 129)	Corresponding Accidents and Malfunctions Assessment Section
Define each category of likelihood.	21.2.3 - Risk Assessment
Define each category of consequence.	21.2.3 - Risk Assessment
Identify potential accidents and malfunctions.	21.3 - Identification of Potential Accidents or Malfunctions
Assess the likelihood of the event occurring, based on historical trends and models (applied where appropriate).	21.4 - Effects Assessment of Accidents or Malfunctions
Assess the consequences of the event, in a manner consistent with direct effects assessment.	21.4 - Effects Assessment of Accidents or Malfunctions
Identify proposed measures to reduce the likelihood of the event.	21.4 - Effects Assessment of Accidents or Malfunctions
Identify measures to mitigate the consequences to the VCs and discussion on their expected effectiveness.	21.4 - Effects Assessment of Accidents or Malfunctions
Conclude on the potential risk (likelihood multiplied by consequence) of the accident or malfunction.	21.5 - Risk Assessment
EIS Guidelines Requirements (Section 6.6.1, Page 35)	**Corresponding Accidents and Malfunctions Assessment Section**
Identify the probability of potential accidents and malfunctions related to the Project	21.4 - Effects Assessment of Accidents or Malfunctions
Include an identification of the magnitude of an accident or malfunction, including the quantity, mechanism, rate, form, and characteristics of the contaminants and other materials likely to be released into the environment during the accident and/or malfunction events and would potentially result in an adverse environmental effect as defined in section 5 of the CEAA 2012.	21.4 - Effects Assessment of Accidents or Malfunctions
Describe the safeguards that have been established to protect against such occurrences and the contingency and emergency response procedures in place if such events do occur.	21.4 - Effects Assessment of Accidents or Malfunctions
Conduct an analysis of the risks of accidents and malfunctions	21.5 - Risk Assessment

The assessment discussed in this chapter used a qualitative approach, which focused on the interactions between the potential accidents or malfunctions and VCs, and the potential effects that may result from these interactions. In addition to this assessment, Dillon Consulting Limited (Dillon) also completed an Accidents and Malfunctions Assessment for the Project (Appendix 21-A), which followed the principles of International Organization for Standardization (ISO) 31000 Risk Management Standards (ISO, 2019). This assessment used a BowTie process to quantitatively assess the risk of potential accidents and malfunctions, with focus placed on the specific Project phases and components that may lead to occurrence of an accident or malfunction. This quantitative approach has been included to supplement the qualitative approach described in this chapter.

21.2.1 Identification of Potential Accidents and Malfunctions

Each accident or malfunction key event scenario that was identified as having the potential to occur over the life of the Project is discussed in Section 21.3. Accidents or malfunctions were selected for further assessment based on a screening level analysis of the activities that would lead to the occurrence of each accident or malfunction, and the potential for that event to adversely affect the VCs identified in the Application/EIS. The focus was on credible accidents or malfunctions that have a reasonable probability of occurrence, rather than hypothetical "what-if" scenarios.

21.2.2 Effects Assessment

The effects assessment for each accident or malfunction is a qualitative analysis of the potential residual adverse effects of each identified credible accident or malfunction, which is provided in Section 21.4. This analysis included consideration of engineering and technical studies prepared as part of the Application/EIS and relied on the expertise of the Project team.

The effects assessment focused on the likelihood of each accident or malfunction and the safety measures and management approaches to be established and applied to reduce or eliminate the likelihood of occurrence and their related impacts on the various receptor VCs that might be affected by the accident or malfunction. The assessment focused on environmental effects on various VCs that have the potential to exceed the effects of regular operation of the Project (i.e., beyond the Project as currently planned). For example, routine emissions to the atmosphere from the operation of heavy machinery to clean up a spill would be considered within the regular operation of the Project, since heavy machinery will be used on a daily basis as part of normal Project activities.

Due to the unique nature of accidents or malfunctions, each event has the potential to affect different VCs. The analysis focused on the individual specific VCs that are most likely to be affected for each specific accident or malfunction. Assessment boundaries and significance thresholds that are used in this assessment are the same as those presented for each VC in Chapters 7 through 19.

21.2.2.1 Determination of Significance, Likelihood, and Confidence

21.2.2.1.1 Determination of Significance

The primary criteria considered in determining significance includes evaluation of the magnitude, duration, frequency, geographic extent, and reversibility of the residual effects. Residual effects on VCs are ranked as 'not significant' or 'significant'. The determination as to whether an effect is significant or not significant is made in consideration of the CEAA guidance document Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects (CEAA, 2018) as well as the Ktunaxa Nation Council's Recommended Minimum Standards for Proponents in Determining Significance of Effects in Environmental Assessments (EAs) in the Elk Valley (Ktunaxa Nation Council, 2020). The rationale for the ranking of significance is based on the residual effects criteria and professional judgment.

21.2.2.1.2 Likelihood

Likelihood, otherwise described in this context as the probability of a predicted significant residual effect occurring, is presented in the characterization of residual effects on each VC by an accident or malfunction. Quantitative or qualitative terms are used to describe the likelihood of a residual effect on a

VC as a result of the Project, where relevant. In addition, assumptions or limitations to determining the likelihood of a predicted residual effect are described.

The categories used to characterize the likelihood of a predicted residual effect are presented in Table 21.2-2.

Table 21.2-2: Categories used to Describe Likelihood of Predicted Residual Effects

Likelihood Category	Definition
Very Low	Not expected to occur at any point over the life of the Project, with no or limited previous examples of occurrence in similar projects.
Low	Limited potential to occur in exceptional circumstances at least once over the life of the Project with limited but consistent occurrence in some similar projects.
Moderate	Might occur at least once over the life of the Project, with an established trend of regular occurrence in most similar projects.
High	Expected to occur at least once over the life of the Project, with frequent occurrence in similar projects.
Very High	Almost certain to occur at least once over the life of the Project.

21.2.2.1.3 Confidence

Confidence refers to the prediction of the significance of a residual effect based on the quality of data used in the assessment, the level of understanding of the residual effect, and the degree to which analyses are complete (Table 21.2-3). The level of uncertainty associated with the residual effects assessment, including the significance determination, is also included in evaluating confidence.

Confidence considers the reliability of data and analytical methods used in the assessment of effects, confidence of effectiveness of proposed mitigation measures will reduce or eliminate effects, and the reliability of the predicted outcomes made in the assessment. In the Application/EIS, confidence is described as low, moderate, and high as per the definitions outlined in Chapter 5.

Table 21.2-3: Categories used to Describe Predicted Confidence

Confidence Category	Definition
Low	Interactions between the accident or malfunction and VC are not well understood; gaps in data and/or limited evidence available; or effectiveness of mitigation measures may not be proven.
Moderate	Interactions between the accident or malfunction and VC are not fully understood (e.g., VC may be understood in similar ecosystems, in regional area, or in literature); relative confidence in the modelling results; or effectiveness of mitigation measures is considered to be moderate to high and may be proven effective elsewhere.
High	Interactions between the accident or malfunction and VC are well understood; necessary data are available to support the assessment; low degree of uncertainty in models used in assessment and of modelling results; or effectiveness of mitigation measures is considered to be moderate to high.

21.2.3 Risk Assessment

An assessment of the residual risk of each selected accident or malfunction is provided in Section 21.5. This was based on the potential residual adverse effects associated with each accident or malfunction (considering emergency response measures that will be implemented) and the likelihood of the event occurring (after safety measures are applied).

Risk was determined as a function of likelihood (probability of occurrence) and severity (degree of consequence, which corresponds to the evaluation of magnitude in the effects assessment discussed in Section 21.2.2). Once the potential effects associated with each accident or malfunction scenario were identified, the level of residual risk (after controls or safety measures have been applied) was determined based on the method described below.

Determinations of likelihood and severity were based on experience and judgment of qualified professionals and considered the lifespan of each Project component (as required by the EIS Guidelines). The potential likelihood and severity of an event were defined using the categories described in Table 21.2-4.

Table 21.2-4: Likelihood and Severity Ratings used in Risk Assessment

Rating	Definition
Likelihood	
Very Low	Not expected to occur at any point over the life of the Project, with no or limited previous examples of occurrence in similar projects.
Low	Limited potential to occur in exceptional circumstances at least once over the life of the Project with limited but consistent occurrence in some similar projects.
Moderate	Might occur at least once over the life of the Project, with an established trend of regular occurrence in most similar projects.
High	Expected to occur at least once over the life of the Project, with frequent occurrence in similar projects.
Very High	Almost certain to occur at least once over the life of the Project.
Severity	
Very Low	Localized effect; readily remediated, recovery within days or weeks.
Low	Localized effect; predictably remediated, recovery within the life of the Project.
Moderate	Widespread effect; predictably remediated, recovery within the life of the Project.
High	Widespread effect; uncertain remediation, not recoverable within the life of the Project.
Very High	Widespread effect, unlikely to be completely remediated, not recoverable within the life of the Project, loss of a considerable portion of a VC.

The risk assessment of potential environmental effects resulting from accidents or malfunctions involves the use of a risk matrix (Figure 21.2-1), where the residual risk is determined based on the likelihood and consequence of a particular accident or malfunction, based on the definitions provided above. The risk levels are colour-coded to provide a visual means of expressing risk, as defined in Figure 21.2-2. Where a range of risk ratings could occur for a specific accident or malfunction, based on varying levels of likelihood or consequence of effects on multiple VCs, a conservative approach was taken whereby the highest rating was considered. The results of the risk assessment are provided in Section 21.5.

		Post-Mitigation Potential Consequence Rating				
		Very Low	Low	Moderate	High	Very High
Post-Mitigation Likelihood Rating	Very High	Low	Moderate	High	Very High	Very High
	High	Low	Moderate	Moderate	High	Very High
	Moderate	Very Low	Low	Moderate	Moderate	High
	Low	Very Low	Low	Low	Moderate	Moderate
	Very Low	Very Low	Very Low	Very Low	Low	Low

Figure 21.2-1: Risk Matrix

Legend		Description
	Very Low	Risk is negligible; no additional risk mitigation is required.
	Low	Risk is acceptable; continue to monitor risk, though no additional mitigation is required.
	Moderate	Risk may be acceptable; additional detailed review is required; if warranted, additional mitigation may be required.
	High	Risk is unacceptable; additional mitigation must be applied to reduce risk.
	Very High	Risk is intolerable; mitigation must be applied to reduce risk, a long-term risk management plan must be developed and implemented.

Figure 21.2-2: Risk Definitions

21.3 Identification of Potential Accidents or Malfunctions

Based on professional judgment, experience with other mining projects, and in consideration of the requirements and guidelines provided in the AIR and EIS Guidelines, respectively, the following key accidents or malfunction scenarios have been identified as having a reasonable potential to occur as a result of the Project (Table 21.3-1). A description of the conditions that would lead to each accident or malfunction, and consideration of the potential for adverse effects on VCs, are used to screen those accidents or malfunctions that warrant further assessment in Section 21.4. A detailed description of methods and assessment results are reported in Appendix 21-A.

Table 21.3-1: Description of Potential Accidents or Malfunctions Potentially Affecting VCs

Potential Accident or Malfunction	General Description
Release of Hazardous Materials	Failure of the on-site storage and handling systems for hazardous materials (including fuels, lubricants, hazardous chemicals, and sewage) or potential spills during their handling may result in the release of these materials into the surrounding environment.
Loss of Containment	Failure of containment systems, including diversion channels, Main Sediment Pond and Grave Creek Reservoir, and erosion or sediment control devices may result in the release of contained water and/or sediment into the surrounding environment. Leakage or rupture from an on-site collection channel would also be considered a loss of containment.
Uncontrolled Detonation of Explosives	Unmanaged or uncontrolled detonation of explosives or detonators associated with blasting of the open pits, may result in excess noise and vibration or damage resulting from fly rock extending beyond defined boundaries.
Fire	A Project-caused fire may result in the loss of product, destruction of Project infrastructure and vegetation and natural features within or beyond the Project footprint, and the release of smoke, combustion gases and ash. Forest fires from natural causes are considered an effect of the environment on the Project and are assessed in Chapter 20.
Slope Failure	Failure of pit walls, coal, soil, and/or mine rock stockpiles may result in slumping into the open pits, and/or the release of coal, soil and/or mine rock outside the storage areas.
Wildlife Encounter	Wildlife encounters may result in disturbance, injuries, and/or fatalities of Project personnel, the public, or wildlife.
Vehicle or Equipment Collision	A Project-related vehicle or equipment accident on road or rail transportation networks (not involving spills) may result in injuries or fatalities of Project personnel, the public, or wildlife, and property damage. Includes collisions with other vehicles or equipment, pedestrians, and wildlife. Accidents involving spills are addressed under "Accidental Release of Hazardous Materials."

The accidents or malfunctions identified above are related to the activities and components associated with the Project. The potential effects of natural events unrelated to the Project, such as extreme weather events (e.g., extreme precipitation, extreme winds, and flooding events), geophysical events (e.g., avalanches, landslides, seismic events), and forest fires are assessed in Chapter 20.

21.4 Effects Assessment of Accidents or Malfunctions

21.4.1 Potential Interactions between Accidents or Malfunctions and Valued Components

The accidents or malfunctions identified in Section 21.3 have the potential to result in adverse effects on VCs in the event of their occurrence; as such, an assessment of each accident or malfunction is provided in the sections below. A summary of the VCs that may be affected by these events, and the Project phases during which these events may occur, is presented in Table 21.4-1.

21.4.2 Release of Hazardous Materials

21.4.2.1 Description of Scenarios

Hazardous materials include any items or chemicals which may pose a risk to public safety or are an environmental hazard. A range of hazardous materials will be transported, stored, or used on-site, including fuel (e.g., diesel, gasoline, and propane), lubricants, coolant, hydraulic fluids, paints and coatings, cleaners, solvents, batteries, and explosive materials. Hazardous waste (such as batteries and used oils) will also be generated onsite during all phases of the Project.

There are several scenarios that could lead to an accidental release of hazardous materials. Relatively small spills of petroleum products may occur during refueling of or leaks from machinery. Tanks used to store various hazardous materials such as fuel may leak. An accident involving a vehicle transporting a hazardous material within the Project footprint could result in a spill, or there could be a spill of material within the coal process plant (CPP).

The most likely scenario is the spill of relatively small amounts of fuel (less than a few litres), lubricants or other fluids used in vehicles and equipment, which may occur during refueling, maintenance, or as a result of leaking components of vehicles and equipment during all phases of the Project. This scenario is highly localized and limited to the active containment areas within the Project footprint. Given the surface water collection and storage methods in place within the Project footprint to manage mine contact water, such a spill would remain confined to the Project footprint and would not be likely to migrate beyond its boundaries if the spill is quickly contained and cleaned up. In the event that a spill occurs in an area outside of the Project footprint (e.g., along a public forest service road), vehicles and mobile equipment used for the Project will be equipped with appropriate spill response materials to contain and clean-up the released material.

