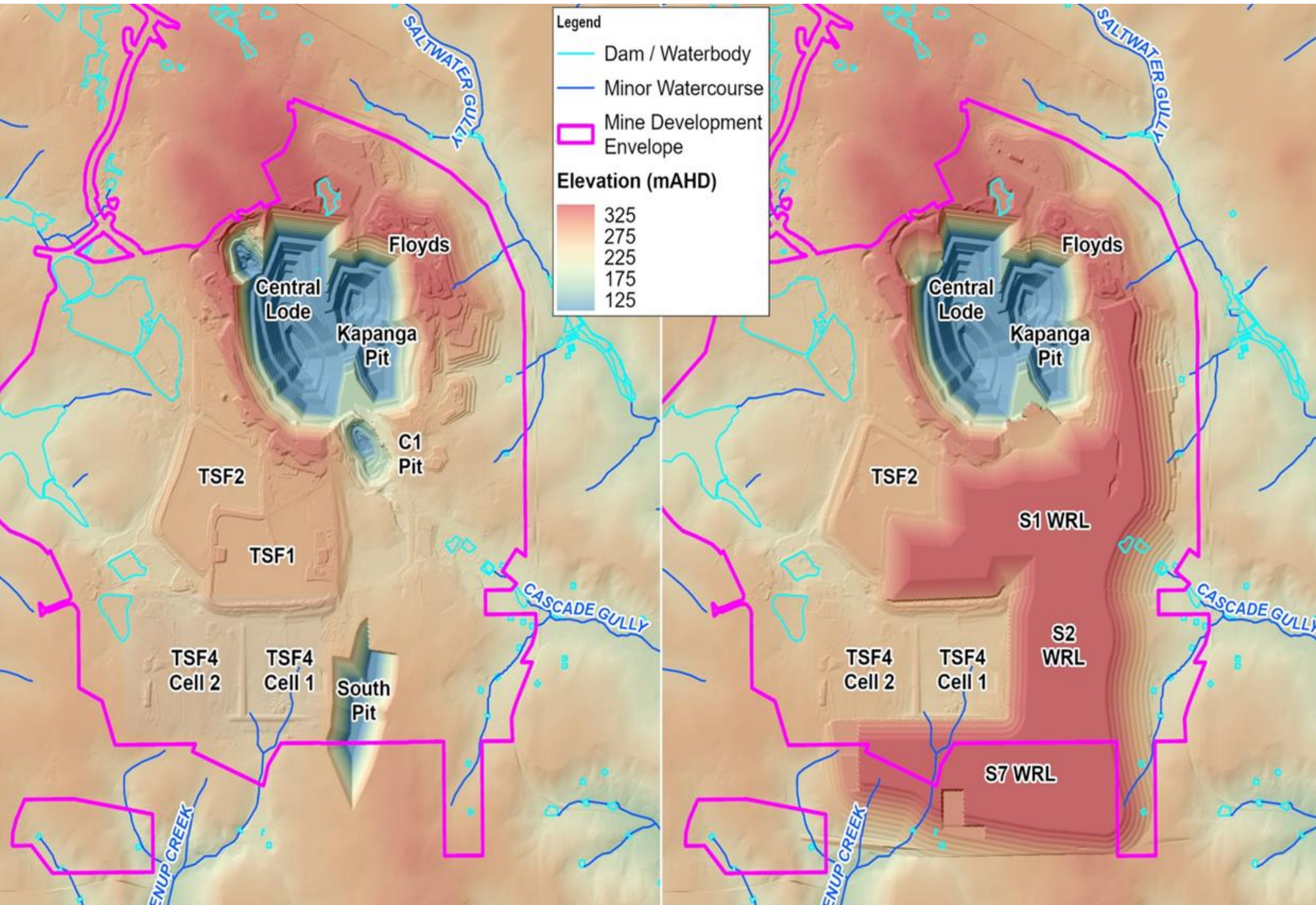
S2 and S7 Waste Rock Landforms Hydrology Study

Preliminary Risk Assessment

Talison Lithium Pty Ltd

4 March 2025

→ The Power of Commitment



Project name	S2 and S7 Waste Rock Landforms Hydrology Study						
Document title	S2 and S7 Waste Rock Landforms Hydrology Study | Preliminary Risk Assessment						
Project number	12604929						
File name	12604929-REP-0_Talison - Eastern Catchments - S2 S7 Risk Assessment						
Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S3	A	M Gebauer	W Schäfer	On File	F Hannon	On File	13 Dec 2024
S4	0	W Schäfer	W Schäfer		F Hannon	Fionnuala Hannon	04 Mar 2025
[Status code]							
[Status code]							
[Status code]							

GHD Pty Ltd | ABN 39 008 488 373

999 Hay Street,, Level 10,

Perth, Western Australia 6000, Australia

T +61 8 6222 8222 | **F** +61 8 6222 8555 | **E** permail@ghd.com | **ghd.com**

The Power of Commitment

Contents

Table index

Figure index

1. Introduction

1.1 Background

GHD Pty Ltd (GHD) was engaged by Talison Lithium Pty Ltd (Talison) to undertake a study (the Study) of additional proposed open pits and Waste Rock Landforms (WRLs). The Study includes hydrological and hydrogeological modelling of the proposed facilities and subsequent preliminary assessments of the environmental and human health risks arising from these facilities. The Study is focussed on the following facilities:

– Expansion of existing open cut pits and development of new open cut pits.
– Establishment of the new Floyds Stage 2 (S2) and Stage 7 (S7) WRLs.

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

The purpose of this Study is to complete a baseline investigation and preliminary risk assessment of the proposed facilities to understand the efficacy of existing management and monitoring of the existing and approved facilities as well as the proposed S2 and S7 WRLs and expanded pits. The Study is also intended to 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:

– Gap Analysis (GHD, 2024a).
– Conceptual Site Model (GHD, 2024b).
– Water Resources Monitoring Plan (GHD, 2024c)
– Groundwater Modelling (GHD, 2024d).
– Surface Water and Mass Balance Modelling (GHD, 2024e).
– 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 the proposed S2 and S7 WRLs and expanded pits and provides recommendations for the management of the emissions where such risks may be unacceptable.

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, 2024e) encompasses the construction footprints of the proposed pits and WRLs, the upstream contributing catchment areas (including Floyds WRL), and the downstream receiving environment. This includes Hester Brook and Woljenup Creek and their tributaries up to their confluences with the 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, 2024d). A plan of the groundwater model domain is provided in **Figure 1.3**.

