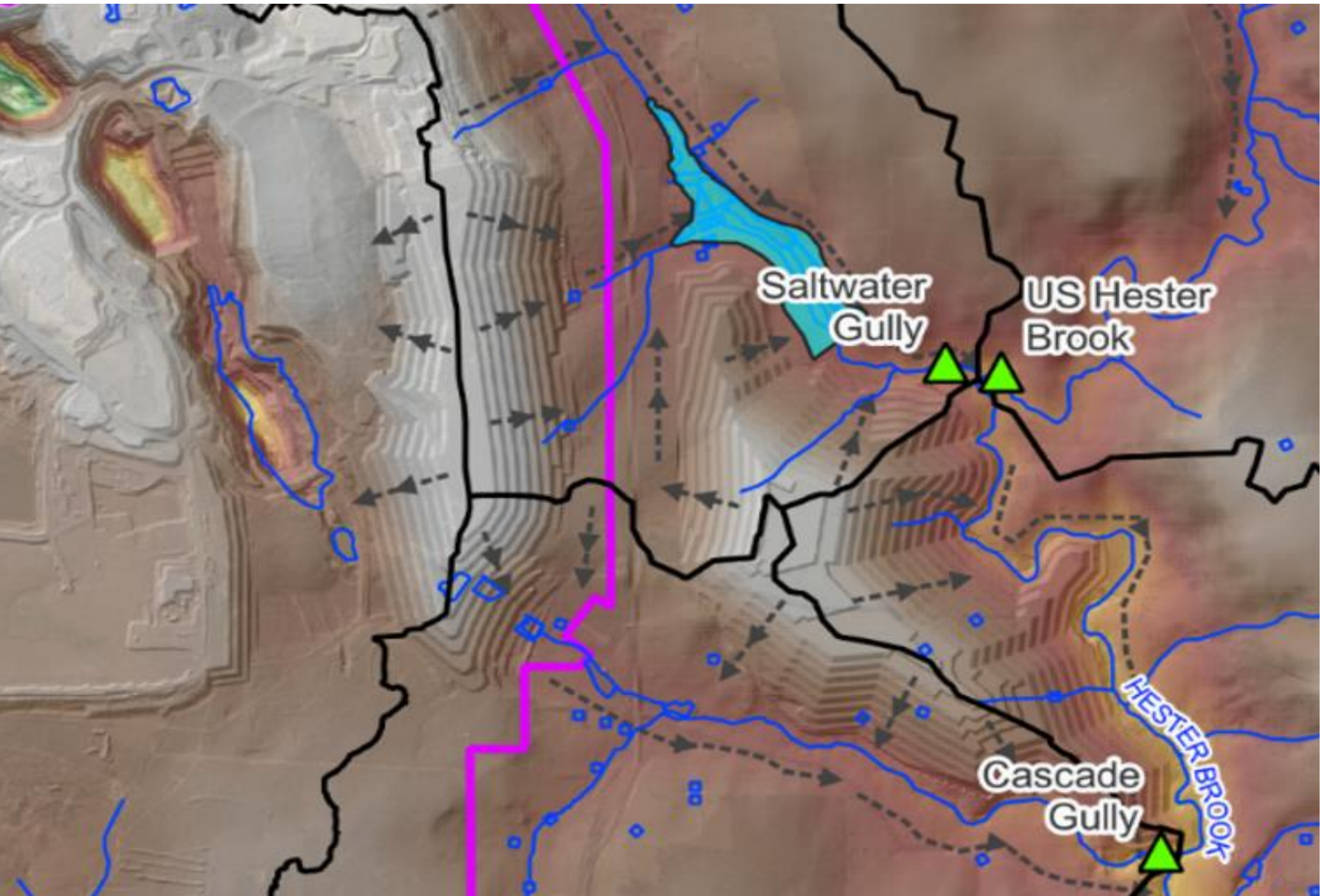
Eastern Catchments Hydrology Study

Water and Mass Balance Modelling

Talison Lithium Pty Ltd

28 November 2023

→ **The Power of Commitment**



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The Power of Commitment

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1. Introduction

1.1 Background

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

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

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

The purpose of the Study is to complete a baseline investigation and preliminary risk assessment of the Eastern Catchments to understand the veracity of existing management and monitoring for approved activities and the above additional proposed activities. The Study is also intended inform the need for management measures for incorporation into the proposed facility designs as well as to guide the development of a future management plan for possible adverse impacts. In doing so, the Study will inform the environmental approvals application.

The Study deliverables are:

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

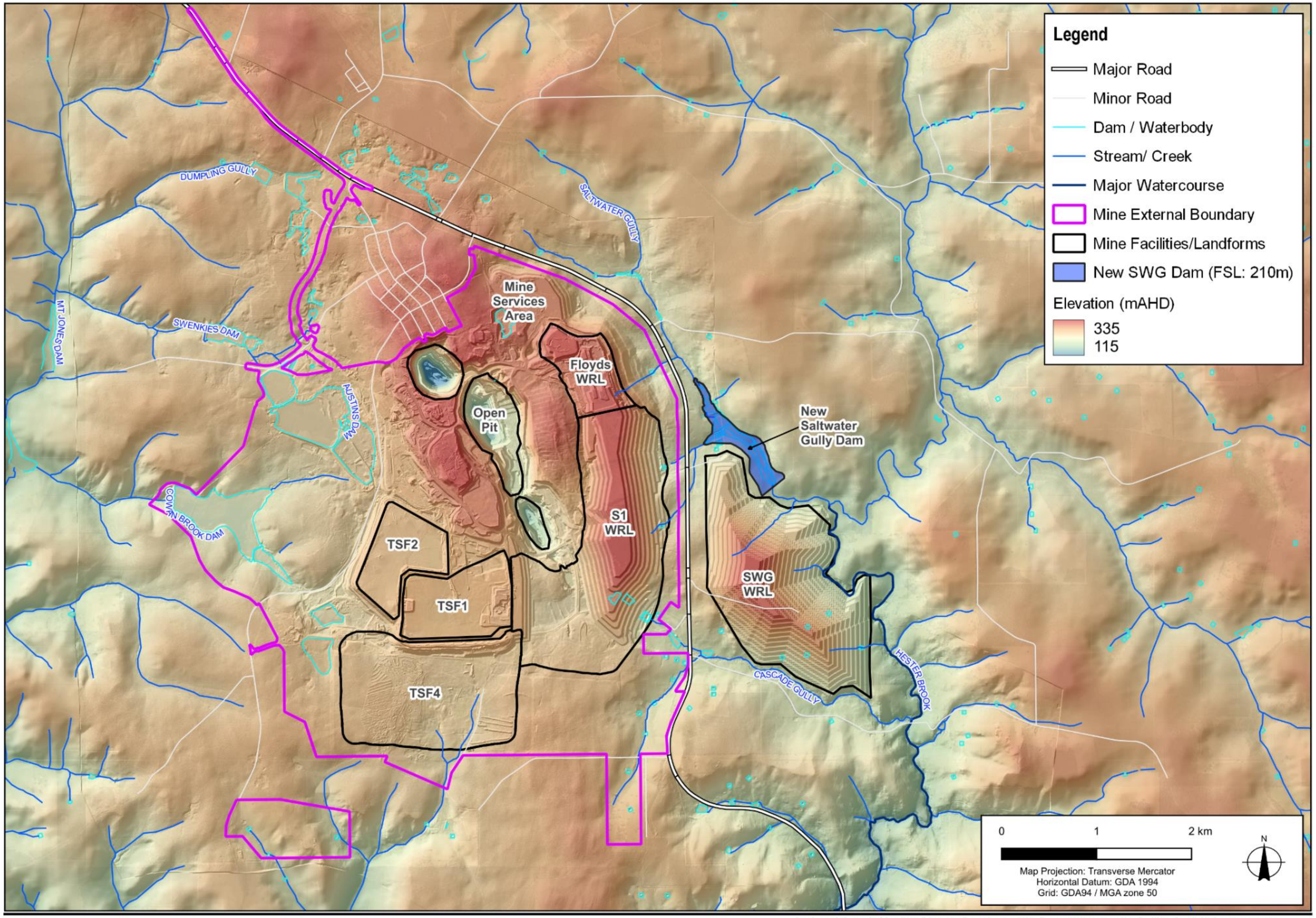
This report documents the water and mass balance modelling of key Contaminants of Potential Concern (CoPCs) emanating from the proposed new facilities within the surface water. The model was configured to simulate the water and mass balance of four key CoPCs (lithium, arsenic, sulphate, and nitrate) for the new SWG Dam and the surface water flows throughout the Hester Brook catchment.

1.2 Study Area

The surface water model domain encompasses the construction footprints of TSF1, the proposed SWG WRL and SWG Dam , the upstream contributing catchment areas and the downstream receiving environment. This includes Hester Brook and its tributaries up to the confluence with Blackwood River. A plan of the surface water model domain is provided in **Figure 1.2**.

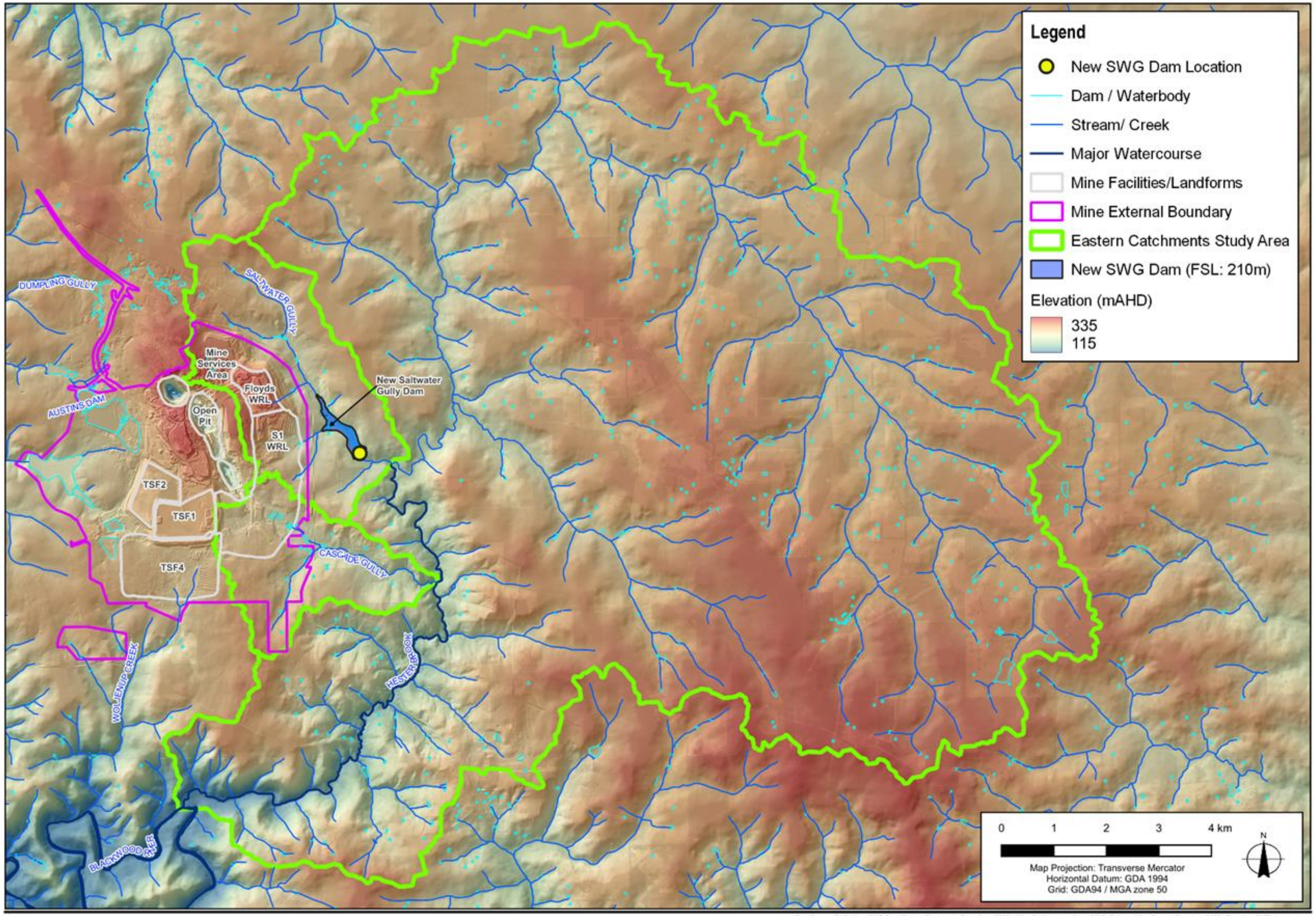
1.3 Purpose of this Report

The purpose of this report is to document and interpret the results of the water and mass balance modelling to forecast the potential flows and range in CoPC concentrations in the receiving environment under a base case and impact scenarios (i.e., includes SWG dam, SWG WRL and re-use of TSF1). The modelling results will be used to inform the subsequent preliminary risk assessment investigating the relative impacts of the proposed facilities on the receiving environment, during operation and post-closure.



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

Figure 1.1: Plan of the Proposed Facilities



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

Figure 1.2: Surface Water Model Domain

1.4 Scope and Limitations

1.4.1 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 in this report (refer **Section 1.5** of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

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.

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.

1.4.2 Model Limitations

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

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

The information, data, and assumptions ("Inputs") 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 in the Report 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 Assumptions and Limitations

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

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

2. Model Set-up

2.1 Overview

The Water Balance Model (WBM) was developed using GoldSim, which is a probabilistic simulation software package for modelling and visualisation of dynamic and complex systems. The WBM involves dynamic simulation of the water balance in SWG Dam, including all inflow and outflow streams, relevant hydrological processes and operational rules and logic. The hydrological processes in the Hester Brook catchment are also modelled.

In addition to the water balance, the WBM also performs a mass balance of the key CoPCs, namely arsenic and lithium. These metals are representative of strongly and weakly attenuated CoPCs, the adsorption characteristics of which can be used to reliably infer the distribution of other CoPCs. The mass balance assumes that the CoPCs are conservative substances that do not decay over time or react with the other substances (i.e., only subject to concentration or dilution). All water storages are assumed to be well mixed and always contain a homogenous mixture (i.e., stratification not considered).

The WBM does not interact with the site wide WBM of Talison's Mine Water Circuit previously developed by GHD (GHD, 2023f), although it has been built to enable easier inclusion in the future.

2.2 Model Configuration

The WBM simulates the hydrology of Hester Brook (including tributaries) and SWG dam for the following two scenarios:

– **Base Case**: Existing site and operations, including the approved expansion of Floyds WRL.
– **Impact Case**: Base Case plus the proposed SWG WRL and SWG Dam[1].

The establishment of the new WRLs (approved Floyds WRL expansion and proposed SWG) will alter the catchment areas and consequently flows discharging off the site. Accordingly, the WBM is configured to simulate the streamflow from the various sub-catchments that were delineated from the natural topography and proposed landforms (i.e., the various WRLs), the extents of which are depicted in **Figure 2.1**.

Runoff from each sub-catchment is simulated using the Australian Water Balance Model (AWBM), which is a module in GoldSim and which is the same rainfall-runoff model adopted in previous water balance work undertaken by GHD for Talison (GHD, 2023f). Sub-catchment runoff is routed downstream by simple addition of flows as indicated in the schematic diagrams provided in **Figure 2.2**. The surface water flow paths for the Base Case and Impact Case Scenarios are shown in **Figure 2.3** along with the model reporting locations.

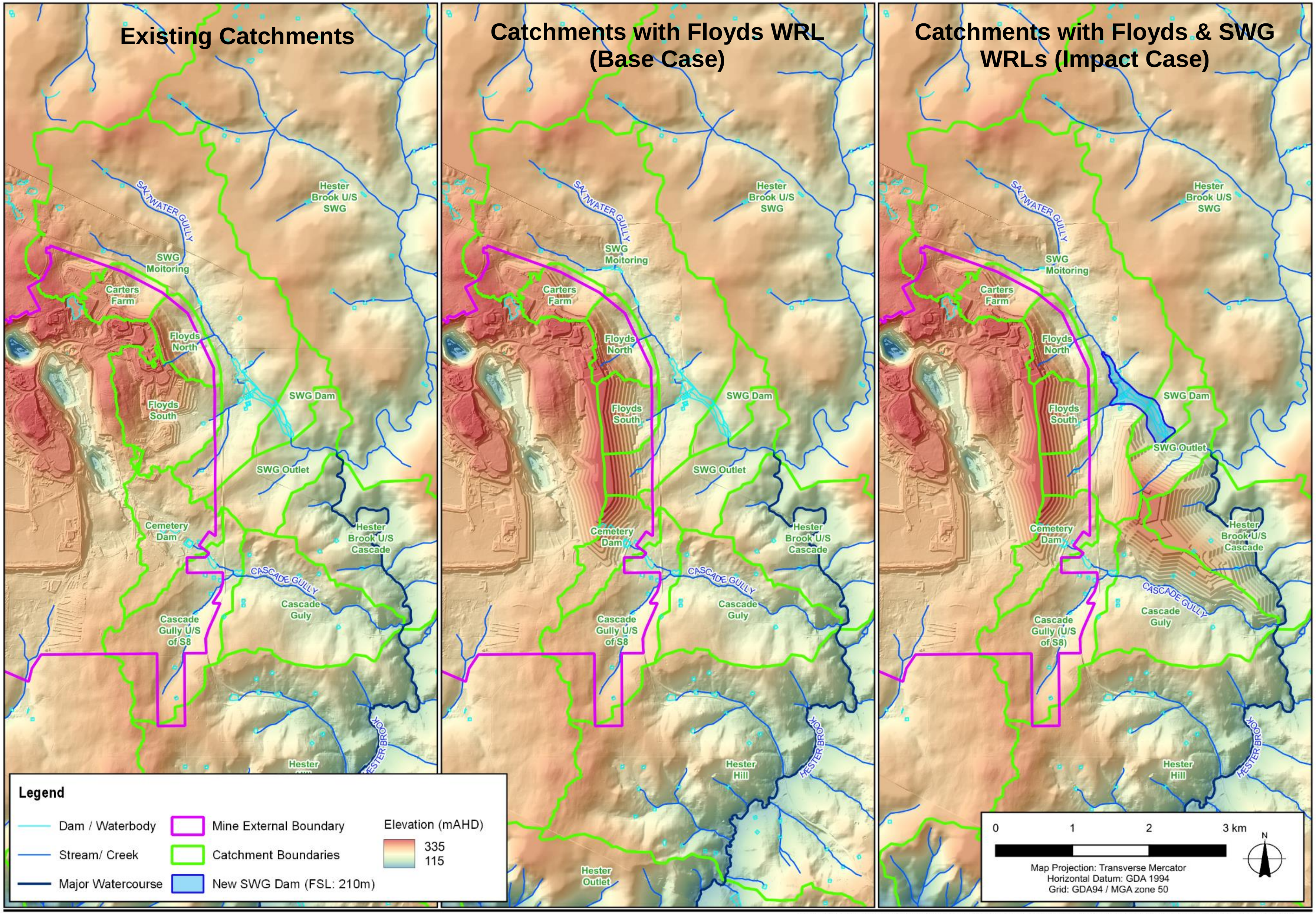
The AWBM simulates both surface runoff and baseflow as detailed in **Figure 2.4**. The CoPC loads in the groundwater discharge to surface water were determined by groundwater modelling (GHD, 2023d) and are simulated as inputs to the WBM. The CoPC loads are converted to concentrations using the baseflows simulated by the AWBM model.

SWG Dam is configured in the WBM (Impact Scenario only), the water balance of which is simulated as follows:

– Incidental rainfall over the full dam area.
– Evaporative losses over the dam water surface area.
– Catchment runoff from the contributing catchment area.
– Seepage losses over the dam water surface area.
– Outflows (i.e., passing flows and transfers).
– Overflows of stored water exceeding the spillway level.

The WBM operates at a daily time step performing a water balance at the dam and sub-catchments.

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



Data Source: GHD - New SWG Dam (2023). Talison - Mine External Boundary (2022), Elevation (2022-23). Landgate - Dam / Waterbody, Major Watercourse, Minor Watercourse, Stream / Creek (2020), Elevation (2020). WA Landgate SLIP - Background Aerial Imagery.

Figure 2.1: Change in Catchment Areas due to WRL Expansion

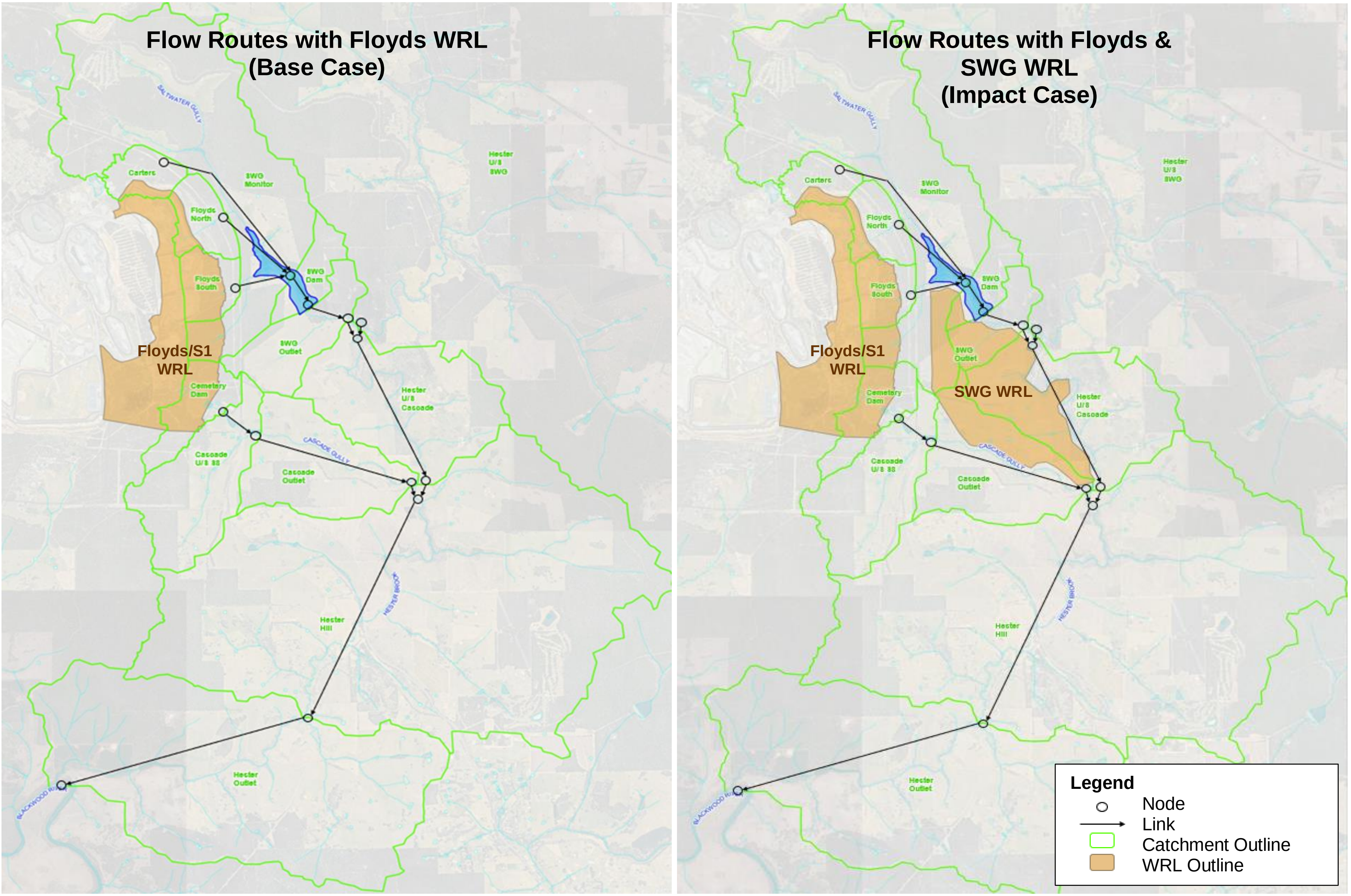


Figure 2.2: Schematic Configuration of Streamflow Routes

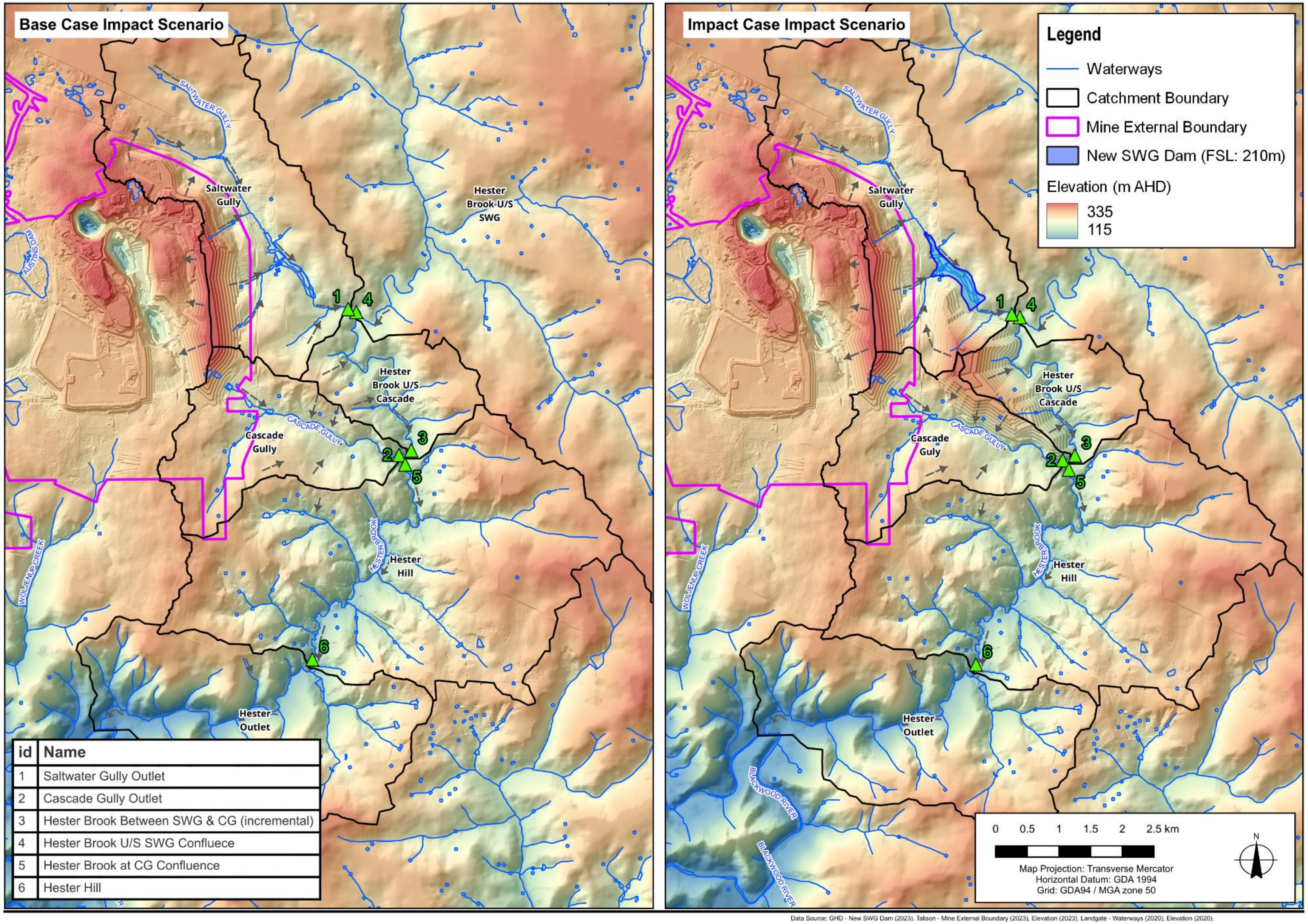


Figure 2.3: Surface Water Flow Paths and Model Reporting Locations

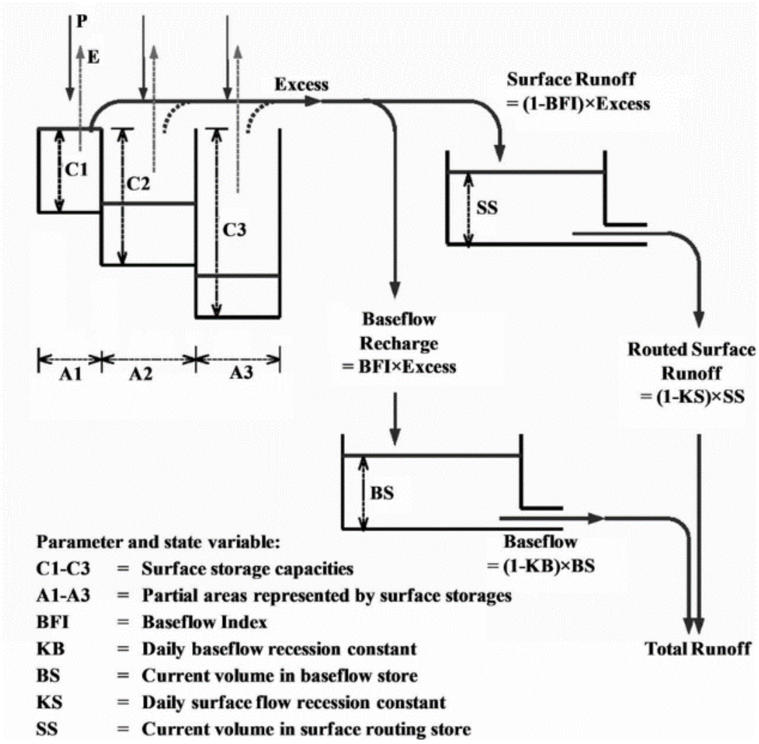


Figure 2.4: Schematic Configuration of AWBM (Boughton, 2004)

2.3 Climate

Historical climate data, including both rainfall and evaporation, was sourced from the Scientific Information for Land Owners (SILO)[2] database (Queensland Department of Environment and Science and Bureau of Meteorology, 2022). Historical daily rainfall and Morton shallow lake evaporation[3] data, which are inputs to the WBM, were extracted for the nearest weather station (Greenbushes - 9552). Evapotranspiration data were sourced from the Bureau of Meteorology (2022)[4]. The annual averages of these climate variables are presented in **Figure 2.5**.

The drying climate at the site is noted by the declining slope of the linear trend depicted in **Figure 2.5**. Whilst future climate scenarios sit outside the agreed scope of work, the following is noted:

- Future climate scenarios cannot account for the effects of future land use changes, which could offset the effects of climate change (e.g., cleared areas could generate higher runoff despite less rainfall).
- The water quality values adopted in the modelling are based on historical data, which already shows elevated CoPC concentrations. Whilst a reduction in rainfall and discharges may elevate the CoPC concentrations, the assessment results demonstrate if the concept will satisfy regulatory requirements under the "best of scenarios".
- Future climate scenarios were assessed in the *Hydrological Assessment of Woljenup Creek* as part of the TSF4 Seepage Assessment (GHD, 2023g), whereby the climate sequences used in the water balance simulations adopted those from the Bureau of Meteorology (2022). The projections were provided for the sixteen future climate sequences for two Representative Concentration Pathways (RCP), namely RCP 4.5 and RCP 8.5. The simulated discharge results for the RCP 4.5 scenario (the moderate pathway) displayed a relatively flat long-term trend over the simulation period.

[2] SILO is a database of Australian climate data from 1889 to the present, hosted by the Queensland Department of Environment and Science (DES) constructed from observational data obtained from BoM and other suppliers.
[3] Morton shallow lake evaporation was used to simulated evaporation SWG Dam.
[4] https://geonetwork.nci.org.au/geonetwork/srv/eng/catalog.search#/metadata/f6683_9441_8676_1139

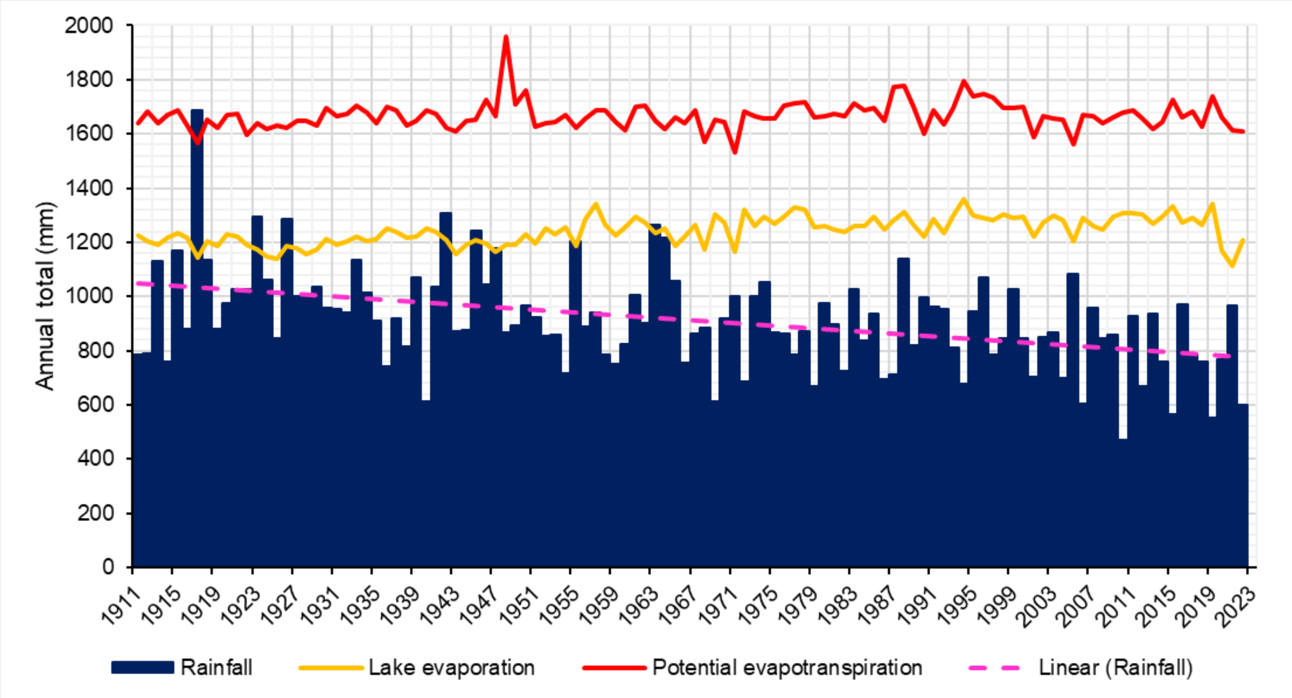


Figure 2.5: Annual Climate Variables

2.4 Catchment Runoff

2.4.1 Catchment Areas

Catchments of the key areas draining the mine site were delineated for the Base Case and Impact Case scenarios using the following information:

– 2 m LiDAR data over the mine site dated May 2022.
– 5 m contour data from Landgate (2020).
– Design surfaces of Floyds and SWG WRL's provided by Talison.

The resulting catchment areas are shown in **Figure 2.1** and described in **Table 2.1**.

Table 2.1: Catchment Areas (ha)

Scenario	Land Use	Saltwater Gully Dam	Saltwater Gully (Total)	Cascade Gully	Hester Brook (Total)
Existing	Mine affected	180	180	41	220
	External catchment[5]	933	1,072	603	18,296
	Total	**1,112**	**1,252**	**643**	**18,517**
Base Case	Mine affected	190	190	40	230
	External catchment	846	986	555	18,164
	Total	**1,036**	**1,176**	**595**	**18,394**
Impact Case	Mine affected	239	279	123	539
	External catchment	833	876	497	17,855
	Total	**1,073**	**1,155**	**620**	**18,394**

5 External catchment refers to natural vegetation, forested and cleared for agricultural

It is noted that the catchment area for Saltwater Gully Dam is ~109 ha larger in this study compared to the *Future Water Storage Options Report* (GHD, 2021). This is due to the expansion of the Floyds WRL that has occurred since 2021 and the location of the dam embankment being moved downstream.

2.4.2 AWBM Calibration

AWBM parameters (see **Figure 2.4**) were determined for the two primary land uses within the Study Area, namely 'mine affected' and 'external catchment'. The mine affected catchment comprises the mine services area and WRLs. The latter constitutes natural vegetation, forested and areas cleared for agricultural purposes. The parameters were determined via calibration based on the following:

– **Mine affected:** Calibrated using continuous streamflow gauging data at three of the licensed discharge points along the eastern boundary of the mine site (Floyds North, Floyds South, and Carters Farm as shown in **Figure 2.6**). The discharge was calculated for the disturbed portions of the catchments only. There are only five years of overlapping data for these three locations from April 2018 to April 2023.

– **External catchment:** Calibrated using the streamflow records collected at the gauging site of Hester Hill (Site Ref: 609016, see **Figure 2.6**), which was in operation for 22 years from March 1983 to July 2005.

The adopted parameters are provided in **Table 2.2**.

Table 2.2: AWBM Calibration Parameters

AWBM parameter	Mine affected	External catchment[16]
Partial areas A_1 / A_2 / A_3	0.380 / 0.180 / 0.440	0.141 / 0.394 / 0.466
Surface store capacities C_1 / C_2 / C_3 (mm)	45.00 / 155.00 / 320.00	6.19 / 188.27 / 475.60
Baseflow index BFI	0.200	0.558
Baseflow recession constant K_b	0.220	0.964
Surface flow recession constant K_s	0.990	0.489

It is acknowledged that adoption of the above parameters may not be entirely valid, due to the following reasons:

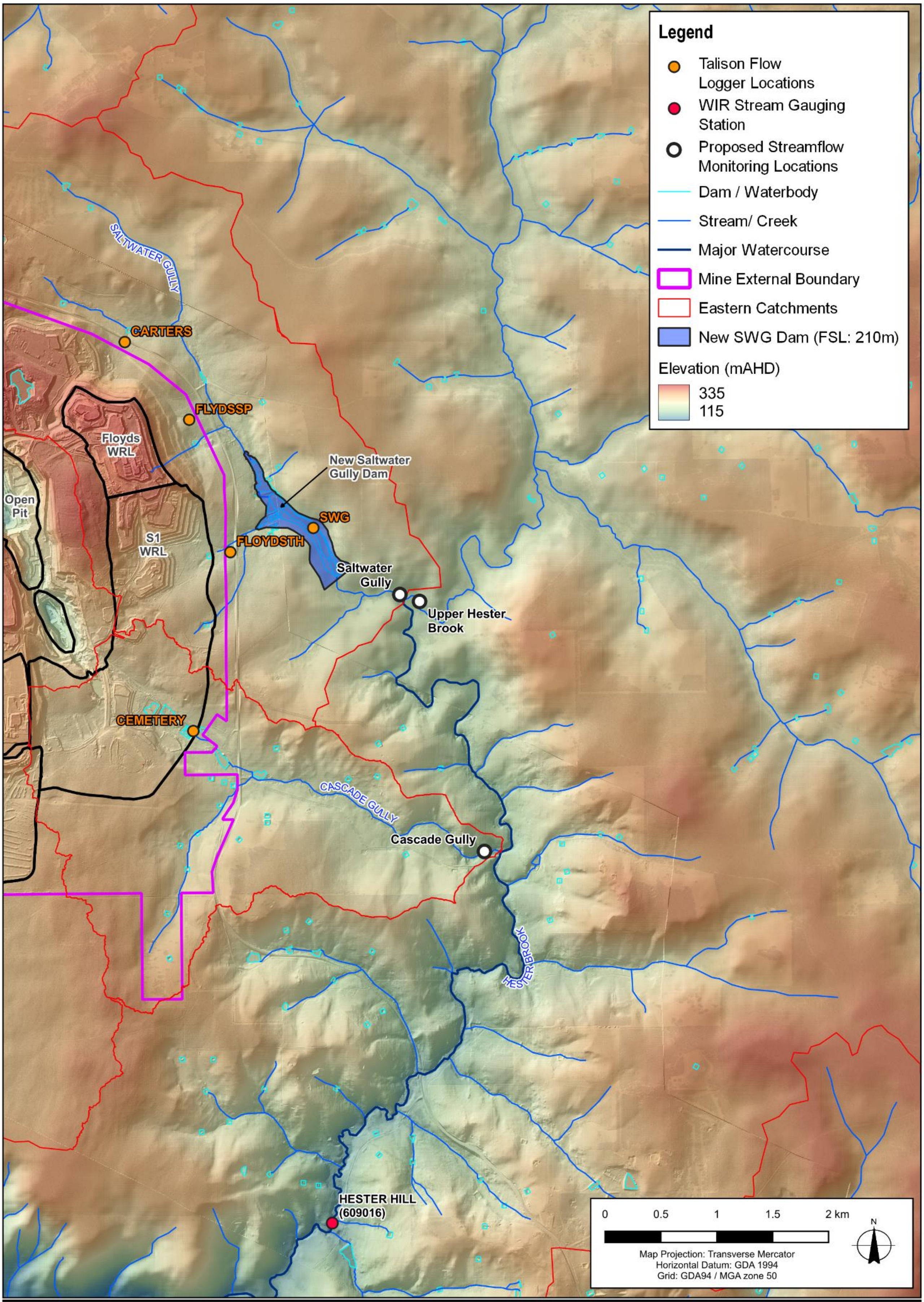
– Changes in land use that have occurred since the Hester Hill streamflow records ceased (2005). There is no available information pertaining to the state of land use when stream gauging was in operation.

– The expansion of Floyds WRL footprint between 2018 and 2023, which impacts the disturbed area catchment reporting to Floyds South gauge. Consequently, the calibration was undertaken over a period when the catchment was less disturbed.

– Construction of two sediment basins at the base of the Mine Services Area (MSA), which appear to have been constructed in mid-2022 based on survey data. The eastern sediment basin sits in the catchment reporting to Carters Farm, however, there is no obvious change to the gauged flows during or post 2022 and therefore the catchment area was not reduced on account of the sediment basin.

Nevertheless, in the absence of any other site-specific information, adoption of these parameters is the best available approach for the purposes of this assessment. This approach is also considered conservative (i.e., result in lower discharges) since calibration was undertaken over a period when the external catchment was more forested and had less clearing and when the mine affected catchment had less WRL areas then currently exists.

[6] External catchment refers to natural vegetation, forested and cleared for agricultural



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

Figure 2.6: Surface Water Flow Gauging Locations and Model Reporting Locations

The adopted parameters differ slightly from the parameters used in the *Future Water Storage Options Report* (GHD, 2021) owing to the following:

– Classification and grouping of land use types, noting that this study grouped the external catchment into a single land use comprising natural vegetation, forests and areas cleared for agriculture.
– External catchment parameters in this study are based on 22 years of streamflow data in the Hester Brook catchment. The previous study used a single year (2020) of streamflow data in Saltwater Gully.
– The previous study did not derive parameters specific to the WRLs, where there is an increase in water storage holding capacity, which is released as baseflow throughout the year.

Figure 2.7 compares the measured discharge for the disturbed catchment portion against values simulated using the calibrated parameters. **Figure 2.8** provides a similar comparison for the measured discharge at the Hester Hill gauging station.