Table 21.4-1: Summary of Potential Interactions between Accidents or Malfunctions and Valued Components

Accident or Malfunction	Valued Component												
	Air Quality	Acoustic Environment	Soils and Terrain	Groundwater	Surface Water	Fish and Fish Habitat	Terrestrial Ecosystems	Vegetation	Wildlife	Archaeological Resources	Economic Conditions	Socio-Community	Land Use
Release of Hazardous Materials	C;O;R;P		C;O;R;P	C;O;R;P	C;O;R;P	C;O;R;P	C;O;R;P	C;O;R;P	C;O;R;P	C;O;R;P			
Loss of Containment			C;O;R;P	C;O;R;P	C;O;R;P	C;O;R;P	C;O;R;P	C;O;R;P	C;O;R;P				C;O;R;P
Uncontrolled Detonation of Explosives	C;O	C;O			C;O	C;O	C;O	C;O	C;O				
Fire	C;O;R;P		C;O;R;P		C;O;R;P	C;O;R;P	C;O;R;P	C;O;R;P	C;O;R;P		C;O;R;P	C;O;R;P	C;O;R;P
Slope Failure	C;O				C;O	C;O			C;O			C;O	C;O
Wildlife Encounter									C;O;R;P			C;O;R;P	
Vehicle or Equipment Collision									C;O;R;P			C;O;R;P	

Note: Symbols in table refer to the Project phases during which a potential interaction is anticipated (i.e., C denotes the Construction and Pre-Production phase; O denotes the Operations phase; R denotes the Reclamation and Closure phase; and P denotes the Post-Closure phase).

During the Operations phase of the Project, there will be several large (e.g., up to 45,000 litre) petroleum storage tanks within the maintenance shop complex in the upper facilities area east of the CPP. The exact number, configuration, and location of tanks will be developed as part of detailed design and using commercially available tank systems equipped with secondary containment. Large leaks from storage tanks could occur as a result of structural failure of the tank or as a result of an accidental impact to a tank from a vehicle, for example. A spill of the entire contents of the fuel storage tank that escapes the secondary containment measures is assumed as a worst case scenario for this accident; however, this scenario is considered to have a very low likelihood of occurrence.

An on-site vehicle collision could result in an unplanned release of fuels, lubricants, coolant, hydraulic fluid, coal, and/or explosives materials on transportation corridors within the Project footprint.

An accidental release of hazardous materials within or adjacent to a watercourse has the potential to disperse over a long distance, and may result in adverse effects on receptors within the aquatic environment.

21.4.2.2 Mitigation Measures

A number of safeguards and preventative procedures will be incorporated into the Project design to reduce the likelihood and severity of an accidental release of hazardous materials. These measures will primarily focus on the transportation, storage, and use of hazardous materials, and spill response. Hazardous materials used for the Project will be transported to and from, and stored at the Project site based on the applicable provincial and federal regulations (e.g., Transportation of Dangerous Goods Regulations).

Facilities used to store and manage hazardous materials (e.g., fuel storage tanks, fueling stations, reagents/consumables storage facilities, explosives storage facilities, septic fields) will be designed to meet all applicable regulatory and industry standards. Fluid storage tanks and vessels will be equipped with secondary containment (e.g., double-walled steel tanks with built-in containment), and appropriate barriers (e.g., concrete barricades) will be installed around storage tanks to protect them from potential impacts by vehicles or equipment. Hazardous material transfer stations (i.e., fuelling stations) will be established in low risk areas within the Project footprint, with an underlying impermeable surface (e.g., paved or concrete pad).

While it is possible for an accidental release of hazardous materials to occur, a number of prevention and mitigation measures will be in place to prevent such a spill from happening, or to minimize the environmental effects. These include the following measures:

- A conceptual Spill Prevention, Control, and Countermeasures Plan (SPCCP; Chapter 33, Section 33.4.1.10) has been developed for the Project, which provides a framework of the preventative measures to minimize the risk of a spill occurrence, response processes to control and remediate spills, spill reporting procedures, and monitoring programs that will be implemented to identify and manage potential spills before they occur;
- Persons responsible for managing spill response efforts, including their authority, role and contact details will be identified in a Mine Emergency Response Plan (MERP; Chapter 33, Section 33.4.2.2) that will be established and implemented during all phases of the Project;

- An appropriate number of staff will be trained in the handling of emergency response and spill scenarios;
- Diagrams of the surrounding layout, topography, evacuation paths and drainage flow paths, ground and surface water resources, sensitive ecological and protected areas will be developed and included as part of the MERP;
- Quantities of hazardous materials that could be released, with predicted flow path, and flow rate will be documented;
- All fuel and service vehicles will carry appropriate spill response materials and equipment, including a commercial sorbent materials suitable for use on both soil and water. These materials will be promptly applied to contain and recover spilled material;
- Vehicle equipment will be inspected for leaks prior to arrival on-site and on a regular basis during the Construction and Pre-Production, Operations, Reclamation, Closure;
- Locations with the potential for a spill of a significant volume of fuel will be graded to flow towards the surface water collection system where it could be safely collected and would not enter the surrounding natural environment;
- Roadside ditches within the Project footprint with regularly spaced culverts will also help to contain spills as the culverts could be blocked to stop the spread of spilled materials;
- Storage of liquid petroleum, and refueling of machinery, will not occur within 30 m of any watercourse or wetland;
- Use of secondary containment for all storage tanks and chemical storage areas;
- The incorporation of road design features for Project roads within the Project footprint (such as speed limits and pullouts), as appropriate;
- Spill response kits will be available at the Project-site during all phases of the Project to minimize any potential adverse environmental effects; and
- All bulk explosives spills will be dealt with quickly for safety and environmental reasons. Product will be recovered quickly by means of a non-sparking shovel and brooms. Spills management will use recommended best practice for clean-up of any spills for the chemicals involved with commercial explosives.

In the unlikely event of a spill of any material, emergency containment and recovery procedures developed in the SPCCP will include:

- Immediate containment and recovery of spill material using a variety of equipment including booms, barriers, sand bags, skimmers, and natural and synthetic sorbent materials;
- Containment measures will immediately be initiated to limit the spread of the spill;
- Any nearby drainage (non-watercourse) culverts will be blocked to limit spill migration if required;
- Excavation and removal of hydrocarbon impacted soils for temporary storage, and eventual permanent treatment/disposal;
- Repair of a secondary containment breach;
- Reporting of any spills that escape the Project footprint to the applicable regulatory authorities in accordance with permit conditions and regulatory requirements;
- Conduct a post-spill response investigation to evaluate the performance of spill prevention measures;
- Post-response samples of soil and water for testing will be collected; and
- Any equipment cleaning that is required as a result of a leak or spill on the equipment will be implemented in a confined area where the wash water can be collected for proper disposal.

21.4.2.3 Characterization of Residual Effects

Based on the effectiveness of the standard prevention measures, Project-specific design considerations, and the type and quantity of the potential hazardous material spill, the likelihood of occurrence of a Project-related accidental release of hazardous materials that escapes the containment measures or mine contact water collection systems is low. Emergency response measures executed in response to the event will also reduce the likelihood and severity of potential residual effects associated with the release.

Based on the interactions identified in Table 21.4-1, an accidental release of hazardous materials, if it escaped the containment and collection systems that will be developed within the Project footprint, has the potential to affect air quality, soils and terrain, groundwater, surface water, fish and fish habitat, terrestrial ecosystems, vegetation, wildlife, and archaeological resources if the spill extends beyond the Project footprint. The potential residual effects on each VC are characterized in the following sections.

21.4.2.3.1 Air Quality

An accidental release of hazardous materials that exposed fuel to the open air would release volatile organic compounds (VOCs) to the atmosphere and potentially affect air quality. Clean-up of the spill would employ hauling trucks and earth moving equipment which would release particulate matter and combustion gases through fuel consumption, and dust emissions from the clean-up activities. A change in the air quality due to a spill will be low in magnitude, local in geographic extent, affecting only the immediate vicinity for a short time while the spill occurs or is being cleaned up. Pollutant emissions from the clean-up will be sporadic in frequency and short-term in duration and likely not be detectable above emissions from other Project activities involving the use of heavy equipment. Any minor adverse environmental effects on air quality will cease once the clean-up is complete. Contaminant emissions are expected to be within all pertinent standards and guidelines, confined to the Project footprint, and no significant residual environmental effects are predicted.

Based on the mitigation and response mechanisms and procedures, the potential residual environmental effects of an accidental release of hazardous materials on air quality for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.2.3.2 Soils and Terrain

An accidental release of hazardous materials may result in a change in the biogeochemical properties of soils within the affected area of the release. A change in soil quality may affect overall soil health and the capability to support the establishment of vegetation communities (Section 21.4.2.3.6). In the event of an accidental release, spill response activities will involve the removal of contaminated soil for proper disposal, which may result in a localized change to the surface expression in the area. However, following clean-up, excavated areas will be backfilled with clean soil and re-contoured to a stable profile that blends into the surrounding landscape. Soil used for backfilling will be sourced from an area with similar ecological properties as the affected area, to facilitate restoration of the ecosystem and avoid the spread of invasive species.

Based on the safeguards that will be implemented to prevent its occurrence, the likelihood of occurrence of an accidental release of hazardous materials is considered low. With the implementation of appropriate spill response and restoration measures following an accidental release, the residual effects are predicted to be low in magnitude, short-term in duration, discrete in extent, and reversible. As a result, the potential

residual environmental effects of an accidental release of hazardous materials on soils and terrain for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.2.3.3 Groundwater

The potential for an accidental release of hazardous materials to affect groundwater quality is dependent on the magnitude of the release and the timing of the spill response activities. A substantial release of a hazardous material (e.g., due to a storage tank rupture) could result in the movement of contaminants into the subsurface, thereby affecting the quality of the underlying groundwater. For example, the presence of floating hydrocarbons on the water table, and dissolved hydrocarbon constituents within the groundwater, can result in a persistent anoxic groundwater condition (e.g., dissolved oxygen is consumed by micro-organisms degrading the hydrocarbon), which can indirectly result in the dissolution of otherwise poorly soluble metals such as iron, manganese and other metals from the host aquifer. When impacted groundwater is intercepted by a water well, complaints of odour, iron fouling, or vapours can render the well unusable.

In the event of an accidental release of a hazardous material, the spill response activities included in the SPCCP will be implemented as soon as feasible. Through the rapid deployment of spill response materials and equipment, the majority of spilled material is anticipated to be quickly contained and recovered. Following completion of the spill clean-up efforts, a monitoring and follow-up program will be implemented to confirm that the release has been sufficiently remediated.

Given the preventative and spill response measures that will be in place during all phases of the Project, the potential residual environmental effects of an accidental release on groundwater will be short-term in duration, low to moderate in magnitude (depending on the volume of the release), discrete to local in extent, and reversible upon completion of the clean-up efforts. As a result, the potential residual environmental effects of an accidental release of hazardous materials on groundwater for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.2.3.4 Surface Water

Numerous watercourses exist in the vicinity of the Project, including Elk River, Michel Creek, Alexander Creek, West Alexander Creek, Harmer Creek, and Grave Creek. Waterbodies in the immediate vicinity include Grave Lake, Harriet Lake, Mite Lake, and Barren Lake. An accidental release of hazardous materials, if not promptly contained, has potential to enter surface water outside of the Project footprint. A release of a hazardous material into a surface water environment could result in severe adverse effects on water quality, sediment quality, and ecological receptors associated with the aquatic environment. The potential environmental effects on fish and fish habitat are discussed in Section 21.4.2.3.5.

Depending on the hydrological conditions at the location of an accidental release of hazardous materials to a surface water environment, flowing waters and/or wave action may disperse contaminants, resulting in decreases in water quality downstream of the release. Natural processes of dispersal and volatilization will immediately decrease the concentrations of contamination in the water, and spill response efforts will remove spill materials from accessible areas. Some constituents of hazardous materials may be less volatile and degrade slowly in alpine environments, and may accumulate in the receiving benthic environment. However, the adverse effects from these constituents are expected to be mitigated by clean-up efforts and natural dispersal.

Being conservative in the assessment, the potential residual effects of an accidental release of hazardous materials on surface water is considered short-term in duration, moderate in magnitude, local in extent, and reversible upon completion of the clean-up efforts and through natural degradation. As a result, the potential residual environmental effects of an accidental release of hazardous materials on surface water for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.2.3.5 Fish and Fish Habitat

An accidental release of hazardous materials that escapes beyond the Project footprint into an aquatic environment could result in localized lethal and sub-lethal effects on fish species and benthic invertebrate communities, as well as indirect effects through degradation or loss of habitat caused by the release, or by the subsequent clean-up efforts (e.g., installation of silt curtains, removal of impacted sediment). Some fish mortality may occur at the immediate location of the release, where concentrations of the hazardous material are high enough to be toxic. Fish will also move to avoid locations affected by the release, resulting in decreased abundance and diversity of fish species in the local area. Released hazardous materials may decrease primary and secondary production of organisms used as sources of prey, forage, or protective cover by fish, thereby resulting in indirect effects on fish through a reduction in food and/or habitat availability.

Project contact water collection systems will be established within the Project footprint, which offer many opportunities for containment and clean-up to minimize the risk of spills affecting aquatic environments, and to enhance the likelihood of containment and clean-up through emergency response procedures.

Based on the preventative mitigation and spill response measures, the likelihood of an accidental release of hazardous materials to affect aquatic environments outside the Project footprint is considered low. In the unlikely event of a worst-case spill scenario into an aquatic environment, the potential residual effects on fish and fish habitat are predicted to be moderate to high in magnitude, short-term in duration, local in geographic extent, and reversible through appropriate spill response measures, natural dispersal of any unrecovered residual hazardous material, and re-establishment of local fish populations. As a result, the potential residual environmental effects of an accidental release of hazardous materials on fish and fish habitat for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.2.3.6 Terrestrial Ecosystems and Vegetation

Terrestrial ecosystems (i.e., avalanche chutes, grasslands, riparian habitat, old growth and mature forests, and wetland ecosystems) and vegetation may be affected by an accidental release of hazardous materials into non-developed or vegetated areas beyond the Project footprint. Depending on the volume and chemical constituents of a hazardous material, an accidental release my affect terrestrial ecosystems and vegetation and ecosystems through alteration of soil, water quality or direct damage to plants, which may result in decreased species diversity of vegetation communities within areas of the release. Further, spill response measures may require vegetation clearing to sufficiently contain and clean-up a spill. However, spill response activities will be implemented promptly following an accidental release, and the affected areas will be localized. Contaminated material will be removed for appropriate disposal, and the affected areas will be restored. Restoration of affected areas may include the following activities:

- Backfilling excavated areas will clean soil and recontouring to a stable profile that blends into the surrounding landscape;

- Re-establishing vegetation using species appropriate for the area;
- Applying weed control measures, where required, to allow successful establishment of an appropriate vegetation community; and
- Implementing a monitoring program to evaluate the success of vegetation re-establishment.