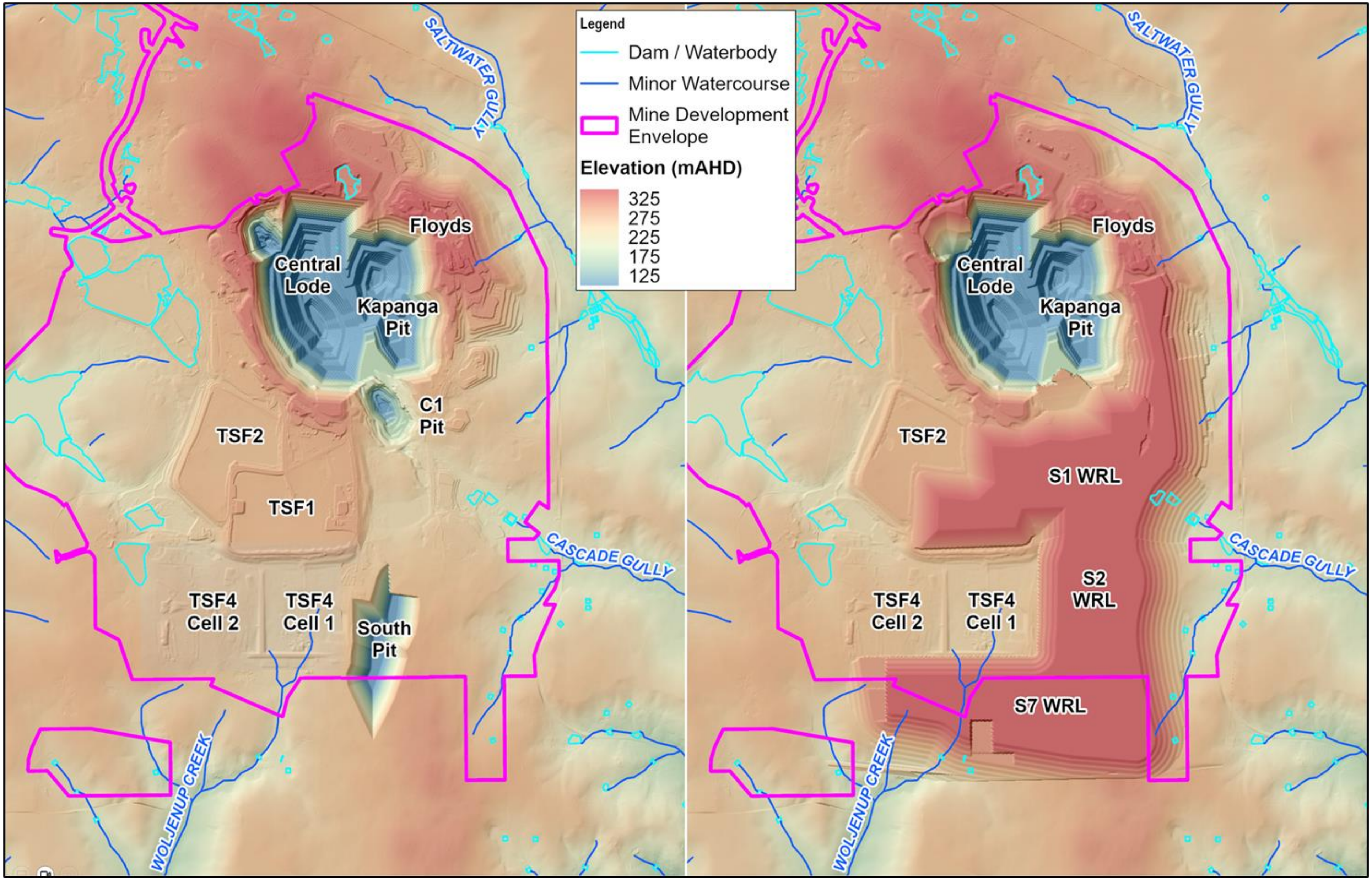


Figure 1.1: Proposed 2052 Landform

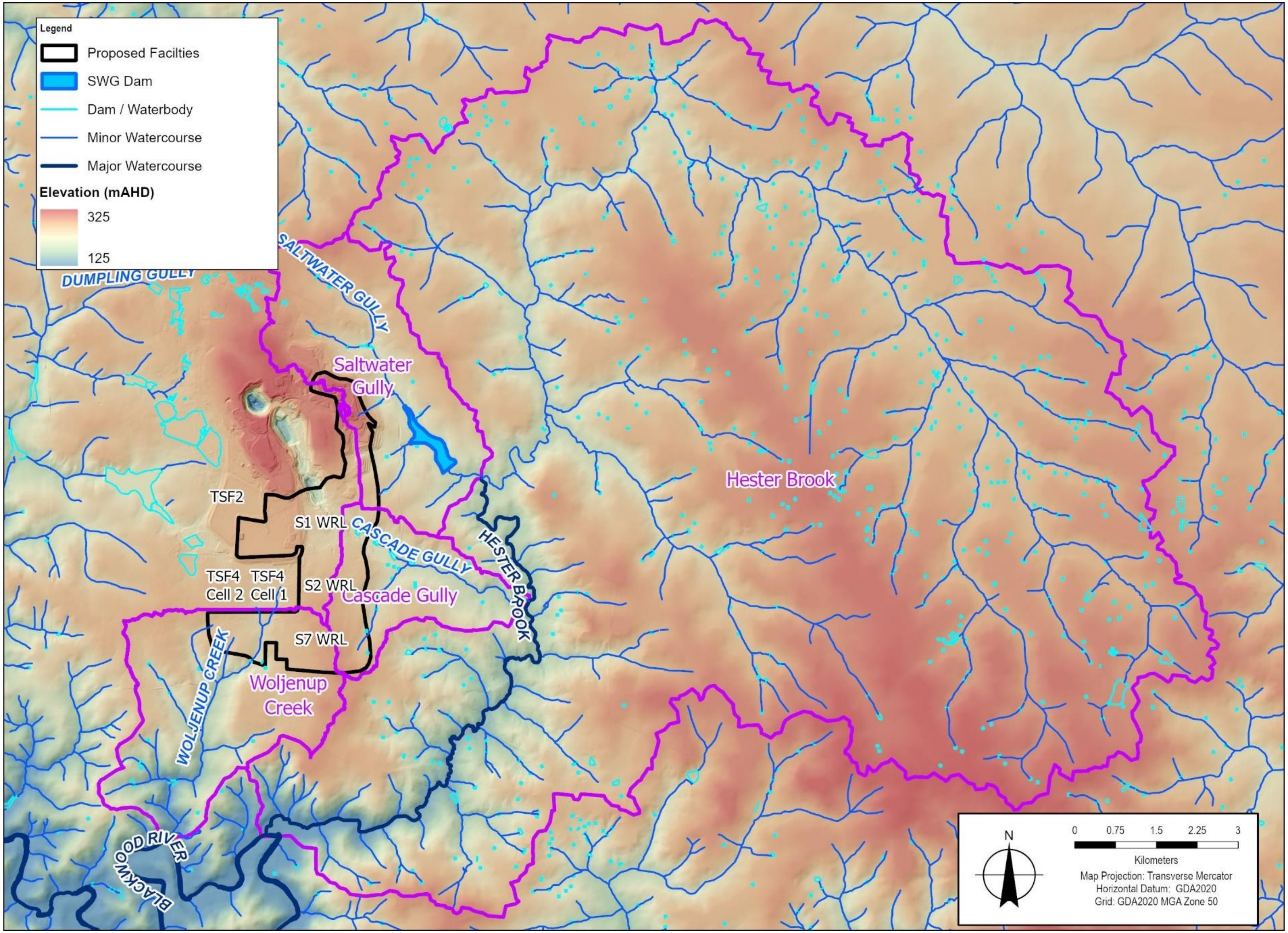
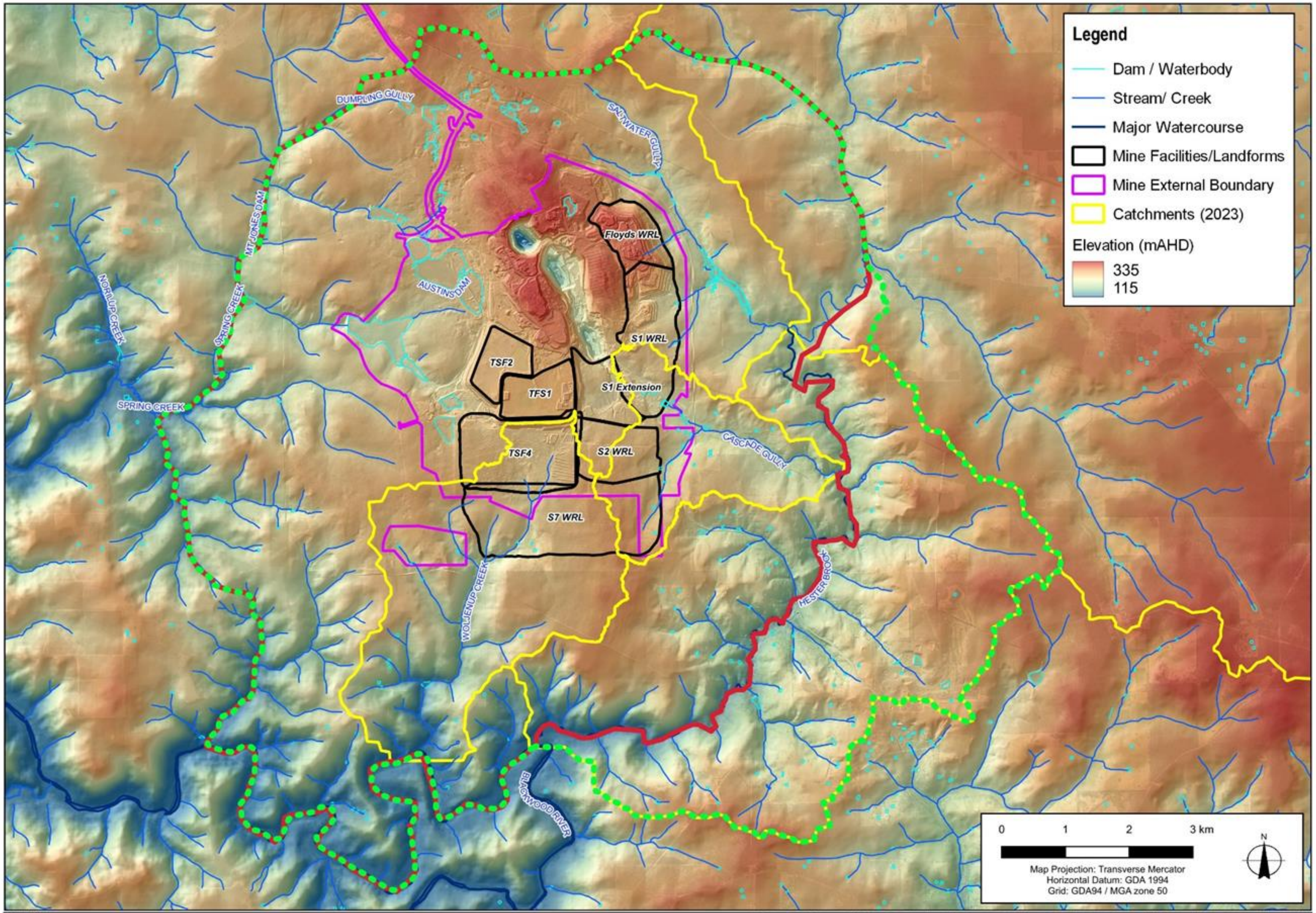


Figure 1.2: Surface Water Model Domain



Document Path:
\\ghdnet\GHD\AU\Perth\Projects\61\12604929\GIS\Maps\Working\Talison_S2S7_Variations\S2S7_Variation_Figures.qgz

Data Source: GHD - Catchments (2023), Mine Facilities/ Landform (2022), Groundwater Model Domain. Talison - Mine External Boundary (2023), Elevation (2022). 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 the pits and S2 and S7 WRLs has the potential to impact the downgradient environment through impacted runoff and seepage into the surface water and groundwater systems. The purpose of this report is to examine whether any Contaminants of Potential Concern (CoPC) 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 Environment 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 CoPC are screened against guidelines and the potential for the CoPC to migrate offsite and impact the receiving environment.

Tier 2: Secondary risk assessment(s) to quantify, or better understand, the CoPC 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 CoPC 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 CoPC discharging from the pits and S2 and S7 WRLs, which is documented separately in GHD (2024d) and GHD (2024e).

– Pathways:
  - Develop a conceptual site model defining the pathways via the surface and subsurface flows, which is documented separately in GHD (2024b).
  - Assess groundwater adsorption of CoPC within the aquifer matrix and CoPC fate and transport through mapping the seepage migration direction and fate of leachate/seepage/CoPC in the subsurface, which is documented separately GHD (2024d).
  - Assess surface water discharges and dilution of CoPC through mixing with background surface water and calculate indicative concentrations leachate/seepage/CoPC within the creeks and drainage lines, which is documented separately in GHD (2024e).

– Receptors:
  - Identify, map, and list the receiving environments which may be impacted by the discharge of leachate/seepage/CoPC, which is documented in this report.
  - Quantify the CoPC 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 (2024d) 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 S2 and S7 WRLs 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 (2024e) developed the surface 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 S2 and S7 WRLs 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 (2024e) 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), GHD (2023g) and GHD (2024b), and the current pit 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 CoPC 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 is modelled with the information provided by Talison.
- Future climate scenarios were not assessed in this report as it's outside the agreed scope of work.

2. Contaminants of Potential Concern

2.1 Contaminant Sources

Impacted sources of seepage from the Tailings Storage Facilities (TSFs), the Mine Services Area (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 2.1**, details of which are presented by GHD (2023l).

Table 2.1: 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)

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 CoPC. A summary of the WQGs for arsenic and lithium (the key CoPC modelled) is provided in **Table 2.1**.

Table 2.2: 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

2.3 Tailings Solids and Decant

Based on a review of the source characterisation data by GHD (2023l), dissolved constituents were deemed as CoPC 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 CoPC 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 (SO_2)
– Nitrate (NO_3)

2.3.1 Waste Rock

Regarding leaching from the waste rock (both WRLs and TSF buttresses) an initial list of CoPC 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 CoPC from the waste rock seepage and leach testing study (GHD, 2022) and screening rationale is presented in **Table 2.3**.

Table 2.3: List and Rationale of CoPC from Waste Rock Seepage and Leach Testing (GHD, 2023l)[1]

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

1 - = indicates that guidelines are not available.

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		
Nickel	Yes	No	No	Yes	No
Rubidium[2]	Yes*	-	Yes *	Yes	Yes
Thallium	-	-	-	Yes	Yes
Uranium	-	No	No	Yes	Yes
Vanadium	-	No	-	No	Yes
Zinc	Yes	No	No	Yes	Yes

2.3.2 Discharge Monitoring

Talison has 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 2.1**, differentiated as the orange locations. The historical monitoring is generally reflective of leachate and runoff from the existing Floyds WRL. Further details of the historical monitoring are provided by GHD (2023l).

Review of the discharge monitoring data (GHD, 2023l) indicated no additional CoPC identified. Further, the limited suites of analytes included in the discharge monitoring (i.e., As, Cd, Cu, Li, Mn, Ni, Th, U, Zn, SO_4, and NO_3), all of which exhibited at least one WQG exceedance, did not allow for any rationalisation of the CoPC. Based on this review of the monitoring data, the following CoPC were considered important for inclusion in the risk assessment:

– 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.

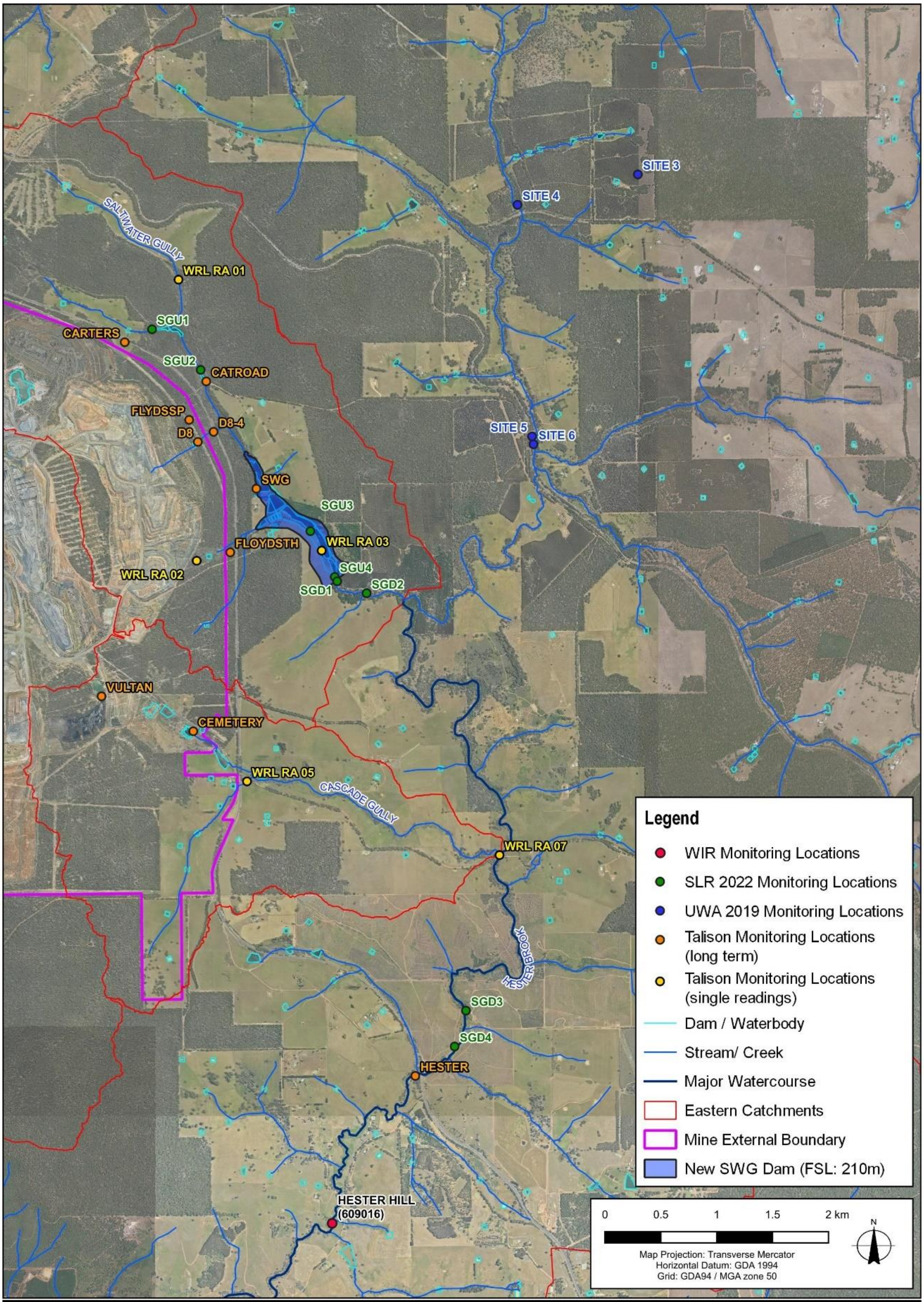
2.3.3 Initial list of CoPC

The CoPC identified in the initial identification process are presented in **Table 2.4** 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 2.4** 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 CoPC posing a risk from the construction of the WRLs.

