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**COMERCIALIZATION AND DE-RISKING FOR AGRICULTURAL
TRANSFORMATION PROJECT**

(CDAT)

MASTER EMERGENCY RESPONSE PLAN
(MERP)

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List of Acronyms

CDAT	Commercialization and De-Risking of Agricultural Transformation Project
EAP	Emergency Action Plan
ERP	Emergency Response Plan
ESP	Environment and Social Performance
HIRA	Hazard Identification and Risk Assessment
HSE	Health Safety and Environment
MSDSs	Material Safety Data Sheets
PAR	Population at Risk
PMPDE	Probable Maximum Precipitation Design Flood
PPE	Personal Protective Equipment
RA	Risk Assessment

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0.0 Glossary

Cascade (or Cumulative) Failure	The sequential failure of multiple dams within the same catchment basin triggered by the same event.
Catchment	The area from which all the water drains naturally into one stream or other body of water.
Consequence	Impacts downstream of a dam, or other areas, caused by a partial or complete failure of the dam or its appurtenances, or as a result of misoperation and an uncontrolled reservoir water release. In relation to risk analysis, represents the outcome or impact of a failure event.
Dam Failure	The uncontrolled release of water, sediment, or other stored contents of a reservoir through partial or complete collapse of the impounding dam, or the inability of a dam to fulfil the intended design purposes.
Dam Safety Requirements	Required minimum criteria and procedures that need to be followed regarding dam registration, licensing, construction permission, safety regulation, investigation, design, operation and maintenance, surveillance, inspection, and so on.
Dam Owner	Any person, organization, or entity legally deemed to be the owner and/or responsible entity of the dam.
Dam Operator	Any person, organization, or legal entity that is responsible for the control and operation and maintenance of the dam, and/or reservoir, and the appurtenant works.
Dam Portfolio	All of the dams that fall under the responsibility of a single owner or single regulatory regime, or are located within a specific jurisdiction.
Deterministic	Describing a process with an outcome that is always the same for a given set of inputs; hence, the outcome is determined by the input.
Emergency	Any condition that develops unexpectedly; endangers the integrity of the dam or downstream life, property, or the environment; and requires immediate and coordinated action.
Failure Mode/ Failure Scenario	A way that failure can occur, described by the means by which element or component failures must occur to cause loss of the subsystem or system function.
Hazard	A source of potential harm or a situation with the potential to cause loss. Threat or condition may result from either an external cause (for example,

earthquake, flood, or human agency) or an internal vulnerability with the potential to initiate a failure mode.

In dam safety, often seen as a measure of the consequences of dam failure. The terms *hazard* and *consequence* are, therefore, used in the same manner as the potential losses in the downstream area of the dam in the event of dam failure or misoperation, resulting in an uncontrolled release of flood waters.

High Risk

When the probability of a hazard or consequence materializing is categorized as high, or when the product of the probability of dam failure and the subsequent consequence or hazard is high.

Incident

An event that could deteriorate to a very serious situation or endanger the dam, or an event that would cause harm or damage to the downstream people, property, or the environment as a result of misoperation.

Inspection

A careful and critical observation and examination of all visible aspects of a dam, searching for abnormal visible phenomena on the surface and inside of the dam. There are generally several levels of inspection: routine inspection undertaken by onsite operators and specialized inspection undertaken by experienced dam engineers. Inspection leads to qualitative knowledge about the visible part of the dam.

Instrumentation

An arrangement of monitoring instruments or devices installed into dams or surrounding areas, possibly including the slopes of abutments and reservoir rims, that provide for measurements that can be used to evaluate the structural behavior, and load and performance parameters of the structure and surrounding areas.

Maintenance

The routine work required to maintain existing facilities and systems (civil engineering structures; hydraulic, mechanical, and electrical equipment) in a safe and reliable working condition to fulfil the intended designed purposes with routine or regular checking, testing, and repair works.

Misoperation

Incorrect operation of the dam resulting in an uncontrolled release of water as a result of not following proper operational procedures for hydraulic facilities, providing required notification or warning to downstream areas, and so on, possibly causing casualties and damages.

Monitoring

The observing of measuring instruments and devices that can provide quantitative data of physical parameters (for example, displacements, strains, water pressure, and leakage), which indicate the performance and behavioral trends of a dam and appurtenant structures, either on its surface or inside its body, and the recording and review of such data to detect any deficiencies in the dam behavior.

Operation and Maintenance	The operation, maintenance, repairs, replacements, testing, and exercising of any or all portions of the dam’s structure and appurtenant facilities for the life of the system that are required to ensure facilities and systems are in a safe and reliable working condition to fulfil the intended purposes.
Population at Risk	Number of people directly exposed to floodwaters within the dam break-affected zone if they took no action to evacuate.
Potential Loss of Life	A subset of population at risk considering a fatality rate and the number of fatalities that would be highly likely because of a dam failure or misoperation, even if they took action to evacuate.
Portfolio Risk Assessment	A particular form of risk assessment or analysis that aims to make a comparative estimation of risks over all, or many, of the dams of a single owner or single regulatory or other jurisdiction.
Portfolio Risk Management	Managing all of, or many of, the dams of a single owner or single regulatory or other jurisdiction by prioritizing the dams that would warrant interventions and effective remedies in an optimal manner based on a particular form of risk assessment or analysis.
Potential Failure Mode	Any one of several mechanisms or set of circumstances that could result in a dam failure or an uncontrolled release of a large amount of water.
Potential Failure Mode Analysis	A process to systematically identify, describe, and evaluate ways a dam and its appurtenant structures could fail or cause an uncontrolled release of a large amount of water.
Probability	A measure of the likelihood that a specific event, outcome, or consequence will occur.
Public Safety	Protecting the welfare of the general public. Public safety considerations include potential dangers resulting from misoperations, such as sudden increases in turbine discharge or the opening of spillway gates without proper downstream notifications. There are also broader public safety considerations associated with dam operations and emerging issues of security that go beyond dam safety, which is primarily concerned with avoiding dam failure.
Qualitative Risk Analysis	An analysis using descriptive or numeric rating scales to describe the system failure likelihood and the magnitude of the subsequent consequences, considering all potential scenarios leading to dam failure or an uncontrolled release of water.

Quantitative Risk Analysis	An analysis based on numerical values of the probability of a series of system failure events and the magnitude of subsequent consequences, considering all potential scenarios leading to dam failure or an uncontrolled release of water.
Regulation	Written law passed by the executive arm of government under the authority of a statutory law or act that has been passed by the legislature (legislative arm of government).
Regulator	The authority that administers the relevant act that controls any aspect of dam safety.
Regulatory Framework	The structure behind regulations that describes the interaction between the regulatory instrument (for example, legislation, regulations, codes, industry standards, guidelines, or even self-regulatory documents) and the expected roles and responsibilities of the regulator and the person or entity being regulated.
Resilience	The capacity of dam safety systems to absorb, accommodate, and adapt to hazards and threats beyond the design criteria, thus preserving the critical core systems for maintaining the overall structural safety of the dam and its water storage and control functions.
Risk	Measure of the likelihood/probability and severity of an adverse consequence or impact to life, health, property, or the environment. In the general case, risk is estimated by the combined impact of all triplets of scenario, probability of occurrence, and the associated consequence. In the special case, average risk is estimated by the mathematical expectation of the consequences of an adverse event occurring (that is, the product of the probability of occurrence and the consequence, combined over all scenarios).
Risk Analysis	Used to identify potential failure modes, structural performance, and adverse consequences of dams using qualitative or quantitative procedures and to estimate the risk—that is, the combination of likelihood of concurrence and magnitude of consequences.
Risk Analysis	Used to examine the safety of dams, evaluating the results of risk analysis along with relevant social, environmental, economic, and other factors, and to make recommendations on risk reduction measures as needed, including additional investigations and enhanced monitoring.
Risk Index	A basic qualitative risk analysis tool for preliminary risk screening of a portfolio of dams. The risk index is not a measure of risk but a relative indication of potential level of risk.

Risk-Informed Approach	Uses the outcomes of a risk assessment as one of the important factors to support decision making, along with other factors, such as risk uncertainty, deterministic analyses, and other local and/or regional considerations.
Risk Management	The systematic application of management policies, procedures, and practices to the tasks of identifying, analyzing, assessing, mitigating, controlling, and monitoring risk.
Risk-Based Approach	Uses the outcomes of a risk assessment as the basis for decision making.
Safety Review	A procedure for assessing the safety of a dam, composed of a detailed examination of structural, hydraulic, hydrological, and geotechnical design aspects and of all relevant design, construction, and surveillance records and reports to assess the integrity of a dam.
Standards-Based Approach	The traditional approach to dams engineering in which risks are controlled by following established rules as to design events and loads, structural capacity, safety coefficients, and defensive design measures.
Supervising Engineer	A suitably trained engineer recognized under dam safety laws to competently supervise all or specific aspects of a dam’s design and construction or ongoing management.
Surveillance	The continuing examination of the condition of a dam and its appurtenant structures aimed at managing risk and reducing the probability of occurrence by providing a means of early identification of any phenomena that can compromise the structural and operating integrity of the structure or its related operating equipment, including monitoring instrumentation, data interpretation, routine supervision, visual observation or inspection, tests of safety-related hydro mechanical equipment, periodic audit, and dam safety review.
Threat	An event that might cause damage or danger to the safety of a dam.
Vulnerability	The level or degree of exposure of structures or areas to potential hazards to be adversely affected because of their locations, conditions, and other relevant factors.
Watershed	An area or ridge of land that separates waters flowing to different rivers or basins.

00. Rationale

Today, society demands an increase in the safety and reliability levels of essential infrastructures, like large dams. It is globally recognized that there is always a probability associated with dam failure, even if it might be very low, and there exists a possibility for adverse consequences to occur. Consequently, there is an associated risk that should be estimated, managed and minimized.

Many people who live near a dam or who might be affected by a potential dam failure do not fully understand the risks that may be present. There are risks to the dam itself and there is resulting risk exposure to the nearby population and infrastructure due to proximity to the dam, including residual risk that remains even after risk reduction measures are enacted

Dams and water reservoirs play a key role in controlling floods and landslides, water supply management, irrigation, and the like. They are built as safe structures, complying with the strict standard requirements. However, there are still threats such as natural disasters or human-made activities that can result in their mechanical damage, whereby endangering the population property and the environment in an inundation area.

The Master Emergency Response plan (MERP) for dam Safety is a road map for the management of assumed extreme flood specially floods, incident, disaster caused by dam failure at downstream of dams with high hazards. Although most dam owners have a high level of confidence in the structures and dams will not fail, history has shown that on occasion dams do fail and that often these events cause extensive property damage and sometimes death.

A carefully conceived and implemented ERP is one positive step can take to accomplish dam safety objectives, protect investment, and reduce potential liability. An emergency action plan is not a substitute for proper maintenance or remedial construction, but it facilitates the recognition of dam safety problems as they develop and establishes nonstructural means to minimize the risk of loss of life and reduce property damage.

In preparation procedure of ERP for a dam may be determine the level of warning, potentially inundated area and inundation maps, identify situations or events damages and deaths, Evaluate the warning time available and identify all jurisdictions, agencies, and individuals who will be involved.

1.0. CDAT Emergency Preparedness Response Plan.

1.1. Introduction

The Emergency Response Plan (ERP) for Commercialization and De-Risking of Agricultural Transformation Project (CDAT) provides a general guide for identifying, preventing, minimizing and managing injuries, accidents and risks to CDAT staff and partners. An effective implementation of this ERP will steer CDAT commitment to eliminating harm to staff, partners and project affected persons. The Emergency Response Plan (ERP) is a living document that will be reviewed and updated as needed at least once a year.

1.2. ERP Objectives

The objectives of this ERP include the following;

- Ensure that potential emergencies that may impact the health and safety of women and men are identified and handled effectively.
- Employ an integrated risk management and gender sensitive approaches for preparedness planning, mitigation, response, recovery and continuity of operations.
- Enhance emergency preparedness capabilities through gender responsive training and capacity building for staff and partners.
- Ensure continuous communication, awareness creation and understanding of actions to be undertaken by different groups of women and men in emergency situations recognizing age differences, levels of disabilities and other relevant social categories.

1.3. Scope and Applicability

This Emergency Response Plan (ERP) applies to all internal operations of CDAT Project as well as Sub-project and activities under the Component one. Thus project designs, implementation, monitoring and reporting will incorporate the relevant provisions of this ERP as appropriate.

1.4. Responsibility

All CDAT staffs, consultants, implementing entities, contractors and their sub-contractors as well as all relevant stakeholders are responsible for ensuring good implementation and compliance with this ERP.

2. Risk Assessment and Risk Analysis

The level of risk associated with each hazard is determined by taking into account the potential consequences and the likelihood of occurrence and the current control as nominated in the Description of Project or as required by legislation. Consequence and likelihood were ranked using the assessment criteria shown in **Table 1** and **Table 2**

The consequence and likelihood ratings were then used to classify the level of risk using the risk matrix shown in **Table 1**. The consequence and likelihood criteria are used to assess the unmitigated and mitigated risk levels for each hazard.

Table 1: Consequences Scale

Category	Health and Safety	General Environmental
Catastrophic	Multiple worker fatalities	Impact on environmental values over a wide area or impact results in the extinction of a population or community or recovery periods of greater than 20 years likely.
Major	Single worker fatality.	Significant impact (as defined by legislation) on environmental values within the Project area or to a species or community on a population scale. May lead to a local extinction or recovery periods of 10 - 20 years are likely.
Moderate	Long term medical or health issue.	Significant impact (as defined under legislation) on environmental values extending locally or to a species or community, but not on a population scale. Would not lead to an extinction at any scale. Recovery periods of 5 - 10 years anticipated.
Minor	Short term medical or health issue.	Impact is present but not to the extent that it would impair the overall environmental values, population or community.
Insignificant	Minor medical treatment.	No impact or, if impact is present, then not to an extent that would draw concern from a reasonable person.

Table 2: Likelihood Scale

Category	Description	Probability
Absolute	Part of the scope of work and will occur	1
Likely	Likely that the risk will occur and that the control measures will fail resulting in the stated consequence level.	0.1
Possible	Possible that the risk will occur and that the control measures will fail resulting in the stated consequence level.	0.01
Unlikely	Unlikely that the risk will occur and that the control measures will fail resulting in the stated consequence level.	0.001
Rare	On a rare occasion that the risk will occur and that the control measures will fail resulting in the stated consequence level.	0.0001

Table 3: Risk Matrix

	Consequences Rating				
Likelihood	Insignificant	Minor	Moderate	Major	Catastrophic
Absolute	Low	Medium	High	Extreme	Extreme
Likely	Low	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Low	Medium	Medium	High
Rare	Low	Low	Medium	Medium	Medium

2.1. Dam safety risk Assessment

This section details the risks and mitigation measures relating dam safety including potential modes of dam failure and dam safety requirements throughout the life of the dam.