With the planned safeguards that will be implemented to prevent an accidental release of hazardous materials, the likelihood of occurrence is considered low. In the unlikely event that an accidental release of hazardous materials does interact with terrestrial ecosystems and vegetation in the vicinity of the Project, the residual effects are predicted to be moderate in magnitude, short-term in duration, discrete in geographic extent, and reversible through implementation of appropriate spill response measures and restoration activities. As a result, the potential residual environmental effects of an accidental release of hazardous materials on terrestrial ecosystems and vegetation for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.2.3.7 Wildlife

An accidental release of hazardous materials within and outside the Project footprint may interact with wildlife through direct contact, alteration of habitat and food availability, and sensory disturbance during the subsequent spill response and restoration activities. Some hazardous materials contain compounds that are toxic to wildlife, and direct contact may result in changes to wildlife health or even mortality. Many wildlife species are mobile and are expected to avoid an area affected by a spill, while other species, such as invertebrates or small rodents, may not be able to effectively avoid an affected area. However, through the implementation of a robust SPCCP with safeguards to prevent an accidental release and response measures to quickly contain and clean-up a release upon its occurrence, the likelihood of effects on wildlife resulting from direct contact with hazardous materials is considered very low.

As discussed in Section 21.4.2.3.6, an accidental release of hazardous materials may affect the health and diversity of terrestrial ecosystems and vegetation communities, and the subsequent spill response activities may require removal of vegetation so that the affected area is appropriately remediated. These effects may result in changes to habitat quality and availability for wildlife species, and alter the movement patterns of wildlife, which may in turn affect the availability of food sources in the area. However, habitat and food availability are predicted to increase following completion of spill response efforts and restoration activities to re-establish vegetation communities within the area affected by a release, over time. Therefore, indirect effects on wildlife and wildlife habitat are expected to be low in magnitude, local in extent, short-term to medium-term in duration, and reversible upon completion of the clean-up and restoration efforts and recovery of the vegetation communities. As a result, the potential residual environmental effects of an accidental release of hazardous materials on wildlife for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.2.3.8 Archaeological Resources

Based on the findings included in the Physical and Cultural Heritage Assessment (Chapter 16), a number of archaeological sites and high archaeological potential areas have been discovered and identified within the Project footprint. If previously undocumented or unrecovered resources exist within or near the affected area of an accidental release of hazardous materials, the adverse effects on those resources could be of high consequence and irreversible. Released contaminants could alter the physical attributes of these resources, or they could be affected by soil disturbance associated with spill response activities.

Project activities will be restricted to the extent of the Project footprint, within which the potential effects of the Project on archaeological resources have been assessed. With the application of preventative safeguards and appropriate spill response measures, in the unlikely event of an accidental release of hazardous materials, the release is expected to be contained within the Project footprint. In the event of an accidental release that extends beyond the Project footprint into undisturbed lands, NWP will retain the services of a qualified archaeologist to determine if the affected area is within a high archaeological potential area, and complete an assessment of the affected to identify the potential impacts of the release on archaeological resources.

The potential effects of an accidental release of hazardous materials on archaeological resources are considered to be moderate in magnitude, permanent in duration, discrete in extent, irreversible, but because of the low likelihood of occurrence, they are thus rated not significant with high confidence.

21.4.2.4 Determination of Significance

Given the temporary and localized nature of most accidental releases of hazardous materials that could occur, and the Project design considerations that will incorporate measures to prevent the off-site migration of surface runoff including spilled material, the potential for an accidental release of hazardous materials to adversely affect the surrounding environment outside the Project footprint is very low. The mine and its facilities will be inherently designed, constructed and operated to prevent spills and to contain and clean-up any spilled material. Therefore, the potential environmental effects of an accidental release of hazardous materials on all potentially affected valued components during all Project phases are rated not significant. There is a high level of confidence in this prediction.

The significance of residual environmental effects that may result from a release of hazardous materials on all potentially affected VCs is presented in Table 21.4-2.

Table 21.4-2: Summary of the Significance of Potential Residual Environmental Effects of a Release of Hazardous Materials

Accident or Malfunction	Valued Component												
	Air Quality	Acoustic Environment	Soils and Terrain	Groundwater	Surface Water	Fish and Fish Habitat	Terrestrial Ecosystems	Vegetation	Wildlife	Archaeological Resources	Economic Conditions	Socio-Community	Land Use
Release of Hazardous Materials	NS		NS	NS	NS	NS	NS	NS	NS	NS			

Note: NS = effects are not significant; empty cell = no anticipated interaction.

21.4.3 Loss of Containment

21.4.3.1 Description of Scenario

Development of the Project will include the construction of water management infrastructure within the Project footprint, which include water diversion channels and collection ditches, sediment ponds, impoundment dam, emergency overflow spillway, as well as erosion and sediment control devices that

will be installed within the Project footprint as required. This infrastructure will be used to direct non-contact water surface runoff away from mine site infrastructure, divert and contain mine site contact water into sediment ponds for treatment, control the release of treated water from sediment ponds to the receiving environment, and prevent erosion and subsequent sediment transfer from the Project footprint into the adjacent undisturbed environment.

A loss of containment scenario may involve the failure of one or more components of the water management infrastructure, which may lead to the unintended release of contact water, effluent, or sediment into the receiving environment. A failure may occur as a result of human error (for example, the inappropriate operation of heavy machinery in/around diversion channels or sediment ponds could result in the breach of a berm), inadequate design or construction techniques, or extreme precipitation events exceeding those accounted for during detailed design. Inadequate freeboard monitoring of the sediment ponds may also lead to the ponds overfilling, resulting in an unintended release to the receiving environment via the emergency overflow spillway.

As a worst case scenario, a loss of containment may result in a large release of contact water, mine effluent, or sediment into a local watercourse (such as Alexander Creek or West Alexander Creek). This scenario may result in soil erosion and creation of new overland flowpaths, changes in groundwater quality, or sediment transfer into the watercourse, which may adversely affect natural hydrological patterns, surface water quality, fish and fish habitat, riparian ecosystems, vegetation health and biodiversity, and wildlife health, and wildlife habitat availability, as noted in the interactions matrix in Table 21.4-1. A loss of containment may also disrupt downstream traditional and non-traditional land use activities by restricting access, or adversely affecting land use resources (e.g., fish populations, tourism destinations).

21.4.3.2 Mitigation Measures

Mine water management infrastructure will be designed, constructed, and maintained by qualified professionals, based on the findings from runoff modelling and geotechnical assessments, to meet or exceed all applicable regulations and policies. Further, a conceptual Site Water Management Plan (Chapter 33, Section 33.4.1.8) has been prepared for inclusion in the Application/EIS, which outlines the strategies to appropriately manage surface water on the mine site during all phases of the Project.

During the Construction and Pre-Production phase of the Project, two smaller sediment basins will be constructed to manage the drainage originating from the area associated with the pre-production construction of the mine. The sediment basins have been designed according to guidelines provided by the Government of Alberta (Government of Alberta Transportation, 2011), which recommend that sediment basins have a minimum storage volume of 250 cubic metres (m^3) per hectare (ha) of disturbed land and a maximum of 1.5 metres (m) depth. These basins are intended for short-term water management and sediment control and will be replaced by an interim sedimentation pond as soon as that impoundment is completed. In addition to the sediment basins, localized best management practices (BMP's) will be incorporated into all construction activities to limit localized erosion and divert runoff away/around construction affected areas.

During the Operations phase, a series of two sediment ponds are proposed for managing the combined runoff from the mine footprint and undisturbed ground as the mine development advances: an Interim

Sediment Pond for Operations up to the end of Year 4 (EOY 4) and a Main Sediment Pond for the full mine footprint into Post-Closure. Both sediment ponds were sized according to the guidelines of the B.C. Ministry of Environment (B.C. MOE) for the design of sediment ponds (B.C. MOE, 2015), which recommends the settling of particles with a diameter of 5 to 10 microns or greater during conveyance of runoff resulting from a 10-year, 24-hour storm event. These ponds will be placed downstream of the main Mine Rock Storage Facility and will be developed through the mine life to accommodate the advancing mine rock placement.

The sediment ponds, and mine site drainage systems reporting to the sediment ponds, were designed to convey and provide containment (without discharge) based on a design runoff event, which was defined as a 200-year, 24-hour storm event (i.e., precipitation depth of 92.3 millimetres [mm] accumulated during a single storm event). The emergency overflow spillway will be similarly designed to at least withstand a design runoff event of 1 in 200 years with a minimum freeboard of 0.5 m and a greater freeboard during normal operations (B.C. MOE, 2015). The sediment ponds and mine drainage systems will be decommissioned and reclaimed during the Reclamation and Closure, and Post-Closure phases of the Project.

Erosion and sediment control measures will be designed and implemented throughout all phases of the Project, to prevent the transfer of sediments into nearby watercourses and terrestrial ecosystems. Erosion and sediment control devices, such as sediment fencing, turbidity curtains, wattles, check dams, sand bags, and geotextile matting, will be available on-site throughout all phases of the Project. These devices will be installed as required to mitigate the potential for erosion and sediment transfer into areas outside of the Project footprint. While deployed, these devices will be monitored and repaired/replaced regularly by qualified environmental personnel. Additional details regarding the prevention and management of erosion and sediment transfer are provided in a conceptual Erosion and Sediment Control Plan (ESCP) that has been prepared for the Project and is included in Chapter 33, Section 33.4.1.4.

The likelihood of a loss containment event will be reduced through the incorporation of appropriate water management strategies into Project design, effective application of erosion and sediment control measures, and regular monitoring of site conditions throughout all phases of the Project. In the unlikely event of a loss of containment occurrence, the following emergency response measures will be implemented to reduce the severity of potential effects on the environment:

- The procedures outlined in the MERP and ESCP will be triggered immediately upon discovering the loss of containment;
- Notification will be provided to regulatory authorities, emergency responders, local residents, and Indigenous communities, as applicable;
- Water will be pumped from the affected areas into the open pit to halt the release, if needed;
- Erosion and sediment control devices will be deployed to promptly contain the released material, including turbidity curtains (within affected watercourse channels), sand bags, and geo-synthetic barriers (e.g., aquadams);
- Earthwork machinery will be deployed to repair and reinforce the source of the loss of containment;
- Confirmatory soil, groundwater, and surface water sampling will be completed as necessary, to assess and delineate the extent of the release; and

- A remedial action plan specific to the event will be developed and implemented to remediate areas affected by the loss of containment.

Upon the completion of remedial activities to address a loss of containment, the following restoration activities may be conducted within the affected areas:

- Areas eroded or disturbed by the loss of containment will be re-contoured to a stable profile that blends with the surrounding landscape;
- Sediment encroaching into a watercourse will be removed, provided that additional damage to fish habitat can be avoided;
- A specific habitat offsetting plan will be developed to repair or improve the quality of fish habitat within or near to the location of the event;
- Terrestrial ecosystems affected by the containment loss will be restored by vegetation establishment programs; and
- A monitoring program will be implemented to evaluate the restoration efforts within the areas affected by a loss of containment.

Following a loss of containment, an investigation will be conducted to identify the root cause of the event, and the procedures or infrastructure that contributed to its occurrence. Project management plans and procedures will be revised through adaptive management strategies, based on the findings of the investigation, to further reduce the likelihood of subsequent loss of containment events.

21.4.3.3 Characterization of Residual Effects

21.4.3.3.1 Soils and Terrain

A loss of containment may result in soil erosion and/or slope failure, due to a sudden increase in surface runoff. In addition, a release of mine contact water or effluent could alter the biogeochemical properties of soils within the areas affected by a loss of containment. In the unlikely event of a loss of containment, initial efforts will focus on containment of any released materials and repairing the source of the breach, to reduce to area affected by the event. Where required, eroded or unstable terrain will be stabilized and re-contoured to protect personnel and the public, and to reduce the risk of further erosion and sedimentation. Spill response and clean-up activities described in Section 21.4.2.3.2 will be implemented to remove contaminated soil for proposal disposal.

With the incorporation of appropriate water management strategies into Project design, construction of water management infrastructure to meet or exceed regulatory requirement and industry standards, and implementation of regular monitoring programs, the likelihood of occurrence of a loss of containment is considered low. With the implementation of appropriate emergency response, erosion and sediment control, and restoration measures following a loss of containment, the residual effects on soils and terrain are predicted to be low in magnitude, localized, short-term, and reversible. As a result, the potential residual environmental effects of a loss of containment on soils and terrain for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.3.3.2 Groundwater

A loss of containment would have the potential to affect groundwater quality depending upon the severity of the event, soil conditions within the affected area, and the timeframe of the cleanup response.

Localized infiltration would be limited due to surface flow along established or natural drainage patterns, and released fluids within the Project footprint would be largely contained by the water management infrastructure. Solid sediments may be deposited near the breach location, but will be cleaned up where possible to limit infiltration and long term effects to groundwater. If land areas cannot effectively be remediated due to the potential damage of natural vegetation (i.e., forested areas) the potential for long-term effects to groundwater quality exist.

In the event of a loss of containment, the location of the breach will be blocked to cease the release, and spill response activities included in the SPCCP will be implemented as soon as feasible. Rapid deployment of spill response materials and equipment would limit the area affected by a loss of containment, and recover the released material if possible. A groundwater monitoring program will be implemented to determine the nature and extent of residual adverse effects on groundwater following a loss of containment. Where a loss of containment results in changes to groundwater quality that exceed applicable water quality guidelines, a site-specific remedial action plan will be developed to appropriately remediate and return groundwater quality within the affected area to an acceptable condition.

With the incorporation of appropriate water management strategies into Project design, construction of water management infrastructure to meet or exceed regulatory requirement and industry standards, and implementation of regular monitoring programs, the likelihood of occurrence of a loss of containment is considered very low. With the implementation of appropriate emergency response, erosion and sediment control, and restoration measures following a loss of containment, the residual effects on groundwater are predicted to be moderate in magnitude, localized, short-term, and reversible. As a result, the potential residual environmental effects of a loss of containment on groundwater for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.3.3.3 Surface Water

A loss of containment may result in the release of mine contact water, effluent, or sediment in aquatic environments outside of the Project footprint, which could result in adverse effects on existing hydrological conditions, water quality, sediment quality, and ecological receptors associated with the aquatic environment. The potential environmental effects on fish and fish habitat are discussed in Section 21.4.3.3.4.