[2] * = Rubidium guidelines derived from water quality guidelines review (GHD, 2023m)



Data Source: GHD - New SWG Dam, Eastern Catchments (2023). Talison - Mine External Boundary (2023), Background Aerial Imagery (2023). Landgate - Dam / Waterbody, Major Watercourse, Minor Watercourse, Stream / Creek (2020). WA Landgate SLIP - Background Aerial Imagery.

Figure 2.1: Locations of Water Discharge Monitoring Points

Table 2.4: Initial List of CoPC Compared Against Site Specific WQGs

CoPC (mg/L)	TSF4 Tailings Source Concentrations					Waste Rock Source Concentrations		Site Specific Guidelines (GHD, 2023m)				
	Decant 2018[3]	Decant 2022 (Total)[4]	Decant 2022 (Filtered)[5]	Talings Solids Leach (ALSP)[6]	Talings Solids Leach (LEAF 1314)[7]	Seepage Testing (Total)[8]	Leach Testing (LEAF 1314)[9]	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

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

2.4 Modelling Initial CoPC values

2.4.1 Groundwater

Solute transport in the groundwater modelling 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) and 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 CoPC 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 CoPC (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 2.5**, 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 CoPC in Groups 1, 2, 3, and 3. 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 CoPC.

Table 2.5: List of CoPC and Partitioning Coefficients[10]

	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[11]	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**

10 There is no published Kd for Thorium.
NO_3 is a conservative ion so does not adsorb onto clays.
SO_4 is subject to redox only and does not adsorb onto clays.

11 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).

2.4.2 Surface Water

Concentrations of CoPC in the runoff from the mine affected areas were assumed to be constant at the average values recorded at the monitoring sites in the downgradient creeks (see **Table 2.6**). 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. This latter assumption may present slightly elevated concentrations relative to upstream of Hester Brook.

Table 2.6: 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, 2024d)			

3. Summary of Modelling Results

3.1 Groundwater modelling

GHD (2024d) documents the fate and transport modelling of groundwater and key CoPC emitted from the existing and proposed facilities to the subsurface.

3.1.1 Arsenic Plume Extents

The modelled arsenic plumes (contours of concentrations reflecting the various WQGs) in the various model layers are provided in GHD (2024d) at various future dates. The base case modelling results indicate that:

– The current impact (2023) is confined to Layer 3 and above, within the footprints of TSF1, TSF2, and Floyds WRL. A small zone is associated with seepage from the existing Salt Water Gully Dams. 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 immediately below the TSFs and WRLs.
– There is no noticeable migration of the plumes from the TSFs in Layer 2 by 2030, either horizontally or vertically. Any increase in extent of arsenic impact corresponds with the expansion of the WRLs and is confined to their immediate footprint. Arsenic impact from TSF4 is evident beyond a zone within the Layer 2 clay lining in Cell 1.
– The impact of the expanding WRLs generally breaks through into in Layer 2 within 10 years after commencement.
– The plume within layer 2, emanating from the WRLs, extends to cover most of the footprint of these facilities by 2100. The drinking water and aquatic environment WQGs remain the only guidelines exceeded.
– There is no noticeable lateral migration of the plumes emanating from the WRLs by 2100. By this date, the plume from Floyds WRL has emerged in Layer 3. There is a small plume from Floyds, S1 and S2 WRLs that has migrated to Layers 4 to and 9 within the open cut pit.

The impact case modelling results indicate the following:

– The first indications of arsenic impact from Floyds appeared in groundwater in the Layer 2 saprolite in 1990. As the WRLs expand, the area of groundwater with arsenic above the 0.01 mg/L (drinking water guideline) and 0.013 mg/L (aquatic environmental guideline) expand but are retained within the footprint of the WRLs.
– The 2030 concentration contours within Layers 2 and 3 are very similar between base case and impact case.
– By 2040, concentrations above 0. 013 mg/L are present in layer 2 below S1, S2, S7 WRLs as well as TSF2 and TSF4.
– By 2070, concentrations above 0. 013 mg/L are present in layer 3 under the S7 WRL.
– By 2100, concentrations above 0. 013 mg/L are present in layer 5 adjacent (west) to Floyds WRL.

3.1.2 Lithium Plume Extents

The modelled lithium plumes (contours of concentrations reflecting the various WQGs) in the various model layers are provided in GHD (2024d) 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 and WRLs is mostly confined within the landform footprints except for the eastern side of TSF1, where the plume extends ~400 m in Layer 2 into the area of historical dredge mining (concentration of 0.14 mg/L contour only representing the non-potable water guideline), and approximately 100 m to the east of the Floyds WRL. The maximum concentration simulated is around 6 mg/L below TSF2, which exceeds all guidelines.

– By 2030, groundwater above 0.14 mg/L is present below the Floyds WRL and the WRL segment immediately south. The plume below Floyds has reached Layer 9, drawn in by pit dewatering. The 0.14 mg/L contour from TSF1 has migrated to extend around 1.2 km eastwards, beneath the WRL.
– By 2040 the impact from the WRLs remain within the WRL footprint, mostly confined to layer two, except beneath Floyds, where it reaches Layer 7 over around half or the footprint. The plume from TSF1, defined by the 0.14 mg/L contour now extends to the eastern edge of the WRL, and some areas beneath the WRL exceed 0.82 mg/L.
– By 2070 more of Layer 2 is showing impact but below 0.82 mg/L. The are of the TSF1 plume exceeding 0.82 mg/L has almost disappeared and the 0.14 mg/L contour has not extended any further east. Impact above 0.14 mg/L does not extend beyond Layer 3, other than the Floyds area and the TSF1 plume.
– By 2100 the 0.14 mg/L contour encompass almost all of the areas of Layer 2 below the WRLS and much of Layer 3 and 5 and extending in part down to Layer 9 The 0.14 mg/L contour extends east of the WRLS some areas, with the maximum extent of around 200-300 m in Layer 5 saprock. At the water table (Layers 1 and 2), the plume remains within the WRL footprint.

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

– The 2030 and 2040 concentration contours are very similar between the base case and impact case (within Layers 2, 3 and 5).
– By 2070, concentrations above 0. 014 mg/L are present in Layer 2 and 3 below the S2 and S7 WRL footprints, with limited breakthrough to Layer 5 in small areas south of S7 WRL.
– By 2100, concentrations above 0. 014 mg/L in Layer 5 extends across the full footprints of S2 and S7 WRLs.

3.1.3 Groundwater Discharge to Surface

The surface water and mass balance modelling (see **Section 3.2**) 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 median values of which are presented in **Table 3.1** and **Table 3.2** for lithium and arsenic respectively.

Table 3.1: Median Simulated Groundwater Discharge Lithium Loads (2025 to 2063)

Name	Base(g/day)	Impact (g/day)
Salt Water Gully Outlet to Hester Brook	2.228	2.233
Cascade Gully Outlet to Hester Brook	5.560	5.610
Hester Brook Upstream of Salt Water Gully Confluence	14.304	14.307
Hester Brook Upstream of Cascade Gully Confluence	9.726	9.734
Hester Brook at Hester Hill	24.528	24.621
Upper Woljenup Creek	5.051	24.317
Middle Woljenup Creek	3.172	3.174
Lower Woljenup Creek	1.497	1.498

Table 3.2: Median Simulated Groundwater Discharge Arsenic Loads (2025 to 2063)

Name	Base (g/day)	Impact (g/day)
Salt Water Gully Outlet to Hester Brook	0.045	0.045
Cascade Gully Outlet to Hester Brook	0.112	0.114
Hester Brook Upstream of Salt Water Gully Confluence	0.291	0.291
Hester Brook Upstream of Cascade Gully Confluence	0.198	0.198
Hester Brook at Hester Hill	0.498	0.500
Upper Woljenup Creek	0.102	0.663
Middle Woljenup Creek	0.065	0.065
Lower Woljenup Creek	0.030	0.030

3.1.4 Point Impacts

The modelled changes in arsenic and lithium concentrations in the groundwater were assessed at three nominal sites within the Study Area (see **Figure 3.1**), these being:

– NE: East of S2 WRL (within the Cascade Gully Catchment).

– SE: East of S7 WRL (within the Cascade Gully Catchment).

– SW: South of S7 WRL (within Woljenup Creek Catchment).

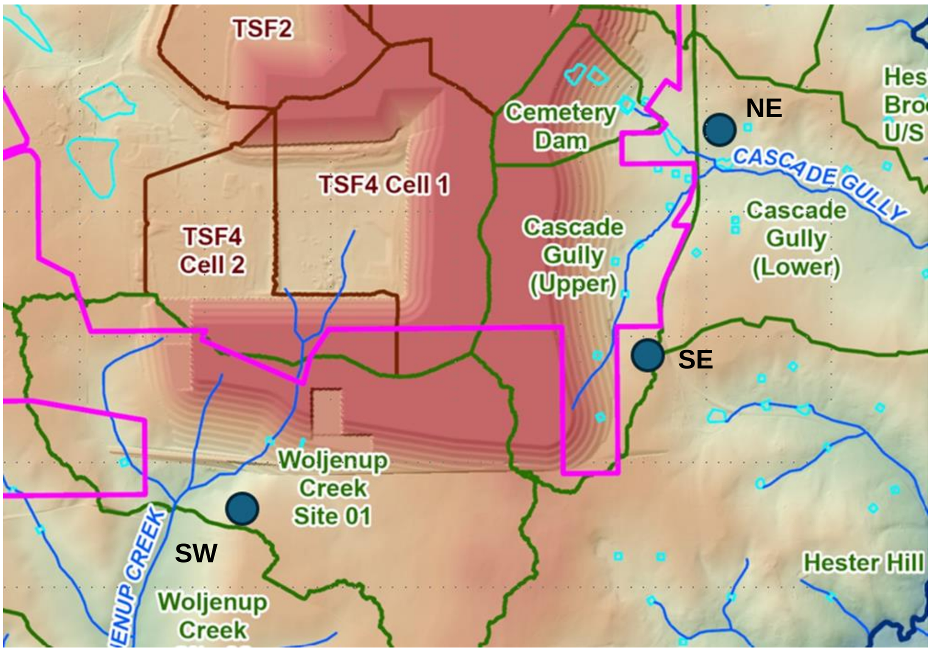


Figure 3.1: Location of Point Impact Sites

3.1.4.1 Arsenic

The modelled arsenic concentrations in layer 2 at the three sites are shown in **Figure 3.2**. The highest concentration of arsenic in any of the locations over the entire modelling period (year 2100) was 0.00052 mg/L at NE. The water use survey reported in GHD (2024b) 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 NE. It should be noted that the drinking water WQG (0.01 mg/L) and the non-potable WQG (0.2 mg/L) were not exceeded. Contours of arsenic concentrations in groundwater reported by GHD (2024d) show that arsenic does not migrate far from the source site (S2 and S7 WRLs) and is likely to decrease in concentration away from the source. Modelling results for SE and SW indicated that arsenic concentrations remain low over the long term, not exceeding 0.0005 mg/L (i.e. the background concentration), which is below the drinking water WQG.

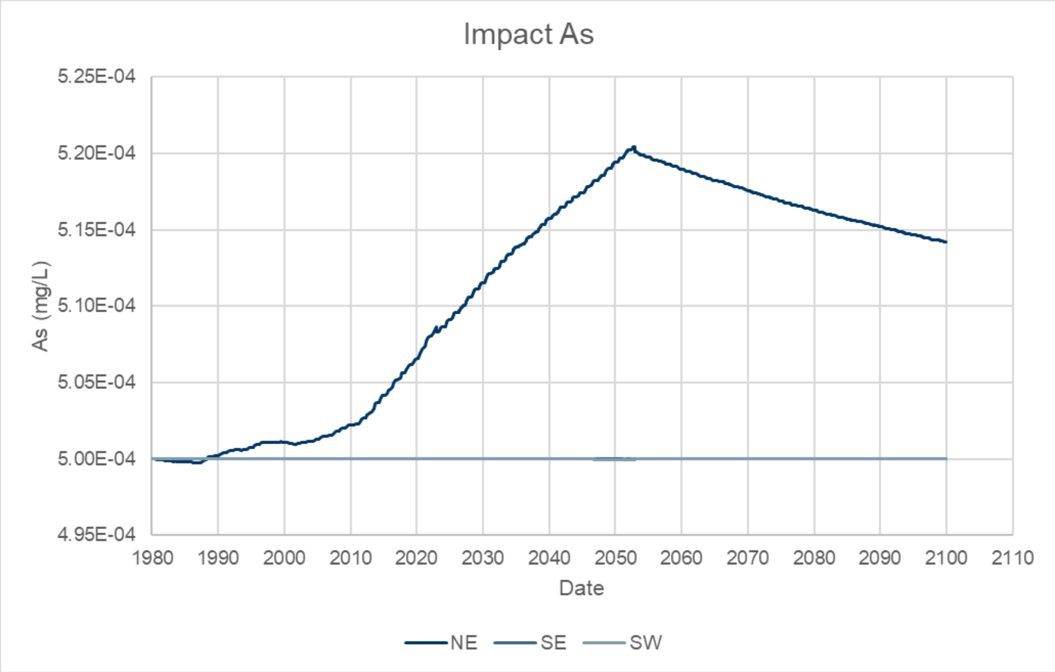


Figure 3.2: Modelled Arsenic Concentrations at Point Impact Sites in Layer 2

3.1.4.2 Lithium

The modelled lithium concentrations in layer 2 at the three sites are shown in **Figure 3.3**. The highest concentration of lithium in any of the locations over the entire modelling period (year 2100) was 0.02465 mg/L at SE. The water use survey (GHD, 2024b) indicates that there is no water use at this location. However, the stock watering WQG (0.82 mg/L), drinking water WQG (0.007 mg/L), and the non-potable WQG (0.14 mg/L) were not exceeded. At NE, lithium remains between 0.0245 mg/L and 0.02464 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 the groundwater at NE and SE is only slightly impacted by mining operations.