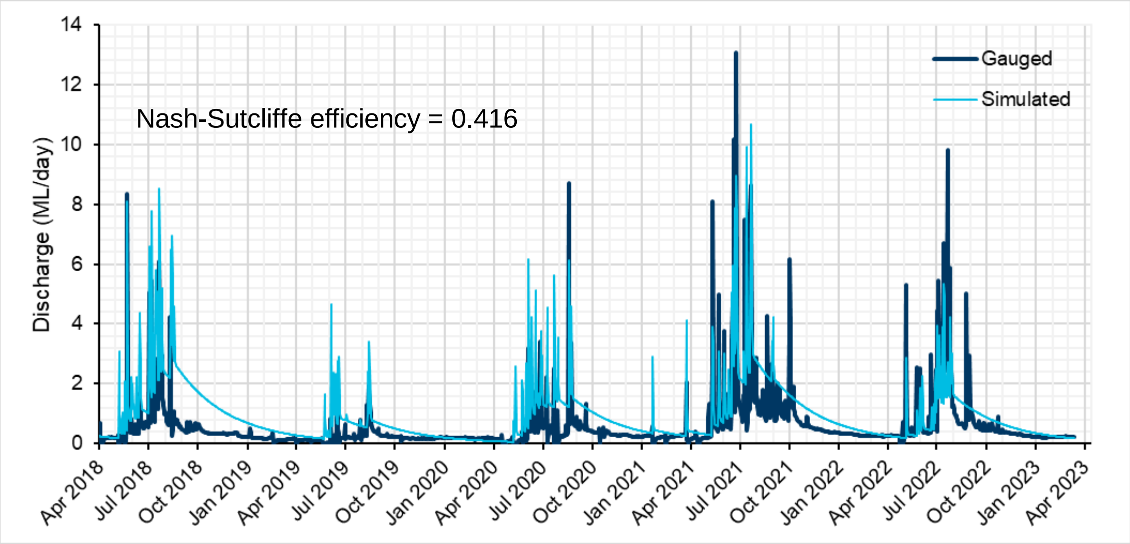


Figure 2.7: Comparison of Gauged and Simulated Streamflow from Disturbed Mine Catchment

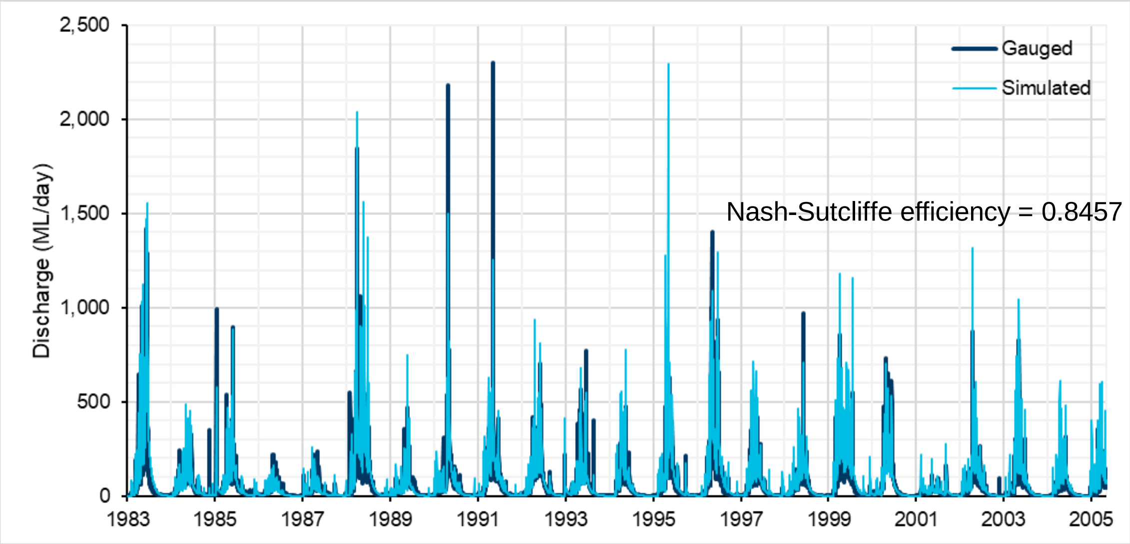


Figure 2.8: Comparison of Gauged and Simulated Streamflow from Hester Brook Catchment

It's noted that Hester Brook flows perennially, but with a marked seasonal variation. Perennial flow is also exhibited at Floyds North, which is likely attributed to the storage and slow release of water from Floyds WRL as baseflow throughout the year. Floyds South and Carters Farm flow seasonally only. Therefore, the baseflow in the 'disturbed mine' is attributable to Floyds North.

2.5 Facilities

2.5.1 Overview

The location of the proposed facilities is shown in **Figure 1.1** and the associated timing of constructing these facilities is provided in **Table 2.3**. The Floyds WRL is considered complete from the outset in both the Base Case and Impact Case scenarios. Details pertaining to each facility is provided in the following sub-sections.

Table 2.3 Timing of facilities

Facilities	Completion date	Capping date
SWG Dam	1 Jan 2026	N/A
Floyds WRL	1 Jan 2023	1 Jan 2046
SWG WRL	1 Jan 2033	1 Jan 2046

2.5.2 Saltwater Gully Dam

SWG Dam is located on Saltwater Gully, east of the Floyds WRL. Planning of the dam is at a conceptual stage, with the footprint being limited to Talison's existing tenure. The assumed completion date for the dam is January 2026 and the model incorporates this as a step change. The construction phase is not modelled in this scope of work. Details pertaining to the storage characteristics and operating rules are provided below.

2.5.2.1 Rating Curve

The storage features of SWG dam are characterised in the model with a rating curve which was defined using 5 m contour data from Landgate (2020). The stage-storage and stage-area curves are provided in **Figure 2.9** and **Figure 2.10** respectively. The capacity of the dam at full supply is 1.42 GL[7].

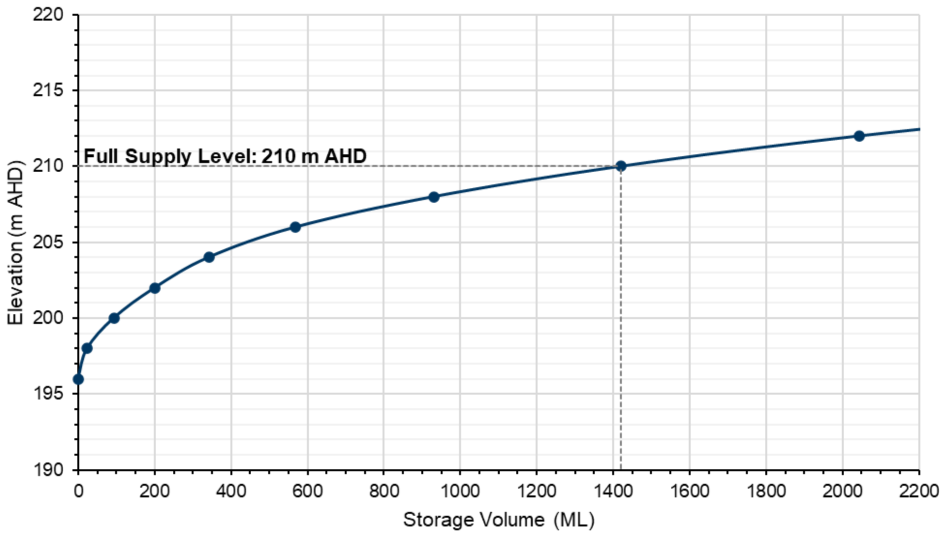


Figure 2.9: SWG Dam Stage-Storage Curve

7 Dam capacity based on planning at the time of the model setup. Recent planning for SWG Dam indicates a new dam wall alignment further downstream will result in a larger dam of ~3.6 GL.

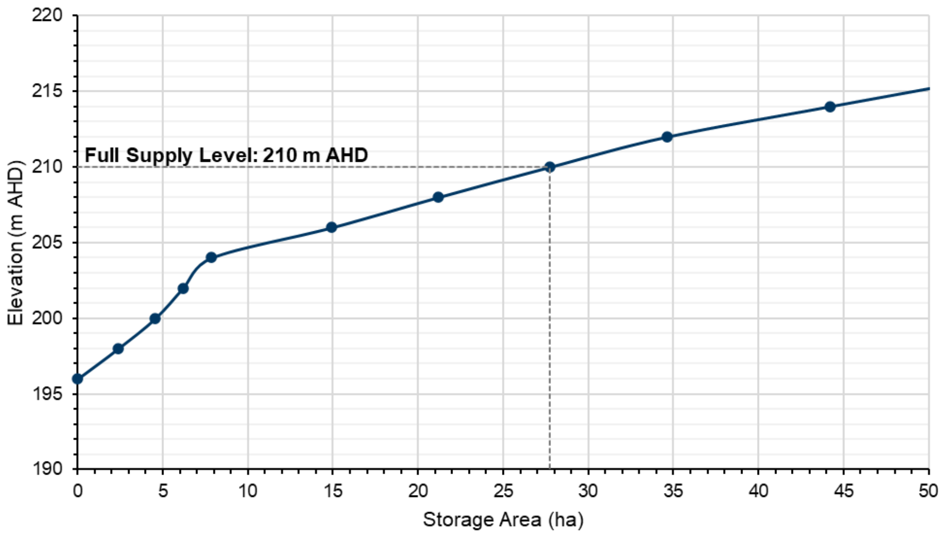


Figure 2.10: SWG Dam Stage-Area Curve

2.5.2.2 Operating Rules

The SWG Dam operating rules configured in the WBM were as follows:

- Maintaining a nominal Low Operating Level (LOL) of 200.9 m AHD, which equates to 10% of the total storage volume. This level was adopted to ensure adequate depth and volume for pumping requirements.
- Passing flow requirements, which are designed to maintain downstream waterway health. These releases, assumed to be 20% of the inflows to the dam, are designed to mimic the existing flow patterns albeit at a lower rate.
- The dam is to be used for water supply only and will not receive water from the Mine Water Circuit (MWC).
- The future operation of SWG Dam, as an integrated component of the MWC, would be subject to an optimisation study to determine the most efficient operating rules, which is outside the scope of this work. Accordingly, the model adopts a simplified approach and assumes that transfers to the MWC (nominally assumed to be 600 m^3/hr) are not limited by the status of the MWC (i.e., maximum transfer to MWC at a given rate). As a result, most of the inflows (minus the passing flows and losses) are transferred to the MWC, which will maintain the storage level to below the FSL.

The SWG dam operating rules configured in the WBM are detailed in **Table 2.4**.

Table 2.4: SWG Dam Operating Rules

Outflow destination	Transfer start trigger	Transfer stop trigger	Maximum transfer rate	Notes
Mine Water Circuit (MWC)	SWG > LOL	SWG <= LOL	600 m^3/sec	A nominal pump rate was selected based on larger pump capacities used in MWC.
Receiving environment (Saltwater Gully)	Runoff > 0 m^3/s	Runoff = 0 m^3/s	20% of runoff inflow	Passing flows are designed to mimic existing flow patterns (albeit at a lower rate).

2.5.3 SWG WRL

Planning of the SWG WRL is at an early stage and was modelled based on the conceptual design surface provided by Talison. The SWG WRL is assumed to be complete on 1 January 2033 and is modelled as a step change (i.e., the progressive staging of the WRL development is not modelled). Capping of the WRL on closure has not been considered in the modelling. It is recommended that future modelling incorporate capping as this will influence the runoff characteristics and groundwater flows.

2.6 Contaminants of Potential Concern

2.6.1 Water Quality Guidelines

Water Quality Guidelines (WQGs) for key CoPCs were derived for the downstream beneficial uses in the *TSF4 Seepage Assessment* (GHD, 2023h) and have been adopted to assess the CoPCs arising from the construction of SWG WRL and the reuse of TSF1.

2.6.2 Contaminant Sources

Impacted sources of seepage and discharge from TSF1 and the WRLs may be derived from the four potential sources, these being:

– Decant tailings slurry waters used to deposit the tailings.
– Leaching from tailings solids via rainfall infiltration.
– Leaching from waste rock, via rainfall infiltration.
– Historical discharge from Floyds WRL.

An initial screening of the monitoring data and that reported in previous studies against the above WQGs indicates the following initial list of CoPCs:

– A total of 15 metals exceed one or more of the adopted WQGs, Al, Sb, As, Cd, Cu, Cs, Cu Cr, Li, Mn, Mo, Ni, Rb, Th, U, Vn.
– NO_3 and SO_4 exceed one or more of the published guidelines and, based on long term monitoring data, are likely to be chemicals to pose a potential risk arising from the construction of SWG WRL.

Further details of the initial screening of the CoPCs are provided in the *Preliminary Risk Assessment Report* (GHD, 2023e).

2.6.3 Monitoring Data

Talison has numerous surface water discharge monitoring sites around the eastern boundary of the mine site and has collected data on metals, anions, and physical stressors (e.g., pH, TDS) as far back as 1997. The locations of these monitoring points are shown in **Figure 2.11**, differentiated as the orange locations, which are described in **Table 2.5**. The historical monitoring is generally reflective of leachate and runoff from waste rock stored in Floyds WRL.

Further screening of the monitoring data against guidelines indicates that:

– Not all the initial CoPCs are monitored.
– A total of 11 CoPCs (As, Cd, Cu, Li, Mn, Ni, Th, U, Zn, SO_4, and NO_3) exceed at least one of the WQGs based on comparing the maximum reported concentrations at all the monitoring locations.

The following CoPCs were eliminated as being not likely to pose an unacceptable risk to the environment following more detailed assessment of the monitoring data:

– Cd, Cu, U, Th: Elevated presence is rare and only shows up a few times over the course of two decades.
– Mg, Ni, Zn: The highest reported concentrations appear to be anomalies compared to the rest of the data, which are consistently below the WQGs.

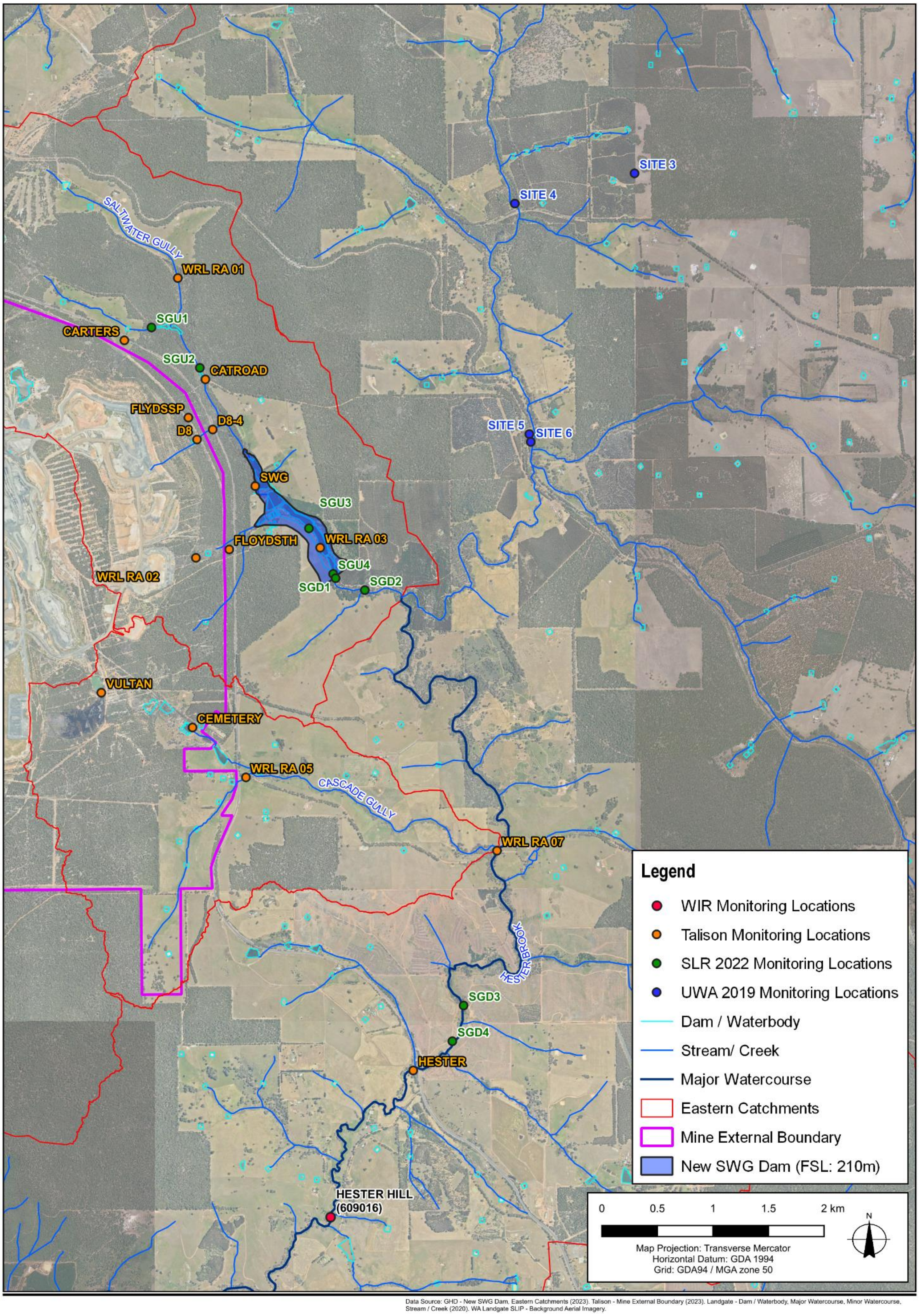


Figure 2.11: Water Quality Monitoring Locations

Table 2.5: Description of Discharge Monitoring Locations

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

Based on historical monitoring, the following CoPCs were considered to be evaluated in more detail: arsenic, lithium, nitrate, and sulphate. Details of this further screening of the CoPCs are provided in the *Preliminary Risk Assessment Report* (GHD, 2023e). It should be noted that the proximity of SWG WRL to the creek lines may result in other CoPCs emanating from this Facility becoming an unacceptable risk to the environment, however, there are no data to model these impacts. Implementation of construction buffers may mitigate such risks.

2.7 Groundwater Interaction

2.7.1 Groundwater Discharge

The groundwater modelling (GHD, 2023d) provides estimates of the groundwater discharge volumes, CoPC concentrations, and loads into the downstream waterways (e.g., creeks, dams, rivers). The time series of the groundwater discharges (flows and arsenic and lithium concentrations[8]) are presented in the *Groundwater Modelling Report* (GHD, 2023d). The groundwater modelling accounts for the attenuation of CoPCs within the underlying strata and migration of the seepage with groundwater flow.

The AWBM already accounts for groundwater flows through the baseflow store "container" (see **Figure 2.4**), therefore the discharge volumes from the groundwater modelling were not applied directly in the WBM as these differ slightly due to the different modelling approaches. To account for CoPCs discharged via groundwater, the CoPC loads were adopted from the groundwater model and multiplied by the baseflows simulated in the AWBM module to determine the relative CoPC concentrations.

To conserve mass, the groundwater concentrations applied to the WBM were factored based on the average baseflow from the groundwater model against the WBM for each sub-catchment. The factored groundwater concentrations for both the Base Case and Impact Case at each sub-catchment are provided in **Appendix A** to **Appendix D**, relatively for lithium, arsenic, sulphate, and nitrate respectively. Note that the sulphate and nitrate concentrations are derived based on a ratio against the lithium concentrations, which is discussed further in **Section 2.8**.

8 Fate and transport of nitrate and sulphate in groundwater were not modelled.

This approach is considered appropriate given there is less variability in the groundwater flows and concentrations relative to the runoff component, which is directly influenced by rainfall. The figures in **Appendix A** to **Appendix D** indicate a similar pattern of a rapid increase in concentration of CoPCs in the few years immediately following construction of Floyds and SWG WRLs, the rate of increase which drops significantly thereafter.

2.7.2 Seepage

The seepage loss from SWG dam was assumed to be a constant 2 mm/day in lieu of calibrated data. This rate is consistent with other dams in the MWC.

2.8 Water Quality

The model is configured to perform mass balances of the various CoPCs, for which the following assumptions were made:

- CoPC concentrations in the surface runoff from the mine affected areas were based on the average concentrations recorded at Carters Farm, D8, D8-4, Floyds North, and Floyds South monitoring sites (see **Figure 2.11**). These sites were selected as they monitor the quality of water discharging off the east of the site, where Floyds WRL and the Mine Services Area (MSA) are located. The average recorded concentrations from 2016 to 2023 are shown in **Figure 2.12** to **Figure 2.15** for lithium, arsenic, sulphate, and nitrate respectively. It should be noted that monitoring data post 2021 were only available at some locations for lithium and arsenic only. Adopted concentrations were based on 2021 results as this is the latest date with results at all monitoring points.
- CoPC concentrations for the external catchment runoff were based on:
  - For lithium and arsenic, the initial concentrations were based on the *2019 Ecological Assessment Study* (University of Western Australia, 2019). The concentrations were typically less than 0.001 mg/L for arsenic and 0.01 mg/L for lithium and were therefore assumed to be undetected (i.e., 0 mg/L).
  - Sulphate and nitrate values were based on WRL 01 monitoring location, which has a one-off sample from 2020. This monitoring location is upstream of the mine along Saltwater Gully and, whilst outside of the influence of the mine, may present slightly elevated concentrations relative to upstream of Hester Brook as Saltwater Gully is known to have naturally high salt levels.
- Groundwater discharge concentrations for lithium and arsenic were adopted from the groundwater modelling (GHD, 2023d) and factored based on relative baseflow between the two models. However, the groundwater modelling did not include sulphate and nitrate and, therefore, these were estimated as a ratio of the mine affected sulphate and nitrate concentration to the mine affected lithium concentration.
- As the simulation of SWG Dam starts empty, there was no need to apply an initial concentration.

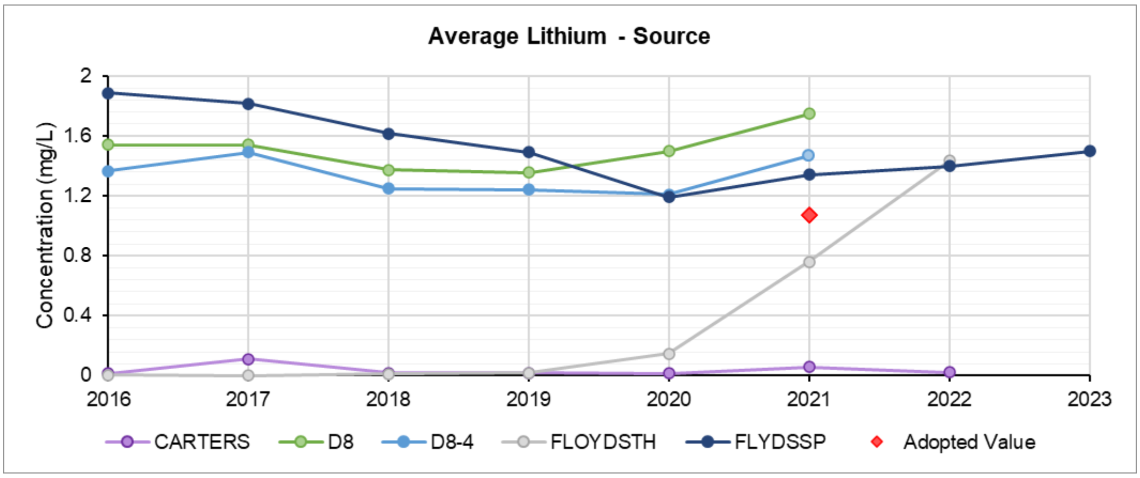


Figure 2.12: Average Annual Lithium Concentrations at Source

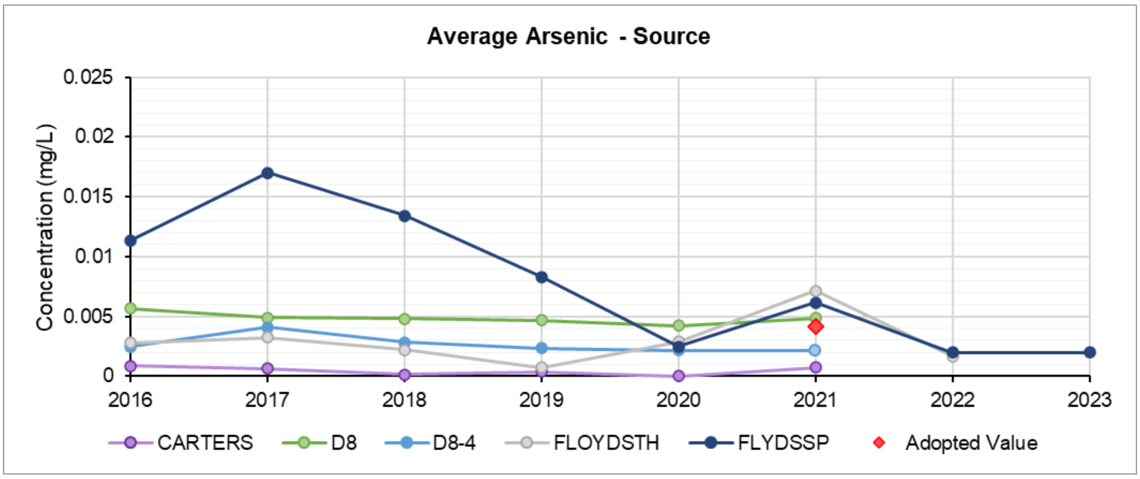


Figure 2.13: Average Annual Arsenic Concentrations at Source

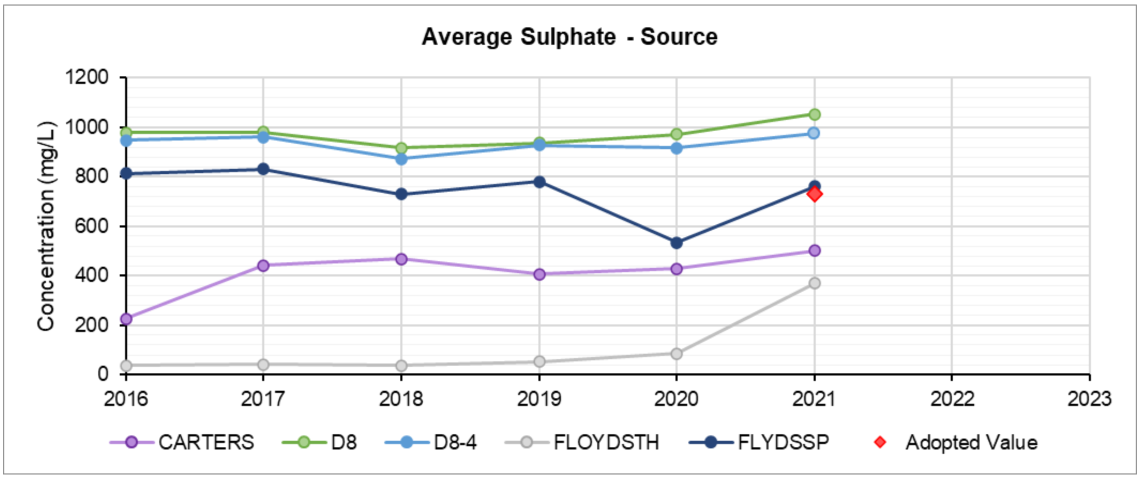


Figure 2.14: Average Annual Sulphate Concentrations at Source

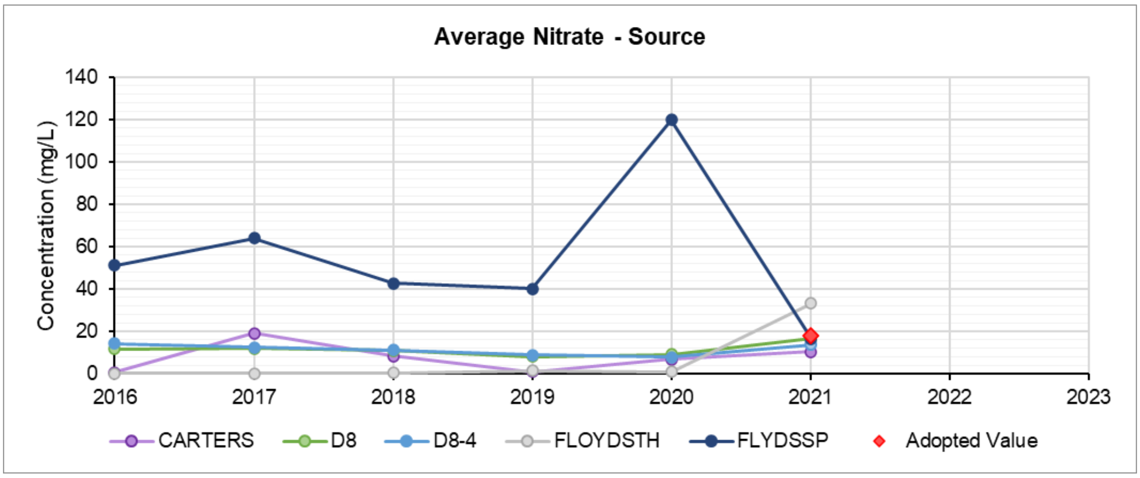


Figure 2.15: Average Annual Nitrate Concentrations at Source

The CoPC concentrations adopted in the modelling at the sources are summarised in **Table 2.6**.

Table 2.6: Initial 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	As per **Appendix A.**	As per **Appendix B.**	As per **Appendix C.**	As per **Appendix D**.

3. Predictive Modelling

3.1 Approach

The WBM was simulated over a 40-year period from January 2023 and extends 20 years post mine closure, which is expected to occur in 2043. The model was simulated 500 times with each simulation adopting a unique climate sequence (of rainfall and evaporation) that was sampled from historical climate records. Simulations were undertaken for two scenarios, namely the Base Case and Impact Case scenarios as discussed in **Section 2.2**.

3.2 Interpretation of Results

Each of the 500 simulations is equally likely and represents one possible path the system could follow through time based on the unique sampled climate sequence. The results of each simulation are assembled into probability distributions of possible outcomes as shown in **Figure 3.1**. The results are therefore represented as probability distributions opposed to a single value. By way of example the 10th percentile result represents the value at which 10% of the modelled outputs were less than this value. Similarly, the 90th percentile represents the value at which 90% of the modelled outputs were less than this value.

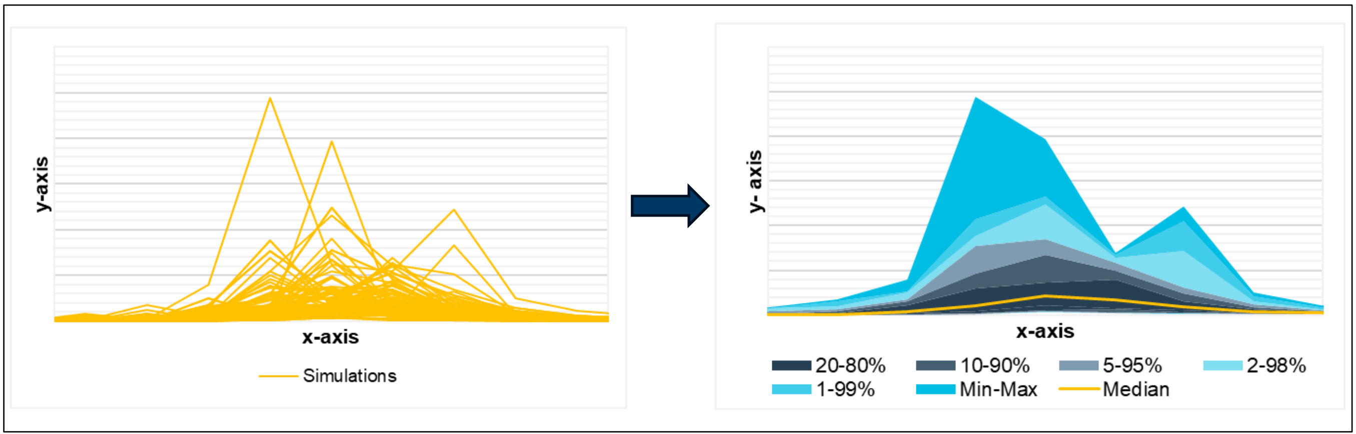


Figure 3.1: Results Interpretation (Simulations to Probability Distribution)

It is important to note that the percentile results do not directly relate to a "wet" or "dry" climate sequences (i.e. 90th percentile does not correspond to a "wet" climate and the 10th percentile does not correspond to a "dry" climate). For example, a 90th percentile water volume would relate to a wetter period, but a 90th percentile CoPC concentration would relate to a dryer period, when there is less dilution.

3.3 SWG Dam Balance

The simulated daily water levels, volume, spill events and seepage flows in SWG Dam are presented in **Appendix E** along with the simulated CoPC concentrations in SWG dam for lithium, arsenic, sulphate, and nitrate. The simulation results indicate the following:

– The median volume in SWG fluctuates seasonally between ~140 ML (LOL) and ~380 ML. In the dryer months between November and April, the volume is maintained just below the LOL volume and unable to transfer the 600 m^3/hr each day.

– Spills typically occur in the winter months and the probability of spilling on a given winter day is typically less than 10%.

– The establishment of SWG WRL in 2023 results in a minimal rise in simulated CoPC concentrations. This can be attributed to the majority of the SWG WRL catchment being located downstream of the dam, thereby limiting the occurrence of a significant spike in CoPC concentrations in the dam.

– The spike in the CoPC concentration maximum result in Year 2062 is attributable to a very dry climate sequence and lower water levels in SWG Dam. As shown in the minimum result for the SWG water level plot, the water level drops quite low, which causes the spike. This spike is to be expected as the concentrations are only influenced by dilution and concentration and are therefore very sensitive to water levels.

3.4 Receiving Catchments

3.4.1 Streamflow

A statistical summary of the simulated daily catchment runoff flows is provided in **Table 3.1** for the reporting locations depicted in **Figure 2.6** and for each of the scenarios simulated. Plots depicting the simulated daily streamflow at the these reporting locations are provided in **Appendix F**..

The reporting locations and associated upstream impacts are as follows:

– Saltwater Gully Outlet to Hester Brook, including discharges from the MSA, Floyds WRL, and S1 WRL for the Base Case and Impact Scenarios, SWG Dam and SWG WRL for Impact Case.

– Cascade Gully Outlet to Hester Brook, including discharges from the current non-operational TSF1 and S1 WRL for the Base and Impact Case, and the future operational TSF1 and SWG WRL for Impact Case.

– Hester Brook Incremental Catchment Between Saltwater and Cascade Gullies, including discharges from SWG WRL for the Impact Case. The Base Case simulates natural runoff only.

– Hester Brook Upstream of Saltwater Gully Confluence, which does not include any mine impacted discharges and is the same for all simulated scenarios.

– Hester Brook Downstream of Cascade Gully Confluence, including discharges from the MSA, Floyds WRL, S1 WRL, and the current non-operational TSF1 for the Base and Impact Case, the future operational TSF1, SWG WRL, and SWG Dam for the Impact Case.

– Hester Brook at Hester Hill, including the discharges described in the above point.

Table 3.1: Statistics of Simulated Flows (ML/day) at Reporting Sites from 2023 to 2063

Location	Saltwater Gully Outlet to Hester Brook		Cascade Gully Outlet to Hester Brook		Hester Brook Incremental Catchment Between Saltwater and Cascade Gullies	
Statistic[9]	Base	Impact	Base	Impact	Base	Impact
5%	1.10	0.38	0.48	0.58	0.27	0.39
20%	2.84	0.95	1.30	1.49	0.75	0.98
50%	5.72	1.88	2.72	3.00	1.62	1.93
80%	12.87	4.25	6.37	6.73	3.94	4.17
95%	26.72	11.41	13.47	13.95	8.45	8.48
Location	Hester Brook Upstream of Saltwater Gully Confluence		Hester Brook Downstream of Cascade Gully Confluence		Hester Brook at Hester Hill	
Statistic	Base	Impact	Base	Impact	Base	Impact
5%	9.52	9.52	11.39	10.91	12.81	12.12
20%	26.36	26.36	31.27	29.86	35.19	33.54
50%	57.12	57.12	67.22	64.01	75.72	72.22
80%	139.13	139.13	162.26	154.13	182.98	174.49
95%	298.63	298.63	347.04	331.85	391.47	376.11

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

The simulated flows indicate the following:

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

3.4.2 CoPC Concentrations

Statistical summaries of the simulated lithium, arsenic, sulphate, and nitrate concentrations are provided in **Table 3.2**, **Table 3.3**, **Table 3.4**, **Table 3.5**, and **Table 3.5** respectively for the reporting locations depicted in **Figure 2.6** 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 3.2** to **Figure 3.9** for lithium, arsenic, sulphate, and nitrate for locations contributing to and along Hester Brook.

Table 3.2: Statistics of Simulated Lithium Concentrations (mg/L) at Reporting Sites from 2023 to 2063[10]

Location	Saltwater Gully Outlet to Hester Brook		Cascade Gully Outlet to Hester Brook		Hester Brook Incremental Catchment Between Saltwater and Cascade Gullies	
Statistic	Base	Impact	Base	Impact	Base	Impact
5%	0.157	0.257	0.070	0.156	0.004	0.234
20%	0.316	0.438	0.169	0.312	0.007	0.390
50%	0.470	0.590	0.299	0.462	0.009	0.510
80%	0.593	0.707	0.420	0.583	0.010	0.598
95%	0.675	0.779	0.509	0.665	0.010	0.650
Location	**Hester Brook Upstream of Saltwater Gully Confluence**		**Hester Brook Downstream of Cascade Gully Confluence**		**Hester Brook at Hester Hill**	
Statistic	**Base**	**Impact**	**Base**	**Impact**	**Base**	**Impact**
5%	0.000	0.000	0.016	0.022	0.015	0.021
20%	0.000	0.000	0.046	0.060	0.041	0.057
50%	0.000	0.000	0.105	0.130	0.096	0.128
80%	0.000	0.000	0.190	0.221	0.176	0.219
95%	0.000	0.000	0.279	0.309	0.263	0.310

[10] 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 3.3: Statistics of Simulated Arsenic Concentrations (mg/L) at Reporting Sites from 2023 to 2063[11]

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

Table 3.4: Statistics of Simulated Sulphate Concentrations (mg/L) at Reporting Sites from 2023 to 2063[12]

Location	Saltwater Gully Outlet to Hester Brook		Cascade Gully Outlet to Hester Brook		Hester Brook Incremental Catchment Between Saltwater and Cascade Gullies	
Statistic	Base	Impact 1	Base	Impact 1	Base	Impact 1
5%	113.3	180.6	55.5	113.0	6.8	164.2
20%	217.7	300.3	118.2	214.8	7.0	267.1
50%	320.4	401.7	204.8	314.7	7.9	347.2
80%	402.4	479.5	285.1	395.6	9.3	406.3
95%	457.7	528.3	345.7	450.9	12.2	442.3
Location	Hester Brook Upstream of Saltwater Gully Confluence		Hester Brook Downstream of Cascade Gully Confluence		Hester Brook at Hester Hill	
Statistic	Base	Impact 1	Base	Impact 1	Base	Impact 1
5%	0.0	0.0	18.1	21.8	16.9	20.2
20%	0.4	0.4	35.1	44.3	32.1	40.3
50%	1.9	1.9	73.8	90.7	67.6	83.0
80%	4.3	4.3	129.6	150.5	120.4	140.1
95%	9.5	9.5	189.5	209.8	179.0	198.5

11 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.

12 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 3.5: Statistics of Simulated Nitrate Concentrations (mg/L) at Reporting Sites from 2023 to 2063[13]

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

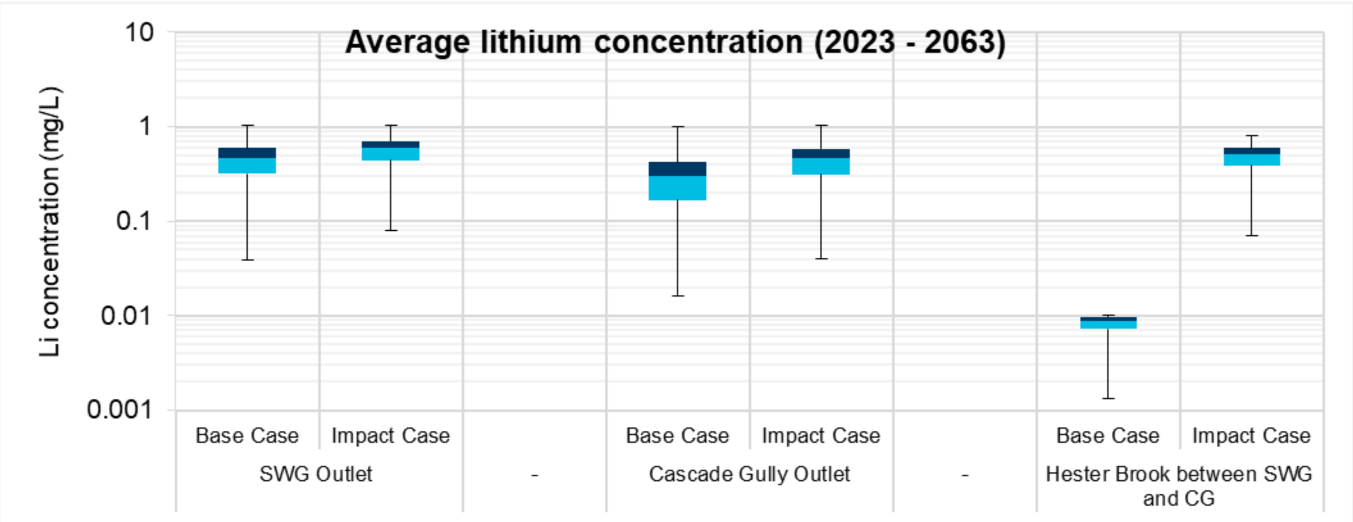


Figure 3.2: Range of Simulated Lithium Concentrations – Contributing Locations to Hester Brook

13 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.

