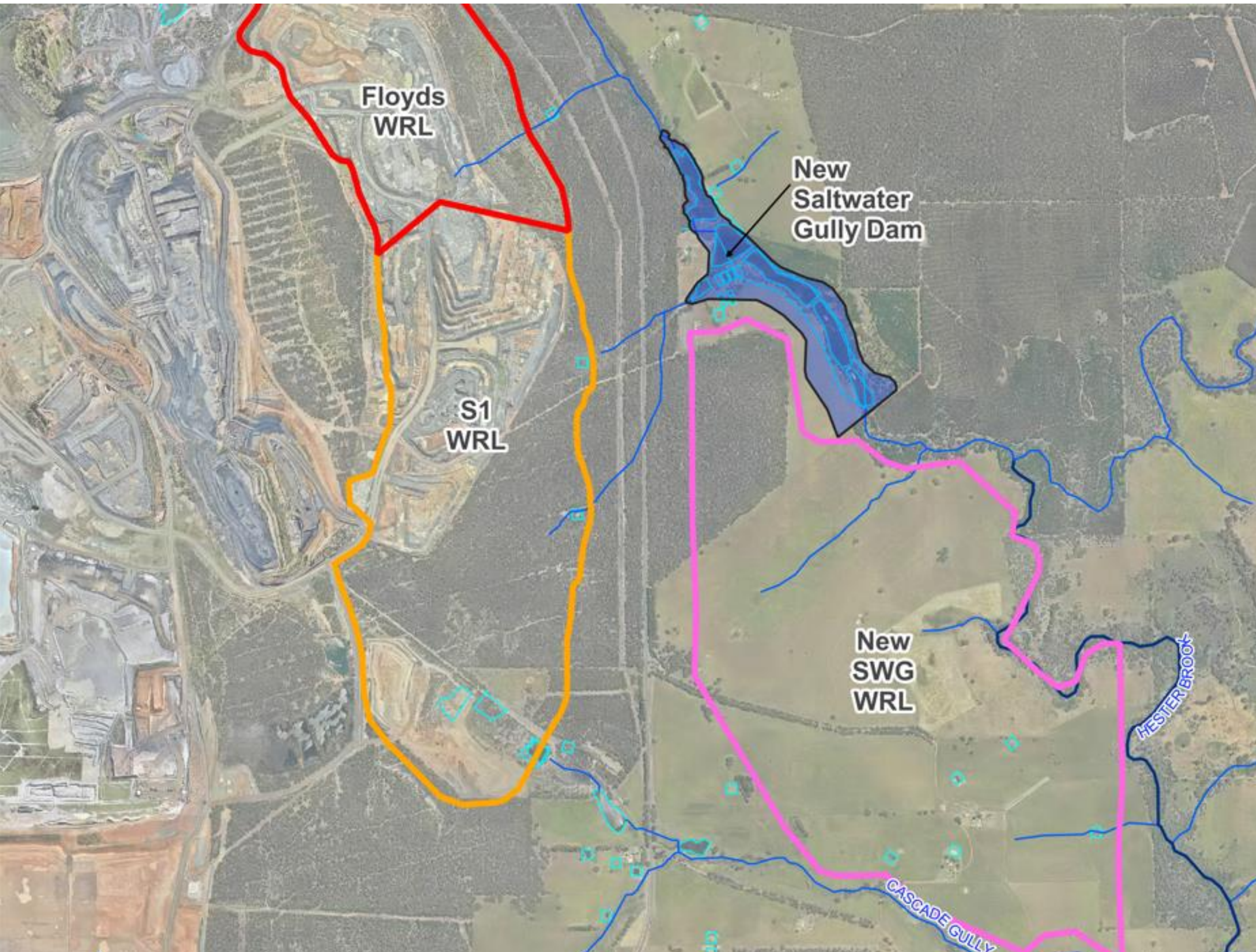
Eastern Catchment Hydrology Study

Preliminary Risk Assessment

Talison Lithium Pty Ltd

19 December 2023

→ **The Power of Commitment**



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The Power of Commitment

Executive Summary

Background

GHD Pty Ltd (GHD) was engaged by Talison Lithium Pty Ltd (Talison) to undertake the Eastern Catchment Hydrology Study (the Study) which entails the hydrological and hydrogeological assessments of proposed new facilities on the mine site and subsequent preliminary assessment of the environmental and human health risks arising from these activities. These facilities are:

– Construction and operation of a new water dam within the mine water supply network, namely Salt Water Gully (SWG) Dam.
– Establishment of the new SWG Waste Rock Landform (WRL).
– Reuse of all or part of Tailings Storage Facility #1 (TSF1) following removal of existing material for reprocessing, either for tailings or water rock deposition.

The scope of the Study is to complete a baseline investigation and preliminary risk assessment of the Eastern Catchments to understand the veracity of existing management and monitoring for approved activities and the above additional proposed activities. The purpose of this report is to examine whether any Contaminants of Potential Concern (CoPCs) emanating from these facilities have the potential to harm human health and/or the downgradient ecological systems.

This preliminary risk assessment is based on the approach documented in the Department of Water and Environment Regulation (DWER) Contaminated Site Guidelines (DWER, 2021) regarding identification of the Source-Pathway-Receptor and exposure scenarios. The focus of the risk assessment is at the Tier 1 level, which is a qualitative risk assessment whereby the CoPCs are screened against guidelines and the potential for the CoPCs to migrate offsite and impact the receiving environment.

Source-Pathway-Receptor Links

The assessment of the Source-Pathway-Receptor links indicates the following:

– Sources: Impacted sources may be derived from TSF tailings slurry waters, leaching from tailings solids and TSF embankment materials (typically waste rock), and leaching and runoff from waste rock in WRLs.
– Pathways: Some of the TSF slurry waters and leachate penetrates through the base of the TSF into the groundwater, and then migrates to surface water discharge points along nearby creeks. Leachate from the waste rock within the WRLs is typically intersected at and within the pre-construction ground surface and discharges as base flow at the toes of the WRLs. Some of this leachate penetrates down to the low permeable subsurface of saprolite and discharges to nearby creeks.
– Receptors: Drinking water, non-potable domestic water, irrigation water, stock water, and aquatic environment uses associated with groundwater extraction and the surface water of Salt Water Gully, Cascade Gully, and Hester Brook.

Identification of CoPCs

The CoPCs were identified from screening of the various tests on the tailings solids and decant, and waste rock leaching, as well as discharge monitoring. The screening indicated that 15 metals (Al, Sb, As, Cd, Cu, Cs, Cr, Li, Mn, Mo, Ni, Rb, Th, U, and Vn) and nitrate and sulphate exceed one or more of the adopted Water Quality Guidelines (WQGs).

Risks to Groundwater

Fate and transport modelling of groundwater and the key CoPCs (lithium and arsenic) was undertaken for two scenarios, namely a Base Case (including the existing TSF1, Floyds WRL, and MSA embankment, and the approved (yet to be constructed) Floyds S1 WRL) and an Impact Case (as for the Base Case model, but includes the reuse of TSF1, establishment of SWG WRL, and construction of SWG Dam).

The groundwater modelling indicates the following:

– Arsenic and lithium plumes from the existing and proposed WRLs and TSF are generally constrained close to or within the TSF or WRL footprints. There is some localised spreading around the SWG Dam due to infiltration of stored water with elevated arsenic and lithium concentrations. Modelling was not undertaken for the other CoPCs, however, given the expected similarity in mobilisation behaviour of the metals, the results are anticipated to present similar distributions and lateral extents.
– Water seeping from the base of the existing farm dams constructed in Salt Water Gully, and the proposed SWG Dam, is effectively returned to the surface as groundwater discharges to Salt Water Gully immediately downstream of these dams. Consequently, the net groundwater contribution from these dams is minimal. Groundwater discharging to SWG Dam had the highest lithium concentrations, which rapidly rose to 1.10 mg/L by 2025 then stabilised at 1.15 mg/L by 2070. This is above the drinking water, non-potable, and livestock WQGs but below the irrigation and freshwater aquatic WQGs.
– Overall, the groundwater discharge to creeks in the Study Area shows an increase in arsenic concentrations from a baseline of 0.0005 mg/L, up to around 0.005 mg/L. Salt Water Gully had the highest arsenic concentrations which rapidly rose to 0.27 mg/L by 2030 then gradually increased to 0.28 mg/L in the long term, which is above all of the adopted WQGs other than for livestock use.
– The average lithium concentration in the groundwater discharge to the Eastern Catchment creeks reaches 0.18 mg/L within ~200 years and stabilises at 0.19 mg/L within ~700 years. This is above the drinking water and non-potable WQGs but below the livestock, irrigation, and freshwater aquatic WQGs.
– The impacts of the leaching from waste rock in the WRLs to the aquifer will likely be limited to the areas beneath and immediately adjacent to the footprints of the WRLs. Accordingly, risks to groundwater users beyond the immediate periphery of the WRLs are assessed as low. It should be noted that the Study has not considered construction buffers, seepage management measures, or capping of the WRLs after closure, all of which would mitigate these low risks to groundwater users further.

Risks to Surface Water

Surface water and mass balance modelling of the key CoPCs (lithium, arsenic, sulphate, and nitrate) was undertaken for three scenarios, namely the Base Case (as for the groundwater modelling), an Impact Case 1 (as for the Impact Case in the groundwater modelling), and Impact Case 2 (as for Impact Case 1 but without SWG Dam). This modelling highlights the following general observations:

– Establishment of the SWG WRL results in increased CoPC concentrations discharging to Salt Water Gully and Cascade Gully into Hester Brook. The increases in CoPC concentrations in Hester Brook at Hester Hill are reduced with SWG Dam in place due to the dam containing much of the impacted runoff. Although there is a significant dilution effect from the flows in Hester Brook upstream of Salt Water Gully, the CoPC concentrations in the lower reaches of Hester Brook increase without the dam in place.
– Streamflow at the Salt Water Gully outlet to Hester Brook reduces by ~67% on average from the Base Case to Impact Case 1 (reflecting the impact of SWG Dam) and increases by ~2% on average from the Base Case to the Impact Case 2 (reflecting the changed runoff characteristics by SWG WRL). Streamflow at the Cascade Gully outlet to Hester Brook also increases (by ~10% on average) from the Base Case to both Impact Cases 1 and 2 (also reflecting the changed runoff characteristics by SWG WRL).
– Streamflow in Hester Brook reduces by ~5% on average from the Base Case to the Impact Case 1 (reflecting the impact of SWG Dam and changed runoff characteristics by SWG WRL) and increases by ~1% on average from the Base Case to the Impact Case 2 (reflecting the changed runoff characteristics by SWG WRL).

Risks to surface water receptors have been assessed using a heatmap approach to assess the multiple considerations required. The simulated 95th percentile concentrations (i.e., those associated with very low flows) have been compared to the various WQGs. The risk ratings for assessing the modelling results are:

– Very Low Risk: Concentration below criteria (reasonable worst-case concentration below criteria).
– Low Risk: Concentration exceeds criteria by less than a factor of three (reasonable worst-case concentration marginally above criteria).
– Medium Risk: Concentration exceeds criteria by more than a factor of three and less than a factor of 10 (reasonable worst-case concentration significantly above criteria, unlikely to be high enough to cause an acute risk exposure to human health and/or environment).

– High Risk: Concentration exceeds criteria by more than a factor of 10 (reasonable worst-case concentration high, and potential for acute exposure to human health and/or environment).

The simulated 95th percentile concentrations of the key CoPCs within the various waterways were assessed against the respective WQGs and assigned a risk rating based on the level of exceedance (factor), which indicated the following:

– Lithium concentrations at all sites (except Hester Brook upstream of the Salt Water Gully confluence) and for all model scenarios exceed the drinking water and non-potable WQGs, but do not exceed the stock watering, freshwater aquatic, and irrigation WQGs.
– Arsenic concentrations at all sites do not exceed any of the WQGs for any of the model scenarios.
– Sulphate concentrations:
  - Exceed the drinking water WQG in Salt Water Gully and Cascade Gully for all model scenarios and in Hester Brook downstream of the Cascade Gully confluence for Impact Case 2.
  - Exceed the freshwater aquatic WQG in Salt Water Gully for all model scenarios and in Cascade Gully for Impact Cases 1 and 2.
  - Do not exceed the stock watering WQG at all locations for all model scenarios (no WQGs have been developed for irrigation and non-potable uses).
– Nitrate concentrations at all sites (except Hester Brook upstream of the Salt Water Gully Confluence) and for all model scenarios exceed the aquatic freshwater WQGs, but do not exceed the drinking water and stock watering WQGs (no WQGs have been developed for irrigation and non-potable uses).

Comparison of the simulated 95th percentile concentrations to the WQGs of the surveyed water uses in the various creeks indicates the following:

– Salt Water Gully Outlet to Hester Brook: The Talison water use survey indicates non-potable domestic and stock watering uses in the Salt Water Gully catchment. Non-potable domestic use (e.g. recreational use of impacted creek water) is assessed as being medium risk due to the elevated concentrations of lithium. Aquatic freshwater use is assessed as being medium risk due to the elevated concentrations of nitrate (and sulphate, which is assessed as low risk). Stock watering use is assessed as being very low. The assessed risks do not change from the Base Case to Impact Cases 1 and 2, indicating that the existing impacts dominate in this catchment.
– Cascade Gully Outlet to Hester Brook: The Talison water use survey also indicates non-potable domestic and stock watering uses in the Cascades Gully catchment. The risks to the various water uses are assessed as being the same as for Salt Water Gully.
– Hester Brook Downstream of Cascade Gully Confluence: The Talison water use survey indicates drinking water, non-potable domestic, and stock watering uses in the incremental catchment between the Salt Water Gully and Cascade Gully confluences. Drinking water use is assessed as being high risk due to the elevated concentrations of lithium.
– Hester Brook at Hester Hill Gauging Point: The Talison water use survey indicates drinking water, non-potable domestic, irrigation, and stock watering uses in the incremental catchment between the Cascade Gully confluence and the gauging point. The risks to the various water uses are assessed as being the same as for the incremental catchment between the Salt Water Gully and Cascade Gully confluences. Irrigation use is assessed as being very low.

Water and mass balance modelling of the other CoPCs was not undertaken, and the assessments of these CoPCs was based on factoring the 95th percentile simulated lithium concentrations in Hester Creek at the Hester Hill gauging point against the average measured concentrations at the existing discharge locations. The assessment of the other CoPCs at the Hester Hill gauge indicates most of these are below the respective WQGs, except for:

– Rubidium, which is assessed as a low risk for the freshwater aquatic environment and potable use.
– Thallium, which is assessed as a low risk for the freshwater aquatic environment.
– Vanadium, which is assessed as a low risk for drinking water use.

Existing Mine Site Management

The current elevated concentrations of lithium in the creek waters are likely the result of elevated background concentrations (pods of naturally occurring pegmatite ore containing lithium within the mineralised zone), disturbance from historical dredge mining activities, and discharges from Floyds WRL. The current elevated concentrations of nitrate (and sulphate) are also likely to be the result of discharges from the existing Floyds WRL.

In the short term, management of the discharges from Floyds WRL and the future approved S1 WRL will be required to prevent discharges into the receiving environment. Waste rock seepage from the toes of these WRLs can be managed by collection and pump-back systems to prevent such discharges. Following closure, the WRL will require capping to mitigate generation of seepage due to ingress of rainfall and leaching of waste rock.

Management of the CoPCs emanating from the naturally occurring mineralised zones downgradient of these WRLs and from historical mining activities in Salt Water Gully would be more complex given the diffuse nature of these sources. Modelling of SWG Dam is seen to reduce the contaminant load discharged into Hester Brook significantly. As a result, construction of SWG Dam for mine water supply purposes would also be an effective pollution control measure.

TSF1 Reuse Management

The current distribution and extent of TSF1 CoPC impacts in the subsurface appear to be limited by the attenuation capacity and slow migration rates within the saprolitic clay aquifer. Any seepage to the east of TSF1 is intersected by a series of historical ponds and Vultans Pit, from which the seepage waters are returned to the Mine Water Circuit (MWC). An elevated north-south access road dams the seepage from discharging further eastwards to areas off-the mine site boundary (i.e., to Cemetery Creek and Cascade Gully). Any overflows from Vultan's Pit discharge towards and are captured in the central lode open pit (and sumps).

Surface water monitoring in Cemetery Creek supports that TSF1 impacted water is not discharging above the concentrations that are consistent with the background, which is likely influenced by historic operations in the early 1900s and the mineralised setting of the area (GHD, 2023f). Given that there is no evidence to indicate that the TSF1 groundwater impacts are discharging to Cemetery Creek, the groundwater pathways with respect to eastern flow are not recognised, and the exposure scenario is considered incomplete.

Although this risk assessment indicates that the TSF1 seepage does not currently pose an adverse risk to the receptors in the Eastern Catchments Study Area, the groundwater should be monitored to confirm the distribution of impacts. The eastern groundwater flow path from TSF1 via the seepage ponds area towards Cemetery Creek should include a monitoring program to identify impacts which may discharge into the Cemetery Creek (monitoring well network likely requires inclusion of additional bores).

SWG WRL Management

Regarding the available CoPC data, the results of this preliminary risk assessment indicate that to maintain the beneficial uses of Hester Brook, the waste rock seepage from SWG WRL will require management during operations and closure. Prior to development, the design of the WRL should include a suitable setback or buffer from the groundwater discharge areas along the creeks to allow for maintenance of riparian vegetation, establishment of a drainage impact mitigation zone, and to facilitate impacted drainage collection. During operations, waste rock seepage from S1 and SWG WRLs can be managed by collection and pump-back systems. Post closure, when seepage collection ceases, the WRL will require capping to mitigate generation of seepage due to ingress of rainfall and leaching of waste rock.

The management options should be conceptualised, and predictive simulations undertaken to demonstrate the effectiveness of controlling seepage discharge. The new simulations should include the full range of CoPCs based on the kinetic leach testing currently underway.

SWG Dam Management

The net contribution of water seeping from SWG Dam (and therefore CoPCs) is minimal. The design of the dam should ensure that effective seepage control measures are included to minimise such seepage.

The magnitude of the passing flows will impact this containment of CoPCs and the need for passing flows and the magnitude thereof should be investigated in more detail.

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1. Introduction

1.1 Background

GHD Pty Ltd (GHD) was engaged by Talison Lithium Pty Ltd (Talison) to undertake the Eastern Catchment Hydrology Study (the Study) which entails the hydrological and hydrogeological assessments of proposed new facilities on the mine site and subsequent preliminary assessment of the environmental and human health risks arising from these activities. These facilities are:

– Construction and operation of a new water dam within the mine water supply network, namely Salt Water Gully (SWG) Dam.
– Establishment of the new SWG Waste Rock Landform (WRL).
– Reuse of all or part of Tailings Storage Facility #1 (TSF1) following removal of existing material for reprocessing, either for tailings or water rock deposition.

A plan of the proposed facilities is provided in **Figure 1.1**.

The purpose of the Study is to complete a baseline investigation and preliminary risk assessment of the Eastern Catchments to understand the efficacy of existing management and monitoring of approved activities and the above additional proposed activities. The Study is also intended inform the need for management measures for incorporation into the proposed facility designs and the findings will be considered and incorporated into various Environmental Management Plans as appropriate. In doing so, the Study will support the applications for the various environmental approvals for the facilities.

The Study deliverables are:

– Data Review and Gap Analysis (GHD, 2023a).
– Conceptual Site Model (GHD, 2023b).
– Water Resources Monitoring Plan (GHD, 2023c)
– Groundwater Modelling (GHD, 2023d).
– Surface Water and Mass Balance Modelling (GHD, 2023e).
– Preliminary Risk Assessment (this report).

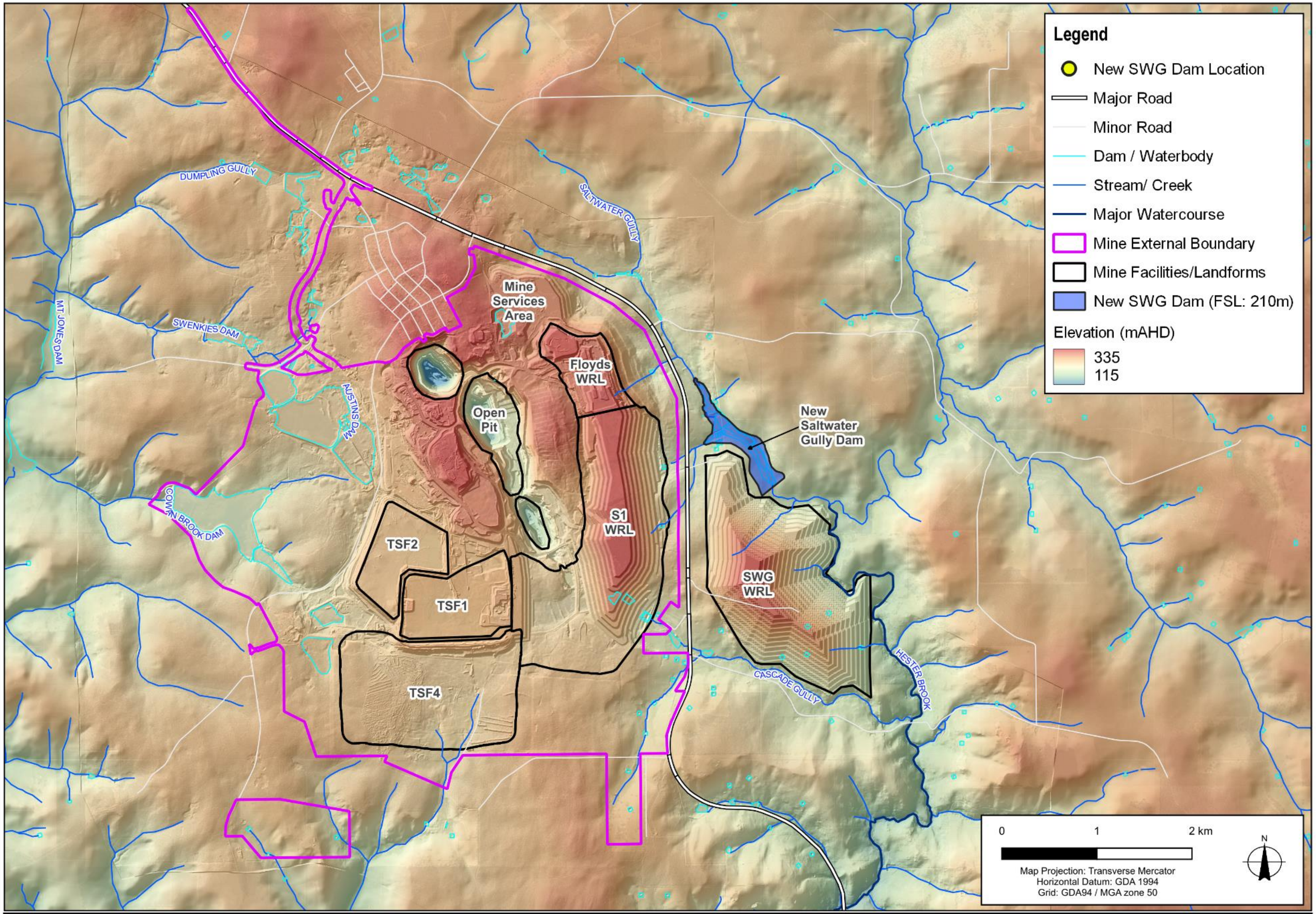
This report documents the Preliminary Human Health and Environmental Risk Assessment (PHHERA) of the surface water and groundwater emissions from SWG WRL and the operation of SWG Dam and provides recommendations for the management of the emissions where such risks may be unacceptable. It should be noted that the preliminary risk assessment of the reuse of TSF1 has been documented separately by GHD (2023f).

1.2 Study Area

The Study Area is defined by the domains of the surface water and groundwater models.

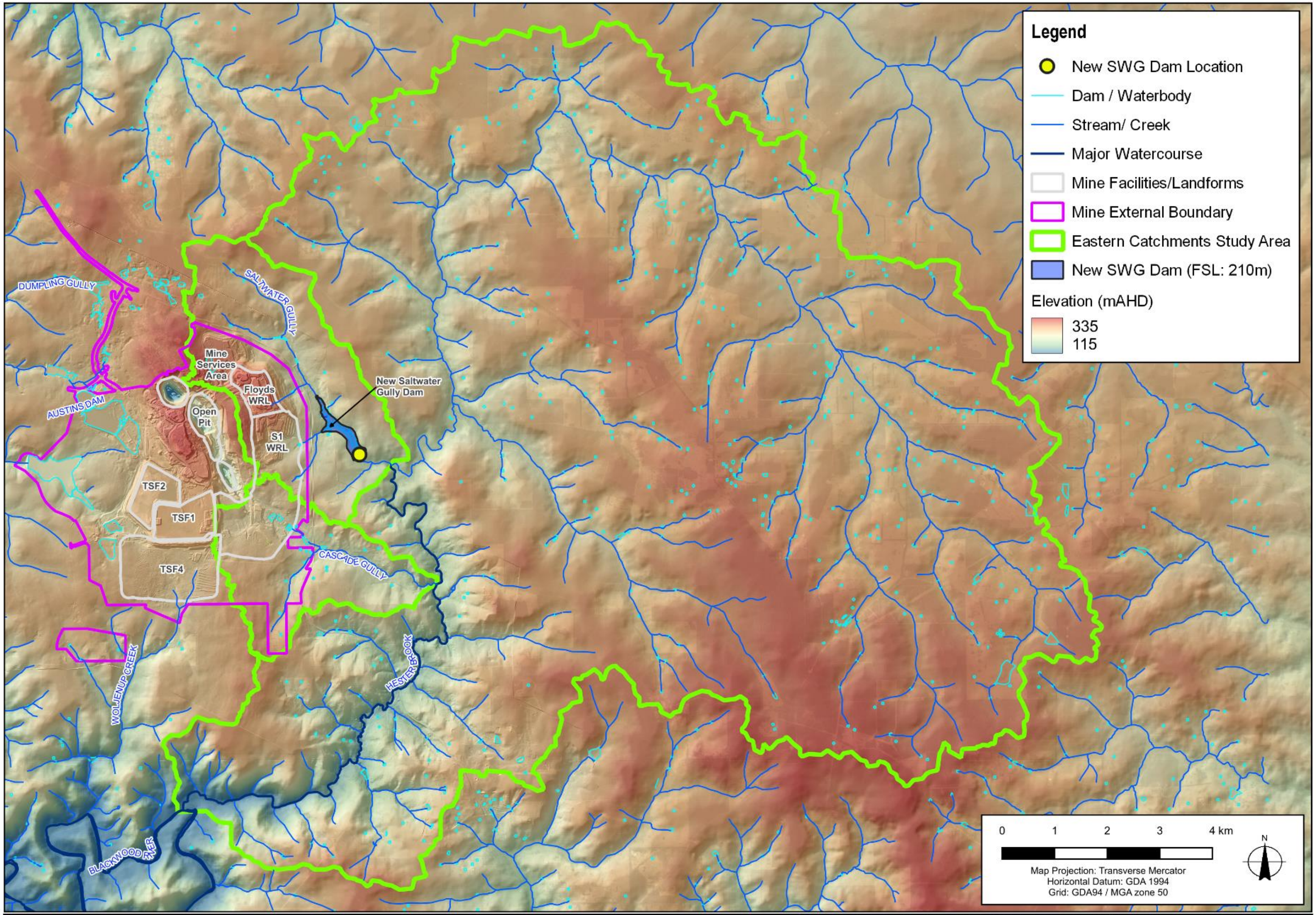
The surface water model domain (GHD, 2023e) encompasses the construction footprints of SWG WRL, SWG Dam, the upstream contributing catchment areas (including Floyds WRL), and the downstream receiving environment. This includes Hester Brook and its tributaries up to the confluence with Blackwood River. A plan of the surface water model domain is provided in **Figure 1.2.**

The site wide groundwater model was extended to accommodate the potential groundwater impact areas downgradient of the proposed activities (GHD, 2023d). A plan of the groundwater model domain is provided in **Figure 1.3**. The groundwater model domain matches the surface water model domain downstream of the confluence of Hester Brook and Salt Water Gully.



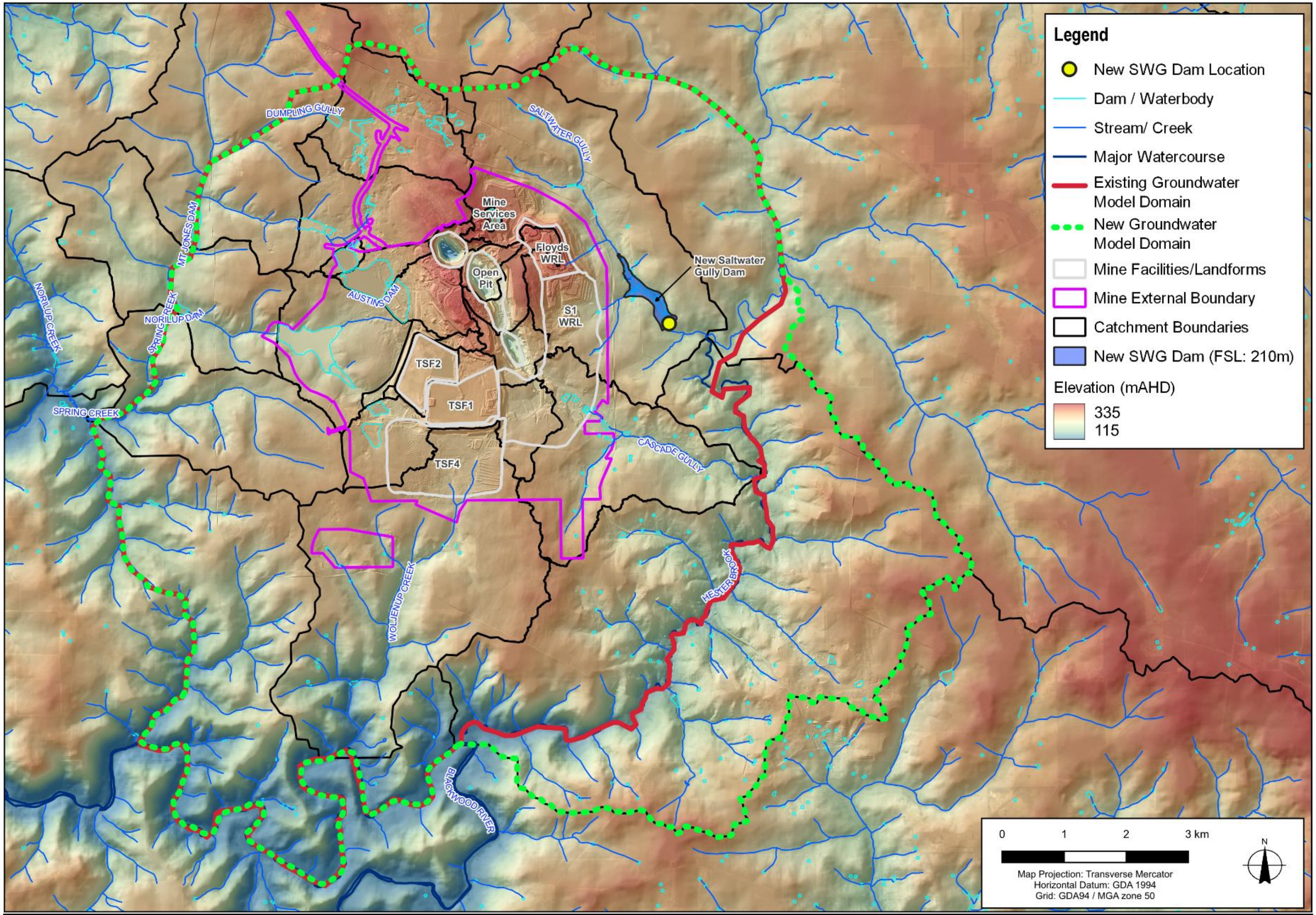
Data Source: GHD - New SWG Dam (2023). Talison - Mine External Boundary (2023). Elevation (2023). Landgate - Major Road/ Minor Road (2020), Dam / Waterbody, Major Watercourse, Minor Watercourse, Stream / Creek (2020), Elevation (2020).

Figure 1.1: Plan of the Proposed Facilities



Data Source: GHD - New SWG Dam, Eastern Catchments Study Area (2023), Mine Facilities/ Landform (2022). Talison - Mine External Boundary (2023), Elevation (2022). Landgate - Dam / Waterbody, Major Watercourse, Minor Watercourse, Stream / Creek (2020), Elevation (2020).

Figure 1.2: Surface Water Model Domain



Data Source: GHD - New SWG Dam (2023), Mine Facilities/ Landform (2022), Catchment Boundaries (2023), Existing/ New Groundwater Model Domain (2023). Talison - Mine External Boundary (2023), Elevation (2023). Landgate - Dam / Waterbody, Major Watercourse, Minor Watercourse, Stream / Creek (2020), Elevation (2020).

Figure 1.3: Groundwater Model Domain

1.3 Purpose and this Report

The development of SWG WRL has the potential to impact the downgradient environment through impacted runoff and seepage into the surface water and groundwater systems. The construction and operation of SWG Dam has the potential to impact the downstream streamflow and water quality. The purpose of this report is to examine whether any Contaminants of Potential Concern (CoPCs) emanating from these facilities have the potential to harm human health and/or the downgradient ecological systems. This PHHERA is based on the approach documented in the Department of Water and Environmnet Regulation (DWER) *Contaminated Site Guidelines* (DWER, 2021) regarding identification of the *Source-Pathway-Receptor* and exposure scenarios, as follows:

Source: Discharge of impacted waters (runoff and leachate) onto the surface and subsurface at or near the footprint of the facilities.

Pathway: Mobilisation of the impacted waters into the surface water systems (creeks/rivers), seepage into the groundwater systems and mobilisation in the direction of groundwater flow.

Receptors: Beneficial users of the surface and groundwater systems, impacted by runoff and/or seepage from the facilities, including impacts to human health and the environment.

The DWER *Contaminated Site Guidelines Series* also promotes the following generalised tiered approach:

Tier 1: A qualitative risk assessment whereby the CoPCs are screened against guidelines and the potential for the CoPCs to migrate offsite and impact the receiving environment.

Tier 2: Secondary risk assessment(s) to quantify, or better understand, the CoPCs and/or exposure pathways and/or receptors.

Tier 3: Additional focused studies as required, which may include eco-toxicological studies, site surveys or quantification of specific exposure routes and scenarios (e.g., effects on aquatic biota).

The focus of this risk assessment is the Tier 1 level.

1.4 Framework and Methodology

The risk assessment has the following generalised inputs and scope based on the DWER guidelines (DWER, 2021):

– Sources:
  - Derive list of CoPCs from existing test work of the leaching of the waste rock, tailings, and water dams, which is documented in this report.
  - Undertake predictive modelling to quantify the fluxes (concentrations and volumes) of CoPCs discharging from SWG WRL and impacted by the operation of SWG Dam, which is documented separately in GHD (2023d) and GHD (2023e).

– Pathways:
  - Develop a conceptual site model defining the pathways via the surface and subsurface flows, which is documented separately in GHD (2023b).
  - Assess groundwater adsorption of CoPCs within the aquifer matrix and CoPC fate and transport through mapping the seepage migration direction and fate of leachate/seepage/CoPCs in the subsurface, which is documented separately GHD (2023d).
  - Assess surface water discharges and dilution of CoPCs through mixing with background surface water and calculate indicative concentrations leachate/seepage/CoPCs within the creeks and drainage lines, which is documented separately in GHD (2023e).

– Receptors:
  - Identify, map, and list the receiving environments which may be impacted by the discharge of leachate/seepage/CoPCs, which is documented in this report.
  - Quantify the CoPCs concentration at the receptor location and compare with relevant guidelines to provide a finding of “adverse risk” to receptor or otherwise, which is documented in this report.

1.5 Limitations

1.5.1 General Limitations

This report has been prepared by GHD for Talison and may only be used and relied on by Talison for the purpose agreed between GHD and Talison as set out in **Section 1.3** of this report.

GHD otherwise disclaims responsibility to any person other than Talison arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described throughout this report. GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

Depth of analysis is determined by the extent of available datasets; analysis may be restricted in locations that are data poor at the time of reporting. Where this is the case, extrapolation of data trends across a broader scale is applied to support assumptions used in conceptually modelling datasets across all areas of interest.

GHD has prepared this report on the basis of information provided by Talison and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.5.2 Groundwater Modelling Limitations

GHD developed the groundwater model for, and for the benefit and sole use of, Talison to support the assessment of the relative impact of the proposed SWG Dam, establishment of SWG WRL, and reuse of TSF1 on the groundwater receiving environment and must not be used for any other purpose or by any other person.

Numerical groundwater models are a mathematical representation of complex real-world systems. The physical domain of interest, comprising layers of rocks and sediments, is discretised into a number of cells and the parameters that control the movement of groundwater and solutes through these layers is prescribed to each cell. Inputs that vary over time are discretised into a limited number of stress periods and time steps. The governing groundwater flow and solute transport equations are solved by the code to compute hydraulic head, concentrations, and fluxes into and out of each cell. This mathematical representation of a natural physical system, using a finite number of cells, is a necessary simplification that is inherent in all numerical modelling. The degree of simplification is influenced by factors including the availability of data, scale of the model, intended model use and computational demand of modelling techniques.

As with all models, the level of uncertainty is larger in parts of the model where observations are not available to constrain the model parameters or benchmark the performance of the model. Site-specific data are available for parameters such as horizontal hydraulic conductivity of the upper weathered materials, but uncertainty remains in areas where data is currently absent or limited, such as the physical and chemical properties of the tailings and the chemical properties of the underlying sediments and rock. As additional data become available over time, the model can be periodically updated and the level of confidence in model's outputs would increase accordingly.

An important limitation of the modelling and associated conclusions of this report are based on observation data from a very limited period of time. For this model, as is typical for most mine simulations, in the order of decades of water level and mine progression data are available for calibration, but the model needs to run for hundreds of years post-closure until quasi-steady-state conditions are achieved. As such, the data are only representative of current climatic conditions, and the system may behave differently beyond those conditions experienced in the limited observation data set. This may have important implications for the effectiveness of the remedial system as modelled in this study under significantly different long-term climatic conditions. However, the limited fluctuation in groundwater levels in response to seasonal rainfall variations suggests that climate variability impact would not be significant, compared to other impacts such as mine dewatering.

1.5.3 Surface Water and Mass Balance Limitations

GHD (2023e) developed the water and mass balance model for, and for the benefit and sole use of, Talison to support the assessment of the relative impact of the proposed SWG Dam, establishment of SWG WRL and re-use of TSF1 on the surface water receiving environment and must not be used for any other purpose or by any other person.

The model is a representation only and does not reflect reality in every aspect. The model contains simplified assumptions to derive a modelled outcome. The actual variables will inevitably be different to those used to prepare the model. Accordingly, the outputs of the model cannot be relied upon to represent actual conditions without due consideration of the inherent and expected inaccuracies. Such considerations are beyond GHD's scope.

The information, data, and assumptions used as inputs into the model are from publicly available sources or provided by or on behalf of the Talison, (including possibly through stakeholder engagements). GHD has not independently verified or checked Inputs beyond its agreed scope of work. GHD's scope of work does not include review or update of the model as further Inputs becomes available.

The model is limited by the mathematical rules and assumptions that are set out by GHD (2023e) or included in the model and by the software environment in which the model is developed.

The model is a bespoke customised model and not intended to be amended in any form or extracted to other software for amending. Any change made to the model, other than by GHD, is undertaken on the express understanding that GHD is not responsible, and has no liability, for the changed model including any outputs.

1.5.4 Assumptions

The groundwater modelling is based on the assumptions that the previously used hydraulic and geochemical properties reported by GHD (2020) and GHD (2023g), and the current TSF and WRL designs are representative of future site conditions. Site-specific adsorption isotherms based on adsorption testing have been used in solute transport modelling of lithium and arsenic and are assumed to be appropriate given the relatively low concentrations of key solutes present in the leachate and decant.

The following assumptions and limitations apply to the water and mass balance modelling:

– The mass balance assumes that the CoPCs are conservative substances that do not decay over time or react with the other substances (i.e., only subject to concentration or dilution). All water storages are assumed to be well mixed and always contain a homogenous mixture (i.e., stratification not considered). This can result in "artificially" elevated CoPC concentrations at low dam levels and flows in the receiving environment.
– The staged construction of the various facilities (SWG Dam, SWG WRL) is not modelled. The model incorporates the facilities as a step change on the date construction is assumed to be completed.
– SWG Dam is assumed to start empty once it's constructed.
– Future climate scenarios were not assessed in this report as it's outside the agreed scope of work.

2. Conceptual Site Model

2.1 Overview

The Conceptual Site Model (CSM), reported by GHD (2023b), was developed to better understand the potential seepage pathways for migration of the CoPCs to the downgradient receptors and endpoints. Rigorous conceptual modelling of the existing datasets creates a more robust understanding of groundwater and surface water characteristics and seepage potential to inform the development of the numeric simulation models.