2.2. Dam Safety Risks

Dam safety is regulated for referable dams so that the community is protected from dam failure. There are three major loading conditions that can cause dam failure. These are discussed here.

➤ Hydrologic

Hydrologic failure modes for dams are those associated with rainfall events. Failures not associated with rainfall events are classified as ‘sunny day’ failures. Hydrologic risks for dams can be classified into four main groups as follows:

- overtopping erosion - erosion of the material of the dam itself by overtopping, for which the design does not protect;
- flood induced piping - the elevated reservoir level during a flood event causing erosion through the embankment;
- overturning or sliding - destabilizing of the dam by hydraulic loads that exceed the structural capacity of the dam; and
- erosion of abutments - erosion of the abutments or foundations by overtopping flows to the extent that support for the dam is removed.

The dam is proposed to be an earth and rock fill dam with a mass concrete ogee crest spillway. Overturning/sliding and foundation/abutment erosion are typically associated with concrete dams not earth and rock fill embankment dams.

To ensure embankment overtopping does not occur, the Nathan Dam spillway will be designed to safely pass the Probable Maximum Flood (PMF) which is defined as “the limiting value of the flood that can reasonably be expected to occur” and has an Annual Exceedance Probability (AEP) of less than 1 in 43,000. Current research undertaken by the Bureau of Meteorology indicates that there is no evidence that the Probable Maximum Precipitation (PMP) will increase with climate change (Smalley *et al.*, 2006; Jakob *et al.*, 2008; 2009). Therefore, the probability of the dam

overtopping due to flooding, even under potential climate change conditions, is very low and consistent with the prevailing guidelines.

Embankment erosion and piping tends to be progressive and irreversible once initiated, and failure of the dam is the typical outcome. The cause of embankment erosion is generally due to inadequate design and construction. The clay core of the embankment will be protected by a series of filters that hold the clay within the wall structure.

To ensure the embankment does not erode the following measures will be taken:

- use defensive design methods that are performed by experienced engineers;
- have backup filters;
- strict quality assurance of supplies; and
- strict supervision of construction performed by experienced engineers.

Hydrologic risks also arise that are not associated with failure of the dam. These may involve limited damage to dam and spillway structures, threats to downstream life and property due to large floods routed through the spillway or over the dam, and threats to upstream life and property due to high surcharge levels. These risks are discussed in **section 2.4**.

➤ **Seismic**

Dams are designed to withstand seismic activity (earthquakes). Historically, some dams have been subjected to strong seismic loads. While damage has occurred, comparatively few dams have failed due to earthquakes in comparison to hydrologic or static causes.

The main risks to dams from earthquake are:

cracking with loss of section strength (mainly concrete dams);

- cracking with potential for internal erosion (embankment dams);
- sliding of foundation (mainly concrete dams);
- sliding of the dam material (mainly embankment dams);
- liquefaction of foundations (mainly embankment dams);
- liquefaction of dam material (certain types of embankment dams such as hydraulic fill or tailings dams);
- landslide induced wave that results in overtopping (mainly concrete gravity dams and embankment dams); and
- cracking or collapse of ancillary structures such as outlet towers leading to loss of control of outflows which can contribute to other failure modes described above.

Properties of the rocks present at the dam site relevant to the Project and which need to be considered as part of the dam design include:

- rock type – sandstones, siltstones, shales and mudstones are common;
- degree of weathering – this ranges from extremely weathered to fresh rock; and

- jointing and other weaknesses – vertical and horizontal jointing is present in the rocks at the site.

The risk of dam failure due to seismic activity is increased with the presence of the fine-grained clays and silts as these strata can liquefy during seismic activity thus reducing the support that the earth provides to the dam structure. Reducing the support to the dam will place extra loads on the embankment. However, the dam site is underlain by sandstone at shallow depth so the hazard is less than would be the case if it were underlain by deep, unconsolidated materials.

There is no record of seismic activity at the dam site. Design of the dam will include stability analysis incorporating seismic loads. The preliminary dam design has been reviewed by a Consultancy firm of internationally recognized dam companies: Furthermore, provision will be made in the design such that rapid drawdown of the storage can be undertaken in the event of damage to avoid catastrophic failure and effect repairs if appropriate.

➤ **Static**

Approximately two thirds of all dam failures are caused by piping or slope instability, two forms of static failure. Other static failures include failure due to outlet conduit leaks, overturning or sliding not associated with floods or earthquakes or a massive land slide within the impoundment area which displaces the water in the reservoir.

The primary cause of static failures is poor design and/ or construction. To ensure static failure is minimized the following measures will be taken:

- design according to rigorous design standards appropriate to the dam type;
- extensive peer review of the design and construction methods;
- rigorous construction supervision provided by experienced engineers;
- rigorous quality control of supplied material; and
- regular dam inspections and safety reviews throughout the life of the dam.

The landscape around the water storage area is generally stable except for the two situations which extend above. Areas of appreciable active erosion in and around the water storage area are restricted to sheet and gully erosion. Stream banks area show no evidence of slumping as a result of rapidly falling water levels during downstream releases. A massive land slide within the water storage area is therefore considered unlikely. To ensure this, a quality assured geotechnical survey will be conducted and taken into account during any excavation. There is a risk of land slip in steeper areas around water level and erosion from wave action around the edge of the water storage area is possible. Slopes that are at risk of eroding will be appropriately stabilized and maintained.

2.3. Construction

During dam and pipeline construction there will be hazards associated with substances stored and used for motor vehicle and machine operation and associated construction activities. **Table 4**

provides an indicative list of dangerous goods and hazardous substances and materials, which may be used during construction. The table details the relevant rate of use and indicative maximum amount of the substance/material stored on site during construction. **Table 4** describes the physical properties of these materials. Material Safety Data Sheet (MSDS) information will be obtained and communicated to all site personnel involved in the storage, handling, use and disposal of dangerous and hazardous substances and materials.

Table 4: Indicative list of dangerous good and hazardous substances – construction

Chemicals Name/Shipping Name	Rate of Use	Indicative maximum inventory
Diesel Fuel Oil	10 000 litres/day	150 000 litres
Unleaded Petrol	200 litres/day	3000 litres
Lubrication Oils (hydraulic oil)	200 litres/day	10 000 litres
Solvents	As required	<200 litres
Paints	As required	<200 litres
Hydrochloric Acid	As required	300 litres
Ammonium Nitrate	Dependent on ground conditions	10,000 kg

All fuel storage will be designed and constructed according to the AS1940-2004, the storage and handling of flammable and combustible liquids.

Storage and handling of corrosive substances, such as hydrochloric acid, will be done in accordance with AS 3780:2008, the storage and handling of corrosive substances.

2.3.1. Operation and Maintenance

During operation there will be hazards associated with chemicals being stored and used for maintenance activities. However, the use of these is expected to be minimal when compared to the construction phase. **Table 4** lists the rate of use and the maximum amount stored on-site during operations. MSDS information will be obtained and communicated to all site personnel involved in the storage, handling use and disposal of hazardous substances and materials.

Table 5 Indicative list of dangerous goods and hazardous substance - Operation

Chemical Name/Shipping Name	Rate of Use	Indicative Maximum inventory
Diesel Fuel Oil	As required	3000 L
Lubrication Oils (hydraulic oil)	As required	3000 L

2.3.2. Transportation

Off-site transportation of chemicals to and from the site could result in accidental release or exposure to hazardous materials. As an example, if a tanker shell became damaged in an incident, the full contents of one tank compartment (5 000-8 500 litres) or greater (up to 20 000 litres) could

spill onto an off-site roadway, and escape into the soil profile or nearby waterway. The environmental damage caused by such a spill is dependent on the area in which the incident occurs.

2.4. Mitigation Measures

2.4.1. Construction, Operation and Maintenance

The chemicals used during the construction, operation and maintenance phases will be relatively benign. Fuel (predominantly diesel), lubricants, oils, minor quantities of solvents, degreasers and domestic cleaning agents will form the majority of chemicals on site.

All hydrocarbons will be stored and handled in accordance with:

- ✓ AS 1940: 2004 The storage and handling of flammable and combustible liquids;
- ✓ AS 4897: 2008 The Design, installation and operation of underground petroleum storage systems; and
- ✓ contained within each Standard there is a list of references for other applicable Australian Standards and other related documents.

The following standards will apply for electrical installations in hazardous zones: AS 3000, AS 2381, AS 2381.1, AS 2430, AS 2430.3.

Chemical storage areas will be suitably bunded and constructed to minimise the potential for leaks to cause environmental harm. All chemicals will be stored, handled and used according to provisions in their Material Safety Data Sheet (MSDS). The health risk presented by these chemicals is relatively low.

2.4.2. Fuel Storage (Mobile & static)

Fuel storage on-site will be predominantly diesel, which presents a relatively low combustion risk and a moderate environmental risk. Ignition sources will be controlled to avoid fire involving bulk fuel oil. Firefighting facilities will be provided at fuel storage facilities.

All hydrocarbons will be stored and handled in accordance with Australian Standard 1940. Chemical storage areas will be suitably bunded and constructed to minimise the potential for leaks to cause environmental harm.

Standard operating procedures for the delivery, storage, containment, disposal and spill response for potentially hazardous materials will be developed. The use of Australian Standards (AS 1940) for the management of fuel storage (bunding and containment) will reduce this risk to a low level.

The hazard associated with the storage of fuel oil arises from leaks/ failures in the system. To minimise the hazards associated with fuel oil leaking during tanker unloading, the following measures will be in place:

- ✓ a program of regular equipment inspection and testing will be continued to ensure reliable performance;
- ✓ operators will continue be trained in the safe operation of the system and emergency procedures in the event of fuel oil leakage;

- ✓ spill containment equipment will be available at the unloading pad for use in the event of spillage;
- ✓ a sump will be provided to collect any spillage and allow recovery;
- ✓ ignition sources will be strictly controlled and limited to avoid a fire;
- ✓ appropriate firefighting materials and equipment will be available to suppress fires; and
- ✓ an approved fire protection system will be installed around new hydrocarbon storage areas.

The following measures will be taken to minimise the potential for the leakage of fuel oil from storage tanks:

- ✓ adequate bunding will be constructed to contain spills, in accordance with AS 1940:2004;
 - ✓ tank level indicators will be installed on fuel oil tanks for monitoring of fuel oil levels;
 - ✓ maintenance of fuel oil tanks will be undertaken, to ensure safe and effective operation of all components; and
- tanks will be designed in accordance with AS 1692: 2006 Steel tanks for flammable and combustible liquids to minimize the potential for failure of the diesel storage vessel.

2.4.3. Explosives

A specialist explosives company will provide the explosives, detonators and boosters to be used during blasting operations. The Contractor's personnel will be licensed and trained in the transport, handling, mixing and use of explosive materials. Blasting operations will comply with the *Explosive Act 1999 and Explosives Regulation 2003*.

Note that the location of the explosives will take into consideration:

- ✓ public risk;
- ✓ enhancing physical protection to the public by the use of natural ground features;
- ✓ vehicular access routes and junctions with public roads;
- ✓ security;
- ✓ other activities within the proximity of the site; and
- ✓ protection from flood, fire, landslide, lightning or other natural incidents.

2.4.4. Transportation

Licensed transporters operating in compliance with the Australian Dangerous Goods Code will undertake the transport of dangerous goods to the construction site.

The transport of ammonium nitrate will be undertaken in compliance with the requirements of AS 1678.5.1.002-1998: Emergency procedure guide - Transport - Ammonium nitrate.

Off-site transport accidents have the potential to occur but that potential is low. Most of the transport occurs along major roadways. The increased exposure of the public to this hazard due to the construction activity is low and the frequency of such an event occurring is low. Therefore, this event is not a likely scenario for the Project.

The potential for a diesel transport accident to occur is also low. Tanker drivers are trained to such a level, and are sufficiently experienced that single vehicle accidents do not regularly occur. An accident involving a road tanker would most likely require a second vehicle to collide with the tanker. The increased exposure of the public to a diesel transport hazard is low and the frequency of such an event occurring is low. Therefore, this event is not a likely scenario for the Project.

To control the damage that may occur, several measures will be put in place for transport operations. These measures include:

- ✓ dam constructor to liaise with emergency services to develop an emergency plan to deal with tanker incidents off-site;
- ✓ all vehicles to carry Identification and response guidelines for use by emergency personnel attending the scene of the accident;
- ✓ tankers to incorporate internal valves on all outlets to prevent spills, in the event of vehicle damage.

2.5. Emergency Management

Each phase of the Project will require the person in control to develop an emergency management plan for their scope of work.

Emergency planning represents the outer layers of the ‘defence in depth’ approach to community safeguards. Any emergency planning must be based on the following components:

- ❖ an assessment of what constitutes ‘an emergency’ for the particular operation, pertaining to hazards cited in the risk assessment, Table 5, Table 6 and Table 7, and on-site plan to handle incidents;
- ❖ an off-site plan with reference to emergency services needed;
- ❖ communication, emergency responsibilities, control centre establishment;
- ❖ post emergency procedures including recovery, debriefing and review of plan; and
- ❖ test the plan under emergency-scenario conditions.

The final detailed plans should be developed by the dam construction company as the detailed engineering design takes shape. This might involve local emergency services such as police, fire brigade and State Emergency Services personnel as well as the local emergency response groups.

The dam operator will also require a plan that addresses the specific emergencies that could arise during operations.

Two specific levels of emergency response planning are required under the Queensland Dam Safety Guidelines:

- ❖ an Emergency Action Plan (EAP) which prescribes activities at the dam (prepared and operated by the dam owner; and

- ❖ a Counter Disaster Plan (CDP) which prescribes activities downstream of the dam (prepared and operated by the local Disaster District Co-ordination Committee with significant input from the dam owner).

2.5.1. Emergency action plan

The EAP must be developed for the dam in accordance with the WB ESS & Rwanda Regulations and Safety Guidelines. It should be fully reviewed and updated at least every 5 years and annual emergency exercises should be undertaken. Notification details should be updated at least every year.

