



## **TSF and Cyanide Monitoring Procedure**

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CRL-ENV-PRO-019-19  
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This document has been prepared based on assumptions as reported throughout and upon information and data supplied by others.

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# 1 Introduction

To support the environmental approvals for the proposed Warrawoona Gold Project (WGP), routine monitoring of cyanide levels is required.

This cyanide monitoring procedure has been prepared for the cyanide destruction process proposed for the WGP and specifically relates to ensuring Weak Acid Dissociable (WAD) Cyanide Levels in Tails discharged to the Tails Storage Facility (TSF) are within limits that are not harmful to native Fauna.

## 1.1 Purpose

The purpose of this procedure is to identify cyanide management and monitoring procedures to minimise the impact of cyanide to the environment. It is intended to be used as part of an overall framework to plan works and mitigate the environmental risks associated with the WGP.

## 1.2 Scope

This procedure applies to all Calidus controlled sites and their activities, employees, contractors and visitors, and is subject to the requirements of the Calidus Health, Safety and Environment (HSE) Standards and applicable environmental legislation.

## 1.3 Context

To avoid potential fauna toxicity the WGP will employ a cyanide destruction process and implement cyanide management procedures. The Telfer Gold Project with a TSF located on a similar latitude to the proposed Warrawoona Gold Project is licenced for <50 mg/L CN<sub>WAD</sub> discharge.

In recognition of the two species of significant Bats and the absence of data to support a <50 mg/L CN<sub>WAD</sub> discharge (related to Ghost Bat and Pilbara Leaf-nosed Bat). Calidus has committed to a concentration of CN<sub>WAD</sub> discharge <30 mg/L and it is likely that following volatilisation of cyanide post discharge that CN<sub>WAD</sub> in the supernatant will be lower still.

## 1.4 Definitions

Term	Definition
Cyanide	Refers to any compound which contains the cyano group (CN). The two forms of Cyanide most considered in this document are:  CN <sub>FREE</sub> Free Cyanide, generally includes the cyanide ion (CN <sup>-</sup> ) and Hydrogen Cyanide Gas (HCN);  CN <sub>WAD</sub> Weak Acid Dissociable (WAD) cyanide, cyanide species liberated at moderate pH (pH 4.5)
Cyanide Destruction	Chemical Means to destroy the cyanide in cyanidation tails
Caro's Acid	Caro's Acid is a mixture of sulphuric acid (H <sub>2</sub> SO <sub>4</sub> ) and hydrogen peroxide (H <sub>2</sub> O <sub>2</sub> ), one of the methods Calidus is investigating for cyanide destruct.

## 2 Responsibilities

All Calidus employees and contractors are required to comply with the requirements of this procedure.

Accountability for fulfilling the requirements of this procedure is dependent on the stage of Project development (exploration, construction, operations, decommissioning).

During construction stages, whether activities are undertaken by an external service provider or internal Calidus personnel, the Project Manager / Registered Manager will be accountable for ensuring the requirements of this procedure are met.

During operational, decommissioning and closure stages, the General Manager (Registered Manager) will be accountable for ensuring the requirements of this procedure are met.

Role	Responsibilities
Exploration Manager/ Project Manager / Registered Manager/ General Manager	Accountable for ensuring the requirements of the procedure are met dependent on the stage of project development.
Processing Manager	<ul style="list-style-type: none"> <li>• Implement and maintain the Cyanide Monitoring Procedure and associated Standard Operating Procedures</li> <li>• Review the Cyanide Monitoring Procedure and associated Standard Operating Procedures</li> <li>• Annual Audit of Compliance.</li> <li>• Organise the review and update, of this Cyanide Monitoring Procedure annually</li> <li>• Implement changes to this procedure based on investigation and audits.</li> </ul>
Production Metallurgist	<ul style="list-style-type: none"> <li>• Monitoring the daily cyanide usage</li> <li>• Managing cyanide leaching set-points</li> <li>• Reporting operational deficiencies and suggesting improvements</li> <li>• Checking Thickener density calibrations</li> <li>• Monitoring and performing calibration of oxygen meters</li> </ul>
Metallurgical Laboratory Technician	<ul style="list-style-type: none"> <li>• Maintenance and weekly calibrations of the cyanide analysers.</li> <li>• Providing the first point of call for cyanide analyser problems and improvements</li> <li>• Entering verification/calibration data for the cyanide analysers</li> <li>• Organising manufacturer service visits and maintaining spare parts</li> </ul>
Process Operational Technician	<ul style="list-style-type: none"> <li>• Checking and maintaining cyanide concentrations within specified targets. Requesting assistance if unable to control to target</li> <li>• Conducting cyanide titrations to verify the analysers and notify the area metallurgist if the difference is greater than 10 ppm</li> <li>• Notify the Production metallurgist if any errors are found with the analysers</li> <li>• Fauna Monitoring and Reporting to Site Environmental Officer</li> </ul>
Site Environmental Officer	<ul style="list-style-type: none"> <li>• Implement and deliver awareness training programs to personnel, contactors and visitors.</li> <li>• The Site Environmental Officer will train the Process Operators to undertake fauna observations of the decant.</li> </ul>
Senior Environmental Officer	<ul style="list-style-type: none"> <li>• Ensure that Fauna Monitoring data is incorporated into regulatory reports as required under the Significant Species Management Plan.</li> <li>• Deliver monitoring/reporting data to the appropriate regulatory authority</li> </ul>

### 3 Monitoring Cyanide Levels

#### 3.1 CN<sub>FREE</sub> and CN<sub>WAD</sub> Levels in the Processing Plant

CN<sub>FREE</sub> and CN<sub>WAD</sub> levels will be monitored in the processing plant to provide information relevant to process control and cyanide destruction to regulate the dosage of the reagent such as Caro's Acid.