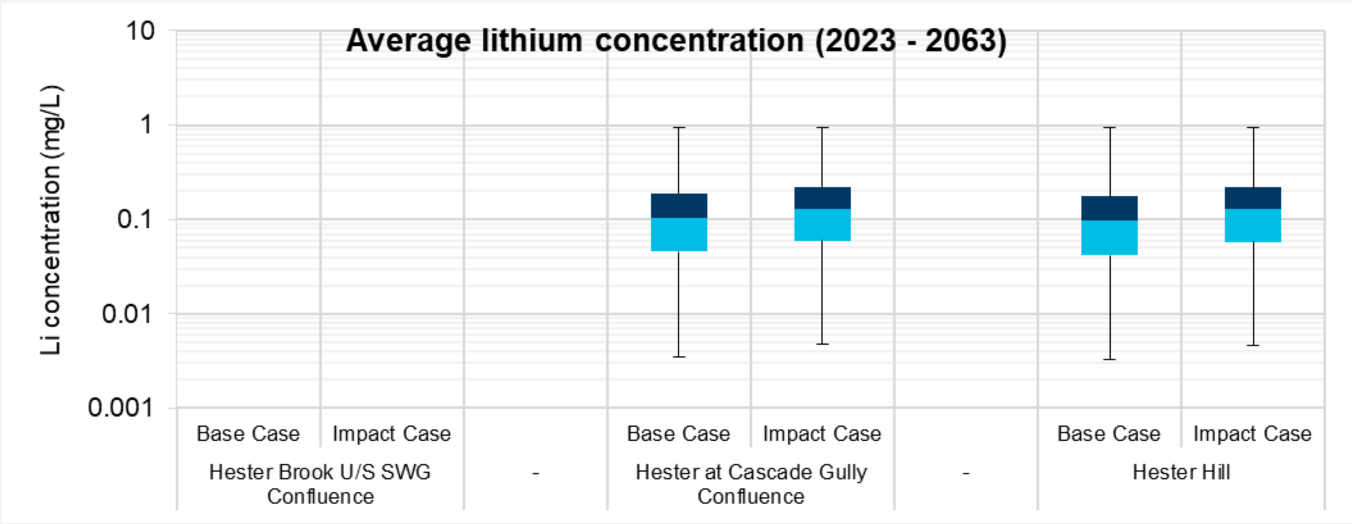


Figure 3.3: Range of Simulated Lithium Concentrations –Hester Brook Locations

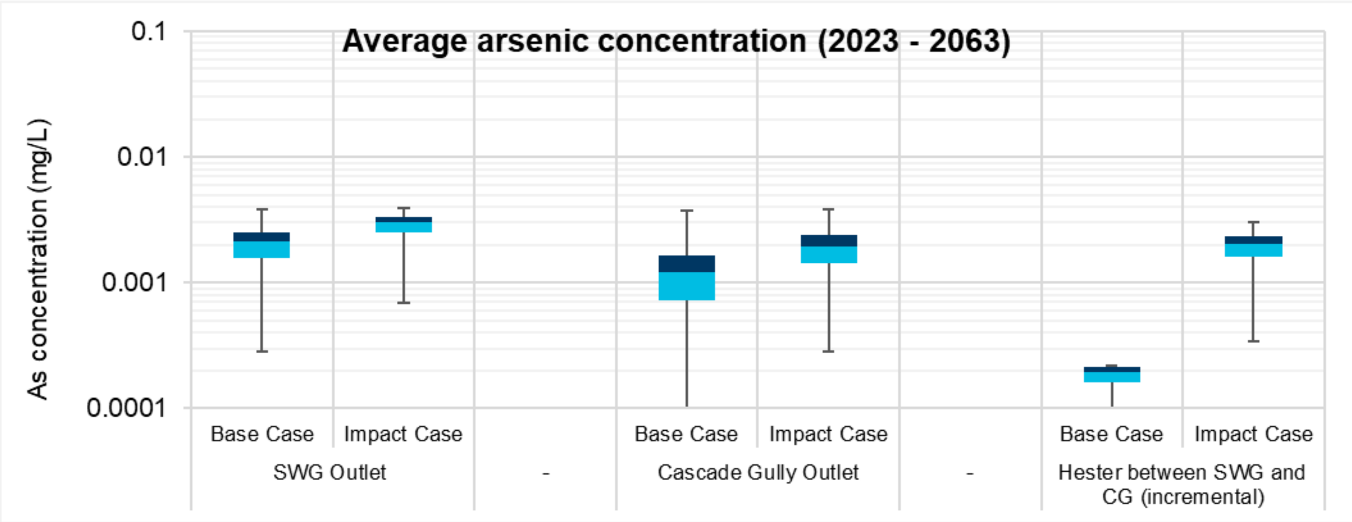


Figure 3.4: Range of Simulated Arsenic Concentrations– Contributing Locations to Hester Brook

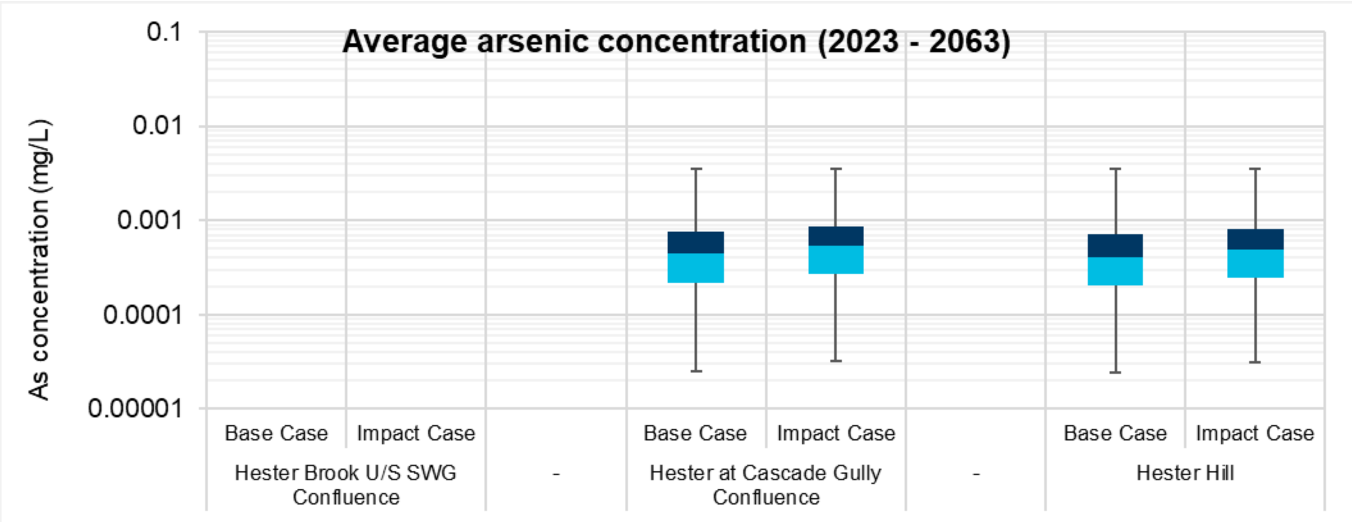


Figure 3.5: Range of Simulated Arsenic Concentrations– Hester Brook Locations

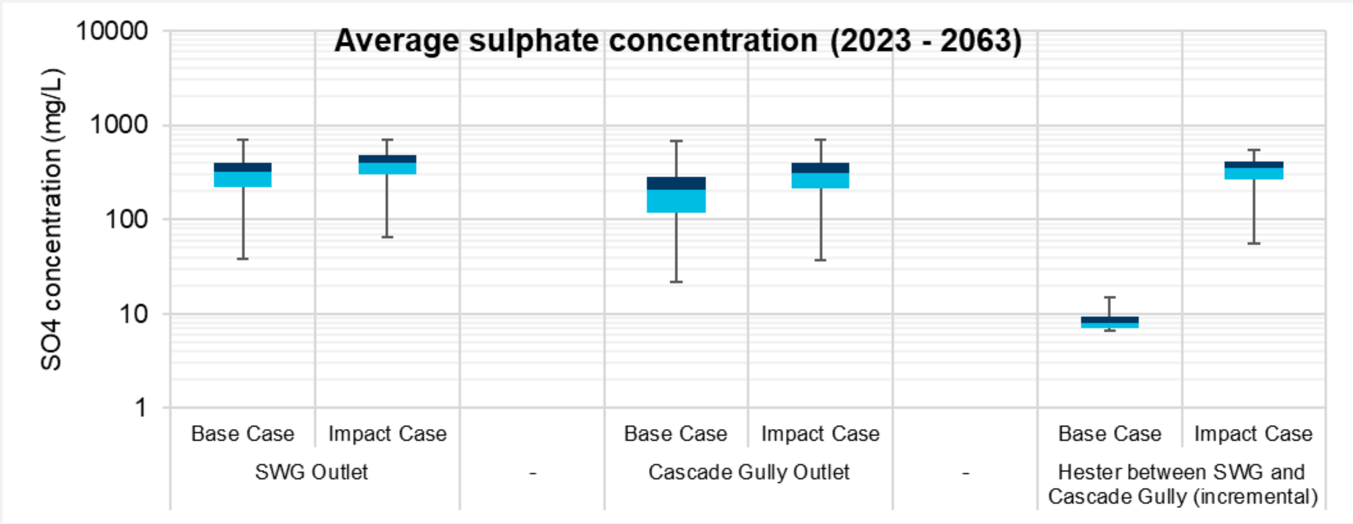


Figure 3.6: Range of Simulated Sulphate Concentrations– Contributing Locations to Hester Brook

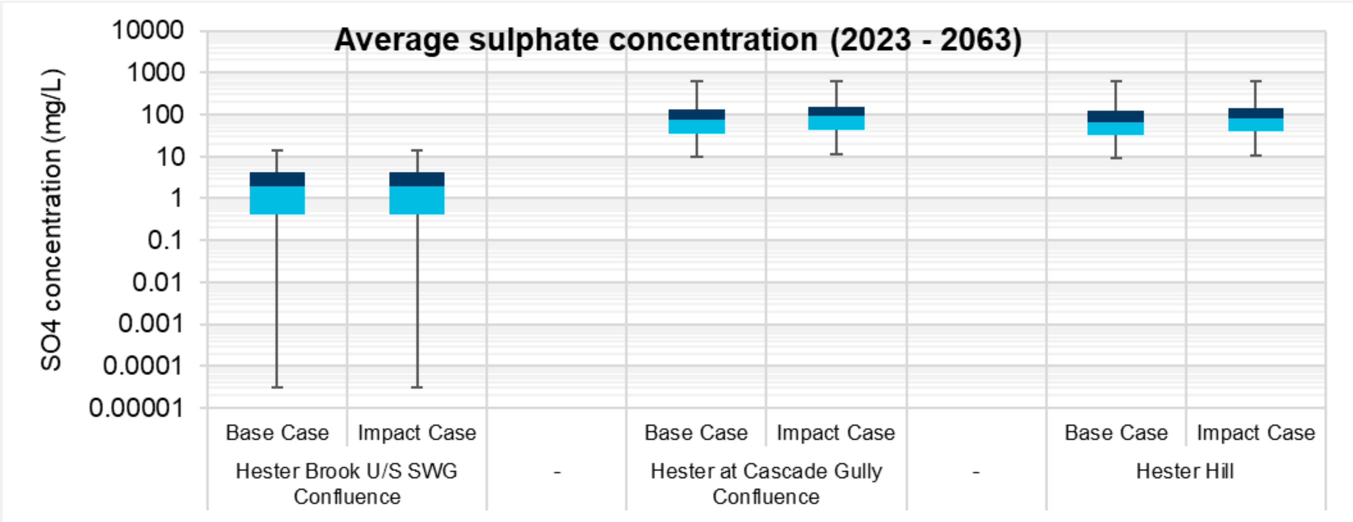


Figure 3.7: Range of Simulated Sulphate Concentrations–Hester Brook Locations

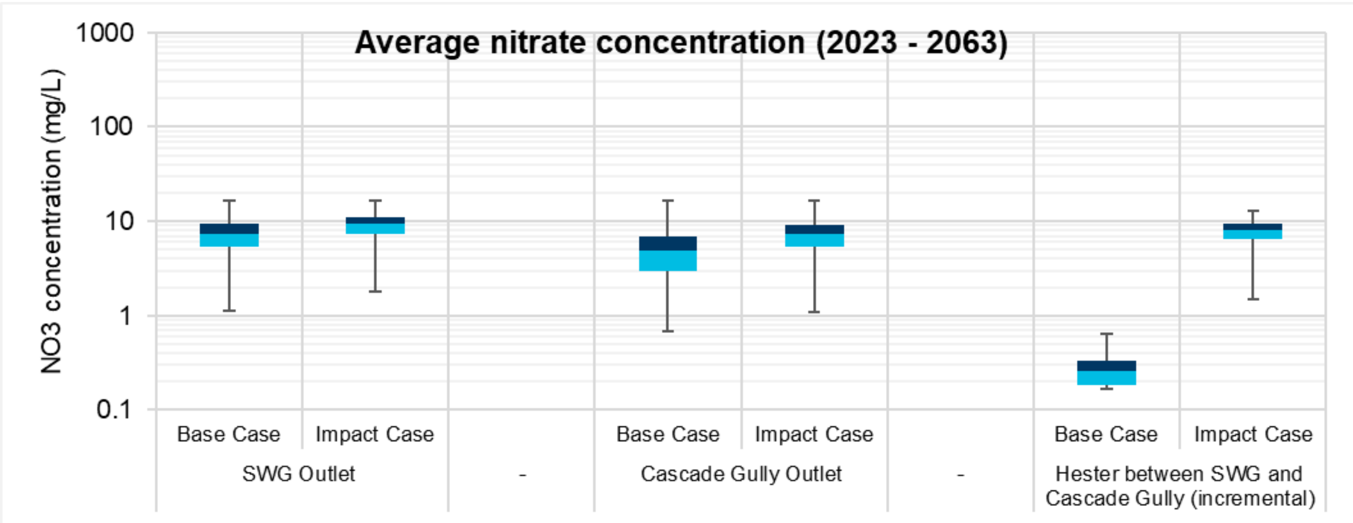


Figure 3.8: Range of Simulated Nitrate Concentrations– Contributing Locations to Hester Brook

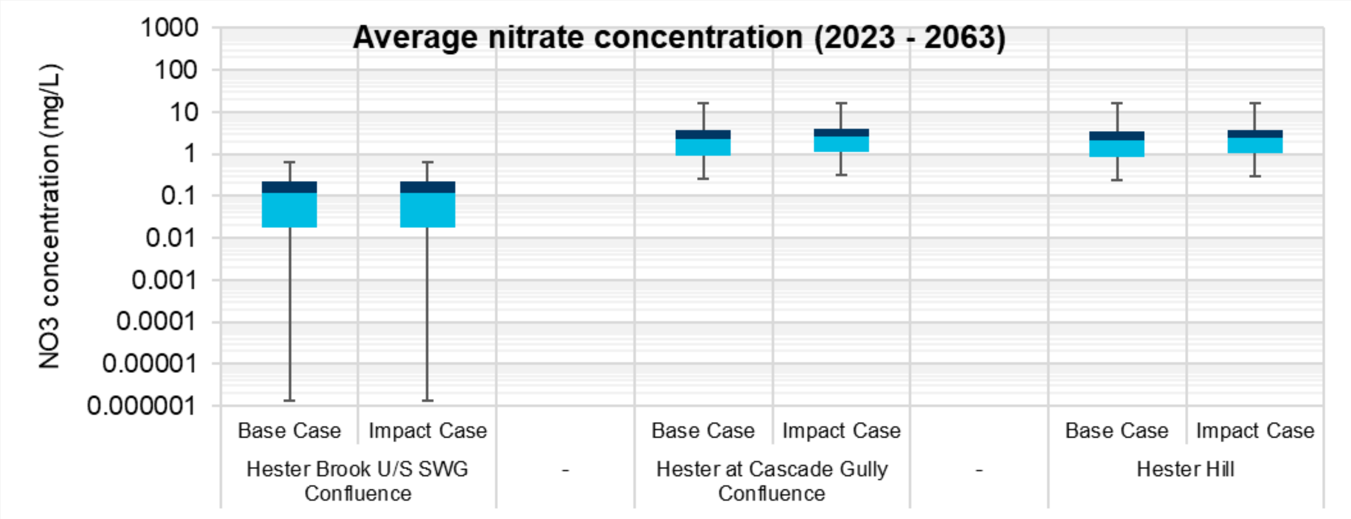


Figure 3.9: Range of Simulated Nitrate Concentrations– Hester Brook Locations

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.

The baseline CoPC concentrations will differ from the monitored water quality data due to the following reasons:

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

4. Conclusions

The water and mass balance modelling indicates that the establishment of SWG WRL results in a worsening of CoPC concentrations discharging from Saltwater Gully and Cascade Gully into Hester Brook. At Hester Hill, the increase in CoPC concentrations is less significant given the dilution from the non-disturbed catchment flows.

SWG Dam effectively dilutes the CoPCs discharged from Floyds and Floyds WRL, however, the majority of the SWG WRL catchment is located downstream of the dam. Consequently, the dam provides little benefit in terms of diluting these flows.

SWG dam volume fluctuates seasonally between ~140 ML (LOL) and ~380 ML. The nominal transfer rate of 600 m^3/hr is only met during the wetter winter months. However, an optimisation study should be conducted which incorporates SWG Dam into the MWC to derive more rigorous operating rules and estimate the dam yield.

The volume of water discharging from Saltwater Gully reduces by ~67% on average from the Base Case to Impact Case, reflecting the impact of SWG Dam. Streamflow at the Cascade Gully outlet to Hester Brook increases by ~10% on average from the Base Case to the Impact Case, reflecting the change in runoff characteristics brought about by SWG WRL. Streamflow in Hester Brook downstream of the confluence with Cascade Gully and at Hester Hill gauging site reduces by ~5% on average from the Base Case to the Impact Case, reflecting the impact of SWG Dam and change in catchment area and runoff characteristics brought about by SWG WRL.

Based on historical monitoring, the following CoPCs were evaluated in the mass balance: arsenic, lithium, nitrate, and sulphate. Details of this further screening of the CoPCs are provided in the Preliminary Risk Assessment Report (GHD, 2023e). It should be noted that the proximity of SWG WRL to the creek lines may result in other CoPCs emanating from this Facility becoming an unacceptable risk to the environment, however, there are no data to model these impacts. Implementation of the Eastern Catchments monitoring plan (GHD, 2023c) will infill these gaps in data and knowledge.

5. References

Boughton, W. (2004). *The Australian Water Balance Model. Environmental Modelling & Software 19 (2004) 943–956.*

Bureau of Meteorology. (2022). *National Hydrological Projections - Design and Methodology. Bureau Research Report – BRR061, ISBN: 978-1-925738-37-7.*

GHD. (2021). *Talison Future Water Storage Options Study. Report prepared for Talison Lithium Pty Ltd. August 2021.*

GHD. (2023). *TSF4 Seepage Assessment Groundwater Model Update and Site Assessment. Report forTalison Lithium Pty Ltd 31 January 2023.* Perth: GHD Pty Ltd.

GHD. (2023a). *Eastern Catchments Hydrological Study: Gap Analysis. Report prepared for Talison Lithium Pty Ltd. October 2023. Ref 12604929.*

GHD. (2023b). *Eastern Catchments Hydrological Study: Conceptual Site Model. Report prepared for Talison Lithium Pty Ltd. October 2023. Ref 12604929.*

GHD. (2023c). *Eastern Catchments Hydrological Study: Monitoring Plan. Report prepared for Talison Lithium Pty Ltd. October 2023. Ref 12604929.*

GHD. (2023d). *Eastern Catchments Hydrological Study: Groundwater Modelling. Report prepared for Talison Lithium Pty Ltd. October 2023. Ref 12604929.*

GHD. (2023e). *Eastern Catchments Hydrological Study: Preliminary Risk Assessment. Report prepared for Talison Lithium Pty Ltd. October 2023. Ref 12604929.*

GHD. (2023f). *Water Dam Raises – Water Balance and Risk Assessment, Report prepared for Talison Lithium Pty Ltd, March 2023, Ref 12585275.*

GHD. (2023g). *TSF4 Seepage Assessment : Woljenup Creek Hydrological Assessment. Report for Talison Lithium Pty Ltd . September 2023. Ref 12575610.*

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

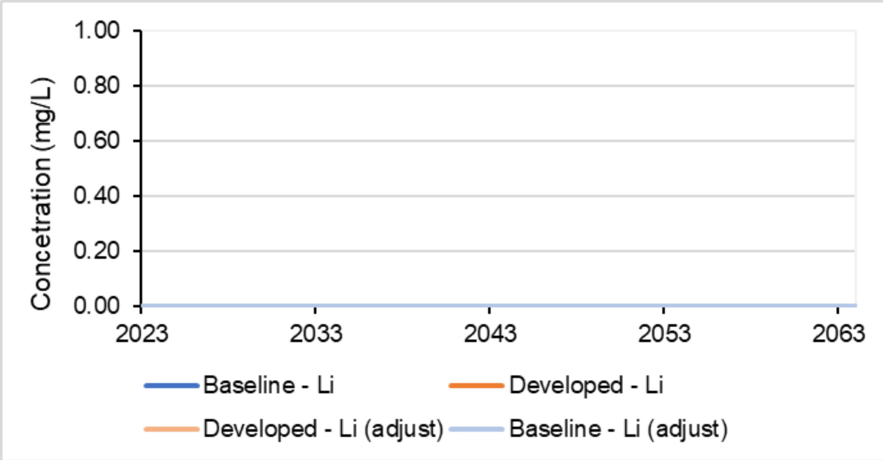
Queensland Department of Environment and Science and Bureau of Meteorology. (2022, 08 24). *SILO Australian Climate Database*. Retrieved from https://www.longpaddock.qld.gov.au/silo/

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.*

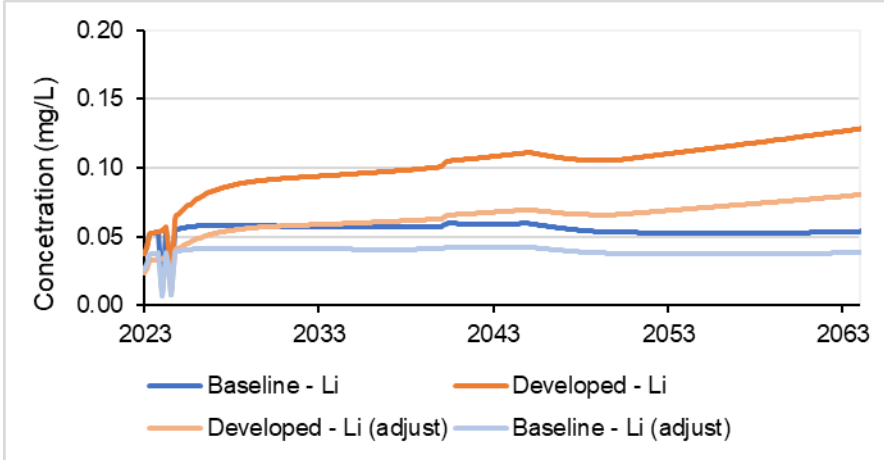
Appendices

Appendix A

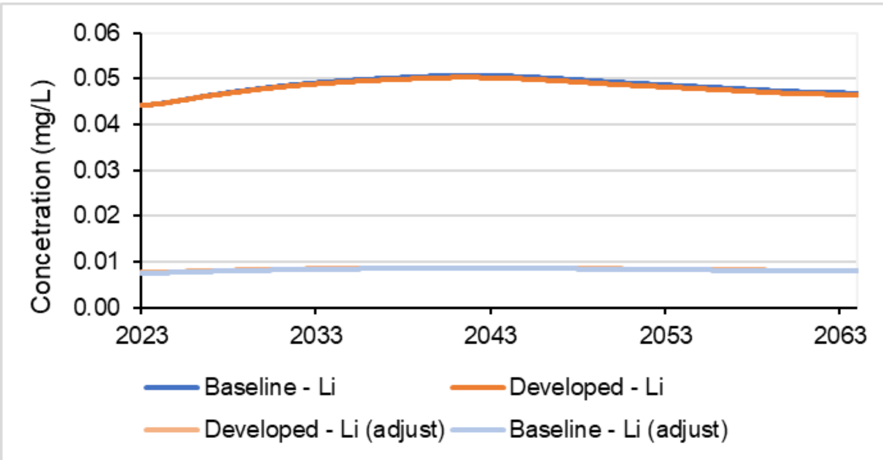
Modelled Groundwater Discharges and Lithium Concentrations to Surface Water



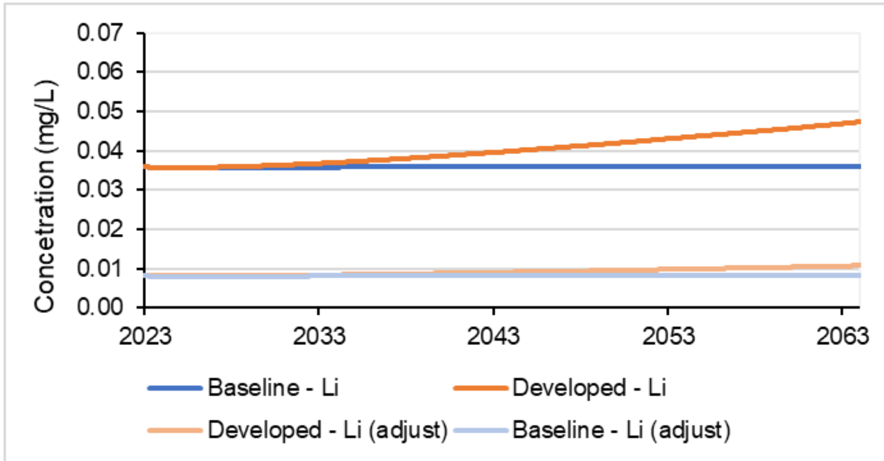
Carters Catchment



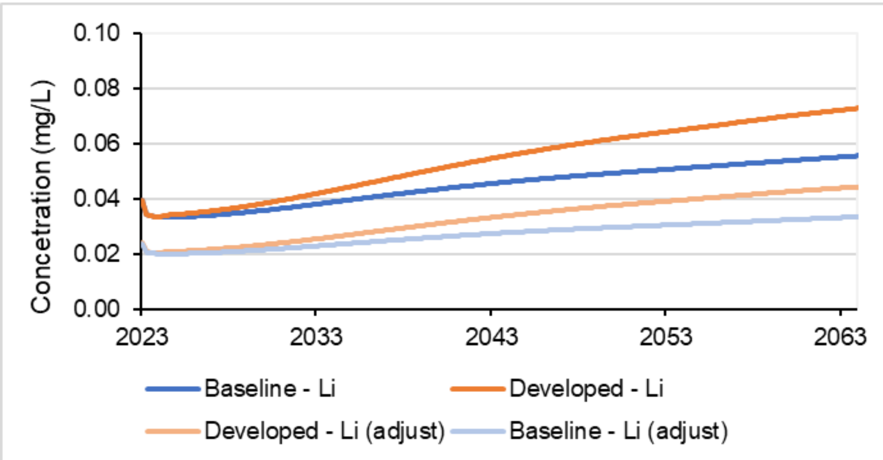
Cemetery Dam Catchment



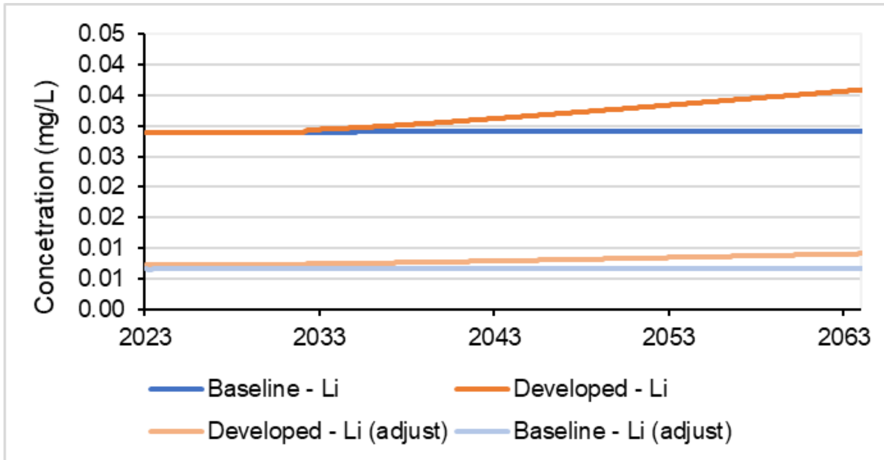
Floyds North Catchment



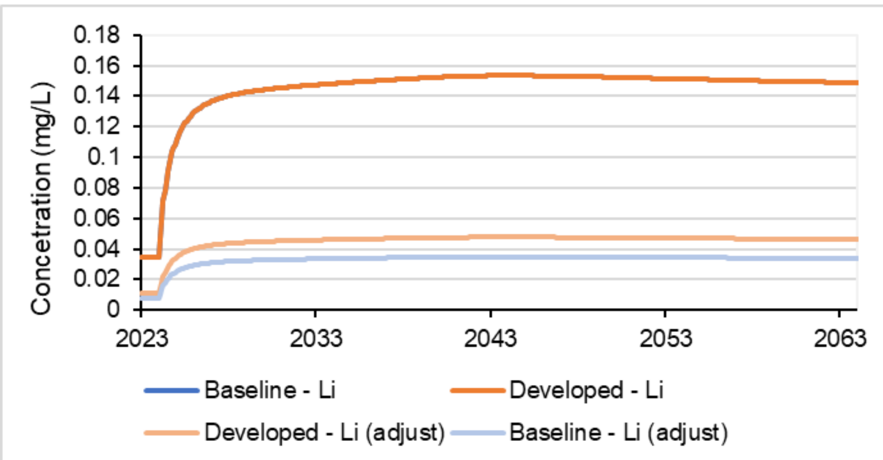
Cascades Gully Catchment Upstream of SWG WRL



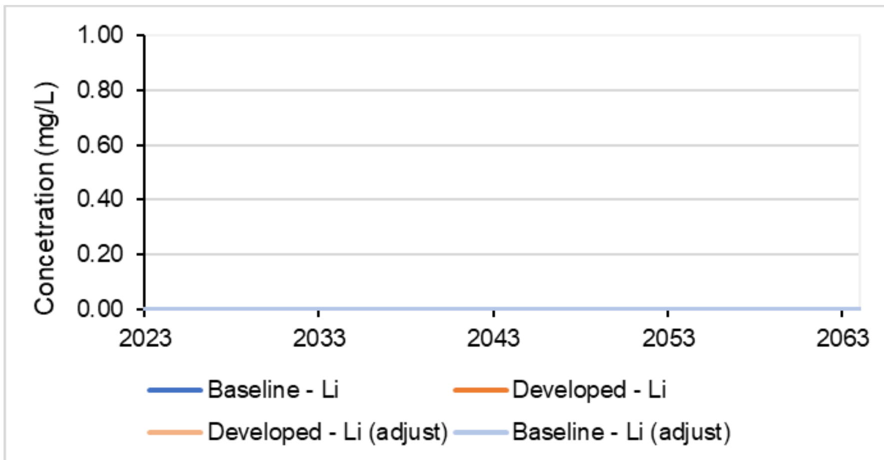
Floyds South Catchment



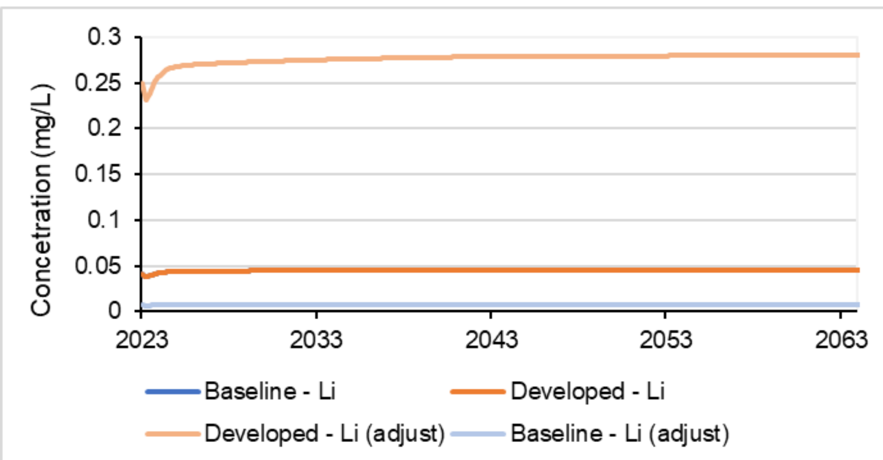
Cascades Gully Catchment at Hester Brook Confluence



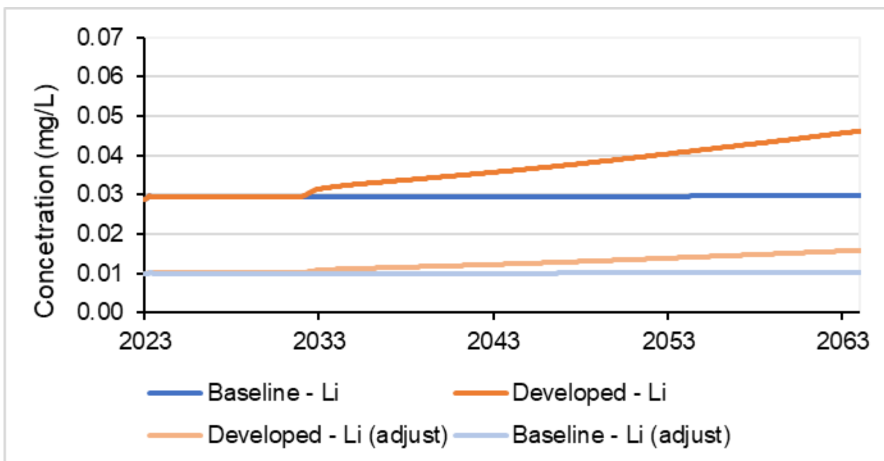
Saltwater Gully Catchment at Monitoring Site



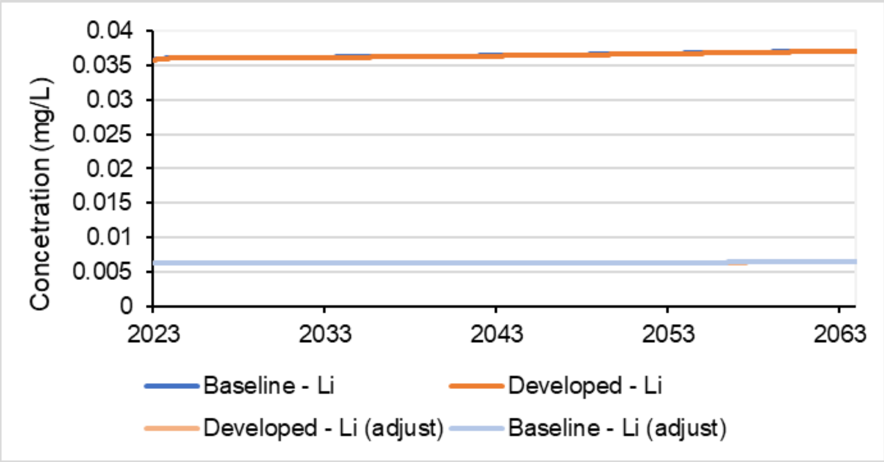
Hester Brook Catchment Upstream of Saltwater Gully Confluence



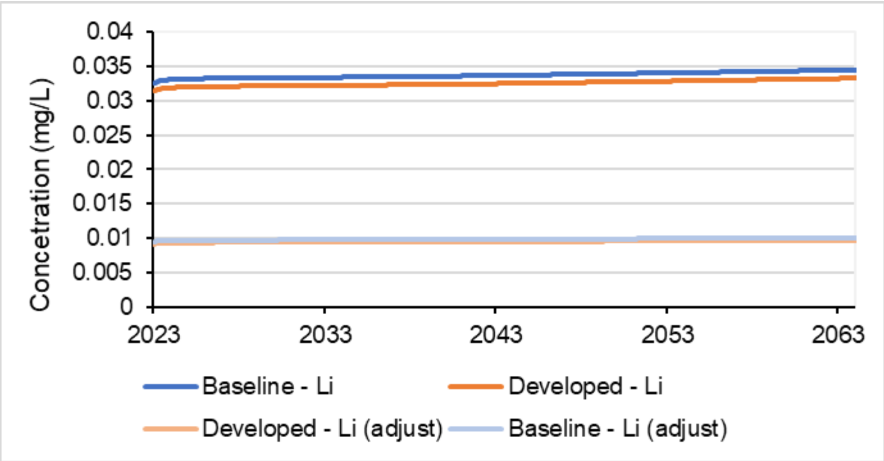
Saltwater Gully Catchment at Hester Brook Confluence



Hester Brook Catchment Upstream of Cascades Gully Confluence



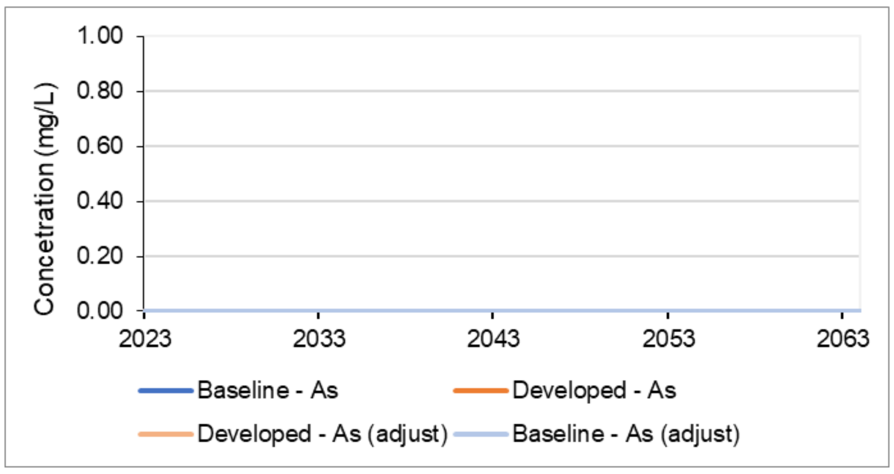
Hester Brook Catchment at Hester Hill



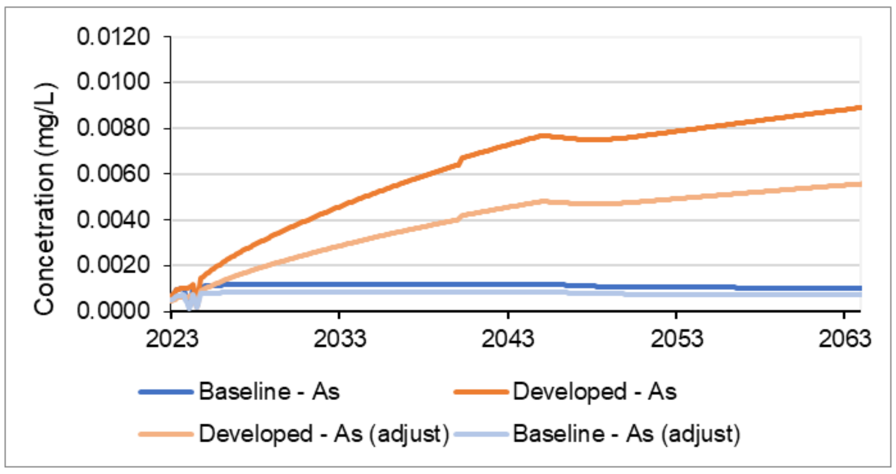
Hester Outlet at Blackwood River

Appendix B

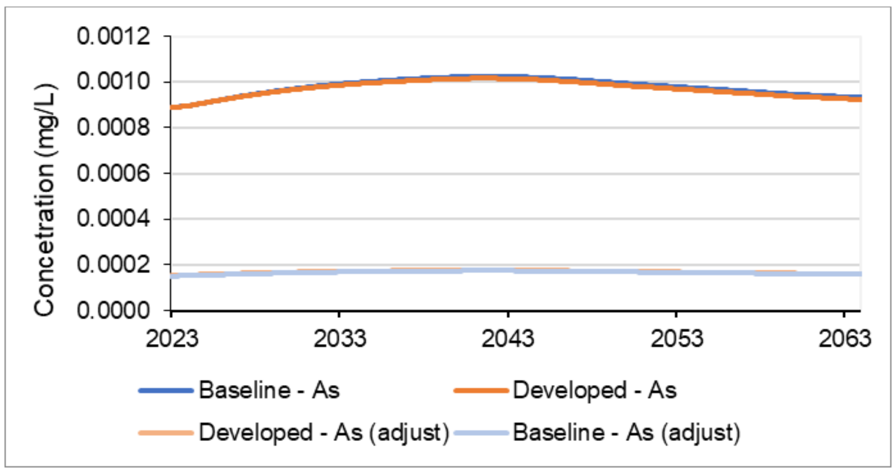
Modelled Groundwater Discharges and Arsenic Concentrations to Surface Water



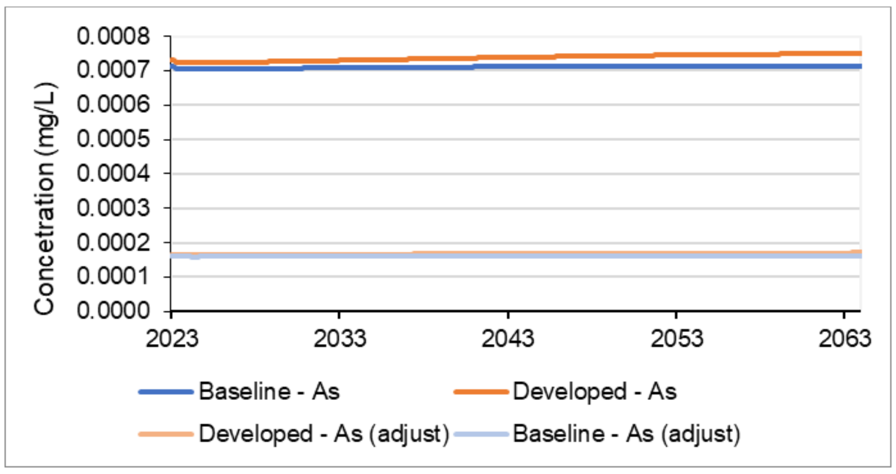
Carters Catchment



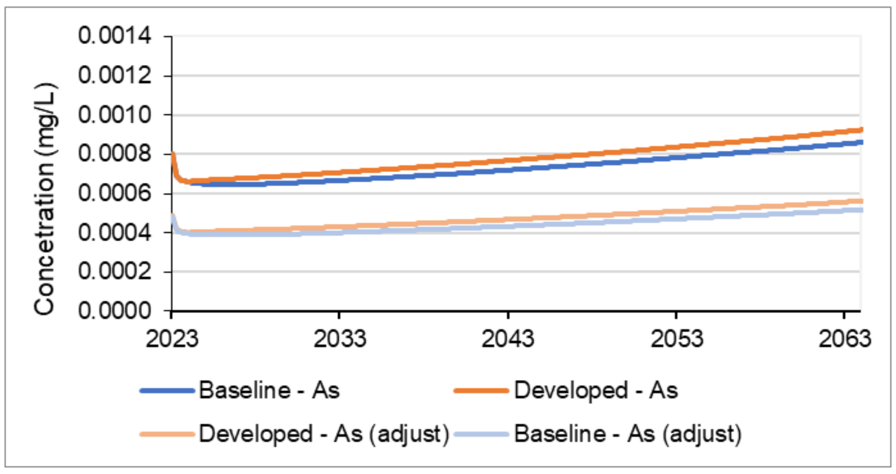
Cemetery Dam Catchment



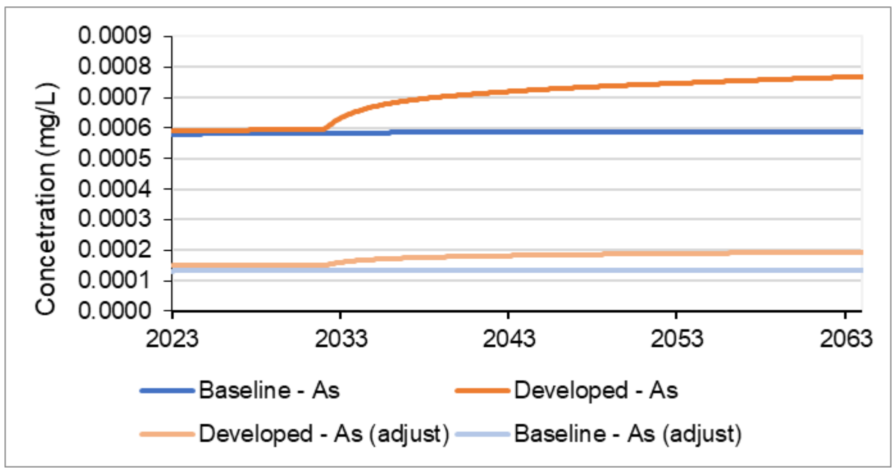
Floyds North Catchment



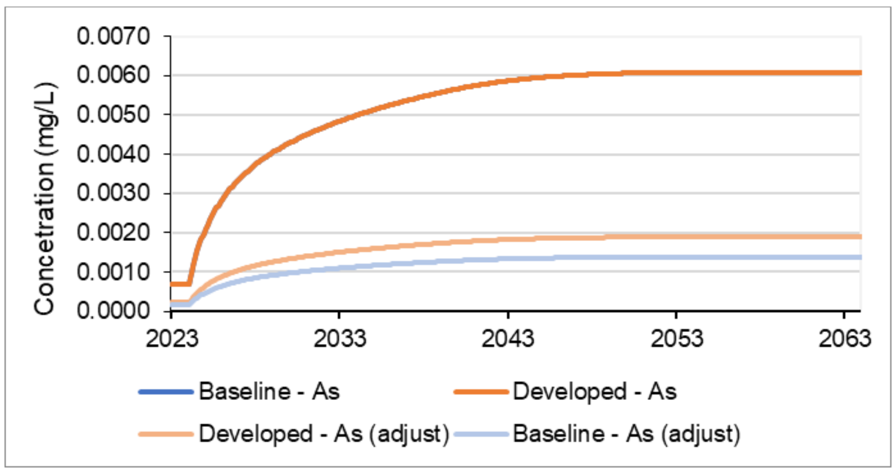
Cascades Gully Catchment Upstream of SWG WRL