A loss of containment could result in a sudden increase in streamflow by a rapid influx of fluid into a watercourse and/ or deposition of a large amount of sediment into a watercourse channel which may decrease streamflow or alter the existing flowpaths. Additionally, flowing waters and/or wave action may disperse released materials, resulting in decreases in water quality downstream of the release, similar to the potential effects of an accidental release of hazardous materials described in Section 21.4.2.3.4.

With the incorporation of appropriate water management strategies into Project design, construction of water management infrastructure to meet or exceed regulatory requirement and industry standards, and implementation of regular monitoring programs, the likelihood of occurrence of a loss of containment affecting the surface water environment is considered low. With the implementation of appropriate emergency response, erosion and sediment control, and restoration measures following a loss of containment, the potential residual effects of loss of containment on surface water is considered short-term in duration, moderate in magnitude, local in extent, and reversible upon completion of the clean-up

and restoration efforts. As a result, the potential residual environmental effects of a loss of containment on surface water for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.3.3.4 Fish and Fish Habitat

A loss of containment that results in a release of mine contact water, effluent, or sediment into an aquatic environment outside the Project footprint could result in localized direct effects on fish species and benthic invertebrate communities, as well as indirect effects through degradation or loss of habitat caused by the release, or by the subsequent clean-up efforts (e.g., installation of silt curtains, removal of impacted sediment). Introduction of suspended material may affect fish metabolism, movement, feeding, and reproductive behaviour. Direct fish mortality is not anticipated to occur, as fish will move to avoid affected locations; however, a release may result in decreased abundance and diversity of fish species in the local area. A decrease in primary and secondary production of organisms used as sources of prey, forage, or protective cover by fish, thereby resulting in indirect effects on fish mortality through a reduction in food and/or habitat availability. However, implementation of appropriate response activities following a loss of containment will cease the release of material from the breach location, and deployment of spill response materials will isolate the affected area within a watercourse from the upstream and/or downstream environment. Fish will be salvaged from the affected area and released into adjacent reaches of the watercourse, and the mine contact water, effluent, or sediment will be recovered from the affected area where feasible, provided that the integrity of existing fish habitat can be maintained. Once the area has been remediated to a condition deemed acceptable by regulatory agencies, the remediated area will be restored to provide fish habitat similar to or exceeding conditions of the area prior to the loss of containment. Residual material remaining within the watercourse following completion of the remedial activities is expected to decrease in overall concentration through natural dispersal and attenuation. A subsequent monitoring program will be implemented to monitor the affected area and downstream receiving environments to confirm that water quality is suitable for aquatic life, or reflective of other areas of the watercourse unaffected by the loss of containment.

With the implementation of appropriate emergency response, erosion and sediment control, and restoration measures following a loss of containment, the potential residual effects on fish and fish habitat is considered short-term in duration, moderate to high in magnitude, local in extent, and reversible upon completion of the clean-up, restoration, and habitat offsetting efforts. Given the low likelihood of occurrence, the potential residual environmental effects of a loss of containment on fish and fish habitat outside the Project footprint for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.3.3.5 Terrestrial Ecosystems and Vegetation

The severity of potential effects of a loss of containment on terrestrial ecosystems and vegetation communities is dependent on the composition and volume of materials released, as well as the release location. A large volume of mine contact water, effluent, or sediment may affect terrestrial ecosystems and vegetation communities through alteration of soil, water quality or direct damage to plants, which may result in decreased species diversity of vegetation communities within areas of the release. Further, response measures may require vegetation clearing to sufficiently contain and remediate the affected areas. However, response activities will be implemented promptly following a loss of containment event,

and the affected areas will be localized. Released materials will be removed for appropriate disposal, and restoration activities will be implemented to stabilize soil and re-establish vegetation where required.

With the implementation of appropriate emergency response and restoration measures following a loss of containment, the potential residual effects on terrestrial ecosystems and vegetation communities are considered short-term in duration, low in magnitude, local in extent, and reversible upon completion of the clean-up, and restoration efforts. Given the low likelihood of occurrence, the potential residual environmental effects of a loss of containment on terrestrial ecosystems and vegetation communities for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.3.3.6 Wildlife

Similar to terrestrial ecosystems and vegetation communities, the severity of potential effects of a loss of containment on wildlife and wildlife habitat is dependent on the composition and volume of materials released, as well as the release location. Due to the presence of ongoing Project activities, a relatively low number of wildlife species are anticipated to occupy habitat within or adjacent to the Project footprint, which would reduce the risk of wildlife mortality as a result of a loss of containment. The sustainability or abundance of regional wildlife populations would not be expected to be affected by a loss of containment, and uptake of contaminants from mine contact water or effluent through vegetation would be limited as communities generally re-establish over one or two growing seasons following clean-up. Flooding or infilling of wildlife habitat could occur near the breach location, but effects would be localized and generally within the Project footprint. A loss of containment may result in alteration of habitat and food availability, and sensory disturbance during the subsequent response and restoration activities. However, these effects are anticipated to be short-term in duration, and habitat and food availability are predicted to increase following completion of restoration activities to re-establish vegetation communities in within the area affected by a release.

Potential residual effects on wildlife and wildlife habitat are expected to be low to moderate in magnitude, local in extent, short-term in duration, and reversible upon completion of the clean-up and restoration efforts and recovery of the vegetation communities. As a result, the potential residual environmental effects of a loss of containment on wildlife for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.3.3.7 Land Use

A loss of containment has the potential to temporarily limit the use of affected areas for recreational and traditional land uses such as hunting, gathering, and fishing. Direct effects on land use resources, such as fish, wildlife, and vegetation communities, may indirectly affect land use opportunities. Additionally, road closures resulting from a loss of containment may restrict access for land use practices. However, as the effects would be largely limited to the vicinity of the Project footprint, which will be restricted from access by members of the public while Project activities are underway.

Land use activities downstream of an area affected by a loss of containment may be temporarily affected following the event, but the initial response efforts would limit these effects to a short-term duration, if they occur at all. Land use resources in areas affected by a loss of containment are anticipated to re-establish following completion of planned remedial and restoration activities. Therefore, the potential residual effects on land use are anticipated to be low in magnitude, short-term in duration, local in extent,

and reversible following remediation and restoration. As a result, the potential residual environmental effects of a loss of containment on land use for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.3.4 Determination of Significance

Based on the mitigation and response measures described above, it is not anticipated that a loss of containment will adversely affect soils and terrain, surface water, fish and fish habitat, terrestrial ecosystems, vegetation, wildlife, or land use to an extent that significant adverse residual environmental effects would be likely to occur on a sustained and prolonged basis.

With the ability to carry out monitoring programs to identify deficiencies in water management infrastructure that may result in a loss of containment, and in consideration of planned mitigation and procedures to respond to an event occurrence, the residual environmental effects of a loss of containment on all potentially affected valued components during all phases of the Project are rated not significant, with a high level of confidence.

The significance of residual environmental effects that may result from a loss of containment on all potentially affected VCs is presented in Table 21.4-3.

Table 21.4-3: Summary of Potential Residual Environmental Effects of a Loss of Containment

Accident or Malfunction	Valued Component												
	Air Quality	Acoustic Environment	Soils and Terrain	Groundwater	Surface Water	Fish and Fish Habitat	Terrestrial Ecosystems	Vegetation	Wildlife	Archaeological Resources	Economic Conditions	Socio-Community	Land Use
Loss of Containment			NS	NS	NS	NS	NS	NS	NS				NS

Note: NS = effects are not significant; empty cell = no anticipated interaction.

21.4.4 Uncontrolled Detonation of Explosives

21.4.4.1 Description of Scenario

An uncontrolled detonation of explosives is defined as an unmanaged or inadvertent detonation of explosives, or inadvertently combined emulsion constituents, or detonators associated with blasting of the open pit, or the detonation of explosives resulting in injury or property damage from fly rock or higher-than-standard-practice vibration levels. An uncontrolled detonation of explosives may affect air quality, the acoustic environment, surface water, fish and fish habitat, terrestrial ecosystems, vegetation, and wildlife. Scenarios involving explosions resulting from a fire or a vehicle/equipment collision are discussed in Section 21.4.5 and 21.4.8, respectively.

While blasting will be a regular part of Project activities during Operations (and to a lesser extent during Construction and Pre-Production for completion of road upgrades), the risk of an unplanned or uncontrolled explosion is greatly reduced by current technology and the legal requirement to follow strict

operating procedures. NWP will implement a strong safety culture during all phases of the Project, including appropriate procedures involving the transportation, use, and storage of explosives, which will be strictly followed by all Project personnel. Explosives will only be handled or managed by qualified persons that have been trained and are licenced to do so.

An uncontrolled detonation of explosives may occur as an unmanaged or inadvertent detonation. An unmanaged explosion would be related to open pit operation, where proper safety measures were not applied as required (e.g., blast mats not used despite management requirements to do so), whereas an inadvertent explosion may be the result of error or malfunction. As a worst-case scenario, an uncontrolled detonation of explosives has the potential to result in injuries or fatalities to site personnel, and cause damage to the terrestrial and aquatic environment in the vicinity of the explosion. Explosives will be prepared, stored, and used entirely within the Project footprint; therefore, an uncontrolled detonation of explosives is not anticipated to affect the health and safety of the public.

21.4.4.2 Mitigation Measures

Explosives required for the Project will be supplied by a distributer who is certified under Canadian regulations, and the method of supply is to not mix the constituent chemicals until they are pumped into the blast hole in the pit. As opposed to older dynamite cartridges which were manufactured and shipped to the user, insensitive emulsion explosives will be transported and stored on-site. The licensed explosives supplier will be responsible for the final mixing of the emulsion explosives prior upon delivery directly to the blast holes.

An on-site explosives magazine will provide for storage of blasting accessories and explosives. This magazine will be in compliance with the Explosives Act and Regulations. Transporting explosives will be regulated by Explosives Regulations under the Explosives Act, Transportation of Dangerous Goods Regulations and the Canada Motor Vehicle Safety Standards. A Blasting Plan will also be developed and followed, which will specifically address health and safety. The Explosives Regulations require a fire safety plan and key control plan to be in place before an application for a magazine licence is submitted, and the applicant must include in the application a declaration that these plans have been prepared. Additionally, a security plan must be prepared for every magazine storing type E (blasting) explosives.

Based on the regulatory requirements identified above, the potential for an uncontrolled explosion would be limited to a malfunction or accident in relation to a planned blasting activity (i.e., an early detonation or unplanned detonation in the pit). Explosives will only be handled or managed by qualified persons that have been trained and are licenced to do so. As all explosives will be handled by a licenced blasting contractor who will be highly trained in the safe handling, storage, and use of explosives, and given the extent of regulation of this type of activity including setback distances and other requirements of these acts and regulations, the likelihood for the occurrence of an uncontrolled detonation of explosives is considered very low.

In the unlikely event of an uncontrolled detonation of explosives, the Project MERP will be immediately triggered, the necessary emergency response procedures will be implemented, depending on the magnitude of the event. The MERP will include specific response procedures to respond to an accidental explosion on the Project footprint. Measures to mitigate effects to the environment as a result of an

uncontrolled explosion will be similar to those proposed in Sections 21.4.2.2 and 21.4.3.2, depending on the magnitude and location of the event.

A fire that may result from an explosion is discussed in Section 21.4.5.

21.4.4.3 Characterization of Residual Effects

21.4.4.3.1 Air Quality

An uncontrolled detonation of explosives may affect air quality through the rapid volatilization of VOCs, particulate matter, and carbon monoxide to the atmosphere. However, through compliance with regulatory requirements and application of appropriate emergency response procedures, the potential residual environmental effects of an uncontrolled detonation of explosives on air quality are expected to be short-term in duration, moderate in magnitude, limited to the extent of certain areas within the Project footprint (i.e., open pits and explosives magazine), and reversible within minutes to hours following the event occurrence. As a result, the potential residual environmental effects of an uncontrolled detonation of explosives on air quality for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.4.3.2 Acoustic Environment

An uncontrolled detonation of explosives is likely to result in unanticipated noise and vibration emissions. However, blasting activities will take place throughout the Operations phase (and to a lesser extent, the Construction phase), and the noise and vibration emitted from an uncontrolled detonation of explosives are generally expected to be similar to those emitted during normal Project activities, although could be greater in magnitude or extent because unlike with planned detonations, the energy resulting from the blast may not be fully directed underground to achieve the intended purpose of breaking up coal and rock—ensuring that explosives are handled only by licenced personnel would reduce the potential for this type of occurrence. Further, an assessment of the effects of Project-related activities (including blasting) on the acoustic environment was completed, which determined that Project activities are not expected to exceed applicable guidelines, with the application of mitigation and industry BMPs (Chapter 7). An uncontrolled detonation of explosives is not expected to exceed the noise levels predicted during normal Project operations.

Through compliance with regulatory requirements and application of industry BMPs, the potential residual environmental effects of an uncontrolled detonation of explosives on the acoustic environment are expected to be short-term in duration, low in magnitude, local in extent, and reversible immediately following the event occurrence. As a result, the potential residual environmental effects of an uncontrolled detonation of explosives on the acoustic environment for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.4.3.3 Surface Water

An uncontrolled detonation of explosives within the Project footprint may affect surface water quality in nearby watercourses outside the Project footprint due to deposition of fly rock, particulate matter, or explosives residues into aquatic environments. Where adverse effects on surface water quality are observed following an uncontrolled detonation of explosives, the mitigation measures outlined in the SPCCP will be implemented to respond to and remove deleterious substances from aquatic environments,

where possible. However, given that an uncontrolled explosion is expected to be limited to within the extents of the Project footprint, the volume of material that that may enter an aquatic environment is expected to be minor, and would quickly disperse by streamflow and wave action.

The potential residual effects on surface water are expected to be short-term in duration, low in magnitude, local in extent, and reversible through clean-up efforts or dispersal. As a result, the potential residual environmental effects of an uncontrolled detonation of explosives on surface water for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.4.3.4 Fish and Fish Habitat

An uncontrolled detonation of explosives within the Project footprint may affect fish and fish habitat due to deposition of fly rock, particulate matter, or explosives residues into nearby fish-bearing aquatic environments outside the Project footprint. Where adverse effects on fish and fish habitat are observed following an uncontrolled detonation of explosives, the mitigation measures outlined in the SPCCP will be implemented to respond to and remove deleterious substances from aquatic environments, where possible. However, given that an uncontrolled explosion is expected to be limited to within the extents of the Project footprint, the volume of material that that may enter an aquatic environment is expected to be minor, and would quickly disperse by streamflow and wave action.

The potential residual effects on fish and fish habitat are expected to be short-term in duration, low in magnitude, local in extent, and reversible through clean-up efforts or dispersal. As a result, the potential residual environmental effects of an uncontrolled detonation of explosives on fish and fish habitat for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.4.3.5 Terrestrial Ecosystems and Vegetation

Potential effects of an uncontrolled detonation of explosives on terrestrial ecosystems and vegetation are expected to be very low in magnitude, as the potential for these events to occur is expected to be limited to some designated areas of the Project footprint (e.g., open pits, explosives magazine). Some plants may be damaged by fly rock, or affected by accumulations of particulate matter resulting from and uncontrolled explosion; however, these effects are not expected to differ from the effects of normal Project operations, for which management plans and mitigation measures will be implemented, as discussed in Chapters 13 and 14.