The development (and constraints) of the CSM was based on a review of the following data and information:

– Local and regional hydrogeology.
– Potential surface and groundwater interactions.
– Groundwater flow behaviour through identified hydrogeological units.
– Defined groundwater flow paths and solute transport within groundwater systems and discharges to surface water.
– Beneficial uses of surface and groundwater.

Key aspects of the CSM are provided in the following sections for ease of reference, the full details of which can be found in GHD (2023b).

2.2 Hydrological Setting

The extent of the surface water model domain, depicted in **Figure 1.2**, comprises the entire catchment of Hester Brook down to its confluence with the Blackwood River. Hester Brook rises northeast of Greenbushes and has two main tributaries that drain parts of the mine site, namely Salt Water Gully and Cascades Gully.

The combined catchment areas of Salt Water Gully and Cascades Gully makes up ~10% of the total Hester Brook Catchment and are considered minor contributors to the overall flow in Hester Brook. Historical dredge mining was undertaken in the upper reaches of Salt Water and Cascade Gullies and Floyds WRL is also located in these areas, so the quality of the runoff from these areas may be impacted by these activities.

Continuous streamflow gauging is undertaken by Talison at the four licenced discharge points along the eastern boundary of the mine site, and one on Salt Water Gully. There is also a DWER streamflow gauge located on Hester Brook downstream of the mine site. The locations of the various streamflow gauging points are depicted in **Figure 2.1**.

The following conditions are noted from the streamflow data:

– Hester Brook flows perennially, but with a marked seasonal variation.
– Floyds North catchment also exhibits perennial flows, which is likely attributable to the storage and slow release of water from Floyds WRL (which makes up a significant portion of the catchment) as base flow throughout the year. This is likely to change once the WRL is capped with surface water being retained by the capped landform.
– Cemetery Dam, Floyds South and Carters Dam only flow seasonally, which is likely due to the smaller proportions of these catchments being made up of the WRL.
– Floyds North catchment contributes significantly greater flows than that of Floyds South catchment, despite similar catchment areas. The reason is likely the increased storage of water and slow release of water from the WRL in Floyds North.

The establishment of the new WRLs (S1 and SWG) will alter the catchments and consequently flows discharging off the site. The changes in catchment areas are detailed in **Table 2.1**. It should be noted that these catchment areas may change as the design of the landforms and associated drainage infrastructure are finalised.

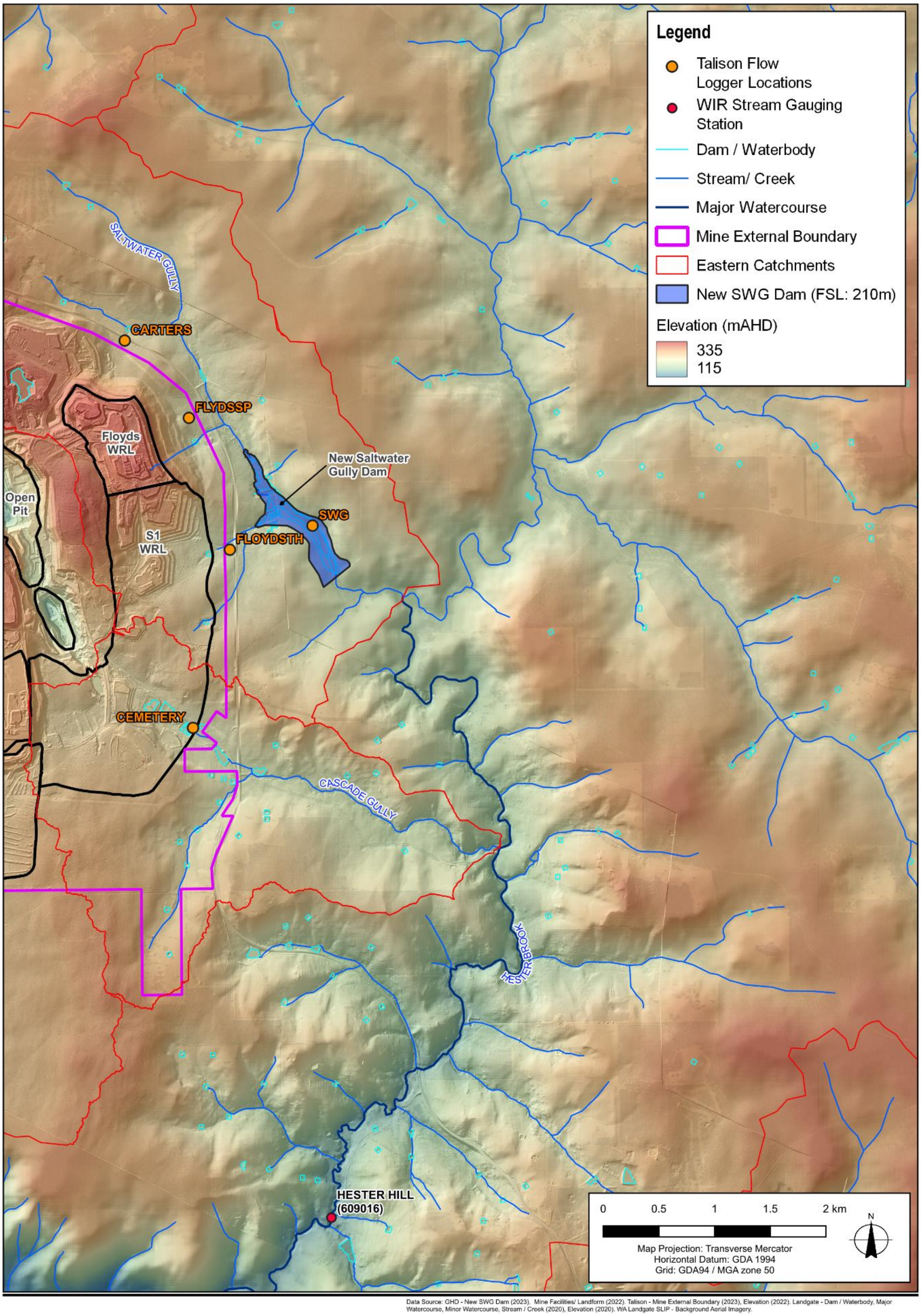


Figure 2.1: Existing Streamflow Gauging Locations

Table 2.1: Changes in Catchment Area (Ha) as a result of Constructing WRLs

Waste Rock Landform	Land use	Salt Water Gully	Cascade Gully	Hester Brook (Total)
Existing (Floyds & MSA)	Mine affected[1]	180	41	220
	Other[2]	1,072	603	18,296
	Total	1,252	643	18,517
Existing (Floyds & MSA) + Approved Floyds S1	Mine affected	190	40	230
	Other	986	555	18,164
	Total	1,176	595	18,394
Existing (Floyds & MSA) + Approved Floyds S1+ SWG	Mine affected	279	123	402
	Other	876	497	17,992
	Total	1,155	620	18,394

2.3 Hydrogeological Setting

2.3.1 Overview

Drilling results indicate that weathering of the Archean basement rocks occurs from surface to >20 m below ground level, with the profile comprising clays (saprolite) which are generally of low permeability and having low groundwater yields (GHD, 2018). The drilling information indicates increased groundwater flows in some areas at the transition zone between the clays and extremely weathered basement saprock (GHD, 2023h).

The rise of the groundwater levels in the saprock/bedrock layers during drilling/intersection of groundwater in the vicinity of TSF4 reported by GHD (2023h) support the understanding that the upper clays function as a confining layer in large areas of the site. Local groundwater systems are differentiated as shallow (that existing in surficial units above the confining clay layers) and intermediate (that in the saprock layer and fractured bedrock beneath the confining saprolite clays).

Sedimentary sequences have been deposited in paleo-drainage channels in areas around the mine site, which are incised into the saprolite/saprock profile and upper fractured bedrock. These paleo-drainage channels have been extensively mined for tin since the end of the Nineteenth Century. The thicknesses of the paleo-drainage channels are not well defined but appear to be ~5 m to ~10 m and are a maximum of ~30 m thick in the western part of the mine site adjacent to TSF2. The channels have been backfilled with dredge/sluice spoil, predominately comprising mixed sands and clays, during and following mining.

The palaeo-drainage channels coexist with more recent alluvial sand deposits, both of which occupy the topographic lows and form a shallow alluvial aquifer. The shallow alluvial aquifer is generally coincident with the surface water drainage system and, given that the water levels in the alluvia are close to the surface, this supports an assumption of a high degree of connectivity between surface water and shallow groundwater.

The alluvial profile consists of fine to medium sands and/or gravels composed of feldspathic/quartz and lateritic/ferrierite and transported gravelly clays. Drilling indicates laterally discontinuous zones of a thin (~1 m to ~2 m) laterite caprock, mostly observed in the vicinity of the Floyds WRL, forming a vuggy, porous lens of increased hydraulic conductivity above the impervious clay layers of the saprolitic profile. Infiltration through the deposited waste material is thought to migrate laterally down gradient along the lateritic caprock.

The common occurrence of water bodies within the alluvium is deemed to reflect the shallow groundwater levels. Within the shallow alluvial system, groundwater flow will generally follow local topography along current drainage lines and paleochannels. Given the low permeability of the underlying clays, this possibly non-contiguous shallow groundwater system demonstrates a restricted hydraulic connection in upland areas within the Archean basement. This is further supported by notable differences in the chemical profiles of the shallow and deep groundwater systems.

1 Mine affected catchment areas refers to the footprints of mine facilities.
2 Other refers to natural vegetation, forested and cleared for agriculture.

2.3.2 Hydrogeological Units

Geological logging from the drilling of the bores in the vicinity of TSF4 reported by GHD (2023h) and in other parts of the site reported by GHD (2018) (see bore locations in **Figure 2.2**) indicates the following geological profile:

1. Surficial/shallow unit:
   - Transported/alluvial materials: Medium sands, lateritic gravels, and gravelly clay, dredge material (historic mine deposition).
   - Fine to medium grained quartz/feldspathic sands averaging ~1 m to ~3 m thick.
   - Surficial laterite averaging ~1 m to ~2 m thick.
2. Intermediate unit:
   - The upper basement rocks typically develop lateritic weathering profiles ~20 m to ~50 m thick, with a saprolitic profile comprising upper and lower clay layers, which yield little groundwater flow and have low or negligible permeability.
   - Upper saprolitic clay: Pallid, leached saprolitic clays and highly oxidised bedrock.
   - Lower saprolitic clay: Non-pallid, darker saprolitic clays.
   - Transition zone of saprock/moderately oxidised bedrock defines the base of the saprolitic profile.
3. Basement Unit:
   - Fresh bedrock (not oxidised) which exhibits a low permeability (fractured bedrock).

2.3.3 Groundwater Movement

2.3.3.1 Recharge

Groundwater recharge mechanisms within the mine boundary relate to TSF seepage, infiltration through material deposited within WRL boundaries, and infiltration from rainfall falling directly upon areas where alluvial sands and gravels are expressed at the surface.

Groundwater levels in the shallow groundwater system indicate seasonal and/or episodic surface water features that can be categorised as expressions of the water table and represent recharge points in topographic lows within the mine boundary. These would also be discharge points at times when groundwater is expressed.

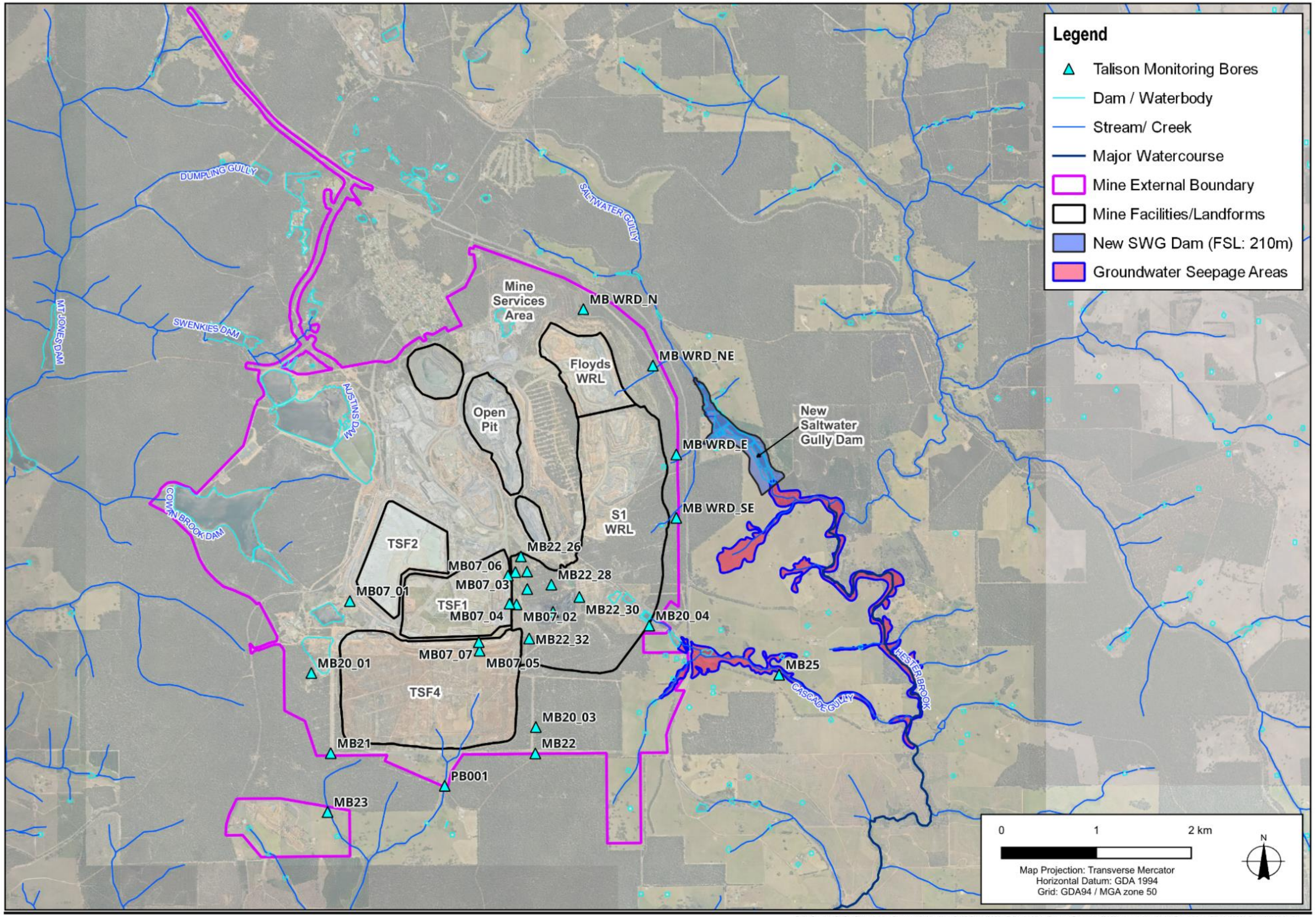
2.3.3.2 Groundwater Levels and Discharge

Groundwater discharge points are reflected closely by the network of local and dams, creeks and streams depicted in **Figure 2.2**. The overall radial flow pattern exhibited outside the central mining open pit operations area suggests groundwater discharges into Cowan Brook Dam, Clear Water Dam and Austins Dam in the West, Woljenup creek to the South, and Cascade Gully, Salt Water Gully and potentially as far as Hester Brook in the East.

The localised flow pattern observed within the bounds of the open pit mining area suggests the majority of the groundwater, moving through the pattern described, discharges into the open pits. The most notable groundwater discharges within the Study Area are the primary receptors of Cascade Gully and Salt Water Gully, both tributaries to Hester Brook.

2.3.3.3 Groundwater Levels

The monitoring bore networks MB20, MB22 and MB WRD (see **Figure 2.2**) provide groundwater level monitoring datasets in specific areas of the Eastern Catchments within the mine boundary. The networks are concentrated in the southwestern corner of the Eastern Catchments, except for the MB WRD bores, which are situated along the eastern edge of Floyds WRL and the future S1 WRL. Groundwater contours across the extent of the current model boundary created from groundwater level monitoring across the entirety of the mine site are depicted in **Figure 2.3**.



Data Source: GHD - Groundwater Seepage Areas, New SWG Dam (2023). Talison - Mine External Boundary (2023) . Landgate - Major Road/ Minor Road (2020), Dam / Waterbody, Major Watercourse, Minor Watercourse, Stream / Creek (2020), Elevation (2020).

Figure 2.2: Groundwater Monitoring Bores and Discharge Areas

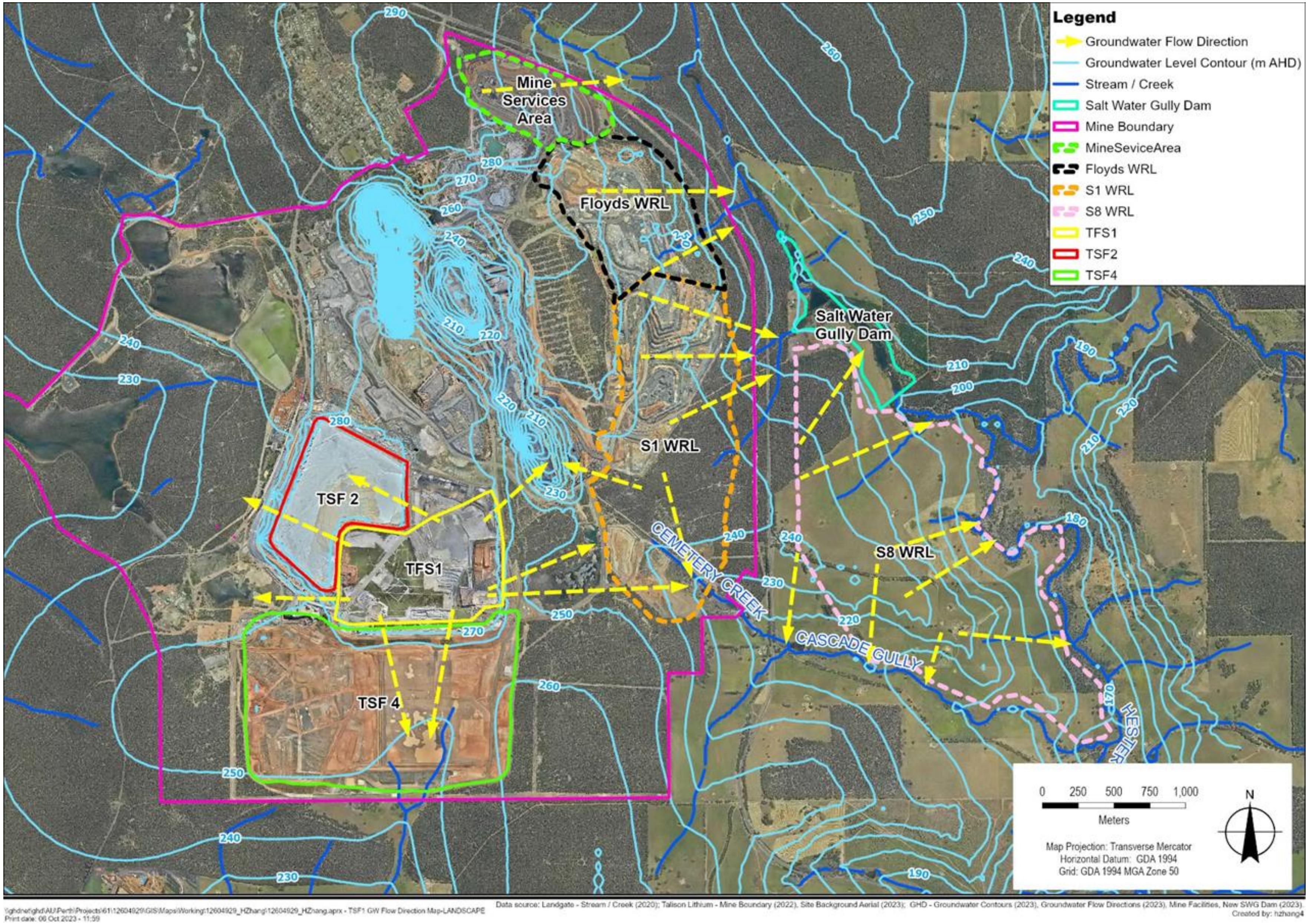


Figure 2.3: Groundwater Level Contours and Flow Directions from Groundwater Model (GHD, 2023d)

The contours indicate a radial flow pattern to the east, south and west of the mine operations, with an overall southerly flow trend. To the north, groundwater levels of ~270 mAHD to ~290 mAHD are observed, with the groundwater gradient sloping south through the mine site (~240 mAHD to ~270 mAHD). The gradient tends to drop quite steeply to the west of the mine boundary, with contour arcs depicting levels declining to ~110 mAHD in the south-western corner and along the southern boundary of the existing model domain.

2.3.3.4 Groundwater Flow Paths

The common occurrence of groundwater within the alluvium is associated with the expression of groundwater at the surface. Within the shallow alluvial system, upon infiltrating the soil profile within recharge zones groundwater flow will generally follow local topography, along current drainage lines and paleochannels. The paleochannels also, generally, reflect surface water drainage lines along topographical lows and discharging to local water bodies or to the open pits of the mining operation itself.

Zones of lateritic caprock within the surficial profile create a preferential pathway for infiltration in the WRL area. Rainfall infiltrates through the WRD material, then primarily moves laterally down-gradient through the thin laterite caprock along the top of the saprolitic profile, discharging into Salt Water Gully to the east, and joining the paleo-drainage channels flowing north into the open pits to the west.

Groundwater levels across monitoring bores MB22_27, MB22_28 and MB30 indicate groundwater flows through lenses of re-deposited gravel and clay within the mine boundary, confirming the heterogenous nature of the shallow groundwater system, assumedly because of the historical deposition of different mine waste materials. Within the immediate vicinity of TSF1 and the southern end of the open pit operations, groundwater flow is northwards, towards the open pits, while at the southern end of the WRL, groundwater flows in a south-easterly direction, beneath Cascade Gully.

2.4 Receiving Environment

2.4.1 Groundwater Dependent Ecosystems

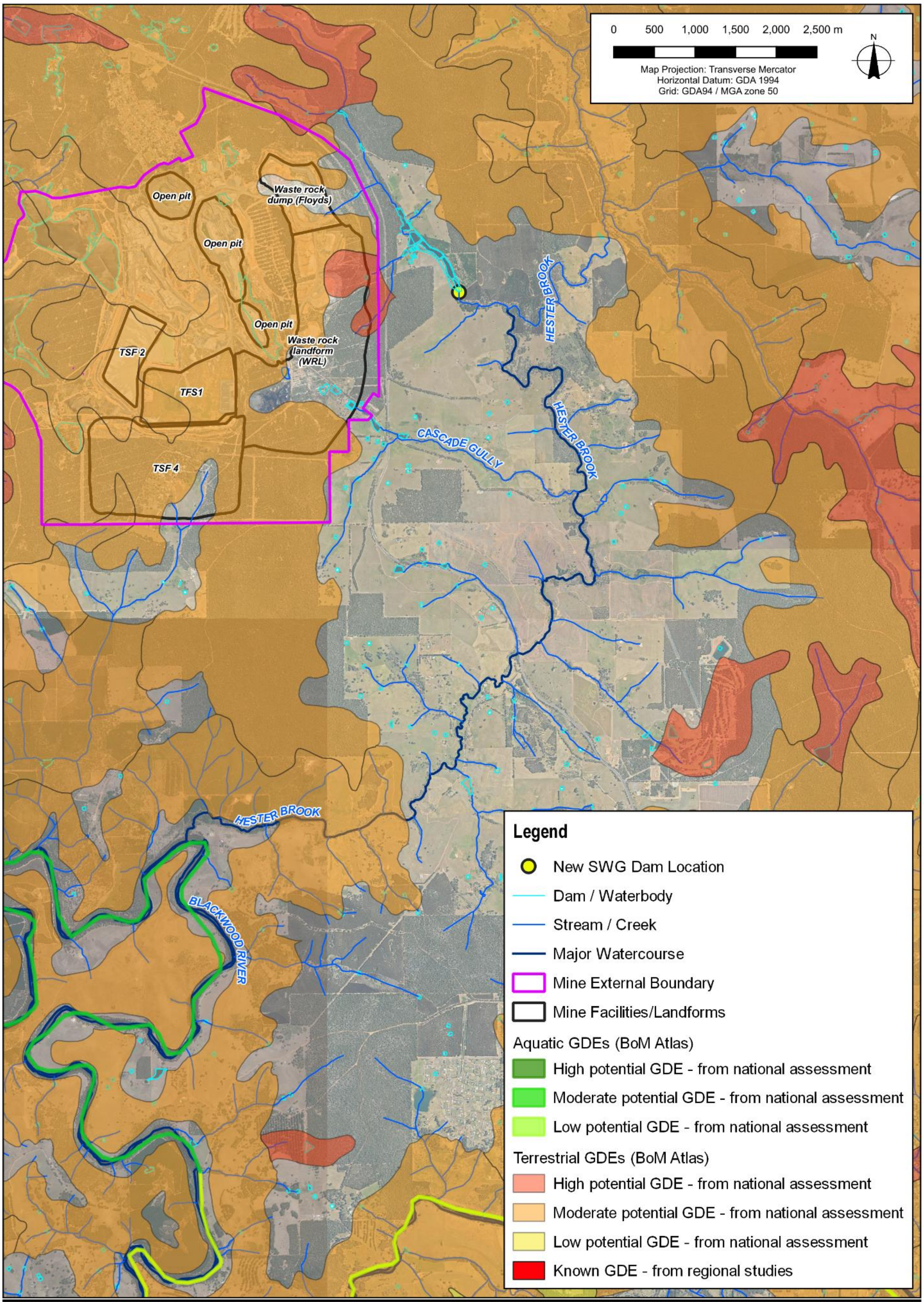
The Groundwater Dependent Ecosystems (GDE) Atlas[3] (GDE Atlas) hosted by the Bureau of Meteorology was utilised to ascertain the nature and extent of GDEs within the receiving environment. **Figure 2.4** illustrates the mapped areas of GDEs, from which the following is noted:

– Low potential Aquatic GDE’s mapped in the Blackwood River.
– Moderate potential Terrestrial GDE’s mapped in Hester Brook, near the confluence with Blackwood River in an area that is predominantly cleared.
– Subterranean GDEs have not been analysed for this area.
– No GDE’s mapped in the riparian areas along the streams in the receiving environment until near the confluence of Hester Brook and Blackwood River.
– There are no known GDE’s mapped in the study area that were derived from regional studies, instead the GDEs have been inferred based on the national scale assessment method which considers the environmental setting.

As the mapped GDE’s are based on the environmental setting rather than on-site surveys, it is unlikely that any remnant GDE’s exist, especially considering that the areas mapped as having potential GDEs are predominantly cleared.

The modelled maximum groundwater levels for the current (2023) mine development are presented in **Figure 2.5**, which indicates that there are areas adjacent to Salt Water and Cascades Gullies and the lower Hester Brook where groundwater is at or within 1 m of the surface. Although these areas may have supported GDEs in the past, these are now mostly cleared, which supports the conclusion that management of flows to sustain GDEs is not required.

[3] http://www.bom.gov.au/water/groundwater/gde/



Data Source: GHD - New SWG Dam Location (2023). Mine Facilities/ Landform (2022). Talison - Mine External Boundary (2022). Landgate - Dam / Waterbody, Major Watercourse, Minor Watercourse, Stream / Creek (2020). BoM - Aquatic GDEs, Terrestrial GDEs (2023). WA Landgate SLIP - Background Aerial Imagery.

Figure 2.4: Groundwater Dependent Ecosystems

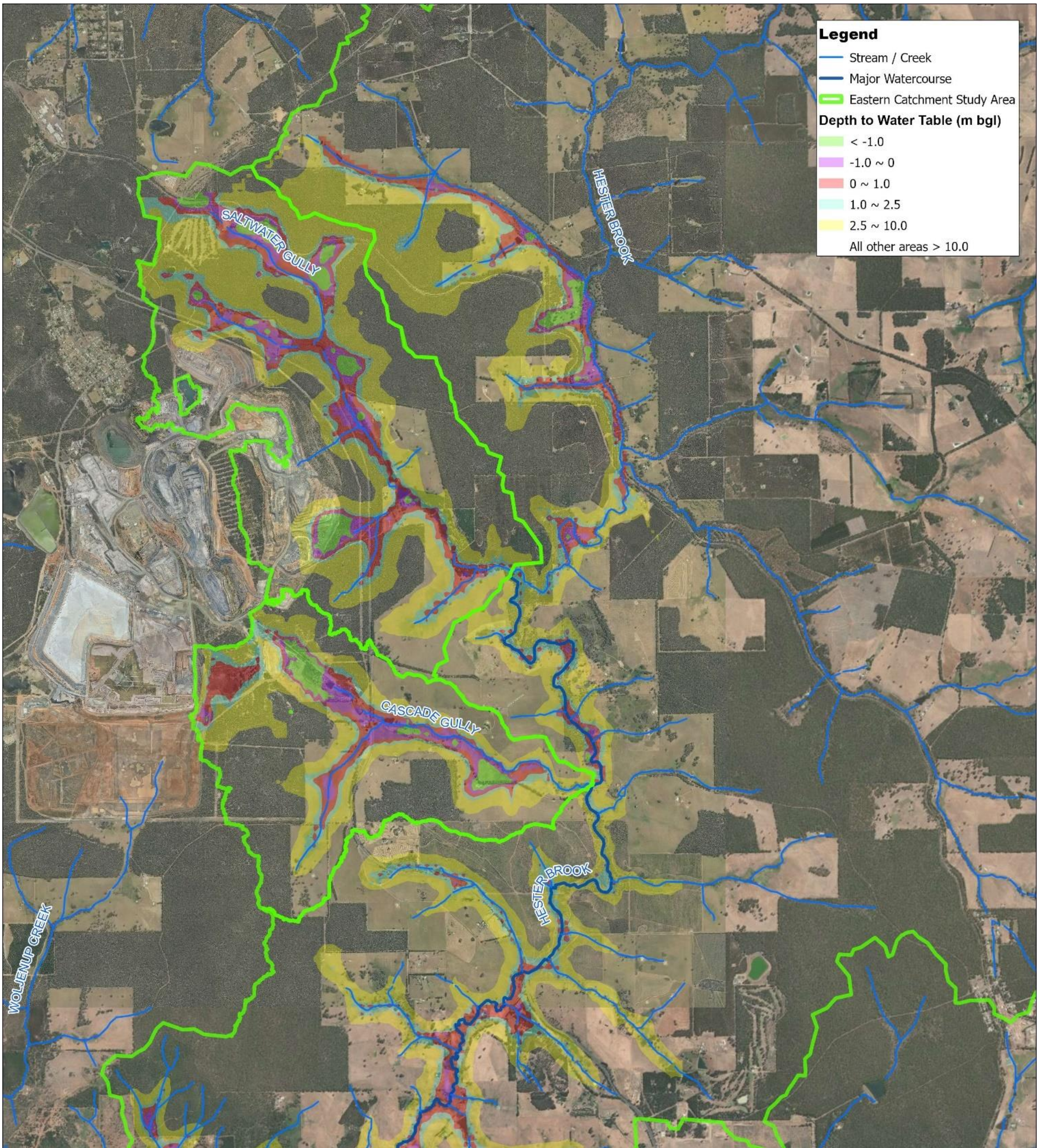


Figure 2.5: Modelled Maximum Groundwater Levels in 2023

2.4.2 Downstream Aquatic Environment

SLR (2022) completed a desktop assessment of the ecology and habitat condition at four sites upstream of the proposed SWG Dam wall (including two sites each upstream and downstream of the Floyds North discharge monitoring point) and four sites downstream of the proposed SWG Dam, including two sites each in Salt Water Gully and Hester Brook (see **Figure 3.1** for locations).

The results of these assessments are summarised as follows:

– The aquatic habitat upstream of the Floyds North monitoring point was assessed as near pristine condition, with no livestock access, very few weeds, and comparatively minor points of erosion.
– Sites located downstream of the Floyds North monitoring point (within the existing farm dams) were assessed as degraded, due to reduced coverage and diversity of native understory vegetation, areas of weedy grass cover, and some erosion of banks, with sediment plumes observed.
– Downstream of the proposed dams, the aquatic habitat of lower Salt Water Gully was assessed as slightly to moderately disturbed, with native instream and riparian vegetation present, though with visible evidence of cattle activity and bank erosion.
– Further downstream in Hester Brook, the aquatic habitat condition was assessed as poor, with limited in-stream vegetation present, low visibility, weedy riparian zones, and considerable bank erosion.

A statistical evaluation of macroinvertebrate assemblages at the sites was also undertaken and larger fauna (turtles and fish) evaluated by SLR (2022). Differences in macroinvertebrate and invertebrate communities between sites attributed to habitat composition and condition, flow status (still water in the dam and upstream sites; flowing water in the downstream sites) and position in the catchment (and surrounding land uses).

2.4.3 Land and Water Use

Much of the Hester Brook catchment comprises State Forest and Crown Reserve. Approximately one-third of the catchment is made up of rural holdings that have been cleared for agricultural use. A survey of the landholder water uses in the Salt Water Gully, Cascade Gully, and lower Hester Brook catchments was conducted by Talison between September and November of 2021.

Figure 2.6 illustrates the types of water use on the surveyed properties. As shown, there are a few properties in the Salt Water Gully and lower Hester Brook catchments where water use has not been identified. A summary of the water use by catchment is as follows:

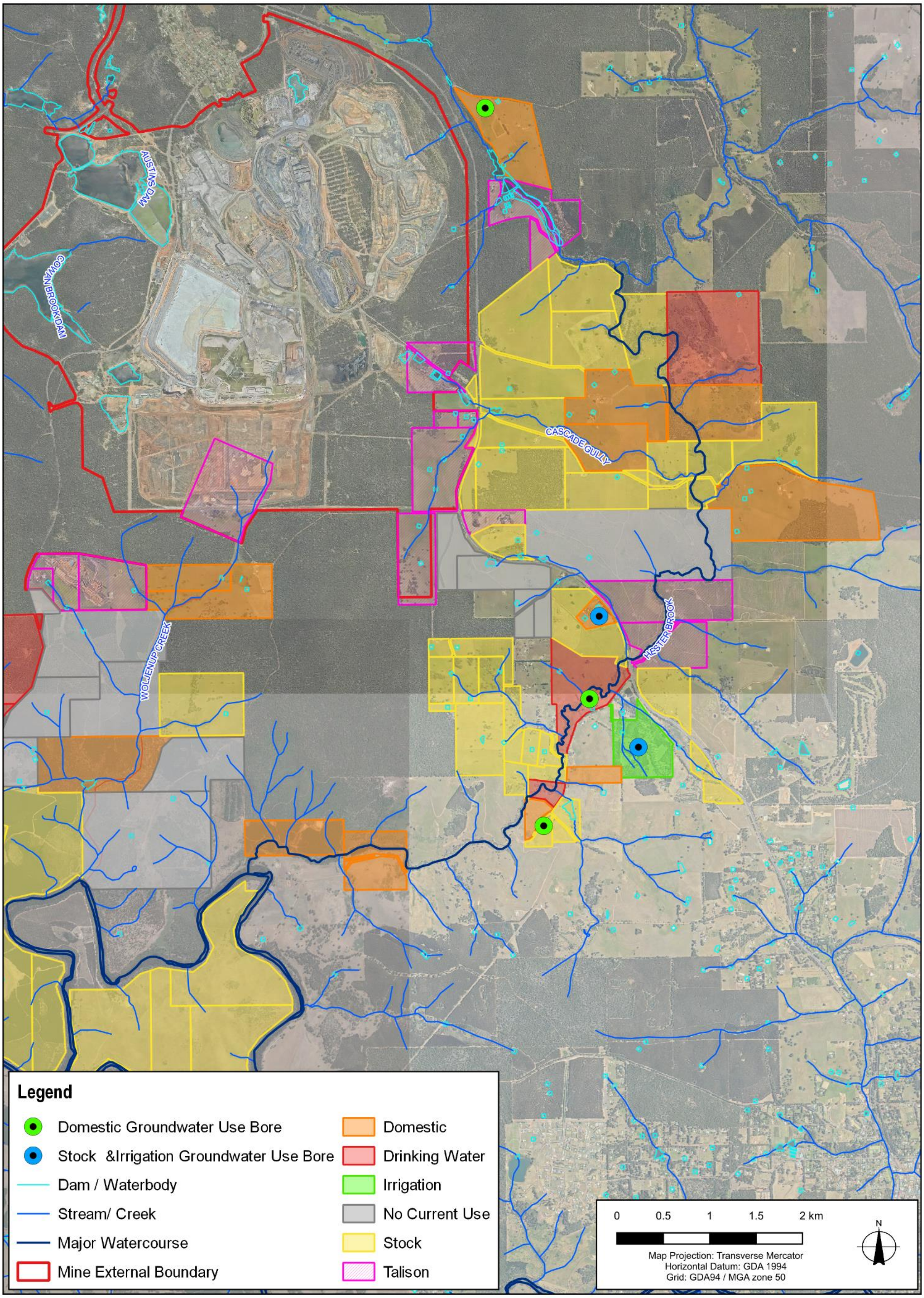
– Salt Water Gully: Non-potable domestic and stock watering uses.
– Cascade Gully: Non-potable domestic and stock watering uses.
– Hester Brook between Salt Water and Cascade Gullies: Drinking water, non-potable domestic, and stock watering.
– Hester Brook downstream of Cascade Gully: drinking water, non-potable domestic, irrigation, and stock watering.

It is noted that the baseline water quality sampling identified that the chloride, TDS, sodium, and hardness concentrations in the waterways downstream of the mine site are typically above potability thresholds limiting suitability for drinking without prior treatment. Hence, based on the currently available data, the use of the downstream waterways for potable use does not appear to be a relevant exposure pathway that is currently being realised.

It is also noted that, given the survey is several years old, and the existence of several gaps, Talison intends to resurvey the water uses in the Hester Brook Catchment downstream of the confluence with Salt Water Gully.

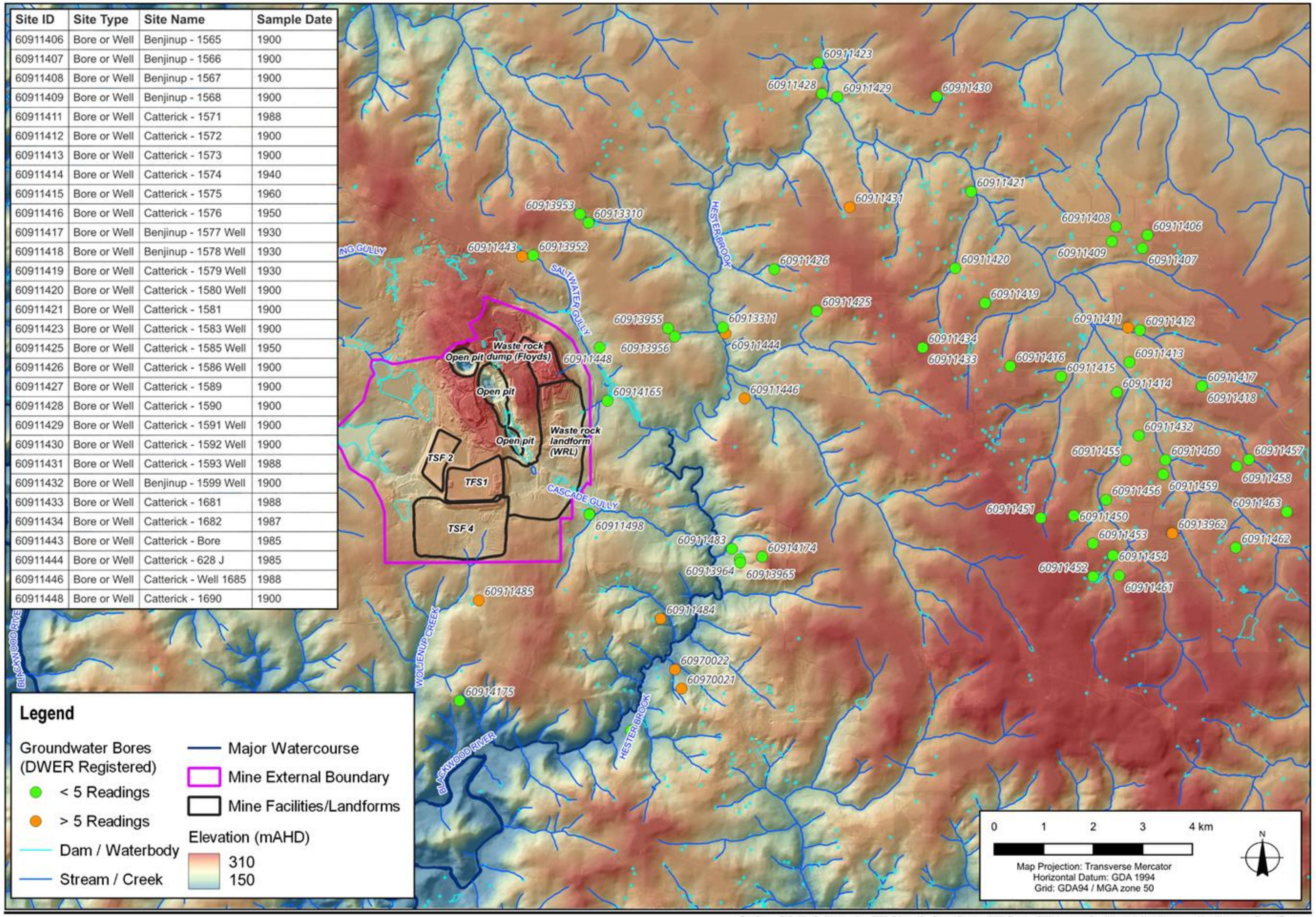
2.4.4 Registered WIN Sites

Existing water users were assessed from the DWER-registered surface water and groundwater sites. The locations of the WIN groundwater sites are presented in **Figure 2.7** and the locations of the WIN surface water sites are provided in **Figure 2.8**. The information from the WIN database is not sufficient to either confirm current water users or the nature of those uses. Talison intends to undertake an audit of the registered surface water and groundwater sites to establish the details thereof.