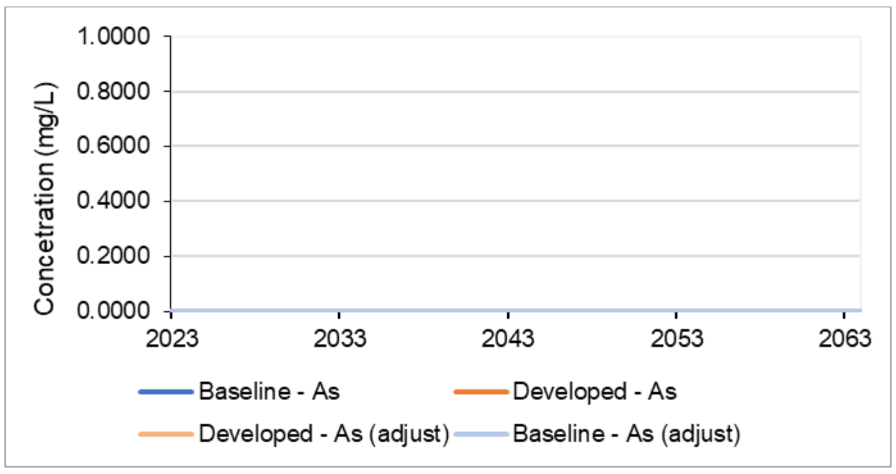
Floyds South Catchment



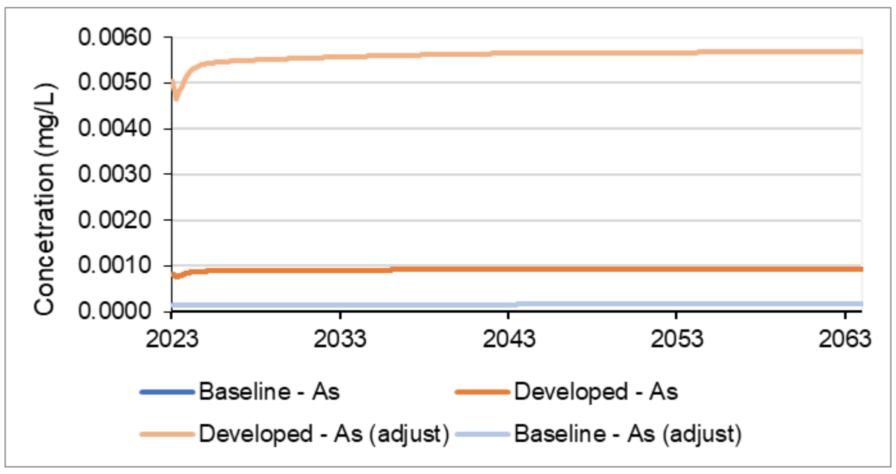
Cascades Gully Catchment at Hester Brook Confluence



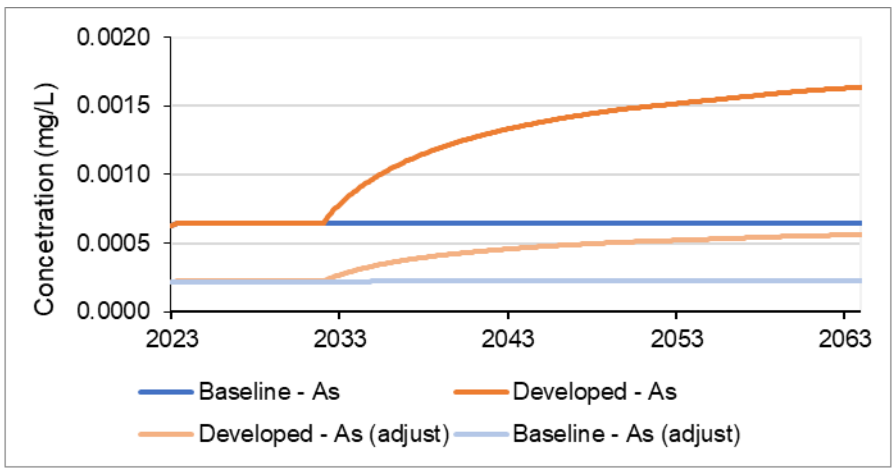
Saltwater Gully Catchment at Monitoring Site



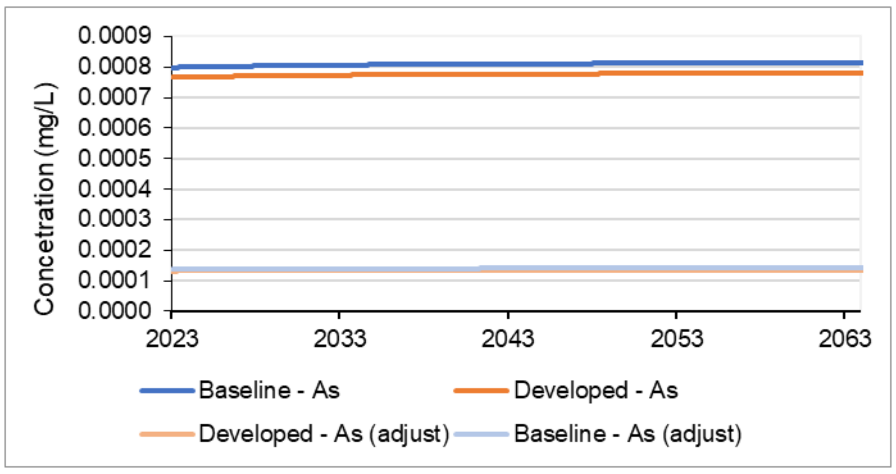
Hester Brook Catchment Upstream of Saltwater Gully Confluence



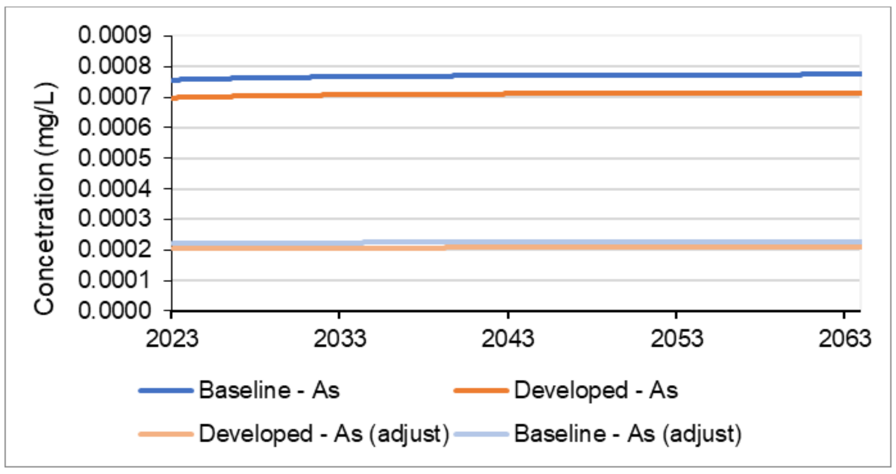
Saltwater Gully Catchment at Hester Brook Confluence



Hester Brook Catchment Upstream of Cascades Gully Confluence



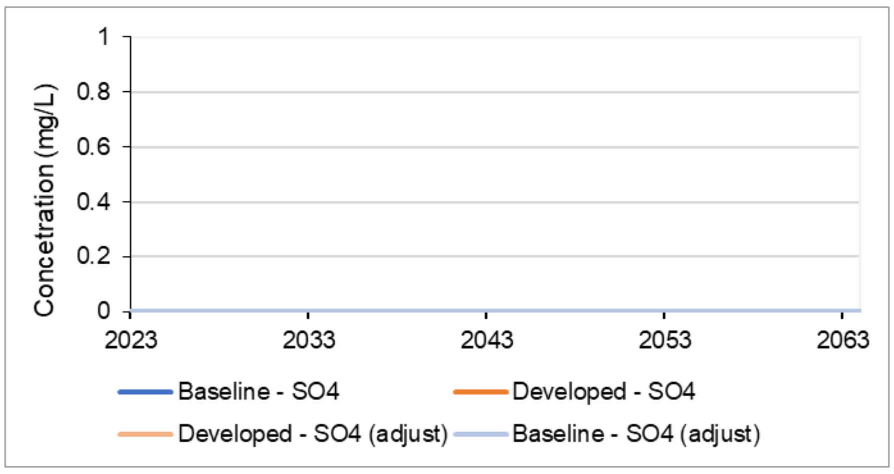
Hester Brook Catchment at Hester Hill



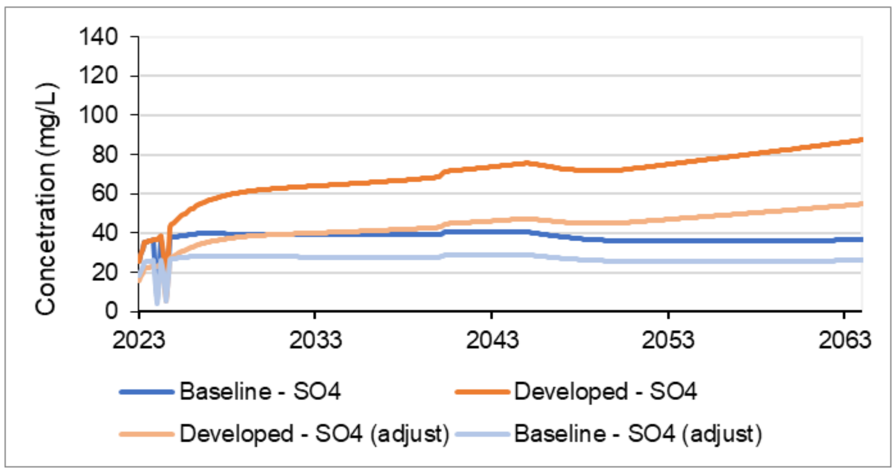
Hester Outlet at Blackwood River

Appendix C

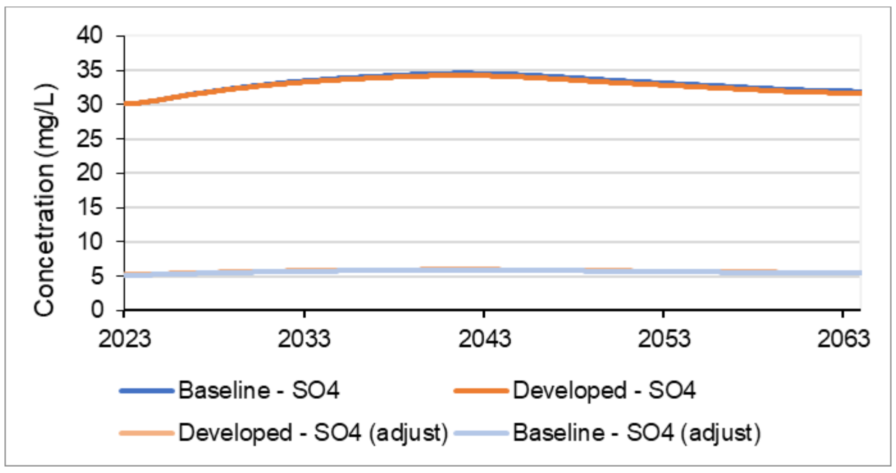
Modelled Groundwater Discharges and Sulphate Concentrations to Surface Water



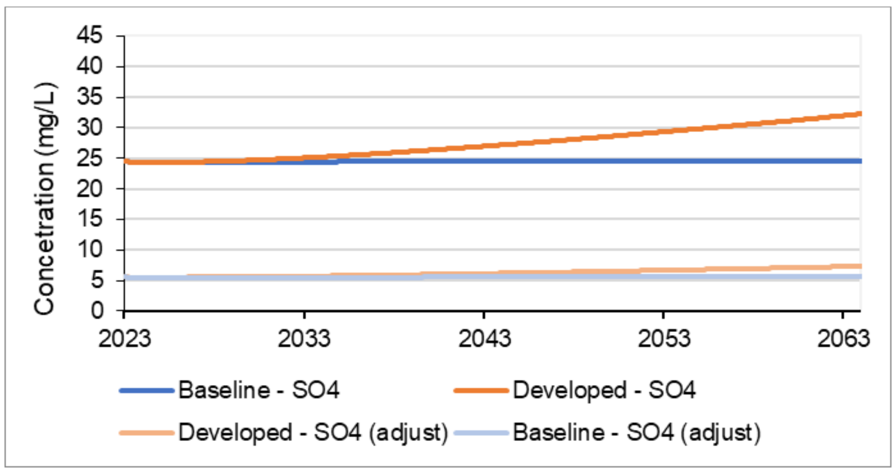
Carters Catchment



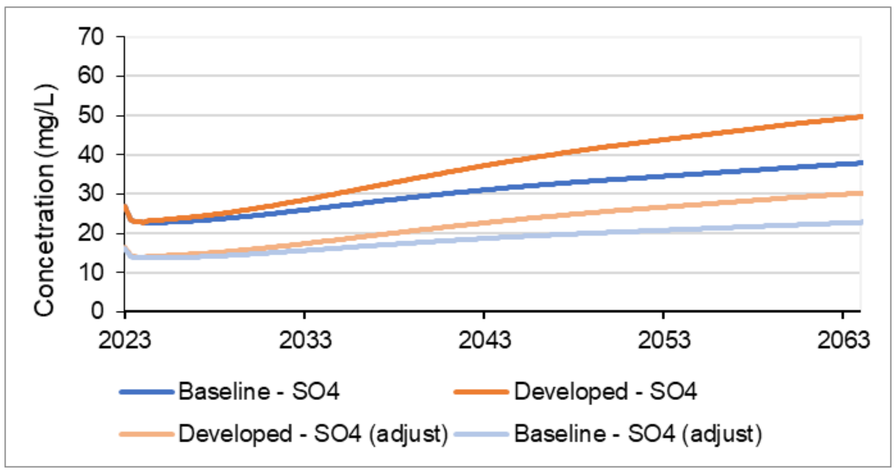
Cemetery Dam Catchment



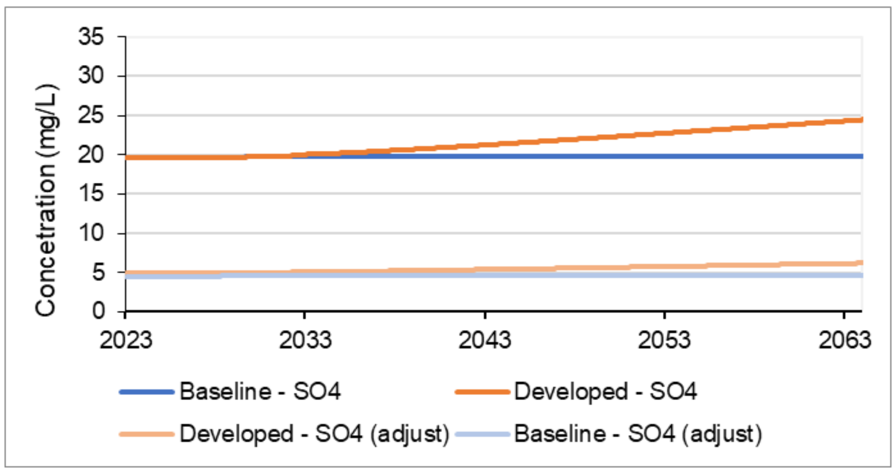
Floyds North Catchment



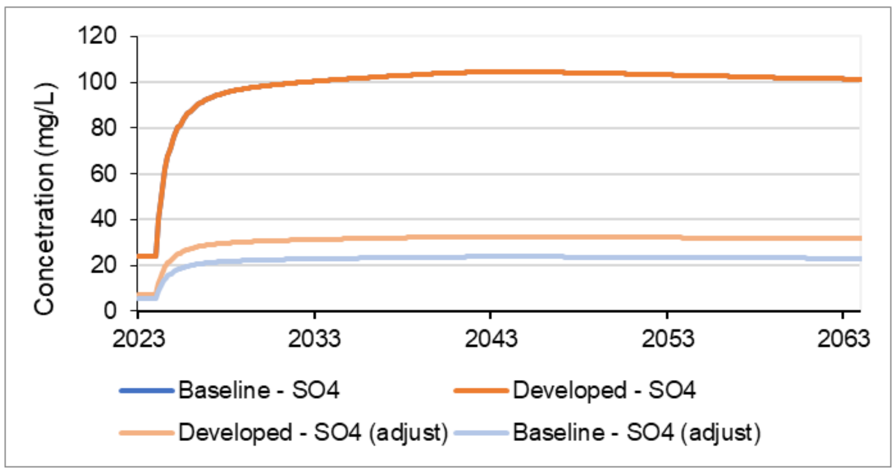
Cascades Gully Catchment Upstream of SWG WRL



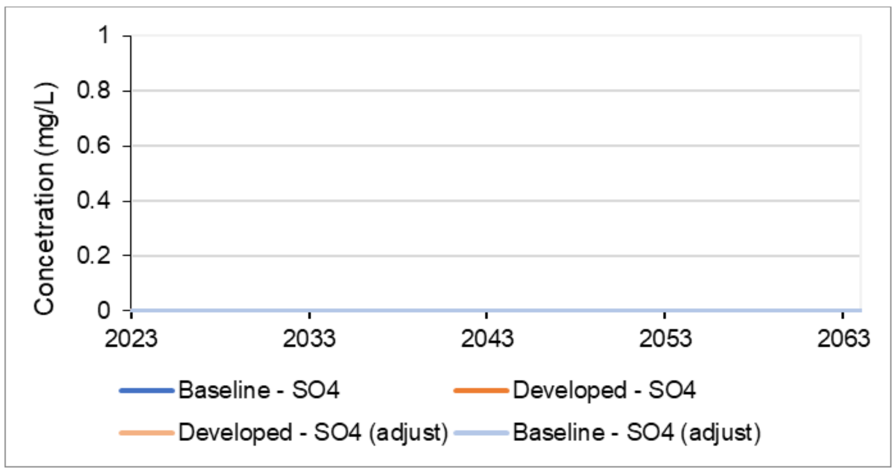
Floyds South Catchment



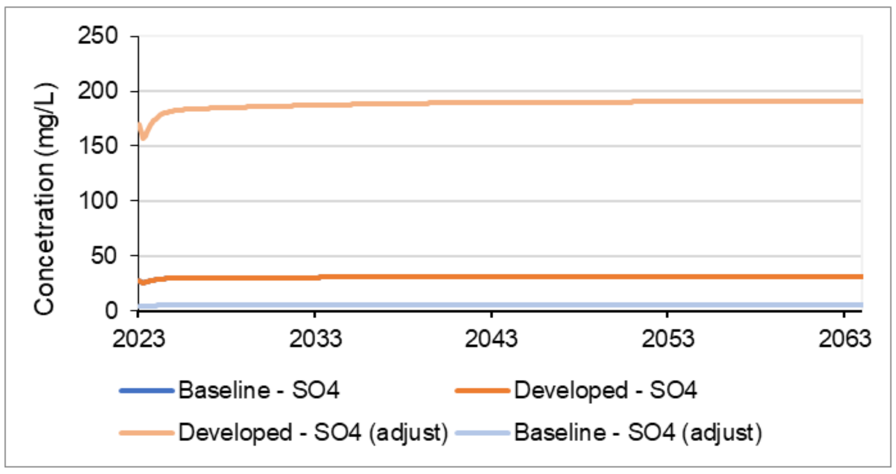
Cascades Gully Catchment at Hester Brook Confluence



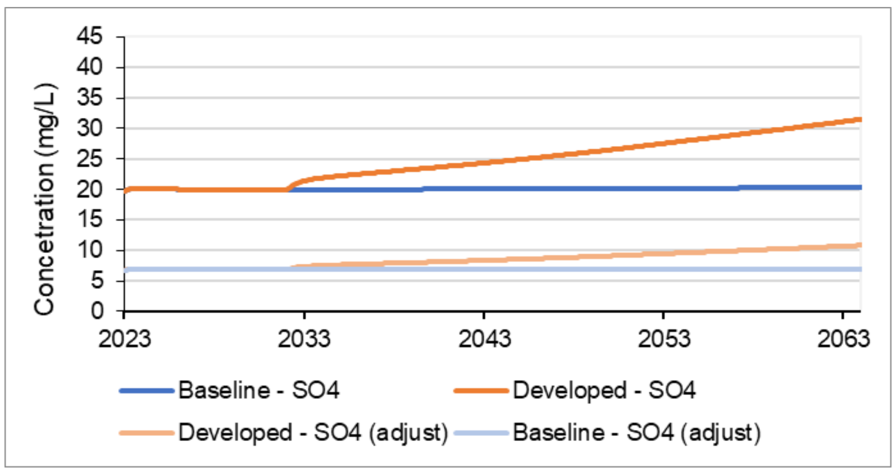
Saltwater Gully Catchment at Monitoring Site



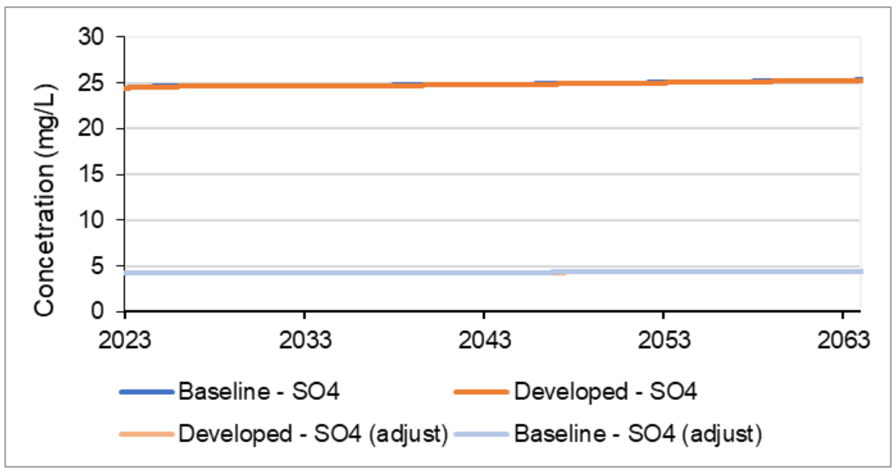
Hester Brook Catchment Upstream of Saltwater Gully Confluence



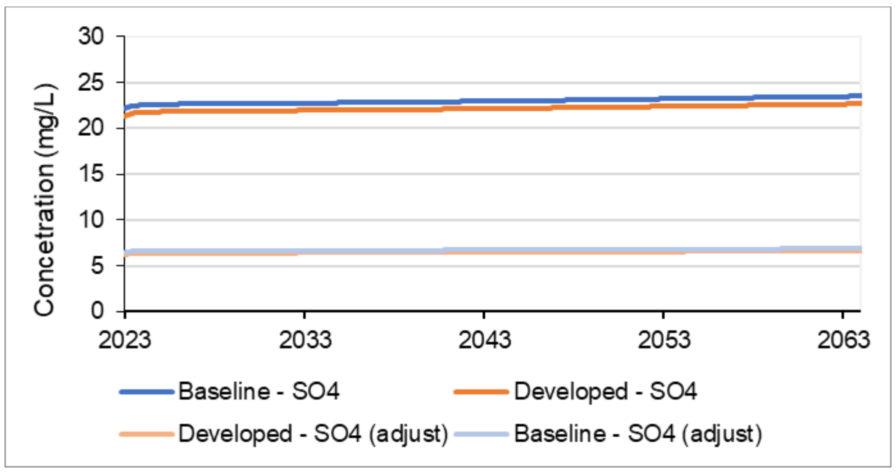
Saltwater Gully Catchment at Hester Brook Confluence



Hester Brook Catchment Upstream of Cascades Gully Confluence



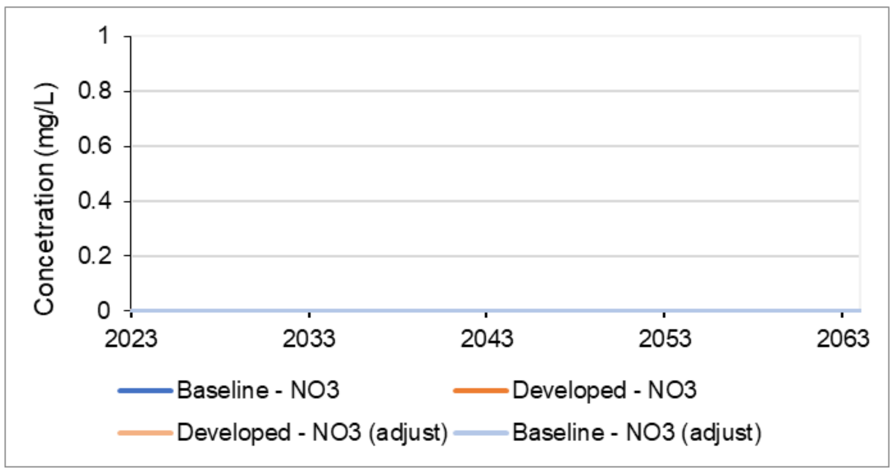
Hester Brook Catchment at Hester Hill



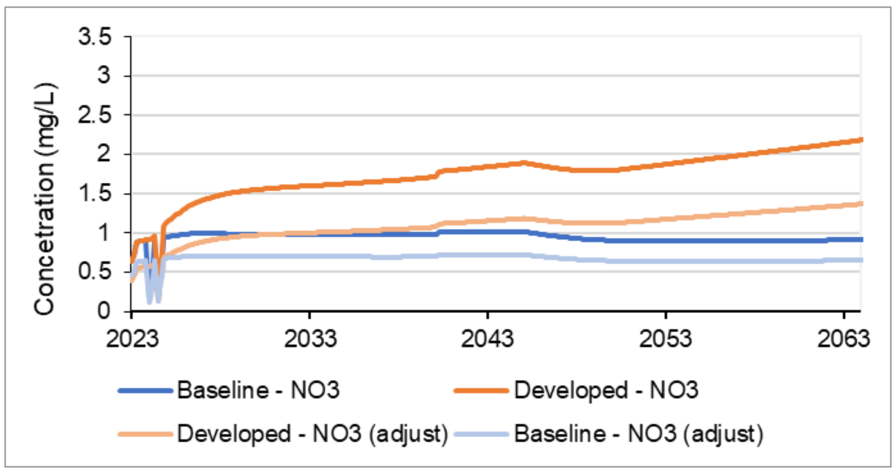
Hester Outlet at Blackwood River

Appendix D

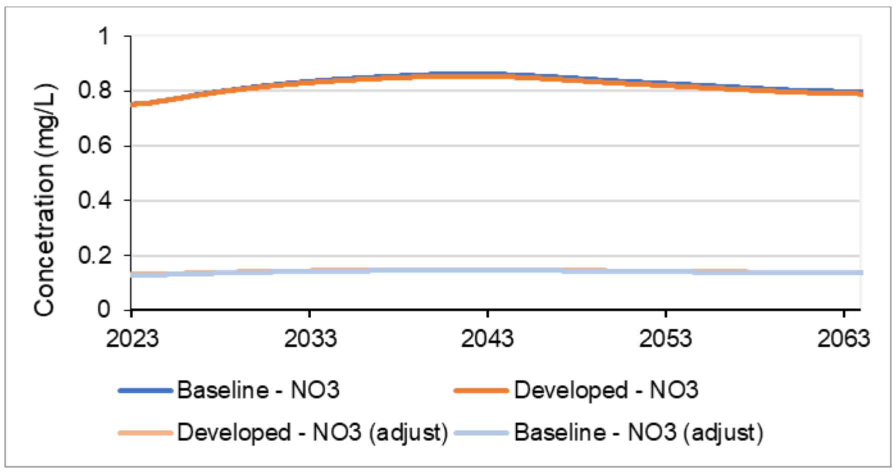
Modelled Groundwater Discharges and Nitrate Concentrations to Surface Water



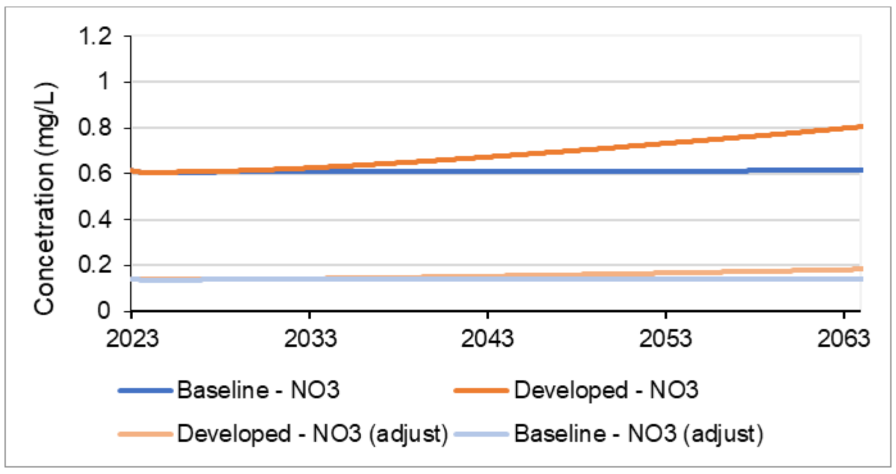
Carters Catchment



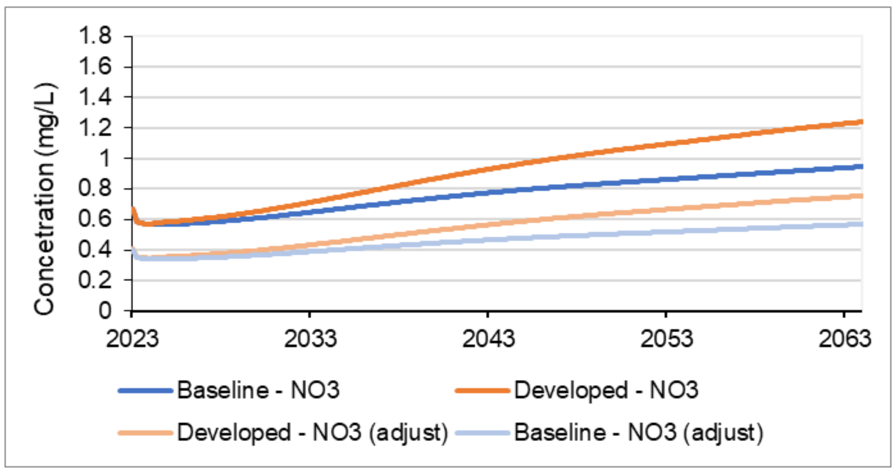
Cemetery Dam Catchment



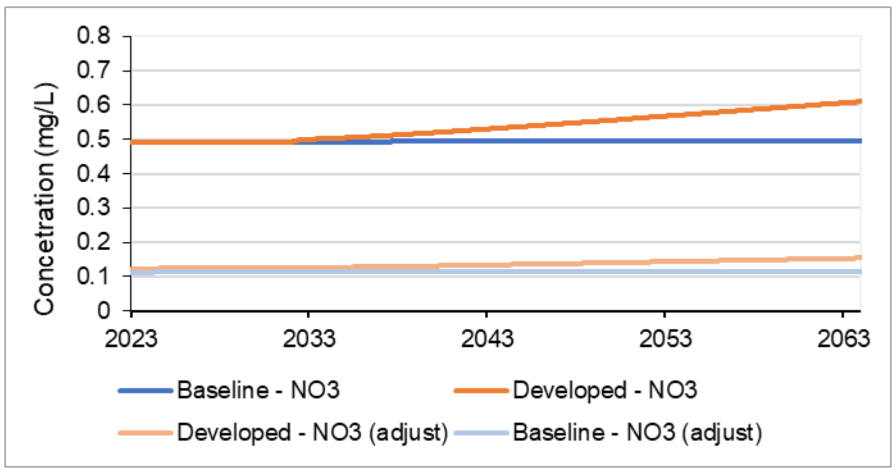
Floyds North Catchment



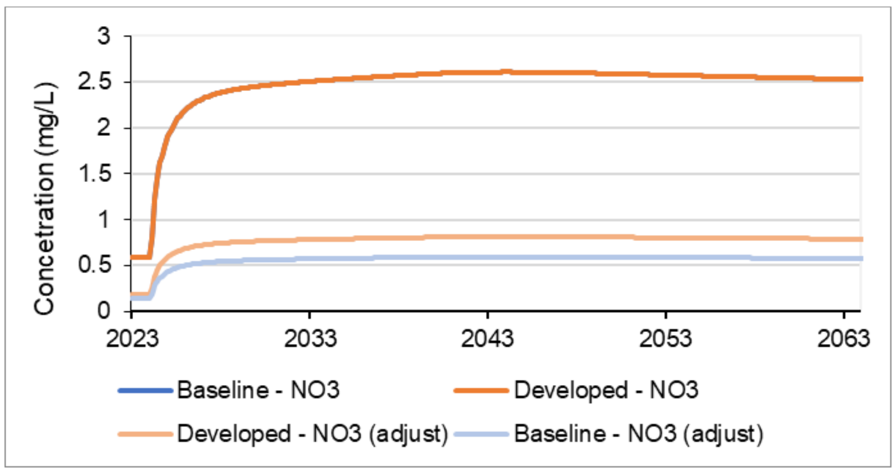
Cascades Gully Catchment Upstream of SWG WRL



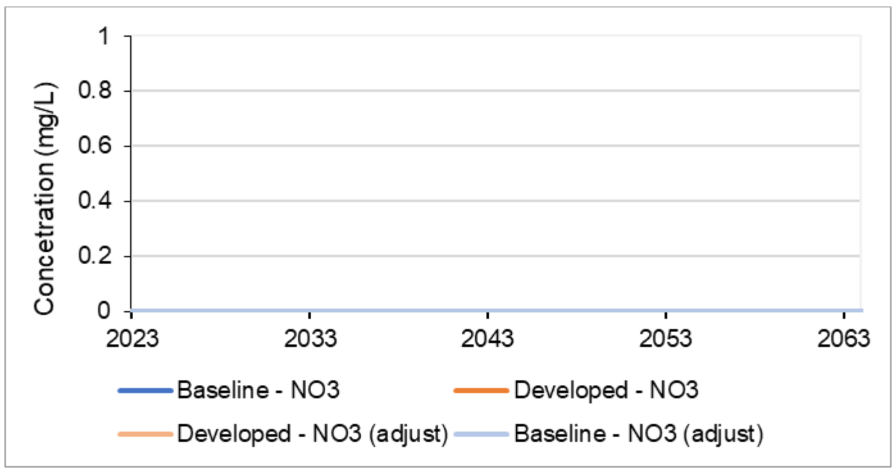
Floyds South Catchment



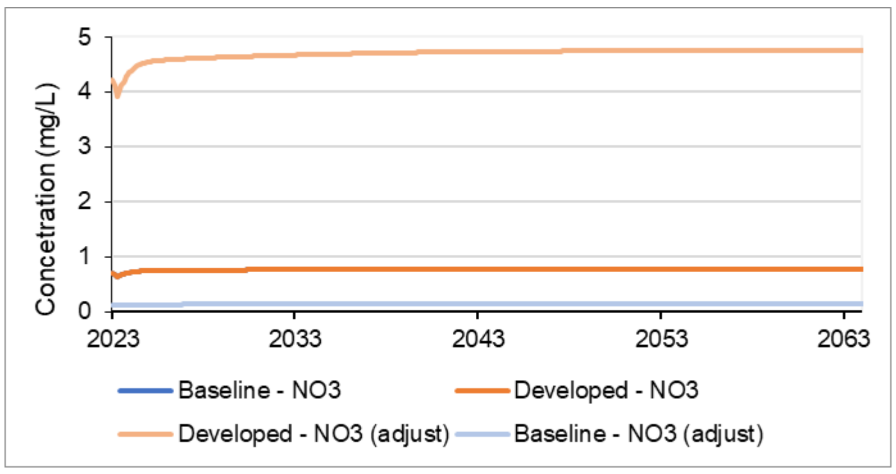
Cascades Gully Catchment at Hester Brook Confluence



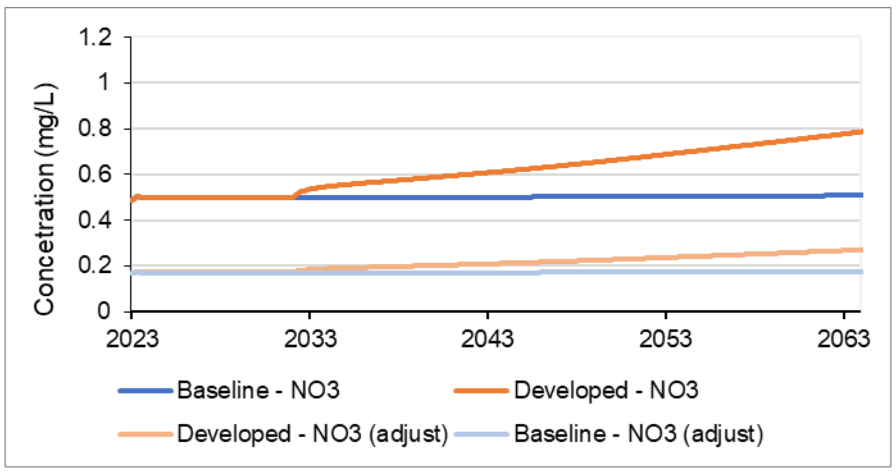
Saltwater Gully Catchment at Monitoring Site



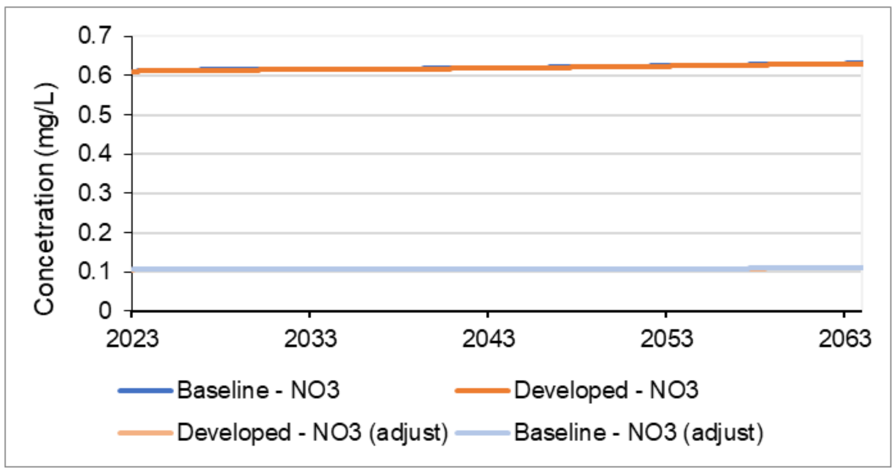
Hester Brook Catchment Upstream of Saltwater Gully Confluence



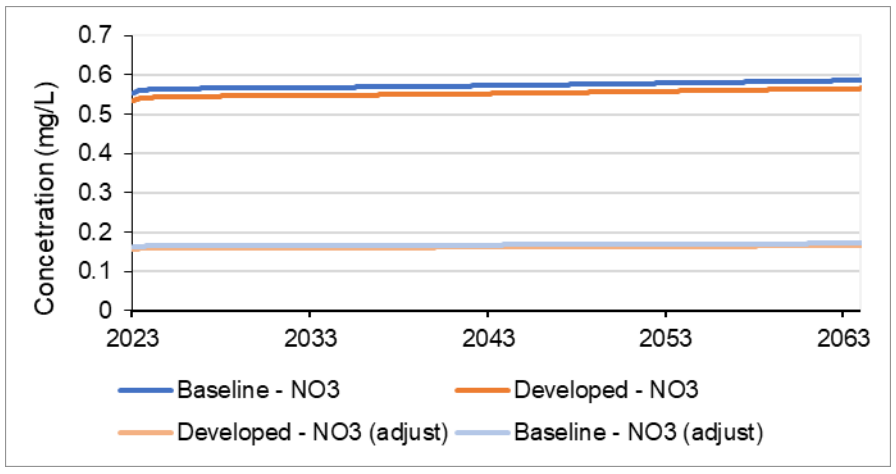
Saltwater Gully Catchment at Hester Brook Confluence