As a result, the potential residual environmental effects of an uncontrolled detonation of explosives on terrestrial ecosystems and vegetation for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.4.3.6 Wildlife

Potential effects of an uncontrolled detonation of explosives on wildlife and wildlife habitat are expected to be very low, as the potential for these events to occur is expected to be limited to some designated areas of the Project footprint (e.g., open pits, explosives magazine). Wildlife habitat may temporarily disturbed by fly rock, or affected by accumulations of particulate matter resulting from and uncontrolled explosion; however, these effects are not expected to materially differ from the effects of normal Project operations, for which management plans and mitigation measures will be implemented, as discussed in

Chapter 15 of the Application/EIS. Similarly, sensory disturbance to wildlife resulting from an uncontrolled explosion are expected to be generally similar to those expected to occur from normal Project operations.

As a result, the potential residual environmental effects of an uncontrolled detonation of explosives on wildlife for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.4.4 Determination of Significance

Based on the regulatory requirements applicable to the transportation, storage, and use of explosives described above, and the site-specific management plans and procedures that will be strictly followed by personnel, an uncontrolled detonation of explosives during Project activities is considered highly unlikely to occur. However, in the event that an uncontrolled explosion does occur as a result of human error or equipment malfunction, the event is not expected to affect air quality, the acoustic environment, surface water, fish and fish habitat, terrestrial ecosystems, vegetation, or wildlife to an extent that significant adverse residual environmental effects would occur on a sustained and prolonged basis beyond those from the Project as planned.

Given the very low likelihood of occurrence, and in consideration of preventative safeguards and procedures to respond to an event occurrence, the residual environmental effects of an uncontrolled detonation of explosives on all affected valued components during all phases of the Project are rated not significant, with a high level of confidence.

The significance of residual environmental effects that may result from an uncontrolled detonation of explosives on all potentially affected VCs is presented in Table 21.4-4.

Table 21.4-4: Summary of Potential Residual Environmental Effects of an Uncontrolled Detonation of Explosives

Accident or Malfunction	Valued Component												
	Air Quality	Acoustic Environment	Soils and Terrain	Groundwater	Surface Water	Fish and Fish Habitat	Terrestrial Ecosystems	Vegetation	Wildlife	Archaeological Resources	Economic Conditions	Socio-Community	Land Use
Uncontrolled detonation of Explosives	NS	NS			NS	NS	NS	NS	NS				

Note: NS = effects are not significant; empty cell = no anticipated interaction.

21.4.5 Fire

21.4.5.1 Description of Scenario

In the context of the assessment of accidents or malfunctions, a fire may occur as a result of activities related to the Project. Fires arising from non-Project causes such as lightning strikes or off-site forest fires due to any undefined cause, which may potentially affect the Project, are assessed in Chapter 20.

Scenarios that may result in a fire include an equipment malfunction within the CPP, ignition of flammable materials (e.g., petroleum products), human carelessness, vehicle or equipment collision, or by accidental ignition or spontaneous combustion of coal during processing, transportation, storage, or in-situ. A fire resulting from one or more of these scenarios could trigger additional accidents, such as an explosion or a release of hazardous materials that could spread outside of the Project footprint.

The immediate concern in the event of a fire would be for the health and safety of Project personnel and the public; additional concerns include adverse environmental effects on air quality, soil stability, surface water quality, fish and fish habitat, terrestrial ecosystems, vegetation, and wildlife, as well as adverse social effects on the local economy, socio-community, and land use practices.

21.4.5.2 Mitigation Measures

The following mitigation measures will be implemented to address the potential effects of a Project-caused fire:

- Incorporation of fire prevention, monitoring, detection, notification and evacuation procedures in the MERP, which will be implemented during all phases of the Project;
- Coordination of fire control efforts with local emergency response personnel;
- Create fire breaks around mine infrastructure as appropriate;
- Maintenance of fire prevention and response equipment on-site at all times, including having fire extinguishers available throughout the site;
- Regular maintenance and replacement of fire extinguishers, as required;
- All employees will be trained in fire prevention, detection and response;
- Prohibition of smoking except in designated areas that are set well back from Project infrastructure as well as potential sources of combustible materials (such as conveyors and coal stockpiles);
- Restrict the use of outdoor fires or open flames except as required for warmth or for signalling;
- Implementation of fire bans during times of elevated fire risk;
- Adjust work procedures to limit risk during times of elevated fire risk;
- Park off-road vehicles on non-vegetated areas kept free of fire fuel;
- Establish designated refuelling areas where open flame is prohibited;
- Maintenance of all equipment in good condition; and
- Construct buildings and infrastructure on-site to comply with British Columbia and federal fire codes.

21.4.5.3 Characterization of Residual Effects

21.4.5.3.1 Air Quality

A fire may affect air quality through the release of particulate matter, greenhouse gases, and VOCs into the atmosphere. In case of a fire following a fuel transportation accident scenario, all efforts would be made to extinguish the fire as rapidly as possible in order to prevent releases to the atmosphere. A fire would be expected to result in short-term environmental effects only in close proximity to the fire, provided that measures are put in place to stop the fire as rapidly as possible in order to minimize the extent of the smoke plume.

Based on the fire prevention and response procedures that will be implemented during all phases of the Project, the potential effects of a fire related to Project activities on air quality is expected to be low to moderate in magnitude, short-term in duration, local in extent, and reversible upon extinguishing the fire. As a result, the potential residual environmental effects of a fire on air quality for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.5.3.2 Soils and Terrain

A fire within the Project footprint may affect soil quality and terrain stability if it extended beyond the Project footprint. The consumption of vegetative cover can expose soils and lead to increased erosion sensitivity and slope instability. Following a fire event, exposed or eroded soils and unstable slopes will be re-contoured to a stable profile and restoration activities will be implemented to re-establish vegetation to stabilize the soils.

Based on the fire prevention and response procedures that will be implemented during all phases of the Project, the potential effects of a fire related to Project activities on soils and terrain are expected to be low in magnitude, short-term in duration, discrete in extent, and reversible through subsequent restoration activities. As a result, the potential residual environmental effects of a fire on soils and terrain for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.5.3.3 Surface Water

A fire has the potential to affect the surface water quality of watercourses in the vicinity of the Project footprint. Deposition of volatile organic compounds, fire suppressant chemicals, ash and other burning residuals may affect local water quality. Additionally, increased soil erosion may result in sediment transfer into watercourse channels, affecting streamflow and water quality. These effects are expected to be temporary, and will be quickly reversed through natural dispersal and attenuation of the deposited compounds. Measures will be in place to monitor water quality, notify potential users and provide alternate drinking water source if required.

In the unlikely event of a fire related to Project activities, the potential residual environmental effects on surface water quality would be low in magnitude, short-term in duration, local in extent, and reversible through natural dispersal and attenuation. As a result, the potential residual environmental effects of a fire on surface water for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.5.3.4 Fish and Fish Habitat

A fire has the potential to affect fish and fish habitat through surface runoff containing impurities associated with the fire itself, fire suppressant chemicals, or from the extraction of surface water used to control the fire. Surface runoff could enter the aquatic environment and potentially cause harmful alteration to fish habitat in adjacent watercourses due to increases in suspended particulate matter (e.g., ash or sediment) with minor traces of hydrocarbon possible (depending on the source of the fire). The runoff water from the Project footprint would be contained on-site by the mine contact water management system and treated before being released. Fire suppressing materials and equipment will kept on-site to manage small fires originating from these sources, and therefore these types of fires are not expected to spread beyond the Project footprint. However, in the event that a large fire does occur in proximity to fish-bearing waters, spawning success or habitat could be adversely affected. Regardless of

the cause or location, fires are temporary in nature and do not typically spread over large extents before being extinguished.

Based on the fire prevention and response procedures that will be implemented during all phases of the Project, the potential effects of a fire related to Project activities on fish and fish habitat are expected to be low in magnitude, short-term in duration, local in extent, and reversible through natural dispersal and attenuation. As a result, the potential residual environmental effects of a fire on fish and fish habitat for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.5.3.5 Terrestrial Ecosystems and Vegetation

A fire could result in potential environmental effects on terrestrial ecosystems and vegetation due to the partial or complete removal of vascular plants from an area of variable size. While a fire event, if one occurred, is expected to be contained within the Project footprint, there is potential for a fire to spread into vegetated areas adjacent to the Project footprint, depending on factors such as wind speed and direction, forest structure and composition, precipitation, topography, and fine fuel moisture. Fires can spread through tree tops, leaving ground vegetation largely intact, while some severe fires can destroy all vegetation as well as the organic material in the soil. However, the B.C. Wildfire Service has a well-developed provincial forest fire management program in place to quickly respond to fires and reduce the magnitude and extent of their effects in the province, including the Project region, in the event that a fire spreads beyond the extent of the Project footprint.

Following a fire, vegetation communities can regenerate naturally through process of succession, over time; however, this process often takes one or two growing seasons for a healthy vegetation community to re-establish, during which time non-native invasive species may become established in the disturbed areas. Therefore, NWP will develop and implement a vegetation management program to promote the successful re-establishment of a vegetation community that will be on a trajectory towards pre-fire conditions. This vegetation management system may include seeding areas with a seed mixture appropriate for the region, planting seedlings, and applying weed control measures, as required.

In the unlikely event that a fire related to Project activities spreads into adjacent terrestrial ecosystems and vegetation communities, the magnitude of the potential residual effects could be moderate to high, local in extent, medium-term in duration, and reversible through natural regeneration and vegetation restoration efforts. However, based on the fire prevention and response procedures that will be implemented during all phases of the Project, the likelihood of a fire related to Project activities spreading beyond the extents of the Project footprint is considered low. As a result, the potential residual environmental effects of a fire on terrestrial ecosystems and vegetation for all phases of the Project are rated not significant. There is a moderate level of confidence in this prediction.

21.4.5.3.6 Wildlife

A fire has the potential to affect wildlife through direct mortality, loss or degradation of habitat and food availability, alteration of movement behaviours, and sensory disturbance during the subsequent fire response and restoration activities. A fire that is left to burn uncontrollably would modify wildlife habitat, potentially resulting in direct mortality to wildlife populations, especially during the breeding season, and possibly influencing the sustained presence of wildlife populations or communities. The resultant loss of habitat may result in adverse environmental effects such as the loss of breeding, nesting, rearing, or other

habitat for birds and other wildlife species. Depending on the timing of this scenario, it can result in the direct loss of individuals that are slow moving or unable to escape the fire, such as nestlings and other wildlife that are unable to leave a nest or den. Fragmentation of habitat is a potential issue for some species with large home ranges and those that migrate to exploit resources that are seasonally available.

Although the environmental effects of a fire that spreads beyond the Project footprint could be significant, the likelihood of such a fire occurring is low, and even if it did occur, it is unlikely that habitat loss or mortality (either direct or indirect) would result in a population-level environmental effect. No significant habitat loss is anticipated as most species will move into adjacent areas and any habitat loss would be reversible over the longer term through natural regeneration and restoration activities.

Based on the fire prevention and response procedures that will be implemented during all phases of the Project, the potential effects of a fire related to Project activities on wildlife are expected to be moderate in magnitude, medium-term in duration, local in extent, and reversible through natural regeneration and habitat restoration efforts. As a result, the potential residual environmental effects of a fire on wildlife for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.5.3.7 Economic Conditions

A fire that is contained within the Project footprint may result in the temporary suspension of Project activities, which could affect employment and procurement generated by the Project. However, these effects are unlikely to result in a significant disruption of economic conditions in the region.

A large fire that spreads beyond the Project footprint could affect local labour and the economy by destroying forests used for forest harvesting and other activities important for local employment. Depending on the severity of the fire, a burned forest could take several decades to return to a condition where forest harvest could resume to current levels. However, various measures described earlier in this section will be implemented to prevent or minimize the adverse environmental effects of a large fire. It is unlikely that a forest fire will originate from the Project site and any fire that might occur would most likely be quickly extinguished as precautions will be taken in accordance with the fire prevention and response procedures included in the MERP (e.g., fire-fighting equipment will be kept and maintained on-site and workers will be trained in emergency response procedures). Further, if a large fire were to occur and damage adjacent forested land, it is unlikely that the geographic extent of such loss would adversely affect forest harvesting and management activities in a manner that would cause a significant adverse environmental effect to economic conditions.

Based on the fire prevention and response procedures that will be implemented during all phases of the Project, the potential effects of a fire related to Project activities on economic conditions are expected to be low to moderate in magnitude, short-term in duration, local in extent, and reversible through resumption of Project activities. As a result, the potential residual environmental effects of a fire on economic conditions for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.5.3.8 Socio-Community

A minor fire that is contained within the Project footprint is not expected to adversely affect community services, infrastructure, well-being or public health and safety. The fire prevention and response

procedures developed for the Project are expected to address such a fire using equipment and materials available on-site.

A severe fire that spreads beyond the Project footprint could affect public health and safety, depending on the severity of the event. If meteorological conditions were such that a fire was to rapidly spread, there is risk to any resource users and cabin owners in the area both from fire and smoke inhalation. Any fire originating from Project activities would be reported immediately and the quick response time would limit the potential for uncontrolled spread. Utmost priority would be placed on the protection of human life, and all efforts would be made in conjunction with local fire fighting and emergency response personnel to evacuate potentially affected areas. A severe fire may also affect the socio-community in the event that support and assistance of local fire fighting and emergency response personnel are required. However, local and regional fire-fighting services are equipped and staffed to respond to large-scale fire events, and should be able provide the necessary service in the unlikely event of a significant fire. Should it be needed, other neighbouring fire-fighting services or the B.C. Wildfire Service can be contacted to assist until the fire is under control.

A significant adverse residual environmental effect on the socio-community is one where the Project directly and substantially endangers the safety of the public and/or Project employees to such an extent that an immediate danger exists to the life and/or health of the public and/or employees as a result of the Project, and for which planned design features, mitigation, or environmental management measures are unsuccessful at minimizing or eliminating the risks to public safety. In the worst case scenario of a large-scale forest fire resulting from Project activities, mitigation and environmental management can minimize the risk to public safety, but cannot fully eliminate these risks. For this reason, a fire could result in a significant residual environmental effect to the socio-community, but is highly unlikely to occur. There is a high level of confidence in this prediction.