Data Source: Talison - Water Survey Users, Mine External Boundary, Aerial Imagery (2023). Landgate - Dam / Waterbody, Major Watercourse, Minor Watercourse, Stream / Creek (2020).

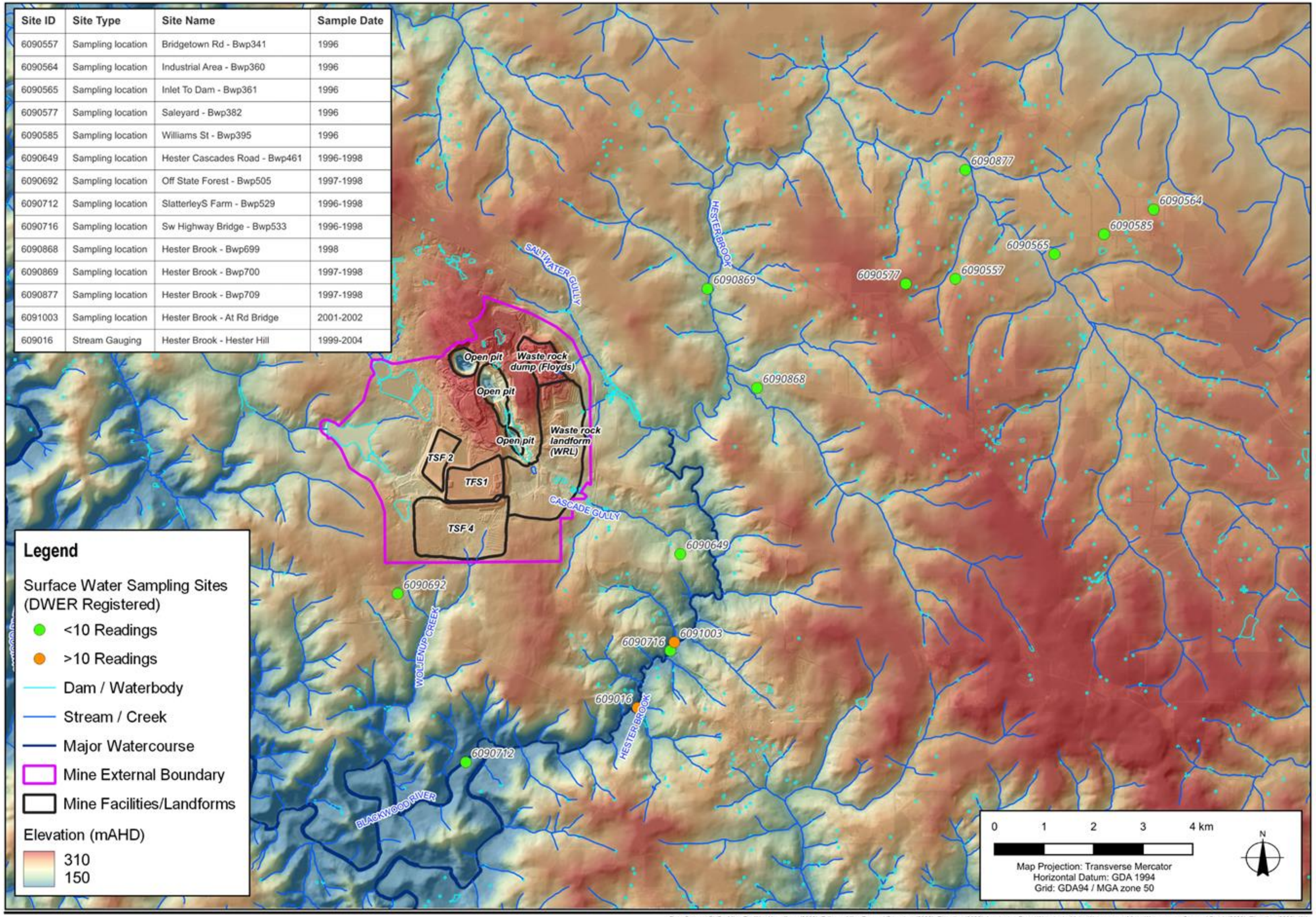
Figure 2.6: Talison Survey Surface and Groundwater Users



Site ID	Site Type	Site Name	Sample Date
60911406	Bore or Well	Benjinup - 1565	1900
60911407	Bore or Well	Benjinup - 1566	1900
60911408	Bore or Well	Benjinup - 1567	1900
60911409	Bore or Well	Benjinup - 1568	1900
60911411	Bore or Well	Catterick - 1571	1988
60911412	Bore or Well	Catterick - 1572	1900
60911413	Bore or Well	Catterick - 1573	1900
60911414	Bore or Well	Catterick - 1574	1940
60911415	Bore or Well	Catterick - 1575	1960
60911416	Bore or Well	Catterick - 1576	1950
60911417	Bore or Well	Benjinup - 1577 Well	1930
60911418	Bore or Well	Benjinup - 1578 Well	1930
60911419	Bore or Well	Catterick - 1579 Well	1930
60911420	Bore or Well	Catterick - 1580 Well	1900
60911421	Bore or Well	Catterick - 1581	1900
60911423	Bore or Well	Catterick - 1583 Well	1900
60911425	Bore or Well	Catterick - 1585 Well	1950
60911426	Bore or Well	Catterick - 1586 Well	1900
60911427	Bore or Well	Catterick - 1589	1900
60911428	Bore or Well	Catterick - 1590	1900
60911429	Bore or Well	Catterick - 1591 Well	1900
60911430	Bore or Well	Catterick - 1592 Well	1900
60911431	Bore or Well	Catterick - 1593 Well	1988
60911432	Bore or Well	Benjinup - 1599 Well	1900
60911433	Bore or Well	Catterick - 1681	1988
60911434	Bore or Well	Catterick - 1682	1987
60911443	Bore or Well	Catterick - Bore	1985
60911444	Bore or Well	Catterick - 628 J	1985
60911446	Bore or Well	Catterick - Well 1685	1988
60911448	Bore or Well	Catterick - 1690	1900

Data Source: GHD - Mine Facilities/ Landform (2022). Talison - Mine External Boundary (2022), Elevation (2022). Landgate - Dam / Waterbody, Major Watercourse, Minor Watercourse, Stream / Creek (2020), Elevation (2020). . WA Landgate SLIP - Background Aerial Imagery. Department of Water and Environment Regulation (DWER) - DWER - Registered Monitoring Sites (2023).

Figure 2.7: DWER Registered Groundwater Sites



Site ID	Site Type	Site Name	Sample Date
6090557	Sampling location	Bridgetown Rd - Bwp341	1996
6090564	Sampling location	Industrial Area - Bwp360	1996
6090565	Sampling location	Inlet To Dam - Bwp361	1996
6090577	Sampling location	Saleyard - Bwp382	1996
6090585	Sampling location	Williams St - Bwp395	1996
6090649	Sampling location	Hester Cascades Road - Bwp461	1996-1998
6090692	Sampling location	Off State Forest - Bwp505	1997-1998
6090712	Sampling location	SlatterleyS Farm - Bwp529	1996-1998
6090716	Sampling location	Sw Highway Bridge - Bwp533	1996-1998
6090868	Sampling location	Hester Brook - Bwp699	1998
6090869	Sampling location	Hester Brook - Bwp700	1997-1998
6090877	Sampling location	Hester Brook - Bwp709	1997-1998
6091003	Sampling location	Hester Brook - At Rd Bridge	2001-2002
609016	Stream Gauging	Hester Brook - Hester Hill	1999-2004

Data Source: GHD - Mine Facilities/ Landform (2022). Talison - Mine External Boundary (2022), Elevation (2022). Landgate - Dam / Waterbody, Major Watercourse, Minor Watercourse, Stream / Creek (2020), Elevation (2020). WA Landgate SLIP - Background Aerial Imagery. Department of Water and Environment Regulation (DWER) - DWER - Registered Monitoring Sites (2023).

Figure 2.8: DWER Registered Surface Water Sites

3. Contaminants of Potential Concern

3.1 Contaminant Sources

Impacted sources of seepage from TSF1, the MSA embankment, and the various WRLs may be derived from the following potential sources:

– Tailings slurry waters used to deposit the tailings (closed process/circuit waters).
– Leaching from tailings solids and embankment materials (typically waste rock) via rainfall infiltration.
– Leaching from waste rock in WRLs via rainfall infiltration.

Previous studies undertaken to characterise these potential sources are summarised **Table 3.1**, details of which are presented by GHD (2023l).

Table 3.1: List of Data Sources and Studies to Characterise Sources of Seepage from TSFs and WRLs (GHD, 2023l)

Studies and data:	Description
Tailings Decant:	
Decant Analysis Results	Tabulated laboratory results of five decant samples (no laboratory certificates supplied).
Decant analysis during Sub-surface Clays Attenuation Capacity Testing (GHD, 2023i)	Collection and laboratory analysis of decant from TSF2 by GHD in 2022 (filtered and unfiltered).
Tailings solids:	
Stage 2 AMD Testing Results (GHD, 2019)	Leach testing of three tailings samples (supplied by Talison) using ASLP and DI leaching methods (single leach).
Tailings Leach Testing (GHD, 2023j)	Testing of four samples taken from TSF2 surface by GHD in 2022 from the outlet areas associated with the processing plants CGP1, CGP2, TGP1 and TRP.
Waste Rock:	
Waste Rock Landform Leaching Risk Assessment (GHD, 2022) (GHD, 2023k)	Testing of seepage from current waste rock dump (six in situ locations), and leach testing of future waste rock comprising 52 samples of dolerite, amphibolite, granofels, and pegmatite waste (ALSP, LEAF 1313 and 1314)

3.2 Identification of Initial CoPCs

3.2.1 Tailings Solids and Decant

Based on a review of the source characterisation data by GHD (2023l), dissolved constituents were deemed as CoPCs provided that concentrations were:

– Above the freshwater aquatic Water Quality Guidelines (WQGs), generally the most sensitive guideline; and/or
– Above any relevant background concentrations or above the laboratory Limits of Reporting (LOR) where no guidelines were available.

The review identified the following initial list of CoPCs for from the tailings solid leach and decant from the TSFs and WRLs:

– Aluminium (Al)
– Antimony (Sb)
– Arsenic (As)
– Barium (Ba)
– Boron (B)
– Caesium (Cs)
– Cadmium (Cd)
– Chromium (Cr)
– Copper (Cu)
– Fluoride (F)
– Iron (Fe)
– Lithium (Li)

Manganese (Mn)
– Molybdenum (Mo)
– Nickel (Ni)
– Rubidium (Rb)
– Thallium (Th)
– Uranium (U)
– Vanadium (V)
– Zinc (Zn)
– Sulphate (SO2)
– Nitrate (NO3)

3.2.2 Waste Rock

Regarding leaching from the waste rock (both WRLs and TSF buttresses) an initial list of CoPCs were identified by GHD (2023l) based on the concentrations of dissolved elements/compounds obtained from the waste rock seepage face and leach testing (ASLP and LEAF 1314), which were:

– Above the freshwater aquatic WQG (most sensitive guidelines), and/or
– Above the local background concentrations (where no guidelines were available).

A list of the CoPCs from the waste rock seepage and leach testing study (GHD, 2022) and screening rationale is presented in **Table 3.2**.

Table 3.2: List and Rationale of CoPCs from Waste Rock Seepage and Leach Testing (GHD, 2023l)[4]

List of metals deemed as CoPCs	Guidelines exceeded in leach results and/or waste rock seepage?			Waste rock dump seepage above background concentrations?	Leaching above background and/or waste rock seepage concentrations?
	Freshwater guidelines	Irrigation guidelines	Stock water guidelines		
Antimony	-	-	-	Yes	Yes
Arsenic	Yes	No	No	Yes	Yes
Cadmium	Yes	No	No	Yes	Yes
Caesium	-	-	-	Yes	Yes
Chromium	Yes	No	No	No	Yes
Lithium	Yes	No	-	Yes	No
Molybdenum	-	No	No	Yes	Yes
Nickel	Yes	No	No	Yes	No
Rubidium[5]	Yes*	-	Yes *	Yes	Yes
Thallium	-	-	-	Yes	Yes
Uranium	-	No	No	Yes	Yes
Vanadium	-	No	-	No	Yes
Zinc	Yes	No	No	Yes	Yes

4 - = indicates that guidelines are not available.
5 * = Rubidium guidelines derived from water quality guidelines review (GHD, 2023m)

3.2.3 Discharge Monitoring

Talison have numerous discharge monitoring points in the Study Area around the mining operation and have collected data on metals, anions, and physical stressors (e.g., pH, TDS) from as far back as 1997. The locations of these monitoring points are shown in **Figure 3.1**, differentiated as the orange locations. This historical monitoring is generally reflective of leachate and runoff from the existing Floyds WRL (see **Figure 1.1**), the key monitoring locations of which are described in **Table 3.3**.

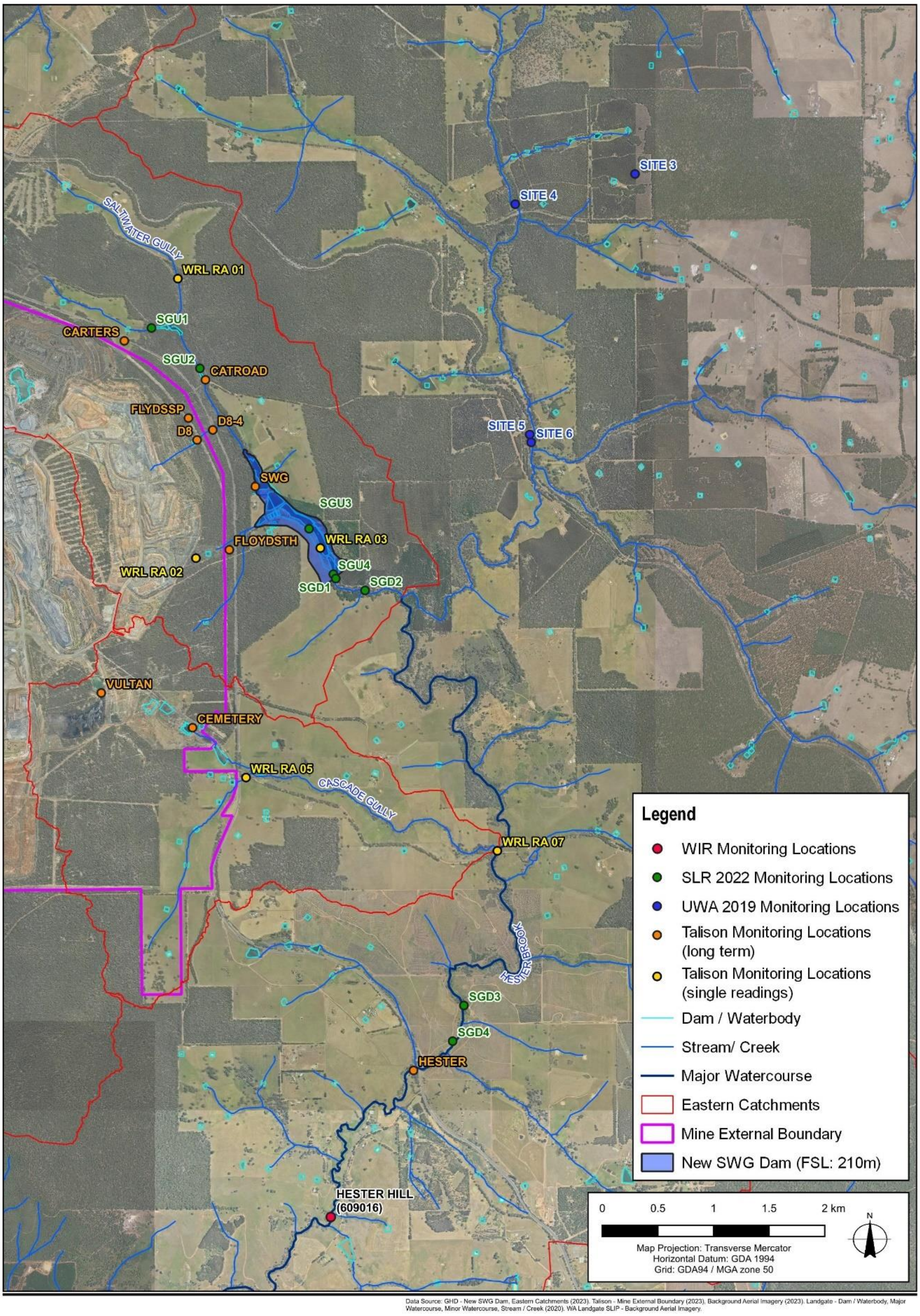


Figure 3.1: Locations of Water Discharge Monitoring Points

Table 3.3: Descriptions of Discharge Monitoring Locations

Monitoring ID	Location	Representative of Source
Carters	Mine boundary northeast	WRL seepage and surface water flows
Cemetery	Mine boundary southeast	WRL seepage and surface water flows
Floydsth	Mine boundary east of S1 WRL	WRL seepage and surface water flows
Floydssp	Mine boundary east of Floyds Waste Rock Dump	WRL seepage and surface water flows
Floyds Nth (D8-4)	Drainage channel along mine boundary east of Floyds Waste Rock Dump	WRL seepage and surface water flows
D8	Drainage channel along mine boundary east of Floyds Waste Rock Dump	WRL seepage and surface water flows
Catroad	Salt Water Gully, east of Floyds Waste Rock Dump	Receiving environment
SWG	Salt Water Gully, southeast of Floyds Waste Rock Dump	Receiving environment
Hester	Southeast of mine site within Hester Brook	Downgradient of total mining operations. Predominantly contributed by Hester Brook (97%) and Cascade Gully (3%) based on volume flows.

Detailed analysis of the monitoring data is presented in **Appendix A**, a summary of the review of which is as follows:

- The maximum concentrations of most metals (Cd, Cu, Mn, Ni, Th, U, Zn) exceed freshwater aquatic WQGs, however, the maximums are short term spikes and generally not representative of long-term average concentrations.
- Lithium concentrations are generally consistent at discharge points, with mean discharge around 1.5 mg/L, marginally below the freshwater aquatic WQG of 2 mg/L, however, exceed the potable and non-potable WQGs (0.007 mg/L and 0.14 mg/L respectively).
- Arsenic concentrations at discharge points of D8, D8-4, and Floydsth report post-2005 concentrations below 0.01 mg/L.
- The highest reported nitrate concentration was 300 mg/L (from D8 and D8-4), which exceeds the freshwater aquatic WQG of 2.4 mg/L. Review of D8 and D8-4 trends indicates a significant decline in concentration over time. Concentrations since 2010 have ranged between 5 and 40 mg/L. Monitoring at Hester has reported typical concentrations between 0.5 and 1.5 mg/L.
- Sulphate measured at D8, D8-4, and SWG ranged between 600 mg/L and 1,300 mg/L since 2000, which is above the freshwater aquatic WQG of 429 mg/L. This would suggest that most of Salt Water Gully is in equilibrium with sulphate content from the discharge points. Hester has reported sulphate concentrations between 20 mg/L and 200 mg/L with an average of 100 mg/L.

In summary, there were no additional CoPCs identified in the review of the discharge monitoring data. Further, the limited suites of analytes included in the discharge monitoring (i.e., As, Cd, Cu, Li, Mn, Ni, Th, U, Zn, SO4, and NO3), all of which exhibited at least one WQG exceedance, did not allow for any rationalisation of the CoPCs identified **Sections 3.2.1** and **3.2.2**. Based on this review of the monitoring data, the following CoPCs should also be evaluated in more detail:

- Nitrate.
- Sulphate.

The source of the nitrate is likely to be residues from explosives used in blasting (i.e. Ammonium Nitrate Fuel). The source of the sulphate is likely to be the result of managing the higher risk waste rock to prevent acid drainage (i.e. segregation and encapsulation of sulphide material within acid neutralising material) thereby allowing elevated salt concentrations (sulphate) to continue to seep.

3.2.4 Initial list of CoPCs

The CoPCs identified in the initial identification process are presented in **Table 3.4** together with the CoPC concentrations, and comparison against the relevant guidelines. The guidelines presented are derived from GHDs review and derivation of site-specific guidelines undertaken in support of a previous risk assessment (GHD, 2023m). It is important to note, that **Table 3.4** reflects a screening process and, although numerous elemental concentrations exceed the WQGs at the source, a potential risk is recognised only at times when seepage discharges in sufficient concentrations into the environment.

The table shows the following:

- A total of 15 metals (Al, As, Cd, Cu, Cs, Cr, Li, Mn, Mo, Ni, Rb, Sb, Th, U, and Vn) exceed one or more of the adopted guidelines.
- Nitrate and sulphate exceed one or more of the adopted guidelines, and based on long term monitoring data, are likely to be key CoPCs posing a risk from the construction of the S1 and SWG WRLs.

Table 3.4: Initial List of CoPCs Compared Against Site Specific WQGs

CoPC (mg/L)	TSF4 Tailings Source Concentrations					Waste Rock Source Concentrations		Site Specific Guidelines (GHD, 2023m)				
	Decant 2018[6]	Decant 2022 (Total)[7]	Decant 2022 (Filtered)[8]	Talings Solids Leach (ALSP)[9]	Talings Solids Leach (LEAF 1314)[10]	Seepage Testing (Total)[11]	Leach Testing (LEAF 1314)[12]	Agricultural Use - Livestock	Agricultural Use - Irrigation	Aquatic Environment	Potable Use - Drinking water	Non-Potable Use - Recreation
Aluminum	0.036	**17.9**	0.0028	**0.90**	**0.13**	NU	NU	5	5	0.055	0.2	4
Antimony	0.02	**0.039**	**0.0276**	**0.004**	**0.014**	0.0009	**0.0047**	0.15	NR	0.09	0.003	0.06
Arsenic	**0.082**	**0.293**	**0.034**	**0.056**	**0.13**	0.002	**0.05**	0.5	0.1	0.013 (As AS V) 0.024 (As AS III)	0.01	0.2
Cadmium	<0.0001	**0.0008**	**0.00014**	<0.0001	<0.001	0.0001	<0.0005	0.01	0.01	0.0003	0.002	0.04
Caesium	**0.0932**	**0.401**	**0.084**	**0.012**	0.004	0.01	<0.001	2.0	NR	0.5	0.07	1.4
Chromium (III+VI)	**0.002**	**0.034**	0.00028	<0.001	<0.01	0.0002	**0.0037**	1	0.1	0.14 (as Cr III) 0.001(as Cr VI)	0.05 (as Cr III)	1.0
Copper	**0.0015**	**0.023**	0.0013	<0.001	<0.01	0.0006	**0.002**	0.5	0.2	0.0014	2	40
Fluoride	0.58	0.9	1.03	<0.1	<0.1	<0.01	NU	2	1	1.3	1.5	30
Lithium	**9.664**	**15.8**	**14.6**	**0.18**	**0.02**	**0.52**	**0.009**	0.82	2.5	2.0	0.007	0.14
Manganese	**0.312**	**1.58**	**0.93**	0.017	0.004	0.13	0.0015	10	0.2	1.9	0.5	10
Molybdenum	0.0034	0.016	0.0148	<0.001	NU	<0.0001	0.0007	0.15	0.01	0.034	0.05	1.0
Nickel	0.003	0.025	0.0055	<0.001	<0.001	0.013	0.00056	1	0.2	0.05	0.02	0.4
Rubidium	**0.43**	**1.31**	**0.567**	**0.39**	**0.013**	**0.06**	0.009	0.26	NR	0.017	0.014	0.28
Thallium	NU	**0.007**	**0.00041**	NU	<0.01	**0.00008**	**0.0003**	0.13	NR	0.00003	0.00004	0.0008
Uranium	**0.0056**	**0.031**	**0.0191**	<0.001	<0.001	**0.0004**	0.00005	0.2	0.01	0.0005	0.017	0.34
Vanadium	<0.01	**0.01**	0.00011	<0.01	<0.01	0.0004	**0.0031**	0.1	0.1	0.0006	0.0002	0.004
Zinc	<0.005	0.017	**0.098**	<0.005	<0.1	0.008	0.001	20	2	0.036	3	60
Nitrate	NU	0.54	NU	0.005	NU	**2.67**	NU	90	NR	2.4	50	NR
Sulphate	NU	231	226	1.1	<10	**427**	0.9	1000	NR	429	250	NR

Key:

NU	Analysis not undertaken.
NR	Guideline not required.
Green	Does not exceed guidelines.
Red	Exceeds guidelines.
orange	Uncertain.
Bold/underline	Concentrations exceed guidelines

[6] Decant average concentration from 5 samples.
[7] Decant concentration July 2022 taken from TSF2 decant pump (GHD, 2023i).
[8] Decant concentration (filtered) July 2022 taken from TSF2 decant pump (GHD, 2023i).
[9] Data taken from, single leach testing of three tailings samples in 2018 using ALSP method Di water leach (GHD, 2019).
[10] LEAF 1314 analysis of four samples (CGP1, CGP2, TGP, TRP), concentrations are an average of the 9th cumulative leaching events ((GHD, 2023j).
[11] Data taken from GHD (GHD, 2022) laboratory analysis of seepage, averaged from seven seepage locations from foot of Floyds WRL.
[12] Data taken from GHD (GHD, 2022) Average concentration at 9th leaching event of 12 samples (LEAF 1314 sequential leaching).

4. Groundwater Modelling

4.1 Modelling Approach

GHD (2023d) documents the fate and transport modelling of groundwater and key CoPCs emitted from the existing and proposed facilities to the subsurface. The model comprises 11 layers with variable thicknesses, elevations, and properties to reflect the infrastructure and underlying geology. The layers represent the features and lithologies detailed in **Table 4.1**, which have a constant thickness relative to the pre-mine surface elevation. Further details of the model construction and calibration are provided by GHD (2023g).

Table 4.1: Layer Tops and Bottoms Relative to Pre-Mining Surface[13]

Layer	Depth From (m)	Depth to (m)	Thickness (m)	Dominant lithologies
1[14]	0	1	1	Tailings, waste rock, embankment, embankment core, and palaeochannel sands
2	1	1.6	0.6	TSF liner, pallid saprolite, palaeochannel sands.
3[15]	1.6	10	8.4	Pallid saprolite, palaeochannel sands
4	10	18	8	Non-pallid saprolite
5	18	20	2	Saprock
6	20	40	20	"U" Upper fractured bedrock"
7	40	60	20	"M" Middle fractured bedrock
8	60	100	40	As above
9	100	180	80	As above
10	180	-100 mAHD	>1 Variable	As above
11	-100 mAHD	-200 mAHD	100	"L" Lower fractured bedrock

The model activated area was extended to the east, within the limits of the existing grid shell, to increase the distance from the edge of WRL SWG and the model edge, and to take in more of the Hester Brook catchment (see **Figure 1.3**). Key model boundary conditions that were changed included the following:

– A General Head Boundary (GHB) polygon was set at the proposed full supply level of SWG Dam with inter-polygon boundaries based on the four existing dam embankments in the gully. The GHB conductance was set at 0.03 $m^2/d/m^2$ and a constant source concentration of 0.025 mg/L for arsenic and 1 mg/L for lithium was assumed (based on historical monitoring).

– Recharge concentrations and rates from the WRLs, including the Mine Services Area (MSA) embankment, which is constructed from waste rock (see **Figure 4.1**), were modelled as follows:
  - Recharge concentrations were initially set to be the same as the regional recharge of 0.0056 mg/L of arsenic and 0.0246 mg/L of lithium, which were based on the average background concentrations in groundwater from wells outside likely impacted areas.
  - Concentrations were increased after construction of the WRLs to 0.056 mg/L of arsenic and 0.166 mg/L of lithium based on the results of waste rock leachate testing (GHD, 2023k). Completion of construction was assumed to be January 1980 for Floyds WRL and MSA, January 2024 for S1 WRL, and January 2032 for SWG WRL.

[13] Data provided for post pit conditions. Key layers were removed within the opencut.
[14] Layer 1 has a base 1 m below pre-mine surface and a top that varies over time as tailings and waste rock are deposited. Pallid saprolite makes up the rest of Layer 1 outside the various tailings and embankment areas.
[15] Sand paleochannel in Layer 3 is assumed to be removed from beneath TSF4.

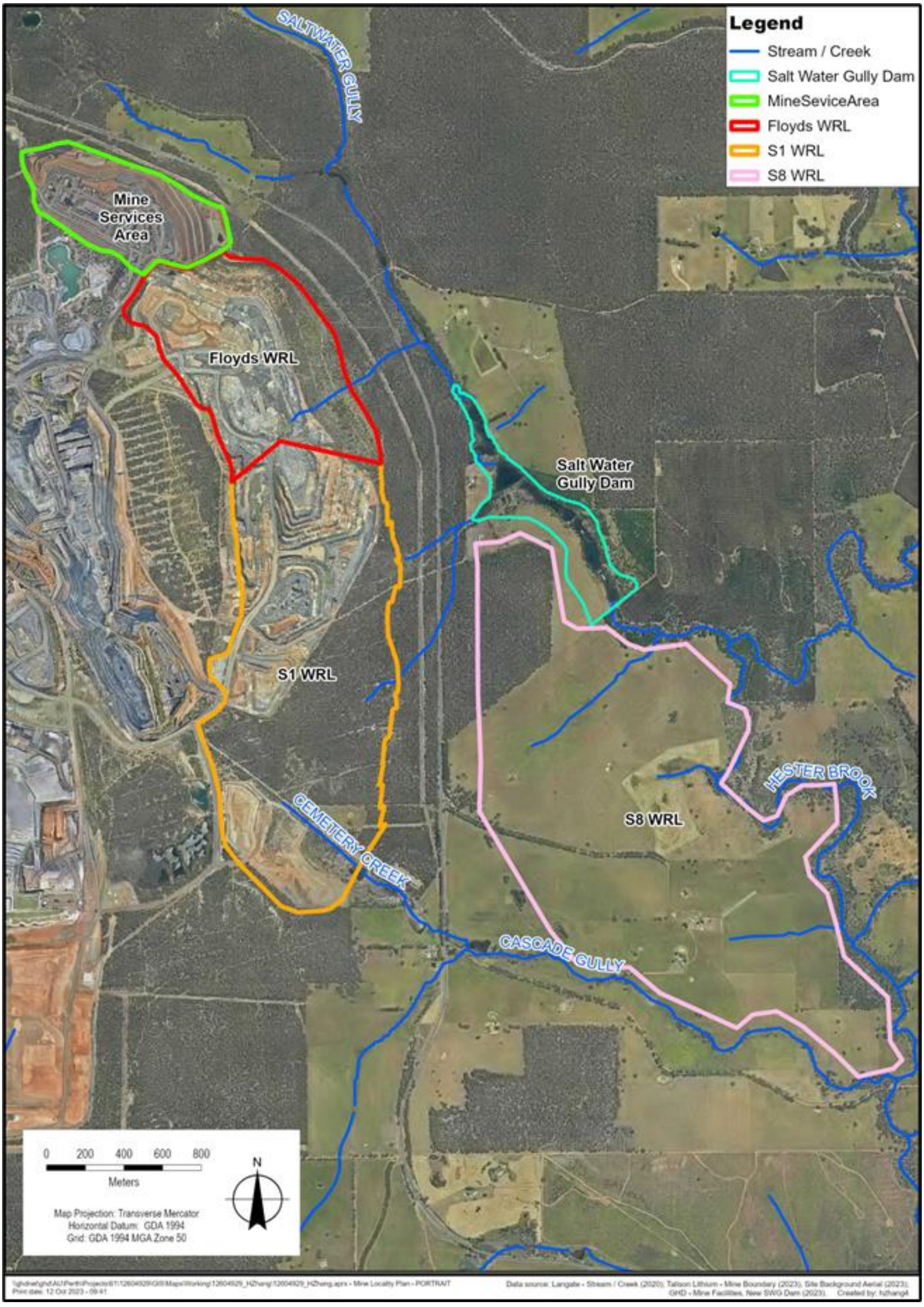


Figure 4.1: Extents of Salt Water Gully Dam General Head Boundary and WRL Recharge Zones

- The concentrations of lithium and arsenic simulated in SWG Dam were assumed to be 1.0 mg/L and 0.025 mg/L respectively, which were the average concentrations derived from the SWG surface water monitoring site for the last five years (see **Figure 4.2**). These concentrations remained constant for the duration of modelling.
- Transient monthly recharge rates were used for the base case prior to 2023, which were based on calibrated rates from previous pit lake and inflow models as a percentage of rainfall. Post 2023 recharge rates were constant, based on the same percentage of rainfall acting as recharge, but using the average rainfall for the period 1980 to 2022 (GHD, 2023g).
- Recharge rates for the impact case modelling were maintained at the base case modelling rates (i.e., no landform design or capping allowed for).

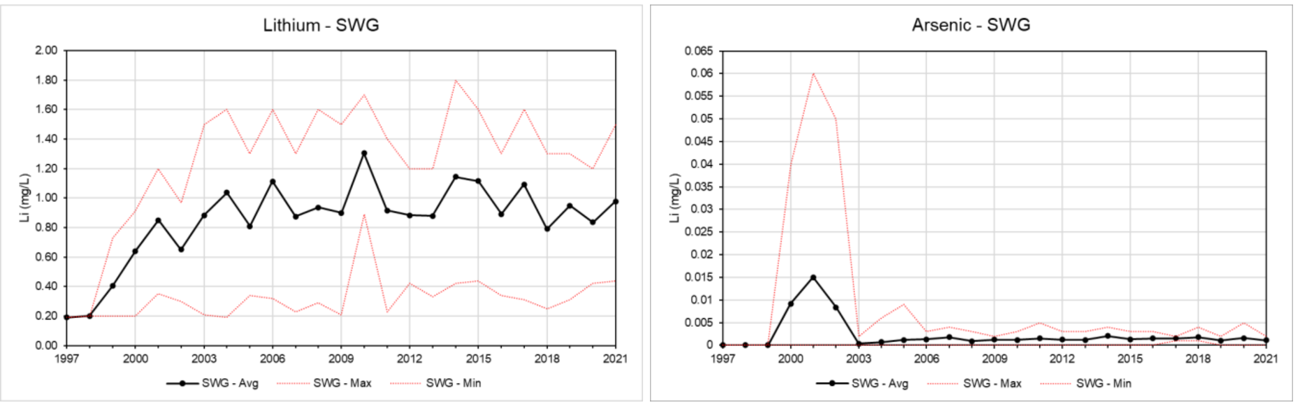


Figure 4.2: Historical Observed Lithium and Arsenic Concentrations at SWG Monitoring Point

The model was not recalibrated. The pre-2023 flow calibration model gave a scaled Root Mean Square (RMS) residual of 15.8% (GHD, 2023g). While this is higher than the typically accepted value of 10% (Barnett, et al., 2012), it is of less concern for this model as it is dominated by bores around the TSFs, with little data in the Eastern Catchments Area.

Solute transport was assumed to be subject to advection, dispersion, and linear adsorption/desorption. The modelling of contaminant transport included two metals, namely:

– Arsenic, a low mobility metal.
– Lithium, a high mobility metal.

These metals are considered 'end-members' due to their respective mobilities and are therefore representative of the range of other CoPCs whose adsorption coefficients fall between arsenic and lithium. Adsorption was only applied in the saprolite and saprock layers (Layers 1 to 5 of the model). The larger the partition coefficient (Kd), the greater amount of solute adsorbed and hence the slower the spread of the plume and, if there is a finite source, the lower the peak concentration. Site-specific adsorption testing of the saprolites is reported separately as part of the *TSF4 Seepage Assessment* (GHD, 2023i). Non-linear Freundlich adsorption isotherms were developed for arsenic and lithium from the test results and applied in the solute transport modelling.

Apart from chromium, the other metals considered as CoPCs (Al, Cd, Cu, Cs, Mn, Mo, Ni, NO_3, Rb, Sb, SO_4, Th, U and Vn) have mobilities that fall between or close to the arsenic and lithium adsorption coefficients based on published partition coefficients (USGS, 1992). The published partition coefficients are presented in **Table 4.2**, which shows groupings (Group 1, 2, 3 and 4) based on the relative adsorption characteristics (published partitioning coefficients). It is reasonable to assume that the groundwater modelling results relating to the fate and transport of the arsenic and lithium and can therefore be used to reliably infer the distribution of the other CoPCs in Groups 1, 2and 2, as presented in **Table 4.2**. Being very strongly adsorbed, the fate and transport of chromium will be significantly reduced compared to that of arsenic and lithium. Modelling was therefore not undertaken for the remaining initial CoPCs.

Table 4.2: List of CoPCs and Partitioning Coefficients[16]

	Solute	Max concentration (tailings decant/leach) mg/L	Kd (mL/g) (USEPA 2019)	Relative adsorption
Group 1	Molybdenum	0.016	20	**More weekly adsorbed**
	Arsenic	0.29	29	
	Copper	0.023	35	
	Antimony	0.039	45	
	Zinc	0.098	62	
	Manganese	1.58	65	
	Nickel	0.025	65	
	Thallium	0.007	71	
	Cadmium	0.0008	75	
Group 2	Caesium[17]	0.40	300	
	Lithium	15.8	300	
	Rubidium	1.31	300	
	Uranium	0.031	450	
Group 3	Vanadium	0.01	1000	
	Aluminium	17.9	1500	
Group 4	Chromium	0.034	1,800,000	**More strongly adsorbed**

4.2 Predictive Modelling

4.2.1 Modelled Scenarios

Predictive modelling was undertaken for both arsenic and lithium, for two scenarios:

– **Base Case:** The base case model was configured to include the flow and transport sources of the existing TSFs, the existing Floyds WRL, and the MSA embankment. The model used the historical modelling up to 2023 as a starting point, and then ran to 2913, which was the final transport step that achieved convergence with satisfactory mass balance errors.

– **Impact Case:** The impact case model was the same as the base case model, but with the reuse of TSF1, establishment of SWG WRL, and construction of SWG Dam configured in the model run. The model ran to completion in the year 3000.

4.2.2 Water Quality Guidelines

Water Quality Guidelines (WQGs) were derived for the downstream beneficial uses for the *TSF4 Seepage Assessment* (GHD, 2023m) and have been adopted to assess the fate and transport modelling of the key CoPCs. A summary of the WQGs for arsenic and lithium (the key CoPCs modelled) is provided in **Table 4.3**.

16 There is no published Kd for Thorium.
NO3 is a conservative ion so does not adsorb onto clays.
SO4 is subject to redox only and does not adsorb onto clays.

17 Kd for Cs is a conservative estimate, based on similar Kd's applied to alkali metals, which include Rb, Li, (no USEPA 2019 value), and that Cs is more strongly adsorbed into clays than Rb and Li (USGS, 1992).

Table 4.3: Water Quality Guidelines (GHD, 2023m)

Contaminant	Water quality guideline (mg/L)				
	Agricultural use - Livestock	Agricultural use - Irrigation	Aquatic Environment	Potable use	Non-potable use
Sample type	Unfiltered	Unfiltered	Filtered	Unfiltered	Unfiltered
Arsenic	0.5	0.1	0.013 (as AsV)	0.01	0.2
Lithium	0.82	2.5	2.0	0.007	0.14

4.2.3 Arsenic Plume Extents

The modelled arsenic plumes (contours of concentrations reflecting the various WQGs) in the various model layers are provided in GHD (2023d) at various future dates.

The base case modelling results indicate that:

– The current impact (2023) of the TSFs is confined to Layer 5 and above within the footprints of TSF1 and TSF2 and there is no impact from Floyds WRL and MSA. The concentration contours of 0.010 mg/L and 0.013 mg/L within the plume indicate that the drinking water and aquatic environment WQGs, the most stringent of these guidelines, are exceeded.

– There is no noticeable migration of the plumes from TSF1 and TSF2 in Layer 2 by 2030, either horizontally or vertically. By this date, seepage from Cell 1 of TSF4 is evident by the plumes forming in layers 2 and 3 within the footprint of the TSF.