CN<sub>WAD</sub> samples will be taken of the cyanide destruct feed and discharge streams. In the event CN<sub>WAD</sub> levels at the discharge point to the tailings storages exceed 30 mg/L (maximum) one or more of the contingency measures outlined below will be implemented to reduce CN<sub>WAD</sub> levels to below this level.

### 3.2 Maintaining Cyanide Levels to the Required Levels

- (a) A flow meter and control valve will regulate the flow of cyanide to the CIL circuit. The flow rate will be controlled to a free cyanide setpoint measured frequently by an automated online cyanide analyser;
- (b) The analyser accuracy will be monitored routinely by operator titrations and maintained by the laboratory staff. The analyser will be serviced by the OEM on a routine basis;
- (c) Cyanide concentration in the slurry reporting the tailings thickener underflow hopper will be measured;
- (d) Destruct reagents such as Caro's acid will be added in a stoichiometric ratio to the cyanide concentration multiplied by an efficiency factor to ensure destruction is achieved below the target;
- (e) Daily samples will be collected from the tailings spigot(s). The sample will be analysed in the on-site laboratory for  $CN_{WAD}$  cyanide concentration. This is the control sample to confirm the slurry deposited on the TSF is below the required level;
- (f) If the sample is below the required level no further action is required;
- (g) If the sample exceeds the target action will be taken to determine the cause of the exceedance and a suitable response;
- (h) All samples will be internally reported on a monthly basis.

### 3.3 Contingency Measures for Reducing CN Discharge Levels

In the event  $CN_{WAD}$  levels in the tailings discharge stream exceed 30 mg/L (maximum), one or more of the following contingency measures will be implemented to reduce  $CN_{WAD}$  levels to below these levels:

- Discharge to the TSF will cease until  $CN_{WAD}$  levels can be achieved below the required level;
- Increase the amount or dosage rate of cyanide destruction chemicals being used in the cyanide destruction circuit to achieve lower cyanide levels in the tailings discharge stream;
- Reduce the amount or rate of cyanide addition;
- Reduce the rate of ore feed;
- Add dilution water, if available.

Monitoring of the effectiveness of the contingency measures will be undertaken.

### 3.4 Exceedance Response

The following steps shall be adhered to in the event of a  $CN_{WAD}$  concentration exceedance:

#### Identify the Cause:

- Check the cyanide addition rate has not been excessive;
- Check the analyser readings are correct with the manual readings;
- Check the CN destruct process is operating efficiently;
- Confirm the addition ratio is appropriate.

## Response

- Once the cause is identified make the required adjustments;
- Once the adjustments have had sufficient time to be effective re-sample the spigot to confirm the discharge is within the target;
- Raise an incident report. Document the exceedance explanation and response taken.

## 3.5 Training of Personnel

- The site trainer will train the operators for cyanide titrations and routine checks required to maintain the cyanide addition and destruction equipment.
- The laboratory supervisor will train the laboratory technicians on the procedures for operating and maintaining the cyanide analyser.
- TSF disposal targets and reasons for these targets will also be communicated via the Calidus Induction.
- The Site Environmental Officer will train the Process Operators to undertake fauna observations of the decant pond and will collate information as per the Significant Species Management Plan (CRL-ENV-PLN-006-19).

## 3.6 Fauna Management and Monitoring

The following management measures will be in place to protect fauna from interactions with the TSF:

- Minimising the area of supernatant water in the TSF (decant);
- Monitoring usage of the TSF decant by fauna;
- Development of Procedures for the rescue of fauna;
- Beach Management via spigots placement to avoid ponding of supernatant water in areas other than the decant

Fauna monitoring at the TSF will occur twice a day to observe and record fauna usage. One patrol will be conducted after dawn and the other in late afternoon. The monitoring results will be utilised to determine the requirement for modification to the mechanisms being implemented to keep fauna away from the TSF.

The following details will be recorded during the fauna observations:

- observer details (name);
- date and time of inspection;
- type of species observed;
- number of individuals of each species observed;
- location within TSF (e.g. beach, embankment or decant, etc);
- behaviour and habits of individuals (e.g. flying, wading, feeding etc);
- fauna effected (e.g. trapped) or deaths.

Groundwater will be monitored for cyanide as per the Ground water Monitoring Procedures (CRL-ENV-PRO-021-19)



## 4 Reporting

Any exceedance of the 30mg/L CN<sub>WAD</sub> target level will be reported within 7 days to the appropriate regulatory agency.

Fauna monitoring results will be collated as per the Significant Species Management Plan and reported to the appropriate regulatory agency.

A summary of the cyanide monitoring results will be completed annually as part of the Annual Environmental Report.

## **5 Adaptive Management**

Calidus will implement adaptive management practices to learn from the implementation of mitigation measures, monitoring and the evaluation against management targets, to more effectively meet the objectives for cyanide management.

The monitoring program will be adaptive, dependent the factors such as UV breakdown of cyanide in the TSF, the cyanide destruct and the results of Ghost Bat and Pilbara Leaf-nosed bat monitoring data. The quality and quantity of data collected over time and innovations in monitoring techniques and methodologies will be incorporated into program design over time.

## **6 Related Documentation:**

CRL-ENV-PLN-006-19 Significant Species Management Plan