21.4.5.3.9 Land Use

A fire within the Project footprint is not likely to affect land and resource use activities, as access to the Project footprint will be restricted during the Construction and Pre-Production, Operations, and Reclamation and Closure phases. In the event of a large fire that spreads beyond the Project footprint into adjacent undisturbed areas, land use activities could be temporarily affected, including fishing, hunting, tourism, or other recreational use both by members of the general public as well as for Indigenous persons carrying out their traditional land use activities. While the extent and duration of any fire is dependent on response efforts and meteorological conditions, a large forest fire has the potential to alter the landscape and deplete forest and brush cover, thereby reducing or eliminating the distribution of flora and fauna currently harvested. It could also reduce access to land use areas. A large forest fire could possibly affect a large number of users and activities. Although many areas within the Local Study Area are used recreationally by members of the public and for traditional uses by Indigenous persons (Chapter 19), in the unlikely event of a fire spreading beyond the Project footprint, areas adjacent to affected areas would remain available for use where activities will not be discontinued. While a fire that spread to forested areas would be expected to change land use in the burned over areas possibly for several decades, this environmental effect would be geographically limited to the directly-affected areas. Fire is a natural part of the forest landscape, and over time, the environmental effects of a fire would reverse. Some land use activities such as berry-picking are compatible with regenerating forests.

Based on the fire prevention and response procedures that will be implemented during all phases of the Project, the potential effects of a fire related to Project activities on land use are considered low in magnitude, medium-term in duration, local in extent, and reversible through natural regeneration and completion of restoration efforts. As a result, the potential residual environmental effects of a fire on land use for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.5.4 Determination of Significance

Despite the best planning, prevention, mitigation and response measures, a fire could result in adverse environmental effects to the VCs described above. However, a fire arising from the Project would be most likely confined to the Project footprint and the spread of a fire outside the Project footprint and causing environmental effects on a larger scale is unlikely. In consideration of the mitigation, prevention and response procedures to be put in place, the potential environmental effects of a fire on air quality, soils and terrain, surface water, fish and fish habitat, terrestrial ecosystems, vegetation, wildlife, economic conditions, and land use during all Project phases are rated not significant. There is a high level of confidence in this prediction.

A fire, should one occur, could endanger the safety of the public and/or Project employees to such an extent that an immediate danger exists to the life and/or health of the public and/or employees as a result of the Project. Planned design features, mitigation, or environmental management measures are expected to minimize risks to public safety; however, they cannot fully eliminate these risks. As such, the potential environmental effects of a fire on the socio-community during all phases of the Project are conservatively rated significant, but are highly unlikely to occur. There is a high level of confidence in this prediction.

The significance of residual environmental effects that may result from a Project-related fire on all potentially affected VCs is presented in Table 21.4-5.

Table 21.4-5 Summary of Potential Residual Environmental Effects of a Fire

Accident or Malfunction	Valued Component												
	Air Quality	Acoustic Environment	Soils and Terrain	Groundwater	Surface Water	Fish and Fish Habitat	Terrestrial Ecosystems	Vegetation	Wildlife	Archaeological Resources	Economic Conditions	Socio-Community	Land Use
Fire	NS		NS		NS	NS	NS	NS	NS		NS	S(U)	NS

Note: NS = effects are not significant; S (L) = effects are significant and are likely to occur; S (U) = effects are significant but are not likely to occur; empty cell = no anticipated interaction.

21.4.6 Slope Failure

21.4.6.1 Description of Scenario

A slope failure involves the loss of stability of an engineered slope of a pit wall, and the slopes of coal, soil, and/or mine rock stockpiles, which may result in slumping into the open pit, and/or the release of coal,

soil and/or mine rock outside the storage areas within the Project footprint. The Project will consist of three open pits (North, East, and South pits), and is projected to produce approximately 270 million m^3 (in-situ or bank) of mine rock or approximately 351 million m^3 of placed mine rock, assuming an overall swell factor of 30%. The majority of the mine rock will be placed as a valley fill located on the west side of the mined out South Pit in the valley of West Alexander Creek. Where the mining sequence allows, mine rock will be backfilled in the North, East and South pits when this can be accomplished safely and economically in order to reduce the total disturbance area. The Project will also consist of three soil stockpile areas, one run-of-mill (ROM) stockpile area adjacent to the CPP, one overflow coal stockpile, and one clean coal stockpile.

Failure of natural and engineered slopes may compromise mining infrastructure and lead to a localized uncontrolled mass movement (i.e., landslide). During Construction and Pre-Production, a slope failure may be caused by inadequate slope design, blasting activities compromising slope stability, extreme precipitation events, seismic events, and/or unforeseen geotechnical conditions. The open pits and bulk material storage stockpiles (i.e., mine rock, soil, run-of-mine [ROM], processed coal) will be progressively developed throughout the Operations phase. A slope failure would not be expected to occur during Reclamation and Closure or Post-Closure since reclamation activities would have eliminated the potential for its occurrence.

In the event of a pit wall failure there is a risk is to the health and safety of personnel working in the area. A pit wall failure may also result in damage to equipment within or near the edge of the pit, or cause subsequent slope failures on other Project components, including the mine rock stockpiles.

A slope failure on a mine rock or coal stockpile may result in the release of solid material with metal leaching and acid-rock drainage (ML/ARD) potential into the surrounding terrestrial or aquatic environments outside the Project footprint. This release may result in adverse environmental effects on air quality, surface water quality, fish and fish habitat, wildlife, socio-community, and land use.

21.4.6.2 Mitigation Measures

The pit walls and bulk material storage stockpiles will be designed by qualified professionals to meet or exceed all applicable regulations and standards. The pit walls will be constructed in accordance to the guidelines developed for the Project by Stantec Inc. (2022), which are based on the findings from geotechnical assessments conducted in the Project footprint. Based on the guidelines, the pit footwall bench face angles will be controlled by bedding dips, which will range in steepness from less than 30° in the South and East pits to as steep as 60° in areas of the North Pit. The highwalls will be controlled by overall rock mass strength, and the location and orientation of coal seams forming part of the wall. Some of the highwalls will require a buttress of in-situ material to be left in place to satisfy global design stability criteria.

A series of geotechnical investigations have been completed to support the placement and design of the mine rock stockpiles' (Mine Rock Storage Facility) stability. Mine rock will be founded both on existing natural soil and overburden that is underlain by competent bedrock and/or on mined-out pit walls and floors. A series of Mine Rock Storage Facility guidelines were developed by Stantec Inc. to assist with Mine Rock Storage Facility layout and development plan (Stantec Inc., 2020).

The Mine Rock Storage Facility will be constructed within the existing West Alexander Creek valley, south of the CPP to an ultimate crest elevation of 1,960 m above sea level (m asl), an overall crest-to-toe height of around 370 m. Individual dump lifts will be no higher than 40 m and dump development headings not less than 50 m wide. The North Dump, to be constructed in the North Pit area, will have an ultimate crest elevation of 2,120 m asl with an overall height of 180 m, and with lift heights not more than 20 m high and dump development headings not less than 25 m wide (narrower headings due to constrained development widths for some lifts). Lifts for the dumps will initially be constructed at the natural angle of repose for the dumped mine rock (approximately 1.3 horizontal to 1 vertical [1.3H:1V] or 37 degrees). Overall slopes (multiple lifts with catch berms) are limited to 2.3H:1V (23 degrees) or shallower to meet regulatory requirements and allow for efficient re-sloping.

Placement of mine rock will begin at the head of the West Alexander Creek basin and progress southwards. This strategy mitigates major concerns related to typical cross-valley fill placement because, in this way, runoff and seepage flowing into the Mine Rock Storage Facility are minimized. Normally cross-valley placement intercepts runoff and seepage generated in upstream catchment areas. The proposed Mine Rock Storage Facility intercepts less runoff and seepage because the dump is situated at the highest point in the catchment basin.

Progressive reclamation of available Mine Rock Storage Facility areas has been integrated into the overall mine schedule and soil handling plan, which will reduce the opportunity for slope failure. Progressive reclamation will consist of re-sloping the Mine Rock Storage Facility to an overall angle of 2H:1V. A low permeability layer of stockpiled plant rejects will be used to cap the mine rock, which will be overlain with topsoil to provide a growing medium for vegetation establishment.

The pit walls, Mine Rock Storage Facility, and bulk material stockpiles will be inspected regularly by Project personnel, to monitor the stability of the engineered slopes and identify areas where repairs or stabilization may be required.

The likelihood of a slope failure will be reduced through the incorporation of appropriate geotechnical considerations into Project design and regular monitoring of site conditions throughout all phases of the Project. In the event of a slope failure, the following response measures will be implemented to reduce the severity of potential effects on the environment:

- Depending on the severity of the slope failure, the procedures outlined in the MERP and ESCP will be triggered immediately upon discovering the slope failure;
- The vicinity of the slope failure will be evacuated of all personnel;
- Notification will be provided to regulatory authorities, emergency responders, local residents, and Indigenous communities, as applicable;
- Efforts will be made to stabilize the failed slope where safe to do so;
- Where material from the slope failure has been deposited into an adjacent receiving environment, it will be contained and removed from the affected area as quickly as possible;
- Erosion and sediment control devices will be deployed as necessary to promptly contain the released material and prevent further deposition into adjacent receiving environments;
- Earthwork machinery will be deployed to return materials to the storage area and stabilize the slope failure;

- Where material has entered an aquatic environment, confirmatory water sampling will be completed as necessary, to assess and delineate the extent of effects; and
- A remedial action plan specific to the event will be developed and implemented to remediate areas affected by the slope failure.

Upon the completion of remedial activities to address a slope failure, the following restoration activities may be conducted within the affected areas:

- Material deposited into a watercourse will be removed, provided that additional damage to fish habitat can be avoided;
- A specific habitat offsetting plan will be developed to repair or improve the quality of fish habitat within or near to the location of the event;
- A monitoring program will be implemented to evaluate the restoration efforts within the areas affected by a loss of containment.

Following a slope failure, an investigation will be conducted to identify the root cause of the event, and the conditions that contributed to its occurrence. Project management plans and procedures will be revised through adaptive management strategies, based on the findings of the investigation, to further reduce the likelihood of subsequent slope failure events.

21.4.6.3 Characterization of Residual Effects

21.4.6.3.1 Air Quality

In the event of slope failure, air quality could be adversely in the immediate to short term by the release of dust and particulate matter; however, the effects on air quality will be localized, short-term (hours to days), and reversible, and not likely distinguishable from effects of the Project as planned on air quality.

Site clean-up will employ hauling trucks and earth moving equipment that could release fugitive dust during support activities and air emissions from combustion exhaust. Changes to the overall air quality will be low in magnitude, local in geographic extent, short-term in duration and sporadic in frequency and are therefore, considered not significant. There is a high level of confidence in this prediction.

21.4.6.3.2 Surface Water

A slope failure may result in the deposition of mine rock, processed or unprocessed coal, or soil into aquatic environments outside of the Project footprint, which could result in adverse effects on existing hydrological conditions, water quality, sediment quality, and ecological receptors associated with the aquatic environment. The potential environmental effects on fish and fish habitat are discussed in Section 21.4.6.3.3.

A pit wall failure is expected to be contained within the extents of the open pit, and is not likely to affect surface water quality. Similarly, the ROM stockpile area is located in the central area of the mine site, and is not likely to interact with a surface water environment due to mine contact water controls in place. However, a slope failure on a Mine Rock Storage Facility or coal stockpile may lead to deposition of materials into a watercourse. For example, the overflow coal stockpile is located near Grave Creek and the Grave Creek Reservoir, and the Mine Rock Storage Facility are located north and up-gradient from West Alexander Creek. Some of the material in the mine rock and clean coal may have ML/ARD properties

and have acid generating potential, which would result in a decrease in surface water quality if release to the environment outside the Project footprint.

With appropriate design of Project infrastructure, construction of pit walls and bulk material storage areas to meet or exceed regulatory requirement and industry standards, and implementation of regular monitoring programs, the likelihood of occurrence of a slope failure affecting a surface water environment outside the Project footprint is considered low. With the implementation of appropriate emergency response, erosion and sediment control, and restoration measures following a slope failure, the potential residual effects of a slope failure event on surface water is considered short-term in duration, moderate in magnitude, local in extent, and reversible upon completion of the clean-up and restoration efforts. As a result, the potential residual environmental effects of a slope failure on surface water for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.6.3.3 Fish and Fish Habitat

A slope failure that results in a deposition of mine rock, processed or unprocessed coal, or soil into an aquatic environment outside of the Project footprint could result in localized direct effects on fish species and benthic invertebrate communities, as well as indirect effects through degradation or loss of habitat caused by the event, or by the subsequent clean-up efforts (e.g., installation of silt curtains, removal of materials). Introduction of suspended material that may increase metal concentrations and change pH of the receiving environment could affect fish metabolism, movement, feeding, and reproductive behaviour. Direct fish mortality is not anticipated to occur, as fish will move to avoid affected locations; however, deposition of materials may result in decreased abundance and diversity of fish species in the local area. A decrease in primary and secondary production of organisms used as sources of prey, forage, or protective cover by fish, thereby resulting in indirect effects on fish mortality through a reduction in food and/or habitat availability.

With the implementation of appropriate emergency response, erosion and sediment control, and restoration measures following a slope failure, the potential residual effects on fish and fish habitat outside the Project footprint is considered short-term in duration, moderate in magnitude, local in extent, and reversible upon completion of the clean-up, restoration, and habitat offsetting efforts. Given the low likelihood of occurrence, the potential residual environmental effects of a slope failure on fish and fish habitat for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.6.3.4 Wildlife

The severity of potential effects of a slope failure on wildlife and wildlife habitat is dependent on the composition and volume of materials released, as well as the release location. Due to the presence of ongoing Project activities, a relatively low number of wildlife species are anticipated to occupy habitat adjacent to the Project footprint, which would reduce the risk of wildlife mortality as a result of a slope failure. The sustainability or abundance of regional wildlife populations would not be expected to be affected by a slope failure, and uptake of contaminants from deposited materials through vegetation would be limited as the materials would be quickly recovered during remediation. Habitat and food availability may be briefly affected, and sensory disturbance during the subsequent response and restoration activities may occur. However, these effects are anticipated to be short-term in duration, and

habitat and food availability are predicted to increase following completion of remediation and/or restoration activities within the area affected by a slope failure.

Potential residual effects on wildlife and wildlife habitat are expected to be low in magnitude, local in extent, short-term in duration, and reversible upon completion of the clean-up and restoration efforts. As a result, the potential residual environmental effects of a loss of containment on wildlife for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.6.3.5 Socio-Community

Depending on the severity of the event, a slope failure that leads to the deposition of materials into a receiving environment could affect public health and safety, through exposure effects from metals in the material, as well as exposure to metals from consumption of affected fish and wildlife. Direct exposure to depositional material is not likely, as the slope failure event would be largely contained within the Project footprint. Active recovery of the deposited material and natural dispersion processes will reduce the concentrations of potentially harmful constituents over time.