– The impact of Floyds WRL and MSA does not appear at the water table (Layer 2) until 2040, where emergence of a plume in Layer 2 is noted, the concentrations of which exceed the drinking water and aquatic environment WQGs. There is no noticeable additional migration or intensification of the plumes from TSF1, TSF2, and TSF4 in Layer 2 by 2040.

– The plume emanating from Floyds WRL and MSA within layer 2 extends to cover most of the footprint of these facilities by 2070. The drinking water and aquatic environment WQGs remain the only guidelines exceeded. There is no noticeable additional migration or intensification of the plumes from TSF1, TSF2, and TSF4 in Layer 2 by 2070, the extents of which remain within the TSF footprints.

– There is no noticeable migration in extent or intensity of the plumes in Layer 2 emanating from the TSFs and from Floyds WRL and MSA by 2123. By this date, the plume from Floyds WRL and MSA has emerged in Layer 3.

– The plume in Layer 2 emanating from Floyds WRL and MSA has migrated ~200 m eastwards by 2913, but remains west of the highway, and the plumes emanating from TSF1 and TSF2 have expanded (but remain within the footprints of the respective TSFs), whilst that from Cell 1 of TSF4 has reduced notably. The plume from Floyds WRL and MSA has migrated into Layers 3 and 5 but remains within the footprint of the landforms. The drinking water and aquatic environment WQGs remain the only guidelines exceeded.

The impact case modelling results indicate the following incremental changes from the base case:

– The first indications of arsenic impact from S1 and SWG WRLs appear between 2040 and 2070, with the 0.01 mg/L (drinking water guideline) and 0.013 mg/L (aquatic environmental guideline) contours covering almost the full footprint of the two WRLs, including the headwaters of Salt Water Gully and some minor gullies leading into Hester Brook.

– By 2123 the 0.01 mg/L plume has extended in Layer 2 to much of Hester Brook between Salt Water Gully and Cascade Gully.

– By 2913, the extent of the plume in layer 2 has increased slightly and extends to almost the same extent in Layer 3. This plume diminished significantly by Layer 5.

4.2.4 Lithium Plume Extents

The modelled lithium plumes (contours of concentrations reflecting the various WQGs) in the various model layers are provided in GHD (2023d) at various future dates. It should be noted that the background lithium concentrations exceed the drinking water guidelines (0.007 mg/L) across much of the mine site and the upper reaches of the receiving catchments, so it was not possible to depict these concentration contours have not been depicted in the above plumes.

The base case modelling results indicate that:

- The current impact (2023) of the TSFs is mostly confined within the footprints except for the eastern side of TSF1, where the plume extends ~200 m in Layer 2 into the area of historical dredge mining (concentration of 0.14 mg/L only representing the non-potable water guideline), and slightly further in Layer 3. The maximum concentration simulated is 5.0 mg/L, which exceeds all guidelines. There is no impact simulated from Floyds WRL and MSA in 2023.
- There is no noticeable migration or intensification of the plume from TSF2 by 2030, however, the plume from TSF1 migrates further eastwards towards Vultans Pit. By this date, seepage from Cell 1 of TSF4 is evident by the plume forming in layers 2, 3, and 5 within the footprint of the TSF. There is no impact simulated from Floyds WRL and MSA in 2030, however, isolated outbreaks of concentrations above the non-potable water guideline are evident within the footprint of Floyds WRL and MSA and along Salt Water Gully.
- The impact of Floyds WRL and MSA at concentrations above the non-potable water guideline in Layer 2 expand across under these facilities by 2040. The plume from TSF1 migrates further eastwards towards the open pit by 2040. The isolated areas of concentrations above the non-potable water guideline along Salt Water Gully remain unchanged.
- The impact of Floyds WRL and MSA at concentrations above the non-potable water guideline in Layer 2 expand across most of the footprint of these facilities by 2070. The plume from TSF1 migrates again slightly further eastwards around the south of the open pit by 2070, but the isolated areas of concentrations above the non-potable water guideline along Salt Water Gully remain unchanged.
- The plume emanating from Floyds WRL and MSA within layer 2 extends across the footprint of these facilities by 2123. The non-potable water guideline remains the only guideline exceeded here. The plume from TSF1 above the guideline migrates beyond the open pit to the upper Cemetery Creek but is unlikely to discharge to the creek. All plumes have extended down to Layer 5 with concentrations exceeding the non-potable water guideline in these layers.
- The extent and intensity of the plume in Layer 2 emanating from Floyds WRL and MSA remains largely unchanged by 2913, and the plumes emanating from TSF1 and TSF2 have reduced in intensity (i.e., concentrations reduce). The plume to the east of TSF1 has reduced to within ~300 m of the TSF footprint. The plume from Floyds WRL and MSA has migrated into Layer 5 and extends as far as SWG Dam by 2913.

The impact case modelling results indicate the following incremental changes from the base case:

- The first indications of lithium impact from S1 WRL appears around 2030 as isolated pockets in Layer 2, and a similar pattern is observed from SWG WRL in 2040. By 2030, the isolated areas of concentrations above the non-potable water guideline along Salt Water Gully seen in the base case have expanded with the construction of SWG Dam.
- By 2070, the plume represented by the 0.14 mg/L contour (non-potable water guideline) in Layer 2 expands to cover almost the full footprint of S1 and SWG WRLs, including the headwaters of Salt Water Gully and some minor gullies leading into Hester Brook.
- By 2123, the 0.14 mg/L plume has extended in Layers 2 and 3 to much of Hester Brook between Salt Water Gully and Cascade Gully. Although the 0.14 mg/L contour from the WRLs merges with that from the TSFs by 2123, the 0.82 mg/L contour from TSF1 does not extend more than ~250 m to the east of TF1, as indicated by the 2123 contours.
- By 2913, the extent of the 0.14 mg/L plume in Layers 2 and 3 has increased slightly but has now extended beyond the S1 WRL footprint in Layer 5. Lithium concentrations below the WRLs did not exceed 0.82 mg/L (i.e., the stock watering guideline, which is the next most sensitive guideline after non-potable).

4.2.5 Groundwater Discharge to Surface

The surface water and mass balance modelling (see **Section 5**) required estimates of the CoPC loads discharged to surface water for the catchment scale mass balances. To this end, the loads of lithium and arsenic in the groundwater discharges to the creeks in the various surface water catchments were simulated, the statistics of which are presented in **Table 4.4** and **Table 4.5** for lithium and arsenic respectively.

Table 4.4: Statistics of Simulated Groundwater Discharge Lithium Loads (Kg/day) at Reporting Sites from 2023 to 2063[18]

Location	Salt Water Gully Outlet to Hester Brook			Cascade Gully Outlet to Hester Brook			Hester Brook Incremental Catchment Between Salt Water and Cascade Gullies		
Statistic[19]	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2
5%	0.01	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00
20%	0.04	0.04	0.08	0.00	0.00	0.00	0.00	0.00	0.00
50%	0.08	0.09	0.17	0.01	0.01	0.01	0.01	0.01	0.01
80%	0.14	0.17	0.31	0.02	0.03	0.03	0.01	0.01	0.01
95%	0.29	0.34	0.65	0.04	0.05	0.05	0.02	0.02	0.02
Location	**Hester Brook Upstream of Salt Water Gully Confluence**			**Hester Brook Downstream of Cascade Gully Confluence**			**Hester Brook at Hester Hill**		
Statistic	**Base**	**Impact 1**	**Impact 2**	**Base**	**Impact 1**	**Impact 2**	**Base**	**Impact 1**	**Impact 2**
5%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20%	0.00	0.00	0.00	0.02	0.02	0.04	0.03	0.03	0.04
50%	0.00	0.00	0.00	0.06	0.06	0.10	0.08	0.08	0.12
80%	0.00	0.00	0.00	0.11	0.12	0.21	0.15	0.16	0.24
95%	0.00	0.00	0.00	0.20	0.24	0.38	0.26	0.30	0.45

Table 4.5: Statistics of Simulated Groundwater Discharge Arsenic Loads (tonnes/day) at Reporting Sites from 2023 to 2063

Location	Salt Water Gully Outlet to Hester Brook			Cascade Gully Outlet to Hester Brook			Hester Brook Incremental Catchment Between Salt Water and Cascade Gullies		
Statistic	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2
5%	0.0005	0.0004	0.0009	0.0001	0.0002	0.0002	0.0000	0.0001	0.0001
20%	0.0014	0.0010	0.0025	0.0002	0.0005	0.0005	0.0001	0.0002	0.0002
50%	0.0028	0.0021	0.0050	0.0004	0.0011	0.0011	0.0002	0.0004	0.0004
80%	0.0049	0.0040	0.0092	0.0007	0.0021	0.0021	0.0004	0.0007	0.0007
95%	0.0100	0.0081	0.0191	0.0015	0.0044	0.0044	0.0009	0.0015	0.0015

[18] Results presented for the following scenarios
Base: Base case for existing site and operations, including the approved expansion of Floyds WRL (S1 WRL)
Impact 1: Impact Case 1: Base case plus the proposed SWG WRL and SWG Dam.
Impact 2: Impact Case 2: Base case plus the proposed SWG WRL only (i.e. excludes the construction of SWG Dam).
[19] Exceedances probabilities, which are the probabilities of the flows equaling or exceeding given rates.

Location	Hester Brook Upstream of Salt Water Gully Confluence			Hester Brook Downstream of Cascade Gully Confluence			Hester Brook at Hester Hill		
Statistic	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2
5%	0.0000	0.0000	0.0000	0.0006	0.0006	0.0011	0.0008	0.0007	0.0013
20%	0.0000	0.0000	0.0000	0.0017	0.0017	0.0032	0.0022	0.0021	0.0036
50%	0.0000	0.0000	0.0000	0.0034	0.0035	0.0065	0.0042	0.0043	0.0073
80%	0.0000	0.0000	0.0000	0.0061	0.0068	0.0120	0.0075	0.0082	0.0134
95%	0.0000	0.0000	0.0000	0.0124	0.0141	0.0251	0.0152	0.0169	0.0279

4.2.6 Point Impacts

4.2.6.1 Approach

The modelled changes in arsenic and lithium concentrations in the groundwater were assessed at three nominal sites within the Study Area, these being:

– Site 1: North of SWG Dam.
– Site 2: Within the footprint of SWG WRL.
– Site 3: South of TSF4 (within Woljenup Creek Catchment).

The location of these sites is shown in **Figure 4.3** and discussions on the changes in concentrations are provided in the following sections.

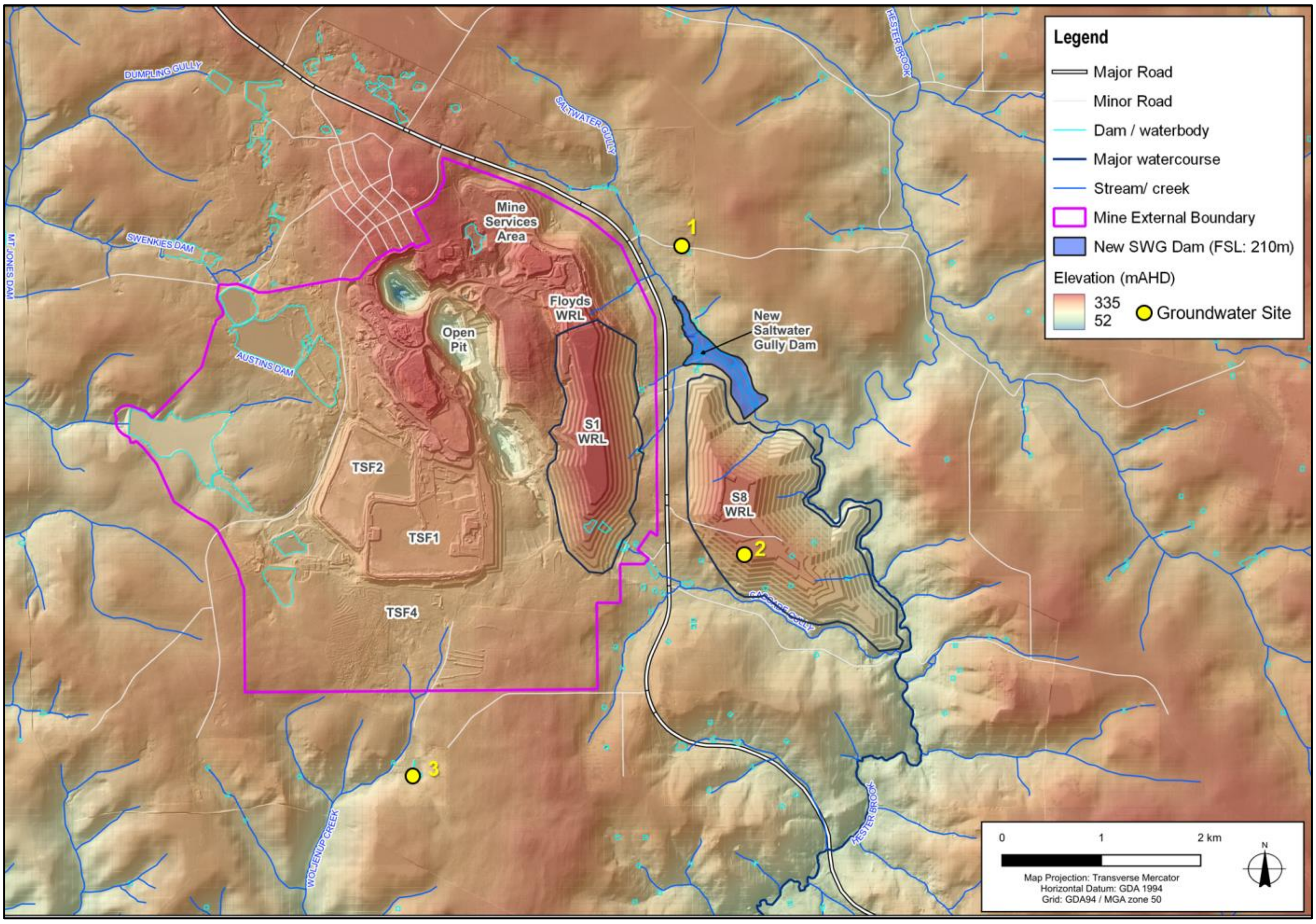


Figure 4.3: Point Impact Sites

4.2.6.2 Arsenic

The modelled arsenic concentrations in layer 2 at the three sites are shown in **Figure 4.4**. The highest concentration of arsenic in any of the locations over the entire modelling period (year 3000) was 0.035 mg/L at Site 2 (within SWG WRL footprint). The water use survey (see **Section 2.4**) indicates that water in this area used for stock watering, the WQG of which (0.5 mg/L) is well above the maximum modelled concentration at Site 2. It should be noted that the drinking water WQG (0.01 mg/L) is exceeded but the non-potable WQG (0.2 mg/L) is not. Contours of arsenic concentrations in groundwater reported by GHD (2023d) show that arsenic does not migrate far from the source site (e.g., SWG WRL) and is likely to decrease in concentration away from the source.

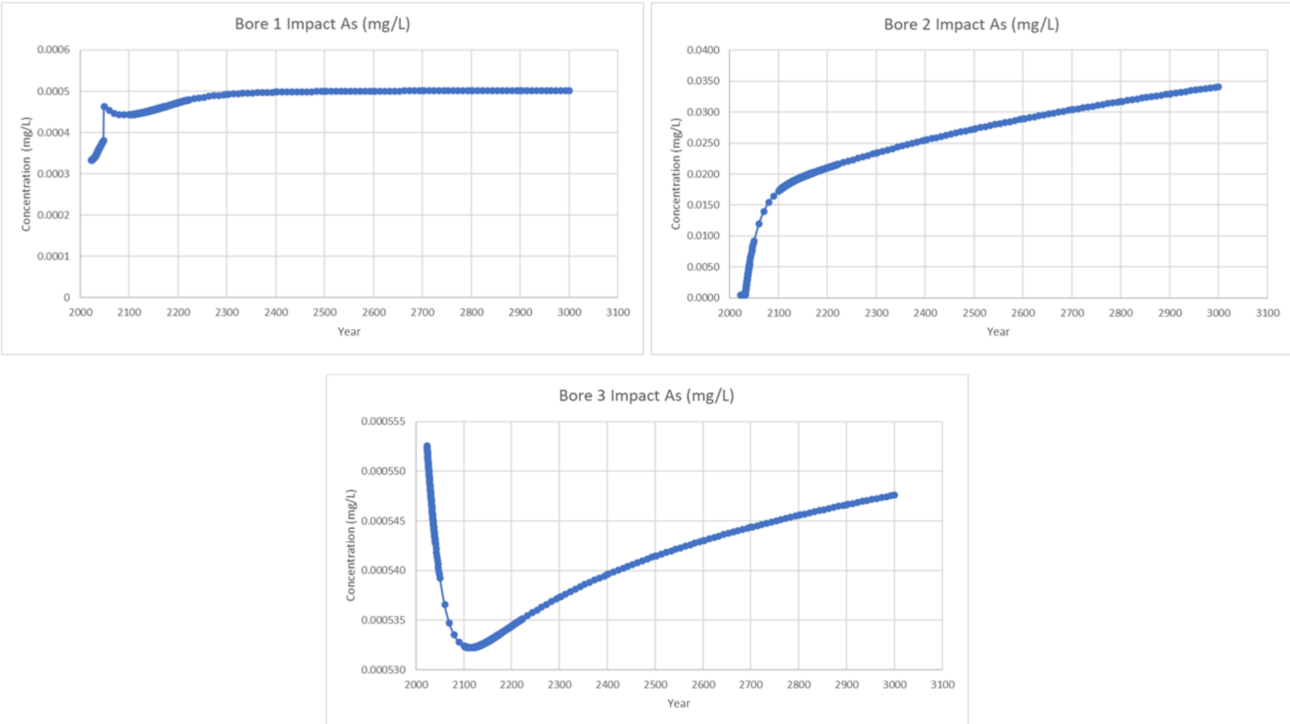


Figure 4.4: Modelled Arsenic Concentrations in Layer 2 at Sites 1, 2, and 3

Modelling results for Sites 1 and 3 indicated that arsenic concentrations remain low over the long term, not exceeding 0.0006 mg/L (background concentration of 0.0005 mg/L), which is below the drinking water WQG.

4.2.6.3 Lithium

The modelled lithium concentrations in layer 2 at the three sites are shown in **Figure 4.5**. The highest concentration of lithium in any of the locations over the entire modelling period (year 3000) was 0.16 mg/L at Site 2. The water use survey (see **Section 2.4**) indicates that water is used stock watering in this area, the WQG of which (0.82 mg/L) is well above the maximum modelled concentration at Site 2. It should be noted that the drinking water WQG (0.007 mg/L) is exceeded and the non-potable WQG (0.14 mg/L) is marginally exceeded. Contours of lithium concentrations in groundwater reported by GHD (2023d) show that lithium impacts do not migrate far from the source site (e.g., SWG WRL), and the concentrations would be significantly lower outside of this footprint.

At Sites 1 and 3, lithium remains between 0.0245 mg/L and 0.0247 mg/L which is above the drinking water WQG (0.007 mg/L) but below the non-potable use WQG (0.14 mg/L). Background levels of lithium are estimated at 0.0246 mg/L, therefore it can be shown that Sites 1 and 3 are not impacted by mining operations.

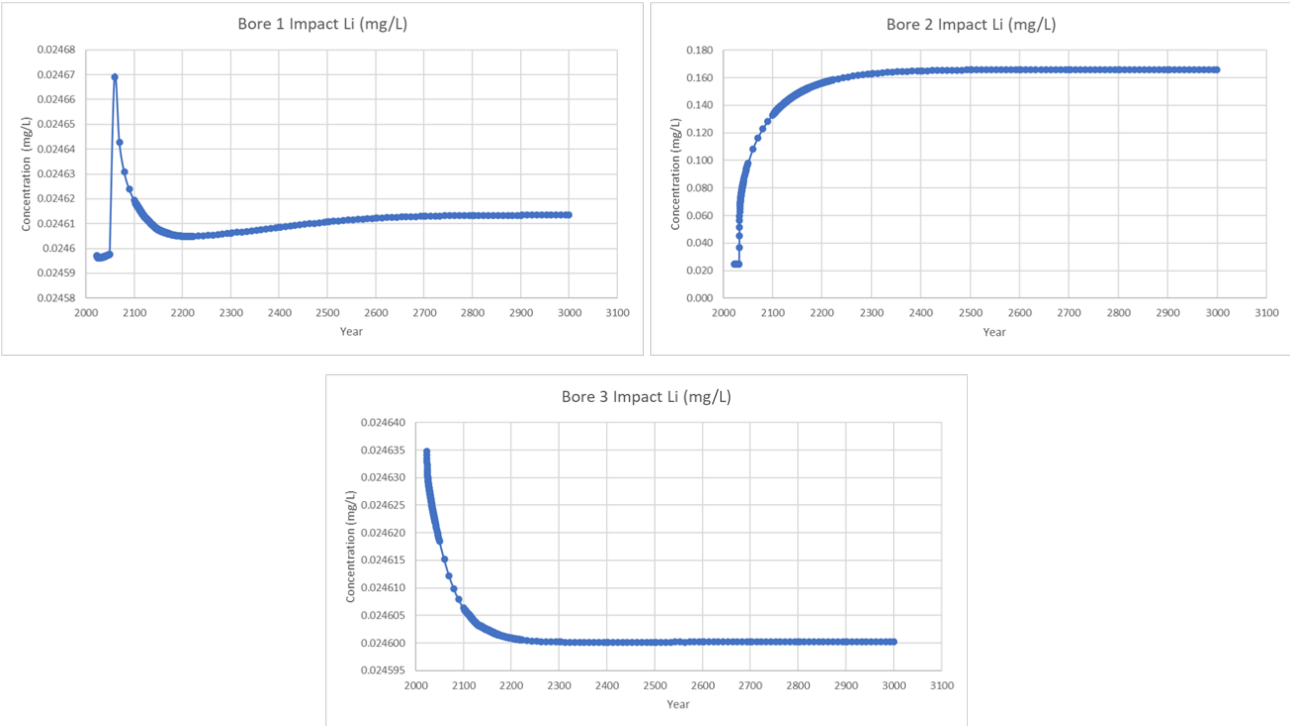


Figure 4.5: Modelled Lithium Concentrations in Layer 2 at Sites 1, 2, and 3

4.3 Conclusions from Modelling

Groundwater modelling indicates that the arsenic and lithium plumes from the existing and proposed WRLs and TSF are generally constrained close to or within the TSF or WRL footprints. There is some localised spreading around the SWG Dam due to infiltration of stored water with elevated arsenic and lithium.

Water seeping from the base of the existing farm dams constructed in Salt Water Gully, and the proposed SWG Dam, is effectively returned to surface as groundwater discharge to Salt Water Gully immediately downstream of these dams. Consequently, the net contribution from these dams is minimal as a component of the overall catchment.

Overall, the eastern catchment groundwater discharge to surface drainage shows an increase in arsenic concentrations from an assumed baseline of 0.0005 mg/L, up to around 0.005 mg/L. Salt Water Gully, immediately adjacent to SWG WRL, had the highest arsenic concentrations which rapidly rose to 0.27 mg/L by 2030 then gradually increased to 0.28 mg/L by the year 3000, which is above all the adopted WQGs other than for livestock use.

The average groundwater discharge lithium concentration to the Eastern Catchment creeks reaches 0.18 mg/L by 2233 and stabilises at 0.19 mg/L by 2753. This is above the drinking water and non-potable guidelines but below the livestock, irrigation, and freshwater aquatic ecosystem guidelines.

Groundwater discharging to SWG Dam had the highest lithium concentrations, which rapidly rose to 1.10 mg/L by 2025 then stabilised at 1.15 0.28 mg/L by the year 2070. This is above the drinking water, non-potable, and livestock guidelines but below the irrigation and freshwater aquatic ecosystem guidelines.

5. Surface Water and Mass Balance

5.1 Modelling Approach

GHD (2023e) documents the water and mass balance modelling of key CoPCs emitted from the existing and proposed facilities to the surface water. The Water Balance Model (WBM) was developed using GoldSim, which is a probabilistic simulation software package for modelling and visualisation of dynamic and complex systems. The WBM involves dynamic simulation of the water balance in SWG Dam, including all inflows, outflows, operational rules, and logic. The hydrological processes in the Hester Brook, Salt Water Gully and Cascade Gully sub-catchments are also modelled.

The establishment of the new WRLs (S1 and SWG) will alter the catchment areas and runoff characteristics from the facilities (there is more runoff from these facilities based on the calibration against the observed flows). Accordingly, the WBM is configured to simulate the streamflow from the various sub-catchments that were delineated from the natural topography and proposed landforms. Runoff from each sub-catchment is simulated using the Australian Water Balance Model (AWBM), which is a module in GoldSim. Sub-catchment runoff is routed downstream by simple addition of flows as indicated in the schematic diagrams provided in **Figure 5.1**.

AWBM parameters were determined by calibration against observed streamflow records for the two broad categories of land use within the Study Area, namely ‘mine affected’ and ‘external catchments’. The former refers to areas predominantly comprising Floyds WRL, whereas the latter refers to areas not impacted by historical mine activities and comprises natural vegetation, forested area, and areas cleared for agricultural purposes. Details of the calibration process are provided by GHD (2023e).

In addition to the water balance, the WBM also performs a mass balance of the key CoPCs (lithium, arsenic, sulphate, and nitrate). The latter two CoPCs were included in the modelling as these are a key risk resulting from the construction of the S1 and SWG WRLs (see **Section 3.2.4**). Sulphate is only subject to redox and does not adsorb onto clays, and nitrate is a conservative ion which does not adsorb onto clays

Concentrations of CoPCs in the runoff from the mine affected areas were assumed to be constant at the average values recorded at the monitoring sites in the creeks downgradient of Floyds WRL in 2021, the most recent year with complete records at all sites (see **Table 5.1**). Lithium and arsenic concentrations in the runoff from the external catchments were assumed to be nil based on the very low concentrations reported in the *2019 Ecological Assessment Study* (University of Western Australia, 2019). Sulphate and nitrate concentrations in the runoff from the external catchments were estimated from a once off sample in 2020 at a monitoring site located in the upper reaches of Salt Water Gully which is outside of the influence of the mine (see **Table 5.1**). This latter assumption may present slightly elevated concentrations relative to upstream of Hester Brook as Salt Water Gully is known to have naturally higher salt levels.

Table 5.1: Surface Water Source CoPC Concentrations

Storage/ catchment	CoPC Concentration (mg/L)			
	Lithium	Arsenic	Sulphate	Nitrate
Mine affected runoff	1.0	0.004	732	18
External catchment runoff	0.0	0.0	16	0.68
Groundwater recharge	Varying, as reported by GHD (GHD, 2023d)			

The groundwater modelling (GHD, 2023d) provides estimates of the varying groundwater loads of lithium and arsenic discharged into the downstream waterways over time (e.g., creeks, dams, rivers), which were input into the WBM. However, the groundwater modelling did not include sulphate and nitrate loads, so these were estimated as a ratio of the sulphate and nitrate concentrations to the lithium concentration as monitored at the sites around the existing WRL (i.e., mine affected runoff in **Table 5.1**).

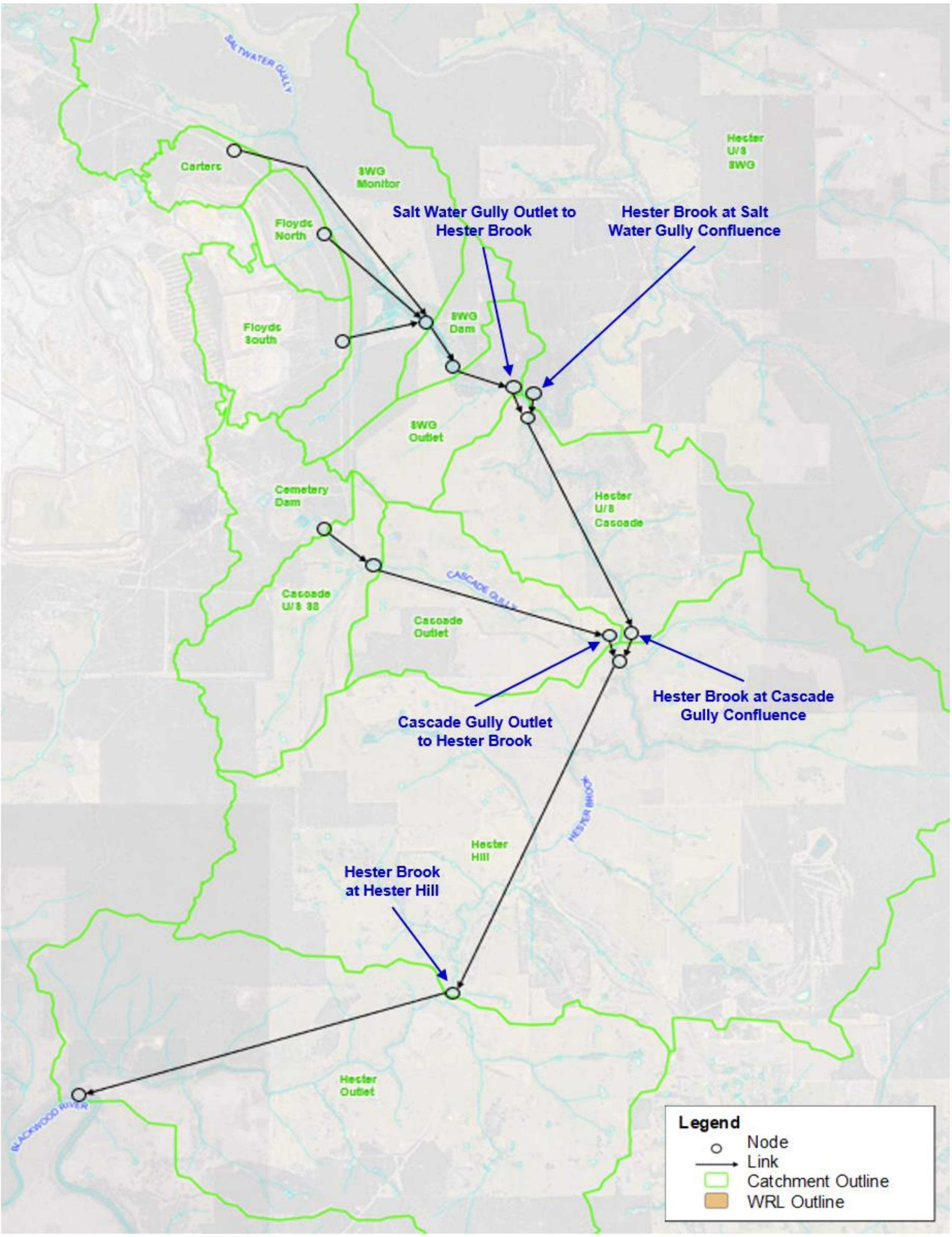


Figure 5.1: Schematic Configuration of Streamflow Routes and Reporting Locations

The water balance model was simulated over a 40-year period from January 2023 and extends 20 years post mine closure, which is expected to occur in 2043. The model was simulated 500 times with each simulation adopting a unique climate sequence (of rainfall and evaporation) that was sampled from historical climate records. It should be noted that the mass balances assume that the CoPCs are conservative substances that do not decay over time or react with the other substances (i.e., only subject to concentration or dilution).

5.2 Modelling Results

5.2.1 Scenarios

The following scenarios were simulated in the WBM and are reported by GHD (2023e):

- **Base Case**: Existing site and operations, including the approved expansion of Floyds WRL (S1 WRL).
- **Impact Case 1**: Base Case plus the proposed SWG WRL and SWG Dam[20] (i.e., to align the impact case from the groundwater modelling).
- **Impact Case 2:** Impact Case 1 but without SWG Dam.

5.2.2 Streamflow

A statistical summary of the simulated daily catchment runoff flows is provided in **Table 5.2** for the reporting locations depicted in **Figure 5.1** and for each of the scenarios simulated. The reporting locations and associated upstream impacts are as follows:

- Salt Water Gully Outlet to Hester Brook, including discharges from the MSA, Floyds WRL, and S1 WRL for the Base Case and Impact Scenarios, SWG Dam and SWG WRL for Impact Case 1, and SWG WRL for Impact Case 2.
- Cascade Gully Outlet to Hester Brook, including discharges from the current non-operational TSF1 and S1 WRL for the Base Case and Impact Scenarios, and the future operational TSF1 and SWG WRL for both Impact Cases.
- Hester Brook Incremental Catchment Between Salt Water and Cascade Gullies, including discharges from SWG WRL for both Impact Cases (Base Case simulates natural runoff only).
- Hester Brook Upstream of Salt Water Gully Confluence, which does not include any mine impacted discharges and is the same for all simulated scenarios.
- Hester Brook Downstream of Cascade Gully Confluence, including discharges from the MSA, Floyds WRL, S1 WRL, and the current non-operational TSF1 for the Base Case and Impact Scenarios, the future operational TSF1, SWG WRL, and SWG Dam for Impact Case 1, and the future operational TSF1 and SWG WRL for Impact Case 2.
- Hester Brook at Hester Hill, including the discharges described in the above point.

The simulated flows indicate the following:

- Streamflow at the Salt Water Gully outlet to Hester Brook reduces by ~67% on average from the Base Case to the Impact Case 1, reflecting the impact of SWG Dam, and increases by ~2% on average from the Base Case to the Impact Case 2, reflecting the change in runoff characteristics brought about by SWG WRL.
- Streamflow at the Cascade Gully outlet to Hester Brook increases by ~10% on average from the Base Case to both Impact Cases 1 and 2, reflecting the change in runoff characteristics brought about by SWG WRL
- Streamflow in the Hester Brook incremental catchment between Salt Water and Cascade Gullies increases by ~19% on average from the Base Case to both Impact Cases 1 and 2, reflecting the change in runoff characteristics brought about by SWG WRL. Streamflow for both Impact Cases 1 and 2 do not change as this is the incremental runoff and is independent of impacts of SWG dam.
- Streamflow in Hester Brook upstream of Salt Water Gully remains unchanged for all scenarios since this is not impacted by the proposed facilities.
- Streamflow in Hester Brook downstream of the confluence with Cascade Gully and at Hester Hill gauging site reduces by ~5% on average from the Base Case to the Impact Case 1, reflecting the impact of SWG Dam and change in catchment area and runoff characteristics brought about by SWG WRL, and increases by ~1% on average from the Base Case to the Impact Case 2, reflecting the increased catchment area and runoff characteristics brought about by SWG WRL.

[20] Note that TSF1 is outside the surface water model domain so is not explicitly included in the model setup, however, the impacts of TSF1 reuse are considered through the groundwater discharges to the surface as detailed in the groundwater Modelling report (GHD, 2023d), which have been included in the model setup.

Table 5.2: Statistics of Simulated Flows (ML/Day) at Reporting Sites from 2023 to 2063

Location	Salt Water Gully Outlet to Hester Brook			Cascade Gully Outlet to Hester Brook			Hester Brook Incremental Catchment Between Salt Water and Cascade Gullies		
Statistic [21]	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2
5%	1.10	0.38	1.16	0.48	0.58	0.58	0.27	0.39	0.39
20%	2.84	0.95	2.95	1.30	1.49	1.49	0.75	0.98	0.98
50%	5.72	1.88	5.86	2.72	3.00	3.00	1.62	1.93	1.93
80%	12.87	4.25	12.86	6.37	6.73	6.73	3.94	4.17	4.17
95%	26.72	11.41	26.39	13.47	13.95	13.95	8.45	8.48	8.48
Location	**Hester Brook Upstream of Salt Water Gully Confluence**			**Hester Brook Downstream of Cascade Gully Confluence**			**Hester Brook at Hester Hill**		
Statistic	**Base**	**Impact 1**	**Impact 2**	**Base**	**Impact 1**	**Impact 2**	**Base**	**Impact 1**	**Impact 2**
5%	9.52	9.52	9.52	11.39	10.91	11.71	12.81	12.12	12.94
20%	26.36	26.36	26.36	31.27	29.86	31.90	35.19	33.54	35.65
50%	57.12	57.12	57.12	67.22	64.01	68.03	75.72	72.22	76.39
80%	139.13	139.13	139.13	162.26	154.13	162.82	182.98	174.49	183.54
95%	298.63	298.63	298.63	347.04	331.85	347.00	391.47	376.11	391.71

5.2.3 CoPC Concentrations

Statistical summaries of the simulated lithium, arsenic, sulphate, and nitrate concentrations are provided in **Table 5.3**, **Table 5.4**, **Table 5.5**, and **Table 5.6** respectively for the reporting locations depicted in **Figure 5.1** and for each of the scenarios simulated. Exceedances of the respective WQGs are depicted in each of these tables through colour coding of the values. Plots of the ranges of simulated concentrations are depicted graphically in **Figure 5.2**, **Figure 5.3**, **Figure 5.4**, and **Figure 5.5** for lithium, arsenic, sulphate, and nitrate respectively. It should be noted that the concentrations at the low exceedance probabilities (e.g., 5%) generally coincide with high flow periods, and those at the high exceedance probabilities (e.g., 95%) generally coincide with low flow periods.

Table 5.3: Statistics of Simulated Lithium Concentrations (mg/L) at Reporting Sites from 2023 to 2063[22]

Location	Salt Water Gully Outlet to Hester Brook			Cascade Gully Outlet to Hester Brook			Hester Brook Incremental Catchment Between Salt Water and Cascade Gullies		
Statistic	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2
5%	0.157	0.257	0.217	0.070	0.156	0.156	0.004	0.234	0.234
20%	0.316	0.438	0.397	0.169	0.312	0.312	0.007	0.390	0.390
50%	0.470	0.590	0.551	0.299	0.462	0.462	0.009	0.510	0.510
80%	0.593	0.707	0.671	0.420	0.583	0.583	0.010	0.598	0.598
95%	0.675	0.779	0.747	0.509	0.665	0.665	0.010	0.650	0.650

21 Exceedances probabilities, which are the probabilities of the flows equaling or exceeding given rates.

22 Red - Above all guidelines, irrigation is highest value (2.5 mg/L).
Blue - Above aquatic environment (2.0 mg/L), Livestock (0.82 mg/L), non-potable (0.14 mg/L) & drinking (0.007 mg/L) guidelines.
Green - Above Livestock (0.82 mg/L), non-potable (0.14 mg/L) & drinking water (0.007 mg/L) guidelines.
Purple - Above non-potable (0.14 mg/L) & drinking water (0.007 mg/L) guidelines.
Orange - Above drinking water (0.007 mg/L) guidelines.
Black - Below all guidelines.

Location	Hester Brook Upstream of Salt Water Gully Confluence			Hester Brook Downstream of Cascade Gully Confluence			Hester Brook at Hester Hill		
Statistic	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2
5%	0.000	0.000	0.000	0.016	0.022	0.032	0.015	0.021	0.031
20%	0.000	0.000	0.000	0.046	0.060	0.086	0.041	0.057	0.082
50%	0.000	0.000	0.000	0.105	0.130	0.177	0.096	0.128	0.173
80%	0.000	0.000	0.000	0.190	0.221	0.282	0.176	0.219	0.278
95%	0.000	0.000	0.000	0.279	0.309	0.374	0.263	0.310	0.371

Table 5.4: Statistics of Simulated Arsenic Concentrations (mg/L) at Reporting Sites from 2023 to 2063[23]

Location	Salt Water Gully Outlet to Hester Brook			Cascade Gully Outlet to Hester Brook			Hester Brook Incremental Catchment Between Salt Water and Cascade Gullies		
Statistic	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2
5%	0.0004	0.0010	0.0007	0.0002	0.0004	0.0004	0.0000	0.0005	0.0005
20%	0.0006	0.0012	0.0010	0.0002	0.0006	0.0006	0.0001	0.0007	0.0007
50%	0.0009	0.0017	0.0014	0.0003	0.0008	0.0008	0.0001	0.0010	0.0010
80%	0.0012	0.0021	0.0017	0.0005	0.0011	0.0011	0.0001	0.0013	0.0013
95%	0.0016	0.0025	0.0021	0.0007	0.0014	0.0014	0.0002	0.0016	0.0016
Location	**Hester Brook Upstream of Salt Water Gully Confluence**			**Hester Brook Downstream of Cascade Gully Confluence**			**Hester Brook at Hester Hill**		
Statistic	**Base**	**Impact 1**	**Impact 2**	**Base**	**Impact 1**	**Impact 2**	**Base**	**Impact 1**	**Impact 2**
5%	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0001
20%	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
50%	0.0000	0.0000	0.0000	0.0001	0.0001	0.0002	0.0001	0.0001	0.0002
80%	0.0000	0.0000	0.0000	0.0001	0.0002	0.0003	0.0001	0.0002	0.0002
95%	0.0000	0.0000	0.0000	0.0002	0.0003	0.0004	0.0002	0.0002	0.0004

Table 5.5: Statistics of Simulated Sulphate Concentrations (mg/L) at Reporting Sites from 2023 to 2063[24]

Location	Salt Water Gully Outlet to Hester Brook			Cascade Gully Outlet to Hester Brook			Hester Brook Incremental Catchment Between Salt Water and Cascade Gullies		
Statistic	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2
5%	113.3	180.6	153.9	55.5	113.0	113.0	6.8	164.2	164.2
20%	217.7	300.3	272.3	118.2	214.8	214.8	7.0	267.1	267.1
50%	320.4	401.7	375.4	204.8	314.7	314.7	7.9	347.2	347.2
80%	402.4	479.5	455.2	285.1	395.6	395.6	9.3	406.3	406.3
95%	457.7	528.3	506.7	345.7	450.9	450.9	12.2	442.3	442.3

23 Red - Above all guidelines, livestock is highest value (0.5 mg/L).
Blue - Above non-potable (0.2 mg/L), irrigation (0.1 mg/L), aquatic environment (0.013 mg/L), & drinking (0.010 mg/L) guidelines.
Green - Above irrigation (0.1 mg/L), aquatic environment (0.013 mg/L), & drinking (0.010 mg/L) guidelines.
Purple - Above aquatic environment (0.013 mg/L), & drinking (0.010 mg/L) guidelines.
Orange - Above drinking water (0.010 mg/L) guidelines.
Black - Below all guidelines.

