

APPENDIX V ESE - WATER AND LOAD BALANCE MODEL REPORT

Mount Frederick South

Water and Load Balance Model

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EXECUTIVE SUMMARY

This report describes the development of a site-wide water and load balance model (WLBm) for Mount Fredrick South (MFS) sub-area, which will support the Assessment of Environmental Effects for the Buller Plateaux Continuation Project for Bathurst Resources Limited (BRL).

Objectives of this Study

The MFS WLBm was developed to achieve the following objectives:

- Forecast changes to flows within waterways as a result of the project-related activities at MFS.
- Support design of water management infrastructure.
- Forecast downstream water quality as a result of the project-related activities at MFS.

The WLBm represented the Operations Phase, Active Closure Phase, and Post Closure Phase, simulating a duration of 100 years at a daily timestep resolution. Key elements represented in the model included:

- Runoff from background catchments.
- Runoff from mine domains (e.g., pit voids, Engineered Landforms [ELFs], etc.).
- Seepage from ELFs.
- Collection and conveyance (channel flow and pumping) of mine impacted water (MIW) water.
- Loading rates of solutes generated from source terms (both from constant concentrations and constant loads).
- Mixing parameters (conservative) and calculation of concentrations in each flow path.
- Solute load changes through the water treatment plant (WTP) and mussel shell bioreactors (MSRs).
- Effects on downstream water quality (for both acute and chronic exposures).

The modelling included the following scenarios:

- Base Case model, with approximate annual average rainfall conditions and typical source terms¹ based on best available empirical water quality datasets. The adopted water management strategy is based on over 25 years of practical experience in similar environments.
- Scenario 1, with *high*² annual rainfall conditions and typical source terms.
- Scenario 2, with *variable* rainfall every year (henceforth referred to as stochastic rainfall) and typical source terms.

¹ Source terms are derived from empirical or analogue site data to characterise water quality associated with different components of the model (e.g., pit surfaces), expressed as constituent concentrations or constant loads.

² The wettest year on record for Lake Brazil meteorological station was used to represent high rainfall conditions.

- Scenario 3, with approximate annual average rainfall conditions and a +30% increase to typical ELF seepage source terms.
- Scenario 4, with approximate annual average rainfall conditions and a -30% decrease to typical ELF seepage source terms.

Findings

The primary outcome of the MFS WLBM is that water quality simulated at compliance locations remained below the proposed guideline values derived for the Project throughout the simulation, including for the Base Case model and the four scenarios which test uncertainties of the model including rainfall variability as well as uncertainty in source terms for ELF seepage water quality (which is the largest influence on solute loads at closure).

Modelling incorporated high intensity rainfall events (24-hour periods) corresponding to a 1 in 20-year event during the Operations Phase and a 1 in 100-year climate adjusted event occurring during the Post Closure Phase (Scenario 2), based on unadjusted rainfall frequency data. Dry periods were also incorporated in the model with a maximum dry period of 41 consecutive days included within Scenario 2.

The assessment findings are summarised below for the Base Case and Alternative Scenarios (i.e., Scenario 1 through 4).

Base Case Model Results

The water balance model results suggest the following:

- The proposed mine water infrastructure and treatment systems deliver compliance including when stress tested against high and low rainfall conditions. Under the Base Case the mine captures and treats all flows associated with rainfall events up to the 95th percentile, bypassing ~5% of the time (>P95³) and direct discharging⁴ ~10% of the time (>P90⁵).
- The combination of the East and West pit sump volumes with the WTP capacity of 235 L/s is suitable for management of predicted stormwater flows.
- The maximum modelled bypass or direct discharge event duration was 2 days. Most events were less than two days (88% of bypass events and 78% of direct discharge events).
- Under average rainfall conditions, mine pit sumps will be bypassed ~5% of the time, leading to untreated discharge to the receiving environment under high flow conditions.
- With the adopted water management strategy pit sump spilling did not occur in the Base Case and Scenario model simulations.

³ 95th %ile

⁴ Bypass: MIW bypass (by gravity) the East and West Pit Sumps inlets based on a 95th percentile flow criteria (waters remain within the Deep Stream catchment). Direct discharge: at times where the Waimangaroa River flows exceed the 90th percentile flow criteria, MIW within the East and West Pit Sumps are pumped directly to the Waimangaroa River. See Section 3.2 for further details.

⁵ 90th %ile

- Seepage rates from the ELF's ranged from approximately 0.4 - 29 L/s (varying as a function of landform size) in the Post Closure Phase, the highest being from MSR's 5, 7, and 8.
- The model predicts a total of 71,460,000 m³ (126 L/s on average) of water will be treated by the WTP over the life of the MFS sub-area.
- The following changes in flow dynamics are predicted to environmental flows (at compliance locations positioned within receiving waterways):
 - A reduction of all flows at surface water monitoring location SW01 during the Operations and Active Closure Phases (-2 to -12% from simulated baseline conditions), as a result of waters being pumped out of SW01 catchment for treatment, and an increase in mean and median flows during the Post Closure Phase (+5 to +23%) along with a significant increase in low flow conditions (+555%), relating to ELF's being modelled with a higher net percolation than the background catchment, with outflows represented as stable seepage (e.g., not fluctuating significantly).
 - Similarly, a reduction in flows occur at surface water monitoring location SW03 within the Operations and Active Closure Phases (-14 to -15%), outside of a modest increase in the 7-day mean annual low flow (+32%). During Post Closure Phase, mean and median flows increase (+5 to +41%) as well as a marked increase in low flows (+895%). These results are reflective of the same outcomes as SW01.
 - Model results for water monitoring location 2W (Smokestack) suggest an increase in mean, median, and low flows over the entire modelled period (+5 to +225%), as a result of waters being pumped into the catchment for treatment. The largest increase of flows occurs in the lower end during active treatment with the presence of the WTP discharging upstream.
 - Water quality monitoring location 17W results suggest the same trend as Smokestack, however, a large increase in low flows also occurs during the Post Closure Phase as noted as reporting via SW01 and SW03 (+223%) due to seepage from ELF's being modelled as stable flow.

The load balance model results suggest the following:

- The peak MIW potential constituents of concern (PCOC) loads reporting to the WTP occur in 2040, with approximately 324 tonnes per year (t/year) of acidity, 31 t/year of aluminium (Al), and 13 t/year of iron (Fe). Modelling also indicates that 2041 is the peak year for total suspended solids (TSS) load, with 870 t/year of TSS.
- Active treatment will be required for about 4 years after completion of rehabilitation before MSR's can treat loads to meet proposed water quality guideline values proposed by Hickey (2026).
- Cadmium (Cd) and Zinc (Zn) were typically the PCOC that were closest to the proposed water quality guideline values.

- Model results were below acute and chronic guideline values for metals and turbidity (Hickey, 2026) over the proposed exposure periods.

Overall, Base Case results suggest discharge of mine impacted water via 'bypass' and 'direct discharge' at proposed frequencies (95% and 90% of the time, respectively) will not elevate PCOC above proposed guideline values over relevant exposure periods.

Alternative Scenario Model Results

The key findings of the alternative scenario simulations are summarised below:

- Scenario 1 (High Annual Rainfall) model results suggested an increased bypass rate (from 5% to 7% of the time on average) and direct discharge rate (from 10% to 12% of the time on average). No exceedance of chronic or acute water quality guideline values over their exposure periods.
- Scenario 2 (Stochastic rainfall) model results suggested an increased bypass rate (from 5% to 6% of the time on average, with an annual variance from 2% to 9%) and decreased direct discharge rate (from 10% to 9% of the time on average, with an annual variance from 5.5% to 12%). No exceedance of chronic or acute water quality guideline values over their exposure periods.
- Scenario 3 and 4 (ELFs varying $\pm 30\%$ of the solute load compared to Base Case scenario) do not result in exceedance of chronic or acute guideline values over their exposure periods.

In summary, modelling results suggest MFS will be able to achieve water quality within proposed compliance limits and exposure periods (at defined water quality compliance monitoring locations), even when stress tested with wet conditions, prolonged dry periods, and ELF source terms that are 30% worse than expected.

Operational Management Recommendations

The following management recommendations are proposed for the Operations Phase:

- Active treatment is required from the start of the Operations Phase at MFS. Commissioning of the WTP is therefore required during the Construction Phase. Noting that portable WTP will be used in the Construction Phase to treat MIW.
- The majority of PCOC loads originate from the ELFs and collection of their seepage is important for minimising potential effects on waterways. As such, it is recommended that design, construction, and ongoing operation of ELFs and associated seepage systems are undertaken at a high standard to ensure high levels of seepage collection are achieved (as per model assumptions).
- Performance monitoring to confirm model inputs and results are reasonable with as-built conditions, including water quality and quantity data from:
 - Background catchments.
 - ELF seepage and runoff.

- Haul road runoff.
- Open pit runoff.
- Sump MIW.
- Sediment control structures.
- Sump bypass MIW.
- WTP discharge.
- MSRs discharge.
- Sump bypass infrastructure should be instrumented such that the frequency, duration, and water volume discharges are recorded and reviewed annually. Similar metrics should be recorded for WTP discharges and direct discharges.
- Demonstrate that adopted net percolation rates can be achieved through a cover system trial. Such a study would provide confidence that water quality closure objectives can be achieved in the proposed timeframes and support closure planning.
- Adaptive management processes should be followed to proactively manage water related risks.
- As more empirical data becomes available as the MFS sub-area is developed, the WLBM should be periodically benchmarked to new data and updated as needed to improve confidence in model results.

Closure Management Recommendations

The following management recommendations are proposed for the Active Closure and Post Closure Phases:

- The model suggests active treatment will be required for four years following completion of mining and rehabilitation works (Operations Phase) before switching solely to passive treatment in 2058. Performance monitoring during operations will improve understanding of the likely duration of active treatment.
- Passive treatment such as MSRs are an important element of achieving water quality objectives in the Post Closure Phase. As such, early implementation of passive treatment systems and associated performance monitoring should be used as an opportunity to monitor treatment performance and inform closure planning.
- The WLBM should be updated on a routine basis to include additional performance monitoring data are available to calibrate the model (e.g., cover system performance and net percolation rates; source terms; water treatment efficiencies, etc.) to improve confidence in model results for closure.

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1 **INTRODUCTION**

Mine Waste Management Limited (MWM) was retained by Bathurst Resource Limited (BRL) to develop a Water and Load Balance Model (WLBM) for the Mount Frederick South (MFS) sub-area to support approvals under the Fast-track Approvals Act 2024 (FTAA) legislation for the Buller Plateaux Continuation Project (BPCP). This report documents the development of this WLBM and key model outputs

1.1 **Background**

BRL is seeking to obtain authorisation through the FTAA for the BPCP to progress development and mining of coal resources across the wider Buller Plateaux.

The purpose of the BPCP is to secure the existing infrastructure and mining operations associated with the Stockton Mine and provide access to additional mining areas as the coal resources within the current operations are depleted. The project proposes to extract approximately 20 million tonnes of coking coal utilising existing infrastructure facilities over a 25-year timeframe to support and extend the mine life of the current Stockton Mine operations.

There are five key project sub-areas:

- Stockton
- Mount Frederick South (MFS)
- Escarpment Extended (ESE)
- Upper Waimangaroa Haul Road (UWHR)
- Cypress Mining Sub-area.

1.2 **Scope and Objectives**

This report documents the development of the MFS WLBM, which comprises a GoldSim-based water balance model, and a Python-based solute load balance model.

The WLBM was developed to achieve the following objectives:

- Forecast changes to flows within waterways as a result of the mining activities.
- Support design of water management infrastructure to enable capture and treatment of mine impacted water (MIW).
- Forecast downstream water quality arising from mine development to assess the effects from the MFS mining activities.

The Stockton and ESE sub-areas are not included within this report. Where the UWHR sub-area may impact water quality of waterways relating to the MFS sub-area, these effects have been incorporated in the WLBM presented in this report.

1.3 Project Description

The MFS mine is located southwest of the Mount Frederick mining area. Historical underground coal mining has been undertaken within the proposed MFS catchment.

The estimated footprint for the MFS mine is ~215 hectares (ha), made up of access roads, pits, in-pit engineered landforms (ELF), ex-pit ELFs, hardstand and stockpile areas, and water management infrastructure.

A site overview is presented in Figure 1 indicating the Life of Mine (LOM) site area, infrastructure areas, and sumps.

The MFS sub-area involves the following major activities:

- Access over three major waterways: the Waimangaroa River, Deep Stream, and Billo Stream. Crossing Billo Stream will allow for connection of the MFS East and West pits, while crossing of the other waterways allows for access to the MFS mining areas.
- Construction of the water treatment plant (WTP) infrastructure and coal stockpile area.
- Construction of the West Pit Sump, for management of mine impacted waters (MIW). And later construction of the East Pit Sump.
- Open-cast mining of the East and West pits, construction of ELFs, and rehabilitation.
- ELFs will be constructed within the mined-out pit shell where possible, however, about 10% of material will be stored in ELFs outside the pits. An ex-pit ELF will be constructed at the base of the MFS access road, adjacent to the Waimangaroa River, for the purpose of storing excess mine rock from the construction of the access road and WTP infrastructure areas – this ELF will then be used as a hard stand area for coal stockpiling. A further ex-pit ELF is to be located on the eastern side of the West Pit Sump for overburden from the construction of the sump, which occurs prior to mining.
- Construction of fourteen mussel shell bioreactors (MSRs) to passively treat MIW prior to discharge to surface water receptors.

Three mine phases are defined for the MFS WLBM:

- Construction Phase, where site works for establishment of the mine (i.e., construction of ancillary infrastructure, and limited pre-stripping of overburden) are completed ahead of mining. The Construction Phase covers the period where the active WTP and all associated WTP ponds are under construction. Where necessary, localised water treatment with small portable plants will be employed to manage water quality during this phase including prior to the establishment of the MFS WTP (MWM, 2026a).
- Operations (Mining) Phase, commencing at Stage 1 when active mining occurs. Water management infrastructure, such as sumps, pumps, pipelines, and the WTP are operational. Progressive rehabilitation of ELFs occurs during this phase. A limited number of MSRs become operational during this phase.
- Active Closure Phase, where active mining has ceased and mine disturbance is rehabilitated (e.g., ELFs). Active treatment via the WTP continues until such time that MIW loads have

reduced such that MSRs can effectively treat all ELF loads to meet water quality criteria. A limited number of MSRs become operational during this phase.

- Post Closure Phase, where the WTP and associated infrastructure is decommissioned and MIW is treated successfully via passive treatment with MSRs to meet water quality criteria.

The Construction Phase, where site works for the establishment of site infrastructure (e.g., initial access roads, sumps, drains, WTP, etc.) are completed ahead of active mining, is not included within the model.

A timeline of these phases for the wider BPCP, including the MFS, is shown in Figure 2. Evolution of the MFS mine disturbance over time (i.e., increasing by stage) is shown in Figure 3.

Two treatment phases are defined for management of MIW:

- Active Treatment Phase, where active treatment via the WTP occurs until such time that all MIW may effectively be treated via MSRs. A limited number of MSRs become operational during this phase. This phase covers the extent of the Operational and Active Closure (mine) phases.
- Post Closure Phase, the same as the Post Closure (mine) Phase, where MIW is passively treated through use of MSRs.

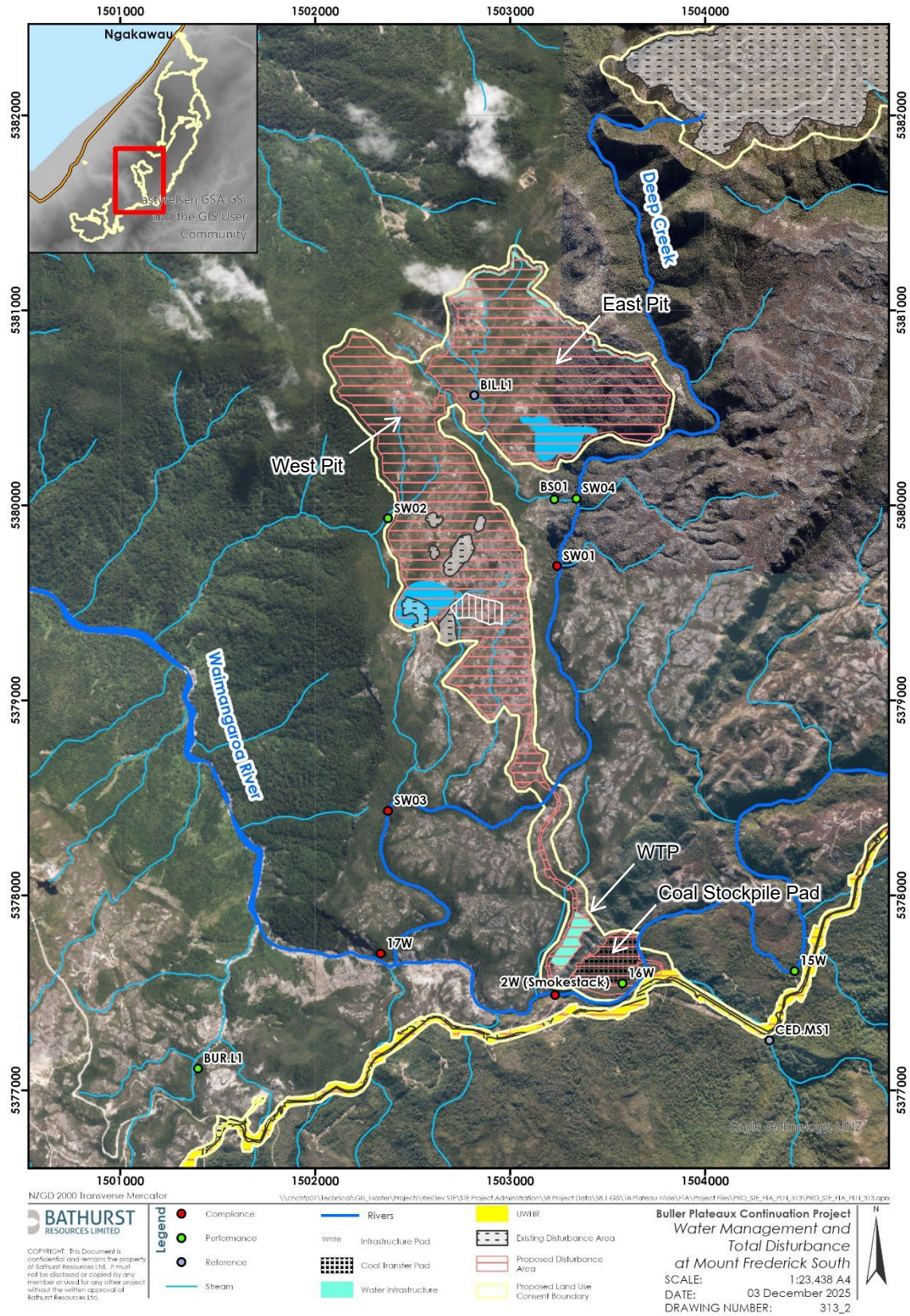


Figure 1: MFS Overview.
 Source: BRL

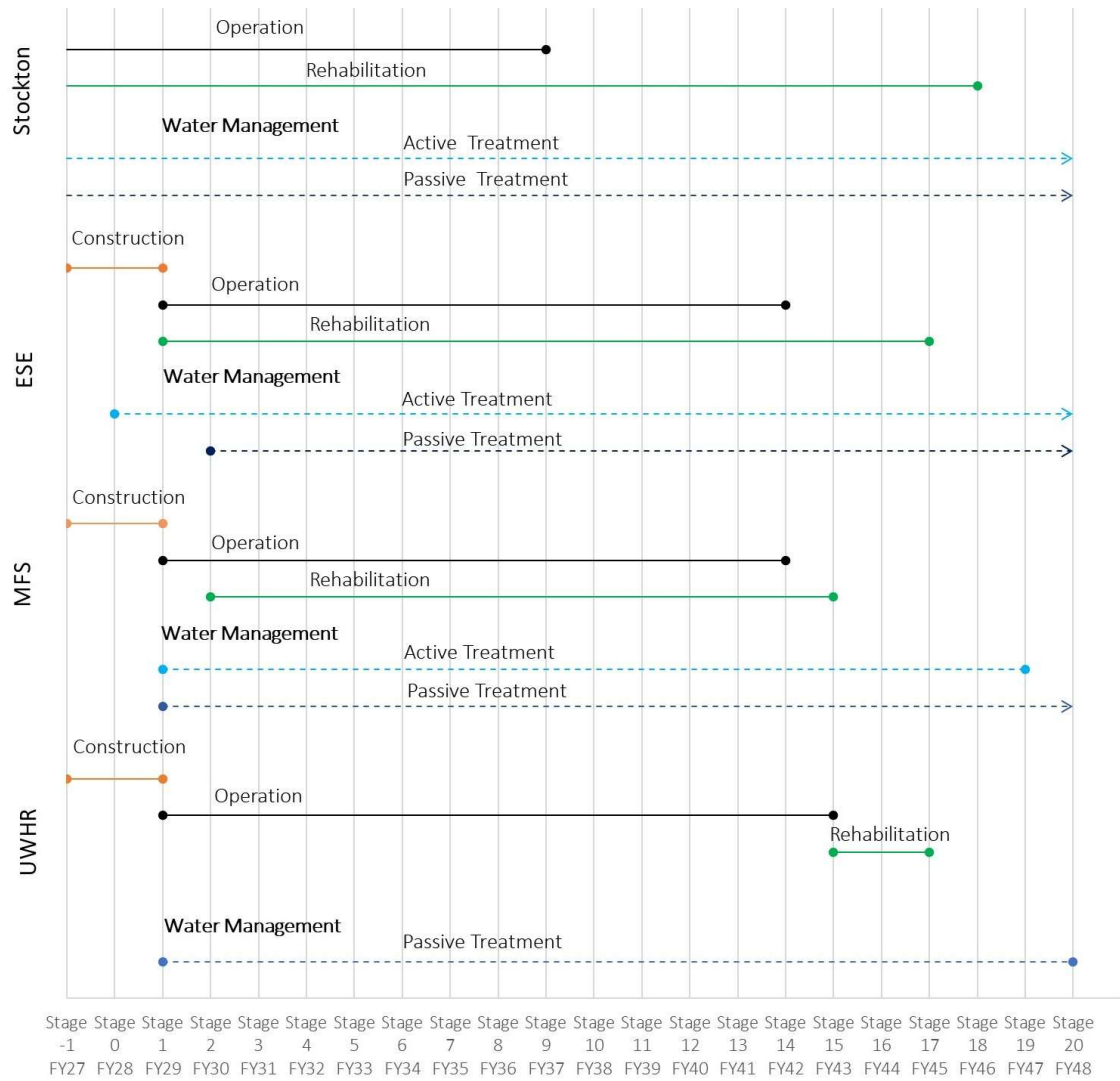
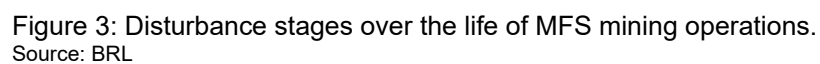


Figure 2: BPCP water treatment phases by sub project area.
Source: BRL



1.4 Report Structure

The remainder of this report is structured as follows:

- Section 2 provides an overview of the proposed compliance monitoring.

Section 3 provides an overview of planned water management at MFS, in regard to the Active Treatment and Post Closure phases.

- Section 4 describes the WLBM, including model framework and inputs.
- Section 5 describes how the model was evaluated, including QA/QC⁶ checks and model calibration.
- Section 6 presents the key model results.
- Section 7 summarises the report.

Report limitations are provided in Appendix A.

⁶ QA/QC = *quality assurance / quality control*

2 PROPOSED COMPLIANCE MONITORING

2.1 Compliance Water Quality Monitoring Locations

Four compliance water quality monitoring locations selected for MFS are shown in Table 1 and Figure 1. Sites SW01 and SW03 are located within the Deep Stream catchment, downstream of the East and West pit mining areas respectively. Site 2W (Smokestack), henceforth referred to as Smokestack, is located downstream of the WTP treated water discharge, within the Waimangaroa River catchment. Site 17W is located downstream at the confluence of Deep Stream and the Waimangaroa River.

Table 1: MFS compliance monitoring locations.

MONITORING LOCATION	RECEIVING WATERWAY	UPSTREAM ACTIVITIES
SW01	Deep Stream	East Pit mining activities. Limited West Pit mining activities. Upstream Deep Stream catchment.
SW03	Deep Stream	All MFS mining activities (less, ancillary areas located within the Waimangaroa River catchment). MFS access road. Upstream Deep Stream catchment.
2W(Smokestack)*	Waimangaroa River	Cypress Mine. UWHR. MFS WTP and direct discharge waters. MFS ancillary infrastructure area. MFS access road. Upstream Waimangaroa River catchment.
17W	Waimangaroa River	All mining activities. UWHR. Deep Stream catchment. Upstream Waimangaroa River catchment (noting waters through 2W (smokestack)).

About 0.15 ha of the West Pit ELF rehabilitated surface is expected to discharge surface runoff to an unnamed Waimangaroa River tributary to the west of the mining area; no other MIW will report here. This occurs via a performance monitoring site identified as SW02 (see Figure 1).

2.2 Proposed Water Quality Limits

Proposed guideline values have been developed by RMA Science for the following categories:

- Metals (Hickey, 2026). These include guideline values that are adjusted by toxicity modified factors (TMF), including pH, hardness, and Dissolved Organic Carbon (DOC). Guideline values were developed for chronic and acute exposure periods, and are to be applied as follows:
 - Chronic exposure – guideline value to be compared to annual median water quality.
 - Acute exposure – guideline value to be compared to annual 95th percentile (P95) water quality.
- Turbidity (Hickey, 2026). These are site specific. Where turbidity criteria are related to an increase compared to background (baseline levels), background turbidity was modelled using the background source term for TSS described in Section 4.3.2 and converted to turbidity as described in Section 4.3.3.

These limits were used to screen model results described in Section 6. The full suite of water quality limits are included in Appendix B.

3 MINE WATER MANAGEMENT OVERVIEW

This section describes water management of the MFS mining area and surrounding catchment.

3.1 Overview

The following catchments will be influenced by the proposed MFS mine area (Figure 4):

- Billo Stream Catchment.
- Deep Stream Catchment.
- Waimangaroa River Catchment.

During the Active Treatment Phase (Figure 5), MIW is managed such that:

- A drainage network collects the MIW and directs it to the East or West pit sumps where the majority of MIW enters the sump; during high river flows, a proportion is bypassed via gravity around the sump and discharged into the natural catchment (occurring on average ~18 days/year; ~5% of the time).
- MIW collected within the sumps is pumped to the WTP (located outside of the Deep Stream catchment) for treatment, where treated water is discharged via a polishing pond, and into the Waimangaroa River.
- Where flows within the Waimangaroa River are equal to or greater than the 90th percentile flow criteria (occurring on average ~37 days/year; ~10% of the time), MIW from the sumps is pumped directly into the Waimangaroa River (in addition to treated water discharge) at a rate of 200 L/s, herein referred to as *direct discharge*.
- Ancillary mining infrastructure is located within the Waimangaroa River catchment (illustrated within Figure 1), where surface waters are managed through use of the WTP (and, later, rehabilitation) and seeps from fill material are managed using MSRs.

During Post Closure (Figure 6), MIW will remain within the Deep Stream catchment, comprising of surface runoff and ELF seepage. At this time, surface runoff will be compliant for discharge to the background environment (due to rehabilitation of landforms) and ELF seepage is to be treated through use of MSRs.

MIW is defined as waters impacted by acid and metalliferous drainage (AMD) and with the potential for inclusion of sediment by MFS Mine and associated infrastructure. After a period of soil stabilisation following rehabilitation of mine domains, runoff from rehabilitated areas is no longer classified as MIW (due to reduce sediment generation) and does not need treatment.

MIW flow volumes and sources will vary throughout the life of MFS, where, for example, flows may initially be the combination of ELF surface water, ELF seepage flows and operational pit surface runoff flows, and then transition to simply ELF seepage after backfilling of pits and rehabilitation of the final landform occurs (including minor coal floor and highwall surfaces). Table 2 describes these MIW sources and how they relate to the treatment methods described in this report.

MIW reporting to the WTP is derived from multiple sources, while MIW reporting to MSRs will only originate from ELF seepage (this assumes the upstream catchment is rehabilitated for management of total suspended solids (TSS), related to surface waters, and does not generate AMD).

Table 2: MIW sources and relative treatment method

SOURCE	CONTAMINANTS	TREATMENT PHASE
Surface waters related to mining operations	TSS and AMD	Active Treatment Phase (WTP)
ELF Seepage	AMD	Active Treatment Phase (WTP) Post Closure Phase (MSRs)
Unstabilised rehab waters	TSS	Active Treatment Phase (WTP & Sediment Ponds)

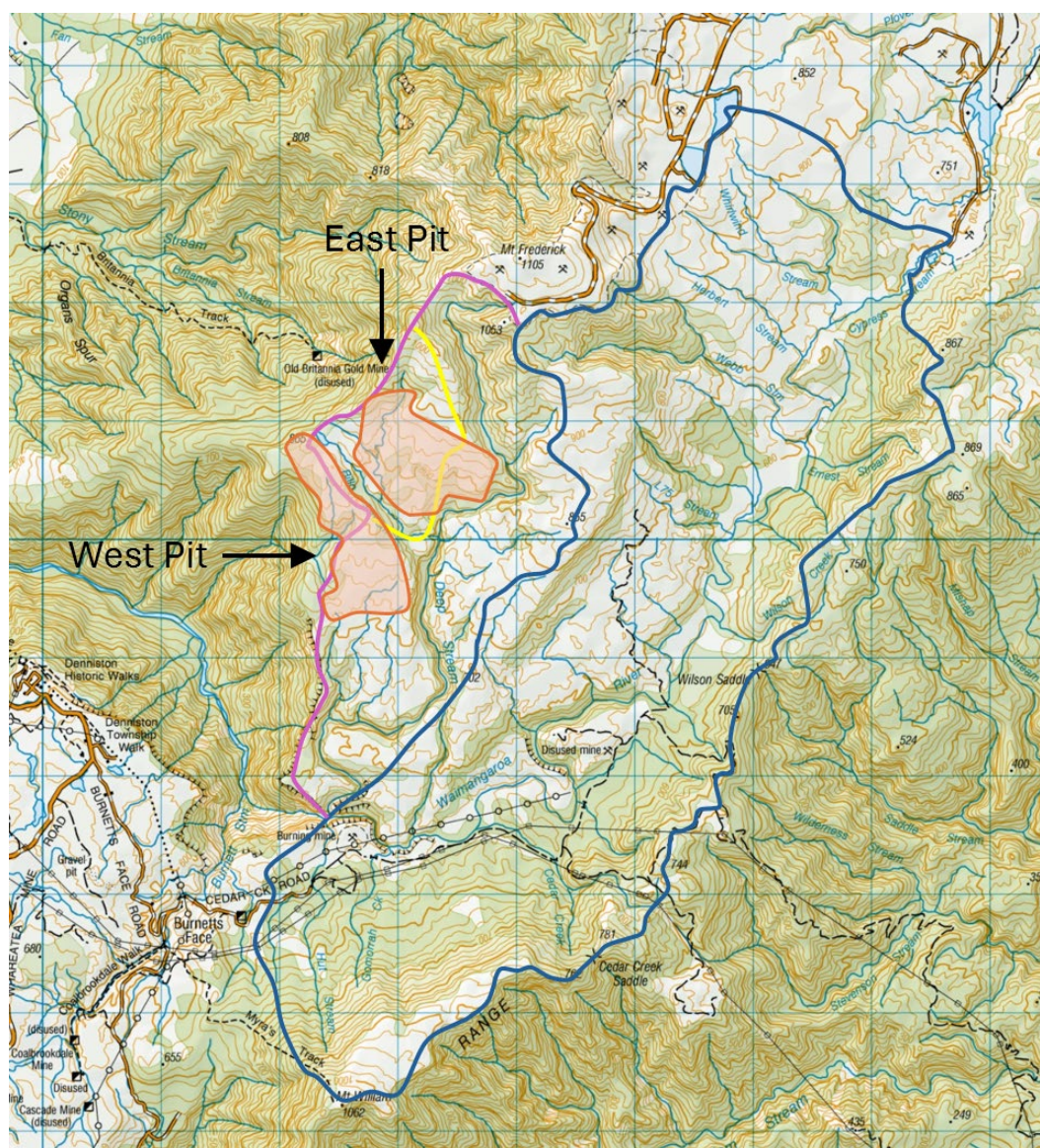


Figure 4: Overview of Catchments within the MFS sub-area, reporting to the Waimangaroa River - Deep Stream confluence.

Blue – Waimangaroa River catchment
 Purple – Deep Stream catchment
 Yellow – Billo Stream catchment
 Orange hatched – Pit outlines

Mount Frederick South (MFS) Active Water Treatment Flow Diagram

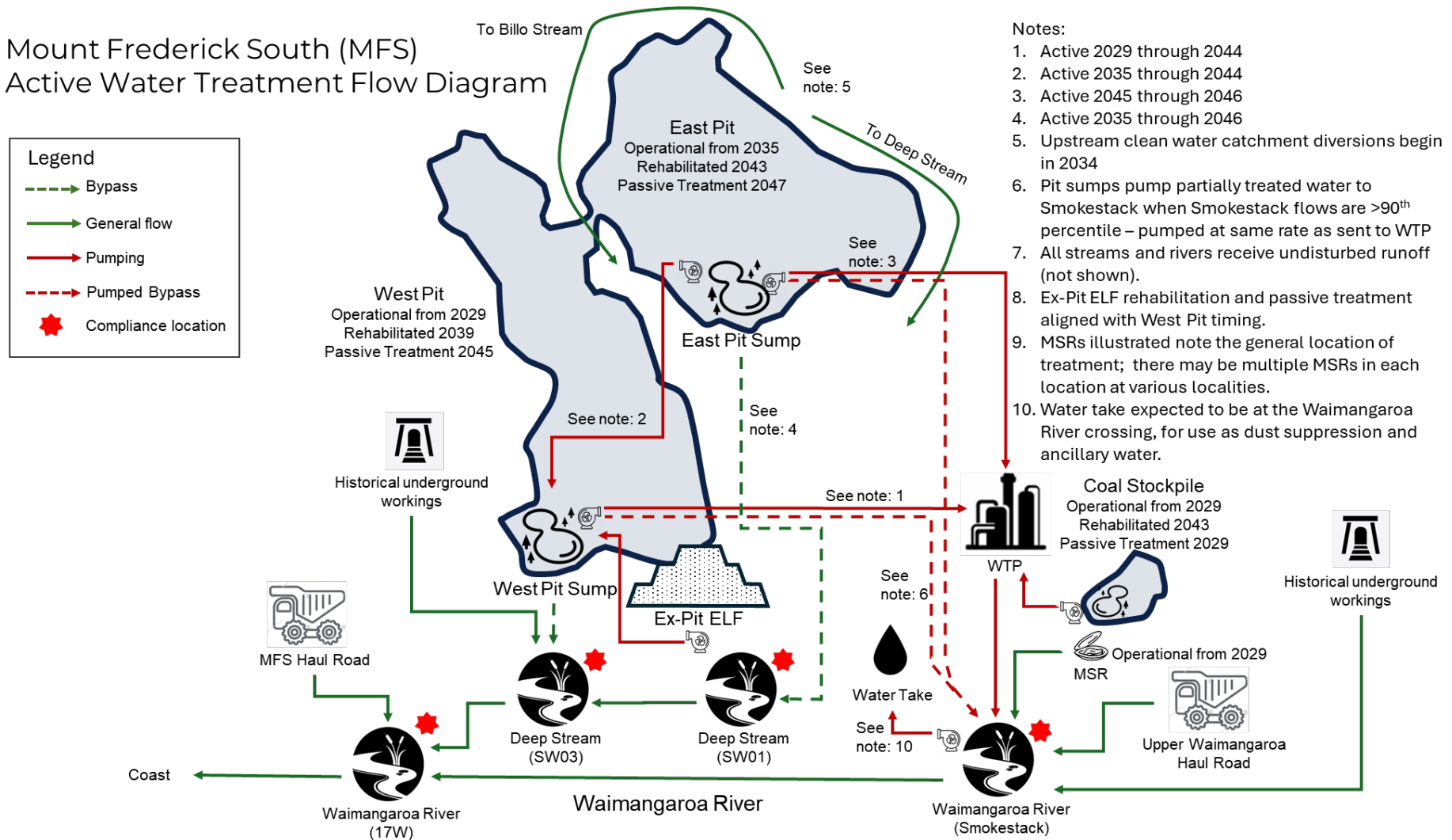


Figure 5: Water flow path diagram – active treatment.

Mount Frederick South (MFS) Post-Closure Flow Diagram

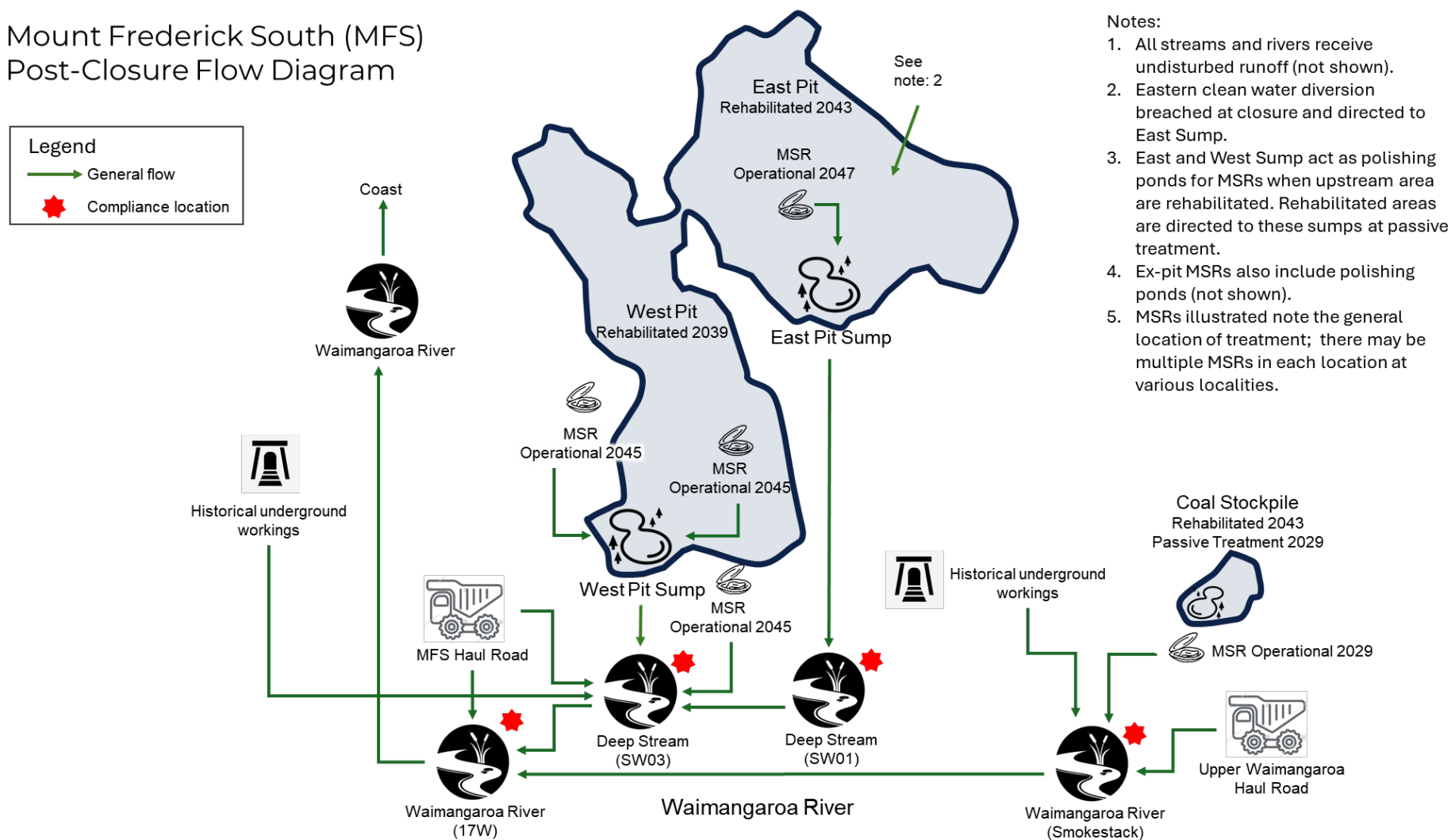


Figure 6: Water flow path diagram – passive treatment.

3.2 In-pit Water Management

Operational in-pit water management will operate as follows:

- Operations will begin within the West Pit, where the West Pit Sump will be constructed ahead of mining to manage MIW. This sump will go on to receive pumped water from the East Pit once mining begins in this area. The collection of MIW will be pumped from the West Pit Sump to the WTP for 16 years (2029-2044) until the West Pit operates under passive treatment; at this point (2045 onwards), MIW from the East Pit will be pumped to the WTP until it, too, shifts to passive treatment after another 2 years (2047).
- The East and West Pit Sumps will be constructed to enable water collection generally via gravity within the mining areas, with limited pumping required to direct MIW to these sumps.
- Sediment laden water from areas such as rehabilitation and vegetation stripping (not impacted by AMD) will incorporate infrastructure to allow for collection and treatment of the waters, primarily relating to sediment removal.
- Mine infrastructure will be in place to facilitate surface water flows to bypass the East and West Pit Sumps based on a 95th percentile flow criteria. For the purposes of this report, a bypass event describes release of MIW directly to the receiving environment (treated only for large particulate sediment removal). The 95th percentile flow criteria dictates that these discharge events will occur approximately 5% of the time on average. Bypass events will be facilitated by a device constructed for each individual sump to allow bypass flows to occur at or above a specified percentile flow during high stream flow events. The bypass mechanism is represented by the schematic in Figure 7. The bypass mechanism will not be active at passive closure and 100% of ELF seepage loads are treated passively.
- Additional infrastructure will facilitate MIW within sumps to be pumped directly to the Waimangaroa River, when Waimangaroa River flows exceed the 90th percentile flow criteria. This flow criteria is modelled based on simulated upstream flow conditions at Smokestack. For the purposes of this report, this pumped discharge event is described as the direct discharge of MIW to the receiving environment. The 90th percentile flow criteria dictates that these discharge events could occur approximately 10% of the time on average over a year. Direct discharge events will be facilitated by a mechanism described in Figure 8.
- Cutoff drains above the East Pit will direct clean water into Billo Stream and Deep Stream throughout the operation of the East Pit mine and the entirety of the Active Treatment Phase. These drains will be decommissioned and flow directed through the East Pit Sump during the Post Closure Phase.
- Water treated at the WTP will be released into a finishing/polishing pond before ultimately discharging to the Waimangaroa River. The WTP capacity will be sized (235 L/s) such that the East and West pit sumps avoid spilling directly to the environment (this is increased to 270 L/s for Scenario 1, see Section 4.2.8.3).
- The mined-out pit will be progressively backfilled with waste rock, creating ELF's. Underdrains will be constructed to enhance and control collection of ELF seepage (MIW).

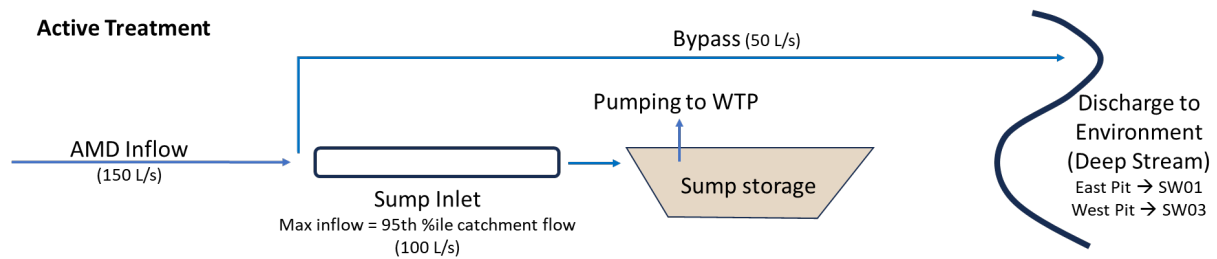


Figure 7: Sump gravity bypass mechanism.

Note: Flow rates in schematic are indicative only and do not represent model outputs.

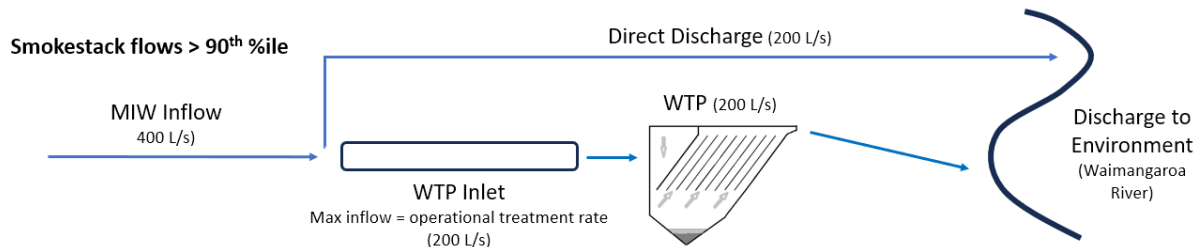


Figure 8: Direct discharge to the Waimangaroa River mechanism.

Note: Flow rates in schematic are indicative only and do not represent model outputs.

Operational water management infrastructure including the WTP will be maintained following closure of the mine, until rehabilitation has been completed and water discharge quality meets compliance criteria through use of passive treatment. Once the Post Closure Phase begins, in-pit sumps will act as polishing ponds for MSRs (installed to treat ELF seepage flows only), receiving inflows from MSR-treated water and surface runoff from rehabilitated mine areas (i.e., final landform ELFs, coal floor, highwalls).

3.3 Coal Stockpile Area

The MFS WTP and coal stockpile area will be located at the base of the MFS access road. The coal stockpile sits adjacent to the Waimangaroa River, with the WTP north of this on an elevated platform.

Surface water from the coal stockpile area will be collected, pumped and treated via the WTP until this area is rehabilitated, while seepage from the backfilled pad will be managed through use of MSRs. It is anticipated that clean water upstream of the coal pad is to be diverted away from the pad.

3.4 Engineered Landforms

The ELFs will be constructed with the following aspects to minimise the generation of AMD (BRL, 2026):

- Bottom-up build with short lifts (3 to 5 metres (m)) to minimise segregation, with higher lifts possible if grainsize segregation does not occur and advective oxygen ingress is prevented.
- Traffic compaction on top of each lift.
- Progressively rehabilitated.
- The final landform surface will be constructed and profiled to a rehabilitation angle of 18 degrees.
- ELF heights will vary between 20 to 60 m.

- ELFs will be developed in-pit where scheduling allows to minimise lateral oxygen ingress where mine rock is placed against pit walls.
- A basal drainage network will be established under the ELFs to collect and convey seepage for treatment. Where this seepage is directed to MSRs, surface waters will be kept separate from these seepage flows.
- Based on empirical data a 10 m thick outer oxidising zone will form (horizontal to ELF surface). Deeper than 10 m, the ELF will be under sub-oxic conditions.
- Cover systems will be constructed as part of rehabilitation to further reduce AMD generation.

3.5 Rehabilitation

Both in-pit and ex-pit ELFs will be progressively rehabilitated, which includes emplacement of a non-acid forming (NAF) cover over any potentially-acid forming (PAF) waste rock. Topsoil is then placed atop the NAF cover, and vegetation planting, vegetation direct transfer (VDT) or hydroseeding is undertaken to establish a vegetation cover to stabilise the surface. The intention of the cover system is to limit ingress of water and oxygen into the ELF, reduce potential constituents of concern (PCOC) loads from ELF runoff and seepage, and provide a growth medium for the planting. Where practicable, runoff from rehabilitated ELFs will be diverted directly to receiving waterways once suitable ground cover is established from the vegetation. Sediment ponds may be installed at the toes of the ELFs or along drainage benches to minimise sediment discharge.

Runoff from rehabilitated portions of an ELF will initially be collected for active treatment (sediment), or where practicable, treated via sediment control structures, until suitable vegetation cover and soil armouring occurs and runoff from rehabilitated areas is suitable for discharge to the receiving environment. BRL estimate this suitable vegetation cover and soil armouring process to take approximately two years following placement of rehabilitation material (BRL pers. comm. email dated 14 May 2025).

The West Pit is modelled to be rehabilitated from 2039, and the East Pit is modelled from 2043.

Rehabilitation of handstand areas, such as infrastructure areas, coal stockpile pad, roadways and highwalls, will be undertaken in a similar manner, reducing the risk of erosion and sedimentation in waterways. Noting road access is required into the Post Closure Phase to maintain the MSR.

3.6 Active Water Treatment

Location of the WTP is illustrated in Figure 1. Active treatment will occur during the Operations Phase for management of MIW which will be impacted by TSS, acidity, and metals. Active treatment will continue after mining until such time that water quality compliance can be managed via MSRs; modelling suggests this timing to be 2045 for the West Pit and 2047 for the East Pit. Process Flow (2026a) describe the process of active treatment via a WTP as:

- Feed pumps for delivery of slurry to the WTP.
- Calcium Oxide silo and slurry dosing for neutralisation of feed water and precipitation of metals particularly Al and Fe.
- Metal chelating agent dosing for further removal of dissolved metals concentrations.

- Flocculant dosing for floc formation.
- Lamella clarifiers for removal of floc formations, removing TSS and metals.
- Sulphuric acid trimming as/if required to meet recommended guidelines for metals and pH.
- Secondary flocculant dosing and pressure filter to dewater TSS/AMD sludge accumulated within the WTP for disposal.
- Polishing pond to allow retention time on treated water prior to discharge. To allow floc carry over to settle prior to discharge.

After treatment, water will then be released into the Waimangaroa River, upstream of monitoring site Smokestack. This will be at a rate of up to 235 L/s.

The WTP capacity is currently designed to manage water within the East and West Pit Sumps such that spilling from pit sumps does not occur (not withstanding bypass of flows greater than the 95th percentile flow criteria and direct discharge occurring when relevant flow criteria are met).

3.7 Passive Water Treatment

Once ELF seepage water quality is demonstrated to be able to be suitably managed through use of MSRs, these will become the method of treatment.

MSRs work to neutralise acidity, partially remove metals, and facilitate bacterial sulfate reduction through use of waste mussel shells. This involves only managing seepage waters, with surface waters being diverted around the system. Polishing ponds are placed at the outlet of MSRs, and aid to remove secondary contaminants and improve water treatment efficiencies for metals such as Ni and Zn.

Fourteen MSRs will be constructed as part of the passive water treatment system at MFS. The MSRs are described in Table 3 below with locations indicated in Figure 9 and Figure 10. MSRs 5 through 10 will make use of the East and West pit sumps as shared polishing ponds (where they will be left to spill), while the remaining MSRs reside ex-pit and will require separate polishing ponds.

It is anticipated that the East and West pit catchments will require active treatment beyond rehabilitation of the mine. Only the coal stockpile MSRs and MDC1 and MDC2 MSRs have been modelled to be operational during the Operations Phase.

Waters from rehabilitated and background areas that may passively direct water into the East and West pit sumps will be used to provide dilution of exposed coal and highwall surfaces reporting to these sumps if required.

Following establishment of passive treatment through use of MSRs - which involves the occurrence of stable flow and chemistry from seeps (for effective treatment), and compliant discharge from polishing ponds - it is expected that the WTP may be decommissioned. During the period of MSR commissioning the WTP will be made available as required and will be maintained as a contingency for 2 years.

While MSRs have been established as the preferred technology for use as passive treatment systems (MWM, 2026c), alternative passive treatment technology may be assessed in the future and may be used as a preferred passive treatment system should they be suitable.

Table 3: Mussel Shell Bioreactors.

MSR	LOM CATCHMENT AREA ¹ (HA)	ELF SEEPAGE AREA	MSR ACTIVATION YEAR	RECEIVING CATCHMENT
MSR1	6.2	West Pit	2045	Deep Stream
MSR2	1.5	West Pit	2045	Deep Stream
MSR3	4.1	West Pit	2045	Deep Stream
MSR4	4.1	West Pit	2045	Deep Stream
MSR5	19.0	West Pit	2045	Deep Stream
MSR6	4.5	West Pit	2045	Deep Stream
MSR7	20.2	West Pit	2045	Deep Stream
MSR8	31.8	East Pit	2047	Deep Stream
MSR9	4.0	East Pit	2047	Deep Stream
MSR10	2.5	East Pit	2047	Deep Stream
MSR11	2.9	Coal Stockpile	2029	Waimangaroa River
MSR12	2.9	Coal Stockpile	2029	Waimangaroa River
MDC1 ²	0.6	MFS Access	2029	Deep Stream
MDC2 ^{2 3}	0.5	West Pit	2036	Billo Stream

Note: ¹Provided values indicate catchment areas at LOM.

²NAF ELF.

³Modelling is undertaken using MSR treatment efficiencies from 2036, however, in practice it will be pumped to the WTP until completion of the ELF when the MSR will be installed in 2038.

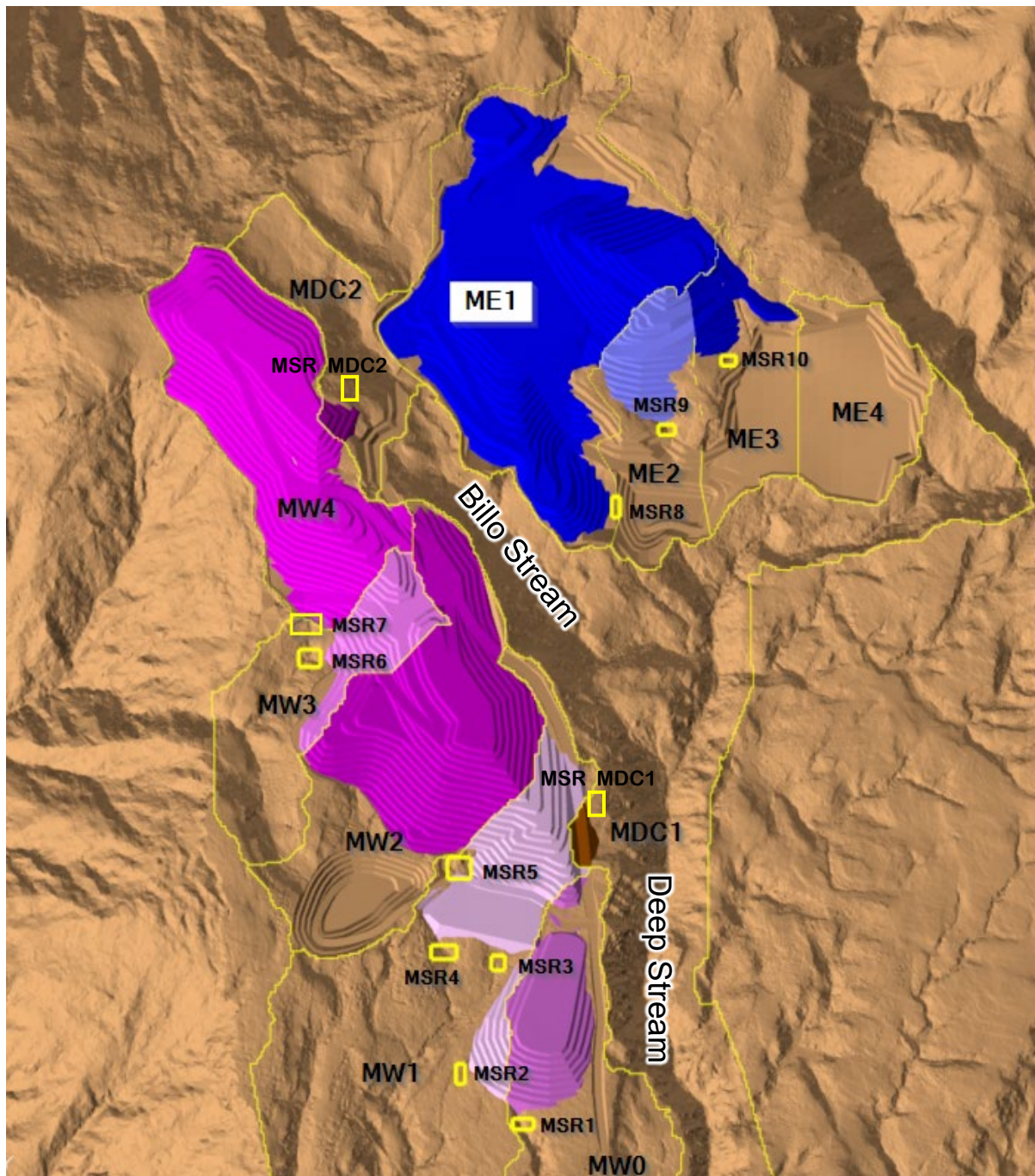


Figure 9: Mount Frederick South, closure landform, including (ELF) basal sub-catchments.

Source: BRL (with additional annotations made by MWM)

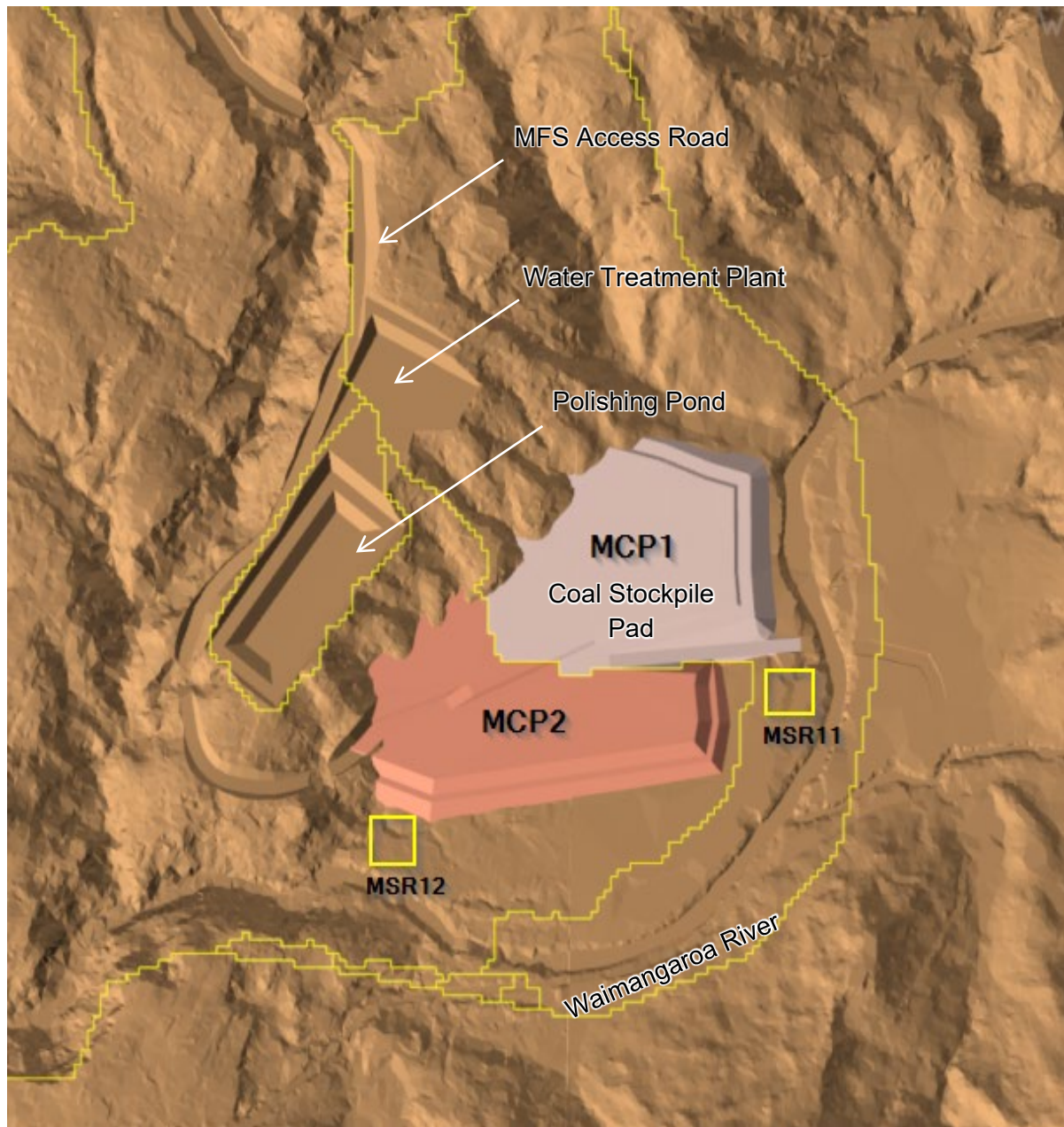


Figure 10: Coal stockpile pad basal sub-catchments.

Source: BRL

Refer Figure 1 for location in context of the MFS mining area

4 **MODEL DESCRIPTION**

4.1 **Model Framework**

4.1.1 *Model Overview*

The WLBM works to mechanistically model the proposed water management system at MFS. Hydrological, geochemical, and operational processes that influence water quantity and quality on site are represented in the model and calibrated against historic monitoring data where available. Some inputs to the model are derived directly from empirical data, while others originate from literature. The model can be used to evaluate factors that affect water management at MFS in the future. This information can then be used to make decisions on the design and operation of the water and AMD management system.

The MFS sub-area was divided such that each surface water catchment has a unique flow path and source term. The model is forced using daily rainfall and potential evapotranspiration (PET). Daily rainfall was used to estimate flow volume for each defined catchment. Runoff coefficients were used for disturbed areas, based on land cover type, to determine runoff as a fraction of precipitation, while runoff from background catchment areas was modelled using the Australian Water Balance Model (a rainfall-runoff model used to calculate surface water runoff with precipitation and evapotranspiration inputs, further described in Section 5.2). Net percolation coefficients were used to estimate ELF seepage as a fraction of precipitation, where a recession coefficient was applied to represent stable seepage.

The load balance is based on a mass balance approach and calculates loading rates by assigning source terms that are either constant concentrations (e.g., mg/L), or constant loads (e.g., kg/day/ha) to the flows calculated in the water balance model and generates water quality projections for both onsite and downstream locations. A decay factor for some of the source terms was also implemented after closure (see Section 4.3.1 for further details).

Mechanisms that are represented in the model included:

- Runoff from background catchments.
- Runoff from mine domains (e.g., pit voids, ELFs, etc.).
- Seepage from ELFs.
- Collection and conveyance of MIW water.
- Loading rates of contaminants generated from source terms (both from constant concentrations and constant loads).
- Mixing of parameters (conservative) and calculation of concentrations in each flow path.
- Parameter load changes through the WTP and MSRs.
- Contaminant load reduction through the WTP and MSRs.
- Effects on downstream water quality (based on compliance advice provided by others, see Section 2).

Model prediction nodes were selected to output model results for key compliance sites (see Section 2.1 for further details):

- SW01 (Deep Stream).
- SW03 (Deep Stream).
- 2W (Smokestack; Waimangaroa River).
- 17W (Waimangaroa River).

4.1.2 Model Platform and Version

The MFS WLBm was developed by building the water balance component to estimate flows. The load balance component was then built, utilising the generated flows in the calculation of loads.

The water balance model was developed using GoldSim (GoldSim Technology Group, 2025) and is currently updated for use in Version 15.0 R2 (#257). GoldSim is a dynamic system modelling software package commonly used for simulating mine water and balances. The load balance model was developed with the use of Python programming language within the Jupyter Notebook environment.

4.1.3 Timescale

The model is run on a daily timestep for the period 01/01/2029 to 1/01/2129. The time scale and mine phases are provided in Table 4 (as described in Section 1.3).

Mining at MFS is planned to begin in 2029 and is planned to cease at the end of 2042, with rehabilitation activities complete by 2043. The Active Closure Phase is modelled to cease in 2046 following passive treatment used to manage MIW, which is likely to continue until 2128 (the end of the model period). Therefore, the simulation timeframe accounts for a 100-year operational to post closure period.

Table 4: Model timescale and mine phases.

MINE STAGE	YEARS (INCLUSIVE)	ACTIVITIES
Operations Phase	2029-2042	Active mining and production, active WTP in operation.
Active Closure Phase	2043-2046	Active mining has ceased. Completion of rehabilitation has been undertaken. Active treatment and associated infrastructure remain operational until ELF seepage water quality is deemed suitable for treatment through use of MSRs. MSR passive treatment systems become active at different times for each ELFs.
Post Closure Phase	2047-2128	MSRs provide complete treatment of the site.

The Construction Phase is not included in the model as the model starts when the active WTP and associated ponds are constructed.

4.1.4 Model Scenarios

The model has been built to accommodate multiple scenarios to understand potential impacts to the environment based on changes to model inputs. A total of 5 model scenarios were applied to the model that incorporate variability in hydrologic conditions and ELF seepage source terms, as summarised in Table 5. Scenarios are described further in this Section.

Table 5: Summary of model scenarios.

MODEL SIMULATION	HYDROLOGY*	ELF SOURCE TERMS	PURPOSE
Base Case	2019 rainfall applied back-to-back as approximation of average rainfall conditions.	Typical	Applied and evaluated at all model nodes, forming the basis of the model assessment.
Scenario 1	2021 rainfall applied back-to-back as approximation of high rainfall conditions.	Typical	Maximise MIW discharges and related potential effects to the receiving environment in terms of flow rates and water quality. Understand pumping / WTP requirements under consecutive high annual rainfall conditions.
Scenario 2	Stochastic realisation of rainfall.	Typical	Evaluates hydrological variability and related potential effects, particularly for the Post Closure Phase.
Scenario 3	Average annual, as per Base Case.	+30%	Evaluates higher loading rates from ELF seepage to downstream environment and the associated in-stream water quality
Scenario 4	Average annual, as per Base Case.	-30%	Evaluates lower loading rates from ELF seepage to downstream environment and the associated in-stream water quality

* Note, rainfall conditions are described in Section 4.2.2.

4.2 Water Balance Inputs

This section describes the inputs use for constructing the water balance model.

4.2.1 Model Structure

The water balance model structure comprises the following:

- Delineation of sub-catchments. A proportion of each sub-catchment was assigned a land use type (e.g., background, ELF, active pits).
- Each sub-catchment was assigned a catchment area. These were set as annualised catchment areas for model simplicity.
- Flow paths were specified for each sub-catchment and for directed flows between model domains as indicated by the water management strategy.
- Nodes representing proposed downstream water quality compliance locations were simulated to calculate flows at these nodes.

4.2.2 Climate Inputs

Climate inputs for the Base Case and model scenarios (that include climate variability, i.e., Scenario 1 and 2) are described in this section.

4.2.2.1 Base Case

BRL provided a patched historical rainfall record for the Lake Brazil Meteorological Station. Where data gaps existed, the Stockton Office Meteorological Station data were used to fill these by BRL. Potential evaporation (PE) was calculated based on Lake Brazil Meteorological Station patched climate data by

MWM (2026a). For modelling purposes, PE was assumed to be representative of PET. Together, these data are henceforth referred to as the 'Project Climate Dataset'. The Project Climate Dataset spans 25/01/2013 and 31/12/2023.

The Base Case model scenario utilised the 2019 rainfall year from the dataset, with 5,449 mm recorded over that year (illustrated in Figure 11). This aligns with average annual rainfall conditions from the dataset (~5.5 m rainfall). The daily rainfall data for this year was repeated for every year in the Base Case model simulation.

The modelled rainfall dataset was also adjusted for elevation to account for the higher rainfall experienced at MFS compared to Lake Brazil. The increase in rainfall with elevation was described by Chater (2024a) and is illustrated in Figure 12; the increase in annual precipitation was determined to be a factor of 1.08 for MFS based on an approximate elevation of 800 m above sea level for the catchment.

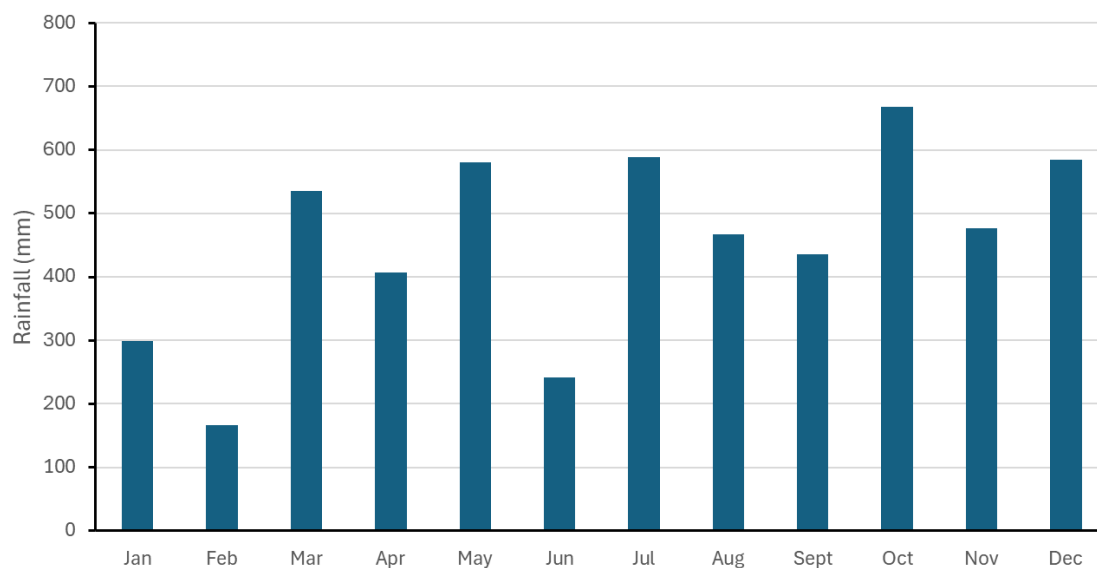


Figure 11: 2019 monthly rainfall data (Base Case)

Note: taken from the Project Climate Dataset without correction for elevation.

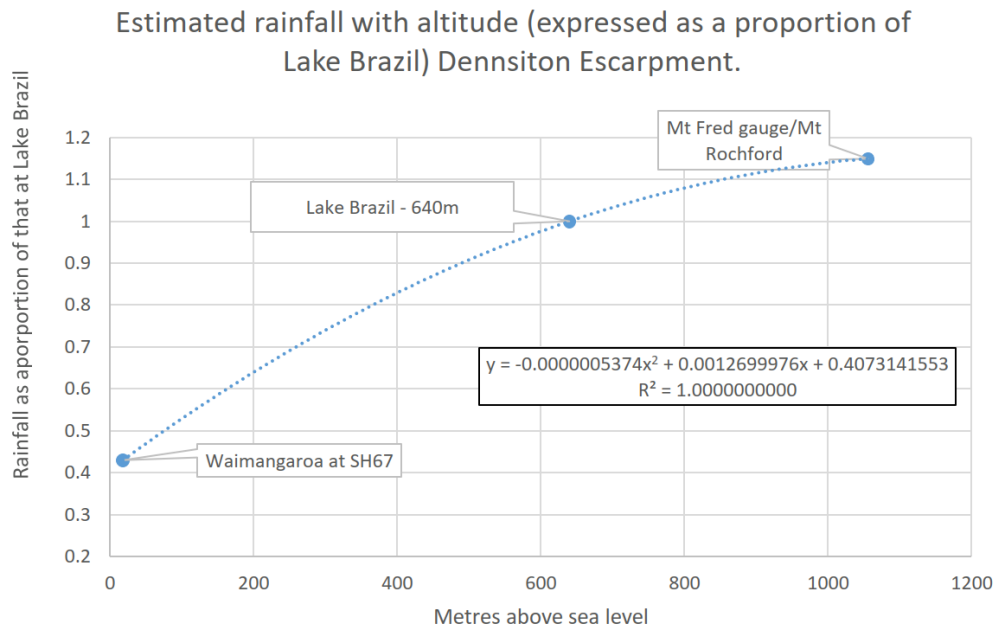


Figure 12: Increase in rainfall with elevation as fraction of rainfall measured at Lake Brazil.

Source: Chater (2024a)

Climate change was implemented in the model using a precipitation multiplication factor that was applied to the generated precipitation timeseries. The multiplication factor represents a uniform 9% increase in rainfall from 2025 to 2100 with no change of precipitation from 2100. This was based off climate change projections for New Zealand (Ministry for the Environment, 2018), utilising the RCP 6.0 scenario. The climate change function (Figure 13) represents the uniform relative increase in rainfall, whereby almost 6 m of rainfall is modelled from 2100 onwards.

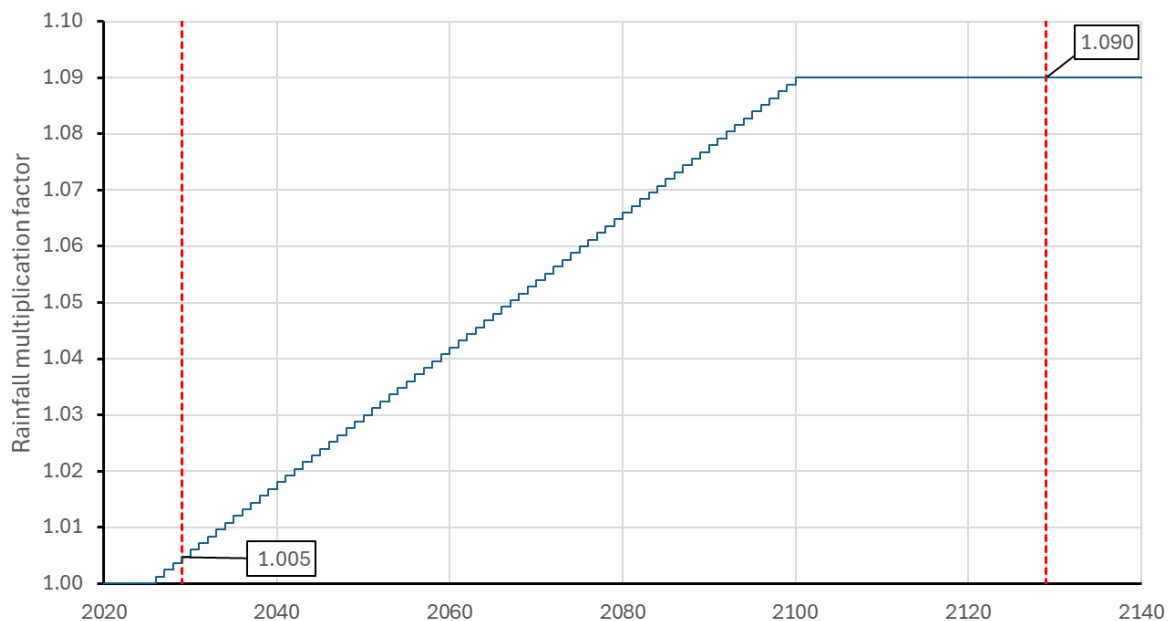


Figure 13: Multiplication factors used to represent influence of climate change on future precipitation (relative to historic data).

Red dashed lines indicate model start/stop dates

Source of climate change predictions: Ministry for the Environment, 2018, Table 11, West Coast Hokitika, RCP 6.0

Increase of annual precipitation applied directly to the rainfall dataset with the assumption this is more conservative than the 1986–2005 time series referenced by Ministry for the Environment (2018)

4.2.2.2 Scenario 1

Scenario 1 was developed to model the influence of a high rainfall year occurring at any time throughout the MFS sub-area duration and occurring consecutively. It is not intended to represent a realistic climatic occurrence. The year 2021 was selected as it included the highest total annual rainfall in the Project Climate Database. As per the Base Case the daily rainfall data for this year was repeated for every year in the model simulation.

The scenario was implemented by applying the 2021 rainfall record for every year in the simulation, whilst applying the climate change function to increase rainfall in the long term, and the elevation adjustment factor as per the Base Case scenario. No other model parameters were altered from the Base Case.

Total rainfall from the 2021 rainfall year was 6,619 mm, 21% higher than the average rainfall year (2019). For the Stockton Meteorological station, 2021 had the second highest annual rainfall recorded from 39 years of data (BRL per. comms., email dated 11 December 2025). Figure 14 compares the monthly rainfall distribution between 2019 (Base Case) and 2021.

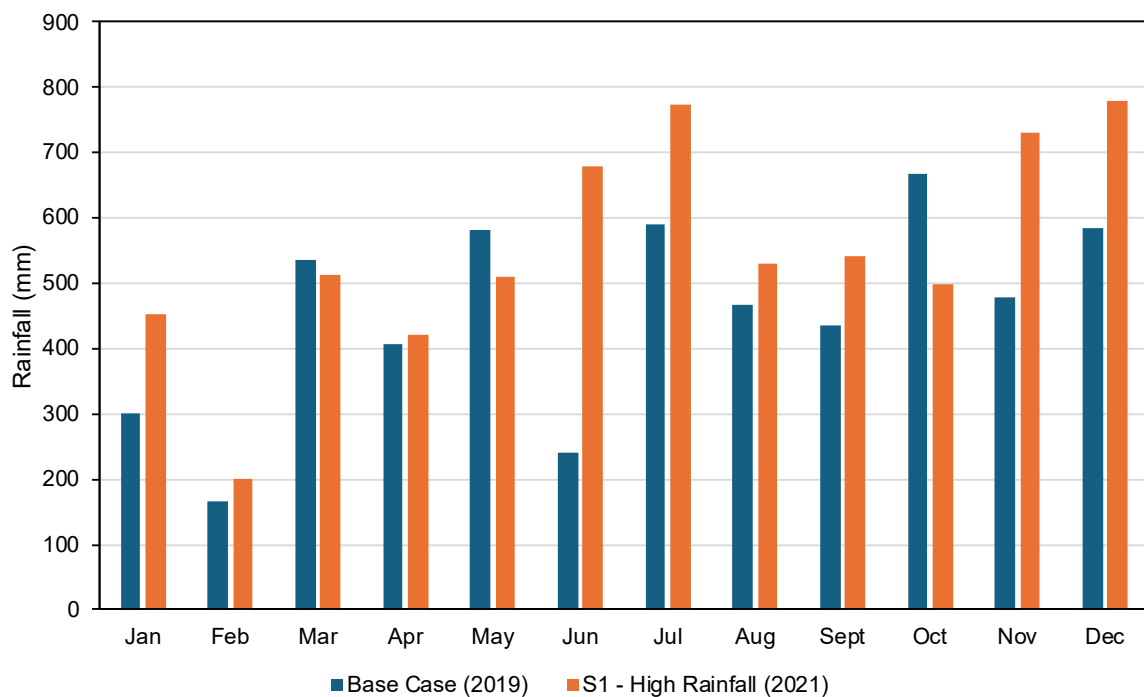


Figure 14: Monthly rainfall comparison.

The following is noted:

- Rainfall was higher in 75% of months in 2021.
- The three highest rainfall months in 2021 exceeded 700 mm. These were July, November, and December.
- Significantly lower rainfall was measured in February 2021 (~200 mm), however, even less was measured in February 2019.

4.2.2.3 Scenario 2

Scenario 2 incorporates a stochastically generated rainfall time series, developed using statistical parameters derived from the Project Climate Database through use of the Stochastic Climate Library v2.2.0 (CRC for Catchment Hydrology, 2006). Figure 15 presents the annual rainfall of the time series data generated for Scenario 2, while comparing this to the Base Case and Scenario 1 annual rainfall data. This stochastic approach allows for the representation of background variability in rainfall patterns while maintaining realistic long-term averages. This scenario applied the climate change function and the elevation adjustment factor as per the other scenarios.

No changes were made to pumping rates, bypass trigger rates, or the source terms within the load balance model.

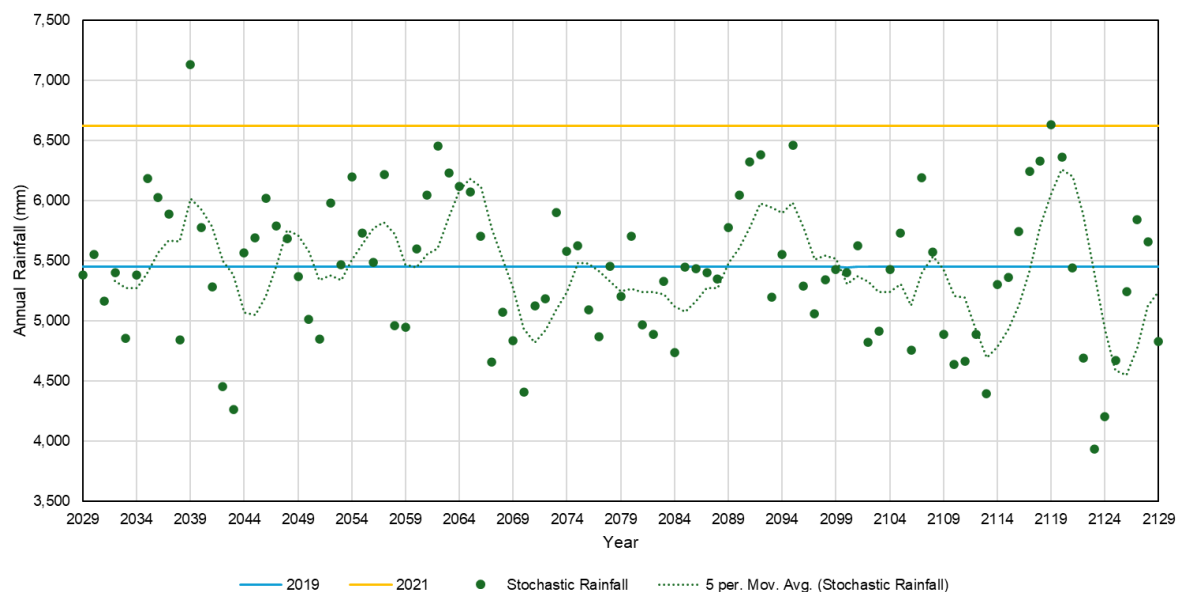


Figure 15: Scenario 2 - stochastic rainfall timeseries.

Notes:

Rainfall timeseries indicated in figure does not include modelled effects of climate change or adjustment for the site altitude.

2019 and 2021 annual rainfall amounts indicated for reference.

4.2.2.4 Rainfall Statistics

This section relates the input rainfall data for each scenario to high intensity rainfall events and anticipated annual return intervals to provide context for the scale of rainfall events included in model scenarios. Prolong dry periods are also examined.

High Intensity Rainfall

Table 6 describes the rainfall frequency results of Stockton Office Meteorological Station for 24-hour rainfall accumulation, as described in Chater (2024b). As per communications with BRL, the Stockton Office Meteorological Station results present similar results to the Lake Brazil rainfall frequency, typically within 5% for the 24-hour accumulation period. In addition, adjustments are made in Table 6 to account for climate change based on Ministry for the Environment (2018). The 2101-2120 period (taken as the closest reporting period to that of the end of the modelled period) presents predicted rainfall frequency results as described in Table 6.

However, high intensity rainfall events are predicted to increase in size at a rate greater than annual accumulation. Ministry for the Environment (2018) present an increase in high intensity rainfall based on a proportion of change relative to a predicted increase in temperature.

Table 6: Summary table of Stockton Office Meteorological Station 24-hour rainfall frequency results.

RETURN PERIOD	STOCKTON OFFICE METEOROLOGICAL STATION 24 hr ACCUMULATION (mm) ¹	PERCENTAGE CHANGE FOR 1°C TEMPERATURE INCREASE ³	24 hr ACCUMULATION BASED ON A PREDICTED INCREASE OF TEMPERATURE OF 2.31°C (mm) ⁴
2 years	256.0	7.2	298.6
2.33 years (mean annual)	271.0	7.2	316.1
5 year	333.9	7.8	394.1
10 year	385.1	8.1	457.2
20 year	434.1	8.2	516.3
50 year	497.6	8.4	594.2
100 year ²	545.2	8.6	653.5

1 – Source: Chater (2024b)

2 – Indicative; see Chater (2024b) for further details.

3 – Taken from Table 13, Ministry for the Environment (2018). Note: this takes the most likely percentage change.

4 – Taken from Table 14, Ministry for the Environment (2018)

High intensity 24-hour periods represented within the model are tabulated in Table 7, noting the model runs on a 24-hour timestep. These values include climate change adjustment on the basis of an increase in annual precipitation (see Section 4.2.2.1).

Table 7: Maximum observed 24-hour rainfall within the modelled scenarios.

	MAX. MODELLED 24 hr RAINFALL (mm)	APPROXIMATE HISTORIC RETURN PERIOD	APPROXIMATE CLIMATE ADJUSTED RETURN PERIOD
Base Case	208.4	< 2 years	< 2 years
Scenario 1 (2021)	285.6	2.33 years	2 years
Scenario 2 (Stochastic)	571.7	100 year	50 year

Comparison of the modelled maximum 24-hour rainfall values (Table 7) with the climate change adjusted rainfall frequency data indicates the Base Case and Scenario 1 do not model a significant 24-hour high intensity rainfall event, whilst Scenario 2 models an event that is close to a 1 in 50-year return period. This highest 24-hour rainfall values for Scenario 2 occurs in during the Post Closure Phase (2047 to 2129) in year 2098. During the Active Treatment Phase (2029 to 2046), Scenario 2 models a 426.5 mm event within the year 2035 (close to 1 in 20-year return period based on the unadjusted rainfall frequency data).

Long Term Dry Periods

Long term dry periods, defined as the maximum number of consecutive days of < 1 mm of 24-hr rainfall accumulation, for the Project Climate Dataset and modelled rainfall are tabulated Table 8. The Base Case and Scenario 1 rainfall had lower consecutive dry days, but Scenario 2 did have a dry period longer than observed in the Project Climate Dataset. During the Active Treatment Phase (2029 to 2046), Scenario 2 models a 37-day dry period within the year 2042. Within the Post Closure Phase of Scenario 2 is when the 41-day dry period (Table 7) occurs (year 2121).

Table 8: Maximum periods of consecutive dry days.

	MAX. CONSECUTIVE PERIOD OF DRY DAYS
Project Climate Dataset	32 ¹
Base Case	10
Scenario 1 (2021)	13
Scenario 2 (Stochastic)	41

Dry days have been defined as observing less than 1 mm of rainfall over 24 hours

1 – Occurred between February and March of 2013

Overall, Scenario 2 included the strongest climatic extremes, effective 'stress testing' the model for high intensity rainfall events and prolong dry periods.

4.2.3 Catchment Delineations

For modelling purposes, the MFS sub-area and its surroundings were divided into surface water catchment areas and land disturbance types as determined by BRL. An example of these catchments, representing post-mining conditions, are illustrated in Figure 16. BRL provided mining disturbance area/catchments for years: 2034, 2036, 2039, 2042 (LOM), and 2043. These areas were translated in the model as shown in Table 9.

Table 9: Mine disturbance model representation.

MINE STAGE	MINE YEAR	MODEL REPRESENTATION
1 to 5	2029 to 2033	Ex-pit ELF's in place from start of simulation. Pit void and in-pit ELF footprints expand linearly over time.
6	2034	2034 disturbance.
7 to 8	2035 to 2036	2036 disturbance.
9 to 13	2037 to 2042	2039 disturbance.
Active Treatment / Post Closure Phases	2043 onwards	Catchment/disturbance areas static from this point onwards.

The surface water catchments were broken down further by BRL into disturbance footprints (Figure 17 provides an example) where the following attributes are defined:

- Background catchment areas.
- Vegetation stripping/exposed soil areas.
- Cut areas, including pits/overburden stripping, highwalls, and exposed cut surfaces.
- Fill areas/ELF's area.
- Coal floor area.
- Rehabilitated landform area (following 2 years of rehabilitation).
- Waterbodies/sumps area.

Within the WLBM, the supplied catchments have been adjusted such that background catchments and vegetation stripping areas have been combined as a single area and cut areas have been split into hardstand and cut (pit) surface areas. The catchment areas used within the WLBM are tabulated in Appendix C.

ELF basal sub-catchments were also provided by BRL, see Figure 9 and Figure 10. Adopted ELF footprints are provided in Appendix D.

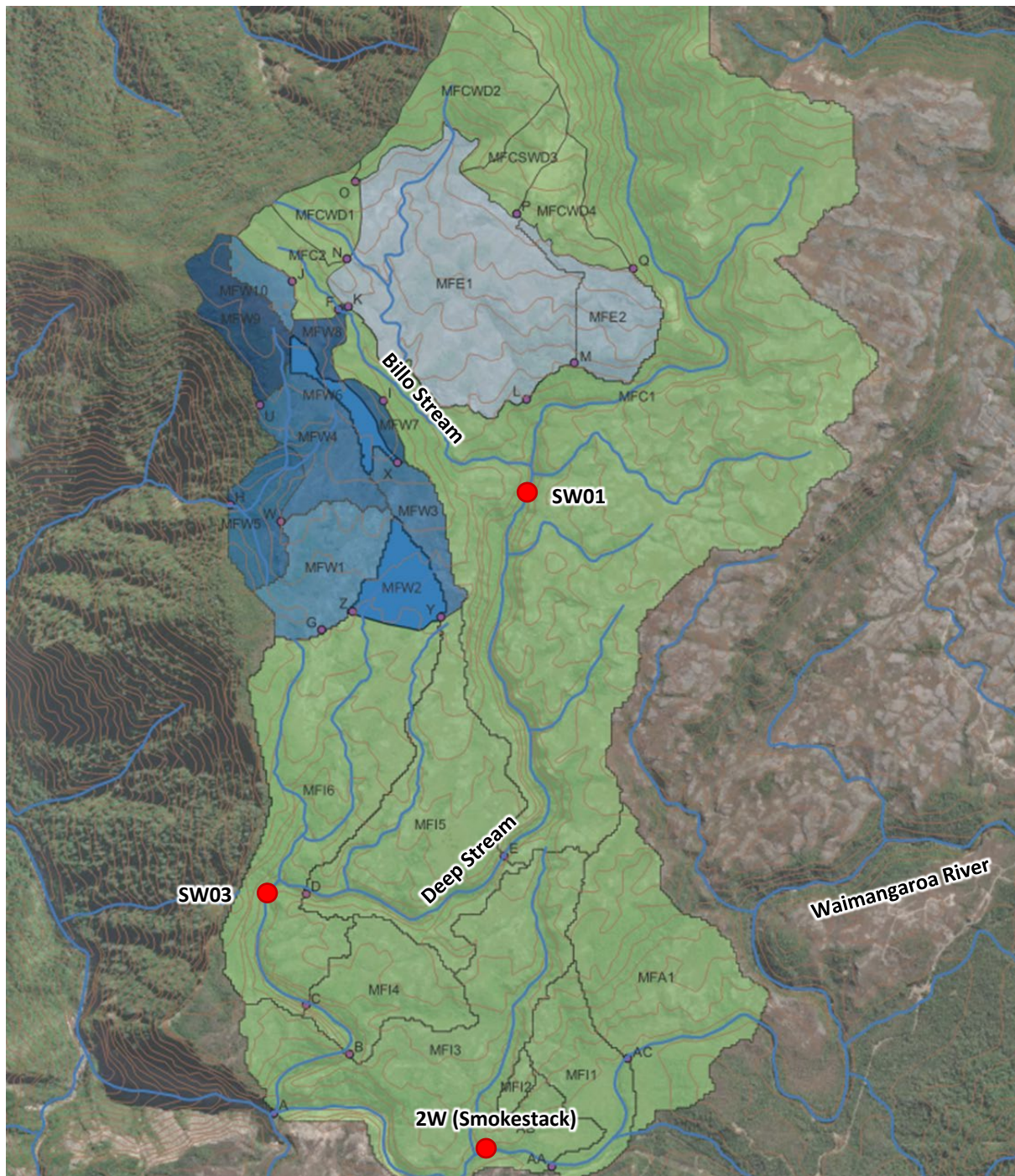


Figure 16: Mount Frederick South post-mining catchments.

Source: BRL (additional annotations by MWM).

Green areas represent background catchments, blue areas represent impacted catchments relating to the West Pit and grey areas represent impacted catchments relating to the East Pit

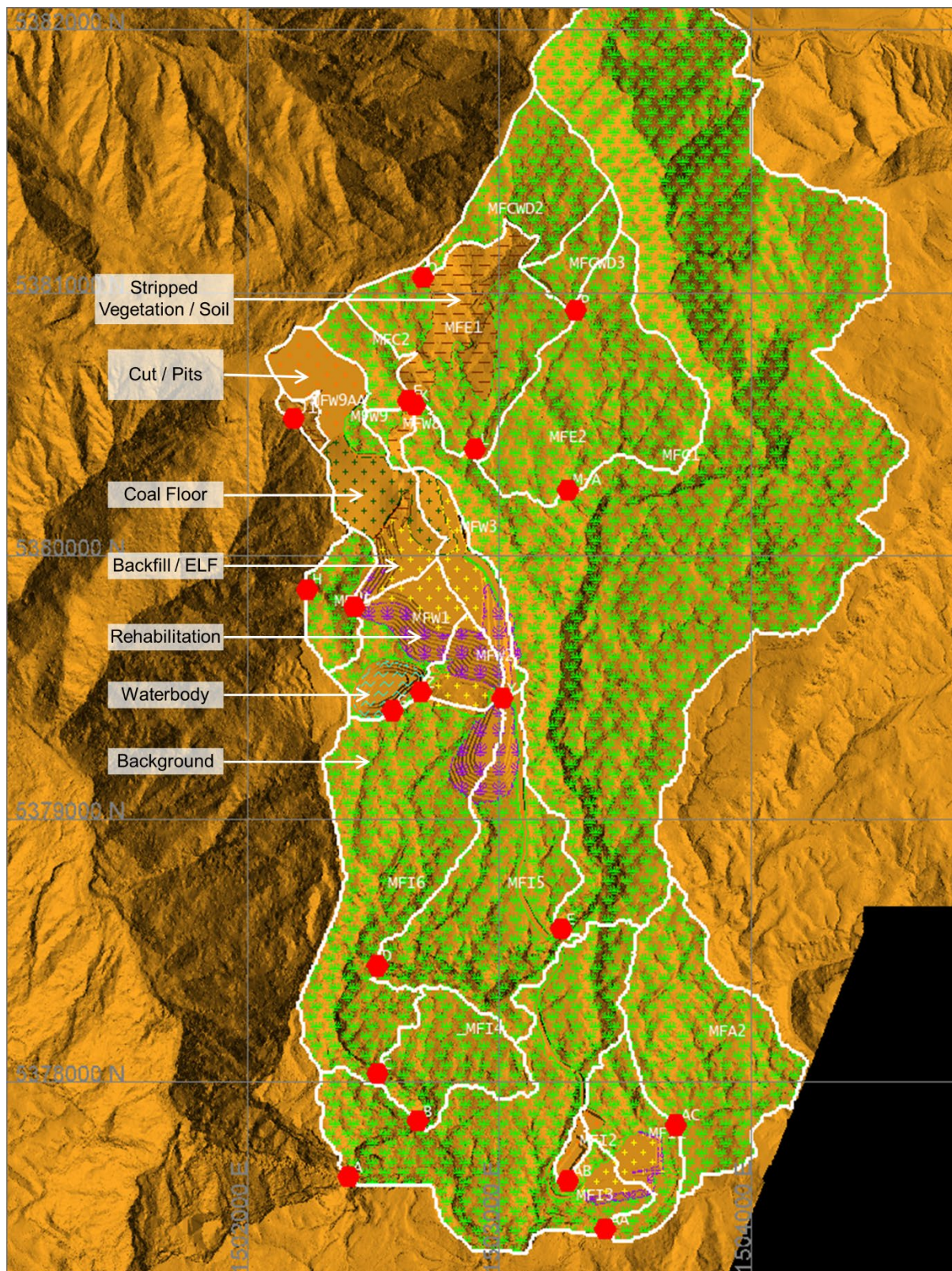


Figure 17: 2034 Mount Frederick South catchment disturbance breakdown.

Source: BRL

Red circles illustrate relevant catchment outflow locations

4.2.4 Background Area Runoff

Simulation of runoff from background areas was based on application of the Australian Water Balance Model (AWBM) by Broughton (2004). The model describes surface runoff for a specific location as a combination of rapid runoff and slower baseflow. The model is forced using precipitation and PET timeseries and requires the following parameters:

- Soil storage capacities (C_1 , C_2 , C_3): these represent different soil storage capacities of different soil types within the catchment. These are represented in the WLBM as 2, 4, and 90 mm, respectively and were calibrated to observed data (see Section 5.2).
- Fractional Areas (A_1 , A_2 , A_3): represent the proportion of the catchment area corresponding to each soil storage capacity. These are represented in the WLBM as 0.134, 0.433, and 0.433 respectively. These values were not part of the calibration routine (held fixed), as is typical for calibration of the AWBM.
- Baseflow Index (BFI): represents the proportion of total runoff provided from baseflow. This is represented in the WLBM as 0.05 and was calibrated to observed data (see Section 5.2).
- Recession Constants (K_s , K_b): are the recession constants for surface flow and baseflow respectively, which control the rate at which water drains from soil or sub-surface storages to runoff. This is represented in the WLBM as 0.07 and 0.84, respectively and were calibrated to observed data (see Section 5.2).

As vegetation stripping/soil catchments have been included within background catchment areas, this results in these areas being subject to the AWBM flow modelling.

4.2.5 Pit Voids

Runoff generated from pit voids (walls and floor) was simulated by applying a high runoff coefficient of 0.9 to the daily rainfall timeseries (assumed infiltration and flow attenuation to be negligible). The remaining 10% of rainfall is therefore assumed to be lost to evaporation. Rehabilitation of these areas was assumed to not materially change the runoff characteristics of these areas (i.e., the coefficient was fixed for the whole simulation).

4.2.6 Hard Stand/Haul Roads

Runoff generated from hard stand areas and haul roads was simulated within the model by applying a high runoff coefficient of 0.8 to the daily rainfall timeseries (assumed infiltration and flow attenuation to be negligible). The remaining 20% of rainfall is therefore assumed to be lost to evaporation. Rehabilitation of these areas was assumed to not materially change the runoff characteristics of these areas (i.e., coefficient was fixed for the whole simulation).

Haul roads represented were the MFS Access Road and a portion of the UWHR (of which reports to monitoring site 17W).

Note, where hardstands are constructed from fill material (e.g., the coal stockpile area), these have been modelled as ELFs as per the following Section (4.2.7).

4.2.7 Engineered Landforms

ELFs have been modelled to simulate surface runoff and seepage. Surface runoff was calculated based on a runoff coefficient applied to the daily rainfall timeseries. ELF seepage was simulated with GoldSim reservoir elements where inflows were driven by the daily rainfall timeseries and a net percolation coefficient (proportion of rainfall infiltrating into the mine waste material), while outflows were set such that a small proportion of the volume within the reservoir element was discharged. Table 10 describes these model inputs.

Table 10: ELF model parameters.

PARAMETER	REHABBED ELF	UNREHABBED ELF	RATIONALE
Runoff coefficient	0.45	0.35	Based on modelling results from MWM (2026a) and professional experience.
Net percolation	0.4	0.6	Based on modelling results from MWM (2026a) and professional experience.
Seepage recession coefficient	0.995	0.995	Set to allow seepage to be relatively steady, but with a minor degree of rainfall driven variability.

Net percolation was used to model basal sub-catchment flows, herein referred to as seepage, from the ELFs to the surface water network. Seepage rates were simulated using a GoldSim reservoir element, where outflow was calculated using a relatively high recession coefficient (see Table 10) to represent stable seepage. Seepage input parameters have been detailed in Appendix D.

During the Active Treatment Phase, where ELFs are located in-pit, seepage flows into the MIWs network via gravity, while major ex-pit ELF seepage flows are pumped into the water management circuit. These waters are treated via the WTP. As the ELFs switch to passive treatment, seepage flows are directed through MSRs and their respective MSR polishing ponds; these are described in Table 3, which present ELF basal sub-catchments reporting to each MSR. The model assumes a functional basal drainage network and lower permeability foundations, resulting in all ELF seepage being captured.

Modelling of rehabilitation (rehab) of the ELFs within the WLBM have been timed such that:

- East Pit:
 - Rehab surface water reports to the East Pit Sump through to the end of 2042.
 - From 2043 through to end of 2046, rehab surface water is assumed suitable for release and is directed into the background catchment.
 - From 2047, rehab surface water is redirected into the East Pit Sump (as well as a portion of the clean water from upper cutoff drains) to aid in dilution of the polishing ponds during passive treatment.
- West Pit
 - Rehab surface water reports to the West Pit Sump through to the end of 2038.
 - From 2039 through to end of 2044, rehab surface water is assumed suitable for release and is directed into the background catchment.

- From 2045, rehab surface water is redirected into the West Pit Sump to aid in dilution of the polishing ponds during passive treatment.

4.2.8 Mine Water Infrastructure

The model assumes mining areas have water infrastructure in place managing all water types (e.g., MIW, clean water, etc). As such, the WLBM is set up that any waters deemed impacted or unable to be kept separate from the MIW network (e.g. runoff of rehabilitated surfaces), are managed such that:

- Waters are collected at a single point (within each pit).
- Waters are passed through bypass structures prior to the entering sumps.
- Bypassed water is directed into the background catchment, while the remaining waters are collected within sumps.
- Waters are pumped from sumps to the WTP for treatment.
- Above the 90th percentile flow criteria in the Waimangaroa River, direct discharge of pit sump water occurs.
- Pit sump spillways will be designed and constructed, but these are only expected to operate under emergency conditions.

Table 2 (Section 3.1) describes how MIW is presented through the different treatment phases.

4.2.8.1 Bypass Mechanism

As the model simulates catchments varying in size over time, this results in a variable flow rate that is directed to sumps on an annual basis. Therefore, the bypass triggers are required to vary in response to this. To achieve bypass 5% of the time, the Base Case adjusts the bypass trigger value on an annual basis based on upstream catchment size. These bypass trigger values are described in Table 11, where the trigger value is defined as the annual 95th percentile flow that the sump inflow is limited to, where flows greater than this are bypassed around the sump (as illustrated in Figure 7).

Within Scenarios 1 and 2, these triggers are unchanged to identify how these bypass rates may vary on an annual basis under the different climate conditions (noting that Scenarios 3 and 4 model the same climate conditions as Base Case). It is important to note that the Base Case trigger flows (based on the 2019 rainfall year) do not represent the 95th percentile flows that would be observed over different years.

Table 11: Modelled pit sump bypass triggers.

YEAR (L/s)	EAST PIT SUMP BYPASS TRIGGER FLOW (L/s)	WEST PIT SUMP BYPASS TRIGGER FLOW (L/s)
2029	0	374
2030	0	375
2031	0	350
2032	0	355
2033	0	361
2034	0	361
2035	270	276

YEAR (L/s)	EAST PIT SUMP BYPASS TRIGGER FLOW (L/s)	WEST PIT SUMP BYPASS TRIGGER FLOW (L/s)
2036	270	281
2037	390	279
2038	390	273
2039	390	114
2040	395	114
2041	395	114
2042	413	114
2043	247	100
2044	245	100
2045	245	0
2046	245	0
2047	0	0

4.2.8.2 Sumps

Reservoir elements were utilised to model pit sumps. The sump volumes were input based on the following values provided by BRL:

- East Pit Sump: 15,000 m³ through to 2040, then 322,109 m³ from 2041.
- West Pit sump⁷: 500,000 m³.

The coal stockpile pad adopted a sump capacity of 420 m³.

These sumps sizes are sufficiently large to allow for surge capacity of storm events (when combined with the pump capacity, bypass mechanism, and direct discharge events), and such that the WTP can operate at a smoother rate.

4.2.8.3 Sump Pumping and the WTP

WTP Inflows

To simulate pumping during the Active Treatment Phase, the model has been set up so that:

- The West Pit Sump is utilised as the central point for MIW collection until 2044, from which MIW is pumped to the WTP.
- The East Pit Sump waters are pumped to the West Pit Sump during the Active Treatment Phase of the West Pit up to the end of 2044. After 2044 the East Pit Sump waters are pumped directly to the WTP through to the end of 2046.
- Major ex-pit ELF's within the West Pit mining area have their MIW directed into the West Pit MIW network during the Active Treatment Phase.

⁷ A nominal value is used that is less than the potential available capacity.

- The coal stockpile area has been modelled utilising sumps and pumps to manage surface water, where MIW is pumped directly to the WTP.

As the East and West Pit Sumps both utilise a bypass mechanism upstream of their intakes, the model is set up so that East Pit Sump waters are pumped directly into the West Pit Sump, as opposed to upstream of the West Pit bypass mechanism.

As described, the WTP throughput rates are a function of the pumped volumes from the described sumps. This has been modelled such that:

- The Base Case and all scenarios bar Scenario 1 use a constant treatment rate⁸ of 235 L/s during the Operations Phase, and a rate of 200 L/s for the remainder of the Active Treatment Phase.
- Scenario 1 was modelled at a higher treatment rate, to ensure spilling of sumps did not occur as a result of higher rainfall, of 270 L/s during the Operations Phase, and 220 L/s occurs for the remainder of the Active Treatment Phase.

This translates to:

- Base Case and all scenarios bar Scenario 1: 200 L/s is necessary for pit operations, and 35 L/s is necessary for coal stockpile area operations (which are rehabilitated post Operations Phase).
- Scenario 1: 220 L/s is necessary for pit operations, and 50 L/s for the coal stockpile area operations.

The discharge of the WTP has been modelled to discharge into the Waimangaroa River.

Pumping and WTP rates are described in Table 12. These rates allow for management of sump waters such that no spilling occurs under all scenarios. Scenario 1 presents an opportunity to understand the pumping and WTP requirements under consecutive high annual rainfall conditions. From 2035 to 2040 the East Pit Sump pumping rate is higher than later years; this is necessary to account for its small sump size during this period. Pumping rates are left unchanged within the modelled scenarios to understand the impact on the water balance and resultant load balance on variable hydrological conditions

⁸ Constant treatment rate: a maximum WTP capacity available over the entire Active Treatment Phase. While available, the full capacity is not always required.

Table 12: Modelled sump maximum pumping rates and inherent WTP inflow rates.

YEAR	EAST PIT SUMP PUMPING (L/s)		WEST PIT SUMP PUMPING (L/s)		COAL PAD PUMPING (L/s)		WTP INFLOW (L/s)	
	Base Case, Scenarios 2-4	Scenario 1	Base Case, Scenarios 2-4	Scenario 1	Base Case, Scenarios 2-4	Scenario 1	Base Case, Scenarios 2-4	Scenario 1
2029	0	0	200	220	35	50	235	270
2030	0	0	200	220	35	50	235	270
2031	0	0	200	220	35	50	235	270
2032	0	0	200	220	35	50	235	270
2033	0	0	200	220	35	50	235	270
2034	0	0	200	220	35	50	235	270
2035	250	250	200	220	35	50	235	270
2036	250	250	200	220	35	50	235	270
2037	390	390	200	220	35	50	235	270
2038	390	390	200	220	35	50	235	270
2039	390	390	200	220	35	50	235	270
2040	395	395	200	220	35	50	235	270
2041	125	125	200	220	35	50	235	270
2042	125	140	200	220	35	50	235	270
2043	125	125	200	220	0	0	200	220
2044	125	125	200	220	0	0	200	220
2045	200	220	0	0	0	0	200	220
2046	200	220	0	0	0	0	200	220
2047	0	0	0	0	0	0	0	0

Note: **Red values** represent rates and sources of MIW being direct discharged to the Waimangaroa River when stream flows exhibit appropriate levels (flows greater than the 90th percentile) – refer below; **bold values** represent the change made within Scenario 1 when compared to the Base Case and other scenarios.

Direct Discharge

A function of the mine water management strategy is the direct discharge of water from the pit sumps into the Waimangaroa River during periods where river flows are equal to or greater than the 90th percentile flow criteria. This has been modelled such that:

- During the period where the West Pit mine is within its Active Treatment Phase (2029-2044), and when stream flows allow, waters from the West Pit Sump are pumped to the Waimangaroa River at a rate of 200 L/s.
- Where the West Pit MIW is managed using MSRs and the East Pit remains within its Active Treatment Phase (2029-2046), and when stream flows allow, East Pit Sump waters are pumped to the Waimangaroa River at a rate of 200 L/s.

This results in pumping of MIW, at a rate of 200 L/s, 10% of the time on average, during the Active Treatment Phase of the mine (2029-2046).

It is important to note that the Base Case trigger flows (based on the 2019 rainfall year) do not represent the average 90th percentile flows that would be observed over multiple years.

4.2.8.4 MSRs

The Post Closure Phase sees pumping and active treatment cease and a reliance on gravity fed passive treatment begin. Here, ELF seepage is treated through use of MSRs and polishing ponds. Where MSR-treated water can gravity feed to sumps, such as the West and East Pit Sumps (MSRs 5-10, see Section 3.7), MSR-treated water will report to these sumps for polishing. Where MSRs are located ex-pit, these will have dedicated polishing ponds.

The WLBM sets a number of ex-pit ELF seepage flows to be passively treated from the beginning of the model. These are seepages where water quality will be within the range treatable by MSRs early in the mine operations, and therefore MSRs and polishing ponds are in place at the model start.

4.3 Load Balance Inputs

The load balance model was developed using the Python programming language within the Jupyter Notebook environment. The Python script used flow outputs from each mine domain generated from the GoldSim model. Ultimately, the load model simulates the transport of solutes through the model following the water balance flow paths.

The load model builds upon the structure of the water balance model to quantify the chemical composition and mass load of dissolved constituents throughout the site's water management system. The inflows of the water balance model are categorised into different groups based on their types for each catchment. Source terms, which are the chemical compositions of these water sources, are derived from historical geochemical assessment data or specific geochemical sub-models.

When multiple inflows converge into a single node of the water balance model, such as a pit sump, the chemical composition of the mixed water is calculated by blending the incoming flows based on their influx proportions. This mixed water can then flow to the next node in the water balance model, carrying its newly calculated chemical signature. By integrating flow rates from the water balance model with these calculated chemical compositions, the model also quantifies the total mass load for each

constituent. This approach primarily simulates conservative mixing (dilution and enrichment); however, mass removal rates (or concentration adjustments) are applied at treatment nodes (WTP, MSRs, polishing ponds) to account for non-conservative behaviour. Additionally, the model incorporates simplified reactive logic to estimate pH based on the interaction between alkalinity and acidity.

Water quality results at proposed monitoring points and key points are shown and discussed in this report.

4.3.1 Source Terms

The development of source terms is an essential aspect of the WLBM. Detailed descriptions are provided in the source term definition report (MWM, 2026b), and this section summarises the development and approach used. Constituents not classified as PCOCs (e.g., arsenic) were not included in the model given their low risk (see Hickey, 2026 and MWM, 2026c for further details).

The key source-term approaches are listed below:

- Constant Concentration (e.g., mg/L) source terms: The concentration remains constant, so loads vary only with the flow rate. This approach is used for background catchments, active pits, rehabilitated areas, and ELF runoffs (NAF and PAF).
- Constant Load (e.g., kg/day/ha) source terms: The concentration varies based on flow to achieve a constant load. Higher flow rates result in lower concentrations (more dilution), while low flow rates result in higher concentrations. This approach is used for haul roads, hardstand areas, and non-rehabilitated (i.e., active) coal floor.
- Mixed Approach: Some source terms use a mixed approach. Constant concentrations are applied during the Active Treatment Phase (before 2047), and a constant load is applied during the Post Closure Phase (after 2047).

The ELF seepage water quality is discussed in Section 4.3.1.7.

4.3.1.1 Background Catchment

The background catchment source terms represent the water quality originated by the background conditions of the catchment. Background solute concentrations for background catchments are mostly assumed to be constant concentration. This assumption is based on the observation that water quality appears to remain relatively stable regardless of flow rate and load is minor with regard to MIW effects (MWM, 2026b).

Two background monitoring points are used in the model: SW01 and 2W (Smokestack). The SW01 dataset is used to represent background water quality derived from undisturbed catchment and its average data are shown in Table 13. The dataset from Smokestack represents background conditions with some degree of impact, potentially from historical mining activities or natural exposure of mineralised rock and its water quality is greatly influenced by the flow rate in several parameters, resulting in higher concentrations in general compared to SW01 and a dependency on flow rates.

Table 13: Source terms – Background catchment SW01.

ANALYTE	SW01
Units	mg/L
Acidity (mg CaCO ₃ /L)	2.92
Alkalinity (mg CaCO ₃ /L)	1.43
Ca	0.89
Mg	0.91
Na	2.63
K	0.27
SO ₄	3.95
Al	0.09
Fe	0.074
Ni	0.00039
Mn	0.0026
Cr	0.00038
Cd	0.000025
Co	0.0001
Cu	0.0003
Pb	0.00025
Tl	0.000025
Zn	0.0037
DOC	3.17
pH (pH units)	5.78

Water Quality from MWM (2026f).

Red = ½ limit of reporting.

The dependence on flow rate, expressed as flow rate exceedance, is modelled using a second- or third-order polynomial regression. This approach is applied specifically to parameters that exhibited a significant flow dependency, as indicated by a strong R² value between the parameter's values and flow rate exceedance.

Variable parameters as a function of flow rate exceedance are shown on Figure 18 and Figure 19. Typically, constituent concentrations are elevated during low flows (high flow exceedance). In contrast, Fe and DOC concentrations decrease under these low-flow conditions.

The relationship between flow rate exceedance and the value of the parameters is modelled using the 2nd order polynomial regression as follows:

$$value = ax^2 + bx + c$$

Where x is the flow rate exceedance value. For the third order polynomial regression the equation is as follows:

$$value = ax^3 + bx^2 + cx + d$$

Where x is the flow rate exceedance value.

Parameters, their model values, and polynomial coefficients are shown on Table 14.

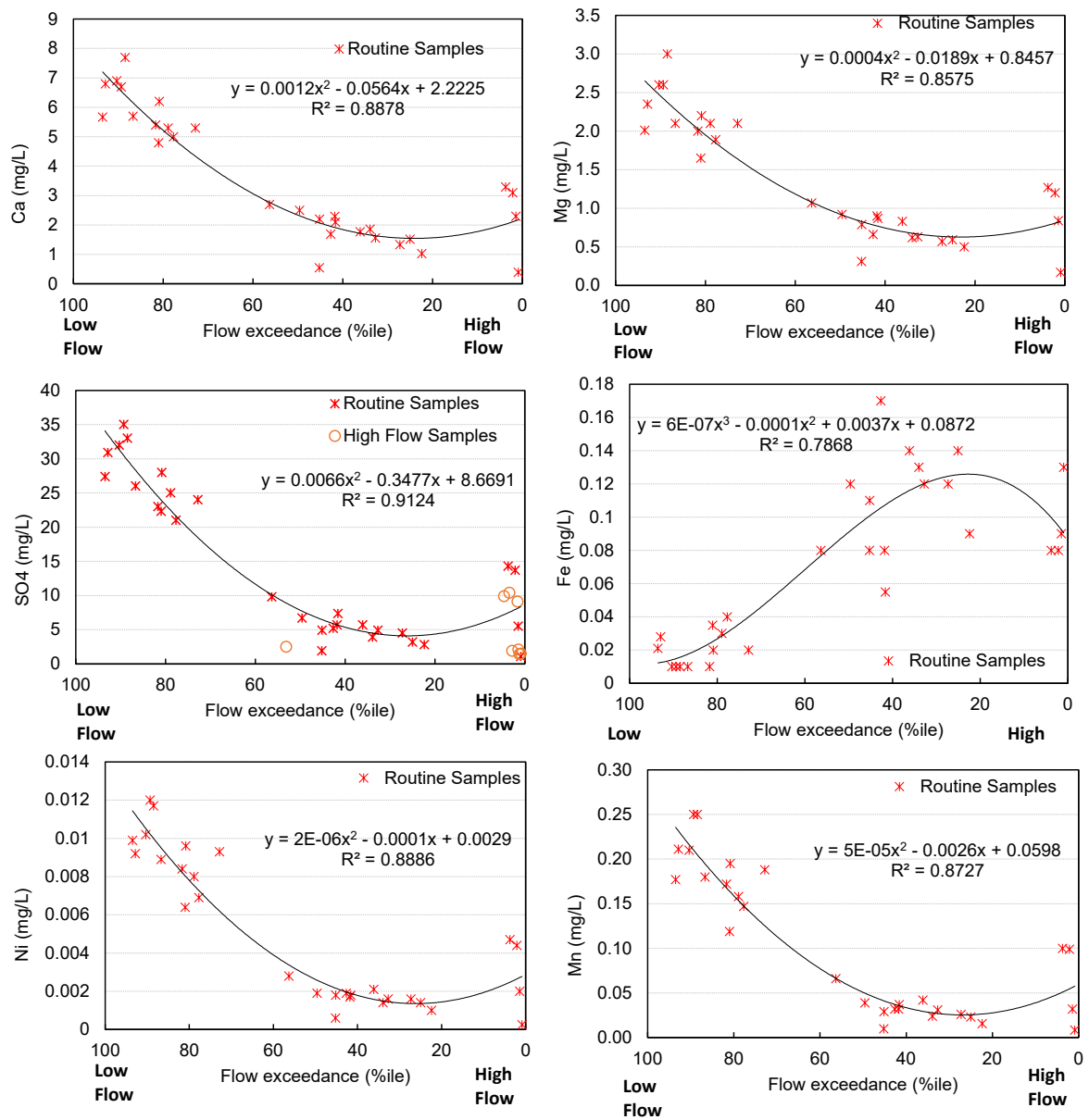


Figure 18: Concentrations of parameters (Ca, Mg, SO₄, Fe, Ni, Mn) versus flow rate exceedance at Smokestack.

Water Quality from MWM (2026f).

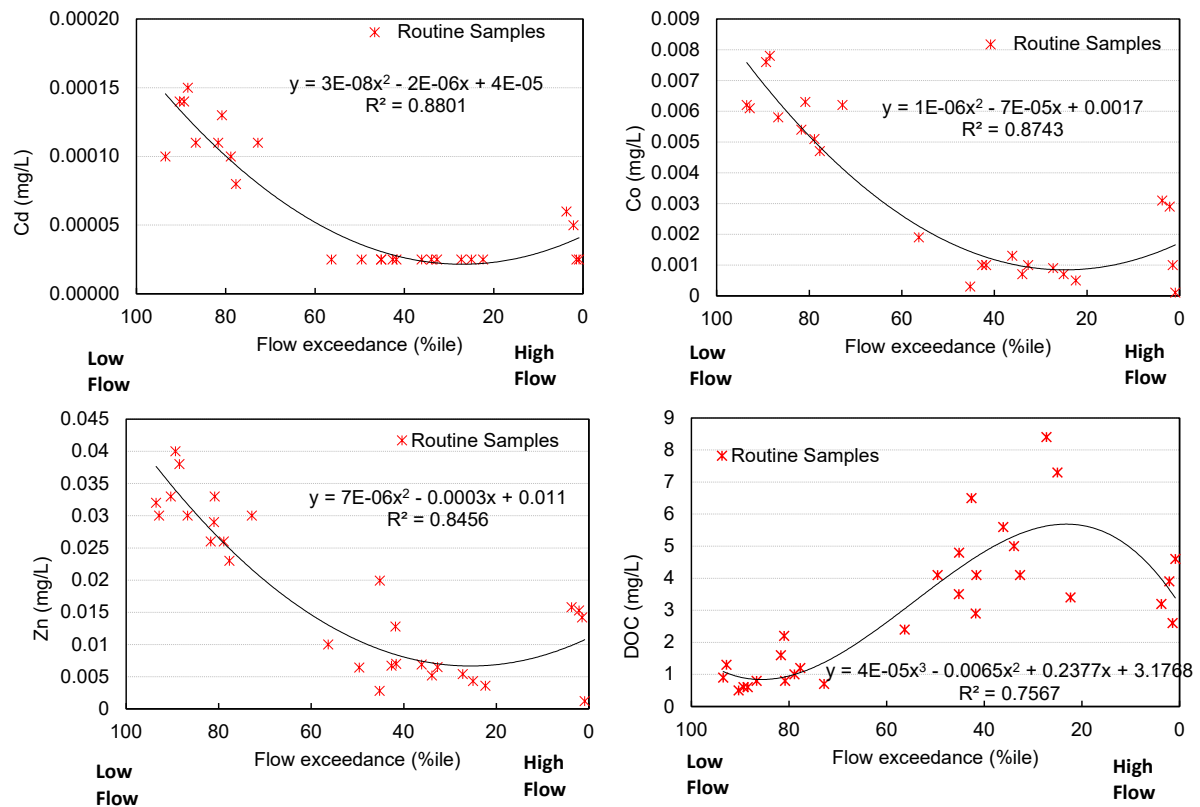


Figure 19: Concentrations of parameters (Cd, Co, Zn, DOC) versus flow rate exceedance at Smokestack.

Water Quality from MWM (2026f).

Table 14: Source terms and polynomial regression coefficients for modelled parameters.

PARAMETER	NO OF SAMPLES	VALUE	POLYNOMIAL COEFFICIENTS				R ²
			a	b	c	d	
Acidity	29	4.86	-	-	-	-	0.19
Alkalinity	3	1.53	-	-	-	-	Insufficient data
Ca	29	variable	0.001173	-0.05636	2.222471		0.89
Mg	29	variable	0.000409	-0.01888	0.845657		0.86
Na	2	2.2	-	-	-	-	Insufficient data
K	3	0.78	-	-	-	-	Insufficient data
SO4	29	variable	0.006627	-0.34771	8.669119		0.91
Al	29	0.35	-	-	-	-	0.36
Fe	29	variable	5.58E-07	-0.0001	0.003693	0.08718	0.79
Ni	29	variable	2.22E-06	-0.00012	0.00288	-	0.89
Mn	29	variable	4.74E-05	-0.00255	0.059841	-	0.87
Cr	13	0.00025	-	-	-	-	0.23
Cd	26	variable	2.81E-08	-1.5E-06	4.22E-05	-	0.88
Co	24	variable	1.43E-06	-7.1E-05	0.001718	-	0.87
Cu	13	0.0003	-	-	-	-	0.13

PARAMETER	NO OF SAMPLES	VALUE	POLYNOMIAL COEFFICIENTS				R ²
			a	b	c	d	
Pb	3	0.00025	-	-	-	-	Insufficient data
Tl	18	0.000111	3.66E-08	-1.5E-06	6.81E-05		0.67
Zn	29	variable	6.71E-06	-0.00034	0.011044		0.85
DOC	29	variable	3.98E-05	-0.0065	0.237655	3.17685	0.76
TSS	28	4.3	0.004203	-0.51264	15.75503		0.50
pH	29	variable	-0.00024	0.020896	5.493407		0.21

Values in mg/L, except for pH (pH units).

Water Quality from MWM (2026f).

Red = ½ limit of reporting.

4.3.1.2 Active Pits and Cuts (High walls), and active ELF Runoff

The active pit source terms represent the areas within the pit, such as coal floor, high walls, or cuts that release solutes and are assigned to two main areas, the East Pit and the West Pit. During operations, the water quality associated with these areas is represented by two datasets derived from the existing Escarpment site (empirical analogue data). The implementation of these source terms uses a function that applies a probabilistic flow splitting between two end-member conditions over a defined time range. Specifically, the function divides the total flow into two portions (“low” and “high”) following a normal distribution, then assigns the base water quality to one portion and the alternative source term (with higher concentrations) to the other. These are then recombined through a mixing process, producing a gradual transition between the two water quality end-members: one representing high flow conditions (sulfate ~100.1 mg/L) and the other representing higher concentrations associated with lower flow conditions (sulfate~121.5 mg/L). Further details are provided in the Source Term Report (MWM, 2026b).

Water quality for the end-members are shown on Table 15.

Table 15: Source terms – Active Pits and cuts.

ANALYTE ¹	AVERAGE	90 TH %ILE
	PIT 3 WATER QUALITY ²	PIT 3 WATER QUALITY
Source Term	Pit Surface runoff Water – high flow	Pit surface runoff Water – low flow
pH	3.70	3.60
Total Alkalinity as CaCO ₃	0	0
Acidity pH 8.3	44.4	54.5
Al	4.41	5.39
As	0.007	0.007
B	0.015	0.015
Cd	0.00011	0.00013
Ca	19.0	29.0
Cr	0.0036	0.0044
Co	0.010	0.013
Cu	0.0029	0.0035
Fe	0.835	1.28
Pb	0.00025	0.00025
Mg	2.63	3.11
Mn	0.21	0.26 ³
Ni	0.116	0.139
K	10.2	10.2
Se	0.0025	0.0025
Na	0.25	0.25
Tl	0.00019	0.00023
Zn	0.769	0.995
Si	2.1	2.1
SO ₄	100.1	121.5
Cl	0.25	0.25

¹Units reported in mg/L unless otherwise noted.

²Average Pit 3 water quality data was derived from February 2016 – November 2016 prior to the installation of the BV ELF MSR.

Red = ½ limit of reporting.

Table from MWM (2026b).

It is assumed that for post-operations these areas will be rehabilitated with some pit and cut areas reverting to highwall or coal floor source terms where a separate source term has been developed to represent those conditions. Therefore, during the Active Closure and Post Closure Phases, a rehabilitated source term is used for these surfaces. The following section provides further detail on the non-rehabilitated coal floor surfaces and their corresponding source term assumptions, as well as the source-term assumptions for the rehabilitated areas.

For runoff from active ELFs (during the Operations Phase), the High Flow Active Pit source term is applied.

4.3.1.3 Non-rehabilitated Coal Floors

Five coal floor areas will be left at closure as part of the MFS sub-area in the East Pit shown on Figure 20 shown as CF1 – CF5 within the green polygons. The areas and Acid-Base Accounting (ABA) properties are shown in Table 16 for reference.

It is assumed for this source term that there is a constant load that will decay over time. The constant load is derived from the modelled sulfur content of the rock that underlies the coal floor for each area. The higher the sulfur content, the higher the acid and metal release is. When using constant load, the concentrations are high when the flows are low (same load is divided by a lower flow), while lower concentrations are reached due to dilution during high flows.

The constant load values (source terms) used for each coal floor are shown in Table 17. Derivation of these source terms is described on the Source Term Report (MWM, 2026b)

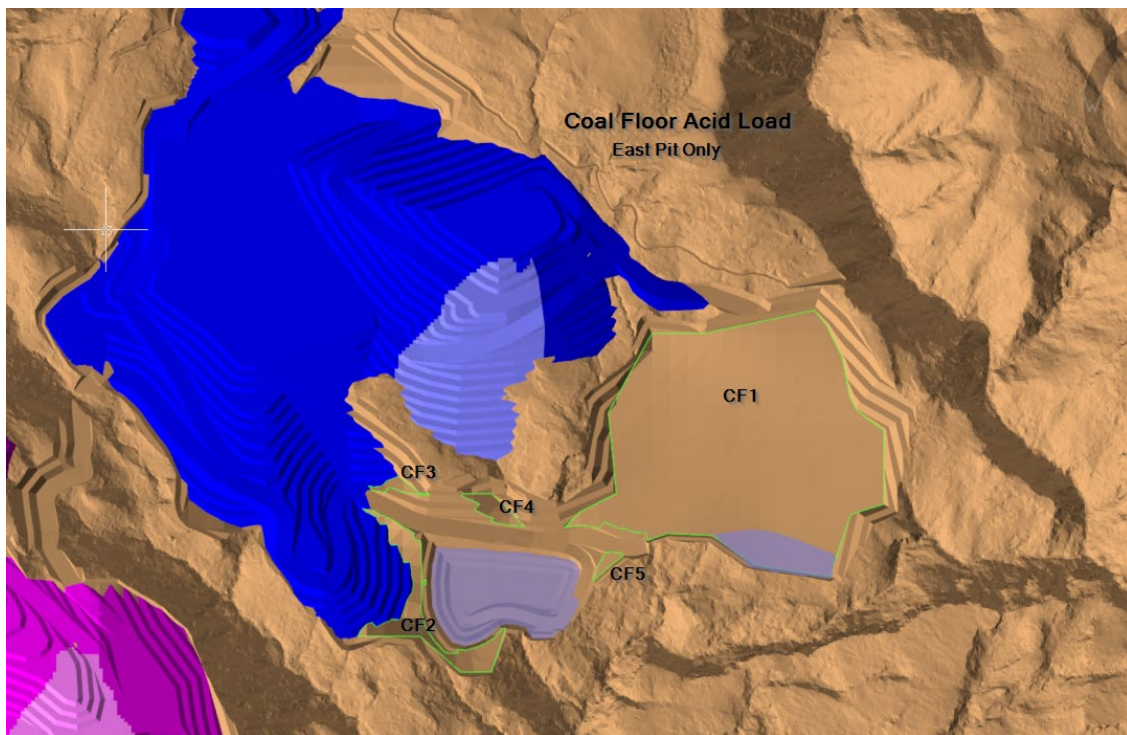


Figure 20: Non-rehabilitated areas at MFS.

Table 16: Coal floor areas and ABA properties that remain unrehabilitated at MFS.

COAL FLOOR	SURFACE AREA (m ²)	S (wt%)	ANC (kg/H ₂ SO ₄ /t)	NAPP (kg/H ₂ SO ₄ /t)
Coal Floor 1 (CF1)	223,932	0.113	3.69	-0.2
Coal Floor 2 (CF2)	18,101	0.906	0.814	26.9
Coal Floor 3 (CF3)	1,777	0.084	2.99	-0.4
Coal Floor 4 (CF4)	3,906	0.151	3.02	1.6
Coal Floor 5 (CF5)	1,291	0.157	2.96	1.8

Table from MWM (2026b).

Table 17: Source terms – MFS coal floor runoff.

PARAMETER	CF1 (kg/ha/day)	CF2 (kg/ha/day)	CF3 (kg/ha/day)	CF4 (kg/ha/day)	CF5 (kg/ha/day)
pH ²	-	3.8	-	3.8	3.8
Acidity to pH 8.3	- ¹	5.32807	- ¹	0.88801	0.92330
Chloride	0.15816	1.26808	0.11757	0.21135	0.21974

PARAMETER	CF1 (kg/ha/day)	CF2 (kg/ha/day)	CF3 (kg/ha/day)	CF4 (kg/ha/day)	CF5 (kg/ha/day)
Sulfate	0.76200	6.10952	0.56645	1.01825	1.05871
Al	- ¹	0.29979	- ¹	0.04997	0.05195
Sb	0.00002	0.00018	0.00002	0.00003	0.00003
B	0.00066	0.00533	0.00049	0.00089	0.00092
Cd	0.000004	0.00004	0.000003	0.00001	0.00001
Ca	0.01329	0.10656	0.00988	0.01776	0.01847
Cr	0.00002	0.00018	0.00002	0.00003	0.00003
Co	0.00005	0.00043	0.00004	0.00007	0.00007
Cu	0.00013	0.00107	0.00010	0.00018	0.00018
Fe	0.04696	0.37652	0.03491	0.06275	0.06525
Pb	0.00003	0.00025	0.00002	0.00004	0.00004
Mg	0.01949	0.15629	0.01449	0.02605	0.02708
Mn	0.00105	0.00845	0.00078	0.00141	0.00146
Ni	0.00026	0.00206	0.00019	0.00034	0.00036
K	0.02304	0.18471	0.01713	0.03078	0.03201
Se	0.00011	0.00089	0.00008	0.00015	0.00015
Na	0.13512	1.08337	0.10045	0.18056	0.18774
Sn	0.00001	0.00009	0.00001	0.00001	0.00002
Zn	0.00097	0.00781	0.00072	0.00130	0.00135
SiO ₂	0.22107	1.77247	0.16433	0.29541	0.30715
As	0.00002	0.00018	0.00002	0.00003	0.00003
Tl	0.00001	0.00009	0.00001	0.00001	0.00002

Red data uses ½ LOR

CF = Coal Floor

1. - Source term for NAF samples is adjusted separately as explained for NAF ELF Seepage

2. - pH is not converted into a load due to the complexity of assignment to variable flow rates. A pH of 3.8 has been used for modelling of PAF surfaces.

Table from MWM (2026b).

After closure, these loads are subject to a decay process based on empirical relationships (based on data presented on Pope et al. (2018)). The long-term decay assumes the previous constant concentration as the initial load, from which a rapid decay of 26% per year begins. Unlike a simple first-order decay model with a fixed rate, this model also reduces the decay rate itself by 5% each year.

Equation 1:
$$C(t) = C_0 \exp\left(\frac{F_1}{F_2}(1 - \exp(F_2 * t))\right)$$

Where:

- C(t) = Concentration (or load) at year t.
- C₀ = Initial concentration (or load, prior to decay).
- F₁ = ln (1 - 0.26) (represents an initial 26% yearly decay).
- F₂ = ln (1 - 0.05) (represents a 5% yearly decay applied to the 26%).
- t = time in years (with t = 0 at coal floor closure, assumed to occur in 2043).

4.3.1.4 Rehabilitated Areas

For the rehabilitated areas, a constant concentration is assumed, as this source term is expected to maintain relatively stable water quality conditions after areas are rehabilitated. The adopted concentrations for each parameter are presented in Table 18 (MWM, 2026b).

Table 18: Source terms – Rehabilitation Surfaces.

PARAMETER	REHABILITATION SURFACES ¹
pH	4.9
Acidity (pH 7.0) – mg CaCO ₃ /L	4.2
Alkalinity (mg CaCO ₃ /L)	1.2
Chloride	4.2
Sulfate	1.8
Silicon	1.9
Al	0.15
As	0.001
Ca	0.5
Cd	0.0001
Cr	0.0001
Co	0.0062
Cu	0.001
Fe	0.15
Pb	0.0002
Mg	0.5
Mn	0.01
Ni	0.0006
K	0.29
Se	0.0025
Na	2.66
Tl	0.0004
Zn	0.005
TOC	3.7
TSS	-

Red = ½ LOR

Table from MWM (2026b).

4.3.1.5 NAF ELF Runoff

This source term represents the water quality generated by the runoff on the NAF ELF Surfaces. A constant concentration is assumed it is expected to maintain relatively stable water quality. The adopted concentrations for each parameter are presented in Table 19 (MWM, 2026b). Only ELFs MDC1 and MDC2 are considered to be NAF, the rest is assumed to be PAF.

Table 19: Source terms – NAF Running surfaces.

PARAMETER	NAF RUNNING SURFACES AND NAF BATTER SLOPES
pH	5.6
Acidity (pH 7.0) – mg CaCO ₃ /L	1.3
Alkalinity (mg CaCO ₃ /L)	0.3

PARAMETER	NAF RUNNING SURFACES AND NAF BATTER SLOPES
Chloride	1.0
Sulfate	4.3
Silicon	0.2
Al	0.007
As	0.0005
Ca	0.044
Cd	0.0001
Cr	0.0008
Co	0.00025
Cu	0.00025
Fe	0.13
Pb	0.00025
Mg	0.00025
Mn	0.023
Ni	0.0011
K	1.7
Se	0.0025
Na	0.65
Tl	0.00025
Zn	0.004
TOC	-
TSS	-

Red = ½ LOR

Table from MWM (2026b).