Hester Brook Catchment Upstream of Cascades Gully Confluence



Hester Brook Catchment at Hester Hill

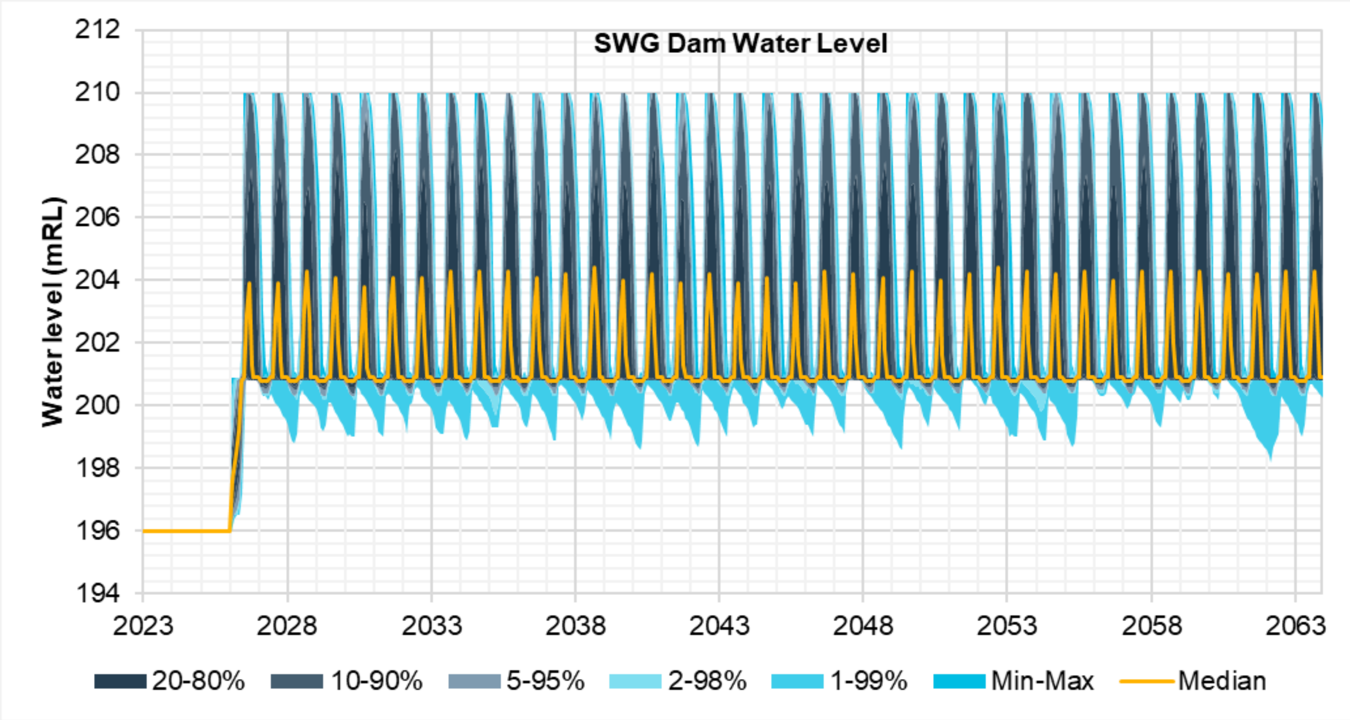


Hester Outlet at Blackwood River

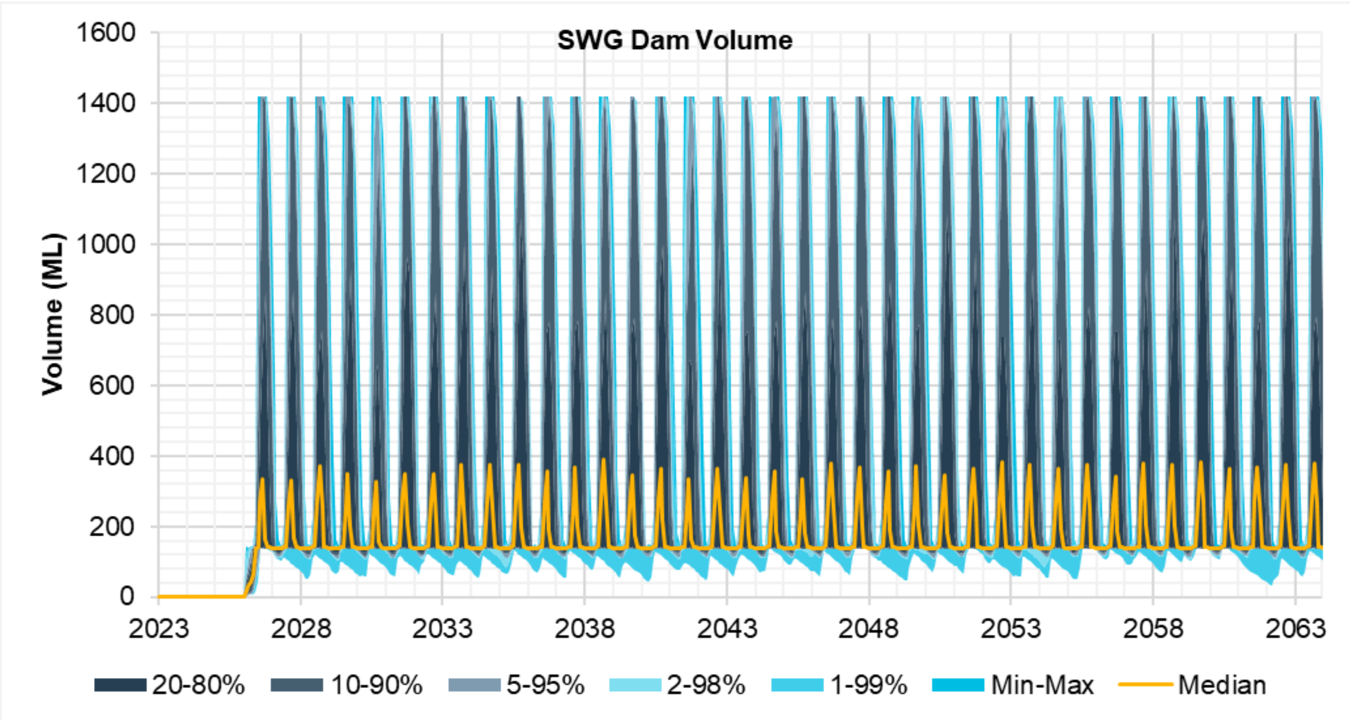
Appendix E

SWG Dam Water Balance Results

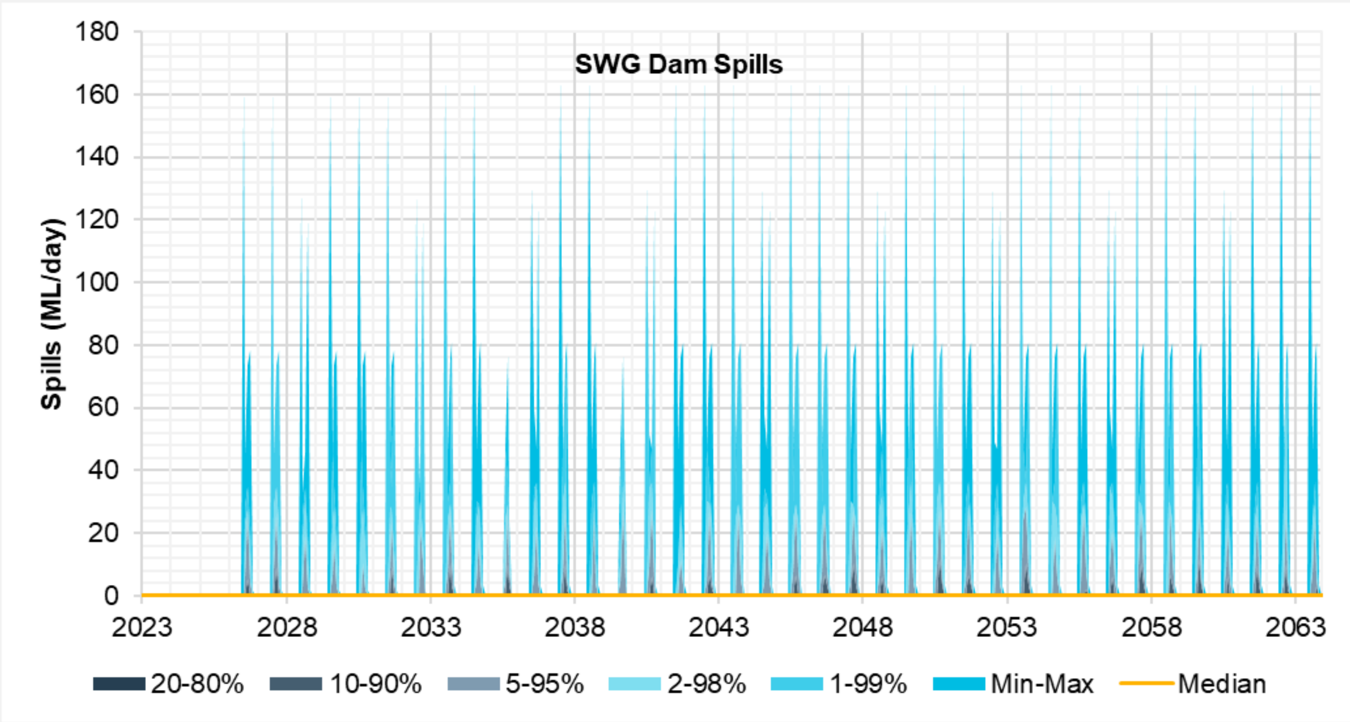
Simulated Daily Water Levels in SWG Dam



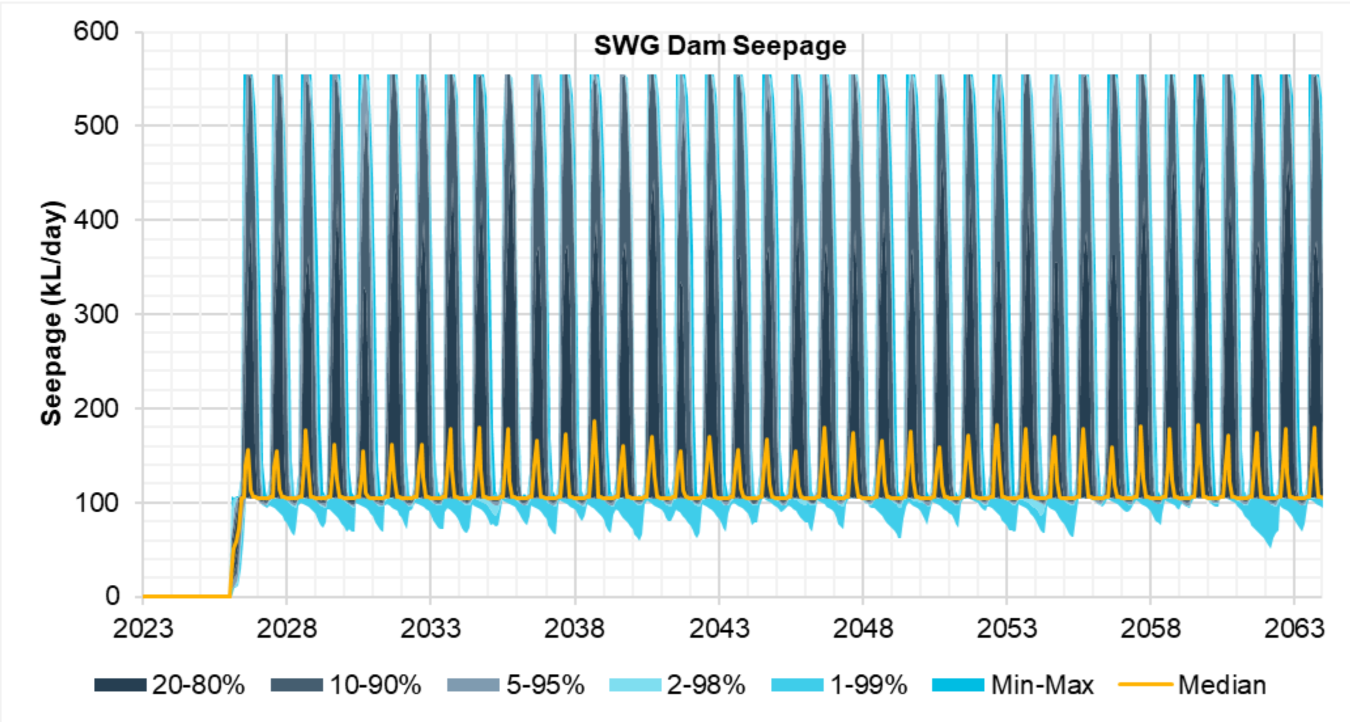
Simulated Daily Water Volumes in SWG Dam



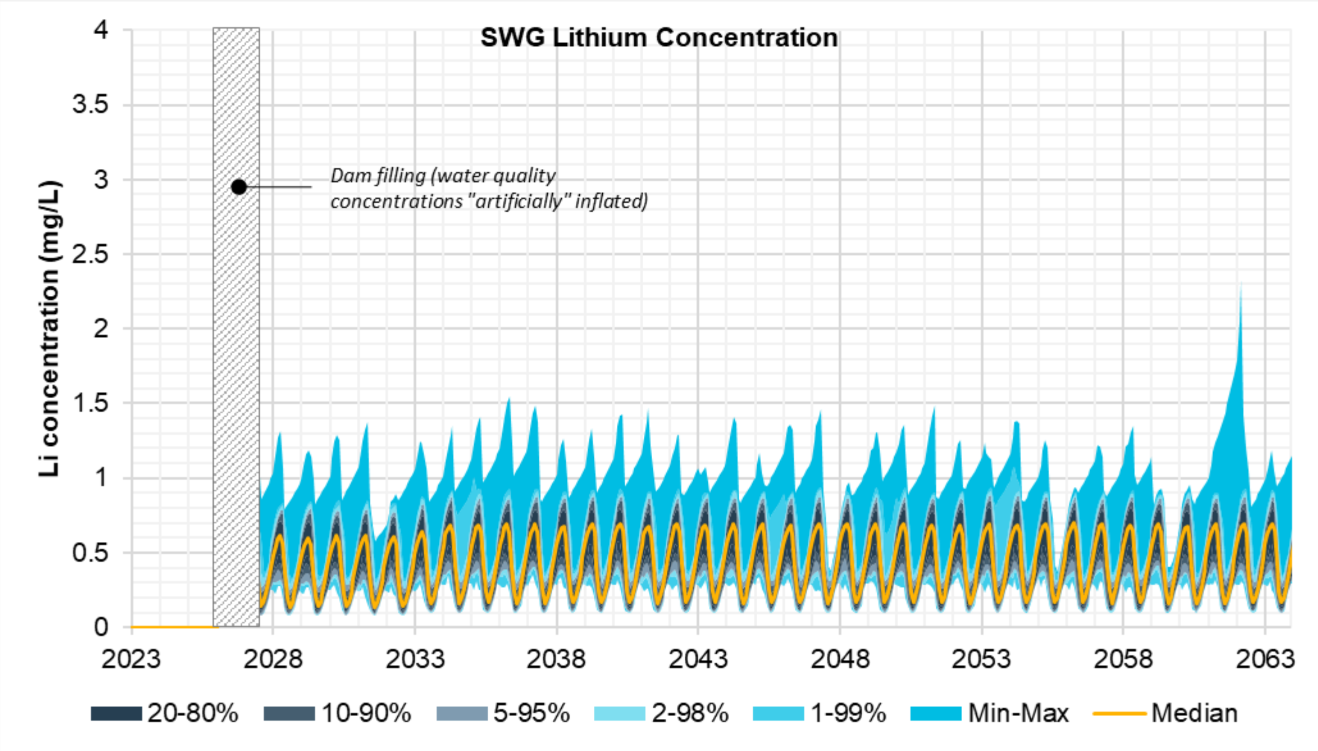
Simulated Daily Spills from SWG Dam



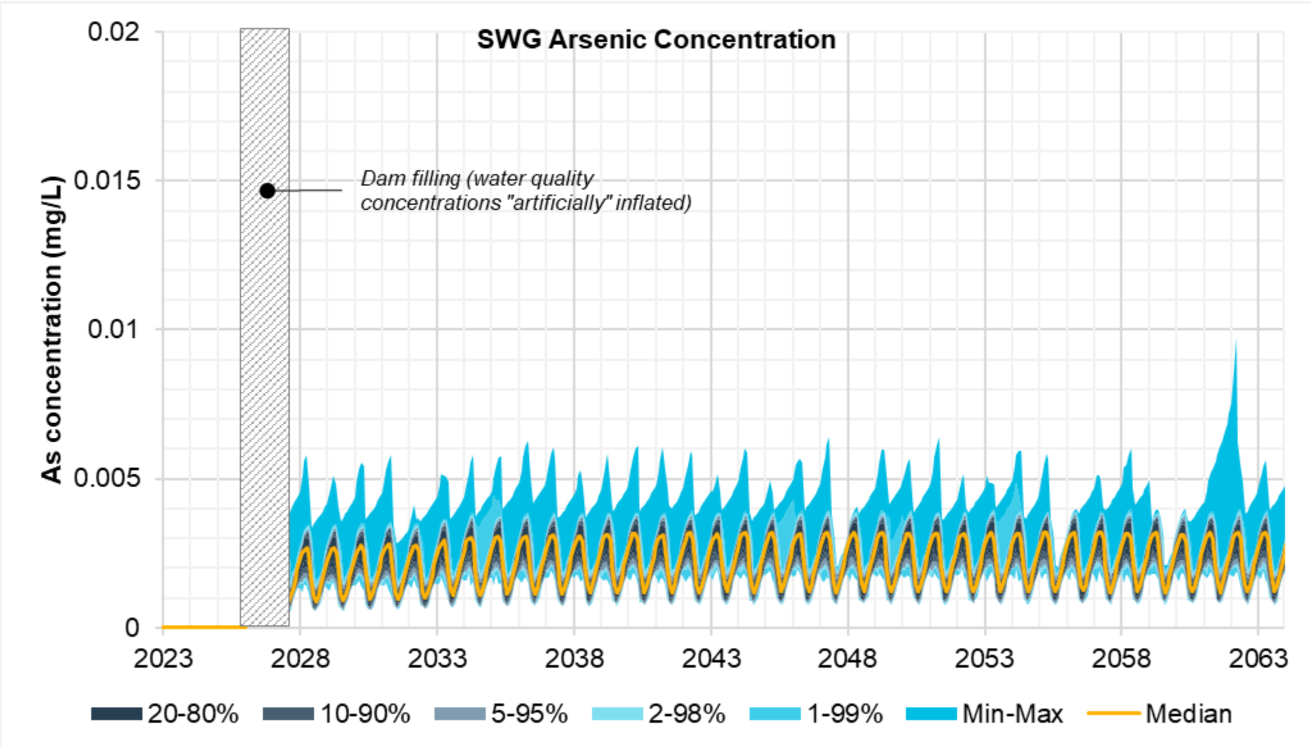
Simulated Daily Seepage Flows from SWG Dam



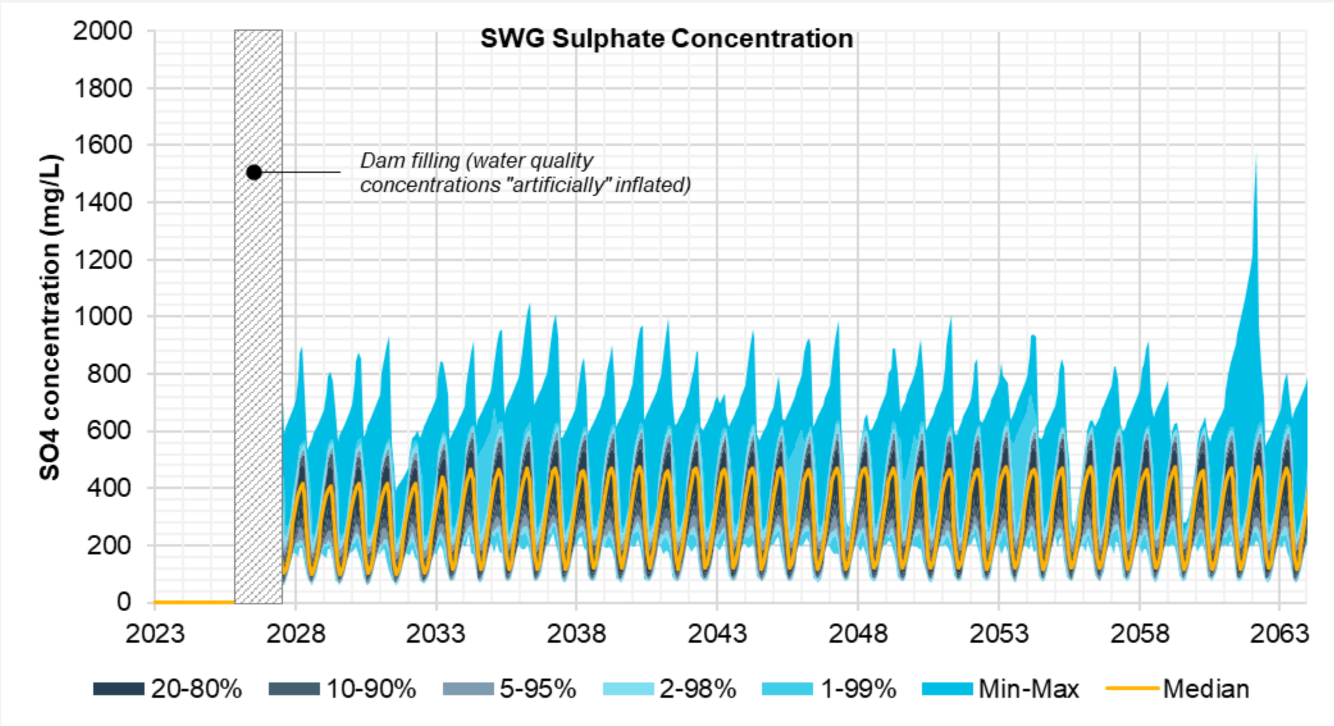
Simulated Lithium Concentrations in SWG Dam



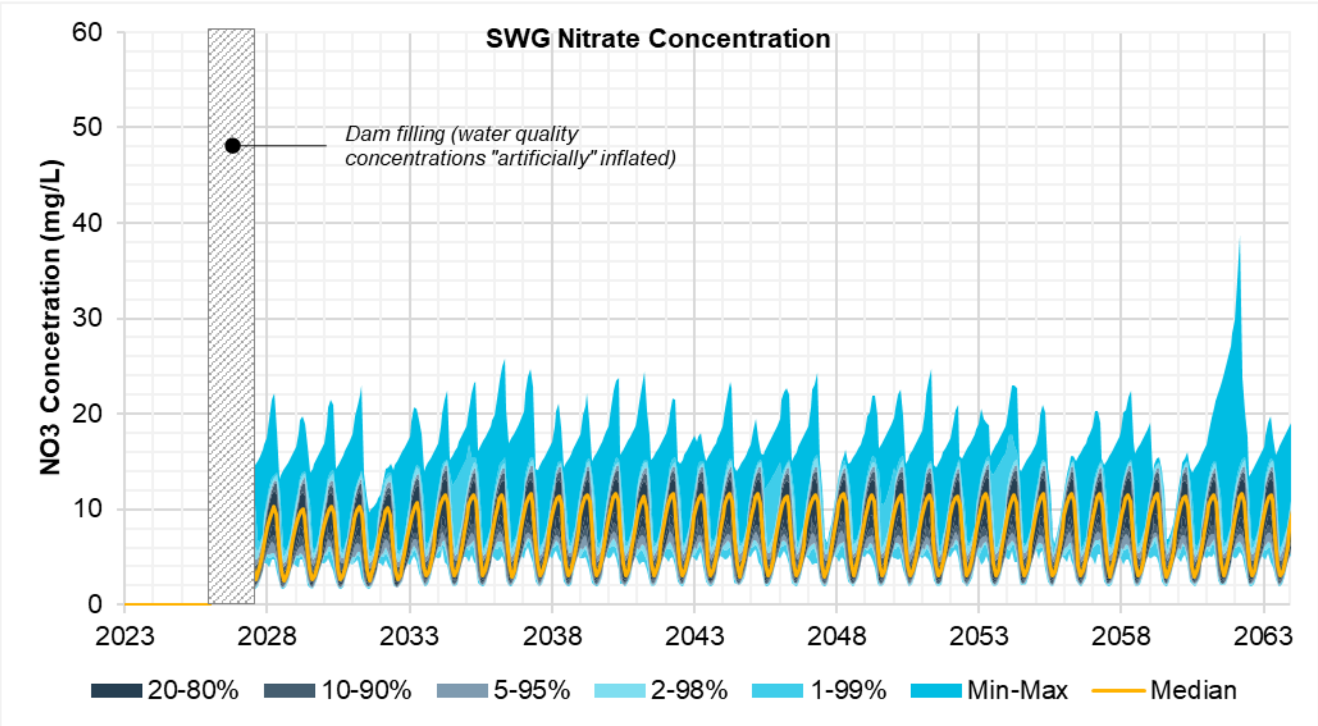
Simulated Arsenic Concentrations in SWG Dam



Simulated Sulphate Concentrations in SWG Dam



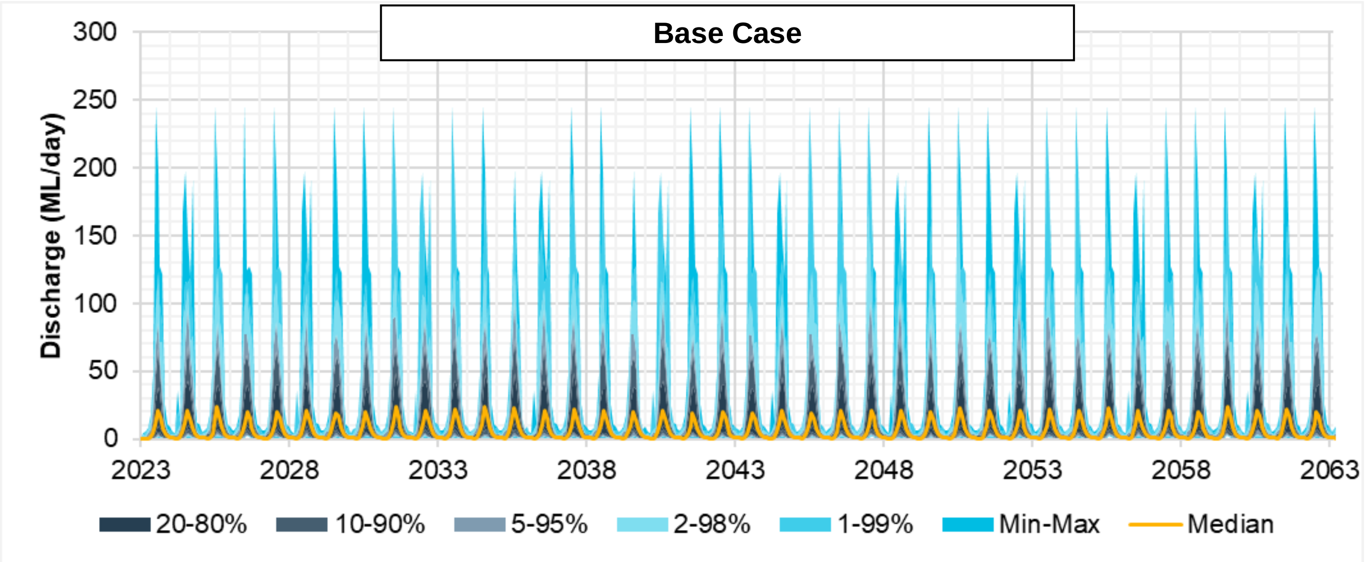
Simulated Nitrate Concentrations in SWG Dam

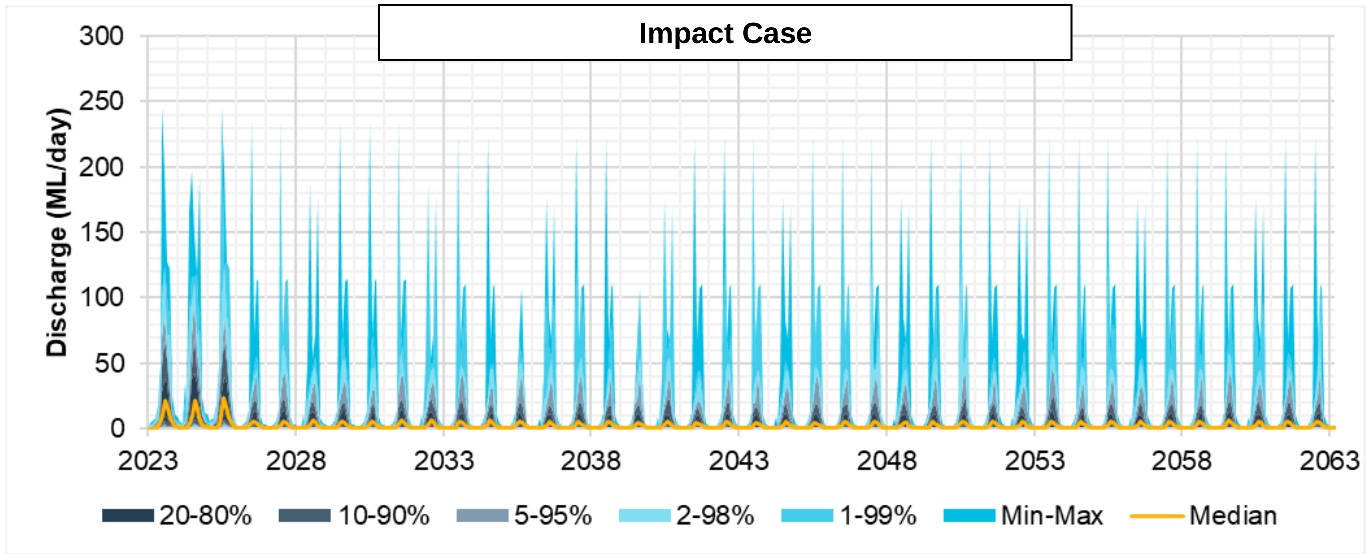


Appendix F

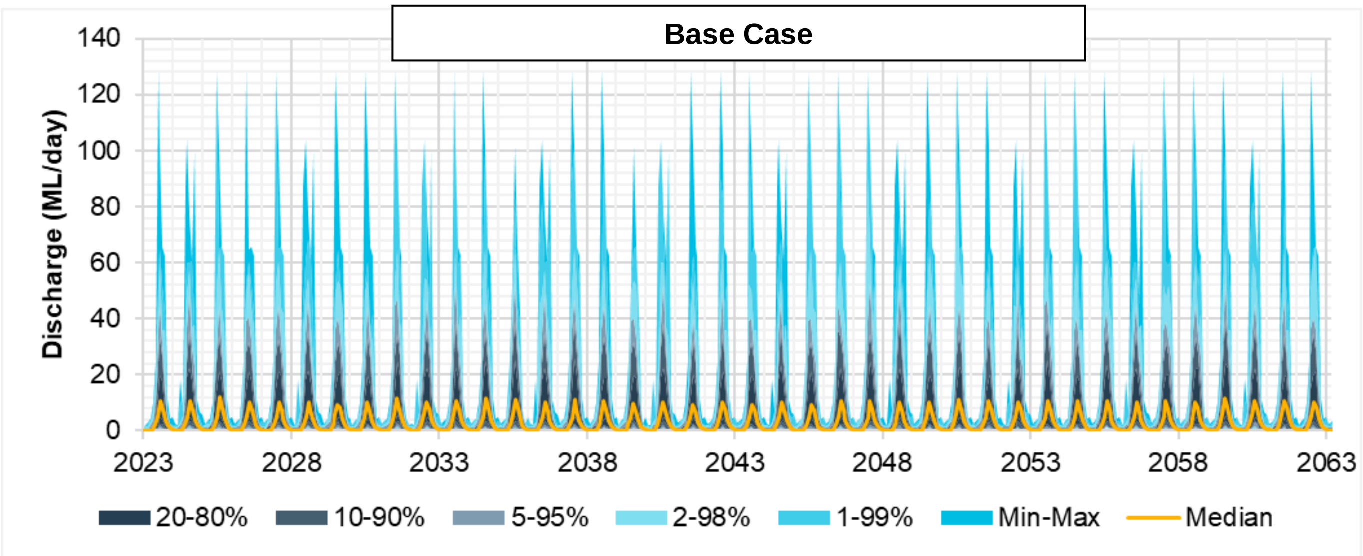
Simulated Streamflow

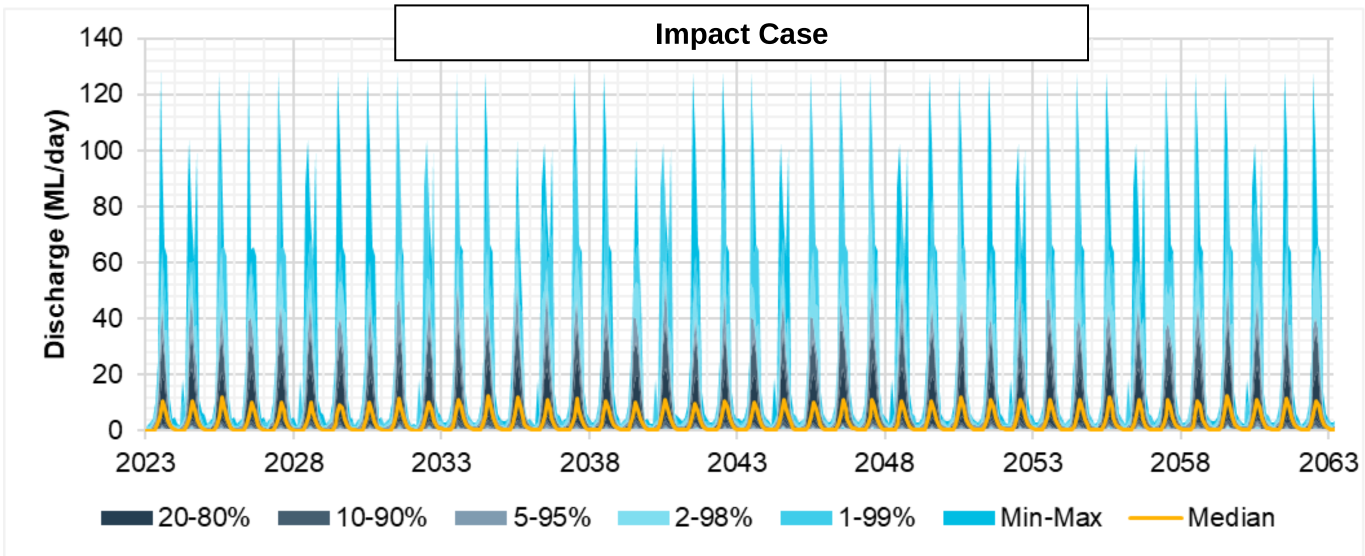
Simulated Daily Streamflow at Saltwater Gully Outlet to Hester Brook



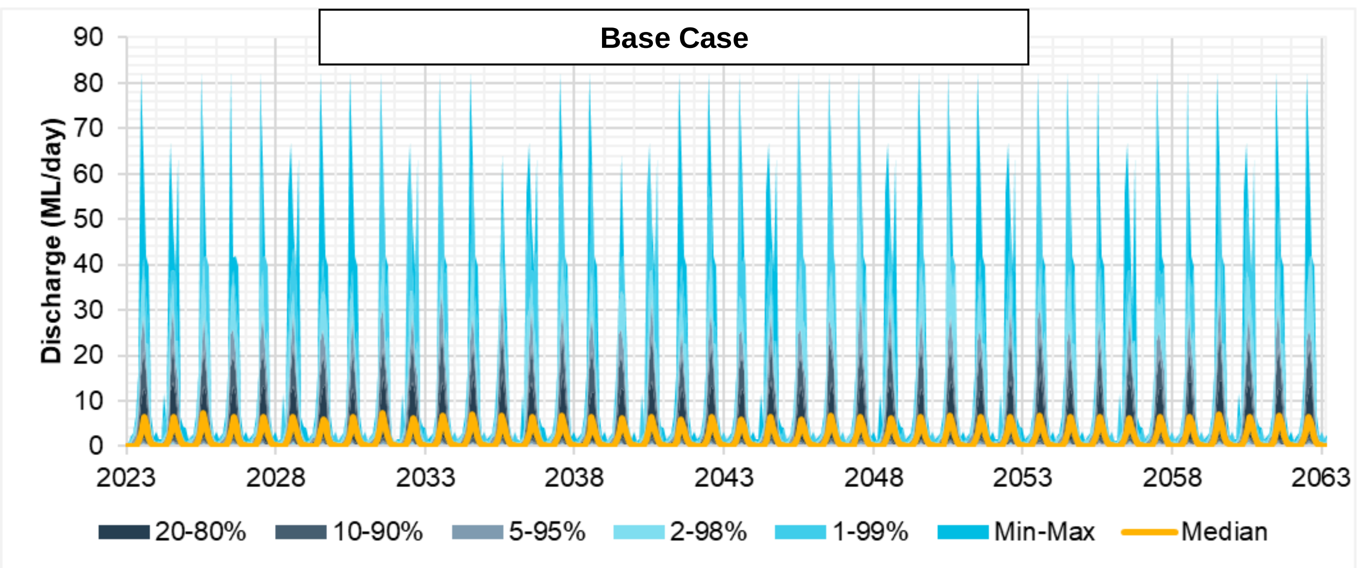


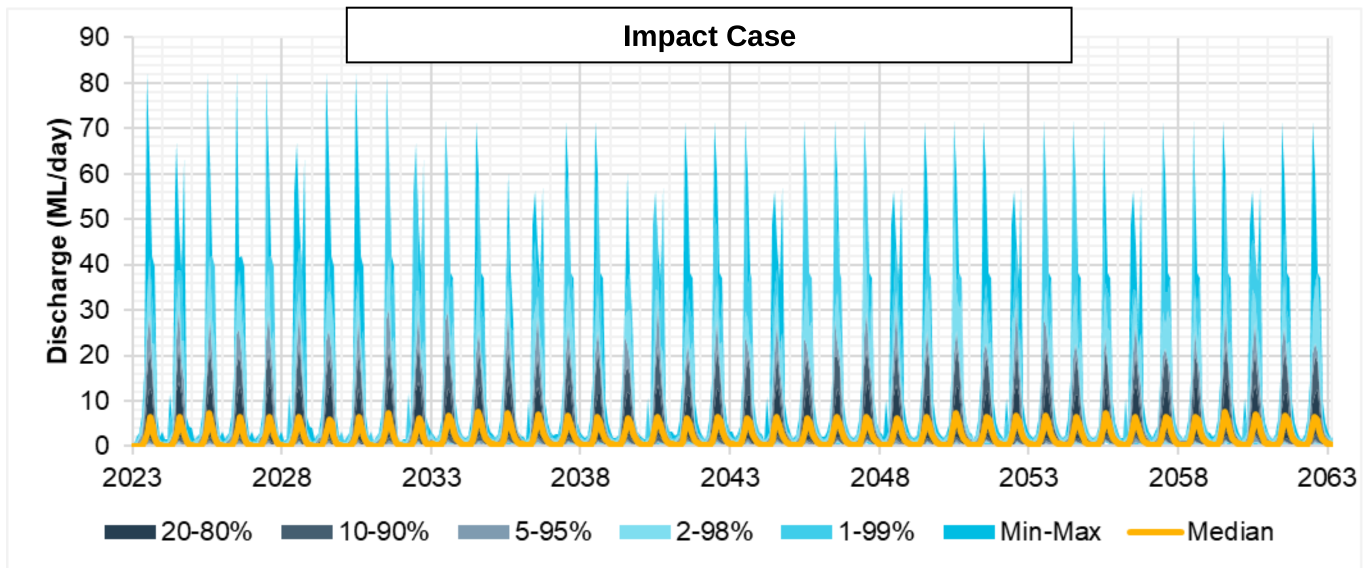
Simulated Daily Streamflow at Cascade Gully Outlet to Hester Brook



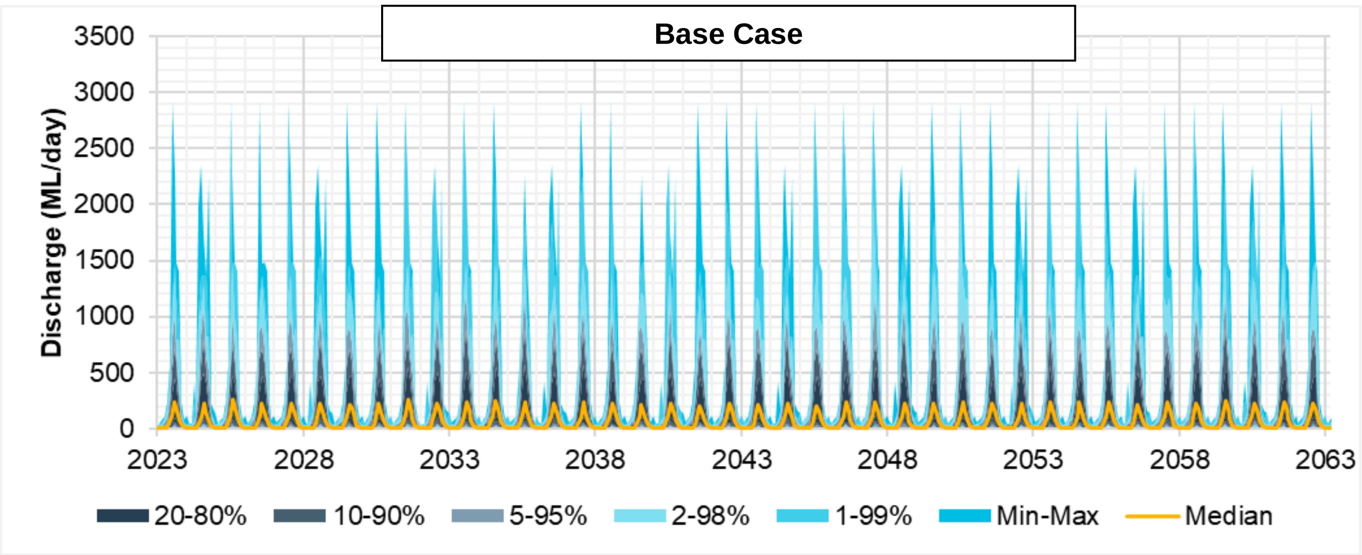


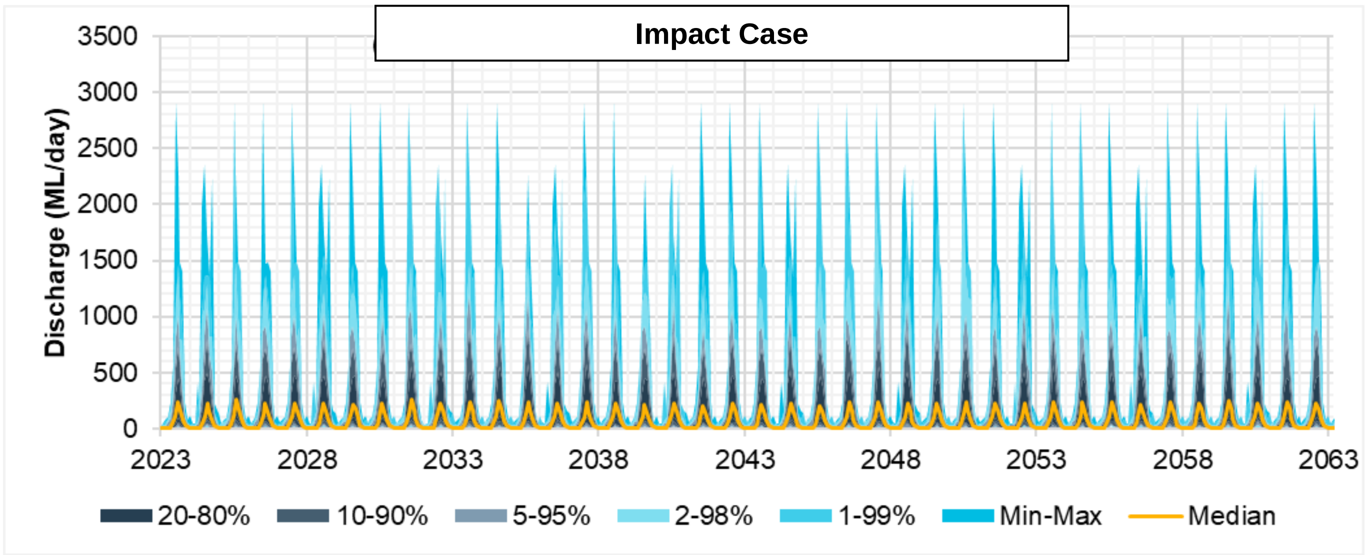
Simulated Daily Streamflow in Hester Brook, between Saltwater Gully and Cascade Gully (incremental)



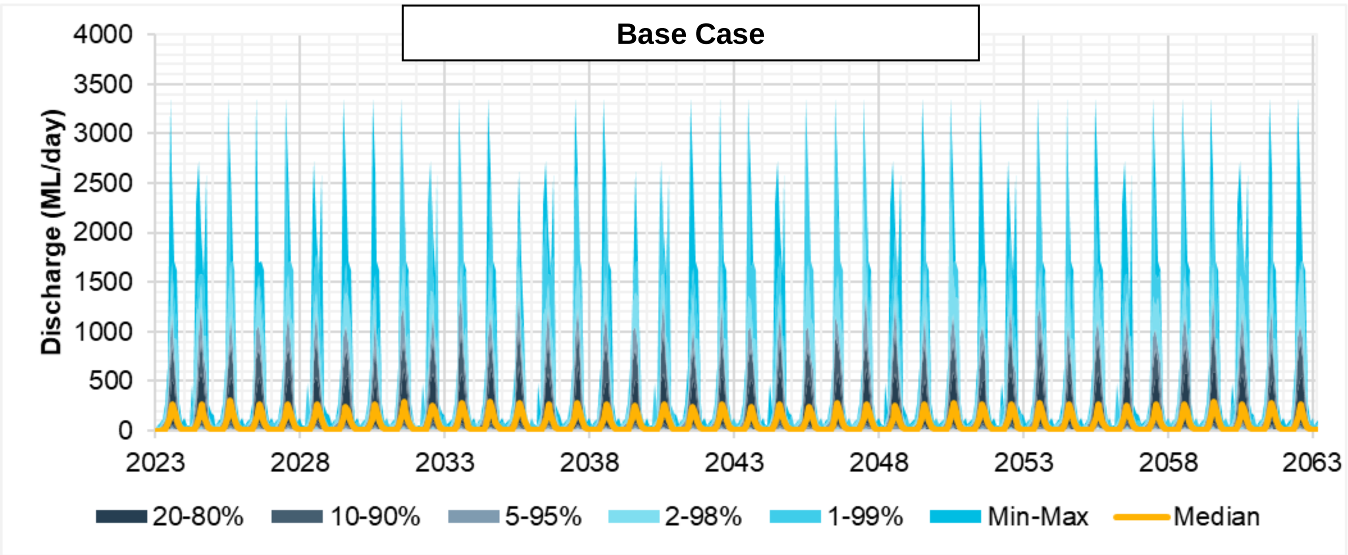


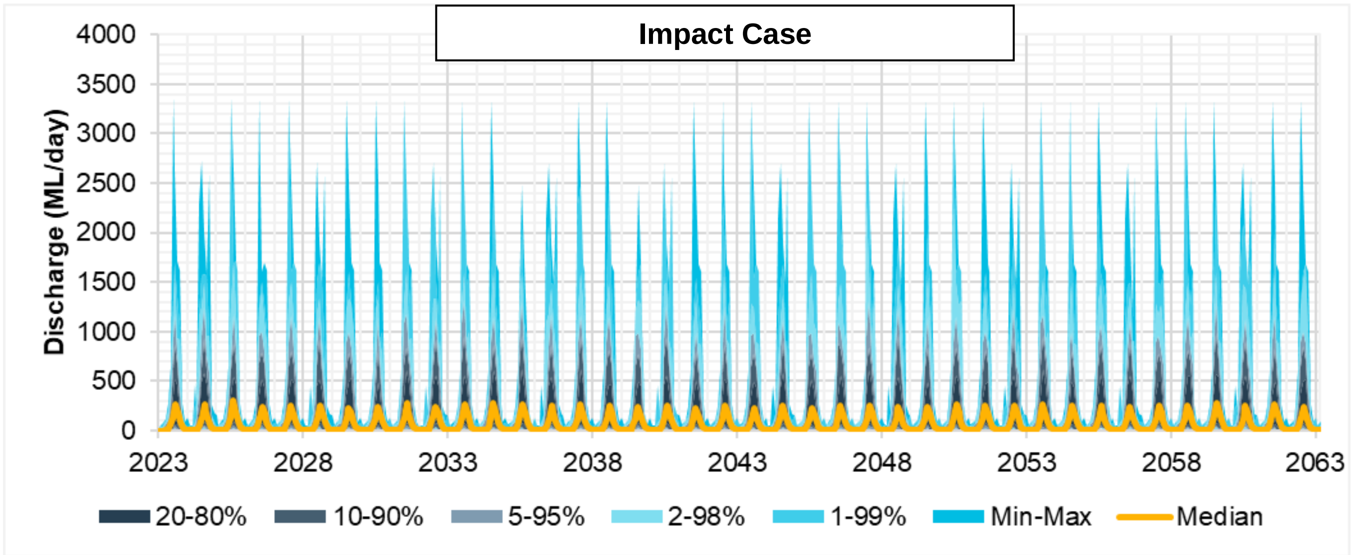
Simulated Daily Streamflow in Hester Brook, upstream of Saltwater Gully Confluence