24 Red - Above all guidelines, livestock is highest value (1000 mg/L).
Blue - Above aquatic environment (429 mg/L), & drinking (250 mg/L) guidelines.
Green - Above drinking (250 mg/L) guidelines.
Black - Below all guidelines.
NB Irrigation and non-potable guidelines not required.

Location	Hester Brook Upstream of Salt Water Gully Confluence			Hester Brook Downstream of Cascade Gully Confluence			Hester Brook at Hester Hill		
Statistic	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2
5%	0.0	0.0	0.0	18.1	21.8	29.5	16.9	20.2	27.3
20%	0.4	0.4	0.4	35.1	44.3	62.4	32.1	40.3	56.9
50%	1.9	1.9	1.9	73.8	90.7	122.4	67.6	83.0	113.0
80%	4.3	4.3	4.3	129.6	150.5	191.7	120.4	140.1	180.1
95%	9.5	9.5	9.5	189.5	209.8	253.9	179.0	198.5	242.1

Table 5.6: Statistics of Simulated Nitrate Concentrations (mg/L) at Reporting Sites from 2023 to 2063[25]

Location	Salt Water Gully Outlet to Hester Brook			Cascade Gully Outlet to Hester Brook			Hester Brook Incremental Catchment Between Salt Water and Cascade Gullies		
Statistic	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2	Base	Impact 1	Impact 2
5%	2.9	4.5	3.9	1.5	2.9	2.9	0.2	4.1	4.1
20%	5.4	7.4	6.7	3.0	5.3	5.3	0.2	6.6	6.6
50%	7.9	9.9	9.2	5.0	7.7	7.7	0.2	8.5	8.5
80%	9.9	11.7	11.1	7.0	9.7	9.7	0.3	10.0	10.0
95%	11.2	12.9	12.4	8.5	11.0	11.0	0.5	10.9	10.9
Location	**Hester Brook Upstream of Salt Water Gully Confluence**			**Hester Brook Downstream of Cascade Gully Confluence**			**Hester Brook at Hester Hill**		
Statistic	**Base**	**Impact 1**	**Impact 2**	**Base**	**Impact 1**	**Impact 2**	**Base**	**Impact 1**	**Impact 2**
5%	0.0	0.0	0.0	0.5	0.6	0.8	0.5	0.6	0.8
20%	0.0	0.0	0.0	0.9	1.1	1.6	0.8	1.0	1.5
50%	0.1	0.1	0.1	1.9	2.3	3.0	1.7	2.1	2.8
80%	0.2	0.2	0.2	3.2	3.7	4.7	3.0	3.5	4.4
95%	0.4	0.4	0.4	4.7	5.2	6.2	4.4	4.9	5.9

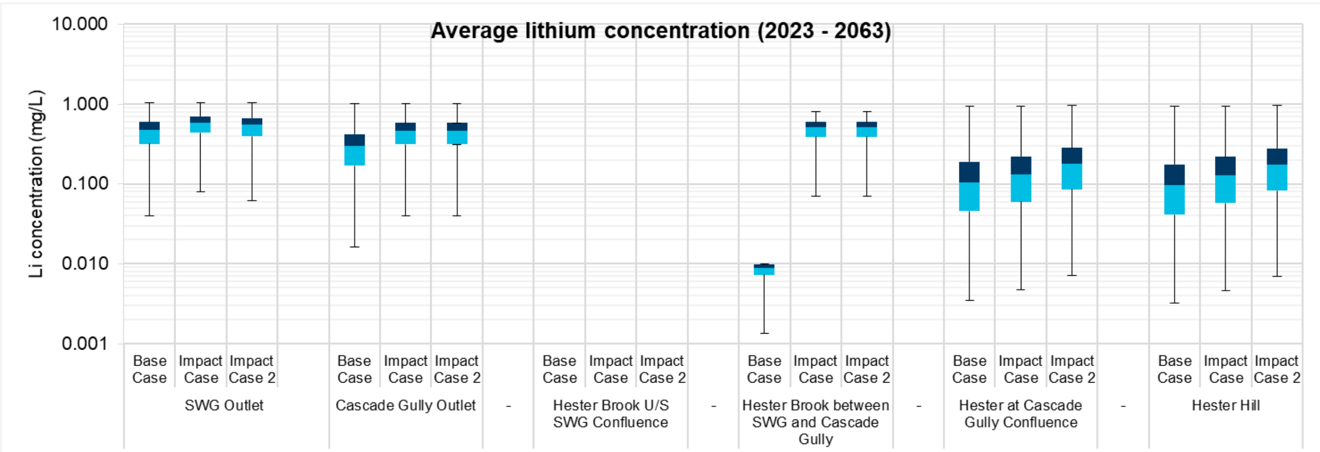


Figure 5.2: Range of Simulated Lithium Concentrations

[25] Red - Above all guidelines, livestock is highest value (90 mg/L).
Blue - Above drinking (50 mg/L) & aquatic environment (2.4 mg/L) guidelines.
Green - Above aquatic environment (2.4 mg/L) guideline.
Black - Below all guidelines.
NB Irrigation guideline not required and non-potable guideline not undertaken.

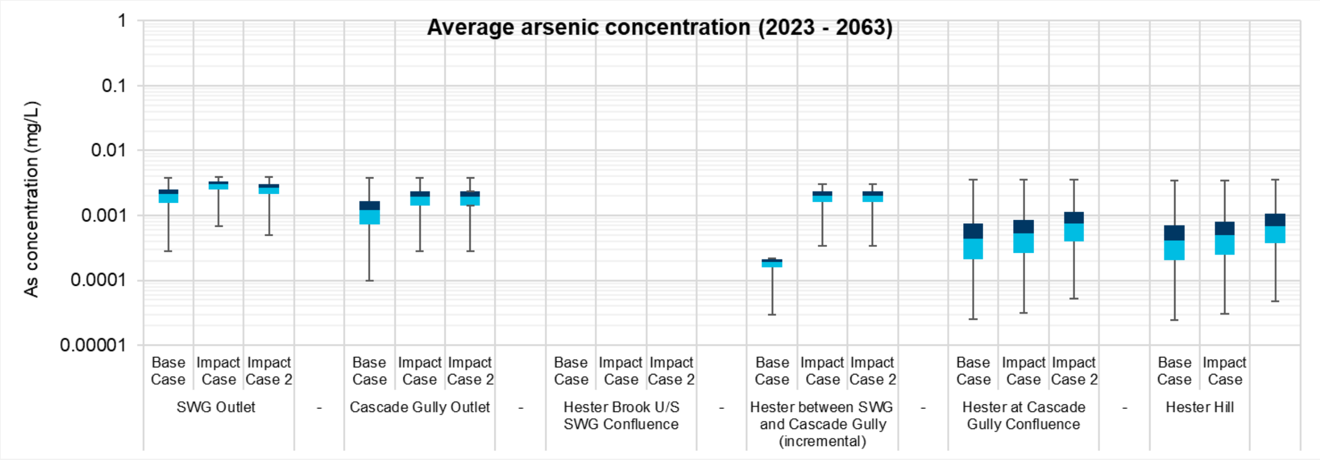


Figure 5.3: Range of Simulated Arsenic Concentrations

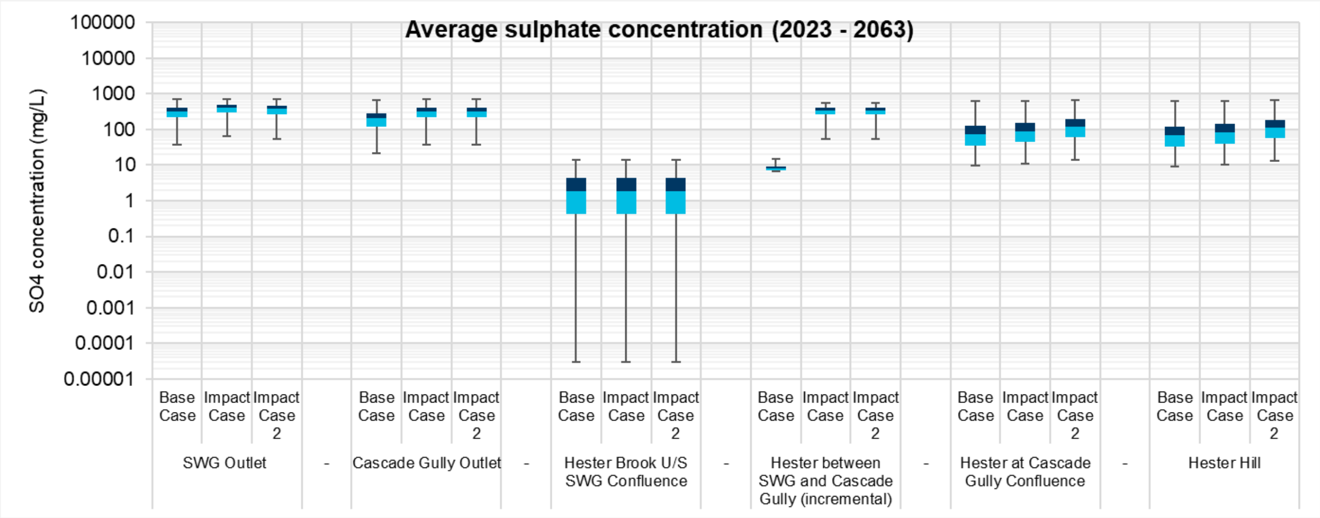


Figure 5.4: Range of Simulated Sulphate Concentrations

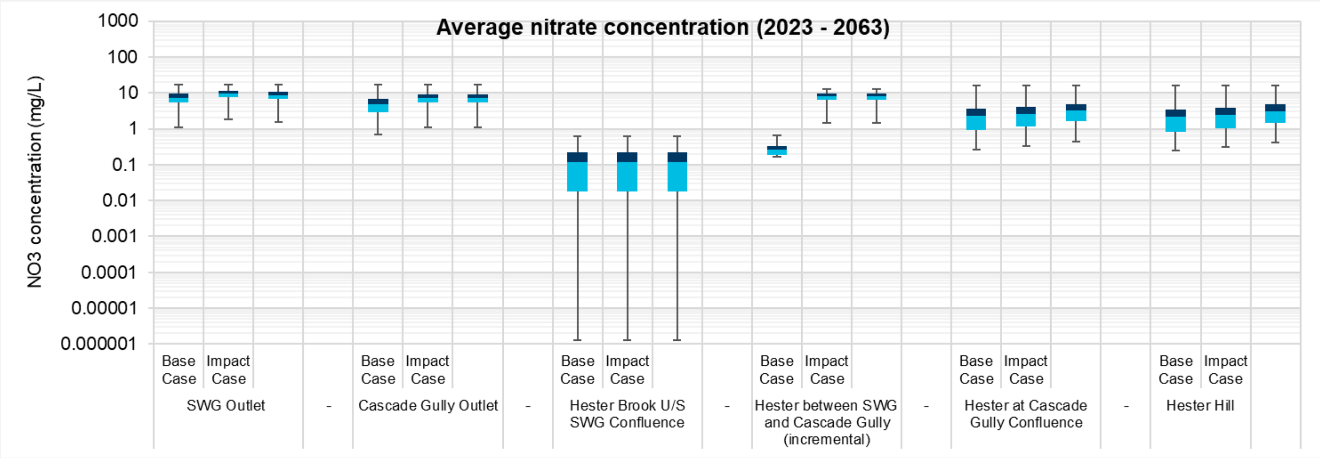


Figure 5.5: Range of Simulated Nitrate Concentrations

A comparative summary of the simulated CoPC concentrations is presented in **Table 5.7**.

Table 5.7: Comparative Summary of Simulation Results[26]

CoPC	WQG Exceedances for Given Exceedance Probability[27]			Increase in Concentration from Base Case for Given Exceedance Probability	
	Base Case	Impact Case 1	Impact Case 2	Impact Case 1	Impact Case 2
Salt Water Gully Outlet to Hester Brook					
Lithium	Exceeds non-potable & drinking WQGs for all EPs			~64% @ 5% ~26% @ 50% ~15% @ 95%	~38% @ 5% ~17% @ 50% ~11% @ 95%
Arsenic	Does not exceed any WQGs			~120% @ 5% ~91% @ 50% ~62% @ 95%	~64% @ 5% ~52% @ 50% ~36% @ 95%
Sulphate	Does not exceed any WQGs @ 5% Exceeds drinking WQG @ 50% Exceeds aquatic environment & drinking WQGs @ 95%			~59% @ 5% ~25% @ 50% ~15% @ 95%	~36% @ 5% ~17% @ 50% ~11% @ 95%
Nitrate	Exceeds aquatic environment WQG for all EPs			~57% @ 5% ~25% @ 50% ~15% @ 95%	~34% @ 5% ~17% @ 50% ~11% @ 95%
Cascade Gully Outlet to Hester Brook[28]					
Lithium	Exceeds drinking WQG @ 5% Exceeds non-potable & drinking WQGs for other EPs	Exceeds non-potable & drinking WQGs for all EPs		~122% @ 5% ~54% @ 50% ~30% @ 95%	
Arsenic	Does not exceed any WQGs			~171% @ 5% ~142% @ 50% ~97% @ 95%	
Sulphate	Does not exceed any WQGs @ 5% & 50% Exceeds drinking WQG @ 95%	Does not exceed any WQGs @ 5% Exceeds drinking WQG @ 50% Exceeds aquatic environment & drinking WQGs @ 95%		~104% @ 5% ~54% @ 50% ~30% @ 95%	
Nitrate	Does not exceed any WQGs @ 5% Exceeds aquatic environment WQG @ 50% & 95%	Exceeds aquatic environment WQG for all EPs		~94% @ 5% ~53% @ 50% ~30% @ 95%	

[26] Results from Hester Brook upstream of Salt Water Gully Confluence omitted since results do not change between Base Case and Impact Cases 1 and 2.
[27] EP = Exceedance Probabilities.
[28] Simulation results for Impact Cases 1 and 2 are the same since SWG Dam has no influence ion the flows in Cascades Gully.

CoPC	WQG Exceedances for Given Exceedance Probability[27]			Increase in Concentration from Base Case for Given Exceedance Probability	
	Base Case	Impact Case 1	Impact Case 2	Impact Case 1	Impact Case 2
Hester Brook Incremental Catchment Between Salt Water and Cascade Gullies[29]					
Lithium	Does not exceed any WQGs @ 5% Exceeds drinking WQG @ 50% & 95%	Exceeds non-potable & drinking WQGs for all EPs		~59 x Base Case @ 5% ~58 x Base Case @ 50% ~65 x Base Case @ 95%	
Arsenic	Does not exceed any WQGs			~14 x Base Case @ 5% ~12 x Base Case @ 50% ~10 x Base Case @ 95%	
Sulphate	Does not exceed any WQGs	Does not exceed any WQGs @ 5% Exceeds drinking WQG @ 50% Exceeds aquatic environment & drinking WQGs @ 95%		~24 x Base Case @ 5% ~44 x Base Case @ 50% ~36 x Base Case @ 95%	
Nitrate	Does not exceed any WQGs	Exceeds aquatic environment WQG for all EPs		~24 x Base Case @ 5% ~37 x Base Case @ 50% ~23 x Base Case @ 95%	
Hester Brook Downstream of Cascade Gully Confluence					
Lithium	Exceeds drinking WQG @ 5% & 50% Exceeds non-potable & drinking WQGs @ 95%		Exceeds drinking WQG @ 5% Exceeds non-potable & drinking WQGs @ 50% & 95%	~33% @ 5% ~24% @ 50% ~11% @ 95%	~97% @ 5% ~68% @ 50% ~34% @ 95%
Arsenic	Does not exceed any WQGs			~27% @ 5% ~24% @ 50% ~25% @ 95%	~102% @ 5% ~95% @ 50% ~86% @ 95%
Sulphate	Does not exceed any WQGs		Exceeds drinking WQG @ 95%	~20% @ 5% ~23% @ 50% ~11% @ 95%	~63% @ 5% ~66% @ 50% ~34% @ 95%
Nitrate	Exceeds aquatic environment WQG @ 95%		Exceeds aquatic environment WQG @ 50% & 95%	~22% @ 5% ~22% @ 50% ~11% @ 95%	~66% @ 5% ~63% @ 50% ~34% @ 95%

29 Simulation results for Impact Cases 1 and 2 are the same since SWG Dam has no influence ion the flows in the incremental catchment between Salt Water and Cascade Gullies.

CoPC	WQG Exceedances for Given Exceedance Probability[30]			Increase in Concentration from Base Case for Given Exceedance Probability	
	Base Case	Impact Case 1	Impact Case 2	Impact Case 1	Impact Case 2
Hester Brook at Hester Hill					
Lithium	Exceeds drinking WQG @ 5% & 50% Exceeds non-potable & drinking WQGs @ 95%		Exceeds drinking WQG @ 5% Exceeds non-potable & drinking WQGs @ 50% & 95%	~40% @ 5% ~33% @ 50% ~18% @ 95%	~106% @ 5% ~80% @ 50% ~41% @ 95%
Arsenic	Does not exceed any WQGs			~25% @ 5% ~21% @ 50% ~23% @ 95%	~93% @ 5% ~86% @ 50% ~22% @ 95%
Sulphate	Does not exceed any WQGs			~19% @ 5% ~23% @ 50% ~11% @ 95%	~62% @ 5% ~67% @ 50% ~35% @ 95%
Nitrate	Exceeds aquatic environment WQG @ 95%		Exceeds aquatic environment WQG @ 50% & 95%	~22% @ 5% ~22% @ 50% ~11% @ 95%	~66% @ 5% ~64% @ 50% ~35% @ 95%

30 EP = Exceedance Probabilities.

The simulated CoPC concentrations indicate the following:

- The establishment of SWG Dam in 2026 and SWG WRL in 2032 results in increased CoPC concentrations at Salt Water Gully outlet to Hester Brook (between 15% and 120% for Impact Case 1, and between 11% and 64% for Impact Case 2). The establishment of SWG WRL also results in increased CoPC concentrations at Cascade Gully outlet to Hester Brook (between 30% and 171% for both Impact Cases).
- The increases in CoPC concentrations in Hester Brook at Hester Hill are markedly reduced with SWG Dam in place as this contains much of the impacted runoff and there is significant dilution from the undisturbed Hester Brook catchment upstream of the confluence with Salt Water Gully (between 11% and 40% for Impact Case 1). However, without the dam in place, the CoPC concentrations increase (between 35% and 106% for Impact Case 2).
- SWG contains most of the discharges from the MSA, Floyds WRL, S1 WRL, and SWG WRL as demonstrated by the difference in concentrations at the Salt Water Gully outlet to Hester Brook between the Impact Case 1 and Impact Case 2 scenarios.
- Lithium concentrations in the mine impacted waterways always exceed the drinking WQG (except for the undisturbed Hester Brook catchment upstream of the confluence with Salt Water Gully). Lithium concentrations during low flow periods also exceed the non-potable WQG in the mine impacted waterways.
- Arsenic concentrations do not exceed any WQGs for all the scenarios modelled.
- Sulphate concentrations at the Salt Water Gully outlet to Hester Brook and at the Cascade Gully outlet to Hester Brook exceed the drinking WQG for median flow conditions and exceed the aquatic environment WQG during low flow periods. Sulphate concentrations in Hester Brook do not exceed any WQGs for all the scenarios modelled.
- Nitrate concentrations at the Salt Water Gully outlet to Hester Brook and at the Cascade Gully outlet to Hester Brook exceed the aquatic environment WQG for most flow conditions, but only exceed the WQG during low flow conditions in Hester Brook.

It should be noted that CoPC concentrations simulated in the Base Case may differ from the monitored water quality data due to the following reasons:

- Limitations of the model: CoPCs are assumed to be conservative substances that do not decay over or react with other substances. In the model they are only subject to concentration or dilution.
- Monitoring of CoPCs in the catchment only occurs when there is sufficient flow. The modelled results are based on a range of flows and due to dilution and concentration will vary significantly depending on the volume of water in the creeks (e.g., concentrations may be inflated at very low flows).

For this reason, the emphasis should be on the concentration difference between scenarios, rather than the specific concentration values.

5.3 Conclusions from Water and Mass Balance

The modelling indicates that the establishment of the SWG WRL results in increased CoPC concentrations discharging from Salt Water Gully and Cascade Gully into Hester Brook. The increases in CoPC concentrations in Hester Brook at Hester Hill are markedly reduced with SWG Dam in place due to the dam containing much of the impacted runoff. Although there is a significant dilution effect from the flows in Hester Brook upstream of Salt Water Gully, the CoPC concentrations in the lower reaches of Hester Brook increase without the dam in place.

SWG Dam, therefore, has a marked impact on reducing the CoPC loads discharging into Hester Brook by containing much of the impacted runoff from the MSA, Floyds WRL, S1 WRL, and SWG WRL when it is constructed. The magnitude of the passing flows will impact this containment of CoPCs and the need for passing flows and the magnitude thereof should be investigated in more detail.

Lithium concentrations under median flow conditions exceed the non-potable and drinking WQGs at the Salt Water and Cascade Gullies outlets to Hester Brook for the Base Case, but only exceed the drinking WQGs in Hester Brook. There are no additional exceedances at the Salt Water and Cascade Gullies outlets to Hester Brook for Impacts Cases 1 and 2, however, the non-potable WQG is also exceeded in Hester Brook for Impact Case 2.

Arsenic concentrations do not exceed any WQGs for all the scenarios modelled.

Sulphate concentrations under median flow conditions exceed the drinking WQG at the Salt Water Gully outlet to Hester Brook for the Base Case, but no WQGs are exceeded at the Cascade Gully outlet to Hester Brook or in Hester Brook. Concentrations under these flow conditions exceed the drinking WQG at both the Salt Water and Cascade Gullies outlets to Hester Brook for Impact Cases 1 and 2, but there are still no exceedances in Hester Brook.

Nitrate concentrations under median flow conditions exceed the aquatic environment WQG at the Salt Water and Cascade Gullies outlets to Hester Brook for the Base Case and Impact Cases 1 and 2. Nitrate concentrations in Hester Brook only exceed the aquatic environment WQG in Hester Brook for Impacts Case 2.

Streamflow at the Salt Water Gully outlet to Hester Brook reduces by ~67% on average from the Base Case to the Impact Case 1, reflecting the impact of SWG Dam, and increases by ~2% on average from the Base Case to the Impact Case 2, reflecting the change in runoff characteristics brought about by SWG WRL. Streamflow at the Cascade Gully outlet to Hester Brook also increases (by ~10% on average in this case) from the Base Case to both Impact Cases 1 and 2, reflecting the change in runoff characteristics brought about by SWG WRL.

Streamflow in Hester Brook downstream of the confluence with Cascade Gully and at Hester Hill gauging site reduces by ~5% on average from the Base Case to the Impact Case 1, reflecting the impact of SWG Dam and change in catchment area and runoff characteristics brought about by SWG WRL, and increases by ~1% on average from the Base Case to the Impact Case 2, reflecting the increased catchment area and runoff characteristics brought about by SWG WRL.

6. Risk Assessment

6.1 Source-Pathway-Receptor Links

6.1.1 Sources

Detailed discussion on the sources of contamination is presented in **Section 3.1**. In summary, impacted sources of seepage from the TSF1 and the WRLs may be derived from the following potential sources:

– Tailings slurry waters used to deposit the tailings (closed process/circuit waters).
– Leaching from tailings solids and embankment materials (typically waste rock) via rainfall infiltration.
– Leaching from waste rock in WRLs via rainfall infiltration.

The initial list of CoPCs derived from the assessment of the tailings decant and leaching which exceed the relevant guidelines (see **Table 3.4**) and which may present a potential risk to the receptors includes:

– Aluminium (AQ, DW)
– Antimony (AQ, DW, NP)
– Arsenic (AQ, DW, NP, IR)
– Cadmium (AQ)
– Caesium (DW)
– Chromium (III+VI) (AQ)
– Copper (AQ)
– Lithium (AQ, DW, NP, IR, AG)
– Manganese (IR)
Molybdenum (IR)
– Nickel (DW)
– Rubidium (AQ, DW, NP, AG)
– Thallium (AQ, DW, NP)
– Uranium (AQ, DW, IR)
– Vanadium (AQ, DW)
– Zinc (AQ)
– Nitrate (AQ)
– Sulphate (DW)

The above list includes the WQGs that are exceeded by each CoPC.[31]

Historical monitoring of discharge waters has also provided a measure of contaminant concentrations of waste rock from existing WRLs, however, no additional CoPCs were identified from this data set and none of the initial list of CoPCs could be eliminated.

6.1.2 Pathways

The site conceptual model reported in **Section 2.3** provides details of the migration pathways, which can be summarised as follows:

– Tailings slurry waters from TSF1 and leachate from the waste rock materials used to construct the buttresses of TSF1 that migrates eastwards are generally captured within mine pits and pumped back to the Mine Water Circuit (MWC). Some of the slurry waters and leachate penetrates through the base of the TSF into the groundwater, and then migrates to surface water discharge points in the nearby catchments water. This is discussed in more detail by GHD (2023f).
– Leachate from the waste rock within the MSA embankment, Floyds WRL, S1 WRL, and SWG WRL is typically intersected at and within the pre-construction ground surface and discharges as base flow at the toes of the WRLs. Some of this leachate penetrates down to the low permeable subsurface of saprolite and discharges to nearby creeks. This pathway is the focus of this Study.

31 AG = Agricultural Use – Livestock
IR = Agricultural Use – Irrigation
AQ = Aquatic Environment
DW = Potable Use - Drinking Water
NP = Non-potable use

6.1.3 Receptors

The various groundwater and surface water receptors in the receiving environment are discussed in **Section 2.4**. The sensitive receptors in the receiving environment are recognised as associated with groundwater extraction, and the surface water environment of Salt Water Gully, Cascade Gully, and Hester Brook, including the following beneficial uses:

- Drinking water.
- Non-potable domestic water (recreation).
- Irrigation water.
- Stock water.
- Aquatic environment of creek lines.

6.1.4 Conclusions

The source-pathway-receptor linkage for waste rock leaching is summarised in **Table 6.1**. The following conclusions can be made with respect to risks posed by the tailings decant and leaching based on the summary in **Table 6.1** and the information presented throughout this report:

Table 6.1: Waste Rock Leach Source-Pathway-Receptor Scenarios and Linkage Assessment

Source CoPCs in Waste Rock Leachate	Pathways for Wate Rock Impacted Seepage and Drainage[32]	Receptors (Beneficial Uses)	Potential of Exposure Risk to Receptors (scenarios)
– Aluminium (AQ, DW) – Antimony (AQ, DW, NP) – Arsenic (AQ, DW, NP, IR) – Cadmium (AQ) – Caesium (DW) – Chromium (III+VI) (AQ) – Copper (AQ) – Lithium (AQ, DW, NP, IR, AG) – Manganese (IR) – Molybdenum (IR) – Nickel (DW) – Rubidium (AQ, DW, NP, AG) – Thallium (AQ, DW, NP) – Uranium (AQ, DW, IR) – Vanadium (AQ, DW) – Zinc (AQ) – Nitrate (AQ) – Sulphate (DW)	**Groundwater Pathways:** – Downwards migration of waste rock leachate into geological profile. – CoPCs attenuated and largely retained in geological profile, within or close to the footprint of WRL. – Discharge of groundwater impacted with elevated concentrations of CoPCs may occur into downstream water courses where WRL is adjacent to a water course.	**Salt Water Gully, Cascade Gully, and Hester Brook (from Salt Water Gully confluence):** – Aquatic ecology – Human health (drinking water) – Human recreation (non-potable) – Agricultural use (irrigation and stock watering)	**Groundwater:** – The CoPCs are largely attenuated in geological profile within or adjacent to the WRL footprint. However, the exposure pathway may be complete for WRLs located near water course. Capping of WRLs after closure may mitigate this.
	Surface Water Pathway: – WRL leachate intersected at and within the pre-construction ground surface and discharges as base flow at toe of WRL and flows into downstream water courses. – Runoff from surface of WRL impacted with elevated concentrations of CoPCs discharges into downstream water courses.		**Surface Water:** – Exposure scenario is complete. Drainage waters may require management (construction buffers, seepage cutoff and treatment, etc.). Capping of WRLs after closure may further mitigate this

[32] No consideration of seepage management at toes of WRLs or capping of WRLs after closure. These are fundamental management measures required for both existing and proposed facilities.

6.2 Risk to Groundwater Receptors

The groundwater modelling presented in **Section 4** indicates that the arsenic and lithium plumes from the existing and proposed WRLs and TSF are generally constrained close to or within the TSF or WRL footprints. There is some localised spreading around the SWG Dam due to infiltration of stored water with elevated arsenic and lithium.

The modelled changes in arsenic and lithium concentrations in layer 2 were assessed at three nominal sites, namely northeast of SWG Dam (Site 1), within the footprint of SWG WRL (Site 2), and south of TSF4 within the Woljenup Creek Catchment (Site 3). The modelling results indicated the following:

- The highest modelled concentration of arsenic (0.035 mg/L) and lithium (0.16 mg/L) were both simulated at Site 2, where the water use survey indicates that water is used for stock watering (likely from soaks as there are no registered bores in this area). The stock watering WQGs are 0.5 mg/L (arsenic) and 0.82 mg/L (lithium) which are both well above the maximum modelled concentrations.
- The highest modelled concentration of arsenic at Site 2 exceeds the drinking water WQG (0.01 mg/L) and the aquatic environment WQG (0.013 mg/L for As and V) but does not exceed the freshwater aquatic WQG (2.0 mg/L) and irrigation WQG (2.5 mg/L).
- The highest modelled concentration of lithium at Site 2 exceeds the drinking water WQG (0.007 mg/L) and marginally exceeds the non-potable WQG (0.14 mg/L) but does not exceed the irrigation WQG (0.1 mg/L) and the non-potable WQG (0.2 mg/L).
- Simulated contours of both arsenic and lithium concentrations in the groundwater reported by GHD (2023d) show that these CoPCs do not migrate far from the source (e.g., SWG WRL) and rapidly decrease in concentration away from the source.
- The modelled concentrations at Sites 1 and 3 indicate that:
  - Arsenic concentrations remain low over the long term, not exceeding 0.0006 mg/L (background concentration of 0.0005 mg/L), which is below the drinking WQG, the most stringent of the guidelines.
  - Lithium concentrations remain between 0.0245 mg/L and 0.0247 mg/L, which exceed the drinking water WQG, but is below the other WQGs. Background levels of lithium in the vicinity of the mine site are estimated at 0.0246 mg/L, therefore it is unlikely that Sites 1 and 3 are impacted by mining operations.

Groundwater modelling indicates that the impacts of the leaching from waste rock in the WRLs to the aquifer will likely be limited to the areas beneath and immediately adjacent to the footprints of the WRLs. Accordingly, risks to groundwater users beyond the immediate periphery of the WRL are assessed as low. It should be noted that the Study has not considered seepage management measures around the WRLs (e.g., seepage cutoff and returns to the MWC) or capping of the WRLs after closure, both of which would mitigate the already low risks to groundwater users further.

Modelling was not undertaken for the remaining CoPCs (Al, Cd, Cu, Cs, Cr, Mn, Mo, Ni, NO_3, Rb, Sb, SO_4, Th, U, and Vn), however, given the published adsorption characteristics and expected similarity in mobilisation behaviour (see **Table 4.2**) the results are anticipated to present similar distributions and lateral extents to that presented for arsenic and lithium. Consequently, the extent of impacts to the aquifer from the remaining CoPCs will also likely be limited to areas beneath and adjacent to the footprint of the WRLs.

6.3 Risk to Surface Water Receptors

6.3.1 Assessment Basis

As reported in **Section 5**, the WBM simulated the flows and concentrations of arsenic, lithium, sulphate, and nitrate over the period from 2023 to 2063 at the following locations:

- Salt Water Gully Outlet to Hester Brook.
- Cascade Gully Outlet to Hester Brook.
- Hester Brook Upstream of Salt Water Gully Confluence.
- Hester Brook Downstream of Cascade Gully Confluence.
- Hester Brook at Hester Hill gauging station.

Assessment results are presented for the following model scenarios:

- **Base Case**: Existing site and operations, including the approved expansion of Floyds WRL (S1 WRL).
- **Impact Case 1**: Base Case plus the proposed SWG WRL and SWG Dam.
- **Impact Case 2:** Impact Case 1 but without SWG Dam.

Risks to surface water receptors have been assessed using a heatmap approach to assess the multiple considerations required. The simulated 95th percentile concentrations (i.e., those associated with very low flows) have been compared to the various WQGs. The risk ratings for assessing the modelling results are shown in **Table 6.2**. Consideration has been given to the level of exceedance (factor), where a factor of 10 or more has the potential to result in acute risk impacts for aquatic ecosystems, and potentially unacceptable exposure levels for human health (hazard quotients above 10).

Table 6.2: Risk Rating Descriptors (Comparison to WQGs)

Risk	Criteria exceedance factor	Description
Very Low	Concentration below criteria	Reasonable worst-case concentration below criteria.
Low	Concentration exceeds criteria by less factor 3	Reasonable worst-case concentration marginally above criteria, average concentration (50th) likely to be near criteria.
Medium	Concentration exceeds criteria by more factor 3 and less factor 10	Reasonable worst-case concentration significantly above criteria. Unlikely to be high enough to cause an acute risk exposure to human health and/or environment.
High	Concentration exceeds criteria by more factor 10	Reasonable worst-case concentration high, and potential for acute exposure to human health and/or environment.

6.3.2 Assessment of Key CoPCs

The simulated 95th percentile concentrations in the various locations are compared to the various WQGs and presented in **Table 6.3**, **Table 6.4**, and **Table 6.5** along with the assessed risks for lithium, sulphate and nitrate respectively. The assessments are only presented for those concentrations that exceeded respective guidelines. The following should be noted in this regard:

- Lithium concentrations at all sites (except Hester Brook upstream of the Salt Water Gully Confluence) and for all model scenarios exceed the drinking water and non-potable WQGs, but do not exceed the stock watering, freshwater aquatic, and irrigation WQGs.
- Arsenic concentrations at all sites do not exceed any of the WQGs for any of the model scenarios.
- Sulphate concentrations:
  - Exceed the drinking water WQG in Salt Water and Cascade Gully for all model scenarios and in Hester Brook downstream of the Cascade Gully confluence for Impact Case 2.
  - Exceed the freshwater aquatic WQG in Salt Water Gully for all model scenarios and in Cascade Gully for Impact Cases 1 and 2.
  - Do not exceed the stock watering WQG at all locations for all model scenarios (no WQGs have been developed for irrigation and non-potable uses).
- Nitrate concentrations at all sites (except Hester Brook upstream of the Salt Water Gully Confluence) and for all model scenarios exceed the aquatic freshwater WQGs, but do not exceed the drinking water and stock watering WQGs (no WQGs have been developed for irrigation and non-potable uses).

The assessment results have not been presented for locations where a WQG is not exceeded, and the risks thereof are assessed as very low.

Table 6.3: Assessed Surface Water Risks - Lithium[33]

Location	95th Percentile Concentration (mg/L)			Guideline Value (mg/L)	Exceedance Factor		
	Base Case	Impact Case 1	Impact Case 2		Base Case	Impact Case 1	Impact Case 2
Drinking WQG							
Salt Water Gully Outlet to Hester Brook	0.675	0.779	0.747	0.007	96.39	111.30	106.73
Cascade Gully Outlet to Hester Brook	0.509	0.665	0.665		72.78	94.96	94.96
Hester Brook Upstream of Salt Water Gully Confluence	0.000	0.000	0.000		0.00	0.00	0.00
Hester Brook Downstream of Cascade Gully Confluence	0.279	0.309	0.374		39.83	44.09	53.42
Hester Brook at Hester Hill	0.263	0.310	0.371		37.62	44.24	53.07
Non-potable WQG							
Salt Water Gully Outlet to Hester Brook	0.675	0.779	0.747	0.140	4.82	5.56	5.34
Cascade Gully Outlet to Hester Brook	0.509	0.665	0.665		3.64	4.75	4.75
Hester Brook Upstream of Salt Water Gully Confluence	0.000	0.000	0.000		0.00	0.00	0.00
Hester Brook Downstream of Cascade Gully Confluence	0.279	0.309	0.374		1.99	2.20	2.67
Hester Brook at Hester Hill	0.263	0.310	0.371		1.88	2.21	2.65

Table 6.4: Assessed Surface Water Risks – Sulphate

Location	95th Percentile Concentration (mg/L)			Guideline Value (mg/L)	Exceedance Factor		
	Base Case	Impact Case 1	Impact Case 2		Base Case	Impact Case 1	Impact Case 2
Drinking WQG							
Salt Water Gully Outlet to Hester Brook	457.7	528.3	506.7	250.0	1.83	2.11	2.03
Cascade Gully Outlet to Hester Brook	345.7	450.9	450.9		1.38	1.80	1.80
Hester Brook Upstream of Salt Water Gully Confluence	9.5	9.5	9.5		0.04	0.04	0.04
Hester Brook Downstream of Cascade Gully Confluence	189.5	209.8	253.9		0.76	0.84	1.02
Hester Brook at Hester Hill	179.0	198.5	242.1		0.72	0.79	0.97

33 Red: High Risk - 95th percentile concentration exceeds WQG by more factor 10.
Orange: Medium Risk -95th percentile concentration exceeds WQG by more factor 3 and less factor 10.
Green: Low Risk - 95th percentile concentration exceeds WQG by less factor 3.
No colour: Very Low Risk - 95th percentile concentration below WQG.

Location	95th Percentile Concentration (mg/L)			Guideline Value (mg/L)	Exceedance Factor		
	Base Case	Impact Case 1	Impact Case 2		Base Case	Impact Case 1	Impact Case 2
Freshwater Aquatic WQG							
Salt Water Gully Outlet to Hester Brook	457.7	528.3	506.7	429.0	1.07	1.23	1.18
Cascade Gully Outlet to Hester Brook	345.7	450.9	450.9		0.81	1.05	1.05
Hester Brook Upstream of Salt Water Gully Confluence	9.5	9.5	9.5		0.02	0.02	0.02
Hester Brook Downstream of Cascade Gully Confluence	189.5	209.8	253.9		0.44	0.49	0.59
Hester Brook at Hester Hill	179.0	198.5	242.1		0.42	0.46	0.56

Table 6.5: Assessed Surface Water Risks - Nitrate

Location	95th Percentile Concentration (mg/L)			Guideline Value (mg/L)	Exceedance Factor		
	Base Case	Impact Case 1	Impact Case 2		Base Case	Impact Case 1	Impact Case 2
Drinking WQG							
Salt Water Gully Outlet to Hester Brook	11.2	12.9	12.4	2.4	4.7	5.4	5.2
Cascade Gully Outlet to Hester Brook	8.5	11.0	11.0		3.5	4.6	4.6
Hester Brook Upstream of Salt Water Gully Confluence	0.4	0.4	0.4		0.2	0.2	0.2
Hester Brook Downstream of Cascade Gully Confluence	4.7	5.2	6.2		1.9	2.1	2.6
Hester Brook at Hester Hill	4.4	4.9	5.9		1.8	2.0	2.5

Comparison of the concentrations and exceedance factors for the key CoPCs simulated for Impact Case 1 to those for Impact case 2 (no SWG Dam) indicates the following:

- CoPC concentrations at the Salt Water Gully outlet to Hester Brook are similar for both Impact Cases, however, the flows are much diminished with SWG Dam bypassing only 20% of the dam inflows. Therefore, the CoPC loads (which discharge into Hester Brook) are much higher without SWG in place.
- CoPC concentrations in Hester Brook (both downstream of the Cascade Gully confluence and at the Hester Hill gauging point) increase by ~20% without SWG Dam in place due to the additional loads discussed above.
- Although there is an increase in concentrations, the assessed risks do not change from Impact Case 1 to Impact Case 2, except for sulphate concentrations in Hester Brook downstream of the Cascade Gully confluence where the assessed risk increases from very low to low.