4.3.1.6 Hardstand and Haul Roads

It is assumed that for the MFS sub-area, all hardstands are low in sulfur and therefore classified as NAF. The source term applied is the NAF Hardstand source term with a constant load, which results in lower concentrations during high-flow periods and higher concentrations during low-flow periods (MWM, 2026b). The same source term is also applied to the road surfaces and the hardstands or cuts associated with the roads. No rehabilitation is assumed for these areas, and they are expected to maintain the same constant load throughout the simulation period, covering both the Active Closure and Post Closure Phases. It is assumed however, that the TSS will be lower post-operations.

Regarding the Haul Roads, the MFS Access road cut faces are classified as NAF and use the same source term. In contrast, the Upper Waimangaroa Haul Road cuts are assumed to be PAF, adjusted for a sulfur concentration of 0.932%, but the road surface itself is considered to be made of NAF material.

Values used for these source terms are shown in Table 20.

Table 20: Source terms – NAF Hardstand and road highwalls.

PARAMETER	NAF HARDSTAND	UWHR CUTS
	(kg/ha/day)	(kg/ha/day)
pH ²	-	-
Acidity to pH 8.3	- ¹	5.48
Sulfate	0.56645	6.285
I	-	0.3080
Cd	0.000003	0.000037
Ca	0.00988	0.11
Cr	0.00002	0.00018
Co	0.00004	0.00044
Cu	0.0001	0.0011
Fe	0.03491	0.387
Pb	0.00002	0.00026
Mg	0.01449	0.161
Mn	0.00078	0.0087
Ni	0.00019	0.0002
K	0.01713	0.0171
Na	0.10045	1.114
Zn	0.00072	0.008
Tl	0.00001	0.000091

Table from MWM (2026b).

Red = ½ LOR

4.3.1.7 ELFs Seepage Water Quality

The estimation of seepage water quality from the ELFs is described in the MWM (2026c) report and is used as an input for the MFS WLBM.

Sulfate concentrations are derived based on the amount of material, sulfur content, volume and spatial area of each ELF. The concentrations of other elements are derived from their relationship to sulfate; therefore, the patterns are similar for all elements. Sulfate and acidity concentrations from the ELFs are shown in Figure 21.

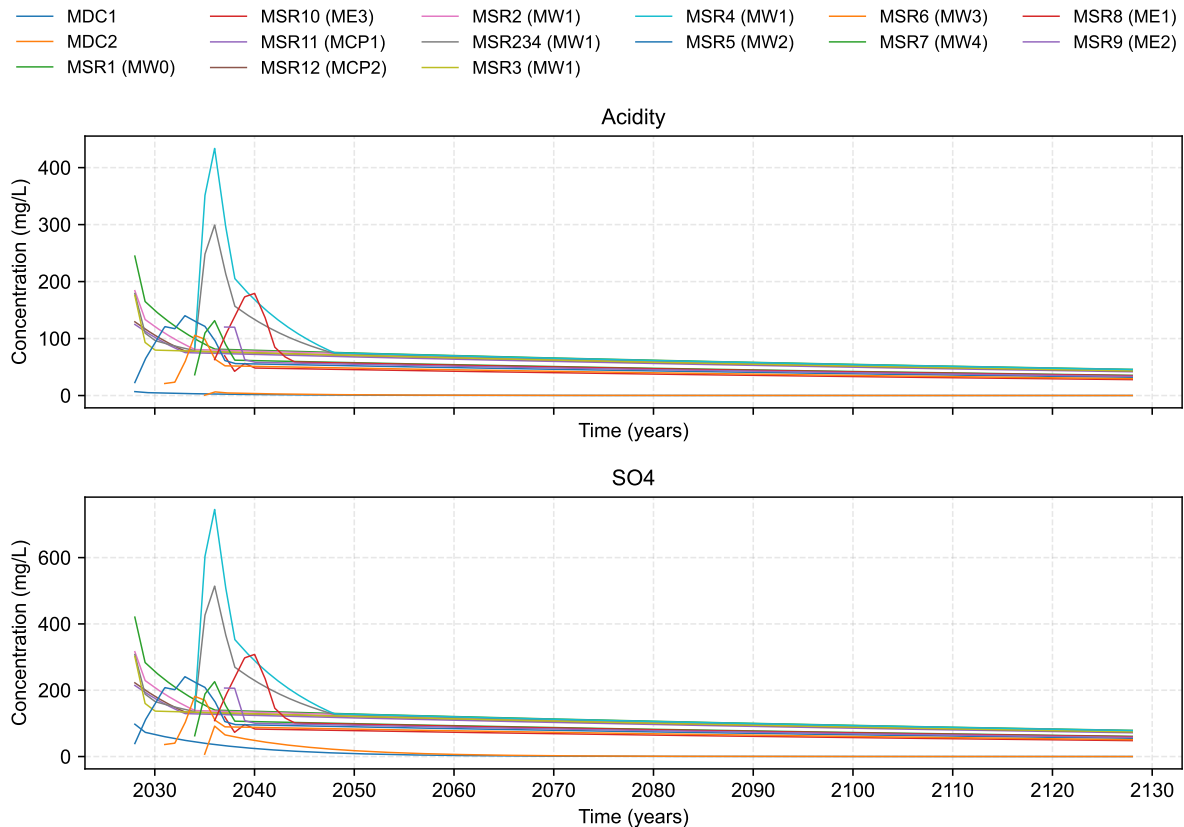


Figure 21: Acidity and sulfate concentrations for the ELFs.

4.3.2 Total Suspended Solids

The derivation of source terms for total suspended solids (TSS) is based on empirical data documented in the MGIU TSS Review Report (MWM, 2026d) and historically reported data (MWM, 2026b). Where TSS to rainfall relationships call for use of median and 95th percentile statistics, these have been defined using the Project Climate Dataset as:

- Median daily Rainfall: 1.6 mm.
- 95th Percentile daily Rainfall: 69.7 mm.

The key functions included in the simulation of TSS are described in Table 21.

In-pit sumps were modelled as follows:

- All inflowing sources to the sumps were mixed.
- Sump removal factor (Figure 23) applied to TSS load reporting to the sump on a given day. TSS loads from previous days assumed to settle out.
- Pumping from the sumps assume the sump removal factor is applied.
- During bypass events, it is assumed the sump removal factor is applied to outgoing waters.
- Polishing pond discharge, which includes sources from ELF seepage, coal floor and highwall runoff, has been assigned the TSS relationship identified below as Post Passive Treatment.

Table 21: Modelled TSS source terms.

SOURCE TERM	TSS RANGE	SOURCE
Background Water Quality	Rainfall ≤ 1.6 mm, TSS = 1 mg/L Rainfall > 1.6 mm and < 69.7 mm, = linearly interpolated Rainfall ≥ 69.7 mm, TSS = 10 mg/L	Water quality data from the W-M2 site on the Whareatea River. Dynamic source term was adopted in a similar manner to WM Group (2014).
Mine Impacted Water Quality	As per Figure 22 Linear interpolation: Rainfall = 0 mm, TSS = 0 mg/L Rainfall = 149 mm, TSS = 3,757 mg/L Rainfall = 458 mm, TSS = 4,518 mg/L	MWM, 2026b
Rehabilitated ELF Runoff	Linear interpolation: Rainfall = 0 mm, TSS = 3 mg/L Rainfall = 21.6 mm, TSS = 3 mg/L Rainfall = 95.1 mm, TSS = 12 mg/L Rainfall = 800 mm, TSS = 12 mg/L	WM Group (2014), where hydroseeded rehabilitation is assumed to achieve the same level of erosion management as the ““ELF rehabilitated forest” TSS range is adopted. BRL expect a 2 year desilting period following rehabilitation of ELFs (BRL pers. comm. email dated 14 May 2025).
Rehabilitated Coal Floor, Highwalls, and Hardstand	Rainfall ≤ 1.6 mm, TSS = 3 mg/L Rainfall > 1.6 mm and < 69.7 mm, TSS = linearly interpolated Rainfall ≥ 69.7 mm, TSS = 30 mg/L	Assumed to achieve this level of required performance naturally or through used of sediment pond structures.
ELF Seepage	Constant 20 mg/L	WM Group (2014) “ELF-Uncovered seepage”.
Post Active Treatment (WTP)	Constant 1.5 mg/L	Process Flow, 2026b
Post Passive Treatment	Rainfall ≤ 1.6 mm, TSS = 3 mg/L Rainfall > 1.6 mm and < 69.7 mm, TSS = linearly interpolated Rainfall ≥ 69.7 mm, TSS = 30 mg/L	Assumed to achieve this level of required performance as the water treated from the MSRs and polishing ponds.
Sump Outflow	As per Figure 23 TSS removal rain = $0.0289 \ln(x) + 0.5869$ where x = rainfall over the period of the day	MWM, 2026d

Source: MWM (2026b)

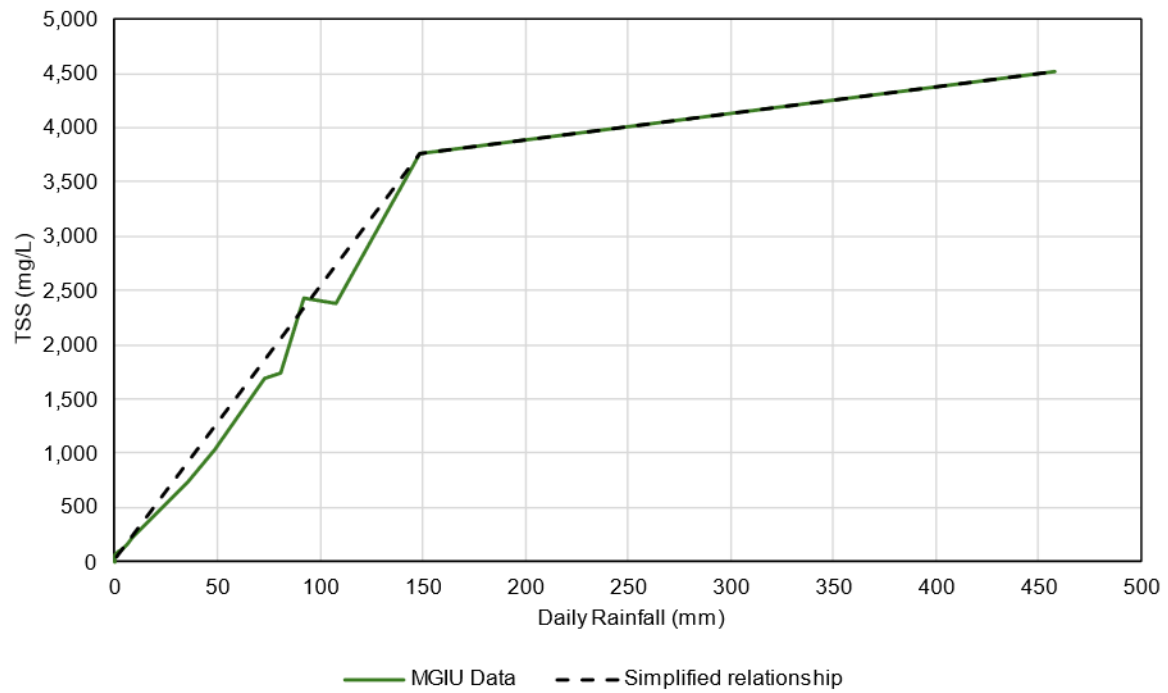


Figure 22: TSS relationship derived from MGIU empirical data

Source: MWM (2026b).

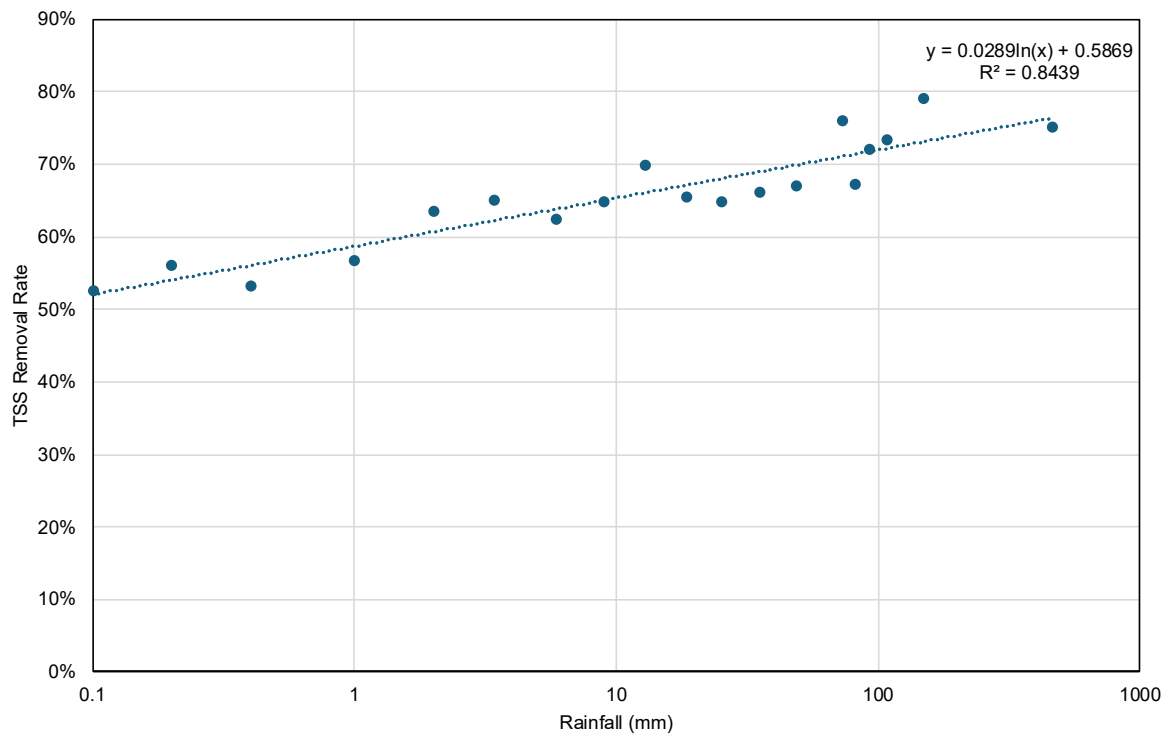


Figure 23: Relationship between daily rainfall and TSS removal from sumps.

Source: MWM (2026b).

4.3.3 Turbidity

Turbidity (units of NTU) was estimated from the TSS model results, based on the relationship derived by MWM (2026d) for the S16 site at Stockton Mine:

$$\text{Equation 2:} \quad \text{Turbidity (NTU)} = 0.79 \times \text{TSS} \left(\frac{\text{mg}}{\text{L}} \right)$$

4.3.4 Sump / Void Mixing

A complete mix is assumed for the sumps used in the model. For MFS two sumps are modelled: West Pit Sump and East Pit Sump.

4.3.5 Hardness

Hardness is calculated based on the concentrations of Ca and Mg using the following equation:

$$\text{Equation 3:} \quad \text{Hardness} \left(\frac{\text{mg}}{\text{L}} \text{ as } \text{CaCO}_3 \right) = 2.497 \times \text{Ca} \left(\frac{\text{mg}}{\text{L}} \right) + 4.118 \times \text{Mg} \left(\frac{\text{mg}}{\text{L}} \right)$$

Hardness can be affected by the water treatment process due to the addition of Ca from active and passive treatment processes. Further details are provided below in Section 4.3.6.

4.3.6 Active and Passive Treatment

The Active Treatment Phase assumed that the WTP treats the inflowing water effectively, and the treated effluent water quality is assumed to be constant except for some parameters where the concentration can be affected by the treatment process (e.g., Ca) or remains the same as the inflow concentration (as is the case for Mg, Na, K, SO₄).

As described in Section 3.7, the passive treatment comprises a two-stage treatment system. Seepage initially reports to an MSR, with the MSR-treated water proceeding to a polishing pond. Treatment at each stage is simulated by applying a set of treatment efficiency factors. This works by multiplying the influent concentration by the treatment efficiency. Treatment efficiency factors are detailed in the source term definition report (MWM, 2026b).

For the Post Closure Phase, it is assumed that each ELF is treated with its own MSR and polishing pond, and that water quality improves according to the removal efficiency assigned to each parameter. For example, if the removal efficiency factor for Cu is 0.966, this means the MSR removes 96.6% of the influent Cu (MWM, 2026b). Therefore, if the inflow concentration is 1 mg/L, the treated water concentration would be 0.034 mg/L.

Regarding the polishing ponds, it is assumed that they remove additional Fe, Ni, and Zn due to adsorption processes (MWM, 2026b). As per Figure 6, the West Pit MSRs are simulated to being operation in 2045, while at the East Pit set to 2047. Concentrations and factors for active and passive treatment are shown in Table 22 (MWM, 2026b).

Table 22: Water quality concentrations and factors used for active (WTP) and passive treatment.

PARAMETER	WTP WATER QUALITY	MSR TREATMENT EFFICIENCY	POLISHING POND TREATMENT EFFICIENCY
Units	mg/L	Factor	Factor
Acidity	2.5	1	-
Alkalinity	5.5	115.5 mg/L	-
Ca	Calculated	Calculated	-
Mg	=Input	=Input	-
Al	0.074	0.997	-
Fe	0.01	0.8	0.99
Ni	0.0027	0.402	0.125
Mn	0.18	0.586	-
Cr	0.0011	-	-
Cd	0.000025	0.0189	-
Co	0.001	0.828	-
Cu	0.00025	0.966	-
Pb	0.00005	0.858	-
Tl	0.00117	-	-
Zn	0.0058	0.637	0.59
DOC	0.25	2.9 mg/L	-
TSS	1.5	-	-
pH	6.4	7.9	-

Red denotes where set concentrations or pH values are applied to MSR-treated water.

- Indicates no treatment

4.3.6.1 WTP Ca Calculation

Hardness can be affected by the water treatment process due to the addition of Ca from active and passive treatment processes.

The WTP-treated water Ca concentration is calculated using the following equation:

$$\text{Equation 4: } Ca_{WTP-treated} \left(\frac{mg}{L} \right) = \left[Hardness_{influent} \left(\frac{mg CaCO_3}{L} \right) + Acidity_{influent} \left(\frac{mg CaCO_3}{L} \right) \right] \times \frac{40}{100.1}$$

Fundamentally, this calculation applies a stoichiometric mass balance rather than an empirical correlation. It derives the final concentration by summing the baseline calcium load (approximated here by influent hardness) with the specific stoichiometric dosage of lime chemically required to neutralise the influent acidity. Note: the calculation does not remove the magnesium contribution to hardness (to derive the calcium concentration). Model sensitivity testing where the adjustment was corrected showed that the adjustment to the Ca calculation (i.e., removal of Mg hardness contribution) does not affect water quality compliance (e.g., Hickey, 2026) during the Active Treatment Phase.

4.3.6.2 MSR Ca and Mg Calculation

For the MSR-treated water Ca and Mg concentrations, the following equations are used:

$$\text{Equation 5:} \quad Ca_{MSR-treated} \left(\frac{mg}{L} \right) = SO_{4\ Influent} \times 0.3618 + 39.5 \frac{mg}{L}$$

$$\text{Equation 6:} \quad Mg_{MSR-treated} \left(\frac{mg}{L} \right) = SO_{4\ Influent} \times 0.0185$$

Based on these relationships, an influent sulfate concentration of 0 mg/L results in a baseline Ca concentration of the MSR-treated water of 39.5 mg/L. This value results from the water interaction with the mussel shells under these conditions and corresponds to a hardness of approximately 100 mg CaCO₃/L. Further details of this relationship are provided in the Source Term Definition Report (MWM, 2026b).

4.3.7 *pH Estimation and Acidity and Alkalinity Balance*

An acidity-alkalinity balance approach is applied to estimate the relative contributions of alkalinity and acidity in water samples. Alkalinity represents the neutralisation capacity of a solution; specifically, the amount of acid required to reduce the sample pH to 4.5. In contrast, acidity is defined as the amount of base needed to increase the pH of an acidic solution to a standard reference value, typically pH 8.3.

When an acidic solution (characterised by high acidity) is mixed with a neutral or alkaline solution (characterised by high alkalinity), both parameters decrease proportionally, and the dominant component determines the resulting balance. Accordingly, the following relationships are used:

- Net Alkalinity = Alkalinity – Acidity (= 0 if Acidity > Alkalinity).
- Net Acidity = Acidity – Alkalinity (= 0 if Alkalinity > Acidity).

Then through relationships we estimate the pH based on the values of Net Alkalinity or Net acidity by using the following relationships:

If Net Alkalinity > 1:

$$\text{Equation 7:} \quad pH = 0.55 \times LN (NetAlkalinity) + 5$$

The derivation of this relationship is provided in MWM (2026b).

If Net Acidity > 0:

$$\text{Equation 8:} \quad pH = \log_{10}(0.0000035 \times Net\ Acidity + 0.00001)$$

The derivation of this relationship is provided in MWM (2026e).

If $0 \leq \text{Net Alkalinity} \leq 1$:

$$\text{Equation 9:} \quad pH = 5$$

5 **MODEL EVALUATION**

5.1 **Model Quality Assurance/Quality Control**

Model QA/QC procedures were undertaken as part of the WLBM review process. The review process included the following steps:

- Checking that data sources are documented.
- Verification that storage, inflows, and outflows are correctly located and allocated to the right source and sink within the model.
- Cross checking modelled flows to ensure they are not duplicated or missed.
- Verification of model functions and expressions to ensure they are working as intended.
- Verification that total model catchment area is constant throughout the model timeframe.
- Verification that the calibration period predictions were evaluated through comparison to monitoring data.
- Sanity checks, including using professional judgement and experience to evaluate whether results reflect the understanding of the MFS sub-area regarding water management processes and source terms.

5.2 **Model Calibration**

Given the current relatively undisturbed nature of the MFS sub-area, the only data available for model calibration was historic river flow records to calibrate the AWBM for background runoff. To calibrate this part of the model, calibration to Waimangaroa River flow at Smokestack was initially undertaken, but it was found that the annual runoff yield was more than recorded rainfall at Lake Brazil or Stockton, making reliable calibration impossible. In addition, sufficient flow data for Deep Stream was not available.

As such, the model was calibrated to the Whareatea River flow record, at the flow recorder site WM2, instead. The calibration period spanned 24/03/2011 to 31/12/2014, matching to daily average flow data. Given the use of Whareatea River flow data for calibration of the AWBM, there will be differences in flow yields across the flow distribution curves with that of Deep Stream and Waimangaroa River. This is particularly true for low flow conditions with the influence of underground workings on Whareatea River not as prevalent, if at all, in Deep Stream and Waimangaroa River. As a result, the model will likely underestimate background baseflow conditions (i.e., less background dilutive capacity), and therefore be conservative with respect to predicting water quality at compliance points.

History matching with the Runoff Model was completed using a manual trial and error approach, with a focus on balancing the match between:

- Daily average simulated and observed stream flow rates (Figure 24 and Figure 25).
- Flow exceedance probability (Figure 26).
- Cumulative water volume (Figure 27).

The statistical comparison is summarised in Table 23.

Findings from the calibration effort were as follows:

- A reasonable visual match to average, median, higher flow conditions was achieved.
- A Nash-Sutcliffe criterion of 0.872 was achieved for the daily model results. Values closer to 1 indicate a better representation than the average of the flow dataset, while values less than 0 indicate the fit is worse than the average of the flow dataset.
- Low flow conditions could not be matched as well (see Table 23), likely due to the influence of extensive underground workings within the catchment upstream of WM2 that drain to the Cascade Catchment rather than the Whareatea River (which could not be represented in the AWBM).

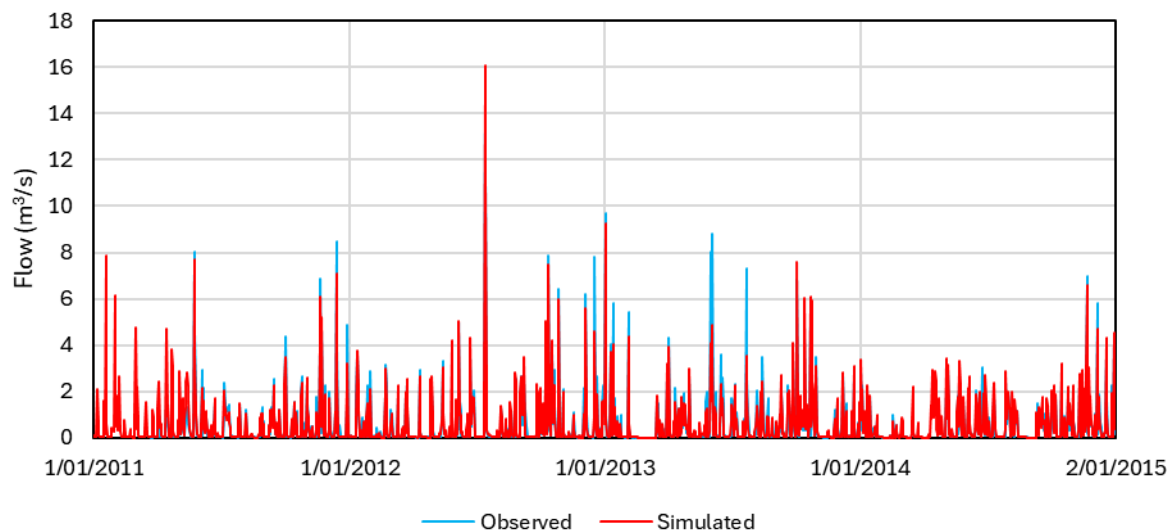


Figure 24: Daily flow rate comparison.

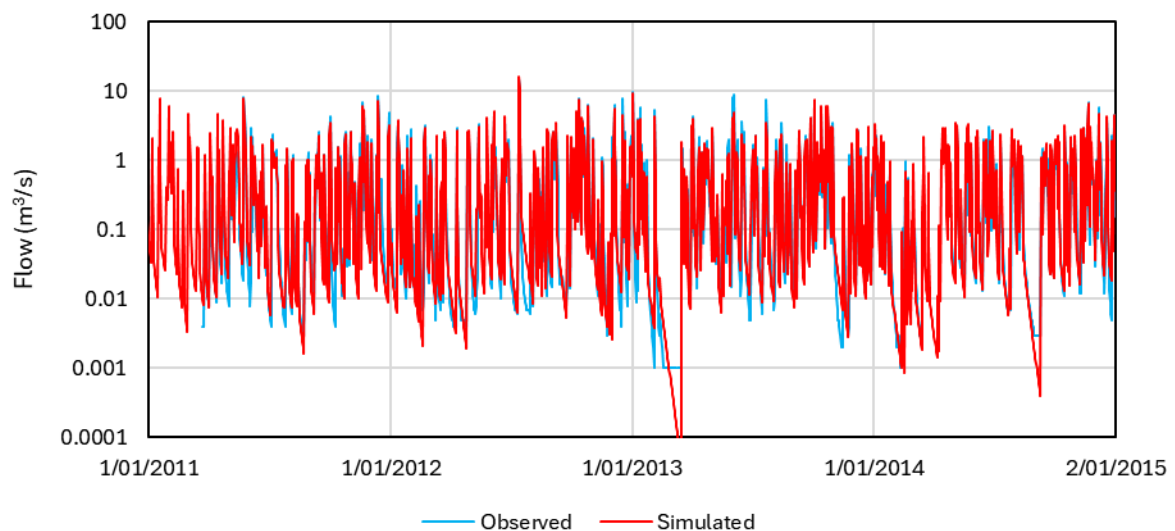


Figure 25: Daily flow rate comparison (log scale).

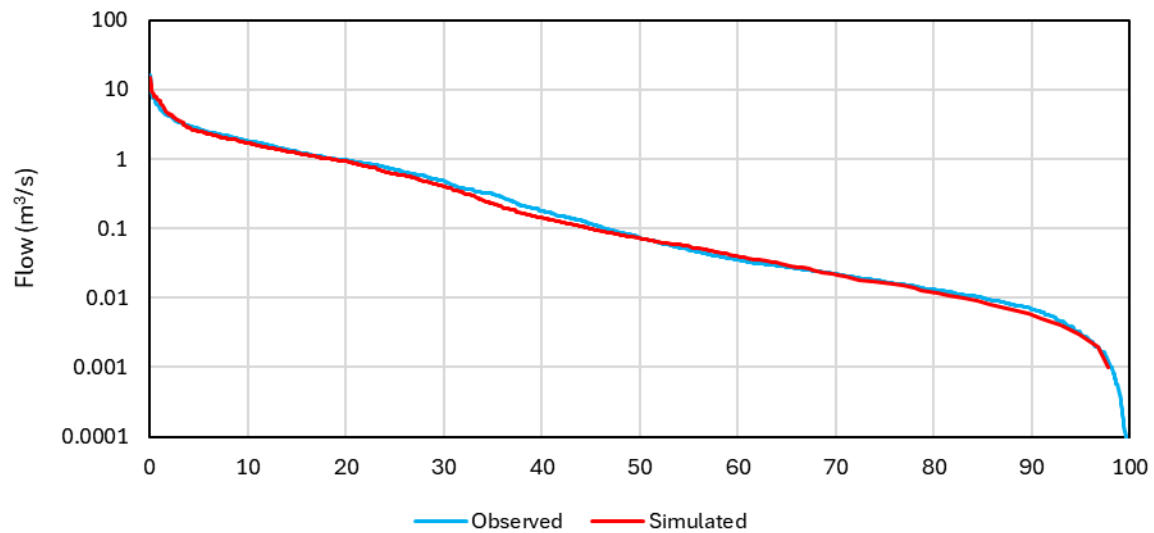


Figure 26: Flow exceedance comparison.

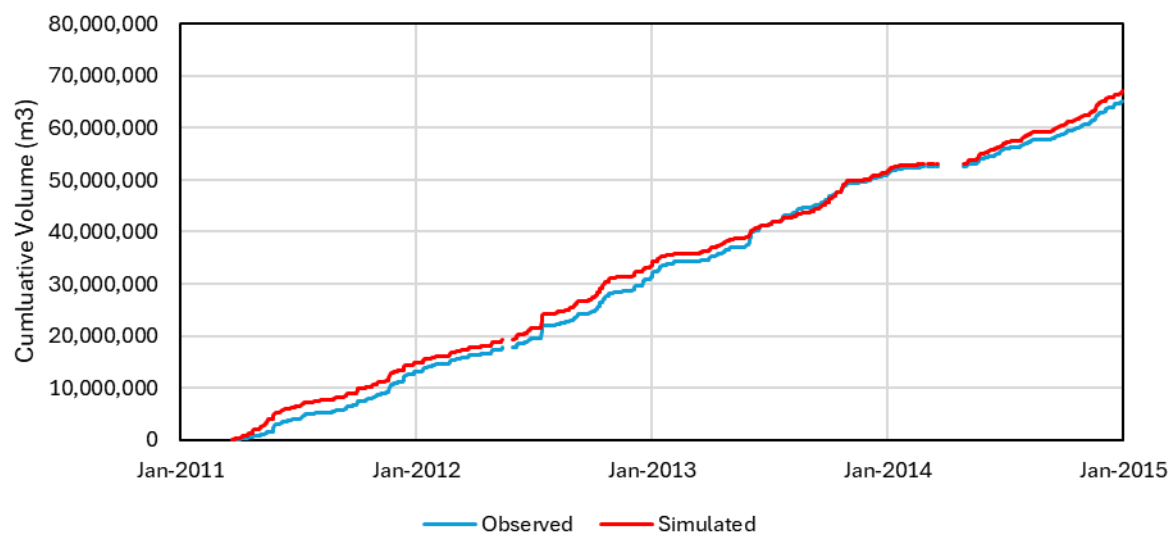


Figure 27: Cumulative water volume comparison.

Table 23: WM2 flow statistic comparison.

METRIC	OBSERVED FLOW	SIMULATED FLOW
Mean Flow	0.59	0.57
Median Flow	0.074	0.072
7-day MALF	0.0018	0.0028
95 th Percentile Flow	2.69	2.53

Note: All values reported as m³/s. MALF is mean annual low flow.

5.3 Model Limitations

5.3.1 Water Balance

The primary limitations regarding the water balance are listed below:

- **Catchment area simplifications:** Catchments areas are input on an annual basis. Therefore, smaller changes in catchment area within each year are not accounted for. However, this approach is considered appropriate for the purposes of the model.
- **Rainfall accumulation and intensity:** Rainfall characteristics such as rainfall accumulation, intensity, and variability, have a major influence on the result of the water balance model. These uncertainties are tested for sensitivity within the scenario modelling section.
- **Flow generation parameter simplifications:** Parameters used to represent flow generation from mine disturbed areas have been calibrated and are based on professional experience and judgement.
- **Model timestep:** The model uses a daily (24-hour) timestep and therefore does not capture sub-daily time step flow variability.
- **Net percolation is based on uncalibrated numerical modelling** as is important for simulating water quality from ELF seepage. Empirical data collected as part of performance monitoring to confirm values adopted remain appropriate.
- **Background runoff is calibrated to WM2 flows**, which may not be fully representative of MFS catchments. High flow events are not considered to be well represented due to limitations with calibration of high flow events (discussed in Section 5.2) and the use of a single runoff coefficient (that is independent of rainfall accumulation) for background areas.

5.3.2 Load Balance

The following limitations are noted regarding the load balance model:

- **Conservative transport assumption:** The model assumes that all parameters are transported downstream without accounting for geochemical reactions. This means that processes such as precipitation (e.g., formation of hydroxy-sulfates) and adsorption are not represented. As a result, elements known to be removed from solution, such as Al, Fe, and As, are likely overestimated in downstream model nodes. Other trace metals, including Vanadium (V), Co, and others, may also be affected. These processes can occur within waterbodies or along flow pathways.
- **pH:** The pH is expected to remain neutral in this load balance due to the net effect of active and passive AMD treatment. To account for “pH transport,” the hydrogen ion concentration (estimated from the source terms using the equation $\text{pH} = -\log_{10}[\text{H}^+]$) is used instead, with some estimations of pH based on the alkalinity and acidity balance based on empirical data.
- **Timestep:** While the simulation is made at a daily timestep, most of the water quality data used for the derivation of source terms are approximately at a monthly scale, therefore daily (or intra-monthly) trends might not be represented well in the source terms, and therefore, nor in the model results.

6 MODEL RESULTS

This section presents the water balance and load balance modelling results. Base Case model results are presented in Sections 6.1 and 6.2, then alternative scenario results are presented in Section 0.

6.1 Base Case Water Balance Model Results

6.1.1 Sump Volumes

The operating levels of the West Pit and East Pit Sumps during the Active Treatment Phase are presented in Figure 28 and Figure 29, respectively.

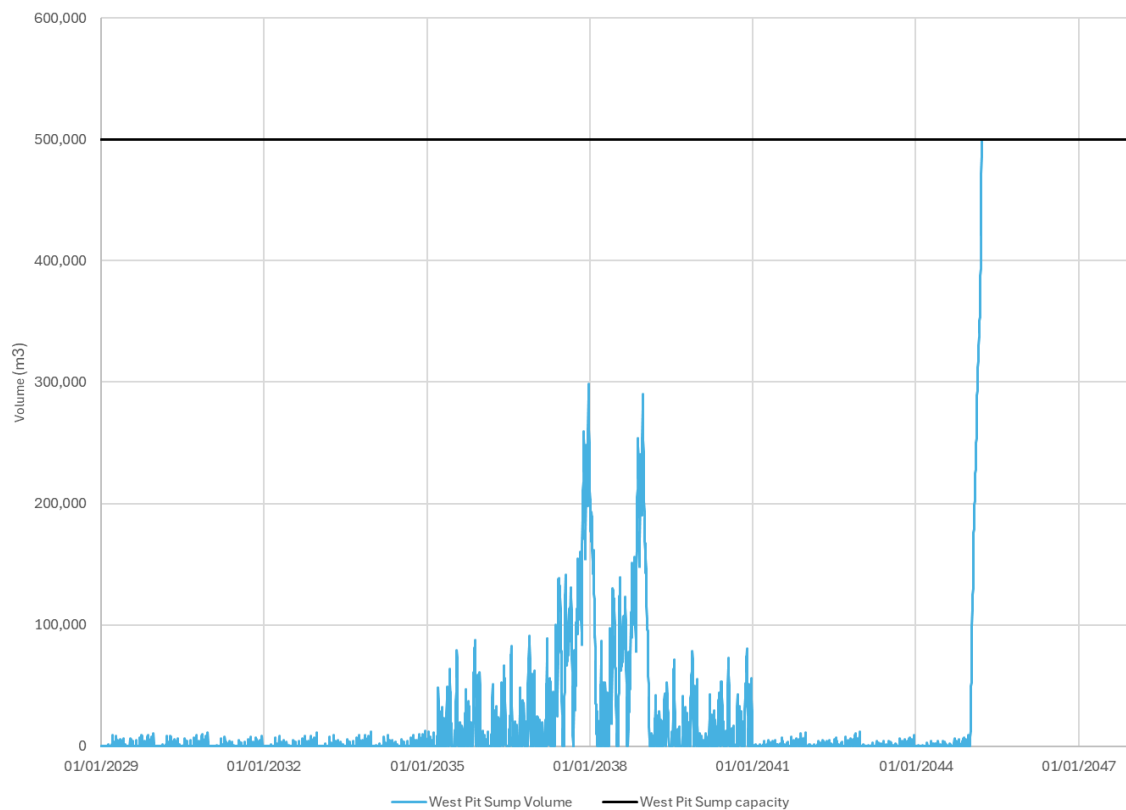


Figure 28: West Pit Sump simulated volume.

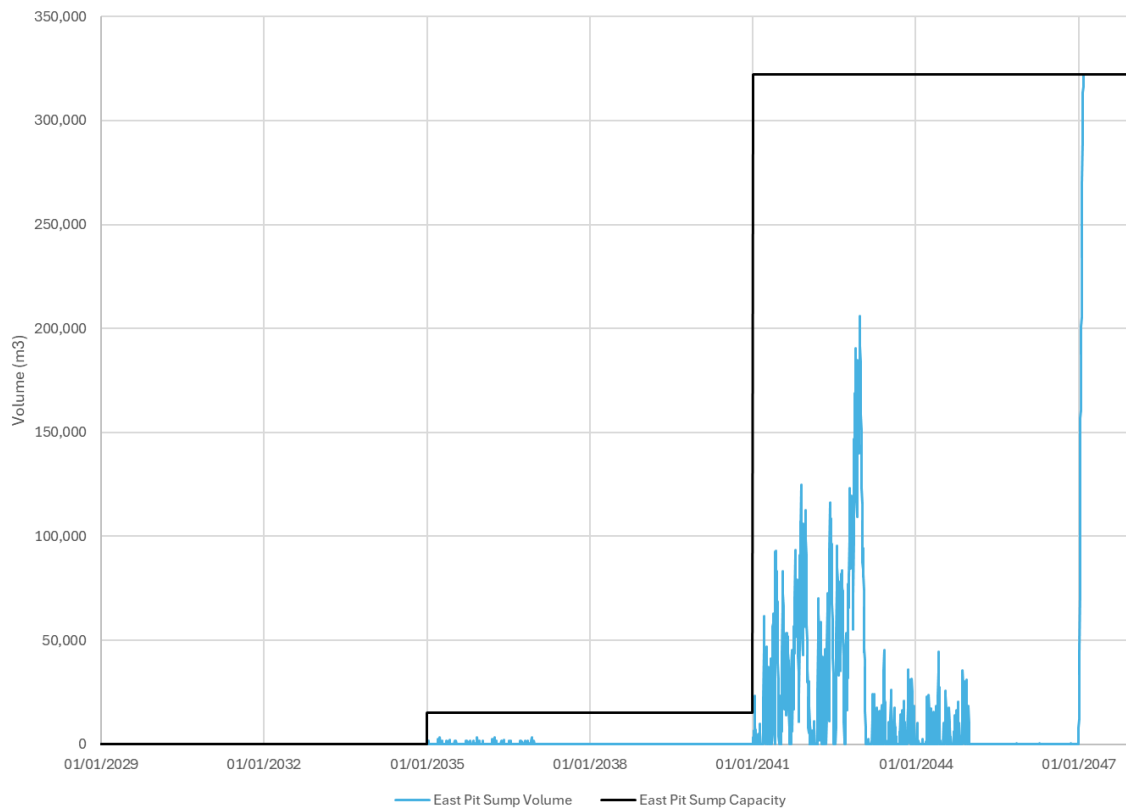


Figure 29: East Pit Sump simulated volume.

The following is noted regarding the above graphs:

- Utilising a fixed pumping rate of 200 L/s and direct discharge rate of 200 L/s (where flows criteria is met) at the West Pit Sump through its Active Treatment Phase (2029 - 2044), and the East Pit Sump from 2045 to 2046, exceeds requirements under Base Case.
- The East Pit Sump has relatively small volume from 2035 to 2040 – as such, this limited surge capacity results in the need for higher pumping rates, as noted in Table 12.

6.1.2 Bypass and Direct Discharge Events

The frequency and duration of East and West pit sump bypass events and direct discharge events to Waimangaroa River are tabulated in Table 24.

Table 24: Sump bypass and direct discharge simulated frequency (events per year).

EVENT DURATION	EAST SUMP BYPASS	WEST SUMP BYPASS	DIRECT DISCHARGE TO WR*
1 day	15.9	15.8	28
2 days	2	2.1	8
3 days	0	0	0

Note: values reported are the average number of events per year.

WR: Waimangaroa River

The following observations are noted:

- Achieving 5% bypass events on an annual basis was not always possible as the trigger flow was sometimes such that it could not be limited to exactly 18 events per years. As such, a value of 4.4% was adopted for modelling to avoid bypass more than 5% of the time.
- The maximum period in the model where consecutive bypass or direct discharge events occur is 2 days. Most events were less than two days (88% of bypass events and 78% of direct discharge events).
- It should be noted that the model is based on daily time steps and therefore cannot simulate events that may occur for less than a 24-hour period.

6.1.3 ELF Seepage Flows

Seepage flows are illustrated below and have been collated based on how they may interact, or share commonalities with other areas as follows (see Figure 9 for their locations):

- MSRs 1 to 4: relate as external West Pit seepage flows (Figure 30).
- MSRs 5 to 7: are seepage flows directed to the common West Pit Sump polishing pond (Figure 31).
- MSRs 8 to 10: are seepage flows directed to the common East Pit Sump polishing pond (Figure 32).
- MSRs 11 and 12: are seepage flows relating to the coal stockpile pad (Figure 33).
- MSRs MDC1 and MDC2: relate as external West Pit NAF ELF seepage flows (Figure 34).

Note, MSRs 2 to 4 have been modelled in the WLBM as a single seepage rate based on the ELFs sharing a discharge pathway. The breakdown of flows relative to the sum is approximately: MSR2 = 11.2%, MSR3 = 44.4%, MSR4 = 44.4% based of the proportion of basal catchment area.

Table 25 describes the basal catchment area reporting to the MSRs, identifying how these translate to flows illustrated in Figure 30 through Figure 34.

Table 25: MSR reporting basal catchment.

MSR IDENTIFIER	REPORTING AREA (Ha)
MSR1	6.2
MSR2	1.5
MSR3	4.1
MSR4	4.1
MSR5	19.0
MSR6	4.5
MSR7	20.2
MSR8	31.8
MSR9	4.0
MSR10	2.5
MSR11	2.9
MSR12	2.9
MDC1 (NAF Only)	0.6
MDC2 (NAF Only)	0.5

Source: BRL

Whilst the graphs illustrate flows reporting to MSRs, activation of MSRs are not all immediate and occur at different times throughout the model. Prior to MSR activation, ELF seepage is directed into the MIW network.

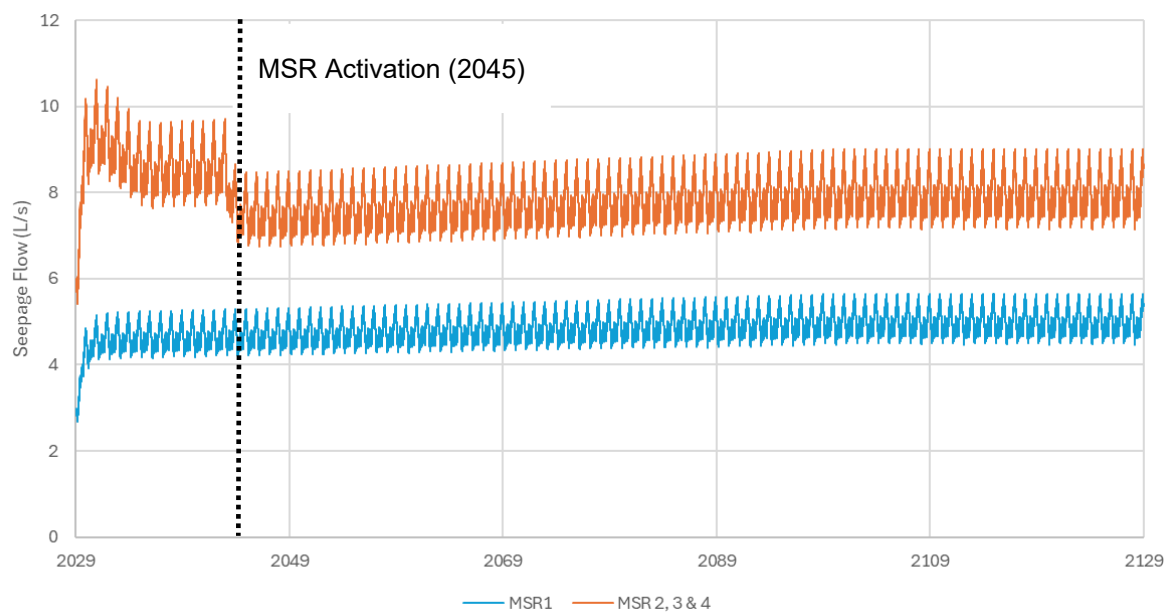


Figure 30: Daily seepage rates related to MSR1 and the sum of MSR2 through 4.

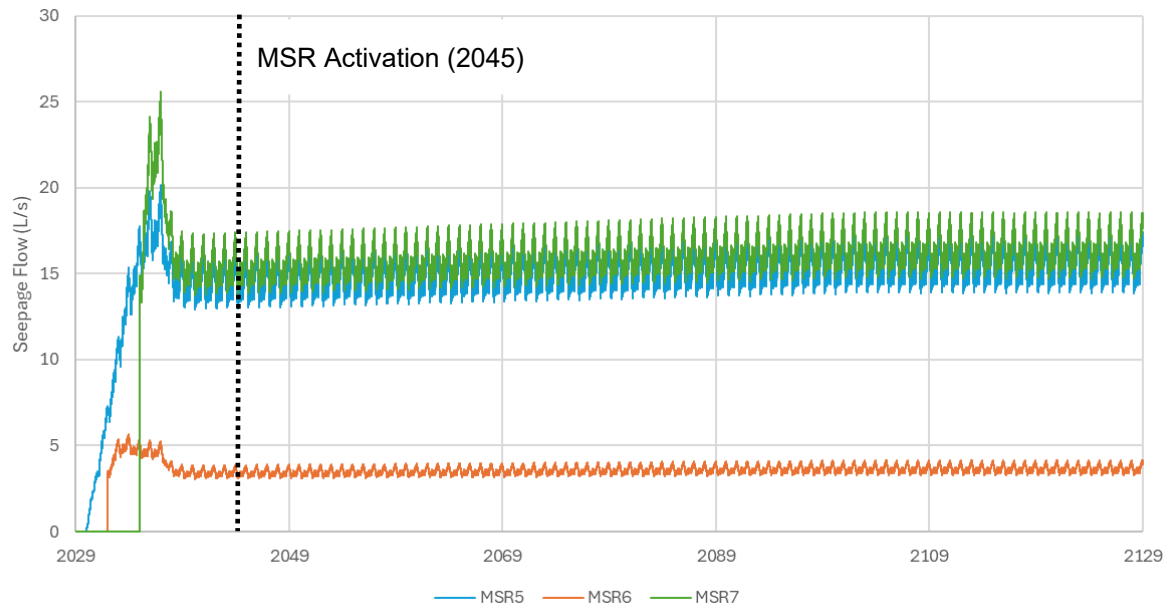


Figure 31: Daily seepage rates related to MSR 5 through 7.

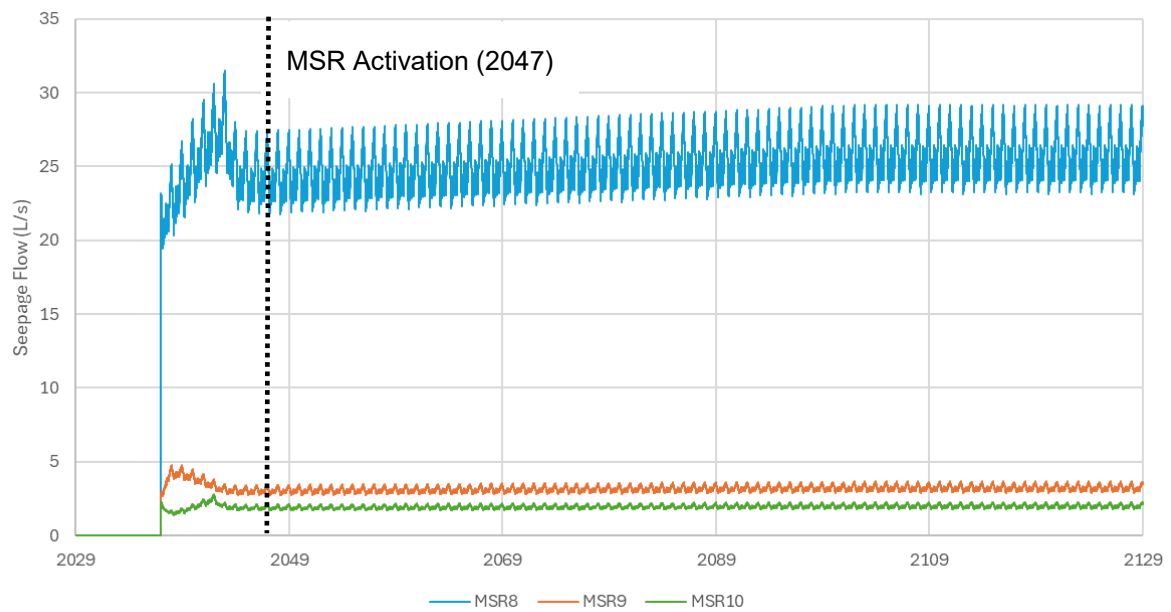


Figure 32: Daily seepage rates related to MSR 8 through 10.

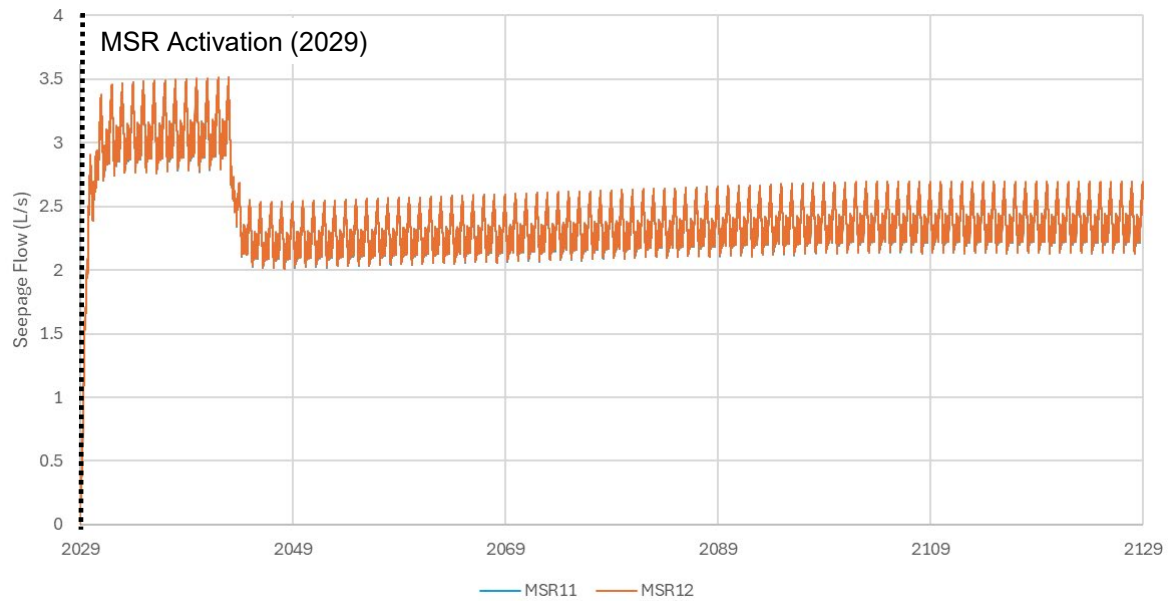


Figure 33: Daily seepage rates related to MSR 11 and 12.

Note: Rates are almost identical, hence MSR11 is hidden by MSR12

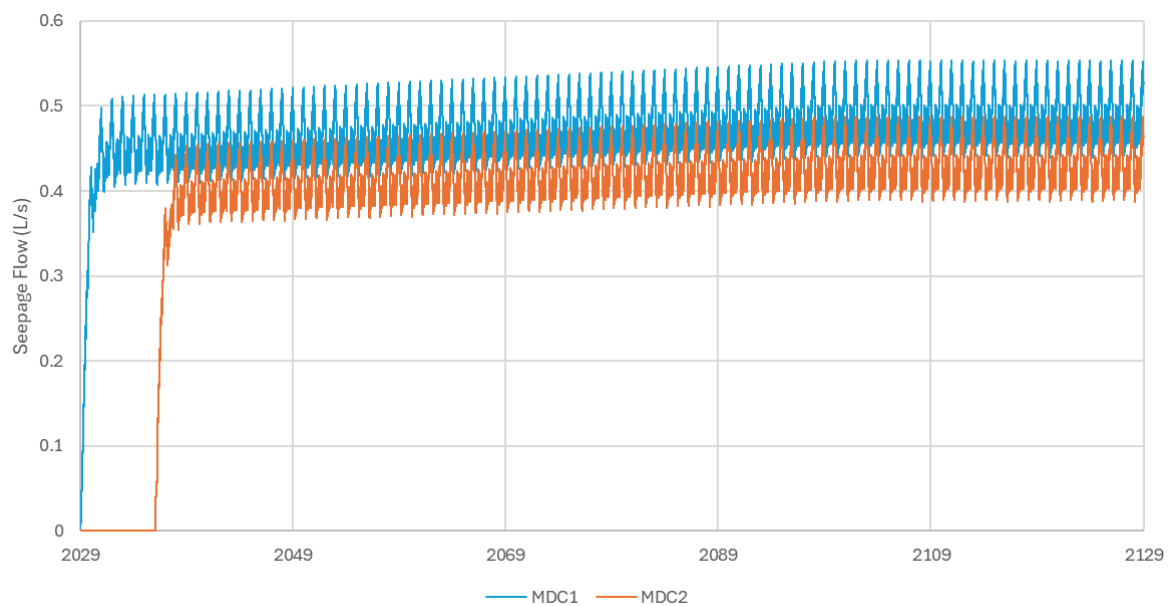


Figure 34: Daily seepage rates related to MSRs MDC1 and MDC2.

The following is noted regarding the above graphs:

- The East Pit ELF upstream of MSR8 produces the highest seepage flow rates throughout the simulation.
- Seepage rates are relatively stable on a daily basis (e.g., compared to surface runoff), because the simulated ELFs release water more gradually due to their storage effects. The minor variation in seepage rates relates to periods of wet and dry weather, whilst the distinct repetitions is a function of the repeated annual rainfall time series.

- Peak flows for some ELF's occur during the Operations Phase, where rehabilitation has not fully occurred. As such, net percolation, and therefore seepage flow rate is higher.
- Seepage rates for ELF's gradually increase throughout the Post Closure Phase until 2100 due to the modelled increase in precipitation caused by climate change.

6.1.4 Volume of Water Treated at WTP

The cumulative volume of actively treated water is presented in Figure 35, with the following noted.

- A total of 71,460,000 m³ (126 L/s on average) of water is treated within the model over the simulation.
- 58,800,000 m³ of water is treated during the Operations Phase with the remaining 17.7% being treated during the Active Closure Phase.
- In 2045 treatment volumes reduce, at this time the West Pit transitions to passive treatment and only East Pit ELF seepage is treated.

From 2046 the WTP is modelled to not be required, however, will be available should it be required.

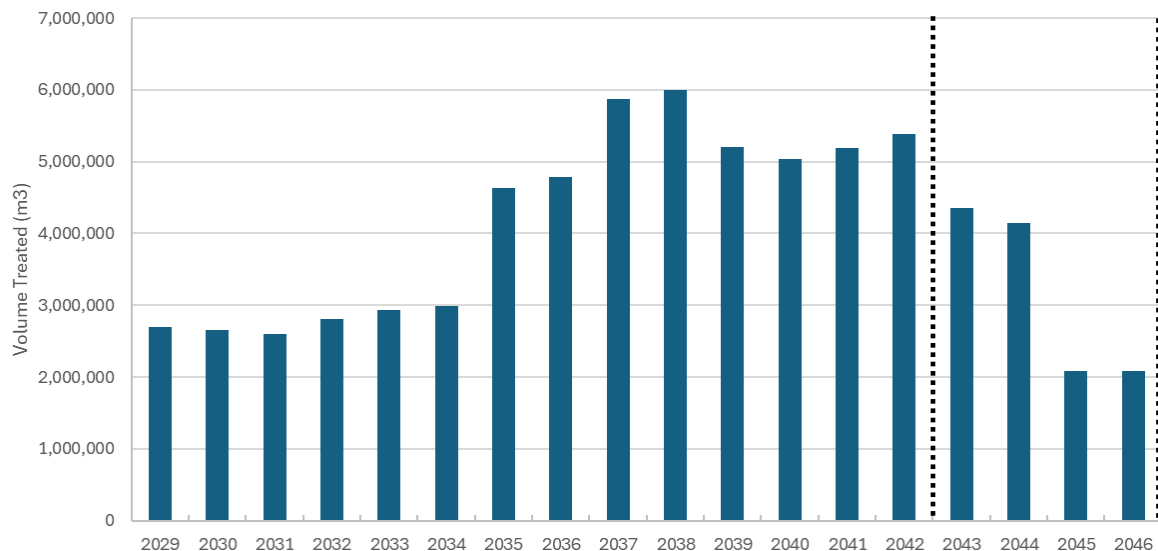


Figure 35: Annual volume of water treated by WTP during the Active Treatment Phase.

Note: active treatment is complete at the end of 2046, the Post Closure Phase (where all treatment is managed through use of MSRs) then begins in 2047. Active closure is defined as the period where the mine is rehabilitated, however, active treatment is still required. As previously described, the Post Closure Phase begins in 2045 for the West Pit, and 2047 for the East Pit.

6.1.5 Environmental Flows

This section focuses on modelled flow distribution results at the proposed compliance locations. The presented flow distributions compare modelled baseline flows with the Active Treatment and Post Closure Phases. The baseline conditions presented in the plots were generated by applying the AWBM outputs to the catchment upstream of the compliance/identified site.

The following is noted regarding the following plots:

- Modelled results represent the Base Case.

- The results are influenced by the modelled gradual increase in rainfall simulating climate change.
- Modelled results should be evaluated for their relative change in flows – given the use of Whareatea River flow data for calibration of the AWM, there will be differences in flow yields across the flow distribution curves with that of Deep Stream and Waimangaroa River. See Section 5.2 for further details on the repercussions on calibration to Whareatea River flow data.
- The Active Treatment Phase includes the period where mining commences (Operations Phase) until the Post Closure Phase starts – mine progression, progressive rehabilitation, and active closure are all features throughout this period which impact annual flows at the compliance sites; this period is therefore more variable than illustrated. The Construction Phase is not included.
- The Post Closure Phase begins when all water reporting to the respective compliance locations begins passive treatment via MSRs.

6.1.5.1 SW01

Expected flow distributions during the different treatment phases have been modelled for site SW01 in Deep Stream (Figure 36, Table 26).

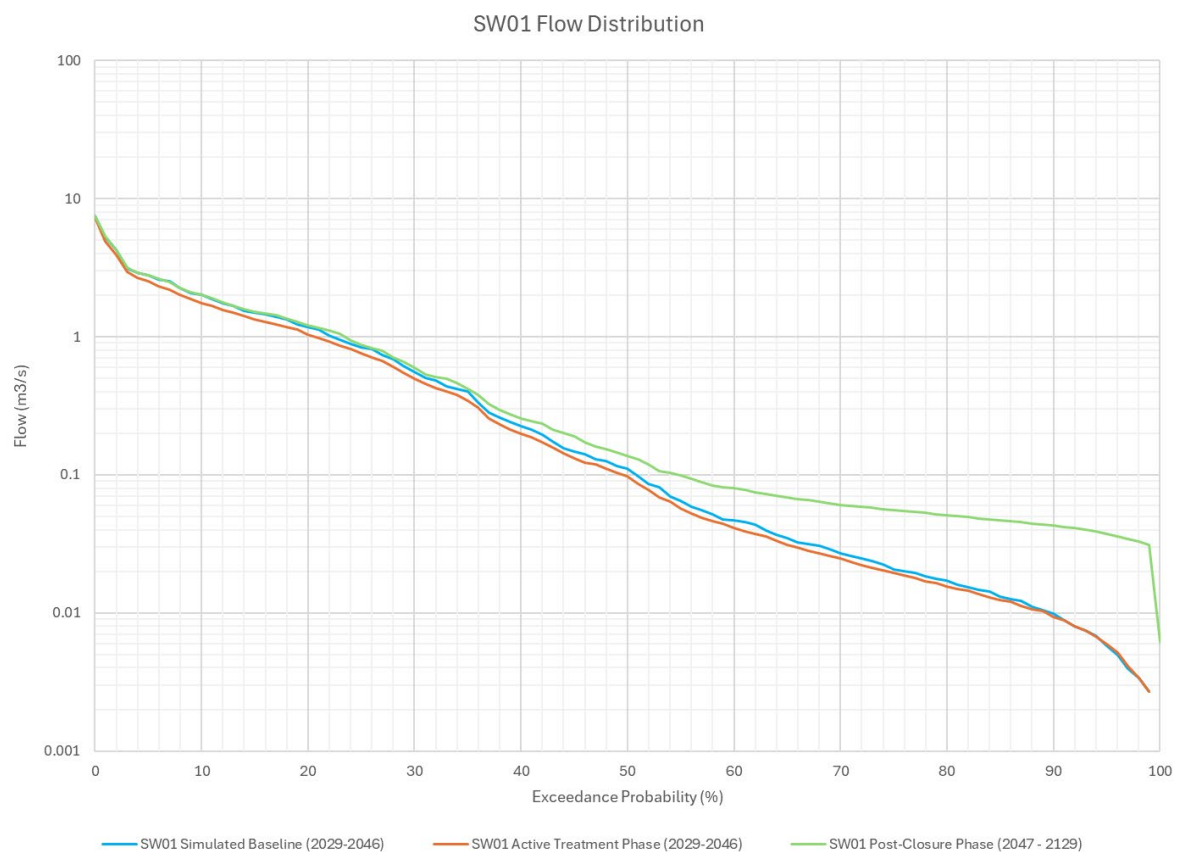


Figure 36: SW01 modelled flow distribution results.

Table 26: SW01 hydrological statistics summary.

	MEAN FLOW (L/s)	MEDIAN FLOW (L/s)	7D MALF(L/s)
Simulated Baseline (2029-2046)	634	111	5.5
Active Treatment Phase (2029-2046)	572 [-10%]	97 [-12%]	5.4 [-2%]
Post Closure Phase (2047-2128)	664 [+5%]	136 [+23%]	36.1 [+555%]

Notes: Brackets indicate percentage change compared to baseline.

7D MALF = 7 Day Mean Annual Low Flow.

The following is noted regarding the model results for SW01:

- The Active Treatment Phase conditions cause limited change in the hydrograph, more noticeably a reduction in flows and overall volumes through SW01 as a result of water being removed from the catchment for treatment, and high flows being impacted by higher net percolation rates relating to ELF.
- The Post Closure Phase conditions cause higher base flows, mostly related to creation of groundwater storage within the ELF and stable release as seepage (through the MSR), and this is also related to higher rainfall with climate change.

6.1.5.2 SW03

Expected flow distributions during the different treatment phases have been modelled for site SW03 in Deep Stream (Figure 37, Table 27).

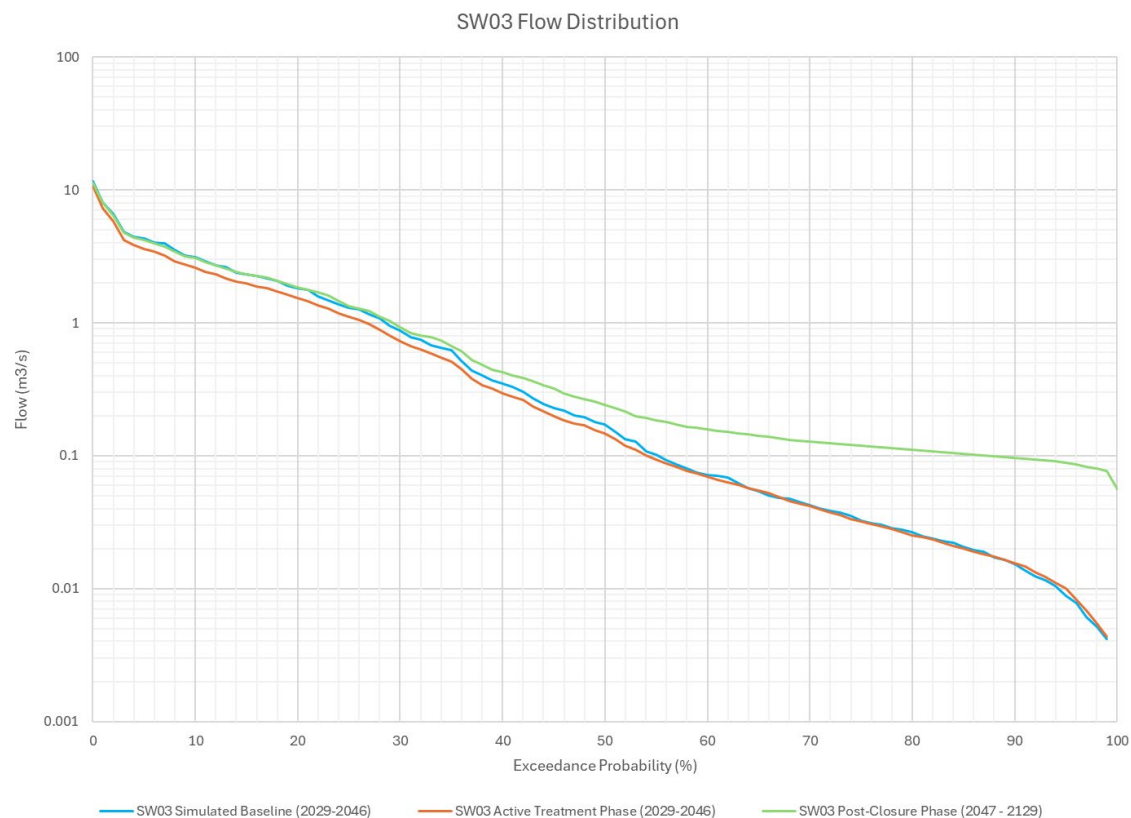


Figure 37: SW03 modelled flow distribution results.

Table 27: SW03 hydrological statistics summary.

	MEAN FLOW (L/s)	MEDIAN FLOW (L/s)	7D MALF(L/s)
Simulated Baseline (2029-2046)	984	172	8.6
Active Treatment Phase (2029-2046)	841 [-14%]	147 [-15%]	11.3 [+32%] ¹
Post Closure Phase (2047-2128)	1,033 [+5%]	242 [+41%]	85.2 [+895%]

Notes: Brackets indicate percentage change compared to baseline.

7D MALF = 7 Day Mean Annual Low Flow.

1 - These figures are impacted by high basal flows in years 2045 and 2046 as a result of the West Pit MSRs being brought online – prior to 2045, 7D MALF figures are less than baseline.

The following is noted regarding the model results for SW03:

- The Active Treatment Phase conditions cause limited change in hydrograph, more noticeably a reduction in flows and overall volumes through SW03 as a result of water being removed from the catchment for treatment, and high flows being impacted by higher net percolation rates relating to ELF's.
- The Post Closure Phase conditions cause higher base flows, mostly related to a drawn-out release of ELF seepage/MSR discharge and to a lesser extent climate change.

6.1.5.3 Smokestack

Expected flow distributions during the different treatment phases have been modelled for site Smokestack in the Waimangaroa River (Figure 38, Table 28).

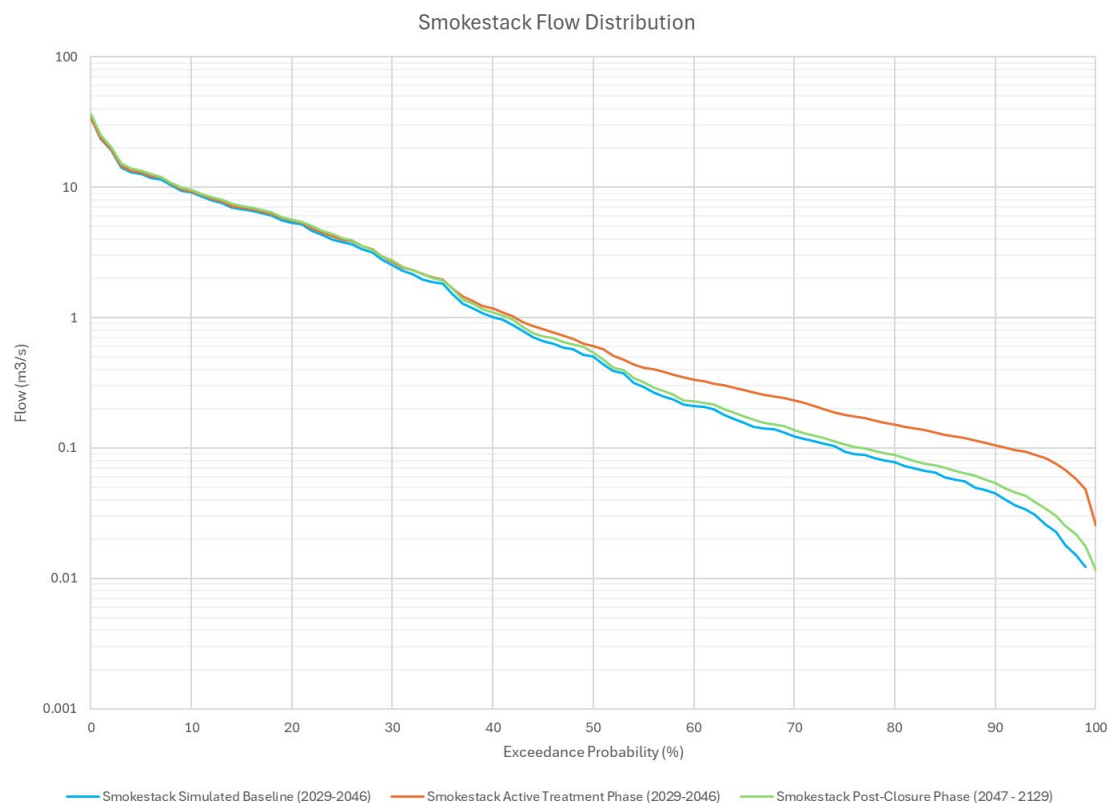


Figure 38: Smokestack modelled flow distribution results.

Table 28: Smokestack hydrological statistics summary.

	MEAN FLOW (L/s)	MEDIAN FLOW (L/s)	7D MALF(L/s)
Simulated Baseline (2029-2046)	2,866	501	24.9
Active Treatment Phase (2029-2046)	3,017 [+5%]	606 [+21%]	81.0 [+225%]
Post Closure Phase (2047-2128)	3,049 [+6%]	542 [+8%]	32.8 [+31%]

Notes: Brackets indicate percentage change compared to baseline.

7D MALF = 7 Day Mean Annual Low Flow.

The following is noted regarding the model results for Smokestack:

- The Active Treatment Phase conditions cause an increase in base flow rates, most related to WTP flows directed to Smokestack (facilitated by surge capacity of the East and West pit sumps which results in extended operation of the WTP into low flow conditions).
- The Post Closure Phase conditions cause increased base flows, likely related to MSR discharge from the coal stockpile pad and to a lesser extent climate change.

6.1.5.4 17W

Expected flow distributions during the different treatment phases have been modelled for site 17W in the Waimangaroa River (Figure 39, Table 29).

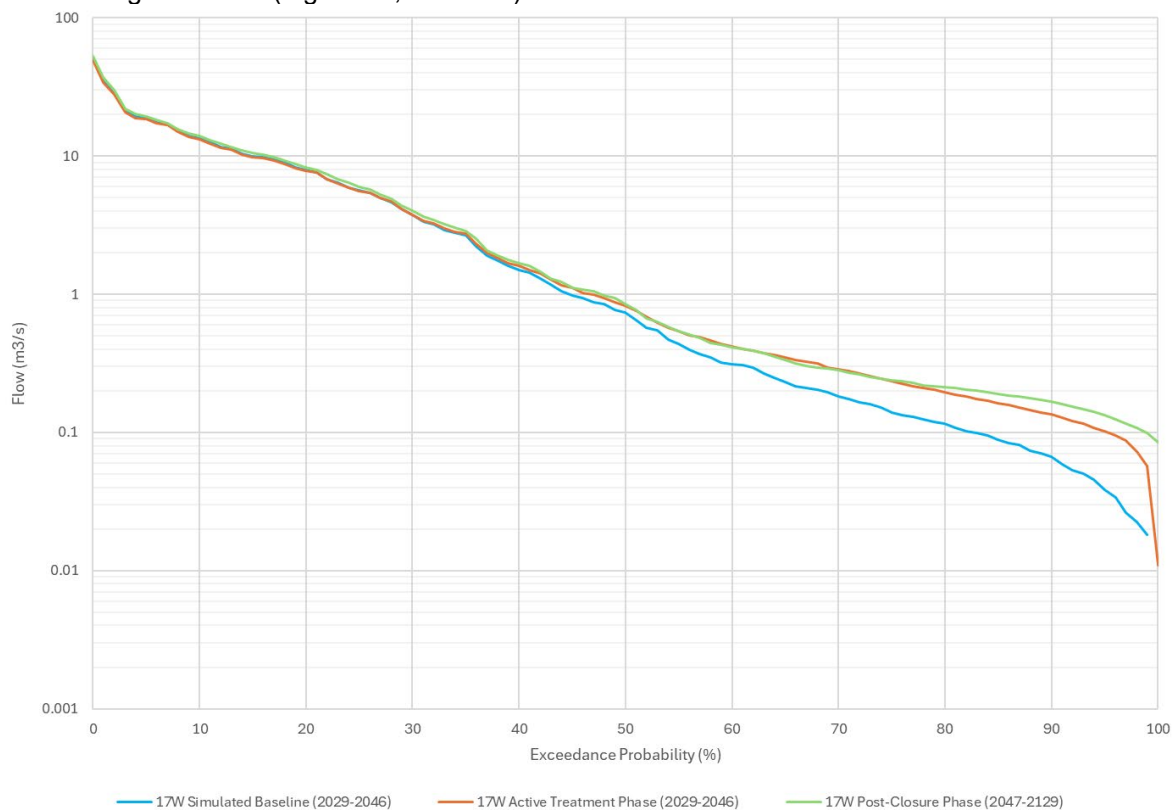


Figure 39: 17W modelled flow distribution results.

Table 29: 17W hydrological statistics summary.

	MEAN FLOW (L/s)	MEDIAN FLOW (L/s)	7D MALF(L/s)
Simulated Baseline (2029-2046)	4,246	743	37.0
Active Treatment Phase (2029-2046)	4,254 [0%]	821 [+11%]	96.0 [+160%]
Post Closure Phase (2047-2128)	4,501 [+6%]	847 [+14%]	123.2 [+233%]

Notes: Brackets indicate percentage change compared to baseline.

7D MALF = 7 Day Mean Annual Low Flow.

The following is noted regarding the model results for 17W:

- The Active Treatment Phase conditions cause a distinguishable increase in base flow rates, mostly related to WTP flows directed to Smokestack (exacerbated by pit sump surge capacity).
- The Post Closure Phase conditions cause similarly higher base flows as a result of the drawn-out release of ELF seepage/MSR discharge from the MFS mining areas, and to a lesser extent climate change.

6.2 Base Case Load Balance Model Results

This section presents the water quality and load results from the model for PCOCs. The results include general water quality parameters (such as pH, sulfate (SO₄), DOC, and hardness) to provide a chemical overview.

The results relate to the Base Case scenario unless otherwise stated. Alternative scenarios are shown alongside Base Case model results for annual and 95th percentile (P95) plots (plotted together) for comparison and assessment of compliance.

The results presented in this section focus on key PCOC: parameters known to have high concentrations in mine-impacted water from Brunner Coal Measures ELFs or active pits. These include Zn, Co, Cd, and Ni, in addition to other relevant metals like Al, Fe, Mn, and Cu; TSS and turbidity are also presented.

The full suite of results is presented in Appendix E.

Model results were screened against guideline values provided in Section 2.2, and summarised in Section 6.2.7. Model simulated TMFs are used to calculate dynamic guideline values.

6.2.1 Presentation of Results

Model results for water quality are presented in three separate ways in this report:

- As a 30-day rolling median to smooth out daily variability of raw model outputs. General temporal patterns of model results for pH, SO₄, DOC, and hardness.
- As concentration exceedance probability plots for SO₄, hardness, and TSS.
- For screening model results against proposed guideline values:
 - Annual Metal Eco-toxicity Quotient (MEQ, Weber et al., 2016) plots to assess compliance against proposed chronic and acute guideline values (see Section 2.2). These are

presented for the Base Case and compared against scenarios to compare effects of the various scenarios.

- Turbidity was plotted as daily probability of exceedance, 7 day rolling median, annual median and 95th percentile values, to compare to chronic and acute guidelines values. TSS model results are also presented for context.

6.2.1.1 Understanding the MEQ plots

The MEQ value for a given parameter is calculated by dividing its concentration by the compliance limit.

- An MEQ value greater than 1 indicates an exceedance of water quality guidelines.
- An MEQ value of 1 or less indicates the parameter is within compliance limits.

The MEQ plots presented within this section involved calculating the MEQ value for each daily model timestep. For the chronic assessment, the median MEQ value was calculated for each model year and plotted as a time series. For the acute assessment the P95 MEQ values were calculated for each model year and plotted as a time series. Therefore, plots where all annual MEQ values are 1 or less indicate compliance.

6.2.2 *Level of Protection*

The level of protection (LoP) percentile recommended for SW01 and SW03 is the 95% LoP. For Smokestack and 17W, the 80% LoP used as per RMA Science (Hickey, 2026).

For screening turbidity, the 'ecological-continuous' LoP was used. Background Catchment (Table 21) TSS source terms (converted to turbidity) were used as the 'background' to add to for the chronic guideline values (Hickey, 2026).

6.2.3 *SW01 – Deep Stream*

6.2.3.1 General Water Quality Parameters

Results for four general parameters (pH, sulfate, DOC and hardness) are shown in Figure 40.

The most significant feature across all four parameters is a major step-change event in 2047, resulting from the suspension of the WTP during which time the facility will likely remain in a ready but inactive state until passive treatment has demonstrated to meet all compliance standards (2 years has been proposed by BRL). This change is caused by the cessation of pumping from the East Pit Sump to the WTP, which in turn allows the East Pit Sump to overflow and discharge into the stream (near SW01).

The associated increases in pH and hardness are a direct effect of the commissioning of the MSRs that treat the seepage of the ELF's before flowing into the East Pit Sump, which also occurs in 2047. This step-change impacts also downstream points: SW03 and 17W.

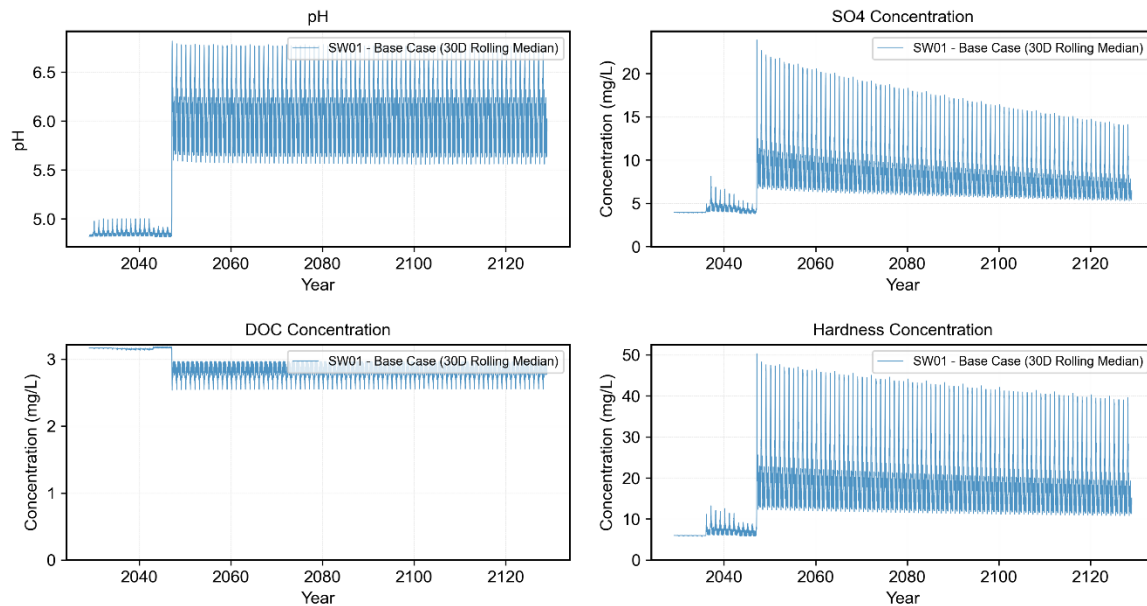


Figure 40: Model results at SW01 for pH, SO₄, DOC, and hardness for a 30D rolling median.

The exceedance probability plots for the daily results of SO₄ and hardness (Figure 41 and Figure 42) indicate lower concentrations during the Operations Phase.

The lower sulfate concentrations (at SW01) during operations are directly associated with the pumping of the mine impacted waters to the WTP, where the primary discharge occurs at Smokestack. After the water treatment switches from active to passive, the primary discharge takes place at SW01 increasing sulfate concentration at this point.

The simulated increase in hardness concentrations in the Post Closure Phase, are due to the commissioning of the MSRs, which generate more Ca (shell dissolution) and minor Mg.



Figure 41: Exceedance probability of daily results for SO₄ at SW01 for the 'Active Treatment Phase' (≤ 2046) and 'Post Closure Phase' (≥ 2047), and the overall data.

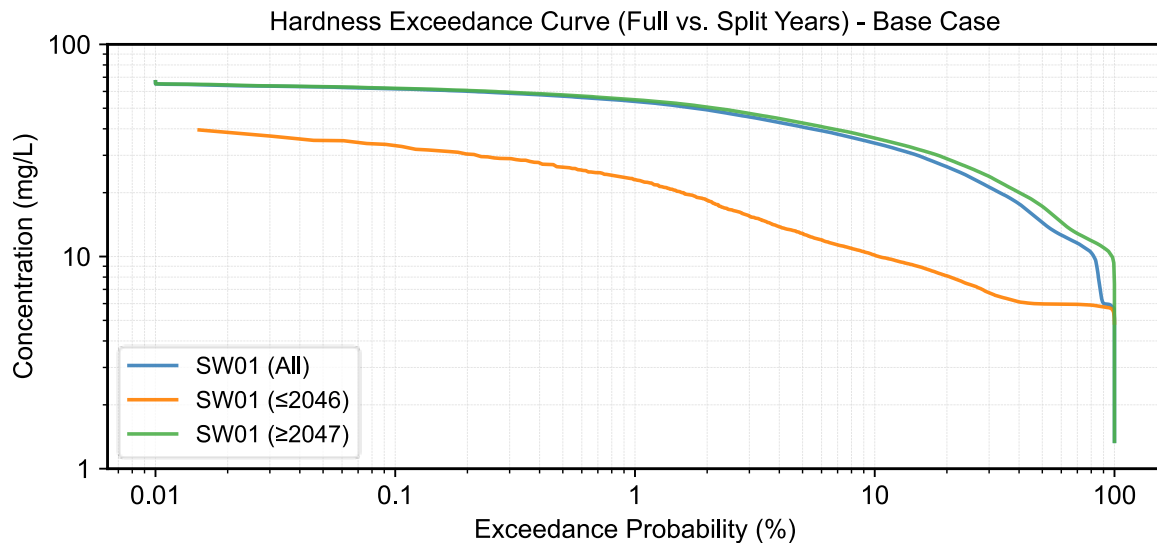
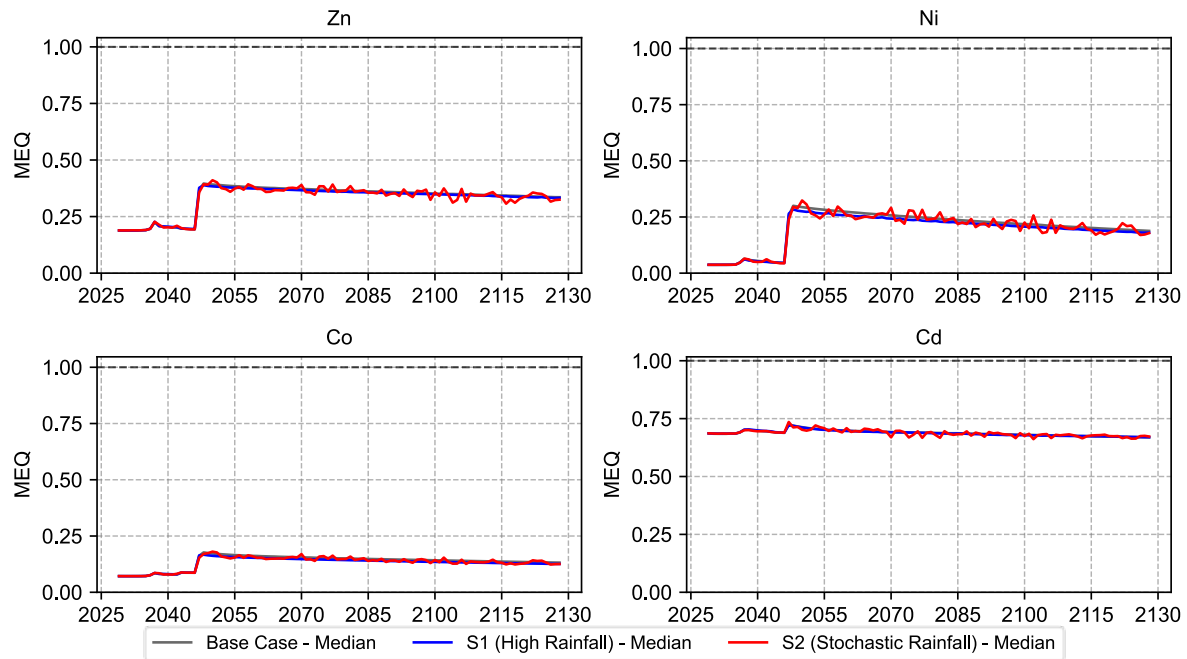


Figure 42: Exceedance probability of daily results for hardness at SW01 for the 'Active Treatment Phase' (≤ 2046) and 'Post Closure Phase' (≥ 2047), and the overall data.

6.2.3.2 Metals

Model results of key PCOCs in relation to guideline values for the Base Case and Scenarios 1 to 4 are shown below. The followings observations are noted:

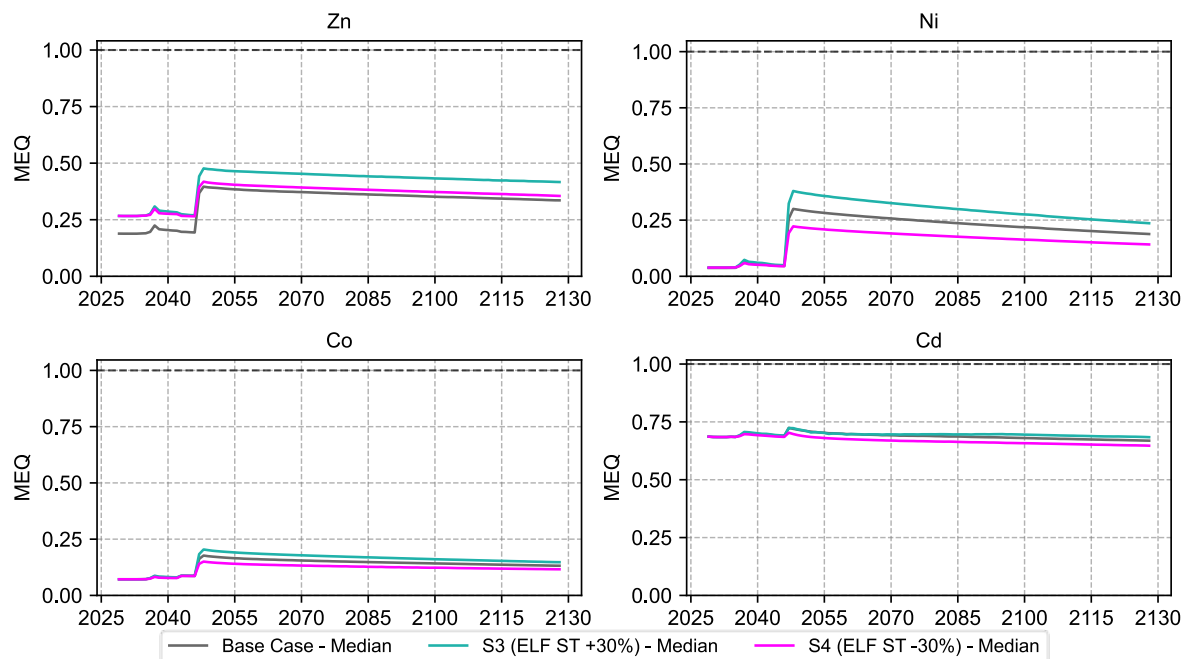
- Annual median (Figure 43 and Figure 44) plots show an increase in MEQ when transitioning to passive treatment at 2047. Overall, no exceedances were modelled for all of the scenarios and parameters.
- Scenarios 1 and 2 median MEQ values were similar to the Base Case.
- Scenario 3 median MEQ values were higher than the Base Case. On the contrary, Scenario 4 median MEQ was lower than the Base Case.
- The annual 95th percentile MEQ values (Figure 45 and Figure 46) indicated no exceedances for all parameters and scenarios.
- Scenarios 1 and 2 95th percentile MEQ values were elevated for Zn due to an increase in bypass rates, as a result of higher rainfall years. Otherwise, the scenarios show similar patterns to the median MEQ plots with respect to the Base Case.
- Exceedance probability plots are shown for all scenarios (Figure 47 and Figure 48):
 - Scenario 1 resulted in slightly lower concentrations compared to the Base Case.
 - Scenario 3 and 4 resulted in the most significant difference in concentrations compared to the Base Case.



SW01 – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 95% LoP)

Figure 43: Annual median MEQ calculated for Zn, Ni, Co, and Cd at SW01.

Note: the plots show the Base Case with Scenarios 1 and 2.



SW01 – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 95% LoP)

Figure 44: Annual median MEQ calculated for Zn, Ni, Co, and Cd at SW01.

Note: the plots show the Base Case with Scenarios 3 and 4.

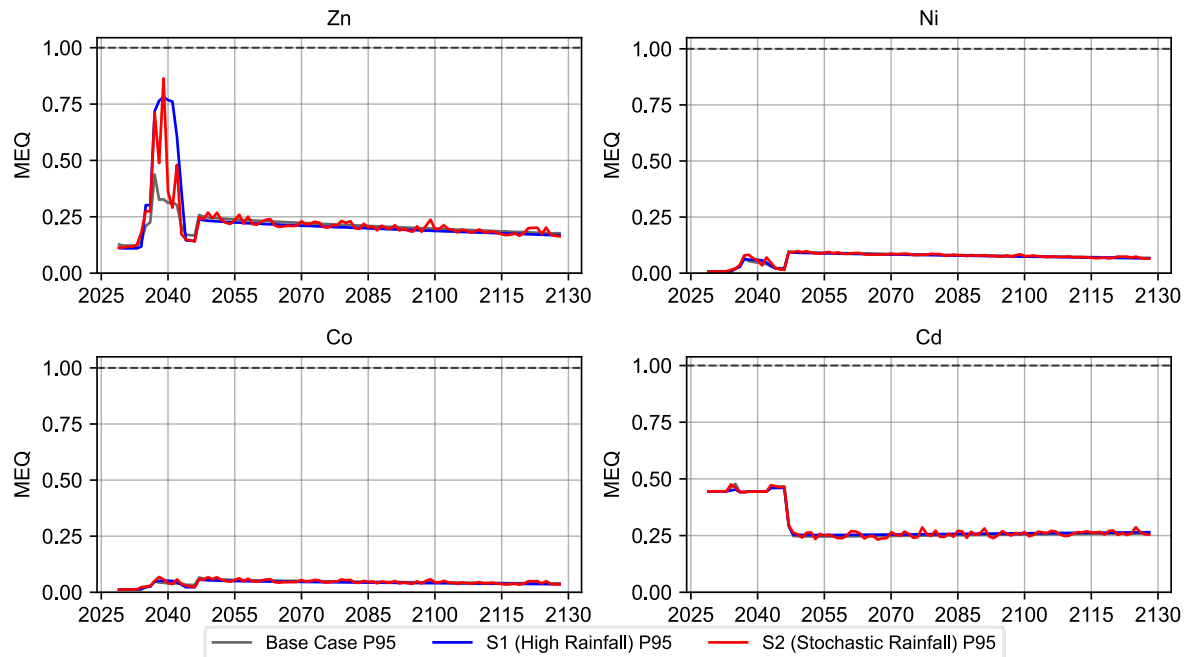


Figure 45: Annual 95th percentile MEQ calculated for Zn, Ni, Co, and Cd at SW01.

Note: the plots show the Base Case with Scenarios 1 and 2.

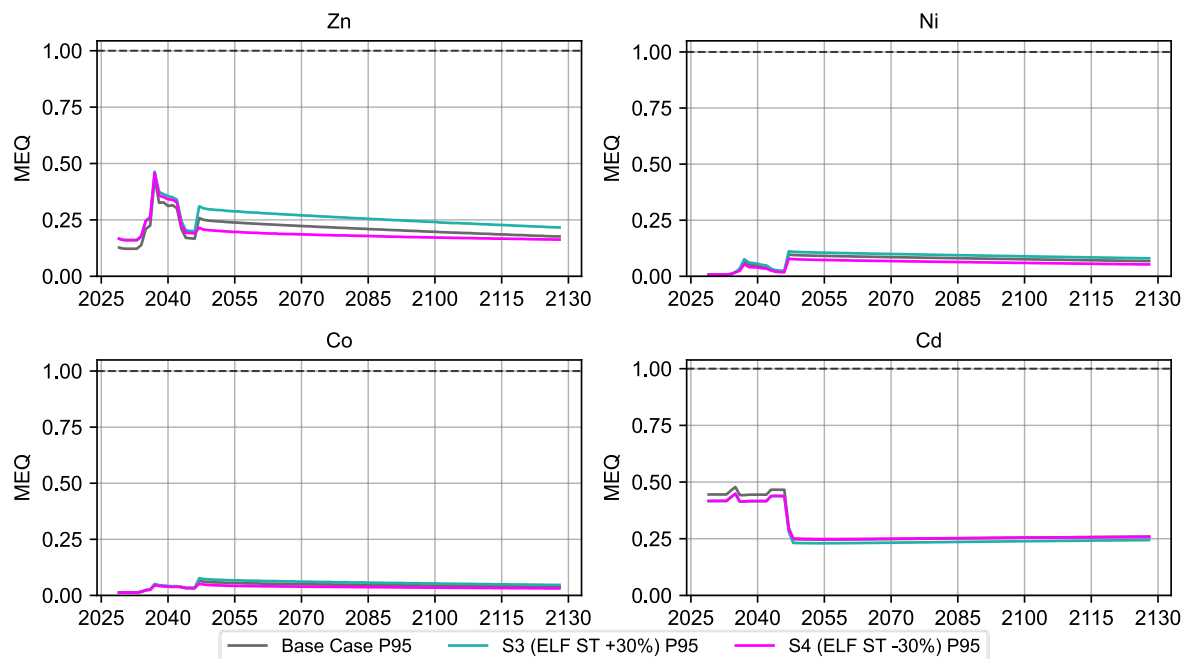


Figure 46: Annual 95th percentile MEQ calculated for Zn, Ni, Co, and Cd at SW01.

Note: the plots show the Base Case with Scenarios 3 and 4.

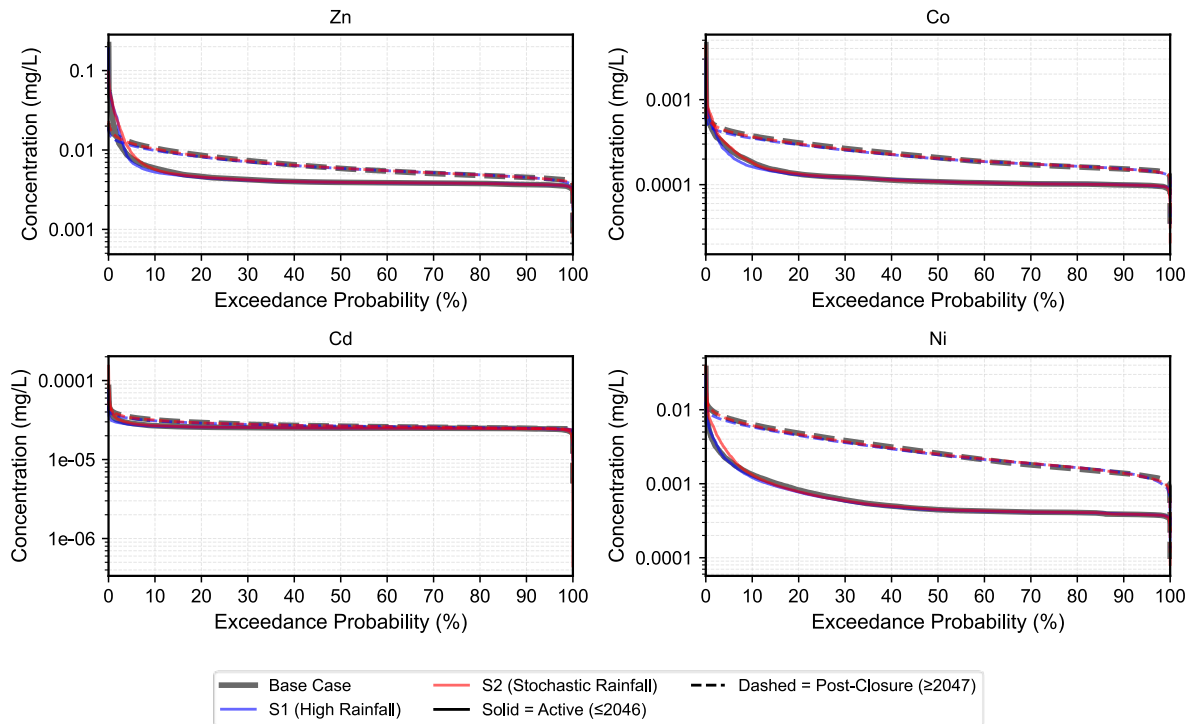


Figure 47: Exceedance probability plots for Zn, Co, Cd, and Ni, at SW01 for the Base Case Scenario, and Scenario 1 and 2.

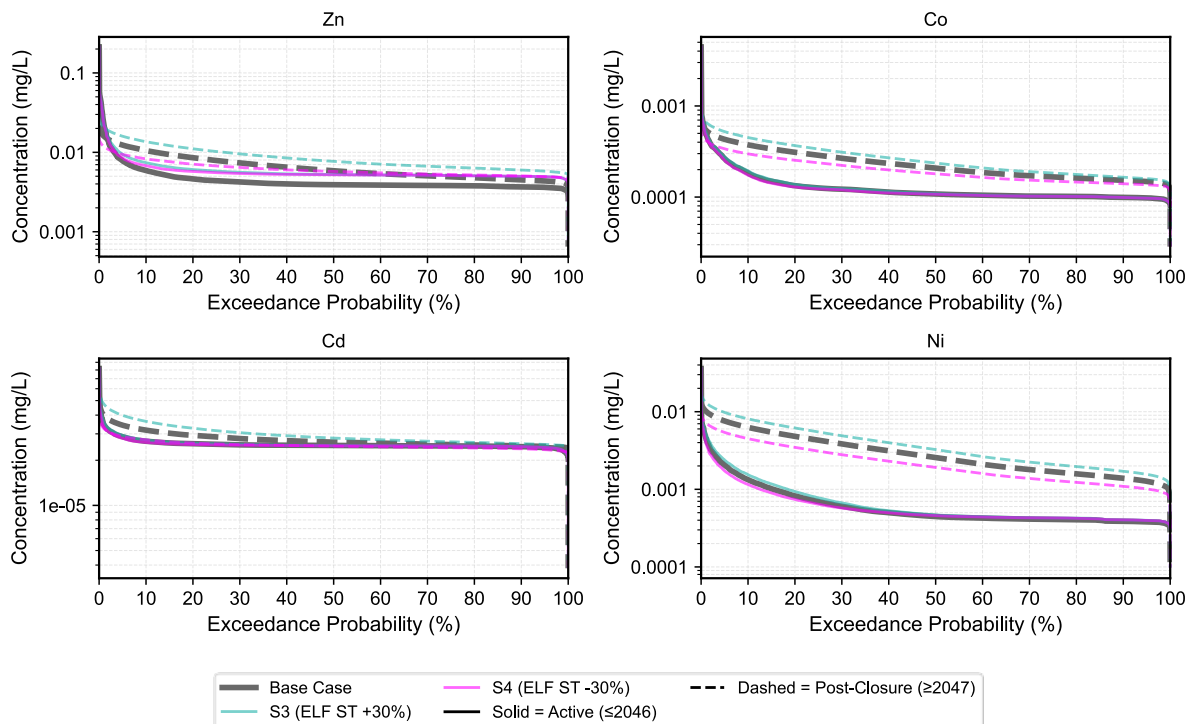


Figure 48: Exceedance probability plots for Zn, Co, Cd, and Ni, at SW01 for the Base Case Scenario, and Scenario 3 and 4.

6.2.3.3 TSS and Turbidity

The exceedance probability plot for TSS at SW01 is shown in Figure 49, and concentrations at SW01 reach about 70 - 80 mg/L during the Active Treatment Phase, when sites have not yet been rehabilitated (values not visible at the 30-day rolling median), and bypass events occur discharging elevated TSS concentrations. TSS levels tend to be higher during heavy rainfall events. However, this occurs in less than 3% of the period; for most days, concentrations remain below 10 mg/L, with a median of around 3 mg/L.

For the Post Closure Phase (≥ 2047) concentrations are stable at around 10 mg/L and lower.

Concentrations for TSS during the Active Treatment Phase are lower compared to the Post-Closure Phase (in general) due to the pumping of mine impacted water to the WTP (discharging at Smokestack) and increase slightly for the Post Closure Phase (2047 and after) which can be observed in the median (Figure 51).

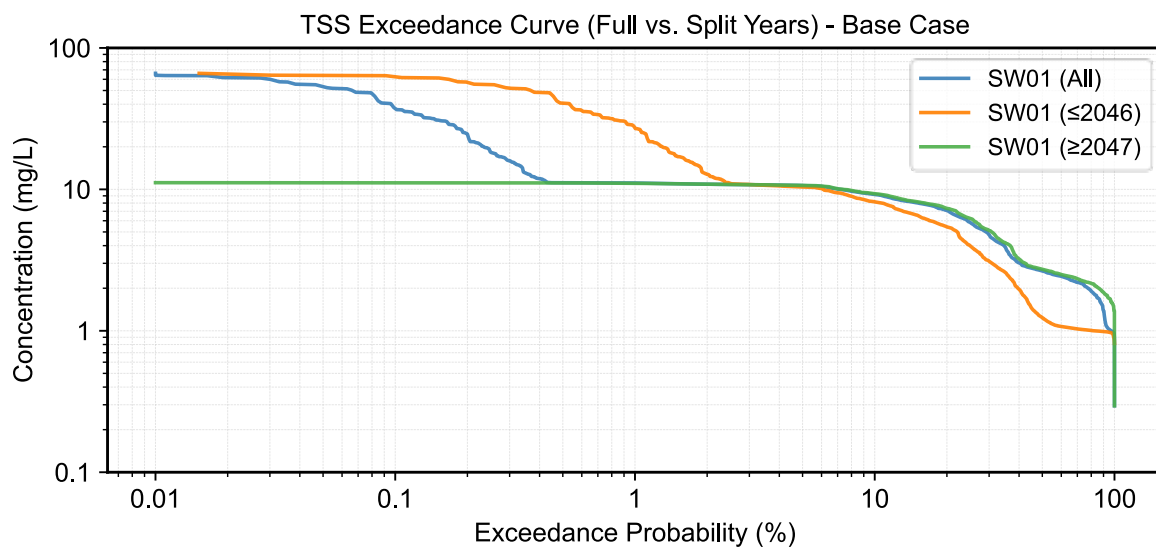


Figure 49: Exceedance probability of daily results TSS at SW01 for the 'Active Treatment Phase' (≤ 2046) and 'Passive Post Closure Phase' (≥ 2047), and the overall data.

The daily and 8-day rolling median for turbidity and comparison against short term acute effects criteria (as defined in section 1.4.2) are shown in Figure 50. Figure 51 shows the annual median and 95th percentile for turbidity and comparison against chronic effects criteria (defined in section 1.4.2).

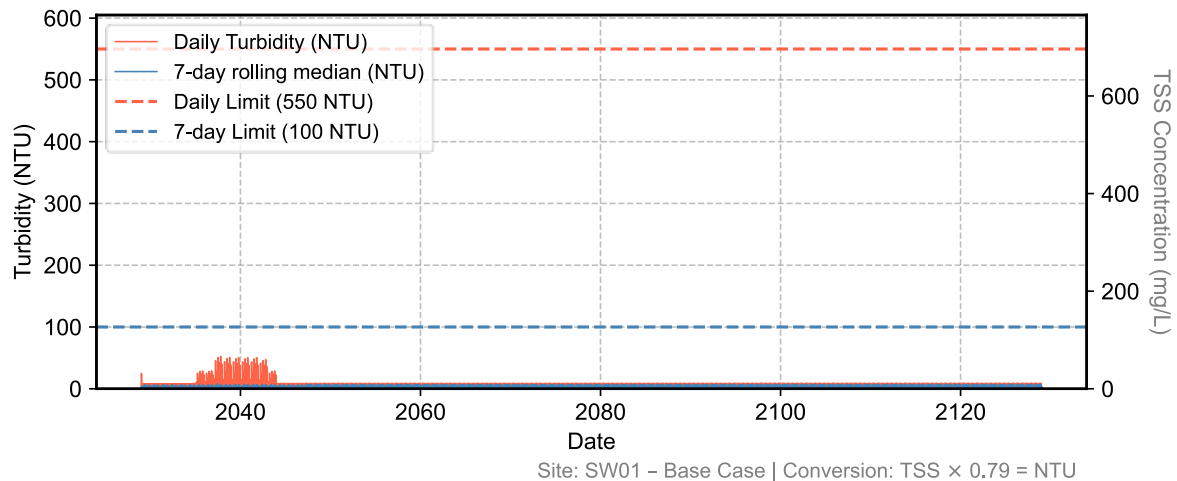


Figure 50: Daily and 7-day rolling median turbidity model results at SW01, with the daily (550 NTU) and 7-day rolling median (100 NTU) acute guideline value limits.

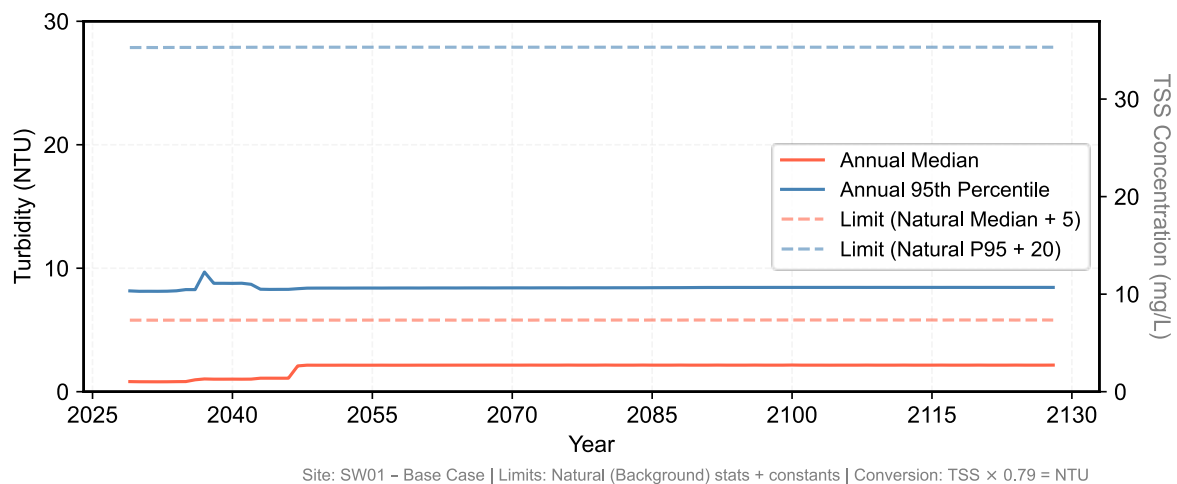


Figure 51: Annual turbidity statistics at SW01 and chronic guideline values.

6.2.4 SW03 – Deep Stream

6.2.4.1 General Water Quality Parameters

Results for four general parameters (pH, sulfate, DOC and hardness) at SW03 are shown in Figure 52.

The major step-change event in 2047 (coming from SW01) is also visible, resulting from the transition from active to passive treatment. An additional step can be observed in 2045 caused by this same transition which allows the West Pit Sump to overflow and discharge into the stream (at SW03).

The associated increases in pH and hardness are a direct effect of the commissioning of the MSRs at the East Pit Sump (2047) and West Pit Sump (2045) that treat the seepage of the ELF's before flowing into the sumps. This step-change impacts also downstream point: 17W.

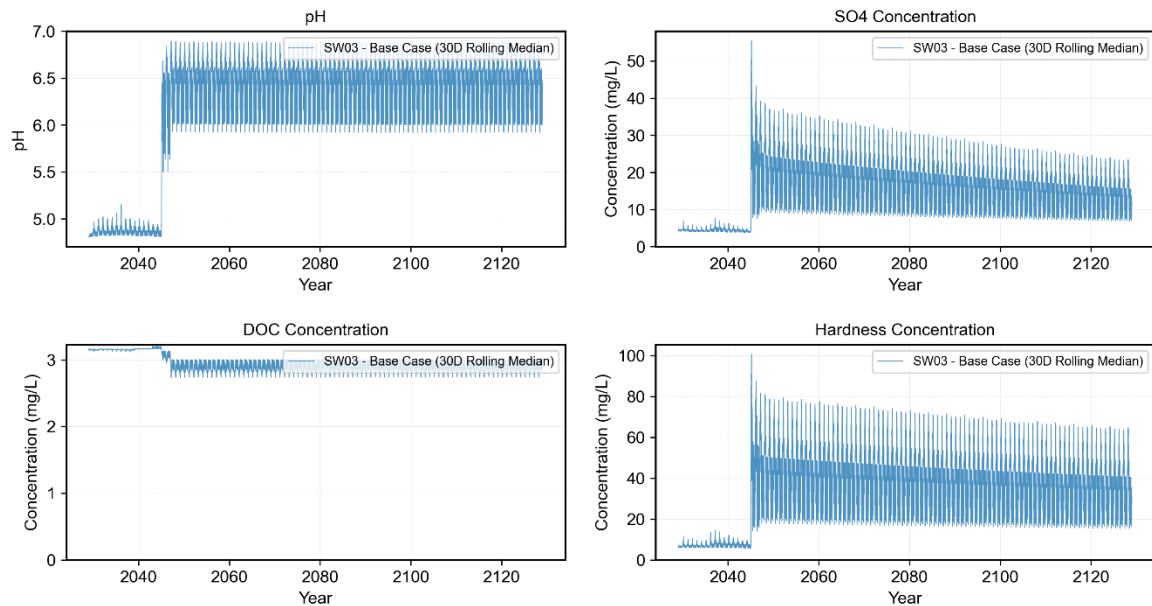


Figure 52: Model results at SW03 for pH, SO₄, DOC, and hardness for a 30D rolling median.

The exceedance probability plots for the daily results of SO₄ and hardness (Figure 53 and Figure 54) indicate lower concentrations during the Operations Phase.

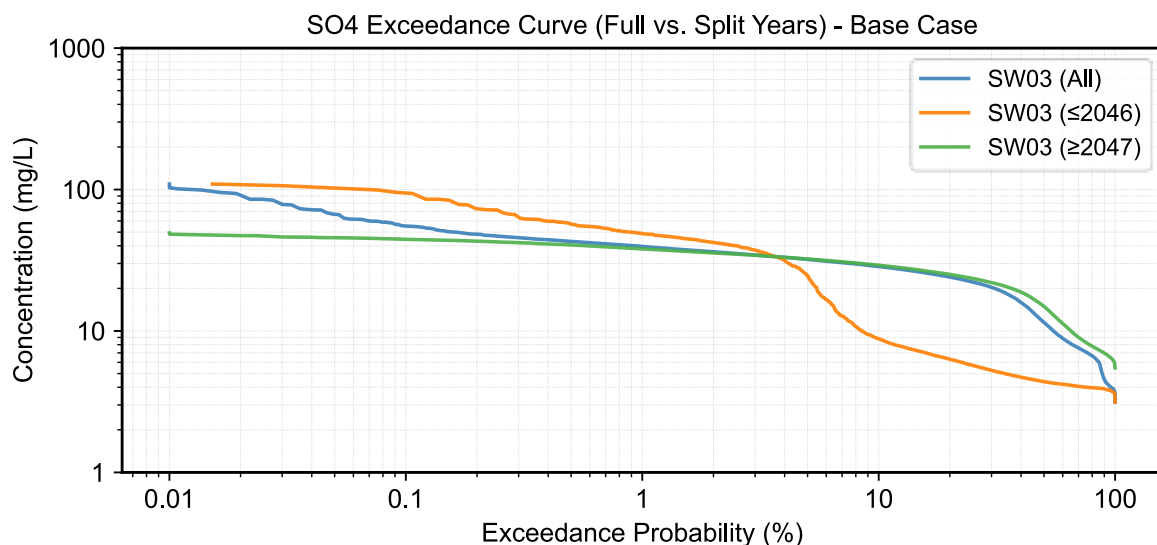


Figure 53: Exceedance probability of daily results for SO₄ at SW03 for the 'Active Treatment Phase' (≤ 2046) and 'Post Closure Phase' (≥ 2047), and the overall data.

The following details are noted:

- Similar to site SW01, lower sulfate concentrations during Active Treatment Phase are directly associated with the pumping of the MIW to the WTP, where the discharge occurs at Smokestack. After treatment transitions to passive treatment, the West Pit Sump discharges to SW03.

- Sulfate concentrations at SW03 are higher than concentrations at SW01 especially for the high values (below 5% exceedance probability) prior to 2047 due to the increased effect of the bypass events (receiving the bypass events from the West Sump and East Sump).
- Similarly to site SW01, the increase in hardness concentrations during the Post Closure Phase is due to the commissioning of the MSRs, which generates more dissolved Ca.

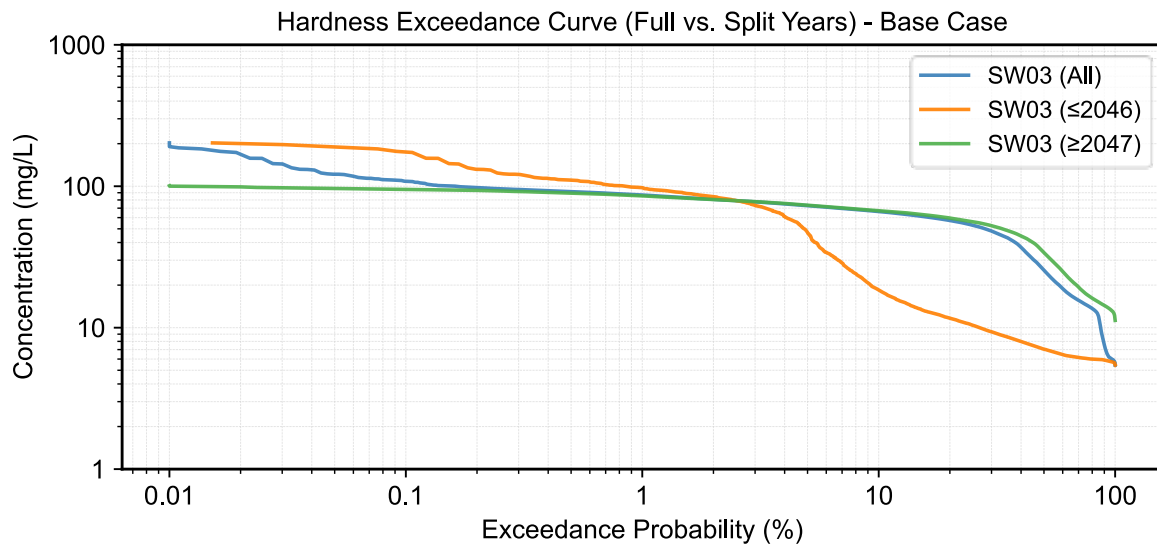


Figure 54: Exceedance probability of daily results for hardness at SW03 for the 'Active Treatment Phase' (≤ 2046) and 'Post Closure Phase' (≥ 2047), and the overall data.

6.2.4.2 Metals

Model results of key PCOCs in relation to guideline values for the Base Case and Scenarios 1 to 4 are shown below for site SW03. The followings observations are noted:

- Annual median (Figure 55 and Figure 56) plots show an increase in MEQ when transitioning to passive treatment at 2045 and 2047. Overall, no exceedances were modelled for all of the scenarios and parameters.
- Scenarios 1 and 2 median MEQ values were similar compared to the Base Case.
- The median MEQ values resulting from Scenario 3 are elevated compared to the Base Case, with the relative difference highest for Ni. On the contrary, Scenario 4 resulted in lower MEQ values compared to the Base Case.
- The annual 95th percentile of MEQ values (Figure 57 and Figure 58), indicate compliance for all parameters and scenarios.
- Exceedance probability plots are shown for all scenarios (Figure 59 and Figure 60):
 - Scenario 1 resulted in slightly lower concentrations compared to the Base Case.
 - Scenario 3 and 4 resulted in the most significant difference in concentrations compared to the Base Case.

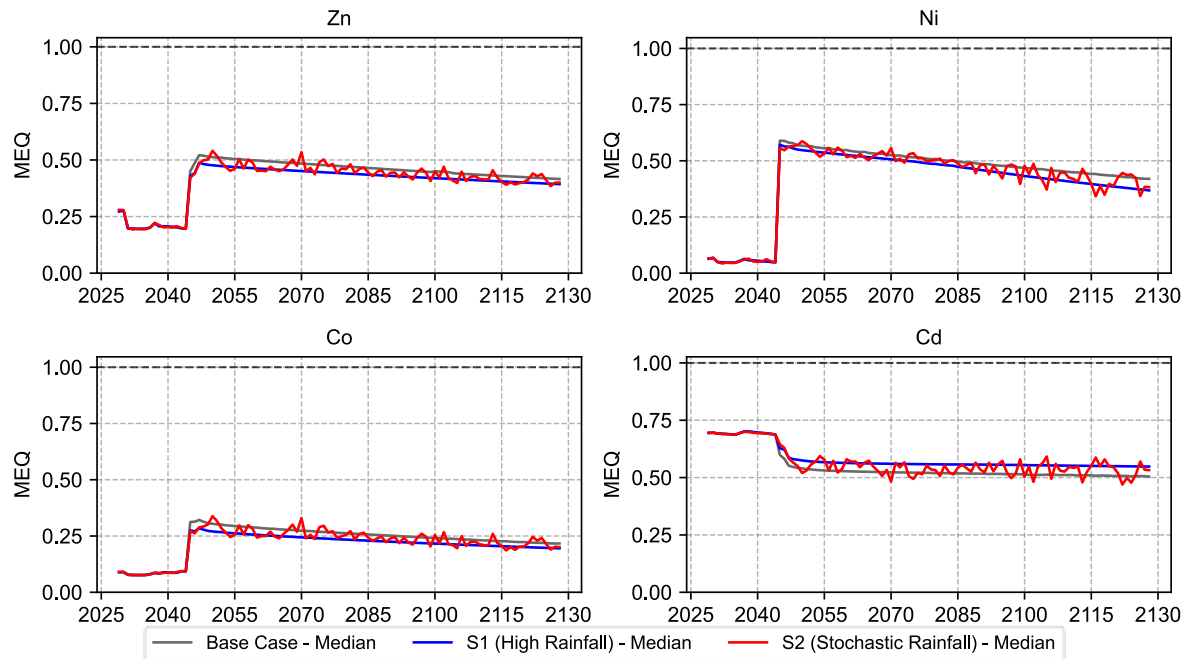


Figure 55: Annual median MEQ calculated for Zn, Ni, Co, and Cd at SW03.

Note the plots show the Base Case with Scenarios 1 and 2.

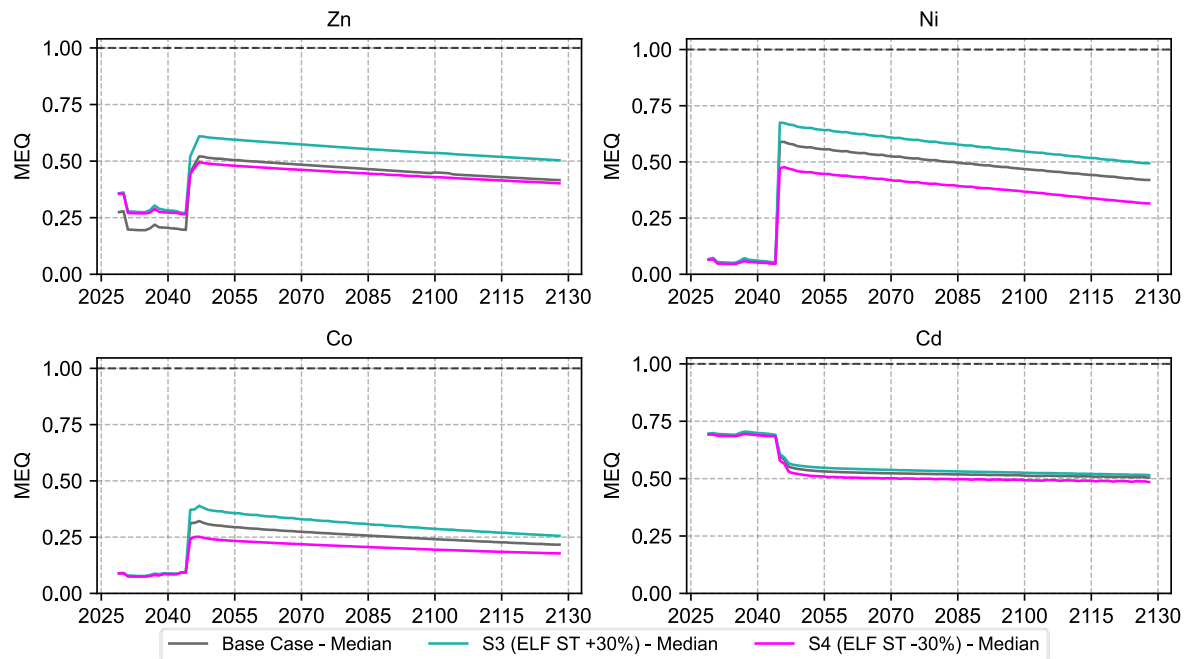
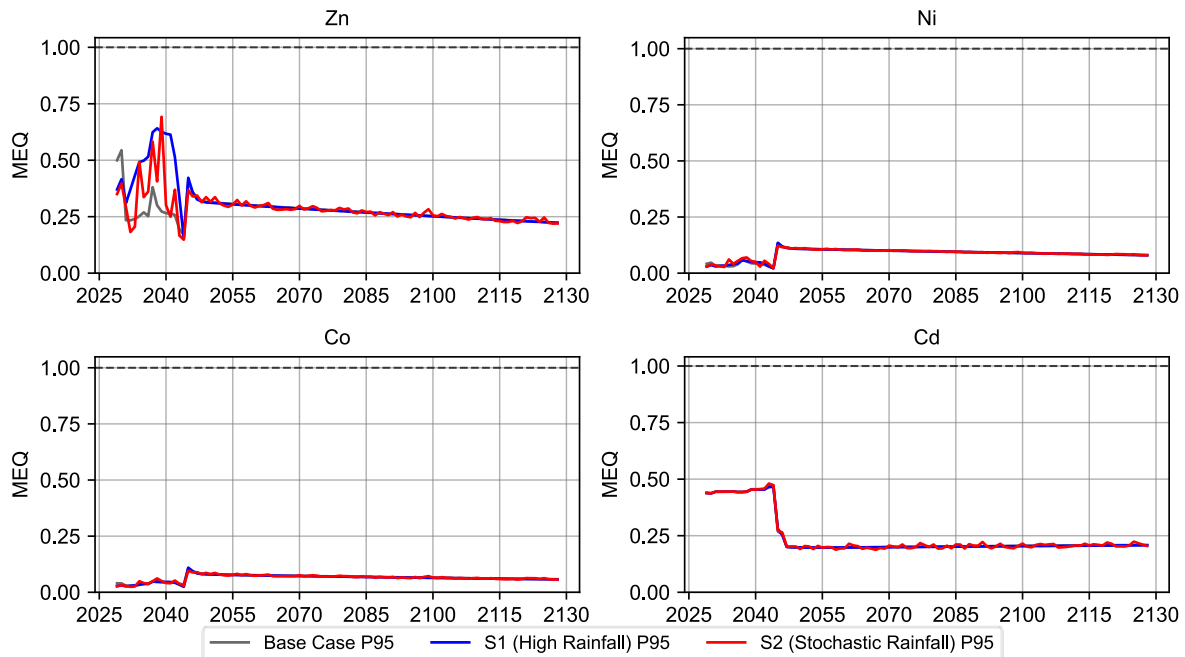


Figure 56: Annual median MEQ calculated for Zn, Ni, Co, and Cd at SW03.

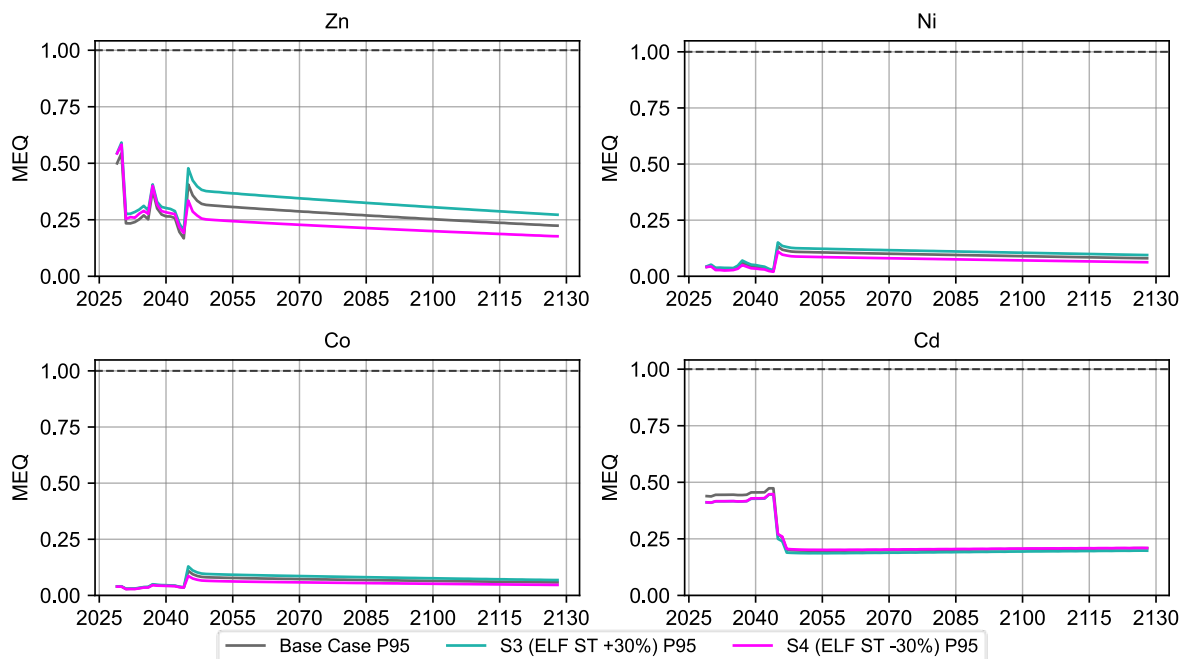
Note the plots show the Base Case with Scenarios 3 and 4.



SW03 – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 95% LoP Acute)

Figure 57: Annual 95th percentile MEQ calculated for Zn, Ni, Co, and Cd at SW03.

Note: the plots show the Base Case with Scenarios 1 and 2.



SW03 – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 95% LoP Acute)

Figure 58: Annual 95th percentile MEQ calculated for Zn, Ni, Co, and Cd at SW03.

Note: the plots show the Base Case with Scenarios 3 and 4.

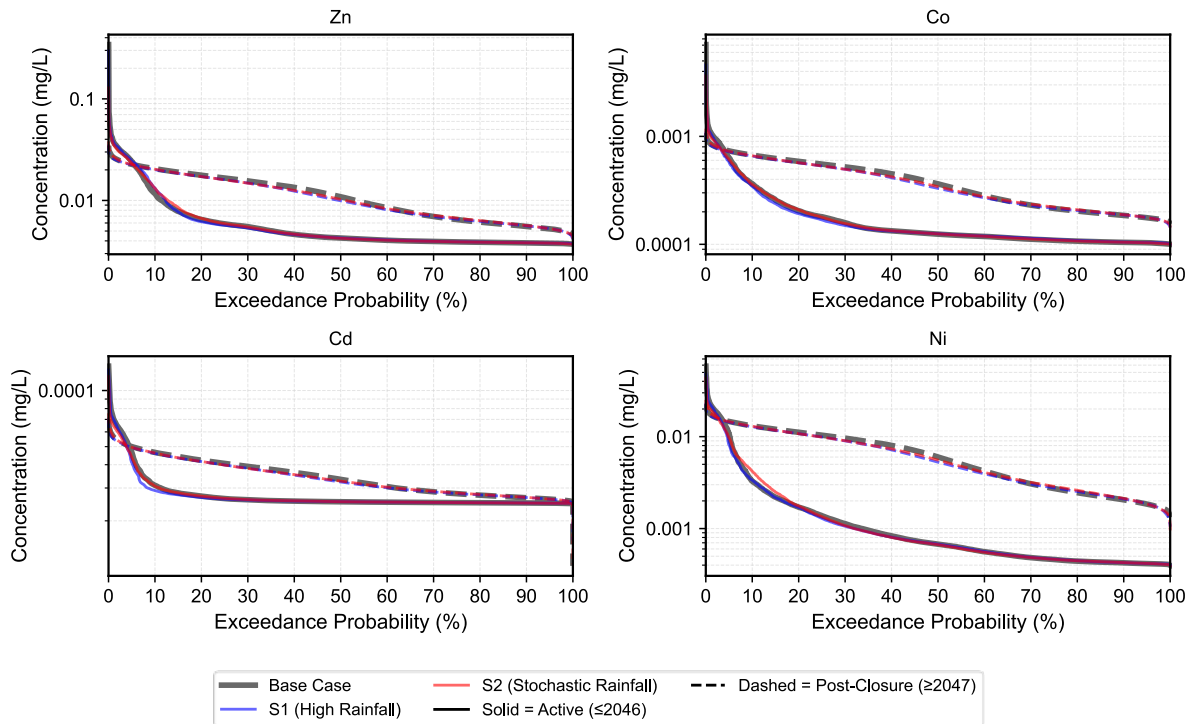


Figure 59: Exceedance probability plots for Zn, Co, Cd, and Ni, at SW03 for the Base Case Scenario, and Scenario 1 and 2.

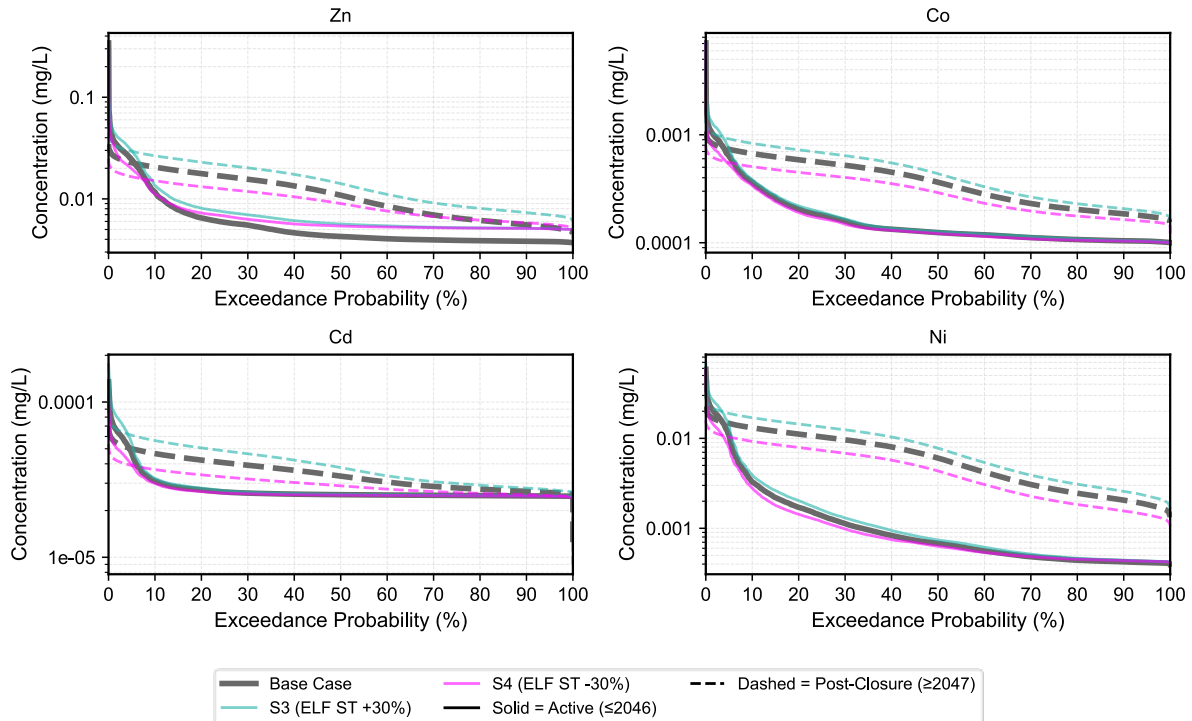


Figure 60: Exceedance probability plots for Zn, Co, Cd, and Ni, at SW03 for the Base Case Scenario, and Scenario 3 and 4.