The EAP should include the following:

- roles and responsibilities – of the dam owner, operator and dam personnel during emergency situations;
- notification listing or flowchart – identifying responsibility for notification, the order of notification and who is to be notified;
- area map – showing the access routes to the storage during fair and adverse weather conditions, including distance and travel times;
- a drawing of the storage catchment area;
- emergency events and actions list, including:
- identification of emergency conditions which could endanger the integrity of the dam;
- description of typical problems, problem characteristics and when/ what to check for during inspections;
- dam operation procedures to follow in the event that such emergency conditions are identified;
- dam failure inundation maps – these should identify: downstream inhabited areas subject to danger, inundated areas, a narrative description of areas affected by dam break; and
- any other charts, rating tables, considered by the dam owners as necessary.

2.5.2. Emergency response

Each phase of the Project will require the person in control to develop an emergency response plan for their scope of work. The dam constructor, pipeline constructor and operator will liaise with local Emergency Services and local ambulance and hospital services with respect to planning for Emergency Response. Emergency planning will be undertaken during detailed design, when a construction contractor has been appointed. This is because aspects of the Project that are particularly relevant to such planning are strongly influenced by the contractor's work practices, policies and procedures.

Designated first aid and emergency rescue facilities and equipment (including a helipad) will be available during the construction and operation phases. Appropriately trained personnel will be

available throughout the life of the Project to provide first aid and emergency response to on site emergencies. First aid response and provision will be included in site induction training that will be provided to all staff members. Fire drills will be undertaken on a regular basis.

Stores, workshops and offices will be fitted with approved and certified fire detection (smoke detectors) and sprinkler systems. Permanent facilities, such as fuel storage areas, will have a dedicated fire alarm, suppression and firefighting systems. First aid and firefighting equipment (hand held extinguishers and fire hoses) will be installed at strategic points within each building. Firefighting equipment and exit locations will be suitably signed. All work areas will be within the required distance to reach emergency exits.

Site firefighting capabilities also will be addressed in the Emergency Response Plan. The dam construction site will have a fire truck or suitably equipped water truck or trailer that can support fire response requirements during construction and operation.

Evacuation and access maps of the construction camps, including the identification of a possible helicopter landing site if required, will be provided during the emergency planning process to emergency services.

2.6. Dam Safety Risk Mitigation

The recommendations specific to ensuring that the Project is constructed and operated safely to minimize the risk of dam failure are summarized in this section. The dam is being designed by experienced engineers to meet both National guidelines and International guidelines. The dam design and construction will be subject to independent peer review to ensure that these guidelines and objectives are met. This peer review will continue throughout the life of the Project.

➤ Hazard Category

Dams are assigned a hazard category based on the Population at Risk (PAR) downstream of the dam and the potential consequences of dam failure. The potential severity of damage and loss is assessed based on a range of factors including:

- cost of damages to infrastructure downstream including residential, commercial, agricultural and roads;
- cost of damages to the dam itself;
- social impacts; and
- impacts on the natural environment.

During detailed design a FIA including dam break analysis and inspection of potential PAR locations must be undertaken to accurately assess the PAR and severity of damage and loss downstream. However, this will be finalized during the detailed design phase with results provided to the reviewer and regulator prior to approval.

During an early phase of the Project, a FIA was undertaken for a larger, gated concrete dam at the Kageyo and Karambi Dams sites. Results from this assessment provide a conservative estimate of the potential consequences of failure of the currently proposed structure. However, it is not expected that the incremental flood hazard category will exceed the sunny day failure hazard category.

The fallback option for a *High A* hazard category dam is that it is required to have adequate spillway capacity to safely pass the Probable Maximum Precipitation Design Flood (PMPDF). However, due to the uncertainty of the hazard category at this time, the Kageyo (8,940,660 m³) & Karambi (500,000 m³) Dam spillway has been designed to pass the Probable Maximum Flood (PMF) which significantly exceeds this requirement.

The final design should include a quantitative risk assessment consistent with the requirements of the ANCOLD Guidelines on Risk Assessment (2003b). This will involve demonstrating compliance with ANCOLD societal and individual risk criteria as well as demonstrating that the risks posed by the dam are as Low as Reasonably Practicable (ALARP). In practice this means that the risks have been reduced to a point that further risk reduction is impracticable or the cost is grossly disproportionate (depending on the level of risk) to the improvement gained.

➤ **Dam Safety management program**

As a referable dam, additional conditions for dam safety management will be required under National and International Legislation.

The guideline requires that a dam safety management program should ultimately result in six levels of documentation being available for each dam.

These are:

- Investigation, Design, and Construction Documentation;
- Standard Operating Procedures (SOPs);
- Detailed Operating and Maintenance Manuals (DOMMs);
- Inspection and Evaluation Reports;
- Dam Safety Review Report; and
- Emergency Action Plan (EAP).

Dam owners must ensure that appropriate training of personnel engaged in dam operations and dam safety is undertaken. Furthermore, quality management of the dam safety management program must be undertaken.

2.7. Unmitigated and Mitigated Risk details

This section provides tabulated data for the hazards, causes, consequences and risk mitigations relevant to the construction and operation of the dam.

2.8. Summary

The failure hazard category has important impacts on the design work to be undertaken to achieve the required reliability of the structure under the various failure modes.

The risk assessment shows that the residual risks are no higher than moderate with most being related to common construction and decommissioning activities that are regularly managed through the contractor selection process and implementation of current health and safety practices. Operational risks relate to public safety at the dam and public access to the pipeline especially during maintenance activities.

The remainder of the assessed risks relies heavily on the information provided in the other parts of the EIS under which a scientific assessment of the risks has been undertaken. References to these areas were provided at the start of this section.

Provided competent construction, operation, maintenance and decommissioning of the dam and pipeline is in place there are no identified residual risks that are abnormal or pose an increased level of uncertainty in achieving the objectives for this project.

Table 6: Risk Assessment –Construction and Decommissioning

Hazards	Factors	Impact	Project Description Controls & Standards Industry Practice	Risk With Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current			C	L	Mitigated Risk
Impacts on access and egress for emergency services.	Dam changes the travel routes for response.	Delayed response times to critical assets and people.	Roads will be relocated to provide required access.	Moderate	Rare	Medium			Moderate	Rare	Medium
			Discussions are required with emergency services to identify any route access issues. Helipad provided.								
On site spill of fuel or chemicals	Spill or leakage of fuel or lubricating oil	Short term degradation of river water quality	Construction activities to operate to approved Environmental Management Plan.	Minor	Unlikely	Low			Minor	Unlikely	Low
			Provide spill cleanup kits								
			Provide means and guidelines for responsible disposal.								
Chemical exposure	Grouts	Personal exposure during application.	MSDS information is reviewed for correct PPE and controls.	Moderate	Rare	Medium			Moderate	Rare	Medium
	Cements		Users trained in the safe handling and use of chemicals.								
	Fuels										
	Construction compounds										
Explosive incident	Inadequate supervision	Fly rock hitting nearby structures or personnel.	Exclusion limit applies to the proximity of blasting near structures.	Moderate	Rare	Medium			Moderate	Rare	Medium
	Poor procedures		Adequate signage and security to warn and protect the public.								
	Poor signage and security		Persons to have completed a magazine operators course.								

Hazards	Factors	Impact	Project Description Controls & Standards Industry Practice	Risk With Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current			C	L	Mitigated Risk
Interaction between vehicles	Heavy/heavy	Worker safety impacts.	Security to limit the access to the site by normal vehicles.	Moderate	Rare	Medium			Moderate	Rare	Medium
	Heavy/light										
	Parking areas										
	Maintenance activities		Traffic management plan to be developed to outline traffic rules, vehicle safety equipment, parking, isolations, routes, communications, sight distances, speed, prestart checks, hot tyres and vehicle access.								
	Loss of control on slopes		Induction of all delivery drivers and/or escort provided								
Equipment roll over	Slopes on stockpiles	Worker safety impacts.	Equipment is fitted with FOPS and ROPS as required for clearing operations.	Moderate	Rare	Medium			Moderate	Rare	Medium
Vehicle collision or roads congestion	Road for material delivery is inadequate or collision with other vehicle/obstacle	Loss of life	Development of a Traffic Management Plan.	Minor	Unlikely	Low			Minor	Unlikely	Low
		Loss of equipment	Upgrade of roads.								
		Project disruption									
Construction zones inaccessible.	Construction staging may not provide for access around each site.	Damage to local environment by forced	The construction schedule and site planning will allow for access.	Minor	Unlikely	Low			Minor	Unlikely	Low

Hazards	Factors	Impact	Project Description Controls & Standards Industry Practice	Risk With Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current			C	L	Mitigated Risk
		access to the site.									
Personal injury gaining access to the site.	Difficult terrain.	Worker safety impacts.	Traffic management plan to be developed to outline traffic rules, vehicle safety equipment, parking, isolations, routes, communications, sight distances, speed, prestart checks, hot tyres and vehicle access.	Minor	Unlikely	Low			Minor	Unlikely	Low
	Traffic and vehicle issues.										
Injury traversing ground	Rough terrain	Muscle strains or other trip slip injuries.	Appropriate PPE for foot wear is worn for traversing rough terrain.	Minor	Unlikely	Low			Minor	Unlikely	Low
			Ground and working areas to be finished to a reasonable surface to reduce machinery breakdown and employee injury.								
Injury of person working alone.	Surveyors and other specialist teams/persons.	Exacerbation of initial injury.	Radio supplied.	Moderate	Rare	Medium			Moderate	Rare	Medium
			All remote operating light vehicles to have first aid kits and personnel are trained in first aid.								
			Ensure adequate budget allowance for PPE including hearing protection, respiratory protection, footwear and hearing conservation program, etc.								

Hazards	Factors	Impact	Project Description Controls & Standards Industry Practice	Risk With Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current			C	L	Mitigated Risk
			High visibility clothing required for worker identification								
Uncontrolled ground failure at creek crossings	Existing erosion conditions.	Localised damage to the environment.	Work method statements are to consider local conditions.	Minor	Unlikely	Low			Minor	Unlikely	Low
	Poor ground stability.	Construction worker exposure to falling ground or equipment.									
	Excess loads from construction equipment.										
Welding injury	Inexperienced welders or assistants.	Welding flash.	Experienced welders to be used.	Minor	Unlikely	Low			Minor	Unlikely	Low
	Inappropriate equipment.	Burns.	Correct equipment for welding.								
Dust	Vehicles	Environmental impacts.	Ensure adequate water trucks are provided for dust suppression.	Moderate	Rare	Medium			Moderate	Rare	Medium
	Blasting	Eye injury									
Excessive noise	Dozer operations	Hearing impairment or hearing loss.	Adequate budget allowance including hearing protection and hearing conservation program.	Minor	Unlikely	Low			Minor	Unlikely	Low
	Drill rigs										
Construction fires	Diesel exhaust	Equipment or asset damage or loss.	Extinguishers fitted to equipment.	Moderate	Rare	Medium			Moderate	Rare	Medium
	Sparks from blades hitting rocks.	Burns to personnel.									
Landslide	Inadequate excavation.	Construction safety impacts	Excavation with stable slopes.	Moderate	Rare	Medium			Moderate	Rare	Medium

Hazards	Factors	Impact	Project Description Controls & Standards Industry Practice	Risk With Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current			C	L	Mitigated Risk
Dam wall failure during construction	Flood during construction period.	Downstream public may be affected.	Emergency action plan to be development.	Moderate	Rare	Medium			Moderate	Rare	Medium
			Programming of works outside of high risk periods.								
Failure of diversion works.	Inadequate construction planning.	Uncontrolled release but manageable	Construction timed to occur during dry season.	Moderate	Rare	Medium			Moderate	Rare	Medium
			Sizing of coffer dams and diversion tunnels need to be optimized using the probability of flooding.								
Major flood during construction resulting in 'wash out'.	Unpredicted heavy rainfall event.	Loss of coffer dam and abutments	Construction timed to occur during dry season.	Moderate	Rare	Medium			Moderate	Rare	Medium
			Monitoring of the weather.								
Dam overtops before construction is complete.	Seasonal weather conditions.	Potential dam integrity compromised.	Prepare a flood plan in case the dam over tops before construction is complete.	Moderate	Rare	Medium			Moderate	Rare	Medium
			Adequate pumping capacity provided for clearing flood water.								
			Diversion conduit to have capacity to pass small floods, reducing likelihood of occurrence								
Health exposure from disease vectors.	Mosquitoes	Worker health and hygiene impacts.	There are no disease vectors other than mosquitoes identified in the area.	Moderate	Rare	Medium			Moderate	Rare	Medium
			Mosquito controls for high breeding areas.								
Health issues with food safety.	Poor food waste control.	Worker health and hygiene impacts.	Semi-permanent construction sites to have crib rooms with adequate refrigeration.	Minor	Unlikely	Low			Minor	Unlikely	Low
	Inadequate refrigeration.		Workers at mobile and temporary sites to have								

Hazards	Factors	Impact	Project Description Controls & Standards Industry Practice	Risk With Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current			C	L	Mitigated Risk
			portable coolers or non-perishable foods suitable to the weather conditions.								
Health issues with contaminated water.	Lack of clean water supply.	Worker health and hygiene impacts.	Semi-permanent construction sites to have crib rooms with adequate clean water supply.	Minor	Unlikely	Low			Minor	Unlikely	Low

Table 7: Risk Assessment – Dam Operation & Maintenance

Hazards	Factors	Impact	Project Description Controls & Standards Industry Practice	Risk With Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current			C	L	Mitigated Risk
Impacts on access and egress for emergency services.	Dam changes the travel routes for response.	Delayed response times to critical assets and people.	Roads will be relocated to provide required access.	Moderate	Rare	Medium			Moderate	Rare	Medium
			Discussions are required with emergency services to identify any route access issues.								
Damage to existing road infrastructure.	Construction equipment movements.	Environmental impacts.	Identifying the make good requirements.	Moderate	Rare	Medium			Moderate	Rare	Medium
	Deliveries to site.	Road safety impacts.									
		Construction issue risk.									
Sudden "sunny day" failure of dam.	Structural Failure	Delayed release of water followed by a surge downstream with wall of water and subsequent loss of life.	Design according to category of installation determined by Failure Impact assessment according to ANCOLD standards.	Catastrophic	Rare	Medium			Catastrophic	Rare	Medium
	Poor maintenance		Use of failsafe design principles								
	Inadequate design/ construction		Regular maintenance								
	Foundations eroding		Develop Emergency Action Plan								
Dam overtopping	Design estimation of the Probable Maximum Flood (PMF) too low - resulting in flood bigger than	Dam rim erosion, leading to dam failure, sudden release and loss of life	Design estimation of the Probable Maximum Flood (PMF) too low - resulting in flood bigger than design parameters occurring	Moderate	Rare	Medium	Emergency action plans to cater for around 18 hours of inundation warning and	Significant	Moderate	Rare	Medium

Hazards	Factors	Impact	Project Description Controls & Standards Industry Practice	Risk With Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current			C	L	Mitigated Risk
	design parameters occurring cyclonic activity leading to flood		Use guidelines on Selection of Acceptable Flood capacity for Dams, by ANCOLD Hydrological modelling. Develop Emergency Action Plans in conjunction with Emergency Departments.				include flood warning devices such as upstream river level and rainfall gauges in order to increase warning time.				
Reservoir landslide	Slope too steep	Wall of water over top of dam, dam rim erodes, dam failure leading to loss of life	Quality assurance performed on geotech investigations Ensure slopes are stable with rocks/vegetation	Minor	Unlikely	Low			Minor	Unlikely	Low
	Lack of stability										
	Inadequate geotech investigation										
High Pressure	Pump operating against closed valve(s).	Pipe line failure	Operating procedures	Moderate	Rare	Medium			Moderate	Rare	Medium
	Water hammer from closure of vacuum after a pump stoppage.	Water hammer may over pressurize the pipe.	Design to consider the safety system (such as key interlock for the valve and pump start system) to ensure valves are open prior to restarting the pump after maintenance.								
			Pipeline design can consider surge tanks at high points with non-return valves to fill the pipe when under vacuum.								