A summary of the risks assessed based on the modelling results is provided in **Table 6.6** and further discussed below.

Hester Brook Upstream of Salt Water Gully Confluence

The Talison water use survey (see **Section 2.4**) did not extend to above the confluence of Hester Brook with Salt Water Gully. That said, all assessed water uses in Hester Brook upstream of the Salt Water Gully confluence are evaluated to be low risk for the Base Case and Impact Cases 1 and 2.

Salt Water Gully Outlet to Hester Brook

The Talison water use survey indicates non-potable domestic and stock watering uses in the Salt Water Gully catchment. The risks to the various water uses are assessed as follows:

- Although not an indicated use, drinking water use is assessed as being high risk due to the elevated concentrations of lithium.
- Non-potable domestic use is assessed as being medium risk due to the elevated concentrations of lithium. The current presence of lithium in the creek waters is likely the result of elevated background concentrations (pods of naturally occurring pegmatite ore containing lithium within the mineralised zone), disturbance from historical dredge mining activities, and discharges from Floyds WRL.
- Aquatic freshwater use is assessed as being medium risk due to the elevated concentrations of nitrate (and sulphate, which is assessed as low risk). The elevated concentrations of nitrate (and sulphate) are likely to be the result of discharges from the existing Floyds WRL.
- Stock watering use is assessed as being very low.

The assessed risks do not change from the Base Case to Impact Cases 1 and 2, indicating that the existing impacts dominate in this catchment. Risk reduction measures need to be considered in this regard, including the provision of suitable buffers from the water courses, the capture and treatment of seepage from the WRLs during operation (and possibly immediately after closure), and capping of the WRLs after closure to reduce leaching of CoPCs in the long term.

Cascade Gully Outlet to Hester Brook

The Talison water use survey also indicates non-potable domestic and stock watering uses in the Cascades Gully catchment. The risks to the various water uses are assessed as being the same as for Salt Water Gully, and risk reduction measures also need to be considered in this catchment.

Hester Brook Downstream of Cascade Gully Confluence

The Talison water use survey indicates drinking water, non-potable domestic, and stock watering uses in the incremental catchment between the Salt Water Gully and Cascade Gully confluences. The risks to the various water uses are assessed as follows:

- Drinking water use is assessed as being high risk due to the elevated concentrations of lithium. The presence of lithium is likely the result of discharges from Salt Water and Cascade Gullies (which are closer to the existing mine site and within the disturbance areas), as well as discharges from the SWG WRL (for the Impacts Case 1 and 2). Dilution from fresh inflows of Hester Brook upstream of the Salt Water Gully confluence also play an important role.

Table 6.6: Summary of Surface Water Risks

Water Use	Base Case		Impact Case 1		Impact Case 2	
	Highest Risk Rating	CoPC	Highest Risk Rating	CoPC	Highest Risk Rating	CoPC
Hester Brook Upstream of Salt Water Gully Confluence						
Freshwater aquatic	Very Low	-	Very Low	-	Very Low	-
Stock water	Very Low	-	Very Low	-	Very Low	-
Irrigation	Very Low	-	Very Low	-	Very Low	-
Drinking	Very Low	-	Very Low	-	Very Low	-
Non-potable domestic	Very Low	-	Very Low	-	Very Low	-
Salt Water Gully Outlet to Hester Brook						
Freshwater aquatic	Medium	Nitrate	Medium	Nitrate	Medium	Nitrate
Stock water	Very Low	-	Very Low	-	Very Low	-
Irrigation	Very Low	-	Very Low	-	Very Low	-
Drinking	High	Lithium	High	Lithium	High	Lithium
Non-potable domestic	Medium	Lithium	Medium	Lithium	Medium	Lithium
Cascade Gully Outlet to Hester Brook						
Freshwater aquatic	Medium	Nitrate	Medium	Nitrate	Medium	Nitrate
Stock water	Very Low	-	Very Low	-	Very Low	-
Irrigation	Very Low	-	Very Low	-	Very Low	-
Drinking	High	Lithium	High	Lithium	High	Lithium
Non-potable domestic	Medium	Lithium	Medium	Lithium	Medium	Lithium
Hester Brook Downstream of Cascade Gully Confluence						
Freshwater aquatic	Low	Nitrate	Low	Nitrate	Low	Nitrate
Stock water	Very Low	-	Very Low	-	Very Low	-
Irrigation	Very Low	-	Very Low	-	Very Low	-
Drinking	High	Lithium	High	Lithium	High	Lithium
Non-potable domestic	Low	Lithium	Low	Lithium	Low	Lithium
Hester Brook at Hester Hill Gauging Point						
Freshwater aquatic	Low	Nitrate	Low	Nitrate	Low	Nitrate
Stock water	Very Low	-	Very Low	-	Very Low	-
Irrigation	Very Low	-	Very Low	-	Very Low	-
Drinking	High	Lithium	High	Lithium	High	Lithium
Non-potable domestic	Low	Lithium	Low	Lithium	Low	Lithium

– Non-potable domestic use is assessed as being low risk due to the elevated concentrations of lithium.
– Aquatic freshwater use is assessed as being low risk due to the elevated concentrations of nitrate and sulphate.
– Stock watering use is assessed as being very low.

The assessed risks do not change from the Base Case to Impact Cases 1 and 2. The risk reduction measures outlined above also need to be considered in this regard.

Hester Brook at Hester Hill Gauging Point

The Talison water use survey indicates drinking water, non-potable domestic, irrigation, and stock watering uses in the incremental catchment between the Cascade Gully confluence and the gauging point. The risks to the various water uses are assessed as being the same as for the incremental catchment between the Salt Water Gully and Cascade Gully confluences. Irrigation use is assessed as being very low.

6.3.3 Assessment of Other CoPCs

Modelling of the fate and transport of the other CoPCs from the initial list in **Section 3.2.4** (Al, Cd, Cu, Cr, Cs, Mn, Mo, Ni, Rb, Sb, Th, U and Vn) was not undertaken. Noting that these metals have mobilities that fall between or close to the arsenic and lithium adsorption coefficients based on published partition coefficients (see **Table 4.2**), the assessments of these CoPCs was based on factoring the simulated lithium concentrations as follows:

– The primary source of the CoPCs is the discharges from the toes and runoff from the surfaces of the WRLs. Scaling of the simulated lithium concentrations was based on the average measured concentrations monitored at the discharge locations (Carters, Floyds SP, Cemetery, D8, D8-4, Floyds South, and WRL RA 02, as depicted in **Figure 3.1**) downgradient of the existing WRLs. Details of the monitoring results are presented in **Appendix B**, and are summarised in **Table 6.7**.

– The scaling of the average measured discharge concentrations was applied to the 95th percentile simulated lithium concentrations in Hester Creek at the Hester Hill gauging point for the Base Case and Impact Cases 1 and 2.

– The estimated CoPC concentrations were compared with the WQGs with the assessed risk ratings of any exceedances following the approach detailed in **Table 6.2**, the outcomes of which are shown in **Table 6.7**.

The assessment of the other CoPCs at the Hester Hill gauge indicates most of these are below the respective WQGs, except for:

– Rubidium, which is assessed as a low risk for the freshwater aquatic environment and potable use.

– Thallium, which is assessed as a low risk for the freshwater aquatic environment.

– Vanadium, which is assessed as a low risk for drinking water use.

6.3.4 Historical Monitoring

The maximum measured concentrations of lithium, arsenic, sulphate, and nitrate monitored at sites deemed best to reflect to conditions in the various waterways are compared to the respective WQGs in **Table 6.8**, the sites being:

– Salt Water Gully Outlet to Hester Brook - SWG monitoring point.

– Cascade Gully Outlet to Hester Brook **-** Cemetery monitoring point.

– Hester Brook at Hester Hill gauging point – Hester Hill monitoring point.

The locations of these monitoring sites are depicted in **Figure 3.1**. The historical monitoring data is summarised in **Appendix B**. The key observations are discussed below.

Salt Water Gully Outlet to Hester Brook (SWG Monitoring Point)

Historical monitoring at SWG indicates that Salt Water Gully already contains elevated concentrations of lithium, arsenic, sulphate, and nitrate. Lithium already poses a high risk to drinking water and non-potable water uses and a low risk to livestock. Sulphate poses a medium risk to drinking water use and a low risk to freshwater aquatic and livestock uses. Nitrate poses a medium risk to drinking water and freshwater aquatic uses.

Cascade Gully Outlet to Hester Brook (Cemetery Monitoring Point)

Historical monitoring at Cemetery Dam indicates that the maximum CoPC concentrations in Cascade Gully all reported to be below the WQGs, except for lithium which exceeds the drinking water WQG and is assessed as medium risk.

Table 6.7: Comparison of other CoPCs with WQGs in Hester Brook at Hester Hill

CoPC (for those measured)	Average Source Concentration (mg/L)	Scaling Factor (using Li as basis)	Simulated 95th Percentile Concentrations (mg/L)			WQG (mg/L) – Colour codes indicates WQG exceeded (associated risks as defined in Table 6.2)				
			Base Case	Impact Case 1	Impact Case 2	Livestock	Irrigation	Freshwater Aquatic	Drinking Water	Non-potable use
Lithium	0.519	1.0	0.263	0.310	0.371	0.82	2.5	2.0	0.007	0.14
Antimony	0.00086	0.00165	0.00043	0.00013	0.00005	0.15	NR	0.09	0.003	0.06
Cadmium	0.00011	0.00021	0.000056	0.000017	0.000006	0.01	0.01	0.0003	0.002	0.04
Caesium	0.0097	0.01871	0.00492	0.00153	0.00057	2.0	NR	0.5	0.07	1.4
Chromium (III+VI)	0.00024	0.00047	0.000123	0.000038	0.000014	1	0.1	0.14 (as Cr III) 0.001(as Cr VI)	0.05 (as Cr III)	1.0
Copper	0.00064	0.00124	0.000326	0.000101	0.000037	0.5	0.2	0.0014	2	40
Manganese	<0.0001	0.00019	0.000051	0.000016	0.000006	10	0.2	1.9	0.5	10
Molybdenum	0.0128	0.02473	0.00650	0.00202	0.00075	0.15	0.01	0.034	0.05	1.0
Nickel	0.055	0.10591	0.0279	0.0086	0.0032	1	0.2	0.05	0.02	0.4
Rubidium	0.000077	0.00015	0.000039	0.000012	0.000004	0.26	NR	0.017	0.014	0.28
Thallium	0.00043	0.00082	0.000217	0.000067	0.000025	0.13	NR	0.00003	0.00004	0.0008
Uranium	0.00040	0.00077	0.000203	0.000063	0.000023	0.2	0.01	0.0005	0.017	0.34
Vanadium	0.0084	0.01609	0.004232	0.001312	0.000487	0.1	0.1	0.0006	0.0002	0.004
Zinc	0.519	1.0	0.263	0.310	0.371	20	2	0.036	3	60

Table 6.8: Comparison of Historical Monitoring against WQGs

CoPC	Maximum Measured Concentration (mg/L)	WQG (mg/L) – Colour codes indicates WQG exceeded by measured value (associated risks as defined in Table 6.2)				
		Livestock	Irrigation	Freshwater Aquatic	Drinking Water	Non-potable use
Salt Water Gully Outlet to Hester Brook (SWG monitoring point)						
Lithium	1.8	0.82	2.5	2.0	0.007	0.14
Arsenic	0.006	0.5	0.1	0.013	0.5	0.1
Sulphate	1,250	1000	NR	429	250	NR
Nitrate	20	90	NR	2.4	50	NR
Cascade Gully Outlet to Hester Brook (Cemetery monitoring point)						
Lithium	0.05	0.82	2.5	2.0	0.007	0.14
Arsenic	0.007	0.5	0.1	0.013	0.5	0.1
Sulphate	120	1000	NR	429	250	NR
Nitrate	1.0	90	NR	2.4	50	NR
Hester Brook at Hester Hill monitoring point						
Lithium	0.05	0.82	2.5	2.0	0.007	0.14
Arsenic	0.004	0.5	0.1	0.013	0.5	0.1
Sulphate	210	1000	NR	429	250	NR
Nitrate	2.0	90	NR	2.4	50	NR

Hester Brook at Hester Hill Monitoring Point

Historical monitoring at Hester Hill indicates that the maximum CoPC concentrations in Hester Brook all reported to be below the WQGs, except for lithium which exceeds the drinking water WQG and is assessed as medium risk.

7. Summary and Conclusions

7.1 Summary

7.1.1 Source-Pathway-Receptor Links

An assessment of the Source-Pathway-Receptor links indicates the following:

– Sources: Impacted sources of seepage from the TSF1 and the WRLs may be derived from tailings slurry waters used to deposit the tailings, leaching from tailings solids and embankment materials (typically waste rock), and leaching and runoff from waste rock in the WRL, the latter being the dominant source in the Study Area.
– Pathways: Tailings slurry waters from TSF1 and leachate from the waste rock materials used to construct the TSF buttresses migrating eastwards are generally captured within mine pits and pumped back. Some of the slurry waters and leachate penetrates through the base of the TSF into the groundwater, and then migrates to surface water discharge points along nearby creeks. Leachate from the waste rock within the WRLs is typically intersected at and within the pre-construction ground surface and discharges as base flow at the toes of the WRLs. Some of this leachate penetrates down to the low permeable subsurface of saprolite and discharges to nearby creeks.
– Receptors: The sensitive receptors in the receiving environment are associated with groundwater extraction and the surface water use and environment of Salt Water Gully, Cascade Gully, and Hester Brook, and include drinking water, non-potable domestic water, irrigation water, stock water, and aquatic environment uses.

7.1.2 Identification of CoPCs

The CoPCs were identified from screening of the various tests on the tailings solids and decant, and waste rock leaching, as well as discharge monitoring. The screening indicated that 15 metals (Al, As, Cd, Cu, Cs, Cr, Li, Mn, Mo, Ni, Rb, Sb, Th, U, and Vn) and nitrate and sulphate exceed one or more of the adopted WQGs. No additional CoPCs identified in the review of the discharge monitoring data and the limited suites of analytes did not allow for any rationalisation of the CoPCs.

7.1.3 Risks to Groundwater

Fate and transport modelling of groundwater and the key CoPCs (lithium and arsenic) was undertaken for two scenarios, namely:

– Base Case: Includes the existing TSF1, Floyds WRL, and MSA embankment, and the approved S1 WRL.
– Impact Case: Same as the base case model, but includes the reuse of TSF1, establishment of SWG WRL, and construction of SWG Dam.

The groundwater modelling indicates the following:

– Arsenic and lithium plumes from the existing and proposed WRLs and TSF are generally constrained close to or within the TSF or WRL footprints. There is some localised spreading around the SWG Dam due to infiltration of stored water with elevated arsenic and lithium concentrations.
– Water seeping from the base of the existing farm dams constructed in Salt Water Gully, and the proposed SWG Dam, is effectively returned to the surface as groundwater discharges to Salt Water Gully immediately downstream of these dams. Consequently, the net contribution from these dams is minimal.
– Overall, the groundwater discharge to creeks in the Study Area shows an increase in arsenic concentrations from an assumed baseline of 0.0005 mg/L, up to around 0.005 mg/L. Salt Water Gully, immediately adjacent to SWG WRL, had the highest arsenic concentrations which rapidly rose to 0.27 mg/L by 2030 then gradually increased to 0.28 mg/L in the long term, which is above all the adopted WQGs other than for livestock use.

– The average lithium concentration in the groundwater discharge to the Eastern Catchment creeks reaches 0.18 mg/L within ~200 years and stabilises at 0.19 mg/L within ~700 years. This is above the drinking water and non-potable WQGs but below the livestock, irrigation, and freshwater aquatic WQGs.
– Groundwater discharging to SWG Dam had the highest lithium concentrations, which rapidly rose to 1.10 mg/L by 2025 then stabilised at 1.15 mg/L by 2070. This is above the drinking water, non-potable, and livestock WQGs but below the irrigation and freshwater aquatic WQGs.
– The impacts of the leaching from waste rock in the WRLs to the aquifer will likely be limited to the areas beneath and immediately adjacent to the footprints of the WRLs. Accordingly, risks to groundwater users beyond the immediate periphery of the WRLs are assessed as low. It should be noted that the Study has not considered construction buffers, seepage management measures, or capping of the WRLs after closure, all of which would mitigate these low risks to groundwater users further.
– Modelling was not undertaken for the other CoPCs, however, given the published adsorption characteristics and expected similarity in mobilisation behaviour, the results are anticipated to present similar distributions and lateral extents to that presented for arsenic and lithium.

7.1.4 Risks to Surface Water

The WBM of the Study Area includes the Hester Brook, Salt Water Gully, and Cascade Gully sub-catchments and also performs a mass balance of the key CoPCs (lithium, arsenic, sulphate, and nitrate). The latter two CoPCs were included in the modelling as these are considered key risks based on existing WRL discharge monitoring. The following three scenarios were simulated in the WBM:

– Base Case: Existing site and operations, including the approved S1 WRL.
– Impact Case 1: Base Case plus the proposed SWG WRL and SWG Dam (i.e., to align the impact case from the groundwater modelling).
– Impact Case 2: Impact Case 1 but without SWG Dam.

The WBM modelling indicates the following:

– Establishment of the SWG WRL results in increased CoPC concentrations discharging to Salt Water Gully and Cascade Gully into Hester Brook. The increases in CoPC concentrations in Hester Brook at Hester Hill are reduced with SWG Dam in place due to the dam containing much of the impacted runoff. Although there is a significant dilution effect from the flows in Hester Brook upstream of Salt Water Gully, the CoPC concentrations in the lower reaches of Hester Brook increase without the dam in place.
– Lithium concentrations under median flow conditions exceed the non-potable and drinking WQGs at the outlets of Salt Water and Cascade Gullies to Hester Brook for the Base Case, but only exceed the drinking WQGs in Hester Brook. There are no additional exceedances at the outlets of Salt Water and Cascade Gullies to Hester Brook for Impacts Cases 1 and 2, however, the non-potable WQG is also exceeded in Hester Brook for Impact Case 2.
– Arsenic concentrations do not exceed any WQGs for all the scenarios modelled.
– Sulphate concentrations under median flow conditions exceed the drinking WQG at the Salt Water Gully outlet to Hester Brook for the Base Case, but no WQGs are exceeded at the Cascade Gully outlet to Hester Brook or in Hester Brook. Concentrations under these flow conditions exceed the drinking WQG at both the outlets of Salt Water and Cascade Gullies to Hester Brook for Impact Cases 1 and 2, but there are still no exceedances in Hester Brook.
– Nitrate concentrations under median flow conditions exceed the aquatic environment WQG at the outlets of Salt Water and Cascade Gullies to Hester Brook for the Base Case and Impact Cases 1 and 2. Nitrate concentrations in Hester Brook only exceed the aquatic environment WQG for Impacs Case 2.
– Streamflow at the Salt Water Gully outlet to Hester Brook reduces by ~67% on average from the Base Case to Impact Case 1 (reflecting the impact of SWG Dam) and increases by ~2% on average from the Base Case to the Impact Case 2 (reflecting the changed runoff characteristics by SWG WRL). Streamflow at the Cascade Gully outlet to Hester Brook also increases (by ~10% on average) from the Base Case to both Impact Cases 1 and 2 (also reflecting the changed runoff characteristics by SWG WRL).
– Streamflow in Hester Brook reduces by ~5% on average from the Base Case to the Impact Case 1 (reflecting the impact of SWG Dam and changed runoff characteristics by SWG WRL) and increases by

~1% on average from the Base Case to the Impact Case 2 (reflecting the changed runoff characteristics by SWG WRL).

– The simulated 95th percentile concentrations of the key CoPCs within the various waterways were assessed against the respective WQGs and assigned a risk rating based on the level of exceedance (factor), which indicated the following:
  - Lithium concentrations at all sites (except Hester Brook upstream of the Salt Water Gully confluence) and for all model scenarios exceed the drinking water and non-potable WQGs, but do not exceed the stock watering, freshwater aquatic, and irrigation WQGs.
  - Arsenic concentrations at all sites do not exceed any of the WQGs for any of the model scenarios.
  - Sulphate concentrations:
    – Exceed the drinking water WQG in Salt Water and Cascade Gully for all model scenarios and in Hester Brook downstream of the Cascade Gully confluence for Impact Case 2.
    – Exceed the freshwater aquatic WQG in Salt Water Gully for all model scenarios and in Cascade Gully for Impact Cases 1 and 2.
    – Do not exceed the stock watering WQG at all locations for all model scenarios (no WQGs have been developed for irrigation and non-potable uses).
  - Nitrate concentrations at all sites (except Hester Brook upstream of the Salt Water Gully Confluence) and for all model scenarios exceed the aquatic freshwater WQGs, but do not exceed the drinking water and stock watering WQGs (no WQGs have been developed for irrigation and non-potable uses).
  - Salt Water Gully Outlet to Hester Brook: The Talison water use survey indicates non-potable domestic and stock watering uses in the Salt Water Gully catchment. The risks to the various water uses are assessed as follows:
    – Although not an indicated use, drinking water use is assessed as being high risk due to the elevated concentrations of lithium.
    – Non-potable domestic use is assessed as being medium risk due to the elevated concentrations of lithium.
    – Aquatic freshwater use is assessed as being medium risk due to the elevated concentrations of nitrate (and sulphate, which is assessed as low risk).
    – Stock watering use is assessed as being very low.
    – The assessed risks do not change from the Base Case to Impact Cases 1 and 2, indicating that the existing impacts dominate in this catchment.
  - Cascade Gully Outlet to Hester Brook: The Talison water use survey also indicates non-potable domestic and stock watering uses in the Cascades Gully catchment. The risks to the various water uses are assessed as being the same as for Salt Water Gully.
  - Hester Brook Downstream of Cascade Gully Confluence: The Talison water use survey indicates drinking water, non-potable domestic, and stock watering uses in the incremental catchment between the Salt Water Gully and Cascade Gully confluences. Drinking water use is assessed as being high risk due to the elevated concentrations of lithium.
  - Hester Brook at Hester Hill Gauging Point: The Talison water use survey indicates drinking water, non-potable domestic, irrigation, and stock watering uses in the incremental catchment between the Cascade Gully confluence and the gauging point. The risks to the various water uses are assessed as being the same as for the incremental catchment between the Salt Water Gully and Cascade Gully confluences. Irrigation use is assessed as being very low.

– Water and mass balance modelling of the other CoPCs was not undertaken, and the assessments of these CoPCs was based on factoring the 95th percentile simulated lithium concentrations in Hester Creek at the Hester Hill gauging point against the average measured concentrations at the existing discharge locations. The assessment of the other CoPCs at the Hester Hill gauge indicates most of these are below the respective WQGs, except for:
  - Rubidium, which is assessed as a low risk for the freshwater aquatic environment and potable use.
  - Thallium, which is assessed as a low risk for the freshwater aquatic environment.
  - Vanadium, which is assessed as a low risk for drinking water use.

– The maximum measured concentrations of lithium, arsenic, sulphate, and nitrate monitored at sites deemed best to reflect to conditions in the various waterways were assessed against the respective WQGs to obtain an understanding of the current exceedances in the Study Area, the sites being:
  - Salt Water Gully Outlet to Hester Brook - SWG monitoring point.
  - Cascade Gully Outlet to Hester Brook - Cemetery monitoring point.
  - Hester Brook at Hester Hill gauging point – Hester Hill monitoring point.

  The historical monitoring indicates that:
  - Salt Water Gully already contains elevated concentrations of lithium, arsenic, sulphate, and nitrate. Lithium already poses a high risk to drinking water and non-potable water uses and a low risk to livestock. Sulphate poses a medium risk to drinking water use and a low risk to freshwater aquatic and livestock uses. Nitrate poses a medium risk to drinking water and freshwater aquatic uses.
  - The maximum CoPC concentrations in Cascade Gully and Hester Brook all reported to be below the WQGs, except for lithium which exceeds the drinking water WQG and is assessed as medium risk.

7.2 Conclusions

7.2.1 Existing Mine Site

The current elevated concentrations of lithium in the creek waters are likely the result of elevated background concentrations (pods of naturally occurring pegmatite ore containing lithium within the mineralised zone), disturbance from historical dredge mining activities, and discharges from Floyds WRL and the MSA. The current elevated concentrations of nitrate (and sulphate) are also likely to be the result of discharges from the existing Floyds WRL.

In the short term, management of the discharges from Floyds WRL, the MSA, and the future approved S1 WRL will be required to prevent discharges into the receiving environment. Waste rock seepage from the toes of these WRLs and the MSA can be managed by collection and pump-back systems to prevent such discharges.

Management of the CoPCs emanating from the naturally occurring mineralised zones downgradient of these WRLs and from historical mining activities in Salt Water Gully would be more complex given the diffuse nature of these sources. Modelling of SWG Dam is seen to reduce the contaminant load discharged into Hester Brook significantly. As a result, construction of SWG Dam for mine water supply purposes would also be an effective pollution control measure.

7.2.2 TSF1 Reuse

The current distribution and extent of TSF1 CoPC impacts in the subsurface appears to be limited by the attention capacity and slow migration rates within the saprolitic clay aquifer, such that impacted groundwater is not discharge into Cemetery Creek / Cascade Gully. Surface water monitoring in Cemetery Creeks supports that TSF1 impacted water is not discharging above the concentrations that are consistent with the background, which is likely influenced by historic operations in the early 1900s and the mineralised setting of the area (GHD, 2023f).

Given that there is no evidence to indicate that the TSF1 groundwater impacts are discharging to Cemetery Creeks, the groundwater pathways with respect to eastern flow are not recognised, and the exposure scenario is considered incomplete. Although this risk assessment indicates that the TSF1 seepage does not currently pose an adverse risk to the receptors in the Eastern Catchments Study Area, the groundwater should be monitored to confirm the distribution of impacts. The eastern groundwater flow path from TSF1 via the seepage ponds area towards Cemetery Creek should include a monitoring program to identify impacts which may discharge into the Cemetery Creek (monitoring well network likely requires inclusion of additional bores).

7.2.3 SWG WRL

Regarding the available CoPC data, the results of this preliminary risk assessment indicate that to maintain the beneficial uses of Hester Brook, the waste rock seepage from SWG WRL will require management during operations and closure. Prior to development, the design of the WRL should include a suitable setback or buffer from the groundwater discharge areas along the creeks to allow for maintenance of riparian vegetation, establishment of a drainage impact mitigation zone, impacted drainage collection etc. During operations, waste rock seepage from S1 and SWG WRLs can be managed by collection and pump-back systems. Post closure, when seepage collection ceases, the waste rock will require capping to mitigate generation of seepage due to ingress of rainfall and leaching of waste rock.

The management options should be conceptualised, and predictive simulations undertaken to demonstrate the effectiveness of controlling seepage discharge. The new simulations should include the full range of CoPCs based on the kinetic leach testing currently underway.

7.2.4 SWG Dam

It is noted that the net contribution of water seeping from SWG Dam (and therefore CoPCs) is minimal. The design of the dam should ensure that effective seepage control measures are included to minimise such seepage.

The magnitude of the passing flows will impact this containment of CoPCs and the need for passing flows and the magnitude thereof should be investigated in more detail.

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Appendices

Appendix A

Discharge Monitoring Data Analysis

The initial screening against criteria is shown in Table A1, which compares the maximum reported concentrations in all of the monitoring locations. The majority of analytes exceed the Aquatic Environment criteria.

Table A1: Maximum Reported Concentrations (mg/L)

CoPC	WRL Seepage					Receiving Environments			Background	Site Specific Guidelines (GHD, 2023m)				
	Carters	Floydsth	Floudssp	D8-4	D8	Cemetery	Catroad	SWG	Hester	Livestock	Irrigation	Aquatic Environment	Potable use	Non-potable use
As	**0.03**	**0.028**	**0.061**	**0.06**	**0.07**	0.013	**0.04**	**0.06**	0.009	0.5	0.1	0.013 (As AS V)	0.5	0.1
Cd	**0.008**	**0.0009**	**0.0004**	**0.138**	**0.02**	<LOR	**0.012**	**0.017**	<LOR	0.01	0.01	0.0003	0.002	0.04
Cu	0.001	**0.02**	**0.01**	**0.03**	**0.02**	**0.01**	<LOR	**0.01**	<LOR	0.5	0.2	0.0014	2	40
Li	**0.23**	**2.1**	**2.5**	**1.8**	**2**	**0.05**	**0.06**	**1.8**	**0.05**	0.82	2.5	2.0	0.007	0.14
Mn	**0.177**	**3.1**	**0.31**	**0.298**	**0.92**	**1.7**	**0.534**	**1.1**	**4.3**	10	0.2	1.9	0.5	10
Ni	0.016	**0.15**	**0.04**	**0.06**	**0.17**	0.01	0.01	0.02	0.01	1	0.2	0.05	0.02	0.4
Th	<LOR	<LOR	<LOR	0.14	0.15	<LOR	<LOR	0.1	<LOR	NR	NR	NR	NR	NR
U	**0.1**	**0.001**	**0.002**	**0.2**	<LOR	**0.002**	<LOR	**0.1**	<LOR	0.2	0.01	0.0005	0.017	0.34
Zn	**0.04**	**0.05**	**0.054**	**0.1**	**0.141**	**0.054**	0.023	**0.07**	**0.04**	20	2	0.036	3	60
SO4	**644**	**457**	**1050**	**1220**	**1310**	118	150	**1350**	212	1000	NR	429	250	NR
NO3	**55**	**58**	**120**	**300**	**300**	2.05	**23**	**71**	**10.8**	90	NR	2.4	50	NR

Key:

NU	Analysis not undertaken.
NR	No reference value.
LOR	Limit of reporting (to be confirmed by Talison)
Green	Does not exceed guidelines.
Red	Exceeds guidelines.
Bold	Concentrations exceed guidelines

Lithium

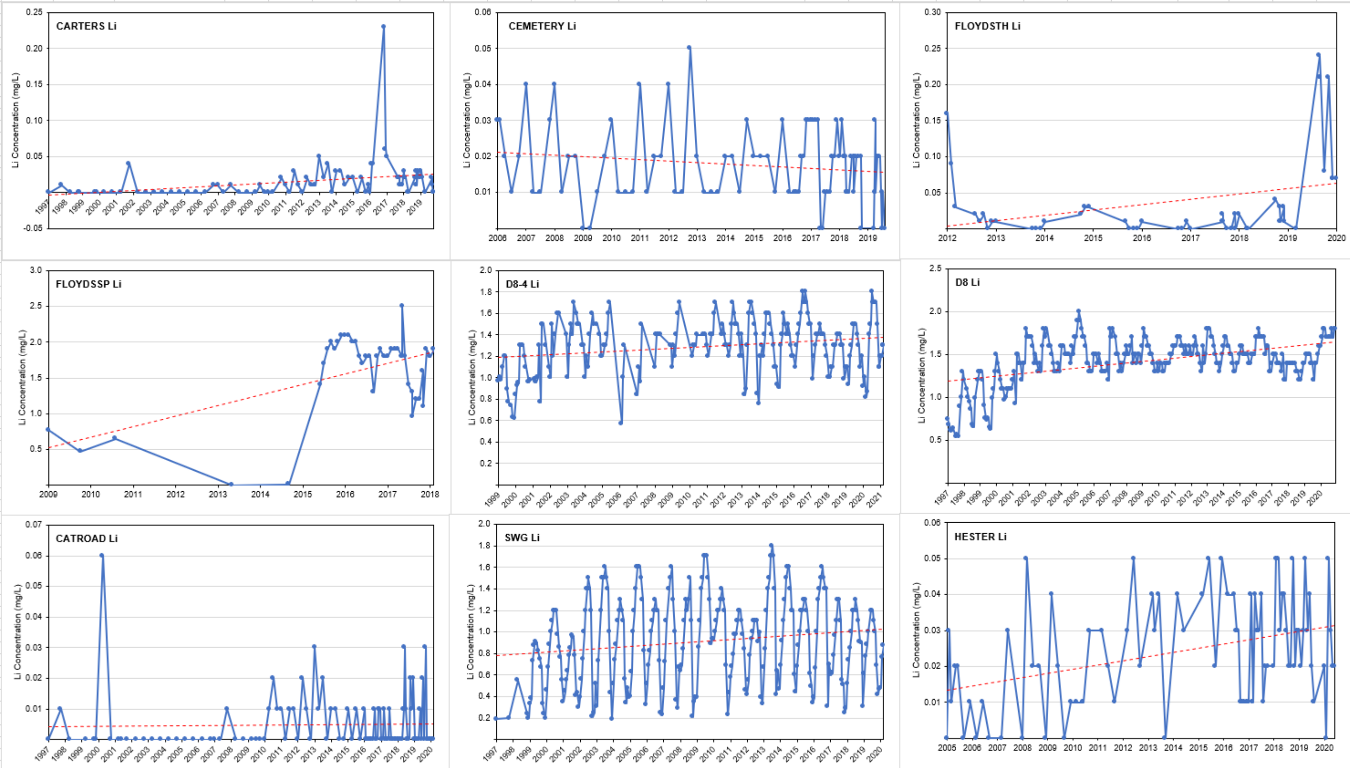

Figure A1: Talison Monitoring Data Trends - Lithium

For the most part, Lithium concentrations are reported to be consistent at most monitoring points since 2005. The Hester monitoring point, which is the most down-gradient typically ranges between 0.01 to 0.05 mg/L, which is well below the immediate discharge points of D8, D8-4 and Floydssp, which are as high as 2 mg/L. This indicates there is a significant level of dilution from Hester Brook, up to two orders of magnitude.

The lithium criterion for aquatic environment is 2 mg/L, with mean discharges below this around 1.5 mg/L. Criteria for domestic potable use and non-potable use (recreation) are significantly lower, however (0.007 mg/L and 0.14 mg/L respectively).

Arsenic

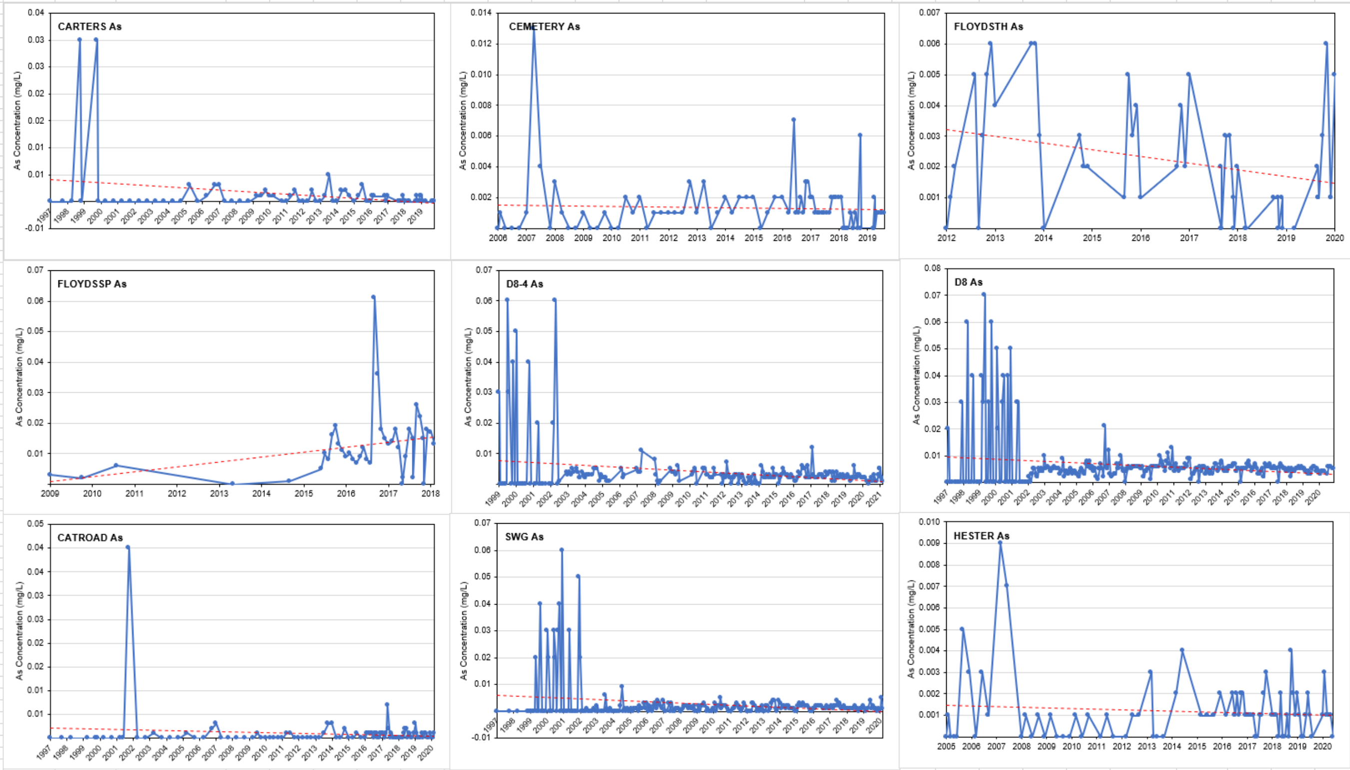

Figure A2: Talison Monitoring Data Trends - Arsenic

There appears to be a significant change in profile for arsenic discharge before 2005 compared to post-2005. Carter, D8, D8-4 and SWG all show elevated arsenic concentrations before 2005, up to an order of magnitude higher than measurements post-2005. Hester concentrations report less than 0.01 mg/L since 2005, which is below the aquatic environment criterion of 0.013 mg/L. Immediate discharge points of D8, D8-4 and Floydsth report post-2005 concentrations below 0.01 mg/L suggesting that the liberation of arsenic from waste rock is limited either due to its aging or through equilibrium processes. Since 2016 Floydssp has reported increases in arsenic concentration up to 0.06 mg/L.

Cadmium

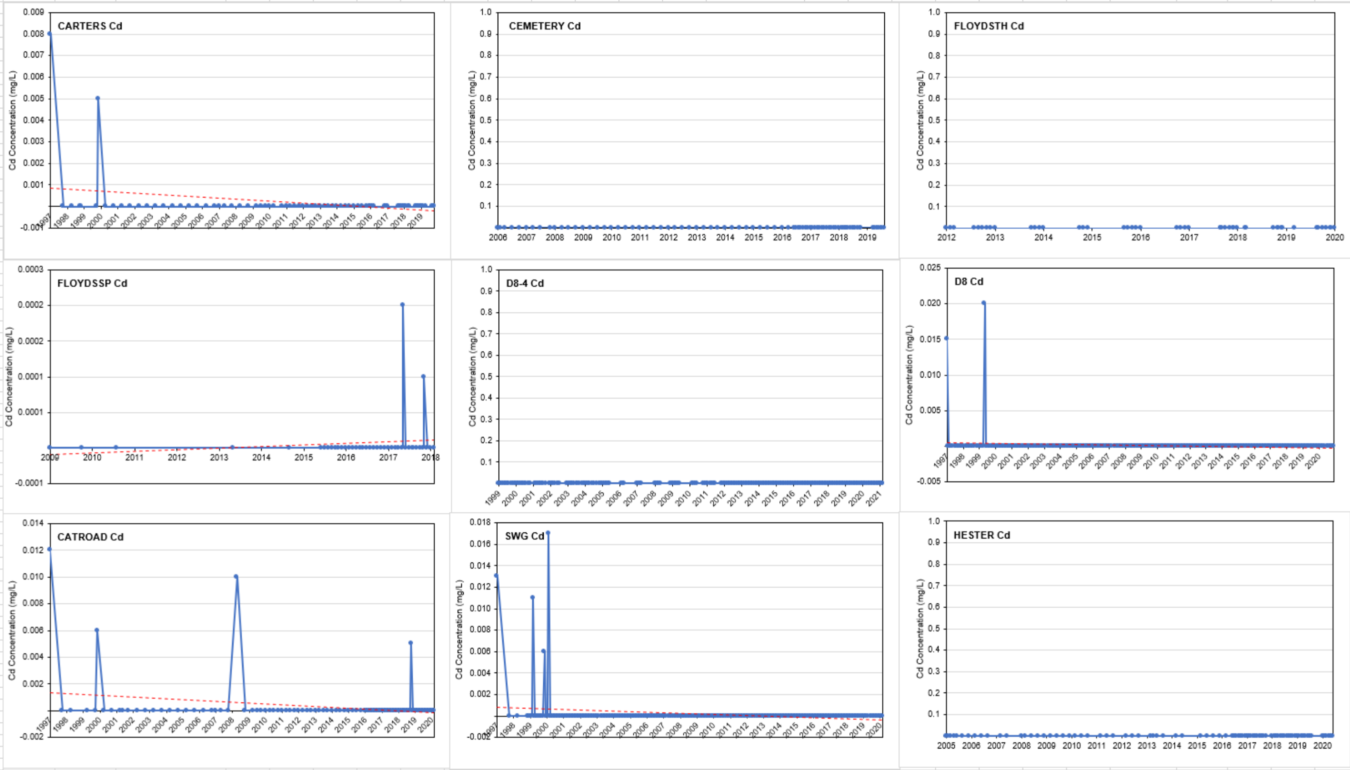

Figure A3: Talison Monitoring Data Trends - Cadmium

The reported concentrations of cadmium in the Talison monitoring data indicate that elevated presence of cadmium in waste rock is rare and only shows up a few times over the course of two decades. Cadmium is not likely to pose an unacceptable risk to the environment, and therefore may be excluded from further consideration.