6.2.4.3 TSS and Turbidity

Two steps in concentration are noticeable for TSS, the one at 2045 caused by the long-term overflow from the West Pit Sump (2045) and the other step by the overflow of the East Pit Sump (2047) to near SW01. Concentrations during the Active Treatment Phase are lower due to the pumping of mine impacted water to the WTP (discharging at Smokestack). After 2047, the concentrations become stable close to background catchment conditions.

The exceedance probability plot for TSS at SW03 is presented in Figure 61. Overall, concentrations at SW03 reach approximately 50 - 60 mg/L for the earlier period (≤ 2046), which are maximum values associated with high rainfall events. Median concentration, across both periods, are at around 3 mg/L. The higher concentrations simulated during the Active Treatment Phase likely reflect TSS generated by mine impacted areas and limited site rehabilitation, whereas the later period shows improved water quality and reduced TSS levels due to rehabilitation of areas.

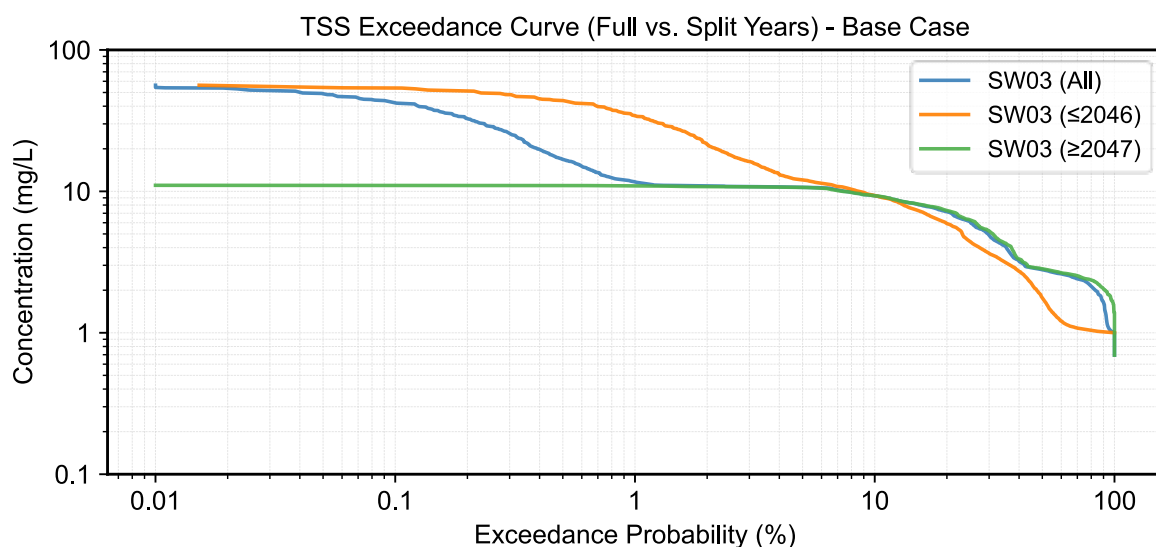


Figure 61: Exceedance probability of daily results TSS at SW03 for the 'Active Treatment Phase' (≤ 2046) and Post Closure Phase' (≥ 2047), and the overall data.

For proposed compliance purposes, the daily and 7-day rolling median for turbidity are shown in Figure 62, and the model results for the Base Case are below the proposed limits. Figure 63 shows the annual median and 95th percentile for turbidity, and model results for the Base Case are also below the proposed limits.

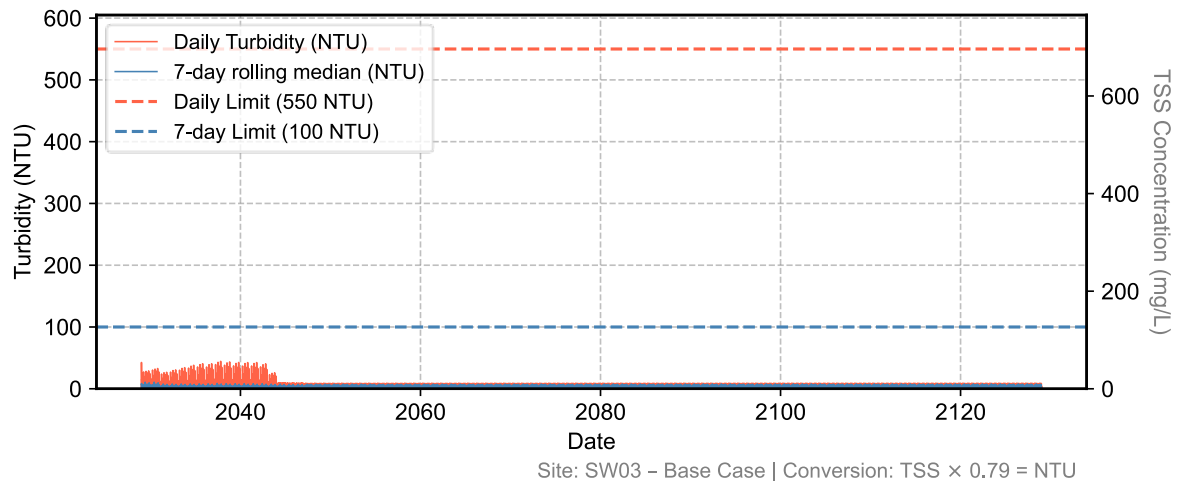


Figure 62: Daily and 7-day rolling median turbidity model results at SW03, with the daily (550 NTU) and 7-day rolling median (100 NTU) limits.

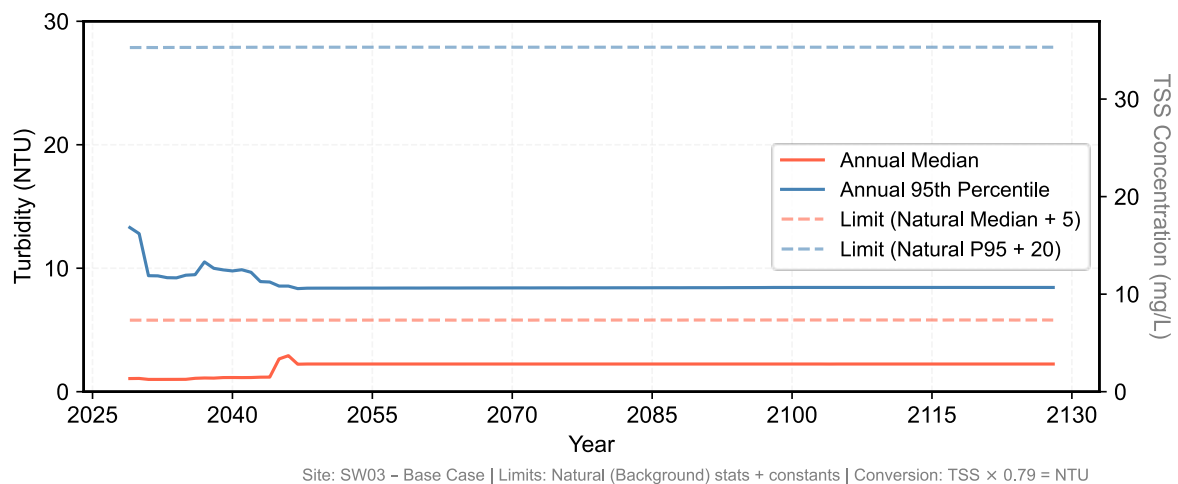


Figure 63: Annual turbidity statistics at SW03.

6.2.5 2W (Smokestack)

6.2.5.1 General Water Quality Parameters

Model results for the Base Case for four general parameters (pH, sulfate, DOC and hardness) at Smokestack are shown in Figure 64.

Due to Smokestack receiving the WTP discharge and bypass, there is a visible evolution during the Active Treatment Phase which correlates with the flow rate treated.

After the transition from active to passive treatment in 2047, there are slight variations in sulfate in the Post Closure Phase, but the water quality is mostly dominated by the background source term used for that catchment.

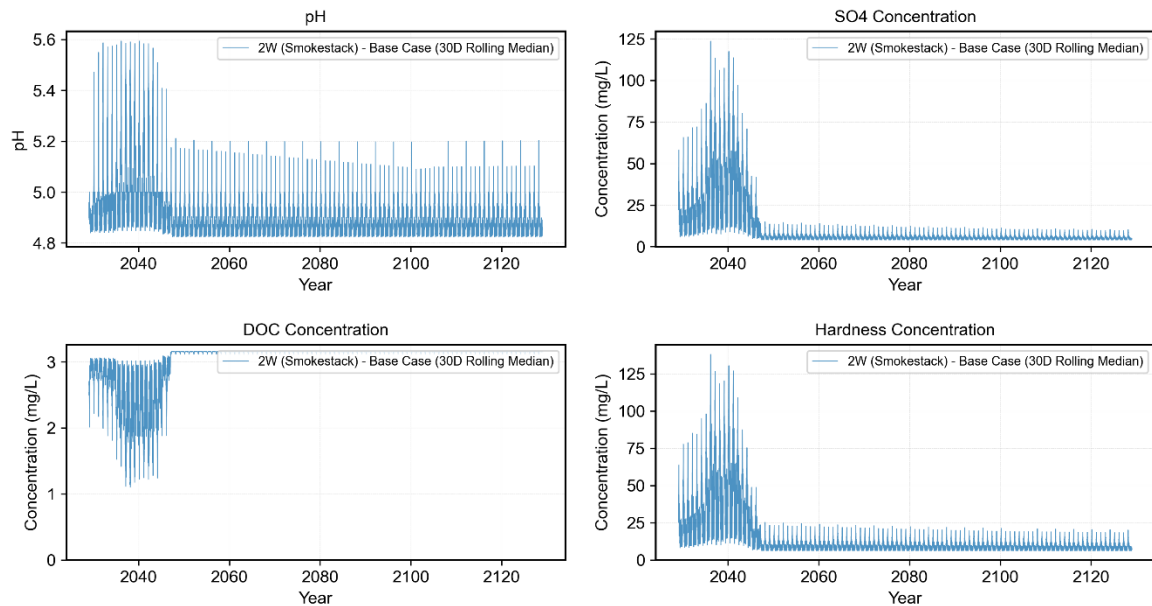


Figure 64: Smokestack – 30 day rolling median plots (pH, SO₄, DOC, hardness).

The exceedance probability plots for the Base Case daily results of SO₄ and hardness (Figure 65 and Figure 66) indicate higher concentrations during the Operations Phase.

Contrary to what is observed at SW01 and SW03, the sulfate concentrations at Smokestack are higher during operations. This increase is caused by the input of sulfate from the direct discharge of the WTP.

Model results indicate higher hardness at Smokestack for the Active Treatment Phase, resulting from the cessation of MIW inputs post 2047.

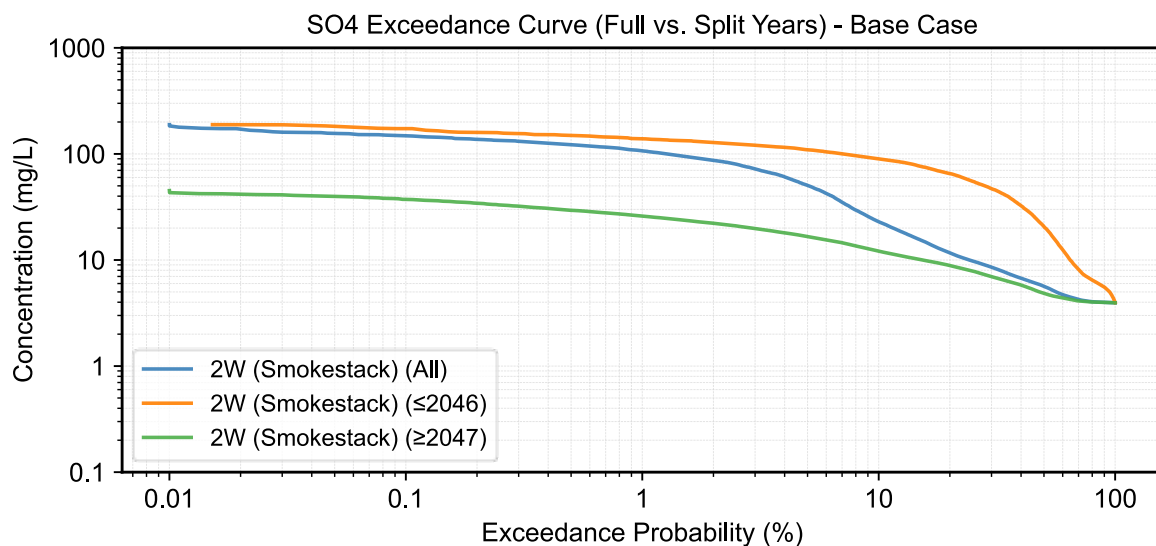


Figure 65: Exceedance probability of daily results for SO₄ at 2W (Smokestack) for the 'Active Treatment Phase' (≤2046) and 'Post Closure Phase' (≥2047), and the overall data.

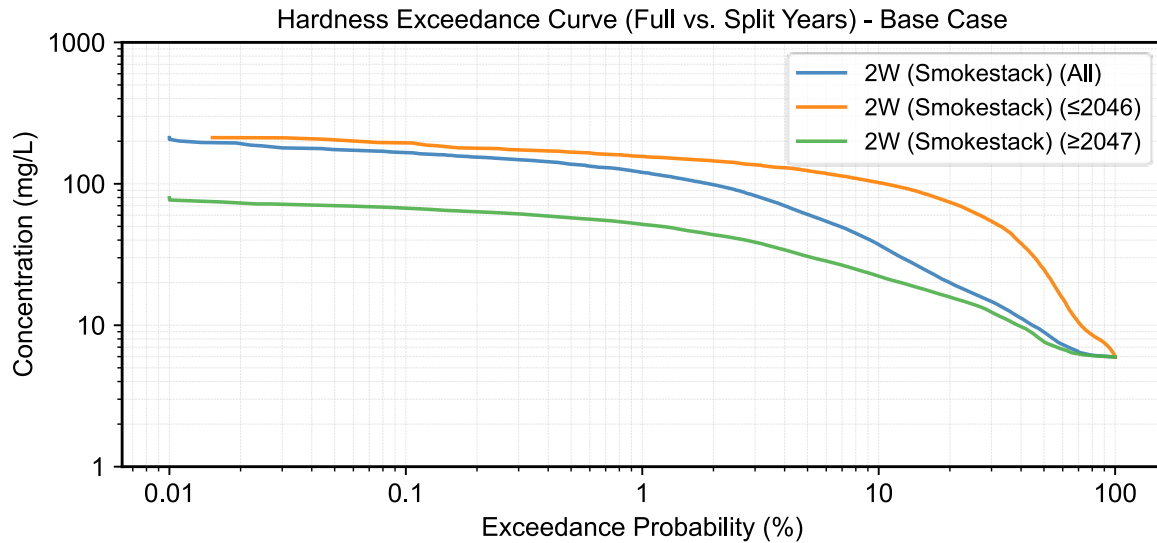


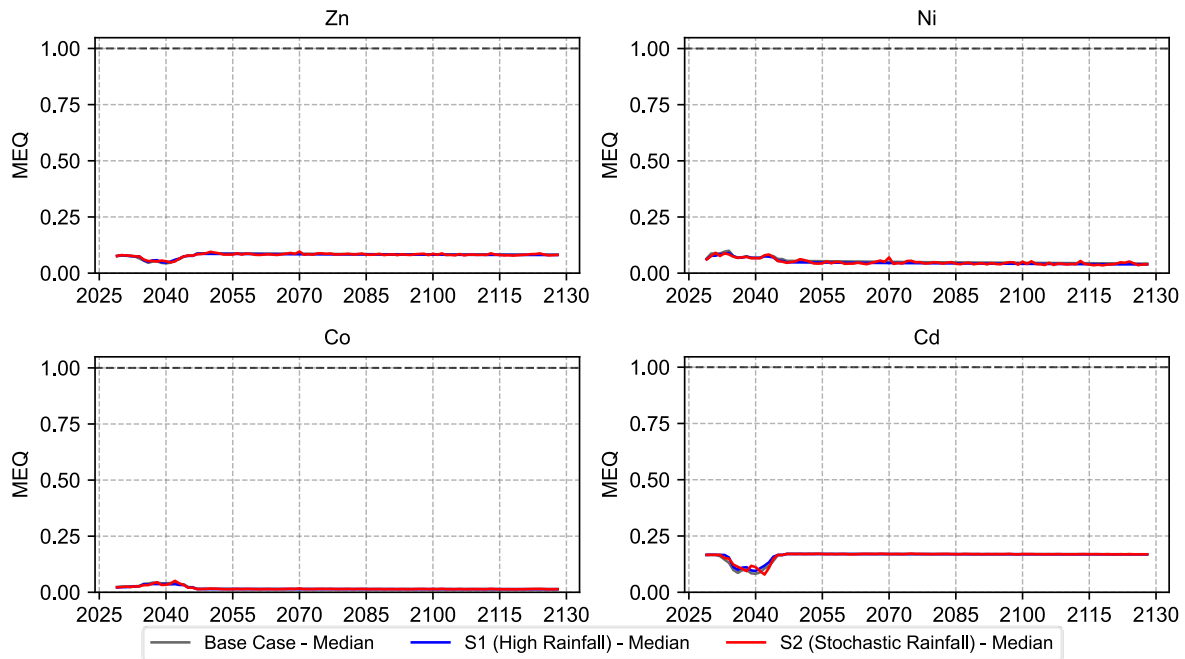
Figure 66: Exceedance probability of daily results for hardness at 2W (Smokestack) for the 'Active Treatment Phase' (≤ 2046) and 'Post Closure Phase' (≥ 2047), and the overall data.

6.2.5.2 Metals

Model results of key PCOCs in relation to guideline values for the Base Case and Scenarios 1 to 4 are shown below for site Smokestack. The followings observations are noted:

- Annual median (Figure 67 and Figure 68) plots show a slight increase in MEQ value when transitioning to Passive Treatment at 2045 and 2047. Overall, median MEQ values did not show any exceedance for all the scenarios and parameters.
- Median MEQ values for all scenarios were comparable to the Base Case.
- The annual 95th percentile of MEQ values (Figure 69 and Figure 70), indicate no exceedances for all parameters and scenarios.
- It is worth noting that 2W Smokestack and 17W limits (acute and chronic guideline values) are using the 80% Level of Protection.

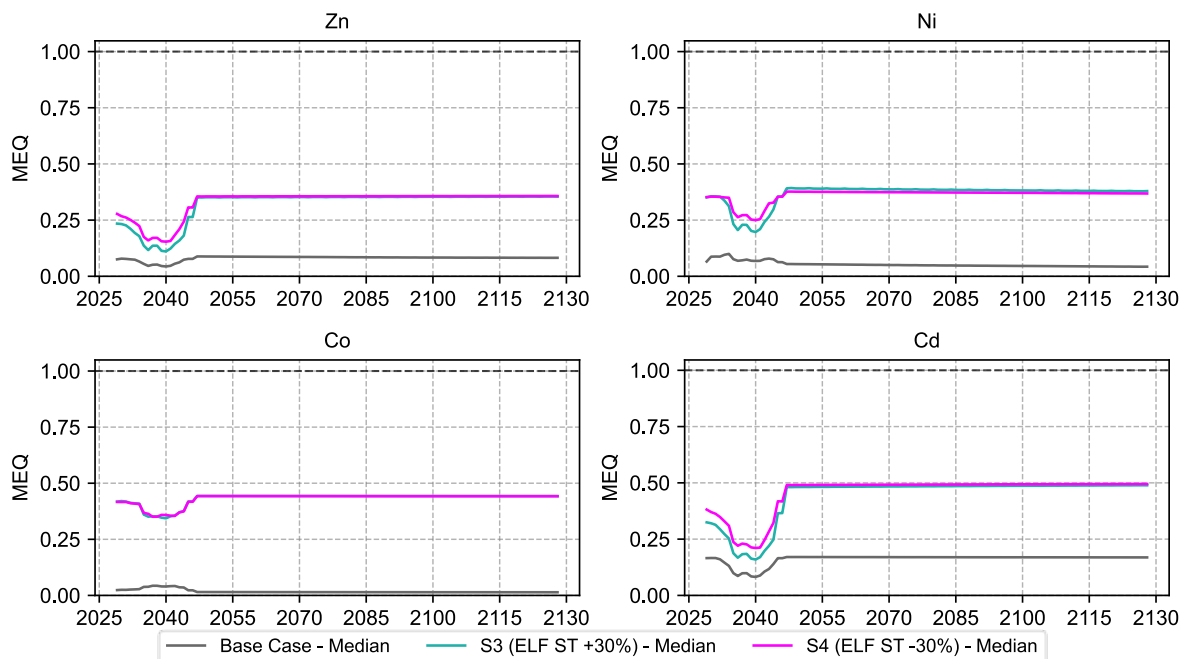
Exceedance probability plots are shown for all scenarios (Figure 71 and Figure 72), and there are no significant differences for the scenarios compared to the Base Case at this site.



2W (Smokestack) – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 80% LoP)

Figure 67: Annual median MEQ calculated for Zn, Ni, Co, and Cd at 2W (Smokestack).

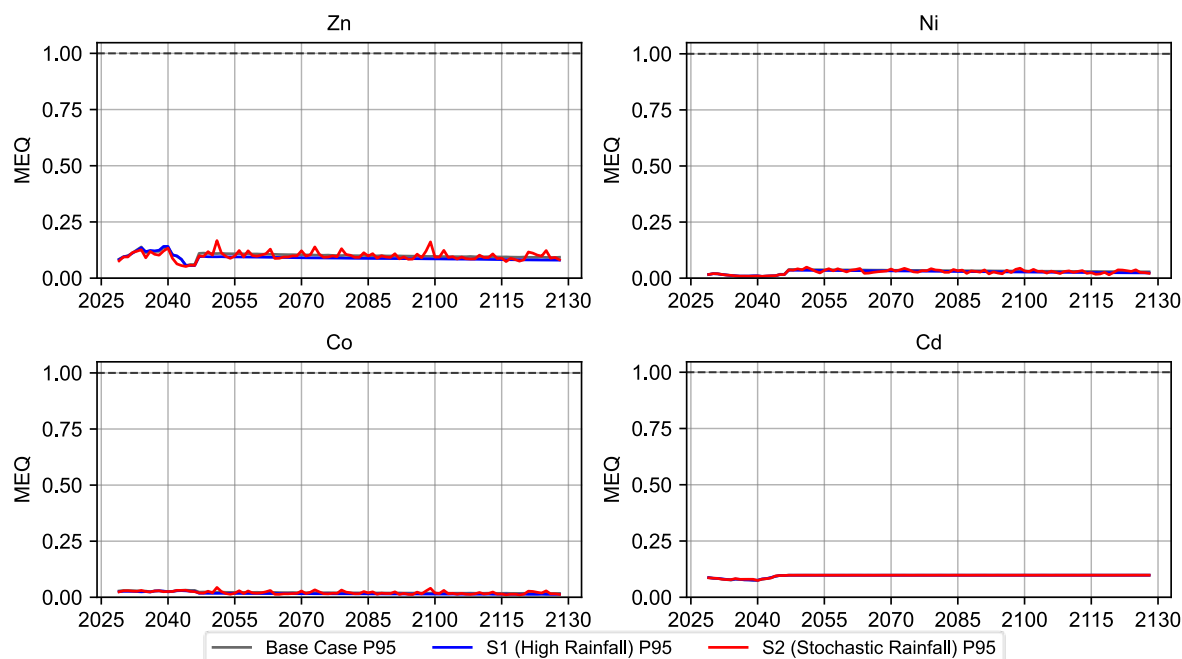
Note: the plots show the Base Case with Scenarios 1 and 2.



2W (Smokestack) – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 80% LoP)

Figure 68: Annual median MEQ calculated for Zn, Ni, Co, and Cd at 2W (Smokestack).

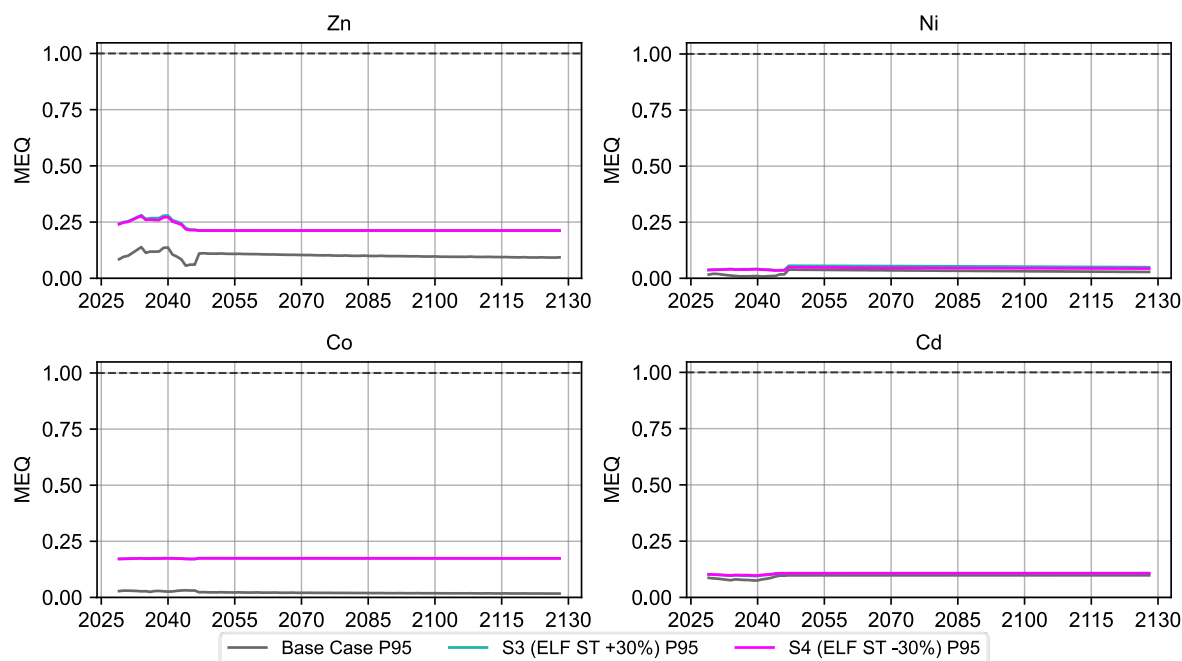
The plots show the Base Case with Scenarios 3 and 4.



2W (Smokestack) – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 80% LoP Acute)

Figure 69: Annual 95th percentile MEQ calculated for Zn, Ni, Co, and Cd at 2W (Smokestack).

Note: the plots show the Base Case with Scenarios 1 and 2.



2W (Smokestack) – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 80% LoP Acute)

Figure 70: Annual 95th percentile MEQ calculated for Zn, Ni, Co, and Cd at 2W (Smokestack).

The plots show the Base Case with Scenarios 3 and 4.

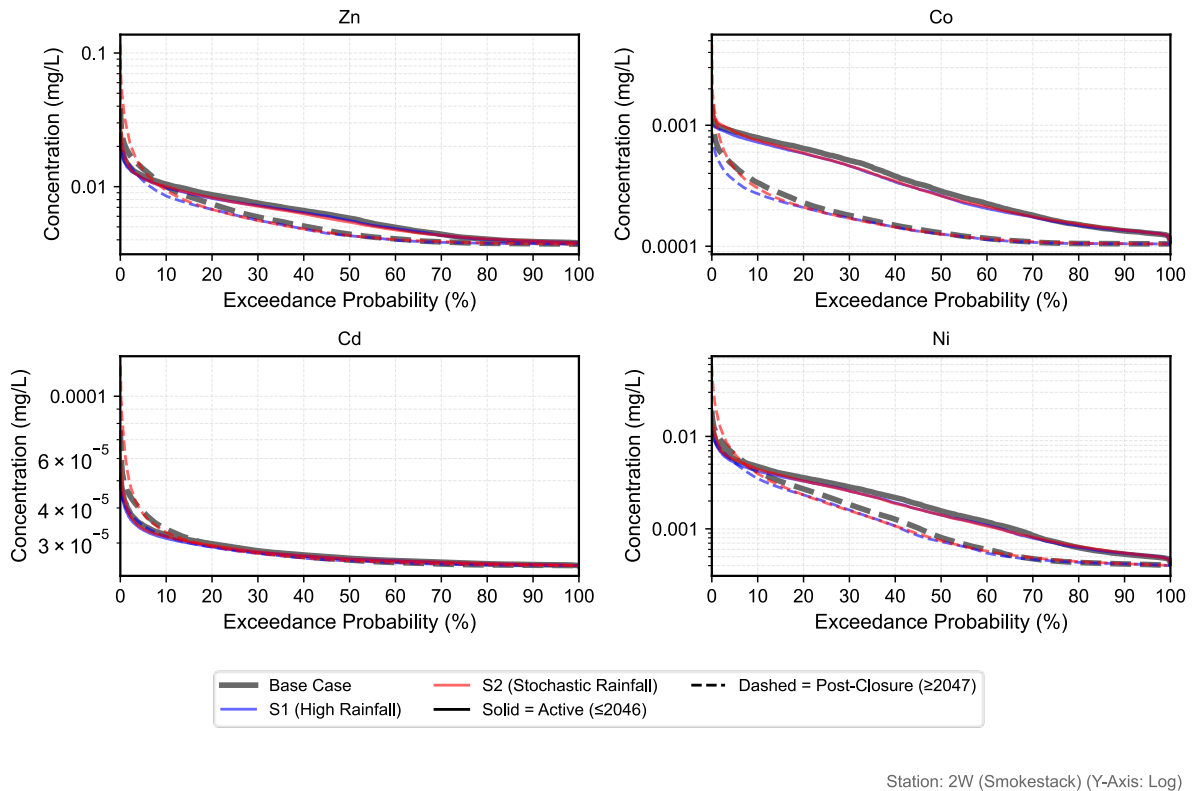


Figure 71: Exceedance probability plots for Zn, Co, Cd, and Ni, at 2W (Smokestack) for the Base Case Scenario, and Scenario 1 and 2.

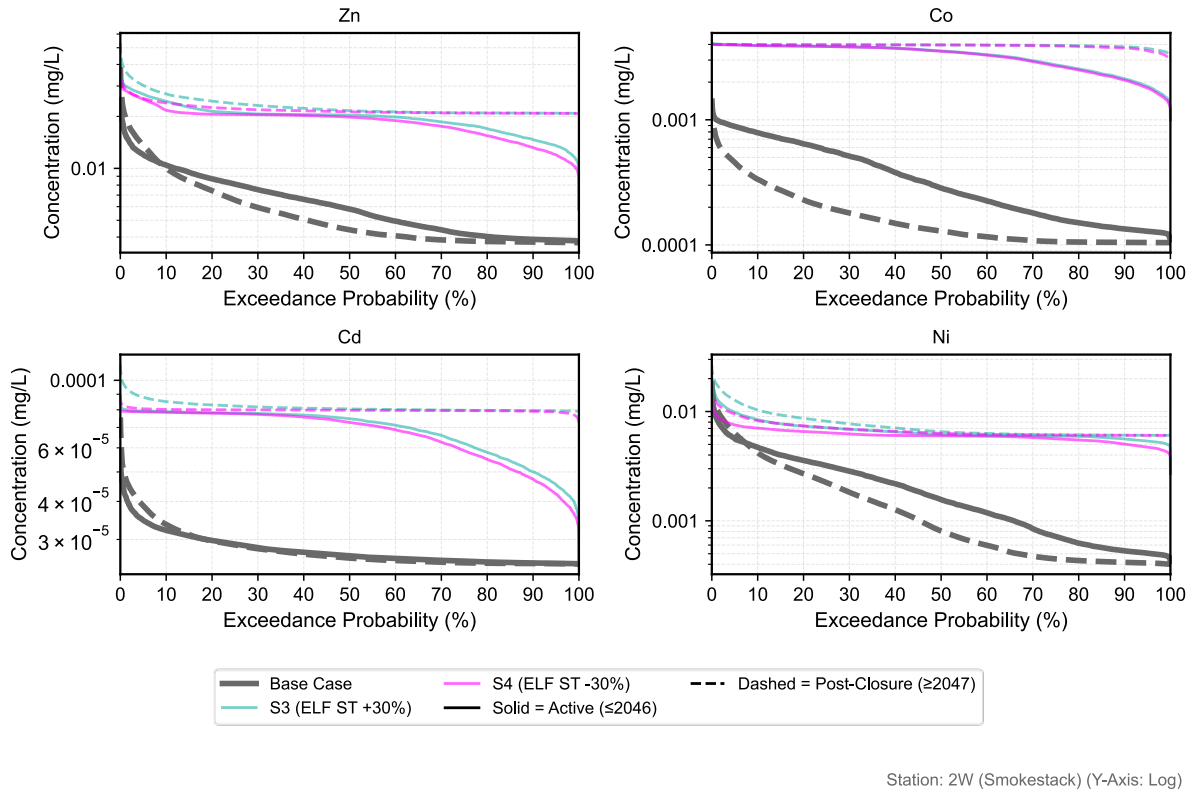


Figure 72: Exceedance probability plots for Zn, Co, Cd, and Ni, at 2W (Smokestack) for the Base Case Scenario, and Scenario 3 and 4.

6.2.5.3 TSS and Turbidity

The exceedance probability plot for TSS for the Base Case at Smokestack is presented in Figure 73. Concentrations at Smokestack reach approximately 10 - 11 mg/L during the earlier period (≤ 2046). During the Active Treatment Phase, Smokestack is influenced by TSS originating from roads, which are later rehabilitated, as well as by discharges from the WTP and untreated pumped discharges during high background flows. In the Post Closure Phase, Smokestack returns to baseline conditions with only minor TSS inputs from rehabilitated landforms and MSRs at the coal stockpile area.

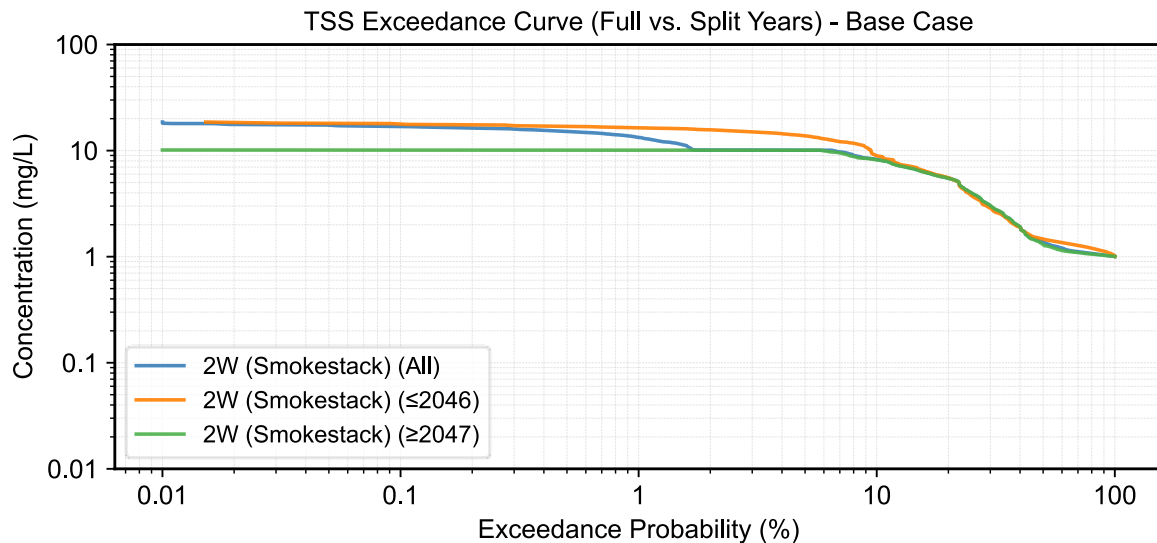


Figure 73: Exceedance probability of daily results for TSS at Smokestack for the 'Active Treatment Phase' (≤ 2046) and 'Post Closure Phase' (≥ 2047), and the overall data.

For proposed compliance purposes, the daily and 7-day rolling median for turbidity are presented in Figure 74 and all values are below the proposed limits. Figure 75 presents the annual median and 95th percentile for turbidity, which are also below the proposed limits.

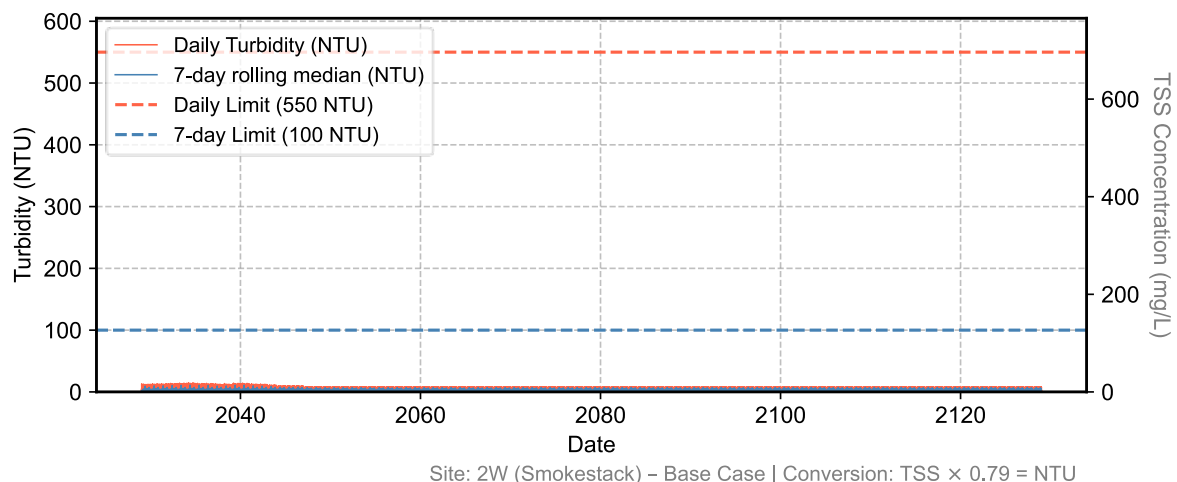


Figure 74: Daily and 7-day rolling median turbidity model results at 2W (Smokestack), with the daily (550 NTU) and 7-day rolling median (100 NTU) acute guideline value limits.

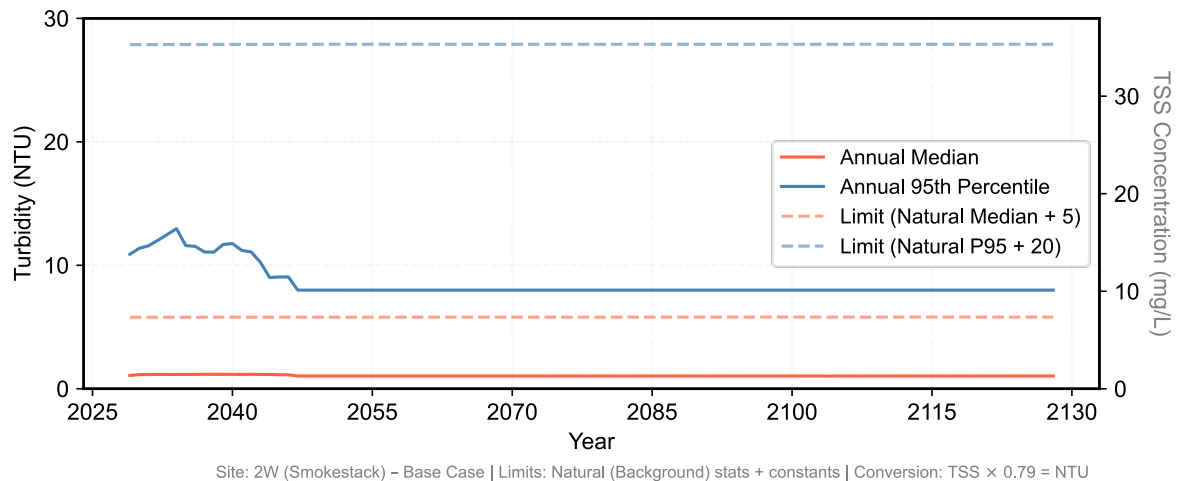


Figure 75: Annual turbidity statistics at 2W (Smokestack), showing the median and 95th percentile of modelled turbidity compared against background reference limits (Background Median + 5 NTU and Background P95 + 20 NTU).

6.2.6 17W (Waimangaroa River – Deep Stream Confluence)

6.2.6.1 General Water Quality Parameters

Results for four general parameters (pH, sulfate, DOC and hardness) at 17W are shown in Figure 76.

17W includes the flow and loads from SW03 (which also includes SW01) and Smokestack. Considering the relevant flow contribution from Smokestack, the water quality resembles that of Smokestack, with an increase in sulfate due to the WTP discharge and an eventual decrease after 2047, with a long-term decay due to the ELF's concentration decaying with years.

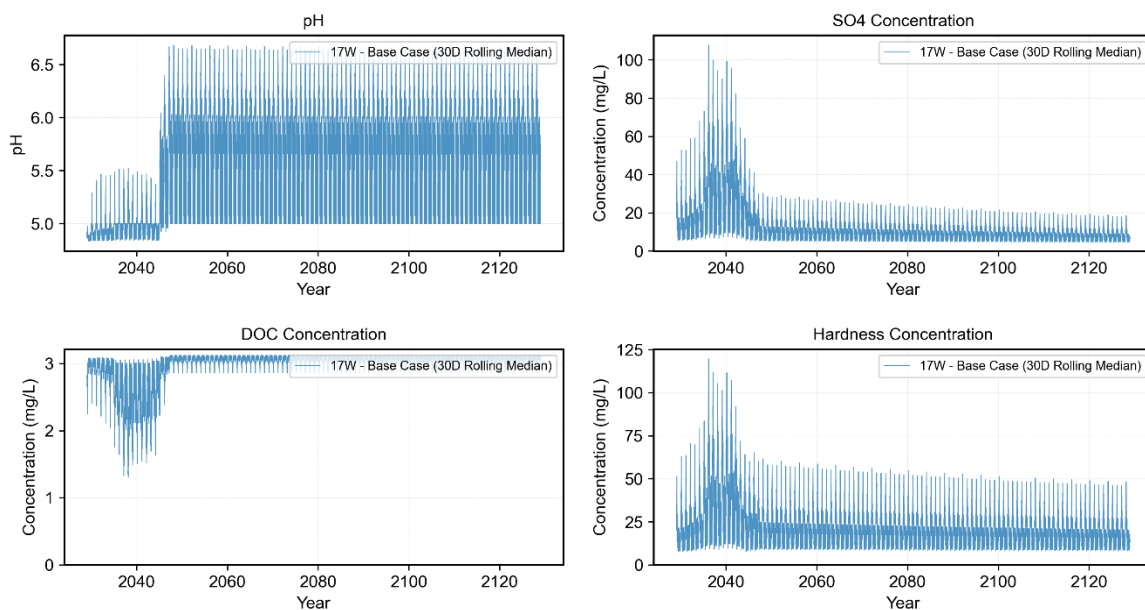


Figure 76: 17W – 30 day rolling median plots (pH, SO₄, DOC, hardness).

The exceedance probability plots for the Base Case daily results of SO₄ and hardness (Figure 77 and Figure 78) indicate higher concentrations during the Active Treatment Phase compared to the Post-Closure Phase.

- Composition of 17W is highly controlled by water flowing from Smokestack, therefore their exceedance probability curves are similar.
- Hardness is also higher at 17W for the Active Treatment Phase, since it does not receive any substantial additional load from the WTP discharge.

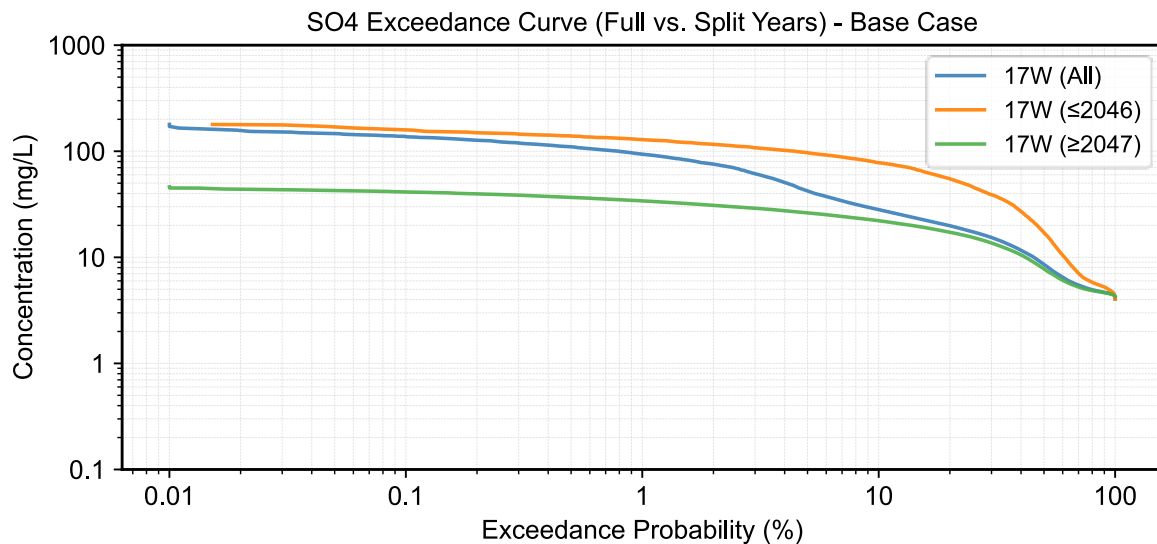


Figure 77: Exceedance probability of daily results for SO₄ at 17W for the 'Active Treatment Phase' (≤2046) and 'Post Closure Phase' (≥2047), and the overall data.

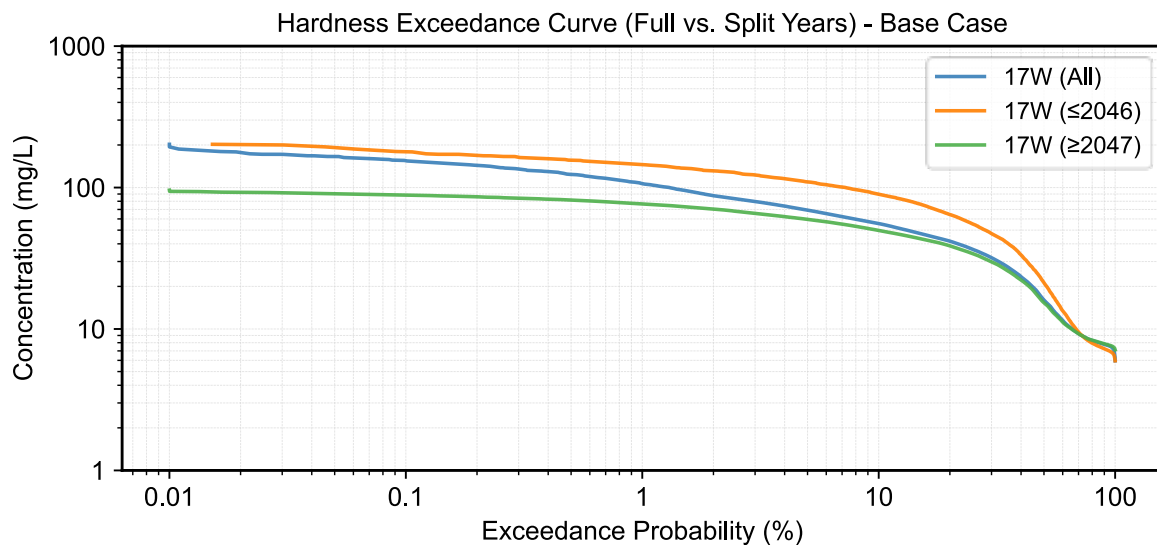
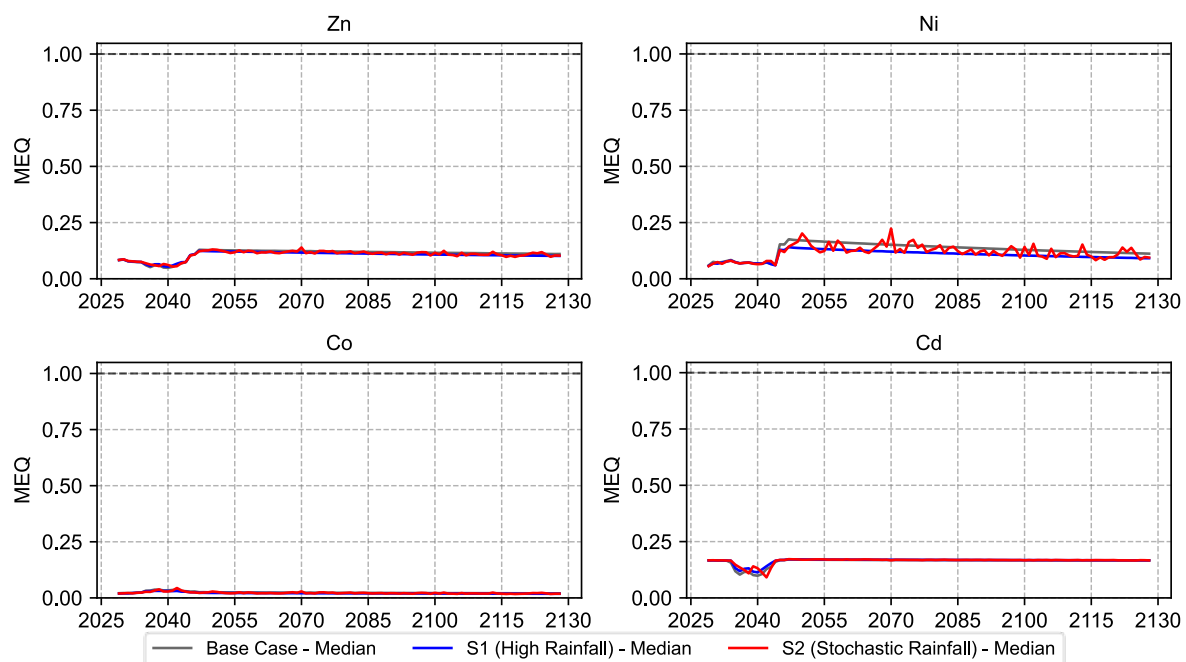


Figure 78: Exceedance probability of daily results for hardness at 17W for the 'Active Treatment Phase' (≤2046) and 'Post Closure Phase' (≥2047), and the overall data.

6.2.6.2 Metals

Model results of key PCOCs in relation to guideline values are shown below for the Base Case and Scenarios 1 to 4 at site 17W. The followings observations are noted:

- Annual median (Figure 79 and Figure 80) plots show slight increase in MEQ value when transitioning to passive treatment at 2045 and 2047. Model results did not show any exceedance for all the scenarios and parameters.
- Only Ni results in a noticeable increase in MEQ compared to the Base Case for Scenario 3 and 4.
- The annual 95th percentile of MEQ plots (Figure 81 and Figure 82), indicate no exceedances for all parameters and scenarios.
- It is worth noting that same as Smokestack, site 17W limits (acute and chronic guideline values) are using the 80% Level of protection limits.
- Figure 83 and Figure 84, which show the exceedance probability plots for all scenarios, noting that Scenarios 3 and 4 produced the largest difference in concentrations compared to the Base Case.



17W – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 80% LoP)

Figure 79: Annual median MEQ calculated for Zn, Ni, Co, and Cd at 17W.

The plots show the Base Case with Scenarios 1 and 2.

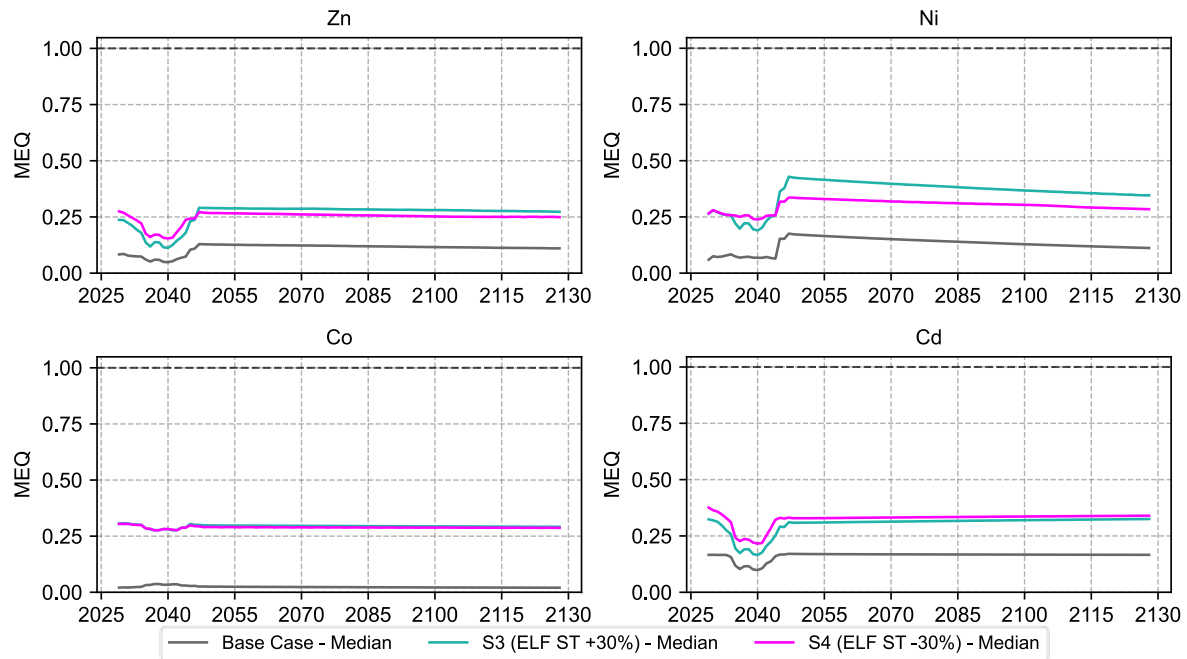


Figure 80: Annual median MEQ calculated for Zn, Ni, Co, and Cd at 17W.

Note: the plots show the Base Case with Scenarios 3 and 4.

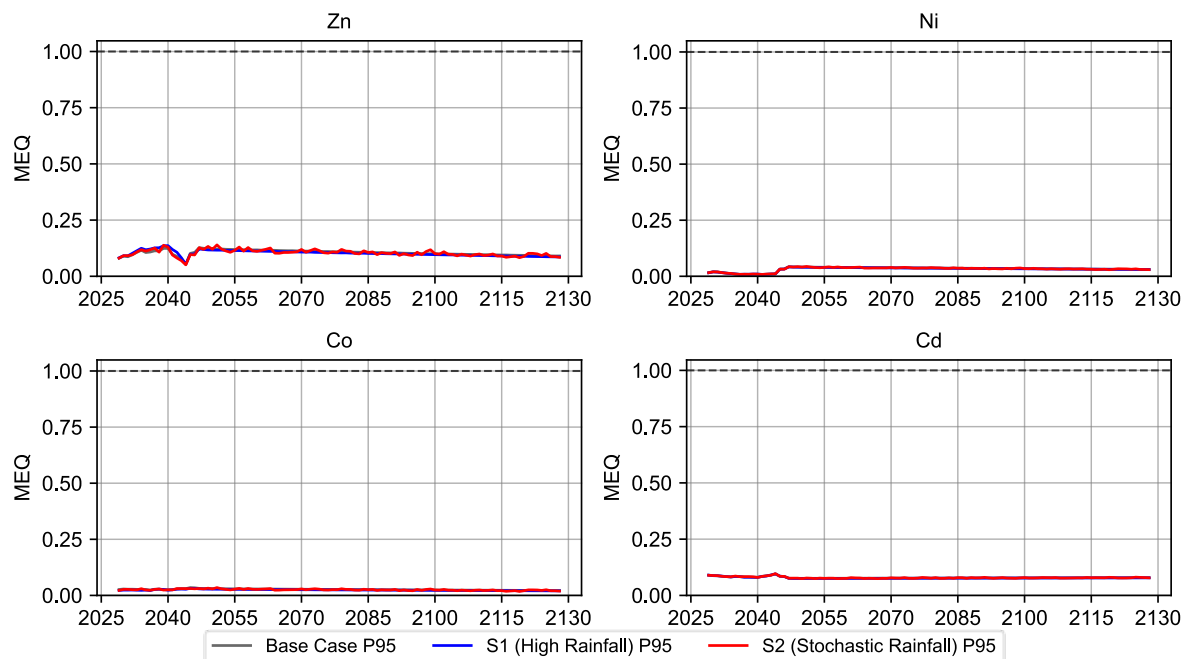
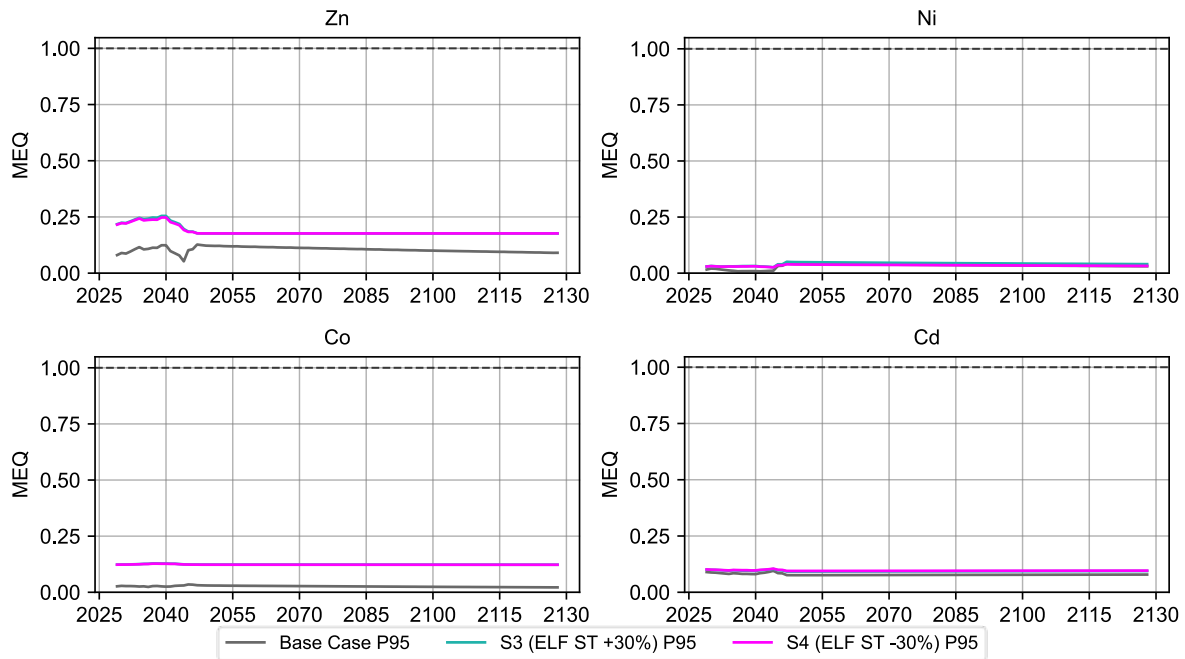


Figure 81: Annual 95th percentile MEQ calculated for Zn, Ni, Co, and Cd at 17W.

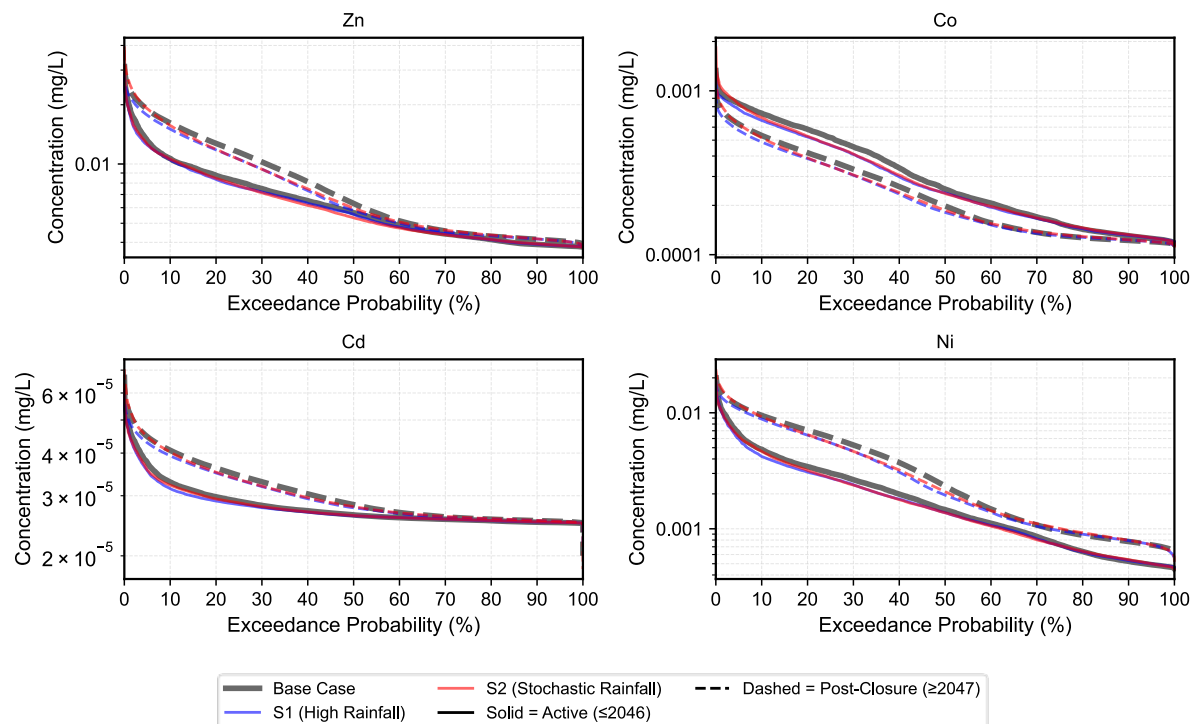
Note: the plots show the Base Case with Scenarios 1 and 2.



17W – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 80% LoP Acute)

Figure 82: Annual 95th percentile MEQ calculated for Zn, Ni, Co, and Cd at 17W.

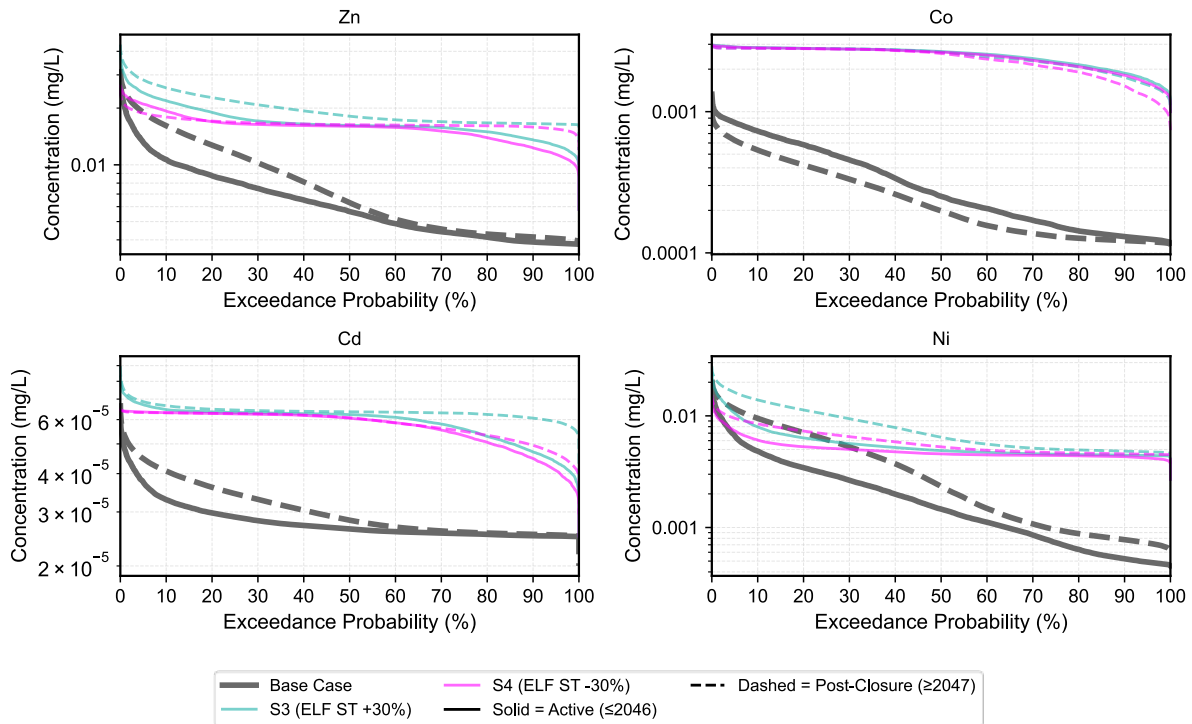
Note: the plots show the Base Case with Scenarios 1 and 2.



Station: 17W (Y-Axis: Log)

Figure 83: Exceedance probability plots for Zn, Co, Cd, and Ni, at 17W for the Base Case Scenario, and Scenario 1 and 2.

Note: Scale is log.



Station: 17W (Y-Axis: Log)

Figure 84: Exceedance probability plots for Zn, Co, Cd, and Ni, at SW01 for the Base Case Scenario, and Scenario 3 and 4.

6.2.6.3 TSS and Turbidity

The exceedance probability plot for TSS for the Base Case is shown in Figure 85. TSS concentrations at 17W are a result of all the upstream-generated TSS. The overall probability exceedance pattern of concentrations at 17W resemble those observed at Smokestack.

During the Active Treatment Phase, high concentrations are typically between 10 and 20 mg/L, and for passive treatment, they are around 9–10 mg/L, while the median is between 1 to 3 mg/L.

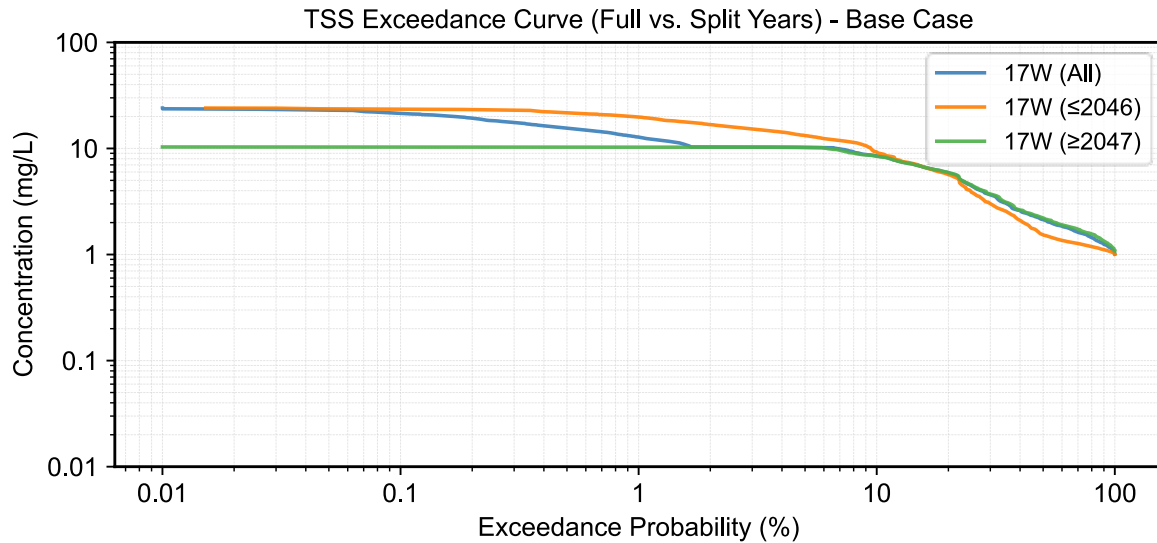


Figure 85: Exceedance probability of daily results TSS at 17W for the 'Active Treatment Phase' (≤ 2046) and 'Post Closure Phase' (≥ 2047), and the overall data.

For proposed compliance purposes, the daily and 7-day rolling median for turbidity for the Base Case are presented in Figure 86 and all values are below the proposed water quality limits. Figure 87 presents the annual median and 95th percentile for turbidity, which are also below the proposed water quality limits.

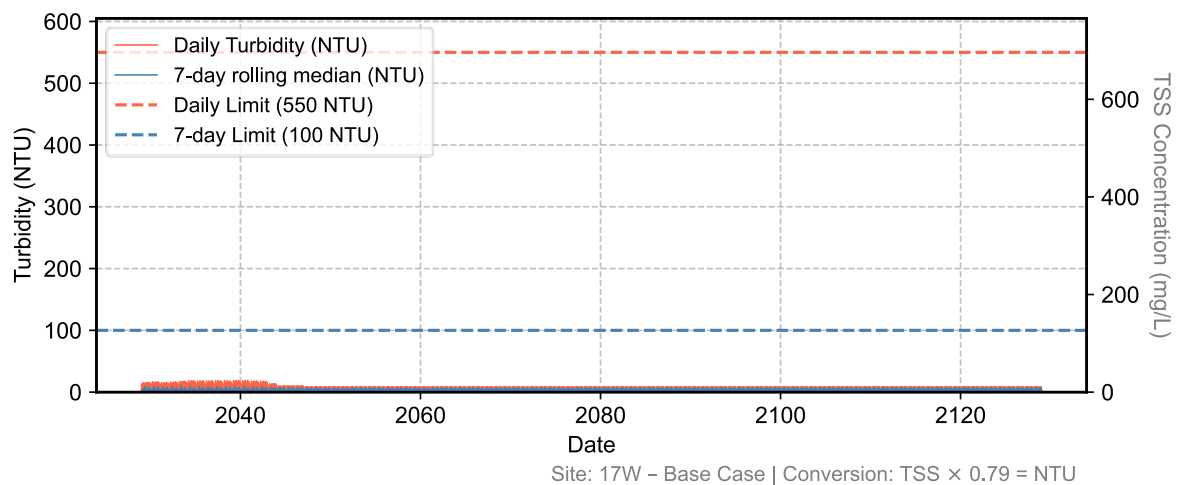


Figure 86: Daily and 7-day rolling median turbidity model results at 17W, with the daily (550 NTU) and 7-day rolling median (100 NTU) limits.

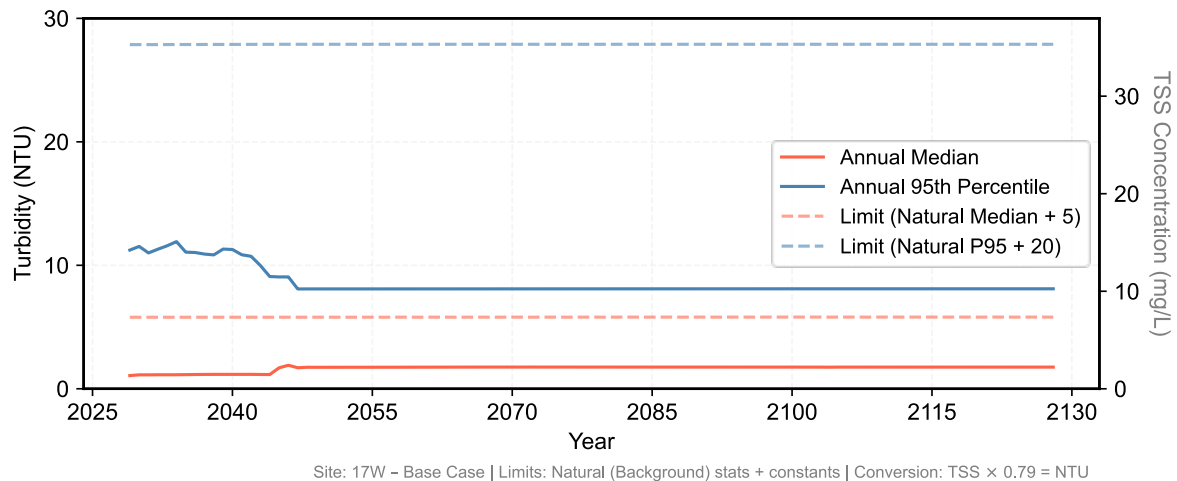


Figure 87: Annual turbidity statistics at 17W, showing the median and 95th percentile of modelled turbidity compared against background reference limits (Background Median + 5 NTU and Background P95 + 20 NTU).

6.2.7 Summary of Screening Against Proposed Water Quality Criteria

Based on the Base Case model results, no exceedances above guideline water quality values were found under either chronic or acute criteria. Even when the model was stress tested with wet conditions or 30% higher ELF source terms, Alternative Scenario model results also found no exceedances above guideline values.

6.2.8 Sump bypasses and direct discharge effect on compliance points

This section presents and discusses the effect of the bypass operation on the compliance points SW01, SW03, and effect of direct discharge on Smokestack. The analysis focuses on the first half of 2038 of the model simulation, during which the East Pit and West Pit Sumps were actively being pumped to Smokestack via the WTP. This period was chosen as a typical example period.

During high flows, the bypass mechanism operates by diverting some of the water before it reaches the sump and mixes with the water contained in the sump. This bypassed water flows directly into the respective stream. The direct discharge mechanism operates such that, at times where the Waimangaroa River flows exceed the 90th percentile flow criteria, MIW within the East and West Pit Sumps are pumped directly to the Waimangaroa River.

For the East Pit Sump, this bypass discharge is reflected at monitoring point SW01 and downstream points SW03 and 17W.

For the West Pit Sump, this bypass discharge is reflected at monitoring point SW03 and downstream point 17W.

The direct discharge flows are directed into the Waimangaroa River, and are reflected at Smokestack and downstream point 17W

High rainfall events typically cause in stream dilution (a decrease in solute concentrations) across the overall system. However, the operation of the bypass and direct discharge introduces a specific effect predicted at the compliance points. As shown in Figure 88 for the East Pit Sump (SW01), Figure 89 for

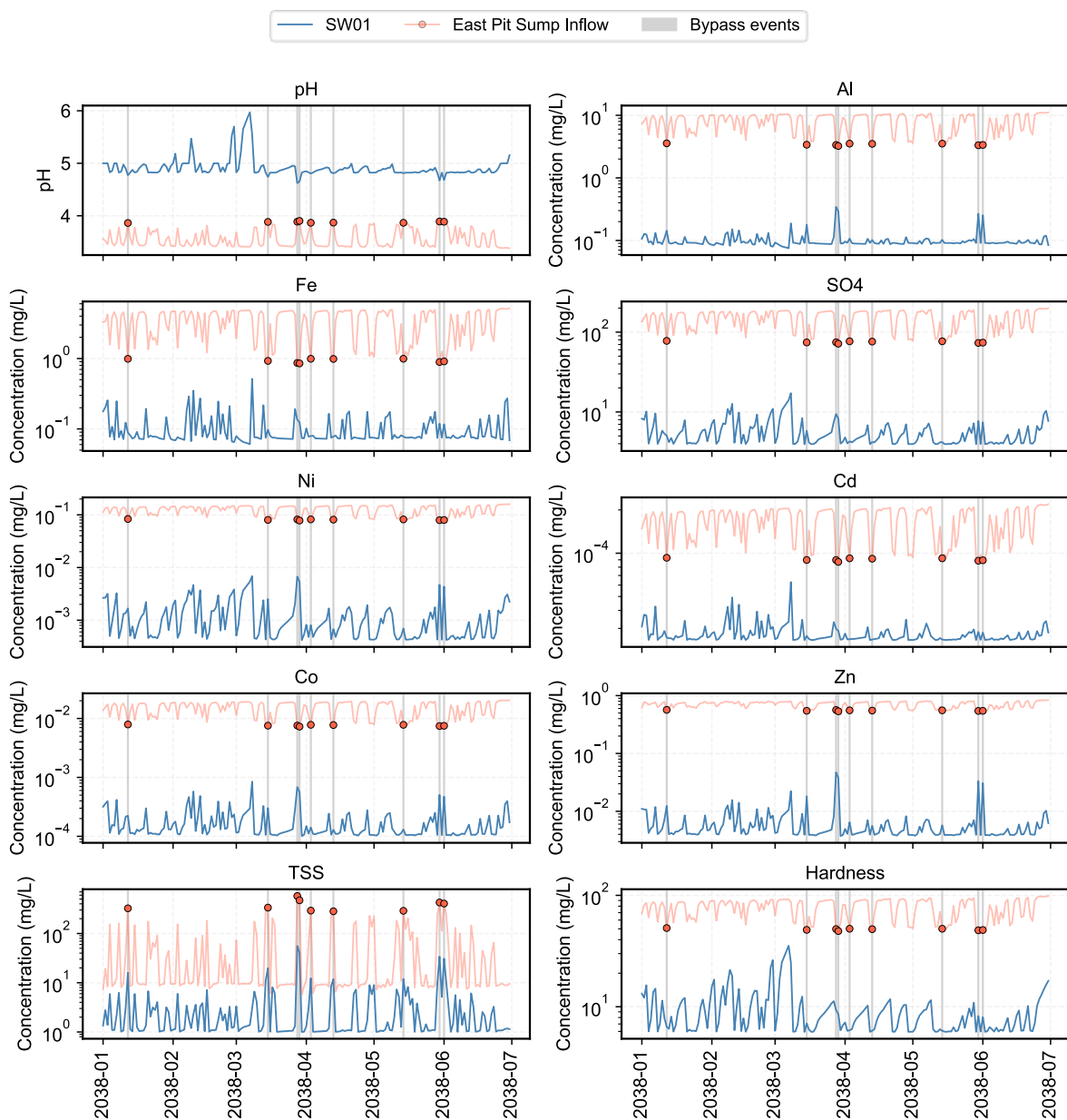
the West Pit Sump (SW03), and Figure 90 for the direct discharge to Smokestack, where events are highlighted by grey lines:

- Bypass and direct discharge events correlate with a decrease in dissolved concentrations in the water flowing into the sump (due to dilution from the rain).
- These events correlate with a resultant increase in dissolved concentrations at the downstream monitoring points (SW01 and SW03).
- Bypass and direct discharge events correlate with increased TSS concentrations.

This increase is directly attributable to the bypass mechanism diverting MIW of a specific quality (prior to sump mixing) into the receiving stream. The concentration increase is generally not visible when using medians or percentiles below the 95th percentile. This is because, as per the management strategy, the bypass is active for less than 5% of events in an average year and direct discharge is active less than 10% of events. Consequently, observing the bypass and direct discharge effect requires an analysis specifically on these short-duration and infrequent events.

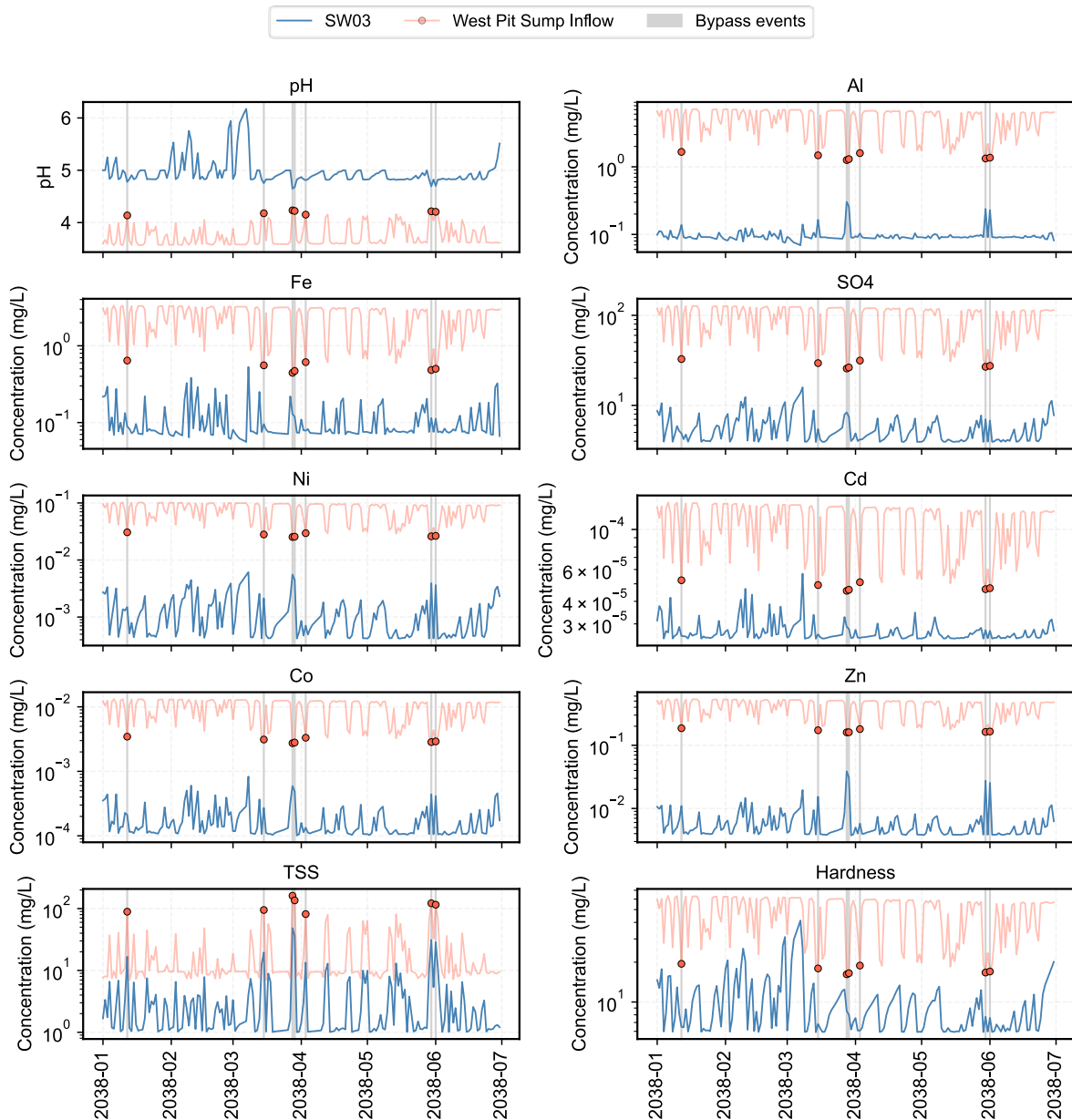
Nine bypass events were identified for the East Pit and West Pit Sumps during the first half of 2038, and more at the direct discharge.

The impact of these events on the monitoring point SW01 is evident through the observation of concentration peaks that correlate directly with the bypass times. However, the contribution of these bypass events to the overall concentration at SW01 is not substantial. The effect of the West Pit Sump bypass events on SW03 is comparable to that simulated at SW01 (East Pit Sump).



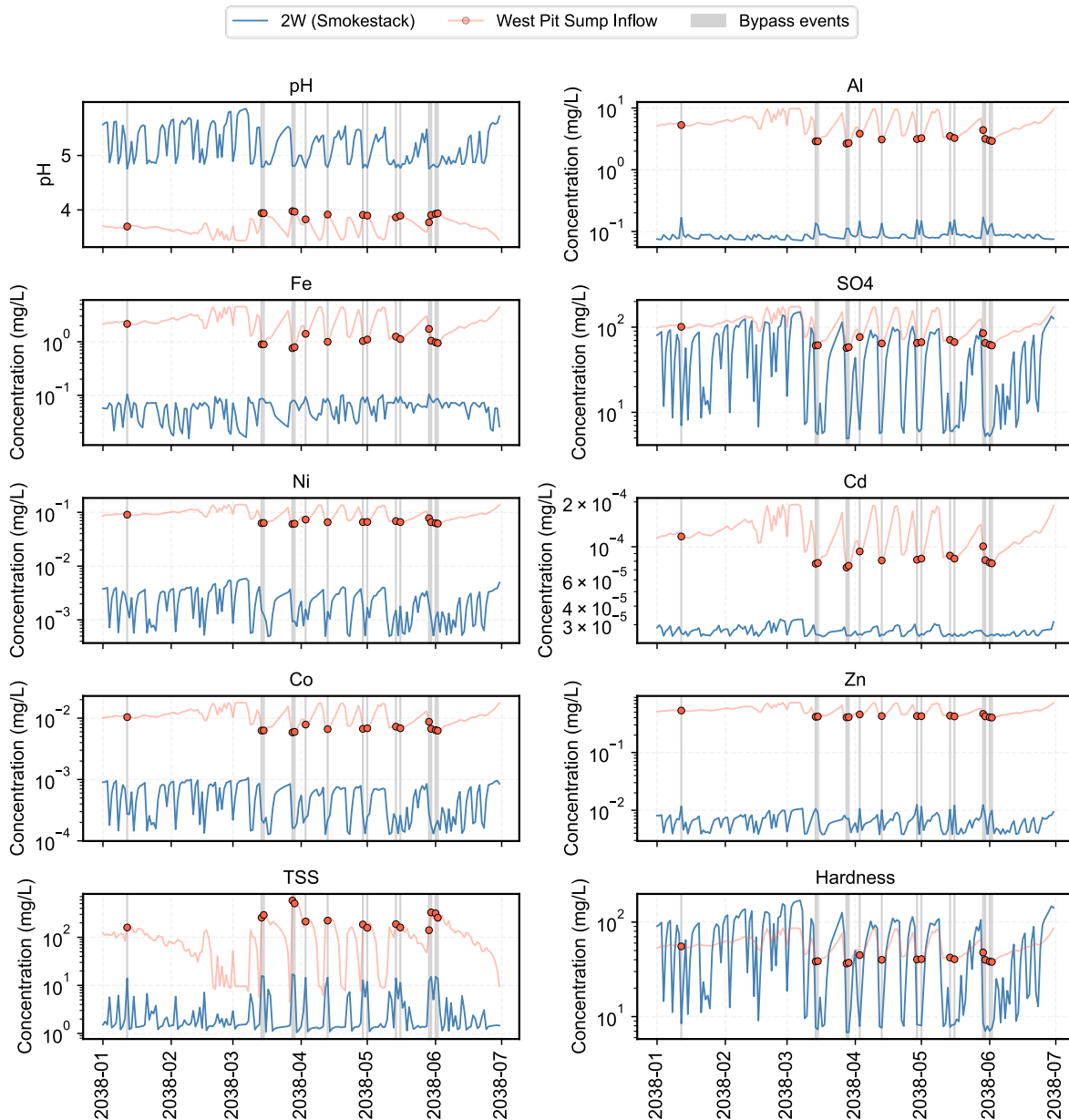
Site: SW01, East Pit Sump Inflow | BaseCase | Period: 2038-01-01 to 2038-06-30

Figure 88: Effect of the East Pit Sump Inflow bypass events on water quality at SW01, over the period January 2038 to June 2038.



Site: SW03, West Pit Sump Inflow | BaseCase | Period: 2038-01-01 to 2038-06-30

Figure 89: Effect of the West Pit Sump Inflow bypass events on water quality at SW03 over the period January 2028 to June 2038.



Site: 2W (Smokestack), West Pit Sump Inflow | BaseCase | Period: 2038-01-01 to 2038-06-30

Figure 90: Effect of the direct discharge events on water quality at 2W (Smokestack), over the period January 2038 to June 2038.

6.2.9 WTP Influent Water Quality and Loads

MIW from the Pit Sumps at the MFS sub-area is pumped to the WTP during the period 2029 to 2046. The estimated annual loads of acidity, Al, Fe, and TSS for the Base Case are presented in Figure 91 while the average concentrations and corresponding loads are detailed in Table 30.

The annual acidity loads show:

- Increase: Acidity loads increase steadily from approximately 90 tonnes/year in 2029, peaking at 324 tonnes/year in 2040.

- **Decrease:** Following the peak, loads begin to decrease over time as active mining surfaces transition to rehabilitated surfaces. This reduction becomes evident in the final two years of WTP operation.
- **Major Reduction:** A significant decrease is simulated in the last years of active treatment due to the transition to the Post Closure Phase, which includes the rehabilitation of mining areas, and commissioning of the MSR's, and removal of pumps from the West Pit sump thus allowing it to spill.

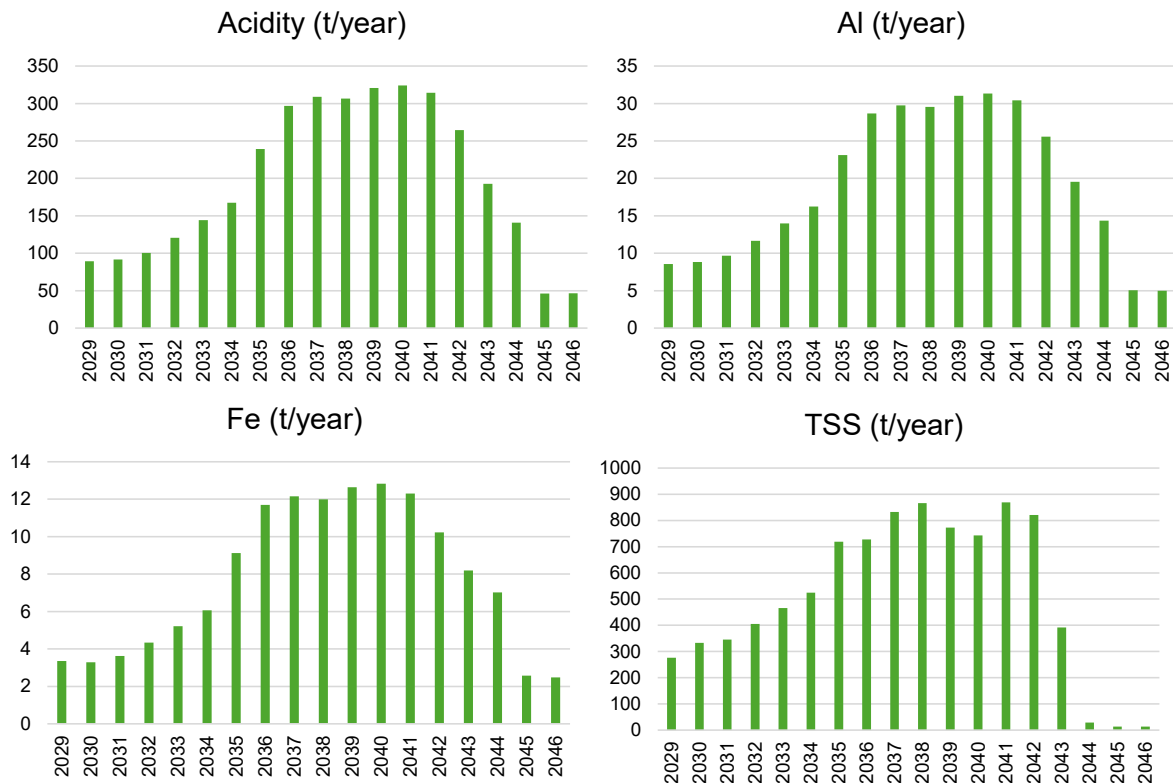


Figure 91: Forecast of the annual loads pumped into the WTP.

Table 30: Annual average concentrations and loads pumped into the WTP.

Year	Acidity (mg CaCO ₃ /L)	Al (mg/L)	Fe (mg/L)	TSS (mg/L)	Acidity (t/year)	Al (t/year)	Fe (t/year)	TSS (t/year)
2029	33.1	3.2	1.2	102	89.254	8.573	3.362	276.063
2030	34.5	3.3	1.2	125	91.711	8.839	3.287	333.063
2031	38.5	3.7	1.4	133	100.363	9.687	3.623	345.451
2032	42.9	4.1	1.5	144	120.643	11.668	4.345	404.894
2033	49.3	4.8	1.8	159	144.284	13.974	5.214	465.688
2034	56.0	5.4	2.0	175	167.447	16.233	6.064	524.356
2035	51.6	5.0	2.0	155	239.068	23.129	9.120	719.160
2036	62.0	6.0	2.4	152	296.797	28.684	11.694	727.371

Year	Acidity (mg CaCO ₃ /L)	Al (mg/L)	Fe (mg/L)	TSS (mg/L)	Acidity (t/year)	Al (t/year)	Fe (t/year)	TSS (t/year)
2037	52.5	5.1	2.1	142	308.814	29.766	12.146	832.554
2038	51.1	4.9	2.0	144	306.592	29.554	11.987	865.945
2039	61.7	6.0	2.4	149	320.668	31.028	12.632	773.182
2040	64.3	6.2	2.5	148	323.959	31.343	12.832	743.210
2041	60.6	5.9	2.4	168	314.403	30.435	12.306	869.073
2042	49.1	4.7	1.9	152	264.640	25.571	10.228	821.233
2043	44.3	4.5	1.9	90	192.862	19.537	8.190	391.251
2044	34.0	3.5	1.7	7	140.958	14.355	7.021	29.207
2045	22.1	2.4	1.2	7	46.089	5.071	2.572	13.689
2046	22.4	2.4	1.2	7	46.741	4.989	2.486	13.701

6.3 Alternative Scenarios

6.3.1 Water Balance Model Results

This section illustrates the resultant differences in WTP treatment volumes, pit sump trends, and site hydrology between the Base Case and Scenarios 1 (High Rainfall) and 2 (Stochastic Rainfall).

6.3.1.1 Volume of Water Treated at WTP

The cumulative volume of treated water as a function of the Base Case and Scenarios 1 and 2 is presented in Figure 92.

It can be observed that more MIW is treated through Scenario 1, as would be expected with the higher rainfall accumulation. Scenario 2 produced similar treated volumes to the Base Case. It should be noted that the volume of water treated within Scenario 1 would not be expected to occur during operations; this scenario is aimed at identifying water management risks associated with high rainfall years occurring at each stage in the mine development, as well as consecutive high rainfall years.

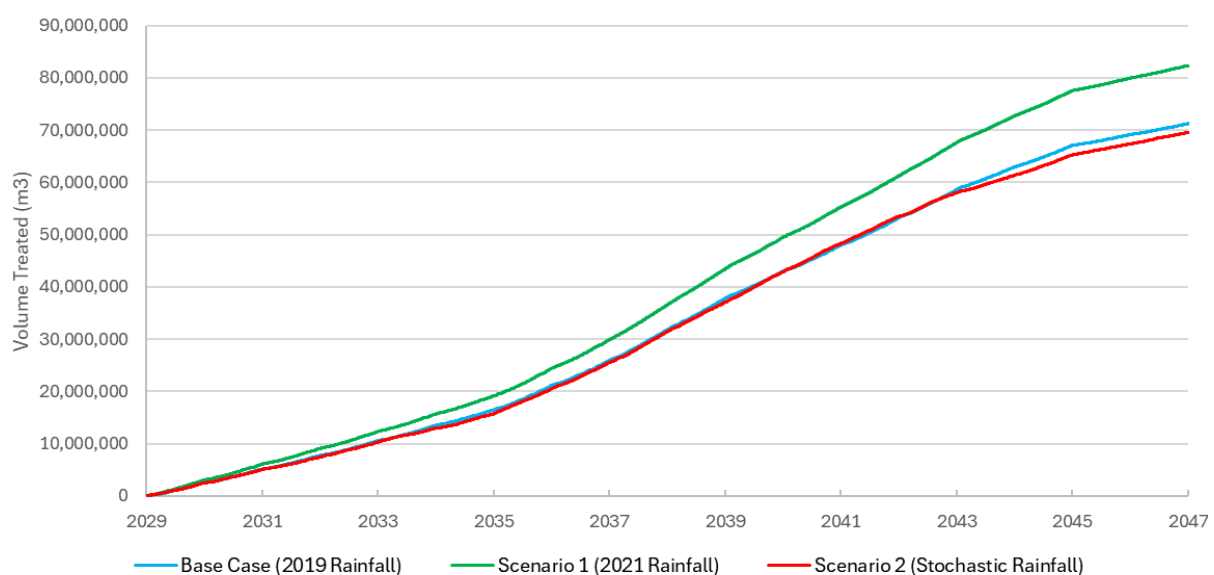


Figure 92: Cumulative volume of water treated by WTP.

6.3.1.2 Pit Sump Trends

Trends pertaining to the East and West Pit Sumps have been illustrated below in relation to Base Case and Scenarios 1 and 2. This includes the modelled sump water levels and the sump bypass rates.

As described in Section 4.2.8.3, the following occurs throughout the Active Treatment Phase:

- A fixed pumping rate of 200 L/s from the West Pit Sump is incorporated into the model for the Base Case and Scenarios 2 to 4.
- Scenario 1 incorporates a fixed pumping rate of 220 L/s from the West Pit Sump.
- A direct pumping rate of 200 L/s to the Waimangaroa River from the West Pit Sump occurs when river flows permit such discharge (Base Case and all scenarios).
- The East Pit Sump pumping rate is modelled to ensure the sump does not spill and, as such, is variable over its life until 2044 (i.e., during the period that the East Pit Sump is pumped to the West Pit Sump).
- In 2045 the East Pit Sump applies the fixed pumping rate to the WTP of 200 L/s for the Base case and Scenarios 2 to 4, and 220 L/s for Scenario 1. Direct discharge to the Waimangaroa River of 200 L/s occurs from the East Pit Sump during this time.

Due to the use of the fixed pumping rates throughout the model, the pit sumps do not make full use of the sump's capacity during some years.

West Sump

The following graphs illustrate the West Pit Sump operations showing modelled water volumes stored and bypass rates for the Base Case and Scenarios 1 and 2 (2029 through to 2046) (Figure 93 and Figure 94).

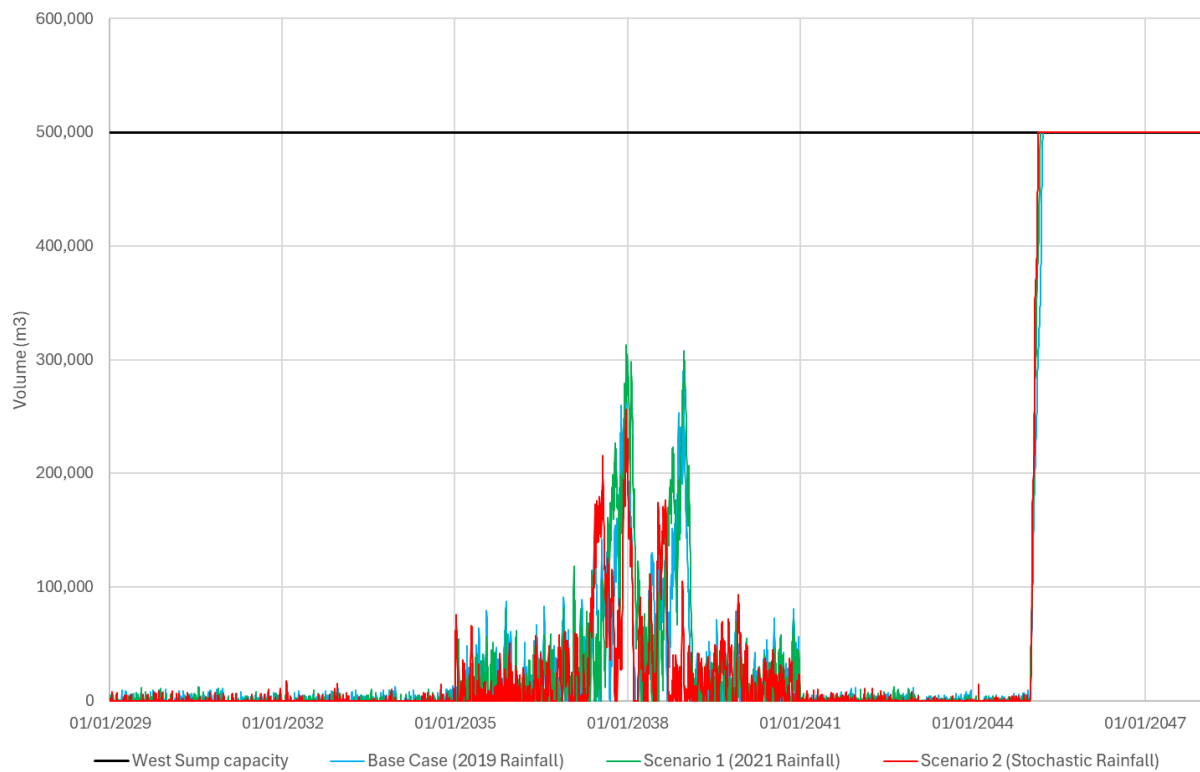


Figure 93: West Pit Sump - modelled volume stored over the Active Treatment Phase (2029-2046).

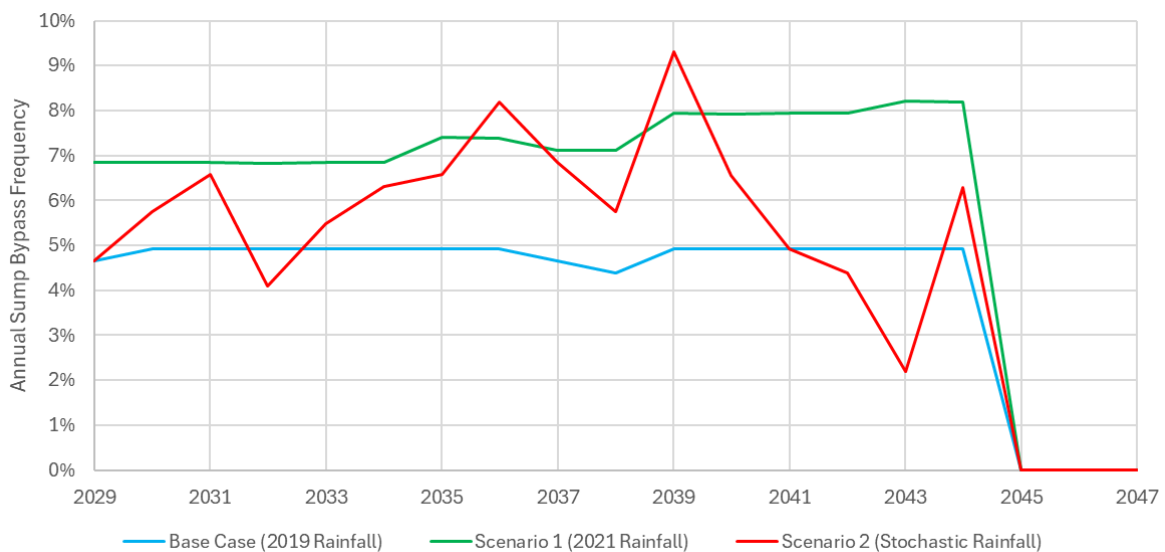


Figure 94: West Pit Sump - modelled bypass rate over the Active Treatment Phase (2029-2046).

The following is noted regarding the above graphs:

- Scenario 1, resulted in the highest bypass proportions (a 7% average bypass rate) when compared to the Base Case and Scenario 2.
- Scenario 2 modelled variable bypass rates (from 2% to 9% bypass rate, 6% on average).
- Base Case modelled the design bypass rates of 5%.

The simulated frequency (average number of events per year) of West Pit Sump bypass events for the Base Case and Scenarios 1 and 2 is summarised in Table 31.

Table 31: West Sump bypass simulated frequency.

EVENT DURATION	BASE CASE	SCENARIO 1	SCENARIO 2
1 day	15.8	21.6	19.4
2 days	2.1	4.4	1.6
3 days	0	1	0.3
4 days	0	0	0.1

Note: frequency values reported are the average number of events per year.

East Sump

The following graphs illustrate the East Pit Sump operations showing modelled water volumes stored and bypass rates for the Base Case and Scenarios 1 and 2 (2029 through to 2046) (Figure 95 and Figure 96).

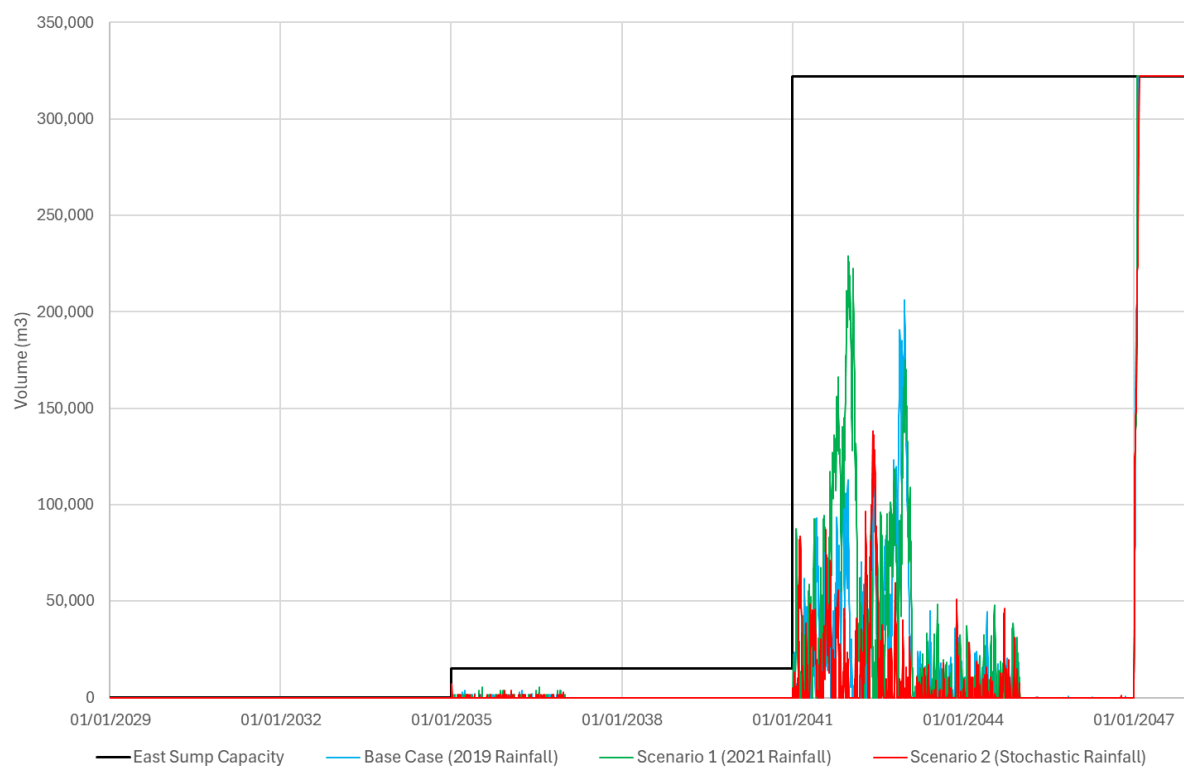


Figure 95: East Pit Sump – modelled volume stored over the Active Treatment Phase (2029-2046).

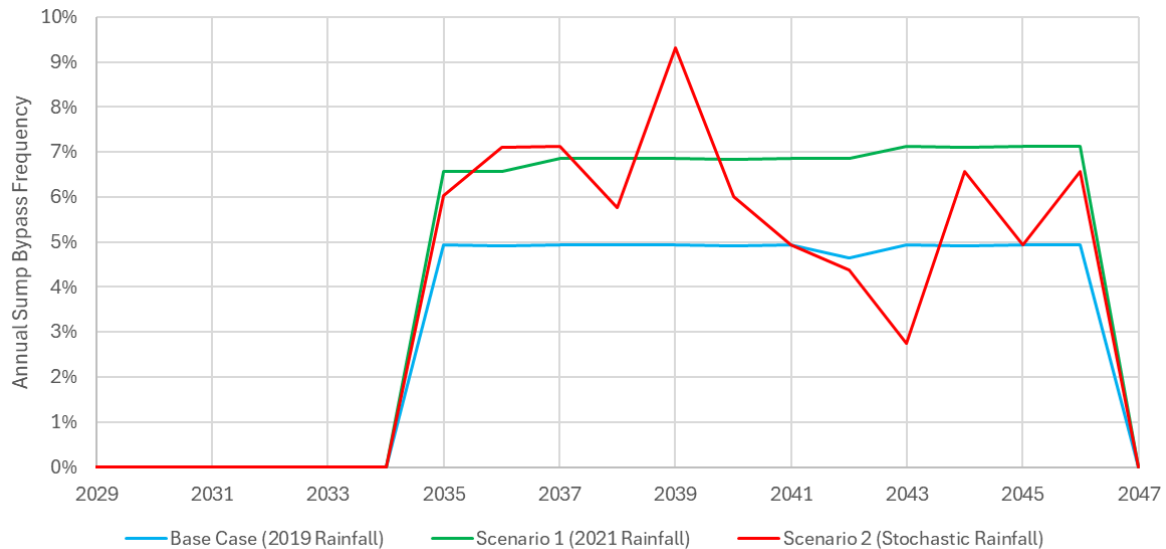


Figure 96: East Pit Sump – modelled bypass rate over the Active Treatment Phase (2029-2046).

The following is noted regarding the above graphs:

- Scenario 1 results in higher bypass proportions (a 7% average bypass rate) compared to the Base Case and Scenario 2 as would be expected with the higher rainfall accumulation and an increased number of high rainfall days.
- Scenario 2 modelled variable bypass rates (from 3% to 9% bypass rate, 6% on average), as would be expected by a stochastic dataset.
- The Base Case the design bypass rates of 5%.

The simulated frequency (average number of events per year) of East Pit Sump bypass events for the Base Case and Scenarios 1 and 2 is summarised in Table 32.

Table 32: East Sump bypass simulated frequency in events per year.

EVENT DURATION	BASE CASE	SCENARIO1	SCENARIO2
1 day	15.9	20.2	19.6
2 days	2	4	1.7
3 days	0	1	0.4
4 days	0	0	0.1

Note: frequency values reported are the average number of events per year.

6.3.1.3 Direct Discharge Events

The simulated frequency (average number of events per year) of direct discharge events (pumping of water from the sump to the Waimangaroa River) for Scenario 1 and 2 is summarised in Table 33 and illustrated as an annual frequency (Figure 97) and compared to the Base Case.

Table 33: Direct discharge simulated frequency.

EVENT DURATION	BASE CASE	SCENARIO 1	SCENARIO 2
1 day	28	31.9	29.1
2 days	8	7	4
3 days	0	3	0.6
4 days	0	1	0.2
5 days	0	0	0.1

Note: values reported are the average number of events per year.

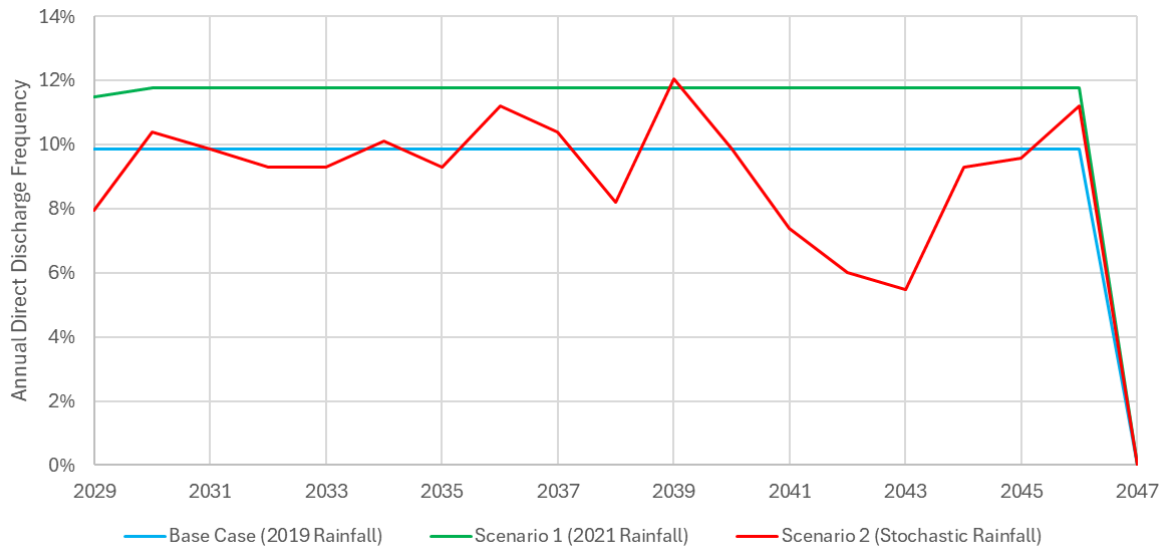


Figure 97: Modelled direct discharge rate over the Active Treatment Phase (2029-2046).

The Base Case and Scenario 1 result in direct discharge 10% and 12% of the time (on an annual basis) respectively. Scenario 2 results in direct discharge 5.5% to 12% of the time, varying annually.

6.3.1.4 Environmental Flows

This section illustrates the model results as flow distributions for the Base Case and scenario conditions at each monitoring site, relative to the Active Treatment and Post Closure Phases (Figure 98 through Figure 105). The following observations are noted:

- All sites follow a similar trend between the scenarios.
- The high rainfall Scenario 1 results in the highest flows over the majority of the hydrograph.
- The stochastic rainfall Scenario 2 results in a steady exceedance curve (which would be expected from a 100-year synthetic rainfall record).
- The Base Case meanders around the stochastic rainfall scenario.

For this reason, the comparisons are illustrated, and a description of differences is not deemed necessary.

Notes described within Section 6.1.5 are also relevant here, in short:

- The results are influenced by simulated climate change, whereby rainfall simulated during the Post Closure Phase is higher than the Active Treatment Phase resulting in higher flows across the flow distribution.
- Modelled results should be noted for their change in flow and should not be taken as what is to be expected.
- The Active Treatment Phase covers the period of 2029 to the end of 2046.
- The Post Closure Phase covers 2047 through to the end of the simulation (2129).

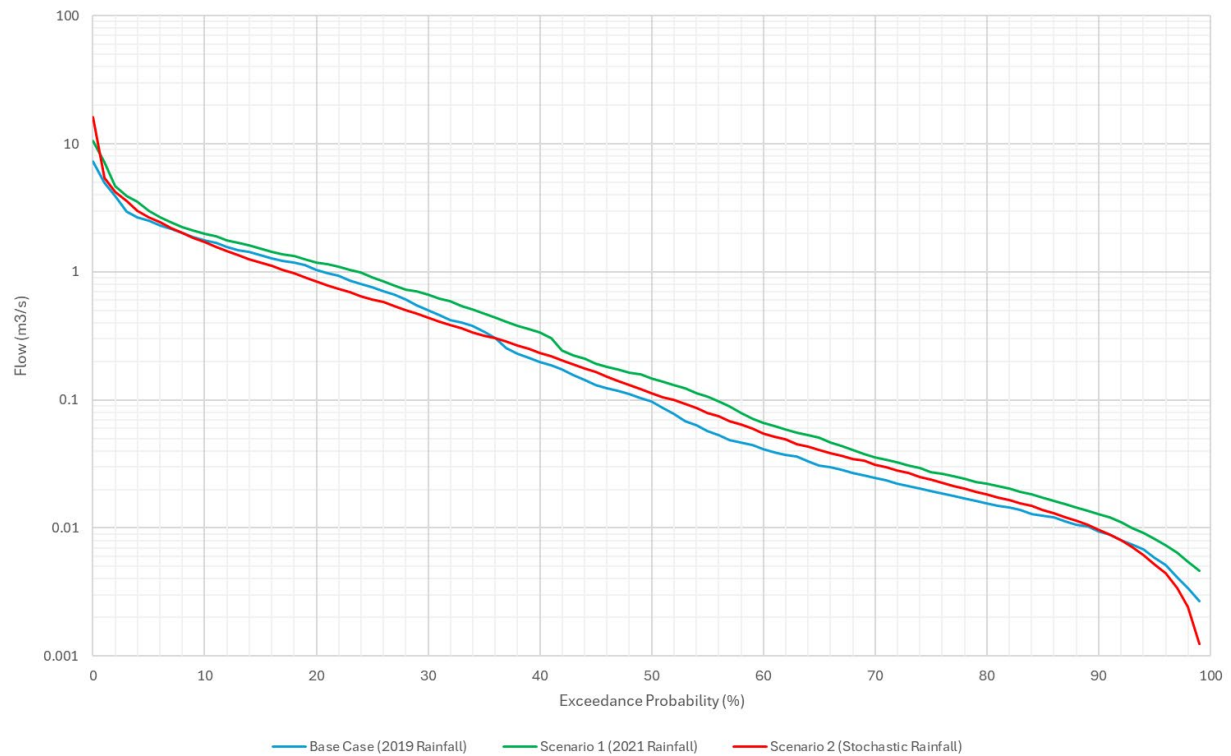
SW01

Figure 98: SW01 modelled scenario flow distribution results - Active Treatment Phase.

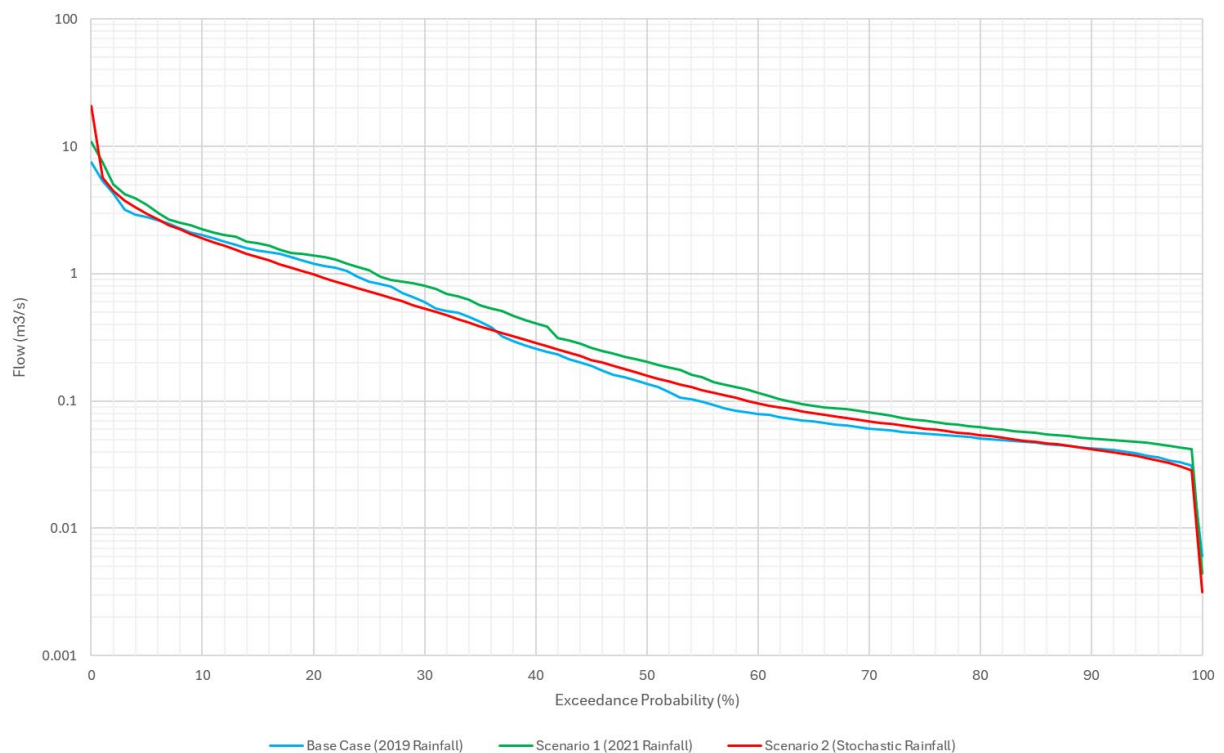


Figure 99: SW01 modelled scenario flow distribution results – Post Closure Phase.

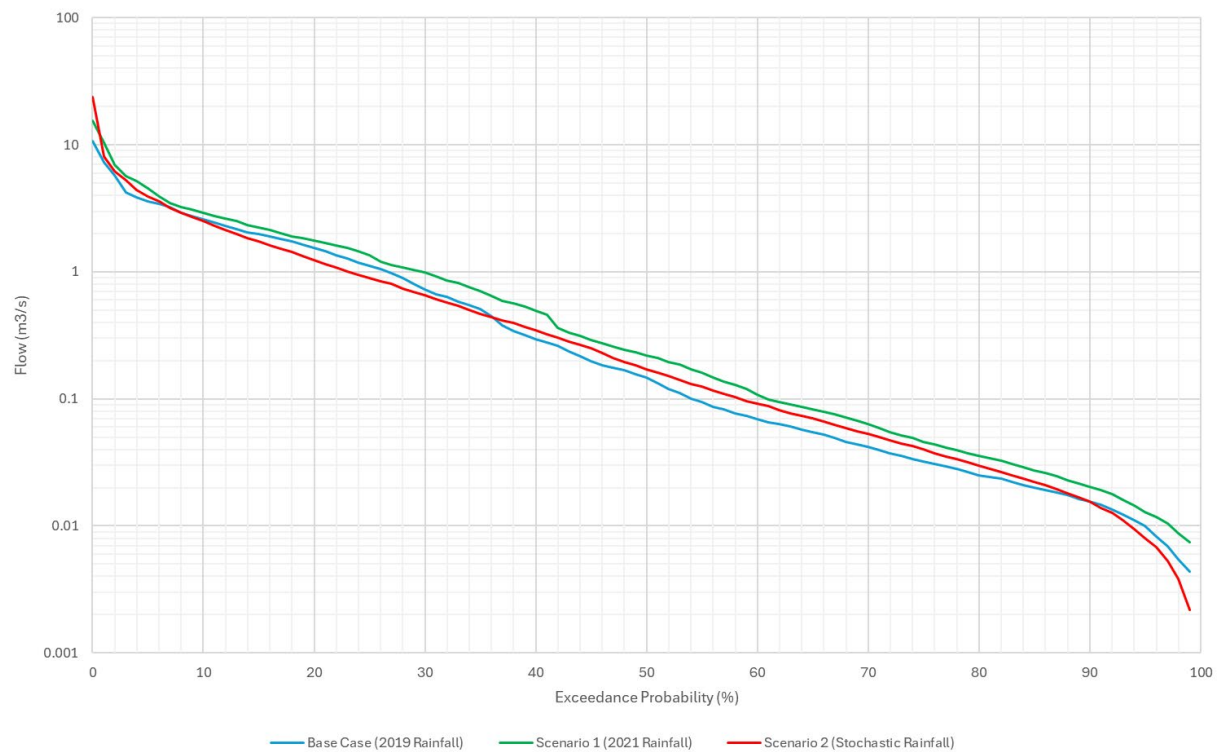
SW03

Figure 100: SW03 modelled scenario flow distribution results - Active Treatment Phase.

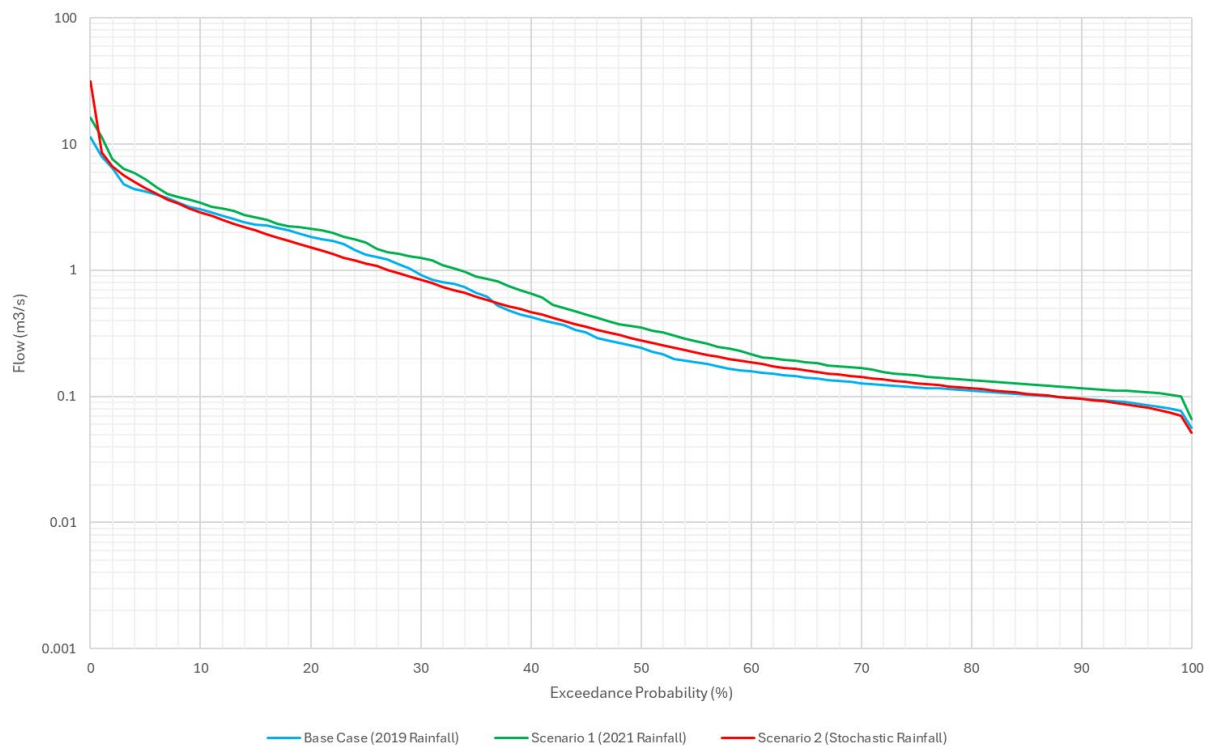


Figure 101: SW03 modelled scenario flow distribution results – Post Closure Phase.

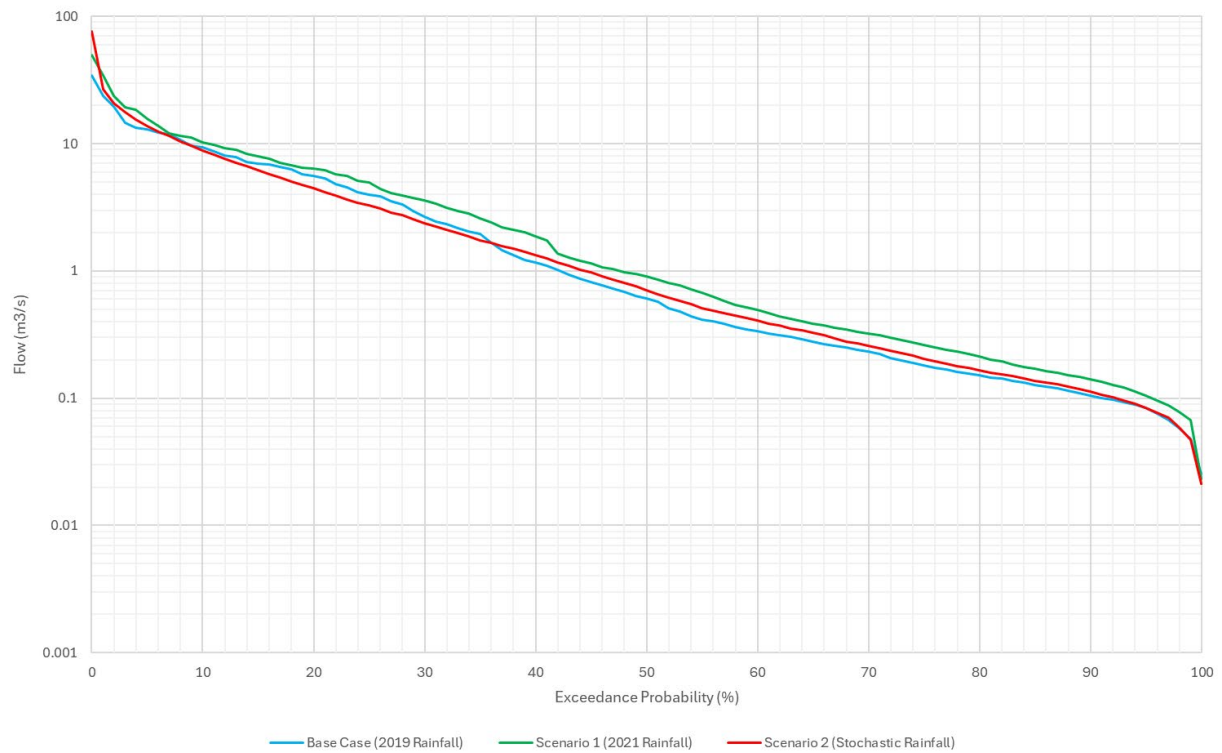
Smokestack

Figure 102: Smokestack modelled scenario flow distribution results - Active Treatment Phase.

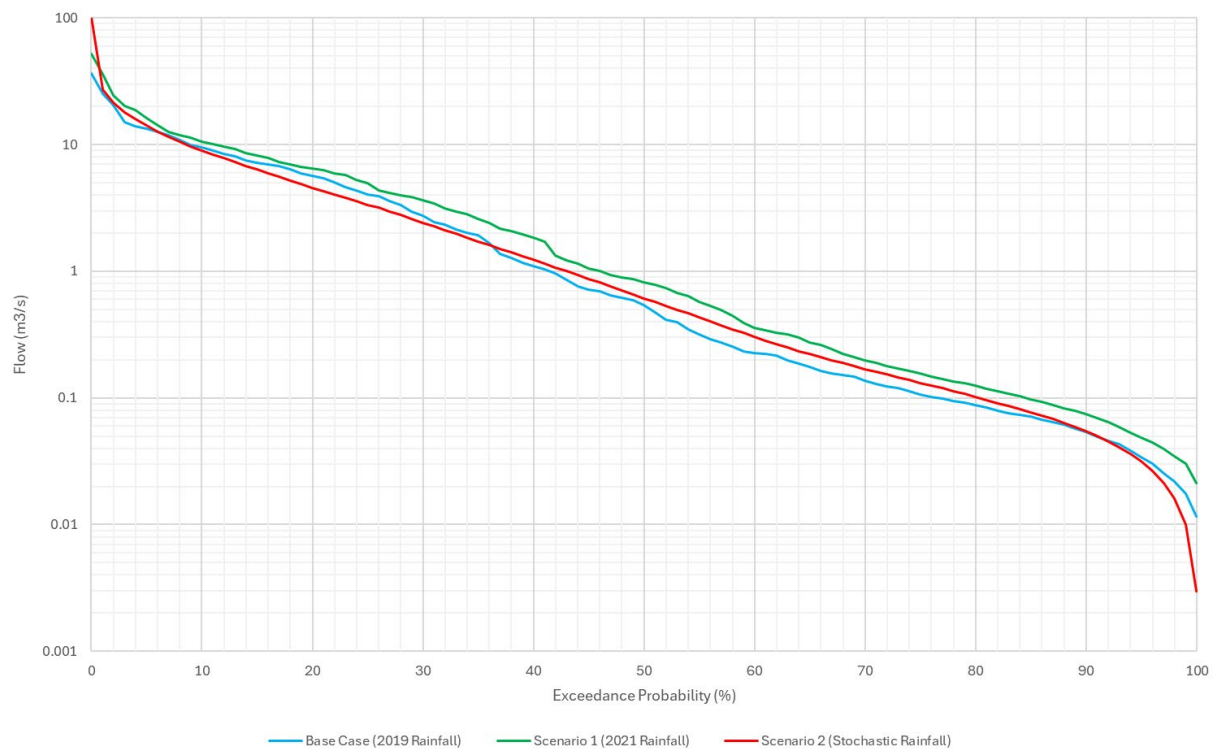


Figure 103: Smokestack modelled scenario flow distribution results – Post Closure Phase.

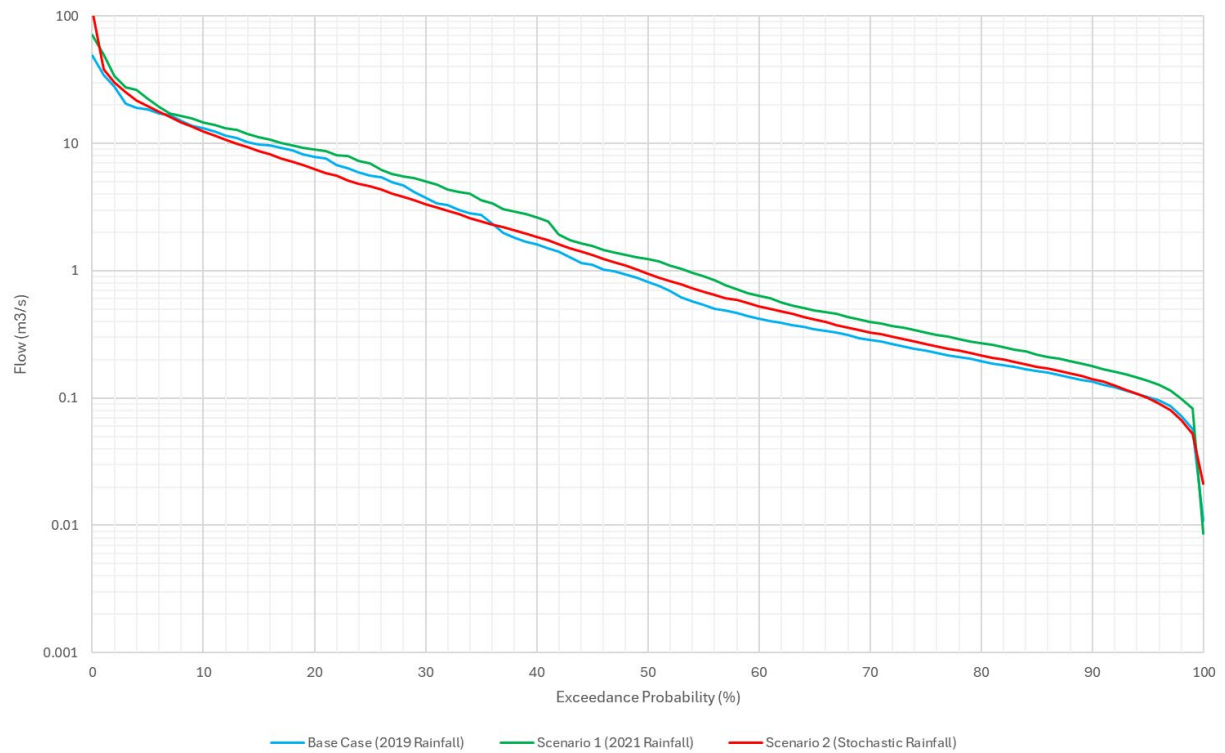
17W

Figure 104: 17W modelled scenario flow distribution results - Active Treatment Phase.