Hazards	Factors	Impact	Project Description Controls & Standards Industry Practice	Risk With Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current			C	L	Mitigated Risk
Water Contamination	Loss of pipeline lining materials.		Adequate operating and maintenance procedures.	Minor	Unlikely	Low			Minor	Unlikely	Low
	Commissioning, maintenance debris.		Design to consider screens at inlet to pumps to catch deposits and foreign objects.								
Ground contamination along the pipeline	Maintenance activities.	Environmental impact	Poor weed control	Minor	Unlikely	Low			Minor	Unlikely	Low
	Oil spills		Controls as noted elsewhere in the EIS.								
	Poor weed control										
Leaks/Rupture	Chaffing of pipes from rocks.	Land erosion from water flows.	Site survey undertaken.	Moderate	Rare	Medium			Moderate	Rare	Medium
	Corrosion from soil type.	Land erosion from water flows.	Permits and safety by design risk studies.								
		Potential impacts to road infrastructure at road crossings.	Potential to use cathodic protection for the pipeline.								
			dependent welding QA checks as defined in the design.								
Fire/explosion	Transformer stations and control room fires.	Building damage	Adequate clearance of vegetation around the switch yards.	Minor	Unlikely	Low			Minor	Unlikely	Low

Hazards	Factors	Impact	Project Description Controls & Standards Industry Practice	Risk With Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current			C	L	Mitigated Risk
	Grass fires.	Ignition source for bushfire.	Confirming that all firefighting equipment is provided to support the use of water from the pump stations.								

Table 8: Risk Assessment –Pipeline operation and Maintenance

Hazards	Factors	Impact	Project Description Controls & Standards Industry Practice	Risk With Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current Risk			C	L	Mitigated Risk
High Pressure	Pump operating against closed valve(s).	Pipe line failure	Operating procedures	Moderate	Rare	Medium			Moderate	Rare	Medium
	Water hammer from closure of vacuum after a pump stoppage.	Water hammer may over pressurise the pipe.	Design to consider the safety system (such as key interlock for the valve and pump start system) to ensure valves are open prior to restarting the pump after maintenance.								
			Pipeline design can consider surge tanks at high points with non-return valves to fill the pipe when under vacuum.								
Water Contamination	Loss of pipeline lining materials.		Adequate operating and maintenance procedures.	Minor	Unlikely	Low			Minor	Unlikely	Low
	Commissioning, maintenance debris.		Design to consider screens at inlet to pumps to catch deposits and foreign objects.								
Ground contamination along the pipeline	Maintenance activities.	Environmental impact	Maintenance procedures and testing.	Minor	Unlikely	Low			Minor	Unlikely	Low
	Oil spills		Controls as noted elsewhere in the EIS.								
	Poor weed control										

Hazards	Factors	Impact	Project Description Controls & Standards Industry Practice	Risk With Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current Risk			C	L	Mitigated Risk
Leaks/Rupture	Chaffing of pipes from rocks.	Long term failure of pipe.	Site survey undertaken.	Moderate	Rare	Medium					
	Corrosion from soil type.	Land erosion from water flows.	Permits and safety by design risk studies.								
		Potential impacts to road infrastructure at road crossings.	Potential to use cathodic protection for the pipeline. Independent welding QA checks as defined in the design.								
Fire/explosion	Transformer stations and control room fires.	Building damage	Smoke detection in buildings	Minor	Unlikely	Low			Minor	Unlikely	Low
	Grass fires.	Ignition source for bushfire.	Adequate clearance of vegetation around the switch yards. Confirming that all fire fighting equipment is provided to support the use of water from the pump stations.								
Maintainability issues	Lack of access to inside of tanks.	Poor reliability and asset utilization.	Maintenance manuals are required.	Minor	Unlikely	Low			Minor	Unlikely	Low
	Lack of visibility of site.	Manual handling issues	Trouble shooting guide included in the specification.								
	Lack of access to inside of the pipe.	Environmental water release.	Design considers the requirements for pigging.								
	Lack of pigging operations access.										

Hazards	Factors	Impact	Project Description Controls & Standards Industry Practice	Risk With Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current Risk			C	L	Mitigated Risk
Public access during maintenance periods.	Interest of general public.	Public safety impacts.	Locking out of public during maintenance. Security fencing to restrict public entry to dangerous areas during maintenance periods.	Moderate	Unlikely	Medium			Moderate	Unlikely	Medium
Discharge during commissioning	First fills of pipeline.	Large quantity of water involved at each stage.	Commissioning plan required for the pipeline to support the description of project information.	Moderate	Rare	Medium			Moderate	Rare	Medium
	Removal of first flush.										

3. Identification of Potential Emergency Scenarios and Response measures

An emergency is an unforeseen situation that threatens employees, the public, disrupts or shuts down operations, or causes physical or environmental damage. Prompt action is required to control and correct the occurrence as well as return operations to a safe condition. Hazard identification and risk assessment shall be a continuous process to accommodate changes in compact project implementation and operations.

The following risks have been identified as key in respect to the implementation of CDAT Sub-Projects. This includes the following:

No	Possible Risks	Risk Cause
1	Medical Emergencies	Injury (Incident& Accident)
2	Fire and Evacuation Emergency	Electrical, Fuel, etc...causing fire outbreak
3	Earthquakes	Dam crack down
4	Floods	Heavy rain or dam failure
5	Shocks/Electrocution	Electricity installations
6	Hazardous materials	Storage of Chemical, Oils & other contaminants
7	Rescue of Fallen workers	Accident/Incident
8	Confined space rescue	Crush, escape, etc...

3.1. Medical Emergency

A medical emergency may arise from the following:

- Injuries due to events such as structural collapse, fire, explosion, hazardous material exposure, electrocution, trips, slips and falls, manual handling etc.
- Exposure to heat as well as poor ventilation
- Fatigue and stress
- Medical condition such as heart attack, allergies, pregnancy related conditions, asthma or other respiratory infection etc.
- Natural event such as earthquakes, flood.
- Disease outbreak and epidemics such as cholera, Covid-19, meningitis etc.

In an event of a medical condition, the following should be followed”

- Stay Calm
- Dial the appropriate CDAT Project emergency contacts provided as soon as possible and explain the type of emergency, the location, condition, and number of victims. You must also contact the First Aid attendant/Emergency Personnel for assistance (*Refer to Attachment 1: Emergency Contact List Sample in the Appendix on page 17*).
- Do not move the victim unless there is danger of further injury if s/he is not moved.
- Render first-aid or cardiopulmonary resuscitation (CPR) only if you have been trained.
- Do not leave the injured person except to summon help.

- Comfort the victim until emergency (medical) services team contacted arrive and have someone stand outside the building to flag down the ambulance or rescue emergency service when they reach the vicinity.
- Provide Medical Care to the injured person immediately

3.2. Fire Safety & Evacuation

Fire in the workplace may be caused by the following:

- Faulty Electrics at the workplace.
- Frequent power outages could lead to burning of office equipment and fire outbreaks.
- Flammable or combustible materials.
- Human Error such as knocking liquid onto electrical equipment, spilling flammable or combustible liquid.
- General negligence.
- Arson
- System Overload

This emergency procedure is to protect employees on project sites (Camp Site, Office, Storages) and Site office from harm and property from damage by minimizing the effects of fire and fire hazards.

Fire Plans will be displayed on the Notice Boards at CDAT Project offices and CDAT Sub-Project on sites. The Plan will include the following;

- *Fire Evacuation Routes*
- *Emergency or Fire Assembly Point*
- *Fire Alarm Location*
- *Fire Fighting Equipment Location*
- *Fire Alarm System*
- *Emergency contact information of the following in the case of an emergency (Example: Police, Nearest Hospital, Fire service, CDAT Project Site Manager, ESP team).*

3.2.1. Fire Safety Plan & Requirements

- Fire Site plan shall be developed for CDAT projects and sub-activities by contractors. Rescue, recovery and emergency response plans and specified equipment developed from a review of potential emergency scenarios must be in place before commencement of any Sub-Project activities and operation.
- When a team/implementing entity/consultant are mobilized on a project, Team Leads and HSE Officer/Specialist shall be involved in the emergency plans as their knowledge on the project will enhance emergency response.

- If fire is small and you are confident you can safely put it out, extinguish fire with the Correct Fire Extinguishers provided at the CDAT Offices and Sub-Projects on site. When in doubt or fire does not extinguish, evacuate building immediately.
- Fire procedures and plan shall be amended in the revision and review log book if there are any changes. Example, the change type and the new corrective action in place.

The Environmental and Social Safeguards team (ESS) and Human Resource (HR) and Contractors must ensure that adequate firefighting equipment (Fire extinguishers) are maintained at CDAT offices and Sub-Project sites and are clearly marked. Fire extinguishers and other equipment are located on all the corridors of the office. Project emergency personnel shall be conversant with the operation of all fire safety equipment. Fire extinguishers must be inspected regularly by the Safeguards maintenance officer, CDAT Project emergency personnel and a competent person.

Details of the fire extinguishers available for specific fire classes include;

- A dry chemical powder extinguisher for fires involving flammable and combustible liquids, gases, energized electrical equipment, paper and wood.
- Water can be used to extinguish wood and paper fires.
- Carbon dioxide extinguisher for fires involving energized electrical equipment.
- Combustible materials within the vicinity where sparks and heat are generated should be carefully controlled.

3.2.2. Fire Prevention and Means of Egress

- Employees will switch off electrical equipment when not in use, particularly at the close of work.
- Waste materials and office rubbish should be managed in a way to minimize fire risk and other risks.
- The entire building and offices as well as project site shall be a smoke free zone.
- Building exits routes will be clearly marked with directional signs. All exit areas will be clear of obstructions of any kind to allow unimpeded escape routes.
- Fire exit doors should not be locked. Employees will be able to evacuate building quickly and easily without any obstruction.

3.2.3. Fire Emergency Procedures

- On finding a fire, emergency personnel must immediately raise the alarm. This should be done by means of the nearest break glass call point.
- Rescue: Any Person(s) in immediate danger provided it is safe to do so.

- Alarm: Raise the alarm. When Fire alarm is alerted, evacuate premises immediately by the shortest route and make your way to the designated assembly point. Escape routes and assembly point shall be indicated in SPIU Head office and project sites.
- Contain: Contain the fire by closing doors and windows provided it is safe to do so.
- Extinguish: Attempt to extinguish fire, only if you are trained and if it is safe to do so. Furthermore, you shall alert the trained emergency personnel to assist in extinguishing the fire.
- Emergency personnel should lead employees to the designated assembly point and assist those who need help to exit and must ensure fire doors in the area are closed. At the assembly point Emergency personnel must look out for individuals missing by conducting roll call.

3.2.4. Earth Tremors/ Earthquake

East African Region was heated by a destructive Earthquake of 4.7 Magnitude in MAY 25th 2022. The recent one heated the Eastern DRC that is bordering Rwanda with Rubavu District at 16Km, Musanze District at 41Km, Muhanga at 54Km, Rusizi at 95Km and Kigali City at 78 Km from the Epicenter. It is common in Rwanda.

The last major earthquakes occurred in September 1960, October 2002, and the very recent one of 2021. Various minor earth tremors shook the east African and Rwanda. This could be disaster if the Dam is not well constructed.

If the CDAT offices or Camping sites are located in an area that has been identified as an earthquake prone zone. In the event of an earthquake, the following must be observed:

- Stay away from large windows, shelving systems, or tall room partitions.
- Get under a desk, table, door arch, or stairwell.
- If none of these is available: move against an interior wall and cover your head with your arms.
- Remain under cover until the movement subsides.
- After the shaking stops, survey your immediate area for trapped or injured persons and ruptured utilities (water, electric wires, etc.)
- If damage has occurred in your area, contact Rwanda National Disaster Management Ministry –MINEMA and other emergency services (*Refer to Attachment 1-Sample*)
- Do not evacuate until instructed by emergency personnel. If it is safe to do so, remain at your location and await further instructions from emergency personnel and emergency rescue team.
- If out in the open:
 - Stay in an open area away from buildings, power lines, trees or roadways.

- If in a car, pull over and stop. Do not park under an overpass or near a building. Be cautious about driving again, in the event roads are damaged.
- After an earthquake:
 - Put on enclosed shoes to protect against broken glass.
 - If the power is out use a flashlight. Do not light a match or candle.
 - Be alert for safety hazards such as fire, electrical wires, gas leaks, etc.
 - Check on others. If there are injuries or other urgent problems, report them to emergency personnel/first aid attendant present.
 - Give or seek first aid. Assist any disabled persons in finding a safe place for them.
- Evacuate if the building seems unsafe or if instructed to do so:
 - Use stairs, not elevators.
 - Unplug small electrical appliances.
 - Bring keys, purses, wallets, warm clothing.
 - Be prepared for aftershocks.
 - Cooperate with emergency personnel, keep informed, and remain calm.