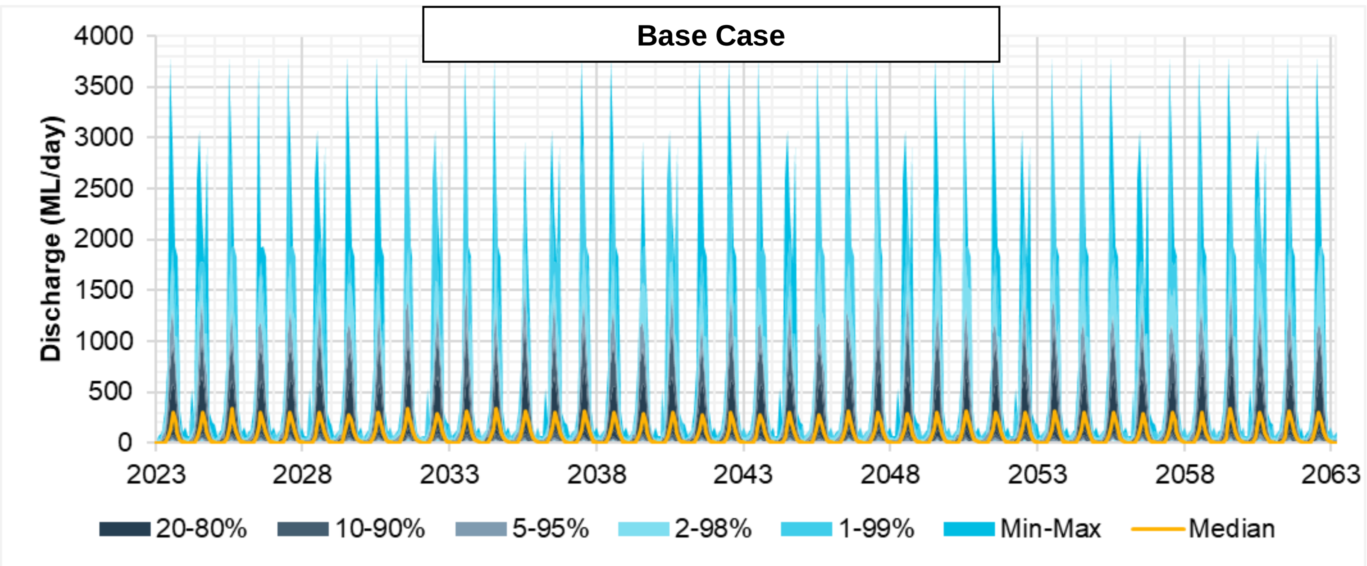


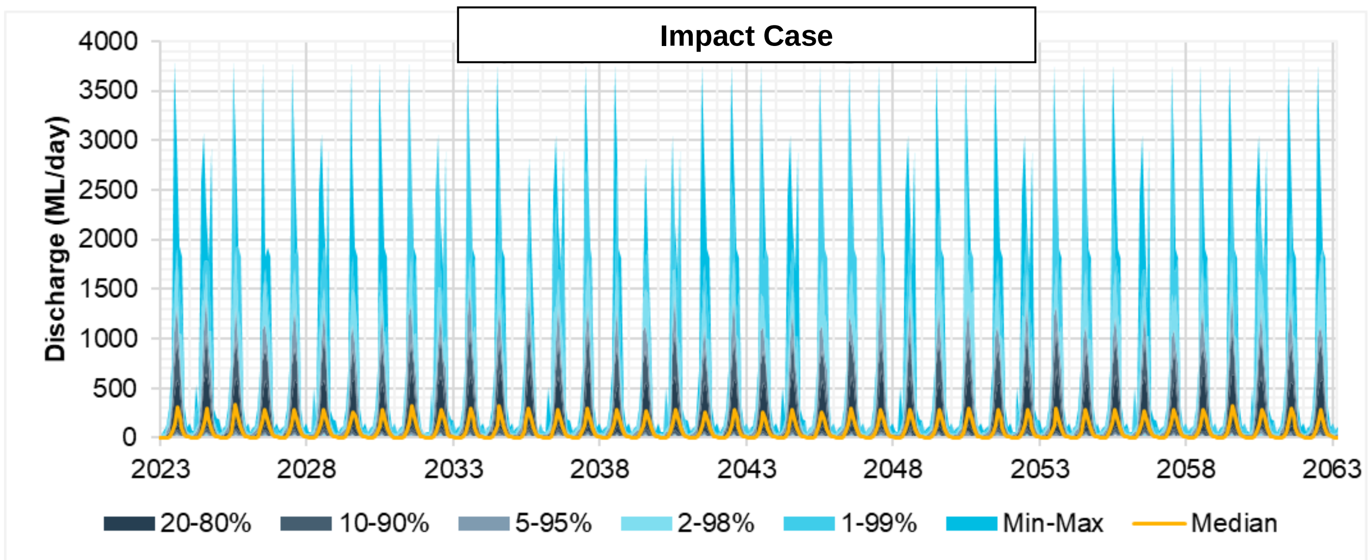
Simulated Daily Streamflow in Hester Brook at Cascade Gully Confluence





Simulated Daily Streamflow at Hester Hill

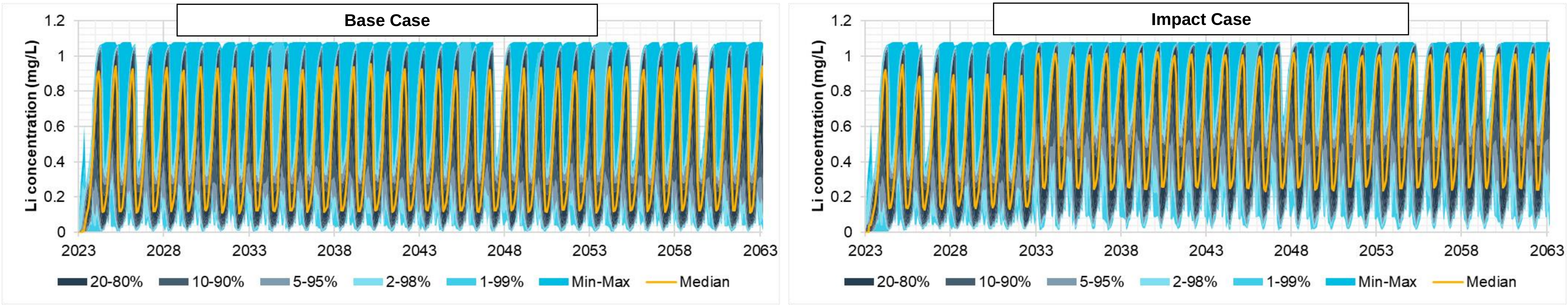




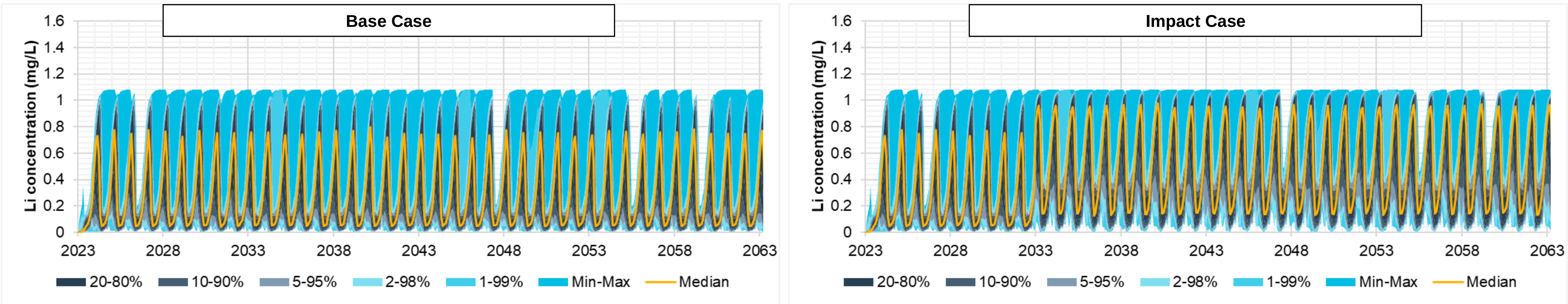
Appendix G

Simulated Lithium Concentrations

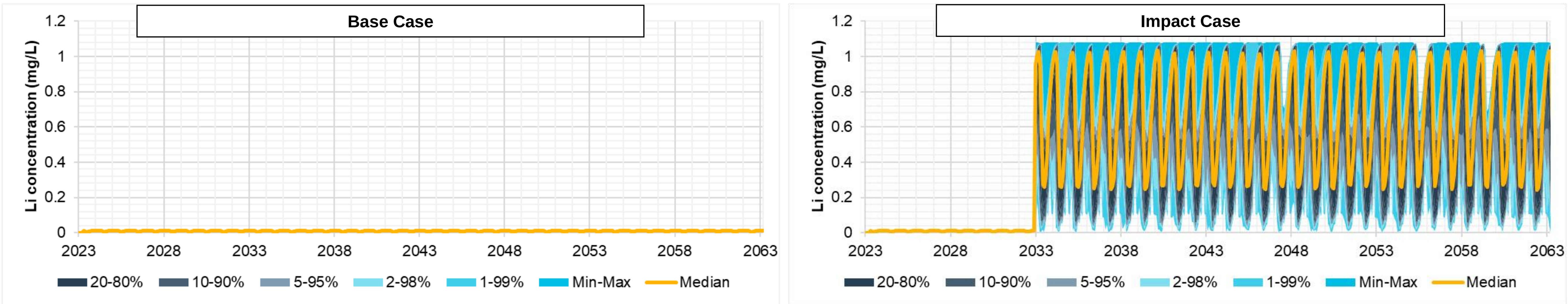
Simulated Daily Lithium Concentrations at Saltwater Gully Outlet to Hester Brook



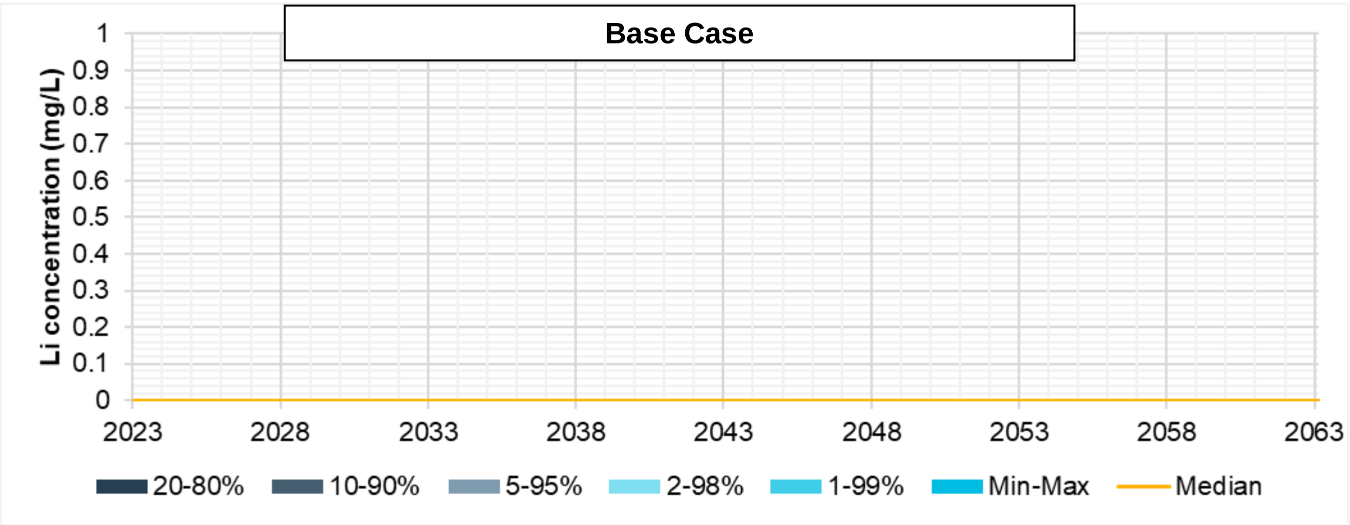
Simulated Daily Lithium Concentrations at Cascade Gully Outlet to Hester Brook

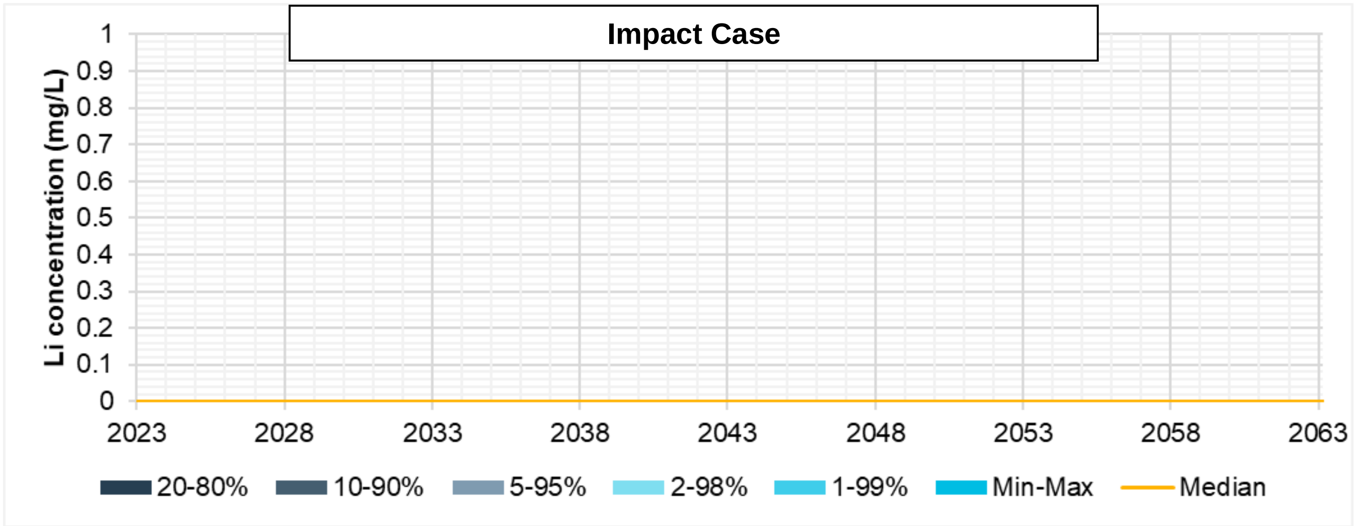


Simulated Daily Lithium Concentrations in Hester Brook, between Saltwater Gully and Cascade Gully (incremental)

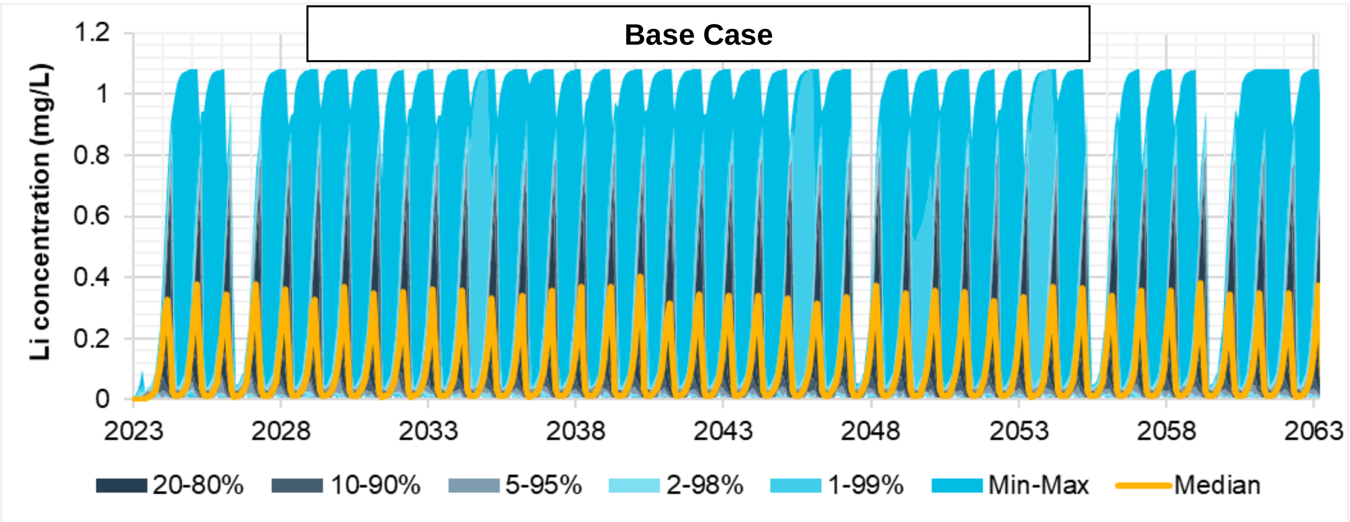


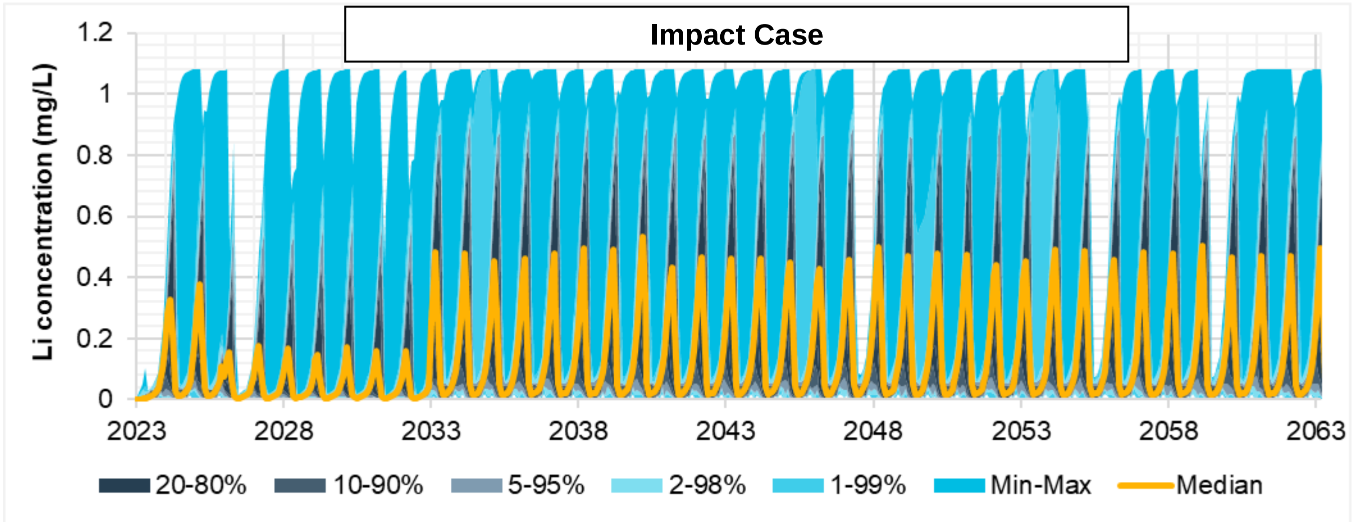
Simulated Daily Lithium Concentrations in Hester Brook, upstream of Saltwater Gully Confluence



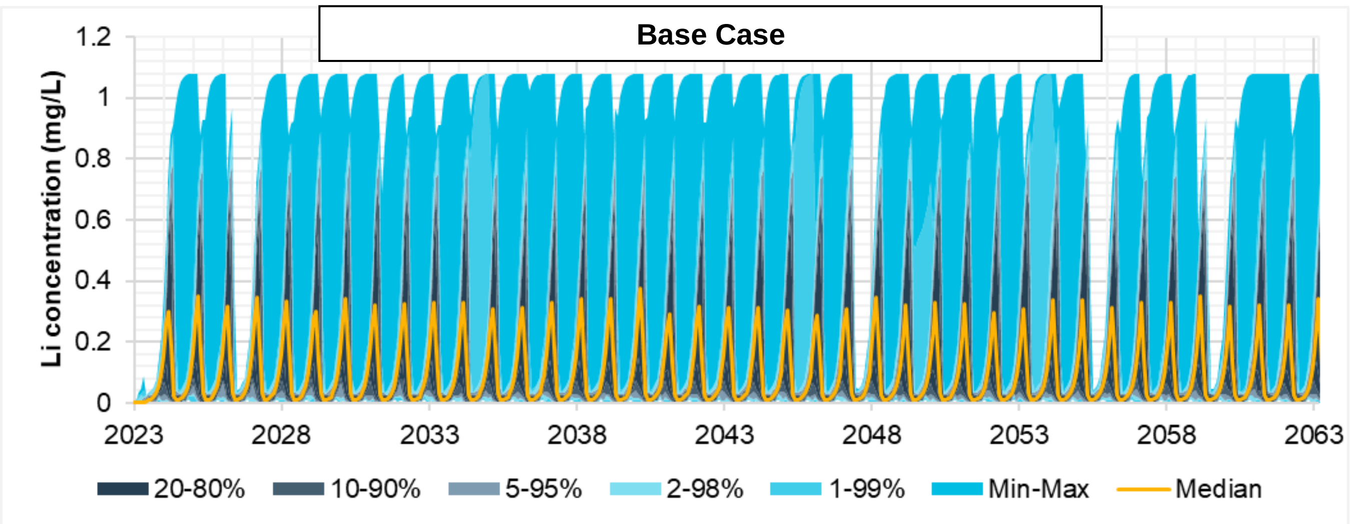


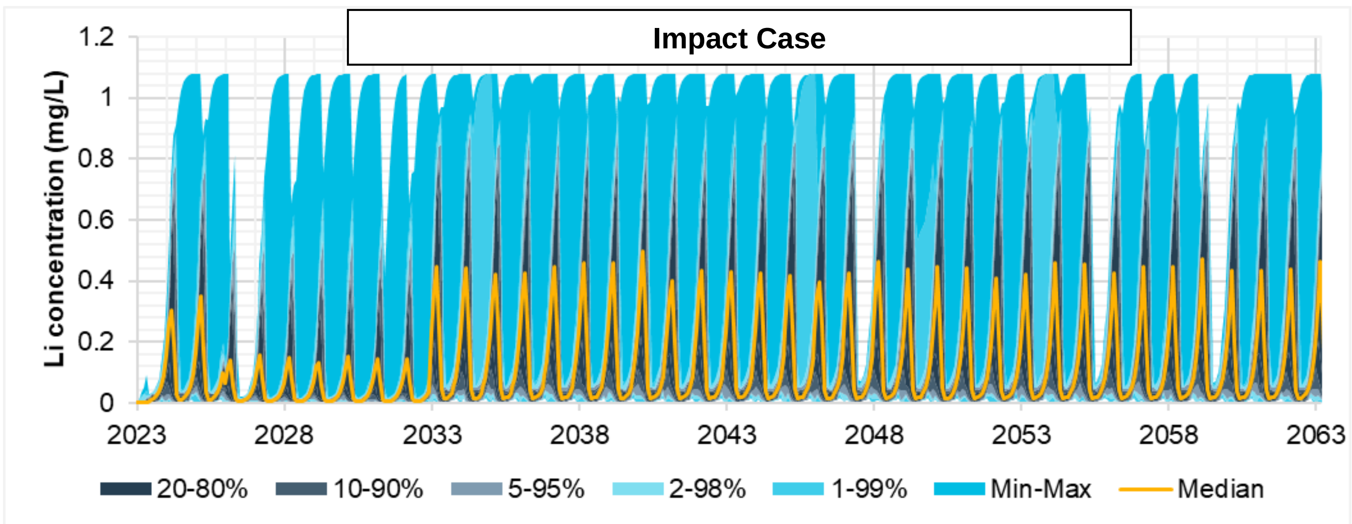
Simulated Daily Lithium Concentrations in Hester Brook at Cascade Gully Confluence



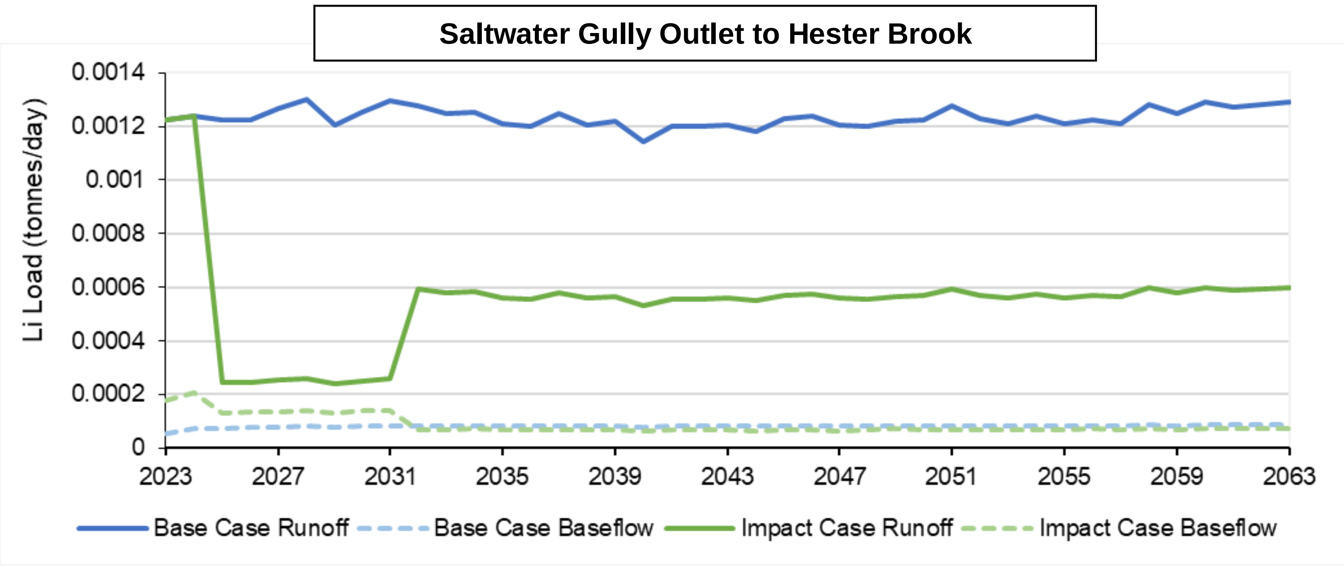


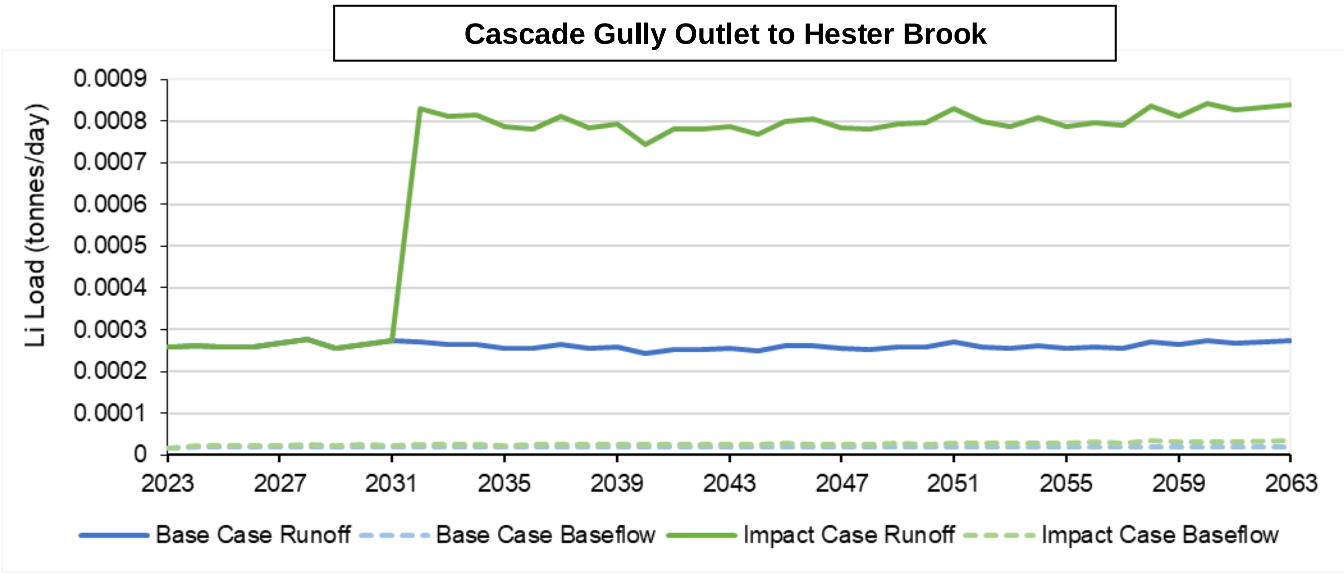
Simulated Daily Lithium Concentrations at Hester Hill

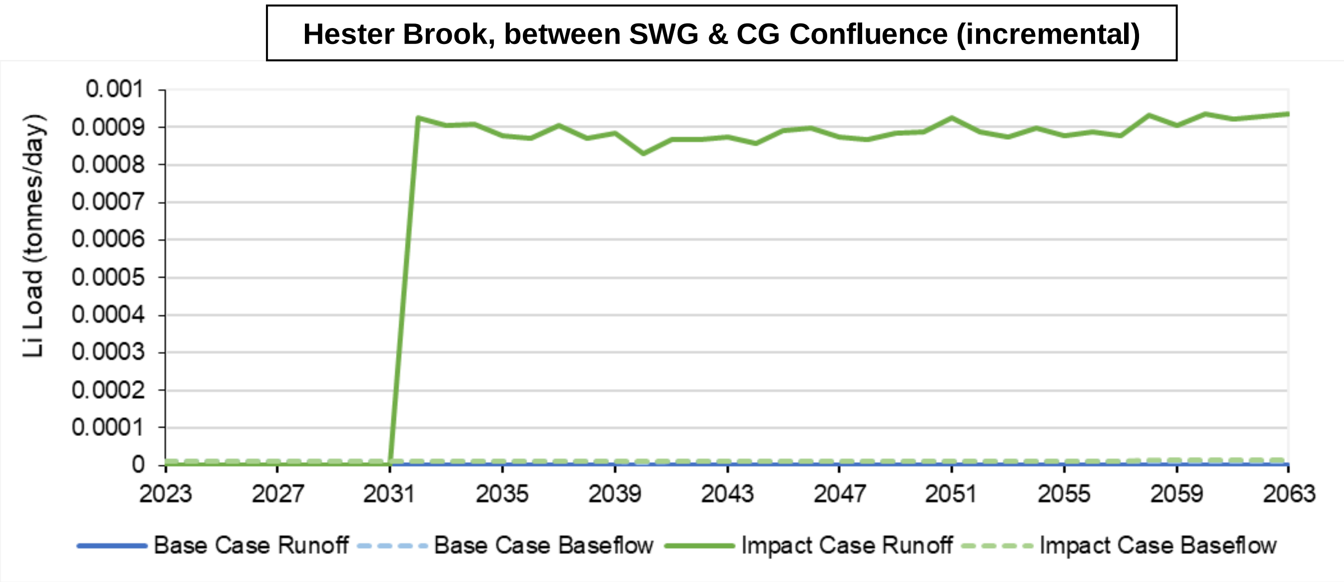


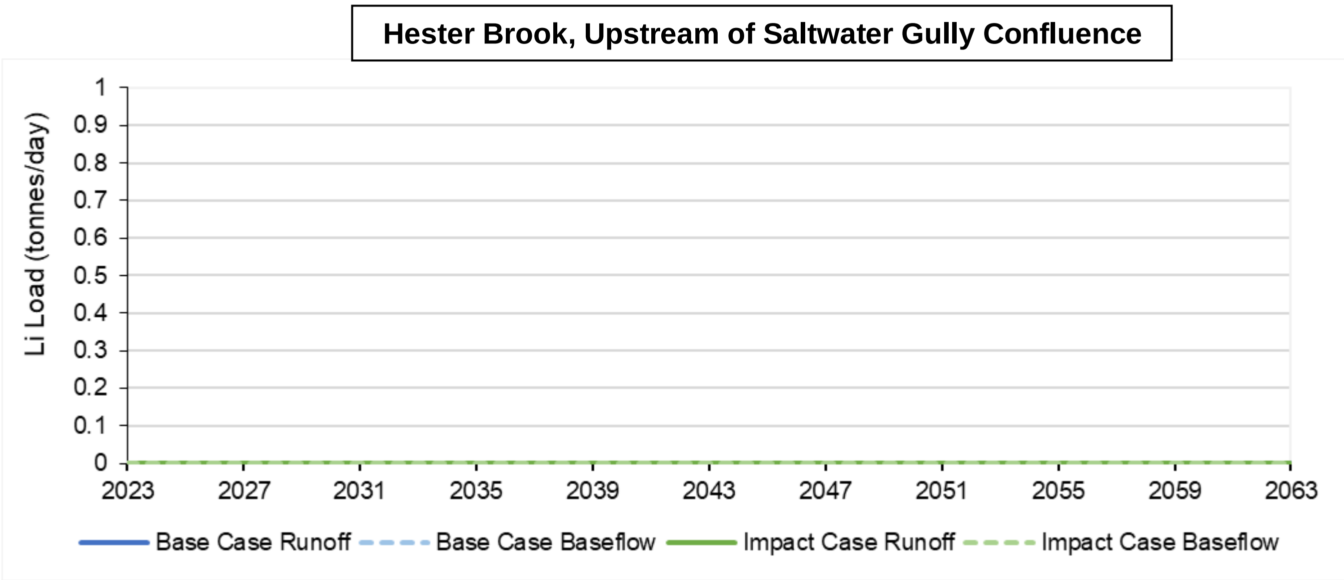


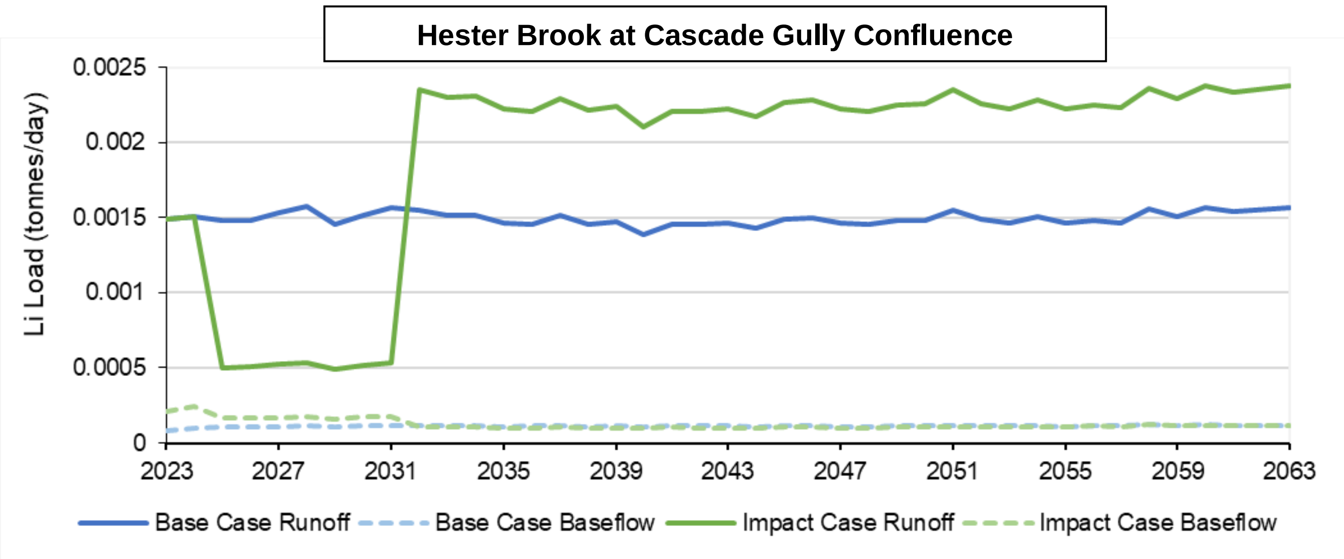
Simulated Daily Lithium Loads – Runoff vs Baseflow (Median Result)

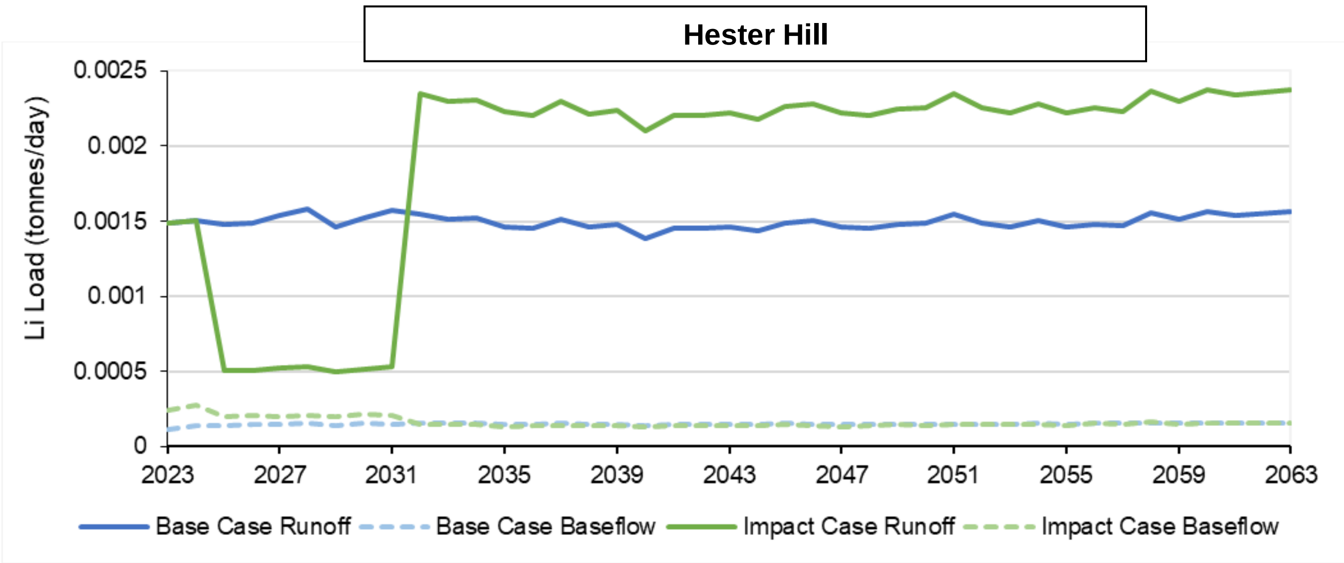








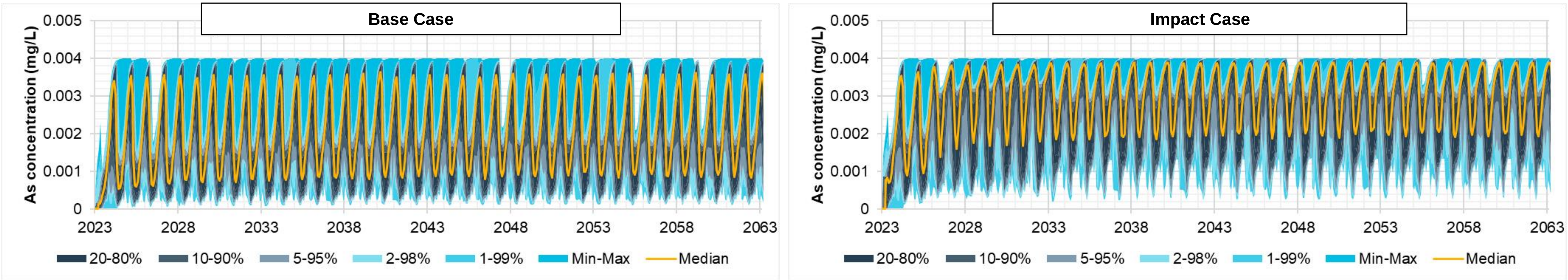




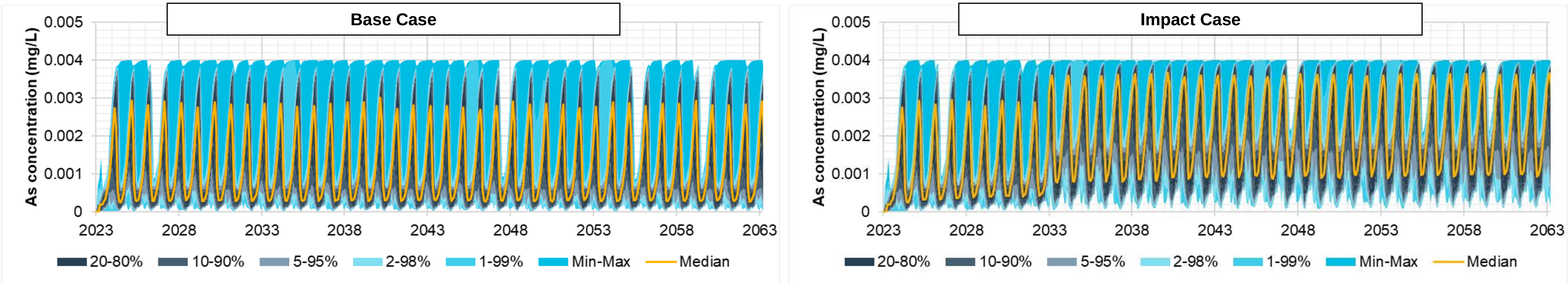
Appendix H

Simulated Arsenic Concentrations

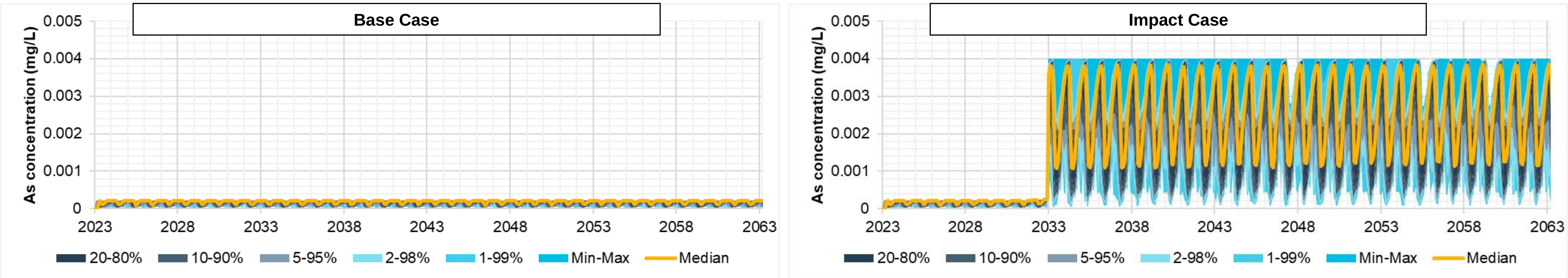
Simulated Daily Arsenic Concentrations at Saltwater Gully Outlet to Hester Brook



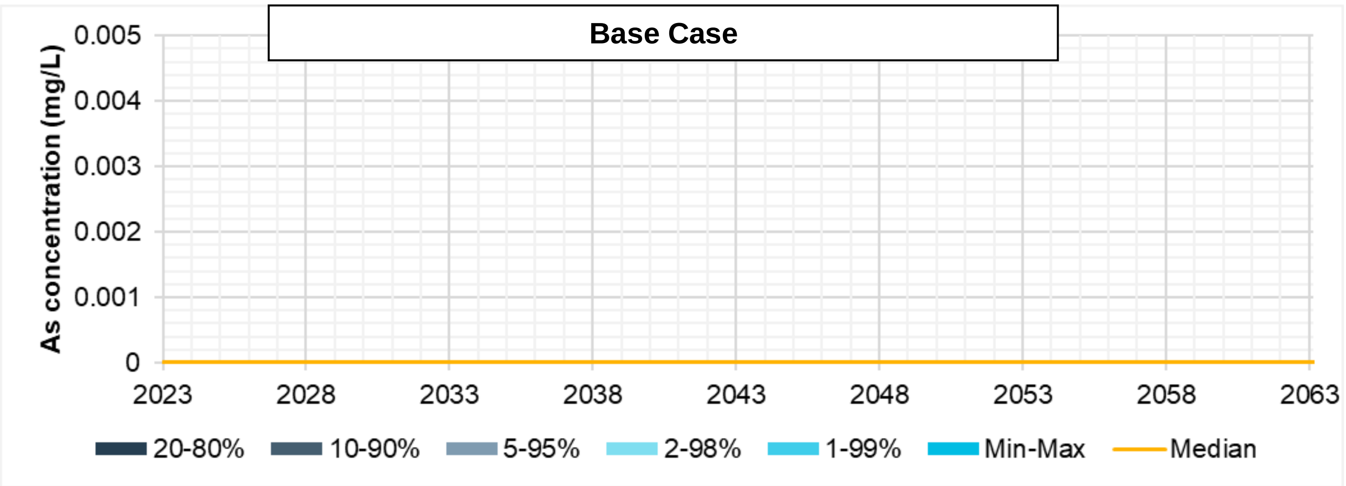
Simulated Daily Arsenic Concentrations at Cascade Gully Outlet to Hester Brook