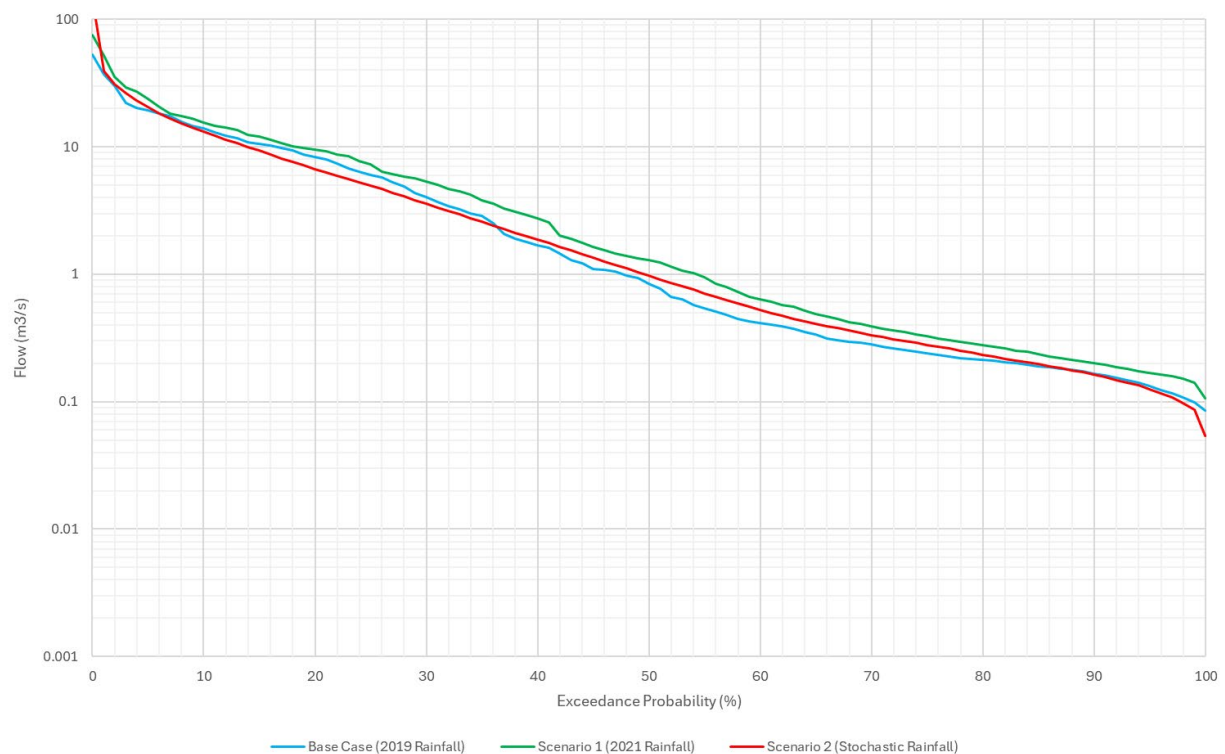


Figure 105: 17W modelled scenario flow distribution results – Post Closure Phase.

6.3.2 Water Quality Model Results

6.3.2.1 Metals

Results for relevant metals for the alternative scenarios were presented in Section 5.2. All scenario results were below chronic or acute guideline values (as shown by MEQ plots) for the relevant exposure period. Additional parameters are shown in Appendix E.

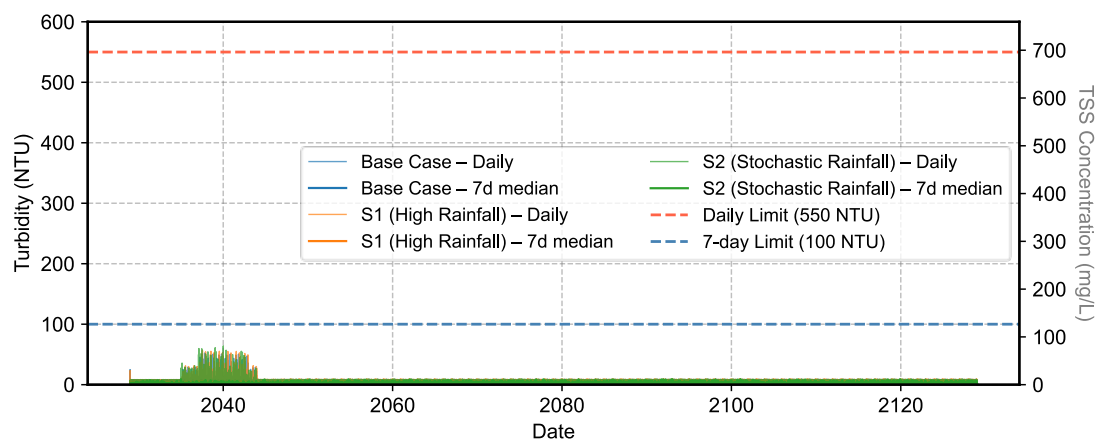
6.3.2.2 TSS and Turbidity

As for TSS (and turbidity), the same compliance plots for turbidity are generated for the different scenarios and sites, and the differences are not significant enough to result in any exceedances of guideline values.

Figure 106 to Figure 109 show the respective turbidity time-series at a daily and 7-day median with their respective limits for the Base Case, and Scenarios 1 and 2, for all sites.

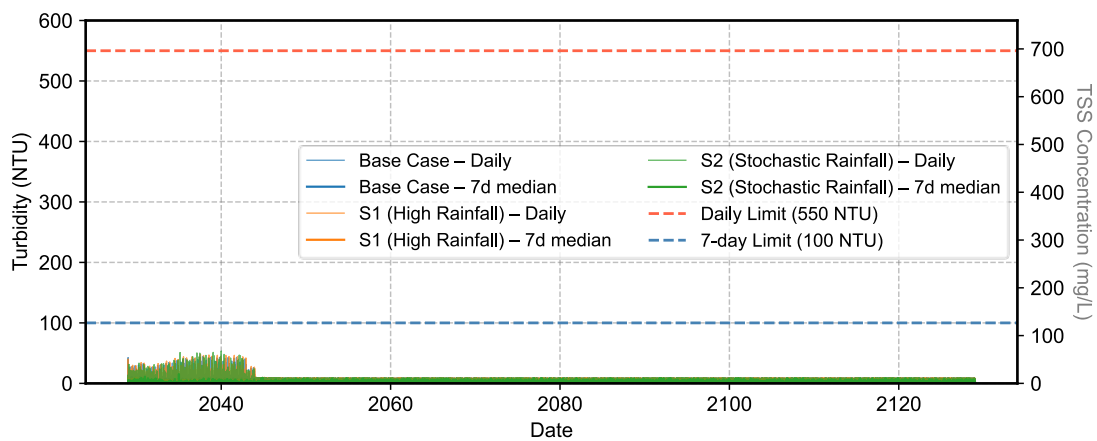
Figure 110 to Figure 114 show the annual-statistics plots for the Base Case and Scenarios 1 and 2 for all sites.

Overall, the alternative scenario model results show a similar outcome to the Base Case model: model results are below proposed guideline values for chronic and acute criteria.



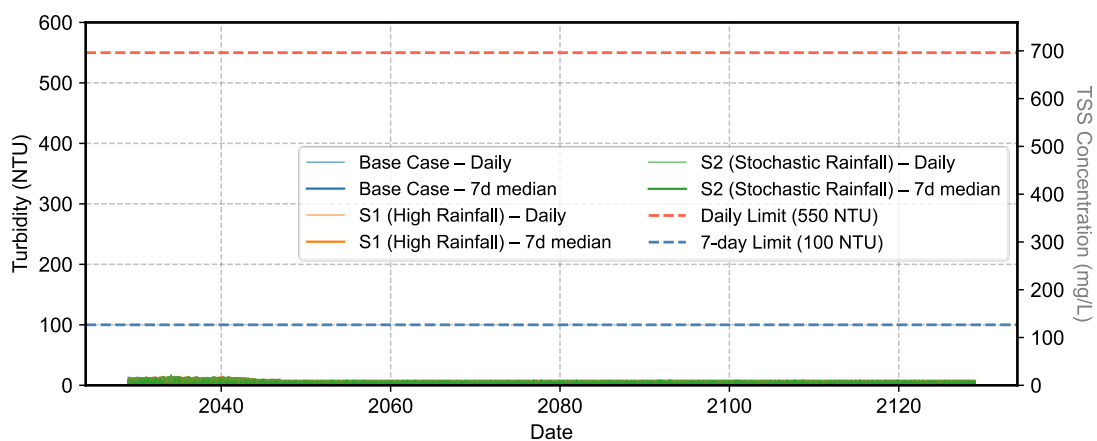
Site: SW01 | Scenarios: Base Case / S1 (High Rainfall) / S2 (Stochastic Rainfall) | Conversion: TSS × 0.79 = NTU

Figure 106: Daily and 7-day rolling median turbidity model results at SW01 for Base case, S1, and S2 with the daily (550 NTU) and 7-day rolling median (100 NTU) limits.



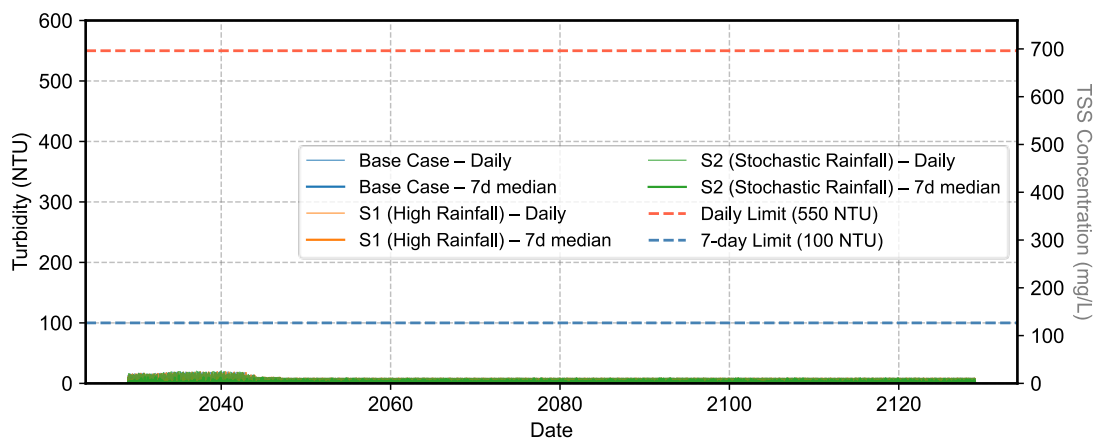
Site: SW03 | Scenarios: Base Case / S1 (High Rainfall) / S2 (Stochastic Rainfall) | Conversion: $TSS \times 0.79 = NTU$

Figure 107: Daily and 7-day rolling median turbidity model results at SW03 for Base case, S1, and S2 with the daily (550 NTU) and 7-day rolling median (100 NTU) limits.



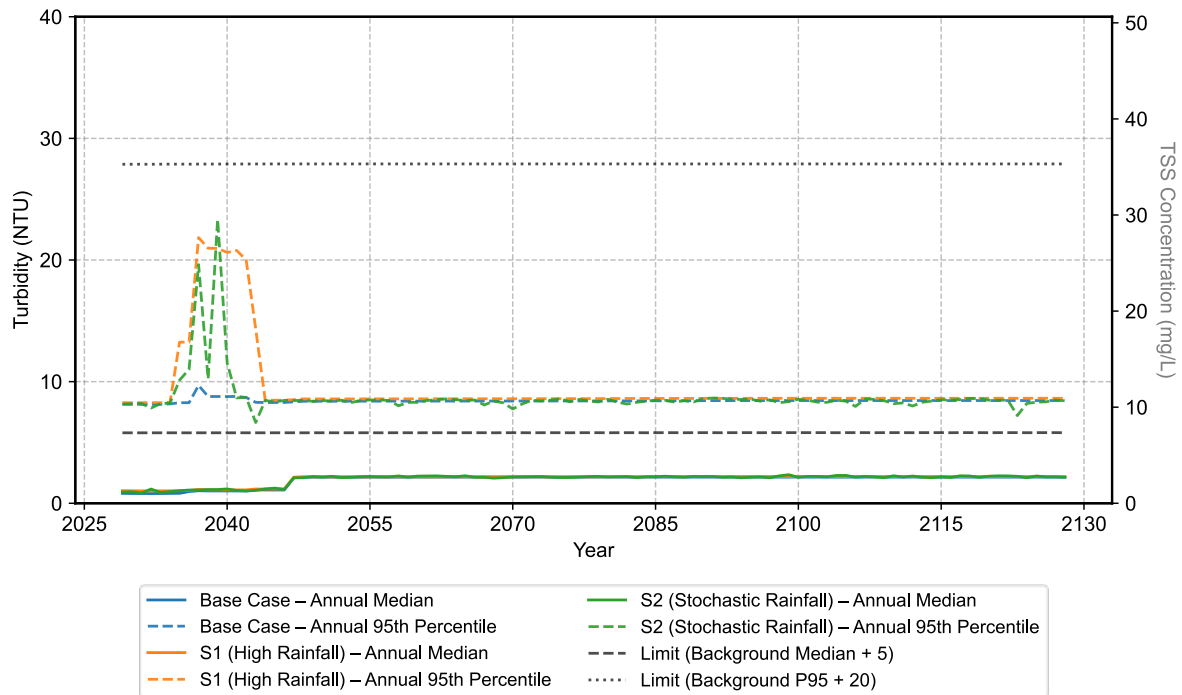
Site: 2W (Smokestack) | Scenarios: Base Case / S1 (High Rainfall) / S2 (Stochastic Rainfall) | Conversion: $TSS \times 0.79 = NTU$

Figure 108: Daily and 7-day rolling median turbidity model results at Smokestack for Base case, S1, and S2 with the daily (550 NTU) and 7-day rolling median (100 NTU) limits.



Site: 17W | Scenarios: Base Case / S1 (High Rainfall) / S2 (Stochastic Rainfall) | Conversion: $TSS \times 0.79 = NTU$

Figure 109: Daily and 7-day rolling median turbidity model results at 17W for Base case, S1, and S2 with the daily (550 NTU) and 7-day rolling median (100 NTU) limits.



Site: SW01 | Limits: Background stats + constants | Conversion: $TSS \times 0.79 = NTU$

Figure 110: Annual turbidity statistics at SW01 for Base case, S1, and S2, showing the median and 95th percentile of measured turbidity compared against background reference limits (Background Median + 5 NTU and Background P95 + 20 NTU).

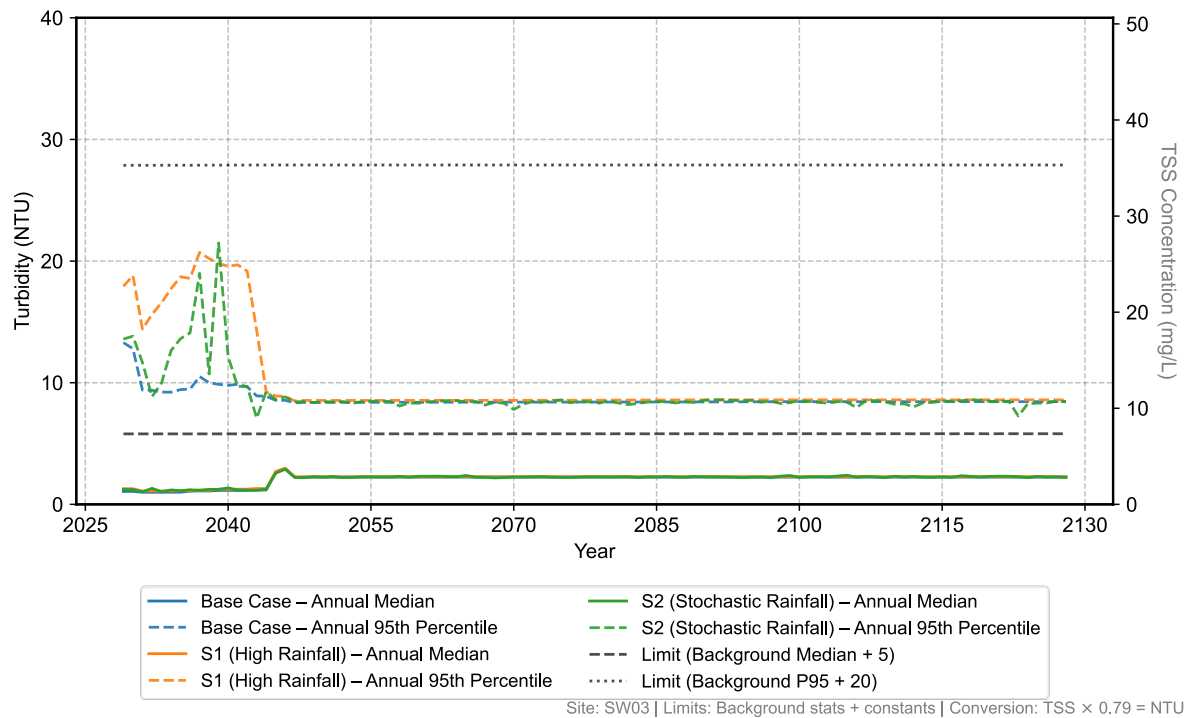


Figure 111: Annual turbidity statistics at SW03 for Base case, S1, and S2, showing the median and 95th percentile of measured turbidity compared against background reference limits (Background Median + 5 NTU and Background P95 + 20 NTU).

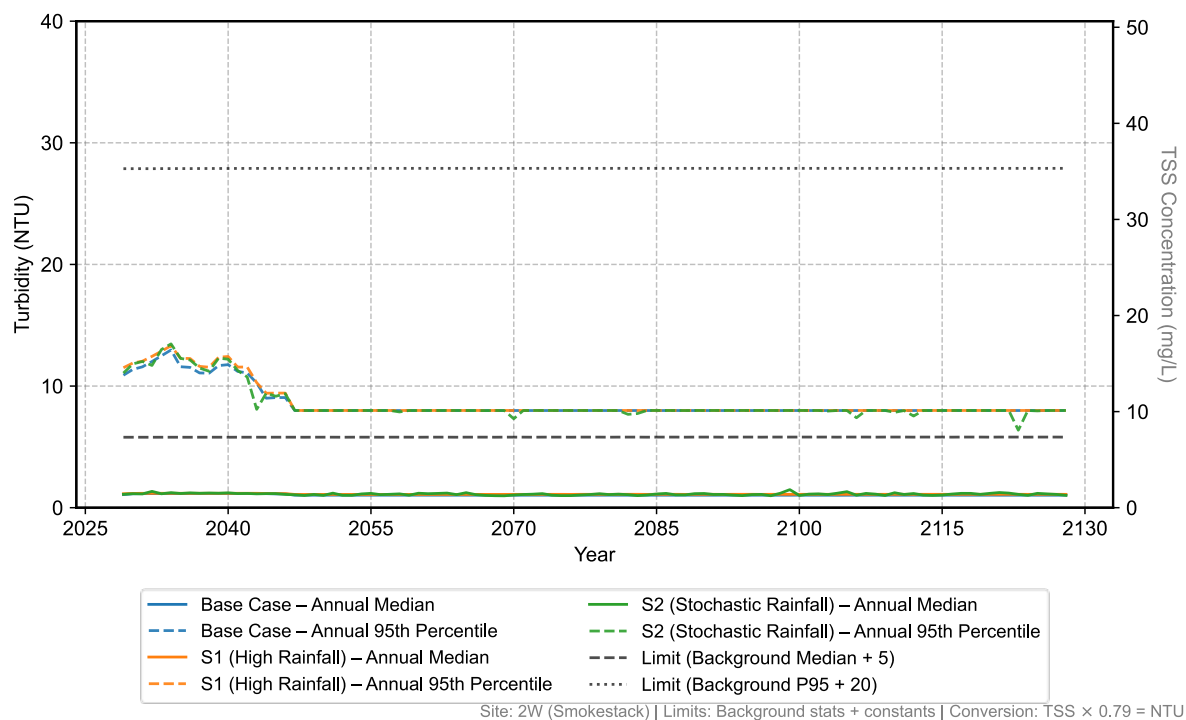


Figure 112: Annual turbidity statistics at Smokestack for Base case, S1, and S2, showing the median and 95th percentile of measured turbidity compared against background reference limits (Background Median + 5 NTU and Background P95 + 20 NTU).

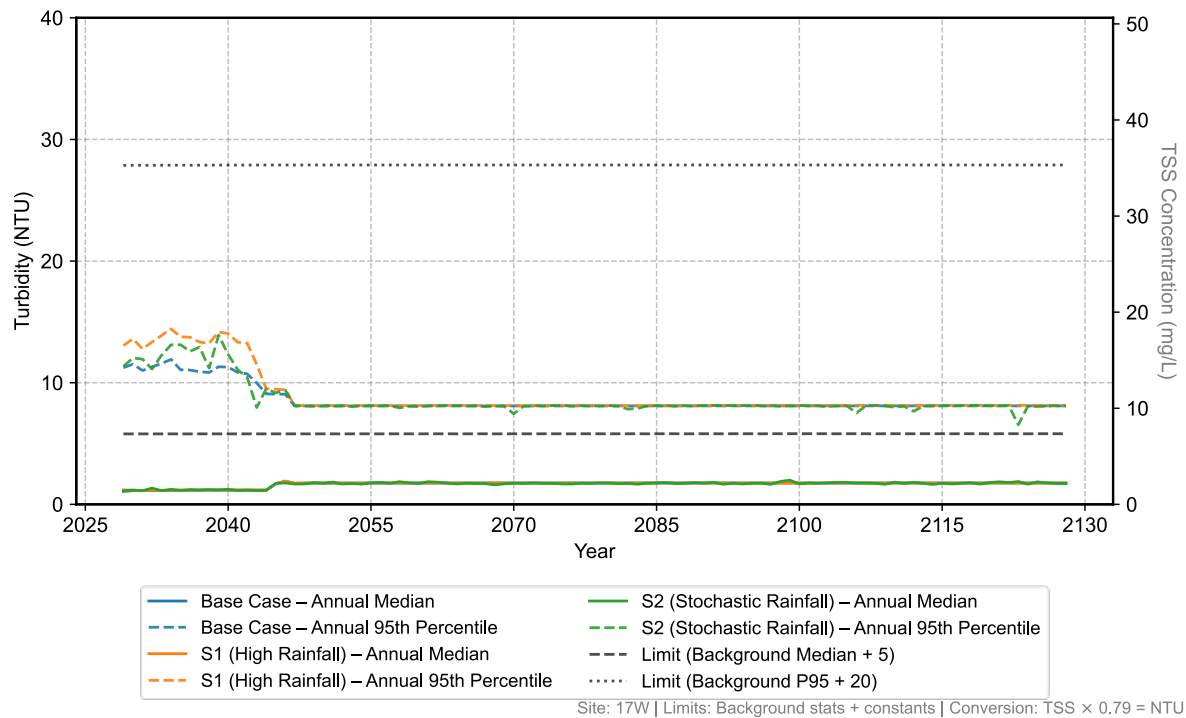


Figure 113: Annual turbidity statistics at 17W for Base case, S1, and S2, showing the median and 95th percentile of measured turbidity compared against background reference limits (Background Median + 5 NTU and Background P95 + 20 NTU).

6.3.3 Water Treatment Plant Influent Loads

Variability in WTP annual influent loads and estimated concentrations for the Base Case and Scenarios 1 to 4 is shown in Figure 114 and the following is noted:

- The highest Al, Fe, and Acidity loads occurred under Scenario 3, followed by Scenario 1.
- Similar concentrations resulted for the Base Case and Scenario 1 and 2, however, higher loads are consistently simulated for Scenario 1, and sometimes higher loads for Scenario 2.
- For TSS, Scenario 1 resulted in the highest loads and concentrations, as expected since TSS in the model is driven by daily rainfall depth. Results were similar between the Base Case and all scenarios.

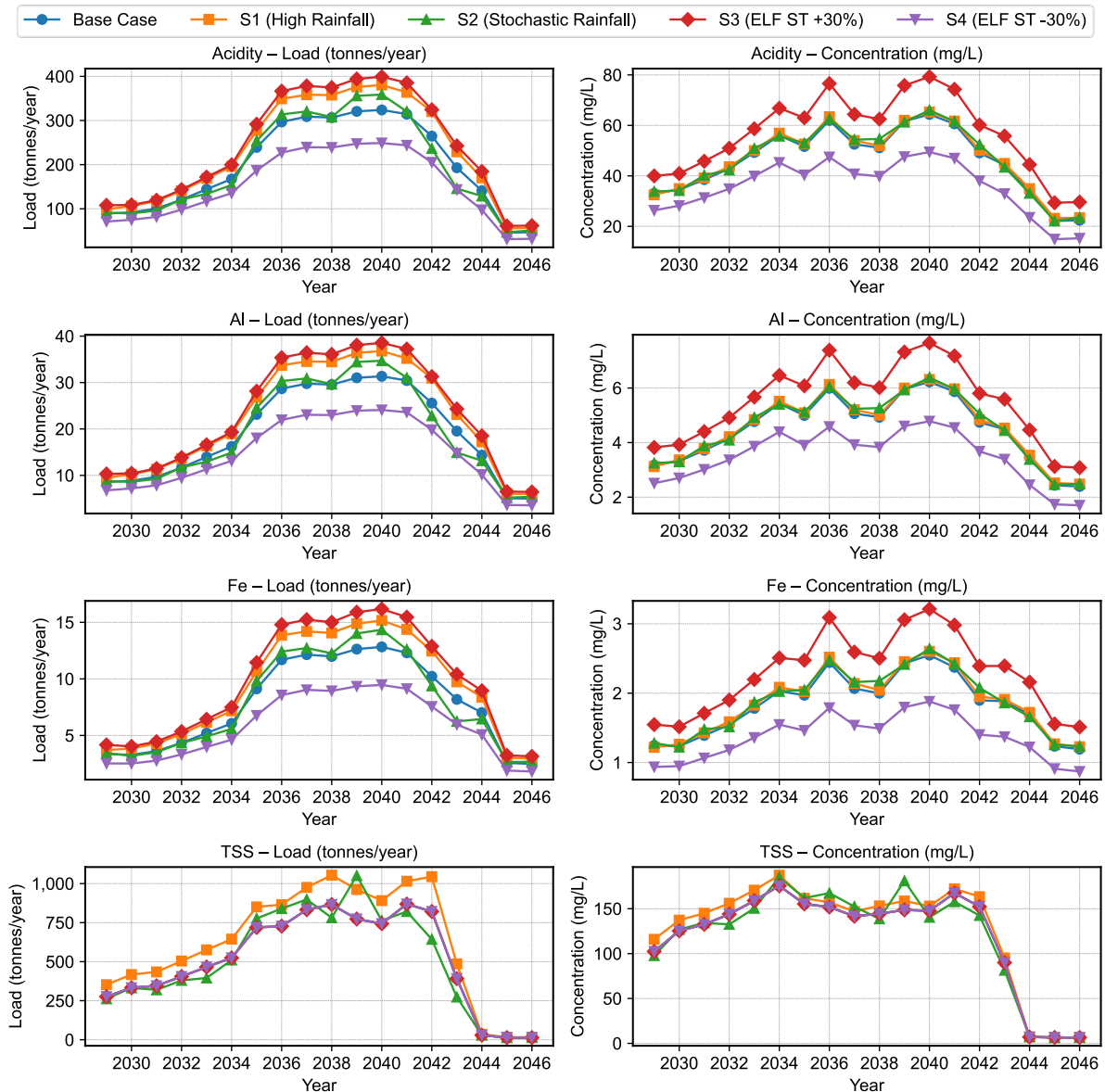


Figure 114: Annual WTP Inflowing loads and weighted concentrations for all scenarios.

Note: Weighted concentrations are calculated as total load per year divided by total water volume per year.

7 **RESULTS SUMMARY AND RECOMMENDATIONS**

7.1 **Model Results Summary**

The MFS WLBM findings are summarised below.

7.1.1 *Water Balance Model Results (Base Case)*

The key findings from the water balance model results are:

- The East and West pit sumps volumes are suitable to manage the simulated MIW volumes (under approximately average annual conditions) given a WTP capacity of 235 L/s and allowance for bypass and direct discharge events.
- The maximum modelled bypass or direct discharge event duration was 2 days. Most events were less than two days (88% of bypass events and 78% of direct discharge events).
- Seepage rates from the ELFs ranged from approximately 0.4 - 29 L/s (varying as a function of landform size) in the Post Closure Phase, the highest being from MSRs 5, 7 and 8.
- The model predicts a total of 71,460,000 m³ (126 L/s on average) of water will be treated by the WTP during the Operations and Active Closure Phases.
- The following changes to flow dynamics are predicted to environmental flows (at compliance locations positioned within waterways):
 - A reduction of all flows occurs at surface water monitoring location SW01 during the Operations and Active Closure Phases (-2 to -12% from simulated baseline conditions), with an increase in mean and median flows during the Post Closure Phase (+5 to +23%) along with a significant increase in low flow conditions (+555%).
 - Similarly, a reduction in flows occur at surface water monitoring location SW03 within the Operations and Active Closure Phases (-14 to 15%), outside of a modest increase in the 7-day mean annual low flow (+32%). During Post Closure Phase, mean and median flows increase (+5 to +41%) as well as a marked increase in low flows (+895%).
 - Model results for water monitoring location 2W (Smokestack) suggest an increase in mean, median and low flows over the entire modelled period (+5 to +225%), while the largest increase of flows occurs in the lower end during active treatment with the presence of the WTP discharging upstream.
 - Water quality monitoring location 17W indicates the same trend as Smokestack, however, a large increase in low flows also occurs during the Post Closure Phase as noted as reporting via SW01 and SW03 (+223%).

7.1.2 *Load Balance Model Results (Base Case)*

The key findings from the load balance model are:

- Modelling indicates that the peak MIW PCOC loads reporting to the WTP occur in 2040, with approximately 324 t/year of acidity, 31 t/year of Al, 13 t/year of Fe. Modelling also indicates that 2041 is the peak year for TSS load, with 869 t/year of TSS.

- Active treatment will be required for about 4 years after completion of rehabilitation before MSRs can treat loads to meet proposed guideline values for some landform seepages.
- Cd and Zn were typically the PCOC that were closest to the proposed guideline values (although still below these limits for the vast majority of the time).
- Screening of model results against acute and chronic guideline values for metals and turbidity does not suggest exceedance above these values over the proposed exposure periods.

Overall, Base Case results suggest discharge of mine impacted water via bypass and direct discharge at proposed frequencies (95% and 90% of the time, respectively) will not elevate PCOCs above proposed water quality guideline values over relevant exposure periods.

7.1.3 *Alternative Scenario Model Results*

The key findings of the scenario modelling are summarised below:

- Scenario 1 impact (High Annual Rainfall): Scenario 1 results in an increase in bypass rate (from 5% to 7% on average) and direct discharge rate (from 10% to 12% on average) compared to the Base Case.
- Scenario 1 identified that, should consecutive high rainfall years occur, increased pumping and WTP rates may be required to stop spilling occurring from sumps.
- Scenario 2 impact (Stochastic rainfall): Scenario 2 also results in increased bypass rate (from 5% to 6% on average, with an annual variance from 2% to 9%), but a decreased direct discharge rate (from 10% to 9% on average, with an annual variance from 5.5% to 12%), less than Scenario 1.
- Scenario 3 and 4 (ELF's generating $\pm 30\%$ of the metal load compared to Base Case scenario) do not result in significant changes (to water quality guideline value exceedance frequency) compared to Base Case scenario.

In summary, modelling results suggest MFS will be able to achieve water quality within proposed water quality compliance limits and exposure periods (at defined compliance locations), even when stress tested with wet conditions and ELF source terms that are 30% worse than expected.

7.2 **Operations Phase Management Recommendations**

The following management recommendations are proposed for the Operations Phase:

- Active treatment is required from the start of the Operations Phase. Commissioning of the WTP is therefore required during the Construction Phase.
- The majority of PCOC loads originate from percolation through the ELF's and collection of their seepage is important for minimising potential effects on waterways. As such, ELF basal drainage systems should include high levels of seepage collection as a design criteria (as per model assumptions).
- Performance monitoring to confirm model inputs and results are reasonable with as-built conditions, including water quality and quantity data from:

- Background catchments.
- ELF seepage and runoff.
- Haul road runoff.
- Open pit runoff.
- Sump MIW.
- Sediment control structures.
- Sump bypass MIW.
- WTP discharge.
- MSRs discharge.
- Sump bypass infrastructure should be instrumented such that the frequency, duration, and water volume discharges is recorded and reviewed annually. Similar metrics should be recorded for WTP discharges and direct discharges.
- Demonstrate that adopted net percolation rates can be achieved through a cover system trial. Such a study would provide confidence that water quality closure objectives can be achieved in the proposed timeframes and support closure planning.
- Adaptive management processes should be followed to proactively manage water related risks.
- As more empirical data becomes available as the MFS sub-area is developed, the WLBM should be periodically benchmarked to new data and updated as needed to improve confidence in model results.

7.3 Closure Phase Management Recommendations

The following management recommendations are proposed for the Active Closure and Post Closure Phases:

- The model suggests active treatment will be required for five years following completion of mining and rehabilitation works (Operations Phase) before switching solely to passive treatment in 2058. Performance monitoring during operations will improve understanding of the likely duration of active treatment.
- Passive treatment such as MSRs are an important element of achieving water quality objectives in the Post Closure Phase. As such, early implementation of passive treatment systems and associated performance monitoring should be used as an opportunity to monitor treatment performance and inform closure planning.
- The WLBM should be updated on a routine basis to include additional performance monitoring data are available to calibrate the model (e.g., cover system performance and net percolation rates; source terms; water treatment efficiencies, etc.) to improve confidence in model results for closure.

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9 LIMITATIONS

Attention is drawn to the document “Limitations”, which is included in Appendix A of this report. The statements presented in this document are intended to provide advice on what the realistic expectations of this report should be, and to present recommendations on how to minimise the risks associated with this project. The document is not intended to reduce the level of responsibility accepted by Mine Waste Management, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in doing so.

APPENDIX A LIMITATIONS

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MWM acknowledges that this report will be relied on by a Panel appointed under the Fast-track Approvals Act 2024 and these disclaimers do not prevent that reliance.

APPENDIX B PROPOSED WATER QUALITY LIMITS

Table B-1: Proposed Water Quality Limits – Metals (Hickey, 2026)

Application (Note 1)	Guideline Value (µg/L) (Note 2)	TMF range (Note 3).	Derivation notes
Dissolved Aluminium Guideline Values (µg/L)			
	Chronic Al GV		
95% LoP. pH ≤ 6.5	500	pH: ≤ 6.5 (Note 4)	See "Note 4" for basis of change of pH threshold. This reduces set change at this pH transition. Eqn at pH 6.5, H=10, DOC=5 → 160 ug/L
95% LoP. pH > 6.5	exp(0.645×ln(DOC) + 2.255×ln(Hardness) + 1.995×pH + (-0.284×ln(Hardness)×pH) -9.898) *Note if algorithm is ≤ pH 6.5 use 500.	pH: 6.5 – 8.7 Hardness: 10 – 430 mg/L DOC: 0.08 – 12.3 mg/L	
90% LoP	95% LoP / 0.79		The adjustment factor is calculated from the Canadian chronic SSD.
80% LoP	95% LoP / 0.58		As above
Dissolved Copper Guideline Values (µg/L)			
	Chronic Cu GV		
95% LoP	DGV _{0.5} x (DOC/0.5)^0.70 where DGV _{0.5} = 0.73	pH: 6 – 8.5 Hardness: 2 – 400 mg/L DOC: 0.1 – 20 mg/L	
90% LoP	DGV _{0.5} x (DOC/0.5)^ 0.70 where DGV _{0.5} = 0.89		
80% LoP	DGV _{0.5} x (DOC/0.5)^ 0.70 where DGV _{0.5} = 1.4		
	Acute Cu GV		
95% LoP	exp (-6.6 + 0.78xpH + 0.58×ln(Hardness) + 0.70×ln(DOC)	pH: 5 – 8.8 Hardness: 3.9 – 898 mg/L DOC: 0.1 – 30 mg/L	
90% LoP	exp (-6.3 + 0.78xpH + 0.58×ln(Hardness) + 0.70×ln(DOC)		
80% LoP	exp (-5.8 + 0.78xpH + 0.58×ln(Hardness) + 0.70×ln(DOC)		
Dissolved Iron Guideline Values (µg/L)			
All LoP	500	All conditions	
Dissolved Zinc Guideline values (µg/L)			
	Chronic Zn GV		
95% LoP	exp(0.947xln(Hardness) - 0.815xpH + 0.398xln(DOC) + 4.63)	pH: 5.7 – 8.1 Hardness: 15 – 399 mg/L DOC: 0.3 – 22.9 mg/L	
90% LoP	95% LoP / 0.67		
80% LoP	95% LoP / 0.39		
	Acute Zn GV		
95% LoP	exp (2.5 - 0.12×pH + 0.6×ln(Hardness) + 0.13×ln (DOC)	pH: 5.4 – 8.5 Hardness: 14 – 826 mg/L DOC: 0.1 – 22 mg/L	
90% LoP	exp (2.9 - 0.12×pH + 0.6×ln(Hardness) + 0.13×ln (DOC)		
80% LoP	exp (3.4 - 0.12×pH + 0.6×ln(Hardness) + 0.13×ln (DOC)		
Dissolved Cobalt Guideline values (µg/L)			
	Chronic Co GV		
95% LoP	Exp((0.414xLn(hardness))-1.285)	Hardness range: 52-396 mg/L	CCME (2017). Equations for 90% and 80% protection calculated from CCME chronic data. Note: This has hardness modifier which was not in the ANZECC (2000) guidelines.
90% LoP	Exp((0.414xLn(hardness)-0.427)		
80% LoP	Exp((0.414xLn(hardness)+0.557)		
	Acute Co GV		
95% LoP	95%Chronic CoGV/0.16	Hardness range: 52-396 mg/L	Acute peak estimated based on zinc no effect acute and chronic ratio for index water quality conditions.
90% LoP	95%Chronic CoGV/0.11		
80% LoP	95%Chronic CoGV/0.062		
Dissolved Nickel Guideline values (µg/L)			
	Chronic Ni GV		
95% LoP	11x(Hardness/30)^0.85	Hardness range: 30-400 mg/L. No guidance for pH application range. Normally taken as physiological pH range as used for testing (pH 6.5-8.5)	ANZG (2018) guideline.
90% LoP	13x(Hardness/30)^0.85		
80% LoP	17x(Hardness/30)^0.85		
	Acute Ni GV		
95% LoP	95%Chronic NiGV/0.16	Hardness range: 30-400 mg/L	Acute peak estimated based on zinc no effect
90% LoP	95%Chronic NiGV/0.11		

Application (Note 1)	Guideline Value (µg/L) (Note 2)	TMF range (Note 3).	Derivation notes
80% LoP	95%Chronic NiGV/0.062		acute and chronic ratio for index water quality conditions.
	Dissolved Manganese Guideline values (µg/L)		
	Chronic Mn GV		
95% LoP	$\text{Exp}((0.411 \times \ln(\text{hardness})) + 4.46)$	Hardness range: 25-670 mg/L Simplified equation for hardness only calculated at pH 7.5. Look-up tables provided for pH 5.8 to 8.4.	CCME (2019). Equations for 90% and 80% protection calculated from CCME chronic data and used to adjust from 95% protection. Note: This has hardness modifier which was not in the ANZECC (2000) guidelines.
90% LoP	$\text{Exp}((0.411 \times \ln(\text{hardness})) + 4.89)$		
80% LoP	$\text{Exp}((0.411 \times \ln(\text{hardness})) + 5.38)$		
	Acute Mn GV		
95% LoP	$(\text{Exp}((0.878 \times \ln(\text{hardness})) + 4.84))/2.13$	Hardness range: 25-250 mg/L	CCME (2019). Equations for 90% and 80% protection calculated from CCME chronic data and used to adjust from 95% protection. Adjustment factor of 2.13 converts the acute EC50 to acute no effect based on the zinc ratio (from Gadd et al 2024).
90% LoP	$(\text{Exp}((0.878 \times \ln(\text{hardness})) + 6.90))/2.13$		
80% LoP	$(\text{Exp}((0.878 \times \ln(\text{hardness})) + 7.20))/2.13$		
	Dissolved Cadmium Guideline values (GVs, µg/L)		
	Chronic Cd GV		CCME (2014)
95% LoP	$10^{(0.83 \times \text{LOG}_{10}(\text{Hardness}) - 2.46)}$	Hardness range: 17-280 mg/L	CCME (2014). Equations for 90% and 80% protection calculated from CCME chronic data and used to adjust from 95% protection.
90% LoP	$(10^{(0.83 \times \text{LOG}_{10}(\text{Hardness}) - 2.46)}) \times 1.84$		
80% LoP	$(10^{(0.83 \times \text{LOG}_{10}(\text{Hardness}) - 2.46)}) \times 4.15$		
	Acute Cd GV		
95% LoP	$(10^{(1.016 \times \text{LOG}_{10}(\text{Hardness}) - 1.71)})/2.13$	Hardness range: 5.3-360 mg/L	CCME (2014) acute dataset. Equations for 90% and 80% protection calculated from CCME chronic data and used to adjust from 95% protection. Adjustment factor of 2.13 converts the acute EC50 to acute no effect based on the zinc ratio (from Gadd et al 2024).
90% LoP	$(10^{(1.016 \times \text{LOG}_{10}(\text{Hardness}) - 1.71)})/2.77$		
80% LoP	$(10^{(1.016 \times \text{LOG}_{10}(\text{Hardness}) - 1.71)})/9.58$		
	Nitrate-N (ANZG – hardness (H)-dependent; guideline)		
	Chronic Nitrate-N GV		
95% LoP	1100 (H<30); 2600 (H30-150); 29,000 (H >150)	Hardness dependent	ANZG (2025a)
90% LoP	1500 (H<30); 4200 (H30-150); 38,000 (H >150)		
80% LoP	2300 (H<30); 7100 (H30-150); 56,000 (H >150)		
	Acute Nitrate-NGV		
	Not available		
	Nitrate-N (NPS-FM; standard)		
	Chronic Nitrate-N Standard (median standard)		MfE (2020)
95% LoP	2400		
90% LoP	Below "bottom line"		
80% LoP	Below "bottom line"		
	Acute Nitrate-N Standard (95th percentile standard)		
95% LoP	3500		
90% LoP	Below "bottom line"		
80% LoP	Below "bottom line"		
	Chronic ammoniacal-N (ANZG guideline)		
95% LoP	1200	pH and temperature dependent. Values at pH 7 and 15°C.	ANZG (2026)
90% LoP	2000		
80% LoP	3600		
	Acute ammoniacal-N (ANZG guideline)		
	Not available		

Application (Note 1)	Guideline Value (µg/L) (Note 2)	TMF range (Note 3).	Derivation notes
	Chronic ammoniacal-N (NPS-FM median standard)		
95% LoP	580	pH dependent. Values at pH 7.	
90% LoP	Below "bottom line"		
80% LoP	Below "bottom line"		
	Acute ammoniacal-N (NPS-FM 95th percentile standard)		
95% LoP	968	pH dependent. Values at pH 8.	
90% LoP	Below "bottom line"		
80% LoP	Below "bottom line"		
	pH		
	Maintain in range 4.5 – 7.0 for WTP discharge		pH: Upper pH to be confirmed from bryophyte analysis for sites with differing levels of protection.

Note 1: The level of protection (LoP) values are species protection levels based on narrative descriptors from ANZG (2018).

Note 2: The compliance range for pH at Smokestack is 4.5 to 7.0. The equations vary in their calibrated TMF ranges. For monitored water quality values less than the lowest calibrated TMF value the calculated guideline value (GV) will apply to that monitoring occasion.

Note 3: Toxicity modifying factors (TMFs) are pH, hardness (calcium and magnesium concentrations) and dissolved organic carbon (DOC, measured as dissolved purgeable organic carbon (DPOC) in natural waters).

For pH, hardness and DOC values exceeding the TMF range use the lowest or highest calculated LoP value (except for dissolved aluminum where a 500 µg/L LoP applies to waters below pH 6.5 for all hardness and DOC concentrations).

Note 4: pH minimum for aluminum is based on the pH transition for Al³⁺ and Al-DOM (dissolved organic matter) binding which have elevated concentrations at lower pH levels. This pH threshold also corresponds to that used in the ANZG (2018) and ANZECC (2000) guidelines for Australia and New Zealand.

Table B-2: Summary of site-specific turbidity guideline values for short- and long-term protection of ecological communities, aesthetic and "Performance" (Hickey, 2026)

CLASSIFICATION/NOMINAL PROTECTION LEVEL	SHORT-TERM (ACUTE) TURBIDITY (NTU) MAXIMUM/LIMIT, EXPOSURE PERIOD	LONG-TERM (CHRONIC) TURBIDITY (NTU) MEDIAN/95TH PERCENTILE/EXPOSURE REPORTING PERIOD
Ecological – continuous ^{a,e}	550 max ^a /100, 7-d rolling median	+5 NTU median above background/+20 NTU 95th percentile/annual
Ecological – discrete ^{b,e}	550 max ^a	As above
Aesthetic ^{c,e}	n/a	+50% change from background for median and 95th percentile background; >1.6 m median clarity ^f
Performance ^{d,e}	n/a	25 NTU 15-sample rolling median

a) Continuous monitoring with 10-min logging frequency and targeting >90% data capture after quality control and clean up procedures for reporting period – to exclude potential spurious instrumental values or debris contacting probe. The 7-d rolling median assessed weekly based on telemetered data. Discrete daily sampling should be used for easily accessible sites upstream and downstream of a WTP. Sites must have reliable access for sample collection during high flow events.

b) Discrete compliance assessment will differ with monitoring frequency (see Hickey (2026)).

c) Aesthetic compliance assessment for mine-related effects based on continuous monitoring at plateau compliance sites and calculated flow adjustment. Weekly or monthly discrete sampling at SH67 to validate upstream monitoring adjustments (Compliance assessment for discrete monitoring sample numbers provided in Hickey (2026)).

d) Proposed limit for "Performance" assumed to be based on weekly or monthly discrete sampling (see Hickey (2026)). Key sites could be assessed based on continuous (10-min averaging) or discrete daily monitoring.

e) All measurements to exclude "extreme event" flood conditions. A proposed 1 in 10-year rainfall event is proposed as an extreme event (see Hickey (2026)).

f) A site-specific relationship between turbidity and visual clarity will need to be developed from representative stream samples.

APPENDIX C MODELLED CATCHMENT AREAS

Table C-1: Catchment areas incorporated into the WLBm.

YEAR	FILL (m ²)	CUT (m ²)	WATER (m ²)	BACKGROUND (m ²)	REHAB (m ²)	HARDSTAND (m ²)	COAL (m ²)
MFE1							
2029	0	0	0	410,344	0	0	0
2034	0	3	0	410,341	0	0	0
2035	0	91,327	0	193,620	0	0	53,165
2036	0	91,327	0	193,620	0	0	53,165
2037	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0
2042	121,433	68,900	23,970	77,454	257,922	0	43,180
2043	0	76,343	23,970	41,449	407,841	0	42,963
3000	0	76,343	23,970	41,449	407,841	0	42,963
MFE1A							
2029	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	194,854	45,179	0	53,054	26,545	0	40,240
2041	194,854	45,179	0	53,054	26,545	0	40,240
2042	0	0	0	0	0	0	0
3000	0	0	0	0	0	0	0
MFE1B							
2029	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	8,379	0	1,164	0	0	19,557
2041	0	8,379	0	1,164	0	0	19,557
2042	0	0	0	0	0	0	0
3000	0	0	0	0	0	0	0
MFE1C							
2029	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	12,182	103	0	89,011	0	0	0
2041	12,182	103	0	89,011	0	0	0
2042	0	0	0	0	0	0	0
3000	0	0	0	0	0	0	0
MFE1D							
2029	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	24,448	41,811	0	27,382	0	0	40,091
2041	24,448	41,811	0	27,382	0	0	40,091
2042	0	0	0	0	0	0	0

YEAR	FILL (m ²)	CUT (m ²)	WATER (m ²)	BACKGROUND (m ²)	REHAB (m ²)	HARDSTAND (m ²)	COAL (m ²)
3000	0	0	0	0	0	0	0
MFE2							
2029	0	0	0	464,915	0	0	0
2034	0	0	0	464,915	0	0	0
2035	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	91,276	0	0	0
2041	0	0	0	91,276	0	0	0
2042	0	23,904	0	17,702	4,854	0	76,166
2043	0	23,880	0	10,194	12,386	0	76,166
3000	0	23,880	0	10,194	12,386	0	76,166
MFE2A							
2029	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	169,082	0	0	0
2036	0	0	0	169,082	0	0	0
2037	0	0	0	0	0	0	0
3000	0	0	0	0	0	0	0
MFE2B							
2029	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	7,425	0	0	0
2036	0	0	0	7,425	0	0	0
2037	0	0	0	0	0	0	0
3000	0	0	0	0	0	0	0
MFE2C							
2029	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	279,060	0	0	0
2036	0	0	0	279,060	0	0	0
2037	0	0	0	0	0	0	0
3000	0	0	0	0	0	0	0
MFW1							
2029	49,725	11,055	39,813	38,032	38,551	0	0
2034	49,725	11,055	39,813	38,032	38,551	0	0
2035	15,856	11,200	39,813	37,825	56,806	0	0
2036	15,856	11,200	39,813	37,825	56,806	0	0

YEAR	FILL	CUT	WATER	BACKGROUND	REHAB	HARDSTAND	COAL
	(m ²)	(m ²)	(m ²)	(m ²)	(m ²)	(m ²)	(m ²)
2037	0	11,200	39,813	37,825	72,662	0	0
2042	0	11,200	39,813	37,825	72,662	0	0
2043	0	11,160	39,813	37,825	72,702	0	0
3000	0	11,160	39,813	37,825	72,702	0	0

MFW2

2029	30,316	1,996	0	5,605	35,935	0	0
2034	30,316	1,996	0	5,605	35,935	0	0
2035	30,745	2,056	0	5,153	39,166	0	0
2036	30,745	2,056	0	5,153	39,166	0	0
2037	26,009	2,056	0	5,639	43,901	0	0
2042	26,009	2,056	0	5,639	43,901	0	0
2043	0	3,366	0	5,639	68,944	0	0
3000	0	3,366	0	5,639	68,944	0	0

MFW3

2029	45,860	13,218	0	8,099	21,627	0	23,697
2034	45,860	13,218	0	8,099	21,627	0	23,697
2035	34,260	9,739	0	7,106	26,205	0	0
2036	34,260	9,739	0	7,106	26,205	0	0
2037	5,564	9,739	0	7,534	54,901	0	0
2042	5,564	9,739	0	7,534	54,901	0	0
2043	0	4,512	0	7,534	65,254	0	0
3000	0	4,512	0	7,534	65,254	0	0

MFW4

2029	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	110,426	2,903	0	559	20,876	0	0
2036	110,426	2,903	0	559	20,876	0	0
2037	0	2,903	0	559	131,302	0	0
2042	0	2,903	0	559	131,302	0	0
2043	0	2,903	0	559	131,302	0	0
3000	0	2,903	0	559	131,302	0	0

MFW5

2029	0	0	0	97,835	0	0	0
2034	1,132	4,465	0	91,885	354	0	0
2035	22	4,443	0	91,885	1,486	0	0
2036	22	4,443	0	91,885	1,486	0	0
2039	0	4,443	0	91,885	1,508	0	0
2042	0	4,443	0	91,885	1,508	0	0

YEAR	FILL	CUT	WATER	BACKGROUND	REHAB	HARDSTAND	COAL
	(m ²)	(m ²)	(m ²)	(m ²)	(m ²)	(m ²)	(m ²)
2043	0	4,443	0	91,885	1,508	0	0
3000	0	4,443	0	91,885	1,508	0	0
MFW6							
2029	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	29,411	1,539	0	4,155	0	0	0
2036	29,411	1,539	0	4,155	0	0	0
2037	12,794	1,538	0	2,146	18,626	0	0
2042	12,794	1,538	0	2,146	18,626	0	0
2043	0	4,073	0	2,146	28,890	0	0
3000	0	4,073	0	2,146	28,890	0	0
MFW7							
2029	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	11,177	0	0	835	3,772	3,845	0
2036	11,177	0	0	835	3,772	3,845	0
2037	412	0	0	835	14,537	3,845	0
2042	412	0	0	835	14,537	3,845	0
2043	0	0	0	835	14,537	4,257	0
3000	0	0	0	835	14,537	4,257	0
MFW8							
2029	0	0	0	28,642	0	89	0
2034	0	0	0	28,636	0	89	6
2035	1,170	0	0	13,836	0	13,726	0
2036	1,170	0	0	13,836	0	13,726	0
2037	0	0	0	9,891	5,115	13,726	0
2041	0	0	0	9,891	5,115	13,726	0
2042	0	0	0	9,628	5,115	13,726	0
2043	0	0	0	9,628	10,363	8,763	0
3000	0	0	0	9,628	10,363	8,763	0
MFW9							
2029	0	0	0	266,250	0	0	0
2034	41,282	99,727	0	27,183	7,828	0	90,229
2035	94,953	6,711	0	5,405	0	0	0
2036	94,953	6,711	0	5,405	0	0	0
2037	0	4,763	0	1,400	100,948	0	0
2042	0	4,763	0	1,400	100,948	0	0
2043	0	4,763	0	1,400	100,948	0	0

YEAR	FILL	CUT	WATER	BACKGROUND	REHAB	HARDSTAND	COAL
	(m ²)	(m ²)	(m ²)	(m ²)	(m ²)	(m ²)	(m ²)
3000	0	4,763	0	1,400	100,948	0	0
MFW9a							
2029	0	0	0	20,156	0	0	0
2034	0	183	0	19,973	0	0	0
2035	0	0	0	0	0	0	0
3000	0	0	0	0	0	0	0
MFW10							
2029	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	30,356	3,339	0	2,667	0	0	0
2036	30,356	3,339	0	2,667	0	0	0
2037	0	1,810	0	670	33,882	0	0
2041	0	1,810	0	670	33,882	0	0
2042	0	1,810	0	670	33,882	0	0
3000	0	1,810	0	670	33,882	0	0
MFA2							
2029	0	0	0	447,087	0	1,013	0
2034	0	0	0	447,087	0	1,013	0
2036	0	0	0	447,087	0	1,013	0
2039	0	0	0	447,087	0	1,013	0
2042	0	0	0	447,087	0	1,013	0
2043	0	0	0	447,087	171	842	0
3000	0	0	0	447,087	171	842	0
MFC1							
2029	1,726	0	0	3,025,734	2,297	1,111	0
2034	1,726	0	0	3,025,734	2,297	1,111	0
2035	1,718	0	0	3,025,447	2,305	1,398	0
2036	1,718	0	0	3,025,447	2,305	1,398	0
2037	1,718	0	0	3,024,696	2,305	1,979	171
2039	1,718	0	0	3,024,696	2,305	1,979	171
2041	1,718	0	0	3,024,696	2,305	1,979	171
2042	1,718	0	14	3,023,208	2,318	3,558	51
2043	0	0	14	3,023,208	2,560	5,035	51
3000	0	0	14	3,023,208	2,560	5,035	51
MFC2							
2029	0	0	0	72,602	0	0	0
2033	0	0	0	72,602	0	0	0

YEAR	FILL (m ²)	CUT (m ²)	WATER (m ²)	BACKGROUND (m ²)	REHAB (m ²)	HARDSTAND (m ²)	COAL (m ²)
2034	0	0	0	72,048	0	554	0
2035	0	0	0	69,390	0	3,212	0
2036	0	0	0	69,390	0	3,212	0
2037	0	0	0	69,390	60	3,152	0
2039	0	0	0	69,390	60	3,152	0
2041	0	0	0	69,390	60	3,152	0
2042	0	0	0	69,383	60	3,152	0
2043	0	0	0	69,383	71	3,148	0
3000	0	0	0	69,383	71	3,148	0

MFCWD1

2029	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0
2035	0	0	0	72,247	0	109	0
2036	0	0	0	72,247	0	109	0
2037	0	0	0	72,247	0	109	0
2039	0	0	0	72,247	0	109	0
2041	0	0	0	72,247	0	109	0
2042	0	0	0	72,247	0	109	0
2043	0	0	0	71,672	575	109	0
3000	0	0	0	71,672	575	109	0

MFCWD2

2029	0	0	0	221,508	0	0	0
2033	0	0	0	221,508	0	0	0
2034	0	0	0	213,849	0	7,660	0
2035	0	0	0	213,836	0	7,677	0
2036	0	0	0	213,836	0	7,677	0
2037	0	0	0	213,836	0	7,677	0
2039	0	0	0	213,836	0	7,677	0
2041	0	0	0	213,836	0	7,677	0
2042	0	0	0	213,836	0	7,673	0
2043	0	0	0	211,226	2,610	7,673	0
3000	0	0	0	211,226	2,610	7,673	0

MFCWD3

2029	0	0	0	70,900	0	0	0
2033	0	0	0	70,900	0	0	0
2034	0	0	0	70,874	0	27	0
2035	0	0	0	77,019	0	3,130	0
2036	0	0	0	77,019	0	3,130	0
2037	0	0	0	67,515	0	3,828	0

YEAR	FILL	CUT	WATER	BACKGROUND	REHAB	HARDSTAND	COAL
	(m ²)	(m ²)	(m ²)	(m ²)	(m ²)	(m ²)	(m ²)
2039	0	0	0	67,515	0	3,828	0
2041	0	0	0	67,515	0	3,828	0
2042	0	0	0	67,517	0	3,388	0
2043	0	0	0	66,722	790	3,388	0
3000	0	0	0	66,722	790	3,388	0
MFCWD4							
2029	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0
2037	0	0	0	84,186	0	4,039	0
2039	0	0	0	84,186	0	4,039	0
2041	0	0	0	84,186	0	4,039	0
2042	0	0	0	83,513	0	4,039	0
2043	0	0	0	81,905	1,674	4,039	0
3000	0	0	0	81,905	1,674	4,039	0
MFI1							
2029	27,417	0	0	126,849	5,160	7,075	0
2034	27,417	0	0	126,849	5,160	7,075	0
2036	27,417	0	0	126,849	5,160	7,075	0
2039	27,417	0	0	126,849	5,160	7,075	0
2042	27,417	0	0	126,847	5,160	7,065	0
2043	0	0	0	126,847	30,443	9,209	0
3000	0	0	0	126,847	30,443	9,209	0
MFI2							
2029	0	0	0	779	0	17,421	0
2034	0	0	0	779	0	17,421	0
2036	0	0	0	779	0	17,421	0
2039	0	0	0	779	0	17,421	0
2042	0	0	0	779	0	17,421	0
2043	0	0	0	779	198	17,223	0
3000	0	0	0	779	198	17,223	0
MFI3							
2029	19,826	0	0	669,519	7,365	19,790	0
2034	19,826	0	0	669,519	7,365	19,790	0
2036	19,826	0	0	669,519	7,365	19,790	0
2039	19,826	0	0	669,519	7,365	19,790	0
2042	19,826	0	0	669,521	7,365	19,789	0
2043	0	0	0	669,521	26,978	20,003	0
3000	0	0	0	669,521	26,978	20,003	0

YEAR	FILL (m ²)	CUT (m ²)	WATER (m ²)	BACKGROUND (m ²)	REHAB (m ²)	HARDSTAND (m ²)	COAL (m ²)
MFI4							
2029	0	0	0	187,200	0	0	0
2034	0	0	0	187,200	0	0	0
2036	0	0	0	187,200	0	0	0
2039	0	0	0	187,200	0	0	0
2042	0	0	0	187,200	0	0	0
3000	0	0	0	187,200	0	0	0
MFI5							
2029	32,950	0	0	404,363	0	23,587	0
2034	56	0	0	404,363	32,894	23,587	0
2036	56	0	0	404,273	32,894	23,587	0
2039	56	0	0	404,363	32,894	23,587	0
2042	56	0	0	404,192	32,894	23,587	0
2043	0	0	0	404,102	41,636	15,072	0
3000	0	0	0	404,102	41,636	15,072	0
MFI6							
2029	45,655	0	0	578,573	0	23	0
2034	5,832	0	0	578,573	39,822	23	0
2036	5,832	0	0	578,573	39,822	23	0
2039	5,832	0	0	578,573	39,822	23	0
2042	5,832	0	0	578,573	39,822	23	0
2043	0	0	0	578,573	45,638	39	0
3000	0	0	0	578,573	45,638	39	0

Note, linear interpolation occurs between years, on an annual basis

APPENDIX D ELF SEEPAGE INPUTS

Table D-1: ELF footprint and rehabilitation.

YEAR	FOOTPRINT (m ²)	REHAB PROPORTION
ME1		
2029	0	0
2036	0	0
2037	206,089	0.12
2042	317,705	0.68
2043	317,705	1
3000	317,705	1
ME2		
2029	0	0
2036	0	0
2037	39,758	0
2042	39,758	1
3000	39,758	1
ME3		
2029	0	0
2036	0	0
2037	12,182	0
2041	22,055	0
2042	24,523	1
3000	24,523	1
MW0		
2029	61,571	1
3000	61,571	1
MW1		
2029	98,272	0.36
2034	98,272	0.7
2042	98,272	0.7
2043	98,272	1
3000	98,272	1
MW2		
2029	0	0

YEAR	FOOTPRINT (m ²)	REHAB PROPORTION
2033	126,679	0
2034	158,349	0.3
2035	190,019	0.5
2036	190,019	0.5
2037	190,019	1
3000	190,019	1
MW3		
2029	45,097	0
2033	45,097	0
2034	45,097	0.25
2036	45,097	0.25
2037	45,097	1
3000	45,097	1
MW4		
2029	202,212	0
2034	202,212	0
2036	202,212	0
2037	202,212	1
3000	202,212	1
MDC1		
2029	6,033	1
3000	6,033	1
MDC2		
2029	5,319	1
3000	5,319	1
MCP1		
2029	29,323	0.21
2042	29,323	0.21
2043	29,323	1
3000	29,323	1
MCP2		
2029	29,350	0.21

YEAR	FOOTPRINT (m ²)	REHAB PROPORTION
2042	29,350	0.21
2043	29,350	1
3000	29,350	1

Note: linear interpolation occurs between years, on an annual basis

APPENDIX E FULL WATER QUALITY RESULTS

1. STATION SW01

1.1 30-DAY ROLLING MEDIAN

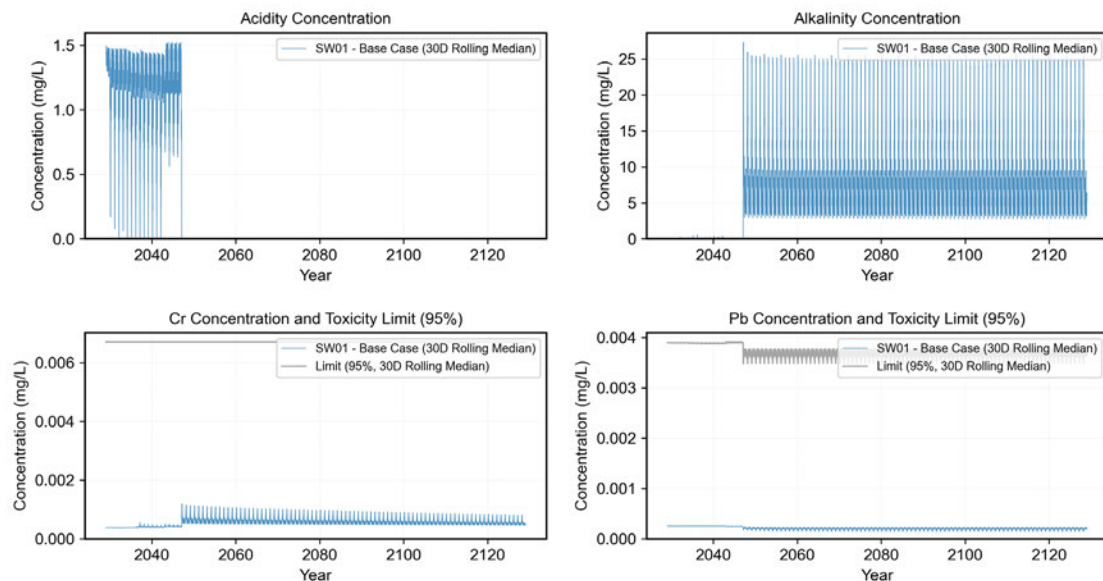


Figure 1: Matrix plot Base Case SW01 Acidity Alkalinity Cr Pb

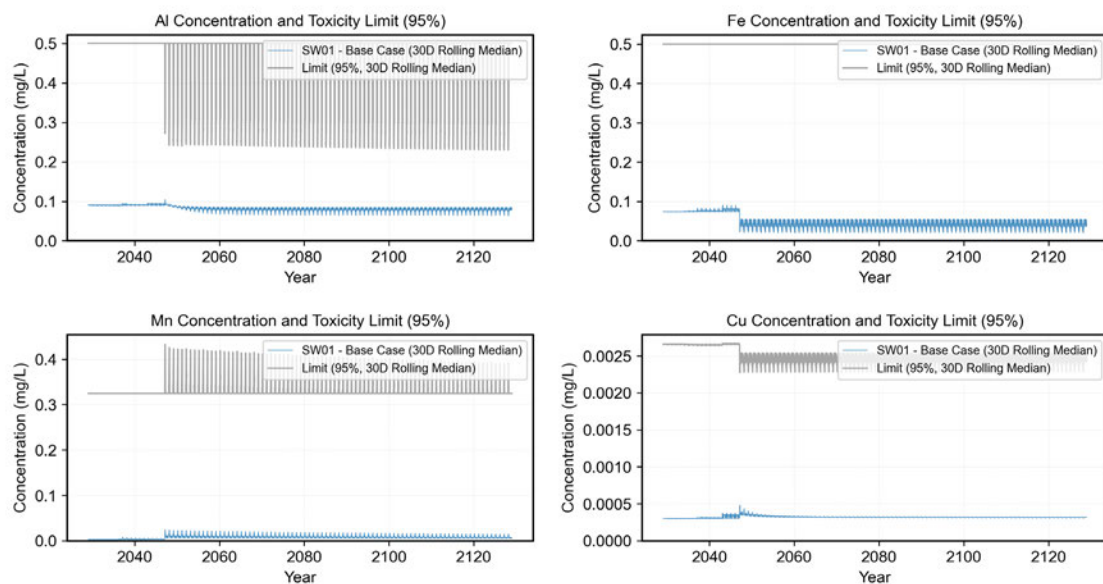


Figure 2: Matrix plot Base Case SW01 Al Fe Mn Cu

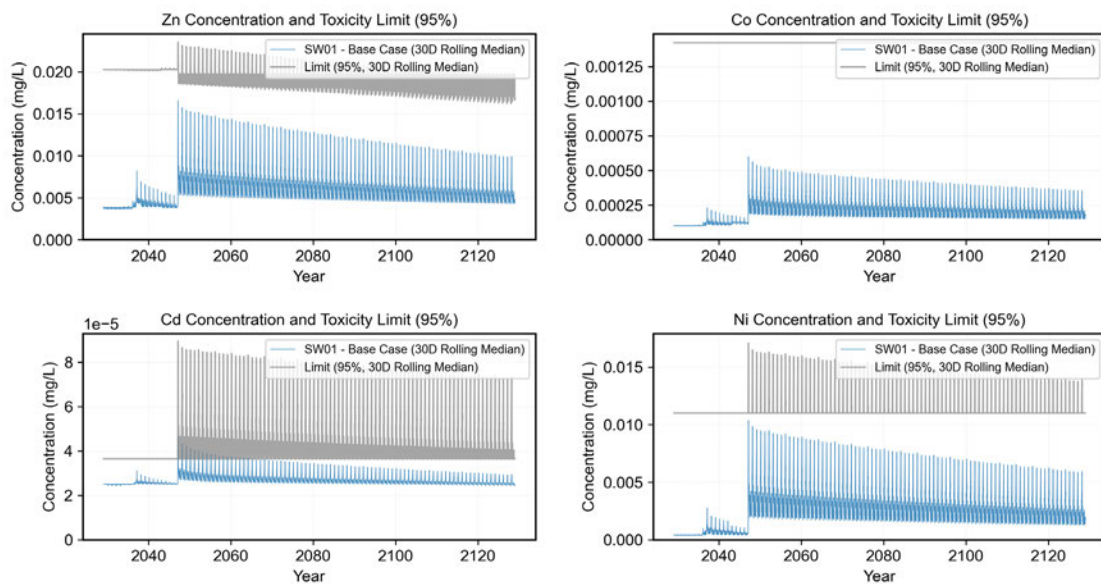


Figure 3: Matrix plot Base Case SW01 Zn Co Cd Ni

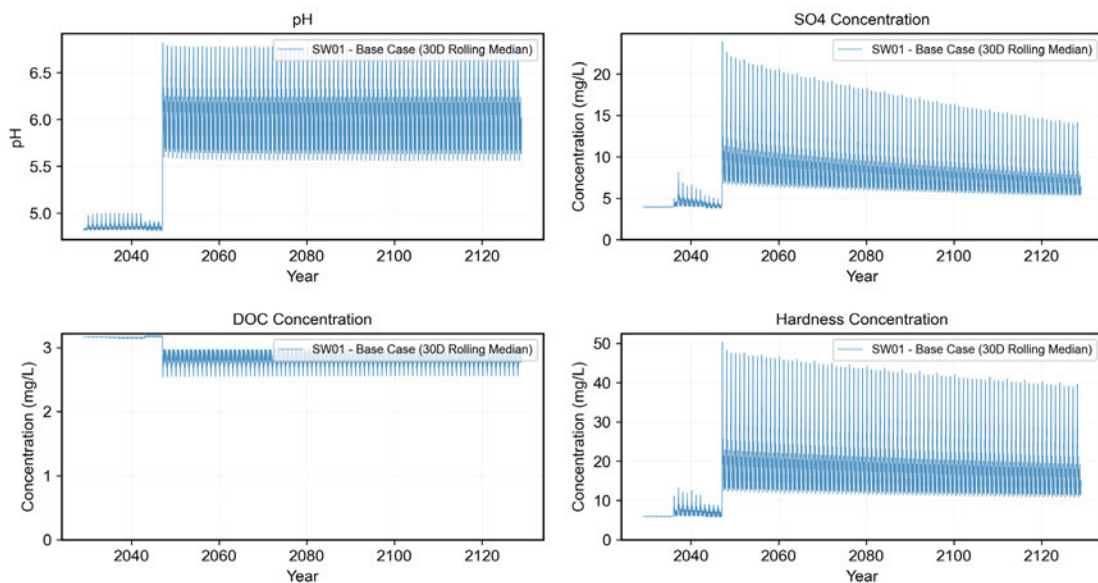


Figure 4: Matrix plot Base Case SW01 pH SO4 DOC Hardness

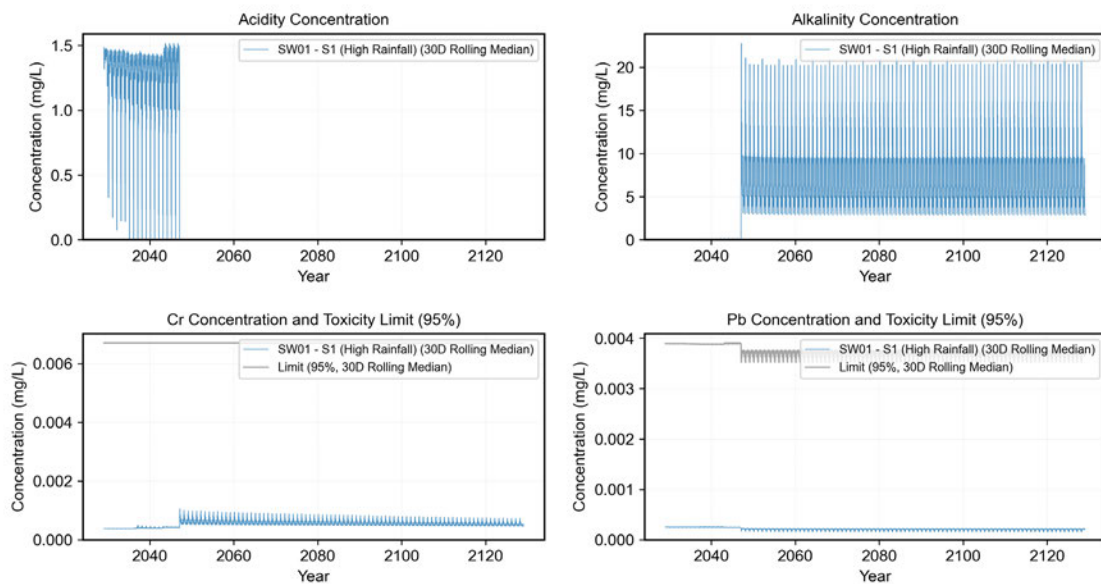


Figure 5: Matrix plot S1 (High Rainfall) SW01 Acidity Alkalinity Cr Pb

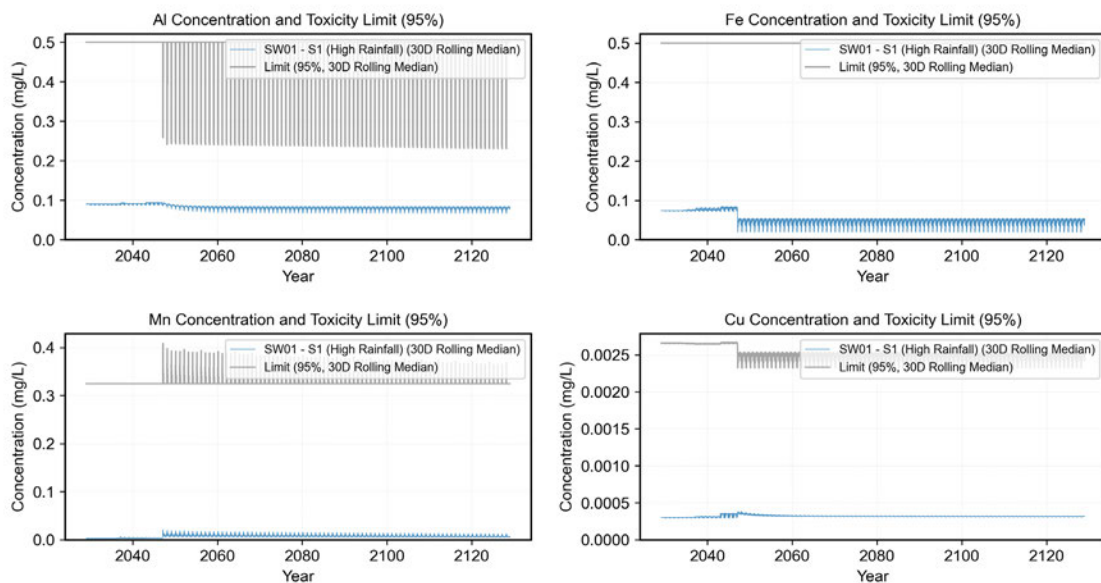


Figure 6: Matrix plot S1 (High Rainfall) SW01 Al Fe Mn Cu

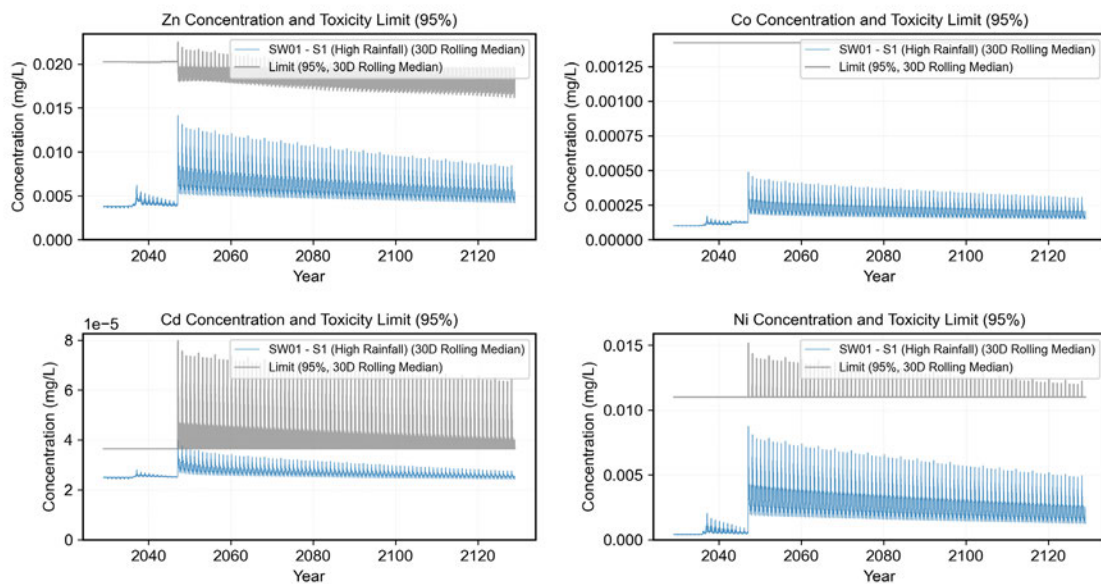


Figure 7: Matrix plot S1 (High Rainfall) SW01 Zn Co Cd Ni

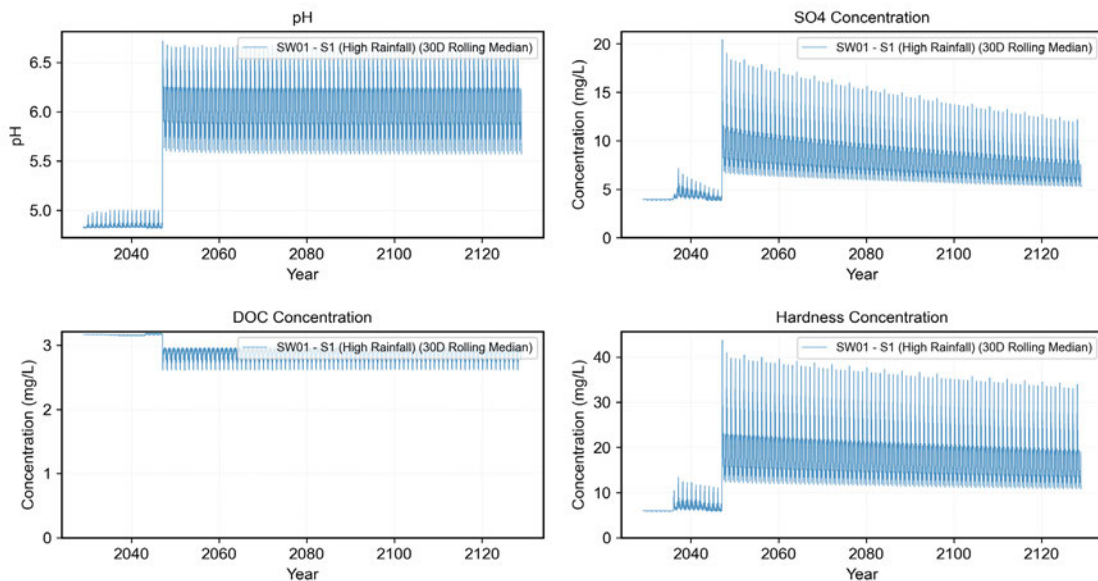


Figure 8: Matrix plot S1 (High Rainfall) SW01 pH SO4 DOC Hardness

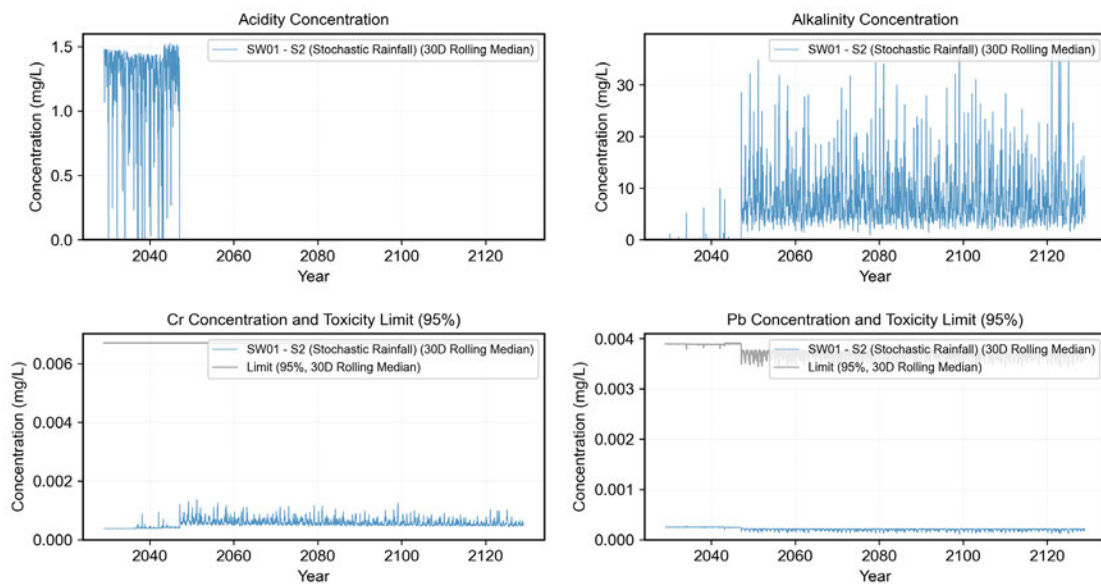


Figure 9: Matrix plot S2 (Stochastic Rainfall) SW01 Acidity Alkalinity Cr Pb

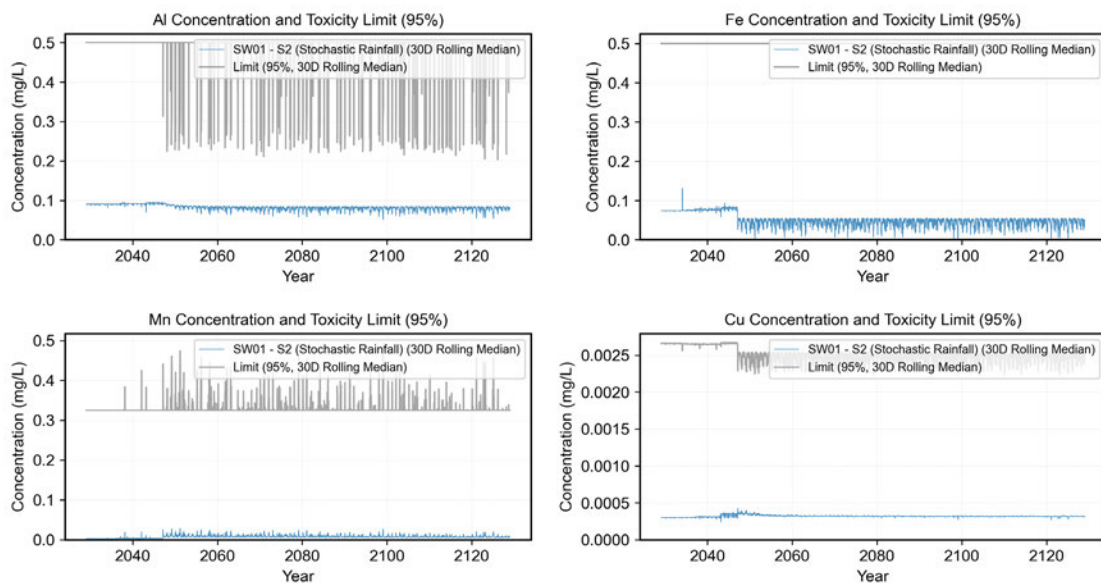


Figure 10: Matrix plot S2 (Stochastic Rainfall) SW01 Al Fe Mn Cu

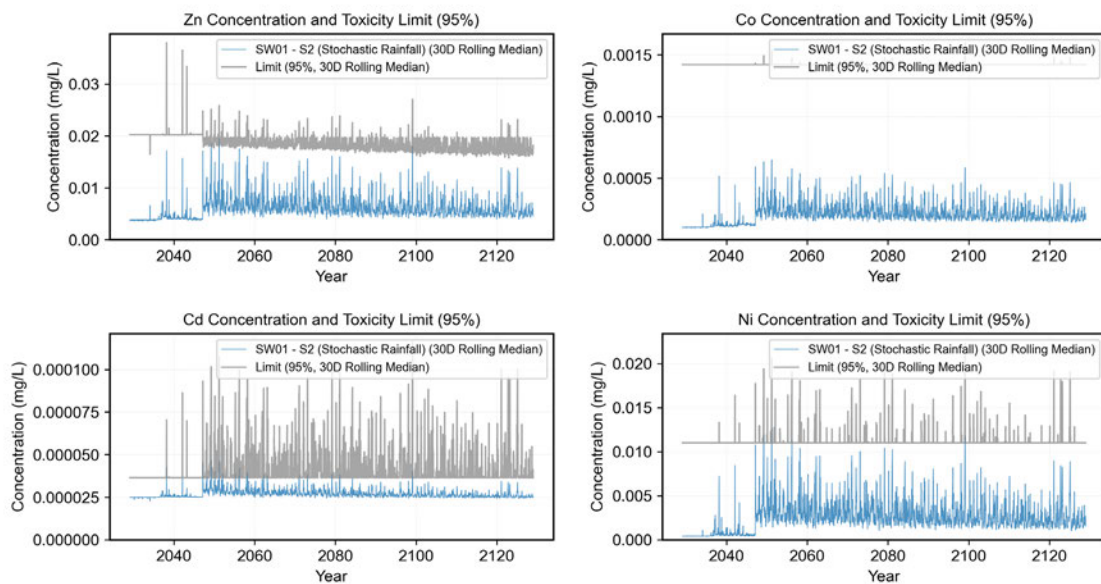


Figure 11: Matrix plot S2 (Stochastic Rainfall) SW01 Zn Co Cd Ni

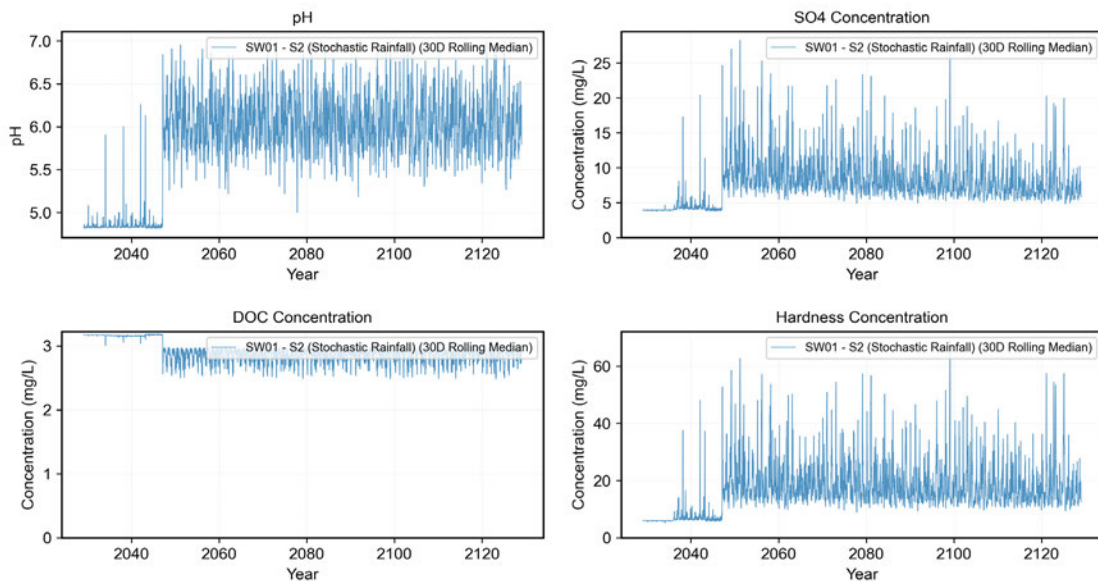


Figure 12: Matrix plot S2 (Stochastic Rainfall) SW01 pH SO4 DOC Hardness

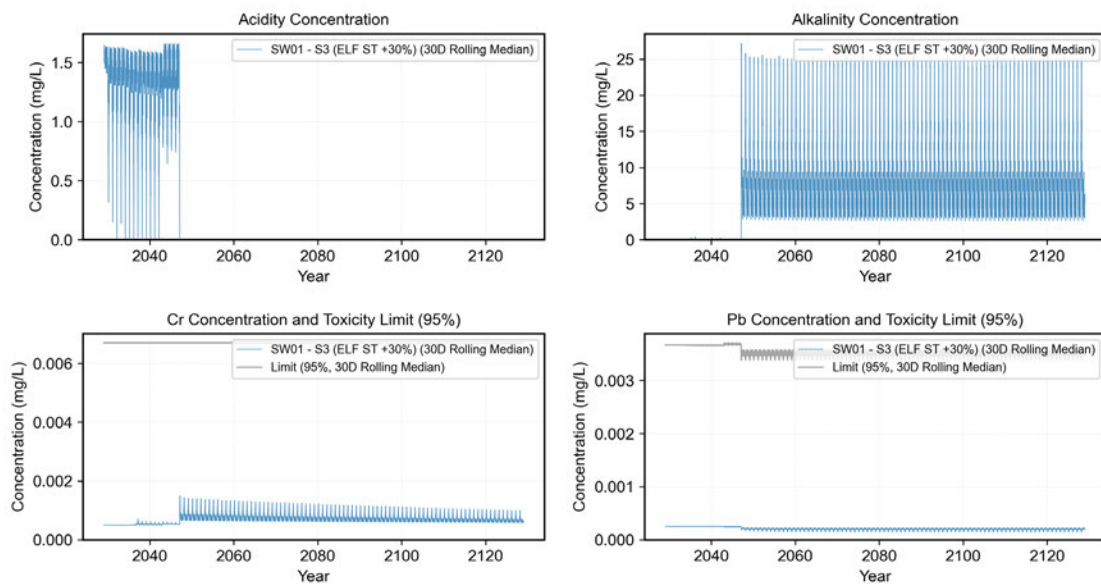


Figure 13: Matrix plot S3 (Elf St +30%) SW01 Acidity Alkalinity Cr Pb

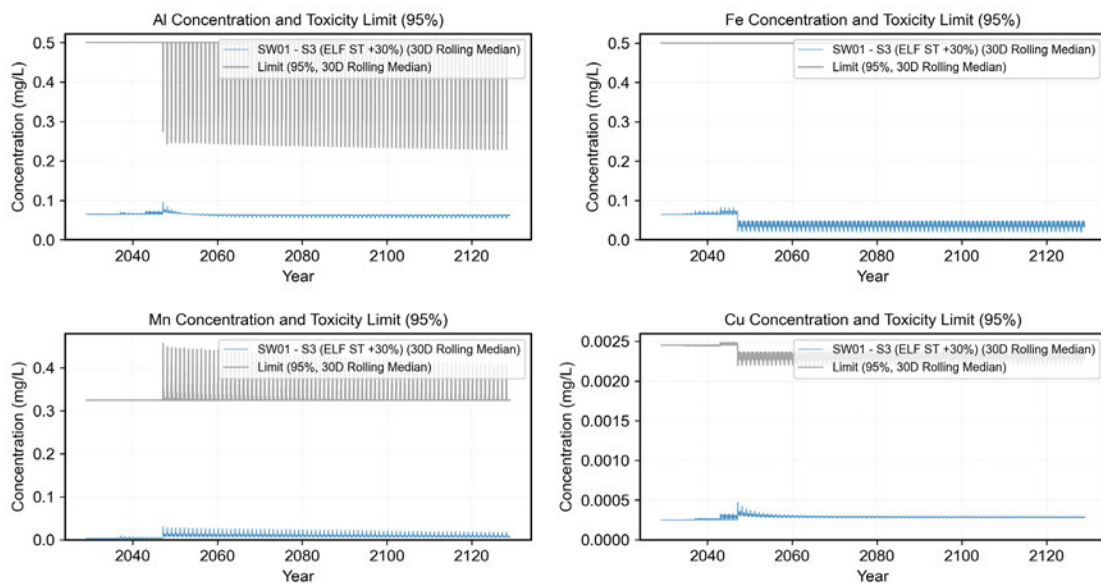


Figure 14: Matrix plot S3 (Elf St +30%) SW01 Al Fe Mn Cu

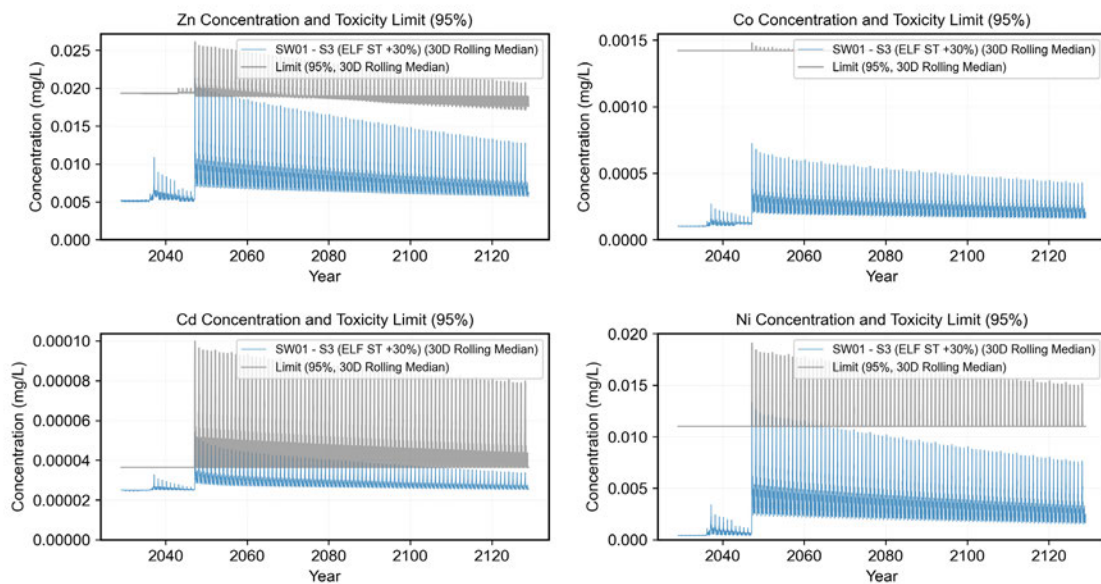


Figure 15: Matrix plot S3 (Elf St +30%) SW01 Zn Co Cd Ni

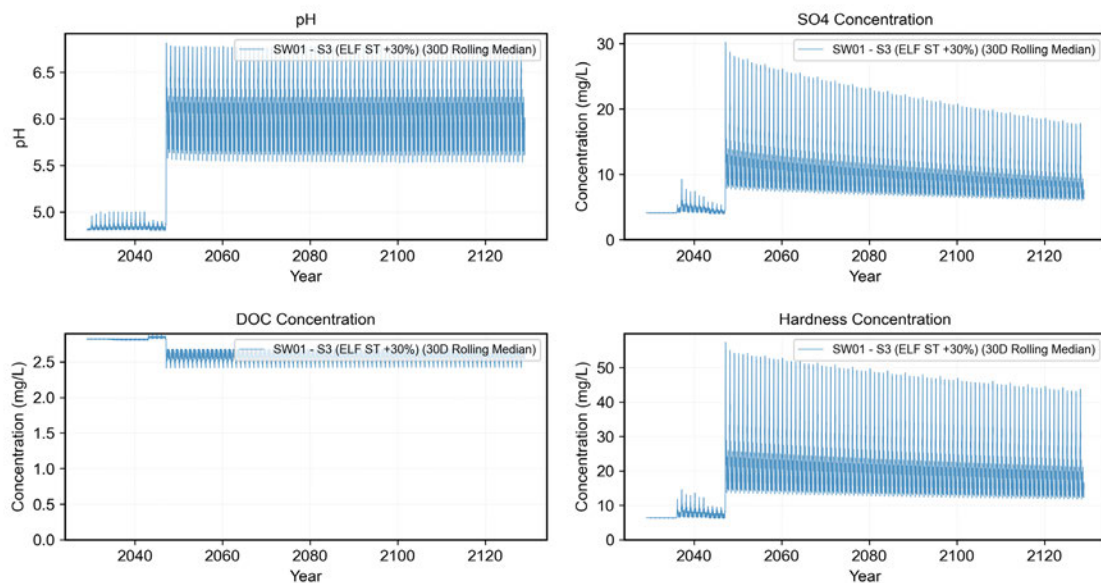


Figure 16: Matrix plot S3 (Elf St +30%) SW01 pH SO4 DOC Hardness

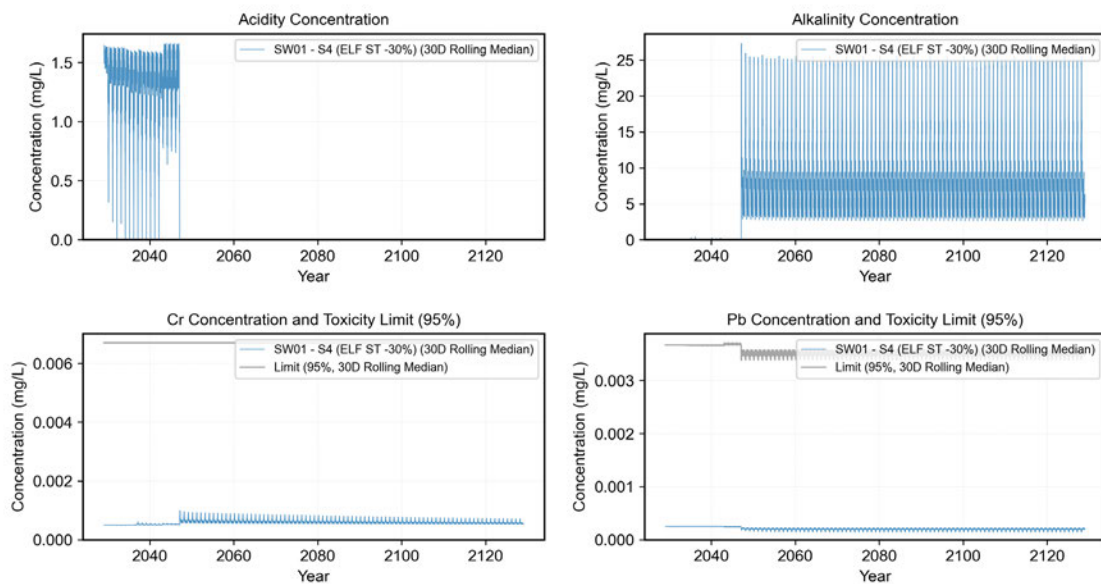


Figure 17: Matrix plot S4 (Elf St 30%) SW01 Acidity Alkalinity Cr Pb

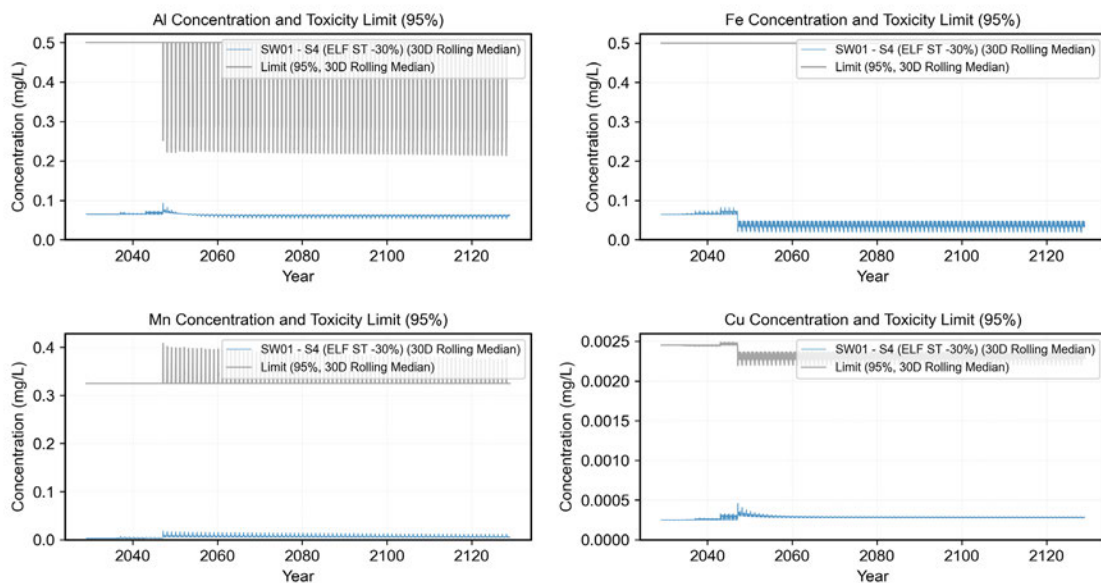


Figure 18: Matrix plot S4 (Elf St 30%) SW01 Al Fe Mn Cu

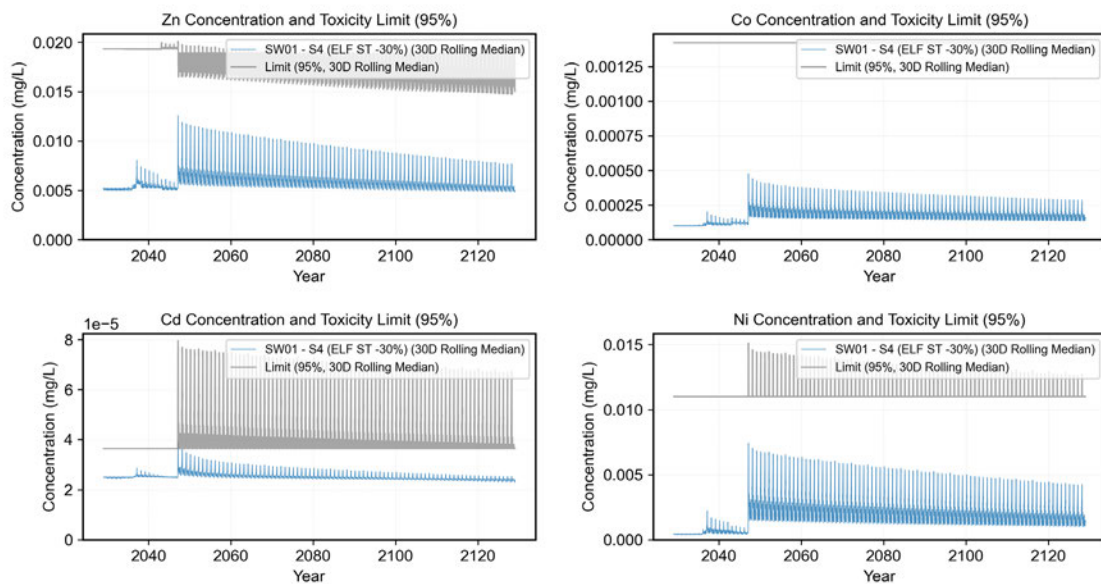


Figure 19: Matrix plot S4 (Elf St 30%) SW01 Zn Co Cd Ni

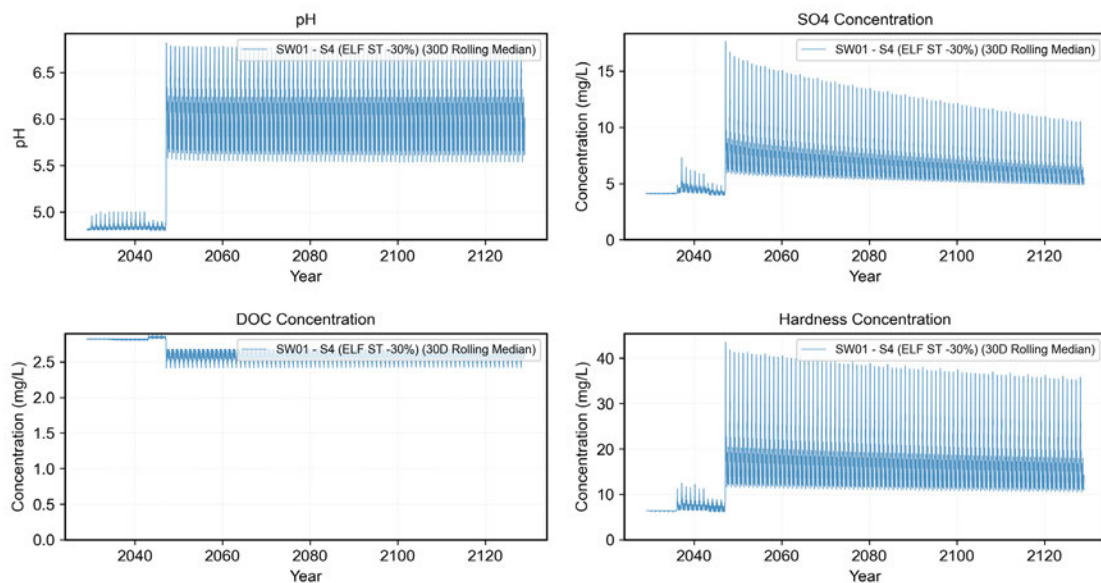
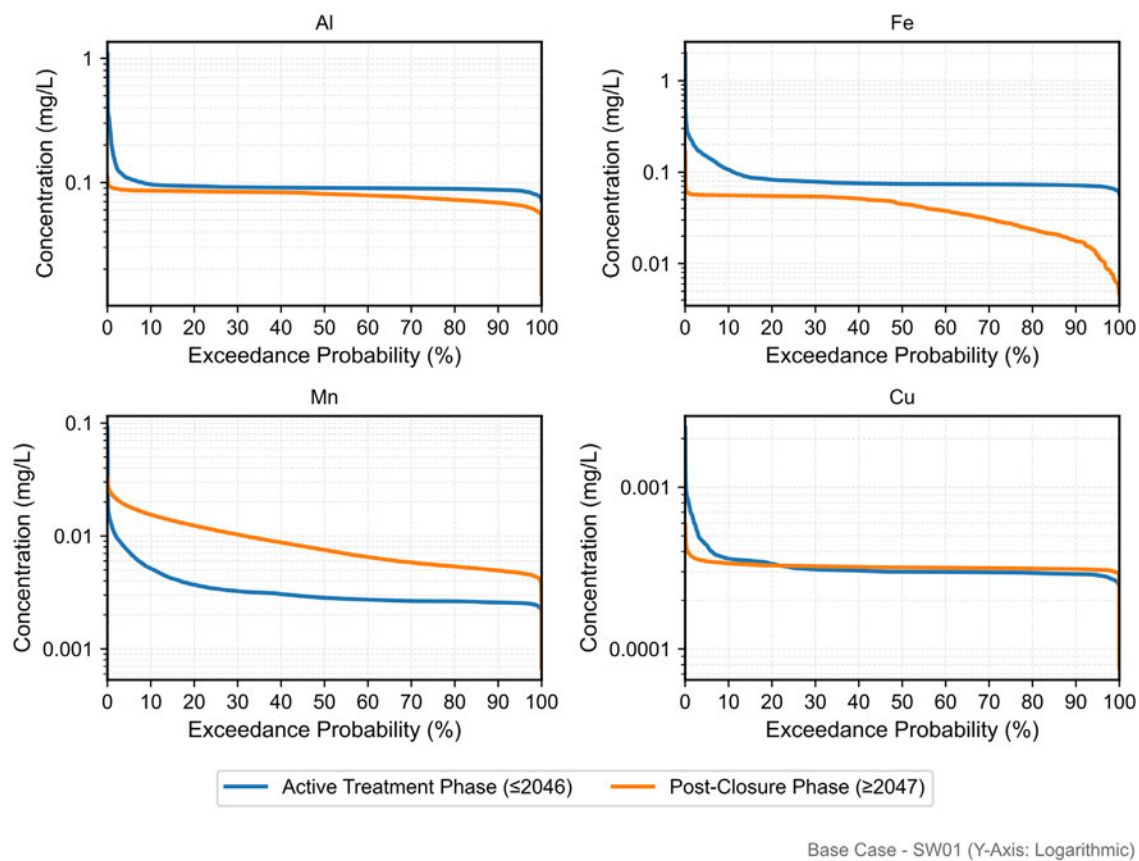
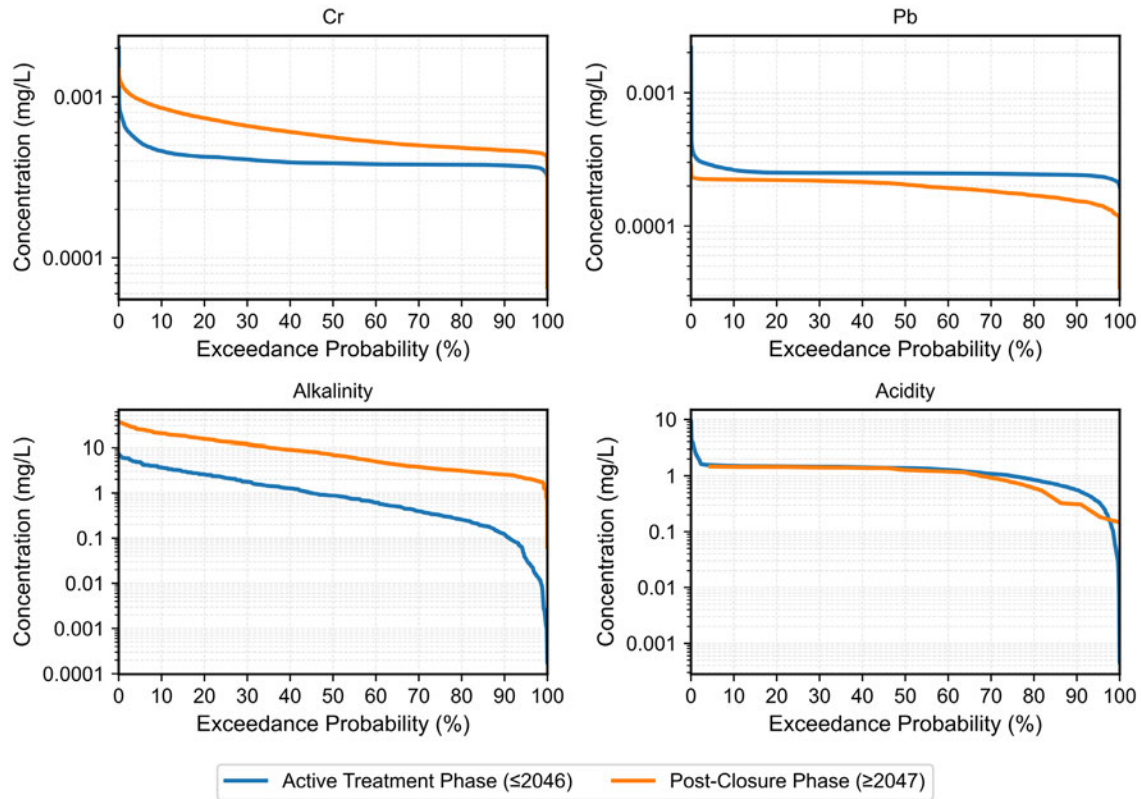


Figure 20: Matrix plot S4 (Elf St 30%) SW01 pH SO4 DOC Hardness

1.2 CONCENTRATION EXCEEDANCE (SINGLE SCENARIO)**Figure 21:** Base Case SW01 Concentration Exceedance Probability Al Fe Mn Cu



Base Case - SW01 (Y-Axis: Logarithmic)

Figure 22: Base Case SW01 Concentration Exceedance Probability Cr Pb Alk Acid

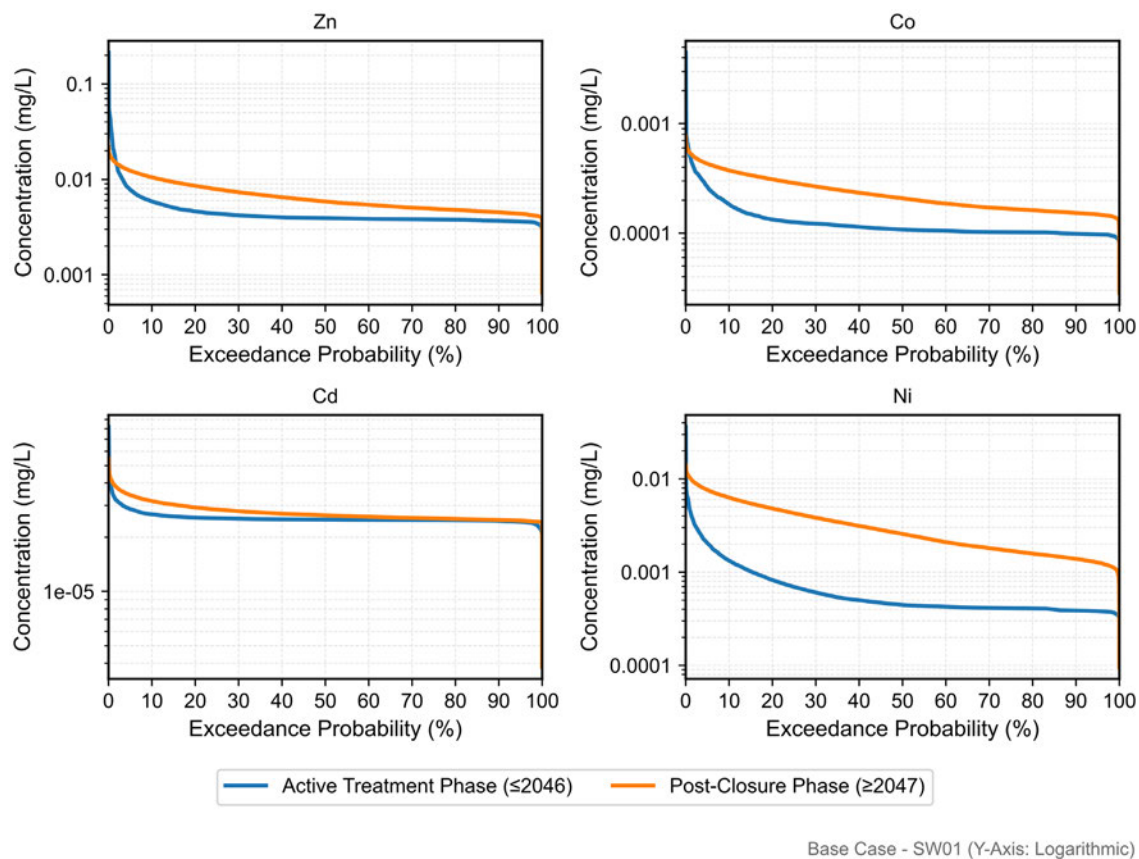


Figure 23: Base Case SW01 Concentration Exceedance Probability Zn Co Cd Ni

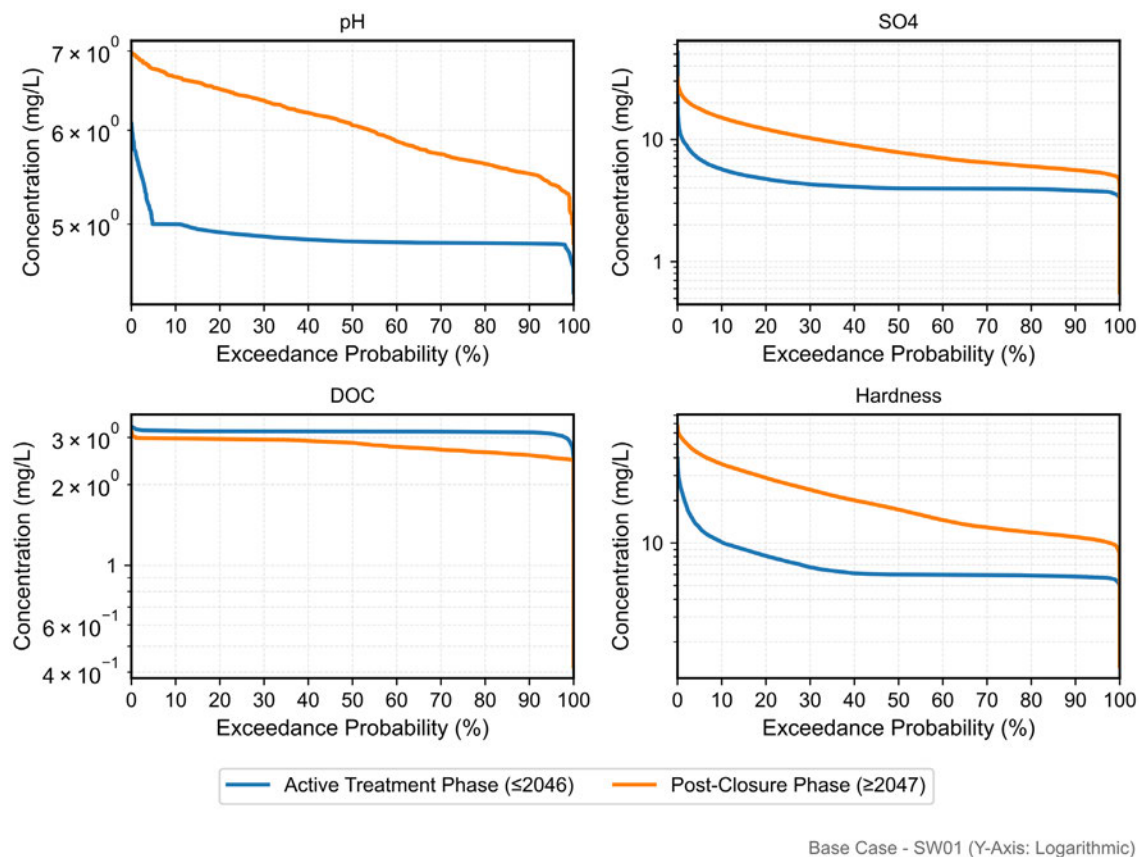


Figure 24: Base Case SW01 Concentration Exceedance Probability pH SO₄ DOC Hardness

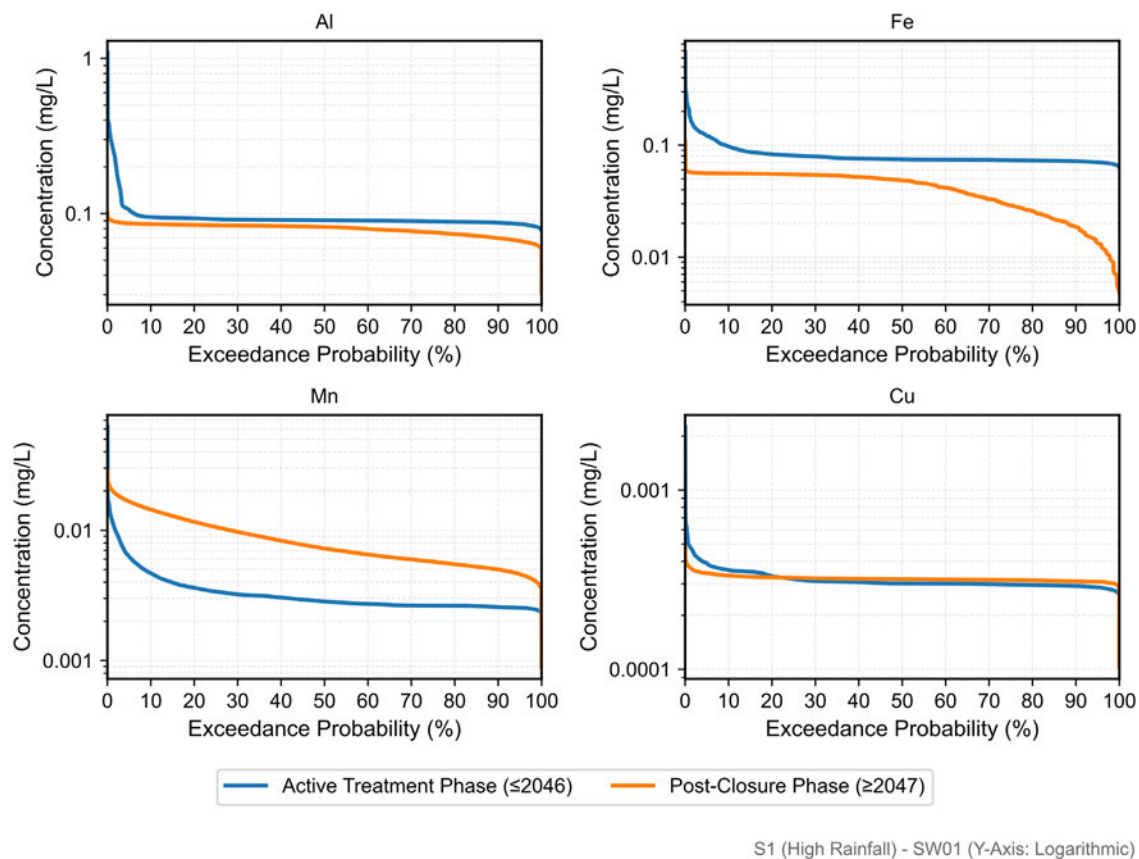
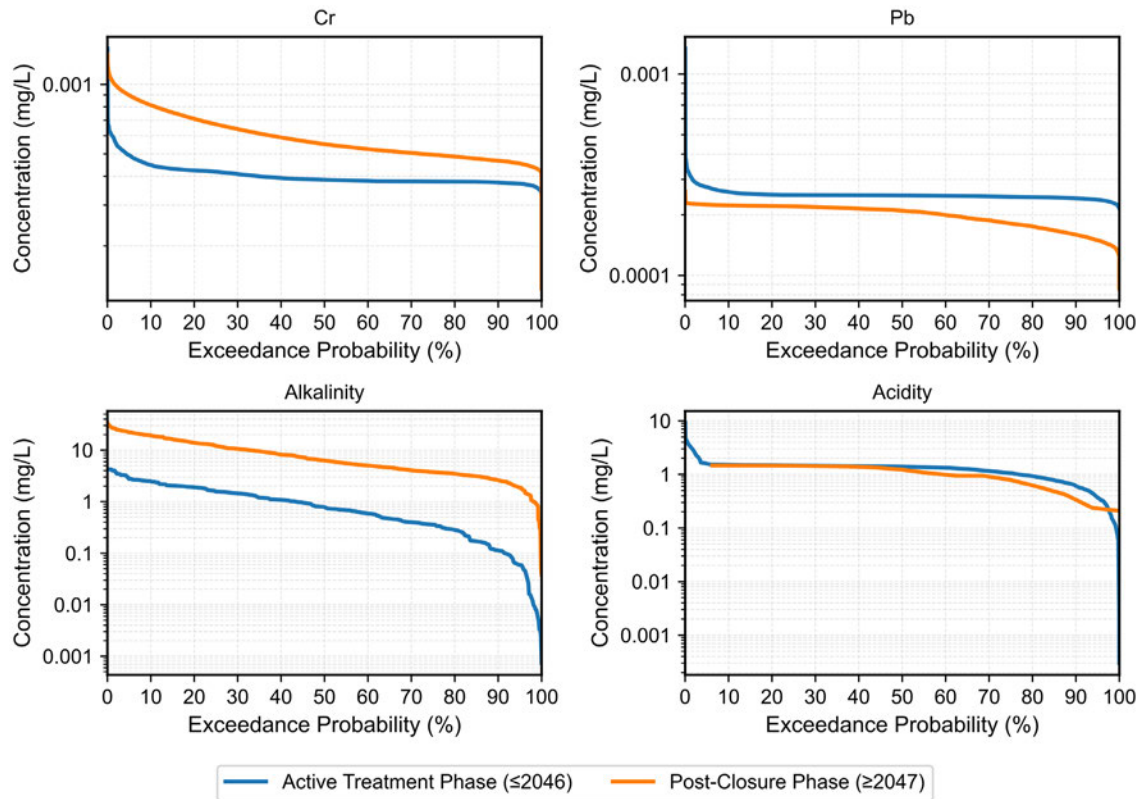


Figure 25: S1 (High Rainfall) SW01 Concentration Exceedance Probability Al Fe Mn Cu



S1 (High Rainfall) - SW01 (Y-Axis: Logarithmic)

Figure 26: S1 (High Rainfall) SW01 Concentration Exceedance Probability Cr Pb Alk Acid

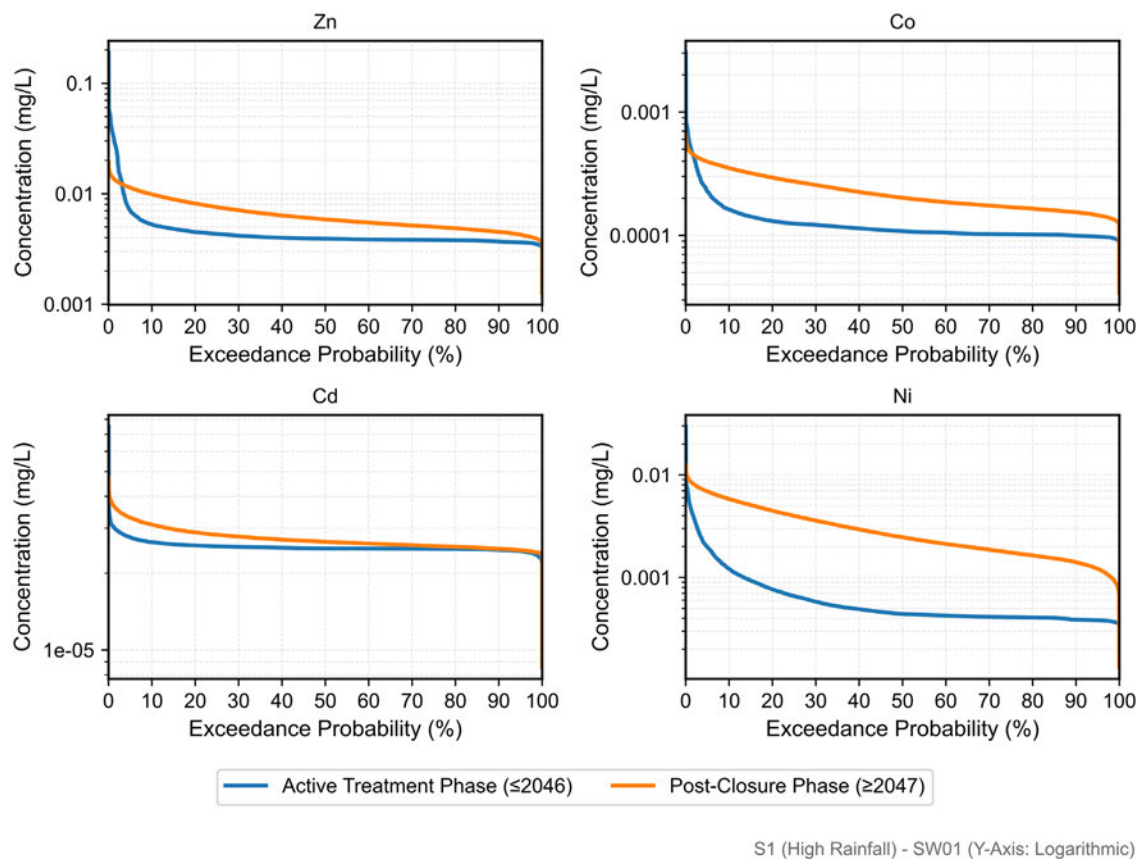
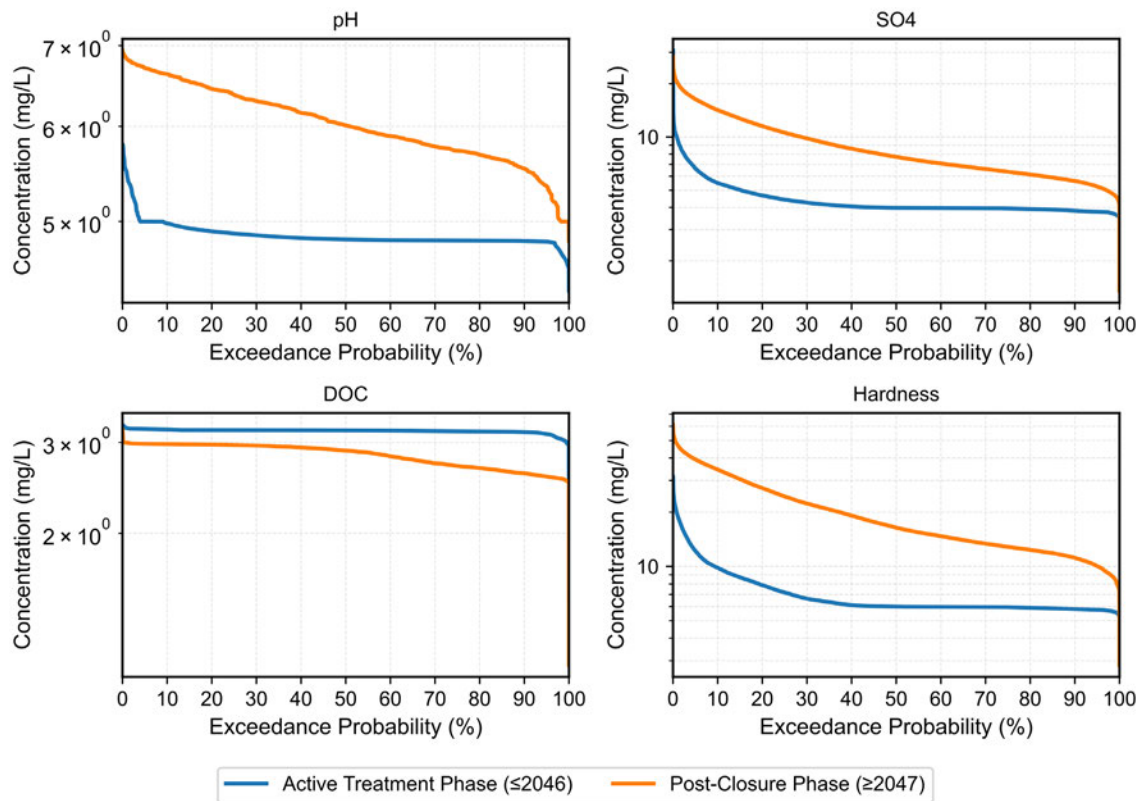
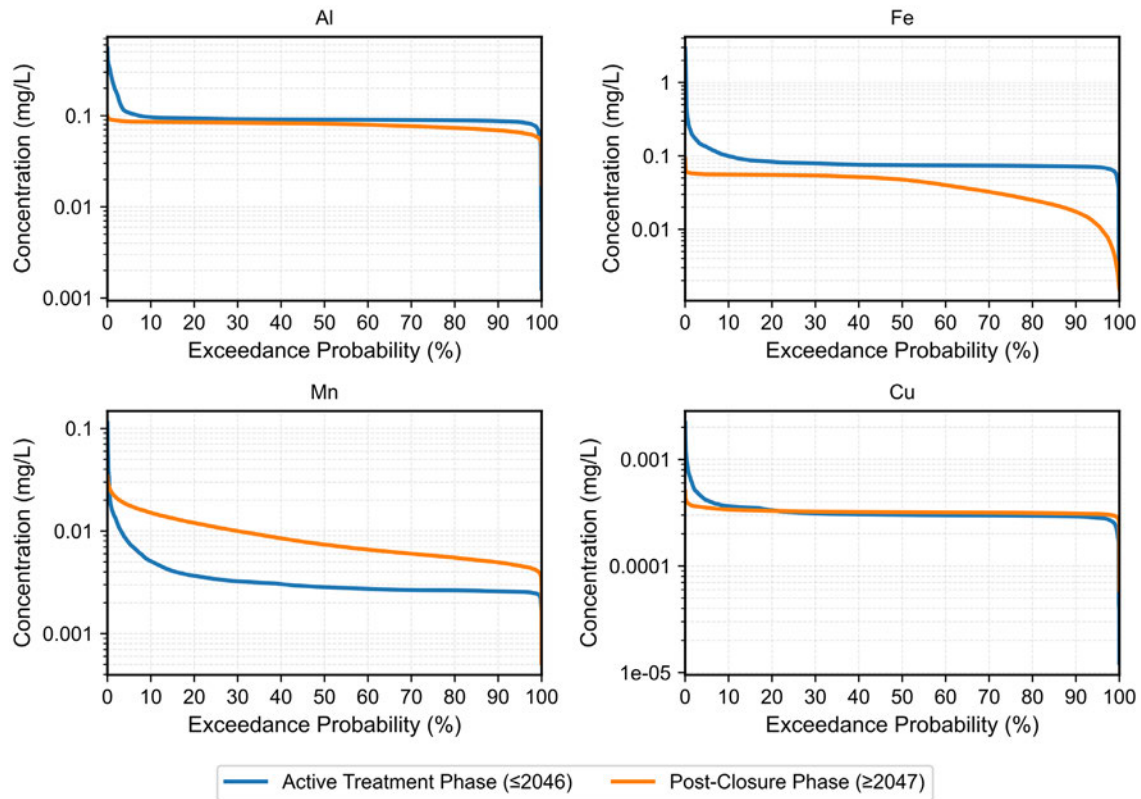


Figure 27: S1 (High Rainfall) SW01 Concentration Exceedance Probability Zn Co Cd Ni



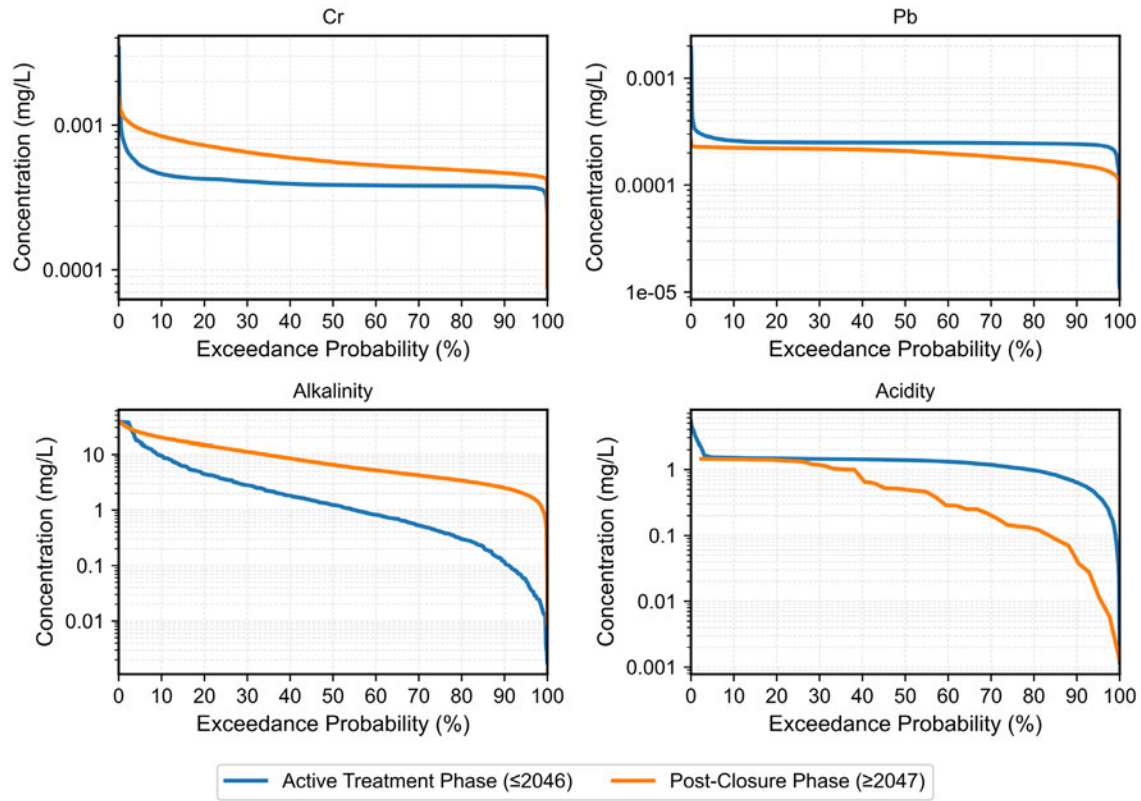
S1 (High Rainfall) - SW01 (Y-Axis: Logarithmic)