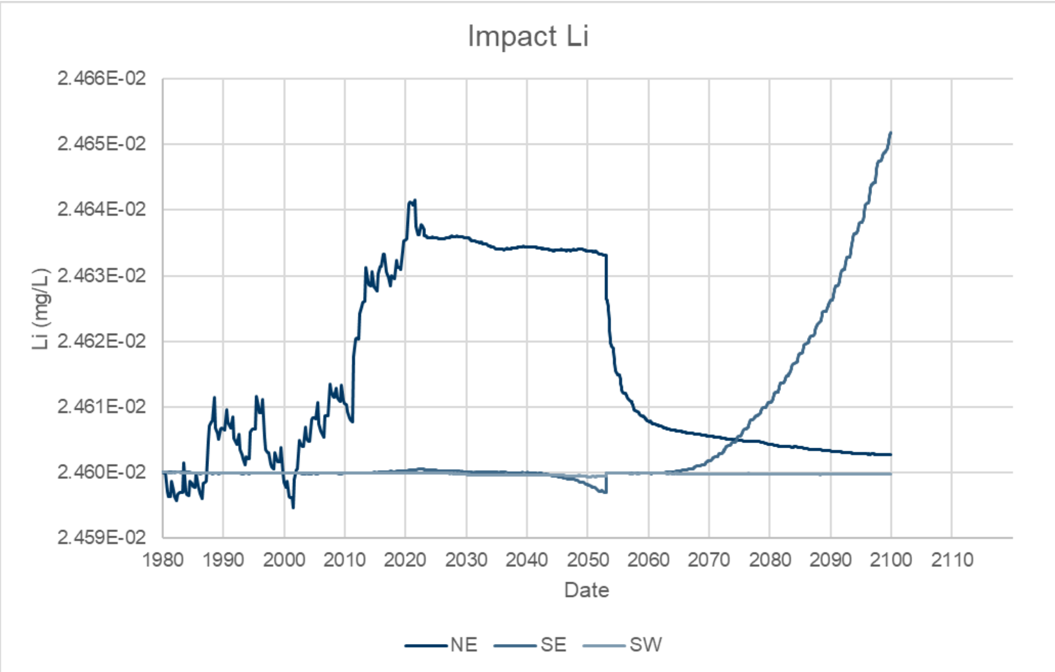


Figure 3.3: Modelled Lithium Concentrations at Point Impact Sites in Layer 2

Contours of lithium concentrations in groundwater reported by GHD (2024d) show that lithium impacts do not migrate far from the source site (S2 and S7 WRLs), and the concentrations would be lower further away from the footprint.

Concentrations remain at 0.0245 mg/L at SW, 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 the groundwater at SW is not considered to be impacted by mining operations.

3.1.5 Conclusions from Groundwater Modelling

The modelling indicates that the arsenic and lithium plumes from the existing and proposed WRLs and TSFs are generally constrained close to or within the TSF or WRL footprints. Modelling predicts a lithium plume extending east along the palaeochannel sand from TSF1, but it remains almost entirely beneath the proposed WRLs. Isolated plumes of elevated lithium extend within the saprock up to around 300 m east of the WRLs but does not extend in the uppermost layers likely to discharge to surface.

3.2 Surface water results

3.2.1 Scenarios

The following scenarios were simulated in the WBM and are reported by GHD (2024e):

– **Base Case**: Existing site and operations, including the approved expansion of Floyds WRL (S1).
– **Impact Case**: Base Case plus the proposed pits, S2 and S7 WRLs, and SWG Dam.

3.2.2 Streamflow

A statistical summary of the simulated daily catchment runoff flows is provided in **Table 3.3** for the reporting locations depicted in **Figure 3.4** and for each of the scenarios simulated. The simulated flows indicate the following:

– Streamflow in Hester Brook upstream of the Salt Water Gully confluence remains unchanged for all scenarios since this is not impacted by the proposed facilities.
– Streamflow at the Salt Water Gully outlet to Hester Brook reduces by an average of ~68% in the Impact Case, reflecting the impact of SWG Dam.
– Streamflow at the Cascade Gully outlet to Hester Brook decreases by an average of ~13% in the Impact Case, reflecting the changes in catchment areas and runoff characteristics due to the S2 WRL.
– Streamflow in Hester Brook upstream of the Cascade Gully confluence decreases by an average of~5% in the Impact Case, reflecting the impact of SWG Dam.
– Streamflow in Hester Brook downstream of the Cascade Gully Confluence and in Hester Brook at Hester Hill gauging site both decrease by an average of ~5% in the Impact Case, reflecting the impact of SWG Dam and the changes in catchment areas and runoff characteristics due to the establishment of S2 WRL.
– Streamflow in Upper Woljenup Creek reduces by an average of ~20% in the Impact Case, reflecting the changes in catchment areas and runoff characteristics due to the establishment of S7 WRL.
– Streamflow in Middle Woljenup Creek reduces by an average of ~10% on average in the Impact Case reflecting the impact of the change in catchment area and runoff characteristics brought about by S7 WRL.
– Streamflow in Lower Woljenup Creek reduces by an average of ~9% on average in the Impact Case reflecting the impact of the change in catchment area and runoff characteristics brought about by S7 WRL.

Table 3.3: Statistics of Simulated Flows (ML/day) at Reporting Sites from 2025 to 2063

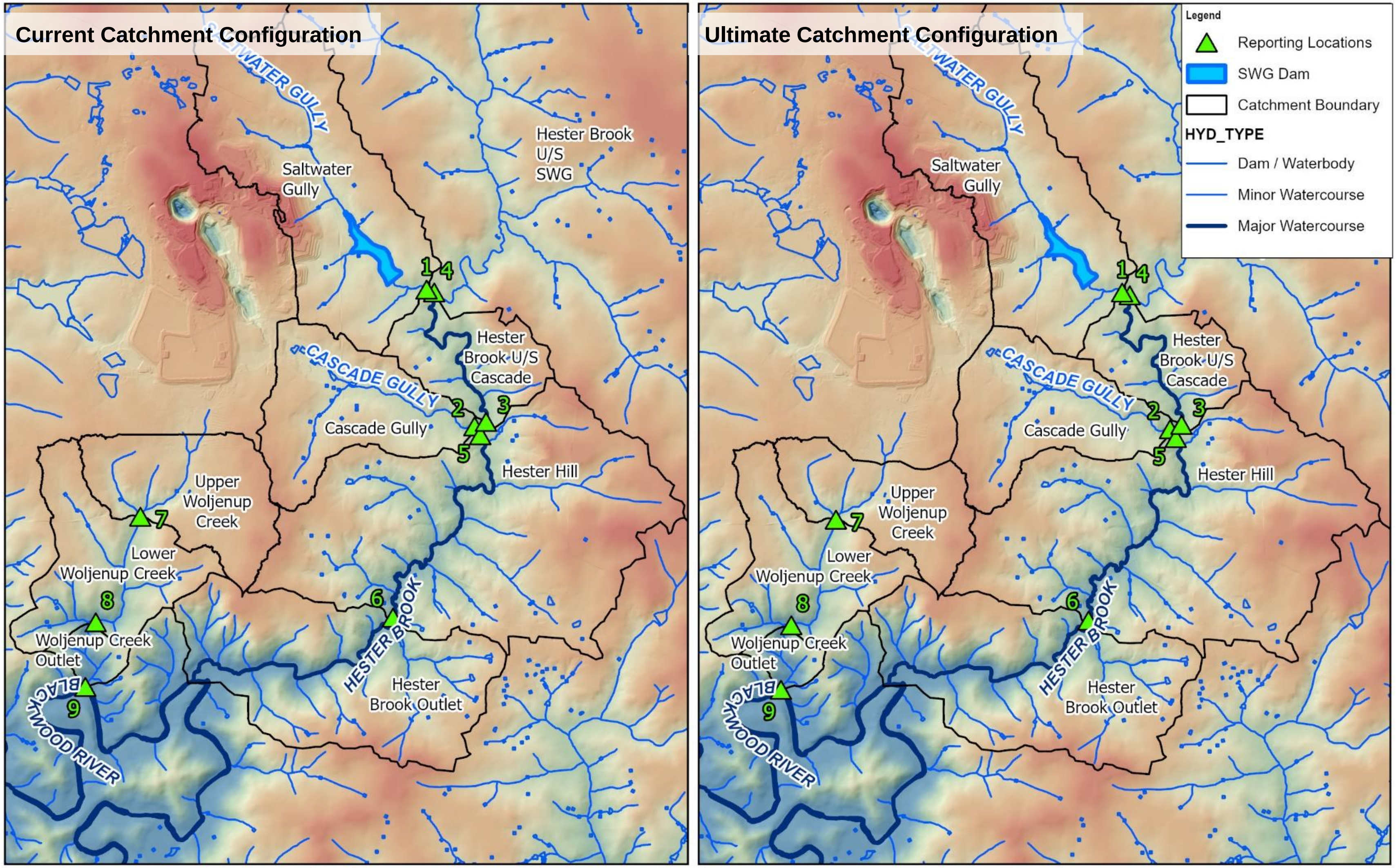
Location	Salt Water Gully Outlet to Hester Brook		Cascade Gully Outlet to Hester Brook		Hester Brook Upstream of Salt Water Gully Confluence	
Statistic[12]	Base	Impact	Base	Impact	Base	Impact
5%	0.56	0.18	0.31	0.25	7.11	7.11
20%	1.40	0.45	0.78	0.64	17.59	17.59
50%	2.67	0.85	1.47	1.23	33.01	33.01
80%	5.00	1.57	2.69	2.43	59.14	59.14
95%	9.55	2.99	5.12	4.77	112.87	112.87
Location	Hester Brook Upstream of Cascade Gully Confluence		Hester Brook Downstream of Cascade Gully Confluence		Hester Brook at Hester Hill	
Statistic	Base	Impact	Base	Impact	Base	Impact
5%	7.88	7.49	8.20	7.77	9.25	8.82
20%	19.50	18.54	20.28	19.20	22.89	21.81
50%	36.64	34.80	38.12	36.09	43.01	40.98
80%	65.80	62.38	68.48	64.82	77.25	73.58
95%	125.49	119.04	130.59	123.60	147.32	140.32
Location	Upper Woljenup Creek		Middle Woljenup Creek		Lower Woljenup Creek	
Statistic	Base	Impact	Base	Impact	Base	Impact
5%	0.29	0.23	0.62	0.55	0.66	0.60
20%	0.72	0.56	1.52	1.36	1.63	1.47
50%	1.36	1.05	2.84	2.56	3.06	2.77
80%	2.45	2.01	5.11	4.68	5.49	5.06
95%	4.65	3.86	9.72	8.87	10.44	9.59

3.2.3 CoPC Concentrations

Statistical summaries of the simulated lithium, arsenic, sulphate, and nitrate concentrations are provided in **Table 3.4**, **Table 3.5**, **Table 3.6** and **Table 3.7** respectively for the reporting locations depicted in **Figure 3.4** 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 3.5**, **Figure 3.6** , **Figure 3.7** , and **Figure 3.8** 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.

A comparative summary of the simulated CoPC concentrations is presented in **Table 3.8**. The Exceedance Probabilities considered in this analysis are 5%, 20%, 50%, 80% and 95%.