3.3. Floods

Flooding in Rwanda is a common phenomenon during heavy rains. The SPIU Safeguards team in collaboration with the Human Resource team and emergency personnel will provide regular updates of such incidents based on meteorological reports/weather news. CDAT Project Consultants and Contractors will be required to provide such period updates at their respective Project sites. For imminent or actual flooding, and only if it is safe to do so:

- Secure vital equipment, vehicles, records, and other important document.
- If present in your area, report all hazardous materials (chemical, biological, and/or radioactive) to Emergency warden or personnel.
- Move to higher, safer ground.
- Shut off all electrical equipment.
- Do not attempt to drive or walk through flooded areas.
- Wait for further instructions on immediate action from emergency personnel or warden.
- If you are assisting with flood cleanup, report immediately to Environmental and Social Safeguards team and experts on field chemical or radioactive materials suspected of mixing with flood waters.

3.4. Electric shock/ Electrocutation

In the event a CDAT Project staff or Sub-Project site employee is electrocuted, the following steps must be taken when such an incident is encountered.

3.4.1. Establish a safe area and contact the first aid attendant/emergency Personnel

- Rushing in to save someone might be your first impulse, but if the danger of electrical shock remains you will only injure yourself as well. In the event an employee encounters such an incident, immediately alert the first aid attendant/emergency personnel.
- Take a moment to assess the scene and look for any obvious dangers and secure the area to prevent further injuries to other persons.
- Check for the source of the electrical shock. Look to see if the victim is still in contact with the source. Remember that electricity can flow through the victim and into you.
- Never use water, even if there is a fire, as water can conduct electricity.
- Never enter an area where electrical equipment is used if the floor is wet.

3.4.2. Shut off the electric current

If you can do so safely, turn off the electrical current. Don't attempt to rescue someone near a high-voltage line. Shutting off the current at the power box, the circuit breaker or the fuse box is the preferred option. Follow these steps to turn the power off with a circuit breaker box:

- Open the circuit breaker box. Look for a rectangular block, with a handle, at the top of the fuse box.
- Grab the handle and flip it to the other side, just like a light switch.
- Try turning on a light or other electrical device to double check the power is off.

3.4.3. Call emergency services

- It is very important that you call as quickly as possible for help. The sooner you call; the sooner help will arrive. Explain your situation as calmly and clearly as you can when you make the call.
- Explain that the emergency involves an electrical shock so the responders can be best prepared.
- Speak clearly. Emergency services will need accurate and clear information. Speaking too quickly might lead to misunderstanding, which can waste valuable time.

3.4.4. Separate the Victim from the source

- Don't touch the victim, even with a non-conducting instrument, if the electricity hasn't been shut off. Once you're sure there is no current, use a rubber or wooden stick, or any other non-conducting tool, to separate the victim from the source. Examples of non-

conducting materials include wood, glass, porcelain, plastic and paper. Cardboard is another common, non-conducting material that you may use.

- Conductors which allow electricity to flow include copper, aluminum, gold and silver, and anything that is wet, even if it is a non-conductor when dry.

3.4.5. Record Incident into the accident/ incident form

- Obtain and record relevant information relating to the electric shock incident.
- You must provide the name and other detail information of the person to the rescue service or medical facility, the nature of injury and documented detail of the shock.

3.5. Hazardous Materials.

Compact projects team lead must ensure compliance with local laws and international requirements applicable to the transport and management of hazardous materials.

Procedures for transportation of hazardous materials should include:

- Proper labeling of containers including identity and quantity of contents and potential hazards must be indicated.
- Exit and entry routes for the transportation of hazardous materials must be marked.
- Training employees involved in the transportation of hazardous materials regarding proper procedures and emergency procedures.
- Hazard identification and risk assessment should identify the potential hazard involved in transportation.
- Hazardous substances must be identified as well as existing criteria for the transportation of hazardous materials including environmental management systems.
- Marking and labeling of packages containing hazardous materials.

Minor Spill:

- A minor spill is characterized by the following criteria:
- Is inside an office, project site (within a confined space) and has not spread outside specified area.
- Did not result in fire or explosion, nor presents a risk for a fire or explosion and
- Did not result in personnel requiring medical attention

Minor Spill Clean Up:

- Alert people in the immediate area of the spill
- Put on appropriate PPE.
- Contain the spill with absorbent material

- Place the absorbed spill material in secondary containment such as spill bucket. Label container and notify the ESP team and experts to pick up container.
- Completely clean area where spill occurred
- Dispose of contaminated PPE properly

Major Spill: A major spill is characterized by all the following criteria:

- Results in a fire, explosion, or release of toxic gas, or presents a risk for a fire, explosion, or gas release;
- Results in personnel requiring medical attention;
- Is not contained within the office or project site only but beyond; or
- Is characterized as a major spill by the Emergency personnel

Major Spill or Leak

- Remove any injured or contaminated persons if you can do so safely
- Contact the emergency service and stand by in a safe location
- Remove all contaminated clothing, shoes etc. Use clean water to shower if one is nearby. Seek medical attention if you have been exposed. Do not attempt to clean up a major spill on your own. Leave it to experts.

3.6. Rescue of a Fallen Workers

When a worker falls and is suspended in a harness, it's important to rescue him or her as quickly as possible because of the following reasons.

- The worker may have suffered injuries during the fall and may need medical attention.
- When workers are suspended in their safety harnesses for long periods, they may suffer from blood pooling in the lower body. This can lead to suspension trauma.
- Suspended workers may panic if they are not rescued quickly.
- The event that led to the fall may create additional risks that need to be addressed.

Planning

- All site personnel must attend a site-specific safety training session where they will review emergency response procedures and receive instruction on alarms and assembly areas.
- Train a designated crew to perform the rescue. This crew must know how to use the equipment that is available to them at the jobsite and where they can find it. They should review the rescue procedure every two weeks with the crane crews.

Emergency Response Plan

If a worker falls and is suspended by a safety harness, implement the emergency response plan by following the steps below.

Note: It's important to know your role.

1. The site supervisor (or alternate foreperson) takes control of the situation.
2. The site supervisor sounds the emergency alarm—two long blasts from a horn. All workers in the immediate vicinity of the incident stop working. The site supervisor quickly evaluates the situation and identifies any further hazards that could arise.
3. The site supervisor or their designate goes to get help if workers are close by. If no one is close enough, the site supervisor calls for help.
4. The site supervisor calls notify local police, fire, and ambulance if required.
5. The crane operator remains on standby. The operator frees the hook and waits for further direction in case the designated rescue team must perform a basket rescue.
6. The site supervisor (or a worker assigned to the task) isolates the accident zone and its perimeter to limit further exposure.
7. The site supervisor (or a worker assigned to the task) moves all non-affected personnel to a safe zone or directs them to remain where they are.
8. The site supervisor sends a designated worker to the site gate to meet the response team (police, medical, fire, etc.) and ensure that they have a safe access path to the accident scene.
9. The site supervisor assembles the emergency rescue team at the accident site as quickly as possible to determine the best rescue procedure for the situation.

Emergency Rescue Plan

Please adhere to the procedures in using any of the following methods identified below;

- If an Elevating Work Platform (EWP) is available on site and the suspended worker can be reached by the platform.
- If an elevating work platform is not available, use ladders to rescue the fallen worker.
- If the fallen worker is suspended near a work area and can be safely reached from the floor below or the area from which they fell do so.
- If a worker has fallen and is suspended in an inaccessible area, you may need to perform a basket rescue.

Post-Rescue Procedure

All non-affected workers should remain in the designated safe gathering zone until the site supervisor notifies them to do otherwise.

The site supervisor and health and safety representative should

- Begin the accident investigation.
- Quarantine all fall-arrest equipment that may have been subjected to fall fatigue effects and/or shock loading for further investigation.
- Secure the area (the OSHA requires that an accident scene not be disturbed where a fatal or critical injury has occurred).
Determine whether or not the jobsite-specific rescue and evacuation plans were followed as designed.
- Record modifications or additions to the plans that the rescue team deems necessary.
- Record all documented communications with fire, police, and other contractors involved.
- Record all documented statements from employees, witnesses, and others.
- Save all photographs of the incident.

Record all key information such as dates, time, weather, general site conditions, and specific accident locales including sketches of the immediate incident area, complete with measurements if applicable.

3.7. Confined Space Rescue

Confined space have limited means for entry or exit and may include, pits, tanks, pipes, sewers, manholes, tunnels, equipment housings, and ductwork. Excavation, ditches and trenches may also be a confined space when access or egress is limited.

Some incidents in confined space may require confined space rescue and may include, fire hazard, electrical shocks, shifting or collapse of materials, moving parts of equipment, slips, falls, and radiation, barrier failure resulting in a flood or release of free flowing solid among others.

- Emergency rescue teams must be available while authorized entrants are in the confined space.
- Deaths often occur during rescue. Employees attempt to rescue an entrant without the proper training and then get caught themselves in the confined space.
- Non-entry – Rescue that is conducted without entry into the confined space. This can be conducted by such means as a rope or winch.
- Entry by others – some companies do not have trained personnel for emergency rescue. They depend on others to conduct emergency rescues such as the Rwanda National Police Fire Brigade.
- Entry by Trained employees from the company – some companies have trained personnel within the company to conduct rescues.

In this case:

- All members of the team must be specially trained in confined space rescue work,
- The team must have at least one member certified in CPR and first aid,
- All members of the team must be trained in the techniques and equipment for specific confined spaces.

- If a rescue is required, the rescue service must close off the area, get authorized entrants out of the space and perform first aid when needed.
- It is best to use a retrieval system to bring the employee out of the space. Never enter the space without proper training and authorization to rescue a co-worker who is trapped.
- Authorized entrants should wear harnesses connected to the retrieval line. The retrieval equipment must be in place before employees enter the permit space.
- Necessary rescue equipment should be available such as harness, ropes, respirator, tripods, wenchers, ventilation system, logout and tagout etc.
- Each confined space must be evaluated to determine what type of equipment is required to perform a rescue should it become necessary.
- If outside resources, such as Private Emergency Rescue Service Fire Brigade (Rwanda National Police.), are utilized to perform confined space rescues, the agency should be given access to your facility to enable them to:
 - Be aware of the types of confined spaces you have
 - Determine the types of equipment and rescue techniques they will need to perform a rescue.

3.8. Emergency Response Procedures

In the event of an emergency on a field trip to project site or other off-site EHS, Environmental and Social Safeguards Officer, CDAT Project will provide the following emergency service contact information (*Refer to Attachment 1-Sample*) for staff and partners;

Police shall be contacted in the event of burglary or armed robbery, road accident among others.

In the Event of a medical emergency and other rescue emergency, a private emergency service provider shall be contracted by CDAT Project to provide such emergency service.

In the event of any emergency, employees shall contact the Emergency response team at SPIU Safeguard Team. The team will then communicate and coordinate with the relevant emergency service provider to provide relief to affected staff (*Refer to Attachment 1- Sample*).

The roles and responsibilities of the emergency response team include;

3.8.1. First Aid Attendant

- When contacted, go to the scene as quickly as possible
- Assess and control any hazards and area where incident has occurred
- Administer first aid and call the emergency medical services
- Report relevant information to the emergency team present
- Record incident/accident in the incident/Accident Reporting Form
- Meet with the ESS team and other first aid attendant and debrief team after any emergency.

3.8.2. Emergency Personnel

- During an evacuation and emergency, lead employees through the appropriate exit routes
- Conduct roll call at the designated assembly point of visitors and employees
- Ensure the Receptionist has the visitors log book field
- Provide the needed assistance during an emergency if it is safe to do so.

3.8.3. Roles and Responsibilities for Emergency Coordination

- Environmental and Social Safeguards Staff shall inform the SPIU Environmental and Social Safeguards Unit and Site Emergency Response team of all planned field visits for projects and other off-site official assignment for effective emergency response coordination. During implementation, a project wide emergency response team shall be established by SPIU Safeguards Unit Team. This shall comprise of representatives of Emergency response team, contractors and relevant Implementing Entities as necessary.
- Emergency Contact details shall be provided by CDT Project emergency preparedness and response team to all CDAT staff prior to embarking on official CDAT Project engagements. In case of any emergency out on the field, CDAT staff will be required to contact the emergency response team at CDAT for emergency response coordination and relief.

Table - 9: Roles and Responsibilities for emergency Coordination and Relief

Emergency	CDAT Office	Project Site
CDAT Employee	<ol style="list-style-type: none"> 1. The Staff calls emergency response team at CDAT Project office onsite. 2. The emergency response team shall communicate and coordinate with the relevant emergency service provider immediately. The team will provide initial first aid relief to the affected person while coordinating with the service provider. 	<ol style="list-style-type: none"> 1. A staff on the scene of the incident calls a member of the emergency response team at project site to attend to the affected person. 2. The emergency response team member at the project site shall communicate and coordinate with the relevant emergency service provider for further assistance <p><i>CDAT emergency response team shall be informed of the emergency for follow-up and necessary action</i></p>

Contractors and other CDAT Project contracted consultants	<ol style="list-style-type: none"> 1. The Staff calls emergency response team. 2. The emergency response team shall communicate and coordinate with the relevant emergency service provider immediately. The team will provide initial first aid relief to the affected person while coordinating with the service provider. 	<ol style="list-style-type: none"> 1. A staff on the scene of the incident calls a member of the emergency response team at project site to attend to the affected person. 2. The emergency response team member at the project site shall communicate and coordinate with the relevant emergency service provider for further assistance
General Public	<ol style="list-style-type: none"> 1. The Staff or individual calls emergency response team at SPIU Office. 2. The emergency response team shall communicate and coordinate with the relevant emergency service provider immediately. The team will provide initial first aid relief to the affected person while coordinating with the service provider. 	<ol style="list-style-type: none"> 1. A staff on the scene of the incident calls a member of the emergency response team at project site to attend to the affected person 2. The emergency response team member at the project site shall communicate and coordinate with the relevant emergency service provider for further assistance

4.0. Training programs and emergency drills

4.1. Training and Capacity Building Programs and Drills

Training and capacity building programs will provide employees with good understanding of human factors, aspects of health and safety, risk management etc. Employee training shall include HSE Policies and Procedures, ERP, physical and mental limitation of people and the potential of human error, individual roles and responsibilities, hazard identification, risk assessment and management and corrective actions, communication procedures, checklist and templates.

Continuous training by the ESS team shall be provided to SPIU ESS staff, consultants, contractors, implementing entities and relevant stakeholders on the EPRP to promote awareness of emergency protocols and inform them of the procedures. This training shall be organized once a month. Emergency and Evacuation drills shall be conducted twice every Month in collaboration with Specialist in OHS where CDAT Project Office is located. Toolbox meeting shall be done regularly at CDAT Project and every identified project site.