Figure 28: S1 (High Rainfall) SW01 Concentration Exceedance Probability pH SO4 DOC Hardness



S2 (Stochastic Rainfall) - SW01 (Y-Axis: Logarithmic)

Figure 29: S2 (Stochastic Rainfall) SW01 Concentration Exceedance Probability Al Fe Mn Cu



S2 (Stochastic Rainfall) - SW01 (Y-Axis: Logarithmic)

Figure 30: S2 (Stochastic Rainfall) SW01 Concentration Exceedance Probability Cr Pb Alk Acid

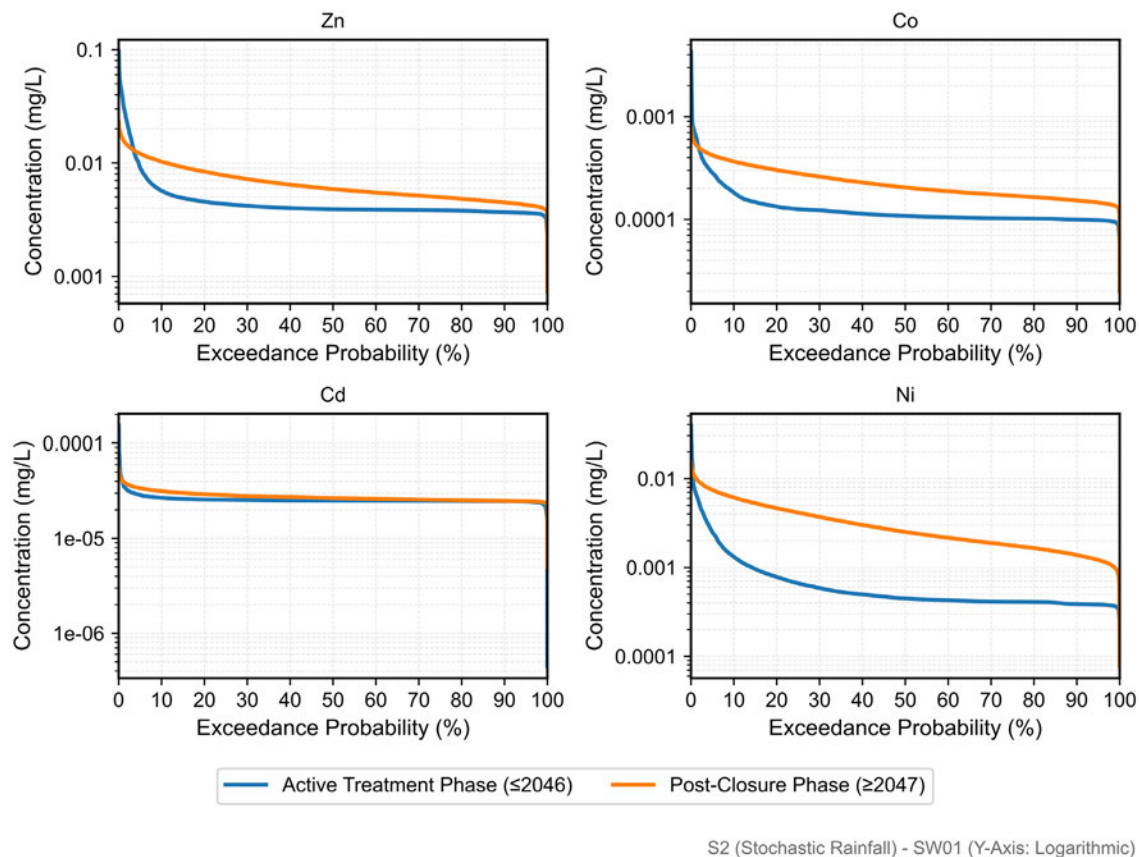
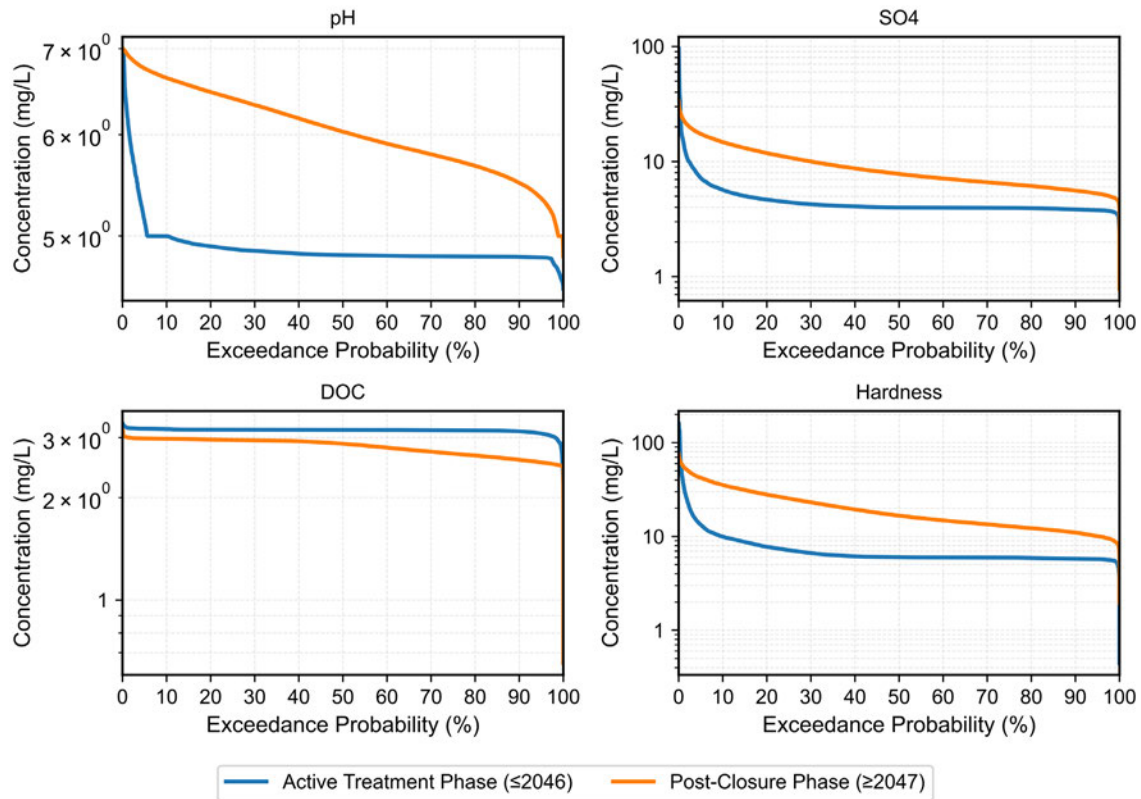


Figure 31: S2 (Stochastic Rainfall) SW01 Concentration Exceedance Probability Zn Co Cd Ni



S2 (Stochastic Rainfall) - SW01 (Y-Axis: Logarithmic)

Figure 32: S2 (Stochastic Rainfall) SW01 Concentration Exceedance Probability pH SO₄ DOC Hardness

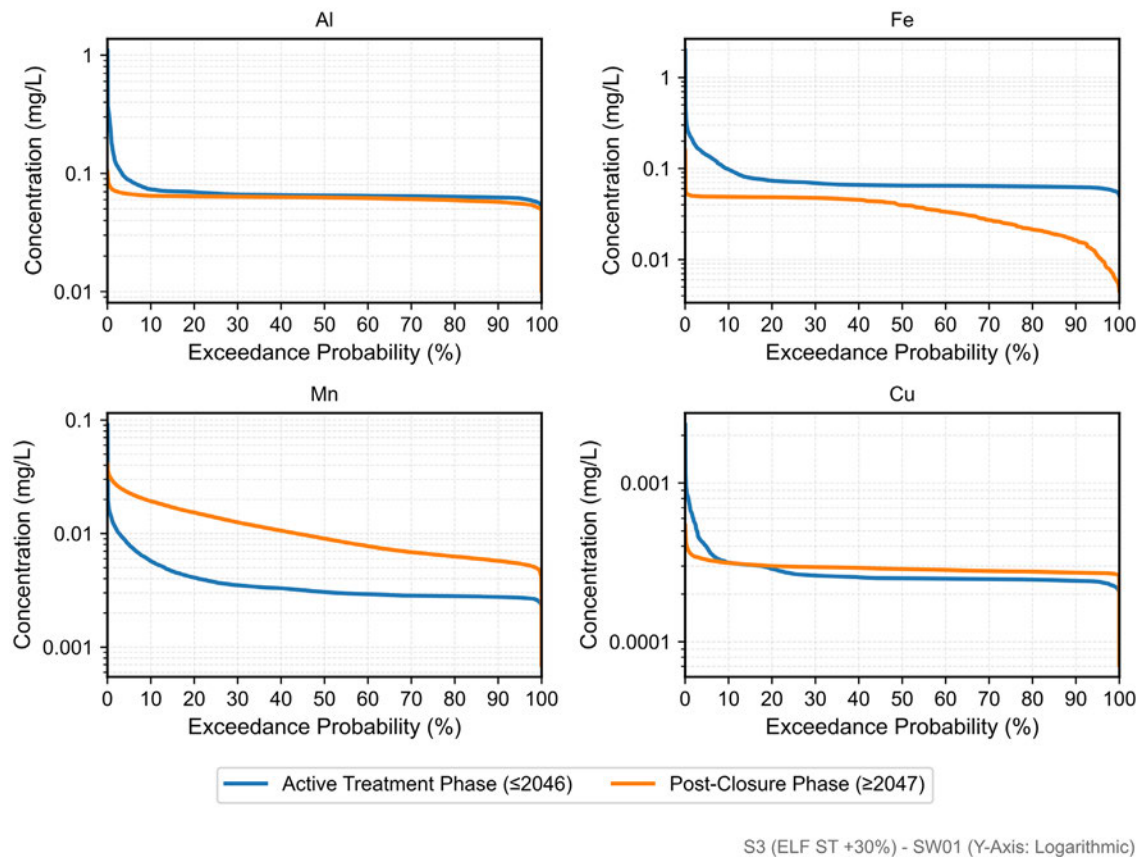


Figure 33: S3 (Elf St +30%) SW01 Concentration Exceedance Probability Al Fe Mn Cu

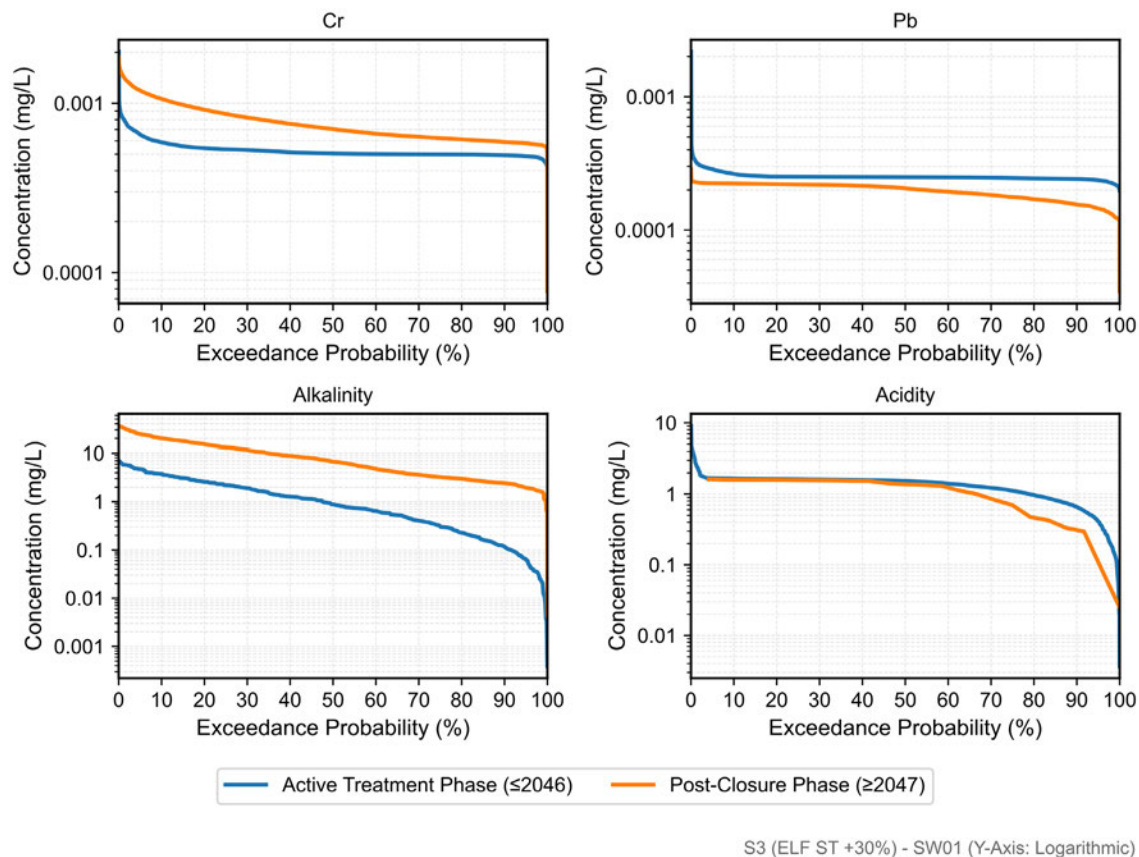
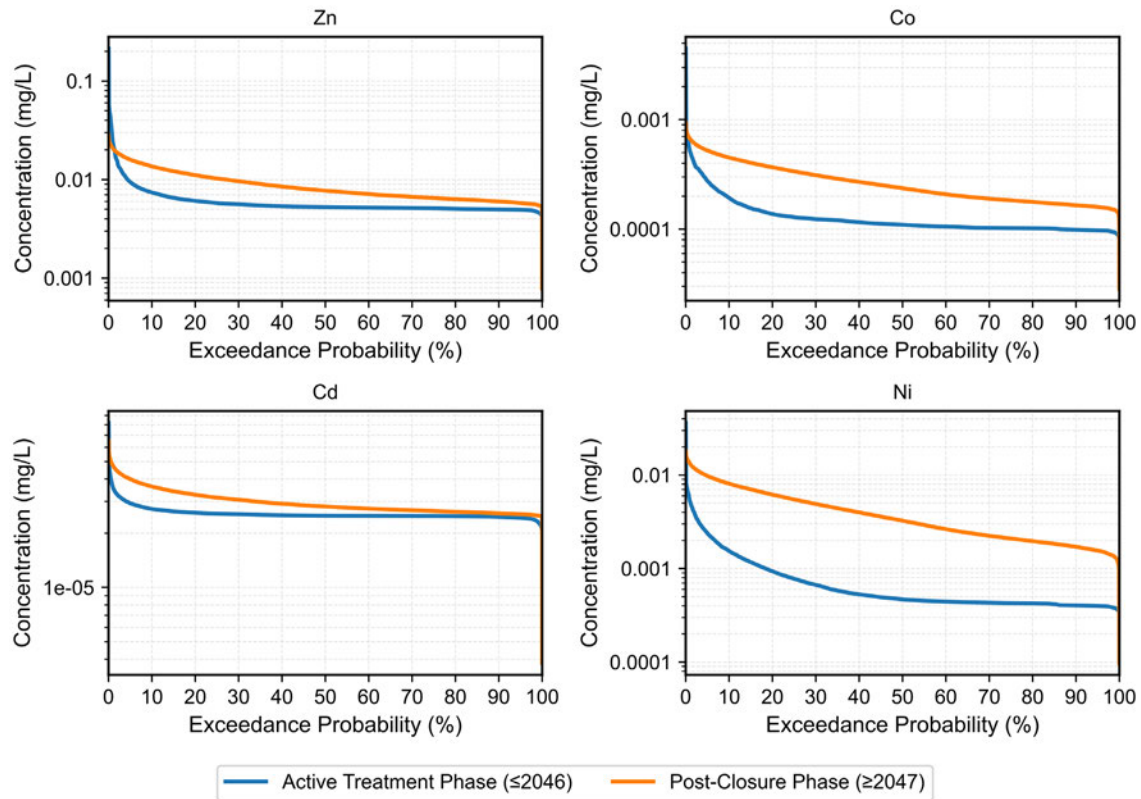
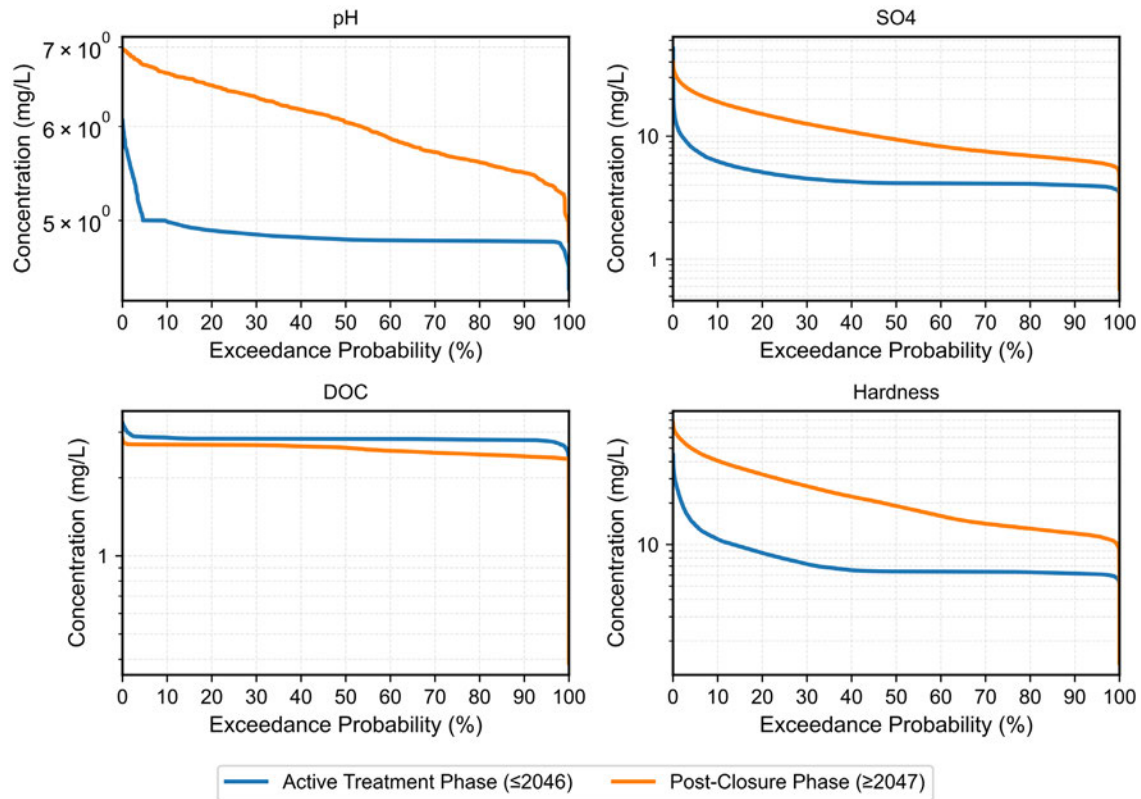


Figure 34: S3 (Elf St +30%) SW01 Concentration Exceedance Probability Cr Pb Alk Acid



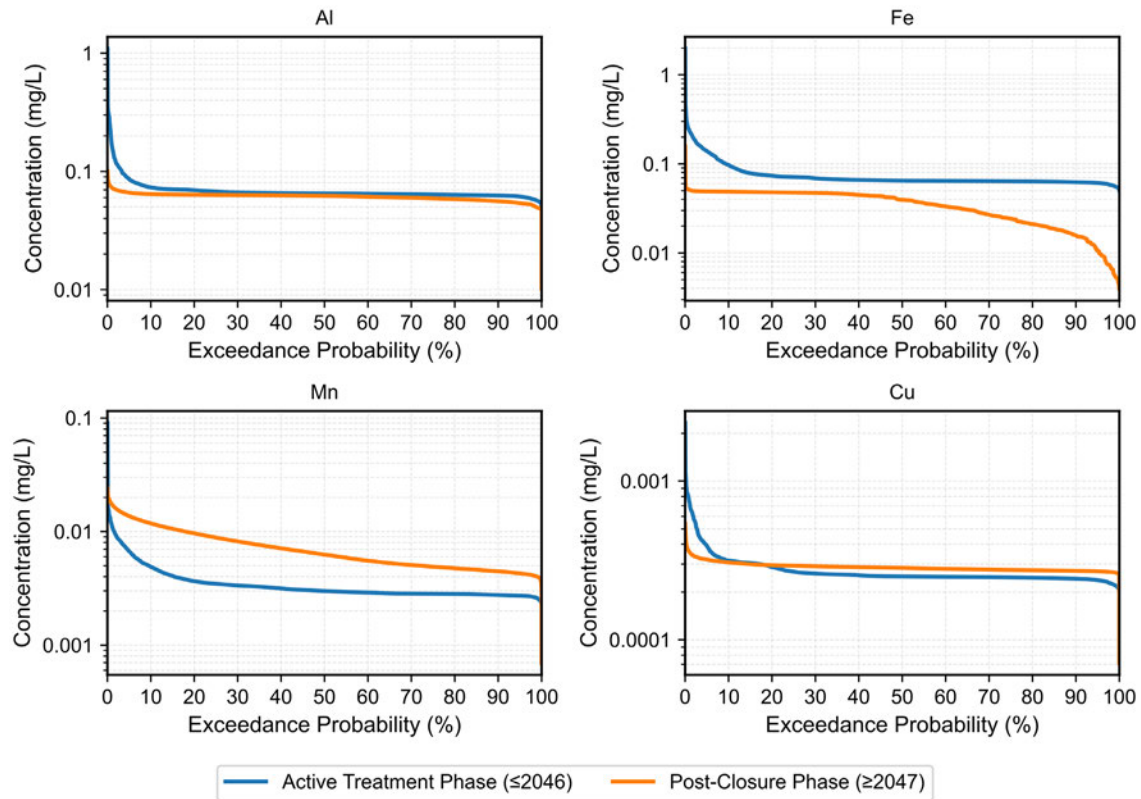
S3 (ELF ST +30%) - SW01 (Y-Axis: Logarithmic)

Figure 35: S3 (Elf St +30%) SW01 Concentration Exceedance Probability Zn Co Cd Ni



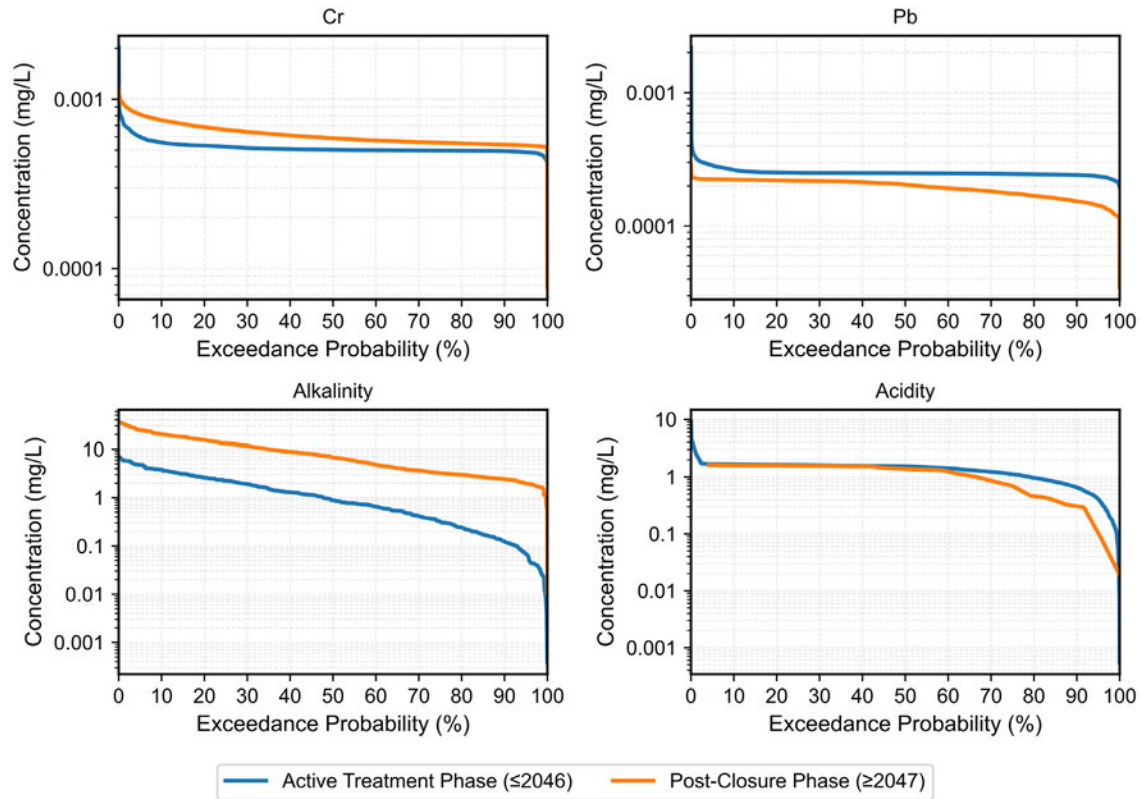
S3 (ELF ST +30%) - SW01 (Y-Axis: Logarithmic)

Figure 36: S3 (Elf St +30%) SW01 Concentration Exceedance Probability pH SO₄ DOC Hardness



S4 (ELF ST -30%) - SW01 (Y-Axis: Logarithmic)

Figure 37: S4 (Elf St 30%) SW01 Concentration Exceedance Probability Al Fe Mn Cu



S4 (ELF ST -30%) - SW01 (Y-Axis: Logarithmic)

Figure 38: S4 (Elf St 30%) SW01 Concentration Exceedance Probability Cr Pb Alk Acid

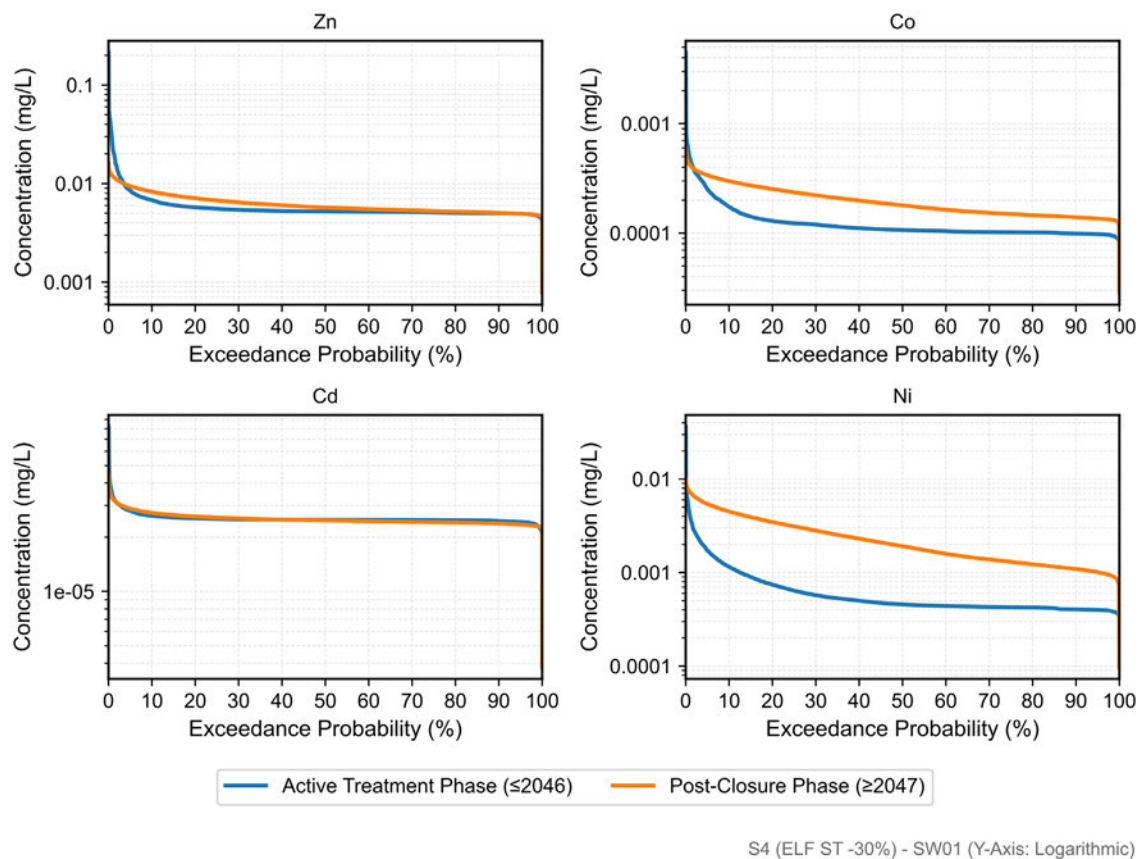


Figure 39: S4 (Elf St 30%) SW01 Concentration Exceedance Probability Zn Co Cd Ni

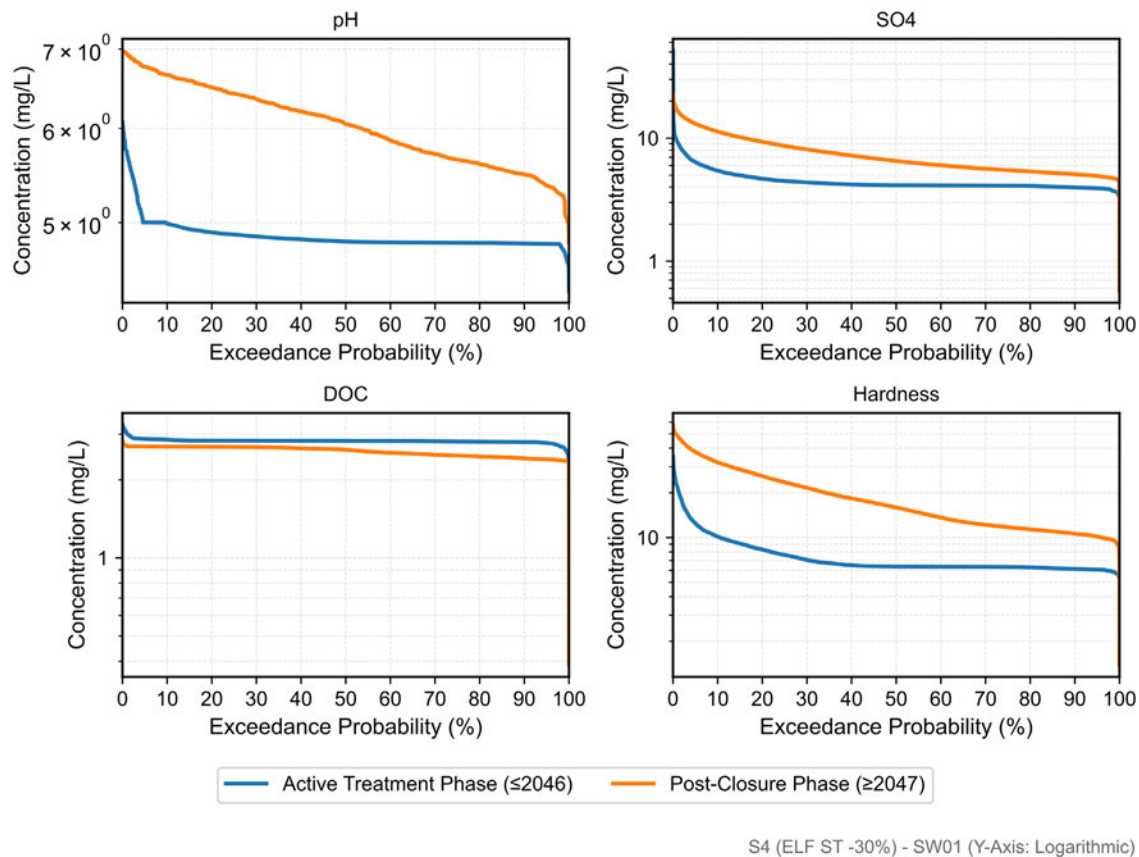


Figure 40: S4 (Elf St 30%) SW01 Concentration Exceedance Probability pH SO₄ DOC Hardness

1.3 CONCENTRATION EXCEEDANCE (MULTI SCENARIO)

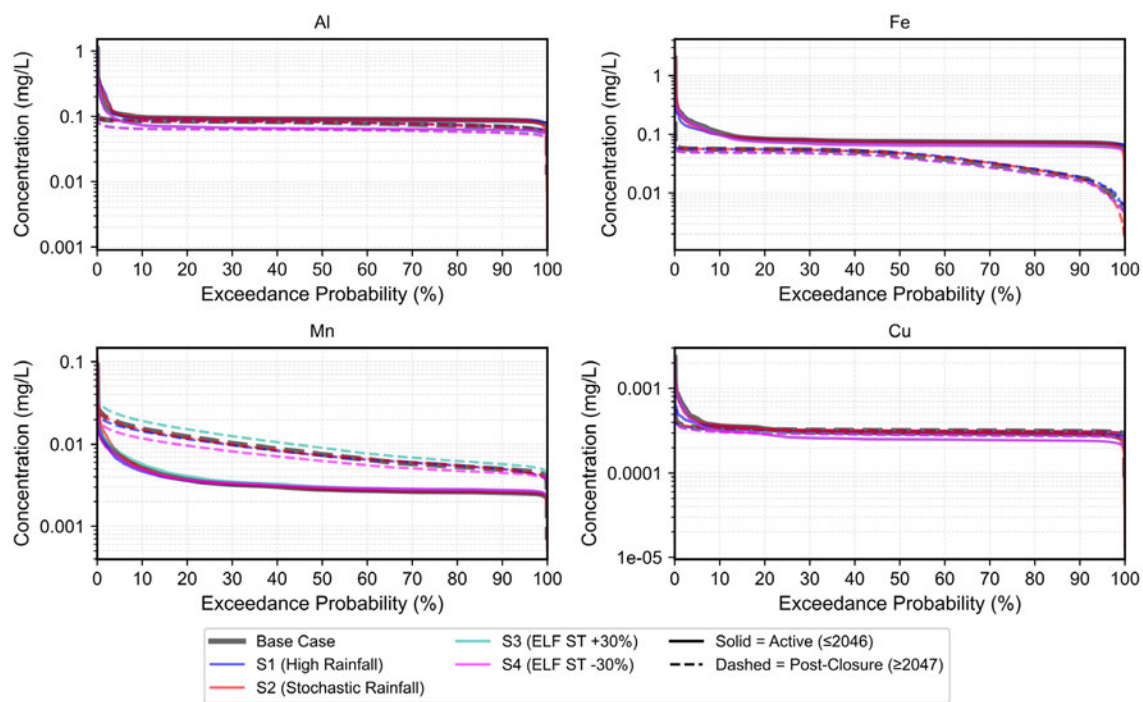


Figure 41: SW01 Matrix Plot Scenarios 5 Al Fe Mn Cu Concentration Exceedance Probability

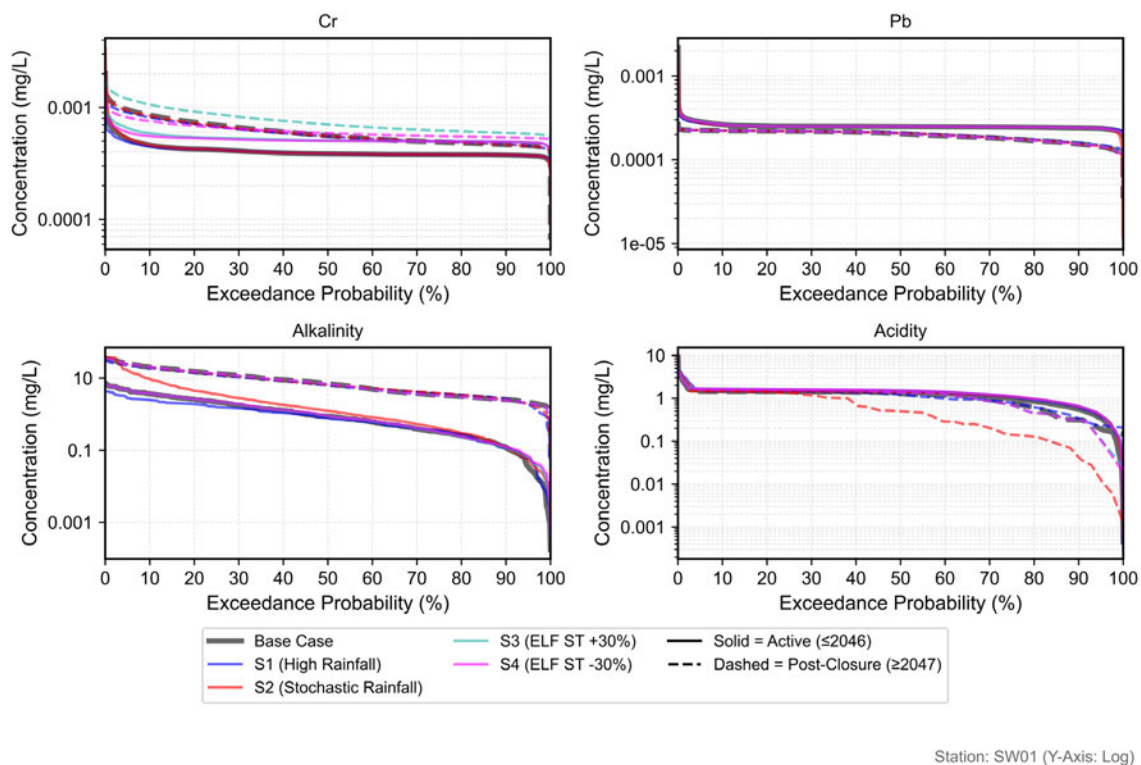


Figure 42: SW01 Matrix Plot Scenarios 5 Cr Pb Alk Acid Concentration Exceedance Probability

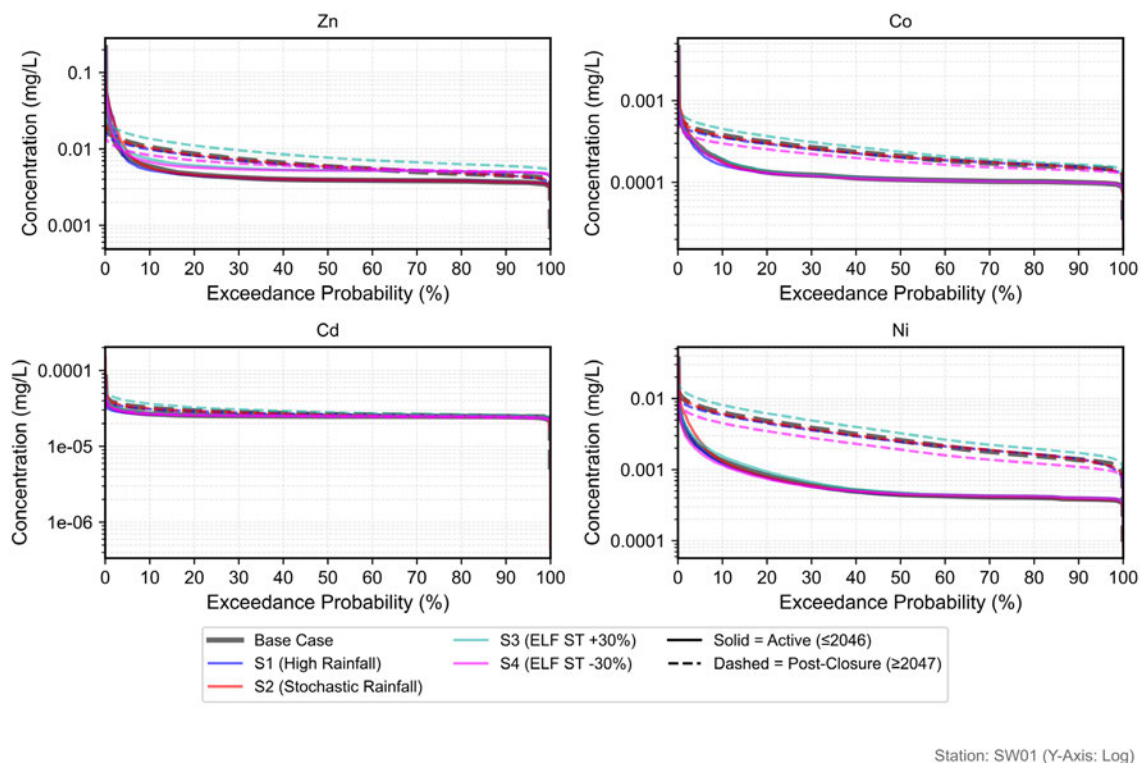
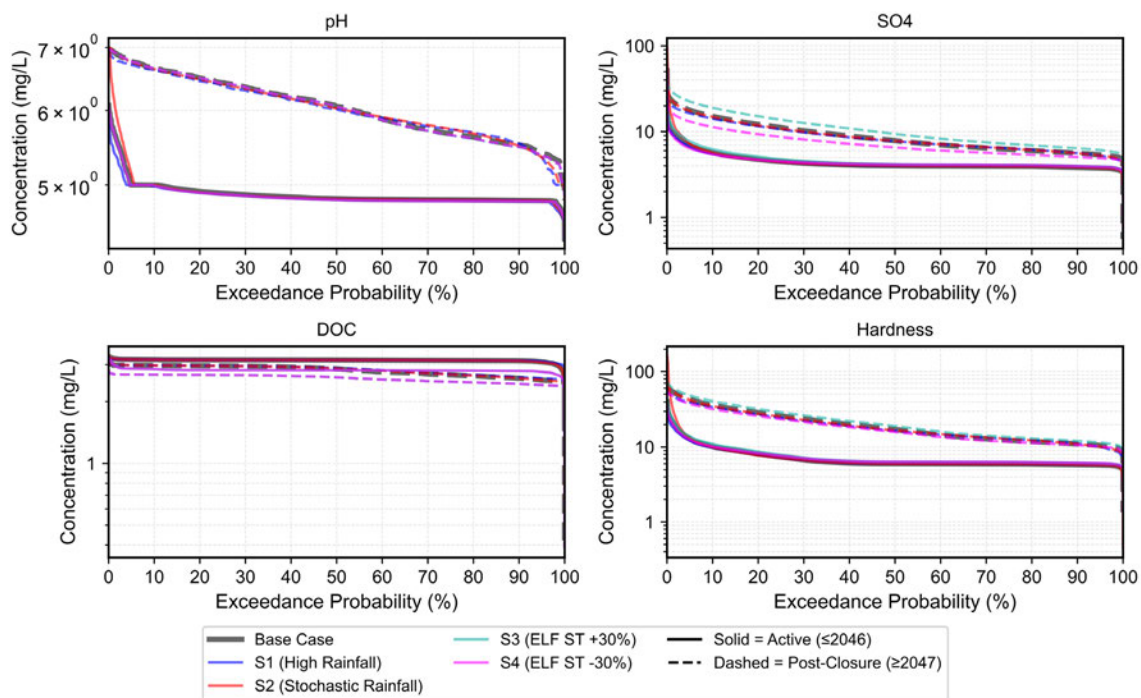


Figure 43: SW01 Matrix Plot Scenarios 5 Zn Co Cd Ni Concentration Exceedance Probability

Station: SW01 (Y-Axis: Log)

Figure 44: SW01 Matrix Plot Scenarios 5 PH SO4 DOC Hardness Concentration Exceedance Probability

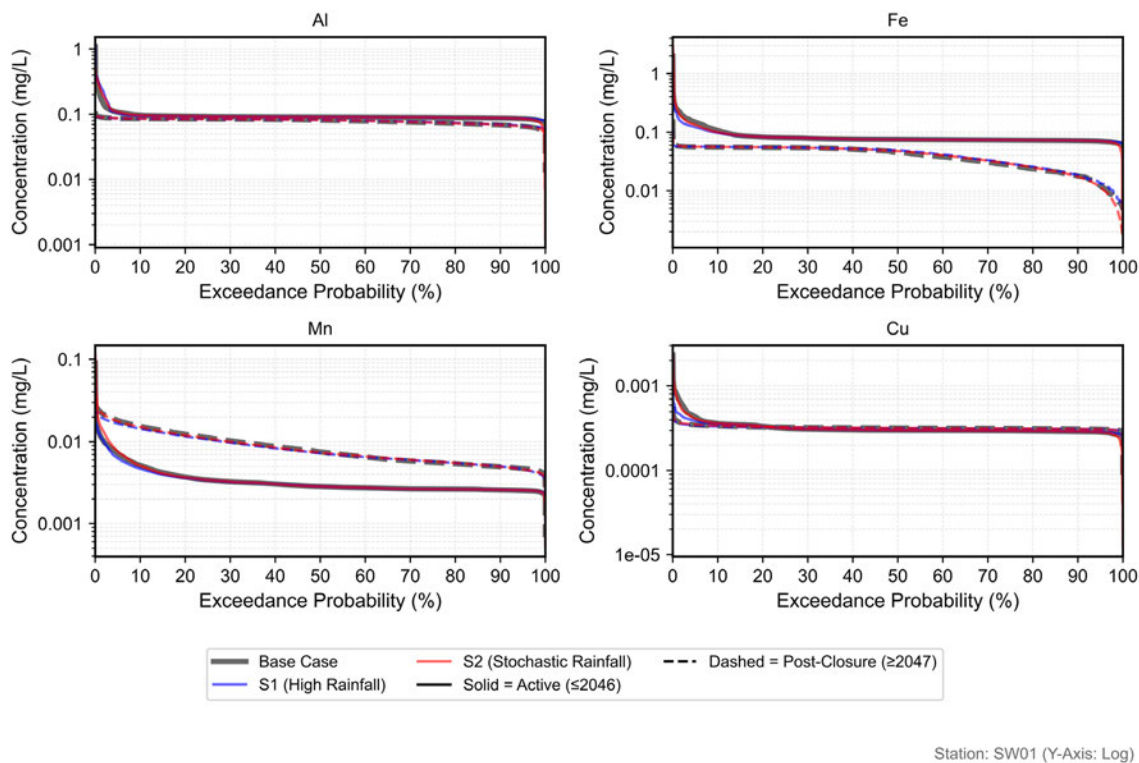


Figure 45: SW01 Rainfall Comp Al Fe Mn Cu Concentration Exceedance Probability

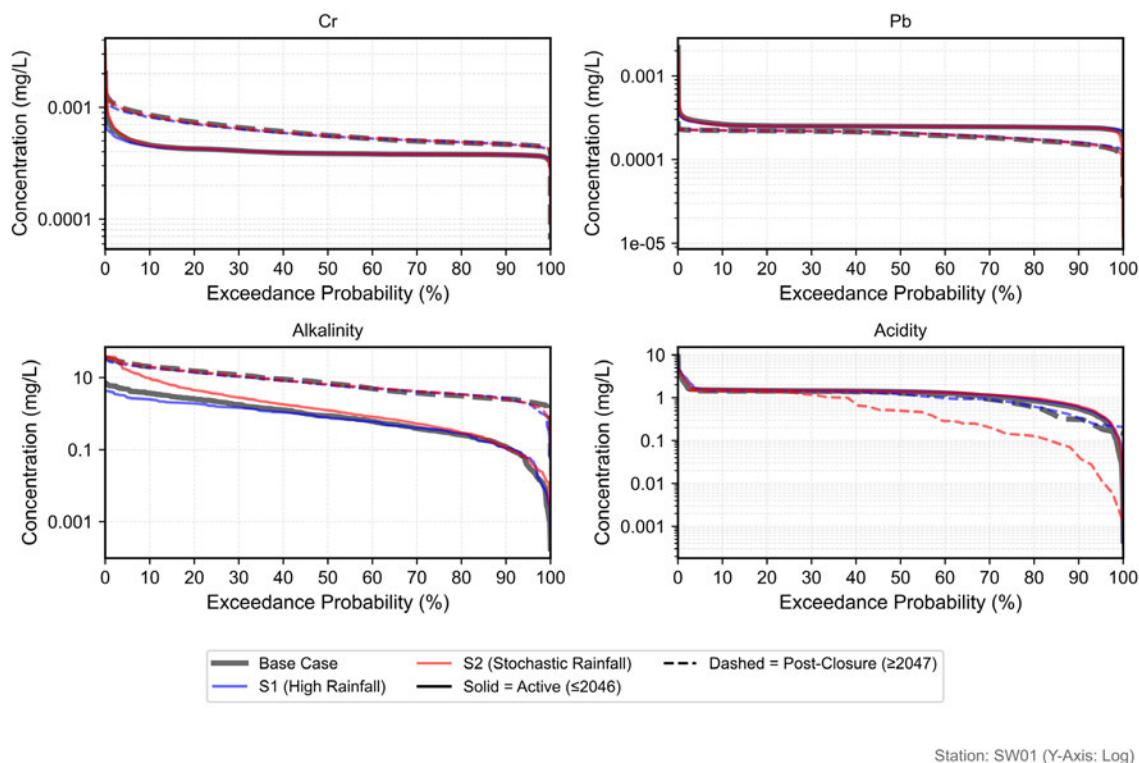
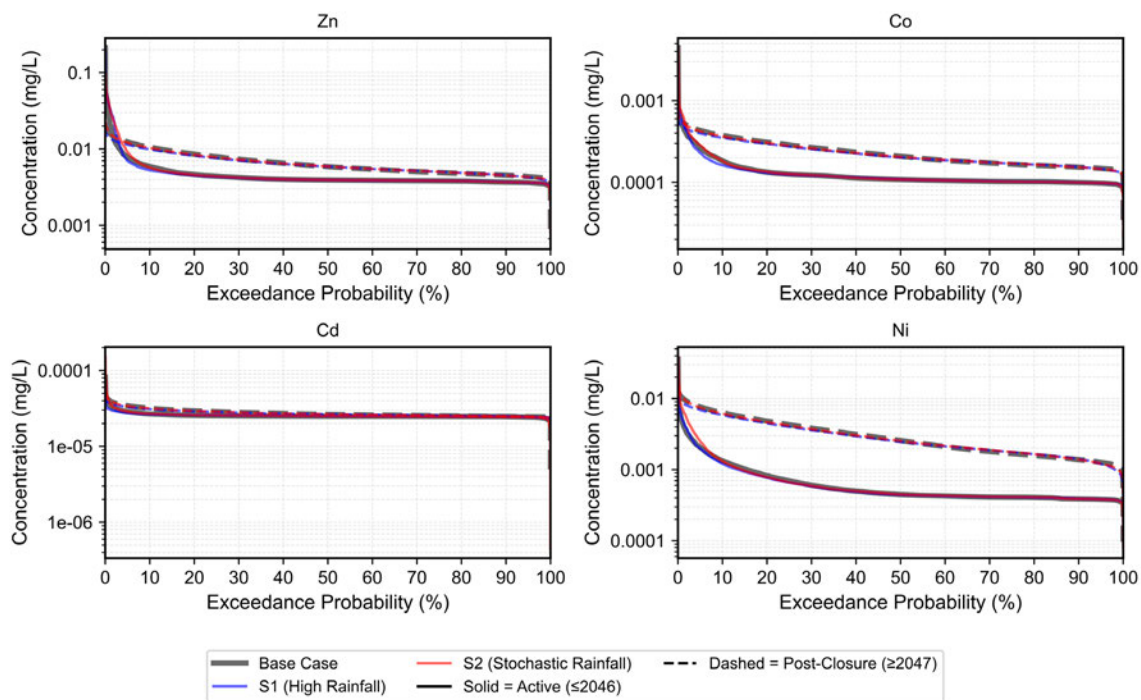


Figure 46: SW01 Rainfall Comp Cr Pb Alk Acid Concentration Exceedance Probability

Station: SW01 (Y-Axis: Log)

Figure 47: SW01 Rainfall Comp Zn Co Cd Ni Concentration Exceedance Probability

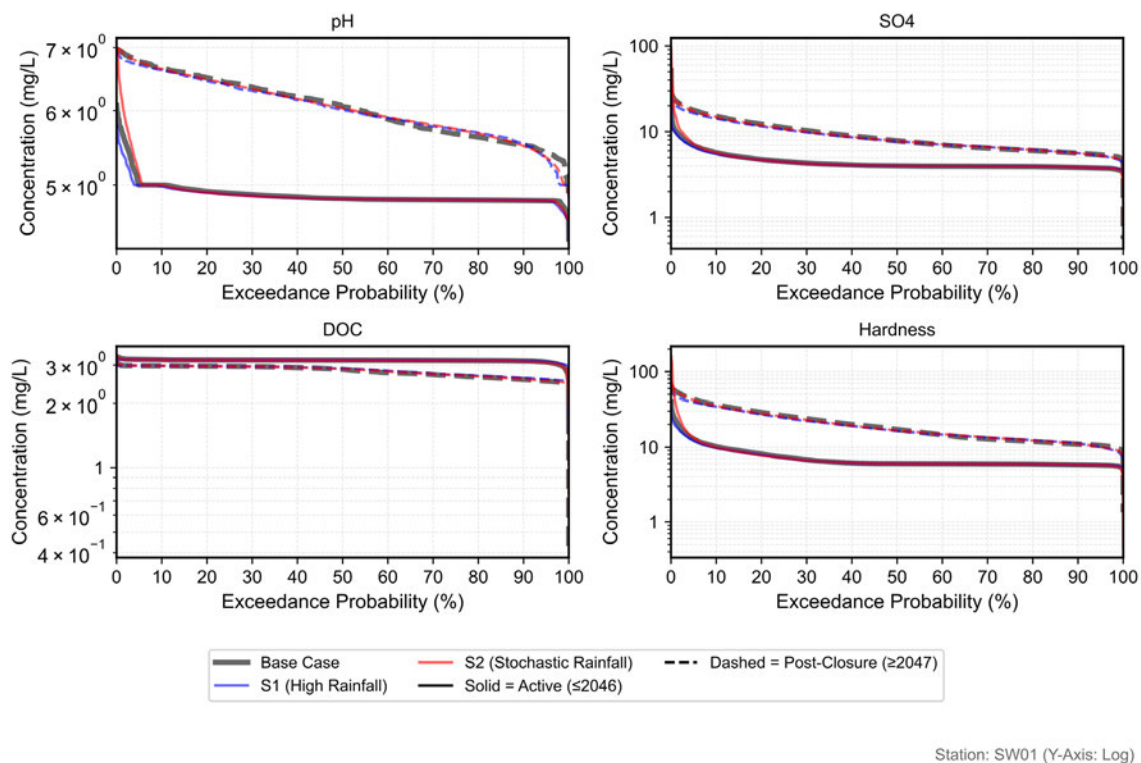
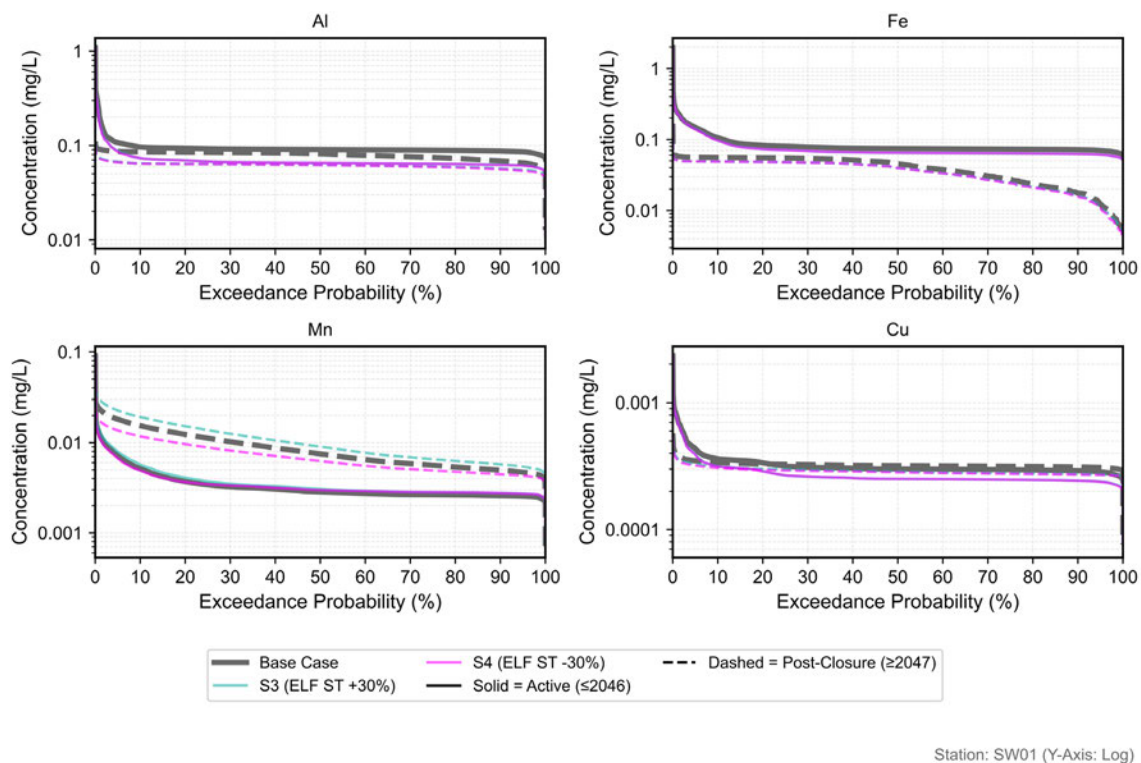
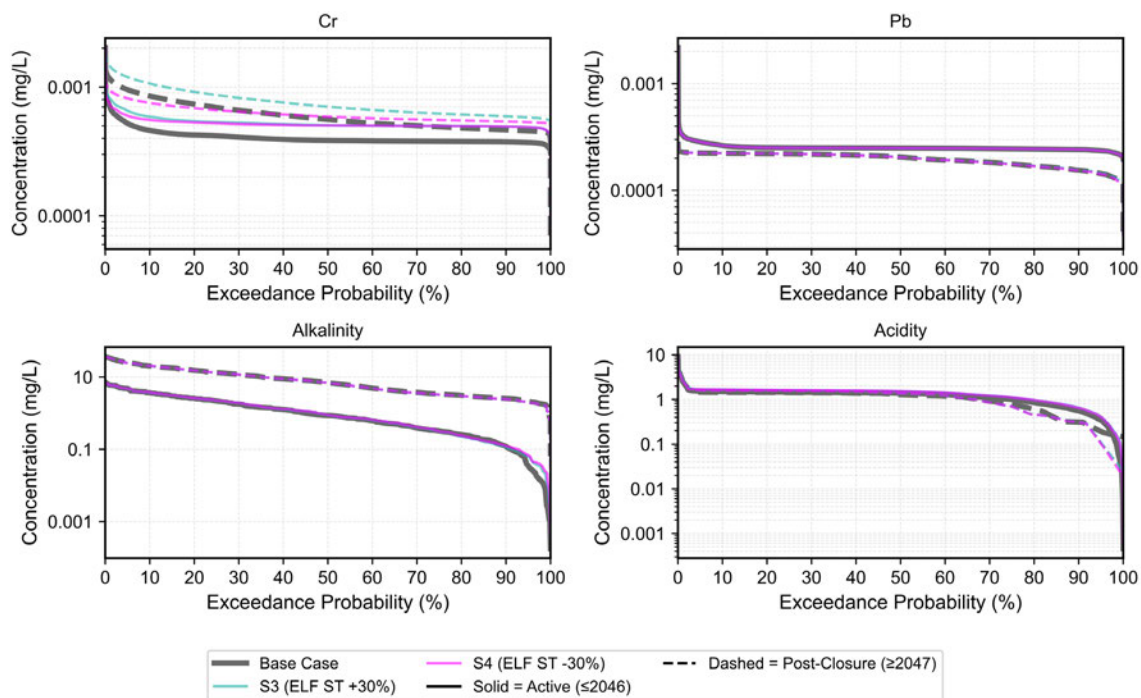
**Figure 48:** SW01 Rainfall Comp pH SO₄ DOC Hardness Concentration Exceedance Probability

Figure 49: SW01 St Comp Al Fe Mn Cu Concentration Exceedance Probability

Station: SW01 (Y-Axis: Log)

Figure 50: SW01 St Comp Cr Pb Alk Acid Concentration Exceedance Probability

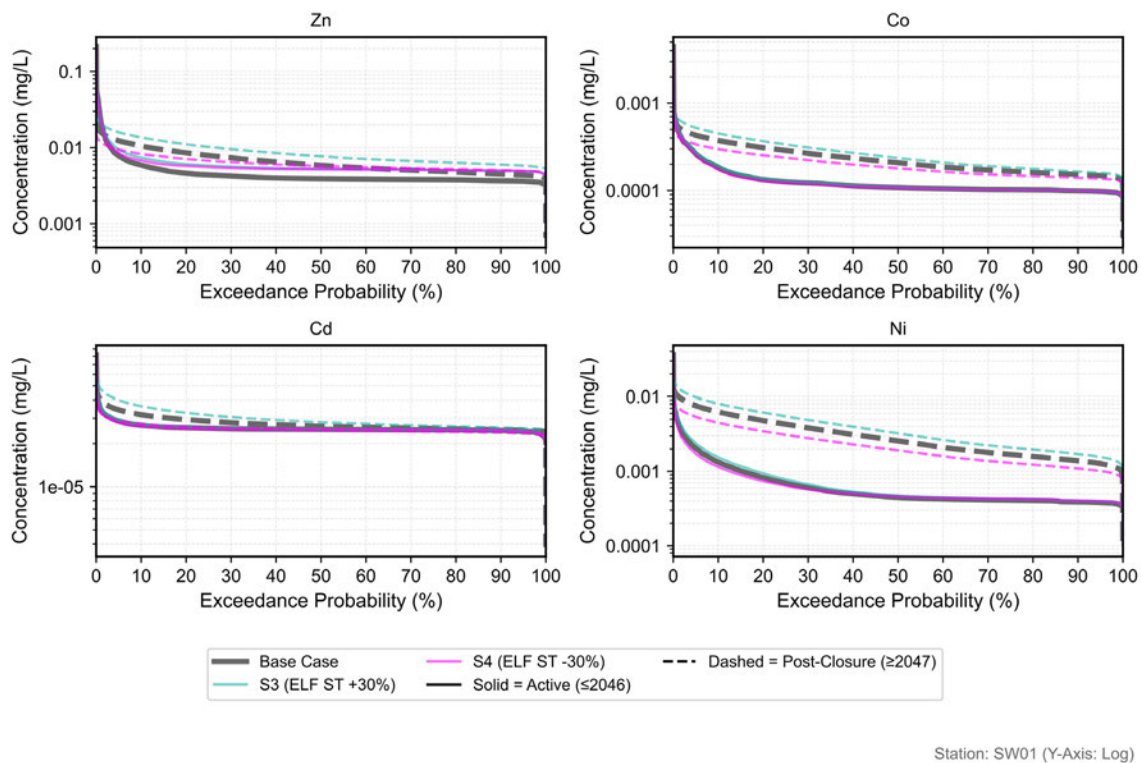


Figure 51: SW01 St Comp Zn Co Cd Ni Concentration Exceedance Probability

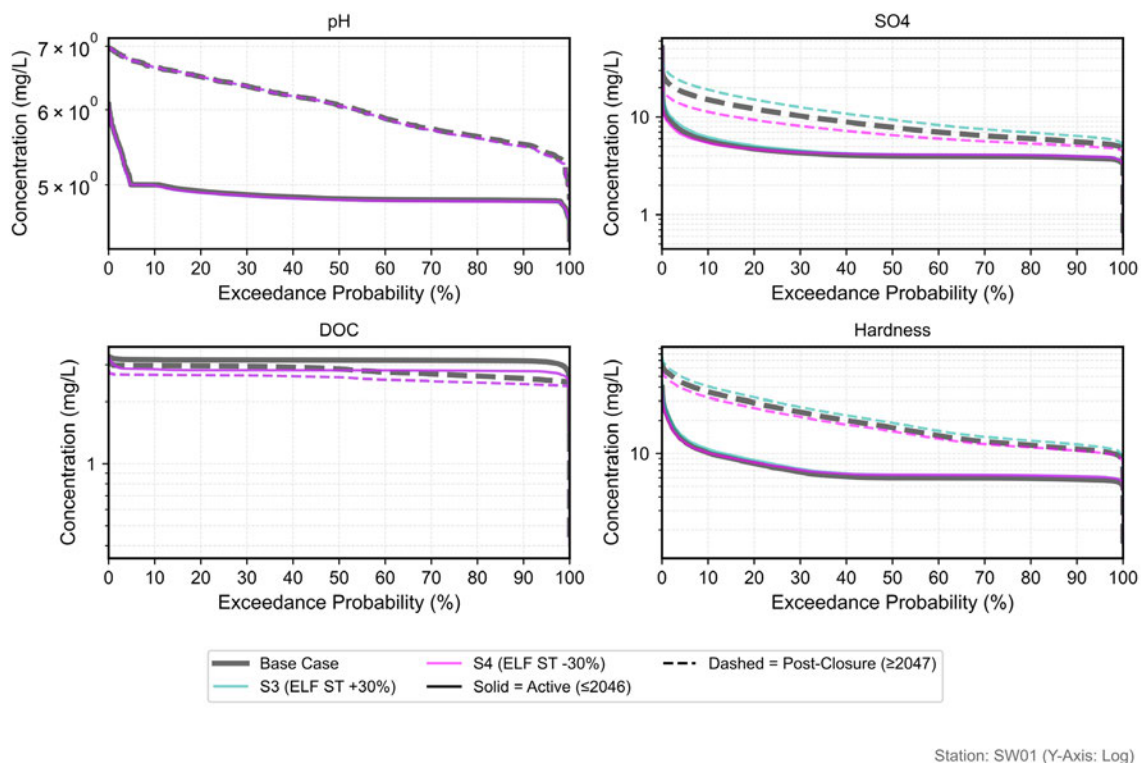
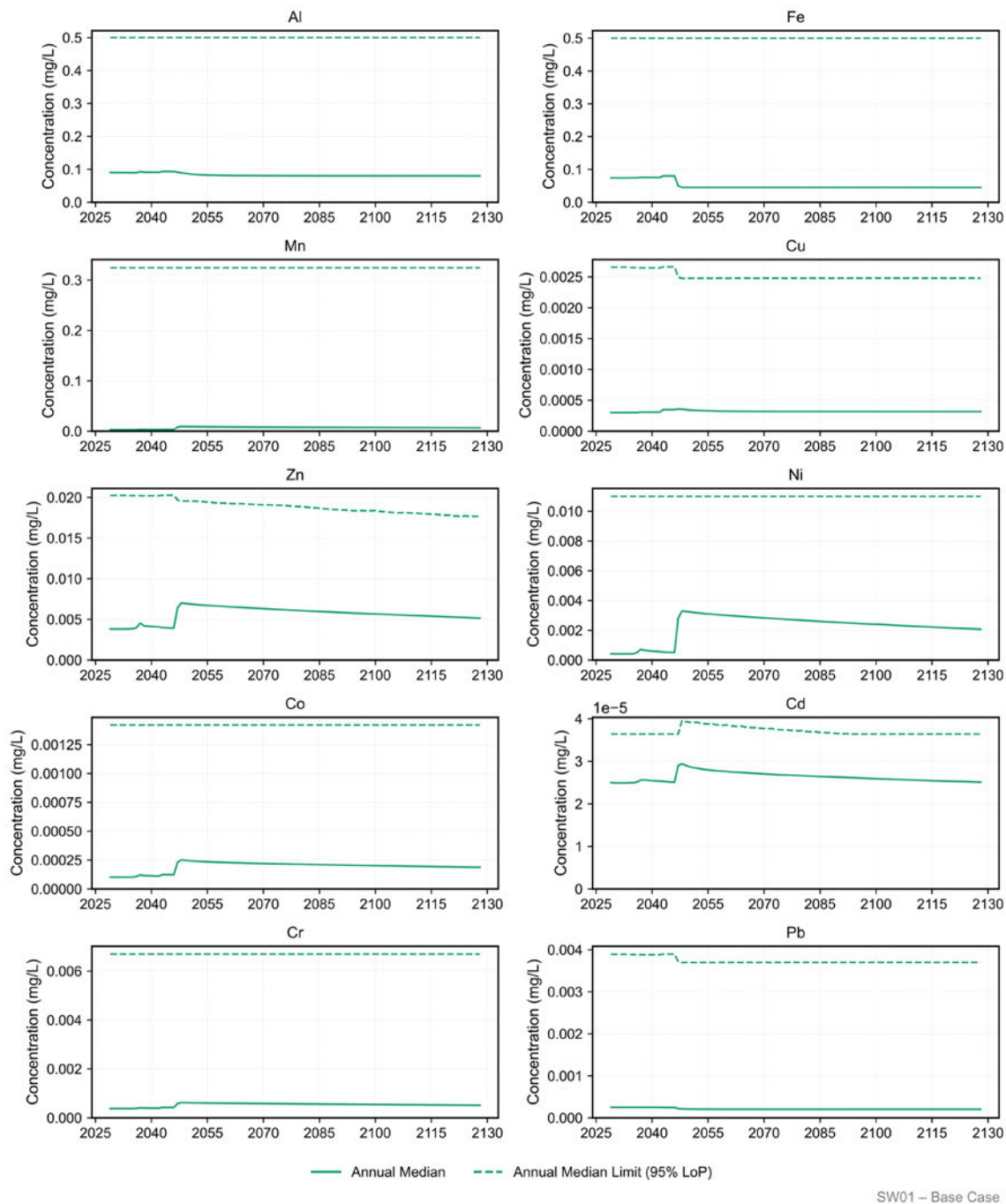
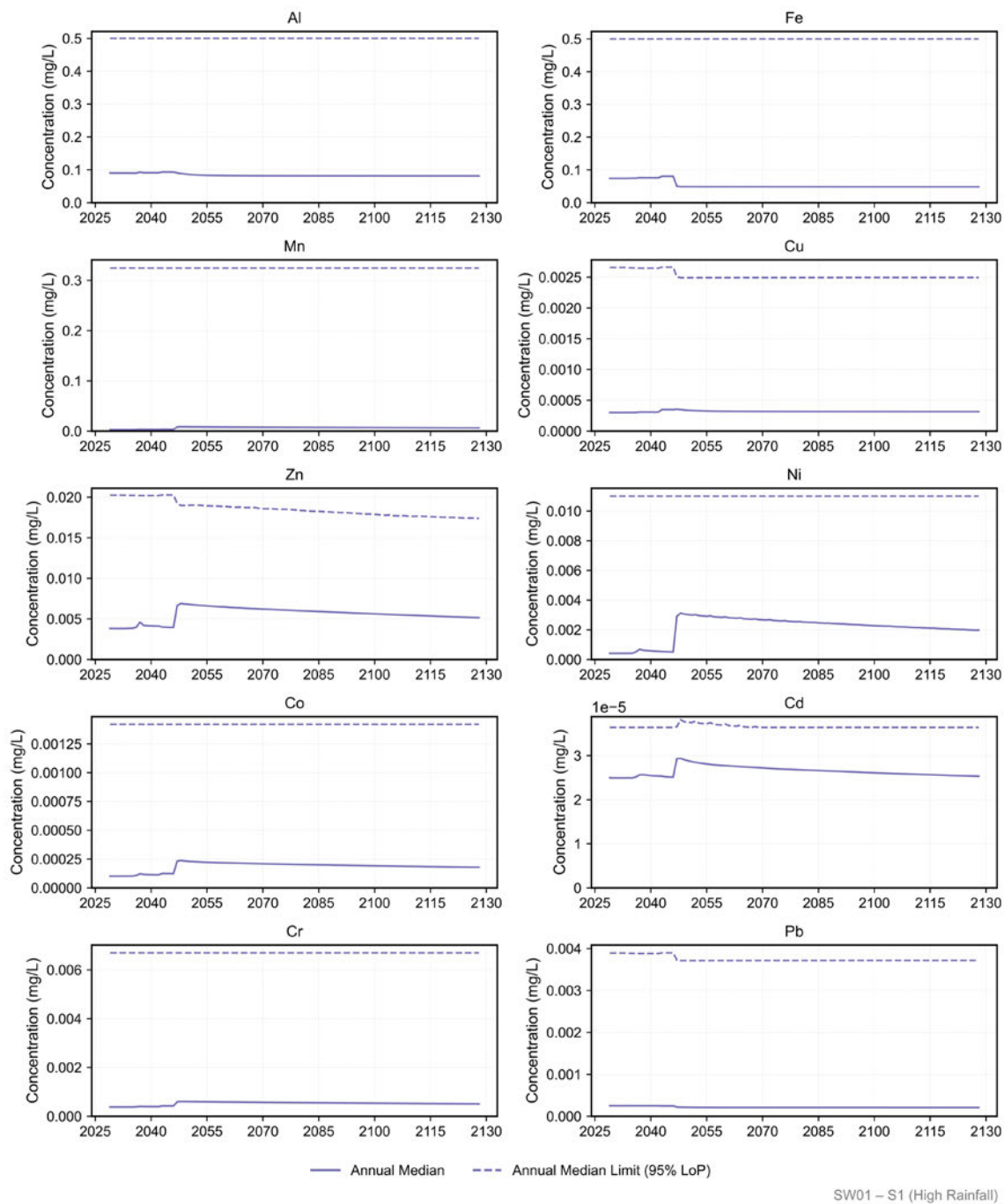


Figure 52: SW01 St Comp PH SO4 DOC Hardness Concentration Exceedance Probability**1.4 ANNUAL MEDIAN (SINGLE SCENARIO)****Figure 53:** SW01 Base Case Elementsmatrix

**Figure 54:** SW01 S1 (High Rainfall) Elementsmatrix

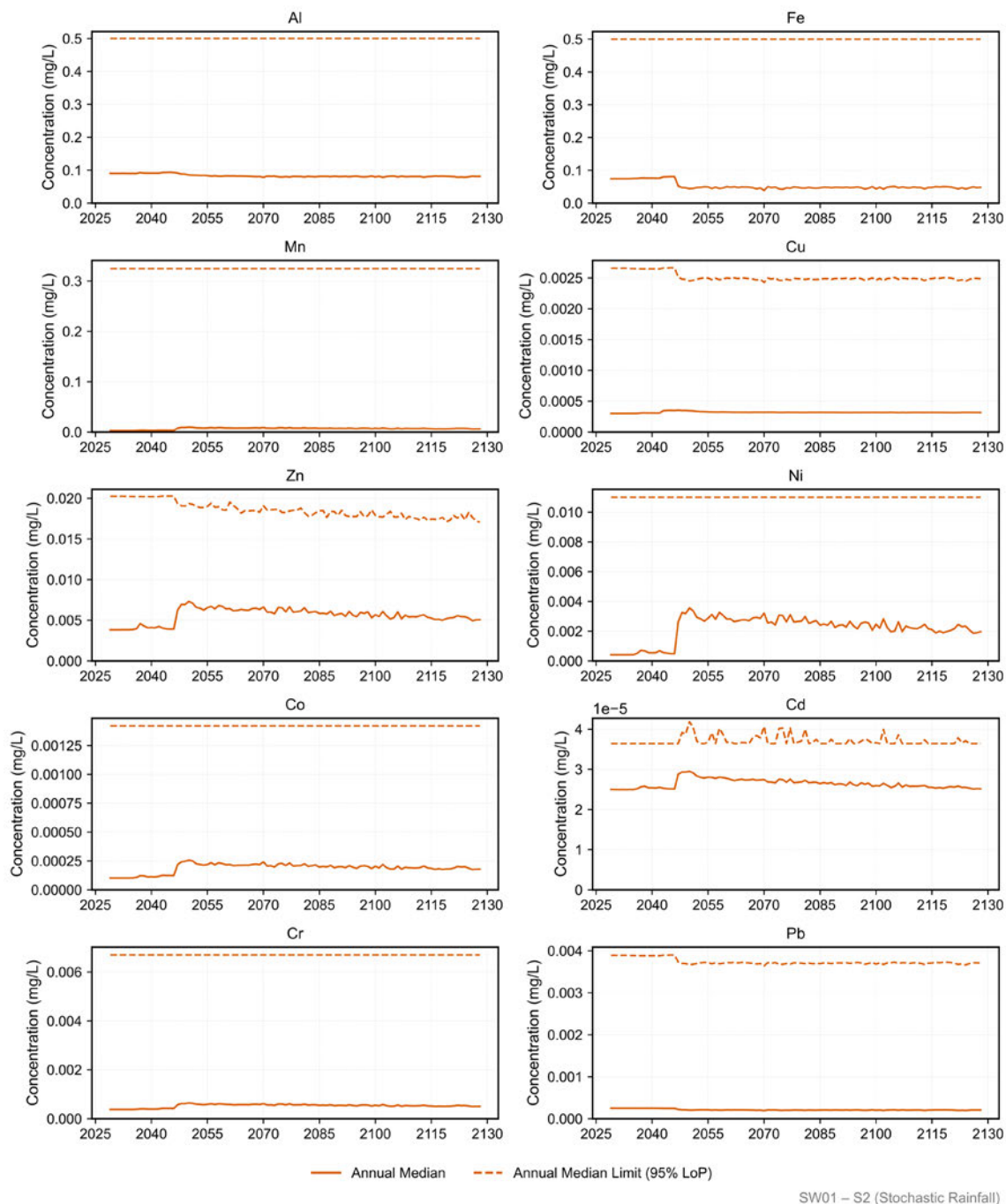
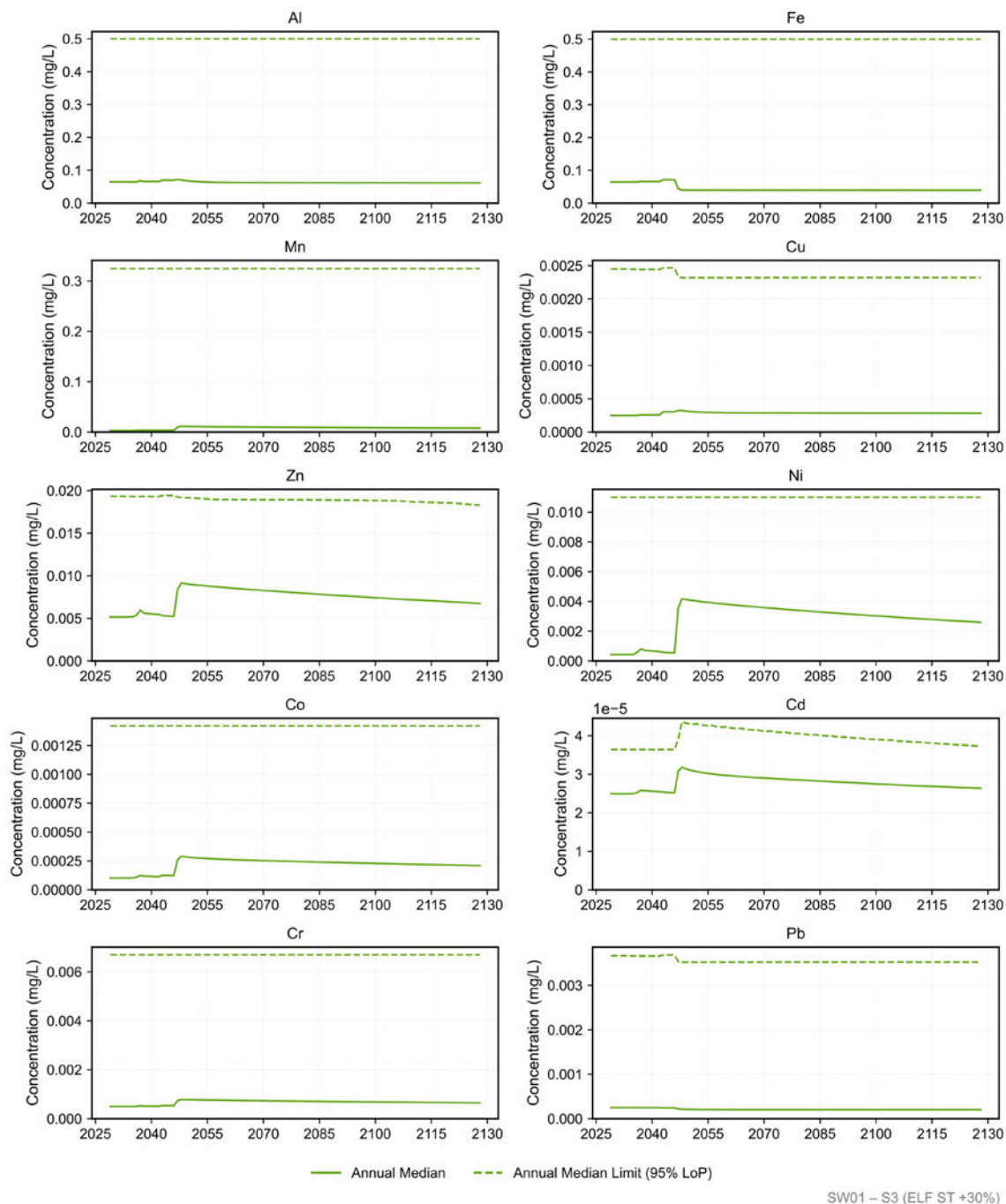
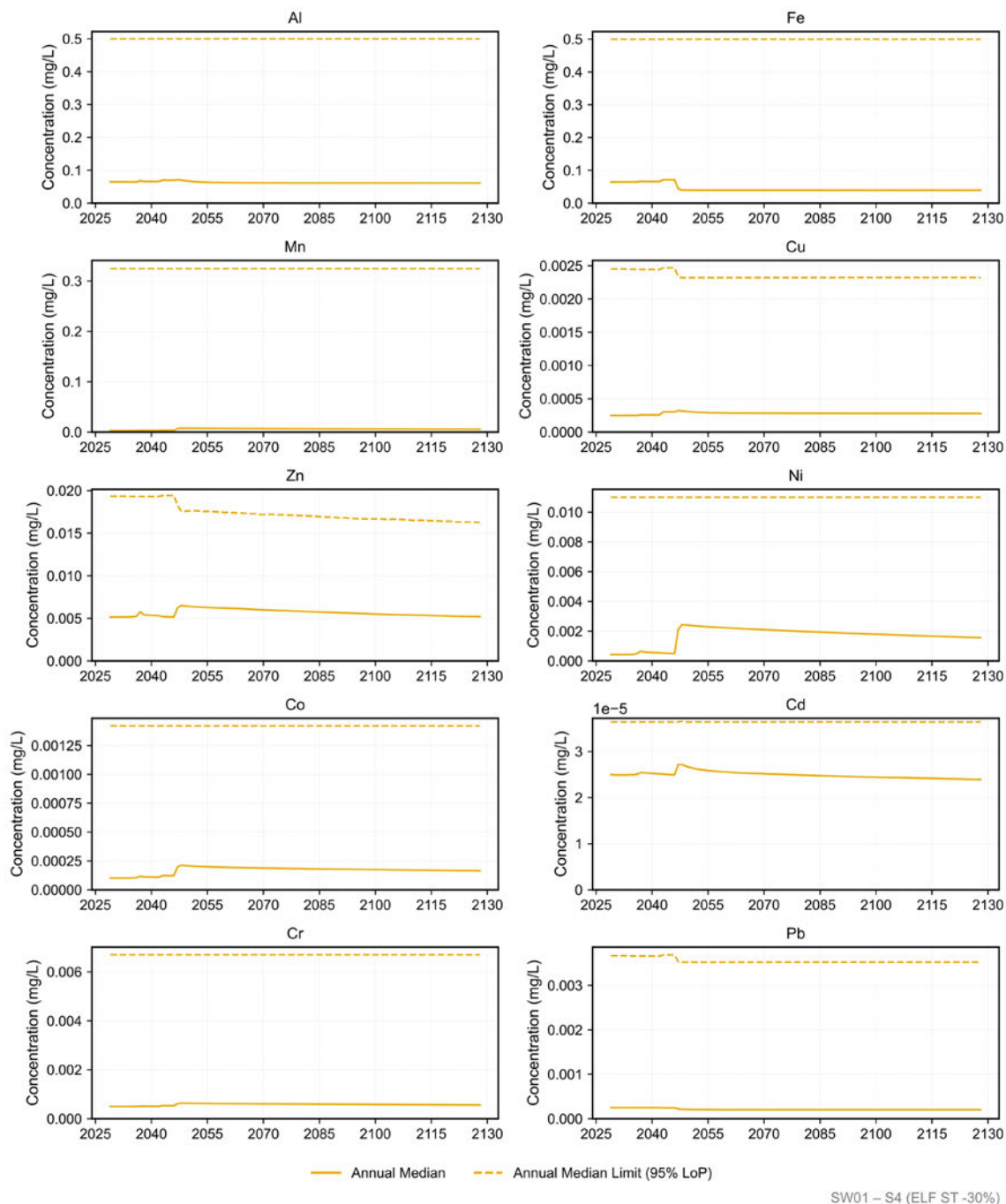


Figure 55: SW01 S2 (Stochastic Rainfall) Elementsmatrix

**Figure 56: SW01 S3 (Elf St +30%) Elementsmatrix**

**Figure 57: SW01 S4 (Elf St 30%) Elementsmatrix**

1.5 ANNUAL MEDIANS (GROUPED SCENARIO)

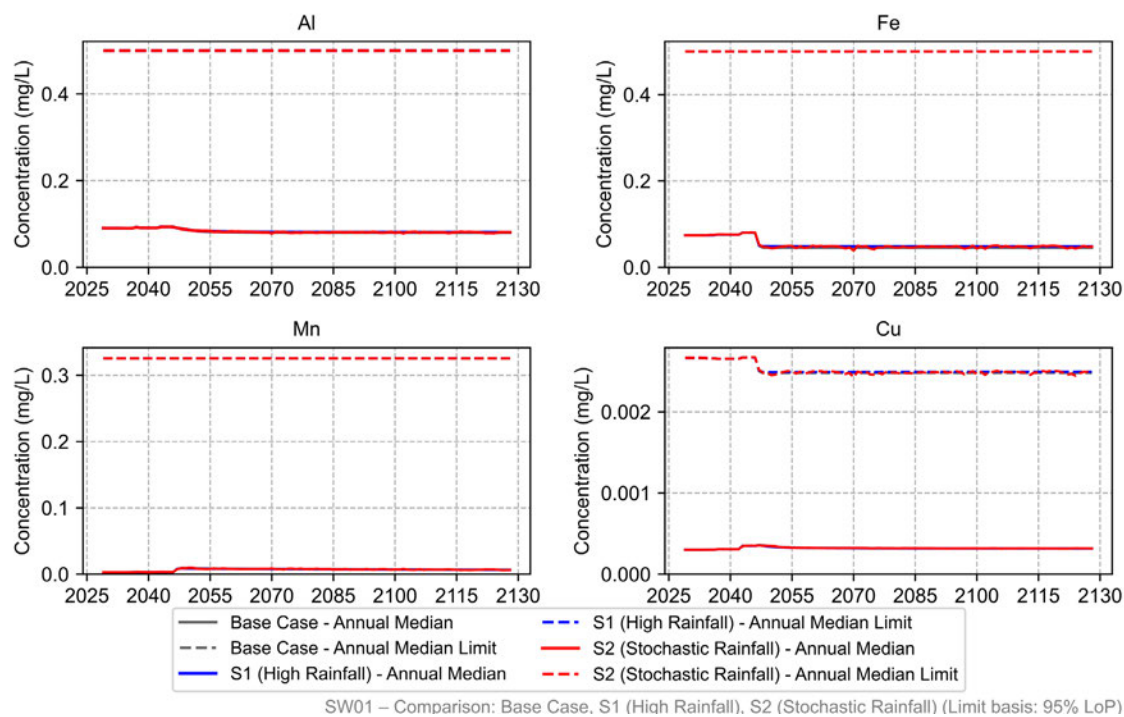


Figure 58: SW01 Base Case S1 S2 Al Fe Mn Cu Matrixcomparison

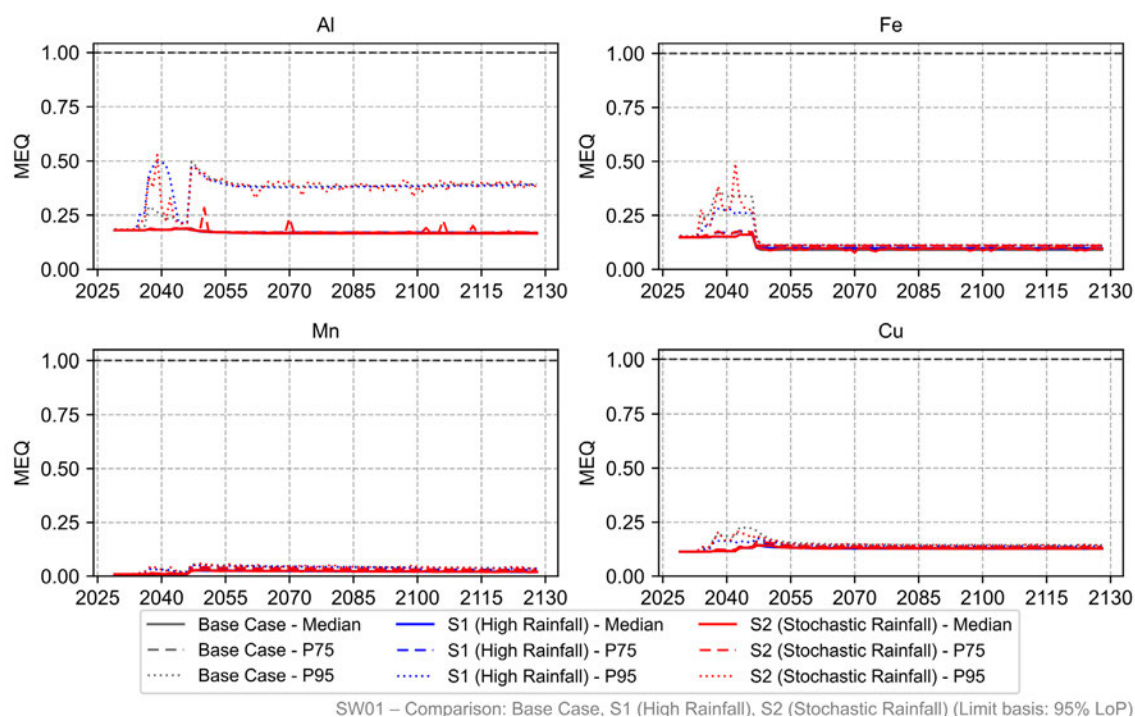
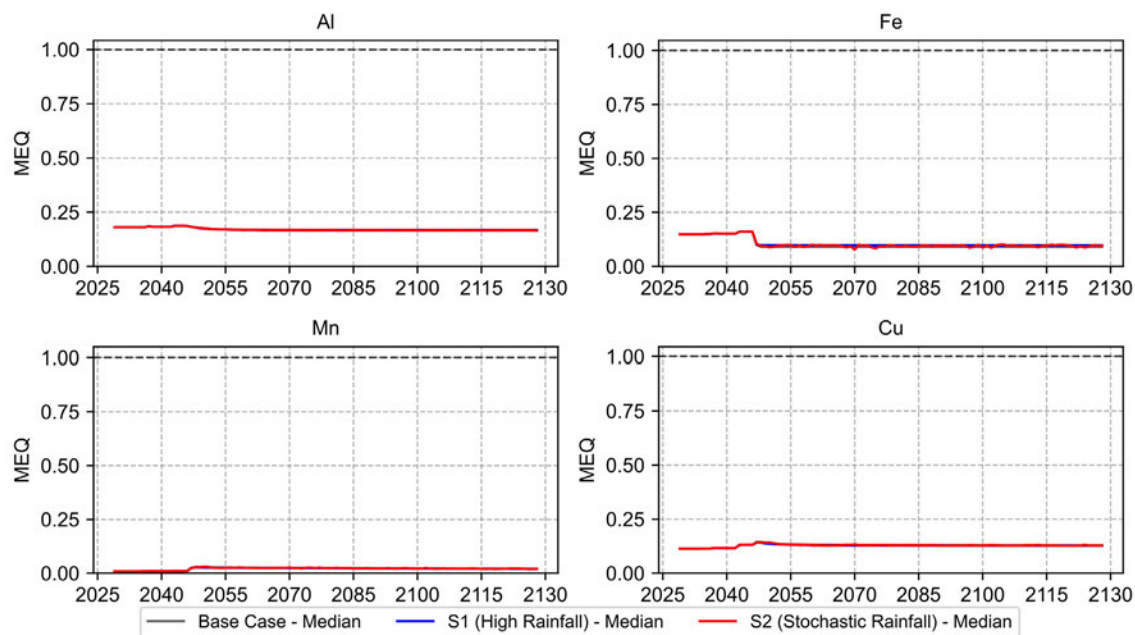
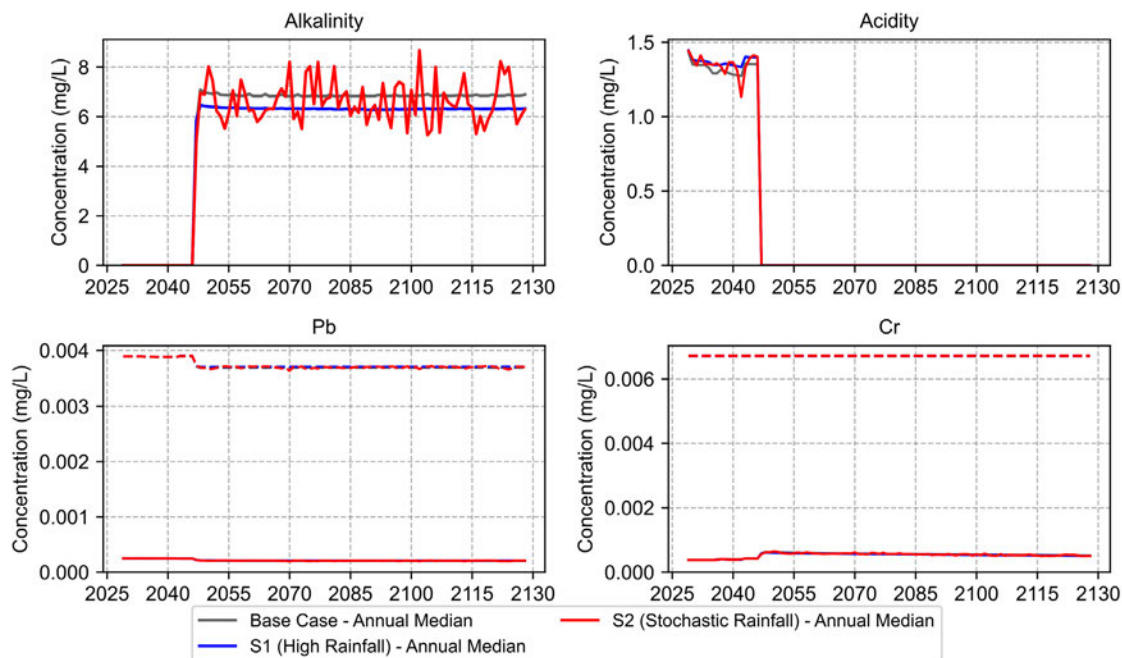


Figure 59: SW01 Base Case S1 S2 Al Fe Mn Cu Matrixcomparison Meq

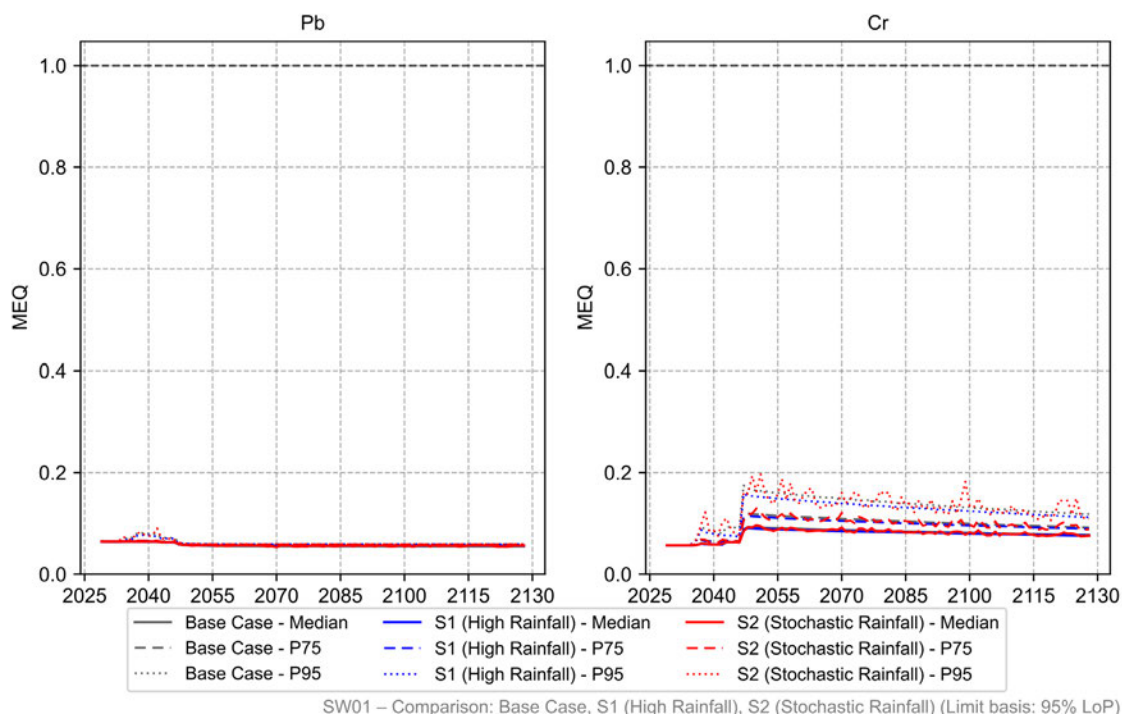


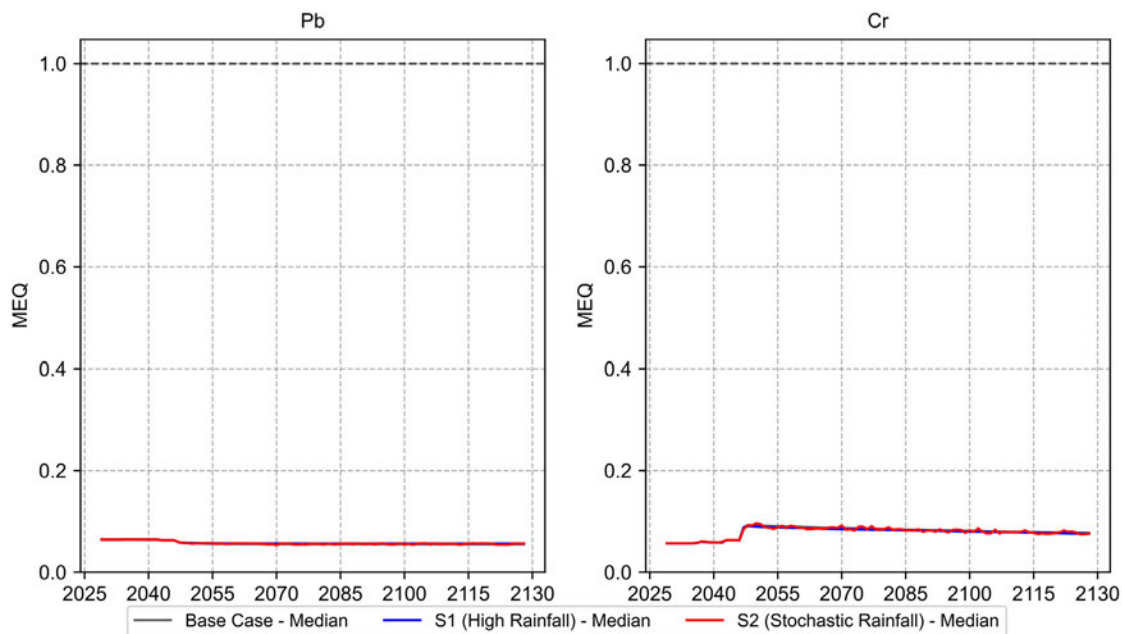
SW01 – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 95% LoP)

Figure 60: SW01 Base Case S1 S2 Al Fe Mn Cu Mxcomp Meq Median Only



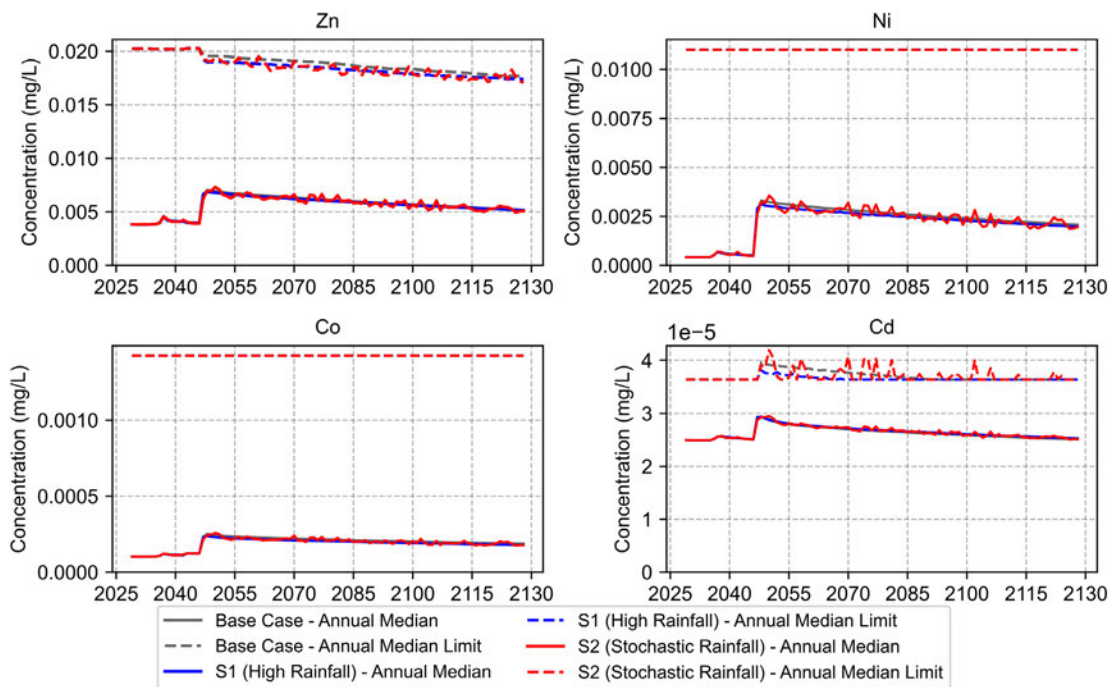
SW01 – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 95% LoP)

Figure 61: SW01 Base Case S1 S2 Alkalinity Acidity Pb Cr Matrixcomparison**Figure 62:** SW01 Base Case S1 S2 Pb Cr Matrixcomparison Meq



SW01 – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 95% LoP)

Figure 63: SW01 Base Case S1 S2 Pb Cr Mxcomp Meq Median Only



SW01 – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 95% LoP)

Figure 64: SW01 Base Case S1 S2 Zn Ni Co Cd Matrixcomparison

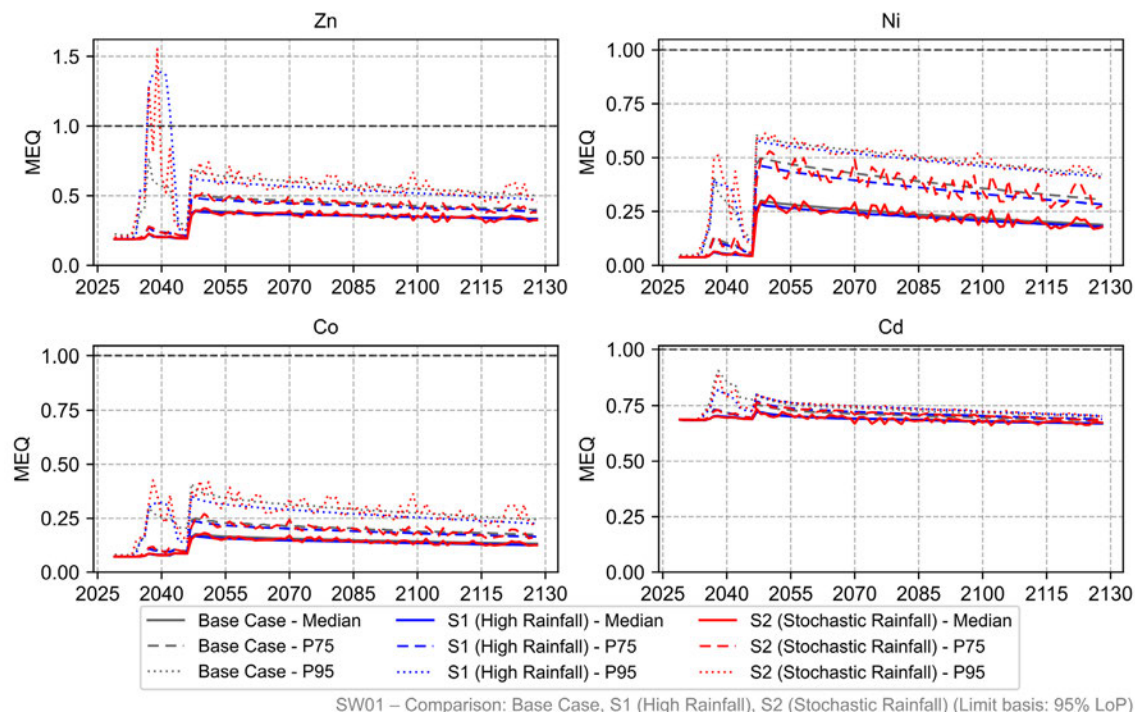


Figure 65: SW01 Base Case S1 S2 Zn Ni Co Cd Matrixcomparison Meq

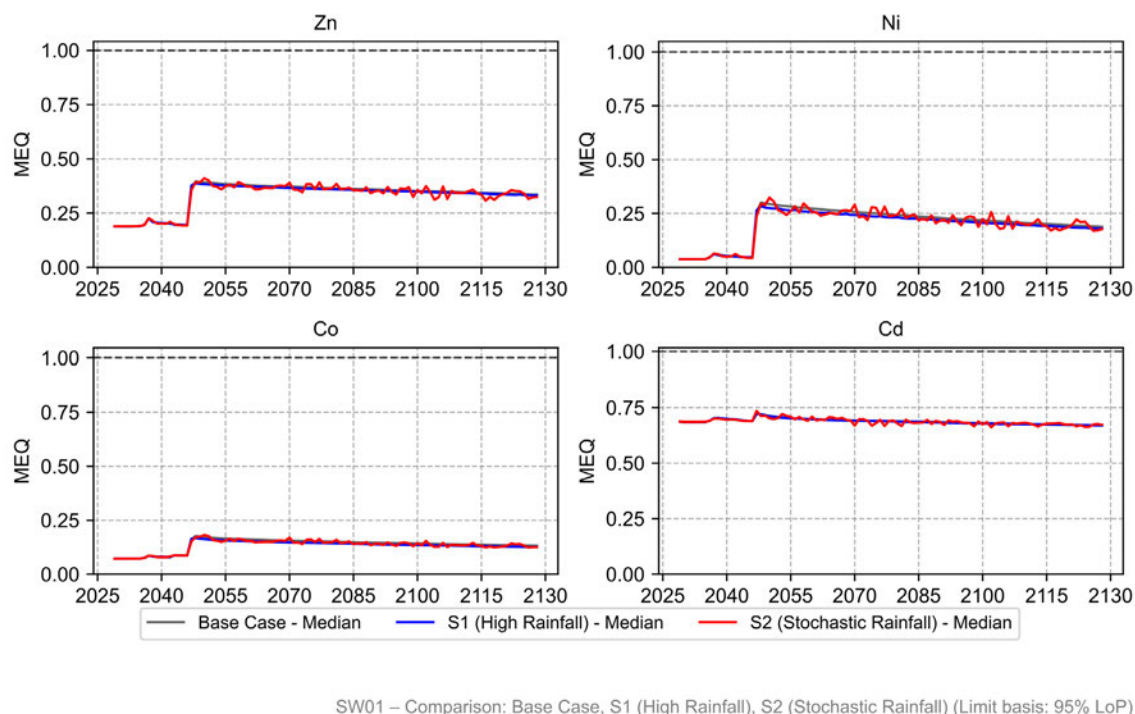


Figure 66: SW01 Base Case S1 S2 Zn Ni Co Cd Mxcomp Meq Median Only

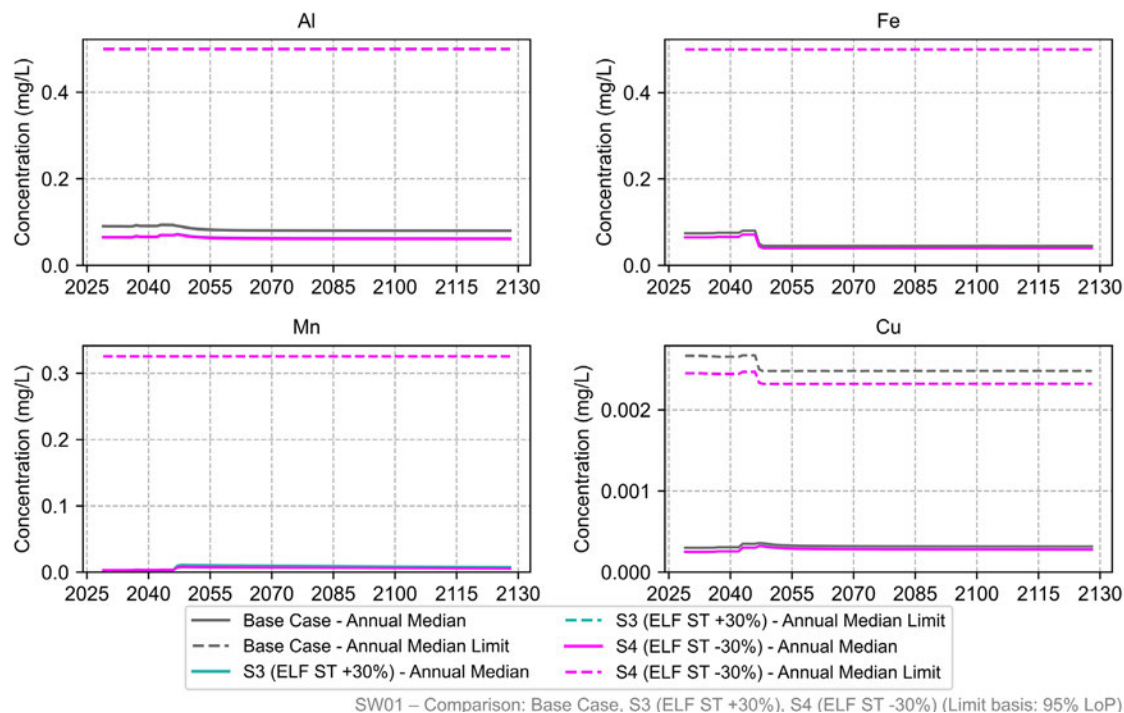


Figure 67: SW01 Base Case S3 S4 Al Fe Mn Cu Matrixcomparison

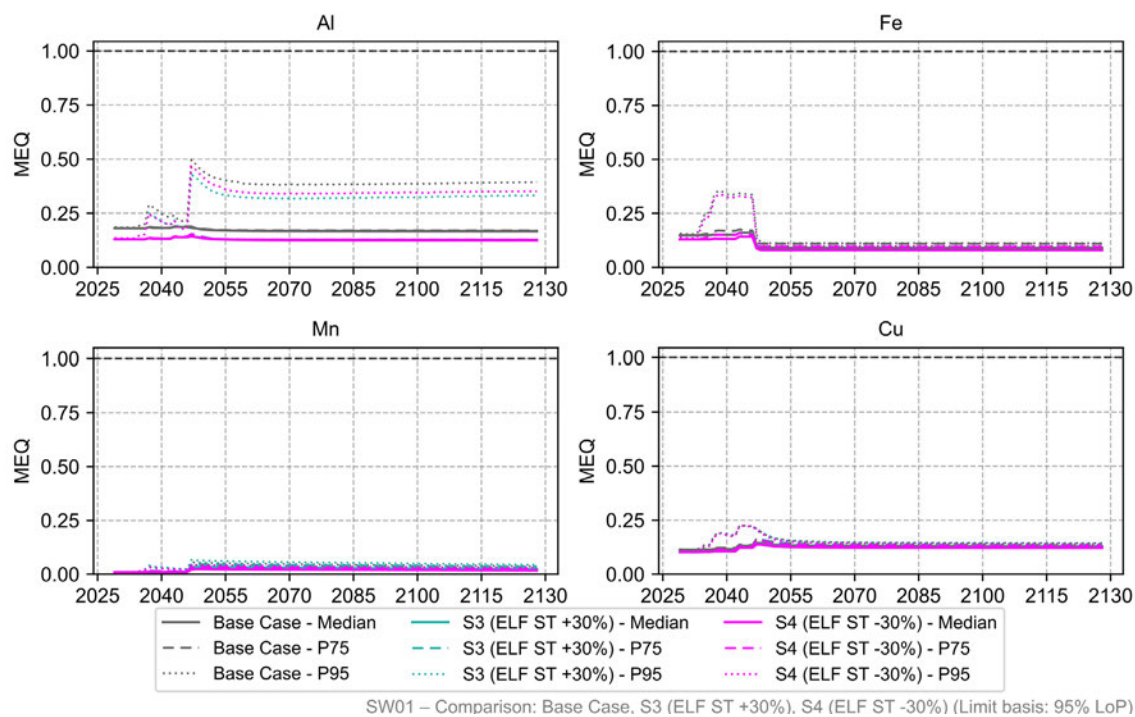
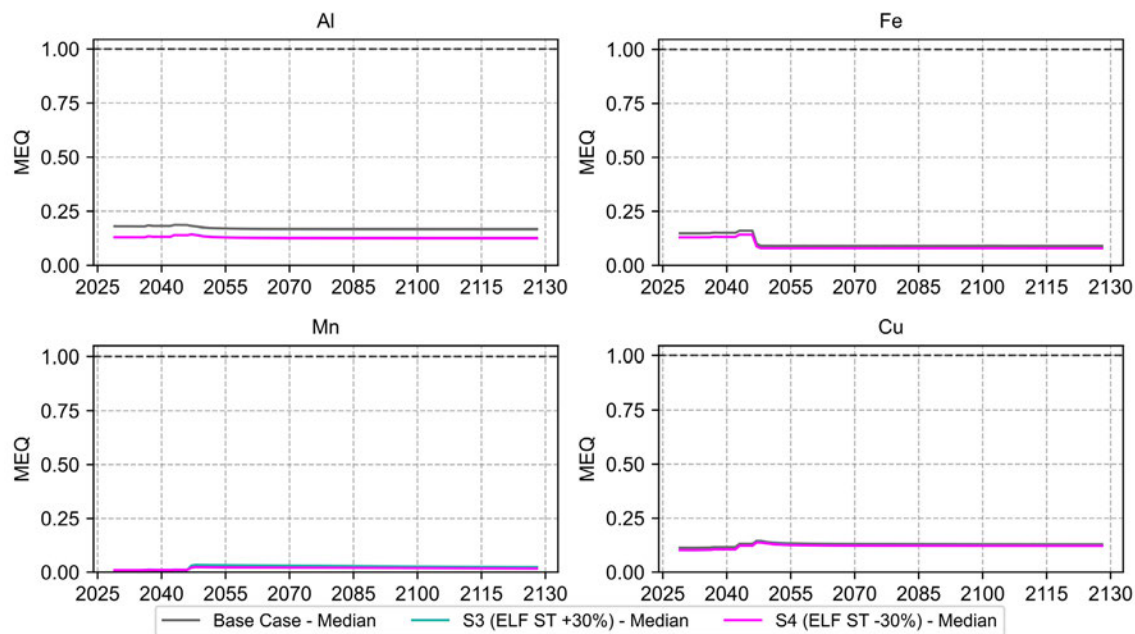
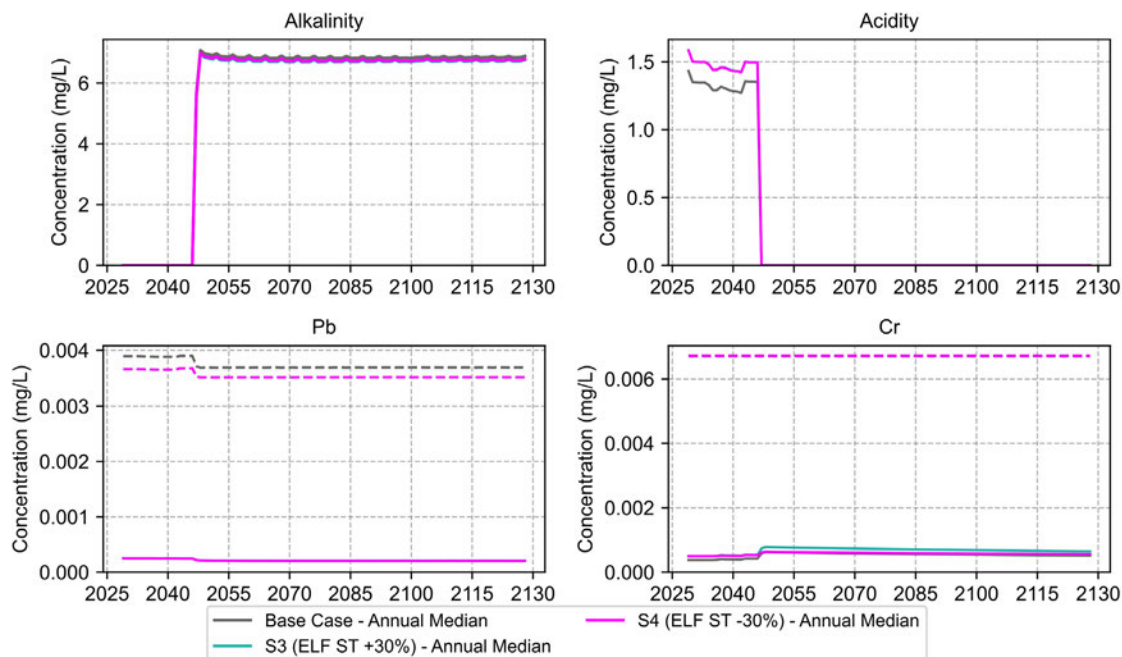


Figure 68: SW01 Base Case S3 S4 Al Fe Mn Cu Matrixcomparison Meq



SW01 – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 95% LoP)

Figure 69: SW01 Base Case S3 S4 Al Fe Mn Cu Mxcomp Meq Median Only



SW01 – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 95% LoP)

Figure 70: SW01 Base Case S3 S4 Alkalinity Acidity Pb Cr Matrixcomparison

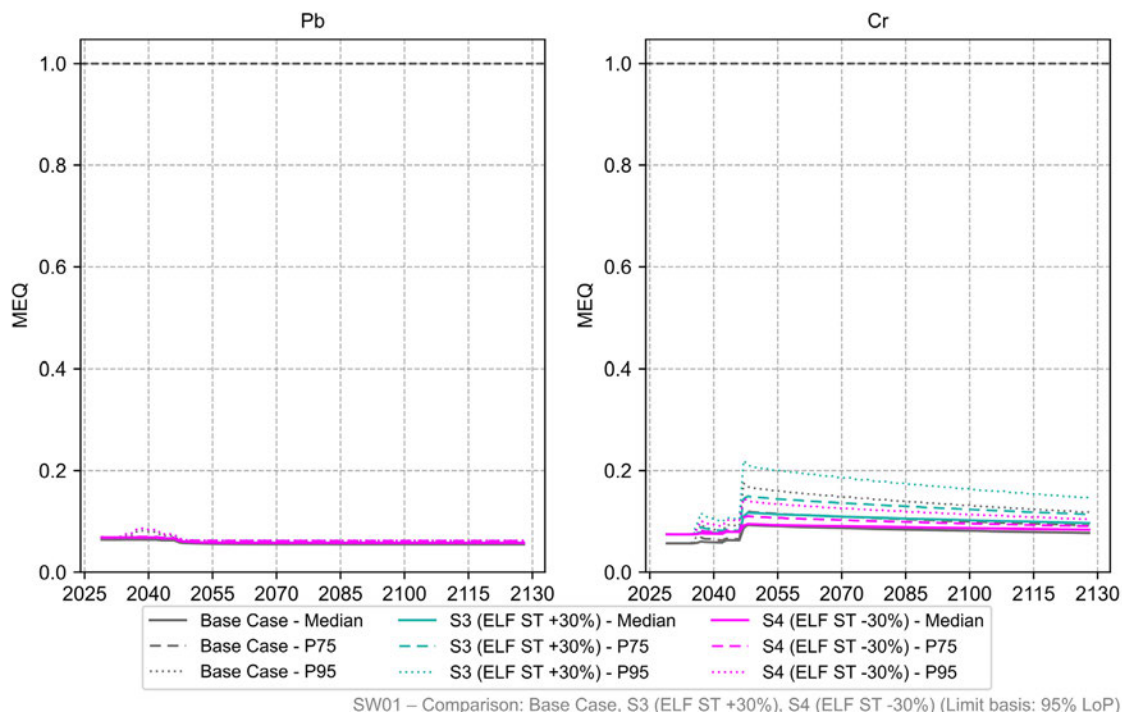


Figure 71: SW01 Base Case S3 S4 Pb Cr Matrixcomparison Meq

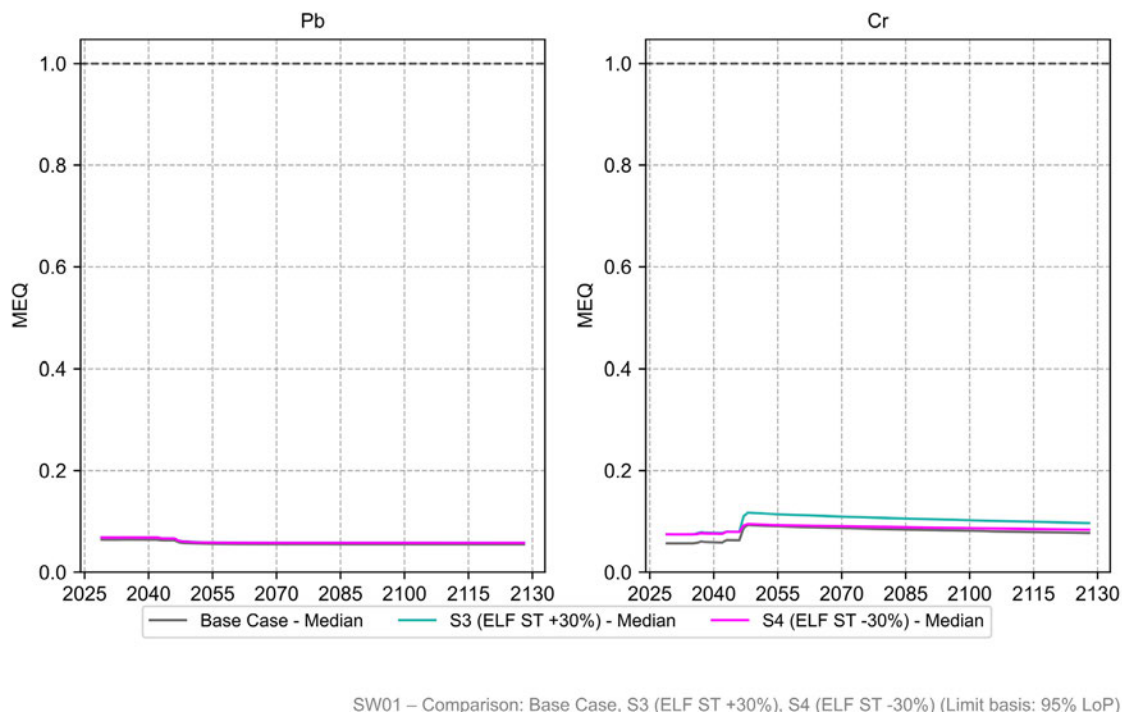


Figure 72: SW01 Base Case S3 S4 Pb Cr Mxcomp Meq Median Only

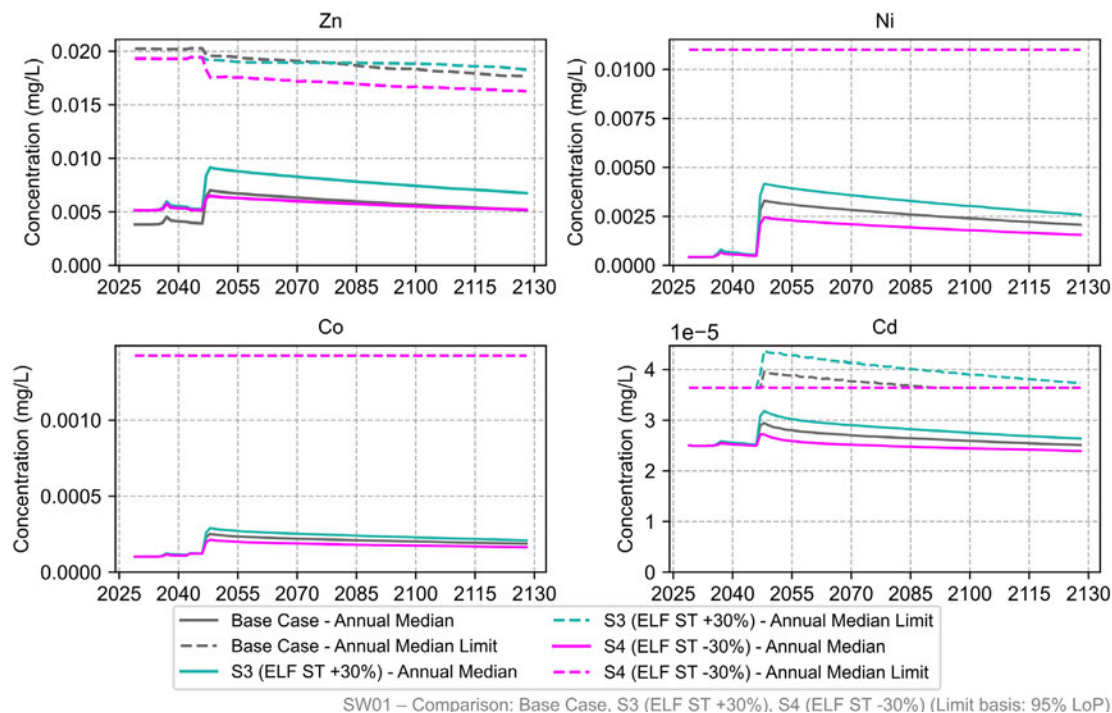


Figure 73: SW01 Base Case S3 S4 Zn Ni Co Cd Matrixcomparison

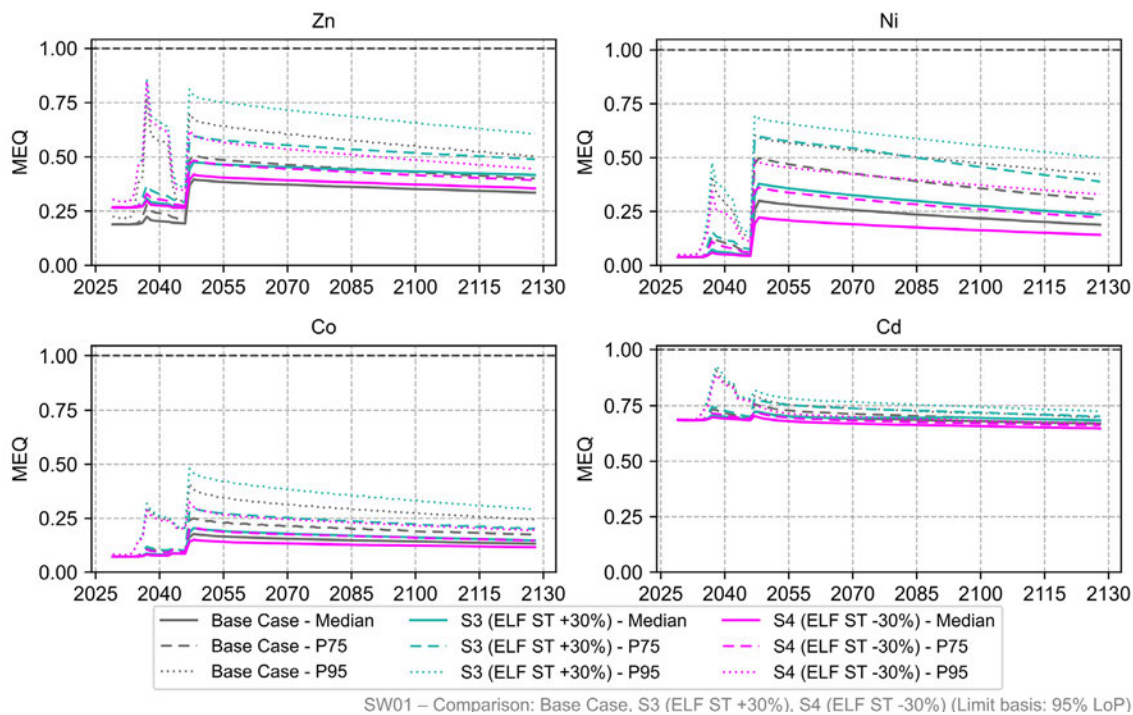
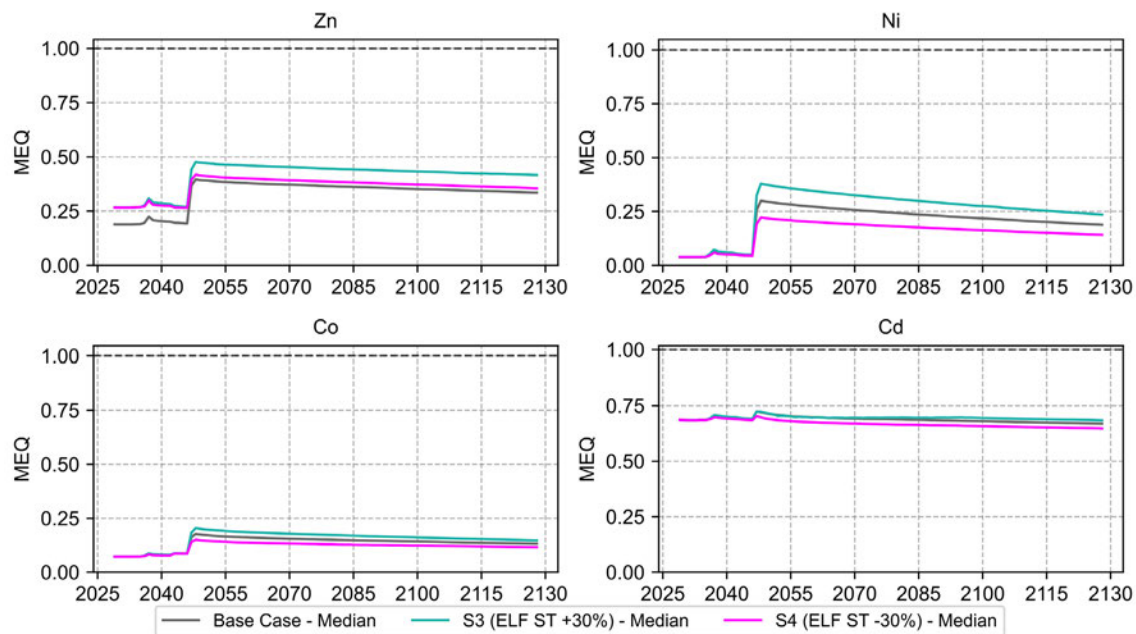
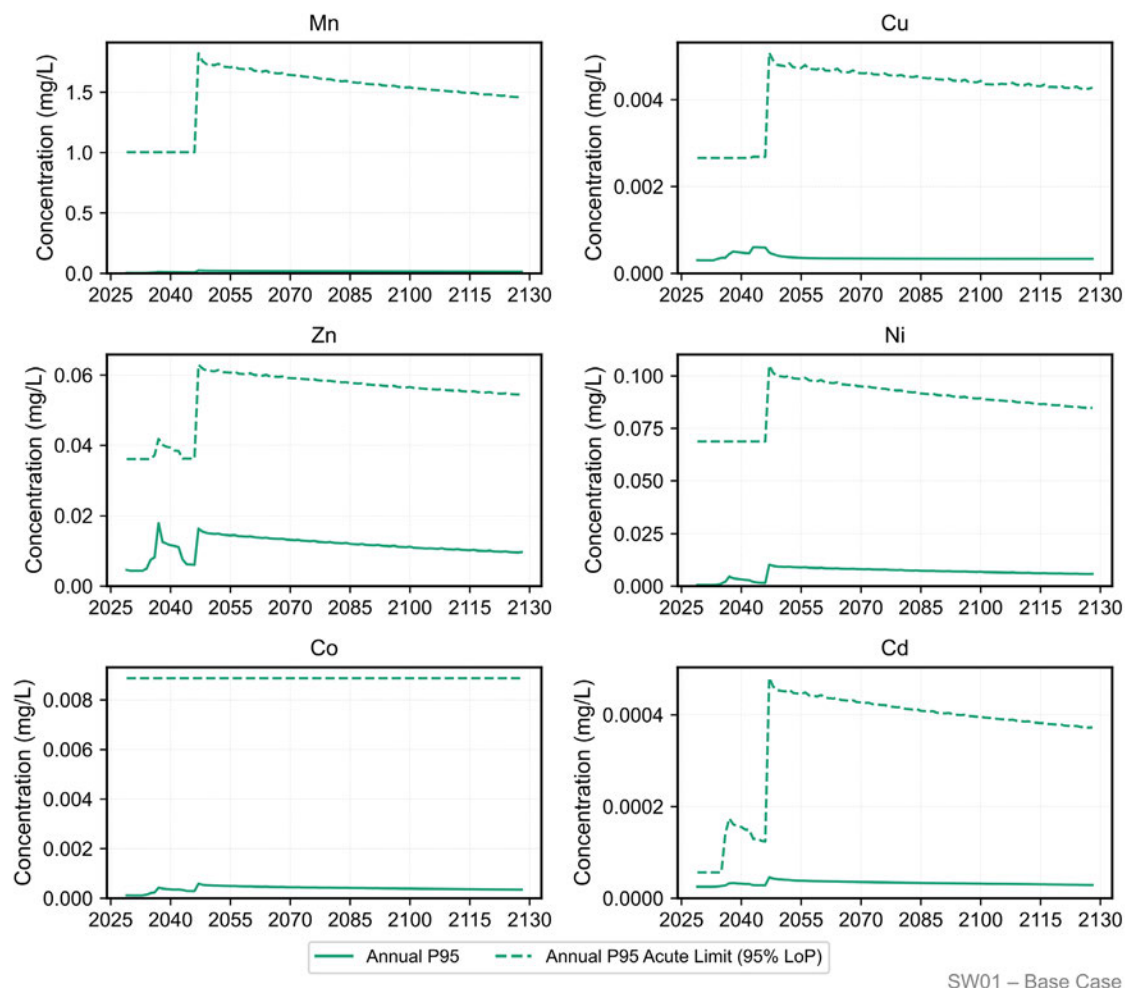


