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TAILINGS FACILITY RISK

Risk Assessment Findings (GISTM Requirement 15.1 B3)

A failure modes and effects analysis (FMEA) and quantitative risk assessment was completed for each of the embankments of Sajana tailing storage facility (TSF).

The FMEA process included a series of workshops with representatives from environment, social, finance, engineering and operational fields. The steps of the FMEA included the following:

- Definition of the system;
- Definition of the functions of each component;
- Identify the failure modes related to the function of each component;
- Identification of the causes of each failure mode;
- Description of the direct, intermediate and end effects;
- Evaluation of the unmitigated risk;
- Identify available measures for detecting the cause and to control or mitigating the effects; and
- Evaluation of the mitigated risk.

As an outcome from the FMEA, the following failure modes were considered credible and suitable for inclusion in the dam break assessment (DBA):

- Overtopping; and
- Seismic slope instability.

The likelihood of failure and the consequences of failure based on the severity of potential impacts were assessed as part of the FMEA process with the probability of failure against each of the credible failure modes assessed for each TSF embankment.

Credible Flow Failure Risk Assessment Outcomes (GISTM Requirement 15.1 B4)

In line with international best practice, DBAs were conducted for two broad scenarios:

- A rainy day scenario, or overtopping scenario, which may cause the erosion of the overflow control channel and may also result in the release of a partial volume of water containing suspended solids. This water would entrain some tailings as it erodes the embankment and would behave as a non-Newtonian fluid. The erosion of the embankment or a portion thereof could result in either a flow slide or slump. The solids concentration of any released tailings would be reduced by dilution with the overtopping flood water; and
- A sunny day scenario, which refers to a situation where the cause of removal of the supporting embankment would be by any mechanism other than overtopping erosion of the overflow control channel. Within this scenario, either a slump or flow slide may occur.

Table 1 summarises impact assessments on environmental and human exposure and vulnerability to tailings facility credible flow failure scenarios for Sajana TSF.

TSF	Credible Flow Failure Scenario	Assessment Outcomes	Environmental and Human Exposure
Sajana	<p>Flow failure on south embankment following the initiating faults of:</p> <ul style="list-style-type: none"> - Probable Maximum Precipitation (PMP) causes overtopping of the overflow control channel resulting in flooding of the El Tigre creek; and - Slope failure due to unrepresentative geotechnical foundation and starter dam conditions leading to seismic slope instability. 	<p>Inundation mapping shows that water outflow containing suspended solids would be contained within the lands owned by CMSA. A portion of this land is leased to local farmers for cattle grazing.</p> <p>Transport of water within the El Tigre would occur beyond the area owned by CMSA.</p>	<p>Any surface water released will not cause significant loss or deterioration of habitat.</p> <p>There is potential contamination of livestock/fauna water supply with no health effects.</p> <p>The potential for human exposure is limited to environmental and geotechnical monitoring personnel and CMSA land leased to a local farmer tending to the cattle.</p>

Table 1: Credible Flow Failure Risk Assessment Outcomes

Review of the credible failure modes and potential causes indicate that the risks are well understood and managed with appropriate controls. The risk assessment outcomes have been agreed and reviewed with the Engineer of Record (EoR) and a Senior Independent Technical Reviewer (IR).