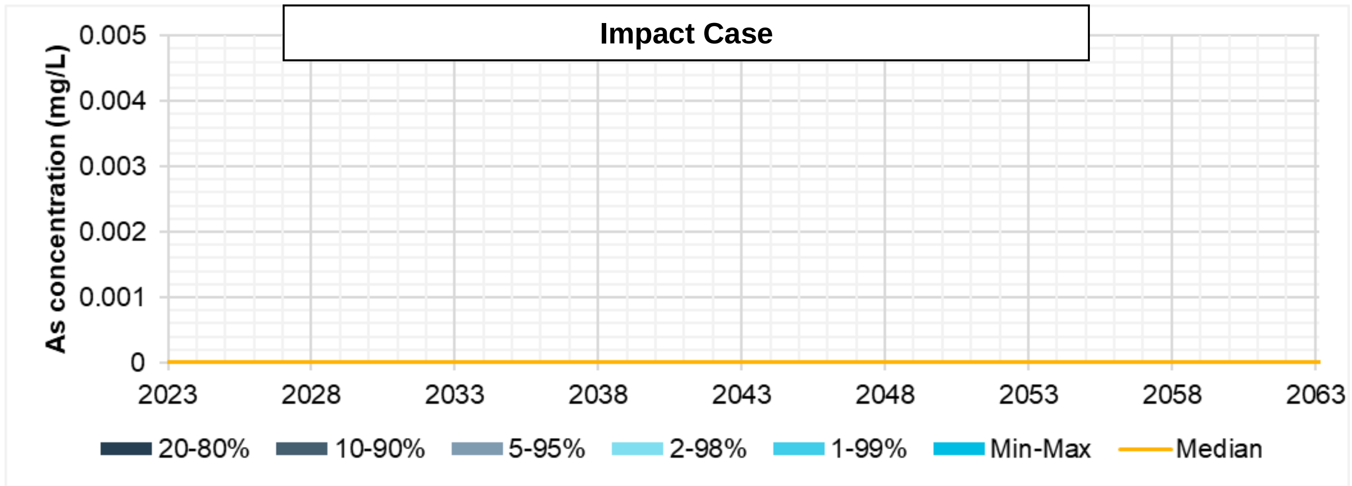


Simulated Daily Arsenic Concentrations in Hester Brook, between Saltwater Gully and Cascade Gully Confluence (incremental)

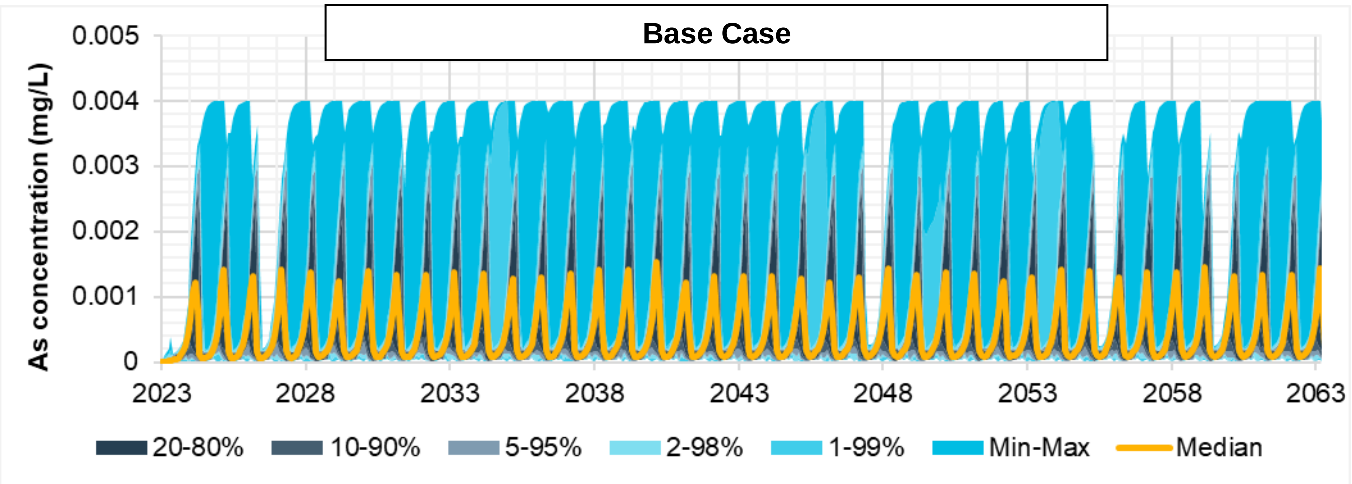


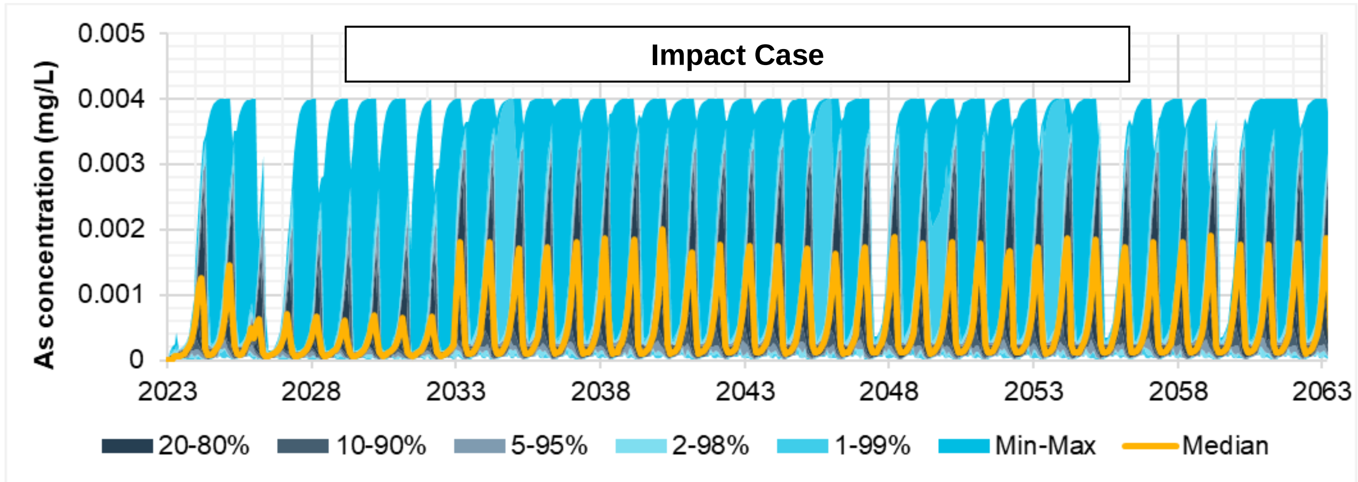
Simulated Daily Arsenic Concentrations in Hester Brook, upstream of Saltwater Gully Confluence



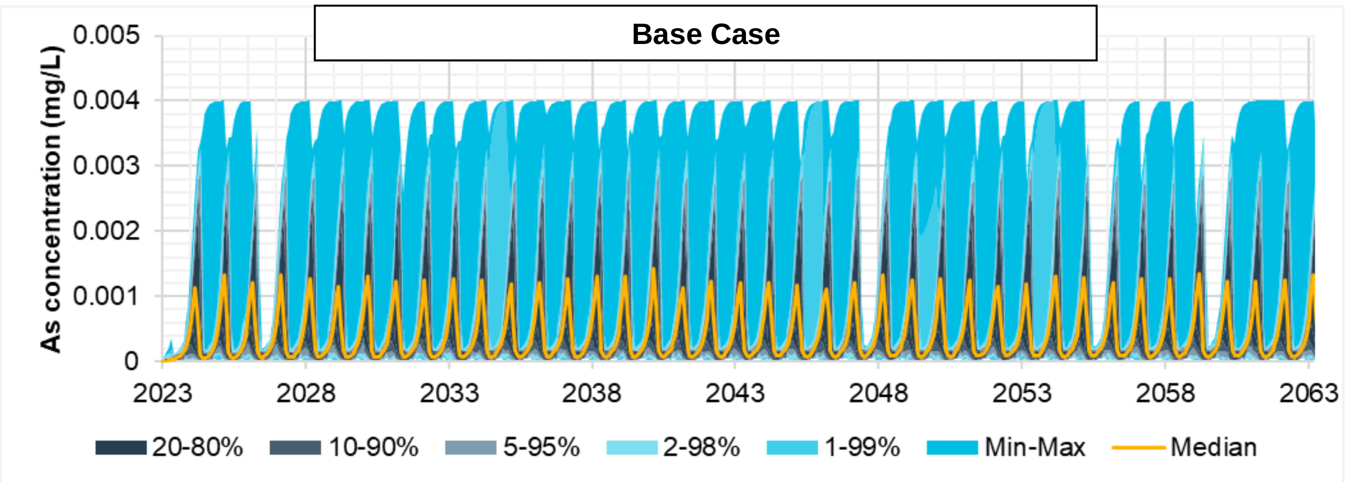


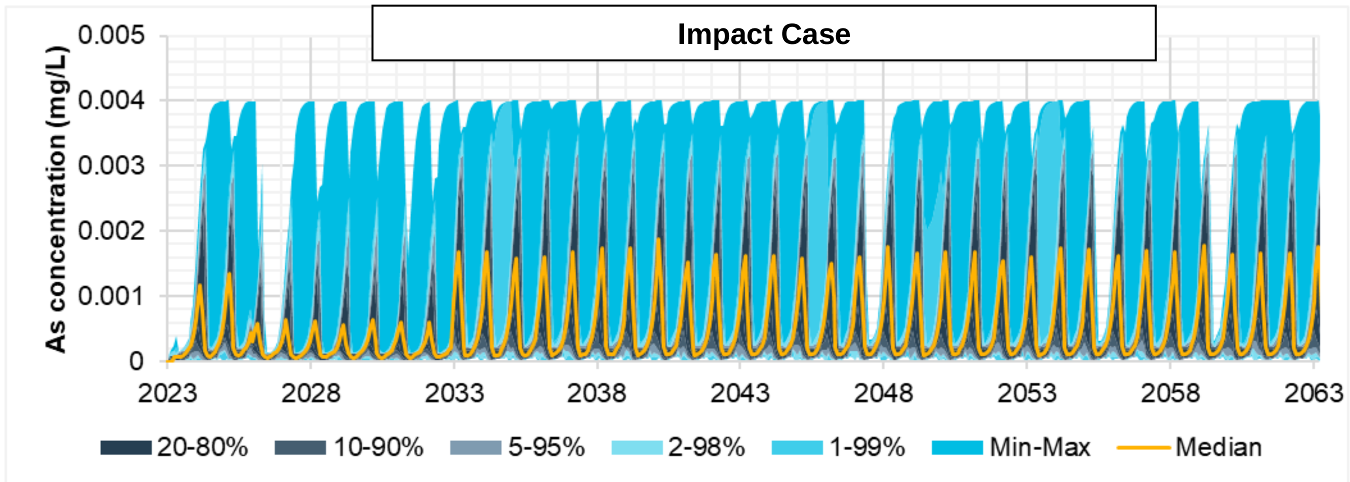
Simulated Daily Arsenic Concentrations in Hester Brook at Cascade Gully Confluence



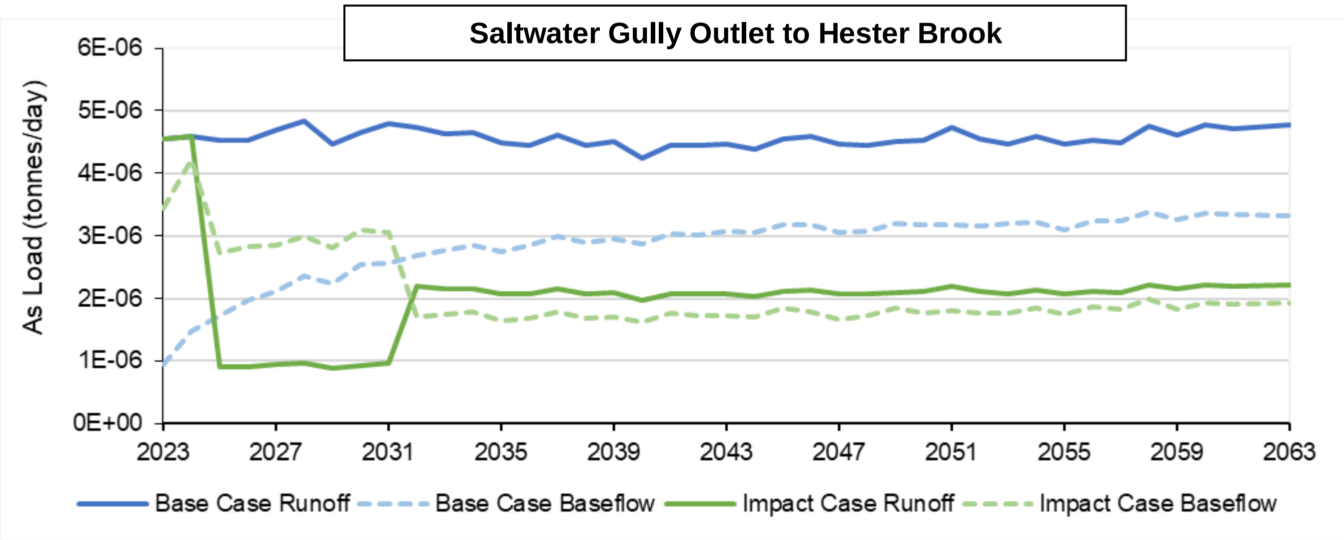


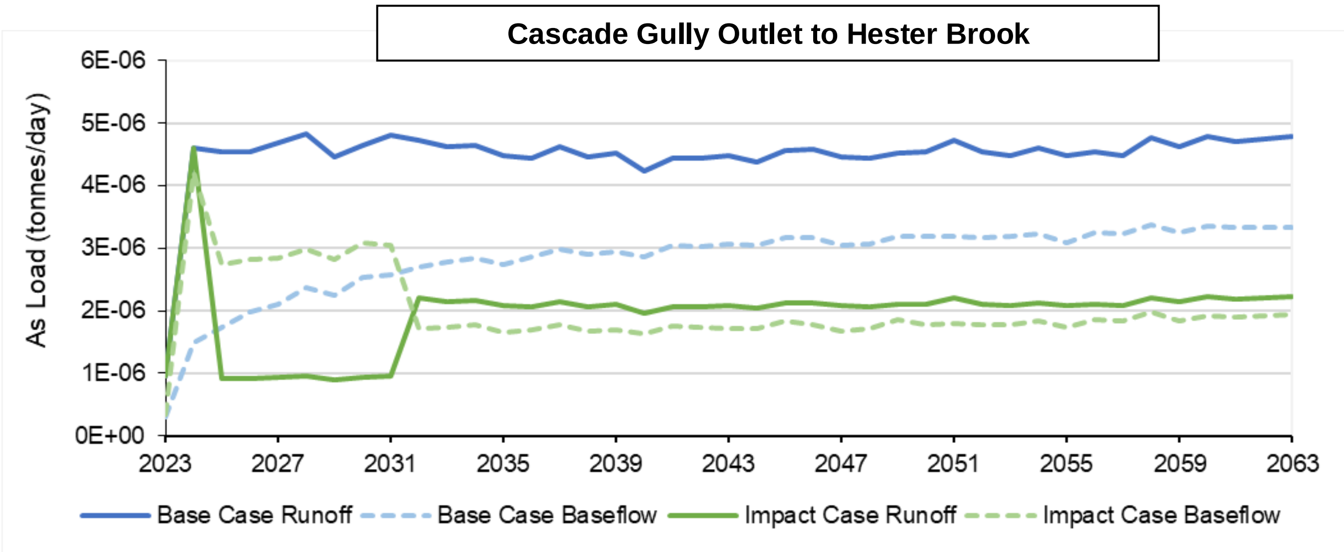
Simulated Daily Arsenic Concentrations at Hester Hill

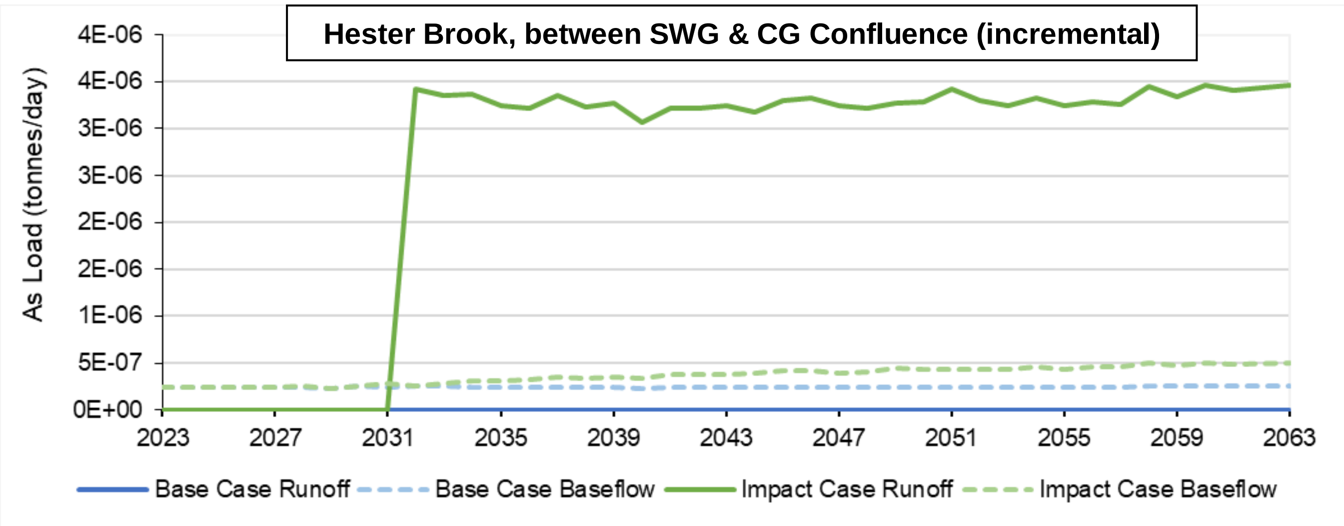


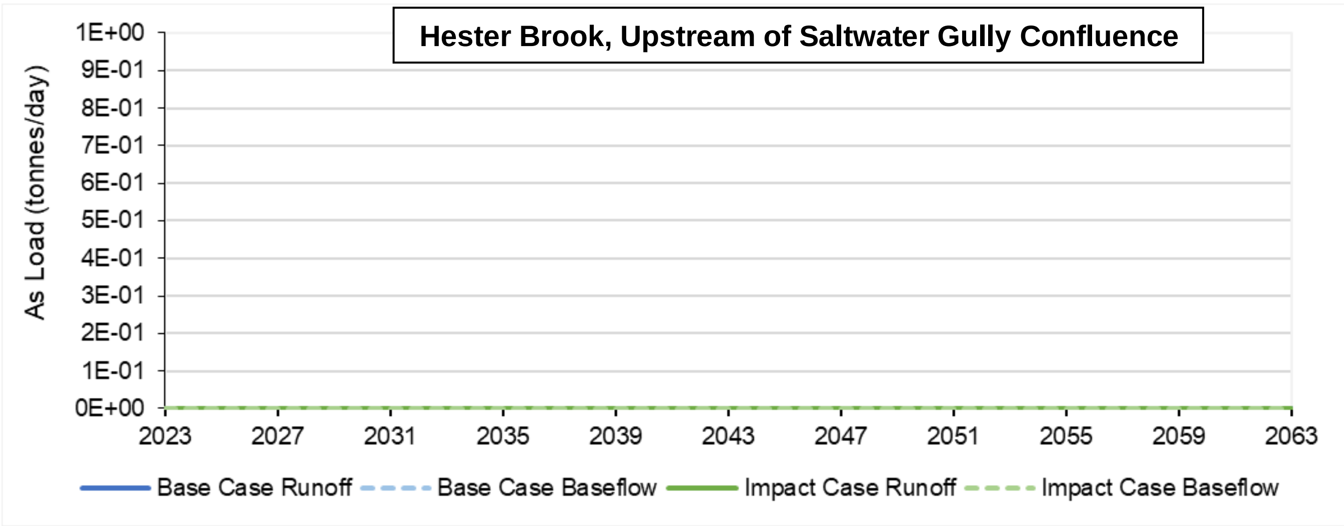


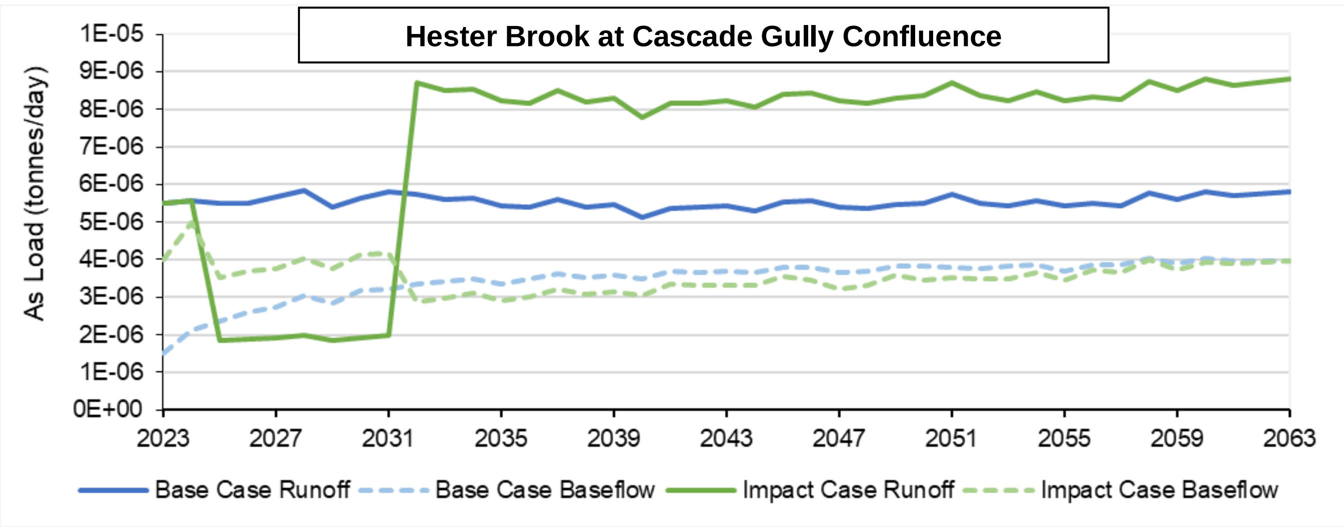
Simulated Daily Arsenic Loads – Runoff vs Baseflow (Median Result)

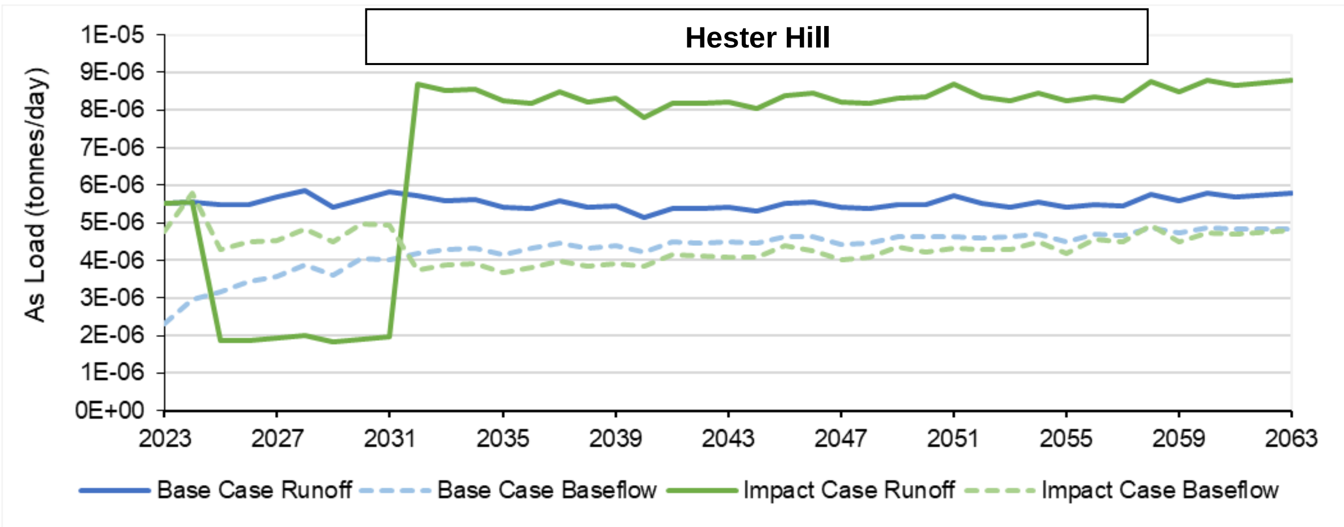








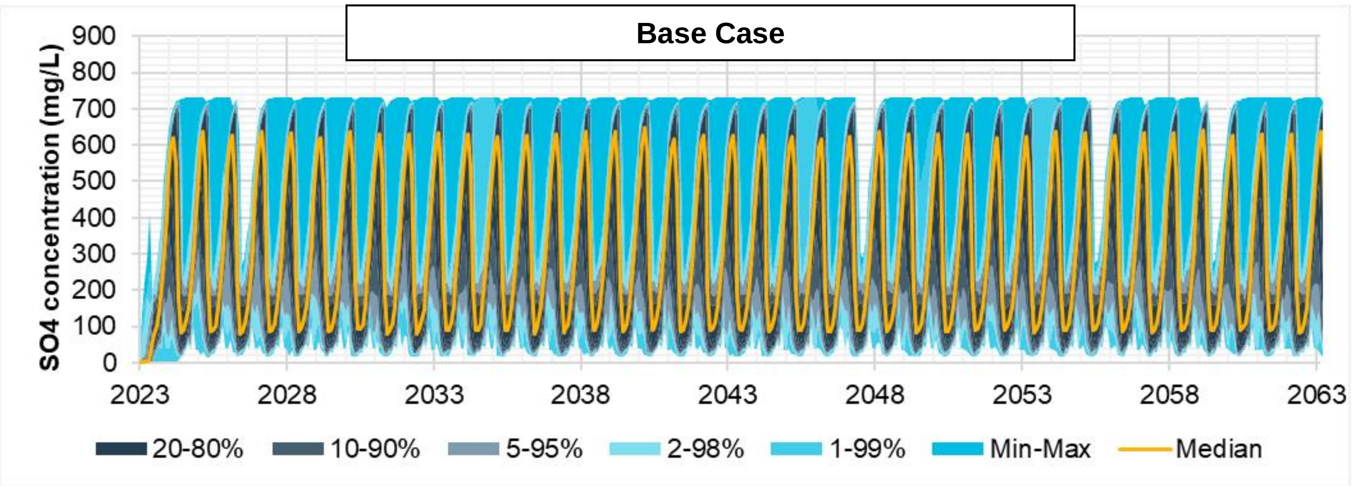


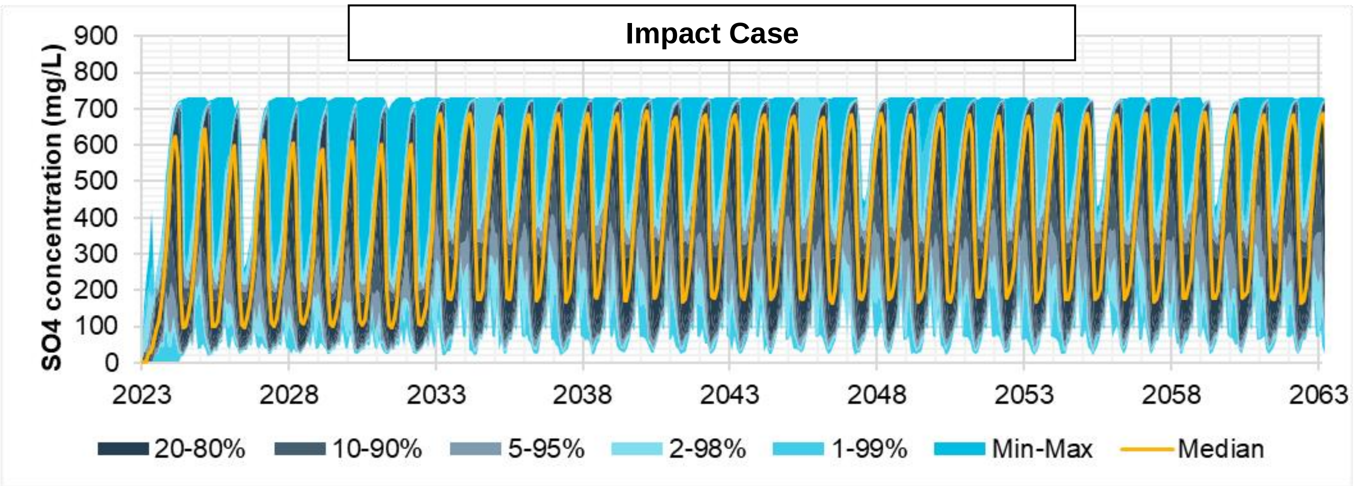


Appendix I

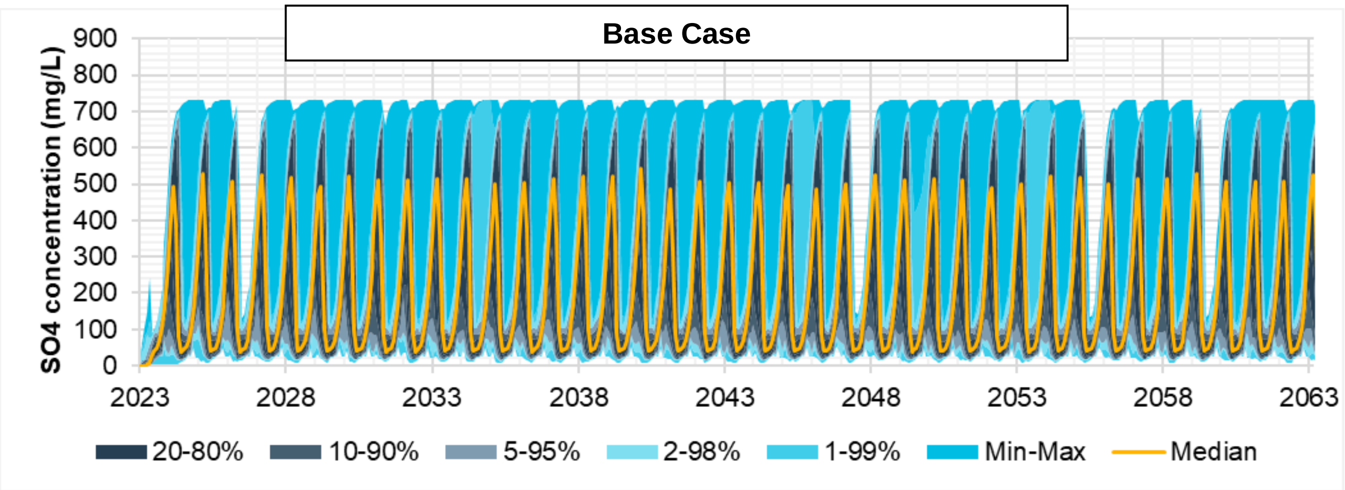
Simulated Sulphate Concentrations

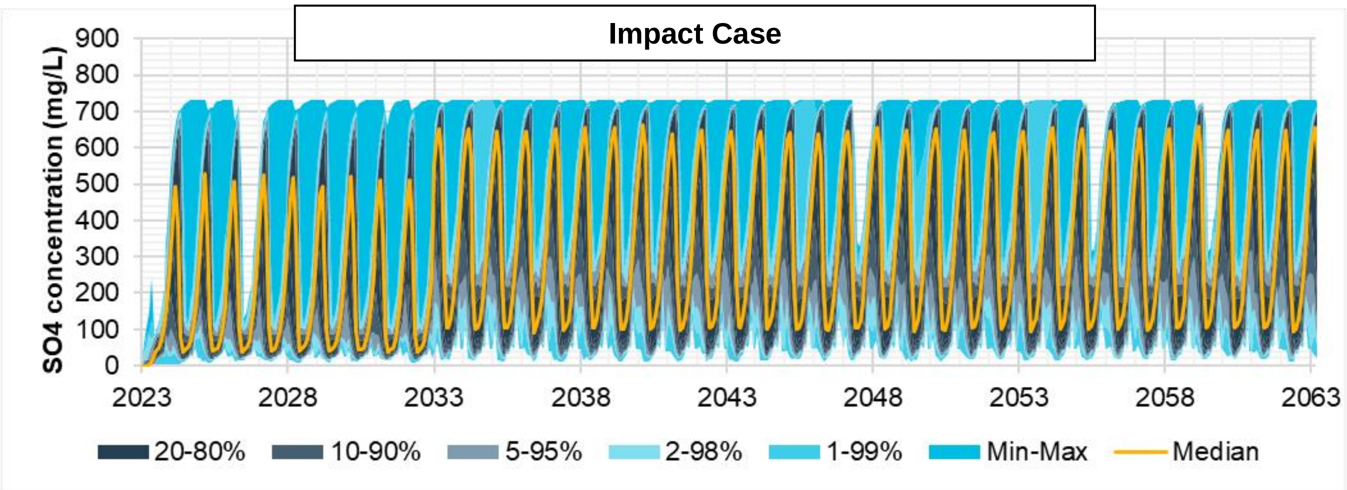
Simulated Daily Sulphate Concentrations at Saltwater Gully Outlet to Hester Brook



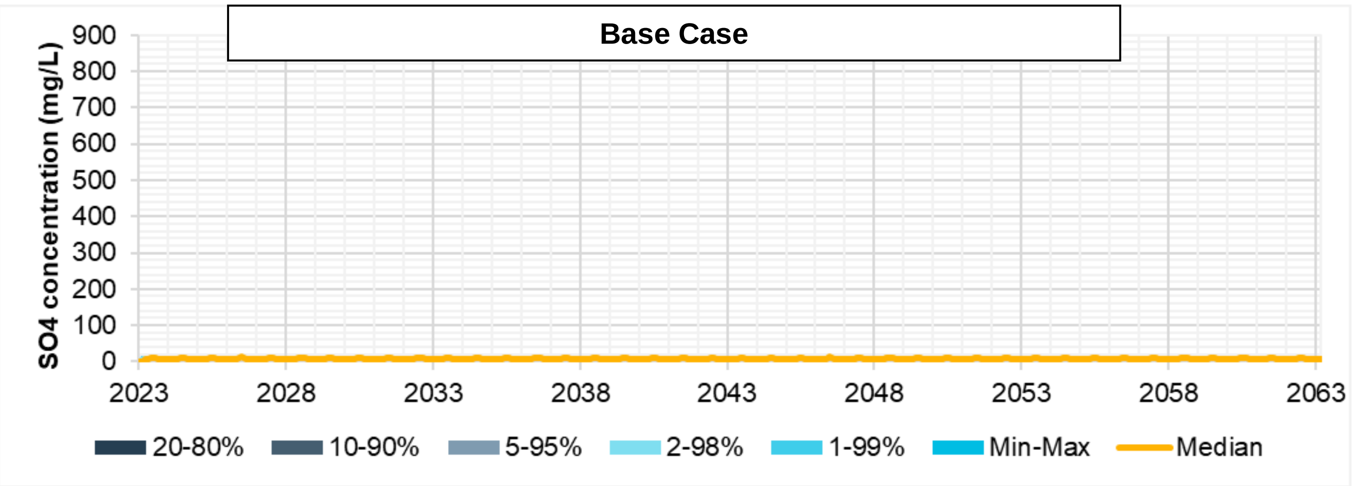


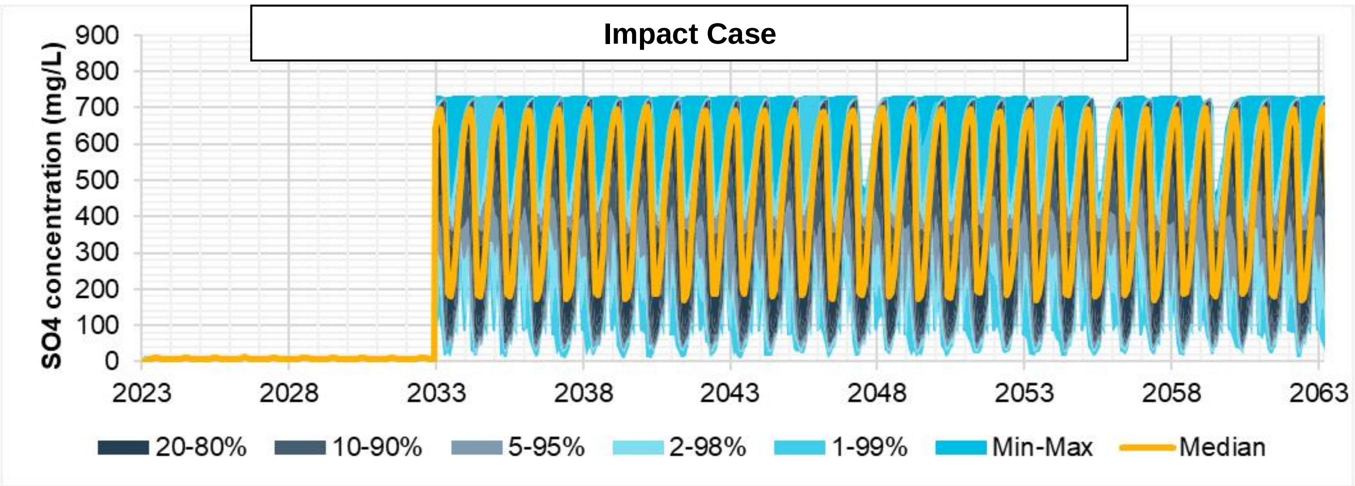
Simulated Daily Sulphate Concentrations at Cascade Gully Outlet to Hester Brook



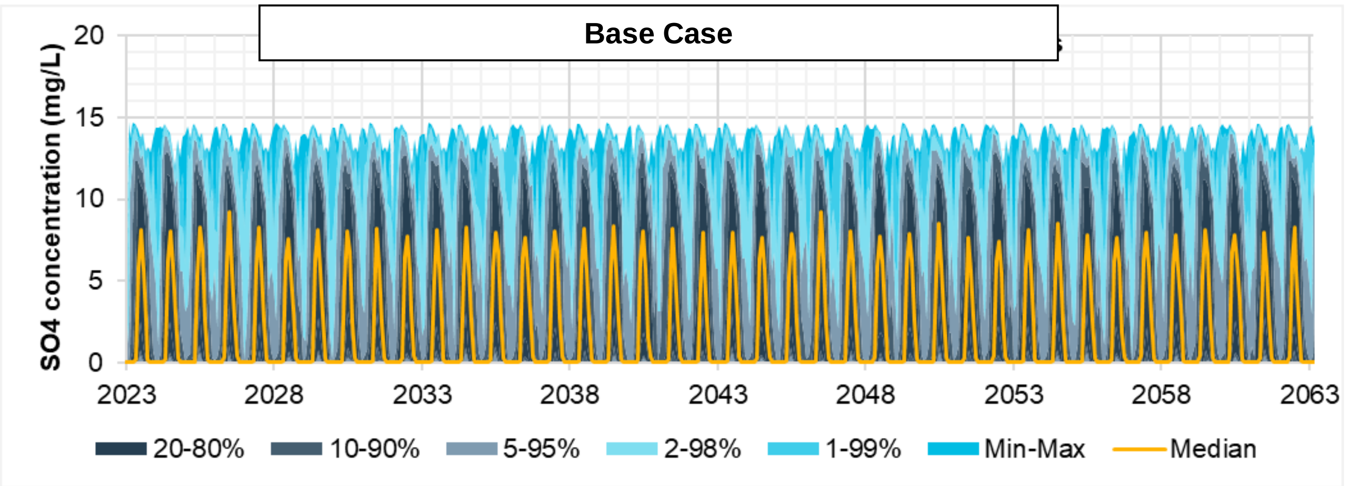


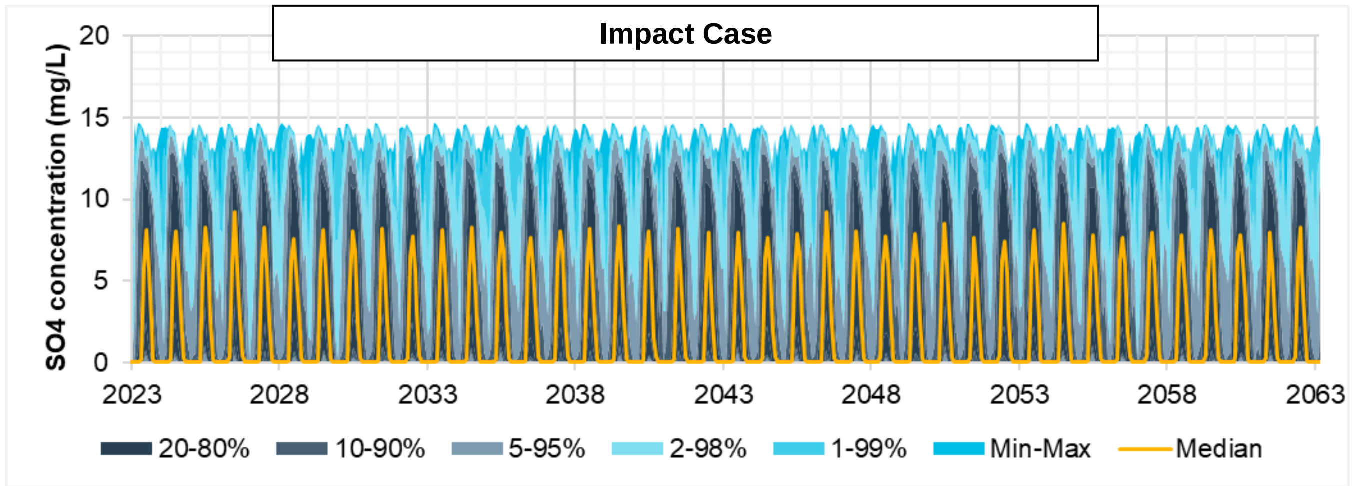
Simulated Daily Sulphate Concentrations in Hester Brook, between Saltwater Gully and Cascade Gully Confluence (incremental)