Figure 74: SW01 Base Case S3 S4 Zn Ni Co Cd Matrixcomparison Meq



SW01 – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 95% LoP)

Figure 75: SW01 Base Case S3 S4 Zn Ni Co Cd Mxcomp Meq Median Only

1.6 ANNUAL P95 (SINGLE SCENARIO)**Figure 76: SW01 Base Case Acute Limits**

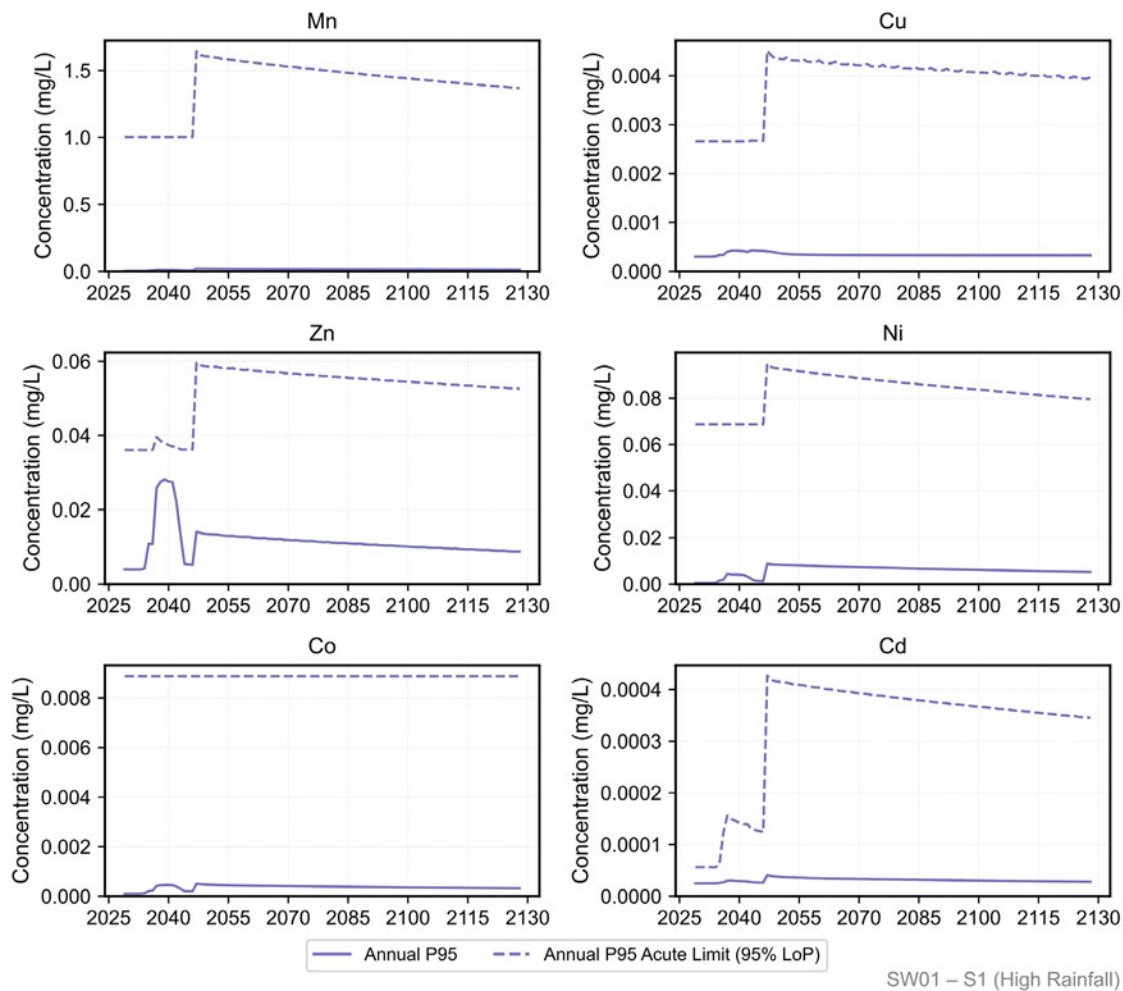


Figure 77: SW01 S1 High Rainfall Acute Limits

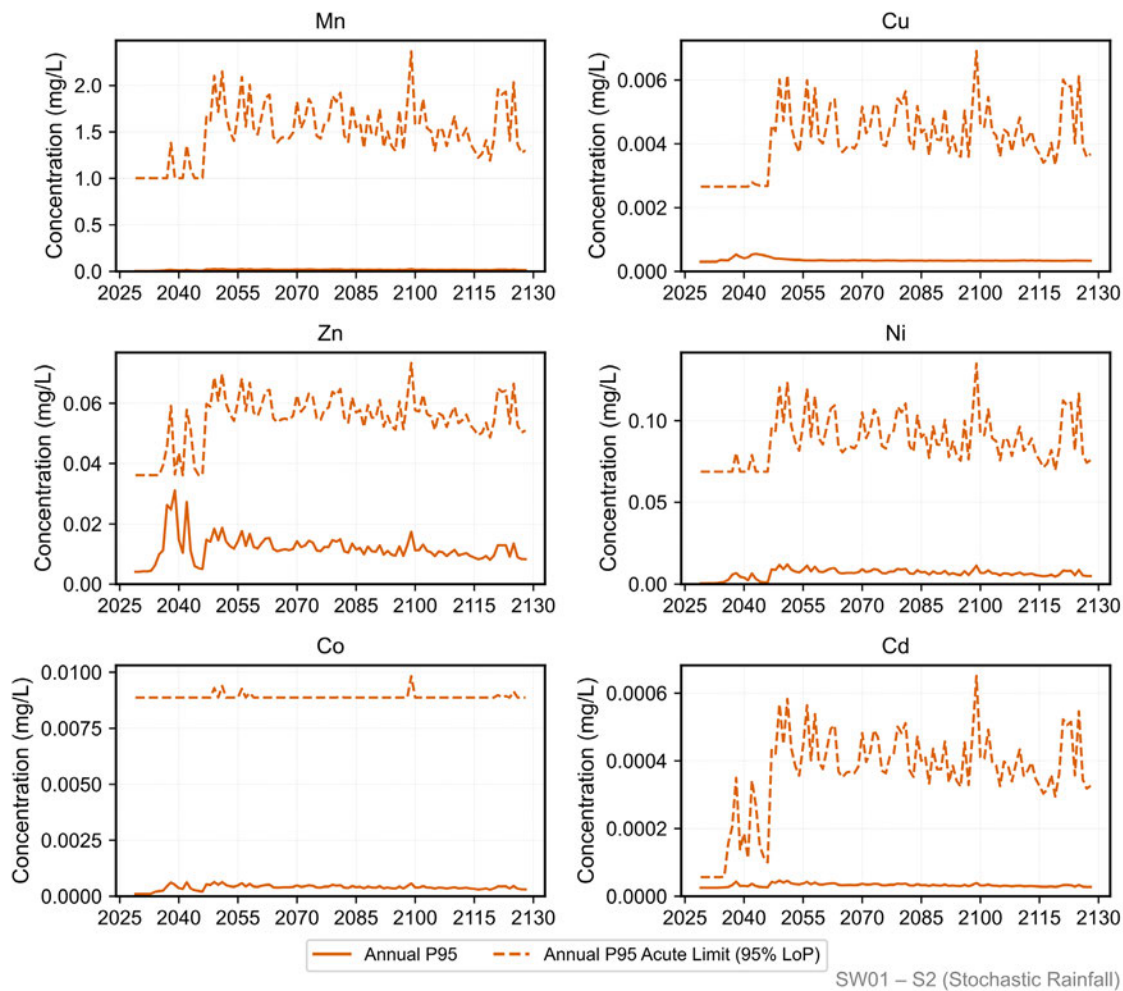


Figure 78: SW01 S2 Stochastic Rainfall Acute Limits

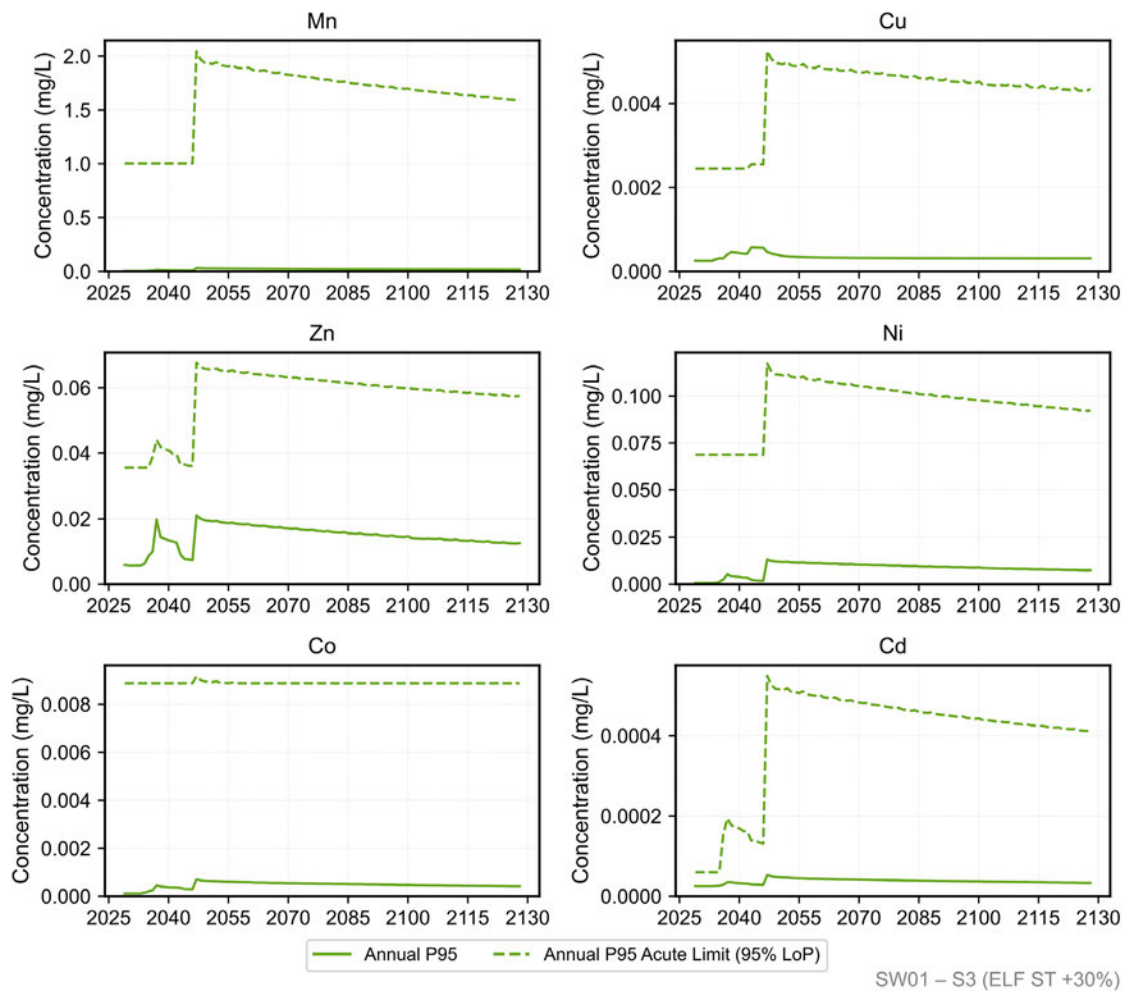


Figure 79: SW01 S3 Elf St 30 Acute Limits

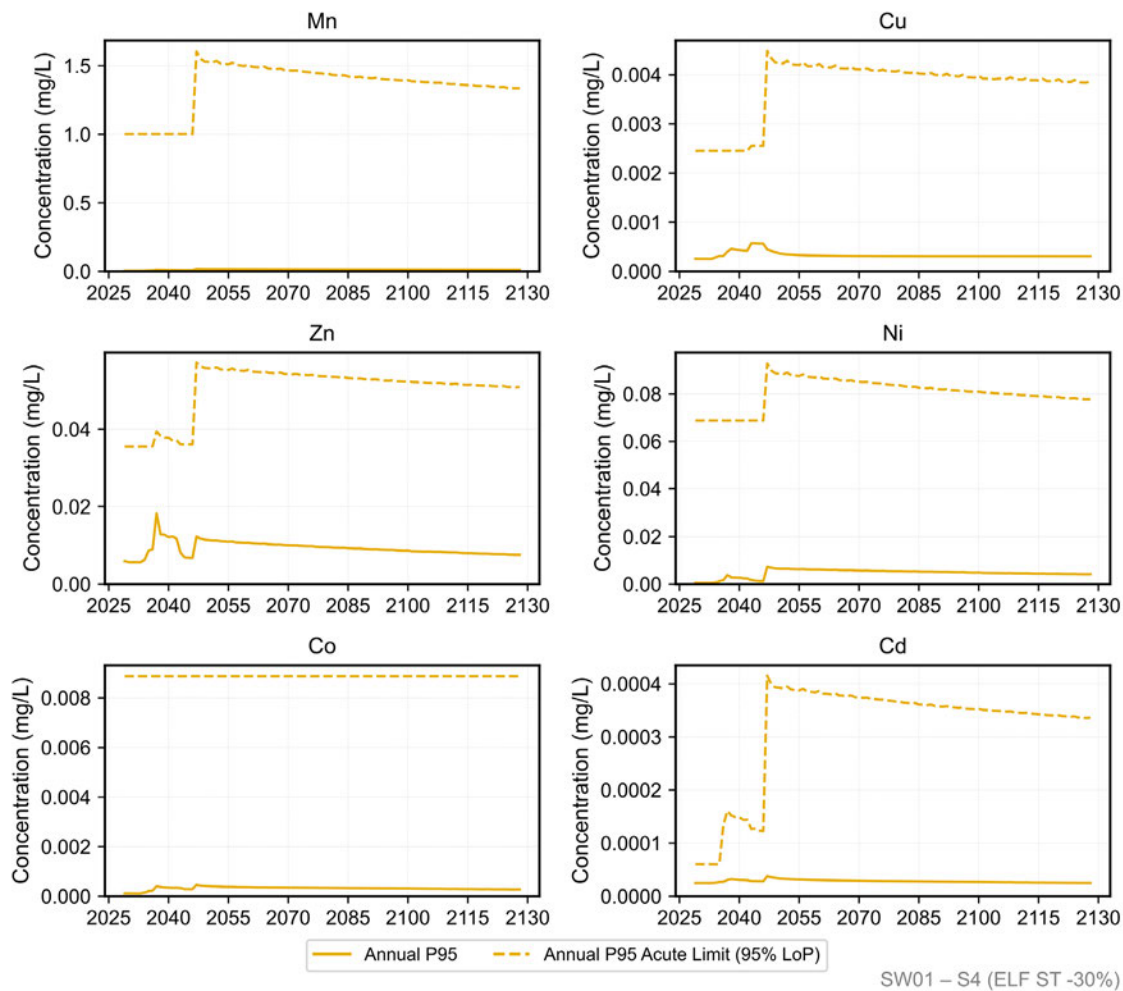


Figure 80: SW01 S4 Elf St 30 Acute Limits

1.7 ANNUAL P95 (GROUPED SCENARIO)

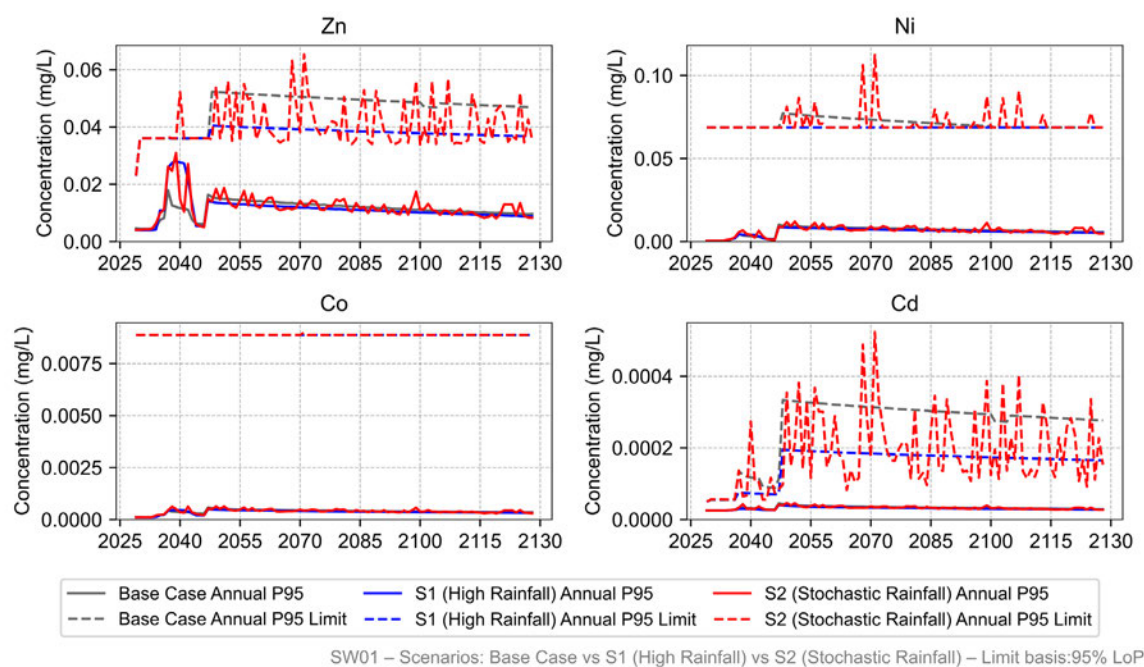


Figure 81: SW01 Set1 Acute Limits

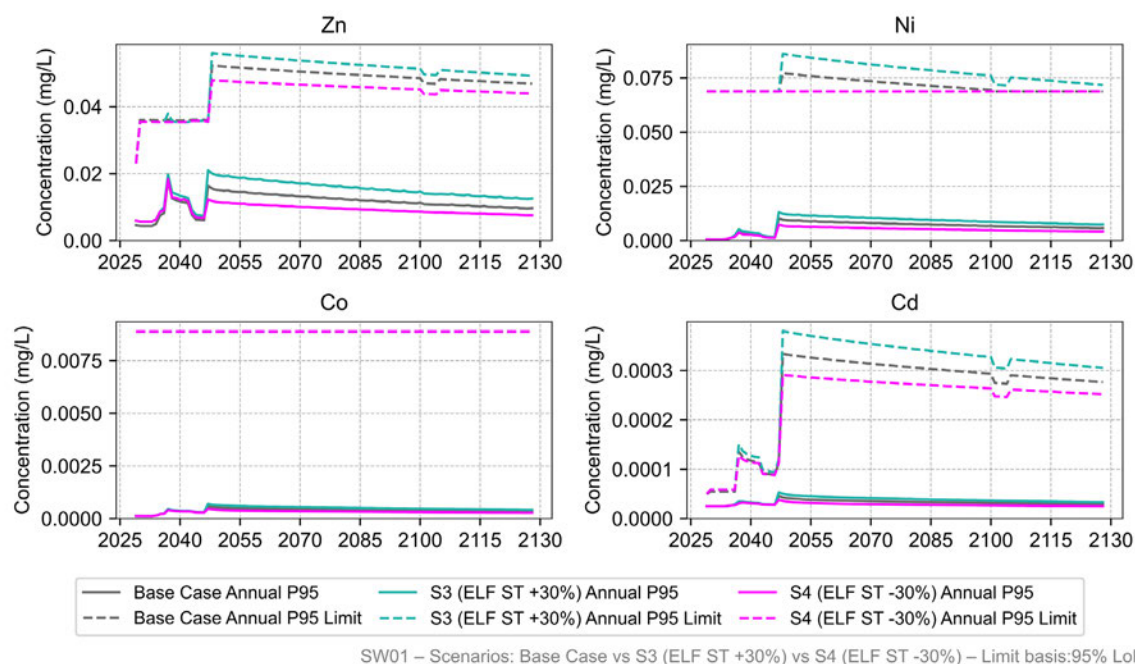


Figure 82: SW01 Set2 Acute Limits

2. STATION SW03

2.1 30-DAY ROLLING MEDIAN

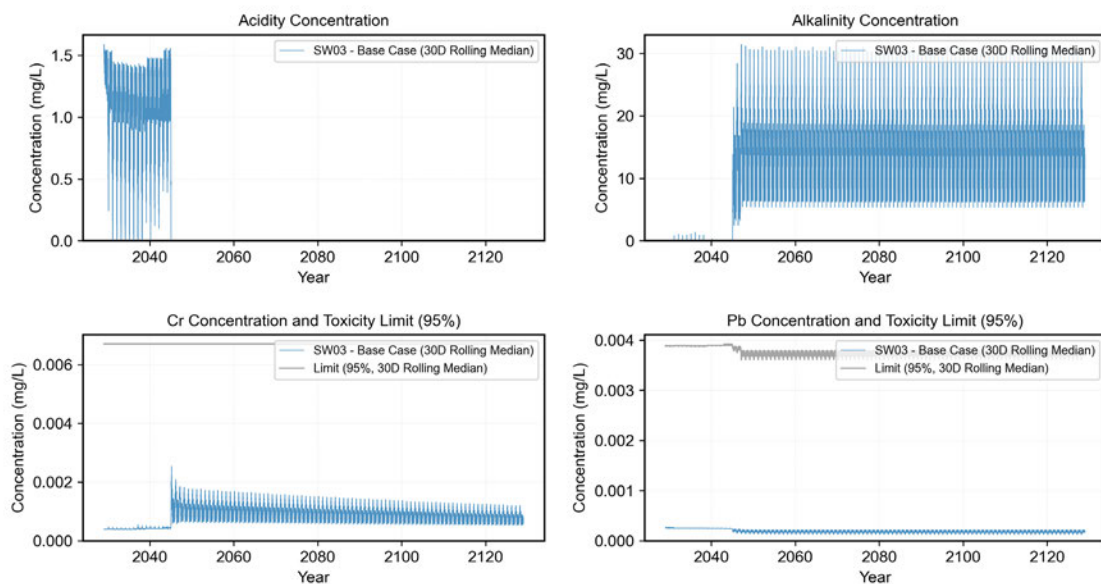


Figure 83: Matrix plot Base Case SW03 Acidity Alkalinity Cr Pb

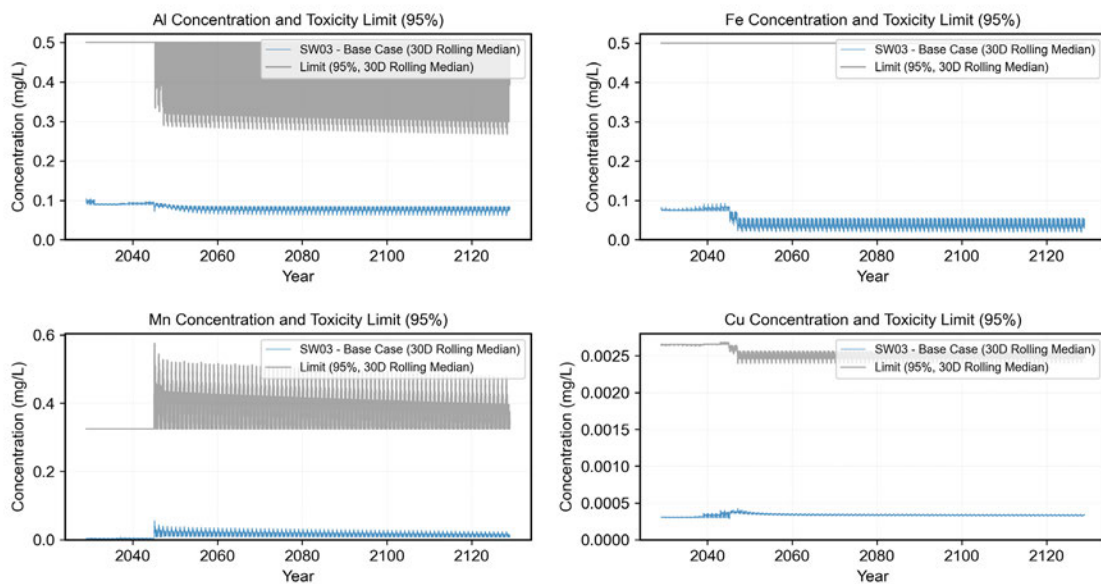


Figure 84: Matrix plot Base Case SW03 Al Fe Mn Cu

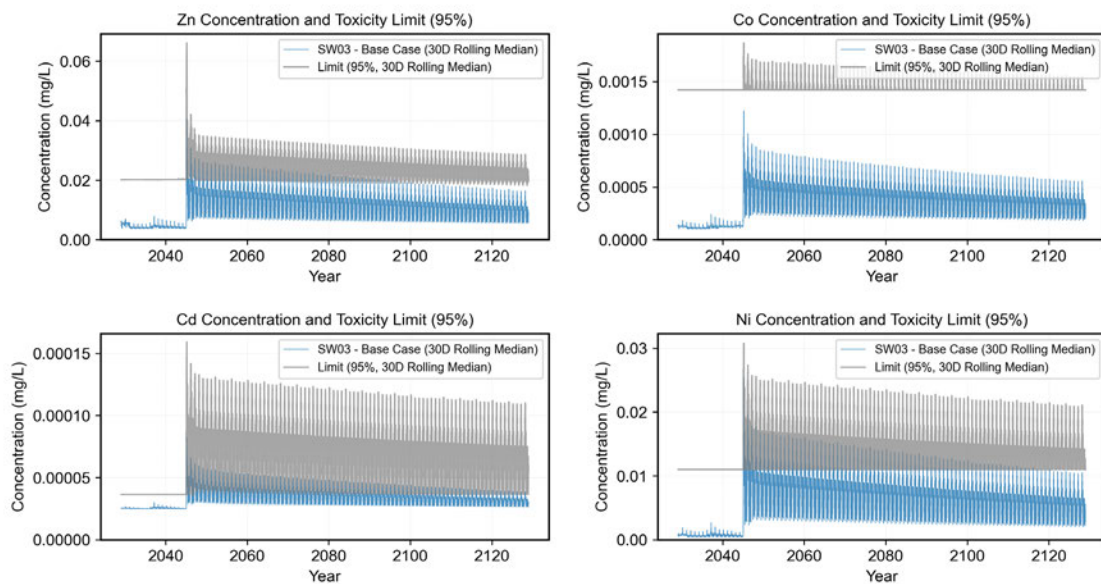


Figure 85: Matrix plot Base Case SW03 Zn Co Cd Ni

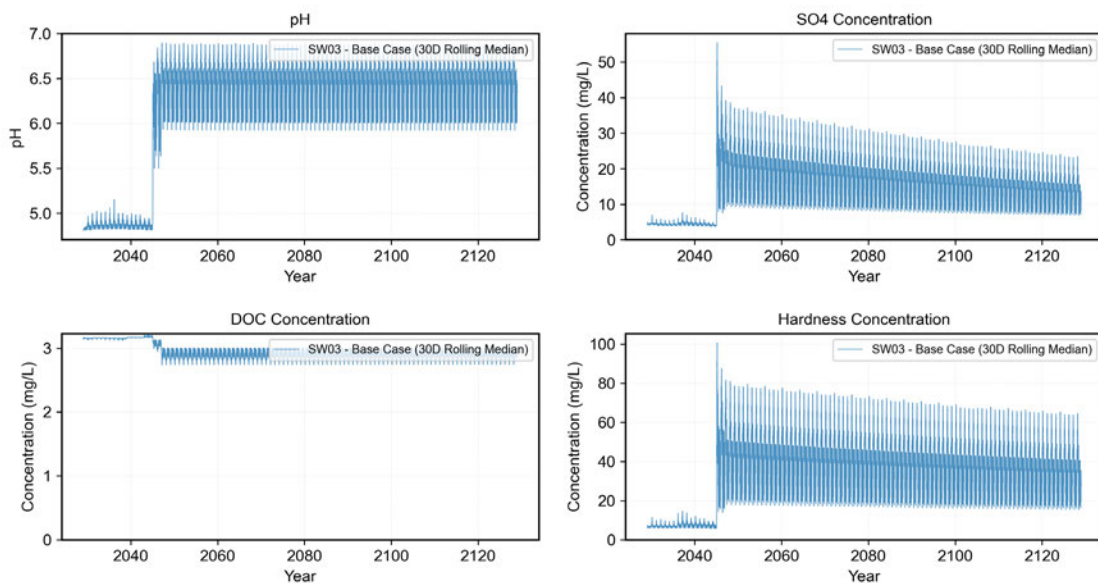


Figure 86: Matrix plot Base Case SW03 pH SO4 DOC Hardness

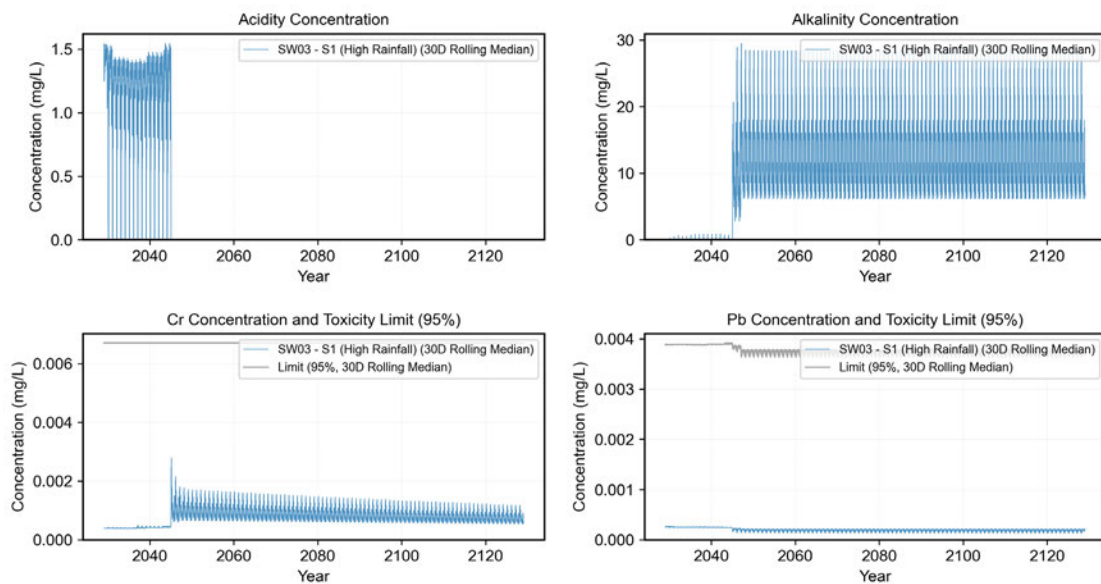


Figure 87: Matrix plot S1 (High Rainfall) SW03 Acidity Alkalinity Cr Pb

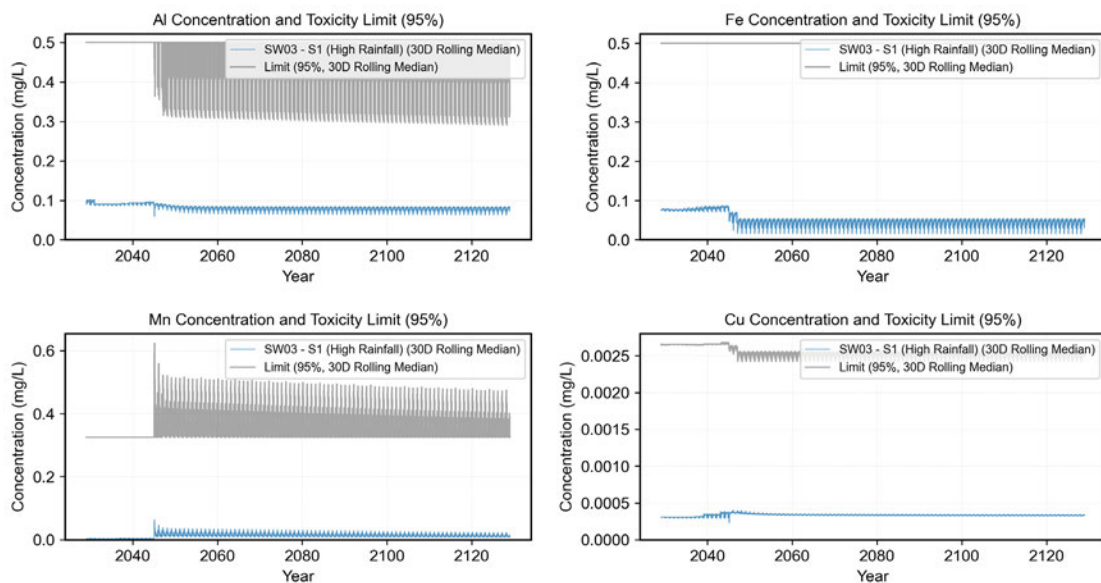


Figure 88: Matrix plot S1 (High Rainfall) SW03 Al Fe Mn Cu

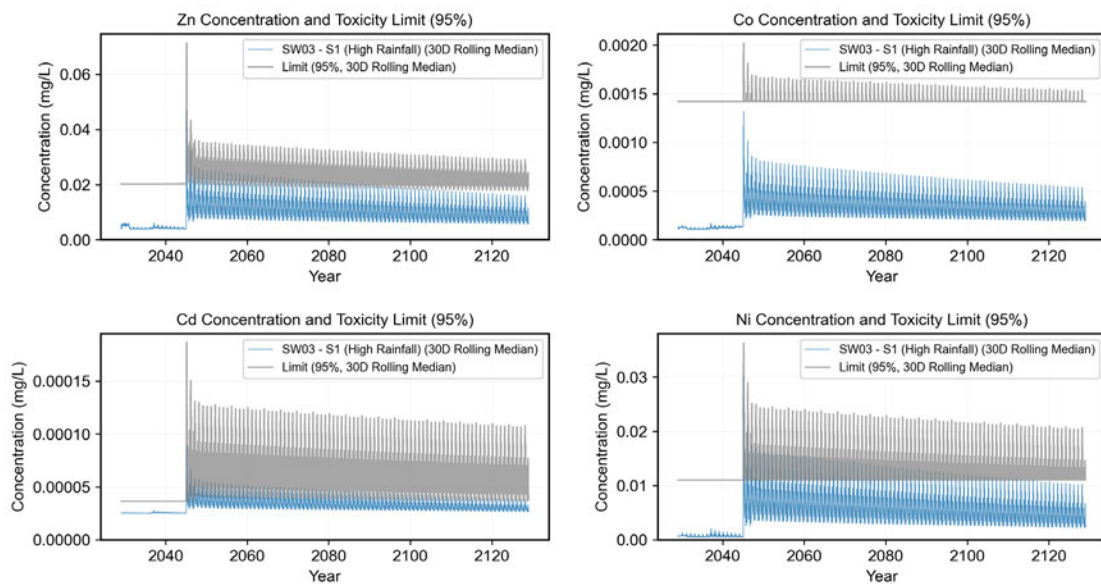


Figure 89: Matrix plot S1 (High Rainfall) SW03 Zn Co Cd Ni

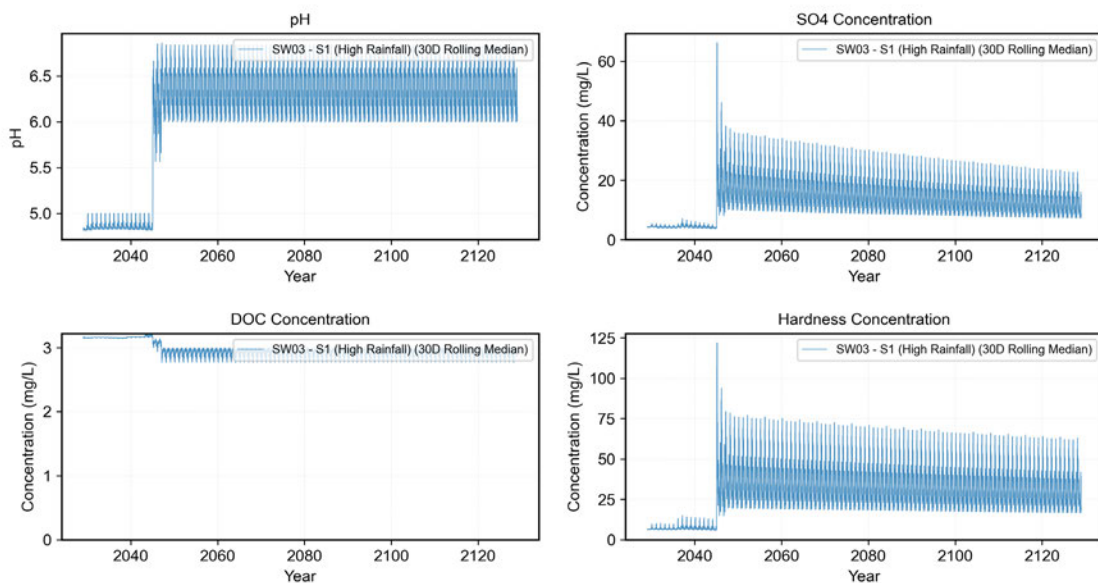


Figure 90: Matrix plot S1 (High Rainfall) SW03 pH SO4 DOC Hardness

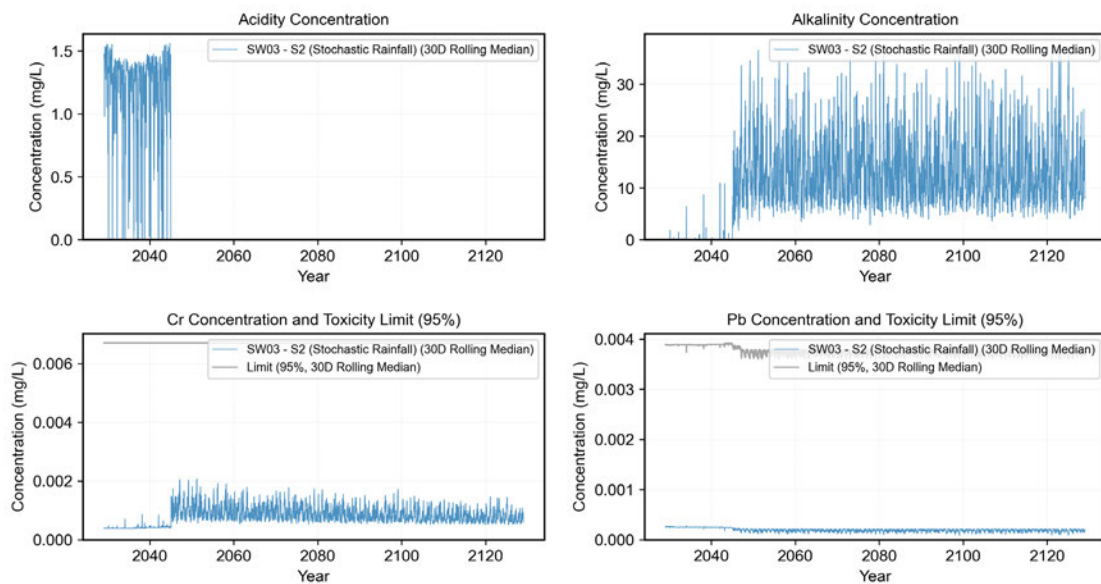


Figure 91: Matrix plot S2 (Stochastic Rainfall) SW03 Acidity Alkalinity Cr Pb

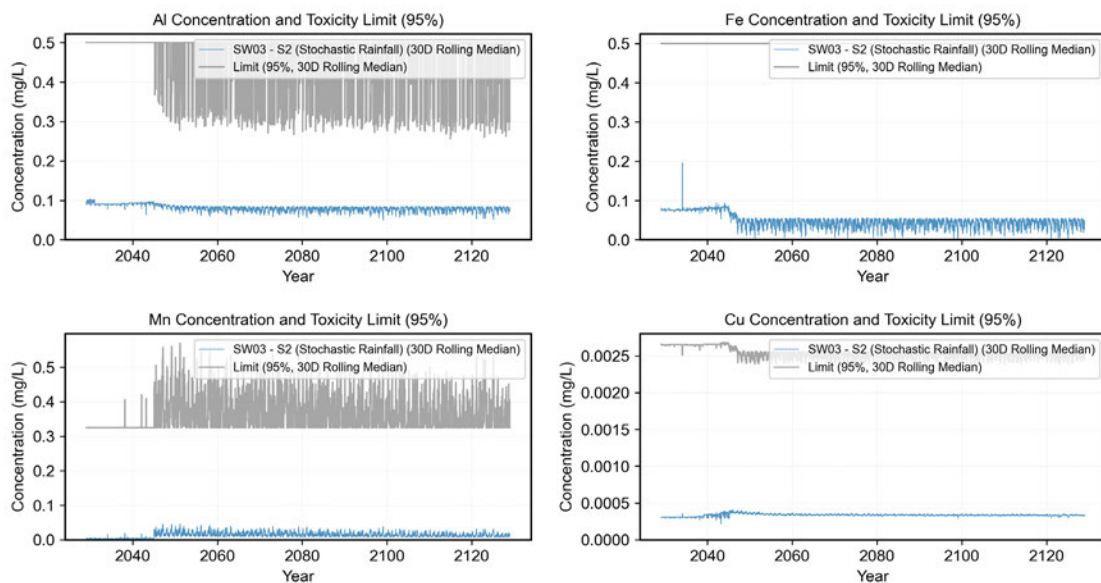


Figure 92: Matrix plot S2 (Stochastic Rainfall) SW03 Al Fe Mn Cu

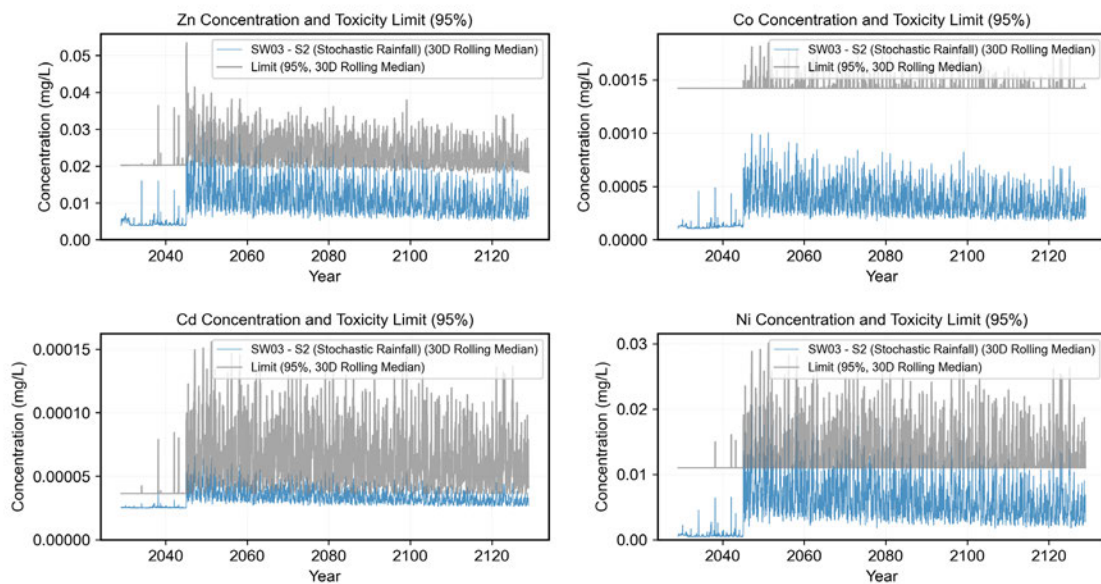


Figure 93: Matrix plot S2 (Stochastic Rainfall) SW03 Zn Co Cd Ni

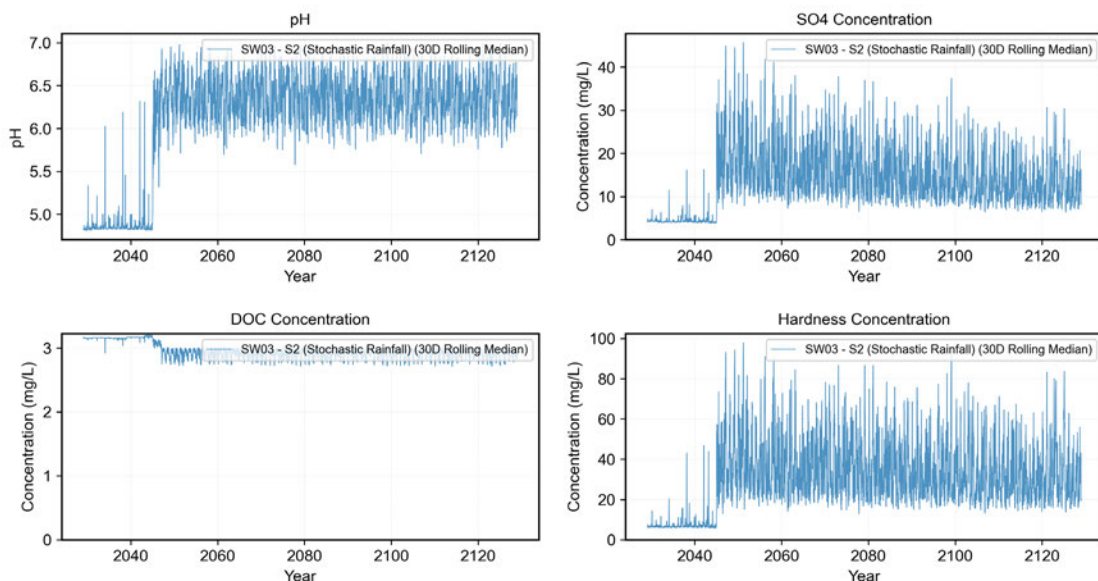


Figure 94: Matrix plot S2 (Stochastic Rainfall) SW03 pH SO4 DOC Hardness

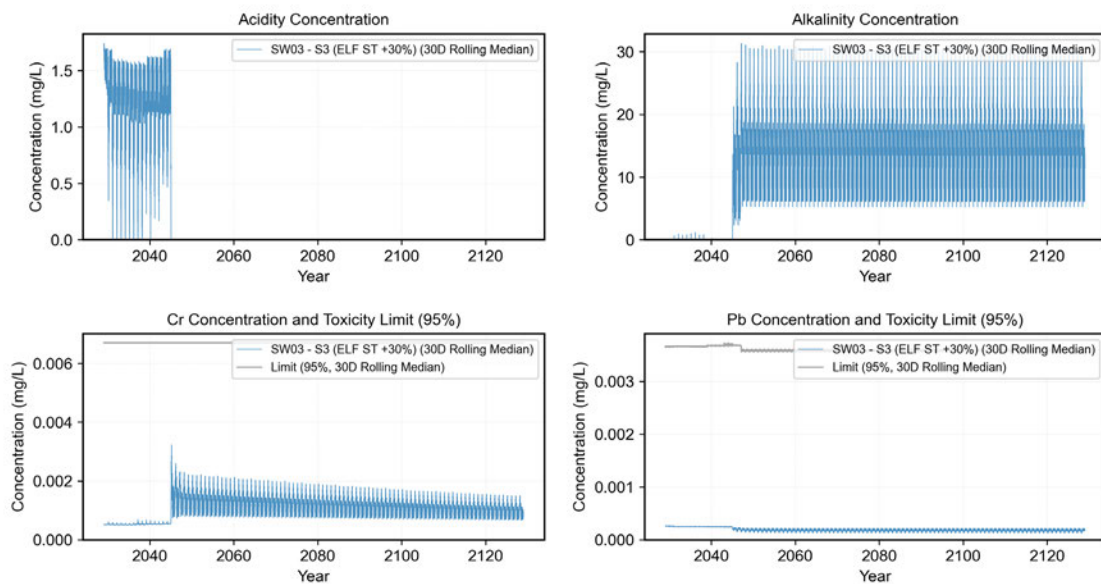


Figure 95: Matrix plot S3 (Elf St +30%) SW03 Acidity Alkalinity Cr Pb

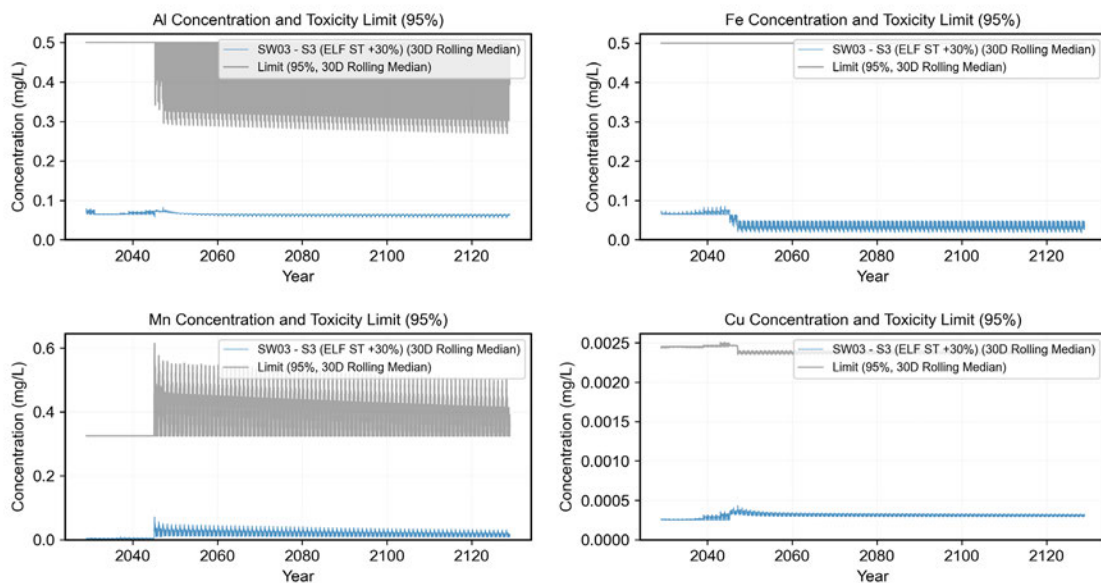


Figure 96: Matrix plot S3 (Elf St +30%) SW03 Al Fe Mn Cu

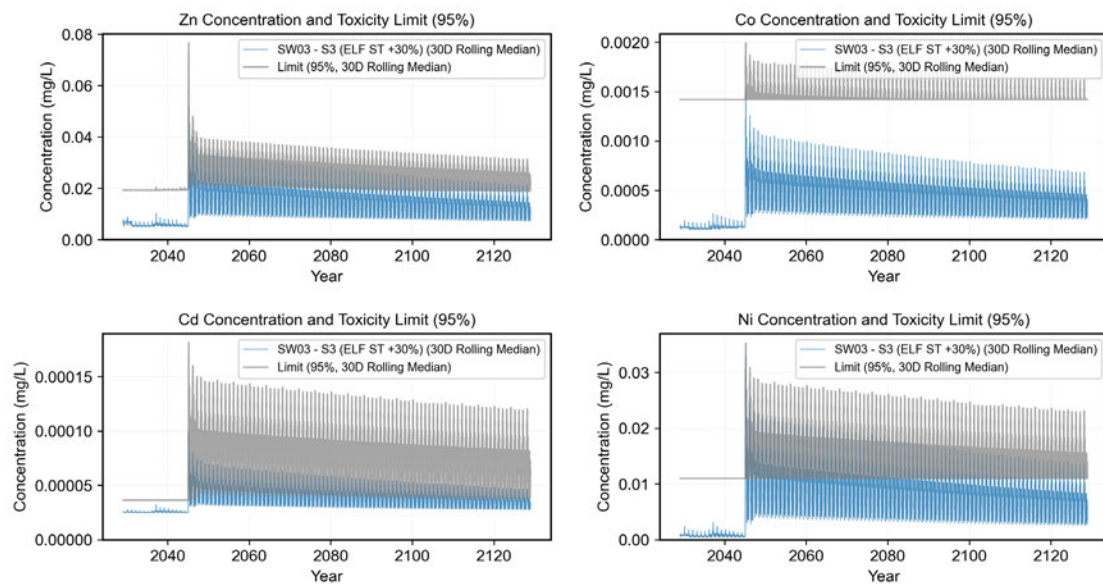


Figure 97: Matrix plot S3 (Elf St +30%) SW03 Zn Co Cd Ni

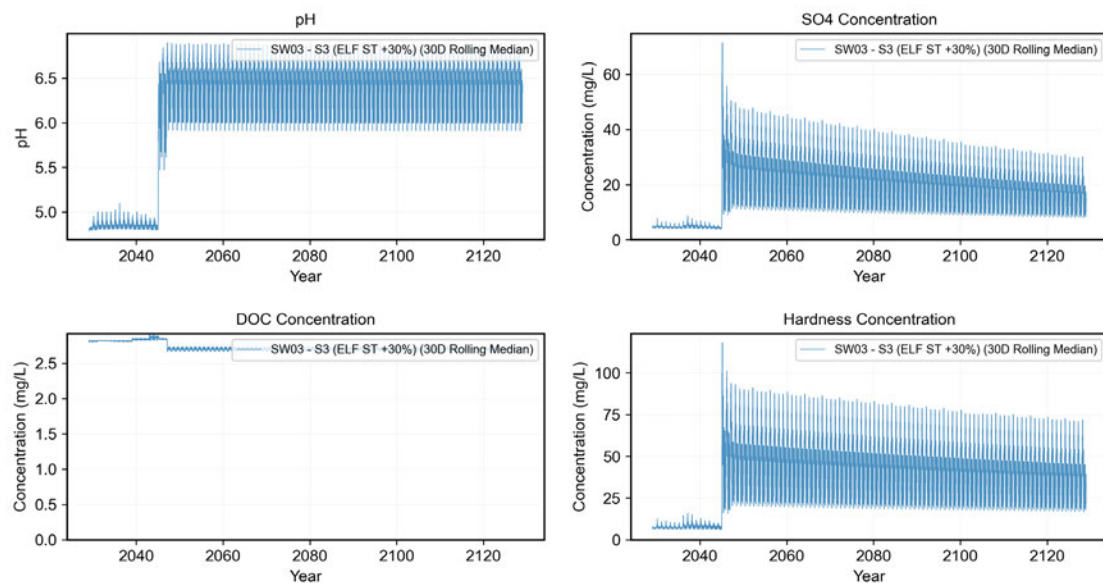


Figure 98: Matrix plot S3 (Elf St +30%) SW03 pH SO4 DOC Hardness

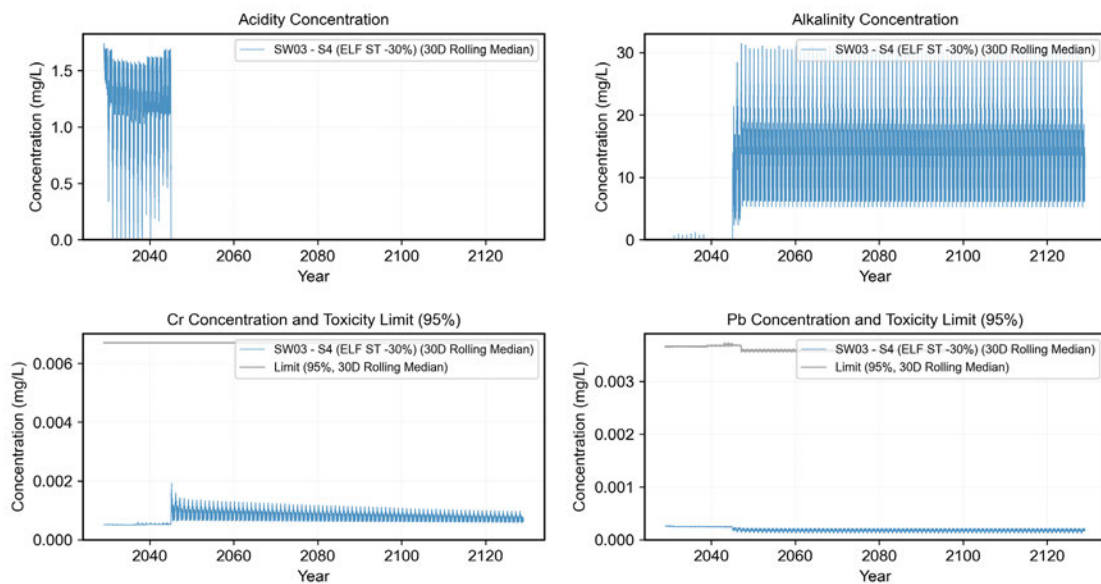


Figure 99: Matrix plot S4 (Elf St 30%) SW03 Acidity Alkalinity Cr Pb

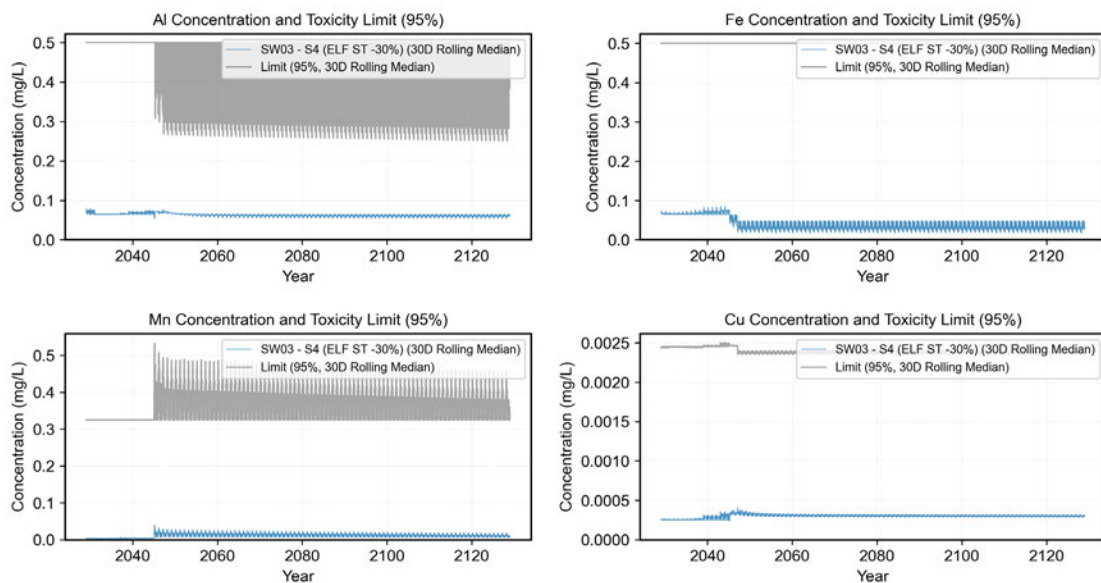


Figure 100: Matrix plot S4 (Elf St 30%) SW03 Al Fe Mn Cu

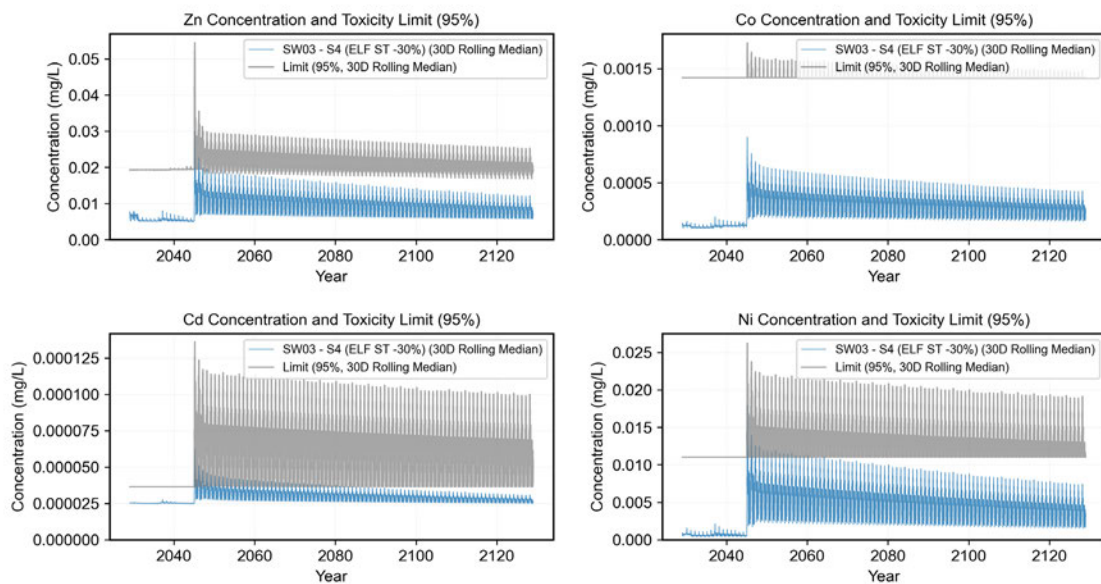


Figure 101: Matrix plot S4 (Elf St 30%) SW03 Zn Co Cd Ni

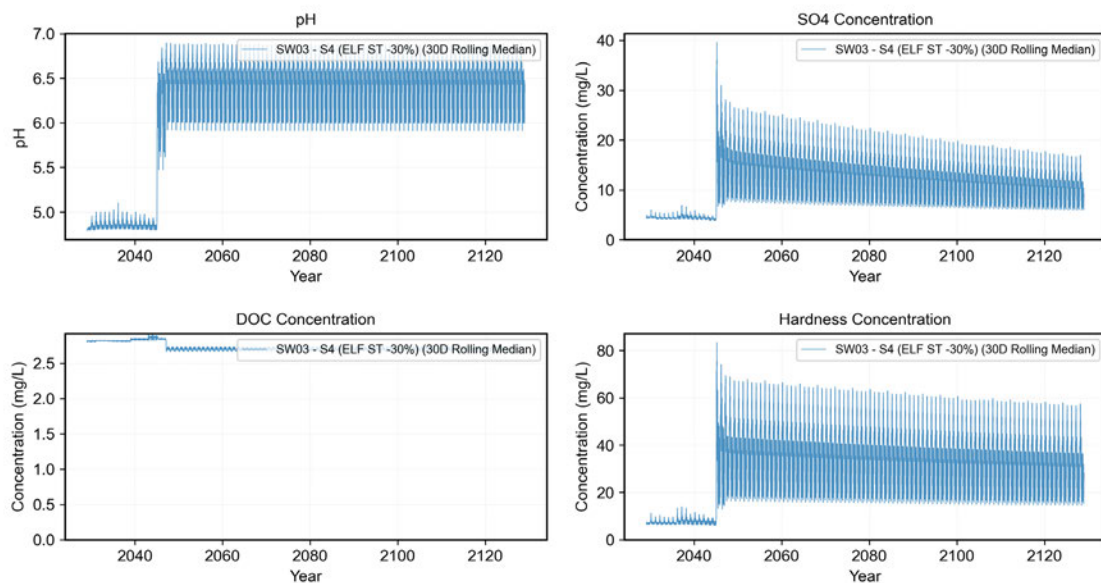
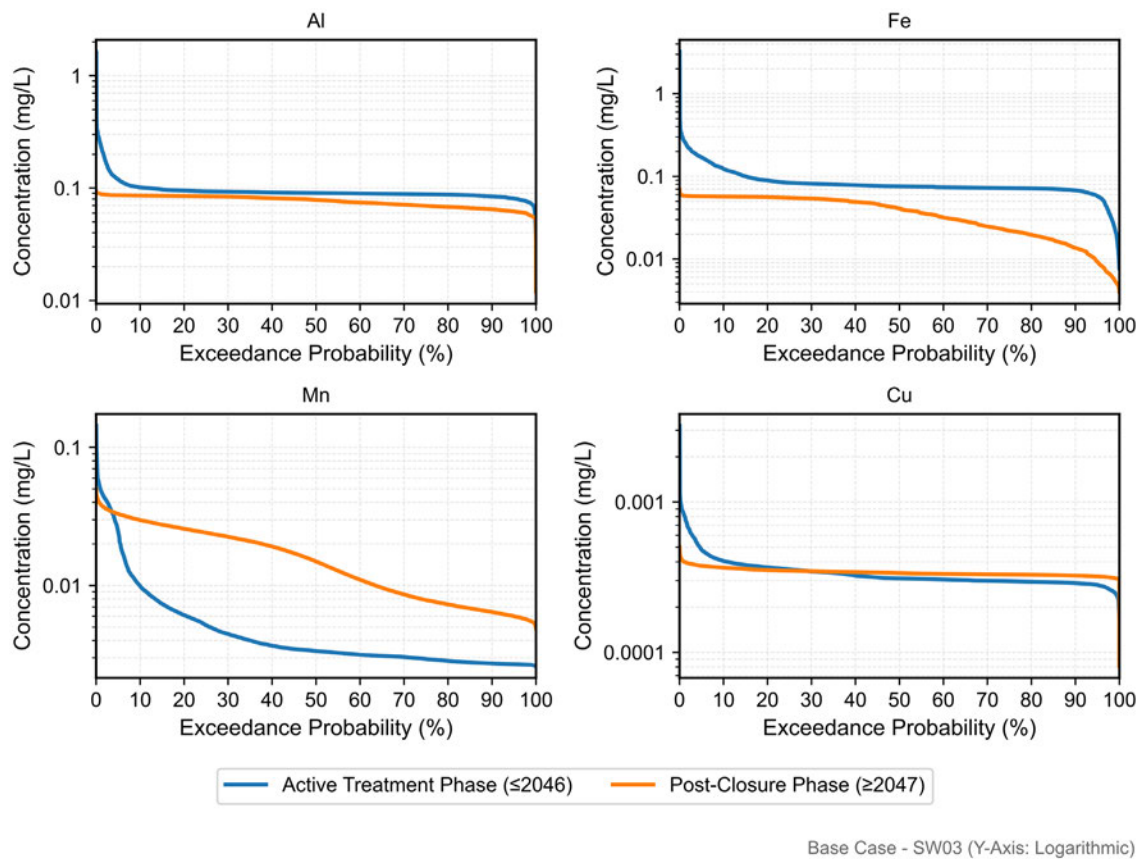


Figure 102: Matrix plot S4 (Elf St 30%) SW03 pH SO4 DOC Hardness

2.2 CONCENTRATION EXCEEDANCE (SINGLE SCENARIO)**Figure 103:** Base Case SW03 Concentration Exceedance Probability Al Fe Mn Cu

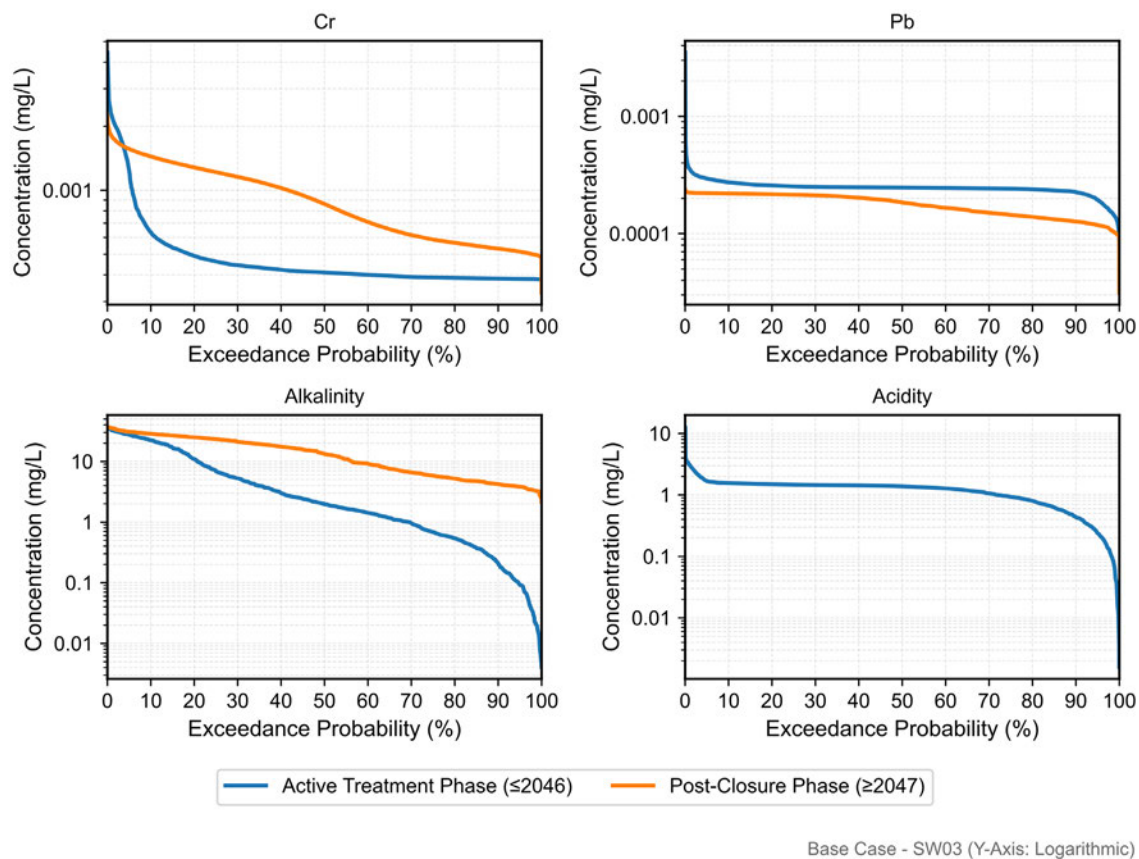


Figure 104: Base Case SW03 Concentration Exceedance Probability Cr Pb Alk Acid

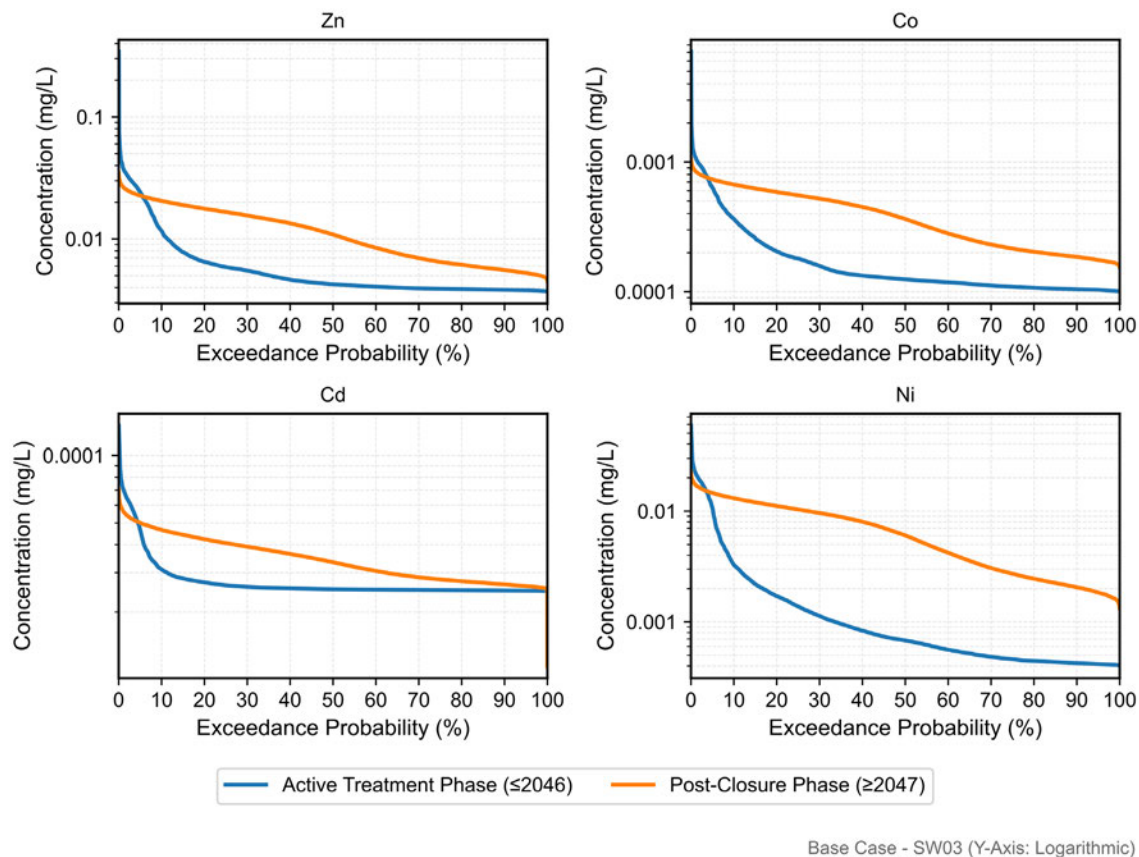


Figure 105: Base Case SW03 Concentration Exceedance Probability Zn Co Cd Ni

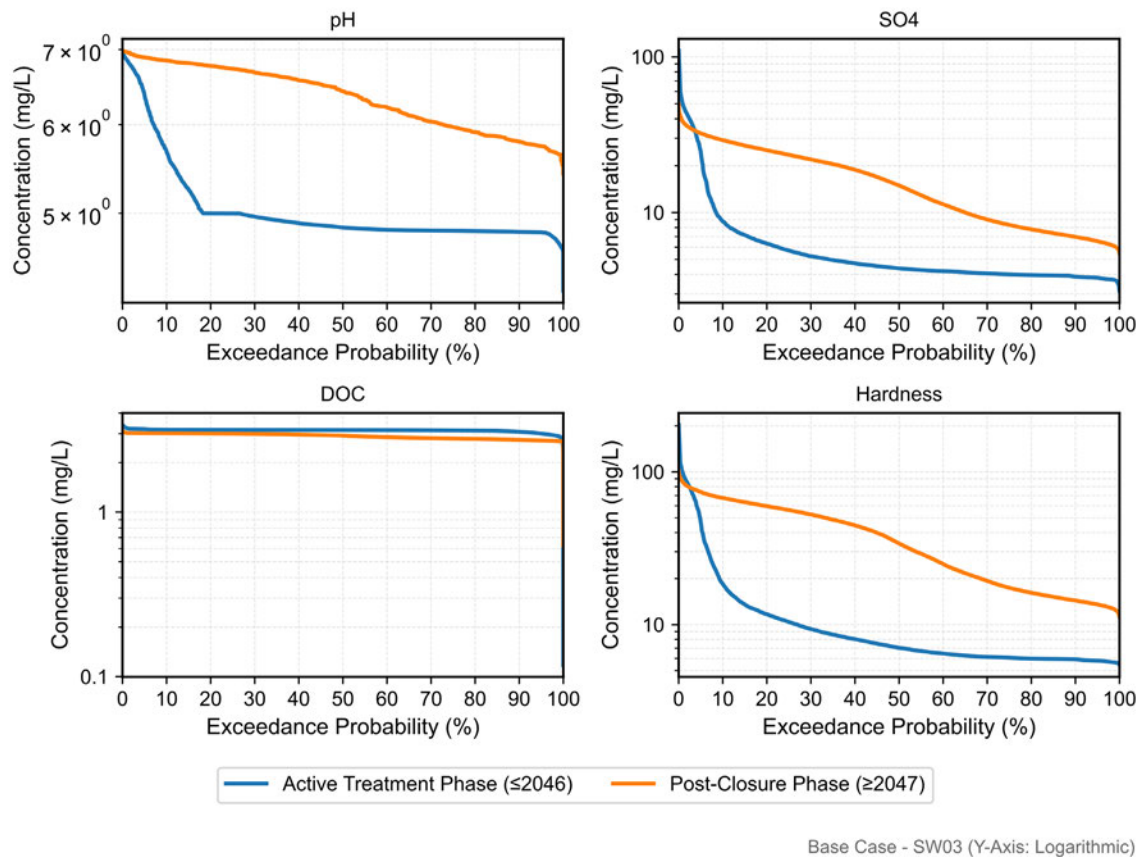


Figure 106: Base Case SW03 Concentration Exceedance Probability pH SO₄ DOC Hardness

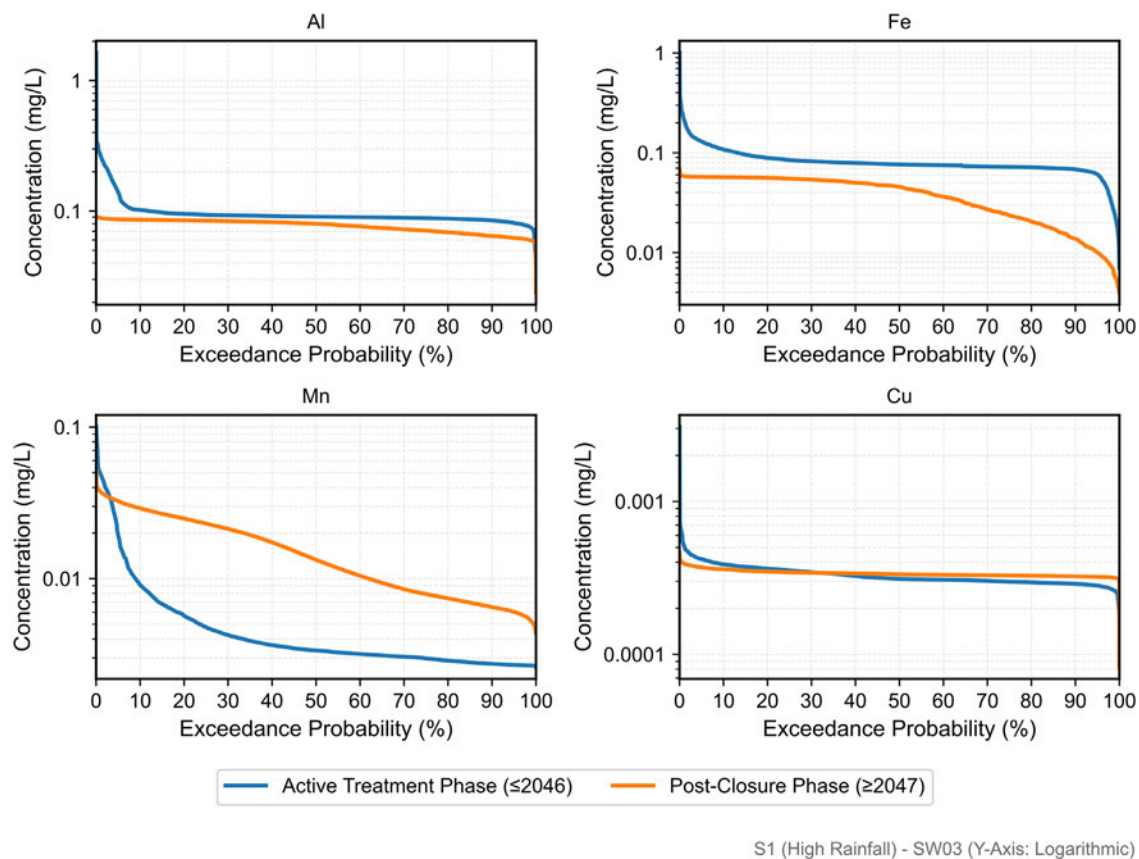


Figure 107: S1 (High Rainfall) SW03 Concentration Exceedance Probability Al Fe Mn Cu

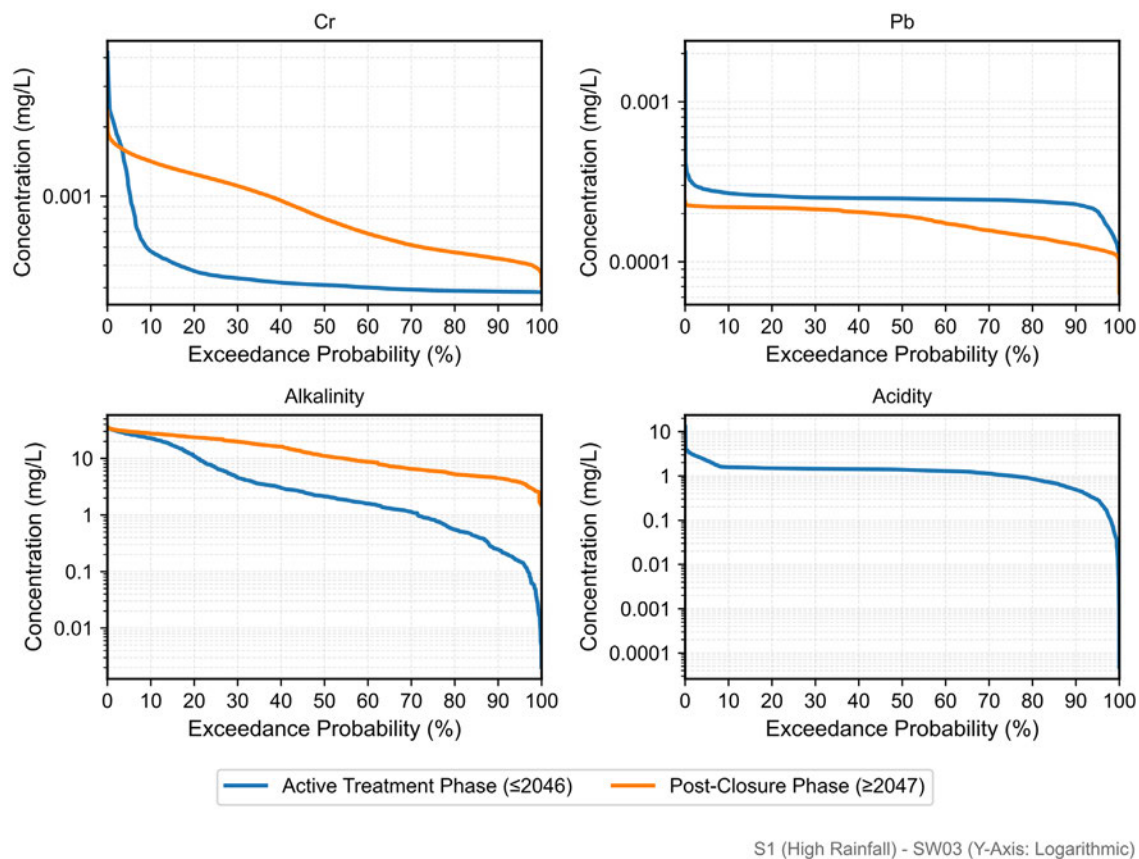
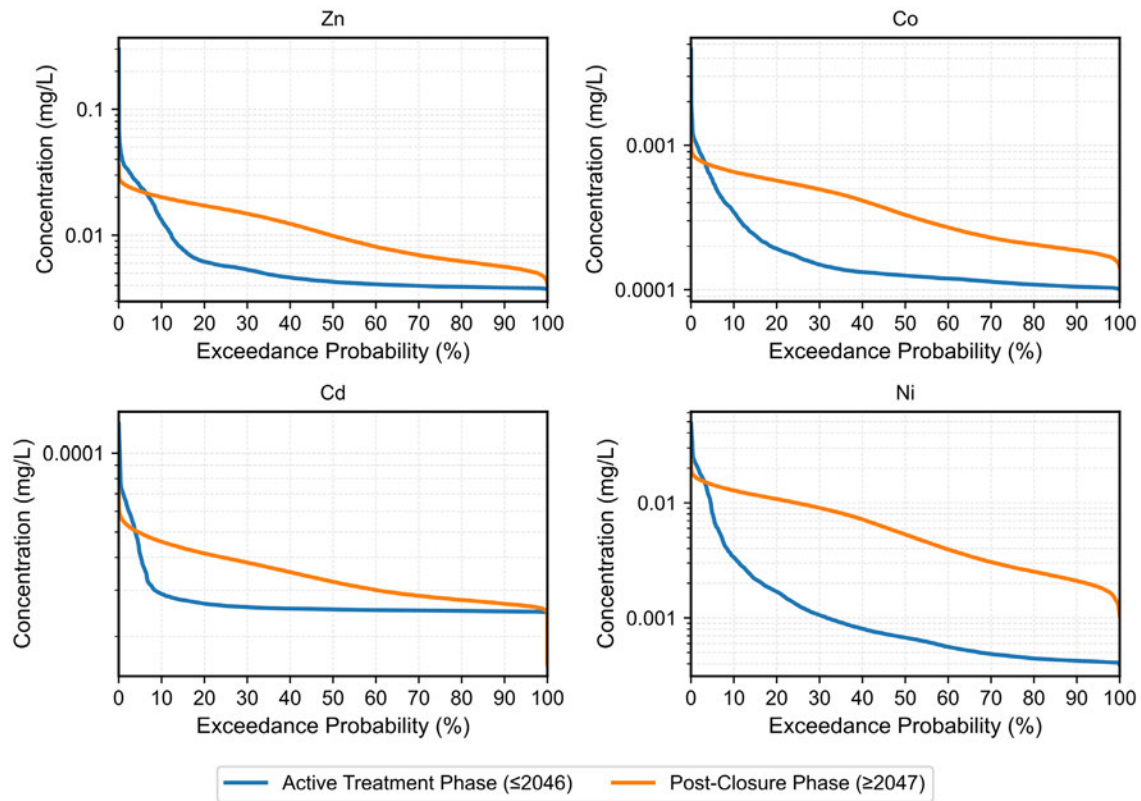
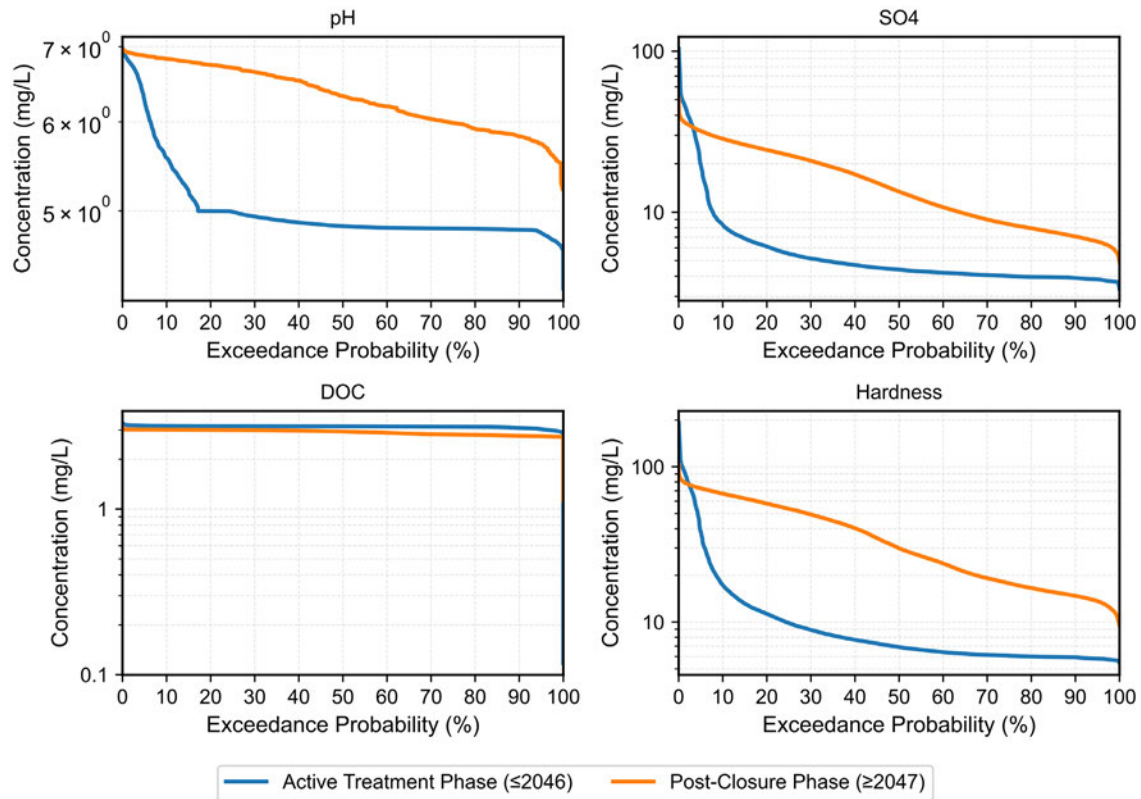


Figure 108: S1 (High Rainfall) SW03 Concentration Exceedance Probability Cr Pb Alk Acid



S1 (High Rainfall) - SW03 (Y-Axis: Logarithmic)

Figure 109: S1 (High Rainfall) SW03 Concentration Exceedance Probability Zn Co Cd Ni



S1 (High Rainfall) - SW03 (Y-Axis: Logarithmic)

Figure 110: S1 (High Rainfall) SW03 Concentration Exceedance Probability pH SO₄ DOC Hardness

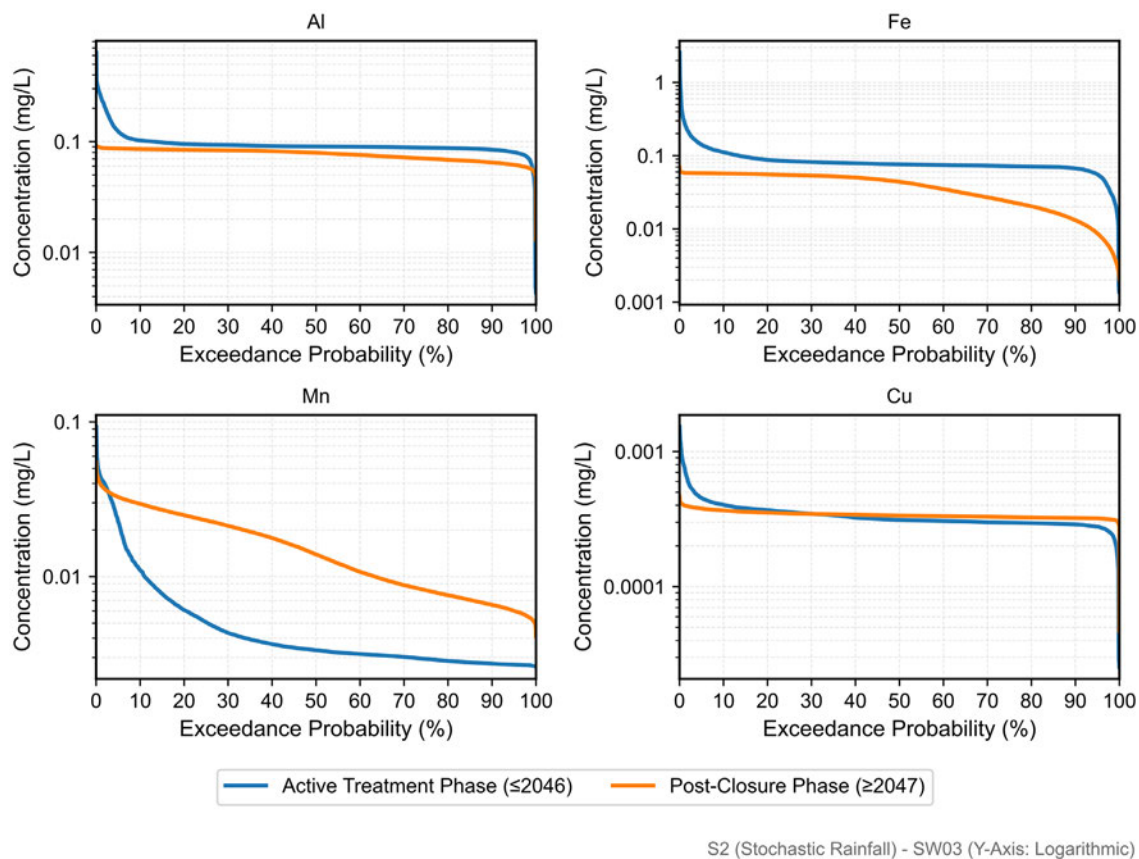


Figure 111: S2 (Stochastic Rainfall) SW03 Concentration Exceedance Probability Al Fe Mn Cu

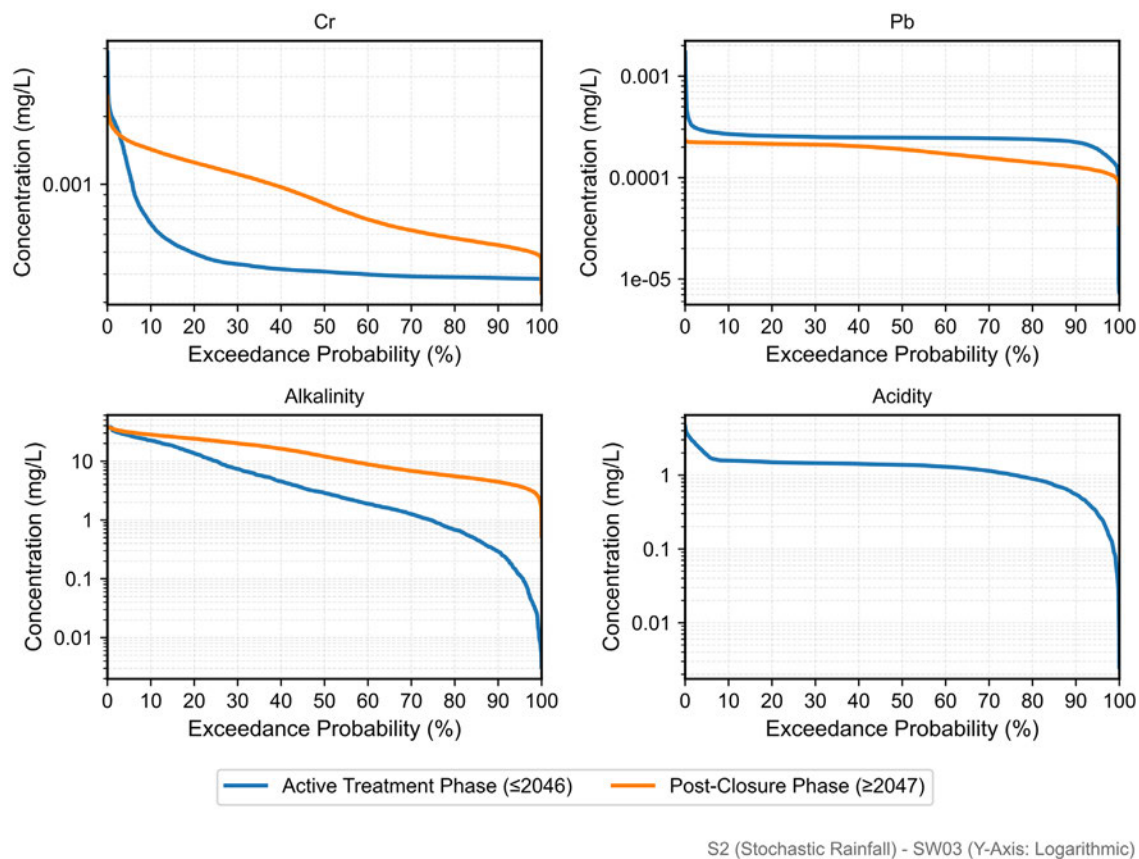


Figure 112: S2 (Stochastic Rainfall) SW03 Concentration Exceedance Probability Cr Pb Alk Acid

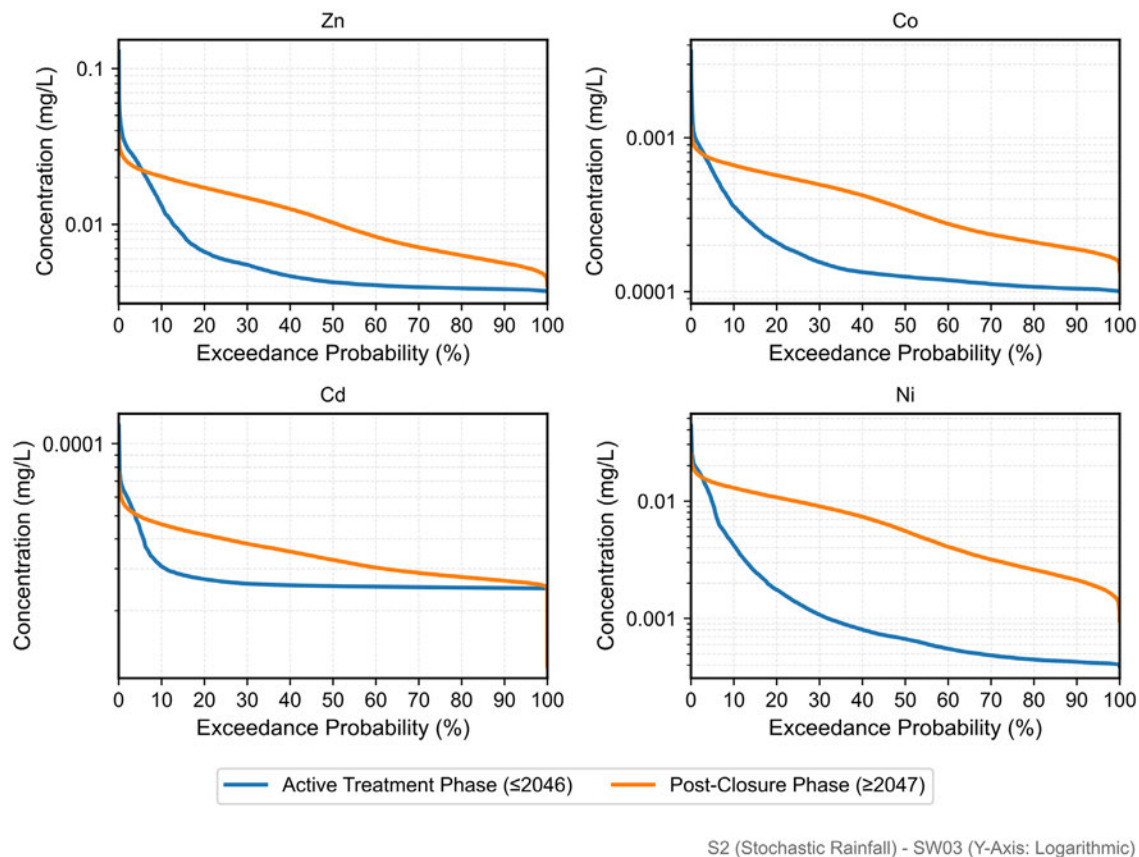
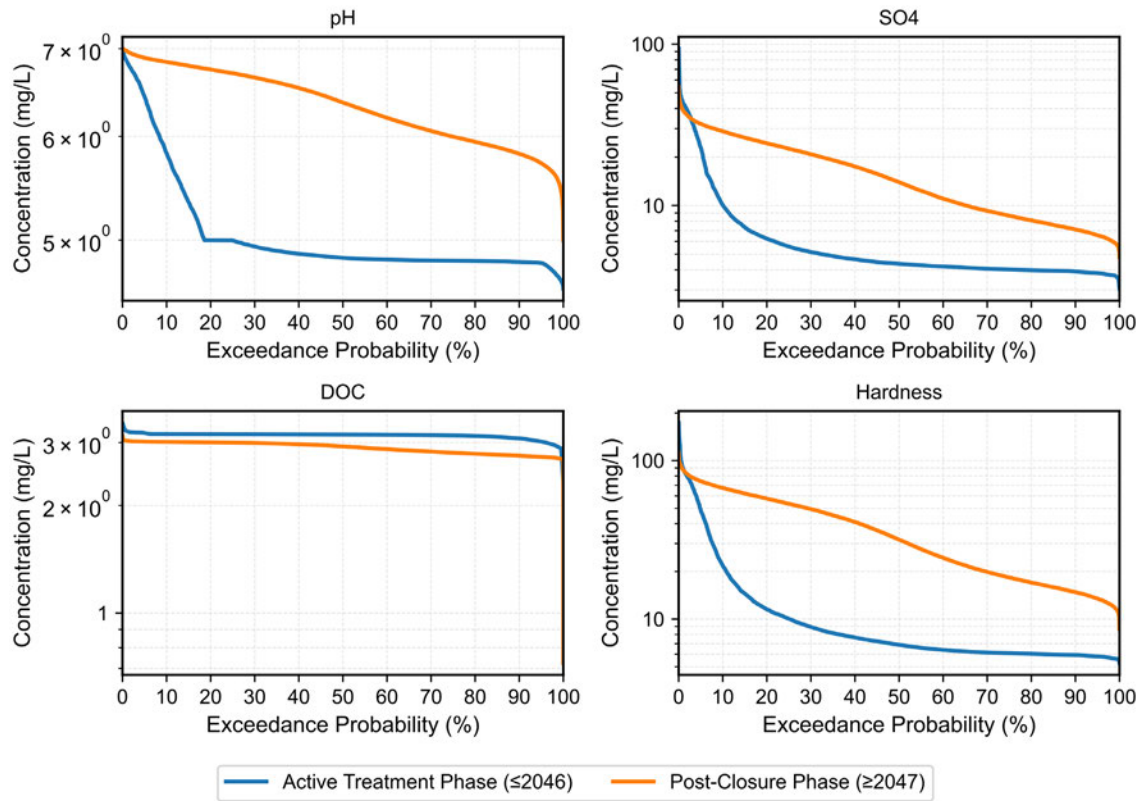


Figure 113: S2 (Stochastic Rainfall) SW03 Concentration Exceedance Probability Zn Co Cd Ni



S2 (Stochastic Rainfall) - SW03 (Y-Axis: Logarithmic)

Figure 114: S2 (Stochastic Rainfall) SW03 Concentration Exceedance Probability pH SO₄ DOC Hardness

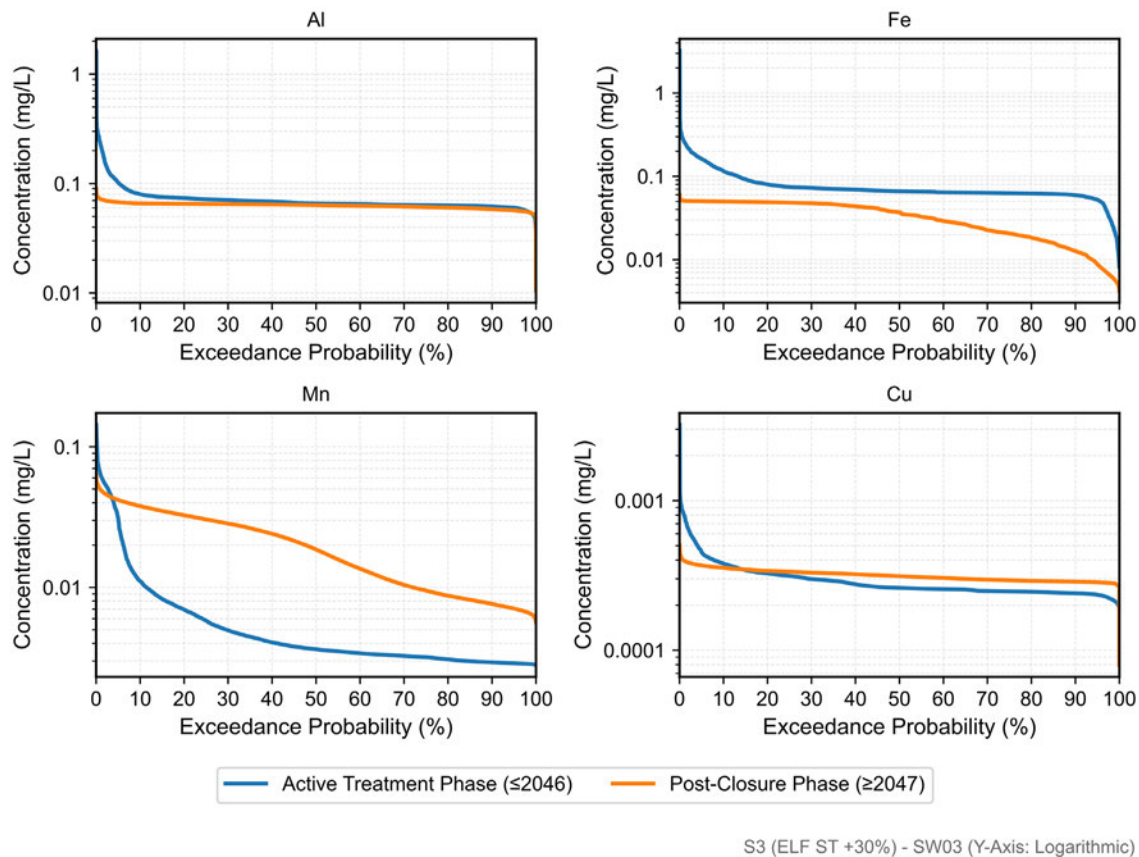


Figure 115: S3 (Elf St +30%) SW03 Concentration Exceedance Probability Al Fe Mn Cu

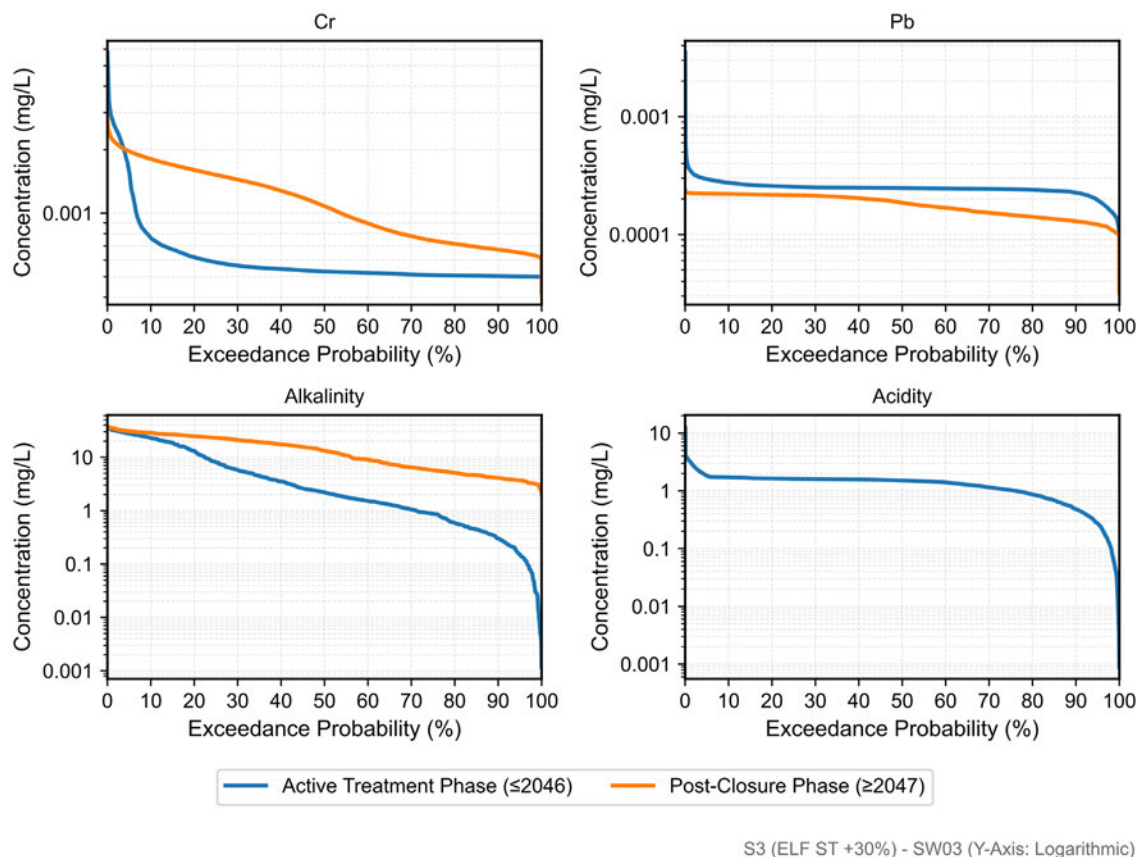


Figure 116: S3 (Elf St +30%) SW03 Concentration Exceedance Probability Cr Pb Alk Acid

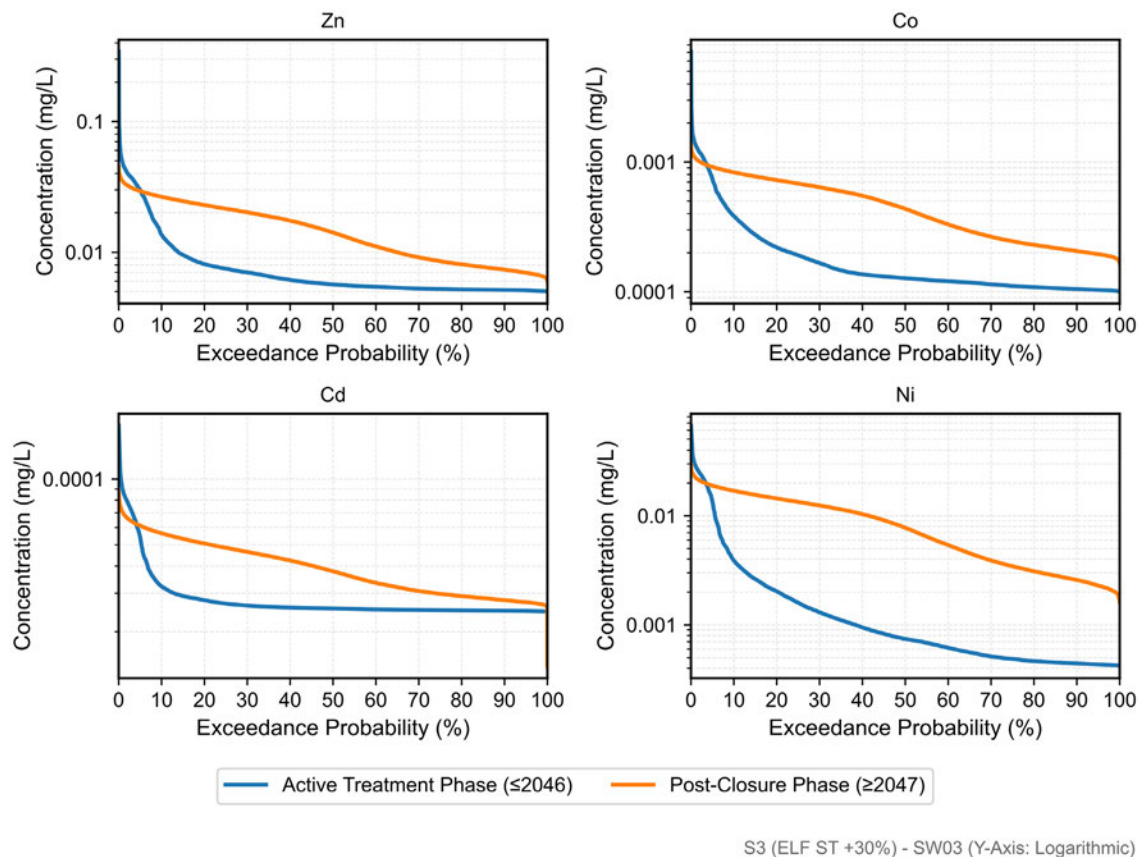


Figure 117: S3 (Elf St +30%) SW03 Concentration Exceedance Probability Zn Co Cd Ni

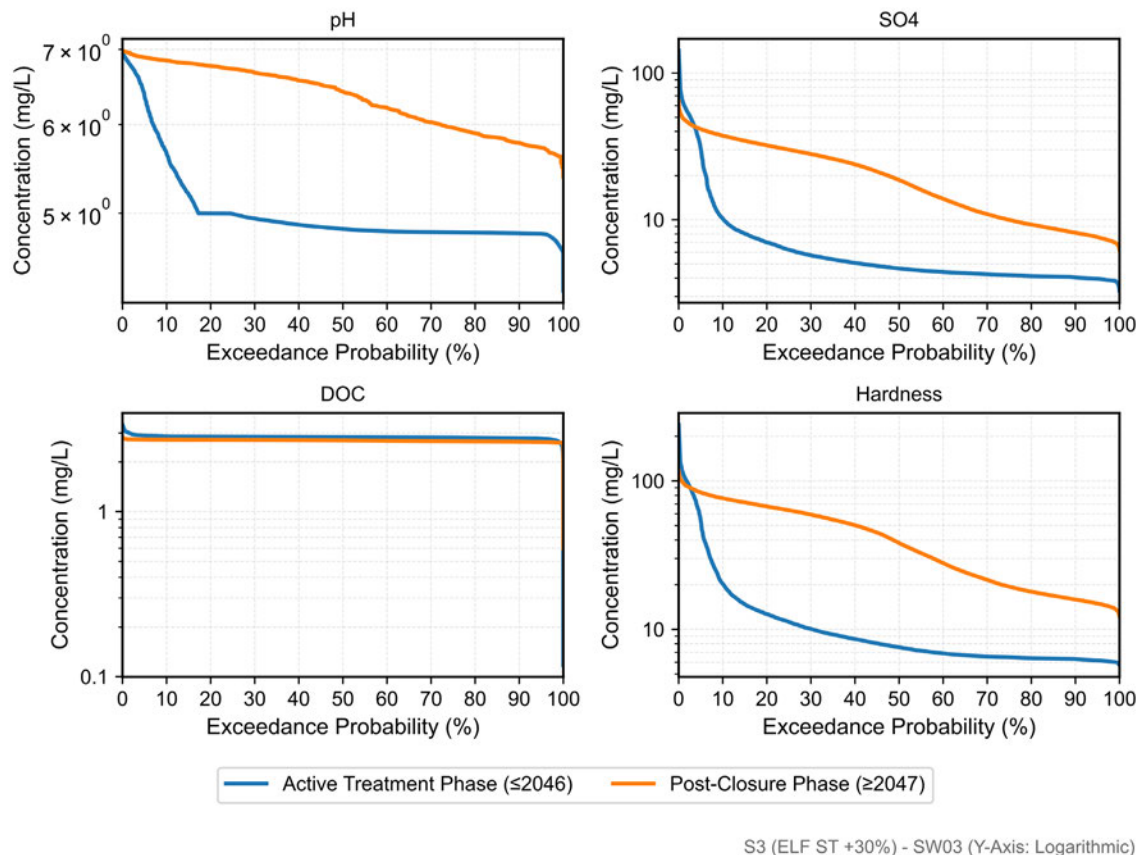


Figure 118: S3 (Elf St +30%) SW03 Concentration Exceedance Probability pH SO₄ DOC Hardness

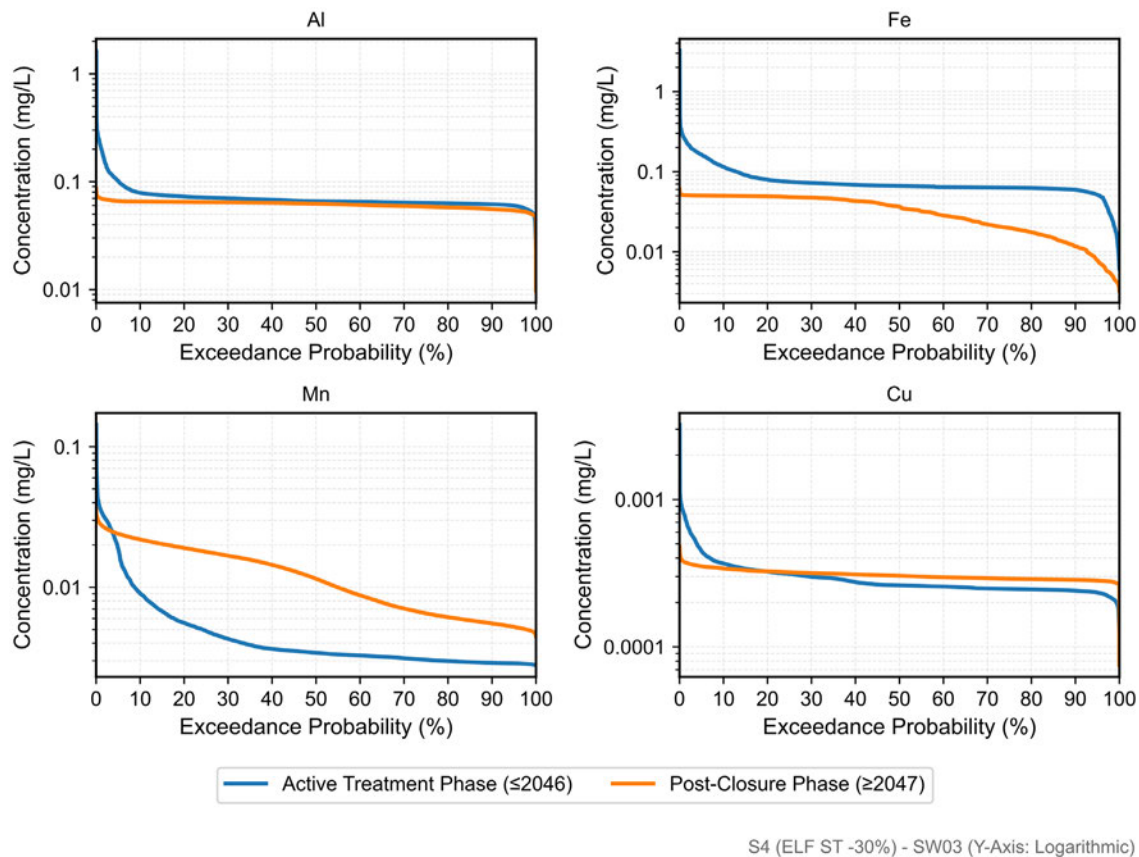
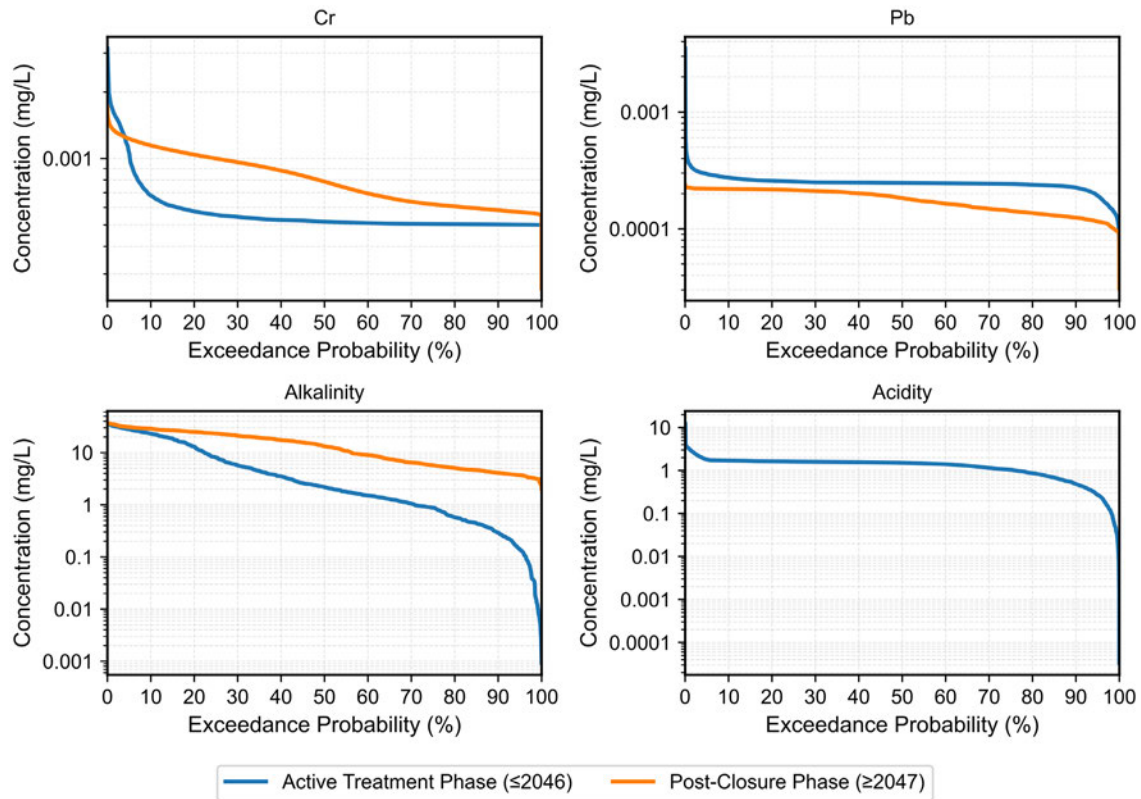


Figure 119: S4 (Elf St 30%) SW03 Concentration Exceedance Probability Al Fe Mn Cu



S4 (ELF ST -30%) - SW03 (Y-Axis: Logarithmic)

Figure 120: S4 (Elf St 30%) SW03 Concentration Exceedance Probability Cr Pb Alk Acid

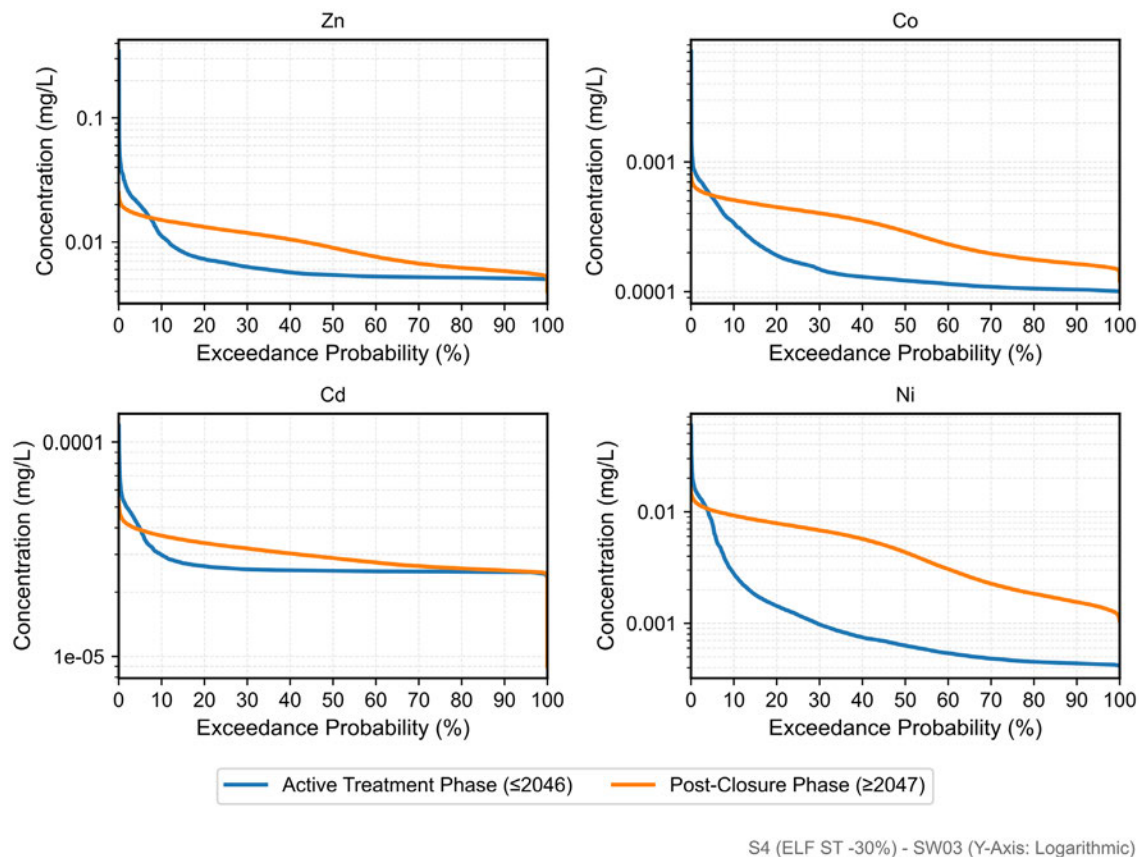


Figure 121: S4 (Elf St 30%) SW03 Concentration Exceedance Probability Zn Co Cd Ni

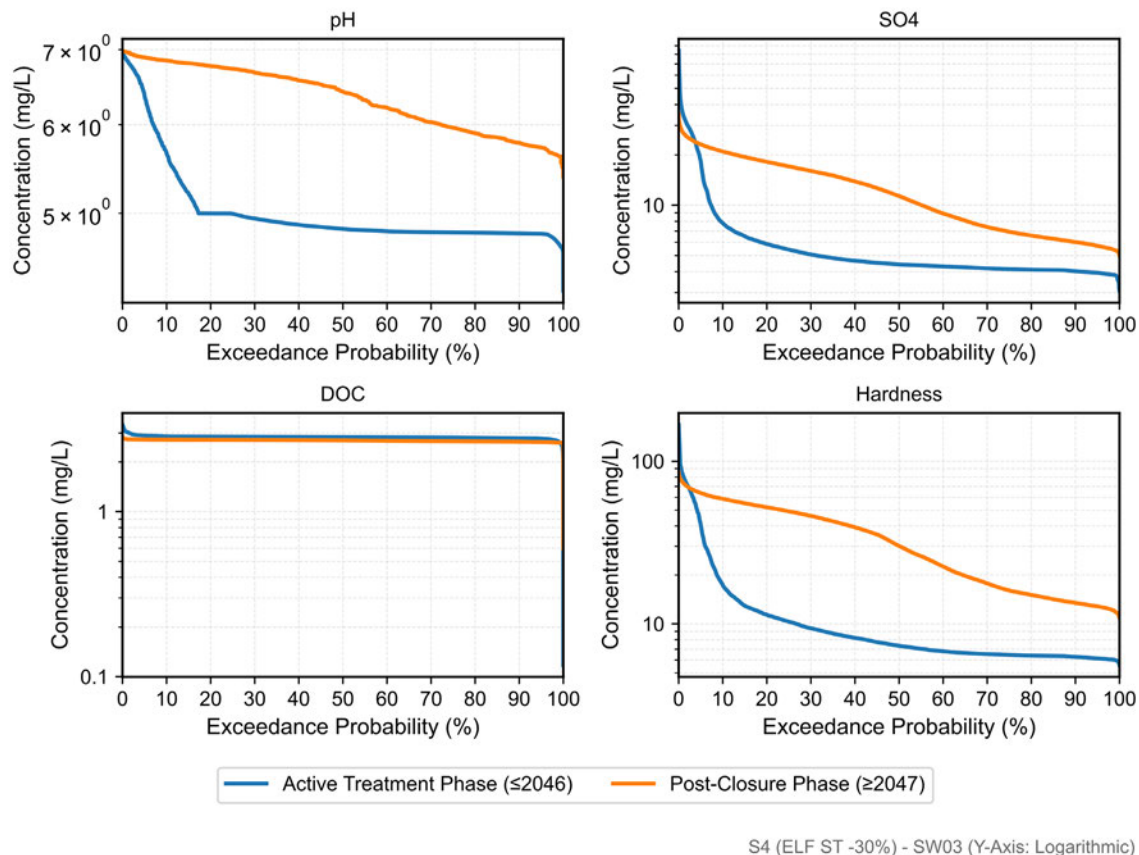
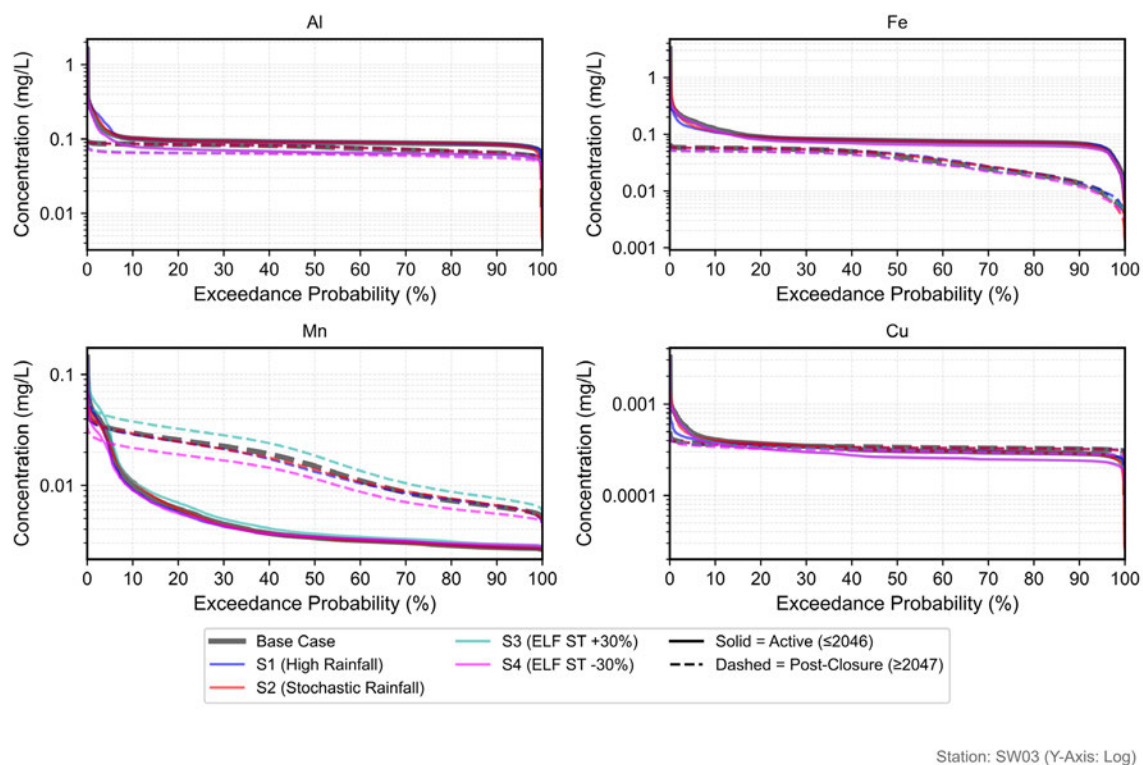


Figure 122: S4 (Elf St 30%) SW03 Concentration Exceedance Probability pH SO₄ DOC Hardness

2.3 CONCENTRATION EXCEEDANCE (MULTI SCENARIO)**Figure 123:** SW03 Matrix Plot Scenarios 5 Al Fe Mn Cu Concentration Exceedance Probability

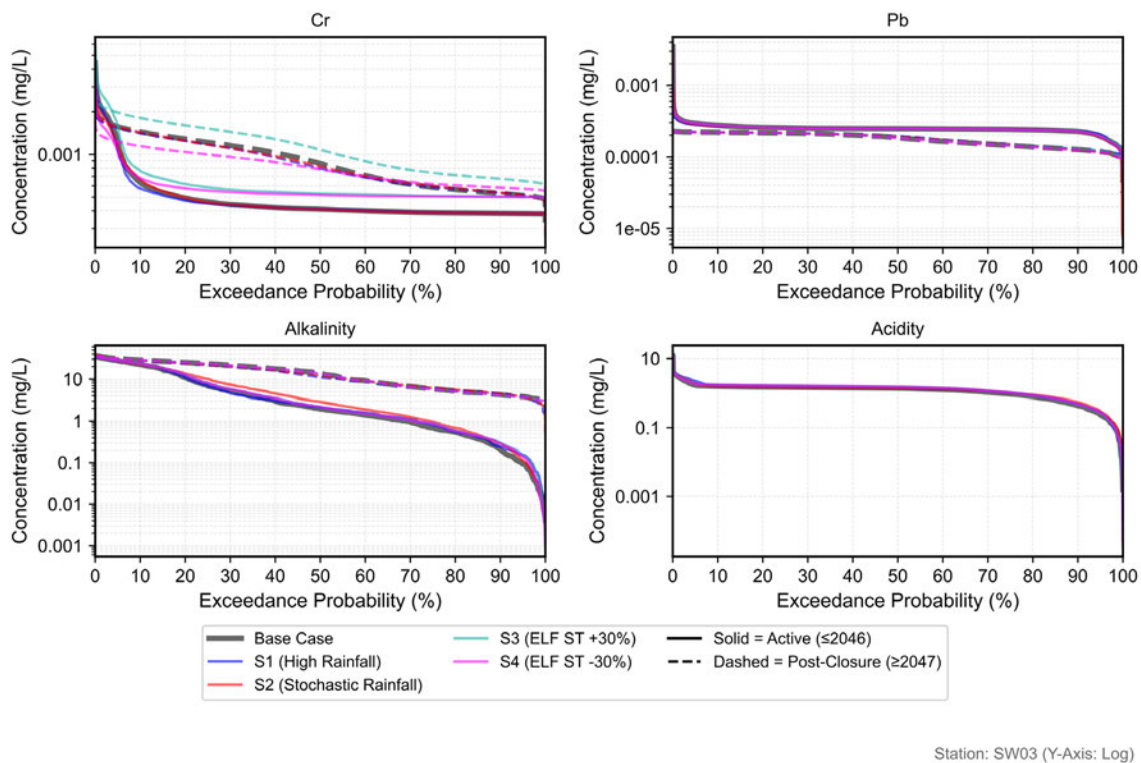
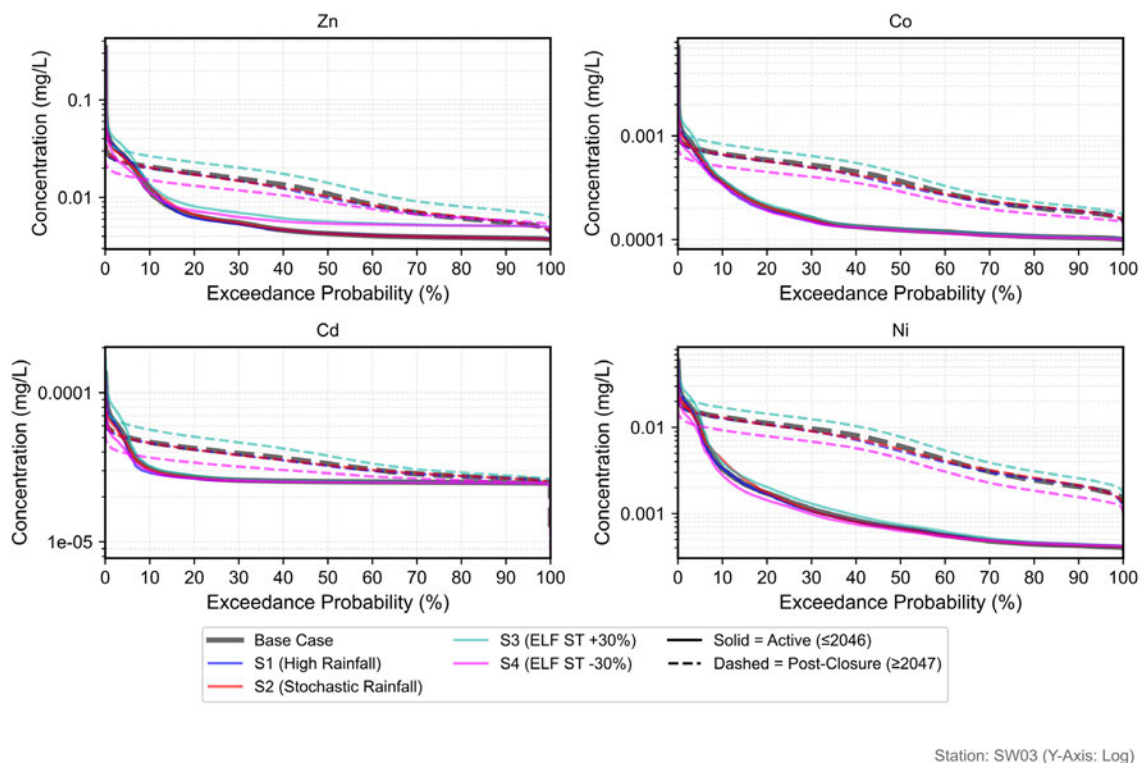
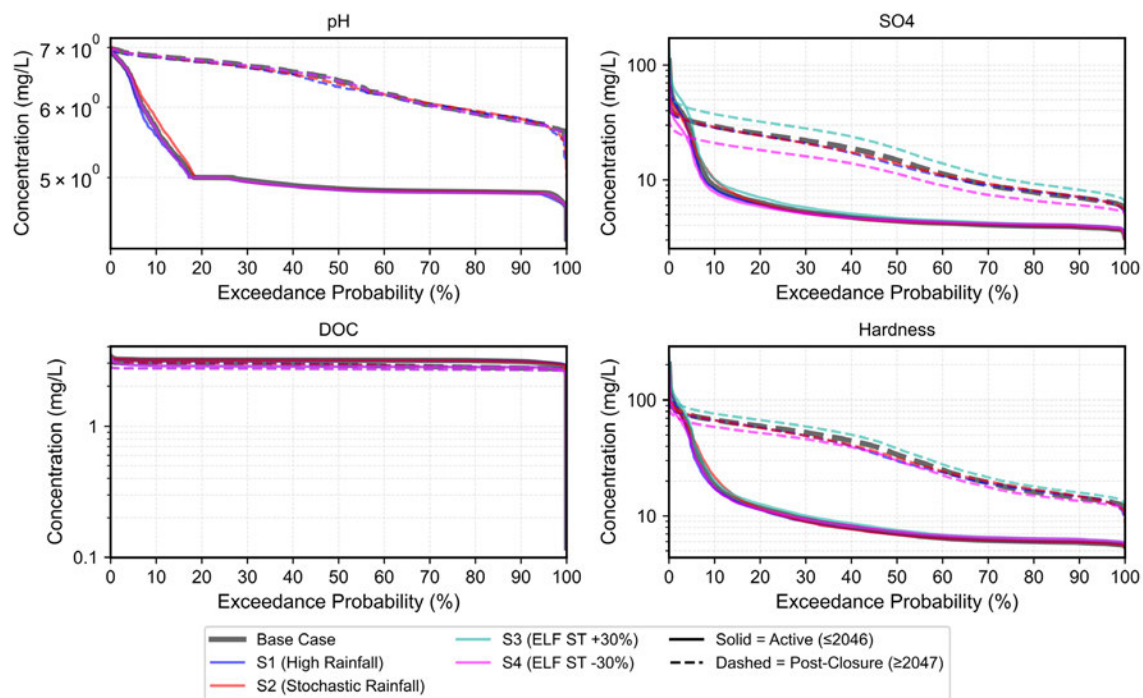
**Figure 124:** SW03 Matrix Plot Scenarios 5 Cr Pb Alk Acid Concentration Exceedance Probability