Copper

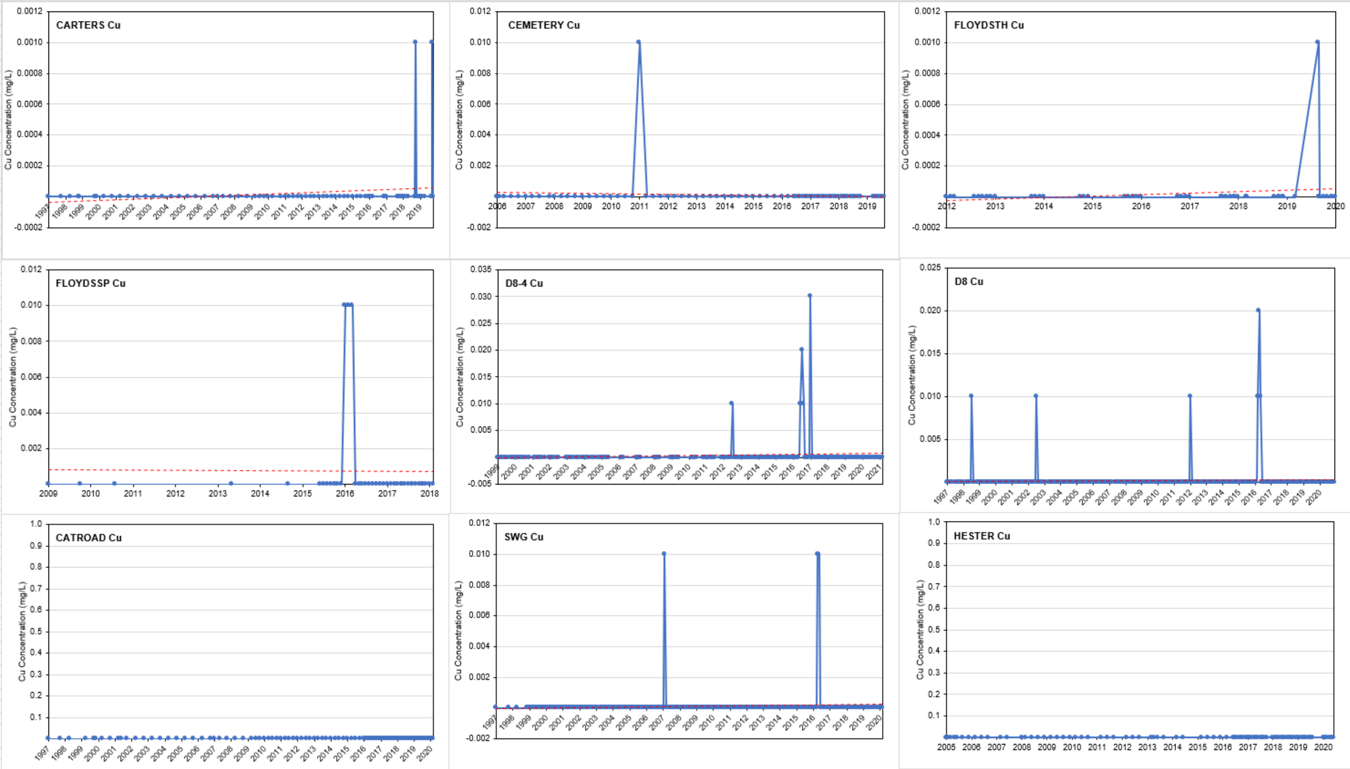

Figure A4: Talison Monitoring Data Trends - Copper

The reported concentrations of copper in the Talison monitoring data indicate that elevated presence of copper in waste rock is rare and only shows up a few times over the course of two decades. In the immediate discharge locations of Floydssp, D8-4 and D8 concentrations have been reported as high as 0.03 mg/L, which exceeds the aquatic environment criterion of 0.0014 mg/L, However the majority of the data reported below 0.001 mg/L.

It may be concluded that copper is not likely to pose an unacceptable risk to the environment, and therefore may be excluded from further consideration.

Manganese

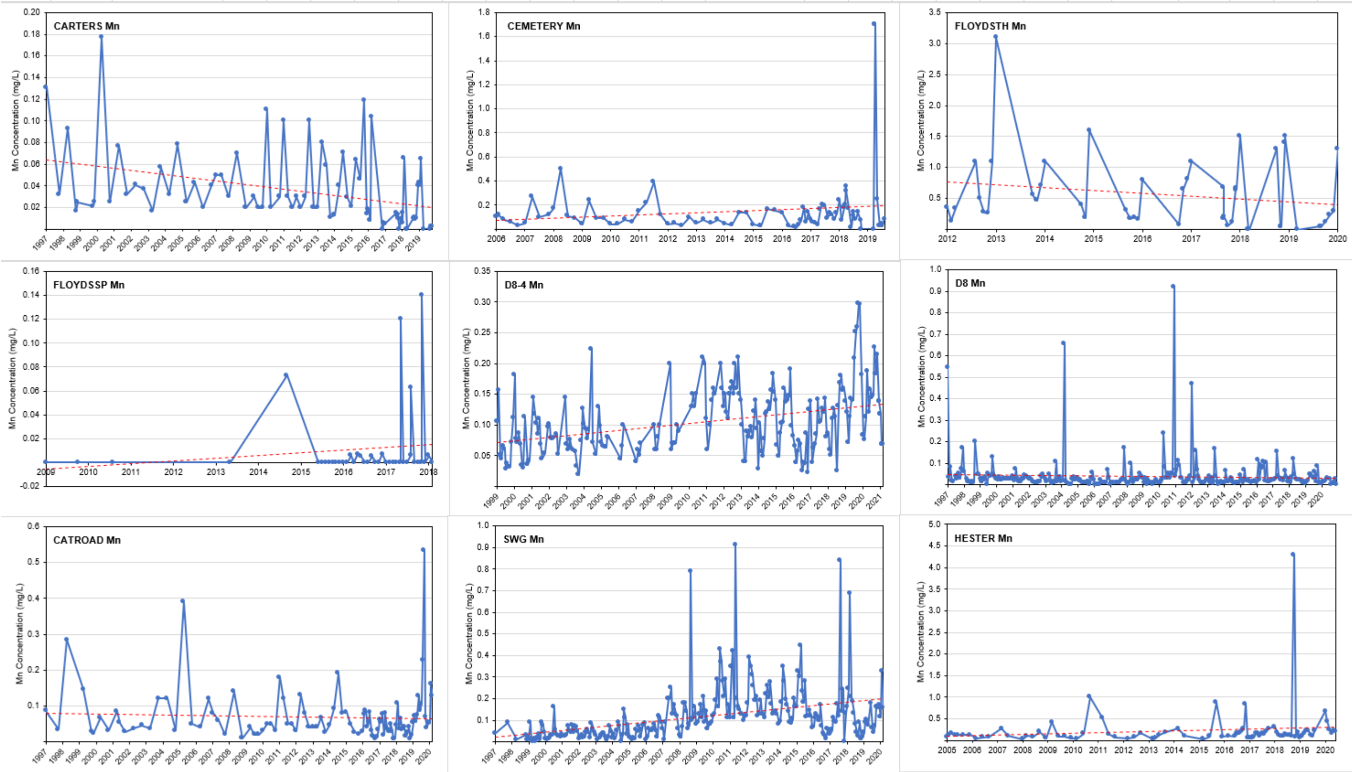

Figure A5: Talison Monitoring Data Trends – Manganese

The highest reported manganese concentration in any of the Talisan monitoring points was 4.5 mg/L at Hester. This data point appears to be an anomaly compared to the rest of the dataset. Hester's values range between non-detect and 1.0 mg/L, averaging around 0.3 mg/L. The aquatic environmental criterion for manganese is 1.9 mg/L.

Immediate discharge locations D8 and D8-4 typically range between 0.05 and 0.2 mg/L. A similar profile is seen at other locations.

It may be concluded that manganese is not likely to pose an unacceptable risk to the environment, and therefore may be excluded from further consideration.

Nickel

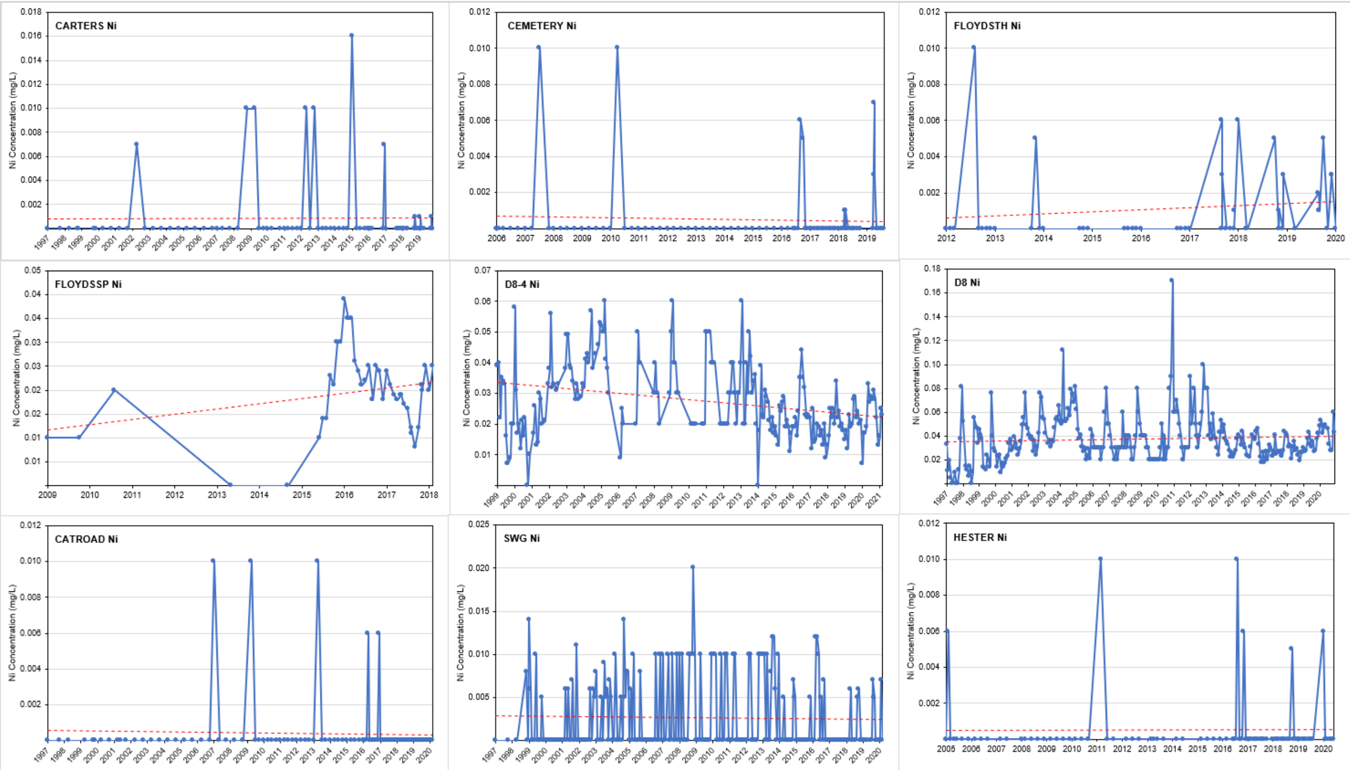

Figure A6: Talison Monitoring Data Trends - Nickel

The highest reported concentration of Nickel is 0.17 mg/L in D8, which exceeds the aquatic environment criterion of 0.05 mg/L. This spike is an isolated value with the majority of reported concentrations between 0.02 mg/L and 0.08 mg/L. All other sampling locations are predominantly below the 0.06 mg/L criterion including Hester with a maximum reported concentration of 0.01 mg/L, which is below the potable drinking water criterion of 0.02 mg/L.

It may be concluded that nickel is not likely to pose an unacceptable risk to the environment, and therefore may be excluded from further consideration.

Zinc

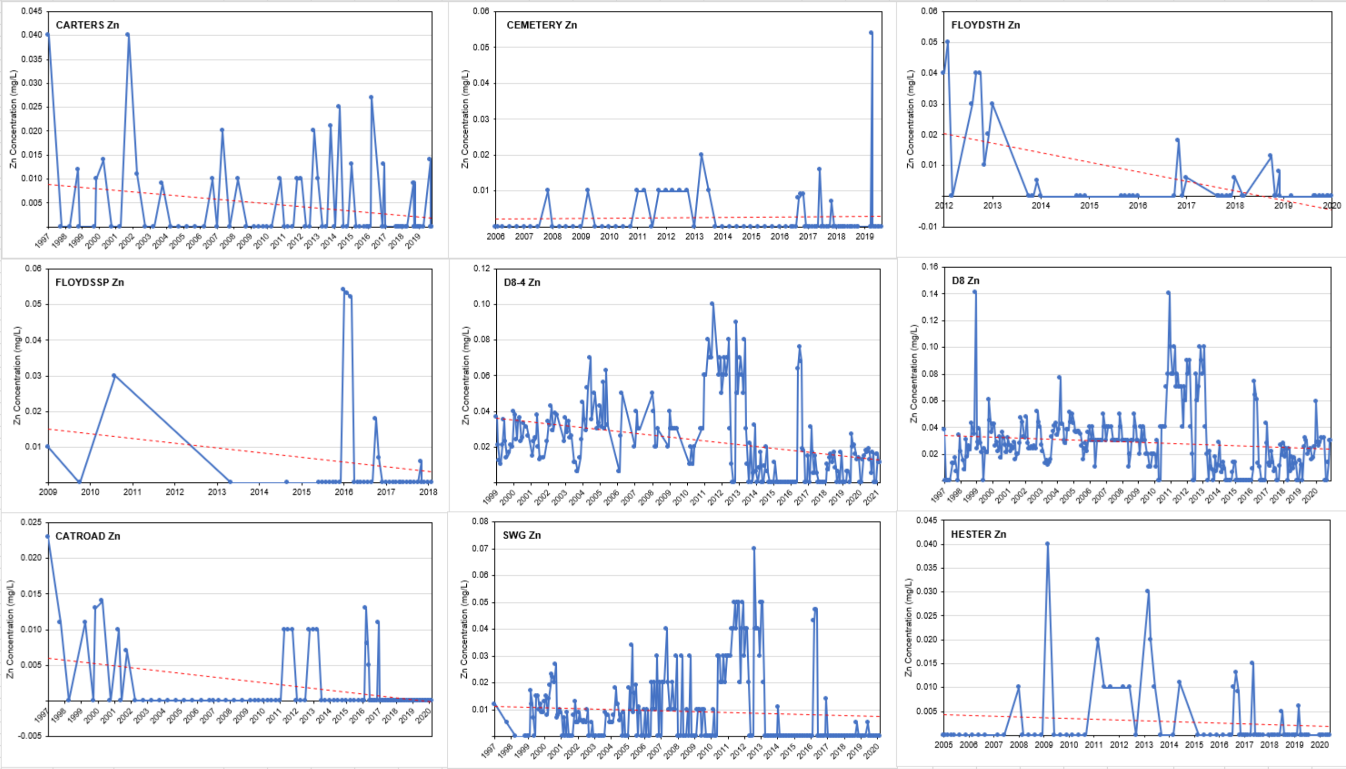

Figure A7: Talison Monitoring Data Trends – Zinc

The highest reported concentration of zinc was 0.14 mg/L from D8, which exceeds the aquatic environment criterion of 0.036 mg/L. This concentration is an isolated case, however the bulk of the measurements at D8 range from 0.01 mg/L to 0.08 mg/L. A similar profile is shown at D8-4. The concentrations reported at Hester range from 0.005 to 0.04 mg/L. The lower difference in dilution between SWG and Hester sampling points suggest zinc levels may be similar to upgradient levels.

It may be concluded that zinc is not likely to pose an unacceptable risk to the environment, and therefore may be excluded from further consideration.

Nitrate

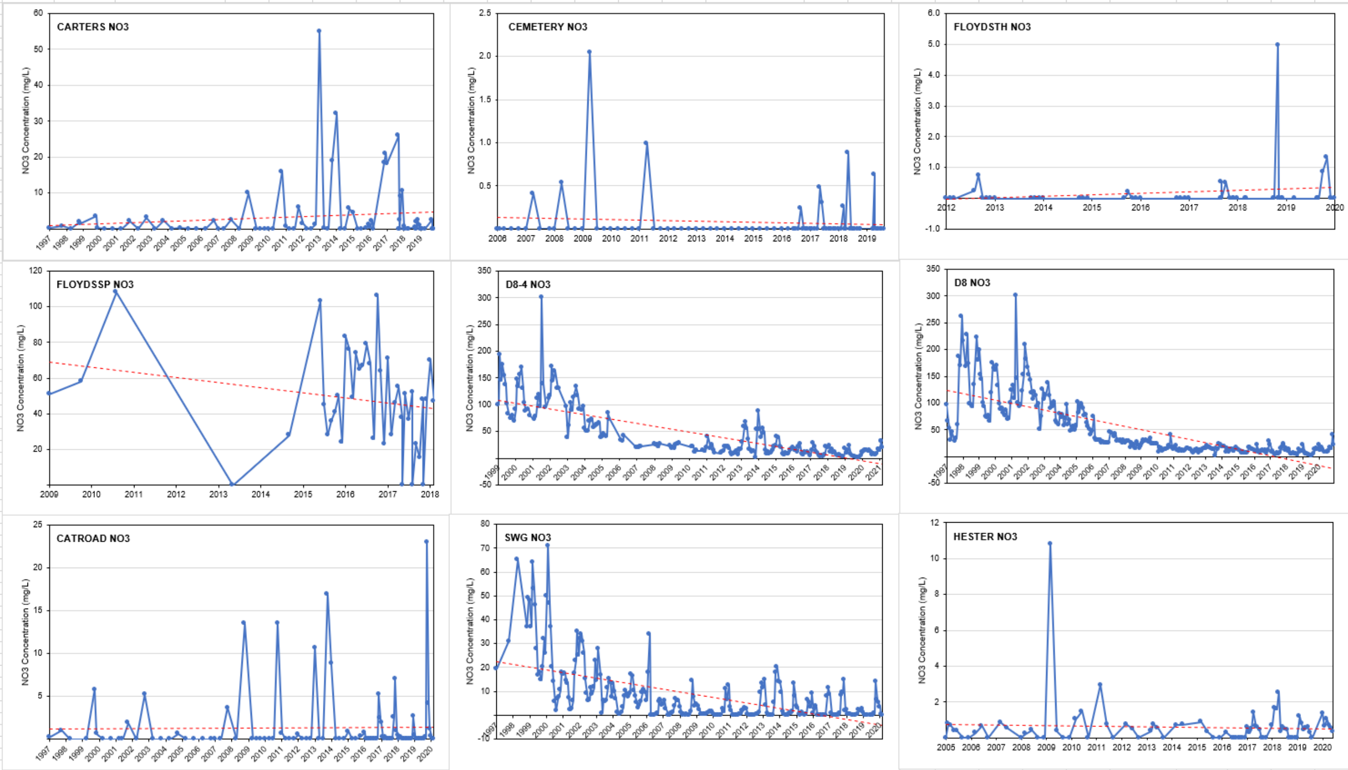

Figure A8: Talison Monitoring Data Trends – Nitrate

The highest reported nitrate concentration was 300 mg/L from D8 and D8-4, exceeding the aquatic environment criterion of 2.4 mg/L. Review of D8 and D8-4 trends indicates a significant decline in concentration over time. And since 2010 concentrations have ranged between 5 and 40 mg/L. A similar pattern is seen in SWG, with concentrations below 20 mg/L since 2010.

Hester has reported a maximum concentration of 11 mg/L in 2009 but this is an isolated case with the rest of the dataset predominantly below 1.5 mg/L. An order of magnitude difference between Hester and SWG sampling concentrations indicates that the mine is a primary source of nitrate to the water way. A three to four fold increase in flux of nitrate resulting from construction of SWG WRL and S1 expansion could result in an increase of nitrate concentration that could potentially pose a risk to aquatic ecosystems.

Sulphate

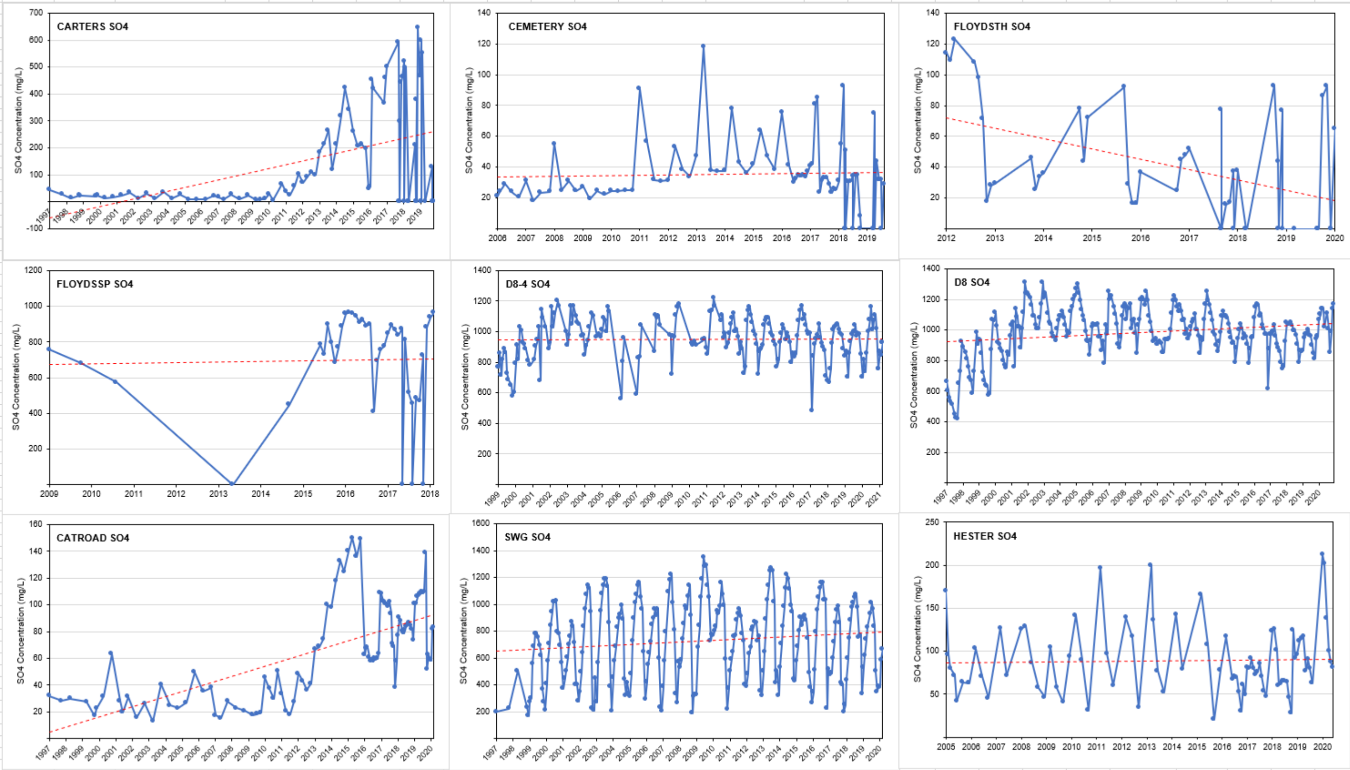

Figure A9: Talison Monitoring Data Trends – Sulphate

Sulphate measured in D8 and D8-4 has consistently ranged between 600 mg/L and 1300 mg/L since 2000. This is above the aquatic environmental criterion of 429 mg/L. Sulphate at SWG has ranged between the same values. This would suggest that most of Salt Water Gully is in equilibrium with sulphate content from the discharge points.

Hester has reported sulphate concentrations between 20 mg/L and 200 mg/L with an average of 100 mg/L. The decrease from Salt Water Gully to Hester is likely due to the inflow dilution from Hester Brook. A three to four fold increase in flux of sulphate resulting from construction of SWG WRL and S1 expansion could result in an increase of sulphate concentration that could potentially pose a risk to aquatic ecosystems.

Uranium

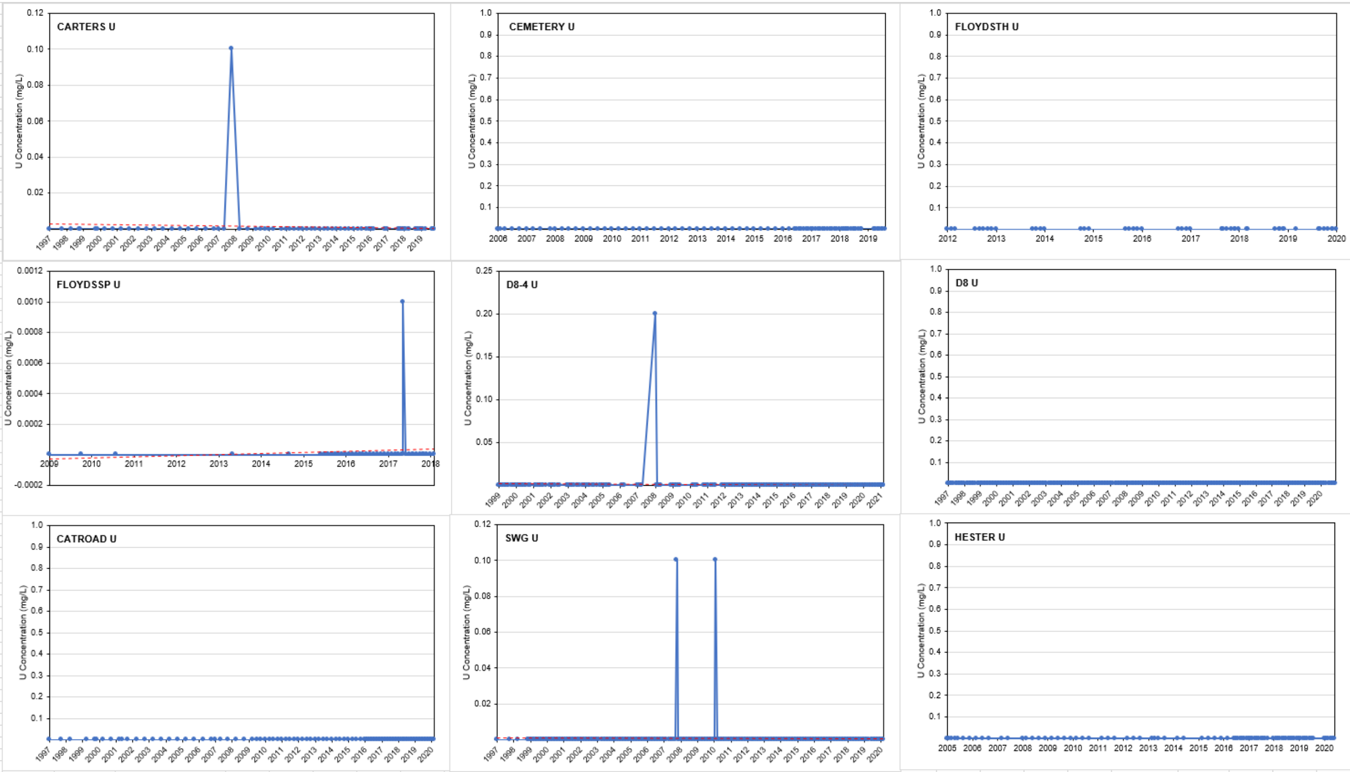

Figure A10: Talison Monitoring Data Trends - Uranium

The reported concentrations of uranium in the Talison monitoring data indicate that elevated presence of uranium in waste rock is rare and only shows up a few times over the course of two decades. Uranium is not likely to pose an unacceptable risk to the environment, and therefore may be excluded from further consideration.

Thorium

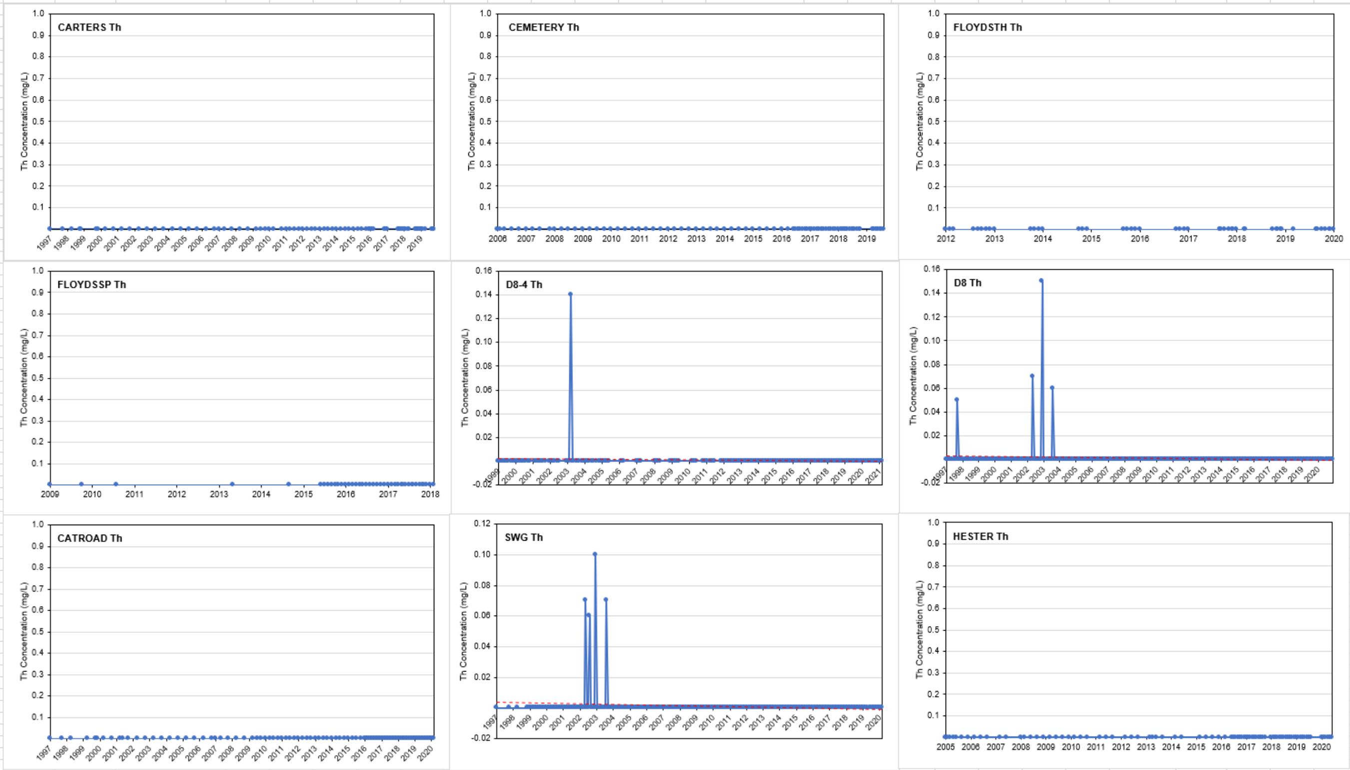

Figure A11: Talison Monitoring Data Trends – Thorium

The reported concentrations of thallium in the Talison monitoring data indicate that elevated presence of thorium in waste rock is rare and only shows up a few times over the course of two decades, and not since 2005. Thorium is not likely to pose an unacceptable risk to the environment, and therefore may be excluded from further consideration.

Appendix B

Tailings and Waste Rock Leachate Results

Table A1
Tailing Decant and Tailing Solid Leaching

Chem Name	Output unit	LOR	Talison Greenbushes Site-specific WQG, Drinking Water	*Talison Greenbushes Site-specific WQG, Freshwater Ecological*	**Talison Greenbushes Site-specific WQG, Irrigation**	Talison Greenbushes Site-specific WQG, Livestock	Talison Greenbushes Site-specific WQG, Recreational	TSF 4 Decant						Talings solids leach			
							Sample Details	Decant test	Decant test	Decant test	Decant test	Decant test	Decant test	ALSP	ALSP	ALSP	Tailings solid leach
							Sample ID	Decant 1	Decant 2	Decant 3	Decant 4	Decant 5	Decant Water	180827_CM_CG	180827_CM_CG	180827_CM_CG	LEAF 1314 [1]
							Date	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	8/07/2022	11/10/2018	11/10/2018	11/10/2018	7/07/2022
							Lab Report	EP1811787	EP1811787	EP1811787	EP1811787	EP1811787	EB2227780/81	EP1811634	EP1811634	EP1811634	ES22254040
pH (Lab)	pH units	0.01	6.5 - 8.5					-	-	-	-	-	7.8	-	-	-	-
Electrical conductivity (lab)	µS/cm	1						-	-	-	-	-	1,590	-	-	-	-
Total Dissolved Solids	mg/L	10	600					775	789	797	793	790	1,030	-	-	-	-
Alkalinity (Carbonate as CaCO3)	mg/L	1						-	-	-	-	-	<1	-	-	-	-
Alkalinity (Bicarbonate as CaCO3)	mg/L	1						-	-	-	-	-	245	-	-	-	-
Alkalinity (Hydroxide as CaCO3)	mg/L	1						-	-	-	-	-	<1	-	-	-	-
Alkalinity (total as CaCO3)	mg/L	1						117	146	147	136	145	245	-	-	-	-
Hardness as CaCO3 (Filtered)	mg/L	1	200					-	-	-	-	-	136	-	-	-	-
Calcium (Filtered)	mg/L	1						35	30	31	32	31	28	-	-	-	<1
Magnesium (Filtered)	mg/L	1						18	19	19	18	18	16	-	-	-	<1
Potassium (Filtered)	mg/L	1						192	204	201	196	199	15	-	-	-	<1
Sodium (Filtered)	mg/L	1	180					9	9	9	9	9	278	4	3	4	<1
Chloride	mg/L	1	250					198	226	213	206	209	257	-	-	-	<1
Sulfate (Filtered)	mg/L	1	250	*429*	**NR**	1,000	NR	206	155	177	196	179	231	-	-	-	<1
Silicon as SiO2 (Filtered)	mg/L	0.1						5.54	5.55	5.51	5.79	5.73		2.65	2.19	2.17	-
Ammonia as N	mg/L	0.01				0.5		-	-	-	-	-	0.54	-	-	-	-
Nitrate (as N)	mg/L	0.01	50	*2.40*	**NR**	90	NA	-	-	-	-	-	<0.01	-	-	-	-
Nitrite (as N)	mg/L	0.01						-	-	-	-	-	<0.01	-	-	-	-
Phosphorus (Total)	mg/L	0.01						-	-	-	-	-	0.01	-	-	-	-
Sulfur as S	mg/L	1						-	-	-	-	-		<1	<1	1	<10
Dissolved Organic Carbon	mg/L	1						-	-	-	-	-	7	-	-	-	
Aluminium	mg/L	0.01	0.2		**5.0**	5.0	4.0	0.03	0.08	0.02	0.02	0.03	**17.9**	-	-	-	*0.13*
Aluminium (Filtered)	mg/L	0.01		*0.055*										*0.93*	*0.79*	*1*	
Antimony	mg/L	0.001	0.003		**NR**	0.15	0.06	0.035	0.004	0.014	0.027	0.021	0.039	-	-	-	0.014
Antimony (Filtered)	mg/L	0.001		*0.09*										0.004	0.004	0.003	
Arsenic	mg/L	0.001	0.01		**0.1**	0.5	0.2	**0.101**	0.058	0.074	0.093	0.082	**0.293**	-	-	-	**0.13**
Arsenic (Filtered)	mg/L	0.001		*0.013*										*0.063*	*0.055*	*0.051*	-
Barium	mg/L	0.001				2		0.003	0.005	0.004	0.004	0.004	0.02	-	-	-	-
Barium (Filtered)	mg/L	0.001				2								0.066	0.06	0.071	-
Beryllium	mg/L	0.001				0.06		<0.001	<0.001	<0.001	<0.001	<0.001	0.004	-	-	-	-
Beryllium (Filtered)	mg/L	0.001				0.06								<0.001	<0.001	<0.001	-
Boron	mg/L	0.05				4		0.12	0.12	0.12	0.11	0.11	0.15	-	-	-	-
Boron (Filtered)	mg/L	0.05				4								<0.05	<0.05	<0.05	-
Cadmium	mg/L		0.002		**0.01**	0.01	0.04	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0008	-	-	-	<0.001
Caesium	mg/L	0.001	0.07		**NR**	2	1.4	0.109	0.074	0.088	0.101	0.094	0.401	-	-	-	0.004
Caesium (Filtered)	mg/L	0.001		*0.50*										0.012	0.012	0.01	-
Chromium (III+VI)	mg/L	0.001			**0.1**	1	1	0.002	0.001	0.002	0.004	0.001	0.034	-	-	-	<0.01
Chromium (III+VI) (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Cobalt	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001	0.01				-
Cobalt (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Copper	mg/L	0.001	2		**0.2**	0.5	40	<0.001	0.002	0.001	<0.001	<0.001	0.023				<0.01
Copper (Filtered)	mg/L	0.001		*0.0014*										0.019	<0.001	<0.001	-
Fluoride	mg/L	0.1	1.5	*1.30*	**1**	2	30	0.6	0.5	0.6	0.6	0.6	0.9	0.05	0.05	0.05	<0.1
Gallium	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001	0.006				-
Gallium (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Germanium	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001					-
Germanium (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Gold	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001					-
Gold (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Hafnium	mg/L	0.01						<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				-
Hafnium (Filtered)	mg/L	0.01												<0.01	<0.01	<0.01	-

Notes:
1 LEAF 1314 analysis of four samples (CGP1, CGP2, TGP, TRP), concentrations an average of the 9th cumulative leaching events

Talison Greenbushes Site-specific WQG, Drinking Water
Talison Greenbushes Site-specific WQG, Freshwater Ecological
Talison Greenbushes Site-specific WQG, Irrigation
Talison Greenbushes Site-specific WQG, Livestock
Talison Greenbushes Site-specific WQG, Recreational

Chem Name	Output unit	LOR	Talison Greenbushes Site-specific WQG, Drinking Water	*Talison Greenbushes Site-specific WQG, Freshwater Ecological*	**Talison Greenbushes Site-specific WQG, Irrigation**	Talison Greenbushes Site-specific WQG, Livestock	Talison Greenbushes Site-specific WQG, Recreational	TSF 4 Decant						Talings solids leach			
							Sample Details	Decant test	Decant test	Decant test	Decant test	Decant test	Decant test	ALSP	ALSP	ALSP	Tailings solid leach
							Sample ID	Decant 1	Decant 2	Decant 3	Decant 4	Decant 5	Decant Water	180827_CM_CG	180827_CM_CG	180827_CM_CG	LEAF 1314 [1]
							Date	26/09/2018	26/09/2018	26/09/2018	26/09/2018	26/09/2018	8/07/2022	11/10/2018	11/10/2018	11/10/2018	7/07/2022
							Lab Report	EP1811787	EP1811787	EP1811787	EP1811787	EP1811787	EB2227780/81	EP1811634	EP1811634	EP1811634	ES22254040
Iron	mg/L	0.05				0.3		0.1	0.09	0.05	0.08	0.08	9.67				-
Iron (Filtered)	mg/L	0.05				0.3								0.25	0.16	0.21	-
Lanthanum	mg/L							<0.001	<0.001	<0.001	<0.001	<0.001	0.003				-
Lanthanum (Filtered)	mg/L													<0.001	<0.001	<0.001	-
Lead	mg/L							<0.001	<0.001	<0.001	<0.001	<0.001	0.005				<0.01
Lead (Filtered)	mg/L													<0.001	<0.001	<0.001	-
Lithium	mg/L	0.001	0.007		**2.5**	0.82	0.14	9.96	9.81	10.50	8.98	9.07	15.8				-
Lithium (Filtered)	mg/L	0.001		*2.00*										0.193	0.123	0.182	0.02
Manganese	mg/L	0.001	0.5		**0.2**	10	10	**0.314**	0.132	**0.265**	**0.457**	**0.392**	**1.58**				0.004
Manganese (Filtered)	mg/L	0.001		*1.90*										0.022	0.015	0.019	-
Mercury	mg/L	0.0001						<0.0001	<0.0001	<0.0001	<0.0001	<0.0001					-
Mercury (Filtered)	mg/L	0.0001												<0.0001	<0.0001	<0.0001	-
Molybdenum	mg/L	0.001	0.05		**0.01**	0.15	1	0.004	0.003	0.004	0.003	0.003	0.016				-
Molybdenum (Filtered)	mg/L	0.001		*0.034*										<0.001	<0.001	<0.001	-
Nickel	mg/L	0.001	0.02		**0.2**	1	0.4	0.003	0.003	0.003	0.003	0.003	0.025				<0.01
Nickel (Filtered)	mg/L	0.001		*0.049*										<0.001	<0.001	<0.001	-
Niobium	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001					-
Niobium (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Rhenium	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001					-
Rhenium (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Rubidium	mg/L	0.001	0.014		**NR**	0.26	0.28	0.458	0.384	0.424	0.456	0.434	1.31				0.013
Rubidium (Filtered)	mg/L	0.001		*0.017*										*0.048*	*0.028*	*0.042*	-
Selenium	mg/L	0.01						<0.01	<0.01	<0.01	<0.01	<0.01					-
Selenium (Filtered)	mg/L	0.01												<0.01	<0.01	<0.01	
Silicon (Filtered)	mg/L	0.05												5.7	4.7	4.6	-
Silver	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001					-
Silver (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Strontium	mg/L	0.001						0.096	0.091	0.095	0.098	0.096	0.099				<0.01
Strontium (Filtered)	mg/L	0.001												0.001	0.002	0.003	-
Tantalum	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001					-
Tantalum (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Tellurium	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001					-
Tellurium (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Thorium	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001	0.003				<0.001
Thorium (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Thallium	mg/L	0.001	0.00004		**0.001**	0.125	0.0008						0.007				<0.01
Tin	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001	0.002				-
Tin (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Titanium	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001	0.23				-
Titanium (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Tungsten	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001					-
Tungsten (Filtered)	mg/L	0.001												<0.001	<0.001	<0.001	-
Uranium	mg/L	0.001	0.017		**0.01**	0.2	0.34						0.031				<0.001
Uranium (Filtered)	mg/L	0.001		*0.0005*										<0.001	<0.001	<0.001	-
Vanadium (Filtered)	mg/L		0.0002		**0.1**	0.1	0.004						0.01				<0.01
Zinc (Filtered)	mg/L	0.005		*0.0006*									*0.017*				<0.1