[12] Exceedances probabilities, which are the probabilities of the flows equaling or exceeding given rates.



id	Name
1	Saltwater Gully Outlet
2	Cascade Gully Outlet
3	Hester Brook U/S Cascade Gully

id	Name
4	Hester Brook U/S Saltwater Gully
5	Hester Brook D/S Cascade Gully
6	Hester Hill

id	Name
7	Upper Woljenup Creek
8	Middle Woljenup Creek
9	Lower Woljenup Creek

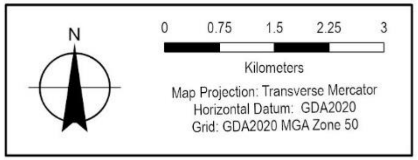


Figure 3.4: Model Reporting Locations

Table 3.4: Statistics of Simulated Lithium Concentrations in mg/L (2025 to 2063)[13]

Location	Salt Water Gully Outlet to Hester Brook		Cascade Gully Outlet to Hester Brook		Hester Brook Upstream of Salt Water Gully Confluence	
Statistic	Base	Impact	Base	Impact	Base	Impact
5%	0.0338	0.0253	0.0202	0.0415	0.0003	0.0003
20%	0.0345	0.0259	0.0273	0.0553	0.0003	0.0003
50%	0.0362	0.0275	0.0404	0.0762	0.0003	0.0003
80%	0.0400	0.0314	0.0569	0.1011	0.0003	0.0003
95%	0.0453	0.0374	0.0757	0.1263	0.0003	0.0003
Location	**Hester Brook Upstream of Cascade Gully Confluence**		**Hester Brook Downstream of Cascade Gully Confluence**		**Hester Brook at Hester Hill**	
Statistic	**Base**	**Impact**	**Base**	**Impact**	**Base**	**Impact**
5%	0.0029	0.0012	0.0035	0.0027	0.0036	0.0028
20%	0.0029	0.0012	0.0040	0.0036	0.0040	0.0037
50%	0.0031	0.0013	0.0051	0.0061	0.0050	0.0059
80%	0.0036	0.0015	0.0075	0.0110	0.0071	0.0103
95%	0.0046	0.0020	0.0115	0.0189	0.0108	0.0175
Location	**Upper Woljenup Creek**		**Middle Woljenup Creek**		**Lower Woljenup Creek**	
Statistic	**Base**	**Impact**	**Base**	**Impact**	**Base**	**Impact**
5%	0.0287	0.0757	0.0167	0.0383	0.0171	0.0375
20%	0.0485	0.1141	0.0277	0.0612	0.0276	0.0591
50%	0.0825	0.1650	0.0503	0.0991	0.0491	0.0957
80%	0.1201	0.2119	0.0799	0.1400	0.0778	0.1358
95%	0.1572	0.2540	0.1125	0.1796	0.1098	0.1749

[13] 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.

Table 3.5: Statistics of Simulated Arsenic Concentrations in mg/L (2025 to 2063)[14]

Location	Salt Water Gully Outlet to Hester Brook		Cascade Gully Outlet to Hester Brook		Hester Brook Upstream of Salt Water Gully Confluence	
Statistic	Base	Impact	Base	Impact	Base	Impact
5%	0.00084	0.00074	0.00022	0.00085	0.00001	0.00001
20%	0.00084	0.00074	0.00025	0.00090	0.00001	0.00001
50%	0.00086	0.00076	0.00030	0.00102	0.00001	0.00001
80%	0.00092	0.00089	0.00038	0.00133	0.00001	0.00001
95%	0.00103	0.00114	0.00050	0.00172	0.00001	0.00001
Location	**Hester Brook Upstream of Cascade Gully Confluence**		**Hester Brook Downstream of Cascade Gully Confluence**		**Hester Brook at Hester Hill**	
Statistic	**Base**	**Impact**	**Base**	**Impact**	**Base**	**Impact**
5%	0.00007	0.00003	0.00007	0.00005	0.00007	0.00006
20%	0.00007	0.00003	0.00008	0.00006	0.00008	0.00006
50%	0.00007	0.00003	0.00008	0.00007	0.00008	0.00007
80%	0.00008	0.00003	0.00010	0.00011	0.00010	0.00010
95%	0.00010	0.00004	0.00013	0.00018	0.00013	0.00017
Location	**Upper Woljenup Creek**		**Middle Woljenup Creek**		**Lower Woljenup Creek**	
Statistic	**Base**	**Impact**	**Base**	**Impact**	**Base**	**Impact**
5%	0.00016	0.00057	0.00013	0.00030	0.00015	0.00031
20%	0.00024	0.00072	0.00017	0.00038	0.00019	0.00039
50%	0.00037	0.00091	0.00026	0.00053	0.00027	0.00053
80%	0.00051	0.00109	0.00037	0.00069	0.00038	0.00069
95%	0.00066	0.00125	0.00050	0.00085	0.00051	0.00085

[14] 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

Table 3.6: Statistics of Simulated Sulphate Concentrations in mg/L (2025 to 2063)[15]

Location	Salt Water Gully Outlet to Hester Brook		Cascade Gully Outlet to Hester Brook		Hester Brook Upstream of Salt Water Gully Confluence	
Statistic	Base	Impact	Base	Impact	Base	Impact
5%	23.04	17.25	13.75	28.23	0.23	0.23
20%	23.49	17.65	18.56	37.65	0.23	0.23
50%	24.67	18.74	27.50	51.89	0.23	0.23
80%	27.23	21.34	38.71	68.84	0.23	0.23
95%	30.85	25.48	51.50	85.95	0.23	0.23
Location	Hester Brook Upstream of Cascade Gully Confluence		Hester Brook Downstream of Cascade Gully Confluence		Hester Brook at Hester Hill	
Statistic	Base	Impact	Base	Impact	Base	Impact
5%	1.95	0.79	2.42	1.82	2.45	1.92
20%	1.98	0.82	2.70	2.46	2.70	2.49
50%	2.09	0.89	3.47	4.15	3.39	3.99
80%	2.44	1.05	5.09	7.47	4.83	6.99
95%	3.15	1.35	7.85	12.88	7.33	11.92
Location	Upper Woljenup Creek		Middle Woljenup Creek		Lower Woljenup Creek	
Statistic	Base	Impact	Base	Impact	Base	Impact
5%	19.54	51.51	11.34	26.10	11.67	25.53
20%	32.99	77.69	18.87	41.63	18.75	40.23
50%	56.13	112.33	34.24	67.45	33.42	65.15
80%	81.75	144.22	54.39	95.27	52.95	92.42
95%	107.04	172.88	76.61	122.25	74.76	119.08

[15] 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.

Table 3.7: Statistics of Simulated Nitrate Concentrations in mg/L (2025 to 2063)[16]

Location	Salt Water Gully Outlet to Hester Brook		Cascade Gully Outlet to Hester Brook		Hester Brook Upstream of Salt Water Gully Confluence	
Statistic	Base	Impact	Base	Impact	Base	Impact
5%	0.56	0.42	0.34	0.69	0.006	0.006
20%	0.58	0.43	0.45	0.92	0.006	0.006
50%	0.60	0.46	0.67	1.27	0.006	0.006
80%	0.67	0.52	0.95	1.69	0.006	0.006
95%	0.76	0.62	1.26	2.10	0.006	0.006
Location	**Hester Brook Upstream of Cascade Gully Confluence**		**Hester Brook Downstream of Cascade Gully Confluence**		**Hester Brook at Hester Hill**	
Statistic	**Base**	**Impact**	**Base**	**Impact**	**Base**	**Impact**
5%	0.05	0.02	0.06	0.04	0.06	0.05
20%	0.05	0.02	0.07	0.06	0.07	0.06
50%	0.05	0.02	0.09	0.10	0.08	0.10
80%	0.06	0.03	0.12	0.18	0.12	0.17
95%	0.08	0.03	0.19	0.32	0.18	0.30
Location	**Upper Woljenup Creek**		**Middle Woljenup Creek**		**Lower Woljenup Creek**	
Statistic	**Base**	**Impact**	**Base**	**Impact**	**Base**	**Impact**
5%	0.48	1.26	0.28	0.64	0.29	0.63
20%	0.80	1.90	0.46	1.02	0.46	0.99
50%	1.37	2.75	0.84	1.65	0.81	1.60
80%	2.00	3.53	1.33	2.33	1.30	2.26
95%	2.62	4.23	1.88	2.99	1.83	2.92

[16] 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.

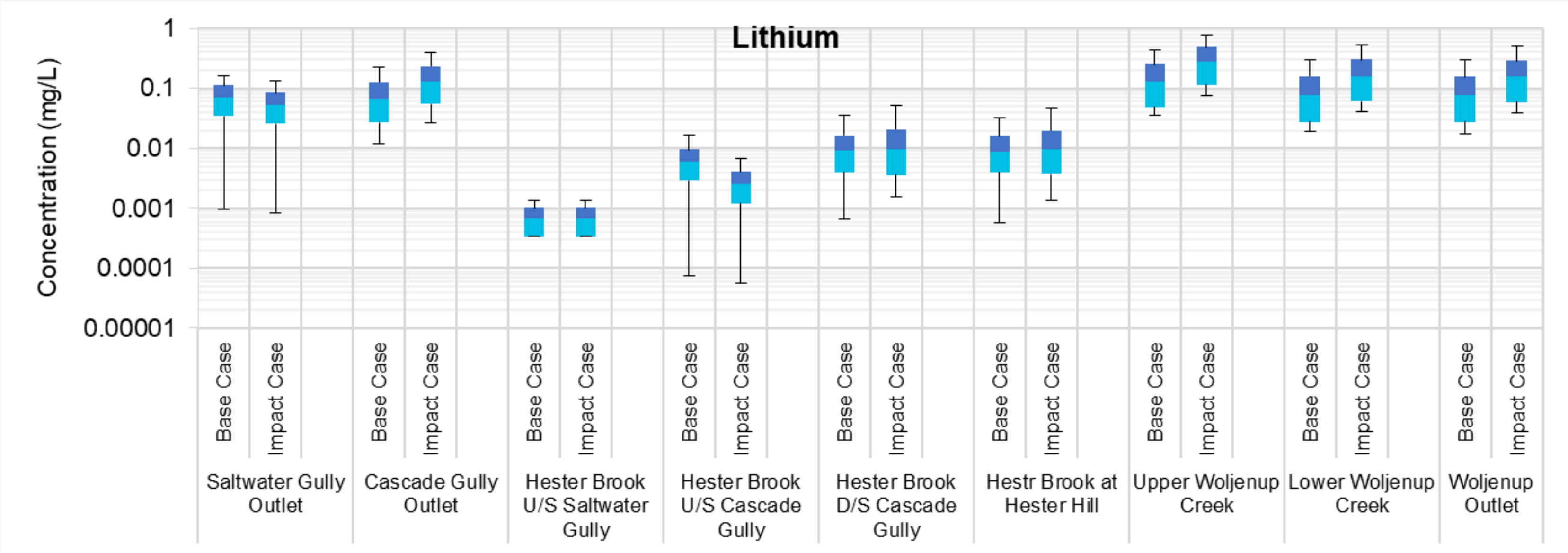


Figure 3.5: Ranges of Simulated Lithium Concentrations (2025 to 2063)

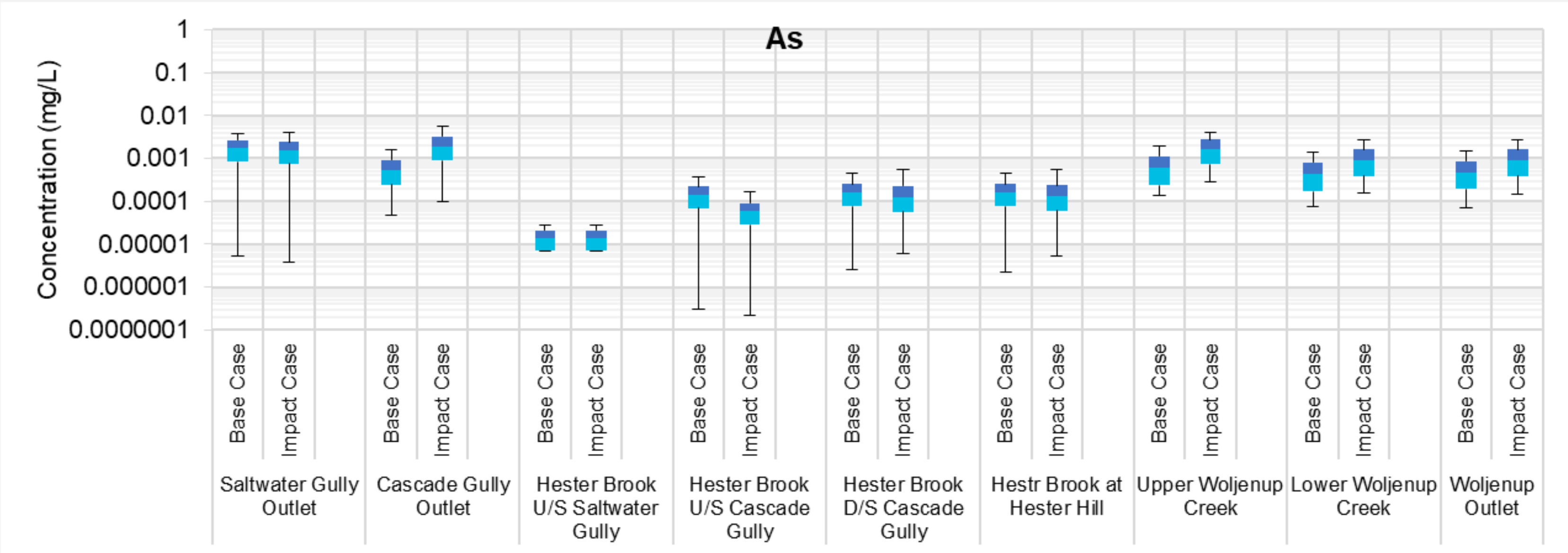


Figure 3.6: Ranges of Simulated Arsenic Concentrations (2025 to 2063)