Figure 125: SW03 Matrix Plot Scenarios 5 Zn Co Cd Ni Concentration Exceedance Probability

Station: SW03 (Y-Axis: Log)

Figure 126: SW03 Matrix Plot Scenarios 5 pH SO₄ DOC Hardness Concentration Exceedance Probability

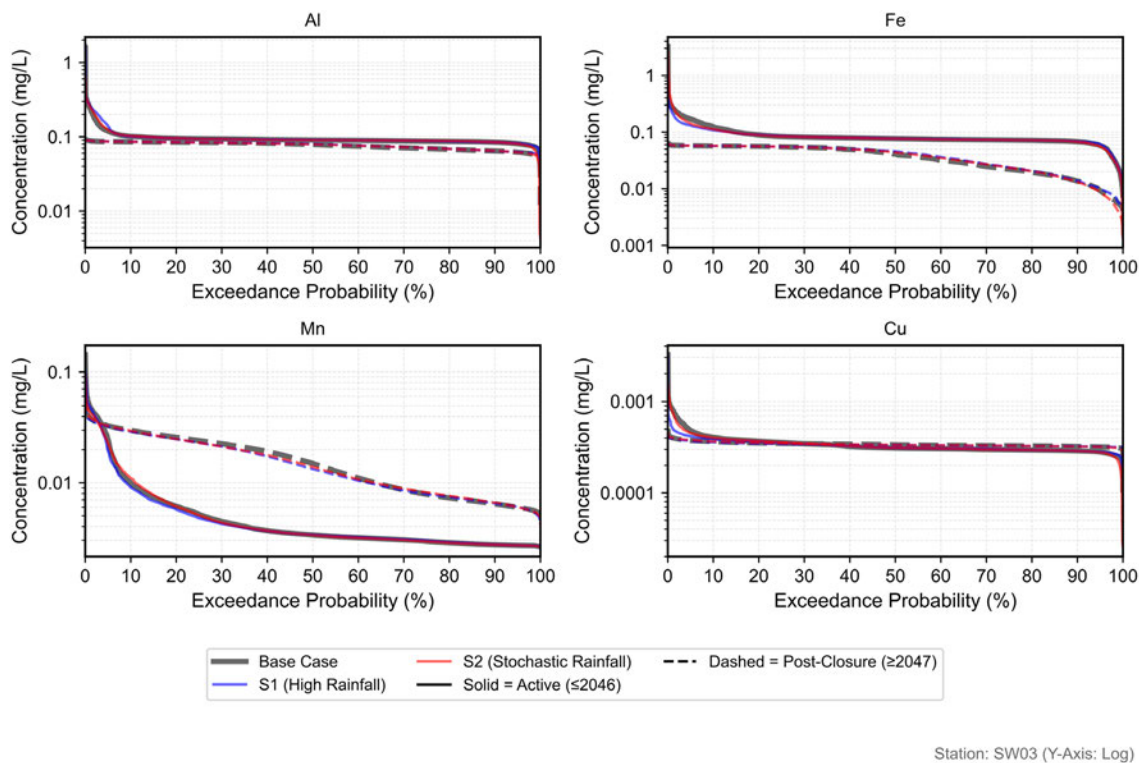


Figure 127: SW03 Rainfall Comp Al Fe Mn Cu Concentration Exceedance Probability

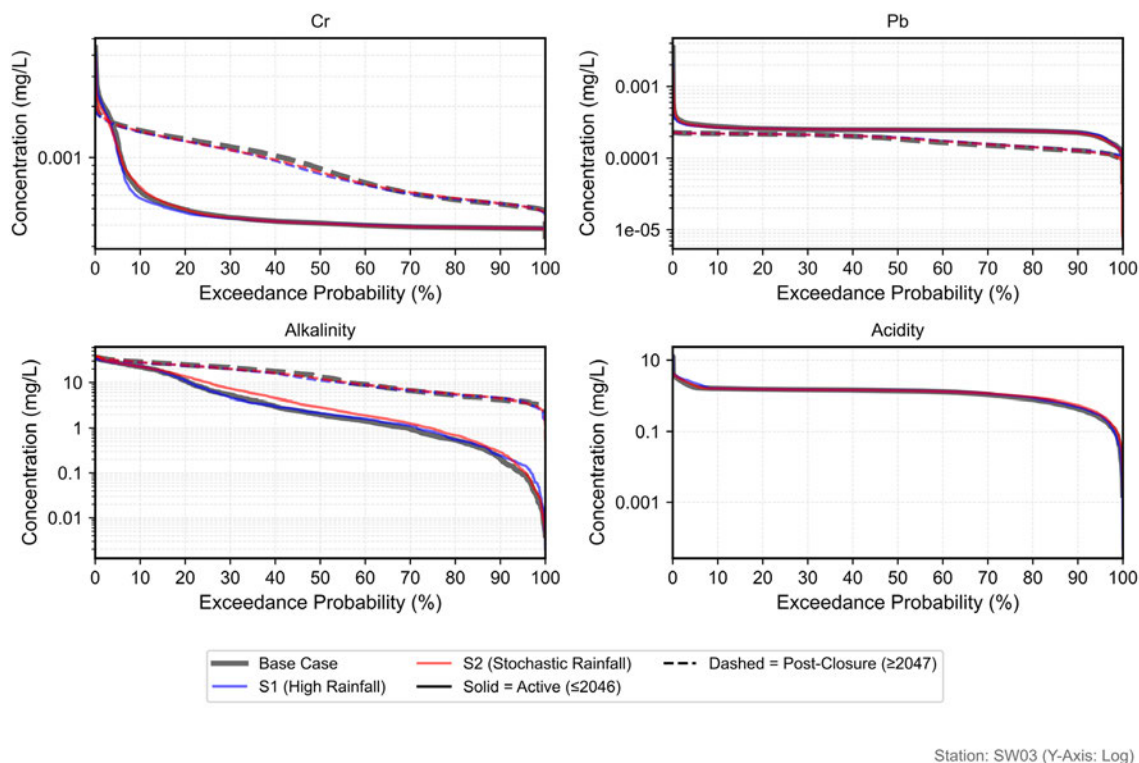
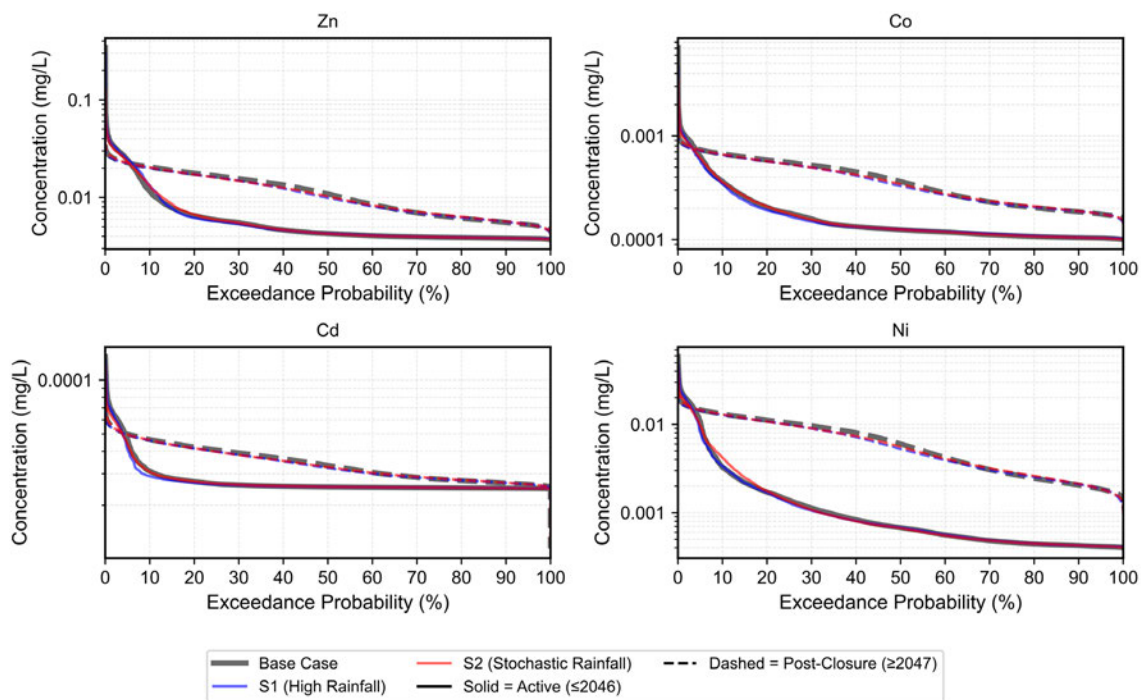


Figure 128: SW03 Rainfall Comp Cr Pb Alk Acid Concentration Exceedance Probability**Figure 129:** SW03 Rainfall Comp Zn Co Cd Ni Concentration Exceedance Probability

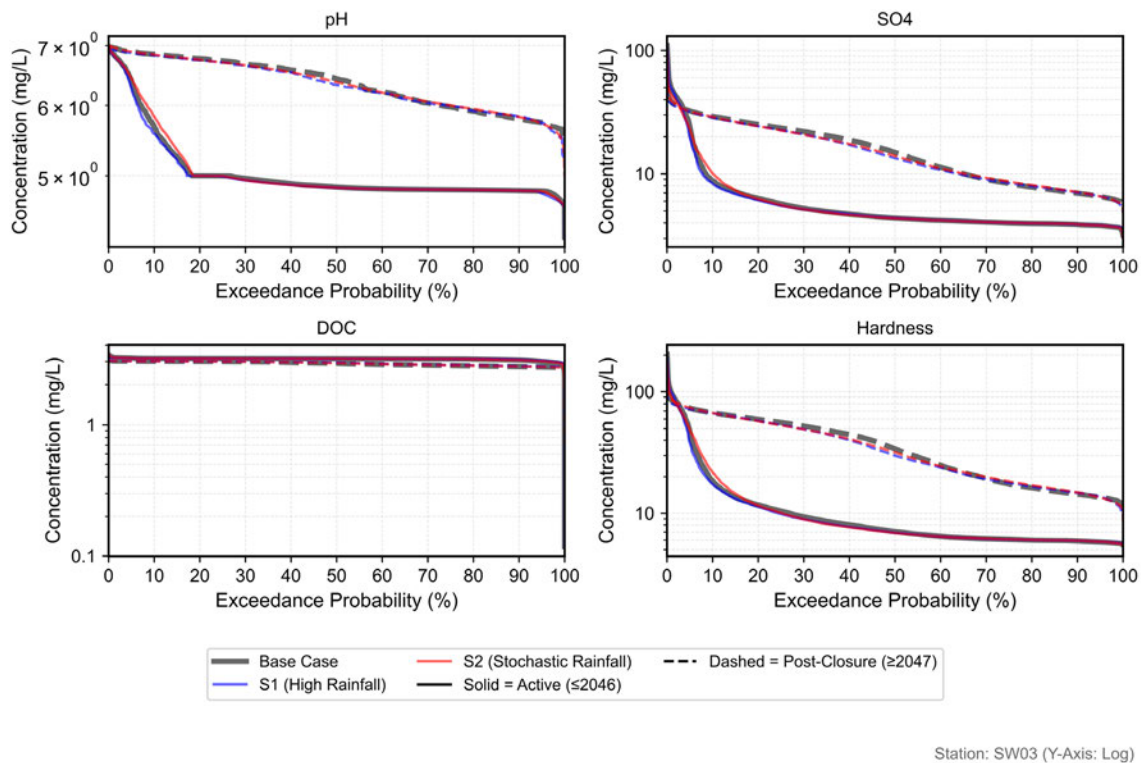


Figure 130: SW03 Rainfall Comp pH SO₄ DOC Hardness Concentration Exceedance Probability

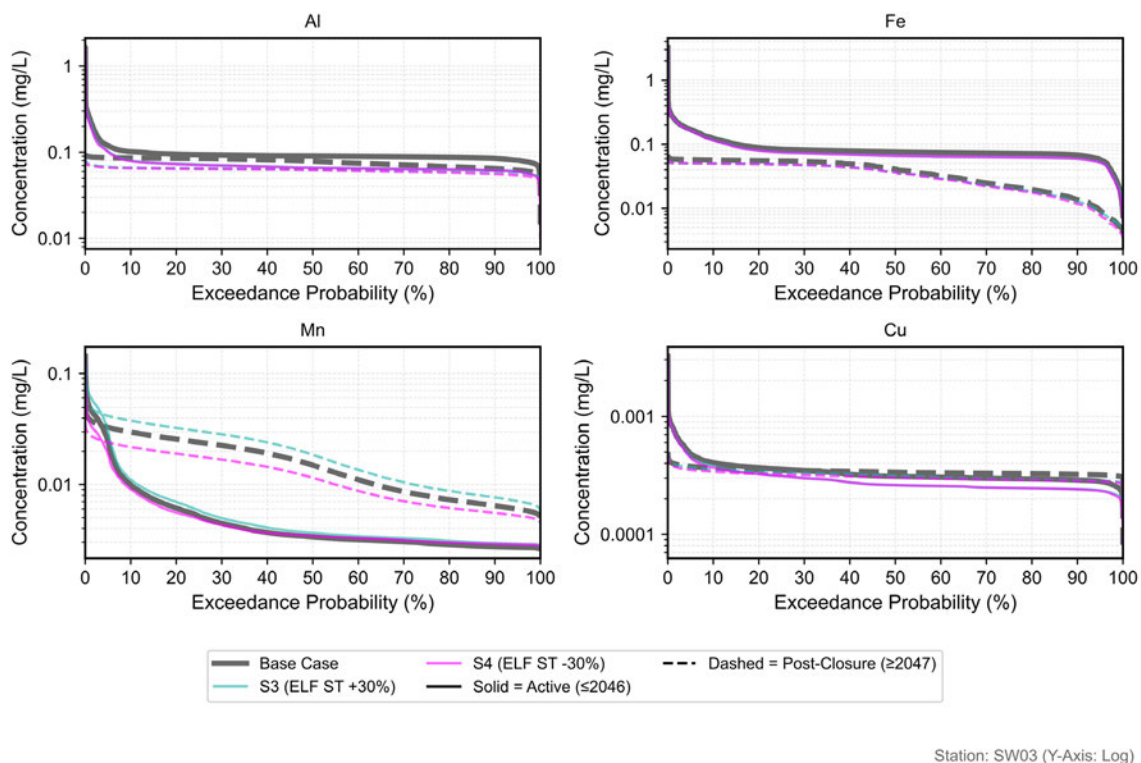
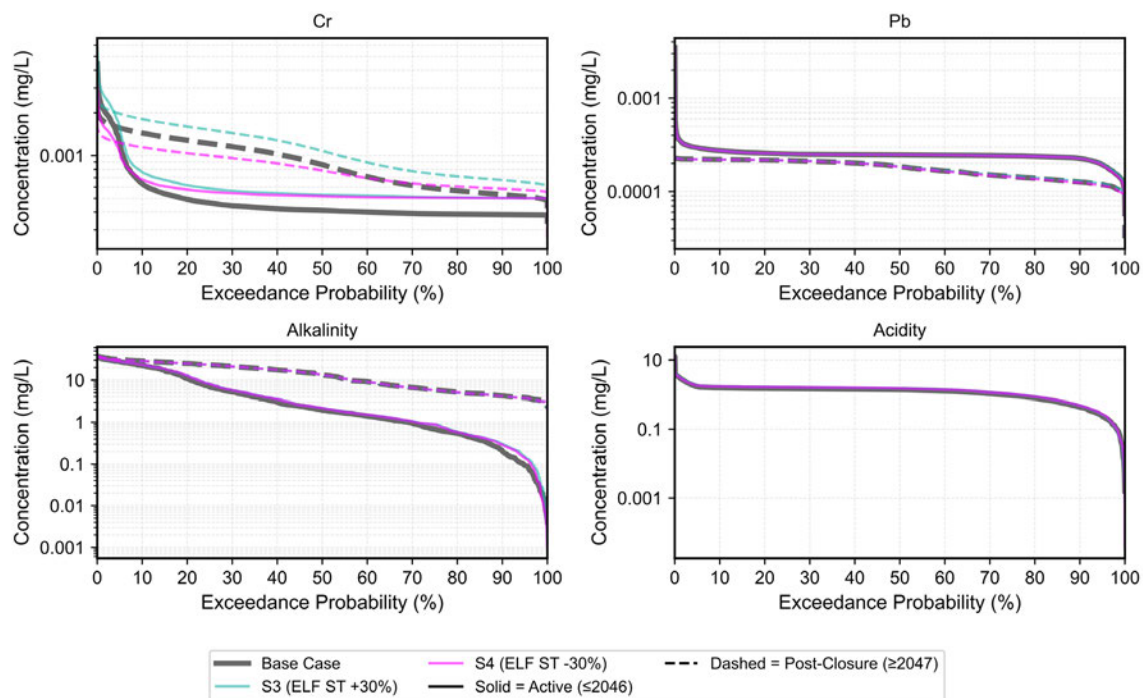


Figure 131: SW03 St Comp Al Fe Mn Cu Concentration Exceedance Probability

Station: SW03 (Y-Axis: Log)

Figure 132: SW03 St Comp Cr Pb Alk Acid Concentration Exceedance Probability

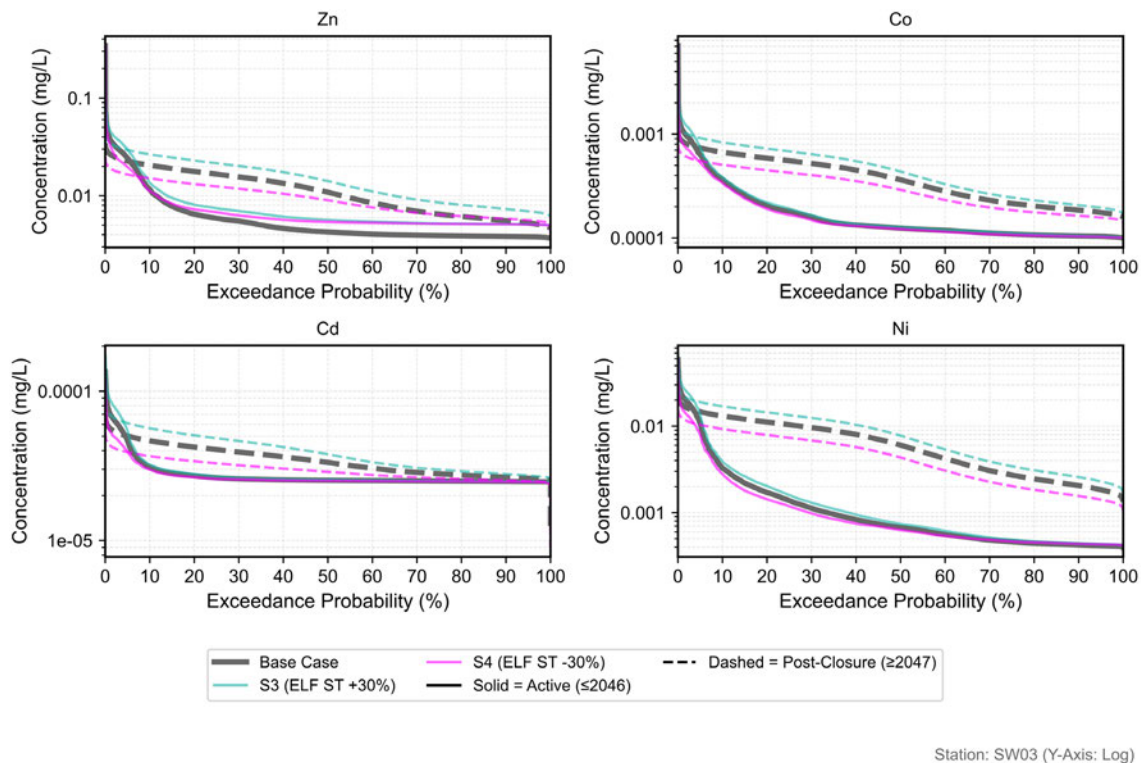


Figure 133: SW03 St Comp Zn Co Cd Ni Concentration Exceedance Probability

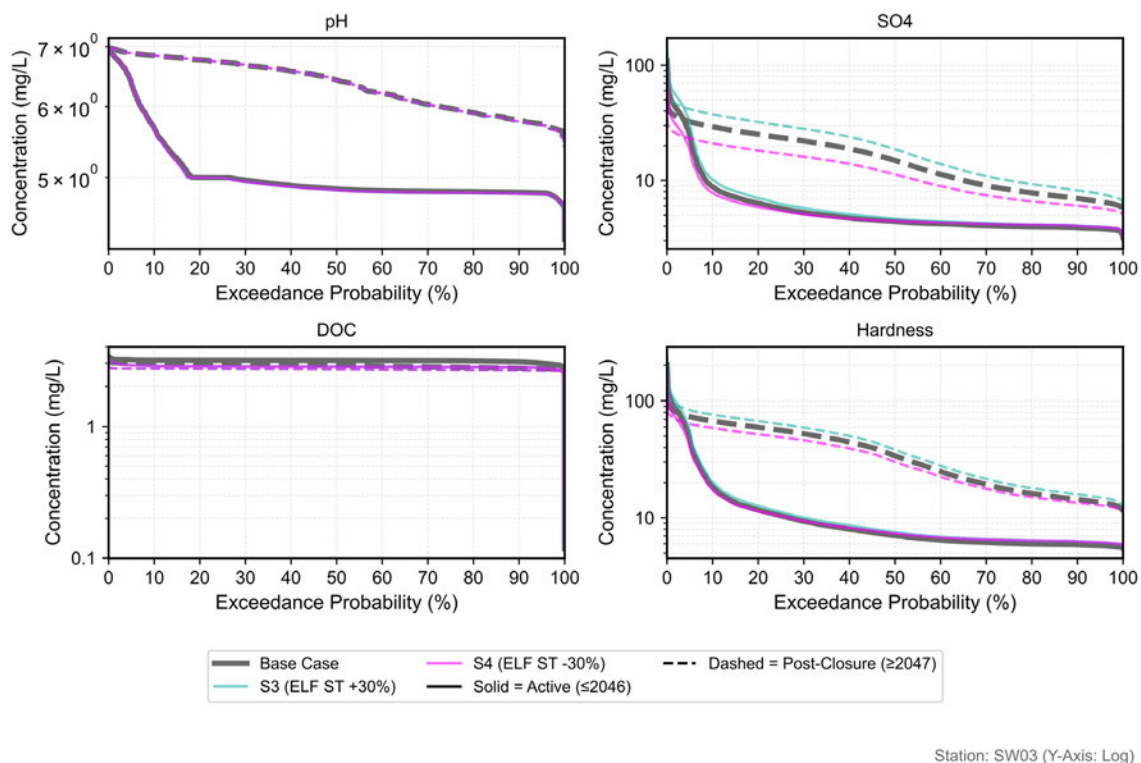
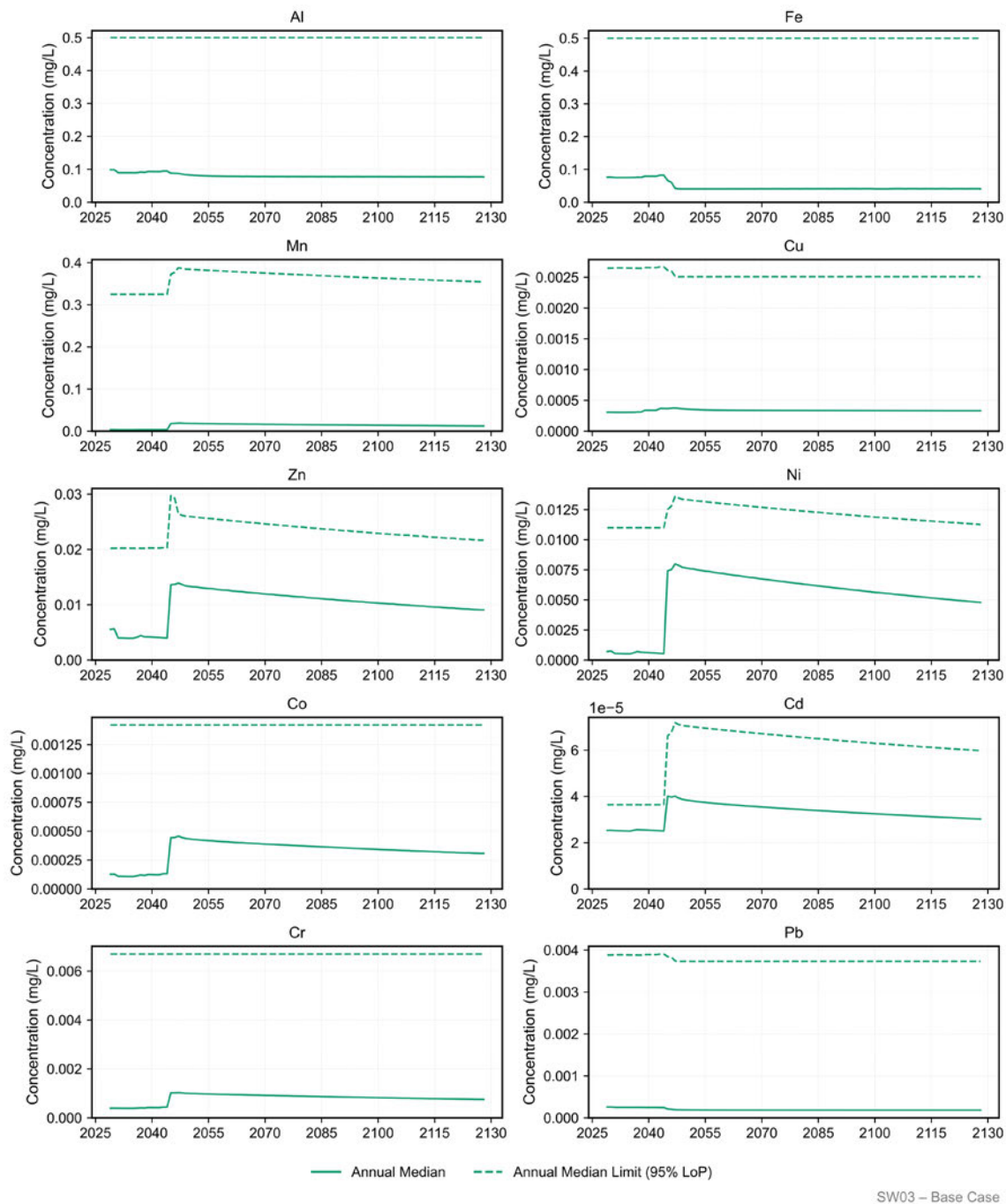


Figure 134: SW03 St Comp pH SO4 DOC Hardness Concentration Exceedance Probability**2.4 ANNUAL MEDIANS (SINGLE SCENARIO)****Figure 135:** SW03 Base Case Elementsmatrix

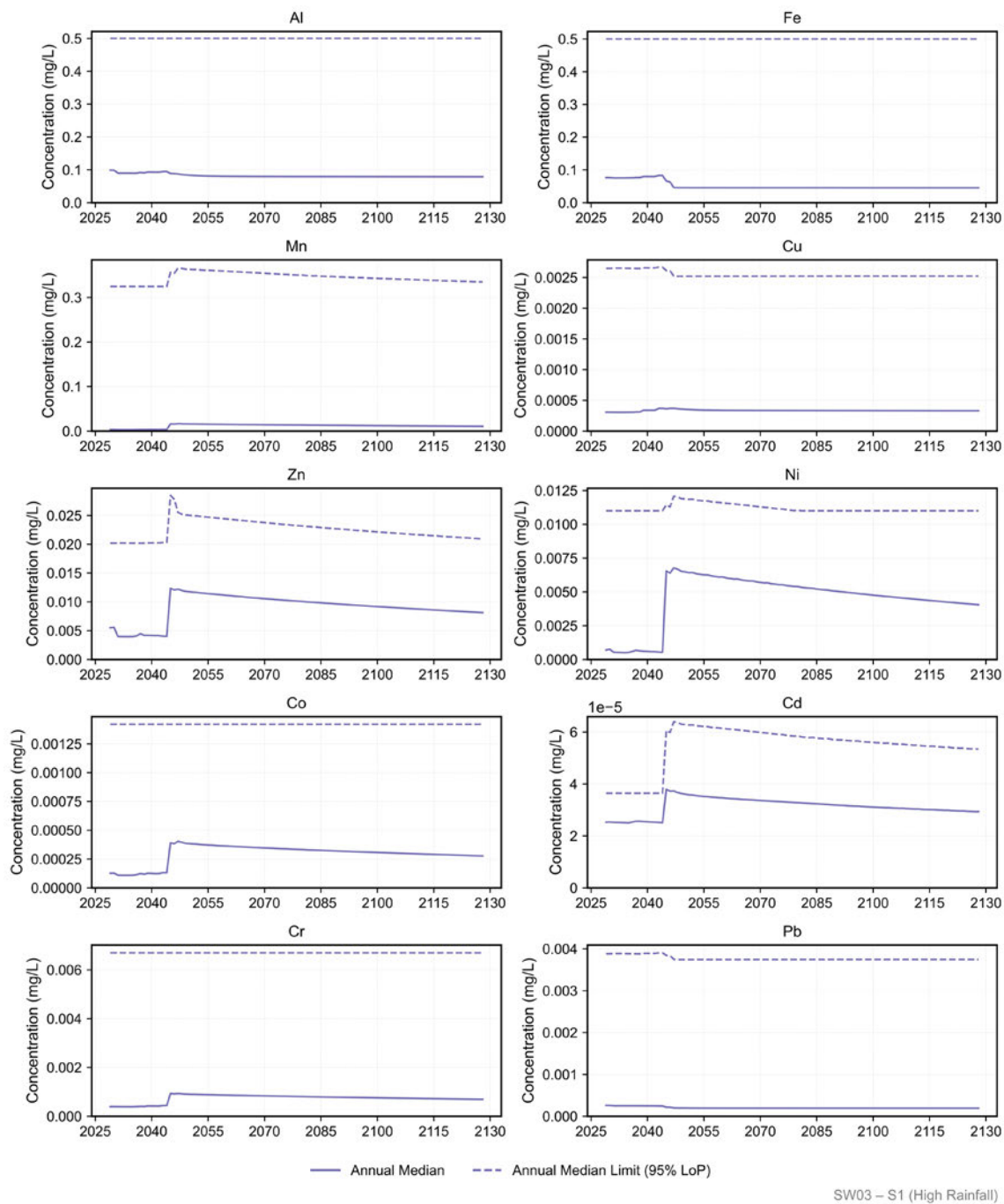
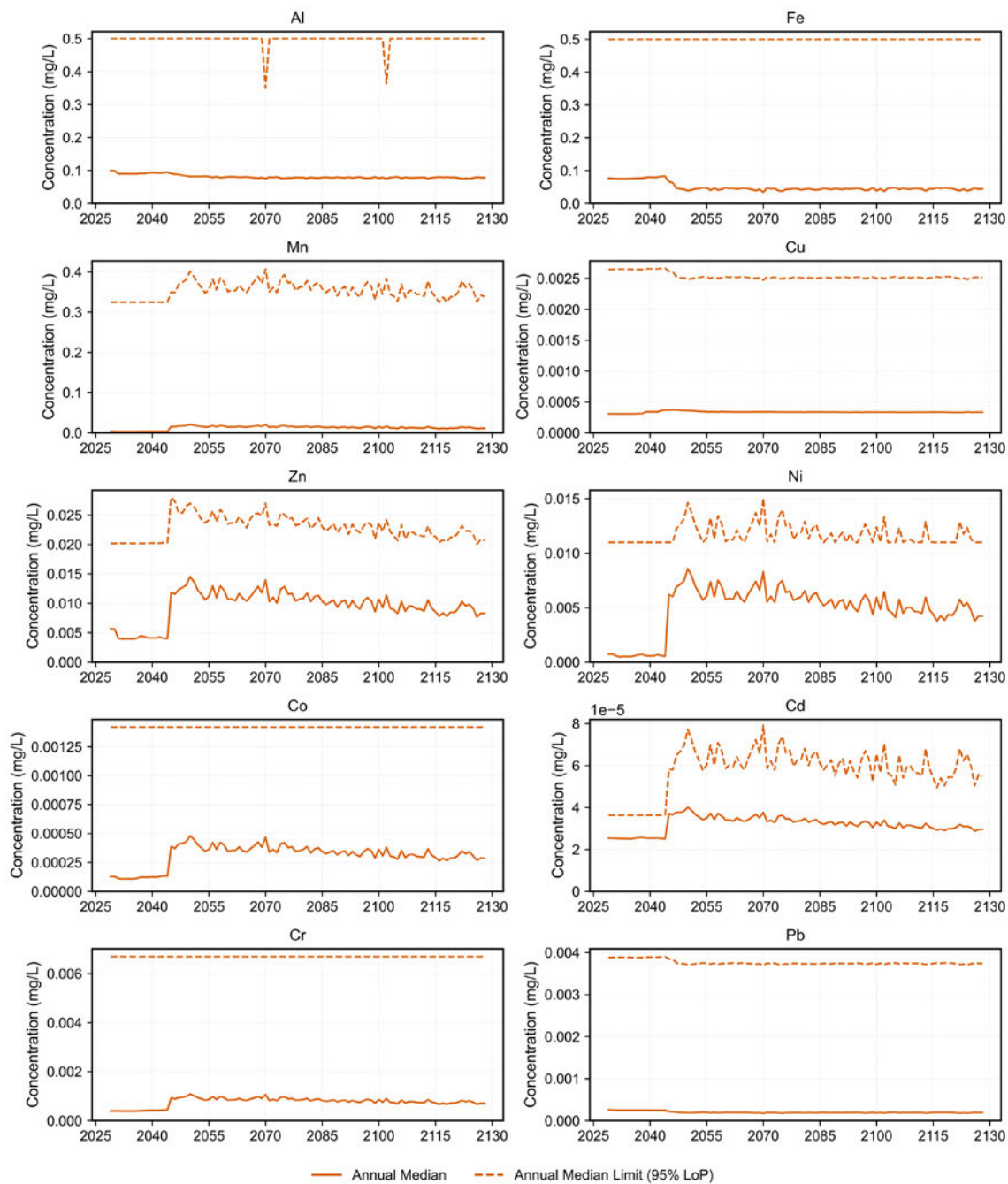
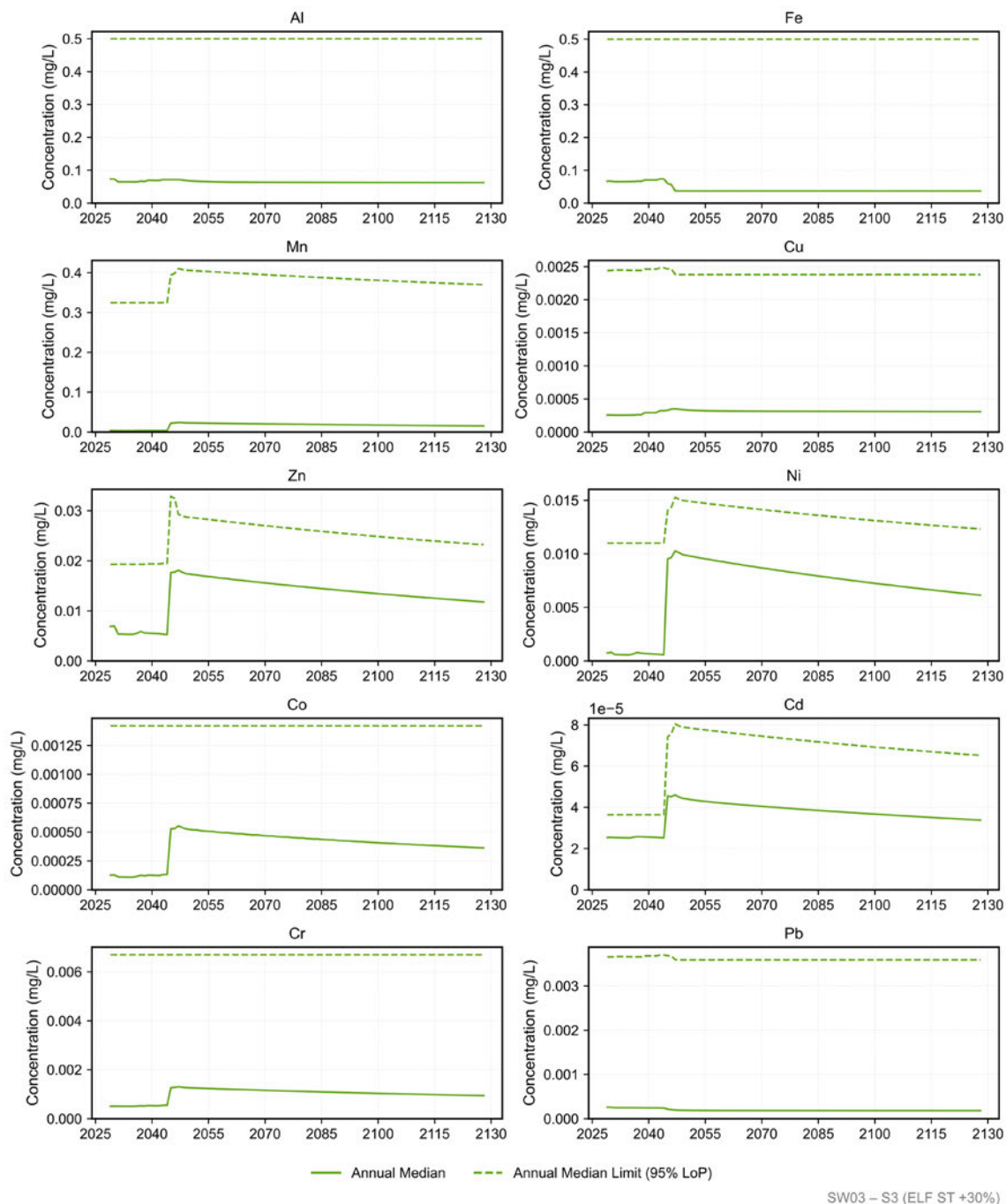


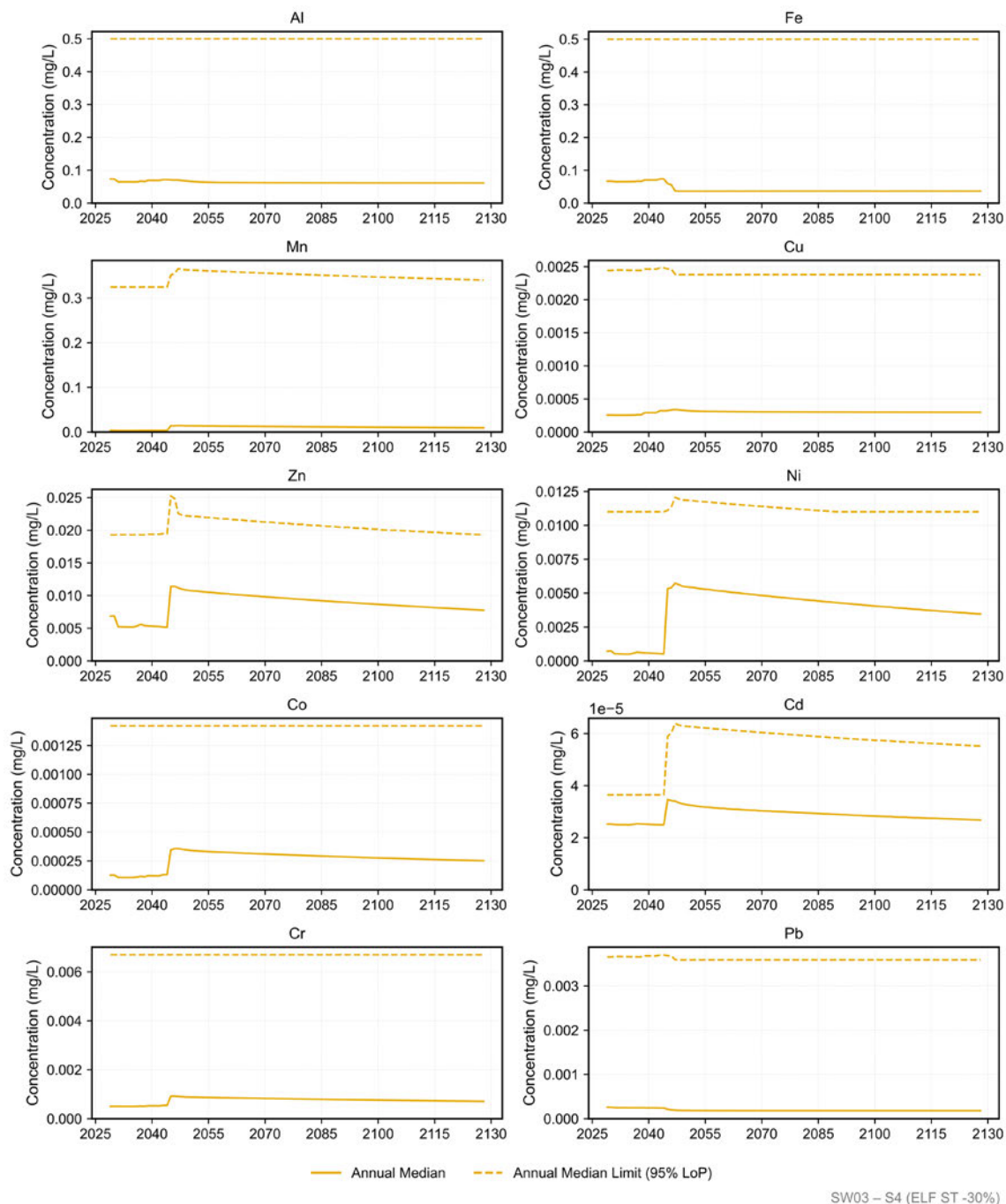
Figure 136: SW03 S1 (High Rainfall) Elementsmatrix



SW03 – S2 (Stochastic Rainfall)

Figure 137: SW03 S2 (Stochastic Rainfall) Elementsmatrix

**Figure 138: SW03 S3 (Elf St +30%) Elementsmatrix**

**Figure 139: SW03 S4 (Elf St 30%) Elementsmatrix**

2.5 ANNUAL MEDIANS (GROUPED SCENARIO)

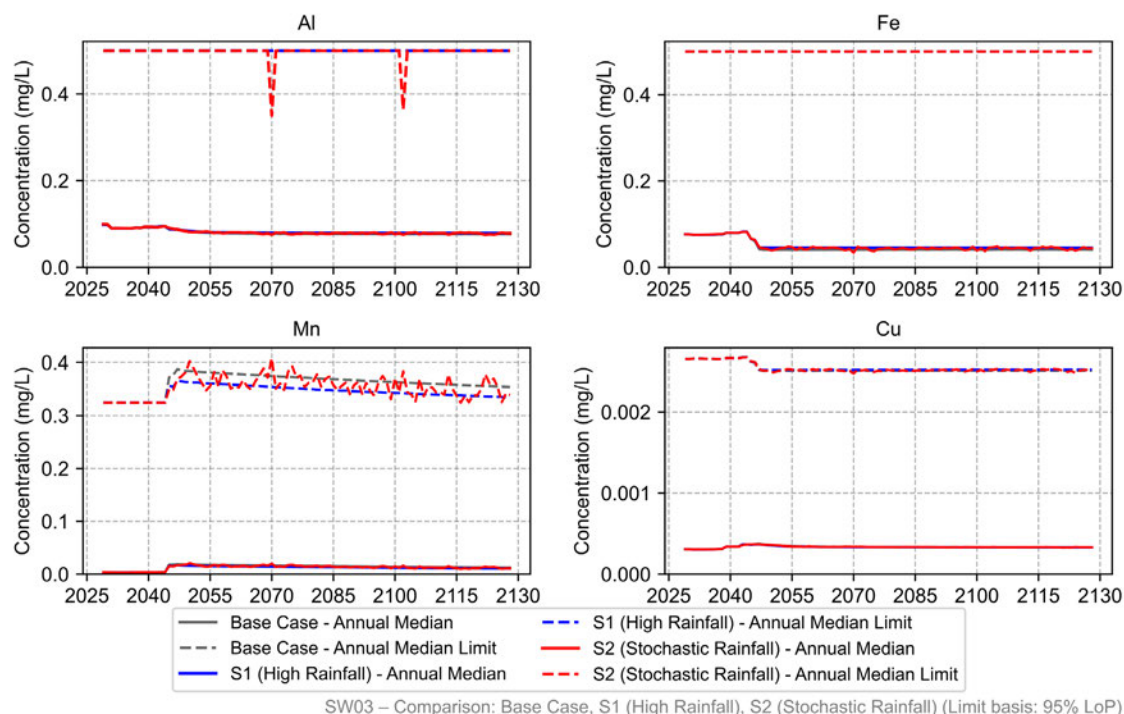


Figure 140: SW03 Base Case S1 S2 Al Fe Mn Cu Matrixcomparison

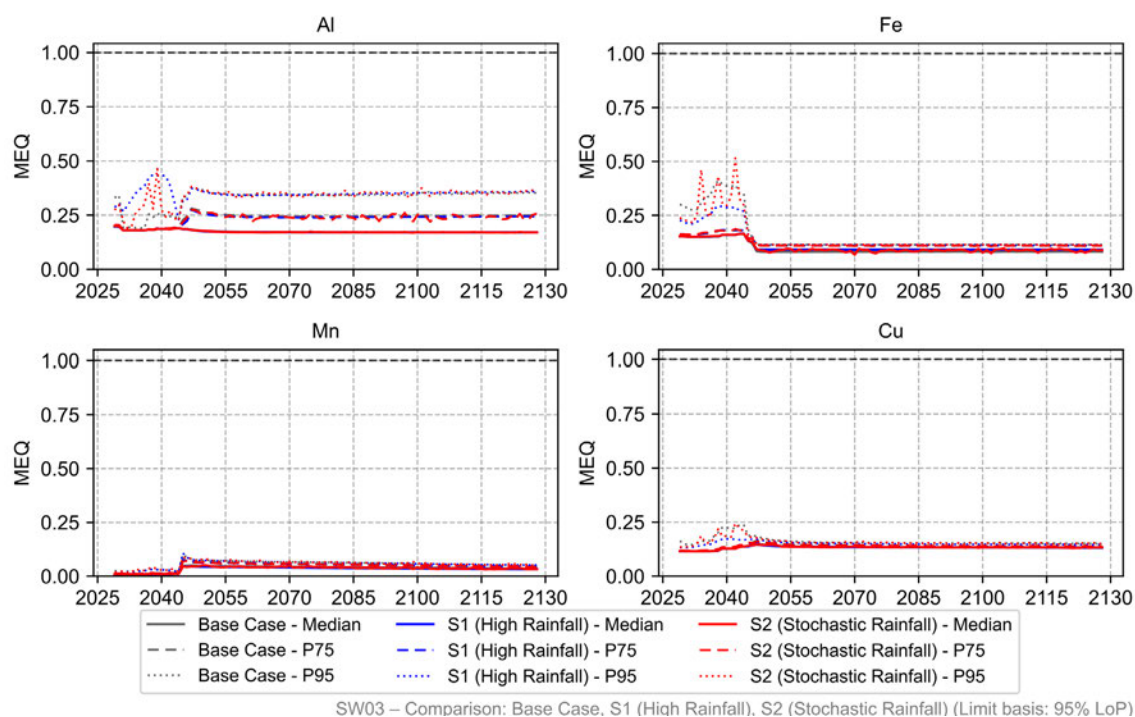
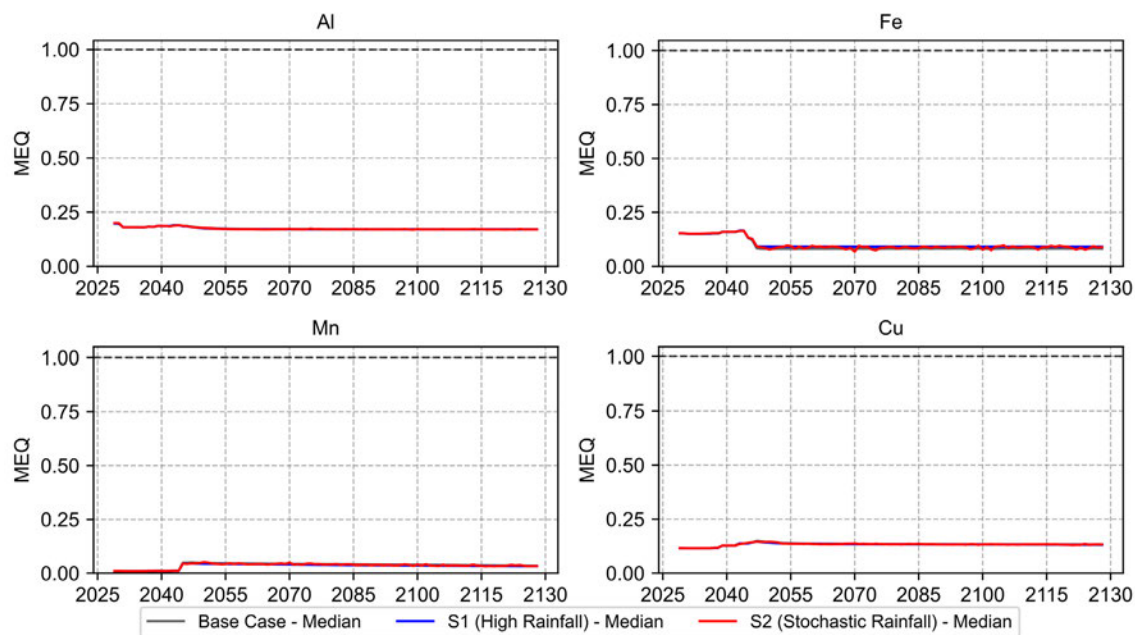
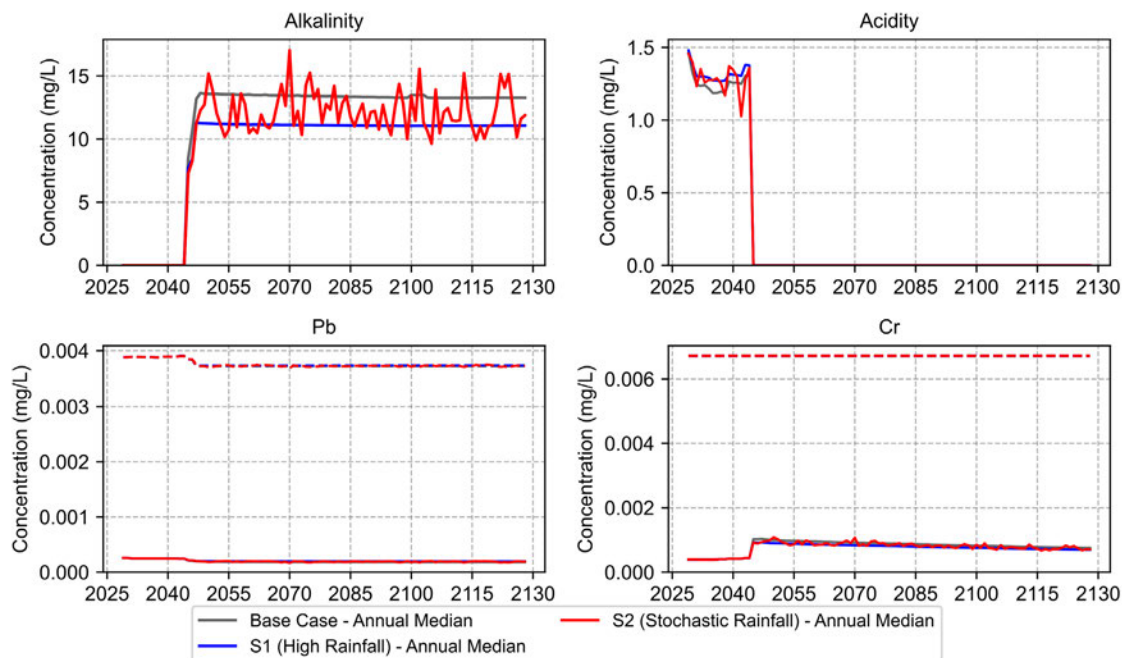


Figure 141: SW03 Base Case S1 S2 Al Fe Mn Cu Matrixcomparison Meq

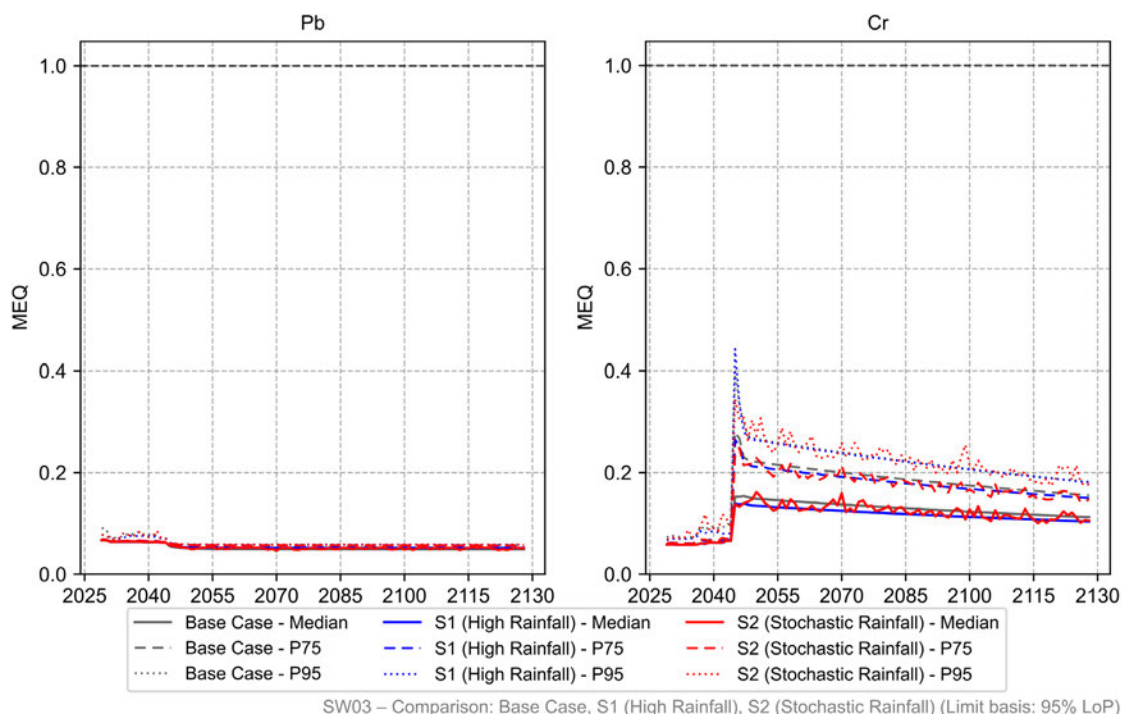


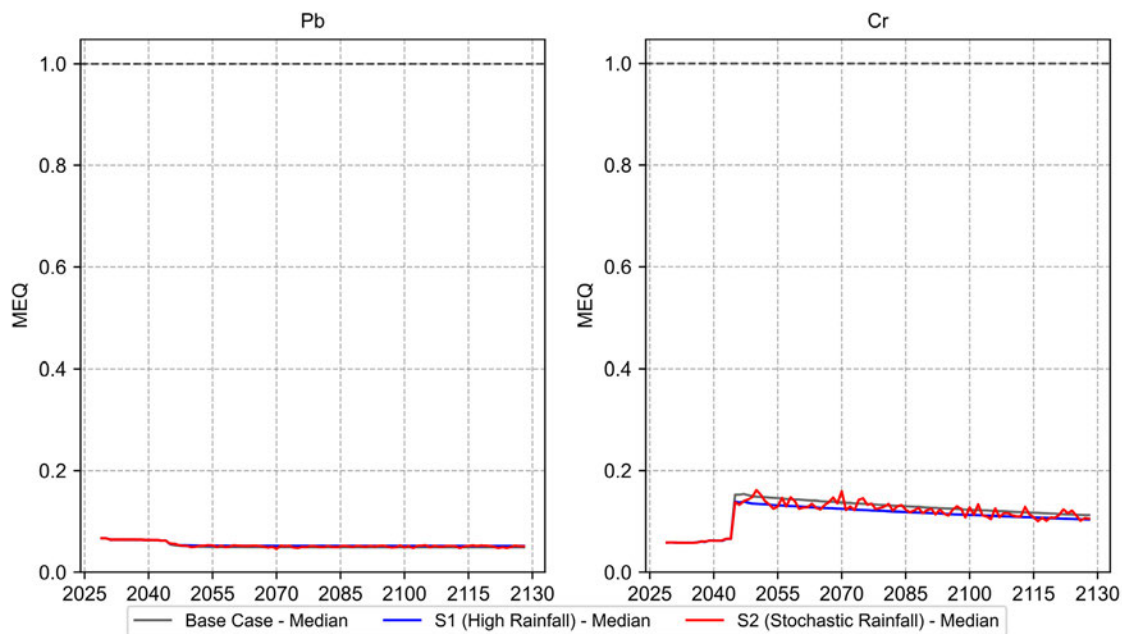
SW03 – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 95% LoP)

Figure 142: SW03 Base Case S1 S2 Al Fe Mn Cu Mxcomp Meq Median Only



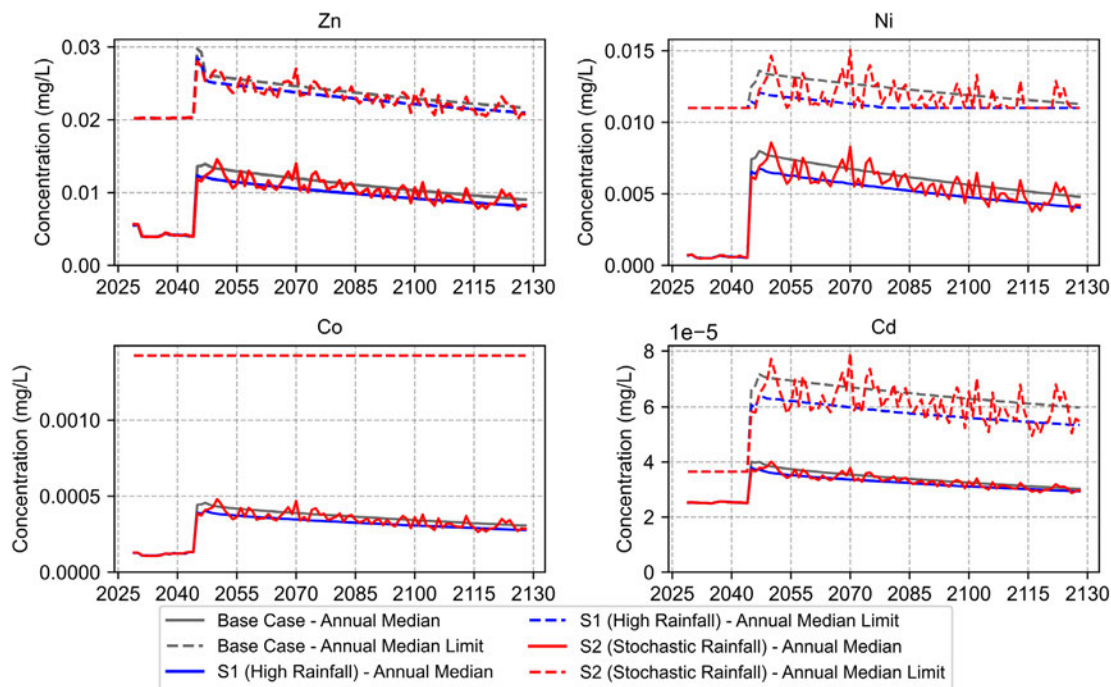
SW03 – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 95% LoP)

Figure 143: SW03 Base Case S1 S2 Alkalinity Acidity Pb Cr Matrixcomparison**Figure 144:** SW03 Base Case S1 S2 Pb Cr Matrixcomparison Meq



SW03 – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 95% LoP)

Figure 145: SW03 Base Case S1 S2 Pb Cr Mxcomp Meq Median Only



SW03 – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 95% LoP)

Figure 146: SW03 Base Case S1 S2 Zn Ni Co Cd Matrixcomparison

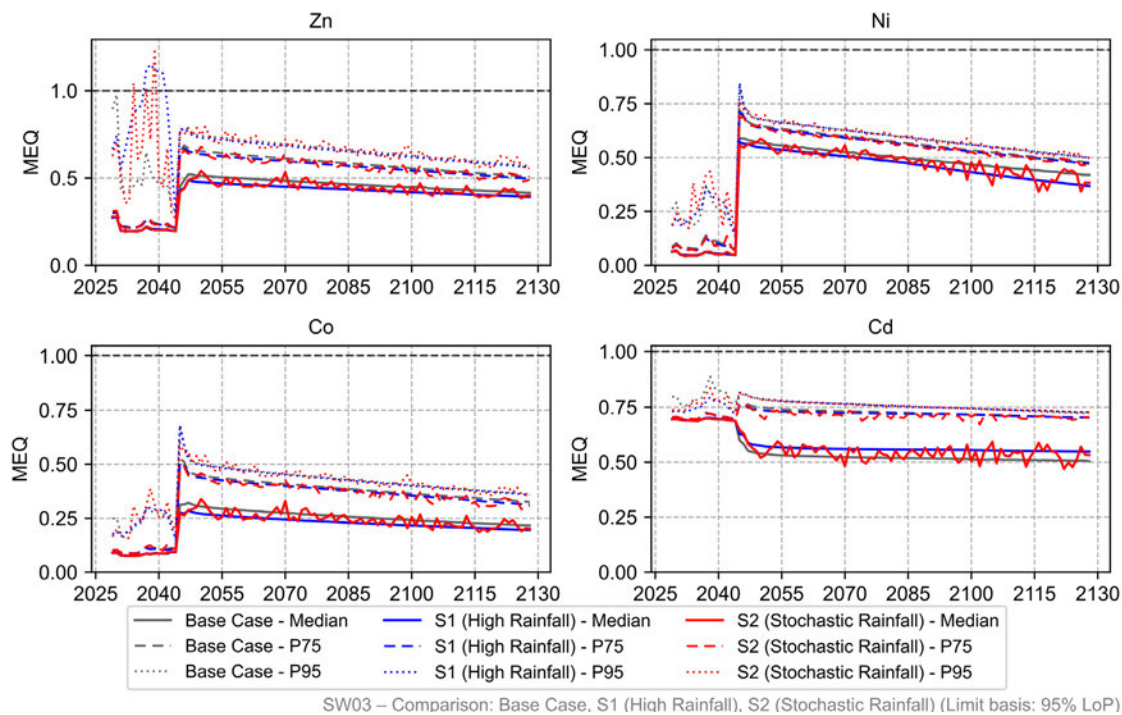


Figure 147: SW03 Base Case S1 S2 Zn Ni Co Cd Matrixcomparison Meq

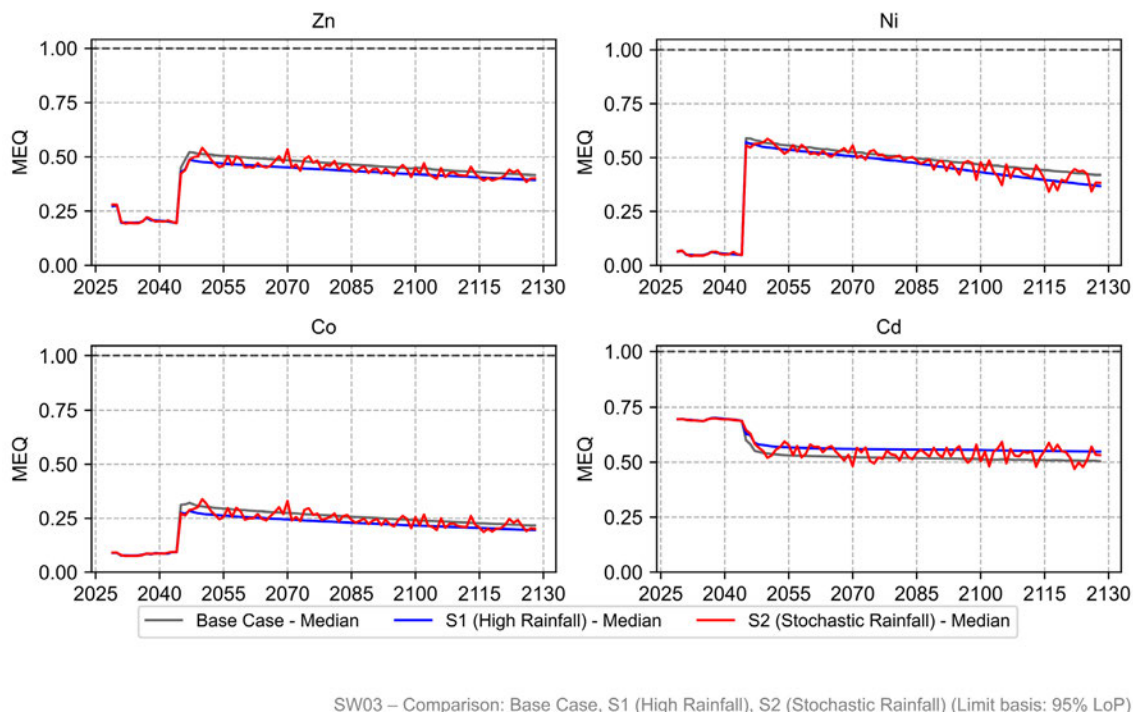


Figure 148: SW03 Base Case S1 S2 Zn Ni Co Cd Mxcomp Meq Median Only

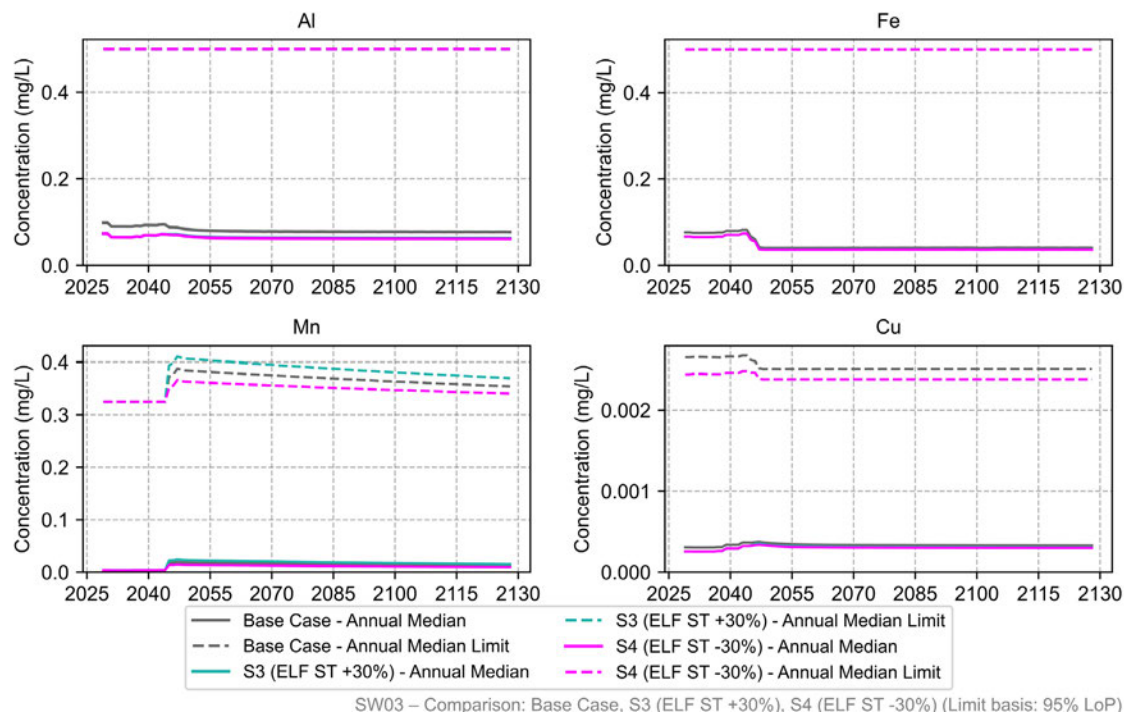


Figure 149: SW03 Base Case S3 S4 Al Fe Mn Cu Matrixcomparison

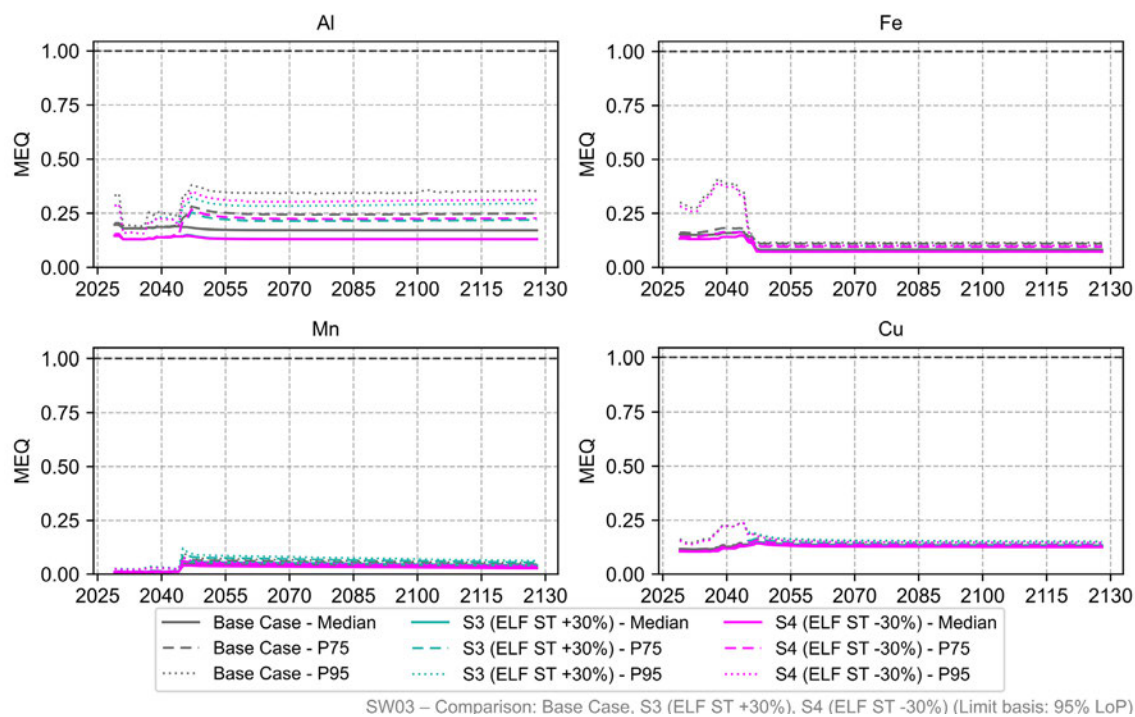
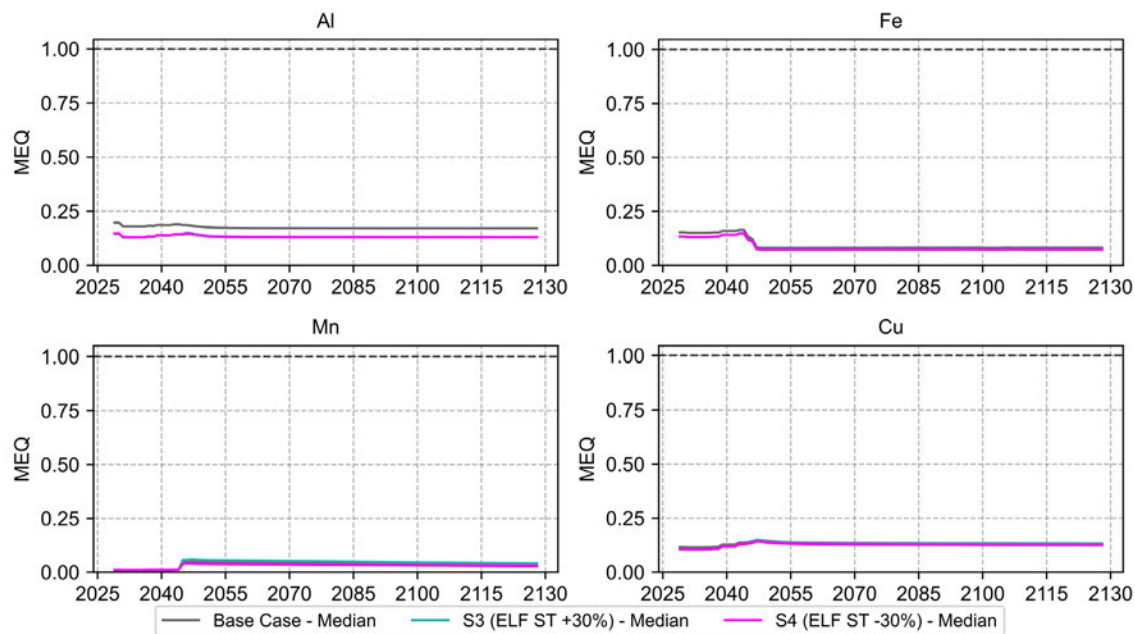
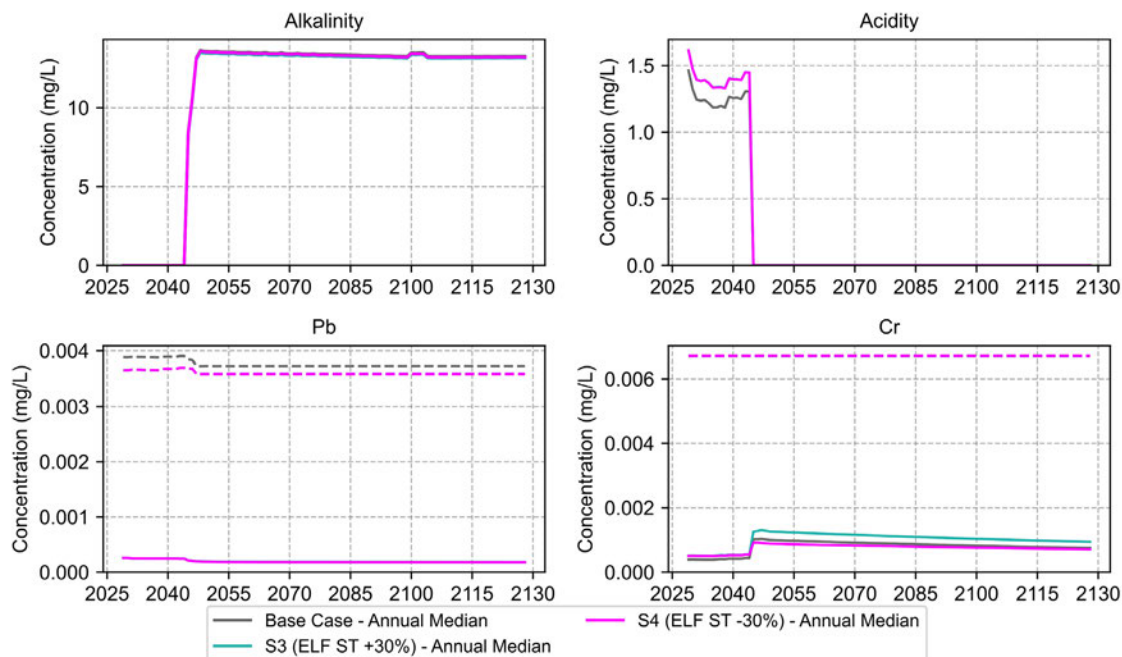


Figure 150: SW03 Base Case S3 S4 Al Fe Mn Cu Matrixcomparison Meq



SW03 – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 95% LoP)

Figure 151: SW03 Base Case S3 S4 Al Fe Mn Cu Mxcomp Meq Median Only



SW03 – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 95% LoP)

Figure 152: SW03 Base Case S3 S4 Alkalinity Acidity Pb Cr Matrixcomparison

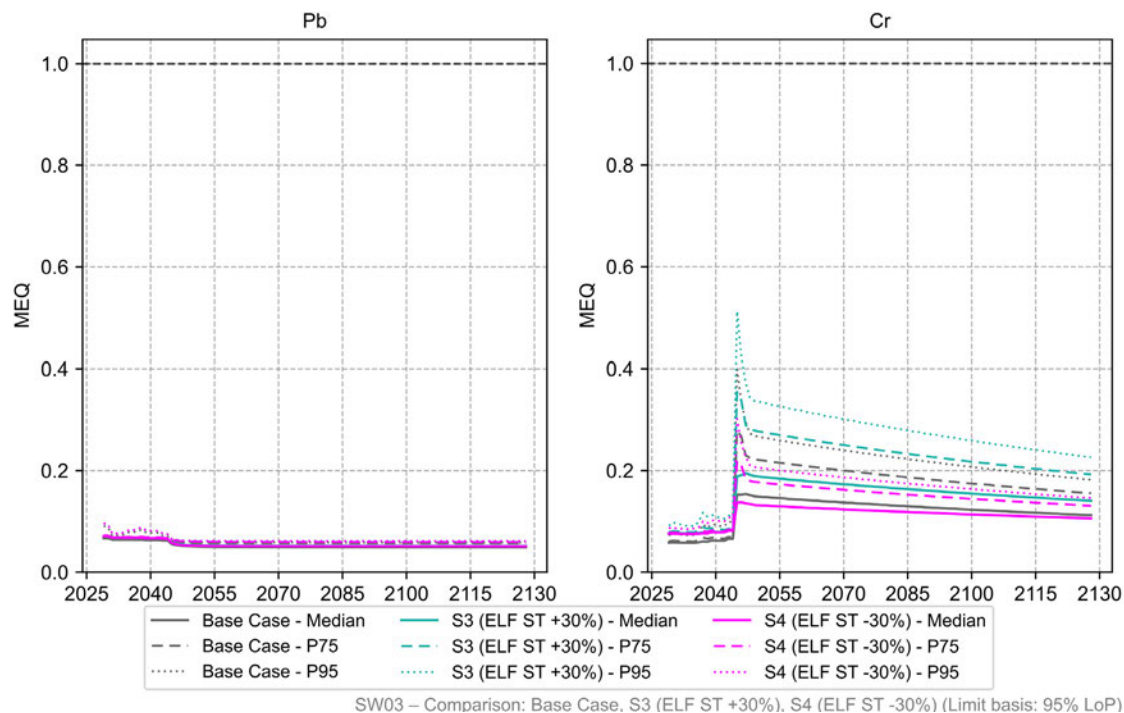


Figure 153: SW03 Base Case S3 S4 Pb Cr Matrixcomparison Meq

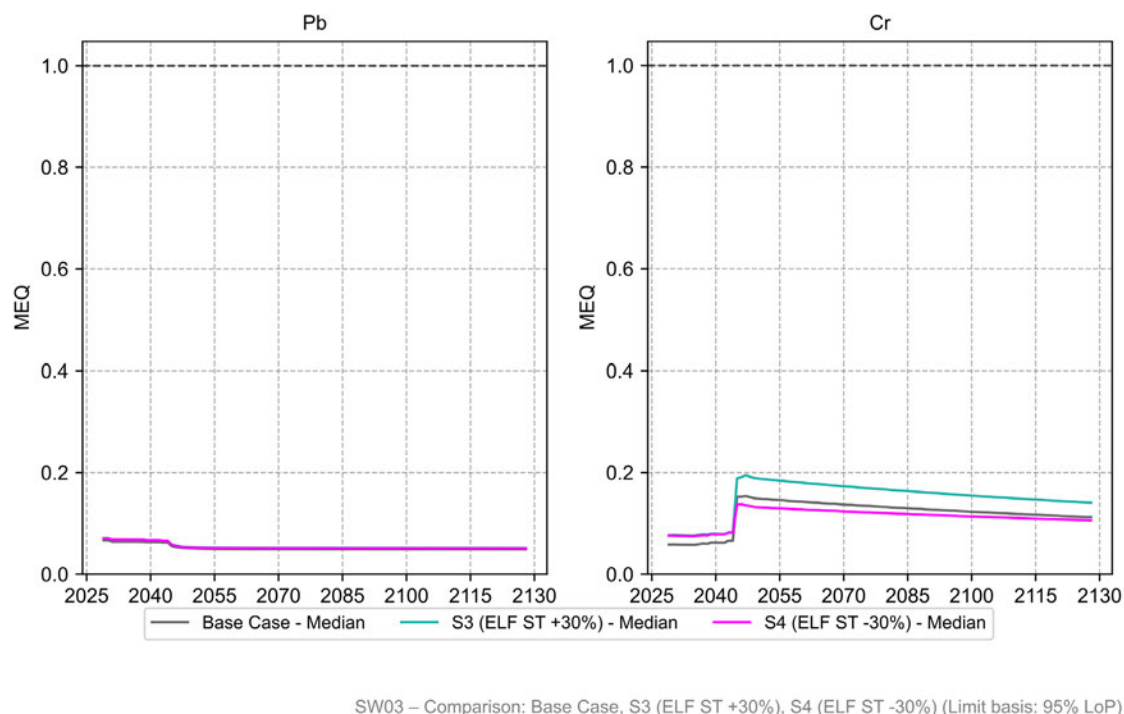


Figure 154: SW03 Base Case S3 S4 Pb Cr Mxcomp Meq Median Only

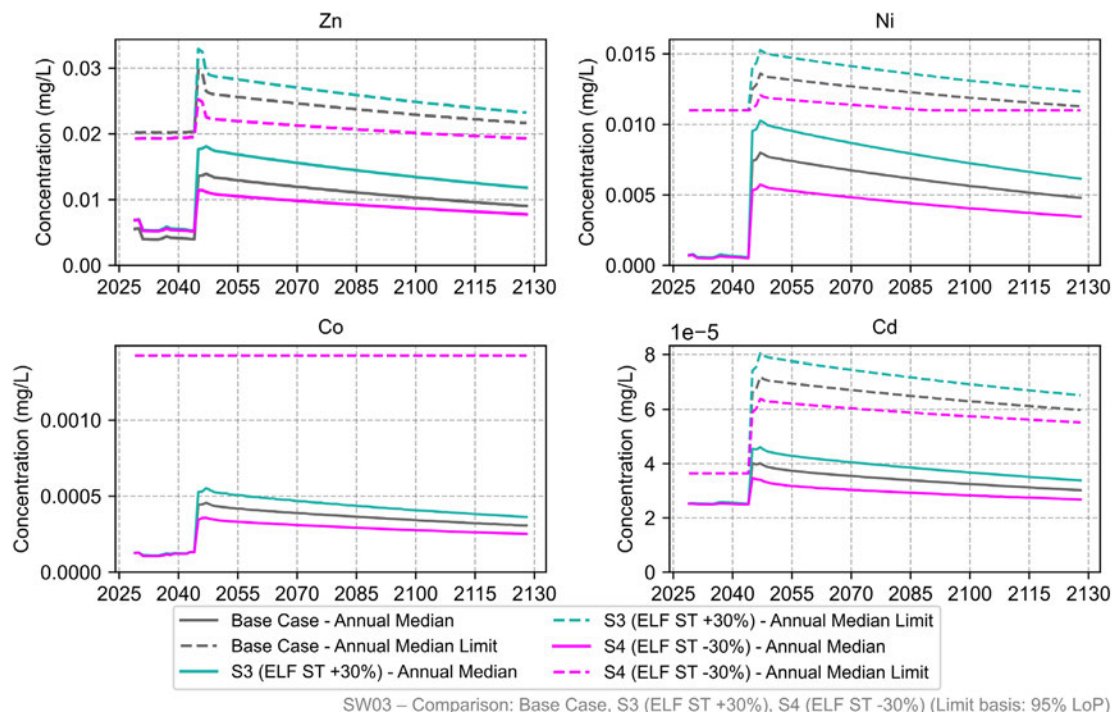


Figure 155: SW03 Base Case S3 S4 Zn Ni Co Cd Matrixcomparison

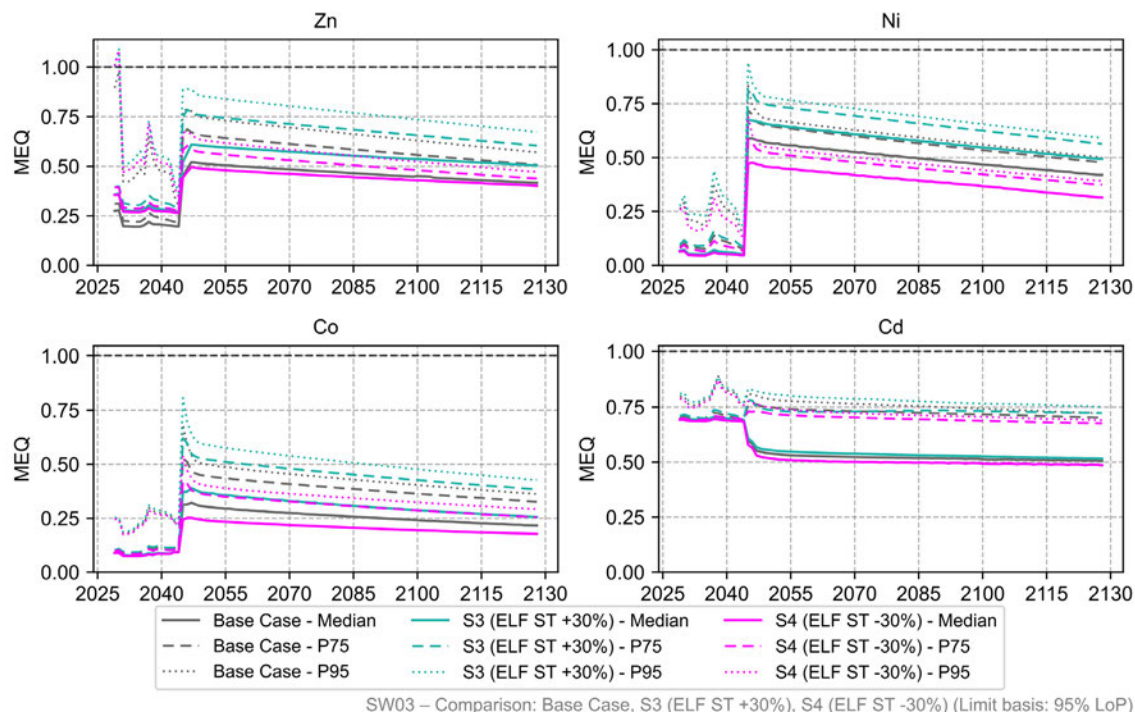
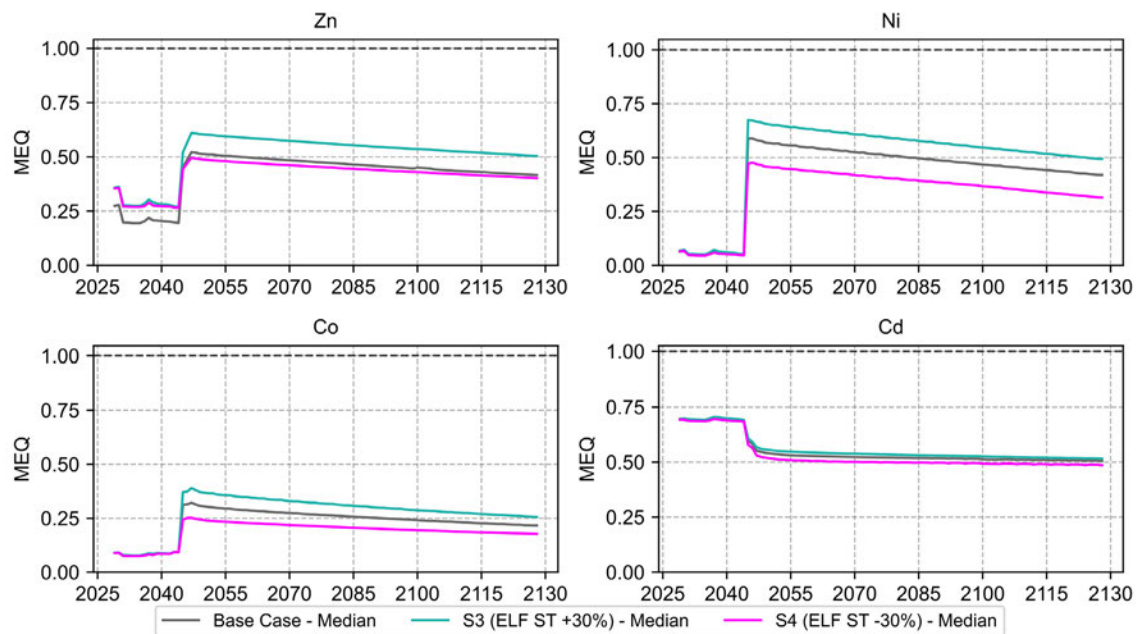
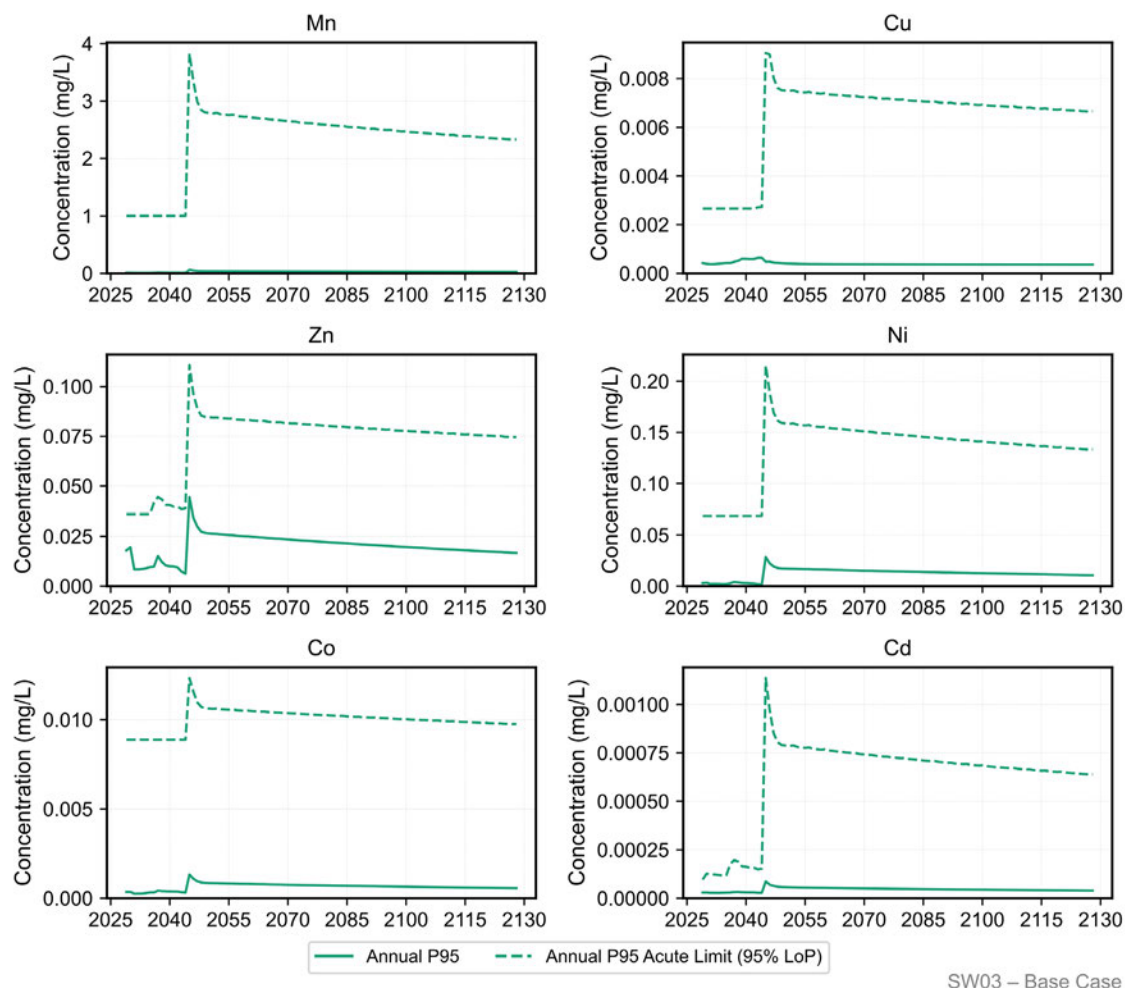


Figure 156: SW03 Base Case S3 S4 Zn Ni Co Cd Matrixcomparison Meq



SW03 – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 95% LoP)

Figure 157: SW03 Base Case S3 S4 Zn Ni Co Cd Mxcomp Meq Median Only

2.6 ANNUAL P95 (SINGLE SCENARIO)**Figure 158: SW03 Base Case Acute Limits**

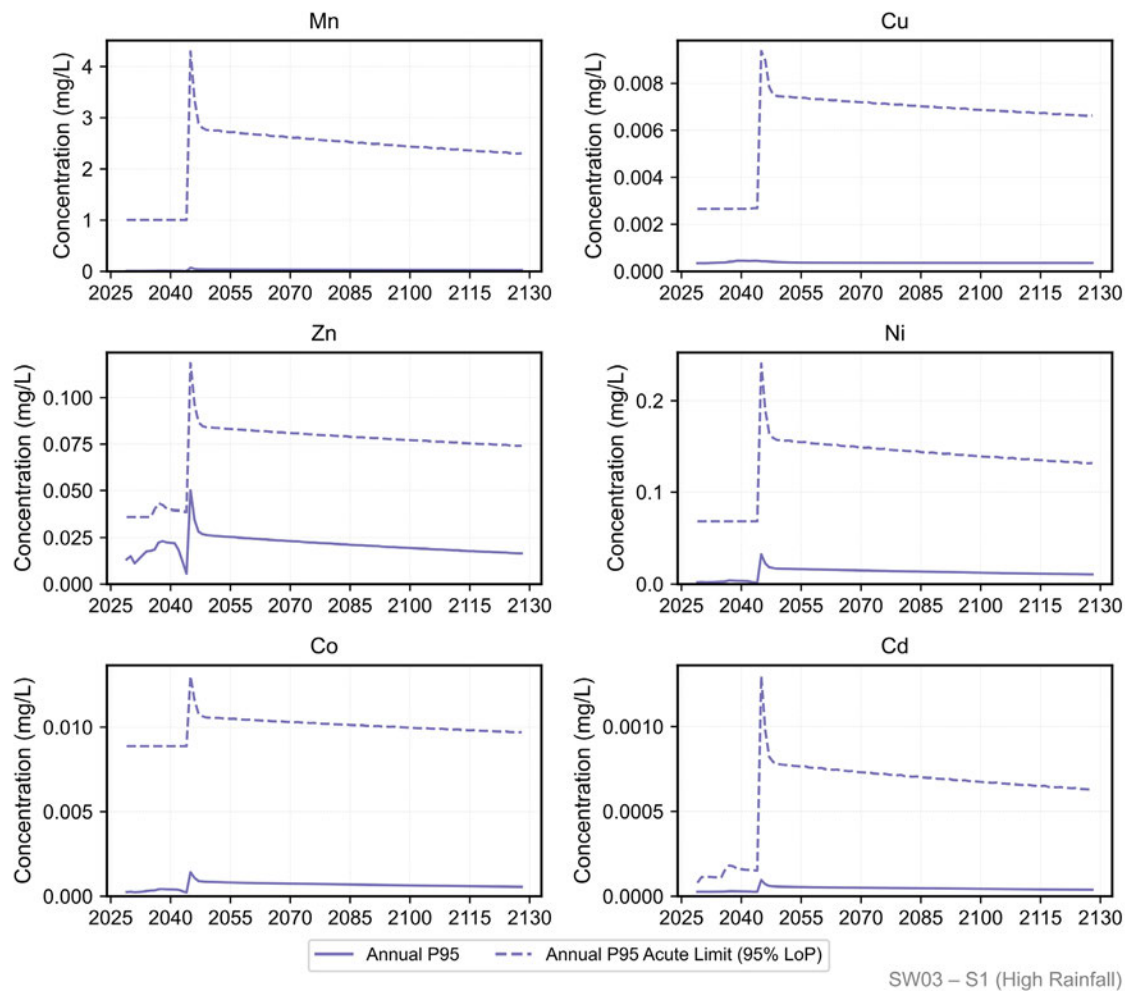


Figure 159: SW03 S1 High Rainfall Acute Limits

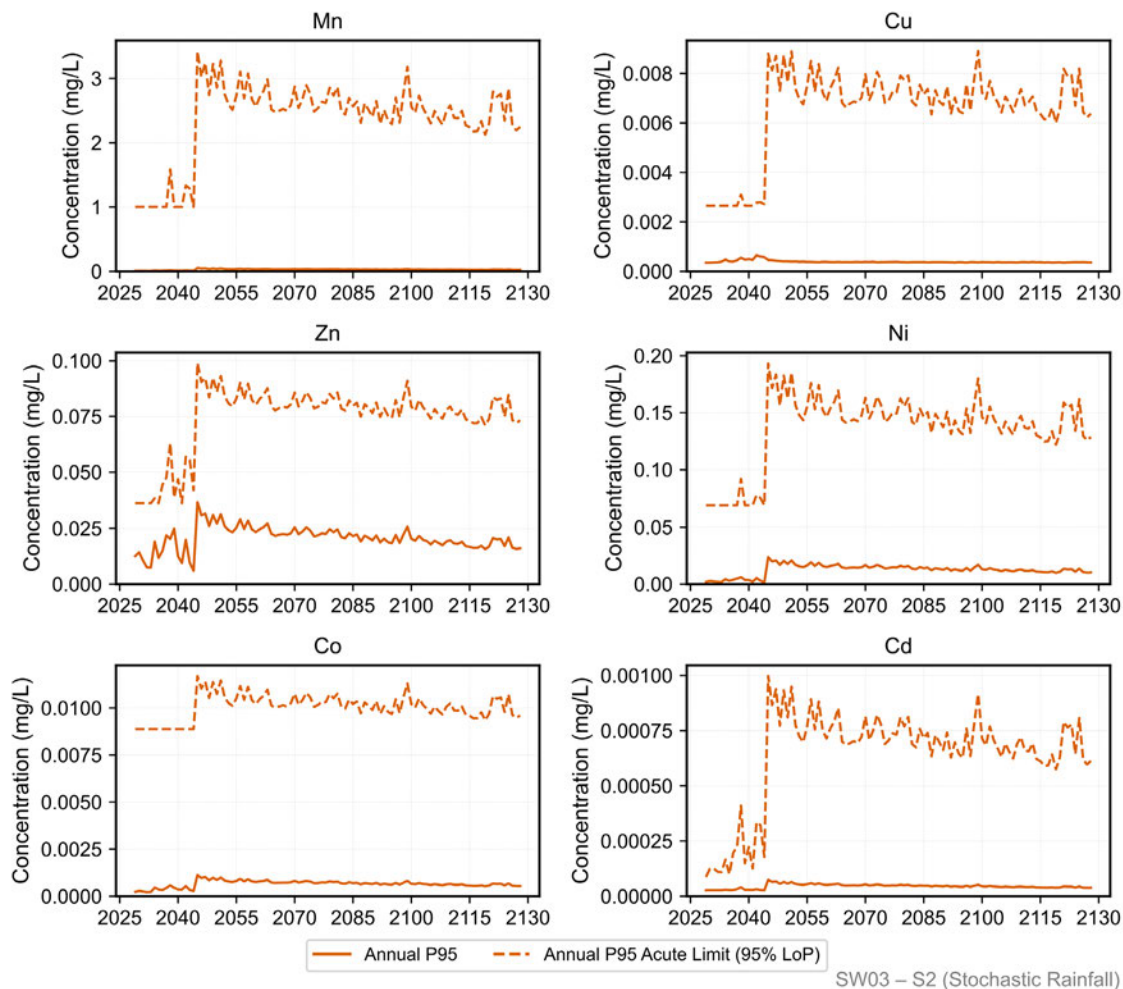


Figure 160: SW03 S2 Stochastic Rainfall Acute Limits

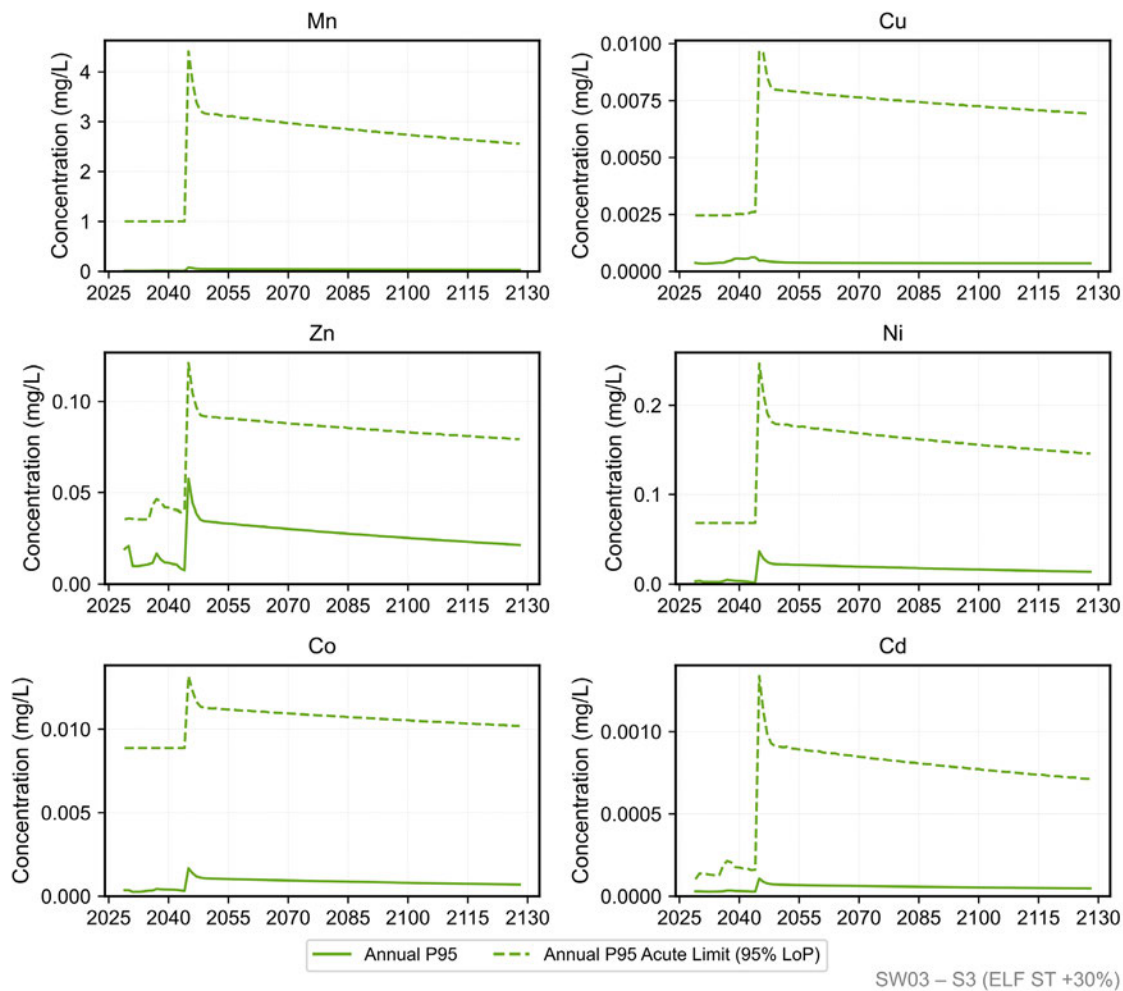


Figure 161: SW03 S3 Elf St 30 Acute Limits

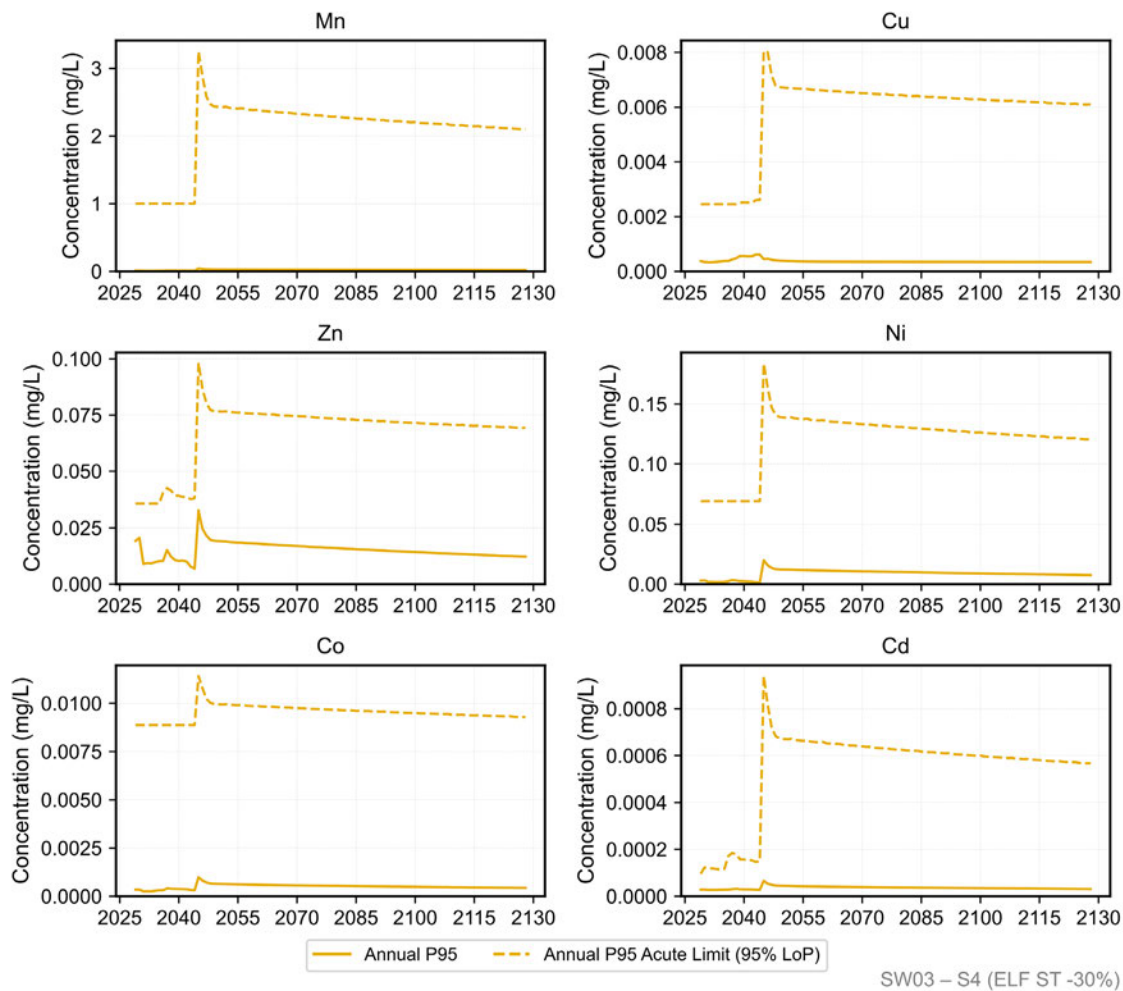


Figure 162: SW03 S4 Elf St 30 Acute Limits

2.7 ANNUAL P95 (GROUPED SCENARIO)

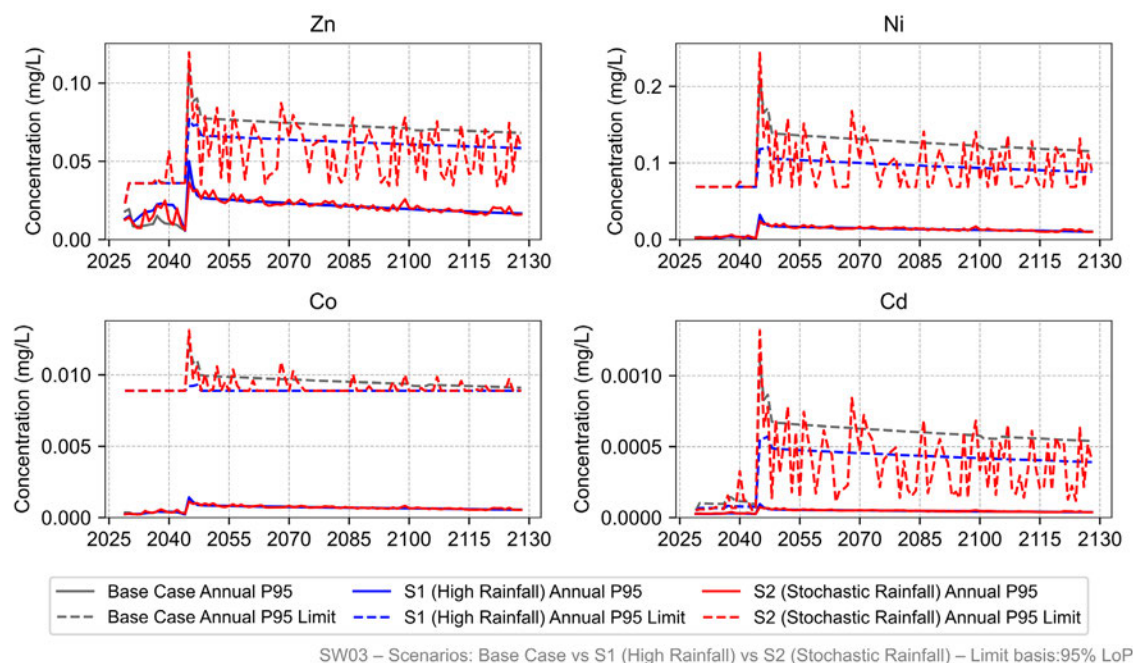


Figure 163: SW03 Set1 Acute Limits

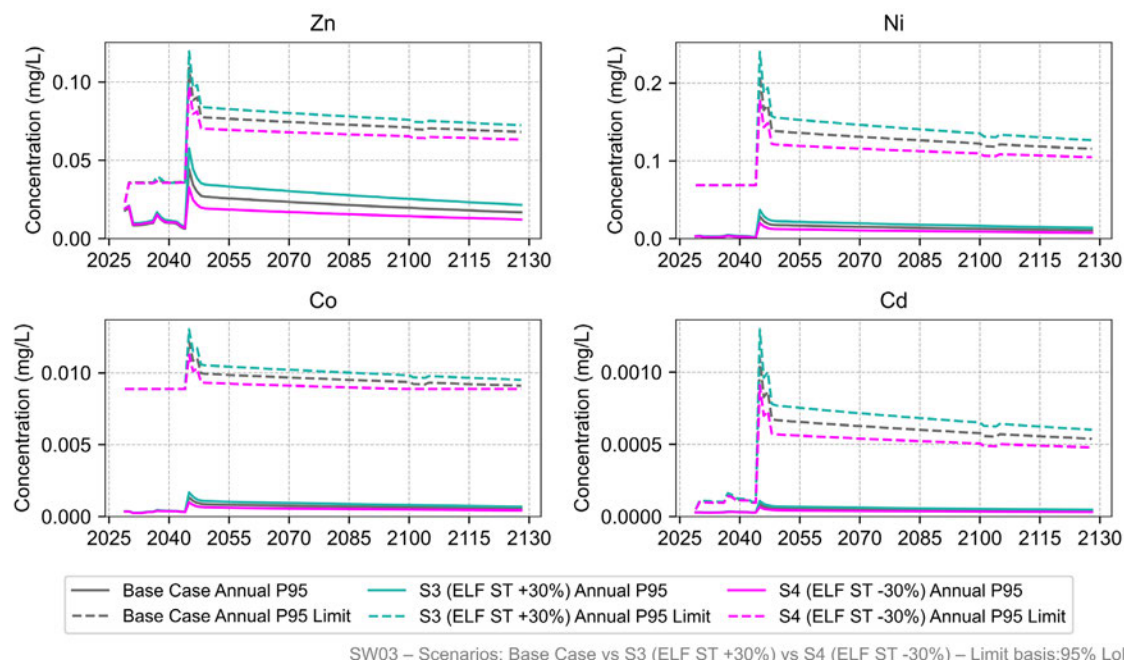


Figure 164: SW03 Set2 Acute Limits

3. STATION 2W

3.1 30-DAY ROLLING MEDIAN

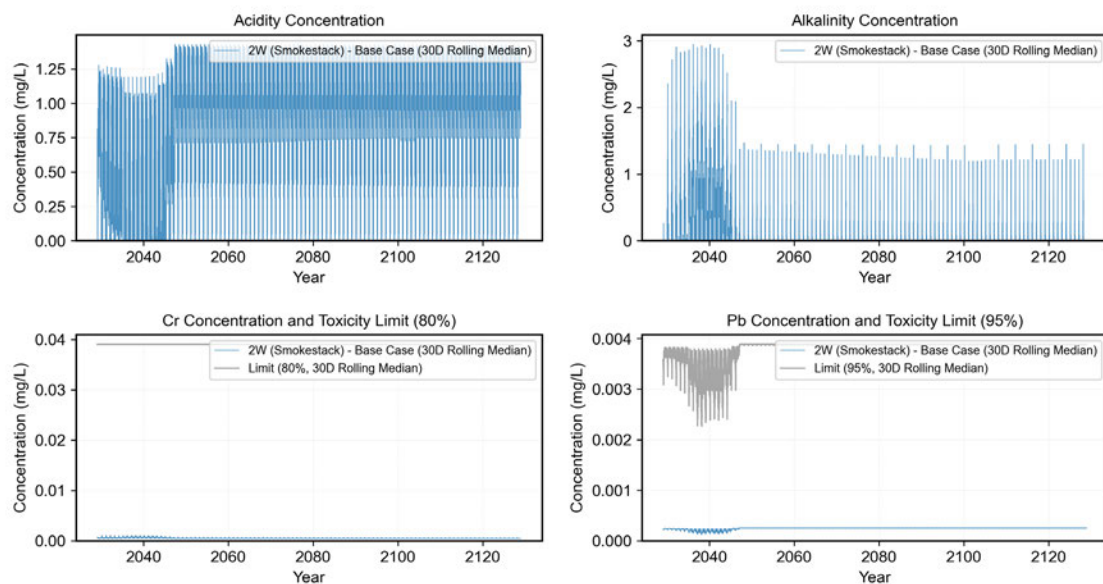


Figure 165: Matrix plot Base Case 2W (Smokestack) Acidity Alkalinity Cr Pb

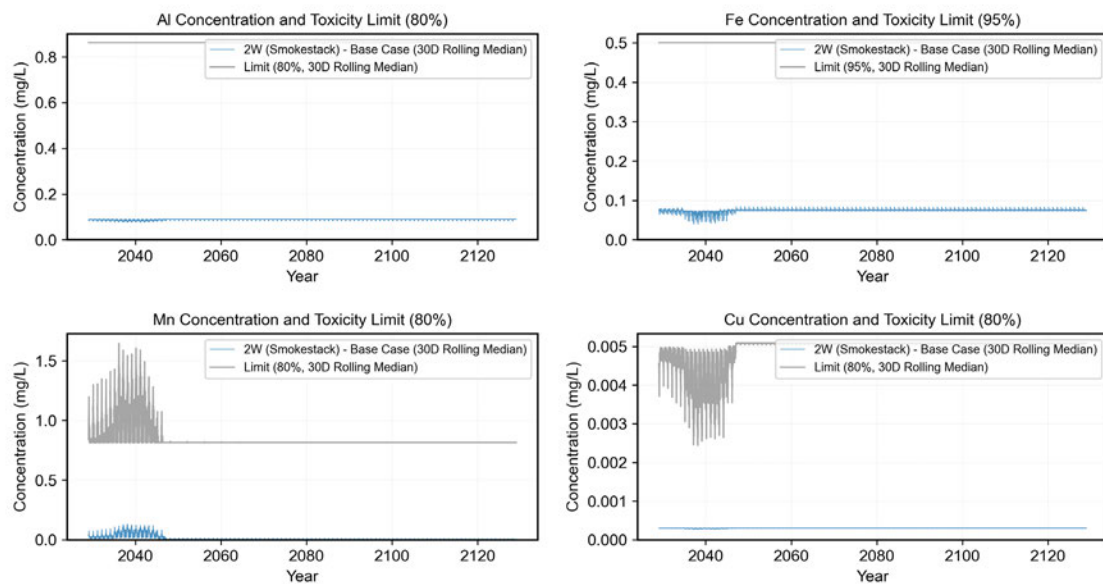


Figure 166: Matrix plot Base Case 2W (Smokestack) Al Fe Mn Cu

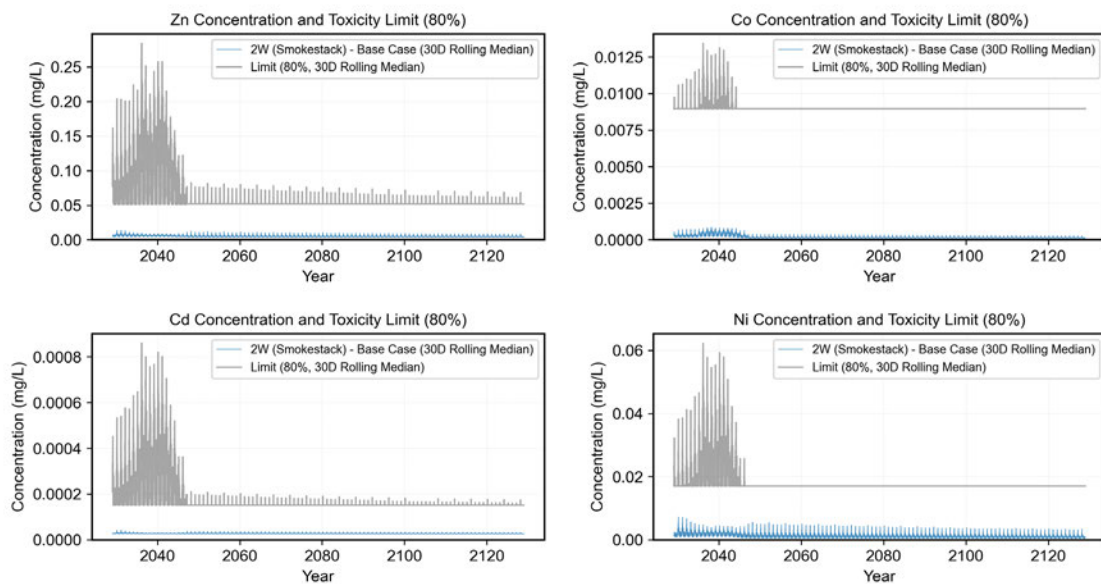


Figure 167: Matrix plot Base Case 2W (Smokestack) Zn Co Cd Ni

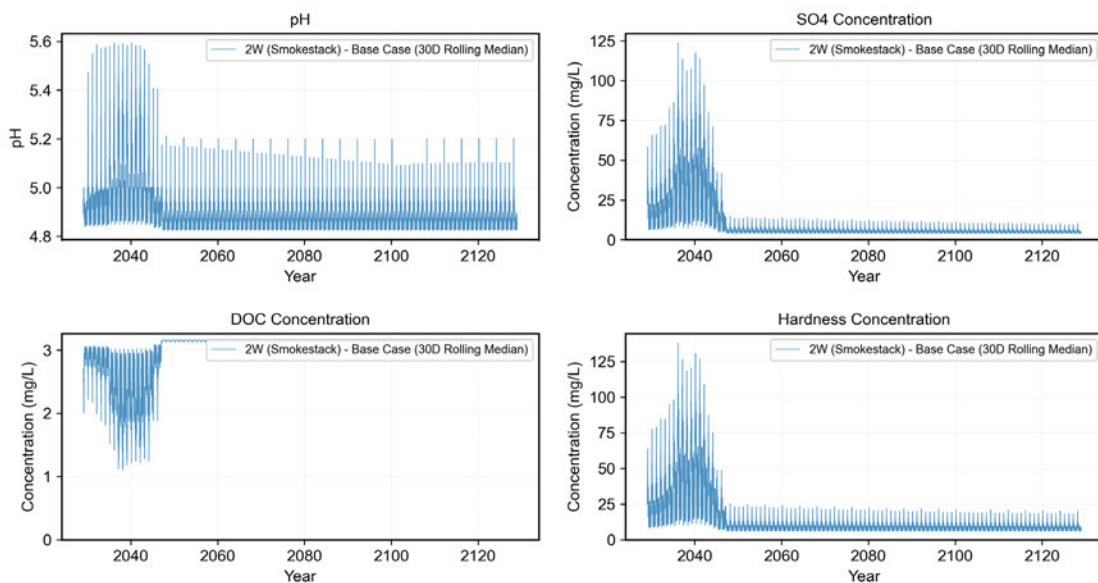


Figure 168: Matrix plot Base Case 2W (Smokestack) pH SO4 DOC Hardness

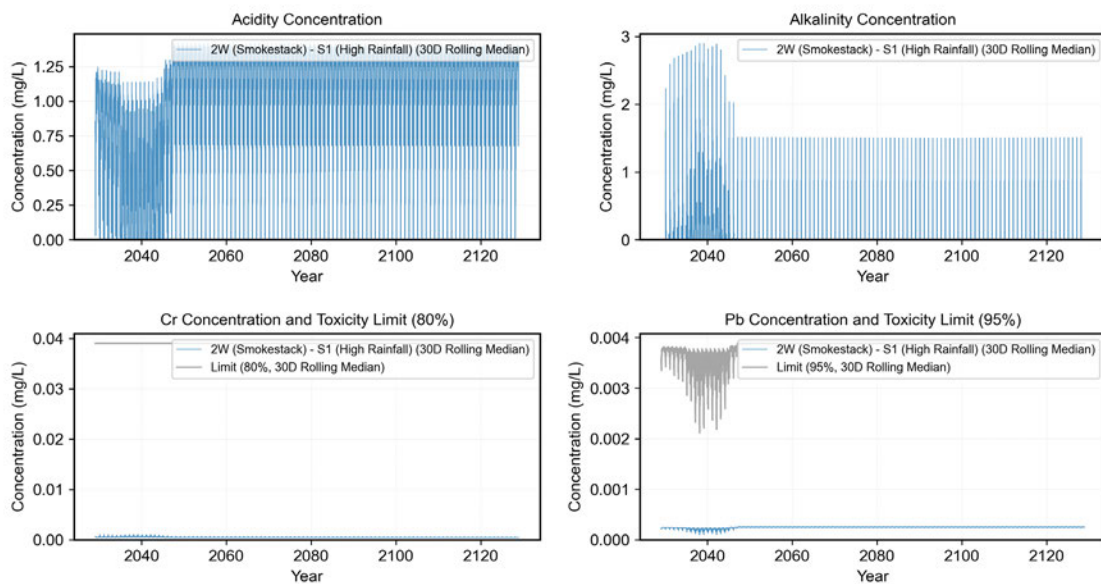


Figure 169: Matrix plot S1 (High Rainfall) 2W (Smokestack) Acidity Alkalinity Cr Pb

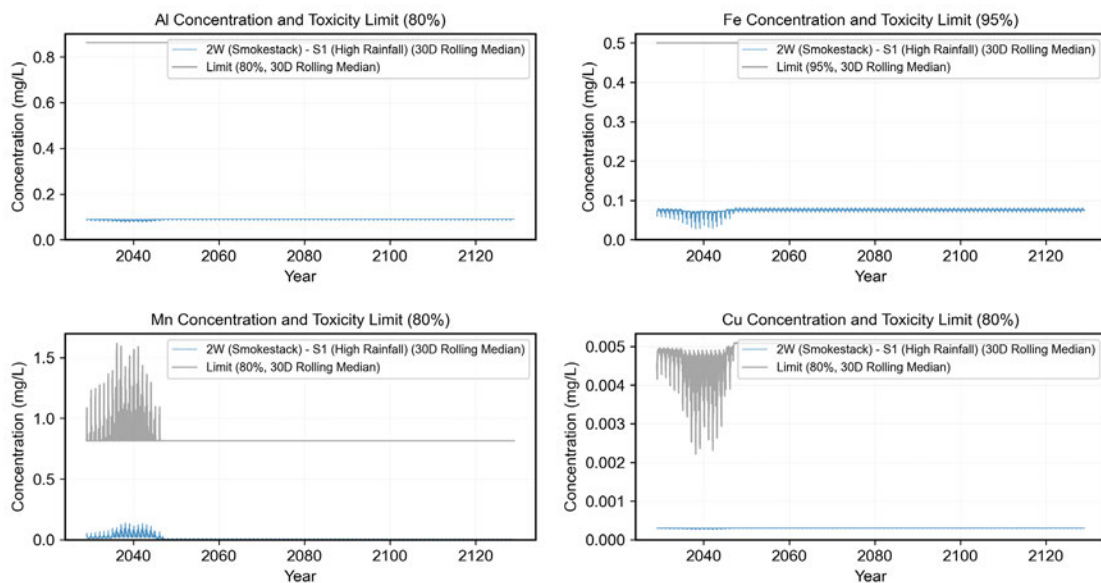


Figure 170: Matrix plot S1 (High Rainfall) 2W (Smokestack) Al Fe Mn Cu

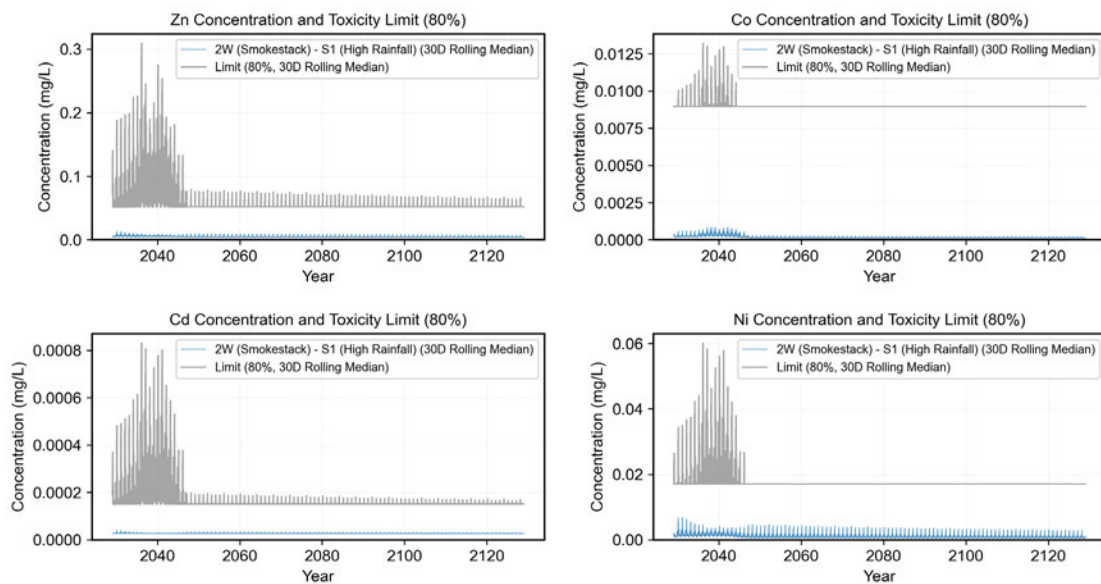


Figure 171: Matrix plot S1 (High Rainfall) 2W (Smokestack) Zn Co Cd Ni

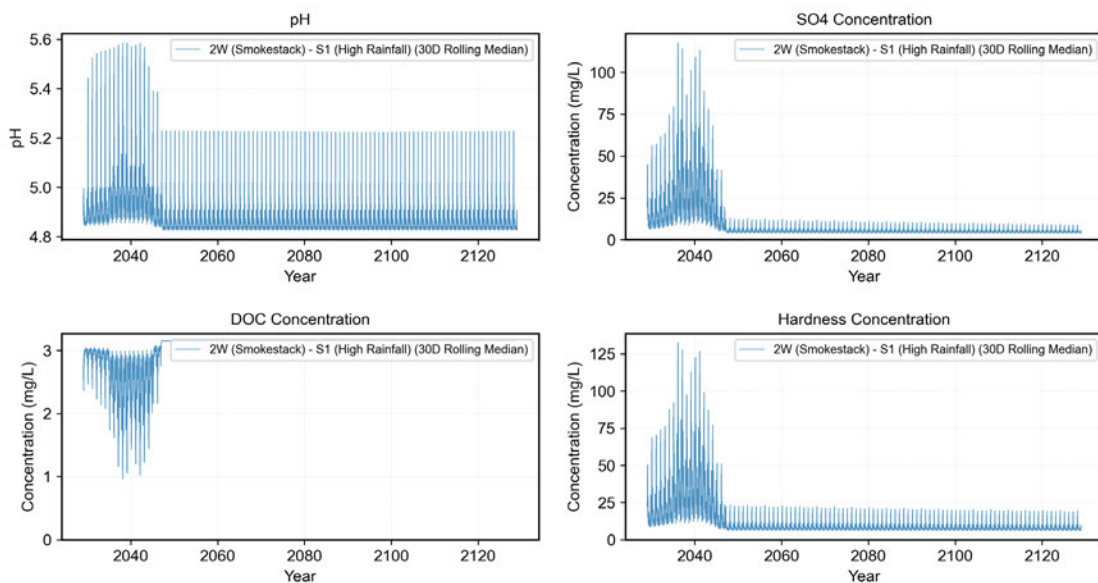


Figure 172: Matrix plot S1 (High Rainfall) 2W (Smokestack) pH SO4 DOC Hardness

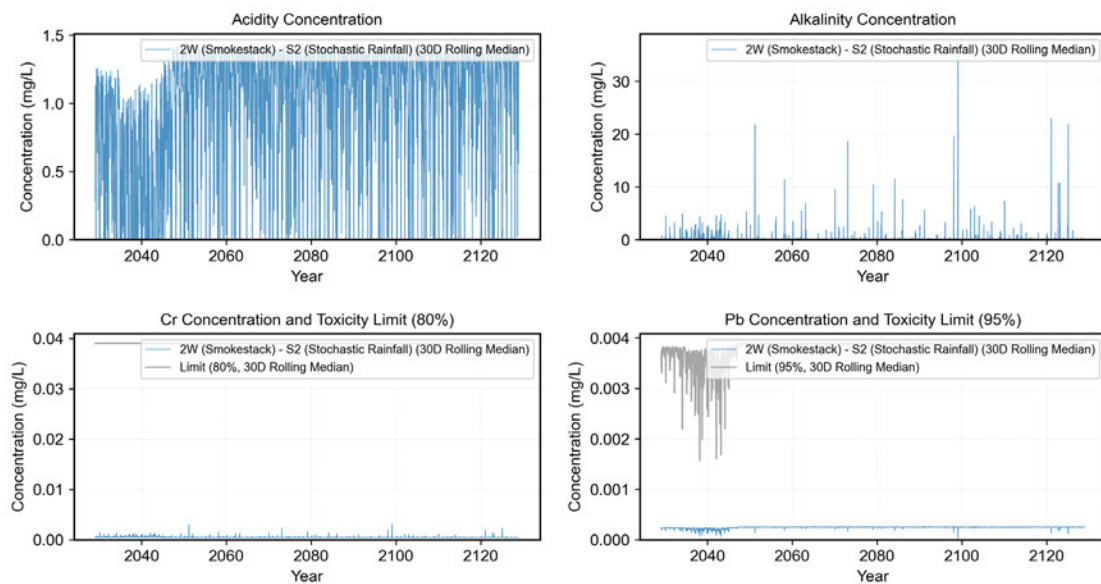


Figure 173: Matrix plot S2 (Stochastic Rainfall) 2W (Smokestack) Acidity Alkalinity Cr Pb