Notes:
1 LEAF 1314 analysis of four samples (CGP1, CGP2, TGP, TRP), concentrations an average of the 9th cumulative leaching events

Talison Greenbushes Site-specific WQG, Drinking Water
Talison Greenbushes Site-specific WQG, Freshwater Ecological
Talison Greenbushes Site-specific WQG, Irrigation
Talison Greenbushes Site-specific WQG, Livestock
Talison Greenbushes Site-specific WQG, Recreational

Table D2
TSF2 Decant Concentration (June 2022)

			Date	1/06/2022	2/06/2022	3/06/2022	4/06/2022	5/06/2022	7/06/2022	8/06/2022	9/06/2022	10/06/2022	***Average (calculated)***
			Field ID	Decant water - QC1 (Decant water only)	B06 9.5 - 10.5 - QC1 (Decant water only)	B10 3.75 - 5.0 - QC1 (Decant water only)	B10 9.0 - 13.5 - QC1 (Decant water only)	B13 3.4 - 4.5 - QC1 (Decant water only)	B14 3.0 - 4.5 - QC1 (Decant water only)	B14 10.2 - 11.9 - QC1 (Decant water only)	B18 3.5 - 4.7 - QC1 (Decant water only)	B18 7.5 - 9.0 - QC1 (Decant water only)	
Chem Group	**Chem Name**	**Output unit**	**Lab Report**	EB2220764	EB2220771	EB2220775	EB2220776	EB2220777	EB2220782	EB2220784	EB2220786	EB2220787	
Inorganics	pH (Lab)	pH units	EQL	8.24	8.27	8.11	8.13	8.06	8.08	8.28	8.33	8.3	***8.2***
	Electrical conductivity (lab)	µS/cm	1	1560	1570	1530	1550	1530	1590	1580	1590	1550	***1561***
	Total Dissolved Solids	mg/L	1	1010	1020	994	1010	994	1030	1030	1030	1010	***1014***
Acidity & Alkalinity	Alkalinity (Carbonate as CaCO3)	mg/L	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	4	6	***2***
	Alkalinity (Bicarbonate as CaCO3)	mg/L	1	191	194	206	210	207	214	193	194	212	***202***
	Alkalinity (Hydroxide as CaCO3)	mg/L	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	***1***
	Alkalinity (total as CaCO3)	mg/L	1	191	194	206	210	207	214	193	198	219	***204***
	Hardness as CaCO3 (filtered)	mg/L	1	136	134	138	142	131	128	131	133	129	***134***
Major Ions	Calcium (filtered)	mg/L	1	28	29	29	29	26	25	26	27	27	***27***
	Magnesium (filtered)	mg/L	1	16	15	16	17	16	16	16	16	15	***16***
	Potassium (filtered)	mg/L	1	13	15	16	16	13	14	14	14	13	***14***
	Sodium (filtered)	mg/L	1	247	250	259	268	241	241	236	243	242	***247***
	Chloride	mg/L	1	246	246	275	284	283	241	280	276	266	***266***
	Sulfate (filtered)	mg/L	1	211	216	226	236	224	224	232	235	233	***226***
	Fluoride	mg/L	0.1	1	1	1.2	1.2	1	1	0.9	0.9	1.1	***1.03***
	Cations Total	meq/L	0.01	13.8	13.9	14.4	14.9	13.4	13.4	13.2	13.6	13.4	***14***
		meq/L	0.01	13.8	13.9	14.4	14.9	13.4	13.4	13.2	13.6	13.4	***14***
	Anions Total	meq/L	0.01	15.1	15.3	16.6	17.1	16.8	15.7	16.6	16.6	16.7	***16***
		meq/L	0.01	15.1	15.3	16.6	17.1	16.8	15.7	16.6	16.6	16.7	***16***
	Ionic Balance	%	0.01	4.69	4.69	6.9	6.89	11.1	8	11.2	10.1	10.9	***8***
	Ionic Balance	%	0.01	4.69	4.69	6.9	6.89	11.1	8	11.2	10.1	10.9	***8***
Minor Ions	Bromine (filtered)	mg/L	0.1	1	3.1	6	5.5	1.4	0.8	1.1	0.8	0.8	***2.3***
	Iodine (filtered)	mg/L	0.1	0.4	0.1	0.05	0.05	0.2	0.5	0.2	0.4	0.2	***0.23***
Organic Indicators	Total Organic Carbon	mg/L	1	1	5	4	5	6	6	6	6	6	***5***
Metals	Aluminium (filtered)	mg/L	0.005	0.0025	0.0025	0.0025	0.0025	0.005	0.0025	0.0025	0.0025	0.0025	***0.0028***
	Antimony (filtered)	mg/L	0.0002	0.0225	0.026	0.0204	0.0239	0.0213	0.0235	0.0359	0.0391	0.0363	***0.0276***
	Arsenic (filtered)	mg/L	0.0002	0.0364	0.0386	0.0388	0.0372	0.0358	0.0366	0.029	0.0264	0.028	***0.0340***
	Barium (filtered)	mg/L	0.001	0.541	0.437	0.535	0.448	0.387	0.309	0.394	0.17	0.135	***0.3729***
	Beryllium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Bismuth (filtered)	mg/L	0.00005	0.000025	0.000025	0.000025	0.000025	0.000025	0.000025	0.000025	0.000025	0.000025	***0.00003***
	Boron (calculated as H3BO3) (filtered)	mg/L	0.3	1.82	1.73	1.35	1.26	1.31	1.13	1.17	1.34	1.36	***1.39***
	Boron (filtered)	mg/L	0.05	0.32	0.3	0.24	0.22	0.23	0.2	0.2	0.23	0.24	***0.24***
	Cadmium (filtered)	mg/L	0.00005	0.00017	0.00017	0.00018	0.00015	0.00013	0.00013	0.00017	0.0001	0.0001	***0.00014***
	Caesium (filtered)	mg/L	0.001	0.084	0.086	0.084	0.088	0.087	0.084	0.085	0.079	0.08	***0.084***
	Cerium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.001***
	Chromium (III+VI) (filtered)	mg/L	0.0002	0.0001	0.0001	0.0014	0.0001	0.0001	0.0001	0.0001	0.0001	0.0004	***0.00028***
	Cobalt (filtered)	mg/L	0.0001	0.0012	0.0016	0.0016	0.0016	0.0014	0.0011	0.0014	0.003	0.0029	***0.002***
	Copper (filtered)	mg/L	0.0005	0.001	0.0012	0.0013	0.0013	0.0016	0.001	0.0014	0.0016	0.0016	***0.0013***
	Dysprosium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Erbium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***

Table D2
TSF2 Decant Concentration (June 2022)

			Date	1/06/2022	2/06/2022	3/06/2022	4/06/2022	5/06/2022	7/06/2022	8/06/2022	9/06/2022	10/06/2022	***Average (calculated)***
			Field ID	Decant water - QC1 (Decant water only)	B06 9.5 - 10.5 - QC1 (Decant water only)	B10 3.75 - 5.0 - QC1 (Decant water only)	B10 9.0 - 13.5 - QC1 (Decant water only)	B13 3.4 - 4.5 - QC1 (Decant water only)	B14 3.0 - 4.5 - QC1 (Decant water only)	B14 10.2 - 11.9 - QC1 (Decant water only)	B18 3.5 - 4.7 - QC1 (Decant water only)	B18 7.5 - 9.0 - QC1 (Decant water only)	
Chem Group	**Chem Name**	**Output unit**	**Lab Report**	EB2220764	EB2220771	EB2220775	EB2220776	EB2220777	EB2220782	EB2220784	EB2220786	EB2220787	
Metals	Europium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Gadolinium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Gallium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Germanium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Gold (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Hafnium (filtered)	mg/L	0.01	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	***0.0050***
	Holmium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Iron (filtered)	mg/L	0.002	0.001	0.001	0.015	0.001	0.006	0.002	0.003	0.004	0.003	***0.0040***
	Lanthanum (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Lead (filtered)	mg/L	0.0001	0.0002	0.00005	0.0001	0.0001	0.00005	0.0001	0.00005	0.00005	0.00005	***0.00008***
	Lithium (filtered)	mg/L	0.001	17.5	13.7	14.8	15.4	14.2	13.2	13.9	14.1	15	***14.6***
	Lutetium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.001***
	Manganese (filtered)	mg/L	0.001	0.846	0.923	0.986	1.02	0.934	0.854	0.848	0.961	0.968	***0.930***
	Molybdenum (filtered)	mg/L	0.0001	0.0146	0.0134	0.0148	0.0144	0.0155	0.015	0.015	0.0152	0.0153	***0.015***
	Neodymium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.001***
	Nickel (filtered)	mg/L	0.0005	0.0049	0.005	0.0049	0.0048	0.0044	0.0045	0.0069	0.007	0.007	***0.0055***
	Niobium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Palladium (filtered)	µg/L	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	***0.4***
	Platinum (filtered)	µg/L	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	***0.5***
	Praseodymium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.001***
	Rhenium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Rubidium (filtered)	mg/L	0.001	0.559	0.567	0.557	0.599	0.56	0.566	0.555	0.554	0.584	***0.57***
	Samarium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Selenium (filtered)	mg/L	0.0002	0.0001	0.0002	0.0001	0.0001	0.0002	0.0001	0.0003	0.0003	0.0002	***0.0002***
	Silver (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Strontium (filtered)	mg/L	0.001	0.075	0.077	0.082	0.083	0.072	0.072	0.073	0.074	0.072	***0.0756***
	Tantalum (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	tellurium (filtered)	mg/L	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	***0.0001***
	Terbium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Thallium (filtered)	mg/L	0.00002	0.00032	0.00031	0.00026	0.00025	0.00035	0.00033	0.00067	0.00064	0.00059	***0.0004***
	Thorium (filtered)	mg/L	0.0001	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	***0.0001***
	Thulium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Tin (filtered)	mg/L	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	***0.0001***
	Titanium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Tungsten (filtered)	mg/L	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	***0.0020***
	Uranium (filtered)	mg/L	0.00005	0.0167	0.0168	0.0179	0.0181	0.0174	0.018	0.0223	0.023	0.022	***0.0191***
	Vanadium (filtered)	mg/L	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	***0.0001***
	Ytterbium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Yttrium (filtered)	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Zinc (filtered)	mg/L	0.001	0.154	0.135	0.102	0.101	0.065	0.095	0.103	0.065	0.058	***0.098***
	Zirconium (filtered)	mg/L	0.005	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	***0.0025***

Table D3
Waste Rock Dump Seepage Testing - Major Ions

Talison Lithium Limited
Eastern Catchment Hydrology Study, Risk Assessment

							WRL Seepage and drainge lines							
						Sampled Date	26/08/2020	27/08/2020	26/08/2020	27/08/2020	27/08/2020	27/08/2020	27/08/2020	*Average Concentrations*
						Location Code	Carters	Floyds SP	Cemetery	D8	D8-4	Floyds South	WRL RA 02	
Chem Group	**Chem Name**	**Output unit**	**EQL**	ANZECC 2000 - Stock Watering	ANZECC 2000 Irrigation - Long-term Trigger Values	ANZG (2018) - FW - 95% species protection (updated 15/10/2019)								
Inorganics	pH (Lab)	pH units	0.01		**6-9**		7.39	7.12	7.83	7.53	7.44	7.3	7.09	***7.4***
Acidity & Alkalinity	Alkalinity (Carbonate as CaCO3)	mg/L	1				<1	<1	<1	<1	<1	<1	<1	***<1***
	Alkalinity (Bicarbonate as CaCO3)	mg/L	1				26	28	48	64	57	60	60	***49***
	Alkalinity (Hydroxide as CaCO3)	mg/L	1				<1	<1	<1	<1	<1	<1	<1	***<1***
	Alkalinity (total as CaCO3)	mg/L	1				26	28	48	64	57	60	60	***49***
Major Ions	Calcium (Filtered)	mg/L	1	*1000*			66	113	17	186	168	40	34	***89.1***
	Magnesium (Filtered)	mg/L	1				71	64	23	110	100	56	45	***67***
	Potassium (Filtered)	mg/L	1				3	5	2	7	6	4	6	***4.7***
	Sodium (Filtered)	mg/L	1				196	92	134	178	171	335	189	***185***
	Chloride	mg/L	1		**350**		293	109	259	245	243	674	437	***323***
	Cations Total	meq/L	0.01				17.7	15	8.62	26.2	24.2	21.3	13.8	***18.1***
	Anions Total	meq/L	0.01				18.5	15	9.12	27.7	25.4	21.7	15.2	***18.9***
	Ionic Balance	%	0.01				2.18	0.03	2.8	2.71	2.49	0.96	5.03	***2.31***
	Fluoride	mg/L	0.1	*2*	**1**	1.3*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	***<0.01***
Organic Indicators	Sulfur (Total Oxidised as SO4)	mg/L	10				450	570	50	1040	850	80	90	***447***
	Sulfur as S (Filtered)	mg/L	1				166	202	16	338	307	26	30	***155***
	Sulfate (Filtered)	mg/L	1	*1000*			468	548	41	938	838	71	82	***427***
Nutrients	Ammonium (as N)	mg/L	0.01				0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	***0.03***
	Ammonia as N	mg/L	0.01			0.9	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	***0.02***
	Nitrate (as N)	mg/L	0.01	*90*			0.26	5.86	0.01	3.94	3.28	<0.01	<0.01	***2.67***
	Nitrite (as N)	mg/L	0.01	*9.1*			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	***<0.01***
	Nitrogen (Total Oxidised) (as N)	mg/L	0.01				0.26	5.86	0.01	3.94	3.28	<0.01	<0.01	***2.67***
	Nitrogen (Total)	mg/L	0.1		**5**		0.6	7	0.2	4.8	3.9	0.2	0.1	***2.4***
	Kjeldahl Nitrogen Total	mg/L	0.1				0.3	1.1	0.2	0.9	0.6	0.2	0.1	***0.49***
	Phosphorus (Total)	mg/L	0.01		**0.05**		0.02	0.04	0.02	0.06	0.02	0.2	<0.01	***0.06***
	Phosphorus (Total) (Filtered)	mg/L	0.01		**0.05**		0.02	0.01	<0.01	0.01	<0.01	<0.01	<0.01	***0.013***

Legend

0.1	Denotes exceedance of ANZECC 2000 - Stock Watering guideline
2	Denotes exceedance of ANZECC 2000 Irrigation - Long-term Trigger Values guideline
0.0034	Denotes exceedance of ANZG (2018) - FW - 95% species protection (updated 15/10/2019) guideline
Fluoride Fresh Water Guideline (1.3 mg/L)	Fluoride Freshwater guidelines derived from literature review (GHD, October 2020) see Appendix G

Table D4
Waste Rock Dump Seepage Testing- Metals

						WRL Seepage and drainge lines							
					Sampled Date	26/08/2020	27/08/2020	26/08/2020	27/08/2020	27/08/2020	27/08/2020	27/08/2020	
					Location Code	Carters	Floyds SP	Cemetery	D8	D8-4	Floyds South	WRL RA 02	*Average Concentrations*
Chem name	**Output unit**	**EQL**	ANZECC 2000 - Stock Watering	ANZECC 2000 Irrigation - Long-term Trigger Values	ANZG (2018) - FW - 95% species protection (updated 15/10/2019)								
Antimony	mg/L	0.0002				<0.0002	0.0026	<0.0002	0.0013	0.001	0.0006	0.0003	***0.0009***
Antimony (Filtered)	mg/L	0.0002				<0.0002	0.0025	<0.0002	0.0013	0.0009	0.0006	0.0002	***0.0008***
Arsenic	mg/L	0.0002	*0.5*	**0.1**	0.013	0.0003	0.0009	0.0005	0.0056	0.0019	0.0022	0.0024	***0.0020***
Arsenic (Filtered)	mg/L	0.0002	*0.5*	**0.1**	0.013	0.0003	0.0009	0.0004	0.0054	0.0016	0.0013	0.0016	***0.0016***
Barium	mg/L	0.0005				0.0373	0.0239	0.0217	0.0159	0.0172	0.0653	0.0528	***0.0334***
Barium (Filtered)	mg/L	0.0005				0.0354	0.0231	0.0208	0.0153	0.0163	0.0617	0.0467	***0.0313***
Beryllium	mg/L	0.0001		**0.1**		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	*<0.0001*
Beryllium (Filtered)	mg/L	0.0001		**0.1**		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	*<0.0001*
Bismuth	mg/L	0.00005				<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	*<0.00005*
Bismuth (Filtered)	mg/L	0.00005				<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	*<0.00005*
Boron	mg/L	0.005	*5*	**0.5**	0.37	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	***0.003***
Boron (Filtered)	mg/L	0.005	*5*	**0.5**	0.37	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	***0.003***
Cadmium	mg/L	0.00005	*0.01*	**0.01**	0.0002	<0.00005	<0.00005	<0.00005	0.00044	0.0002	<0.00005	<0.00005	***0.00011***
Cadmium (Filtered)	mg/L	0.00005	*0.01*	**0.01**	0.0002	<0.00005	<0.00005	<0.00005	0.00042	0.0002	<0.00005	<0.00005	***0.00011***
Cerium	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	***0.0006***
Cerium (Filtered)	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	***<0.001***
Caesium	mg/L	0.001				0.003	0.007	0.001	0.026	0.019	0.008	0.004	***0.0097***
Caesium (Filtered)	mg/L	0.001				0.002	0.007	<0.001	0.026	0.019	0.008	0.003	***0.0094***
Chromium (III+VI)	mg/L	0.0002	*1*	**0.1**	0.001	<0.0002	<0.0002	0.0006	<0.0002	<0.0002	0.0003	0.0004	***0.0002***
Chromium (III+VI) (Filtered)	mg/L	0.0002	*1*	**0.1**	0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	*<0.0002*
Cobalt	mg/L	0.0001	*1*	**0.05**		0.0006	0.0002	0.0009	0.0001	0.0006	0.0047	0.0046	***0.0017***
Cobalt (Filtered)	mg/L	0.0001	*1*	**0.05**		0.0005	0.0001	0.0007	0.0001	0.0006	0.0044	0.0042	***0.0015***
Copper	mg/L	0.0005	*1*	**0.2**	0.0014	0.0007	<0.0005	0.0007	0.001	<0.0005	0.001	0.0006	***0.0006***
Copper (Filtered)	mg/L	0.0005	*1*	**0.2**	0.0014	0.0006	<0.0005	0.0006	0.0009	<0.0005	0.0006	<0.0005	*<0.0005*
Dysprosium (Filtered)	mg/L	0.001				<0.001	-	<0.001	<0.001	<0.001	<0.001	-	*<0.001*
Erbium (Filtered)	mg/L	0.001				<0.001	-	<0.001	<0.001	<0.001	<0.001	-	*<0.001*
Europium (Filtered)	mg/L	0.001				<0.001	-	<0.001	<0.001	<0.001	<0.001	-	*<0.001*
Gadolinium (Filtered)	mg/L	0.001				<0.001	-	<0.001	<0.001	<0.001	<0.001	-	*<0.001*
Gallium	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	*<0.001*
Gallium (Filtered)	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	*<0.001*
Germanium	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	*<0.001*

Legend

0.1	Denotes exceedance of ANZECC 2000 - Stock Watering guideline
2	Denotes exceedance of ANZECC 2000 Irrigation - Long-term Trigger Values guideline
0.0034	Denotes exceedance of ANZG (2018) - FW - 95% species protection (updated 15/10/2019) guideline
Rubidium Fresh Water Guideline (0.017 mg/L)	Rubidium guidelines derived from literature review (GHD, October 2020) see Appendix G
Rubidium Stock Watering Guideline (0.014 mg/L)	
Lithium Fresh Water Guidelin (0.42mg/L)	Lithium freshwater ecology guidelines derived from Ecotoxicity testing (CERNM 2017)

Table D4
Waste Rock Dump Seepage Testing- Metals

						WRL Seepage and drainge lines							
					Sampled Date	26/08/2020	27/08/2020	26/08/2020	27/08/2020	27/08/2020	27/08/2020	27/08/2020	Average Concentrations
					Location Code	Carters	Floyds SP	Cemetery	D8	D8-4	Floyds South	WRL RA 02	
Chem name	Output unit	EQL	ANZECC 2000 - Stock Watering	ANZECC 2000 Irrigation - Long-term Trigger Values	ANZG (2018) - FW - 95% species protection (updated 15/10/2019)								
Germanium (Filtered)	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hafnium	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Hafnium (Filtered)	mg/L	0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Holmium (Filtered)	mg/L	0.001				<0.001	-	<0.001	<0.001	<0.001	<0.001	-	<0.001
Iron	mg/L	0.002		0.2		0.082	0.005	0.348	0.01	0.219	0.41	0.503	0.2253
Iron (Filtered)	mg/L	0.002		0.2		0.025	<0.002	0.1	0.003	0.24	0.087	0.272	0.1212
Lanthanum	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lanthanum (Filtered)	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	mg/L	0.0001	0.1	2	0.0034	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Lead (Filtered)	mg/L	0.0001	0.1	2	0.0034	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Lithium	mg/L	0.0005		2.5	0.42	0.0095	0.901	0.0056	1.51	1.12	0.066	0.0231	0.52
Lithium (Filtered)	mg/L	0.0005		2.5	0.42	0.0092	0.801	0.0058	1.36	0.933	0.0587	0.0191	0.46
Lutetium (Filtered)	mg/L	0.001				<0.001	-	<0.001	<0.001	<0.001	<0.001	-	<0.001
Manganese	mg/L	0.0005		0.2	1.9	0.0199	0.0014	0.0733	0.0071	0.0896	0.406	0.288	0.126
Manganese (Filtered)	mg/L	0.0005		0.2	1.9	0.0174	0.0013	0.0701	0.0045	0.091	0.385	0.27	0.12
Mercury	mg/L	0.000005	0.002	0.002	0.0006	<0.000005	<0.000005	<0.000005	0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Mercury (Filtered)	mg/L	0.000005	0.002	0.002	0.0006	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Molybdenum	mg/L	0.0001	0.15	0.01		<0.0001	0.0001	<0.0001	0.0003	0.0002	<0.0001	<0.0001	<0.0001
Molybdenum (Filtered)	mg/L	0.0001	0.15	0.01		<0.0001	<0.0001	<0.0001	0.0003	0.0002	<0.0001	<0.0001	<0.0001
Neodymium (Filtered)	mg/L	0.001				<0.001	-	<0.001	<0.001	<0.001	<0.001	-	<0.001
Nickel	mg/L	0.0005	1	0.2	0.011	0.001	0.0061	0.001	0.0503	0.0262	0.0031	0.0022	0.0128
Nickel (Filtered)	mg/L	0.0005	1	0.2	0.011	0.001	0.0058	0.0007	0.0481	0.0248	0.0028	0.0017	0.0121
Niobium	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Niobium (Filtered)	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Praseodymium (Filtered)	mg/L	0.001				<0.001	-	<0.001	<0.001	<0.001	<0.001	-	<0.001
Rhenium	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Rhenium (Filtered)	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Rubidium	mg/L	0.001	0.014*		0.017*	0.018	0.071	0.006	0.141	0.106	0.026	0.019	0.055
Rubidium (Filtered)	mg/L	0.001	0.014*		0.017*	0.018	0.08	0.006	0.139	0.108	0.025	0.022	0.057
Samarium (Filtered)	mg/L	0.001				<0.001	-	<0.001	<0.001	<0.001	<0.001	-	<0.001
Strontium	mg/L	0.001				0.41	0.41	0.079	0.535	0.515	0.227	0.207	0.340

Legend

0.1	Denotes exceedance of ANZECC 2000 - Stock Watering guideline
2	Denotes exceedance of ANZECC 2000 Irrigation - Long-term Trigger Values guideline
0.0034	Denotes exceedance of ANZG (2018) - FW - 95% species protection (updated 15/10/2019) guideline
Rubidium Fresh Water Guideline (0.017 mg/L)	Rubidium guidelines derived from literature review (GHD, October 2020) see Appendix G
Rubidium Stock Watering Guideline (0.014 mg/L)	
Lithium Fresh Water Guidelin (0.42mg/L)	Lithium freshwater ecology guidelines derived from Ecotoxicity testing (CERNM 2017)

Table D4
Waste Rock Dump Seepage Testing- Metals

						WRL Seepage and drainge lines							
					Sampled Date	26/08/2020	27/08/2020	26/08/2020	27/08/2020	27/08/2020	27/08/2020	27/08/2020	
					Location Code	Carters	Floyds SP	Cemetery	D8	D8-4	Floyds South	WRL RA 02	***Average Concentrations***
Chem name	**Output unit**	**EQL**	ANZECC 2000 - Stock Watering	ANZECC 2000 Irrigation - Long-term Trigger Values	ANZG (2018) - FW - 95% species protection (updated 15/10/2019)								
Strontium (Filtered)	mg/L	0.001				0.383	0.391	0.076	0.506	0.484	0.215	0.166	***0.317***
Selenium	mg/L	0.0002	*0.02*	**0.02**	0.011	<0.0002	0.0025	<0.0002	0.006	0.004	<0.0002	<0.0002	***0.0018***
Selenium (Filtered)	mg/L	0.0002	*0.02*	**0.02**	0.011	<0.0002	0.0024	<0.0002	0.0063	0.004	<0.0002	<0.0002	***0.0019***
Tantalum	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	*<0.001*
Tantalum (Filtered)	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	*<0.001*
tellurium	mg/L	0.0002				<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	*<0.0002*
tellurium (Filtered)	mg/L	0.0002				<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	*<0.0002*
Scandium	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	*<0.0001*
Silver	mg/L	0.0001			0.00005	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	*<0.0001*
Silver (Filtered)	mg/L	0.0001			0.00005	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	*<0.0001*
Terbium (Filtered)	mg/L	0.001				<0.001	-	<0.001	<0.001	<0.001	<0.001	-	*<0.001*
Thorium	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	*<0.0001*
Thorium (Filtered)	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	*<0.0001*
Thallium	mg/L	0.00002				0.00002	0.00003	<0.00002	0.00021	0.00012	0.00008	0.00007	***0.00008***
Thallium (Filtered)	mg/L	0.00002				0.00002	0.00003	<0.00002	0.0002	0.00012	0.00007	0.00005	***0.00007***
Thulium (Filtered)	mg/L	0.001				<0.001	-	<0.001	<0.001	<0.001	<0.001	-	*<0.001*
Titanium	mg/L	0.001				<0.001	<0.001	0.007	<0.001	<0.001	0.006	0.007	***0.003***
Titanium (Filtered)	mg/L	0.001				<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	*<0.001*
Tin	mg/L	0.0002				<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	*<0.0002*
Tin (Filtered)	mg/L	0.0002				<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	*<0.0002*
Tungsten	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	*<0.001*
Tungsten (Filtered)	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	*<0.001*
Uranium	mg/L	0.00005	*0.2*	**0.01**		<0.00005	<0.00005	<0.00005	0.0008	0.00046	0.0001	0.00156	***0.0004***
Uranium (Filtered)	mg/L	0.00005	*0.2*	**0.01**		<0.00005	<0.00005	<0.00005	0.00074	0.00044	0.00009	0.00104	***0.00034***
Vanadium	mg/L	0.0002		**0.1**		0.0002	<0.0002	0.0009	<0.0002	<0.0002	0.0007	0.0007	***0.0004***
Vanadium (Filtered)	mg/L	0.0002		**0.1**		<0.0002	<0.0002	0.0004	<0.0002	<0.0002	<0.0002	0.0002	*<0.0002*
Ytterbium	mg/L	0.001				-	<0.001	-	<0.001	<0.001	<0.001	<0.001	*<0.001*
Ytterbium (Filtered)	mg/L	0.001				<0.001	-	<0.001	<0.001	<0.001	<0.001	-	*<0.001*
Yttrium	mg/L	0.001				<0.001	-	<0.001	-	-	-	-	*<0.001*
Yttrium (Filtered)	mg/L	0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	*<0.001*
Zirconium	mg/L	0.005				<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	*<0.005*
Zirconium (Filtered)	mg/L	0.005				<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	*<0.005*
Zinc	mg/L	0.001	*20*	**2**	0.008	0.009	0.002	<0.001	0.029	0.015	0.002	0.001	***0.008***
Zinc (Filtered)	mg/L	0.001	*20*	**2**	0.008	0.002	0.002	0.001	0.03	0.015	0.001	0.001	***0.007***

Legend

0.1	Denotes exceedance of ANZECC 2000 - Stock Watering guideline
2	Denotes exceedance of ANZECC 2000 Irrigation - Long-term Trigger Values guideline
0.0034	Denotes exceedance of ANZG (2018) - FW - 95% species protection (updated 15/10/2019) guideline
Rubidium Fresh Water Guideline (0.017 mg/L)	Rubidium guidelines derived from literature review (GHD, October 2020) see Appendix G
Rubidium Stock Watering Guideline (0.014 mg/L)	
Lithium Fresh Water Guidelin (0.42mg/L)	Lithium freshwater ecology guidelines derived from Ecotoxicity testing (CERNM 2017)

Table D5
Waste Rock Leach Testing - Short term Kinetic (LEAF 1314)

Talison Lithium Limited
Eastern Catchment Hydrology Study, Risk Assessment

						Location_Code	4Amp	9Amp	12Amp	4DOL	9DOL	12DOL	4GRA	9GRA	12GRA	4PEGW	9PEGW	12PEGW	
						Sampled_Date	28/07/2020	28/07/2020	28/07/2020	28/07/2020	28/07/2020	28/07/2020	28/07/2020	28/07/2020	28/07/2020	28/07/2020	28/07/2020	28/07/2020	
						Matrix_Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	
						SampleCode	ES2029745009	ES2029745019	ES2029745029	ES2029745039	ES2029745049	ES2029745059	ES2029746009	ES2029746019	ES2029746029	ES2029746039	ES2029746049	ES2029746059	***Average***
						Test number*	**T09**	**T09**	**T09**	**T09**	**T09**	**T09**	**T09**	**T09**	**T09**	**T09**	**T09**	**T09**	
Chem Group	**Chem Name**	**Output unit**	**EQL**	ANZECC 2000 - Stock Watering (Leachable)	ANZECC 2000 Irrigation - Long-term Trigger Values (Leachable)	ANZG (2018) - Freshwater (leached) - 95% level of species protection													
Inorganics	pH (Lab)	pH units	0.01				7.92	6.28	6.41	8.11	7.07	6.50	7.70	6.93	5.55	7.19	6.01	5.20	***6.26***
	Electrical conductivity (lab)	µS/cm	1				31.00	18.00	25.00	27.00	33.00	22.00	14.00	36.00	12.00	7.00	8.00	9.00	***14.38***
	Redox (Lab)	mV	0.1				100.00	102.00	101.00	70.00	70.00	76.00	252.00	212.00	237.00	244.00	224.00	228.00	***162.82***
Acidity & Alkalinity	Alkalinity (Carbonate as CaCO3)	mg/L	1				0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	***0.50***
	Alkalinity (Bicarbonate as CaCO3)	mg/L	1				26.00	12.00	15.00	13.00	15.00	9.00	9.00	22.00	3.00	6.00	7.00	3.00	***8.56***
	Alkalinity (Hydroxide as CaCO3)	mg/L	1				0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	***0.50***
	Alkalinity (total as CaCO3)	mg/L	1				26.00	12.00	15.00	13.00	15.00	9.00	9.00	22.00	3.00	6.00	7.00	3.00	***8.56***
Major Ions	Calcium	mg/L	1	*1000*			5.00	2.00	4.00	3.00	3.00	2.00	2.00	6.00	1.00	0.50	0.50	0.50	***1.88***
	Magnesium	mg/L	1				0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	***0.50***
	Potassium	mg/L	1				1.00	2.00	1.00	1.00	1.00	1.00	0.50	0.50	0.50	0.50	0.50	1.00	***0.76***
	Sodium	mg/L	1				0.50	0.50	0.50	0.50	2.00	0.50	0.50	0.50	0.50	0.50	1.00	0.50	***0.62***
	Chloride	mg/L	1				0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	***0.50***
	Sulfate	mg/L	1	*1000*			-	-	-	-	-	-	2.00	0.50	3.00	0.50	0.50	0.50	***1.00***
	Sulfate as SO4	mg/L	1				0.50	0.50	0.50	2.00	2.00	1.00	-	-	-	-	-	-	***0.89***
Minor ions	Fluoride	mg/L	0.1	*2*	**1**		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.10	0.05	0.05	0.05	0.05	***0.05***
Nutrients	Phosphorus (Total)	mg/L	0.01		**0.05**		**0.07**	0.01	0.04	**0.08**	**0.11**	**0.23**	0.01	0.02	0.01	**0.19**	0.04	**0.09**	***0.05***
Organic Indicators	Sulfur (Total Oxidised as SO4)	mg/L	10				-	-	-	-	-	-	0.50	0.50	0.50	0.50	0.50	0.50	***0.50***
Metals	**Antimony**	mg/L	0.0002				0.0028	0.0050	0.0200	0.0010	0.0082	0.0034	0.0094	0.0044	0.0015	0.0194	0.0024	0.0019	***0.0047***
	Arsenic	mg/L	0.0002	*0.5*	**0.1**	0.013	0.02	0.00	0.03	0.01	0.06	**0.45**	0.02	0.09	0.00	0.02	0.02	0.06	***0.05***
	Barium	mg/L	0.0005				0.00025	NA	NA	0.00240	0.00110	0.00080	0.00025	0.00060	0.00025	0.00025	0.00025	0.00050	***0.0005***
	Beryllium	mg/L	0.0001		**0.1**		0.00	0.00	0.00050	0.0001	0.00	0.00005	0.0001	0.0001	0.00005	0.0001	0.0001	0.0001	***0.0001***
	Bismuth	mg/L	0.00005				0.00	0.00	0.00050	-	-	-	0.0000	0.0000	0.00003	0.00003	0.00003	0.0002	***0.0001***
	Boron	mg/L	0.005	*5*	**0.5**	0.37	0.00	0.05	0.05	0.0025	0.00	0.00	0.003	0.003	0.00	0.01	0.01	0.01	***0.01***
	Cadmium	mg/L	0.00005	*0.01*	**0.01**	0.0002	0.000025	NA	NA	0.000025	0.000025	0.000025	0.000025	0.000025	0.000025	0.000025	0.000025	0.000025	***0.000025***
	Cerium	mg/L	0.001				0.00	0.0005	0.0005	0.0005	0.0005		0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Caesium	mg/L	0.001				0.00	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0010	0.0030	0.0020	***0.0008***
	Chromium (III+VI)	mg/L	0.0002	*1*	**0.1**	0.001	0.0207	0.0050	0.0050	0.0110	0.0075	0.0102	0.0004	0.0010	0.0005	0.0004	0.0006	0.0008	***0.0037***
	Cobalt	mg/L	0.0001	*1*	**0.05**		0.00005	NA	NA	0.00005	0.00005	0.00020	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	***0.00***
	Copper	mg/L	0.0005	*1*	**0.2**	0.0014	0.00	0.01	0.02	0.0003	0.0009	0.0042	0.0003	0.0003	0.0017	0.0003	0.0003	0.0003	***0.002047***
	Gallium	mg/L	0.001				0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Germanium	mg/L	0.001				0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Hafnium	mg/L	0.01				0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	***0.01***
	Iron	mg/L	0.002		**0.2**	0.3	<0.002	0.11	0.03	0.03	0.08	0.05	0.02	0.01	0.01	0.02	0.01	0.01	***0.03***
	Lanthanum	mg/L	0.001				0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.0005***
	Lead	mg/L	0.0001	*0.1*	**2**	0.0034	0.0001	0.0050	0.0050	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	***0.0006***
	Lithium	mg/L	0.0005		**2.5**		0.00	0.00	0.01	0.00	0.03	0.00	0.02	0.02	0.01	0.02	0.02	0.03	***0.009***
	Manganese	mg/L	0.0005		**0.2**	1.9	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	***0.0015***
	Mercury	mg/L	0.000005	*0.002*	**0.002**	0.0006	0.00	0.0005	0.0005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	***0.0001***
	Molybdenum	mg/L	0.0001	*0.15*	**0.01**		0.0007	NA	NA	0.0013	0.0018	0.0015	0.0004	0.0013	0.0005	0.0010	0.0006	0.0008	***0.0007***
	Nickel	mg/L	0.0005	*1*	**0.2**	0.011	0.00025	NA	NA	0.00025	0.00460	0.00050	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	***0.00056***
	Niobium	mg/L	0.001				0.00	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	***0.001***
	Rhenium	mg/L	0.001				0.00	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	***0.001***
	Rubidium*	mg/L	0.001				0.0005	0.0050	0.0010	0.0005	0.0030	0.0010	0.0110	0.0020	0.0020	0.0130	0.0540	0.0620	***0.009***
	Strontium	mg/L	0.001				0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.002	0.001	0.001	0.004	***0.005***
	Silver	mg/L	0.0001			0.00005	0.00	0.01	0.01	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	***0.0006***
	Selenium	mg/L	0.0002	*0.02*	**0.02**	0.011	0.0001	NA	NA	0.0005	0.0003	0.0002	0.0003	0.0001	0.0001	0.0001	0.0001	0.0001	***0.0002***
	Tantalum	mg/L	0.001				0.00	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	***0.001***
	tellurium	mg/L	0.0002				0.00	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	***0.0004***
	Scandium	mg/L	0.0001				0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	***0.0001***
	Tin	mg/L	0.0002				0.0001	0.01	0.01	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	***0.001***
	Titanium	mg/L	0.001				0.0005	0.0050	0.0050	0.0005	0.0040	0.0030	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	***0.001***
	Thorium	mg/L	0.0001				0.00005	0.00050	0.00050	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	***0.0001***
	Thallium	mg/L	0.00002				<0.00002	NA	NA	-	-	-	0.0000	<0.00002	<0.00002	0.0001	0.0004	0.0003	***0.0002***
	Tungsten	mg/L	0.001				0.00	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	***0.001***
	Uranium	mg/L	0.00005	*0.2*	**0.01**		0.00003	NA	NA	0.00003	0.00006	0.00003	0.00003	0.00003	0.00003	0.00033	0.00003	0.00003	***0.000048***
	Vanadium	mg/L	0.0002		**0.1**		0.004	0.005	0.005	0.009	0.010	0.008	0.004	0.003	0.003	0.000	0.001	0.002	***0.0031***
	Ytterbium	mg/L	0.001				-	0.001	0.001	-	-	-	-	-	-	-	-	-	***0.001***
	Yttrium	mg/L	0.001				0.00	-	-	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	***0.001***
	Zinc	mg/L	0.001	*20*	**2**	0.008	0.0005	NA	NA	0.0030	0.0005	0.0020	0.0020	0.0010	0.0010	0.0005	0.0010	0.0010	***0.0010***
	Zirconium	mg/L	0.005				0.00	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	***0.003***

* Test number TS09 represents the final analysis event from nine cumulative flow tests on each sample (TS01 to TS09 - methdod LEAF 3134)

Rubidium Fresh Water Guideline (0.017 mg/L)

Rubidium Drinking Water Guideline (0.014 mg/L)

Rubidium guidelines derived from literature review (GHD, October 2020) ghd.com

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