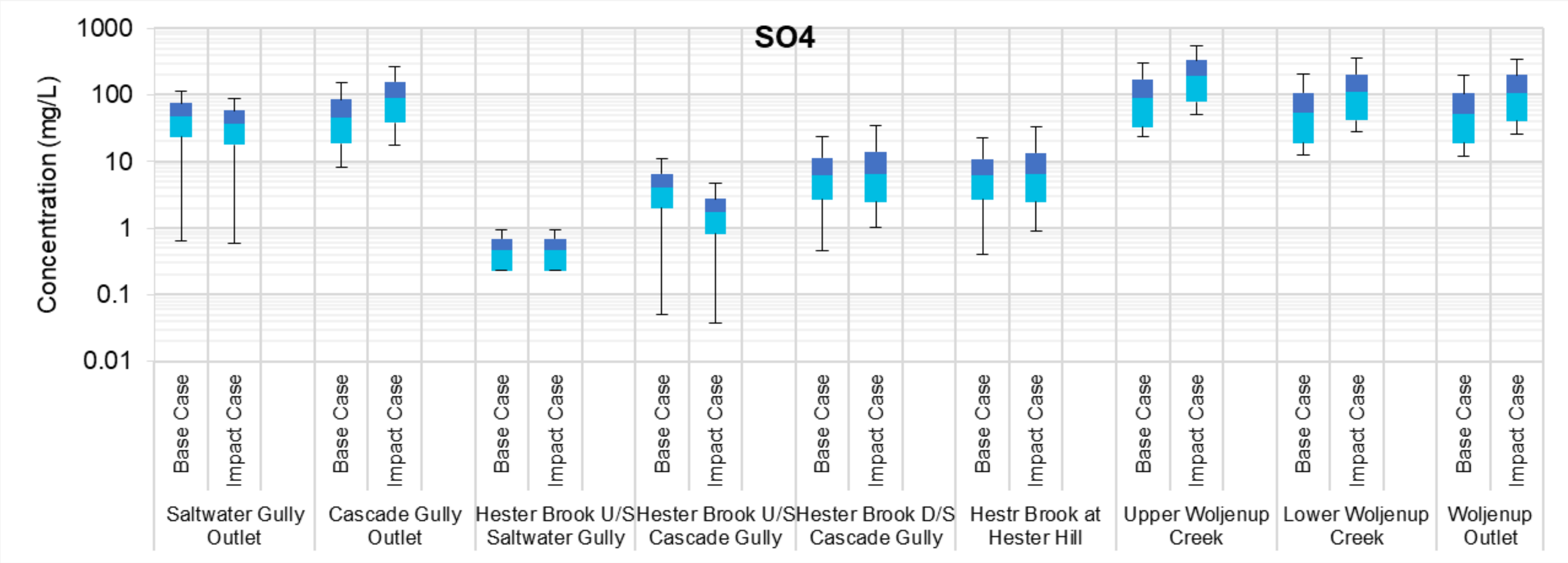


Figure 3.7: Ranges of Simulated Sulphate Concentrations (2025 to 2063)

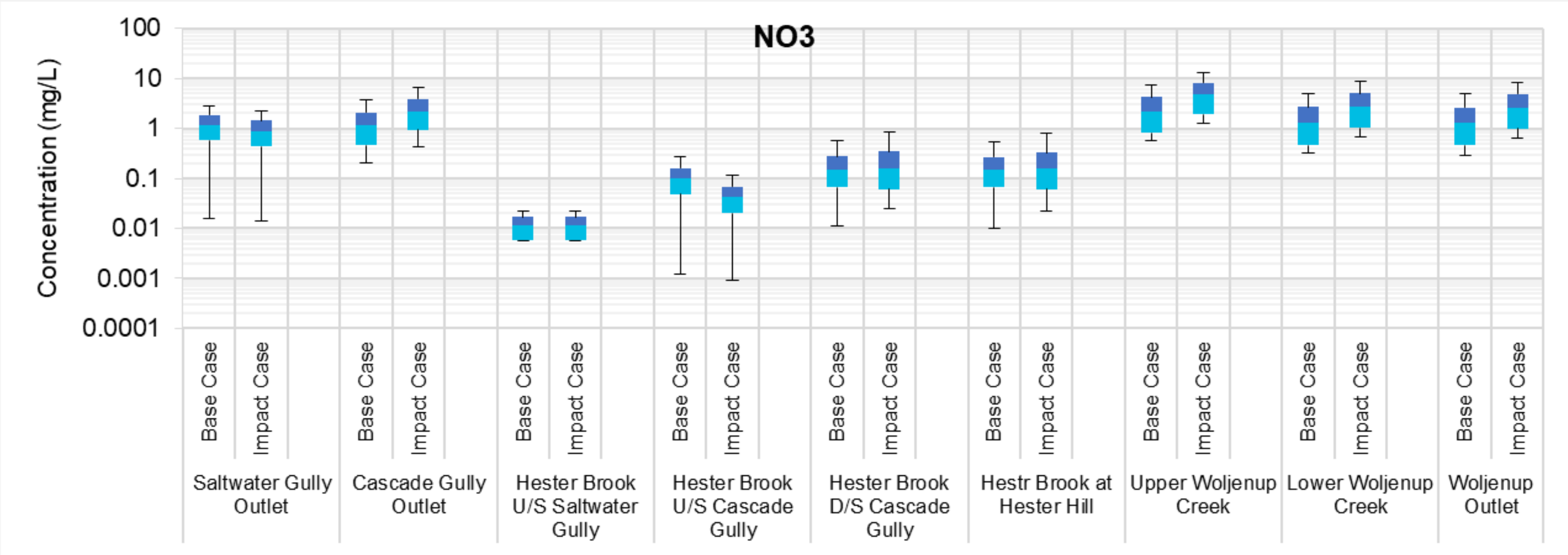


Figure 3.8: Ranges of Simulated Nitrate Concentrations (2025 to 2063)

Table 3.8: Comparative Summary of Simulation Results[17]

CoPC	WQG Exceedances for Given Exceedance Probability[18]		Change in Concentration from Base Case for Given Exceedance Probability		
	Base Case	Impact Case	5%	50%	95%
Salt Water Gully Outlet to Hester Brook					
Lithium	Exceeds drinking WQGs for all EPs	Exceeds drinking WQGs for all EPs	-25	-24	-17
Arsenic	Does not exceed any WQGs	Does not exceed any WQGs	-12	-11	10
Sulphate	Does not exceed any WQGs	Does not exceed any WQGs	-25	-24	-17
Nitrate	Does not exceed any WQGs	Does not exceed any WQGs	-25	-24	-17
Cascade Gully Outlet to Hester Brook					
Lithium	Exceeds drinking WQGs for all EPs	Exceeds drinking WQGs for all EPs	105	89	67
Arsenic	Does not exceed any WQGs	Does not exceed any WQGs	290	242	242
Sulphate	Does not exceed any WQGs	Does not exceed any WQGs	105	89	67
Nitrate	Does not exceed any WQGs	Does not exceed any WQGs	105	89	67
Hester Brook Upstream of Salt Water Gully Confluence					
Lithium	Does not exceed any WQGs	Does not exceed any WQGs	0	0	0
Arsenic	Does not exceed any WQGs	Does not exceed any WQGs	0	0	0
Sulphate	Does not exceed any WQGs	Does not exceed any WQGs	0	0	0
Nitrate	Does not exceed any WQGs	Does not exceed any WQGs	0	0	0
Hester Brook Upstream of Cascade Gully Confluence					
Lithium	Does not exceed any WQGs	Does not exceed any WQGs	-59	-58	-57
Arsenic	Does not exceed any WQGs	Does not exceed any WQGs	-59	-58	-56
Sulphate	Does not exceed any WQGs	Does not exceed any WQGs	-59	-58	-57
Nitrate	Does not exceed any WQGs	Does not exceed any WQGs	-59	-58	-57
Hester Brook Downstream of Cascade Gully Confluence					
Lithium	Exceeds drinking WQGs @ 80%	Exceeds drinking WQGs @ 80%	-25	19	64
Arsenic	Does not exceed any WQGs	Does not exceed any WQGs	-28	-15	34
Sulphate	Does not exceed any WQGs	Does not exceed any WQGs	-25	19	64

[17] Results from Hester Brook upstream of Salt Water Gully Confluence omitted since results do not change between Base Case and Impact Case
[18] EP = Exceedance Probabilities.

CoPC	WQG Exceedances for Given Exceedance Probability[18]		Change in Concentration from Base Case for Given Exceedance Probability		
	Base Case	Impact Case	5%	50%	95%
Nitrate	Does not exceed any WQGs	Does not exceed any WQGs	-25	19	64
Hester Brook at Hester Hill					
Lithium	Exceeds drinking WQGs @ 80%	Exceeds drinking WQGs @ 80%	-21	18	63
Arsenic	Does not exceed any WQGs	Does not exceed any WQGs	-24	-13	32
Sulphate	Does not exceed any WQGs	Does not exceed any WQGs	-21	18	63
Nitrate	Does not exceed any WQGs	Does not exceed any WQGs	-21	18	63
Upper Woljenup Creek					
Lithium	Exceeds drinking WQGs for all EPs Exceeds non-potable WQG @ 95%	Exceeds drinking WQGs for all EPs Exceeds non-potable WQG @ 50%	164	100	62
Arsenic	Does not exceed any WQGs	Does not exceed any WQGs	259	148	90
Sulphate	Does not exceed any WQGs	Does not exceed any WQGs	164	100	62
Nitrate	Exceeds aquatic environment WQG @ 95%	Exceeds aquatic environment WQG @ 50%	164	100	62
Middle Woljenup Creek					
Lithium	Exceeds drinking WQGs for all EPs	Exceeds drinking WQGs for all Eps Exceeds non-potable WQG @ 80%	130	97	60
Arsenic	Does not exceed any WQGs	Does not exceed any WQGs	132	105	72
Sulphate	Does not exceed any WQGs	Does not exceed any WQGs	130	97	60
Nitrate	Does not exceed any WQGs	Exceeds aquatic environment WQG @ 95%	130	97	60
Lower Woljenup Creek					
Lithium	Exceeds drinking WQGs for all EPs	Exceeds drinking WQGs for all Eps Exceeds non-potable WQG @ 95%	119	95	59
Arsenic	Does not exceed any WQGs	Does not exceed any WQGs	106	94	67
Sulphate	Does not exceed any WQGs	Does not exceed any WQGs	119	95	59
Nitrate	Does not exceed any WQGs	Exceeds aquatic environment WQG @ 95%	119	95	59

The simulated CoPC concentrations indicate the following:

- There is a reduction in concentration from base case to impact case in some of the catchments, including all the catchments feeding or within Hester Brook (this excludes the Woljenup Creek catchments).
- Woljenup Creek catchments experience the most consistent increase in concentrations of all CoPC (minimum 50% increase across all exceedance probabilities).
- Lithium concentrations in most of the mine impacted waterways exceed the drinking WQG (except for the undisturbed Hester Brook catchment upstream of the confluence with Salt Water Gully and the Hester Brook catchment upstream of the confluence with Cascade Gully). Lithium concentrations exceed the non-potable WQG low flow (95% EP) at Upper Woljenup Creek catchment for the base case and for median flow conditions for impact case, these exceedances reduce as it progresses through the other Woljenup Creek catchments (Middle and Lower).
- Arsenic concentrations do not exceed any WQGs for all the scenarios modelled.
- Sulphate concentrations do not exceed any WQGs for all the scenarios modelled.
- Nitrate concentrations at Upper Woljenup Creek exceed the aquatic environment WQG for low flows (95% EP) in the base case and for median flow conditions in the impact case, these exceedances reduce as it progresses through the other Woljenup Creek catchments (Middle and Lower).

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: CoPC 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 CoPC 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.