Sub-Project first aid and emergency personnel will provide first aid assistance in case of an emergency. The team will also ensure that employees are safely evacuated during fire evacuation and when there is need to evacuate building due to other emergencies. The team shall be provided with the needed training and certification to perform their duties effectively. First aid and emergency personnel shall meet once every month (Refer to Attachment 1: Emergency Contact List in Appendix for list of First aid and emergency personnel,). Emergency service provider shall

be procured by CDAT for first aid training, fire control procedures and evacuation and other emergency response procedures.

Since theft and burglary is a common phenomenon, security training and tips shall be provided for staff. Security notices shall be sent via email to caution staff on such incidents. Furthermore, such incidents must be reported to emergency personnel and HR team for next steps and action.

Fire and emergency response drills shall be held twice in a year. This is to allow testing of equipment and logistics as well as testing emergency contact lists and communication procedures.

Fire and emergency drills shall be organized by a contracted emergency service provider at MiDA premises.

All training programs and drills shall be recorded and maintained by the ESP team and HR Manager.

3.2. Emergency Equipment and Resources

CDAT Project will ensure adequate and efficient emergency response resources are available and at all times. The following table provide illustrative list of emergency preparedness and response resources that must be available at CDAT Project Level and in every component Project Site.

Basic firefighting equipment such as fire extinguishers, fire bucket, fire water pump, fire blankets
First aid kit for Site & Camping sites and offices, first aid backpack for trips to project sites
Stretcher, basket or wheelchair for moving injured persons
Personal Protective Equipment (PPE)
Emergency Vehicle on project site and Offices
Notice Board, Framed HSE policy statement in CDAT Offices and Project sites
Emergency Service Contact list
Trained First Aid Attendants and Emergency Personnel
Signage for information such as signs, cones, drums, illumination devices, accident protection barriers etc.
Emergency Evacuation Plans
Clean water for eyes and emergency showers
Emergency institution to provide training and rescue services on all project sites and CDAT Offices

CDAT Project Fire extinguishers, fire water pump and fire alarm system are located on the corridors of the office.

Adequate first aid supplies shall be made available and the location of the kit shall be visibly marked. The HSE Officer/ESS Staff will check periodically to ensure that first aid contents are complete and replenish items when necessary.

PPEs shall be made available for all staff of CDAT for field site visits. PPE and First Aid Backpack for field trips shall be located in the Office of the Environment and Social Specialist Unit at the SPIU.

Project Emergency Evacuation plan, Emergency service contact details and HSE Policy are located in the all offices (Reception, Main Office).

3.3. Identification of Evacuation routes and Assembly Points

CDAT Project Management and the HR team shall ensure that adequate emergency access and egress is available to all Project staff.

An appropriate emergency evacuation assembly point shall be designated on project site and communicated to all personnel during site induction and toolbox meetings.

3.4. Emergency Contacts and Communication Procedures

During an emergency, CDAT Project will use the following mode of communicate to staff and partners wherever possible:

- Landline Telephones
- Mobile Phones
- Short Message Service (SMS)/Text message
- Evacuation Siren/alarm
- Email.
- WhatsApp

The Human Resource (HR) team, emergency personnel and ESS team are responsible for communicating emergency information via these selected communication methods. Emergency contact notification will available to CDAT staff including drivers and project site (***Refer to attachment 1-Sample***). Emergency personnel at the CDAT Project office and project site managers shall have the list of names of all CDAT Project staff and other stakeholders (***Refer to attachment 2 - Sample***). Visitors must sign in and out of project site or Project & Sub-Project offices per each visit. (***Refer to attachment 3-Sample***). The emergency personnel shall have record of personnel register taken to the assembly point in the event of an evacuation to conduct roll call.

Media Inquiries

Inquiries from the media during and after an emergency will be addressed by CDAT Project communication team. The communication director will be consulted in releasing any such information to the media.

3.5. Review and revision of ERP to reflect changing conditions

The ERP shall be reviewed and updated by ESS team in consultation with staff and partners annually from date of inception to implementation and when significant changes occur in project operation and process. With minor changes, the ERP can be easily adapted to specific project sites and readily implemented. Any suggestions, comments or questions should be directed to the ESS team. All changes/updates/revision should be recorded in the record of change document (***Refer***

to Attachment 4 - Sample). Health, safety and environment (HSE) inspection shall be done by ESS team every month in SPIU Office & Sub-Project offices & Camping sites and project sites to ensure emergency and disaster risk mitigation measures are adequate and working to enhance the health and safety of women and men beneficiaries.

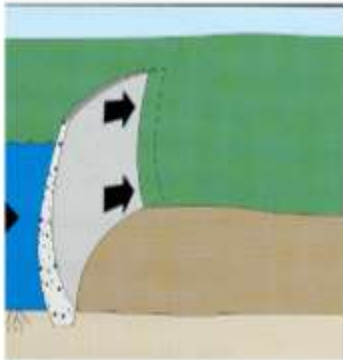
4.0. Dam Safety and Response plan

4.1. Dam basics

The purpose of a dam is to impound (store) water, wastewater or liquid borne materials for any of several reasons, such as flood control, human water supply, irrigation, livestock water supply, energy generation, containment of mine tailings, recreation, or pollution control. Many dams fulfill a combination of the above functions.

Manmade dams may be classified according to the type of construction material used, the methods used in construction, the slope or cross-section of the dam, the way the dam resists the forces of the water pressure behind it, the means used for controlling seepage and, occasionally, according to the purpose of the dam.

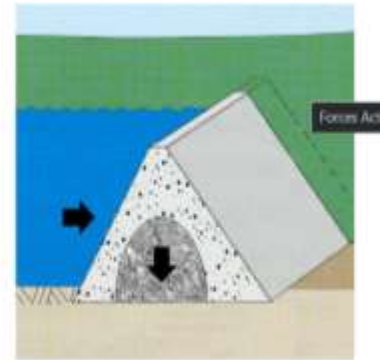
The materials used for construction of dams include earth, rock, tailings from mining or milling, concrete, masonry, steel, timber, miscellaneous materials (such as plastic or rubber) and any combination of these materials



Forces Acting on an Arch Dam



Embankment Dam



Forces Acting on an Embankment Dam

4.2. Types of Dams

Embankment Dams: Embankment dams are the most common type of dam in use today. Materials used for embankment dams include natural soil or rock, or waste materials obtained from mining or milling operations. An embankment dam is termed an “Earthfill” or “Rockfill” dam depending on whether it is comprised of compacted earth or mostly compacted or dumped rock. The ability of an embankment dam to resist the reservoir water pressure is primarily a result of the mass weight, type and strength of the materials from which the dam is made.

Concrete Dams: Concrete dams may be categorized according to the designs used to resist the stress due to reservoir water pressure. Three common types of concrete dams are: **gravity**, **buttress** and **arch**.

Gravity: Concrete gravity dams are the most common form of concrete dam. The mass weight of concrete and friction resist the reservoir water pressure. Gravity dams are constructed of vertical blocks of concrete with flexible seals in the joints between the blocks.

Buttress: A buttress dam is a specific type of gravity dam in which the large mass of concrete is reduced, and the forces are diverted to the dam foundation through vertical or sloping buttresses.

Arch: Concrete arch dams are typically rather thin in cross-section. The reservoir water forces acting on an arch dam are carried laterally into the abutments. The shape of the arch may resemble a segment of a circle or an ellipse, and the arch may be curved in the vertical plane as well. Such dams are usually constructed of a series of thin vertical blocks that are keyed together; barriers to stop water from flowing are provided between blocks. Variations of arch dams include multi-arch dams in which more than one curved section is used, and arch-gravity dams which combine some features of the two types of dams.

4.3. Dam Failures and Incidents

4.3.1. Understanding Dam Failures

Hundreds of dam failures have occurred in many countries. These failures have caused immense property and environmental damages and have taken thousands of lives. As the nation's dams age and population increases, the potential for deadly dam failures grows.

"In order to improve public safety and resilience, the risk and consequences of dam failure must be lowered. Progress requires better planning for mitigating the effects of failures; increased regulatory oversight of the safety of dams; improving coordination and communication across governing agencies; and the development of tools, training, and technology. Dam failures not only risk public safety, they also can cost our economy millions of dollars in damages. Failure is not just limited to damage to the dam itself. It can result in the impairment of many other infrastructure systems, such as roads, bridges, and water systems. When a dam fails, resources must be devoted to the prevention and treatment of public health risks as well as the resulting structural consequences."

4.3.2. The causes of Dam Failures

Dam failures are most likely to happen for one of five reasons:

1. **Overtopping** caused by water spilling over the top of a dam. Overtopping of a dam is often a precursor of dam failure. Statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for approximately dam failures.
2. **Foundation Defects**, including settlement and slope instability, cause about 30% of all dam failures.
3. **Cracking** caused by movements like the natural settling of a dam.
4. **Inadequate maintenance and upkeep.**
5. **Piping** is when seepage through a dam is not properly filtered and soil particles continue to progress and form sink holes in the dam. [See an animation of a piping failure.] Another 20% of U.S. dam failures have been caused by piping (internal erosion caused by seepage). Seepage often occurs around hydraulic structures, such as pipes and spillways; through animal burrows; around roots of woody vegetation; and through cracks in dams, dam appurtenances, and dam foundations.

4.3.3. Emergency Response Plan for Dam

Emergency planning and preparedness procedures must be in place in the event of an incident or failure. Emergency Action Plans (EAPs) play a big role in keeping people and property safe in the event of a dam breach or failure. Several countries are making notable progress on increasing the percentage of dams with EAPs. Emergency preparedness is improving, with the percentage of state-regulated high-hazard potential dams with an Emergency Action Plan (EAP) increasing. The goal is for all high-hazard potential dams to have an EAP so that dam owners and local authorities are prepared for a sudden dam failure and the ensuing downstream consequences.

a) **The six Basic Elements of an EAP** This section lists and briefly examines why there is a need for the six basic elements of an EAP.

1. **Notification Flowchart.** A notification flowchart shows who is to be notified, by whom, and in what priority. The information on the notification flowchart is necessary for the timely notification of persons responsible for taking emergency actions.
2. **Emergency Detection, Evaluation, and Classification.** Early detection and evaluation of the situation(s) or triggering event(s) that initiate or require an emergency action are crucial. The establishment of procedures for reliable and timely classification of an emergency situation is imperative to ensure that the appropriate course of action is taken based on the urgency of the situation. It is better to activate the EAP while confirming the extent of the emergency than to wait for the emergency to occur.

3. **Responsibilities.** A determination of responsibility for EAP-related tasks must be made during the development of the plan. Dam owners are responsible for developing, maintaining, and implementing the EAP. State and local emergency management officials having statutory obligation are responsible for warning and evacuation within affected areas. The EAP must clearly specify the dam owner's responsibilities to ensure effective, timely action is taken should an emergency occur at the dam. The EAP must be site-specific because conditions at the dam and downstream of all dams are different.
4. **Preparedness.** Preparedness actions are taken to moderate or alleviate the effects of a dam failure or operational spillway release and to facilitate response to emergencies. This section identifies actions to be taken before any emergency.
5. **Inundation Maps.** An inundation map should delineate the areas that would be flooded as a result of a dam failure. Inundation maps are used both by the dam owner and emergency management officials to facilitate timely notification and evacuation of areas affected by a dam failure or flood condition. These maps greatly facilitate notification by graphically displaying flooded areas and showing travel times for wave front and flood peaks at critical locations.
6. **Appendices.** The appendices contain information that supports and supplements the material used in the development and maintenance of the EAP.

b) Coordination

It is vital that development of the EAP be coordinated with all entities, jurisdictions, and agencies that would be affected by a dam failure and/or flooding as a result of large operational releases, or that have statutory responsibilities for warning, evacuation, and post-flood actions. The finished product should be user friendly as it realistically takes into account each organization's capabilities and responsibilities.

Coordination with state and local emergency management officials at appropriate levels of management responsible for warning and evacuation of the public is essential to ensure that there is agreement on their individual and group responsibilities. Participation in the preparation of the EAP will enhance their confidence in the EAP and in the accuracy of its components. Coordination will provide opportunities for discussion and determination of the order in which public officials would be notified, backup personnel, alternate means of communication, and special procedures for nighttime, holidays, and weekends.

The tasks and responsibilities of the dam owner and the emergency management officials that would be implemented during a dam emergency incident need to be as compatible as possible.

To facilitate compatibility, the dam owner should coordinate emergency response actions with the local emergency management officials who have the responsibility to provide a timely warning and evacuation notice to populations at risk. This should help prevent over, or under, reaction to the incident by various organizations.

c) Evacuation

Evacuation planning and implementation are the responsibility of the state and local officials who are responsible for the safety of the public who live in areas that would be inundated by failure of a dam or flood releases. The dam owner should not usurp the responsibility of the local authorities responsible for evacuation. However, there may be situations where recreational facilities, campgrounds, or residences may be located below a dam where local authorities would not be able to issue a timely warning. In such cases, the dam owner should coordinate with local emergency management officials to determine who will warn these people and in what priority.

d) Emergency Duration, Security, Termination and Follow-up

An EAP needs to address who in the dam owner's organization will issue status reports during the emergency, when and how a declared emergency will be terminated, what security provisions shall be maintained at the dam, and plans for a follow-up evaluation and report.

- 1. Emergency Duration.** Emergency situations that occur at a dam will require that status reports and situation assessments be provided by the dam owner to appropriate organizations throughout the duration of the incident.
- 2. Security Provisions.** An EAP should consider security provisions at and surrounding the dam during emergency conditions to protect the public and permit effective performance of emergency response actions.
- 3. Emergency Termination.** There are two conditions requiring a termination of the emergency. One has to do with emergency conditions at the dam and the other is related to the evacuation and disaster response. The dam owner is usually responsible for making the decision that an emergency condition no longer exists at the dam. The EAP should clearly designate the responsible party. The applicable state or local emergency management officials are responsible for termination of the evacuation or disaster response activities.

The dam owner and state and local officials should agree on when it is appropriate to terminate an emergency. The dam owner should cooperate with state and local officials to determine if a news release which can be used by the media for broadcast to the general public notifying them of termination of the emergency condition is appropriate. Such news releases are expected to be a supplement to other methods of notifying the public that the emergency has been terminated.

- 4. Follow-up Evaluation.** Following an emergency, an evaluation and review should be conducted that includes all participants. The following should be discussed and evaluated in the after-action review:
- Events before, during, and following the emergency
 - Significant actions taken by each participant, and improvements practicable for future emergencies
 - All strengths and deficiencies found in procedures, materials, equipment, staffing levels, and leadership
- The results of the after-action review should be documented in an evaluation report chaired by the dam owner and used as a basis for revising the EAP.

e) Maintaining an EAP

After the EAP has been developed, approved, and distributed, the job is not done. Without periodic maintenance, the EAP will become out-dated, lose its effectiveness, and no longer be workable. If the plan is not exercised (verified), those involved in its implementation may become unfamiliar with their roles and responsibilities, particularly if emergency response personnel change. If the plan is not updated, the information contained in it may become outdated and useless.