Following a slope failure event, monitoring programs for water quality, sediment quality, aquatic benthic communities, and fish will be implemented as applicable, to identify the concentrations of potentially harmful constituents in the environment and ecological receptors.

Potential residual effects on the socio-community are expected to be moderate in magnitude, local in extent, short-term in duration, and reversible upon completion of the material recovery and following natural dispersal processes. As a result, the potential residual environmental effects of a slope failure on the socio-community for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.6.3.6 Land Use

A slope failure has the potential to temporarily limit the use of affected areas for recreational and traditional land uses such as hunting, gathering and fishing. Direct effects on land use resources, such as fish, wildlife, and vegetation communities, may indirectly affect land use opportunities for recreational or Indigenous traditional use. Additionally, road closures resulting from a slope failure may restrict access for land use practices. However, as the effects would be largely limited to the vicinity of the Project footprint, which will be restricted from access by members of the public while Project activities are underway.

Land use activities downstream of an area affected by a slope failure may be temporarily affected following the event, but the initial response efforts would limit these effects to a short-term duration and largely confine them to the Project footprint. Land use resources in areas affected by a slope failure are anticipated to re-establish following completion of planned remedial and restoration activities. Therefore, the potential residual effects on land use are anticipated to be low in magnitude, short-term in duration, local in extent, and reversible following remediation and restoration. As a result, the potential residual environmental effects of a slope failure on land use for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.6.4 Determination of Significance

Based on the mitigation and response measures described above, a slope failure is not anticipated to adversely affect air quality, surface water, fish and fish habitat, wildlife, the socio-community or land use to an extent that significant adverse residual environmental effects would occur on a sustained and prolonged basis.

With the ability to carry out monitoring programs to identify deficiencies in natural or engineered slopes that may result in a slope failure, and in consideration of planned mitigation and procedures to respond to an event occurrence, the residual environmental effects of a slope failure on all potentially affected valued components during all phases of the Project are rated not significant, with a high level of confidence.

The significance of residual environmental effects that may result from a slope failure on all potentially affected VCs is presented in Table 21.4-6.

Table 21.4-6: Summary of Potential Residual Environmental Effects of a Slope Failure

Accident or Malfunction	Valued Component												
	Air Quality	Acoustic Environment	Soils and Terrain	Groundwater	Surface Water	Fish and Fish Habitat	Terrestrial Ecosystems	Vegetation	Wildlife	Archaeological Resources	Economic Conditions	Socio-Community	Land Use
Slope Failure	NS				NS	NS			NS			NS	NS

Note: NS = effects are not significant; empty cell = no anticipated interaction.

21.4.7 Wildlife Encounter

21.4.7.1 Description of Scenario

The Project is located in the Elk Valley within the front ranges of the southern Rocky Mountains in south-eastern British Columbia. Several existing metallurgical coal mines are located in the region surrounding the Project location; additionally, a network of forest service roads exists in the vicinity of the Project. While the region experiences frequent human activity related to existing industries (i.e., mining, exploration, forestry), as well as recreational and traditional land uses such as hunting, gathering and fishing recreational activities, activities related to the Project will result in increased human activities in the region. A wildlife encounter could affect wildlife and the socio-community.

Increased human activities related to the Project may lead to an increased frequency in encounters between humans and wildlife species, such as black bears, grizzly bears, cougars, and ungulate species. These encounters may pose a risk to the health and safety of Project personnel, members of the public, and wildlife species. It must be noted that vehicle or equipment collisions with wildlife are discussed in Section 21.4.8.

A wildlife encounter may occur at the onset of the Construction and Pre-Production phase, as personnel and equipment mobilize the Project and commence site preparation activities, including vegetation clearing and construction of pioneer access roads. The potential for a wildlife encounter is expected to be at its highest during the commencement of construction activities, as wildlife species in the area adjust their behaviour and movement patterns to avoid these activities. A wildlife encounter may also occur during all phases of the Project as a result of wildlife populations or individuals becoming habituated to human activities within the Project footprint. These types of encounters are often the result of improper storage of household waste, food, or chemicals on-site, which may act as an attractant for wildlife species, such as bears, coyotes, and foxes.

Without the implementation of proper preventative measures or training for Project personnel, a wildlife encounter may lead to injuries, and/or fatalities of Project personnel, the public, or wildlife.

21.4.7.2 Mitigation Measures

The primary preventative measure to reduce the potential for a wildlife encounter during Project activities is the development and implementation of a Wildlife Management Monitoring Plan (WMMP; Chapter 33, Section 33.4.1.13) throughout all phases of the Project. A conceptual WMMP has been prepared; this plan will be updated prior to commencement of Construction to include additional details specific to the site. Throughout the life of the Project, the WMMP will continue to be updated and improved as necessary.

The primary objectives of the WMMP are to reduce disturbance, habitat avoidance, wildlife mortality, and the potential for wildlife encounters during all phases of the Project. The WMMP includes the following mitigation measures to reduce or eliminate the potential for a wildlife encounter:

- All Project waste that may act as an attractant for wildlife will be stored inside buildings, bear-proof compounds, or in wildlife-proof containers;
- All on-site workers will be trained in wildlife management policies to avoid situations that may result in a wildlife encounter;
- Feeding or intentionally attracting wildlife will be strictly prohibited;
- Project infrastructure will be designed and constructed to prevent wildlife from entering active areas of the Project footprint;
- Known locations of active wildlife nests, dens, mineral licks, or other features related to their occupation will be avoided;
- Any wildlife encounter will be reported to the Environmental Manager for documentation and incident tracking;
- Project waste disposal facilities will be regularly inspected for signs of wildlife presence;
- Wildlife observations will be recorded by on-site personnel, including (where possible): species, number of individuals, observation location, and observed behaviour; and
- As necessary, wildlife conservation or enforcement agencies will be contacted for assistance in addressing wildlife encounters that may pose a risk to the health and safety of Project personnel, the public, or wildlife (e.g., bears exhibiting signs of habituation or aggression to Project personnel of the public).

21.4.7.3 Characterization of Residual Effects

21.4.7.3.1 Wildlife

Due to the presence of ongoing Project activities, a relatively low number of wildlife species are anticipated to occupy habitat within and adjacent to the Project footprint, which would reduce the potential for a wildlife encounter. The sustainability or abundance of regional wildlife populations would not be expected to be affected by a wildlife encounter; however, a wildlife encounter may result in unnecessary disturbance to wildlife species that do occupy habitat within and surrounding the Project footprint. This disturbance may lead to habitat avoidance by some species, while other species may become habituated to human activities if these activities become associated with a food source.

Through the implementation of a WMMP during all phases of the Project, the potential for a wildlife encounter is considered low, as the Project footprint is completely surrounded by habitat suitable for a wide range of wildlife species.

Potential residual effects on wildlife are expected to be low in magnitude, local in extent, short-term in duration, and reversible upon resolution of wildlife encounter. As a result, the potential residual environmental effects of a wildlife encounter on wildlife for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.7.3.2 Socio-Community

In most cases, a wildlife encounter is not expected to adversely affect community services, infrastructure, well-being or public health and safety. However, a wildlife encounter involving an aggressive or distressed animal may pose a risk to the health and safety of members of the public involved in the encounter, which may in turn adversely affect community well-being as other members of the public are informed of the event.

A significant adverse residual effect on the socio-community is one where a wildlife encounter associated with the Project directly and substantially endangers the safety of the public and/or Project employees to such an extent that an immediate danger exists to the life and/or health of the public and/or employees as a result of the Project, and for which planned design features, mitigation, or environmental management measures are unsuccessful at minimizing or eliminating the risks to public safety. Implementation of a WMMP throughout all phases of the Project is expected to substantially reduce the potential for a significant adverse effect resulting from a wildlife encounter; however, the behaviour of individual animals can be unpredictable. For this reason, a wildlife encounter could result in a significant residual effect to socio-community, though it is highly unlikely to occur. There is a high level of confidence in this prediction.

21.4.7.4 Determination of Significance

Despite the best planning, prevention, and mitigation measures, a wildlife encounter could result in adverse environmental effects to the VCs described above. However, with the implementation of a WMMP and proper training of Project personnel, a significant adverse effect resulting from a wildlife encounter is considered highly unlikely. In consideration of the management procedures that will be put in place, the potential environmental effects of a wildlife encounter on wildlife during all Project phases are rated not significant. There is a high level of confidence in this prediction.

A wildlife encounter, should one occur, could endanger the safety of the public and/or Project employees to such an extent that an immediate danger exists to the life and/or health of the public and/or employees as a result of the Project. Planned design features, mitigation, or environmental management measures are expected to minimize the risks to public safety, though they cannot fully eliminate these risks. As such, the potential environmental effects of a wildlife encounter on the socio-community during all phases of the Project are conservatively rated significant, but are highly unlikely to occur. There is a high level of confidence in this prediction.

The significance of residual environmental effects that may result from a wildlife encounter on all potentially affected VCs is presented in Table 21.4-7.

Table 21.4-7: Summary of Potential Residual Environmental Effects of a Wildlife Encounter

Accident or Malfunction	Valued Component												
	Air Quality	Acoustic Environment	Soils and Terrain	Groundwater	Surface Water	Fish and Fish Habitat	Terrestrial Ecosystems	Vegetation	Wildlife	Archaeological Resources	Economic Conditions	Socio-Community	Land Use
Wildlife Encounter									NS			S(U)	

Note: NS = effects are not significant; S (L) = effects are significant and are likely to occur; S (U) = effects are significant but are not likely to occur; empty cell = no anticipated interaction.

21.4.8 Vehicle or Equipment Collision

21.4.8.1 Description of Scenario

A vehicle or equipment collision is defined as a Project-related accident involving a vehicle or mobile equipment that occurs on the road or rail transportation networks leading to or from the Project site. A vehicle or equipment collision would pose a danger to the public, workers traveling to and from the Project site, and wildlife crossing or otherwise using access roads or rail infrastructure associated with the Project. A vehicle or equipment collision could occur between vehicles, between a vehicle and other stationary property, between a vehicle and a pedestrian, or between a vehicle and wildlife and potentially lead to property damage, injury, or mortality.

The environmental effects of any hazardous materials spills resulting from a vehicle or equipment collision are not addressed in this section, but rather in Section 21.4.2. A fire resulting from a vehicle or equipment collision is assessed in Section 21.4.5.

The Project will generate vehicle and equipment traffic during all phases as a result of the movement of equipment, supplies, materials, and personnel to and from the Project site. The most noticeable change in traffic will take place during Construction and Pre-Production, when site preparation and physical construction of Project-related infrastructure will require specialized equipment, materials, and supplies, and personnel to be transported on a daily basis to the Project site. In addition to the bus and passenger vehicle transportation of personnel to and from site during the Construction and Pre-Production phase, there will be several trucks and other mobile equipment per day transporting materials, supplies, and

equipment to and from the Project site on these roads. Traffic to and from the site will continue during the pre-operation, Operations, Reclamation and Closure, and Post-Closure phases, but to a lesser extent than during Construction.

An increase in traffic is expected during the Project; however, since most workers will be bussed to the Project site during Construction and Pre-Production, or will be driving their own vehicles, the Project is not anticipated to cause an increase in pedestrian traffic along roads and highways within the Land Use and Access Local Study Area (LSA), as defined in Chapter 19. The Project site is located within a rural forested area that will be accessed using public highways, as well as forest service roads linking public highways to the Project site. The forest service roads cross forested land, supporting large terrestrial wildlife, including deer, moose and bear, as well as small terrestrial animals.

Within the LSA, there is an extensive and interconnected network of local and regional trails used for hiking, running, crossing country skiing and mountain biking. The LSA transects multiple sections of the Elk Valley Trail and the Great Divide Trail. Motorized recreation (i.e., all-terrain vehicle [ATV] and snowmobile) activities also occur on designated trails, gravel roads, access roads, and forest service roads within the LSA. The Project footprint overlaps with sections of ATV trails, including sections of Crown land, Deadman's Pass trails, two staging areas for motorized recreation, and possibly informal trails. Crowsnest Provincial Park is also located within the LSA.

Wildlife and fish harvesting are prevalent activities throughout the LSA. Hunting for big game species commonly occurs in forested areas in the LSA. It is expected that the Project footprint may be subject to hunting activity. Trapping activity, particularly for martens, also occurs within the LSA and Project footprint. The Project footprint overlaps with four traplines; two of these traplines have not reported harvests since 2008. Within the LSA, the Elk River, Michel Creek and Alexander Creek are popular fishing areas for both public use and guided fishing trips.

Given these conditions, there is potential for a number of vehicle or equipment accident scenarios to occur during any phase of the Project, including single vehicle, multiple vehicle, wildlife strikes, or pedestrian strikes, with resulting environmental effects on wildlife and the socio-community.

21.4.8.2 Mitigation Measures

NWP is committed to maintaining safe travel routes within the LSA and a number of traffic safety measures will be in place to reduce the potential for vehicle collisions to occur. These measures are included in a conceptual Traffic Control Plan (TCP), which is included in Chapter 33, Section 33.4.2.4, which is summarized below.

21.4.8.2.1 Access Road Design and Construction

Access roads will be designed and constructed in accordance with industry standards, and with consideration of the following:

- Roads will be properly constructed to manage the equipment and vehicles intended for their use;
- Existing roads networks will be used for Project access where possible, and will be upgrade as required to accommodate mine site traffic during Construction and Operations;
- Roads will be designed to include appropriately spaced pullouts where feasible;
- Road design and construction will incorporate standard water management features, such as:

    - Appropriate road crowning and grading;
    - Roadside drainage ditches installed with check dams, cross-ditches, and waterbars, as required; and
    - Appropriately-sized granular material and rip-rap for the stability of the access roads and drainage ditches; and
- Appropriate regulatory authorization and permits will be obtained for any proposed upgrades to or construction of water crossings, and work will be completed in accordance to these authorizations and permits; and
- Access roads entering the Project site will be secured with gates attended by security personnel to restrict unauthorized access.

21.4.8.2.2 Road Maintenance

A year-round road maintenance program will be developed and implemented throughout the Construction, Pre-Production, Operations, Reclamation and Closure, and Post-Closure phases, to maintain road conditions to a suitable standard. This program will include, but will not be limited to the following:

- Snow removal and application of sand, gravel, or non-palatable salts during snowy or icy conditions;
- Application of dust suppressants or water to reduce fugitive dust emissions from roads during dry conditions;
- Vegetation clearing and management to allow appropriate sightlines for road users;
- Regular inspections, particularly following precipitation events, to identify areas requiring repairs; and
- Deactivation and reclamation of access roads during Project closure, or as otherwise required.

21.4.8.2.3 Vehicle Operation by Authorized Users

All Project personnel and contractors will undergo safety and environmental training during onboarding. This training will include guidance on vehicle and equipment operation within the Project site and along transportation routes used for the Project.