3.2.4 Conclusions from Water and Mass Balance

The water and mass balance modelling for the Base Case indicates that the discharges from the WRLs will result in an increase in CoPC concentrations discharging from Salt Water Gully into Hester Brook. At Hester Hill, the increase in CoPC concentrations is less significant given the dilution from the upstream non-disturbed catchment flows. The modelling of the Impact Case indicates that SWG Dam removes some of the CoPC loads generated from Floyds and S1 WRLs.

CoPC concentrations in Cascade Gully at the Hester Brook confluence increase significantly from the Base Case to the Impact Case as a result of the S1 and S2 WRLs, but the increase in concentrations reduce in the downstream reaches of Hester Brook as a result of dilution from the upstream non-disturbed catchment flows.

The largest increases in CoPC concentrations are noted in Woljenup Creek. A large portion of this catchment is not currently impacted by mining activities and the establishment of S7 WRL will drive these increases.

Concentrations of lithium are simulated to be above the drinking water guideline in Salt Water Gully and Cascade Gully all the time for both the Base and Impact Cases, but do not exceed this guideline in the reach of Hester Brook between Salt Water Gully and Cascade Gully for either Case. The 80^{th} percentile lithium concentrations exceed the drinking water guideline in the reaches of Hester Brook downstream of the Cascade Gully confluence and downstream of the Hester Hill gauging point for both the Base and Impact Cases.

Concentrations of lithium are above the drinking water guideline in all reaches of Woljenup Creek for both the Base and Impact Cases. The 95^{th} percentile lithium concentration exceeds the non-potable guideline in the Upper Woljenup Creek for the Base Case, and the 50^{th} percentile concentration exceeds this guideline for the Impact Case. The non-potable guideline is not exceeded in the Middle and Lower Woljenup Creek reaches for the Base Case, but the 80^{th} percentile concentration exceeds this guideline for the Impact Case.

Concentrations of arsenic and sulphate at all reporting locations are below all guidelines for both Base and Impact Cases.

Concentrations of nitrate in Hester Brook and its tributaries are below all guidelines for both Base and Impact Cases. The 95^{th} percentile nitrate concentration in the Upper Woljenup Creek exceeds the drinking water guideline for the Base Case, and the 50^{th} percentile concentration exceeds this guideline for the Impact Case. Nitrate concentrations in the Middle and Lower Woljenup Creek are below all guidelines for the Base Case, but the 95^{th} percentile concentration exceeds the drinking water guideline.

Streamflow discharging from Salt Water Gully to Hester Brook reduces by ~67% on average from the Base Case to Impact Case, reflecting the impact of SWG Dam. Streamflow discharging from Cascade Gully to Hester Brook reduces by ~13% on average from the Base Case to the Impact Case, reflecting the change in catchment area and runoff characteristics brought about by the S2 WRLs. 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, reflecting the impact of SWG Dam and change in catchment area and runoff characteristics brought about by the S2 WRL. Streamflow discharging from Woljenup Creek to the Blackwood River reduces by ~9% on average reflecting the change in catchment area and runoff characteristics brought about by S7 WRL.

4. Risk Assessment

4.1 Source-Pathway-Receptor Links

4.1.1 Sources

Detailed discussion on the sources of contamination is presented in **Section 2.1**. 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 CoPC derived from the assessment of the tailings decant and leaching which exceed the relevant guidelines (see **Table 2.4**) 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.[19]

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

4.1.2 Pathways

The site conceptual model reported by GHD (2024b) 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, S2 WRL and S7 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.

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

4.1.3 Receptors

The various groundwater and surface water receptors in the receiving environment are discussed by GHD (2024b). 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, Hester Brook, and Woljenup Creek, including the following beneficial uses:

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

4.1.4 Conclusions

The source-pathway-receptor linkage for waste rock leaching is summarised in **Table 4.1**. The following conclusions can be made with respect to risks posed by the tailings decant and leaching based on the summary in **Table 4.1** and the information presented throughout this report:

Table 4.1: Waste Rock Leach Source-Pathway-Receptor Scenarios and Linkage Assessment

Source CoPC in Waste Rock Leachate	Pathways for Wate Rock Impacted Seepage and Drainage[20]	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. – CoPC attenuated and largely retained in geological profile, within or close to the footprint of WRLs. – Discharge of groundwater impacted with elevated concentrations of CoPC may occur into downstream water courses where WRL is adjacent to a water course. **Surface Water Pathway:** – WRL leachate intersected at and within the pre-construction ground surface and discharges as base flow at toe of WRLs and flows into downstream water courses. – Runoff from surface of WRL impacted with elevated concentrations of CoPC discharges into downstream water courses.	**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 CoPC 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 courses. Progressive capping (catch and release cover) is unlikely to mitigate this exposure due to increased infiltrations. **Surface Water:** – Exposure scenario is complete, but progressive capping of the WRLs will limit this exposure. Drainage waters prior to capping may require management (construction buffers, seepage cutoff and treatment, etc.).

[20] 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.

4.2 Risk to Groundwater Receptors

The groundwater modelling results reported by GHD (2024d) and summarised in **Section 3.1** 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. The modelled changes in arsenic and lithium concentrations in layer 2 were assessed at three nominal sites (NE, SE, and SW). The modelling results indicated the following:

– The highest concentration of arsenic was 0.00052 mg/L at NE (east of the S2 WRL). The water use survey (refer to the Conceptual Site Model (GHD, 2024b)) indicates that water in this area used for stock watering (likely from soaks as there are no registered bores in this area). The WQG of which (0.5 mg/L) is well above the maximum modelled concentration at NE. The highest modelled concentration of arsenic at NE does not exceed the drinking water WQG (0.01 mg/L) or the non-potable WQG (0.2 mg/L).

– The highest modelled concentration of lithium (0.02465 mg/L) simulated at SE, where the water use survey indicates that there is no water use. The highest modelled concentration of lithium at SE exceeds the drinking water WQG (0.007 mg/L) but does not exceed the non-potable WQG (0.14 mg/L), irrigation WQG (0.1 mg/L) or non-potable WQG (0.2 mg/L).

– All concentrations of arsenic and lithium at all the point locations are only marginal increases from background levels of 0.0005 mg/L for Arsenic and 0.0246 mg/L for Lithium.

– Simulated contours of both arsenic and lithium concentrations in the groundwater reported by GHD (2024d) show that these CoPC do not migrate far from the source (e.g., S2 and S7 WRLs) and rapidly decrease in concentration away from the source.

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 CoPC (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 2.6**) 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 CoPC will also likely be limited to areas beneath and adjacent to the footprint of the WRLs.

4.3 Risk to Surface Water Receptors

4.3.1 Assessment Basis

The WBM simulated the flows and concentrations of arsenic, lithium, sulphate, and nitrate over the period from 2023 to 2063 at the reporting locations depicted in **Figure 3.4**. Assessment results are presented for the following model scenarios:

– **Base Case**: Existing site and operations, including the approved expansion of Floyds WRL (S1).

– **Impact Case**: Base Case plus the proposed pits and S2 and S7 WRLs.

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 4.2**. 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 4.2: 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 (50^{th}) 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.

4.3.2 Assessment of Key CoPC

The simulated 95^{th} percentile concentrations in the various locations are compared to the various WQGs and presented in **Table 4.3** and **Table 4.4** 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 for Hester Brook Upstream of Cascade Gully Confluence and Hester Brook Upstream of Salt Water Gully Confluence) and for all model scenarios exceed the drinking water WQGs. Lithium concentrations at Upper, Middle and Lower Woljenup Creek impact case and Upper Woljenup Creek base case exceed the non-potable WQG.
- Arsenic concentrations at all sites do not exceed any of the WQGs for any of the model scenarios.
- Sulphate concentrations at all sites do not exceed any of the WQGs for any of the model scenarios.
- Nitrate concentrations at Upper, Middle and Lower Woljenup Creek impact case and Upper Woljenup Creek base case exceed the aquatic environment WQG.

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

A summary of the risks associated with relevant water uses assessed based on the modelling results is provided in **Table 4.5** and further discussed below. The water uses correspond to the water use survey conducted by Talison (GHD, 2024b). Aquatic freshwater use is considered for all catchments.

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 medium risk due to the elevated concentrations of lithium.
- All other uses are indicated as very low risk.

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.

The assessed risks do not change from the Base Case to Impact Case, indicating that the existing impacts dominate in this catchment.

Table 4.3: Assessed Surface Water Risks - Lithium[21]

Location	95th Percentile Concentration (mg/L)		Guideline Value (mg/L)	Exceedance Factor	
	Base Case	Impact Case		Base Case	Impact Case
Drinking WQG					
Salt Water Gully Outlet to Hester Brook	0.045	0.037	0.007	6.475	5.347
Cascade Gully Outlet to Hester Brook	0.076	0.126		10.808	18.037
Hester Brook Upstream of Salt Water Gully Confluence	0.000	0.000		0.049	0.049
Hester Brook Upstream of Cascade Gully Confluence	0.005	0.002		0.661	0.283
Hester Brook Downstream of Cascade Gully Confluence	0.012	0.019		1.648	2.702
Hester Brook at Hester Hill	0.011	0.018		1.539	2.502
Upper Woljenup Creek	0.157	0.254		22.464	36.282
Middle Woljenup Creek	0.113	0.180		16.077	25.656
Lower Woljenup Creek	0.110	0.175		15.690	24.990
Non-potable WQG					
Salt Water Gully Outlet to Hester Brook	0.045	0.037	0.140	0.324	0.267
Cascade Gully Outlet to Hester Brook	0.076	0.126		0.540	0.902
Hester Brook Upstream of Salt Water Gully Confluence	0.000	0.000		0.002	0.002
Hester Brook Upstream of Cascade Gully Confluence	0.005	0.002		0.033	0.014
Hester Brook Downstream of Cascade Gully Confluence	0.012	0.019		0.082	0.135
Hester Brook at Hester Hill	0.011	0.018		0.077	0.125
Upper Woljenup Creek	0.157	0.254		1.123	1.814
Middle Woljenup Creek	0.113	0.180		0.804	1.283
Lower Woljenup Creek	0.110	0.175		0.784	1.250

21 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.

Table 4.4: Assessed Surface Water Risks - Nitrate

Location	95th Percentile Concentration (mg/L)		Guideline Value (mg/L)	Exceedance Factor	
	Base Case	Impact Case		Base Case	Impact Case
Freshwater Aquatic WQG					
Salt Water Gully Outlet to Hester Brook	0.756	0.624	2.400	0.315	0.260
Cascade Gully Outlet to Hester Brook	1.261	2.105		0.525	0.877
Hester Brook Upstream of Salt Water Gully Confluence	0.006	0.006		0.002	0.002
Hester Brook Upstream of Cascade Gully Confluence	0.077	0.033		0.032	0.014
Hester Brook Downstream of Cascade Gully Confluence	0.192	0.315		0.080	0.131
Hester Brook at Hester Hill	0.180	0.292		0.075	0.122
Upper Woljenup Creek	2.621	4.234		1.092	1.764
Middle Woljenup Creek	1.876	2.994		0.782	1.247
Lower Woljenup Creek	1.831	2.916		0.763	1.215

Table 4.5: Summary of Surface Water Risks

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

Water Use	Base Case		Impact Case	
Irrigation	Very Low	-	Very Low	-
Drinking	High	Lithium	High	Lithium
Non-potable domestic	Low	Lithium	Low	Lithium
Middle Woljenup Creek				
Freshwater aquatic	Very Low	-	Low	Nitrate
Stock water	Very Low	-	Very Low	-
Irrigation	Very Low	-	Very Low	-
Drinking	High	Lithium	High	Lithium
Non-potable domestic	Very Low		Low	Lithium
Lower Woljenup Creek				
Freshwater aquatic	Very Low	-	Low	Nitrate
Stock water	Very Low	-	Very Low	-
Irrigation	Very Low	-	Very Low	-
Drinking	High	Lithium	High	Lithium
Non-potable domestic	Very Low	-	Low	Lithium

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 follows:

– Although not an indicated use, drinking water use is assessed as being high risk due to the elevated concentrations of lithium.
– All other uses are indicated as very low risk.
– The assessed risks do not change from the Base Case to Impact Case, indicating that the existing impacts dominate in this catchment.

Hester Brook Upstream of Salt Water Gully Confluence

The Talison water use survey 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 very low risk for the Base Case and Impact Case.

Hester Brook Upstream 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 to be very low risk.

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

Hester Brook at Hester Hill

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 Hester Brook Downstream of Cascade Gully Confluence between the Salt Water Gully and Cascade Gully confluences. Irrigation use is assessed as being very low.

Upper Woljenup Creek

The Talison water use survey indicates non-potable domestic water use in the Upper Woljenup Creek 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.
- Freshwater aquatic use is assessed as being low risk due to elevated levels of nitrate.
- All other uses are indicated as very low risk.

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

Middle Woljenup Creek

The Talison water use survey indicates non-potable domestic and stock water use in the Middle Woljenup Creek 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.
- Freshwater aquatic use is assessed as being low risk due to elevated levels of nitrate.
- All other uses are indicated as very low risk.