- 1. Exercising.** Emergency incidents at dams and/or dam failures are not common events. Therefore, training and exercises are necessary to maintain operational readiness, timeliness, and responsiveness. The status of training and levels of readiness should be evaluated in non-threatening simulated periodic emergency exercises for key personnel of the dam owner.

Key personnel from state and local emergency management agencies should be encouraged to participate in any training and exercises of the EAP whenever possible and as appropriate. The dam owner should exercise the EAP because it promotes emergency preparedness, mitigation, and response, and demonstrates how effective the EAP will be in an actual emergency situation. Periodic exercises will result in an improved EAP as lessons learned during the exercise can be incorporated into an updated EAP document.

There are five types of exercises in an exercise program. It is not a requirement that every exercise program include all five exercises. However, it is advisable to build an exercise program upon competencies developed from simpler exercises to achieve greater success with the more complex exercises. This means that emergency exercises should be developed and conducted in an ascending order of complexity. It is important that sufficient time be provided between each exercise to learn and improve from the experiences of the previous exercise before conducting a more complex exercise. The five exercise types, listed from simplest to most complex, are described below.

- a) **Orientation Seminar** - This exercise is a seminar that involves bringing together those with a role or interest in an EAP, i.e., dam owner and state and local emergency management agencies, to discuss the EAP and initial plans for an annual drill or more in-depth comprehensive exercise. The seminar does not involve an actual exercise of the EAP. Instead, it is a meeting that enables each participant to become familiar with the EAP and the roles, responsibilities, and procedures of those involved. An orientation seminar can also be used to discuss and describe technical matters with involved, non-technical personnel.
- b) **Drill** - A drill is the lowest level exercise that involves an actual exercise. It tests, develops, or maintains skills in a single emergency response procedure. An example of a drill is an in-house exercise performed to verify the validity of telephone numbers and other means of communication along with the dam owner's response. A drill is considered a necessary part of ongoing training.
- c) **Tabletop Exercise** - The tabletop exercise is a higher level exercise than the drill. The tabletop exercise involves a meeting of the dam owner and the state and local emergency management officials in a conference room environment. The format is usually informal with minimum stress involved. The exercise begins with the description of a simulated event and proceeds with discussions by the participants to evaluate the EAP and response procedures and to resolve concerns regarding coordination and responsibilities.
- d) **Functional Exercise** - The functional exercise is the highest level exercise that does not involve the full activation of the dam owner and state and local emergency management agency field personnel and facilities or test evacuation of residents downstream of the dam. It involves the various levels of the dam owner and state and local emergency management personnel that would be involved in an actual emergency. The functional exercise takes place in a stress-induced environment with time constraints and involves the simulation of a dam failure and other specified events. The participants "act out" their actual roles. The exercise is designed to evaluate both

the internal capabilities and responses of the dam owner and the workability of the information in the EAP used by the emergency management officials to carry out their responsibilities. The functional exercise also is designed to evaluate the coordination activities between the dam owner and emergency management personnel.

- e) **Full Scale Exercise** - The full scale exercise is the most complex level of exercise. It evaluates the operational capability of all facets of the emergency management system (both dam owner and state and local emergency management agencies) interactively in a stressful environment with the actual mobilization of personnel and resources. It includes field movement and deployment to demonstrate coordination and response capability. The participants actively "play out" their roles in a dynamic environment that provides the highest degree of realism possible for the simulated event. Actual evacuation of critical residents may be exercised if previously announced to the public.

A comprehensive EAP exercise is an in-depth EAP exercise that simulates a dam failure and involves the active interaction and participation of the dam owner with state and local emergency management personnel in a stressful environment with time constraints. Functional and full scale exercises are considered comprehensive exercises. The basic difference between these two exercise types is that a full scale exercise involves actual field movement and mobilization, whereas field activity is simulated in a functional exercise. A comprehensive exercise provides the necessary verification, training, and practice to improve the EAP and the operational readiness and coordination efforts of all parties responsible for responding to emergencies at a dam, such as failure, mis-operation, and sabotage.

For most dam owners, the orientation seminar, drill, tabletop exercise, and functional exercise should receive the most emphasis in their EAP exercise programs. It is recommended that dam owners conduct a functional exercise at least once every year. Tabletop exercises are usually conducted on a more frequent basis.

Full scale exercises should be considered as optional emergency exercise activities, and should be conducted primarily when there is a specific need to evaluate actual field movement and deployment. When a full scale exercise is conducted, safety becomes a major concern because of the extensive field activity. If a dam owner has the capability to conduct a full scale exercise, a commitment should be made to schedule and conduct the entire series of exercises listed above before conducting any full scale exercise. This will also require that at least one functional exercise be conducted before conducting a full scale exercise. Functional and full scale exercises can be coordinated with other scheduled exercises to share emergency management agency resources and reduce costs.

The primary objectives of a comprehensive exercise are to:

- (1) Reveal the strengths and weaknesses of the EAP, including specified internal actions, external notification procedures, and adequacy of other information, such as inundation maps.
- (2) Reveal deficiencies in resources and information available to the dam owner and the state and local agencies.
- (3) Improve coordination efforts between the dam owner and the state and local agencies. Close coordination and cooperation among all responsible parties is vital for a successful response to an actual emergency.
- (4) Clarify the roles and responsibilities of the dam owner and the state and local emergency management officials.
- (5) Improve individual performance of the people who respond to the dam failure or other emergency conditions.
- (6) Gain public recognition of the EAP. Testing of monitoring, sensing, and warning equipment at remote/unattended dams should be included in emergency exercise activities.

Emergency exercises and equipment tests should be evaluated orally and in writing, and the EAP should be revised and corrected, as necessary. Immediately following an exercise or actual emergency, an evaluation of the EAP should be conducted with all involved parties. The evaluation should focus on the procedures and other information in the EAP, not on the performance of the individuals who carried out the established procedures. It should address both the procedures that worked well and the procedures that did not work so well. The responses from all participants involved in the exercise should be considered. The exercise evaluation should discuss and evaluate the events before, during, and following the exercise or actual emergency; actions taken by each participant; the time required to become aware of an emergency and to implement the EAP; and the improvements practicable for future emergencies.

The purpose of the evaluation is to identify strengths and deficiencies in the EAP, such as outdated telephone numbers on the notification chart, inundation maps with inaccurate information, and problems with procedures, priorities, assigned responsibilities, materials, equipment, and staff

levels. After the evaluation has been completed, the EAP should be revised, as appropriate, and the revisions disseminated to all involved parties

5.0. Response Process

STEP 1- Incident Evaluation and Emergency Level Determination

After an unusual or emergency event is detected or reported, the local EMA Director or the responsible for classifying the event. All decisions that are made should be in accordance within the Incident Command Structure made up with the responsible agencies.

Emergency Level 1- NON-EMERGENCY, Unusual Event, Slowly Developing

This situation is not normal but has not yet threatened the operation or structural integrity of the dam, but possibly could if it continues to develop. The condition of the dam should be closely monitored, especially during storm events, to detect any development of a potential or imminent dam failure situation.

Emergency Level 2- Potential Dam Failure Situation, Rapidly Developing

This situation may eventually lead to dam failure and flash flooding downstream, but there is not an immediate threat of dam failure. The dam owner/operator should closely monitor the condition of the dam and periodically report the status of the situation through Level 2 of the Notification Flowchart.

Emergency Level 3- Urgent; Dam Failure is in Progress or Appears to be Imminent

This is an extremely urgent situation when a dam failure is occurring or obviously about to occur and cannot be prevented. Flash flooding will occur downstream of the dam. This situation is also applicable when flow through the earth spillway is causing downstream flooding of people and roads.

STEP 2- Notification and Communication

After an unusual or emergency event is detected or reported, notifications are made;

Emergency Level 1- NON-EMERGENCY, Unusual Event, Slowly Developing

- If there is a slowly developing failure or unusual situation, where failure is not imminent, but could occur if no action is taken, dam tending personnel should:
- Notify at (*to be provided*), of the potential problem and keep them advised on the situation.
- Determine if there are any immediate actions that can be taken to reduce the risk of failure.
- If necessary, implement preventative actions described in this plan
- Determine if there are any immediate actions that can be taken to reduce the risk of failure.
- If necessary, implement preventative actions described in this plan

Emergency Level 2- Potential Dam Failure, Rapidly Developing

- Implement the Notification Flowchart.
- Advise persons downstream from the dam to evacuate due to the potential failure of the dam.
- Contact Local Emergency Management Office and begin any recommended procedures.
- Take preventative actions described in this plan.
- Make all possible efforts to reduce downstream flooding (i.e. reduce or stop inflow into the, operate outlet works).

Emergency Level 3- Urgent; Dam Failure is in Progress or Appears to be Imminent

If a failure is in progress, downstream evacuation of the floodplain must be started immediately in accordance with the following:

- Implement the Notification Flowchart.
- Notify persons immediately downstream from the dam of the failure.
- Coordinate efforts with other dam owners upstream and downstream to try to reduce flooding, if applicable

STEP 3 - Emergency Actions

In the event of possible dam failure or breach preventative actions should be initiated based on the following events. All decisions that are made should be in accordance with the Incident Command Structure. All preventative actions should be in compliance with the National Disaster Management Committee (NADIMAC) Rules, National Platform for Disaster Management (NPDM) and Regulations for Dam Safety. Overtopping by Flood Waters.

- Open outlet to its maximum safe capacity.
- Place sandbags along the crest to increase freeboard and force more water through the spillway and outlet.
- Provide erosion-resistant protection to the upstream slope, crest and downstream slope by placing plastic sheets or other materials over the eroding areas
- Divert flood waters around the basin if possible.
- Create additional spillway capacity by making a controlled breach in a low embankment or dike section where the foundation materials are erosion resistant. **CAUTION:** Use only as a last resort. Contact (NPDM) before attempting any controlled breach.

Reduction in Freeboard and/or Loss of Dam Crest Width.

- Place riprap or sandbags in damaged areas to prevent further embankment erosion.
- Lower the water level to an elevation below the damaged area.
- Restore freeboard with the sandbags or earth and rock fill.
- Continue close inspection of the damaged area.

A Slide on the Upstream or Downstream Slope of the Embankment.

- Lower the water level at a rate, and to an elevation, that is considered safe given the slide condition. If the outlet is damaged or blocked, pumping, siphoning, or a controlled breach may be required.
- Restore lost freeboard, if required, by placing sandbags or filling in the top of the slide.
- Stabilize slides on the downstream slope by weighting the toe area below the slide with additional soil, rock, or gravel.

Erosional Seepage (Piping) or Leakage through the Embankment, Foundation, or Abutments.

- Plug the flow with whatever material is available (hay bales, bentonite, or plastic sheeting).
- Lower the water level until the flow decreases to a non-erosive velocity or until it stops.
- Place an inverted filter (a protective sand and gravel filter) over the exit area to hold the materials in place.
- Continue operating at a reduced level until repairs are made. A Failure of an Appurtenant Structure such as an Inlet/Outlet or Spillway.
- Implement temporary measures to protect the damaged structure, such as closing an outlet or providing temporary protection for a damaged spillway.
- Employ experienced, professional divers, if necessary, to assess the problem and possibly implement repair

A Mass Movement of the Dam on its Foundation (Spreading or Mass Sliding Failure).

- Immediately lower the water level until excessive movement stops and a safe level is reached.
- Continue operation at a reduced level until repairs are made.

Spillway Erosion Threatening Evacuation.

- Reduce the flow over the spillway by fully opening the main outlet.
- Provide temporary protection at the point of erosion by placing sandbags, riprap materials, or plastic sheets weighted with sandbags.
- When inflow subsides, lower the to a safe level.
- Continue operating at a lower water level in order to minimize spillway flow.

Excessive Settlement of the Embankment.

- Lower the water level by releasing it through the outlet or by pumping or siphoning until it reaches a safe level.
- If necessary, restore freeboard, preferably by placing sandbags.
- Continue operating at a reduced level until repairs can be made.

A Loss of Abutment Support or Extensive Cracking in Concrete Dams.

- Lower the water level by releasing it through the outlet.
- Attempt to block water movement through the dam by placing plastic sheets on the upstream face.
- Continue operating at a reduced level until repairs can be completed.

Malicious Human Activity (Sabotage, Vandalism, or Terrorism)

- If malicious human activity that could endanger public safety is suspected, contact law enforcement to help evaluate the situation.
- If the principal spillway has been damaged or plugged, implement temporary measures to protect the damaged structure. Employ experienced, professional divers, if necessary, to assess the problem and possibly implement repair.
- If the embankment or spillway has been damaged or partially removed, provide temporary protection in the damaged area by placing sandbags, riprap materials, or plastic sheets weighted with sandbags.
- If the water supply has been contaminated, immediately close all inlets to the water supply system and notify appropriate authorities.

STEP 4 – Termination and Follow-Up

Once conditions indicate that there is no longer an emergency at the dam site and the proper authorities (e.g. Local Emergency Management, DEM, or a professional engineer, Safety Engineer) have declared the dam safe, should contact the local authorities who will then terminate the emergency situation

5.1. Responses

5.1.1. Response during Period OF darkness

The spillway, gatehouse, and any distressed areas of the dam should be illuminated if an emergency condition develops during periods of darkness. This will allow the emergency condition to be monitored and assessed, and help facilitate a response. The of will provide emergency power and illumination (e.g., portable light towers) during such events.

5.1.2. Response during Weekends and Holidays

The Emergency Notification Flowchart can be used for Weekends and Holidays. When practical, redundancies of personnel and alternate telephone contact numbers have been provided. This should maximize the probability of activating the Notification Flowchart and engaging all of the responsible parties.

5.1.3. Response during Periods of adverse Weather

During periods of adverse weather, the primary access route should be utilized. It is suggested that adequate quantities of gravel and or/ crushed stone should be stockpiled near the Dam or ready to be transported to the site to allow access roads to be maintained and for making emergency repairs.