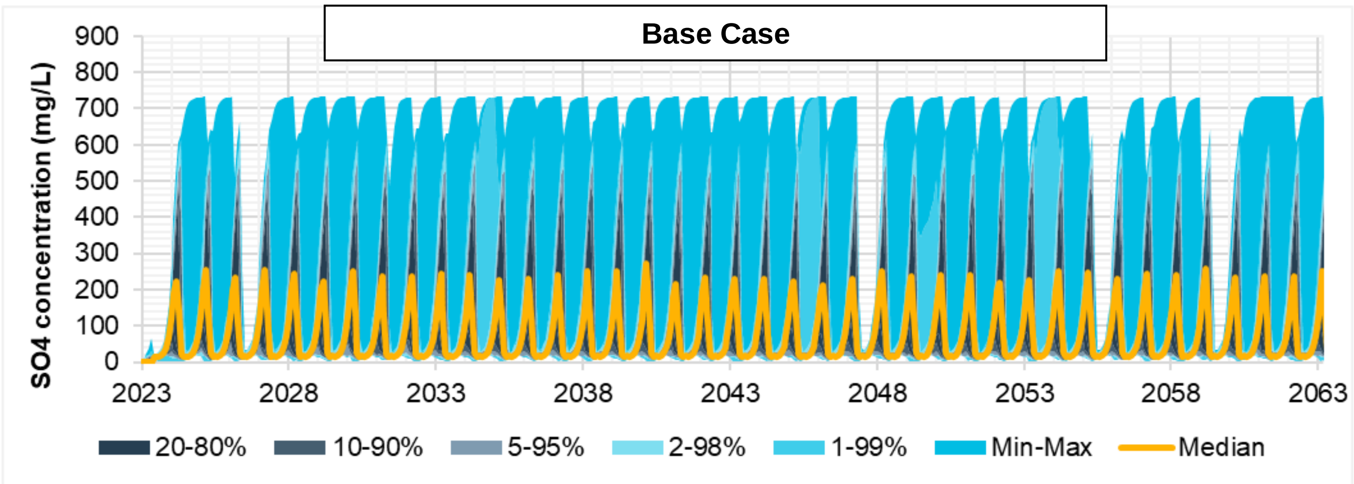


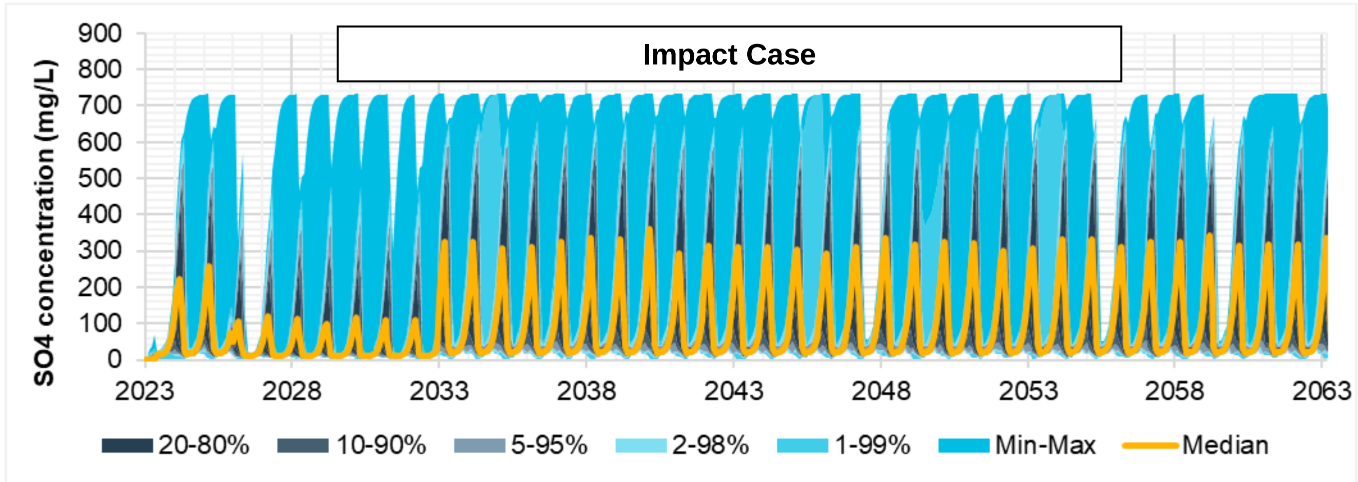
Simulated Daily Sulphate Concentrations in Hester Brook, upstream of Saltwater Gully Confluence



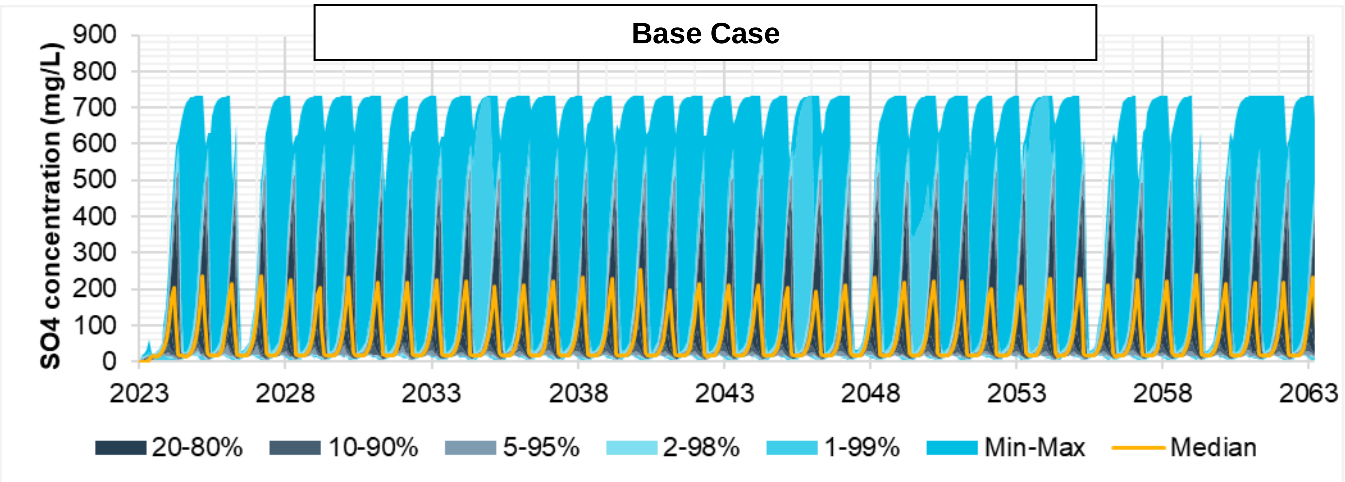


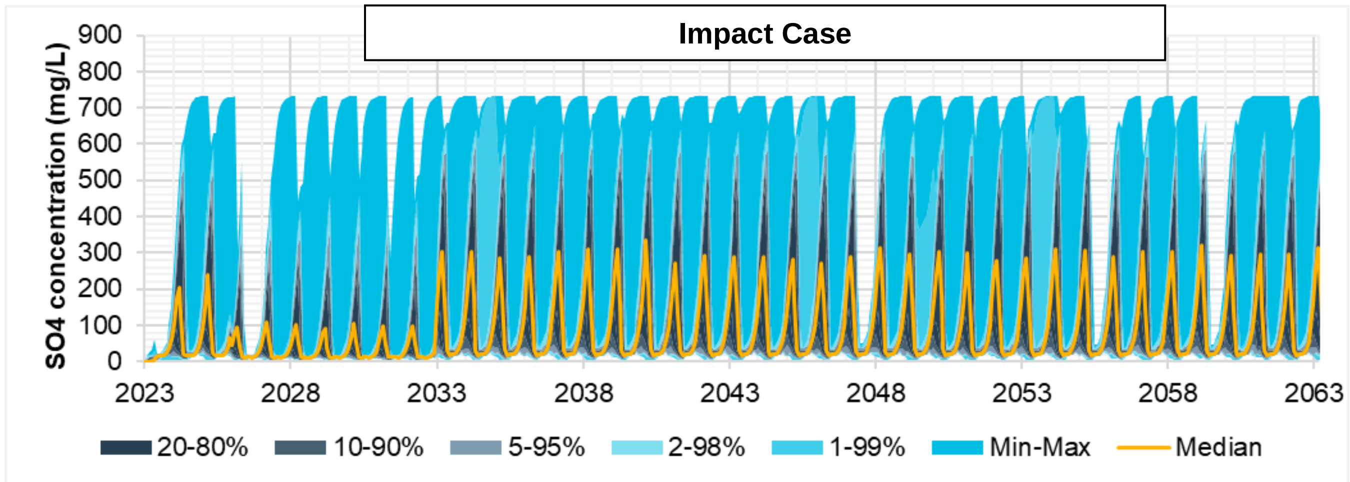
Simulated Daily Sulphate Concentrations in Hester Brook at Cascade Gully Confluence



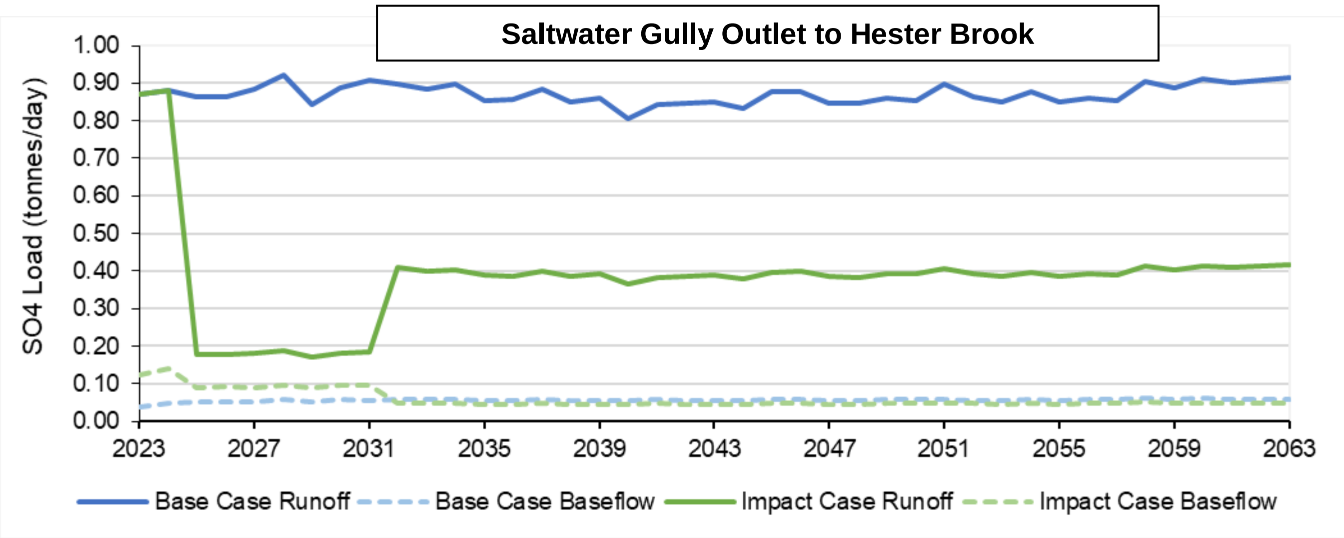


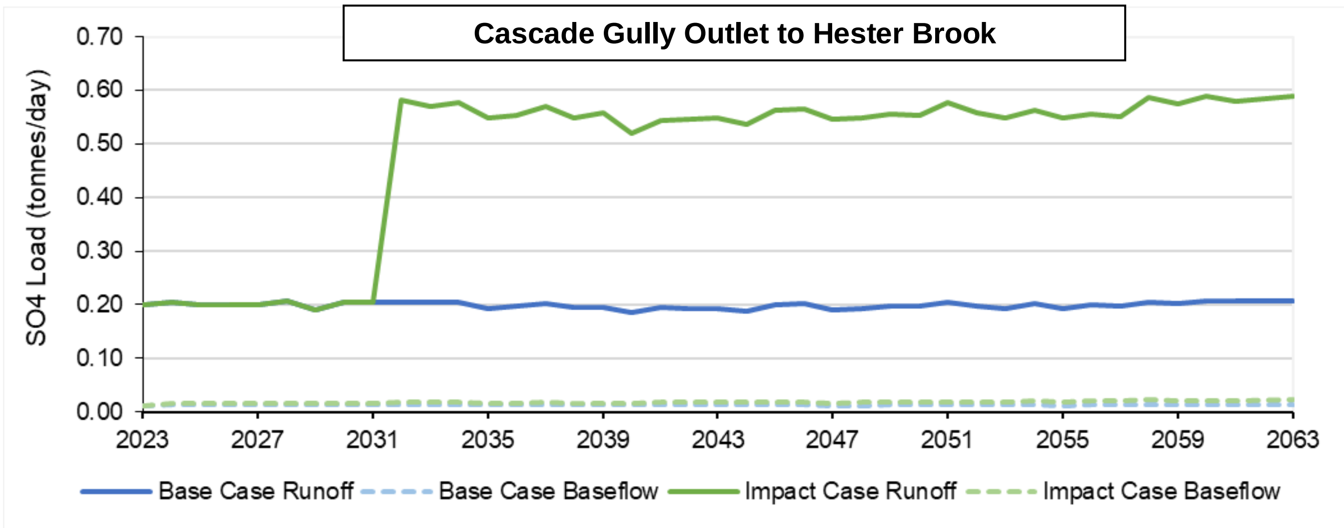
Simulated Daily Sulphate Concentrations at Hester Hill

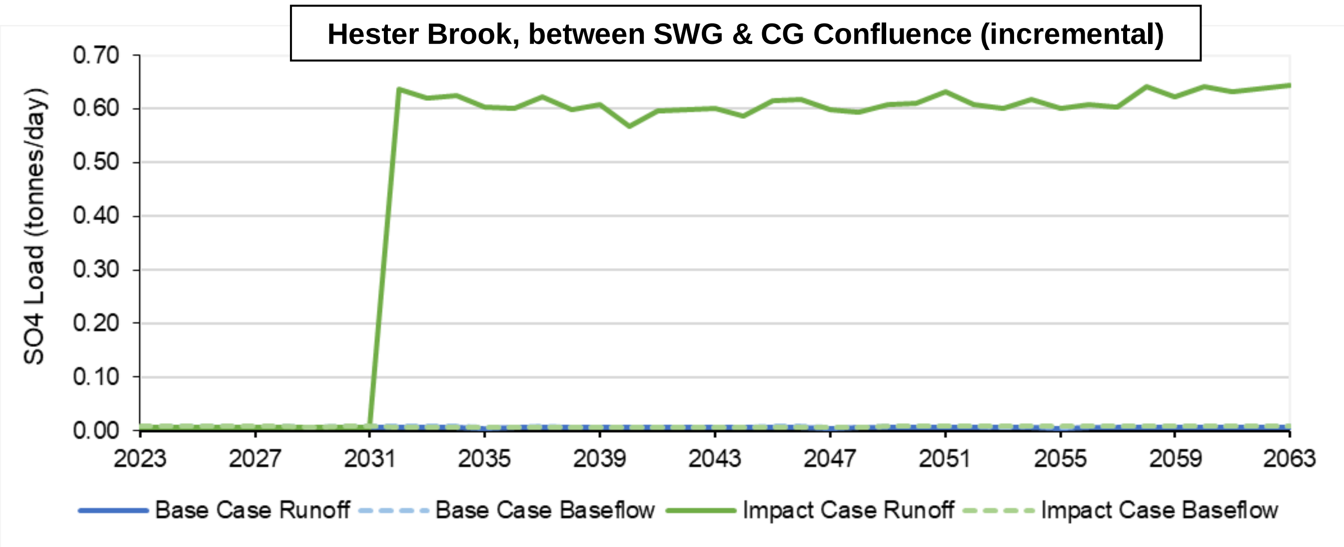


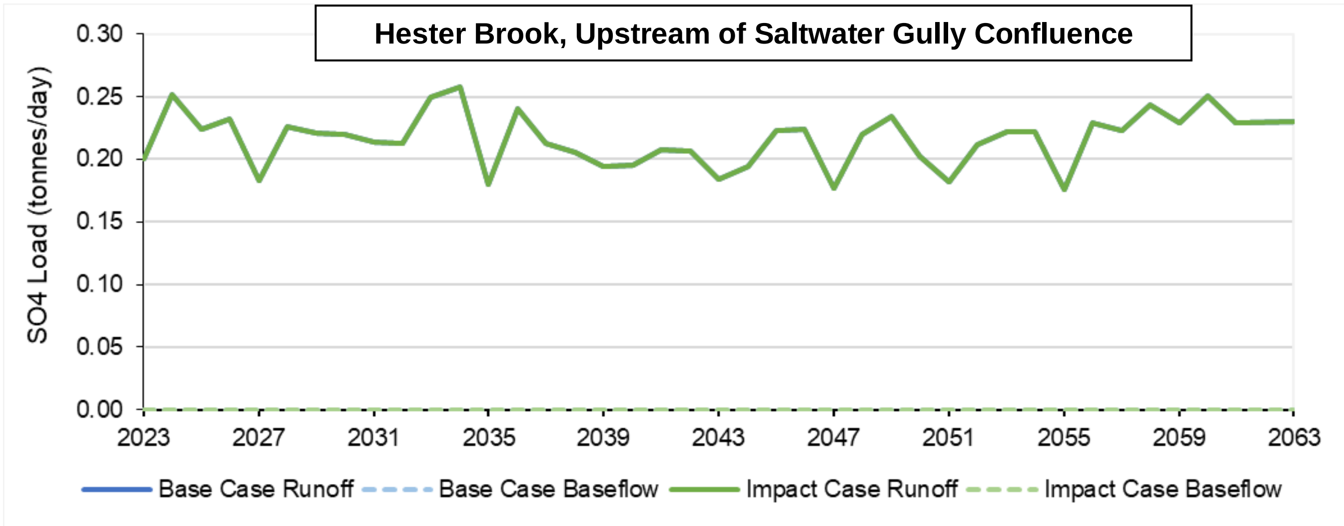


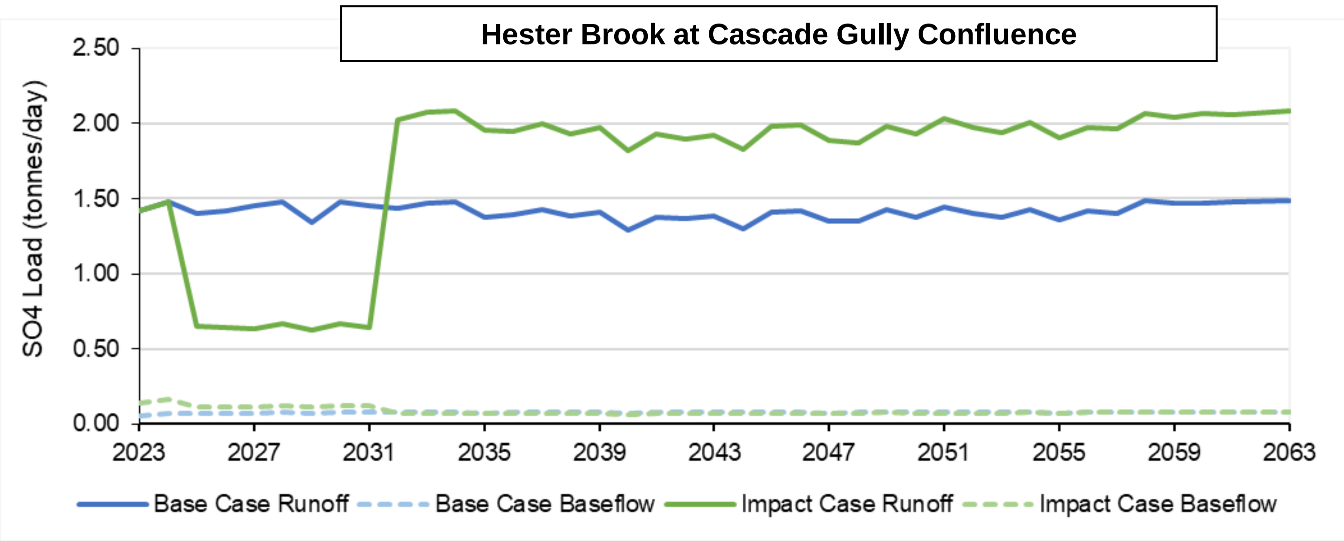
Simulated Daily Sulphate Loads – Runoff vs Baseflow (Median Result)

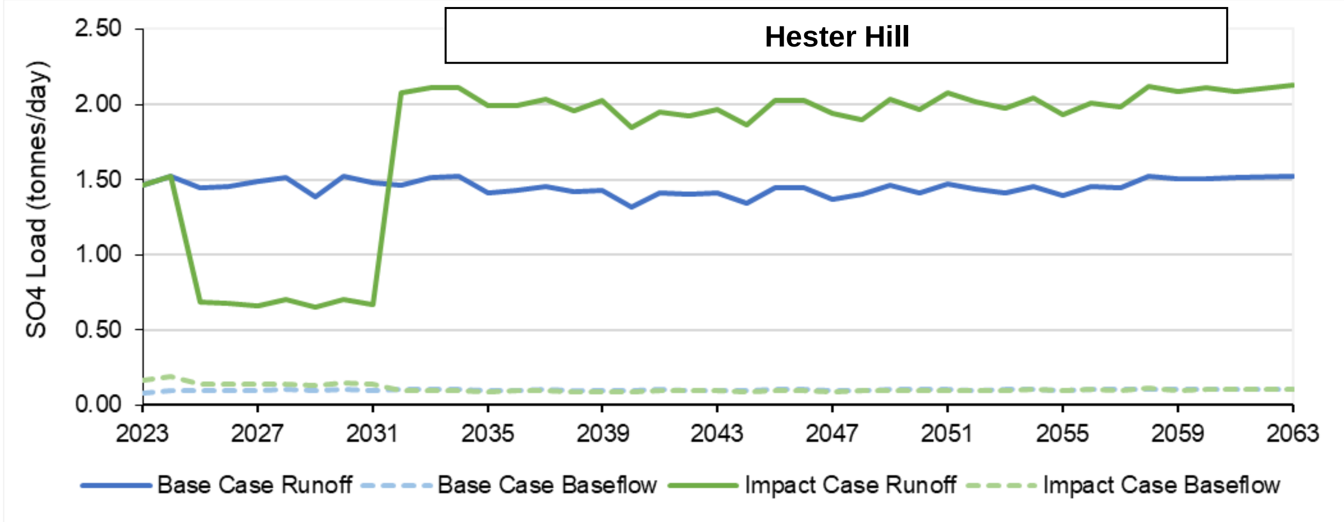








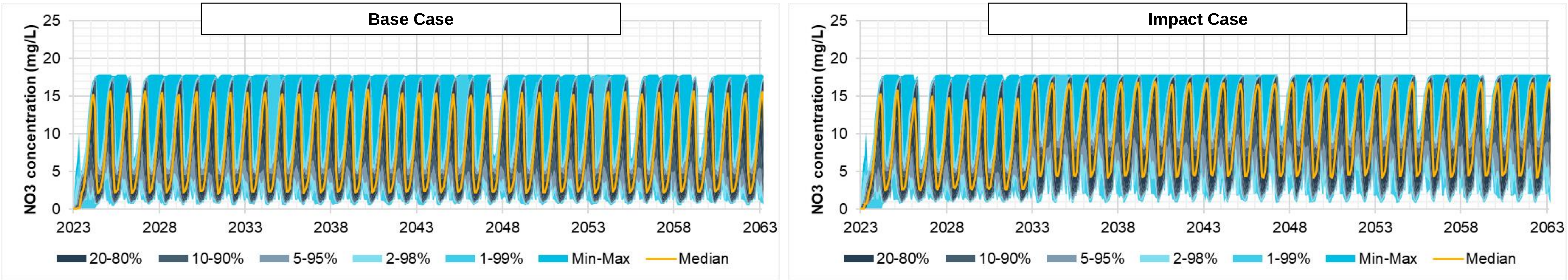




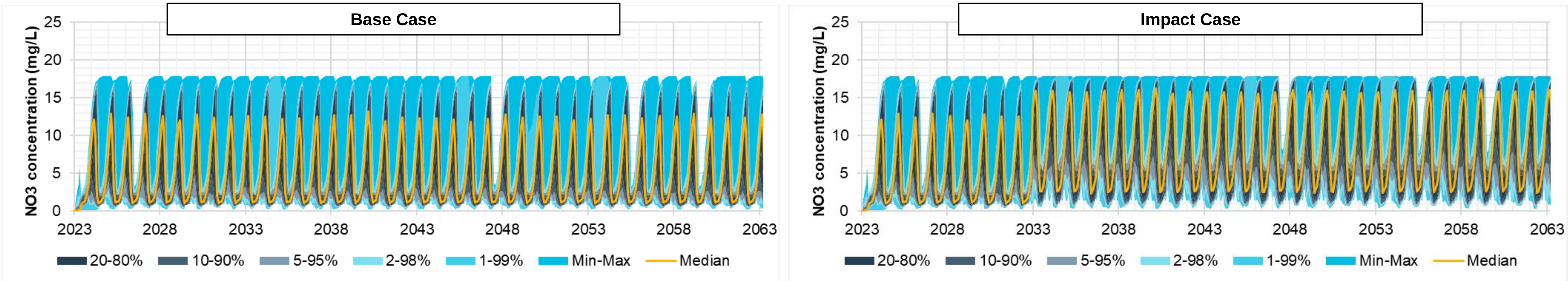
Appendix J

Simulated Nitrate Concentrations

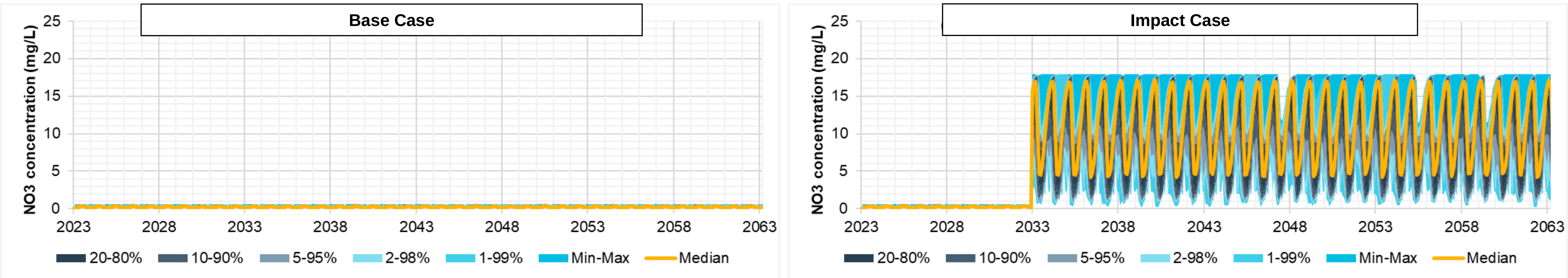
Simulated Daily Nitrate Concentrations at Saltwater Gully Outlet to Hester Brook



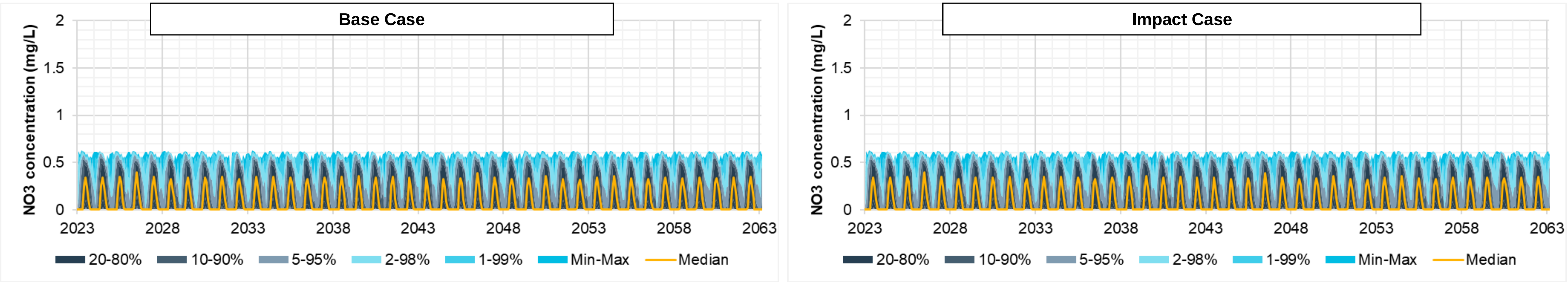
Simulated Daily Nitrate Concentrations at Cascade Gully Outlet to Hester Brook



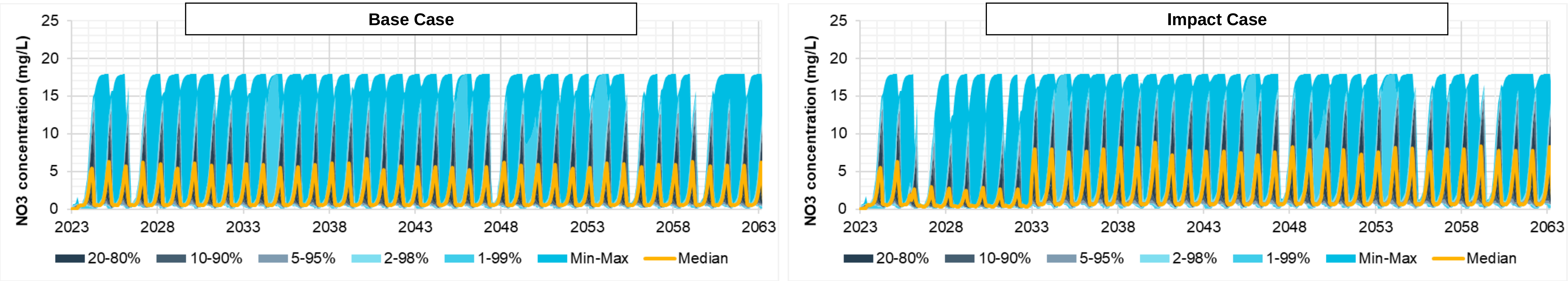
Simulated Daily Nitrate Concentrations in Hester Brook, between Saltwater Gully and Cascade Gully Confluence (incremental)



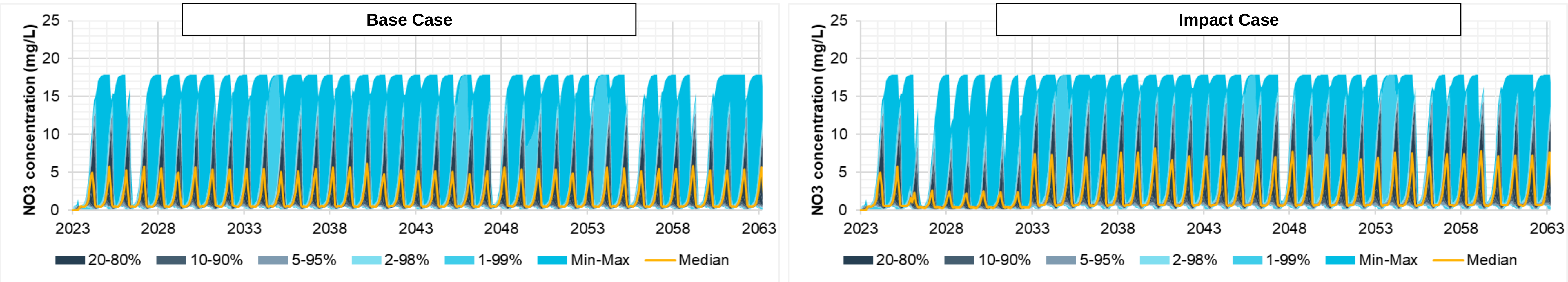
Simulated Daily Nitrate Concentrations in Hester Brook, upstream Saltwater Gully Confluence



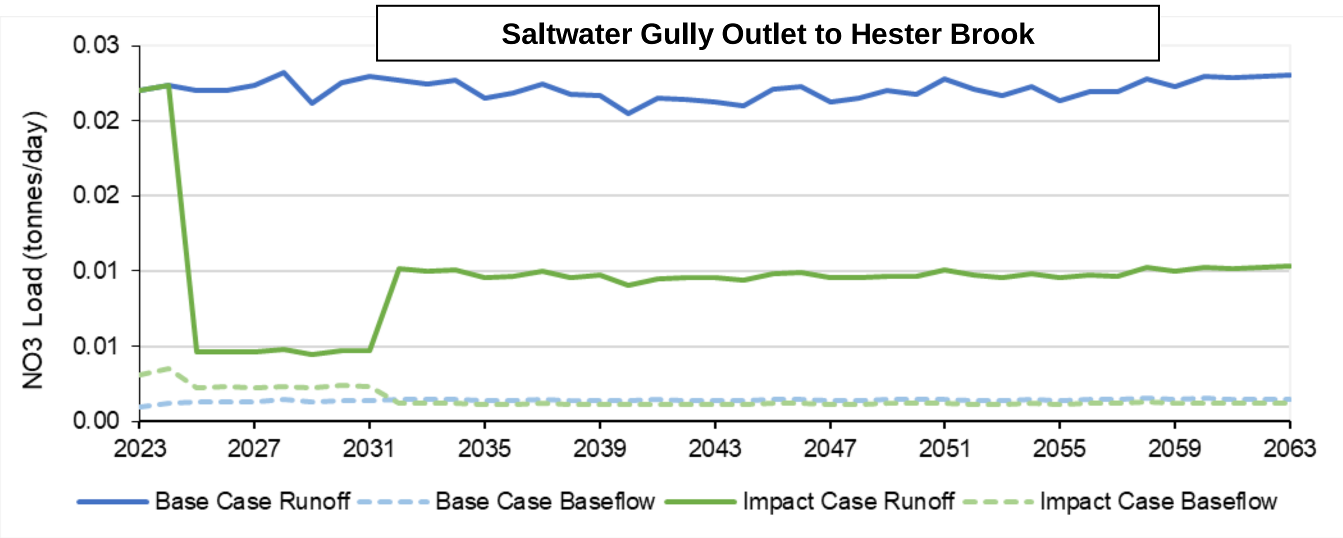
Simulated Daily Nitrate Concentrations in Hester Brook at Cascade Gully Confluence

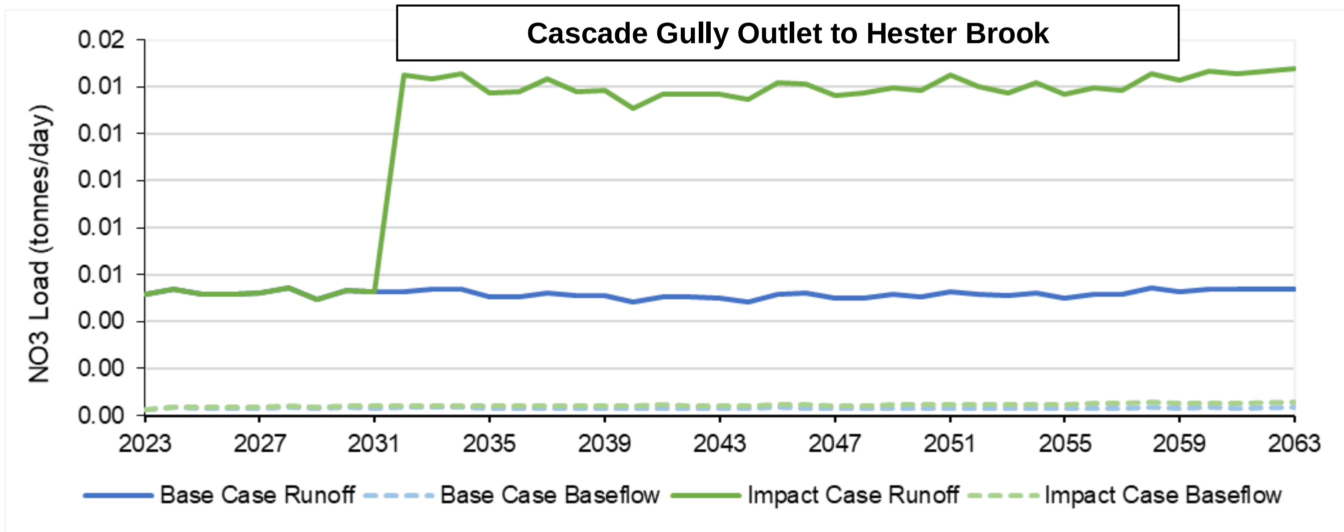


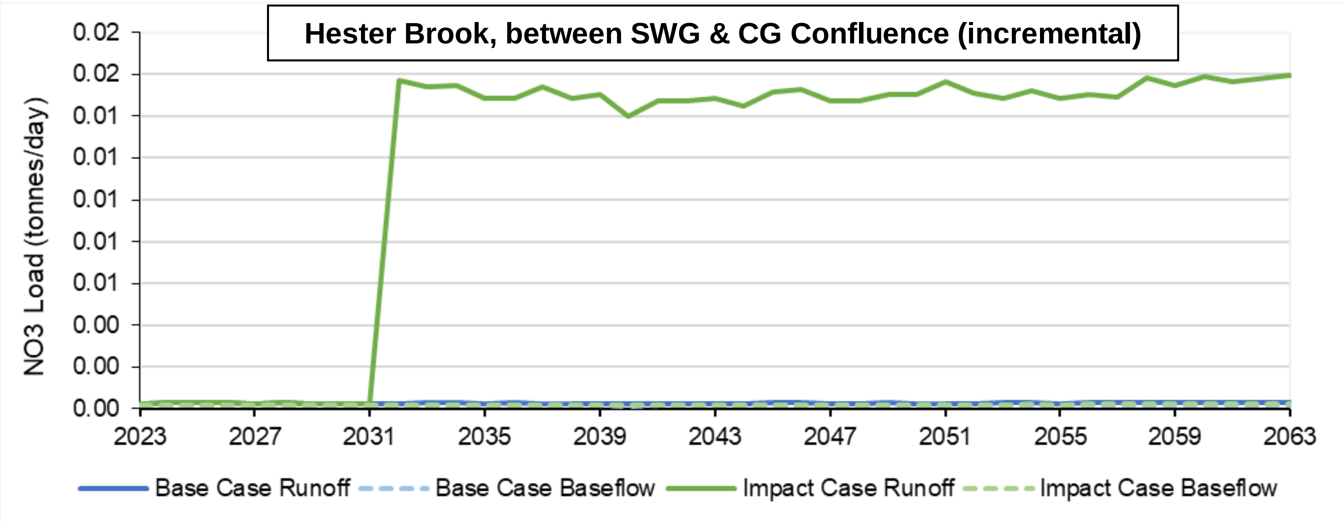
Simulated Daily Nitrate Concentrations at Hester Hill

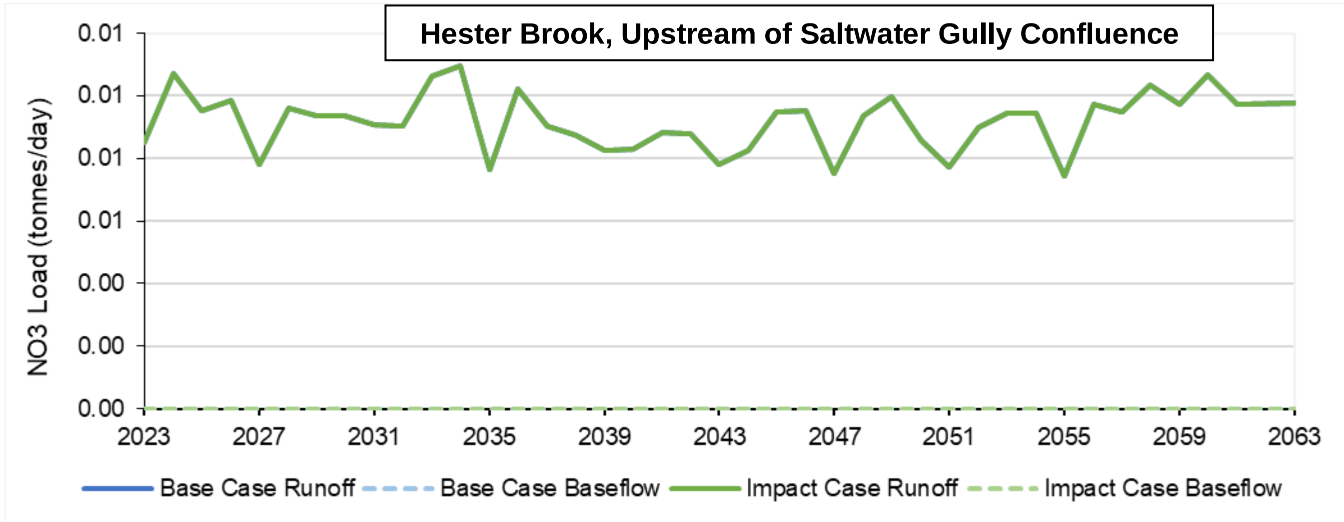


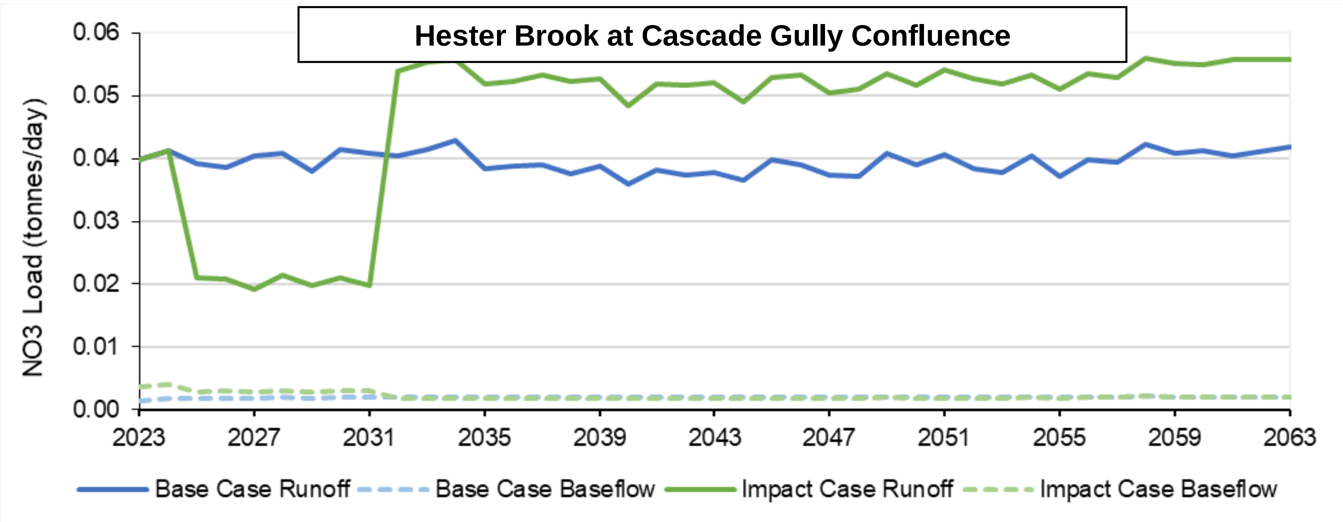
Simulated Daily Nitrate Loads – Runoff vs Baseflow (Median Result)

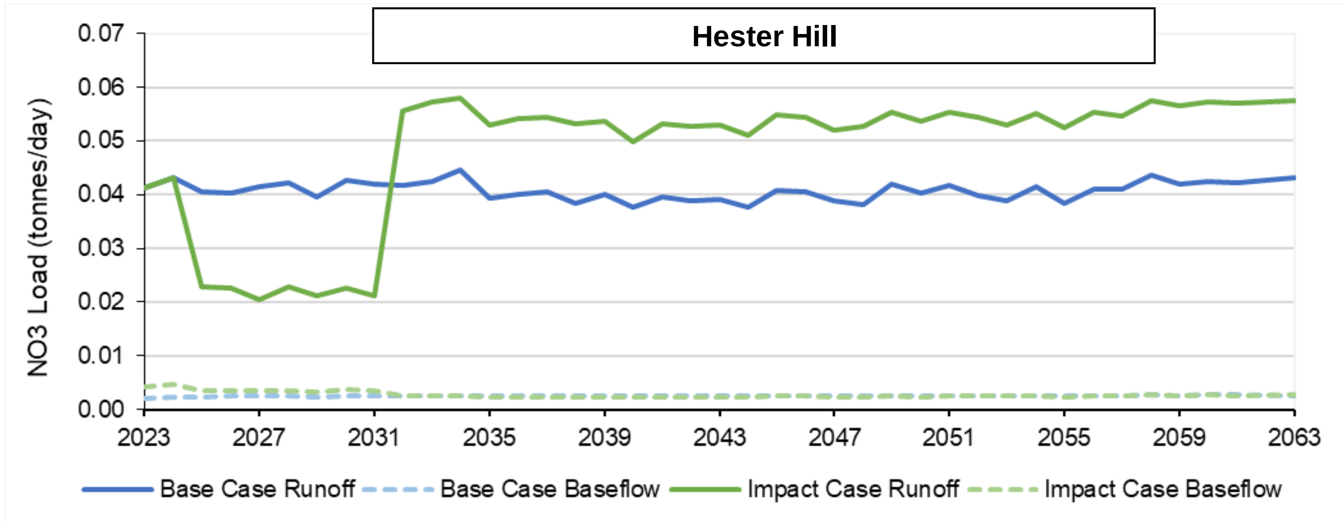












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