The assessed risk level increase from the Base Case to Impact Case. The risk reduction measures outlined above also need to be considered in this regard.

Lower Woljenup Creek

The Talison water use survey indicates non-potable domestic and stock water use in the Lower Woljenup Creek 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.
- Freshwater aquatic use is assessed as being low risk due to elevated levels of nitrate.
- All other uses are indicated as very low risk.

The assessed risk level increase from the Base Case to Impact Case. The risk reduction measures outlined above also need to be considered in this regard.

4.3.3 Assessment of Other CoPC

Modelling of the fate and transport of the other CoPC from the initial list in **Section 2.3.3** (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 (**Table 2.5**) the assessments of these CoPC was based on factoring the simulated lithium concentrations as follows:

- The primary source of the CoPC 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 2.1**) downgradient of the existing WRLs. Details of the monitoring results are presented by GHD, and are summarised in **Table 4.6**.
- 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 Case.
- The estimated CoPC concentrations were compared with the WQGs with the assessed risk ratings of any exceedances following the approach detailed in **Table 4.2**, the outcomes of which are shown in **Table 4.6**.

The assessment of the other CoPC at the Hester Hill gauge indicates all of these are below the respective WQGs,

Table 4.6: Comparison of other CoPC 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 indicate WQGs exceeded (associated risks as defined in Table 4.2)				
			Base Case	Impact Case	Livestock	Irrigation	Freshwater Aquatic	Drinking Water	Non-potable use
Lithium	0.519314	1.000000	0.010774	0.017514	0.82	2.5	2	0.007	0.14
Antimony	0.000857	0.001651	0.000018	0.000029	0.15	NR	0.09	0.003	0.06
Cadmium	0.000110	0.000212	0.000002	0.000004	0.01	0.01	0.0003	0.002	0.04
Caesium	0.009714	0.018706	0.000202	0.000328	2	NR	0.5	0.07	1.4
Chromium (III+VI)	0.000243	0.000468	0.000005	0.000008	1	0.1	0.14 (as Cr III) 0.001(as Cr VI)	0.05 (as Cr III)	1
Copper	0.000643	0.001238	0.000013	0.000022	0.5	0.2	0.0014	2	40
Manganese	0.126471	0.243535	0.002624	0.004265	10	0.2	1.9	0.5	10
Molybdenum	<0.0001	0.000096	0.000001	0.000002	0.15	0.01	0.034	0.05	1
Nickel	0.012843	0.024730	0.000266	0.000433	1	0.2	0.05	0.02	0.4
Rubidium	0.055000	0.105909	0.001141	0.001855	0.26	NR	0.017	0.014	0.28
Thallium	0.000077	0.000149	0.000002	0.000003	0.13	NR	0.00003	0.00004	0.0008
Uranium	0.000428	0.000824	0.000009	0.000014	0.2	0.01	0.0005	0.017	0.34
Vanadium	0.000400	0.000770	0.000008	0.000013	0.1	0.1	0.0006	0.0002	0.004
Zinc	0.008357	0.016093	0.000173	0.000282	20	2	0.036	3	60

4.3.4 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 GHD, 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 key observations are discussed below.

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

Historical monitoring at SWG indicates that SWG 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.

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.

Table 4.7: Comparison of Historical Monitoring against WQGs

CoPC	Maximum Measured Concentration (mg/L)	WQG (mg/L) – Colour codes indicate WQGs exceeded by measured value (associated risks as defined in Table 4.2)				
		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

5. Summary and Conclusions

5.1 Summary

5.1.1 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, Hester Brook, and Woljenup Creek, and include drinking water, non-potable domestic water, irrigation water, stock water, and aquatic environment uses.

5.1.2 Identification of CoPC

The CoPC 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 CoPC identified in the review of the discharge monitoring data and the limited suites of analytes did not allow for any rationalisation of the CoPC.

5.1.3 Risks to Groundwater

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

– Base Case: Groundwater impacts of the mine site facilities as they currently exist plus the S1 WRL extension.

– Impact Case: Groundwater impacts of existing mine site facilities plus the proposed pits and S2 and S7 WRLs.

The groundwater modelling indicates the following:

– As this Study has included capping of the WRLs after closure at a staged approach. Many potential impacts to groundwater users have been mitigated. This indicated by the results from the point impacts as all concentrations of arsenic and lithium at all the point locations are only marginal increases from background levels of 0.0005 mg/L for Arsenic and 0.0246 mg/L for Lithium and that the discharges to creeks in the surrounding surface water catchments also only have a marginal increase of median loads or arsenic and lithium.

– Arsenic and lithium plumes from the existing and proposed WRLs and TSFs are generally constrained close to or within the TSF or WRL footprints.

– 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 very low.

- Modelling was not undertaken for the other CoPC, 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.

5.1.4 Risks to Surface Water

The WBM simulates the hydrology of Hester Brook and Woljenup Creek (including tributaries) for the Base Case and Impact Case scenarios listed above. The WBM modelling indicates the following:

- There is a reduction in concentration from base case to impact case in some of the catchments, including all the catchments feeding or within Hester Brook (this excludes the Woljenup Creek catchments).
- Woljenup Creek catchments experience the most consistent increase in concentrations of all CoPCs (minimum 50% increase across all exceedance probabilities.
- Lithium concentrations in most of the mine impacted waterways exceed the drinking WQG (except for the undisturbed Hester Brook catchment upstream of the confluence with Salt Water Gully and the Hester Brook catchment upstream of the confluence with Cascade Gully). Lithium concentrations exceed the non-potable WQG low flow (95% EP) at Upper Woljenup Creek catchment for the base case and for median flow conditions for impact case, these exceedances reduce as it progresses through the other Woljenup Creek catchments (Middle and Lower).
- Arsenic concentrations do not exceed any WQGs for all the scenarios modelled.
- Sulphate concentrations do not exceed any WQGs for all the scenarios modelled.
- Nitrate concentrations at Upper Woljenup Creek exceed the aquatic environment WQG for low flows (95% EP) in the base case and for median flow conditions in the impact case, these exceedances reduce as it progresses through the other Woljenup Creek catchments (Middle and Lower).
- Streamflow discharging from Salt Water Gully to Hester Brook reduces by ~67% on average from the Base Case to Impact Case, reflecting the impact of SWG Dam. Streamflow discharging from Cascade Gully to Hester Brook reduces by ~13% on average from the Base Case to the Impact Case, reflecting the change in catchment area and runoff characteristics brought about by the S2 WRLs.
- 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, reflecting the impact of SWG Dam and change in catchment area and runoff characteristics brought about by the S2 WRL. Streamflow discharging from Woljenup Creek to the Blackwood River reduces by ~9% on average reflecting the change in catchment area and runoff characteristics brought about by S7 WRL.
- The simulated 95th percentile concentrations of the key CoPC 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 in most of the mine impacted waterways exceed the drinking WQG (except for the undisturbed Hester Brook catchment upstream of the confluence with Salt Water Gully and the Hester Brook catchment upstream of the confluence with Cascade Gully). Lithium concentrations exceed the non-potable WQG low flow (95% EP) at Upper Woljenup Creek catchment for the base case and for median flow conditions for impact case, these exceedances reduce as it progresses through the other Woljenup Creek catchments (Middle and Lower).
  - Arsenic concentrations do not exceed any WQGs for all the scenarios modelled.
  - Sulphate concentrations do not exceed any WQGs for all the scenarios modelled.
  - Nitrate concentrations at Upper Woljenup Creek exceed the aquatic environment WQG for low flows (95% EP) in the base case and for median flow conditions in the impact case, these exceedances reduce as it progresses through the other Woljenup Creek catchments (Middle and Lower).
  - 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 medium risk due to the elevated concentrations of lithium.
    - All other uses are indicated as very low risk.
  - Cascade Gully Outlet to Hester Brook: 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.
- All other uses are indicated as very low risk.
- The assessed risks do not change from the Base Case to Impact Case, indicating that the existing impacts dominate in this catchment.

- Hester Brook upstream 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 to be very low risk.
- 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 Hester Brook Downstream of Cascade Gully Confluence 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 CoPC was not undertaken, and the assessments of these CoPC was based on factoring the 95th percentile simulated lithium concentrations in Hester Brook at the Hester Hill gauging point against the average measured concentrations at the existing discharge locations. The assessment of the other CoPC at the Hester Hill gauge indicates all of these are below the respective WQGs.
- 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 all reported to be below the WQGs, except for lithium which exceeds the drinking water WQG and is assessed as medium risk.
  - 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.

5.2 Conclusions

5.2.1 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 CoPC emanating from the naturally occurring mineralised zones down gradient of these WRLs and from historical mining activities in Salt Water Gully would be more complex given the diffuse nature of these sources.

5.2.2 S2 and S7 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 S2 and S7 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 S2 and S7 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 CoPC based on the kinetic leach testing currently underway.

6. References

Barnett, B., Townley, L. R., Evans, R. E., Hunt, R. J., Peeters, L., Richardson, S., . . . Boronkay, A. (2012). *Australian Groundwater Modelling Guidelines.* Canberra: National Water Commission.

DWER. (2021). *Assessment and management of contaminated sites.*

GHD. (2018). *Hydrogeological Investigation 2018 - Site-Wide Hydrogeological Report. Prepared for Talison Lithium Pty Ltd, January 2019 Ref 6136959.* Perth: GHD Pty Ltd.

GHD. (2019). *Talison Leaching Study: Stage 2 AMD Testing Results. Report prepared for Talison Lithium Australia Pty Ltd, Ref 6136960.*

GHD. (2020). *Greenbushes Lithium Mine - Dewatering Update and Pitlake Assessment.* Perth: GHD Pty Ltd.

GHD. (2022). *Talison - Greenbushes Lithium Mine, Waste rock landform leaching risk assessment, prepared for Talison Lithium Pyt Ltd, May 2022, Ref. 12536556.*

GHD. (2023f). *TSF1 Seepage Risk Assessment: Human Health and Environment Risk Assessment. Report prepared for Talison Lithium Pty Ltd. September 2023. Ref 12575610.*

GHD. (2023g). *TSF4 Seepage Assessment : Groundwater Model Update and Site Assessment. Report for Talison Lithium Pty Ltd . January 2023. Ref 12575610.* Perth: GHD Pty Ltd.

GHD. (2023h). *TSF4 Seepage Assessment: Conceptual Hydrogeological Model. Final report prepared for Talison Lithium Pty Ltd. February 2023 Ref 12575610.* Perth: GHD Pty Ltd.

GHD. (2023i). *TSF4 Seepage Assessment: Sub-surface Clays Attenuation Capacity Testing. Final report prepared for Talison Lithium Pty Ltd. February 2023. Ref 12575610.*

GHD. (2023j). *TSF4 Seepage Assessment: Short Term Tailings Leach Testing Results. Technical Memorandum Prepared for Talison Lithium Pty Ltd, February 2023, Ref 12575610.*

GHD. (2023k). *TSF4 Seepage Assessment: Kinetic Leach Testing of Waste Rock and Tailings. Report for Taison Lithium Pty Ltd. Octoiber 2023. Ref. 12582346.*

GHD. (2023l). *TSF4 Seepage Assessment : Risk Assessment. Report for Talison Lithium Pty Ltd . October 2023. Ref 12575610.*

GHD. (2023m). *TSF4 Seepage Assessment: Site-Specific Water Quality Guidelines, Report prepared for Talison Lithium Pty Ltd, March 2023, Ref 12575610.*

GHD. (2024a). *S2 and S7 WRLs Hydrological Study: Gap Analysis. Draft report prepared for Talison Lithium Pty Ltd. June 2024. Ref 12604929.*

GHD. (2024b). *S2 and S7 WRLs Hydrological Study: Conceptual Site Model. Dratf report prepared for Talison Lithium Pty Ltd. April 2024. Ref 12604929.*

GHD. (2024c). *S2 and S7 WRLs Hydrological Study: Monitoring Plan. Report to be prepared for Talison Lithium Pty Ltd. Undated. Ref 12604929.*

GHD. (2024d). *S2 and S7 WRLs Hydrological Study: Groundwater Modelling. Draft report prepared for Talison Lithium Pty Ltd. August 2024. Ref 12604929.*

GHD. (2024e). *S2 and S7 Waste Rock Landforms Hydrology Study Water and Mass Balance Modelling Report.*

SLR. (2022). *Saltwater Gully New Water Storage Aquatic Ecological Assessment.*

University of Western Australia. (2019). *2019 Ecological Assessment Study for Cowan and Norilup Brook at the Talison Lithium Mine, Greenbushes, Western Australia. Report prepared for Talison Lithium Pty Ltd.*

USGS. (1992). *Study and Interpretation of the Chemical Characteristics of Natural Water.* Washington D.C : U.S Governmnet Prinitng Office .

ghd.com

→ The Power of Commitment