Vehicle and equipment operators will comply with the following requirements during all phases of the Project:

- All vehicles and equipment will remain on established roads and designated travel routes;
- Speed limits will be clearly marked and signed on all Project access roads. These speeds will take into consideration road conditions, potential weather, and wildlife crossings;
- Additional road signs will be posted for wildlife crossings, speed limit changes, advisory corner speeds, areas with limited visibility, and other potential road hazards;
- Wildlife will be given the right of way on all Project roads; wildlife sightings and incidents will be reported to the site supervisor as soon as possible (Chapter 33, Section 33.4.1.13);
- Vehicles and equipment used for the Project will be equipped two-way radios and the operator will be trained on site specific radio use;
- Traffic associated with the Project will be minimized where possible. Multiple passenger transportation options will be provided for personnel to reduce the amount of traffic on Project roads during peak traffic times;
- Vehicle and equipment loads will be optimized to minimize traffic;

- All personnel operating vehicles and equipment will have the proper licenses and training. These records will be regularly updated and maintained at the Project site;
- Vehicle operators will be responsible for determining the suitability of roads prior to use. Project personnel will monitor weather and highway conditions, and plan activities accordingly;
- All vehicles and equipment will maintain a regular inspection and maintenance schedule to maintain proper working condition, cleanliness, and appropriate registration is place;
- Maintenance logs will be maintained for all on-site vehicles and equipment;
- All vehicles and equipment will be equipped with spill response materials and firefighting equipment while on-site;
- Vehicle and equipment idling will be reduced to the extent feasible;
- Vehicle and equipment operators will adhere to company and provincial requirements regarding mobile phone and radio use;
- All vehicles and equipment will meet or exceed Transport Canada requirements;
- A zero-tolerance drug and alcohol policy will be implemented for all workers and contractors operating vehicles in relation to the Project;
- A journey management plan, departure, and check-in schedule and procedure will be developed for all vehicles arriving and departing the Project site;
- During peak traffic periods such as construction, the TCP will be communicated to the public detailing driving routes, peak traffic periods, and potential road shutdowns; and
- Traffic plans will be communicated to provincial and local governments.

21.4.8.3 Traffic Monitoring Program

A monitoring program is a key component of the TCP, as it will be used to evaluate the effectiveness of the traffic control strategies throughout all phases of the Project. The traffic monitoring program will be implemented and managed by the Environmental Manager; however, a range of Project personnel will be trained to participate in the program. The monitoring program may include the following procedures:

- Recording and tracking road, vehicle, and traffic-related safety and environmental incidents;
- Tracking unauthorized use of Project access roads;
- Regular inspection of security gates, road signs, and road conditions, including culverts and bridges;
- Enforcement of posted road speed limits and compliance with the TCP requirements by Project personnel and contractors;
- Regular inspection of vehicles and equipment for maintenance and debris; and
- Tracking vehicle and equipment inspection records.

A TCP "fact sheet" will be developed and dispersed to vehicle operators prior to using Project access roads. This fact sheet will include road use details such as:

- Road rules to be followed on all roads, including details on radio calling;
- A road map detailing road types, radio frequencies, road signage, and current road closures and decommissioned roads; and
- Key personnel and contact information for traffic control and security personnel.

21.4.8.4 Characterization of Residual Effects

21.4.8.4.1 Wildlife

A vehicle or equipment collision may affect wildlife mortality through direct collision with a vehicle or mobile equipment (including rail equipment). A collision, should one occur, would likely involve a single individual and therefore is not likely to substantially reduce the long-term survivability of wildlife species populations within the LSA.

Any wildlife strikes or near-strikes will be reported by drivers (with species, if known, and approximate location) to NWP and a log will be maintained. If necessary, further mitigation will be implemented, such as posting of wildlife crossing signs. As described above, injury or mortality to wildlife as a result of vehicle collisions is not predicted to substantially reduce the long-term survivability of any population within the LSA.

Potential residual effects on wildlife are expected to be low in magnitude, local in extent, short-term in duration, and reversible through natural population growth. As a result, the potential residual environmental effects of a vehicle or equipment collision on wildlife for all phases of the Project are rated not significant. There is a high level of confidence in this prediction.

21.4.8.4.2 Socio-Community

The Project will generate increased traffic during all phases, which will travel along provincial highways and forest service roads that lead to the Project site. The expected increase in traffic volume related to the Project could result in an increased frequency of vehicle or equipment collisions, either within the Project footprint or along public highways and roads leading to the Project site. A collision involving one or more vehicles or mobile equipment or a pedestrian strike, can result in property damage, injury to people involved, and in extreme cases, mortality. Traffic flow may be interrupted temporarily after a collision as emergency response crews respond to the accident and any debris resulting from the collision is cleared. In the unlikely event that a collision and/or pedestrian strike occurs, parties on-site would contact emergency services as necessary to respond to any injuries or fatalities. As with any other vehicle collision that might occur along the provincial highway system, it is unlikely that any vehicle collision scenario would exceed the capacity of area emergency response services. In addition, for any Project-related accidents, emergency preparedness and response procedures that will be defined in the MERP will be implemented immediately.

Through the implementation of the preventative and mitigation measures discussed above, despite the likely increase in traffic volumes within the LSA, the risk of Project-related vehicle or equipment collision (in terms of accident rate) will be no higher than for any other vehicles accessing roads within the LSA. In particular, the mitigation measures in place for the forest service roads leading to the Project site, including planned upgrades and maintenance activities, should help maintain or improve traffic safety. The Project TCP and MERP will a safety system in place that will require employees to report events, accidents and near misses and to put corrective action in place as needed to respond to any trends. This would also apply to Project transportation activities. All vehicles used by NWP or its contractors will be required to have appropriate registration and insurance, and to follow safe driving rules and requirements of legislation as defined in the provincial Motor Vehicle Act. While the potential residual effects of a vehicle collision could be severe for the parties involved (i.e., property damage, severe injury or death to

individuals involved), should one occur, any delays or impairment to traffic as a result of any collisions would be temporary and typical of any accident response scenario. Therefore, while such an accident would be considered significant, it is not likely to occur as no increase in the rate of accidents as a result of Project related traffic is expected. As a result, with consideration of the low likelihood of a serious vehicle or equipment collision causing mortality of an individual, the potential residual effects of a vehicle or equipment collision on the socio-community during all phases of the Project are rated not significant. If a human fatality occurred, the environmental effects would be considered significant, but this is highly unlikely to occur. There is a high level of confidence in this prediction.

21.4.8.5 Determination of Significance

While the Project will likely result in an increase in traffic volume, particularly during the construction phase. However, with the implementation of a TCP, to which all Project personnel must adhere, in addition to the provincial safe driving rules and requirements, the Project is not expected to result in an increase in vehicle or equipment collisions on any road leading to the Project site. Though traffic rates on forest resource roads will increase as a result of the Project in comparison to current levels, the planned road upgrades and maintenance activities are expected to maintain or reduce the potential for accidents to occur on these forest roads.

With respect to wildlife, injury or mortality to wildlife as a result of vehicle collisions is not predicted to substantially reduce the long-term survivability of any population within the LSA. As such, the potential environmental effects of a vehicle or equipment collision on wildlife are rated not significant. There is a high level of confidence in this prediction.

With respect to the socio-community, any vehicle or equipment collision that results in serious injury or death as a result of the Project would be considered significant; however, by implementing the TCP and enforcing safe driving practices by all Project personnel, the Project is not anticipated to result in an increase in vehicle or equipment collision rates, and hence the number of collisions involving people are not expected to increase either, much less those potentially involving fatalities. Therefore, while such an accident would be considered significant, it is not likely to occur as no increase in the rate of accidents as a result of Project related traffic is expected. As a result, with consideration of the low likelihood of a serious vehicle or equipment collision causing mortality of an individual, the potential residual effects of a vehicle or equipment collision on the socio-community during all phases of the Project are rated not significant. If a human fatality occurred, the environmental effects would be considered significant, but this is highly unlikely to occur. There is a high level of confidence in this prediction.

Overall, the potential environmental effects of a vehicle or equipment collision on all Project VCs during all phases of the Project are rated not significant, with a high level of confidence, except for the environmental effects of a vehicle or equipment collision causing human mortality, which are rated significant but highly unlikely to occur. There is a high level of confidence in these predictions.

The significance of residual environmental effects that may result from a vehicle or equipment collision on all potentially affected VCs is presented in Table 21.4-8.

Table 21.4-8: Summary of Potential Residual Environmental Effects of a Vehicle or Equipment Collision

Accident or Malfunction	Valued Component												
	Air Quality	Acoustic Environment	Soils and Terrain	Groundwater	Surface Water	Fish and Fish Habitat	Terrestrial Ecosystems	Vegetation	Wildlife	Archaeological Resources	Economic Conditions	Socio-Community	Land Use
Vehicle or Equipment Collision									NS			S(U)	

Note: NS = effects are not significant; S (L) = effects are significant and are likely to occur; S (U) = effects are significant but are not likely to occur; empty cell = no anticipated interaction.

21.5 Risk Assessment

The assessment of the potential risk of environmental effects resulting from accidents or malfunctions involves the use of the risk matrix, as discussed in Section 21.2.3 (Figure 21.2-1), where the residual risk is determined based on the likelihood and consequence of that particular accident or malfunction, as defined in Section 21.2.3. Risk levels are colour coded to provide a visual means of expressing risk, the definitions of which are provided in Figure 21.2-2. Where a range of risk ratings could occur for a particular accident or malfunction, a conservative approach was taken whereby the highest rating was considered.

The results of the risk assessment are presented in Table 21.5-1.

Table 21.5-1: Summary of Accidents or Malfunctions Risk Assessment

Accident/ Malfunction	Potentially Affected Valued Components	Description of Residual Effects	Likelihood of Event	Severity of Event	Residual Risk
Release of Hazardous Materials	• Air Quality • Soils and Terrain • Groundwater • Surface Water • Fish and Fish Habitat • Terrestrial Ecosystems • Vegetation • Wildlife • Archaeological Resources	An accidental release of hazardous material may result in residual adverse environmental effects to VCs that are rated low to high in magnitude, short-term in duration, discrete to local in geographic extent, and reversible.	Very Low	High	Low
Loss of Containment	• Soils and Terrain • Groundwater • Surface Water • Fish and Fish Habitat • Terrestrial Ecosystems • Vegetation • Wildlife • Land Use	A Loss of containment may result in residual adverse environmental effects to VCs that are rated low to moderate in magnitude, short-term in duration, local in geographic extent, and reversible.	Very Low	Moderate	Very Low
Uncontrolled Detonation of Explosives	• Air Quality • Acoustic Environment • Surface Water • Fish and Fish Habitat • Terrestrial Ecosystems • Vegetation • Wildlife	An accidental detonation of explosives may result in residual adverse environmental effects to VCs that are rated very low to moderate in magnitude, short-term in duration, local in geographic extent, and reversible.	Very Low	Moderate	Very Low

Accident/ Malfunction	Potentially Affected Valued Components	Description of Residual Effects	Likelihood of Event	Severity of Event	Residual Risk
Fire	• Air Quality • Soils and Terrain • Surface Water • Fish and Fish Habitat • Terrestrial Ecosystems • Vegetation • Wildlife • Economic Conditions • Socio-Community • Land Use	A fire may result in residual adverse environmental effects to VCs that are rated low to high in magnitude, short-term to long-term in duration, local in geographic extent, and potentially irreversible in a worst-case scenario.	Low	High	Moderate
Slope Failure	• Air Quality • Surface Water • Fish and Fish Habitat • Wildlife • Socio-Community • Land Use	A slop failure may result in residual adverse environmental effects to VCs that are rated low to moderate in magnitude, short-term in duration, local in geographic extent, and reversible.	Very Low	Moderate	Very Low
Wildlife Encounter	• Wildlife • Socio-Community	A wildlife encounter may result in residual adverse environmental effects to VCs that are rated low to high in magnitude, short-term to long-term in duration, local in geographic extent, and potentially irreversible in a worst-case scenario.	Low	High	Moderate
Vehicle or Equipment Collision	• Wildlife • Socio-Community	A vehicle or equipment collision may result in residual adverse environmental effects to VCs that are rated low to high in magnitude, short-term to long-term in duration, local in geographic extent, and potentially irreversible in a worst-case scenario.	Low	High	Moderate

21.6 Summary and Conclusions

Residual adverse effects from accidents and malfunctions to VCs are characterized in Section 21.4 with the risk of each scenario that was considered summarized in Section 21.5. The Project is planned and designed to prevent accidents and malfunctions primarily through adherence to accepted design codes and standards. Most accidental/unintended events that are expected to occur are expected to be responded to and addressed by Project personnel with little or no environmental consequences. Emergency response plans and management plans will be advanced and implemented to effectively respond to accidents and malfunctions to reduce the magnitude, duration, and likelihood of residual adverse effects. These plans include internal and external communications, roles and responsibilities, training requirements, and mitigation/response measures in the event of an unplanned event or emergency.

In summary, the significance of environmental effects of accidents and malfunctions on all potentially affected VCs and the likelihood of occurrence is presented in Table 21.6-1 below. The effects of accidents and malfunctions on affected VCs were mostly rated significant with a high level of confidence; where significant effects were predicted, they were determined to be unlikely to occur.

Table 21.6-1: Summary of Residual Environmental Effects of Accidents or Malfunctions

Accident or Malfunction	Valued Component												
	Air Quality	Acoustic Environment	Soils and Terrain	Groundwater	Surface Water	Fish and Fish Habitat	Terrestrial Ecosystems	Vegetation	Wildlife	Archaeological Resources	Economic Conditions	Socio-Community	Land Use
Release of Hazardous Materials	NS		NS	NS	NS	NS	NS	NS	NS	NS			
Loss of Containment			NS		NS	NS	NS	NS	NS				NS
Uncontrolled Detonation of Explosives	NS	NS			NS	NS	NS	NS	NS				
Fire	NS		NS		NS	NS	NS	NS	NS		NS	S(U)	NS
Slope Failure	NS				NS	NS			NS			NS	NS
Wildlife Encounter									NS			S(U)	
Vehicle or Equipment Collision									NS			S(U)	

Note: NS = effects are not significant; S (L) = effects are significant and are likely to occur; S (U) = effects are significant but are not likely to occur; empty cell = no anticipated interaction.

In the unlikely event of a major industrial accident at the Project involving a large scale release of hazardous material, fire, wildlife encounter, or vehicle or equipment collision, there is a potential for significant residual adverse effects; however, the risk to VCs from Project-related accidents and malfunctions, considering mitigation and the advanced level of design information in the EA, provide for a very low probability of an event occurring. As a result of Project design and emergency response

measures, the results of the risk assessment indicate that the residual risk (severity and likelihood) of accidents and malfunctions is very low to moderate.

21.7 References

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