5.1.4. Availability of Used of Alternate Systems of Communications

It is assumed that interruption of telephone service during an emergency condition could occur and that the evacuation of affected homes and businesses should be performed by the police or fire personnel informing residents by going street to street

5.1.5. Dam Safety during Response Phase

During the response phase in mitigating dam failure, specific preventative actions may help to prevent or delay dam failure. Because the feasibility and effectiveness of preventative actions will depend on the specific situation, it is advised that the consult a qualified engineer before taking any preventative actions. Departmental Standard Operating Procedures for first responders should be followed during a Dam Incident Response. During a Dam Incident Response, a Safety Officer should be assigned within the Incident Command Structure to oversee incident safety throughout the duration of the Dam Incident Response.

5.1.6. Emergency Supplies and information

In an emergency situation, equipment and supplies might be needed on short notice, such as sandbags, riprap, fill materials, equipment, and laborers.

5.1.7. Staging Area

The parking lot may be used as an emergency response staging area if deemed necessary by responding authorities.

6. Project Control and Mitigation Measures

6.2.Equipment

Construction vehicles and equipment will be operated within the manufacture's specifications. All vehicles and equipment will be maintained and serviced on a regular basis. Records of maintenance and servicing will be retained on-site for the duration of the construction phase. Machinery and equipment operators will be trained and carry current and appropriate licenses, where necessary.

6.2.1. Vehicles Collision and driving condition

Vehicles on the construction site are likely to include front-end loaders, graders, rollers, cranes, water trucks, dump trucks, buses and light vehicles (four-wheel drives) that operate on roads and access roads around the Project. Collisions between these have the potential to cause serious injury to operators and passengers.

Construction workers operating vehicles on-site will be trained and licensed so that these vehicles are driven in a safe and appropriate manner. Speed control (signage), driving to conditions, and prescribed driving etiquette on the site will be used to control the risk. All vehicles will be fitted with radios for two-way communication and high visibility flags for ease of identification.

Watering of roads and access areas will be undertaken regularly to suppress dust and improve visibility. Adequate night lighting through the provision of lighting towers and vehicle headlights will be provided to ensure night operating and driving conditions are safe.

6.2.2. Blasting and misfires

Blasting creates a number of potential risks such as dust, noise, vibration, fly-rock and air-blast effects. Fly-rock and air-blast effects can cause serious personal injury if not properly controlled and therefore create a high risk to the workers.

Mitigation measures include the use of blasting experts to undertake safe blast design, control of access (including temporary road closure) and evacuation warnings before blasting. Personnel in the vicinity of a blast will wear Personal Protective Equipment (PPE) and all personnel will observe safe distances during blasting activities.

Proper stemming will be used in the preparation of charges and appropriate charge ratios will be used to limit the amount of fly rock produced by a blast. Blasting operations will be carried out by a person qualified and experienced in the use of explosives.

Blasting misfires include incomplete detonation of the blast. This may reduce or confine the blast impact, and may pose safety issues to personnel re-entering the area of blast misfires. Training and management of personnel involved in blasting activities will be required to ensure appropriate knowledge.

Safety procedures will be developed and strictly adhered to on site to limit the probability of the hazard occurring and identify appropriate means for identifying and mitigating a misfire should one occur.

6.2.3. Personnel interaction with Machinery

Personnel may be at risk of interacting with construction machinery, parts from vehicles, earth moving equipment or portable plant and equipment resulting in the potential for serious injury. Strict adherence to the Project's workplace health and safety rules and established safety systems will reduce the likelihood of occurrence. Appropriate guarding of fixed and portable equipment will be in accordance with AS4024:2006 Safety of Machinery.

6.2.4. High Voltage Exposure

Power lines may be affected by the Project and will require temporary or permanent relocation. Relocating electricity infrastructure may expose personnel to potentially lethal levels of voltage and amperage. Specialist electrical engineers will undertake this task using approved codes of practice and procedures.

There will be specific and detailed standard operating procedures implemented that deal with high voltage. The residual high risk can be managed by ensuring the preventative controls are well implemented and monitored.

6.2.5. Working at height and falling objects

There will be instances where workers are required to work at height during the construction phase. The Proponent will plan activities to minimize the requirement to work at heights where practical. However, where working at heights is unavoidable, SOPs for working at height will be used to control this risk.

Mandatory PPE on a construction site that protects persons against objects falling includes hard hats and steel capped boots. Fall of persons will be controlled through appropriate elevated work platforms and the proper use of harnesses.

During operations, there will also be instances where operators are required to work at height during maintenance or repair duties.

6.2.6. Food Hygiene

Areas involved in the provision and supply of food, such as the construction mess or meal rooms, will operate in compliance with current food and hygiene legislation. The catering contractor will hold the relevant licence under the Food Act 1981.

6.2.7. Odor

The Project is not expected to produce any odour that may be detrimental to the health and safety of employees, visitors or the general public.

6.2.8. Dust

The Project will implement current particulate and gas/vapour exposure standards and procedures that will apply to dust, fibres, mist and fume (ie. particulates), and gas and vapour exposures in the workplace, (with emphasis on inhalation as the prime route of exposure).

The standards and procedures will cover, amongst other things, evaluation of particulate and gas/vapour hazards, and development of a control program to ensure that employees and contractors will not suffer adverse health effects from particulates or gas/vapours, either used or generated by the Project. Where required, the dust control program will include engineering controls such as water trucks or sprays and use of respiratory protection devices.

The health risks are expected to be low. Dust from earthmoving machinery will be controlled by water trucks. The nearest residences are not expected to be adversely affected by dust during construction with the implementation of appropriate dust control measures

6.2.9. Noise

All equipment (both fixed and mobile) will comply with the relevant Australian Standard in regard to design and operating noise levels.

The Project will implement current hearing conservation standards and procedures during construction and operation to ensure that employees and contractors will not suffer adverse health effects from noise generated in the workplace. These standards and procedures will cover, amongst other things, the identification and evaluation of occupational noise hazards and development of noise control programs to minimise noise levels and protect employees and contractors from adverse exposure. Where required the noise control programs will include use of hearing protection devices.

6.2.10. Pests

The Project is not expected to lead to an increase in the number of pests during construction or as a result of site operations. Requirements for fire ant control will be identified prior to commencement. Pests and weeds have been identified as a moderate risk with the planned controls in place which include plant and equipment wash down and the maintenance of the existing weed management program.

6.2.11. Waste

Waste will be managed to avoid adverse impacts on the health of the workforce and minimise risk of impact on land, air and water.

There will be small amounts of wastes generated during the construction of the power station. This waste will consist of scrap steel, timber, concrete, general waste, recyclable waste and some hazardous waste from the operation and service of equipment.

During the construction phase, food wastes, paper and recyclables will be generated in communal areas. Colour-coded, signed bins will be used to segregate and collect these wastes. The bins will be located throughout offices and canteen areas to achieve maximum economic waste recovery. Waste materials that are known to attract vermin will be stored and handled in a hygienic manner. General wastes will be transported for disposal to the nearest landfill.

Standard procedures will be in place during construction to contain and limit damage from accidental release of waste materials, such as oil spillages.

Operational activities are also expected to produce small quantities of hazardous (regulated) wastes such as hydrocarbons and hydrocarbon contaminated products (oily wastes and oil filters). Waste materials which are known to attract vermin will be stored, handled in a responsible manner and removed from site by a licensed waste management firm.

Standard procedures for the storage, containment, disposal and spill response for potentially hazardous waste materials will minimize potential impacts associated with these materials/substances. The health risks presented by operational wastes are low.

6.2.12. Security

The dam construction area will be enclosed with suitable fencing. Other fencing will protect selected areas with high risk of a security breach or unauthorized public access such as at pump stations along the pipeline and signs will be erected to delineate such areas. Prior to being given access to the Project site, visitors will complete mandatory registration and an environmental, health and safety induction. The scope of induction will reflect those areas of the Project site that the visitor will be permitted to access. Access to the construction site will be denied to any site staff/visitor not wearing mandatory personal protective equipment (PPE).

For the construction phase, public liability will be managed by the constructor with closure of the construction zone to the public. A safety risk assessment will be undertaken to identify areas of increased risk to the public once the construction phasing and final design are established. For land that surrounds the water storage, such as that leased back to landholders, public liability for access onto that land will be with the landholder.

Protection of infrastructure will be maintained by ensuring the constructor has identified all assets and undertakes construction in a way that does not damage this infrastructure or cause a reduction in service provided by the dam and associated infrastructure.

The operators of the Project will have adequate public liability insurances.

6.2.13. Natural Disasters

The exposure of the dam to climate change and natural disasters is partly discussed under dam safety in relation to seismic events.

Additionally, the dam could be exposed to severe storm events that exceed the existing probable maximum flood level. The dam design and construction reduces the likelihood of structural impacts from over topping and is considered to mitigate this risk.

Access and egress to the dam during bushfires will require the consideration of safety zones and or management plans that prevent or mitigate the exposure to construction and operation staff.

6.2.14. Community safeguards

It is vitally important that the Project have minimal impact on local communities. The community safeguards will be implemented through a ‘defence in depth’ approach where there exists a multi-layered approach to public and environmental impacts. These safeguard layers come in two principal forms:

- ✓ the design of processes to ‘good engineering practice’ standard; and
- ✓ the implementation of safety management systems and emergency planning appropriate for the hazards involved in the operations.

Good engineering practice involves, as a minimum, designing in accordance with Australian Standards and industry codes of practice as well as using formal safety in design practices for reviews and issue management. The safety systems of the approach can include:

- ✓ traffic management plans;
- ✓ behavior codes;
- ✓ community engagement sessions;
- ✓ monitoring and control;
- ✓ security systems
- ✓ fire detection, alarm and suppression systems; and
- ✓ emergency procedures.

6.2.15. Monitoring

Monitoring will be undertaken to assess whether Project health and safety measures are being implemented and effective. Monitoring will involve the compilation and assessment of data relating to health and safety issues, such as reported near misses, accident reports and any health surveillance data. Outcomes from this monitoring may trigger the need for additional safety and health risk control actions.

Accident and near hit data will be monitored to identify where:

- common themes occur;
- PPE is being incorrectly used/abused;
- corrective actions have not been strictly implemented;
- corrective actions are ineffective;
- procedures/practices need to be reviewed;
- retraining may be required; and
- health surveillance data will be monitored to identify common themes.

6.2.16. Safety management Systems

The safety management system adopts an integrated approach to risk management of the dam construction and operations, recognizing the hazards at all points in the operations and how these are controlled. Australian Standards AS 4801:2001 and AS4804:2001 will be complied with in developing and operating the safety management system.

The safety management system should include the following:

- ❖ policy statements for health and safety management objectives and goals;
- ❖ responsibility statements and accountabilities;
- ❖ review of modification and design procedures;
- ❖ policies for managing change (new technology, new procedures);
- ❖ assessment of human factors in the design and operation;
- ❖ training programs for operators;

- ❖ internal standards and codes of practice;
- ❖ process and equipment integrity including preventative maintenance and procedures;
- ❖ incident investigation procedures;
- ❖ enhancement of safety knowledge and its dissemination to staff;
- ❖ risk and compliance auditing; and
- ❖ corrective action procedures.

Details of the safety management system are legally required to be provided by the operator.

ANNEX - 1 Emergency Response Matrix

	Type of Event					
	Reservoir water elevation and incoming flood volume	Earthquake	Excessive leakage, internal erosion, or piping	Abnormal instrument readings	Gate failure, power loss, equipment failure, or fire	Accident or sabotage
Level I Preliminary notification for possible flooding event	Reservoir water elevation may reach a spillway sill level, starting discharge over the spillway, and downstream municipalities should be informed	In case of earthquakes with a peak ground acceleration smaller than that of the design base earthquake, the dam must be examined by dam safety engineers.	If water level rises in observation wells at the dam's downstream slope or at the downstream toe, or a leakage is visually observed, examinations must be performed by dam safety engineers.	Dam-specific. Typical instruments providing "early warnings" are piezometers, flow meters, and joint meters.	Damage can be repaired in less than one to three days. Damage control report required. Consider updating the Operation and Maintenance Plan	In case of an incident or threat to the dam and its facilities, the dam security officers will respond first, and the gendarmerie will be informed thereof.
Level II Imminent threat and prepare for evacuation	If the reservoir water level exceeds a certain critical elevation, and the incoming flow rates above, say, one hundred-year flow are anticipated, downstream municipalities and communities should be alerted.	In case of earthquakes greater than the design base earthquake, requiring rapid reservoir drawdown, all downstream municipalities and communities should be alerted appropriately.	If the amount of water leakage observed downstream of the dam increases, and the leakage carries materials, rapid reservoir drawdown may be necessary. Downstream municipalities and communities should be alerted.	Instruments signal the persistence of abnormal behavior; reservoir drawdown may be necessary. External notification required	Damage control requires more than three days. External notification required	If the dam embankment and spillway are damaged as an accident or sabotage, downstream municipalities and communities should be alerted.
Level III Imminent threat and prepare for evacuation	If it is anticipated that the reservoir will exceed the design flood elevation, and the incoming flow rate is expected to reach, say, one-thousand-year flow and more, preparations will be started to evacuate the downstream communities	If a stability problem has occurred in the dam slopes after an earthquake, preparations will be started to evacuate the downstream communities.	In case of major increases in the water leakages with turbidity on the downstream part of the dam, preparations will be started to evacuate the downstream communities.	Dam behavior is such to threaten uncontrolled release of water. Prepare for evacuation	Damage persists and impairs the function of water control works during high reservoir period. Prepare for evacuation	Damage impairs the function of water control works during high reservoir period. Prepare for evacuation.

Type of Event

	Reservoir water elevation and incoming flood volume	Earthquake	Excessive leakage, internal erosion, or piping	Abnormal instrument readings	Gate failure, power loss, equipment failure, or fire	Accident or sabotage
Level IV Emergency declaration and Evacuation order	If Water level is exceeding the design flood level and approaching to the da crest level, the downstream community’s should be ordered.	If the dam has been severely damaged such that it cannot retain water alder an earthquake, evacuation	If the dam has been severely damaged by erosion such that it could no longer retain water safely, evacuation of downstream communities should be ordered.	Reservoir cannot be controlled. Evacuation should take place.	Reservoir level cannot be controlled. Evacuation should take place	Reservoir level cannot be controlled. Evacuation should take place

2. Appendix

Attachment 1: Emergency Contact Information			
Emergency Response Team (Name of Personnel and Position)		Office Location	Contact / Office Extension
Contact	Location	Primary Number	Secondary Number
ESSO	Project Site	-	-
ESSS	SPIU WB&KOICA	0738679596	-
EHS	Project Site	-	-

Attachment 3: Visitor Logbook					
N0	Name	ID Number	TimeIn	Time Out	Signature

Attachment 4: Record of Changes			
Change	Indicate Change	Date of Change	Change entered by