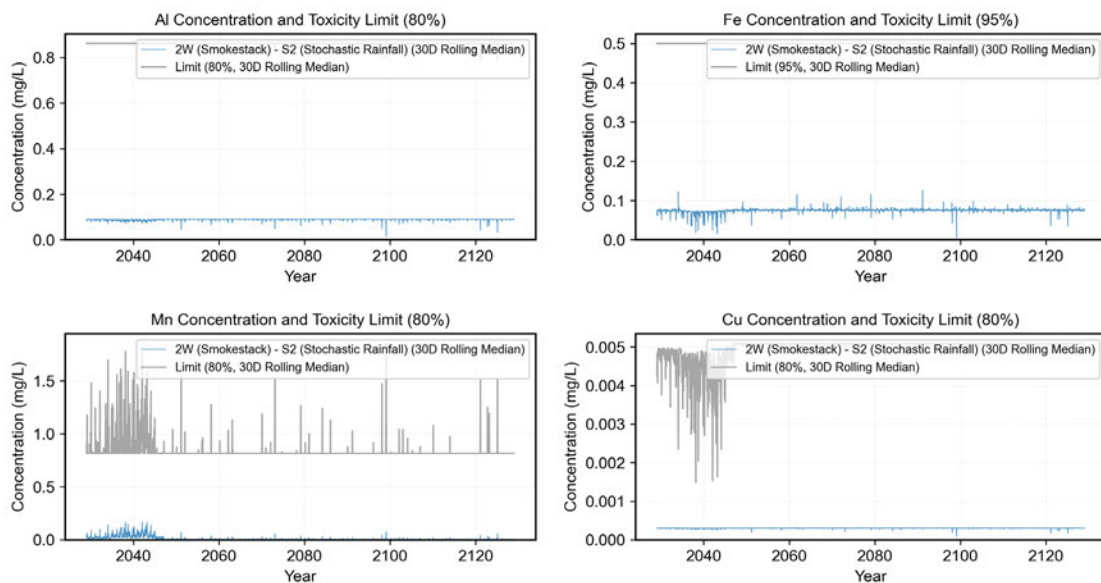


Figure 174: Matrix plot S2 (Stochastic Rainfall) 2W (Smokestack) Al Fe Mn Cu

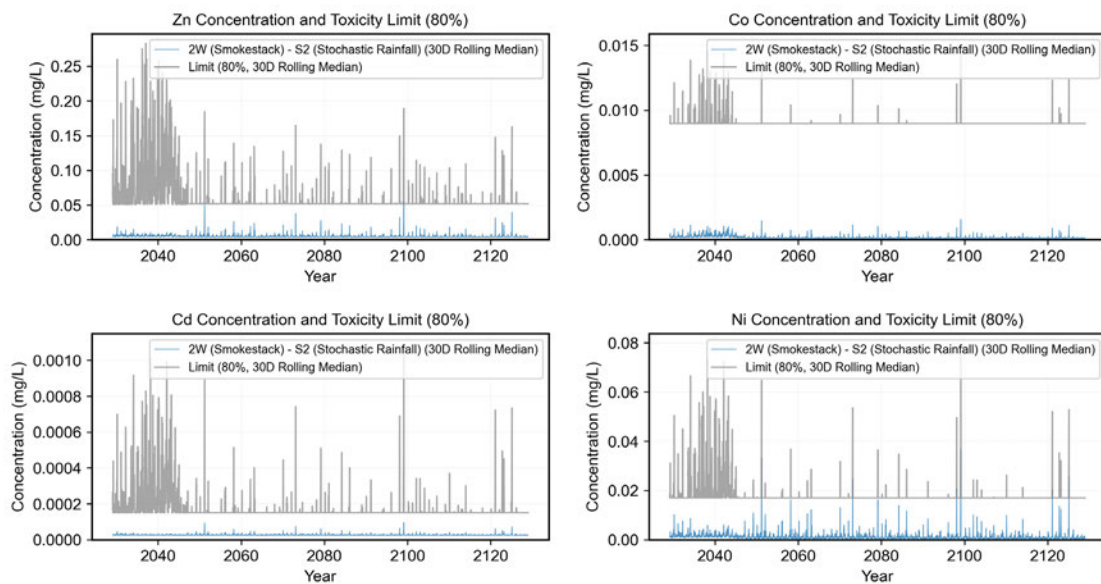


Figure 175: Matrix plot S2 (Stochastic Rainfall) 2W (Smokestack) Zn Co Cd Ni

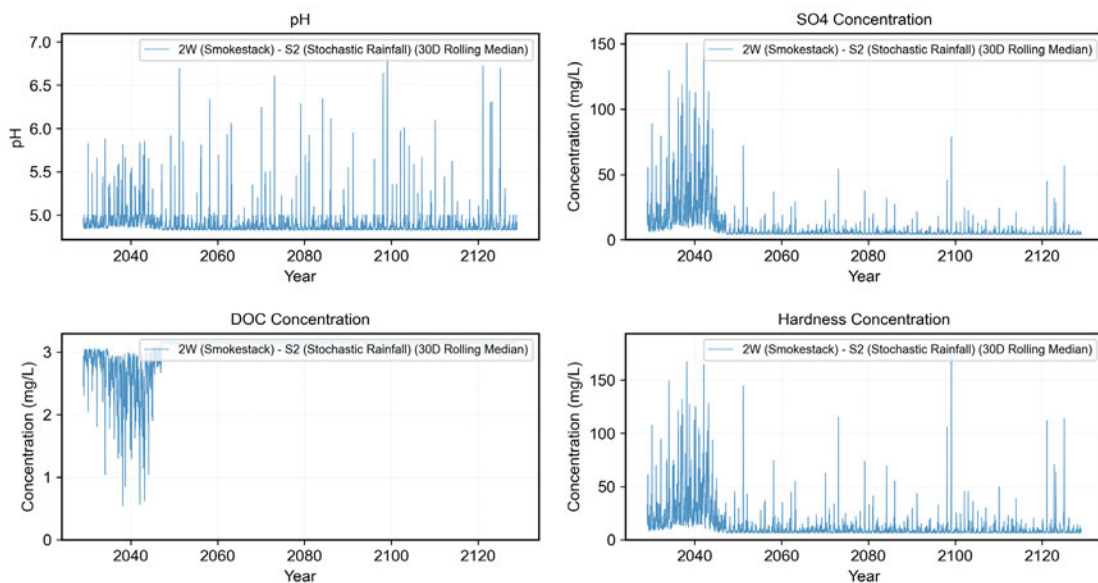


Figure 176: Matrix plot S2 (Stochastic Rainfall) 2W (Smokestack) pH SO₄ DOC Hardness

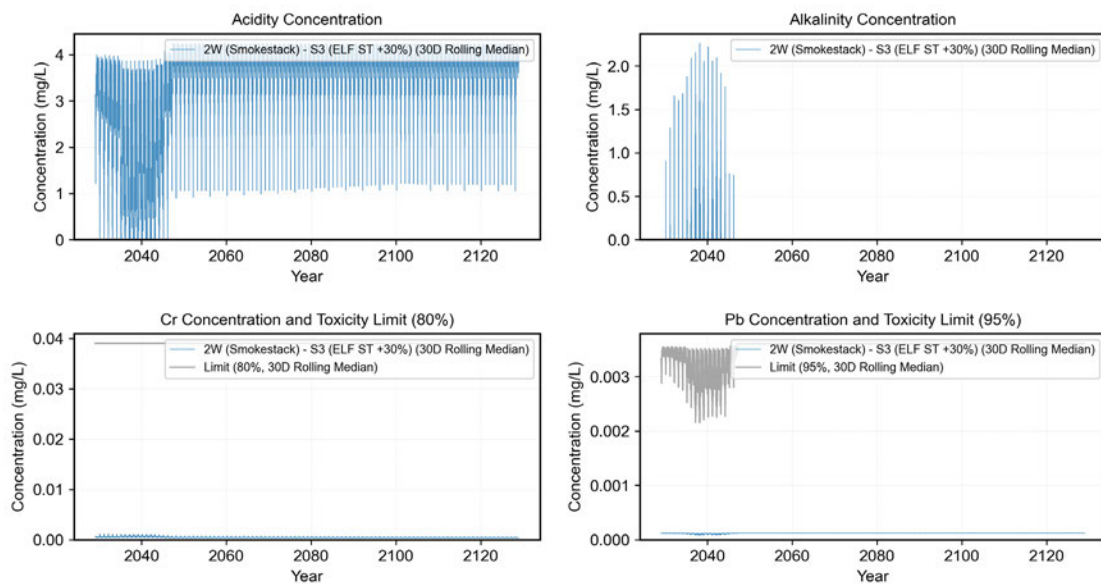


Figure 177: Matrix plot S3 (Elf St +30%) 2W (Smokestack) Acidity Alkalinity Cr Pb

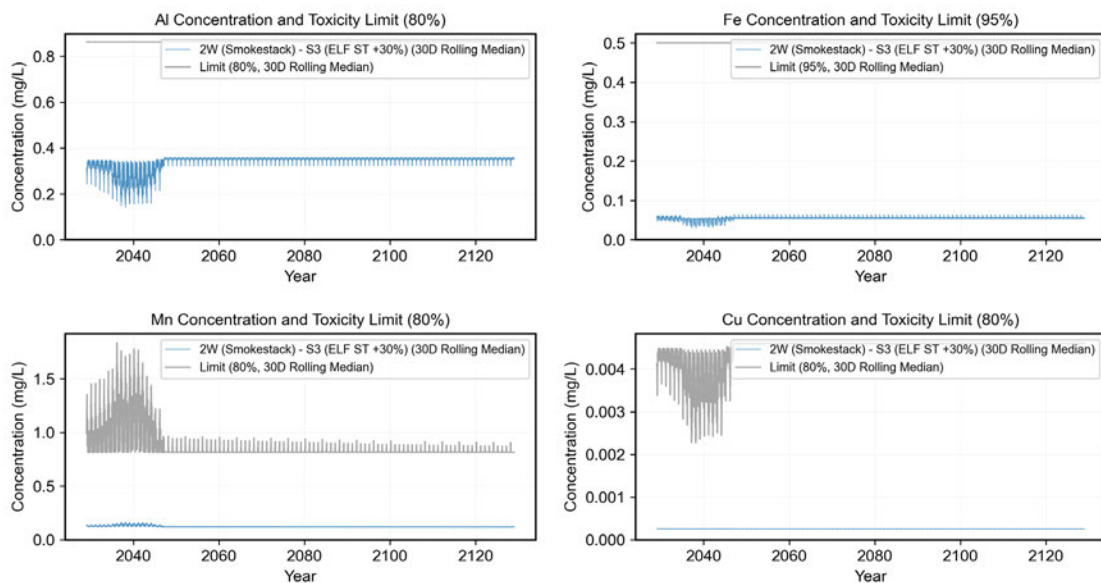


Figure 178: Matrix plot S3 (Elf St +30%) 2W (Smokestack) Al Fe Mn Cu

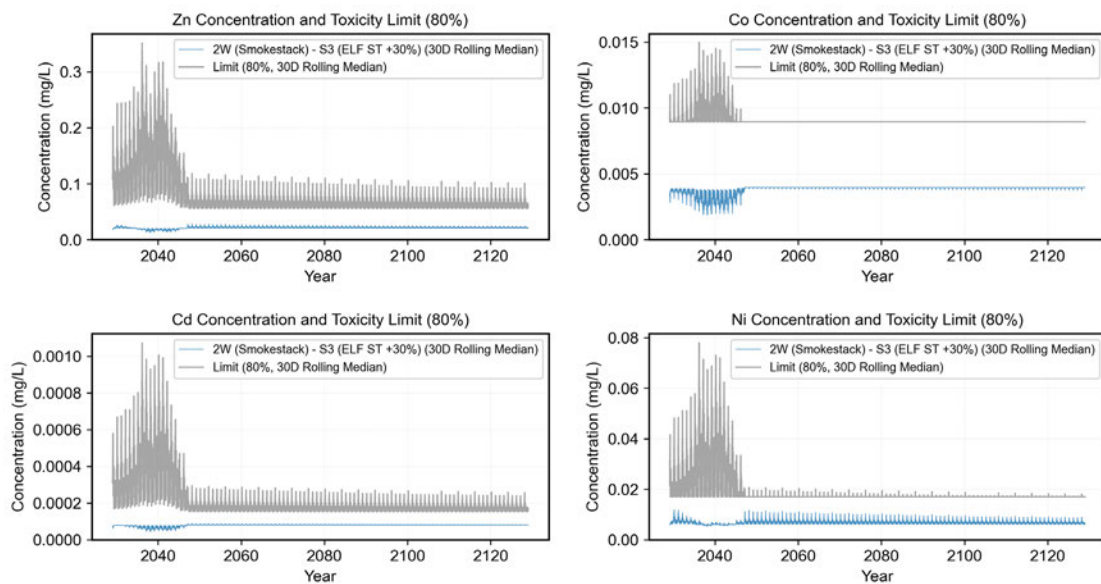


Figure 179: Matrix plot S3 (Elf St +30%) 2W (Smokestack) Zn Co Cd Ni

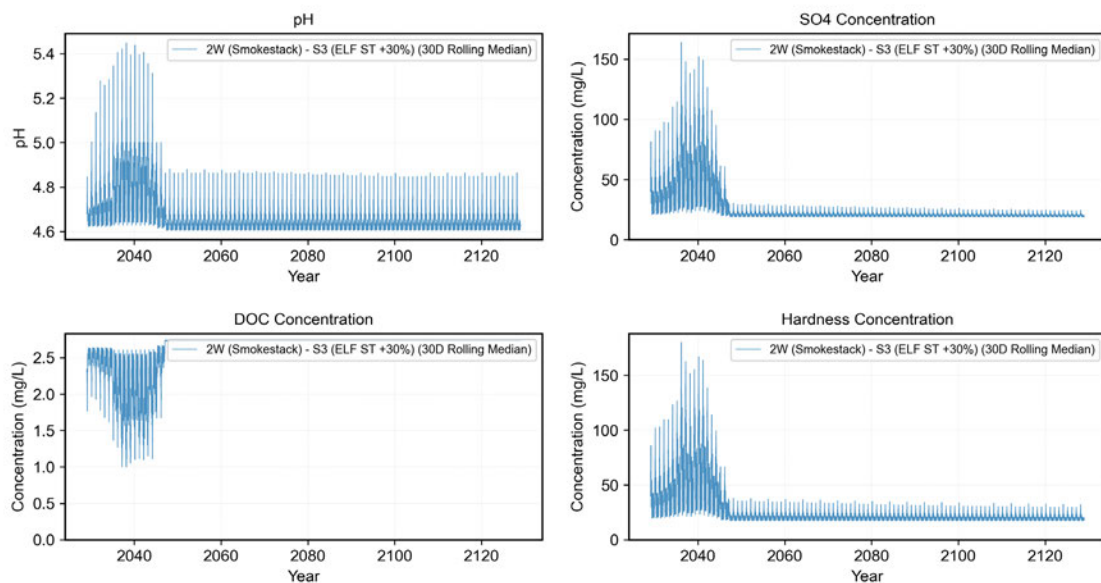


Figure 180: Matrix plot S3 (Elf St +30%) 2W (Smokestack) pH SO₄ DOC Hardness

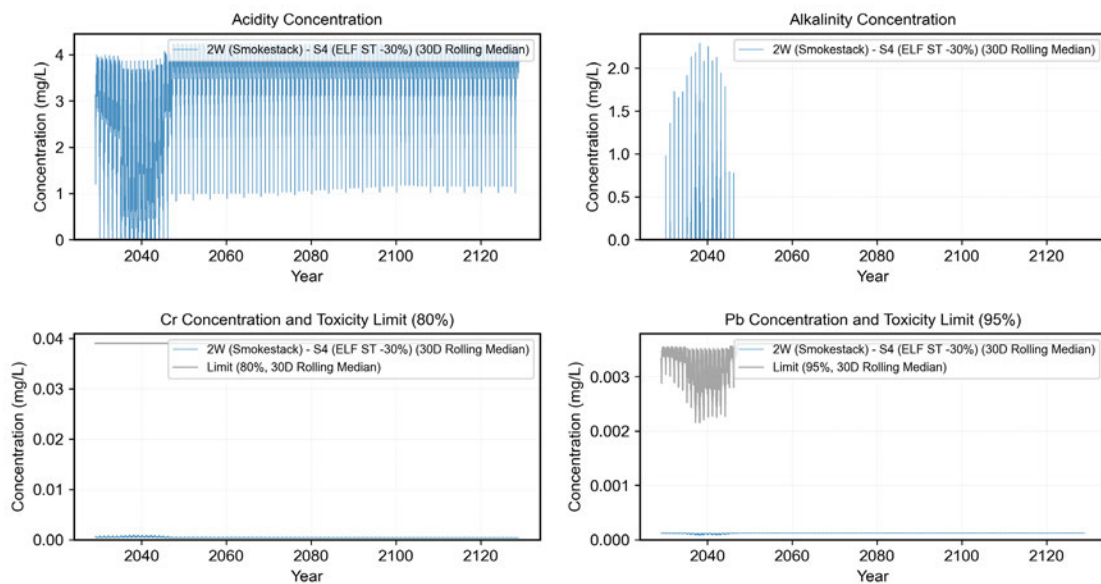


Figure 181: Matrix plot S4 (Elf St 30%) 2W (Smokestack) Acidity Alkalinity Cr Pb

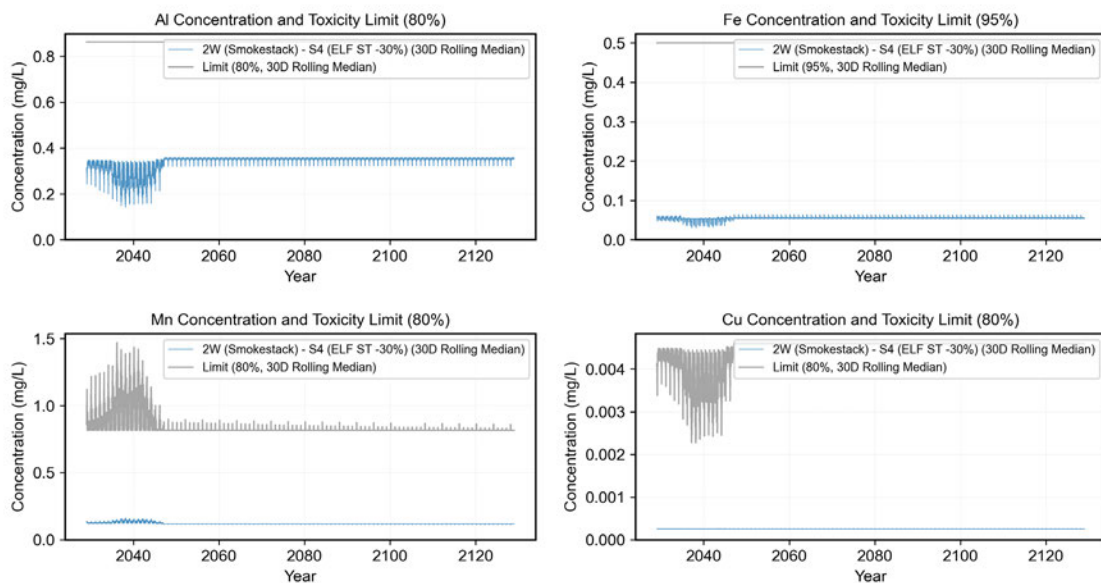


Figure 182: Matrix plot S4 (Elf St 30%) 2W (Smokestack) Al Fe Mn Cu

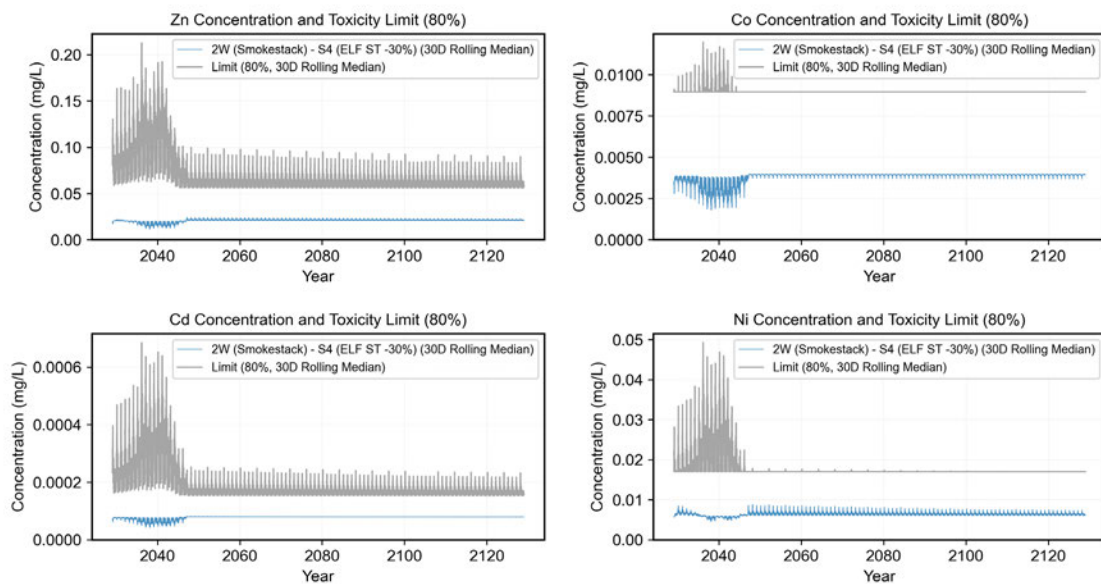


Figure 183: Matrix plot S4 (Elf St 30%) 2W (Smokestack) Zn Co Cd Ni

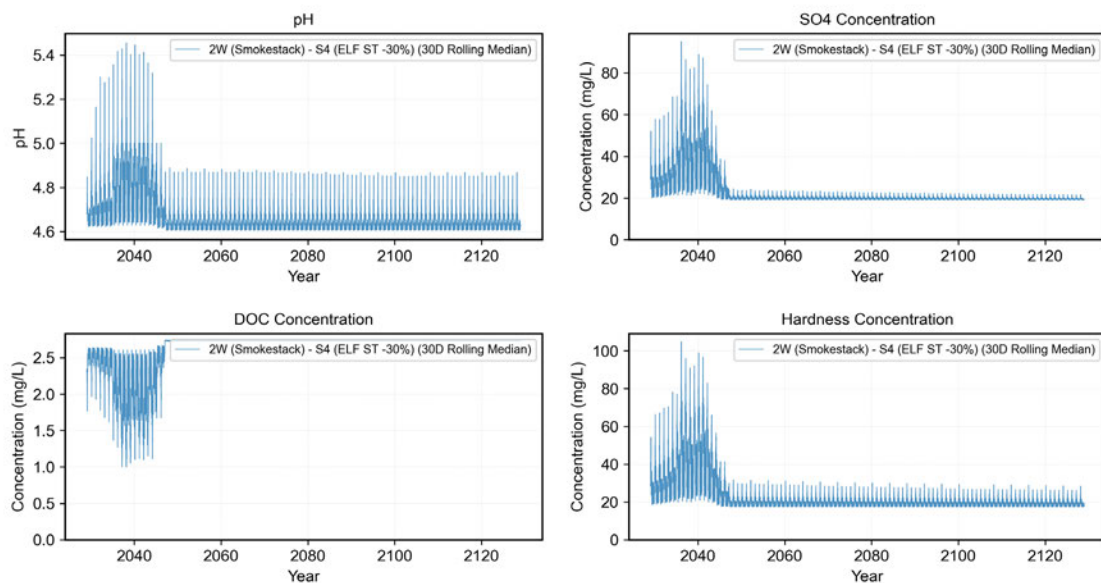
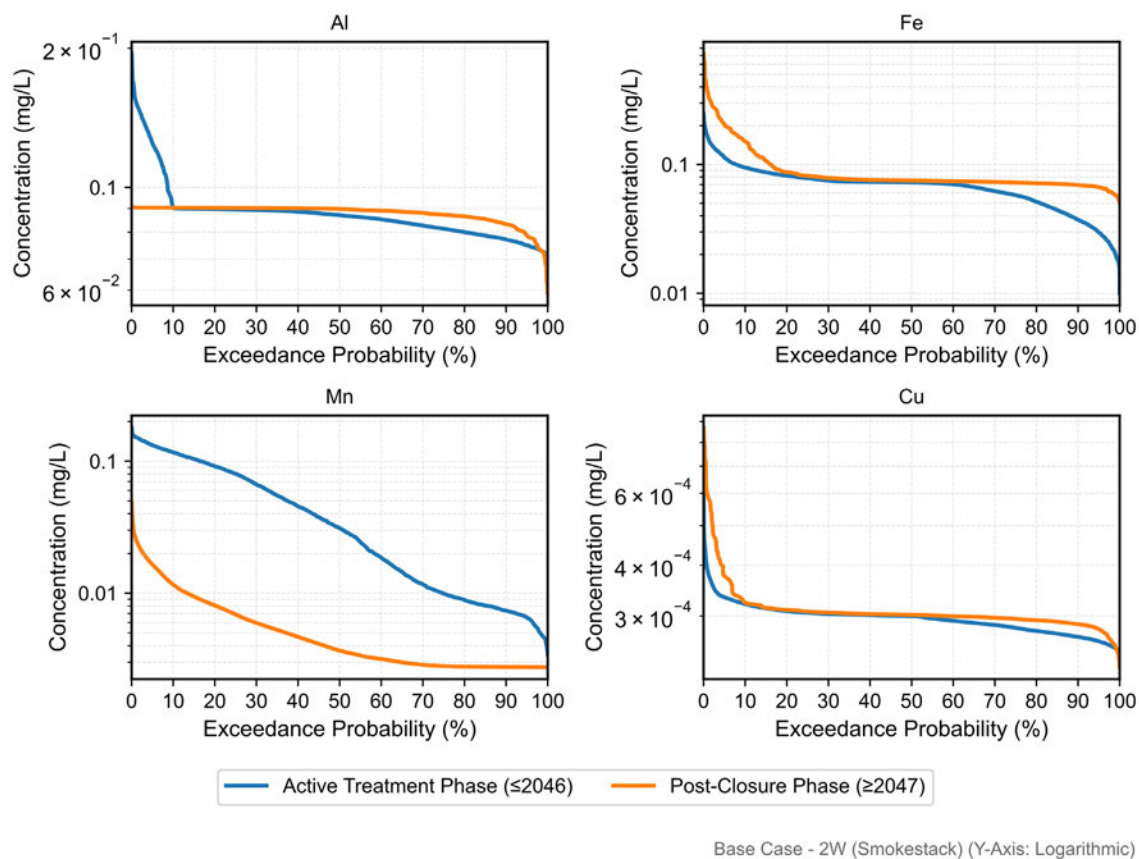


Figure 184: Matrix plot S4 (Elf St 30%) 2W (Smokestack) pH SO4 DOC Hardness

3.2 CONCENTRATION EXCEEDANCE (SINGLE SCENARIO)**Figure 185:** Base Case 2W (Smokestack) Concentration Exceedance Probability Al Fe Mn Cu

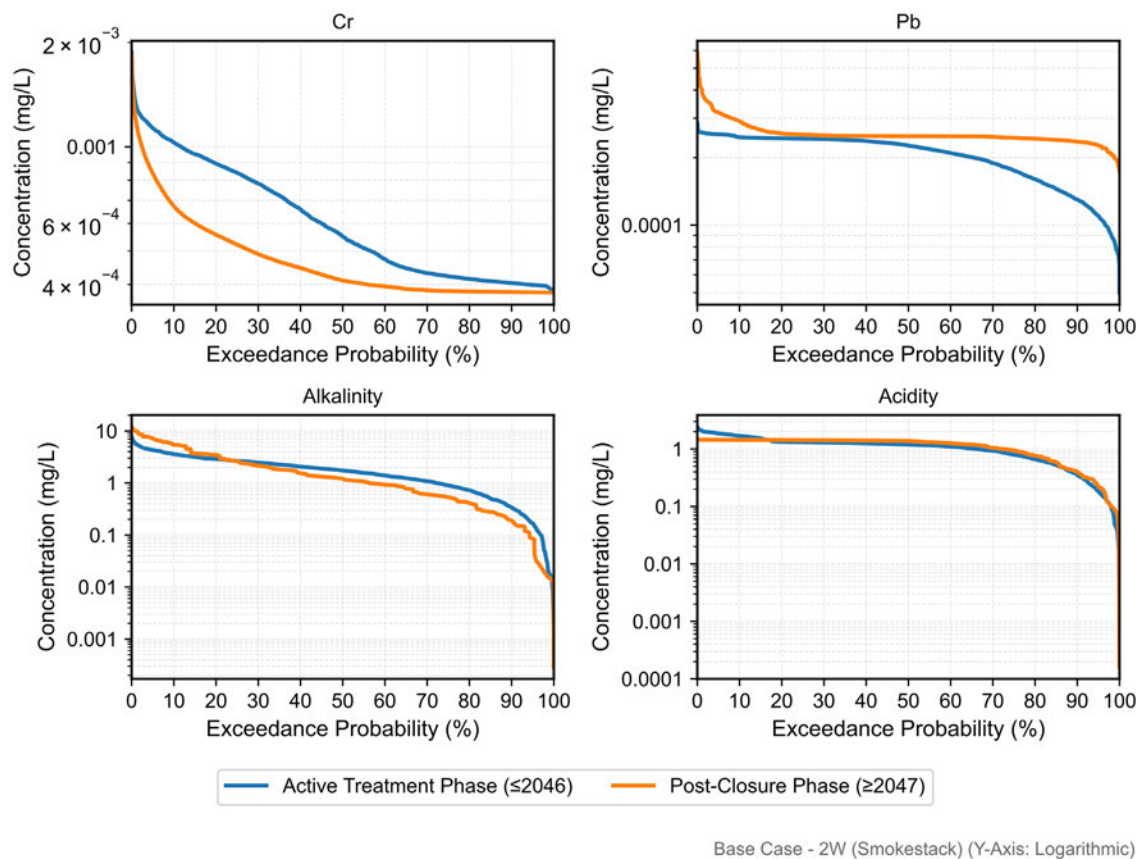


Figure 186: Base Case 2W (Smokestack) Concentration Exceedance Probability Cr Pb Alk Acid

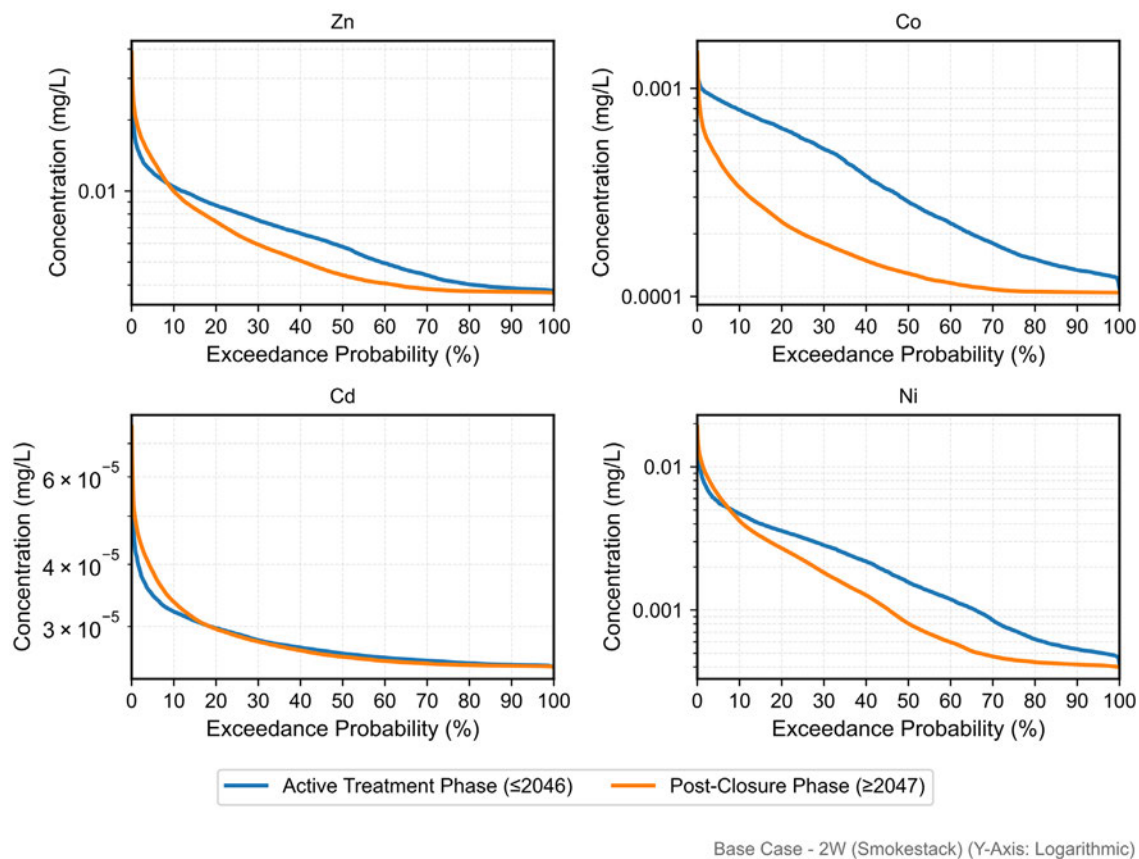


Figure 187: Base Case 2W (Smokestack) Concentration Exceedance Probability Zn Co Cd Ni

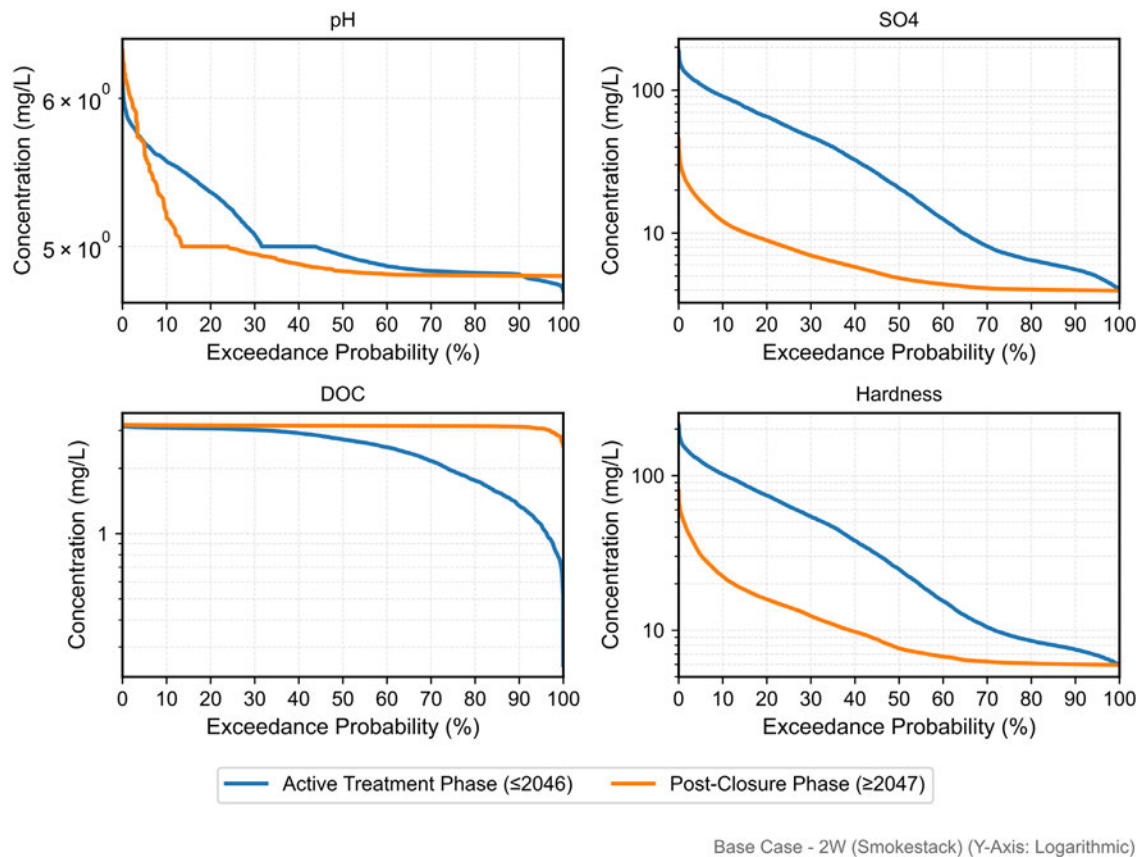


Figure 188: Base Case 2W (Smokestack) Concentration Exceedance Probability pH SO₄ DOC Hardness

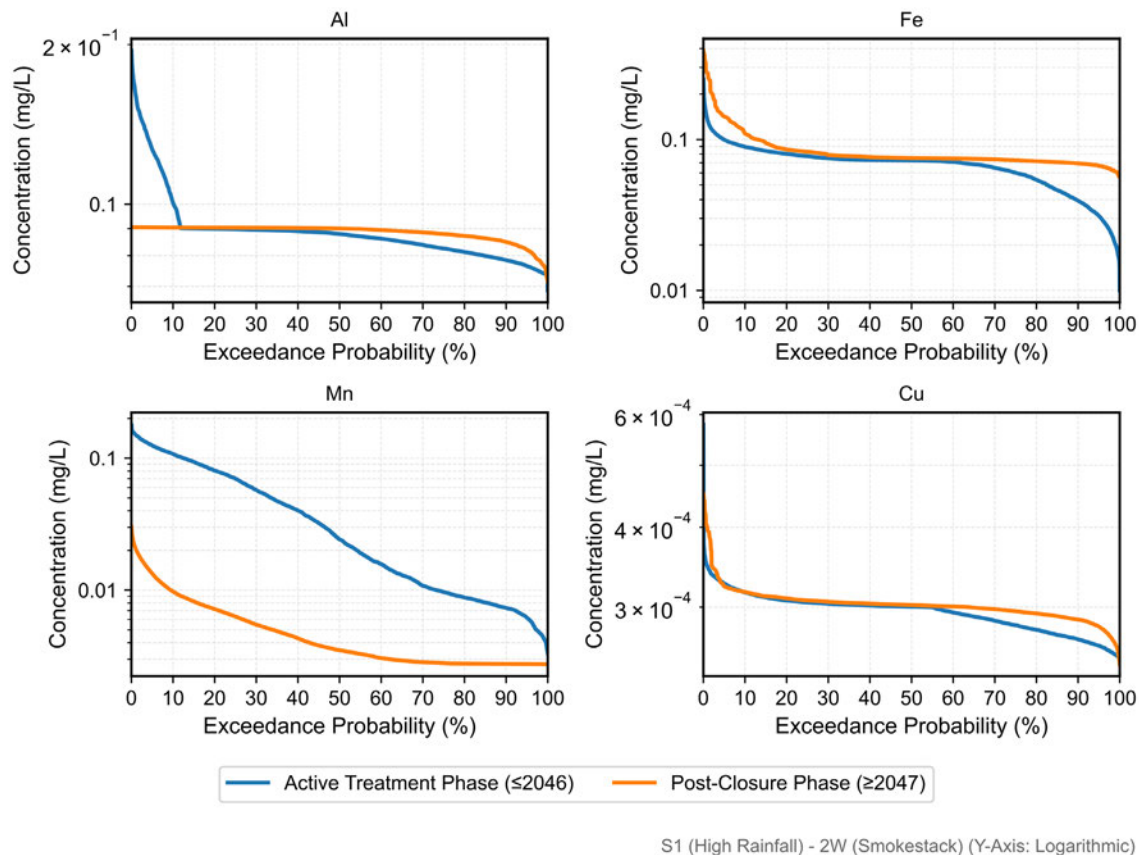


Figure 189: S1 (High Rainfall) 2W (Smokestack) Concentration Exceedance Probability Al Fe Mn Cu

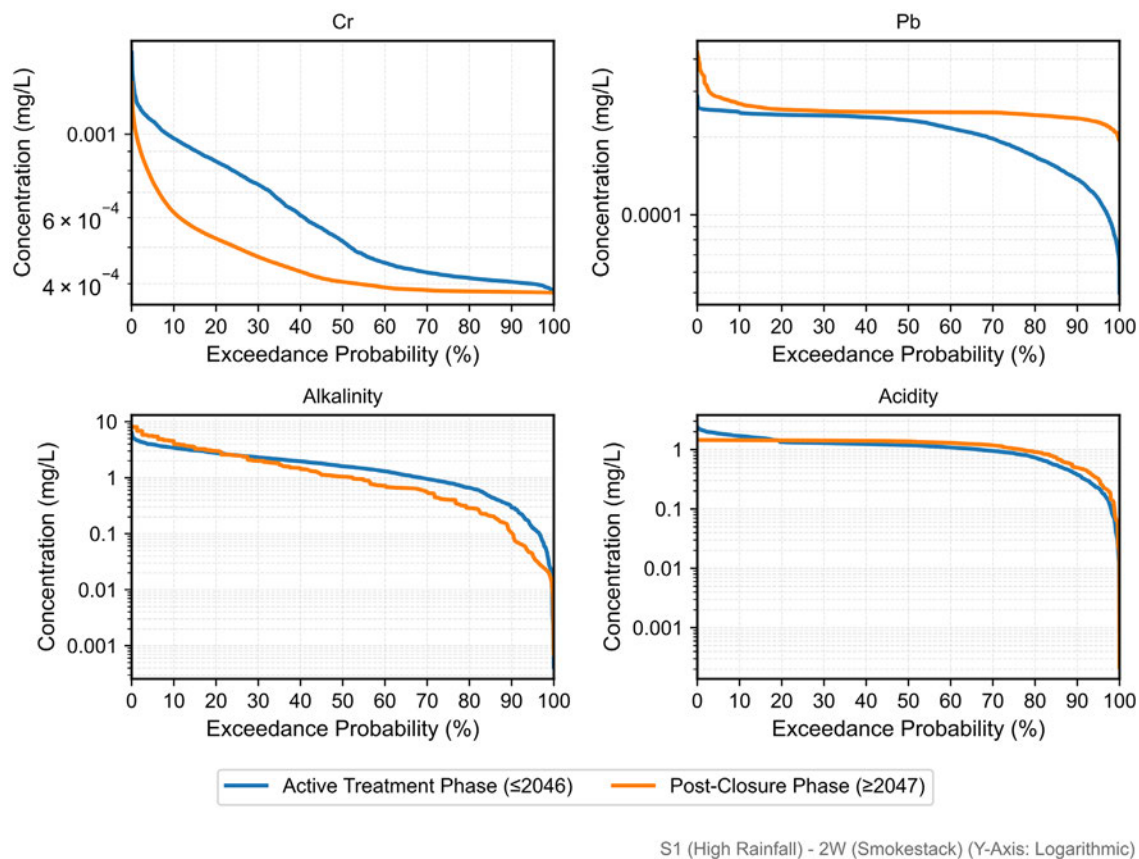


Figure 190: S1 (High Rainfall) 2W (Smokestack) Concentration Exceedance Probability Cr Pb Alk Acid

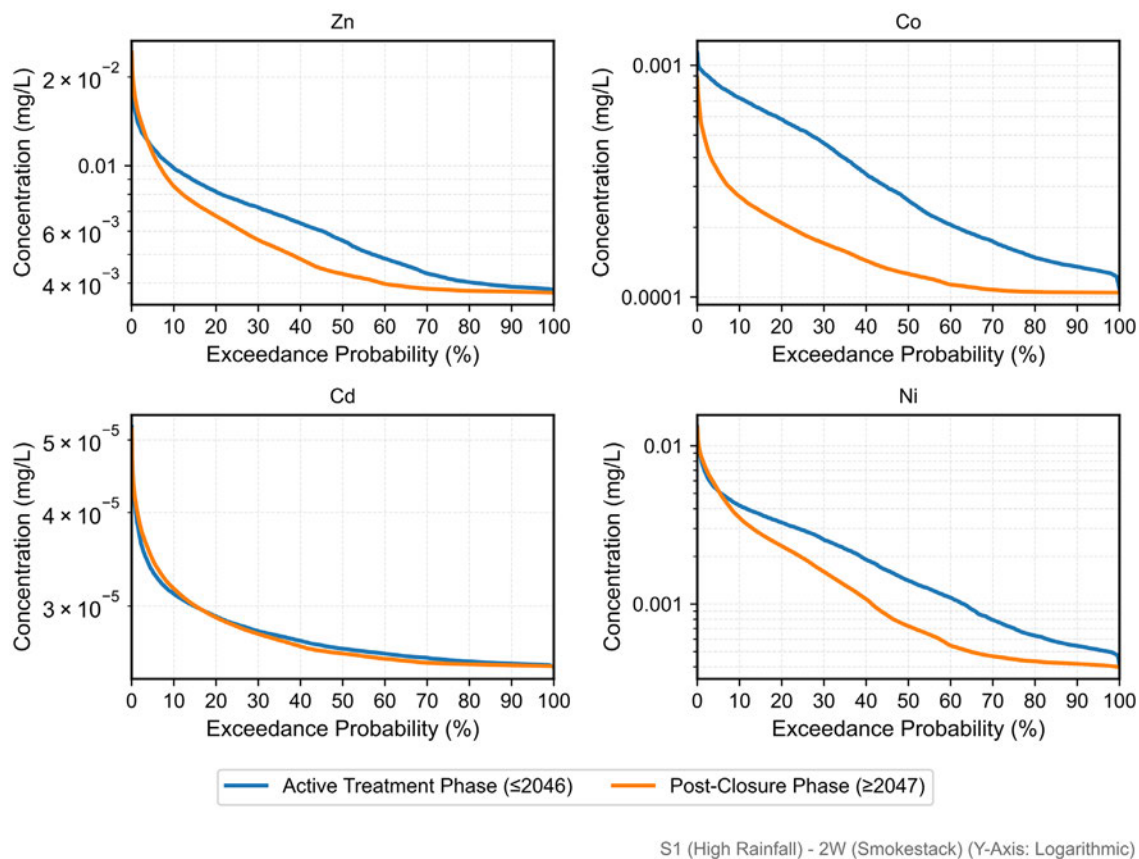


Figure 191: S1 (High Rainfall) 2W (Smokestack) Concentration Exceedance Probability Zn Co Cd Ni

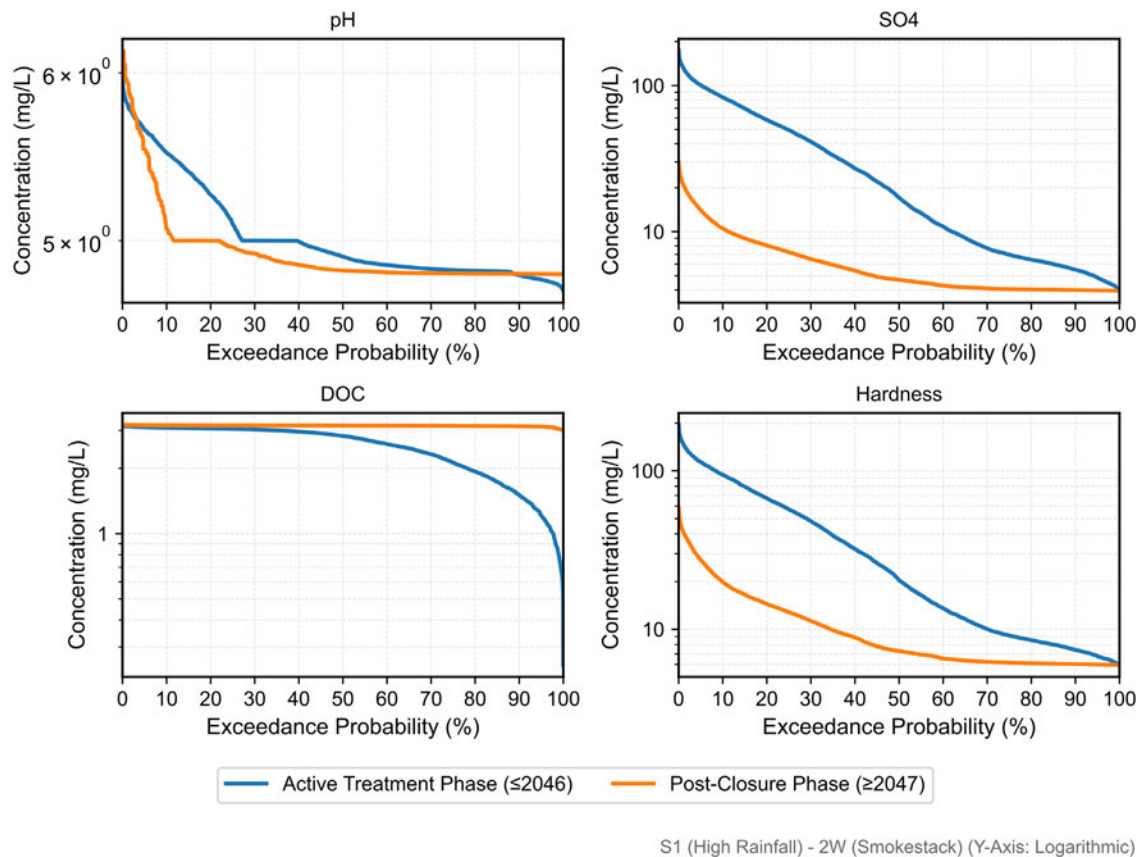


Figure 192: S1 (High Rainfall) 2W (Smokestack) Concentration Exceedance Probability pH SO₄ DOC Hardness

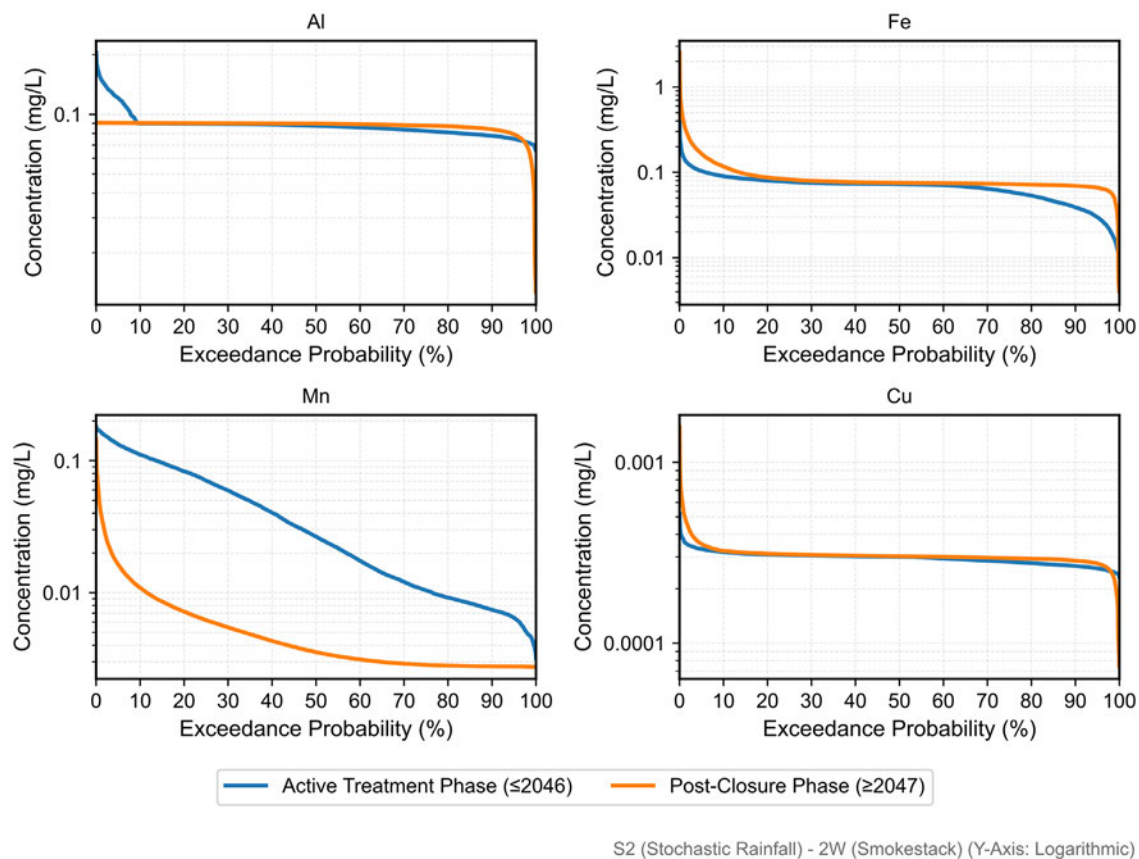


Figure 193: S2 (Stochastic Rainfall) 2W (Smokestack) Concentration Exceedance Probability Al Fe Mn Cu

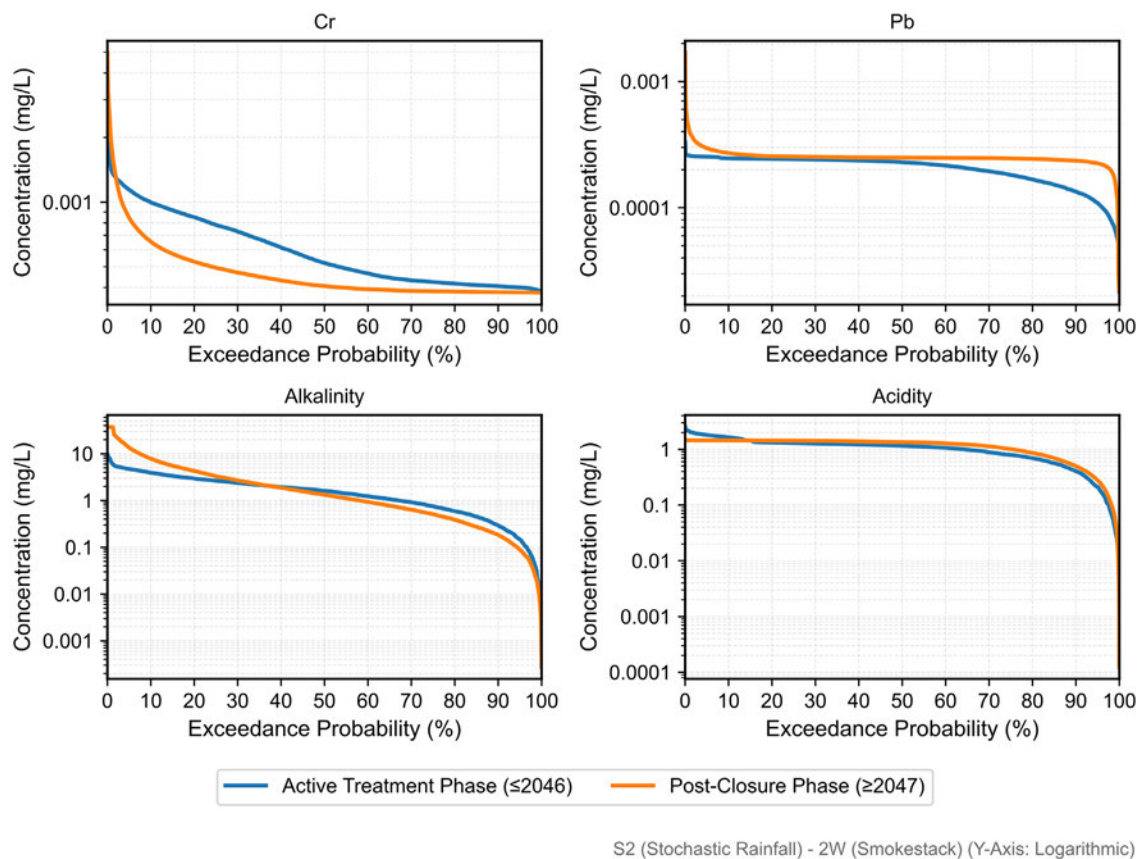


Figure 194: S2 (Stochastic Rainfall) 2W (Smokestack) Concentration Exceedance Probability Cr Pb Alk Acid

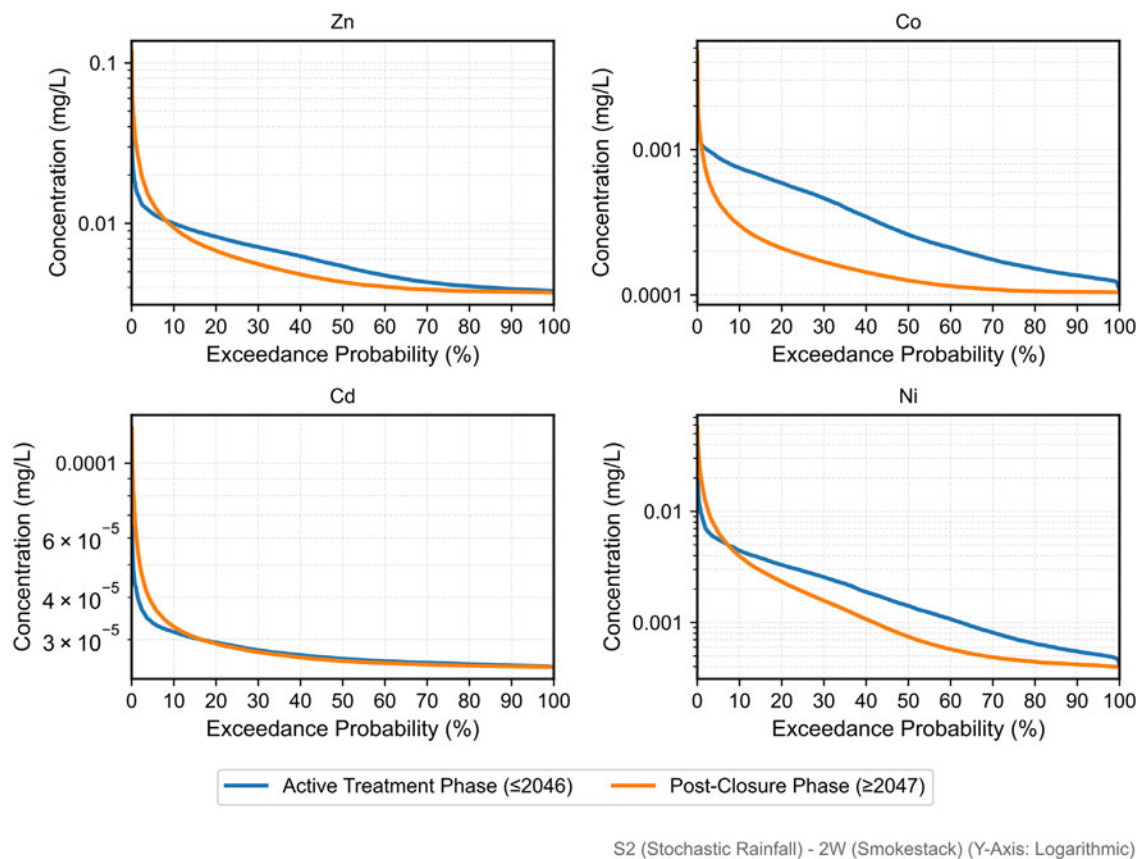


Figure 195: S2 (Stochastic Rainfall) 2W (Smokestack) Concentration Exceedance Probability Zn Co Cd Ni

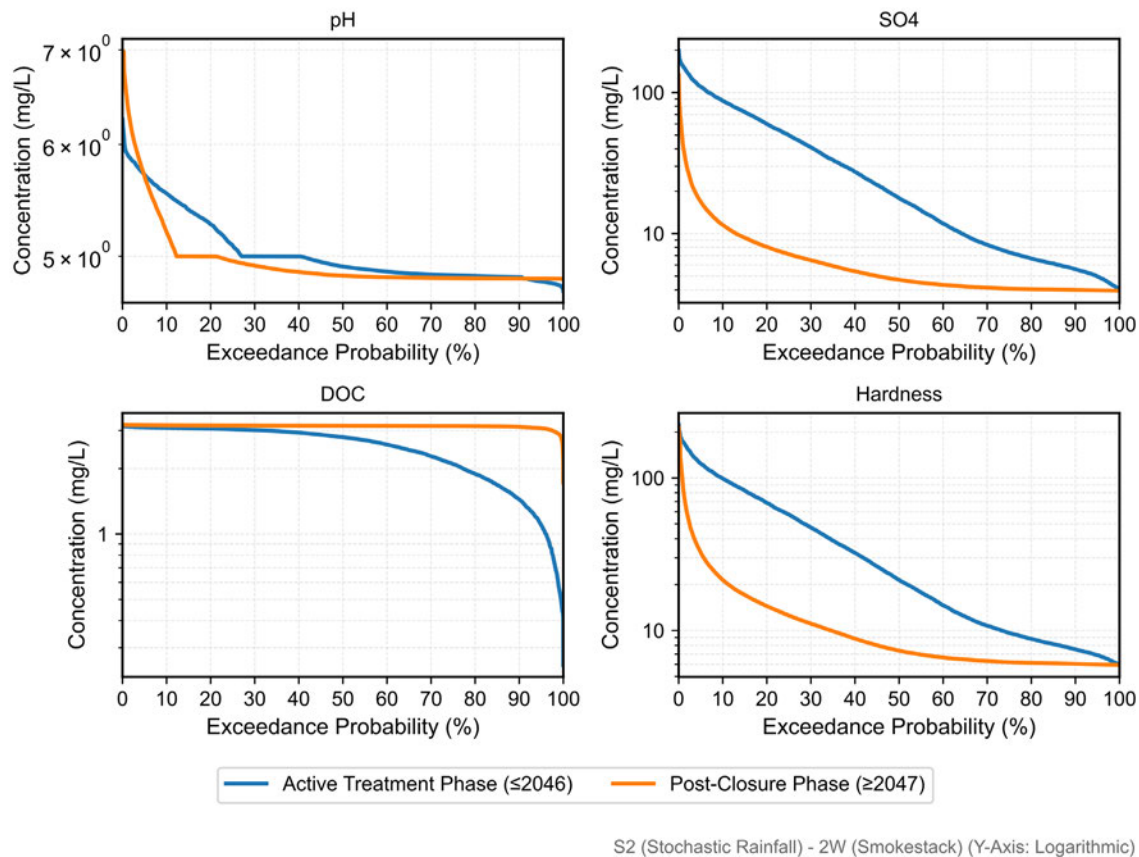


Figure 196: S2 (Stochastic Rainfall) 2W (Smokestack) Concentration Exceedance Probability pH
SO₄ DOC Hardness

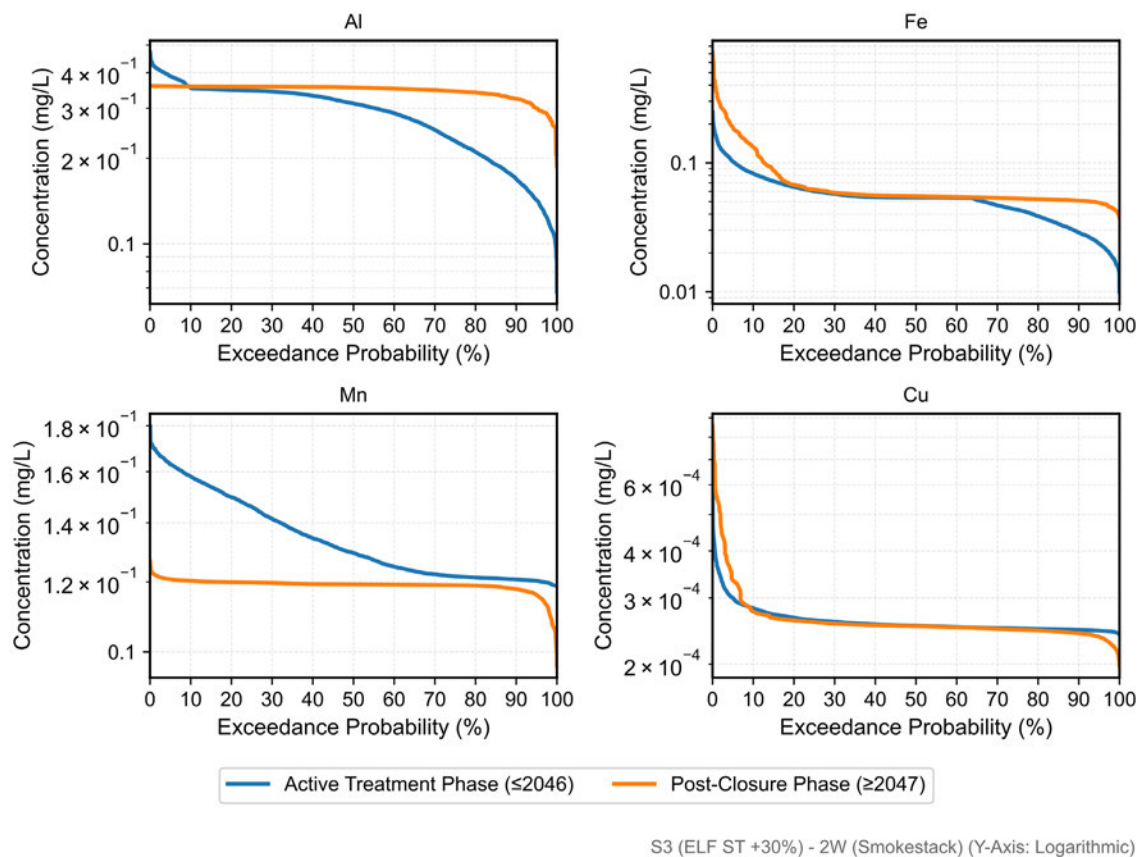


Figure 197: S3 (Elf St +30%) 2W (Smokestack) Concentration Exceedance Probability Al Fe Mn Cu

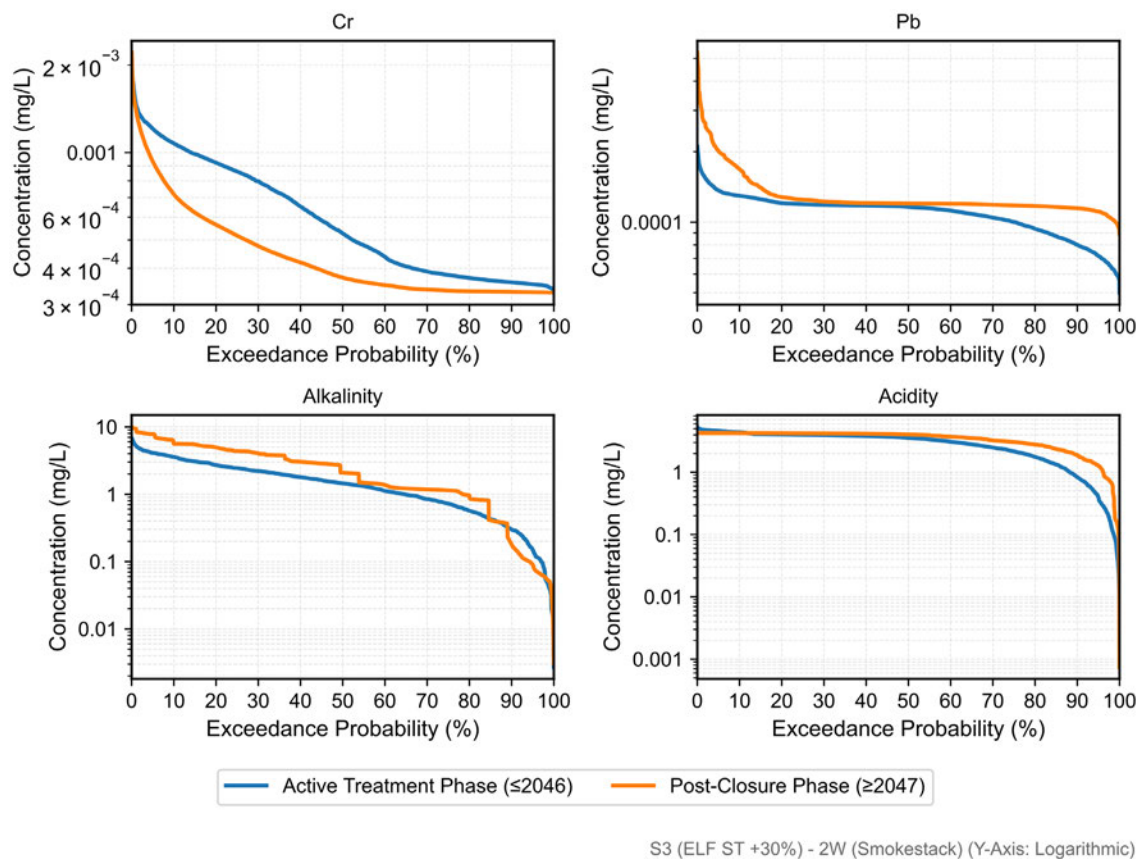


Figure 198: S3 (Elf St +30%) 2W (Smokestack) Concentration Exceedance Probability Cr Pb Alk Acid

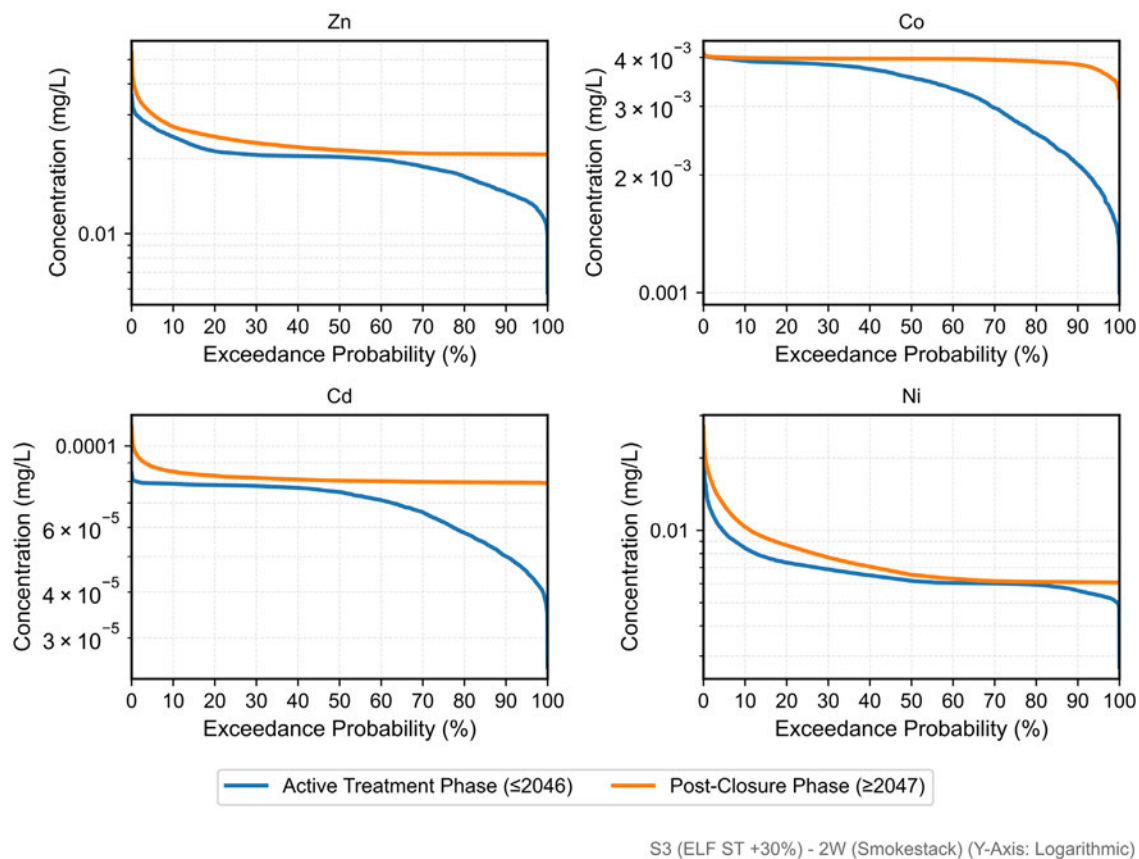


Figure 199: S3 (Elf St +30%) 2W (Smokestack) Concentration Exceedance Probability Zn Co Cd Ni

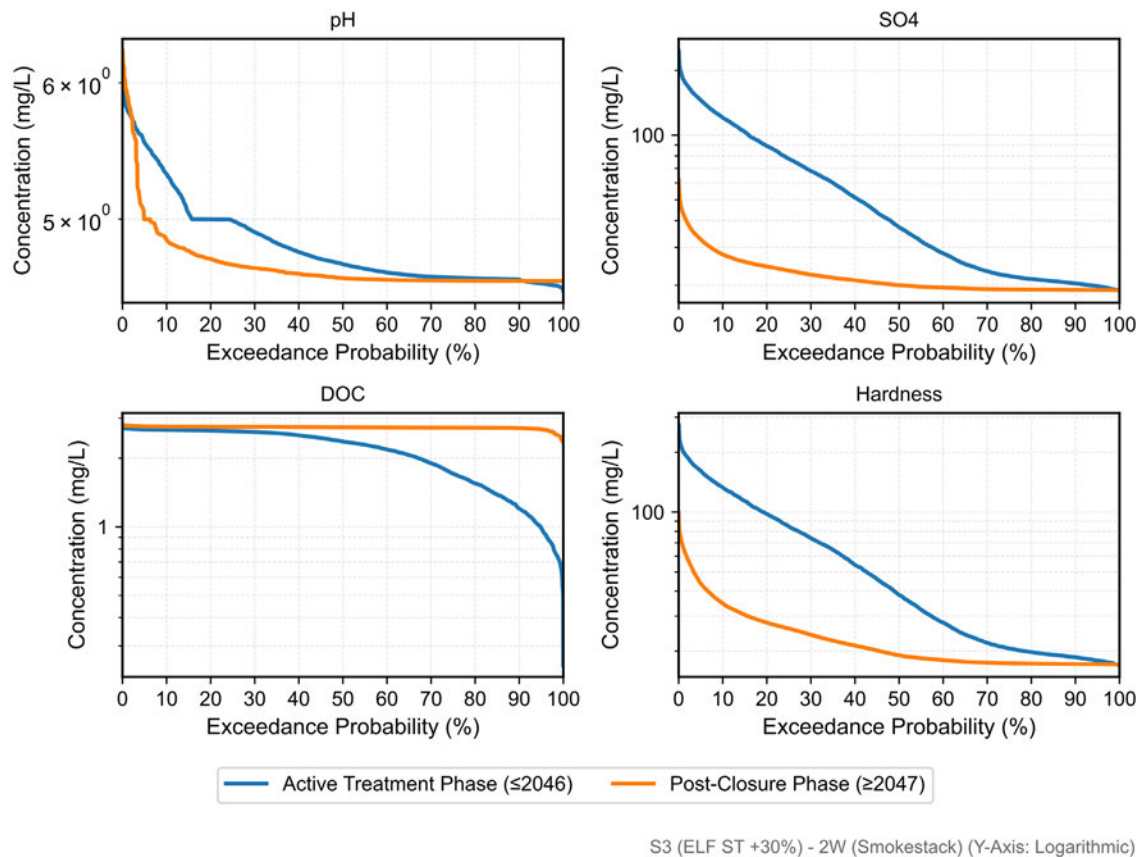


Figure 200: S3 (Elf St +30%) 2W (Smokestack) Concentration Exceedance Probability pH SO₄ DOC Hardness

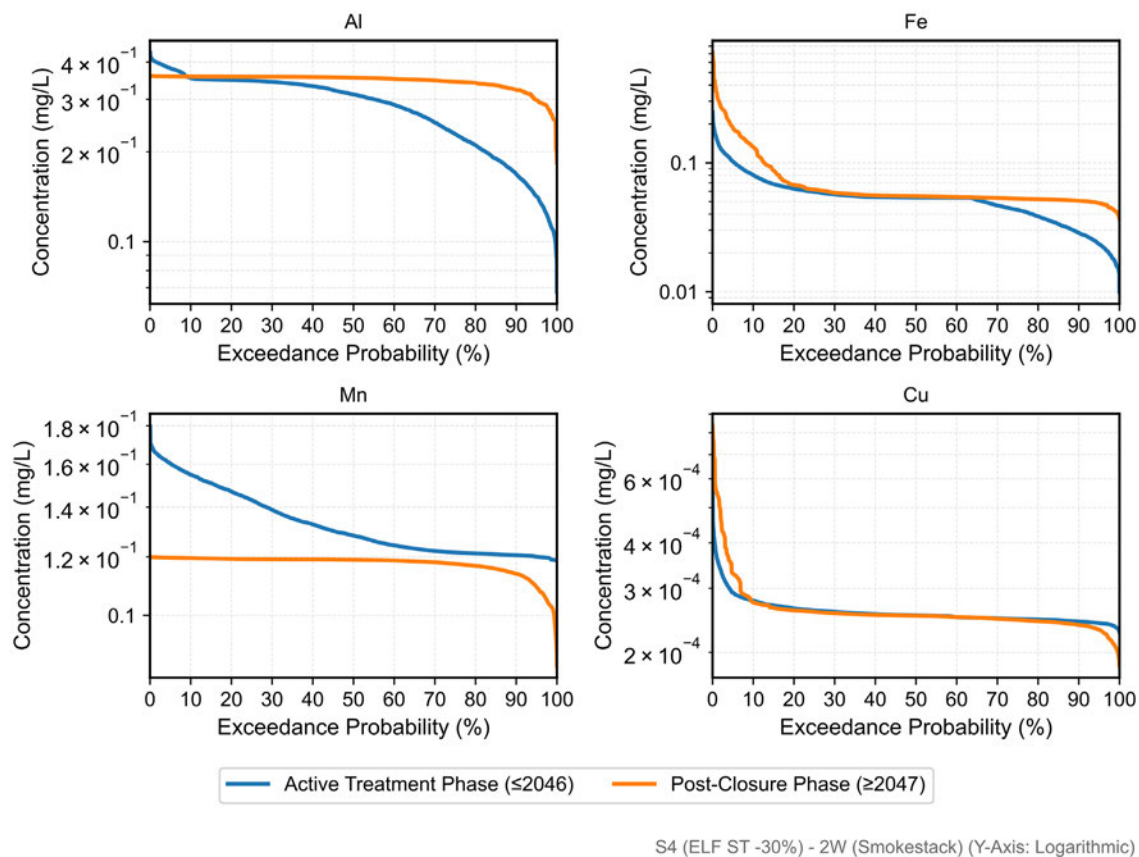


Figure 201: S4 (Elf St 30%) 2W (Smokestack) Concentration Exceedance Probability Al Fe Mn Cu

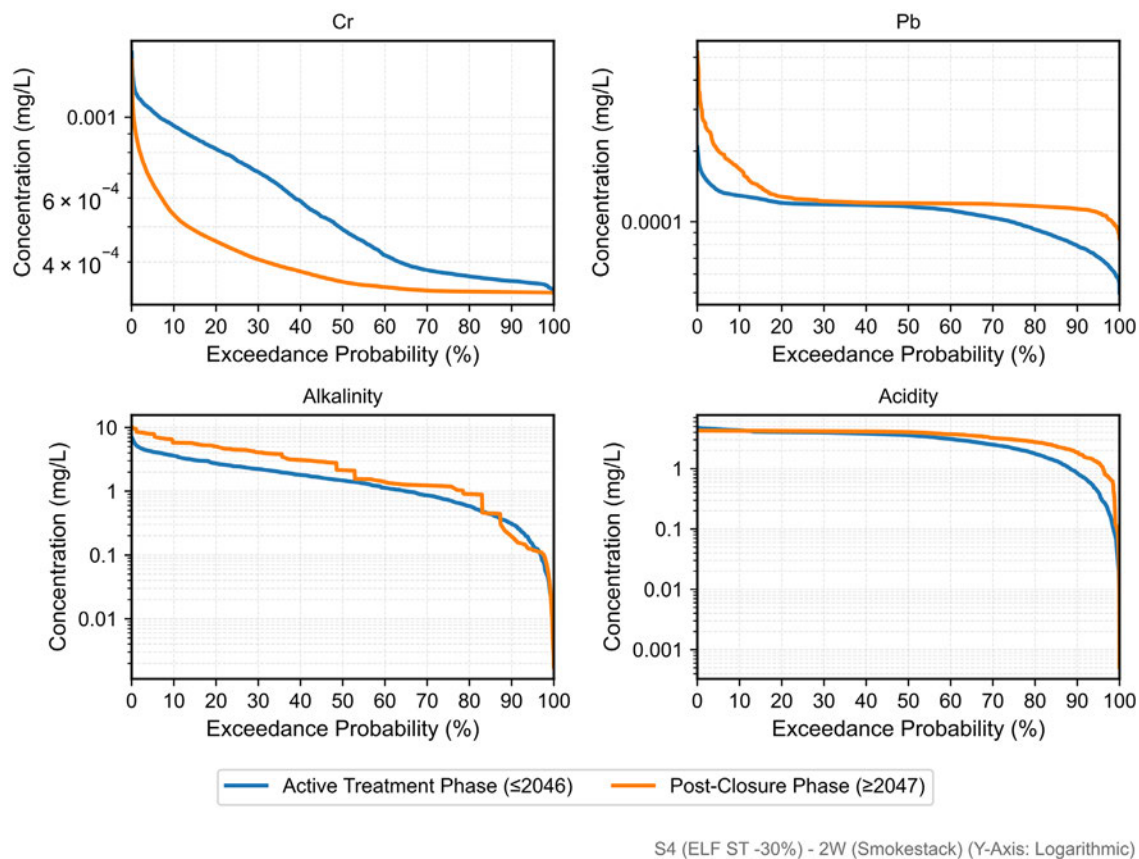


Figure 202: S4 (Elf St 30%) 2W (Smokestack) Concentration Exceedance Probability Cr Pb Alk Acid

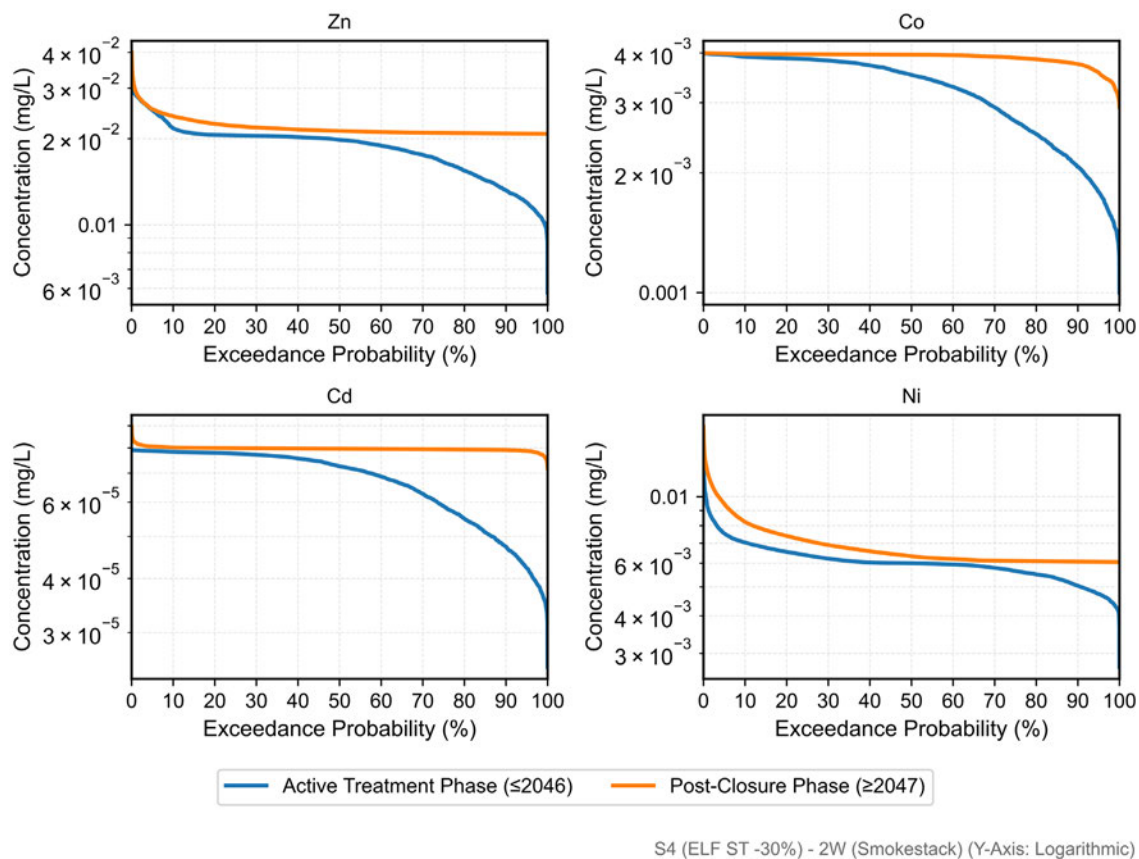


Figure 203: S4 (Elf St 30%) 2W (Smokestack) Concentration Exceedance Probability Zn Co Cd Ni

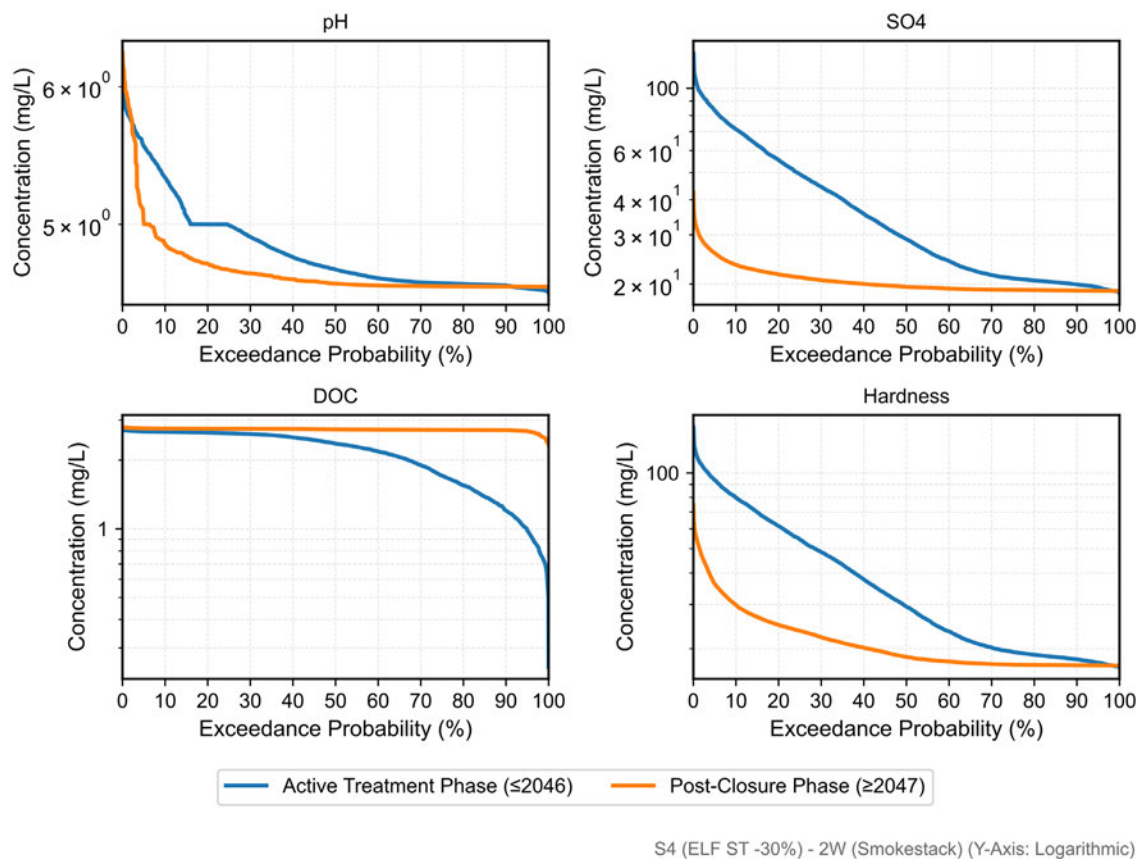


Figure 204: S4 (Elf St 30%) 2W (Smokestack) Concentration Exceedance Probability pH SO₄ DOC Hardness

3.3 CONCENTRATION EXCEEDANCE (MULTI SCENARIO)

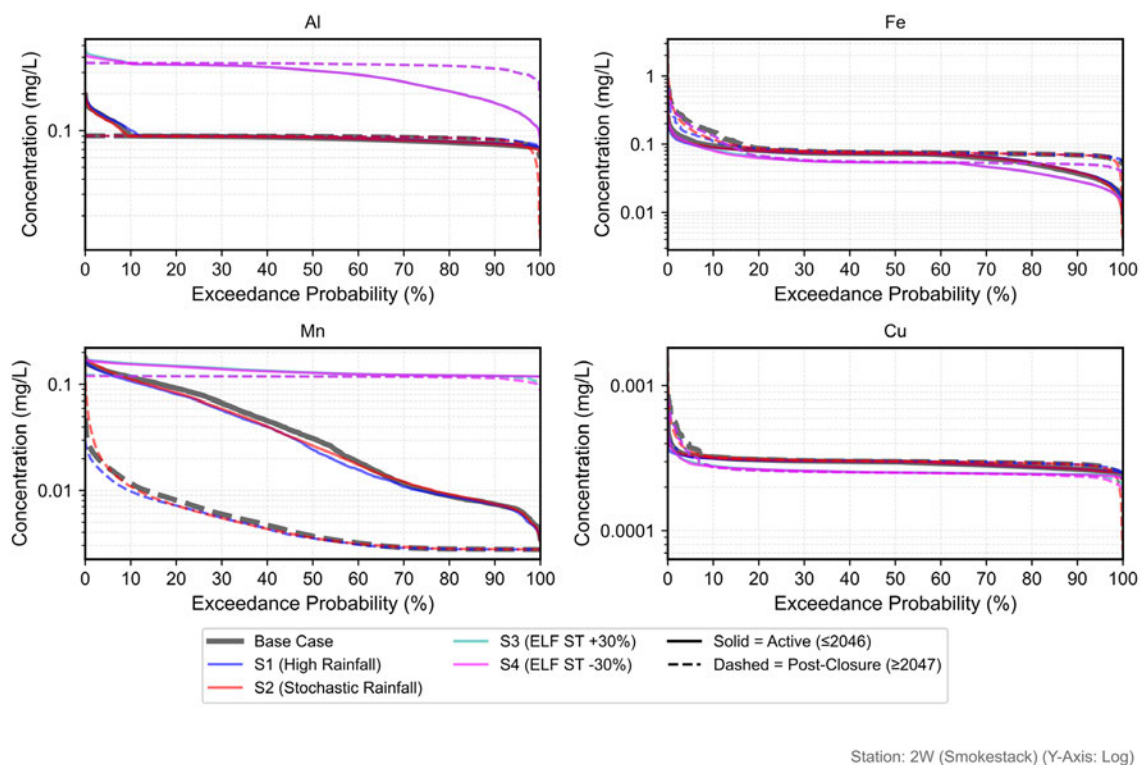


Figure 205: 2W Smokestack Matrix Plot Scenarios 5 Al Fe Mn Cu Concentration Exceedance Probability

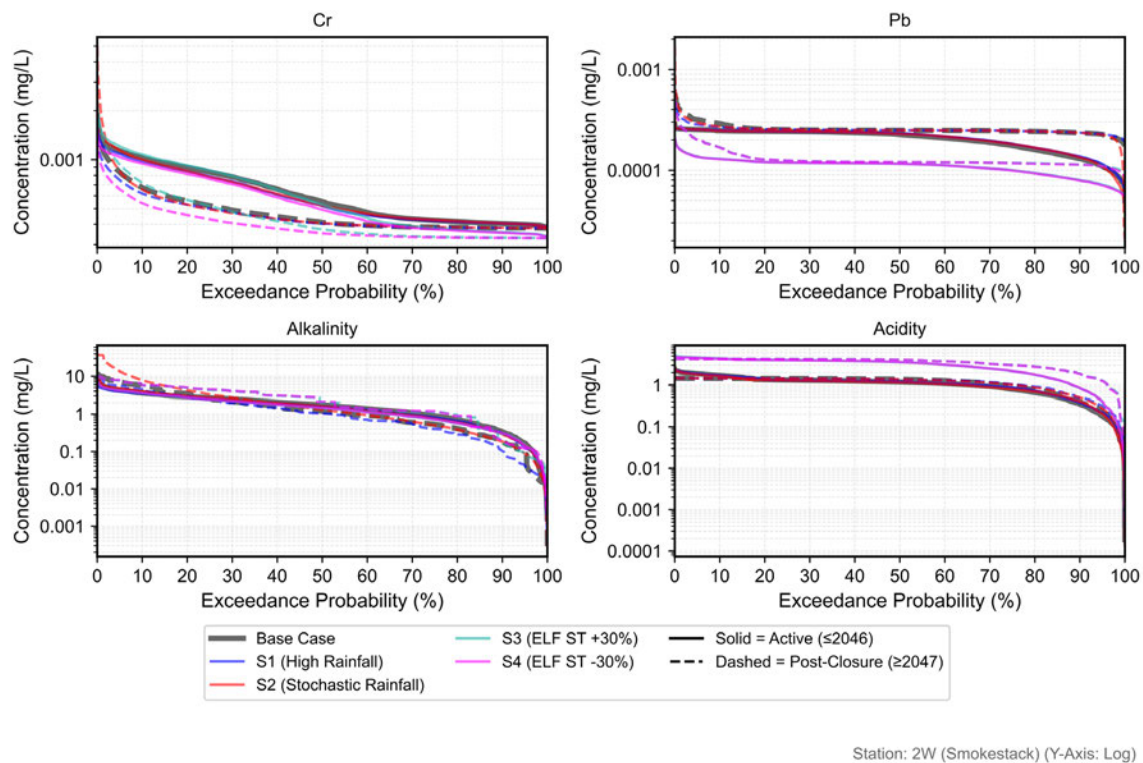


Figure 206: 2W Smokestack Matrix Plot Scenarios 5 Cr Pb Alk Acid Concentration Exceedance Probability

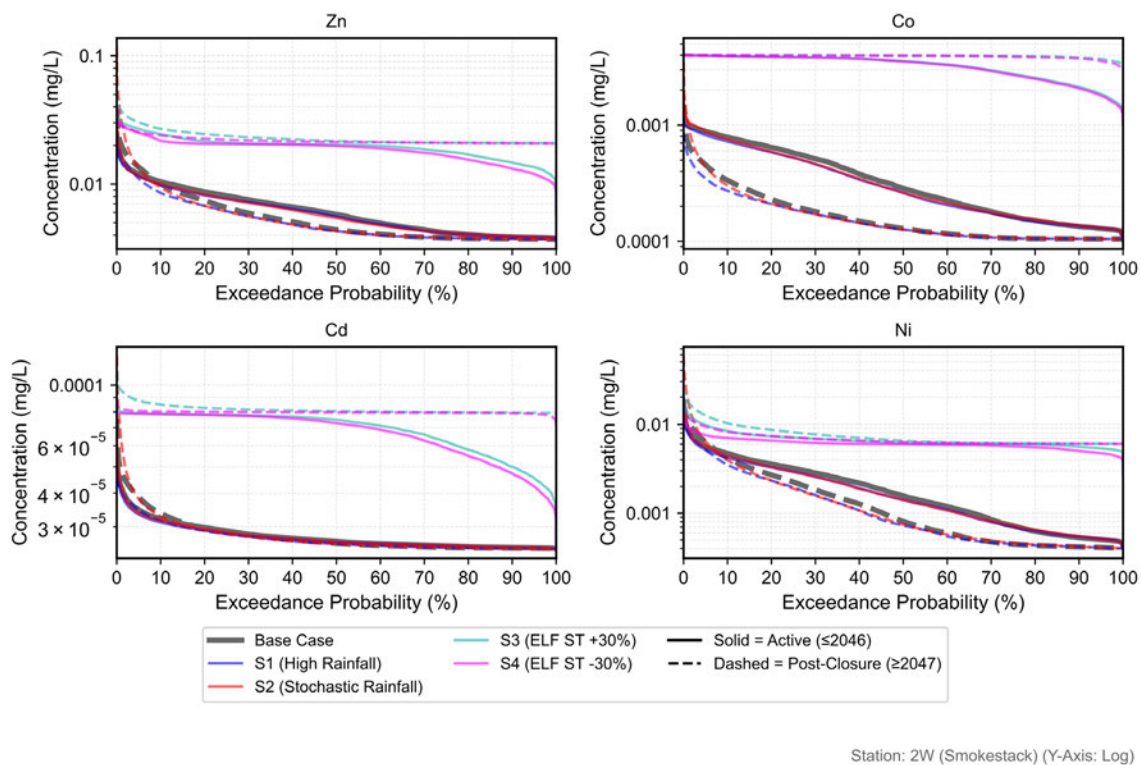


Figure 207: 2W Smokestack Matrix Plot Scenarios 5 Zn Co Cd Ni Concentration Exceedance Probability

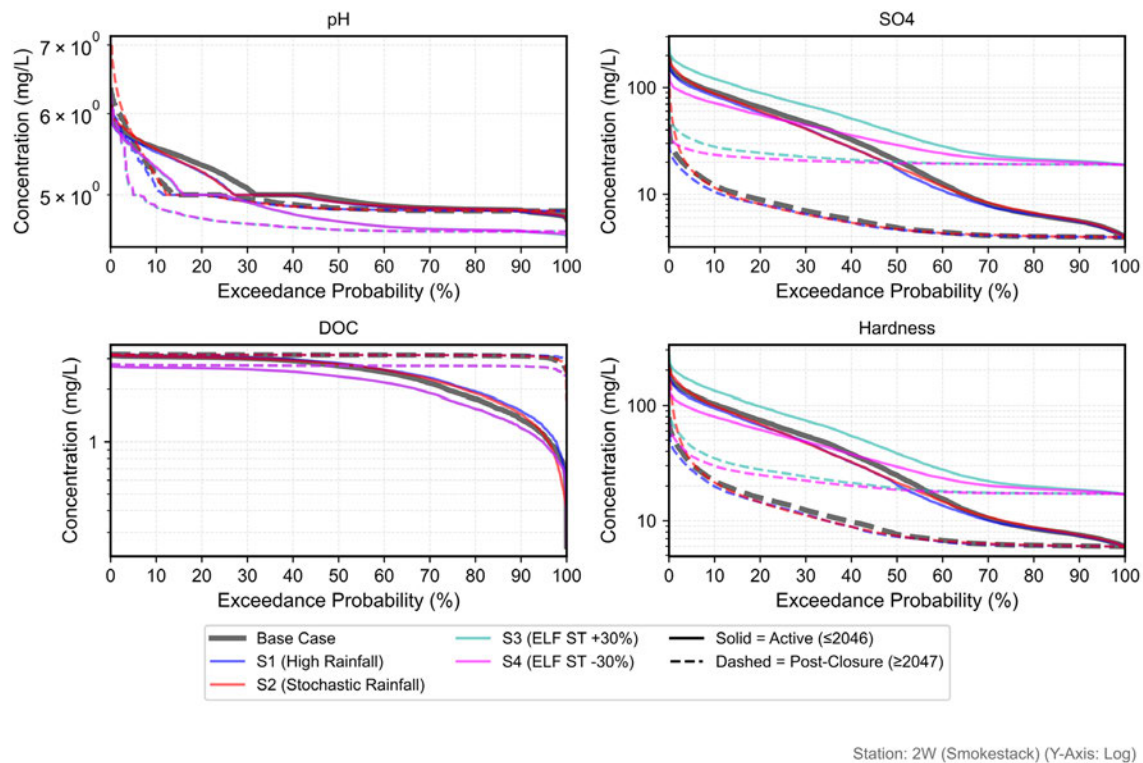


Figure 208: 2W Smokestack Matrix Plot Scenarios 5 pH SO₄ DOC Hardness Concentration Exceedance Probability

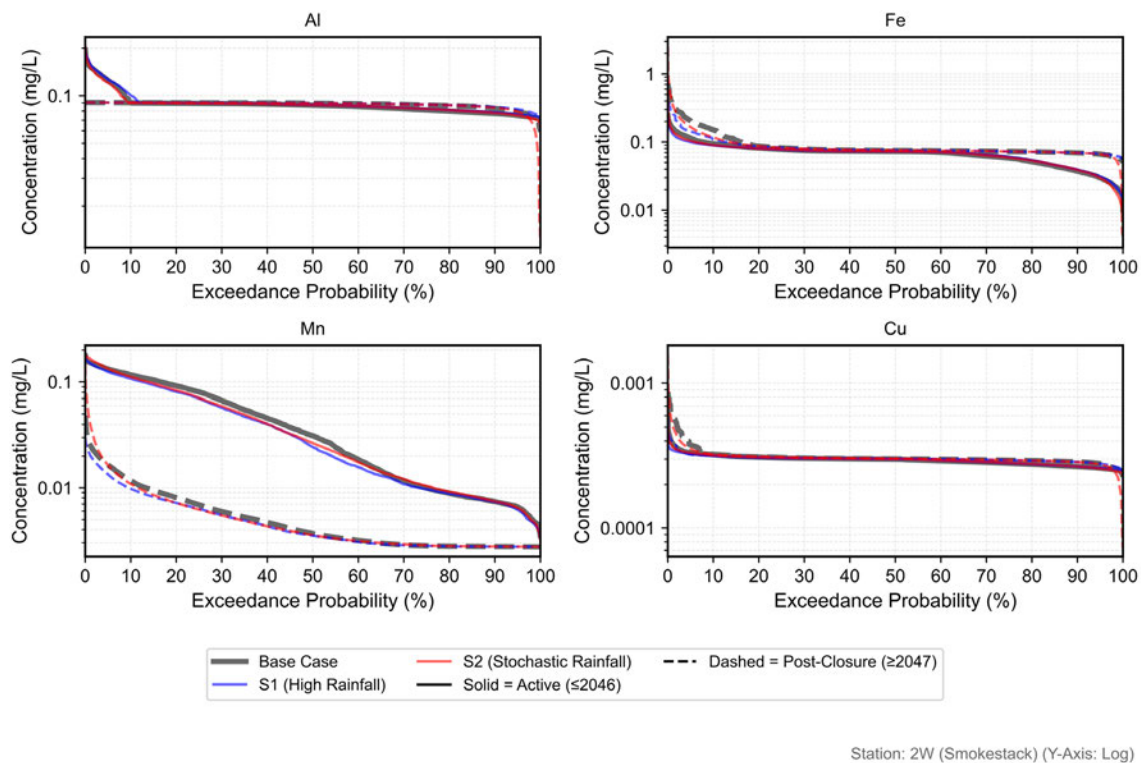


Figure 209: 2W Smokestack Rainfall Comp Al Fe Mn Cu Concentration Exceedance Probability

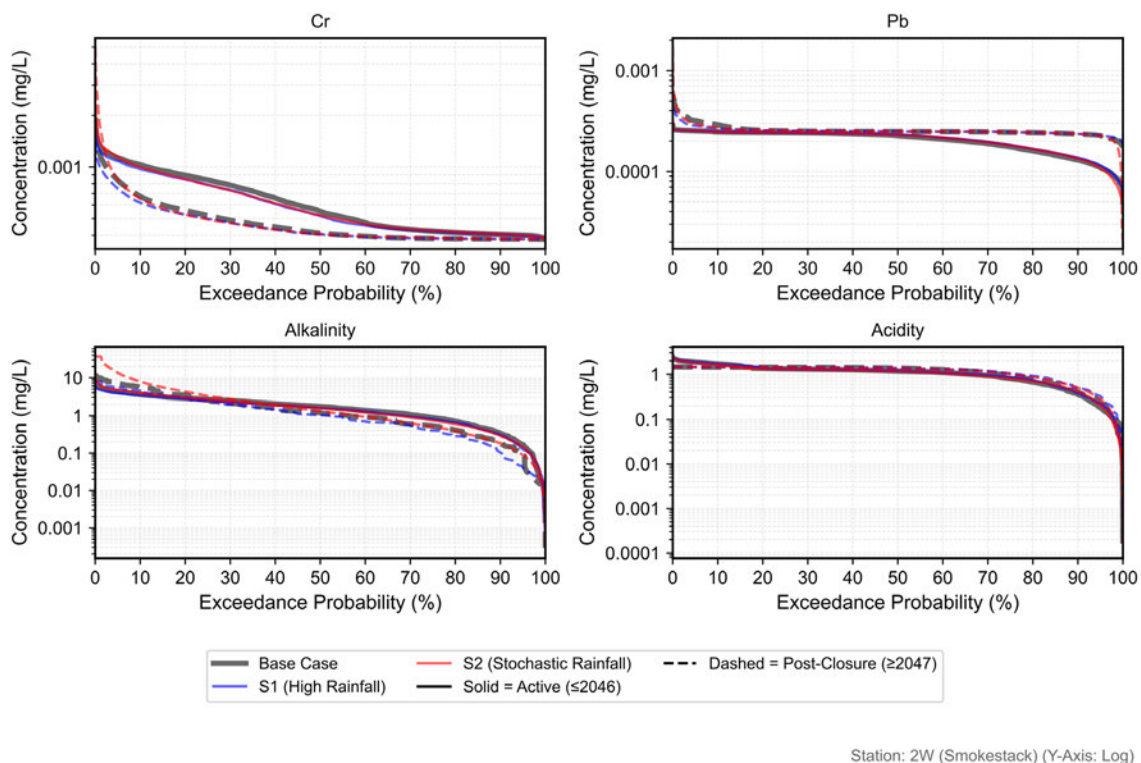
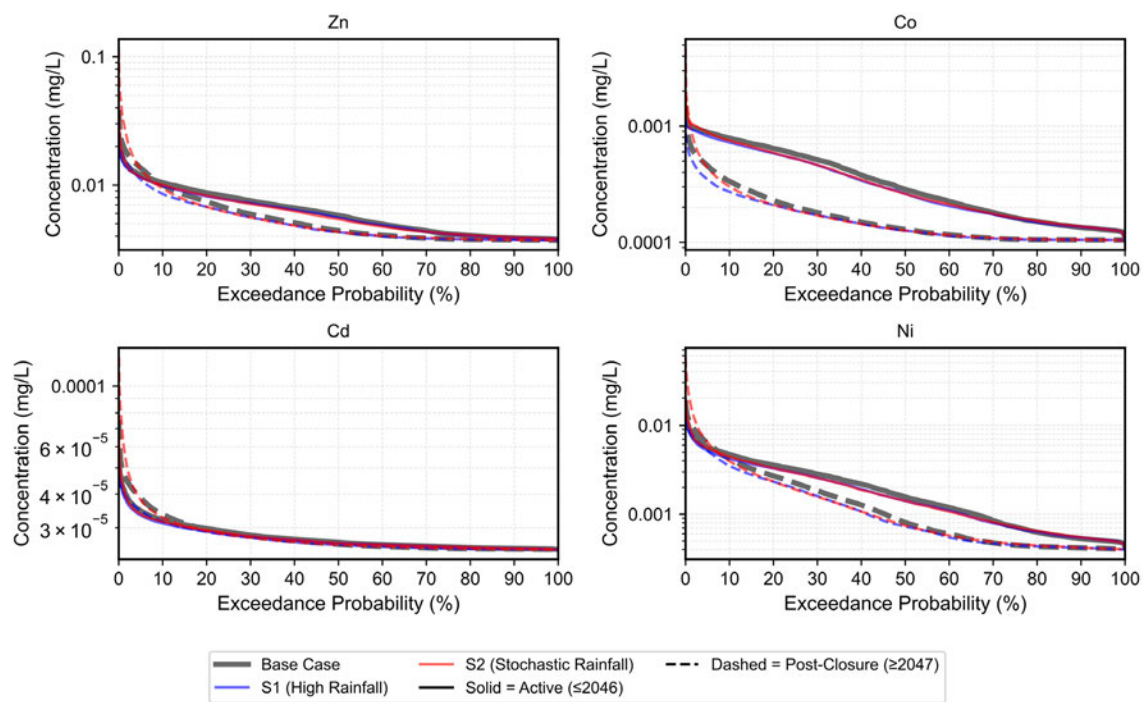


Figure 210: 2W Smokestack Rainfall Comp Cr Pb Alk Acid Concentration Exceedance Probability



Station: 2W (Smokestack) (Y-Axis: Log)

Figure 211: 2W Smokestack Rainfall Comp Zn Co Cd Ni Concentration Exceedance Probability

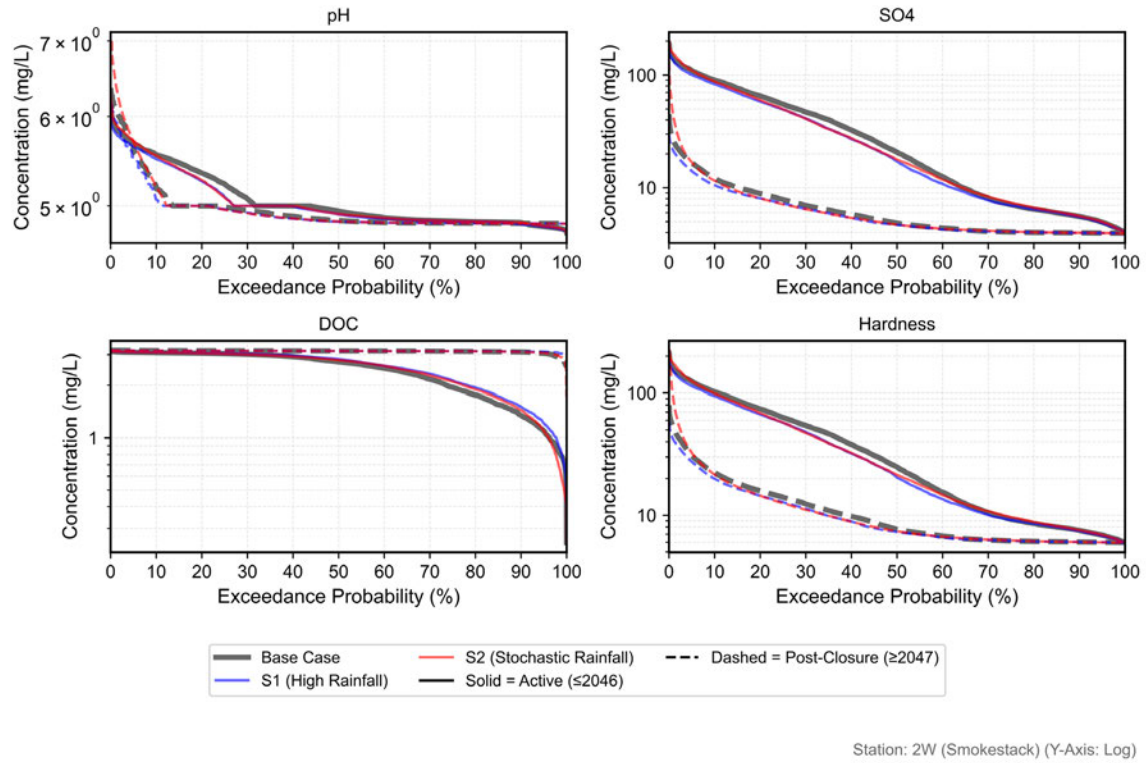


Figure 212: 2W Smokestack Rainfall Comp pH SO₄ DOC Hardness Concentration Exceedance Probability

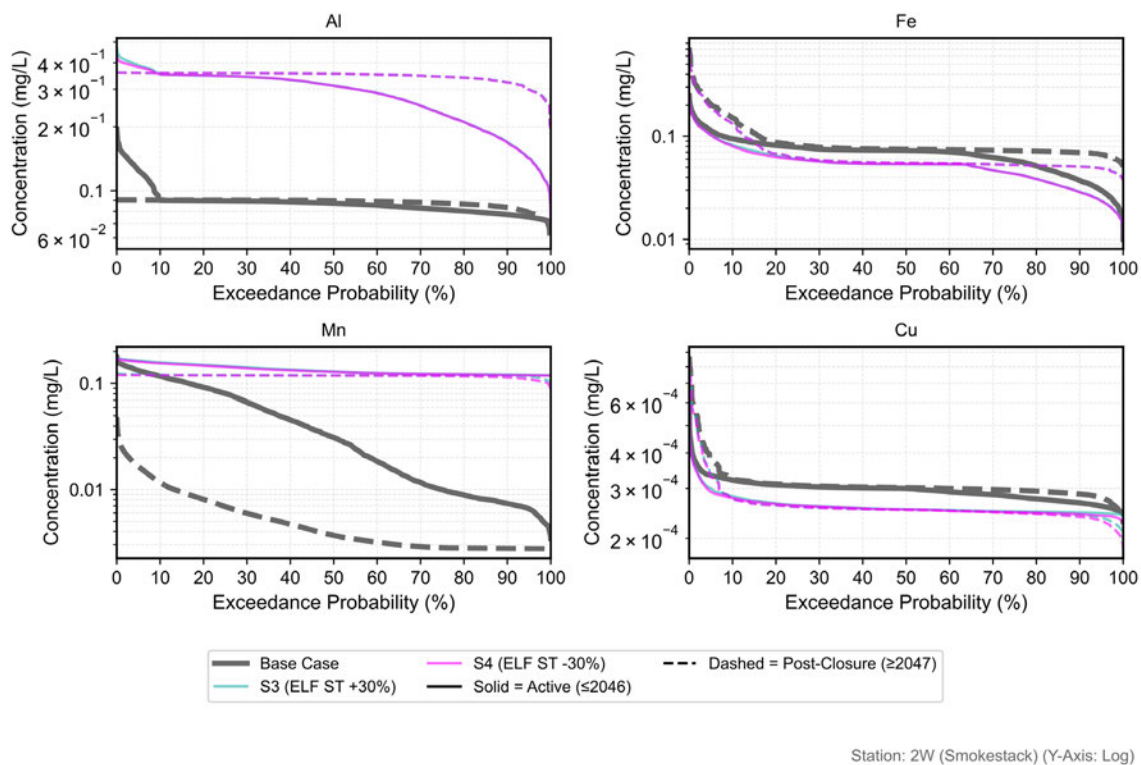


Figure 213: 2W Smokestack St Comp Al Fe Mn Cu Concentration Exceedance Probability

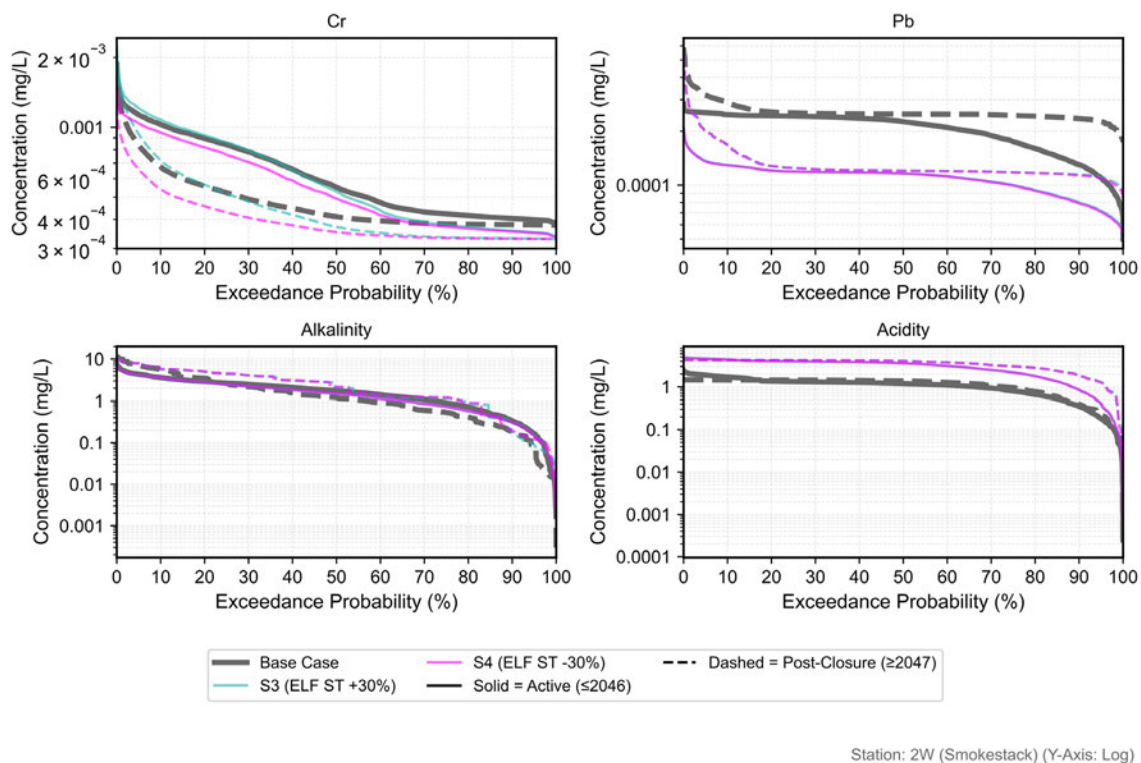


Figure 214: 2W Smokestack St Comp Cr Pb Alk Acid Concentration Exceedance Probability

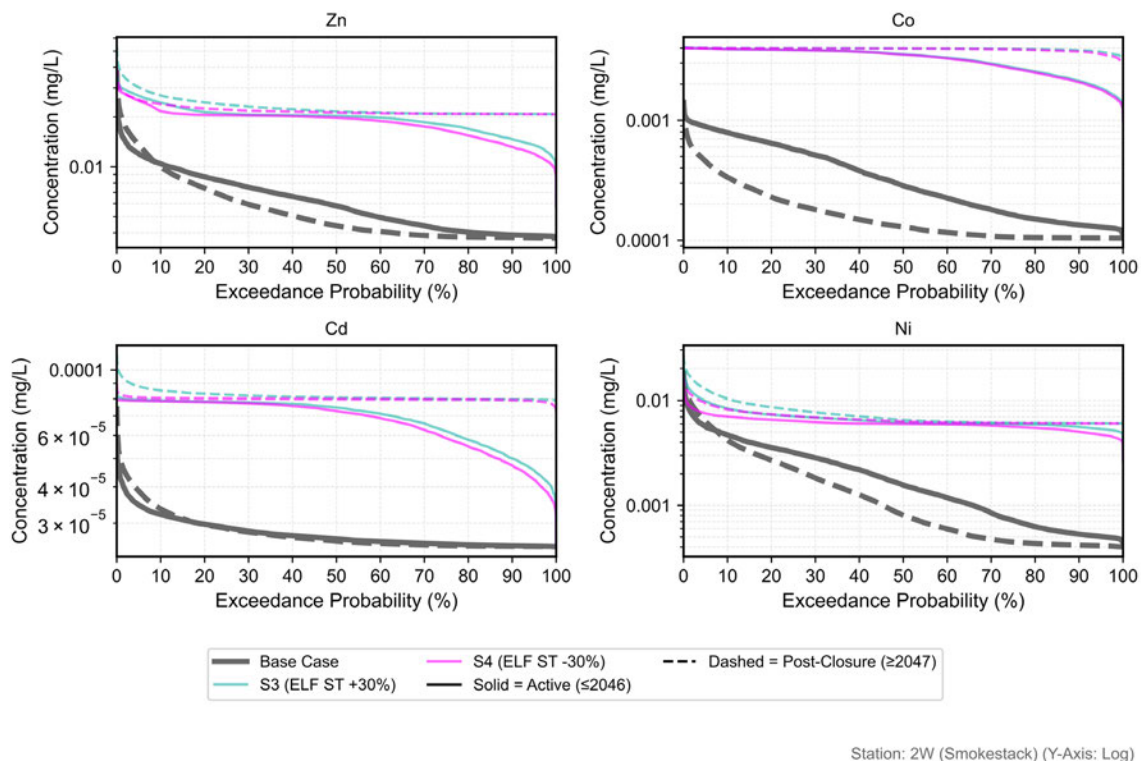


Figure 215: 2W Smokestack St Comp Zn Co Cd Ni Concentration Exceedance Probability

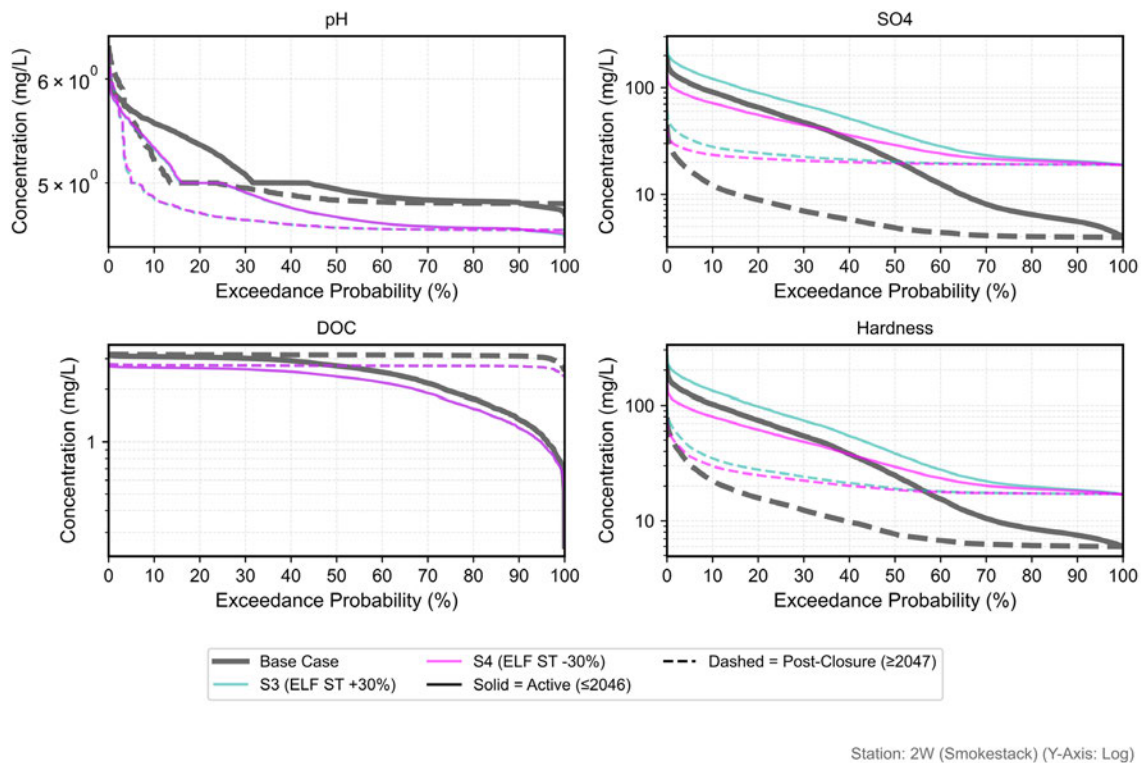
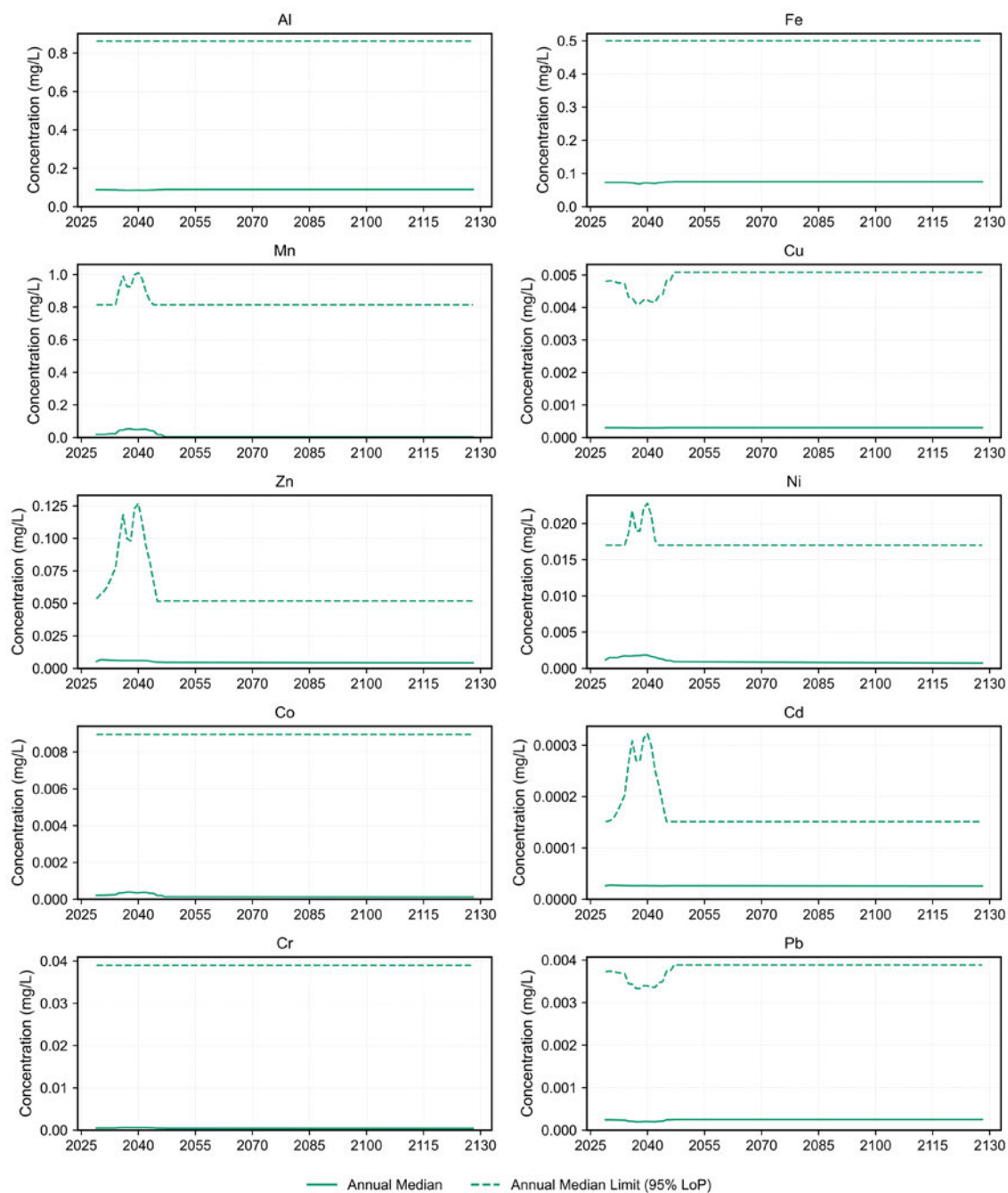


Figure 216: 2W Smokestack St Comp pH SO₄ DOC Hardness Concentration Exceedance Probability

3.4 ANNUAL MEDIAN (SINGLE SCENARIO)

2W (Smokestack) – Base Case

Figure 217: 2W (Smokestack) Base Case Elementsmatrix

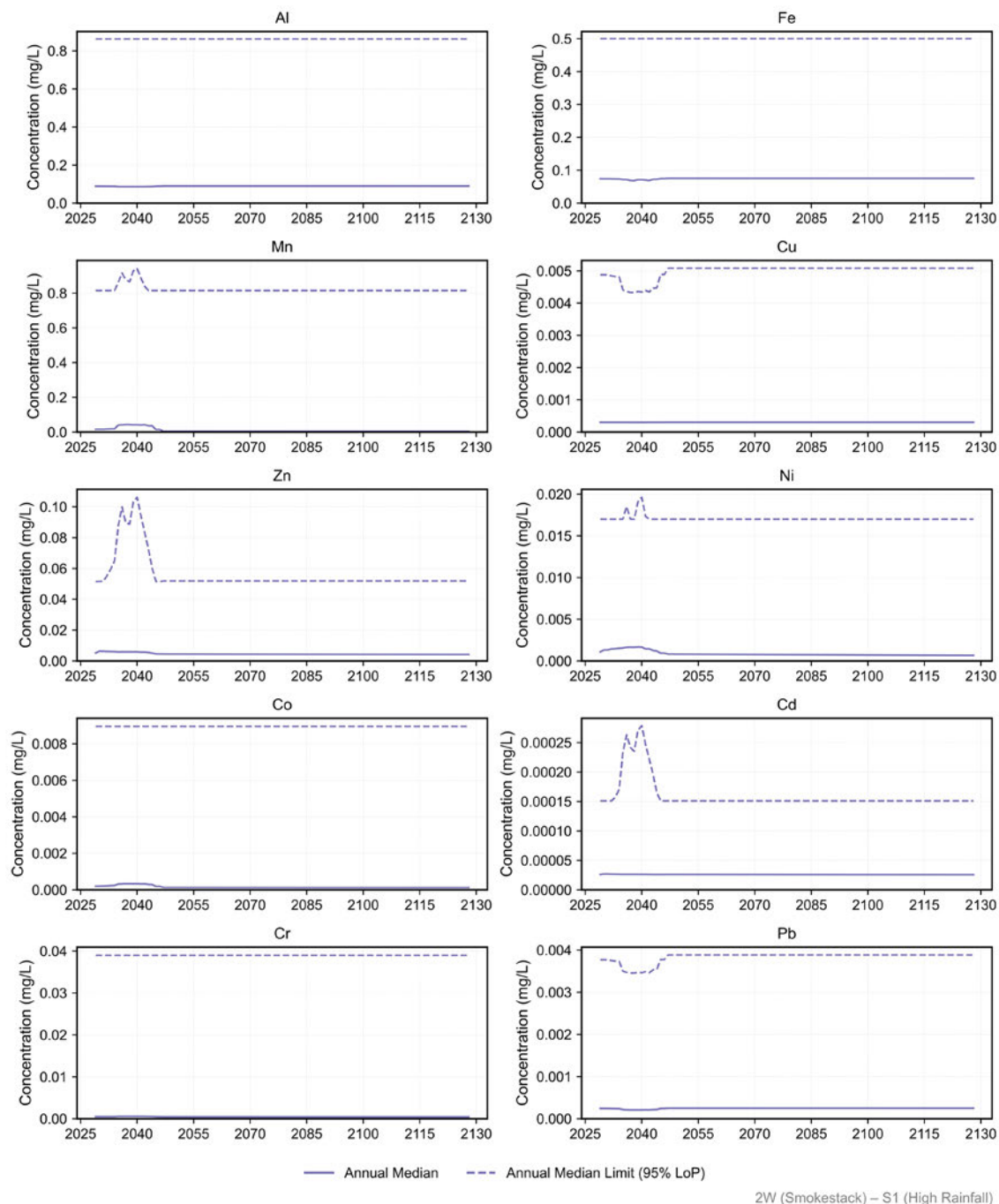


Figure 218: 2W (Smokestack) S1 (High Rainfall) Elementsmatrix

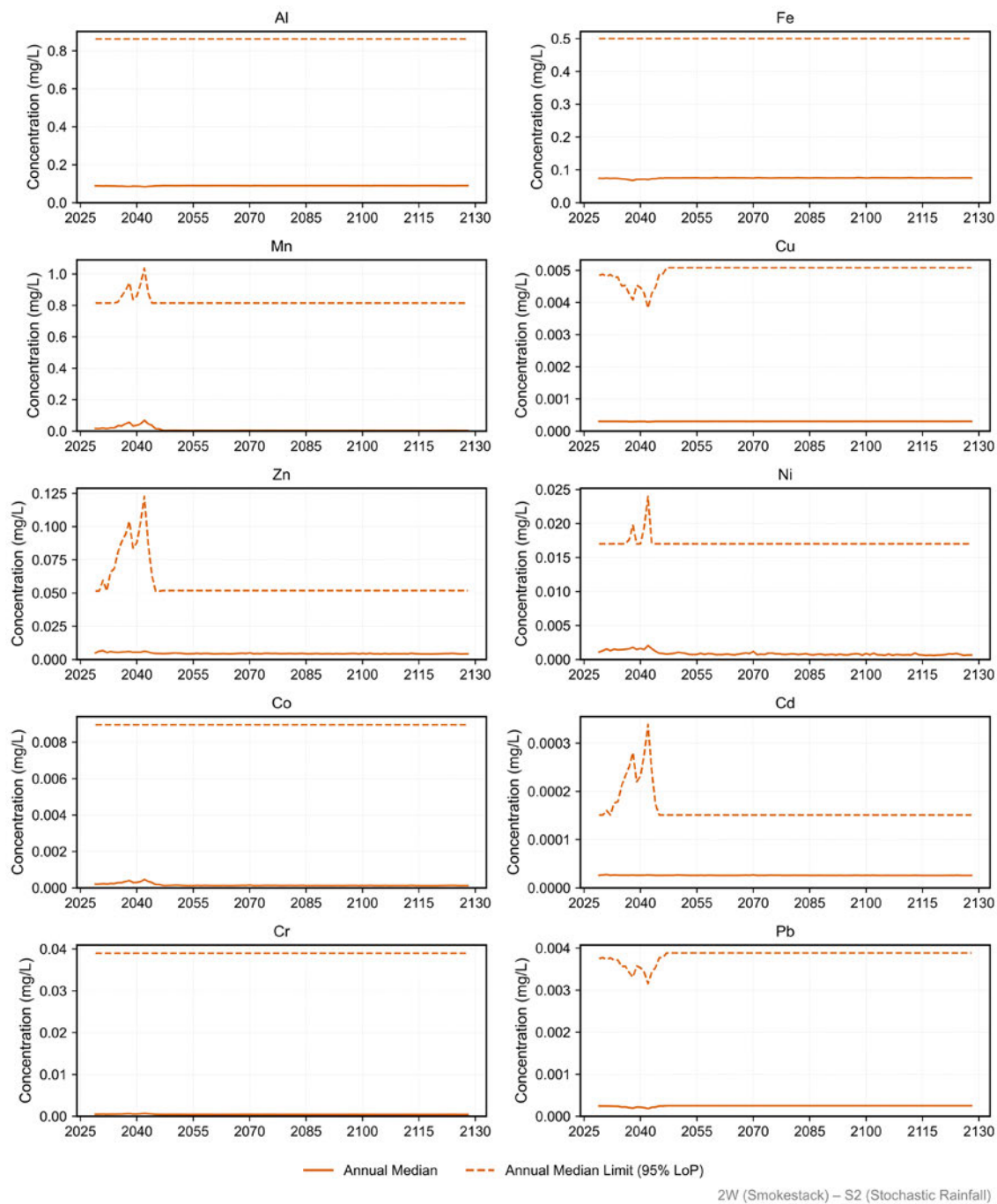
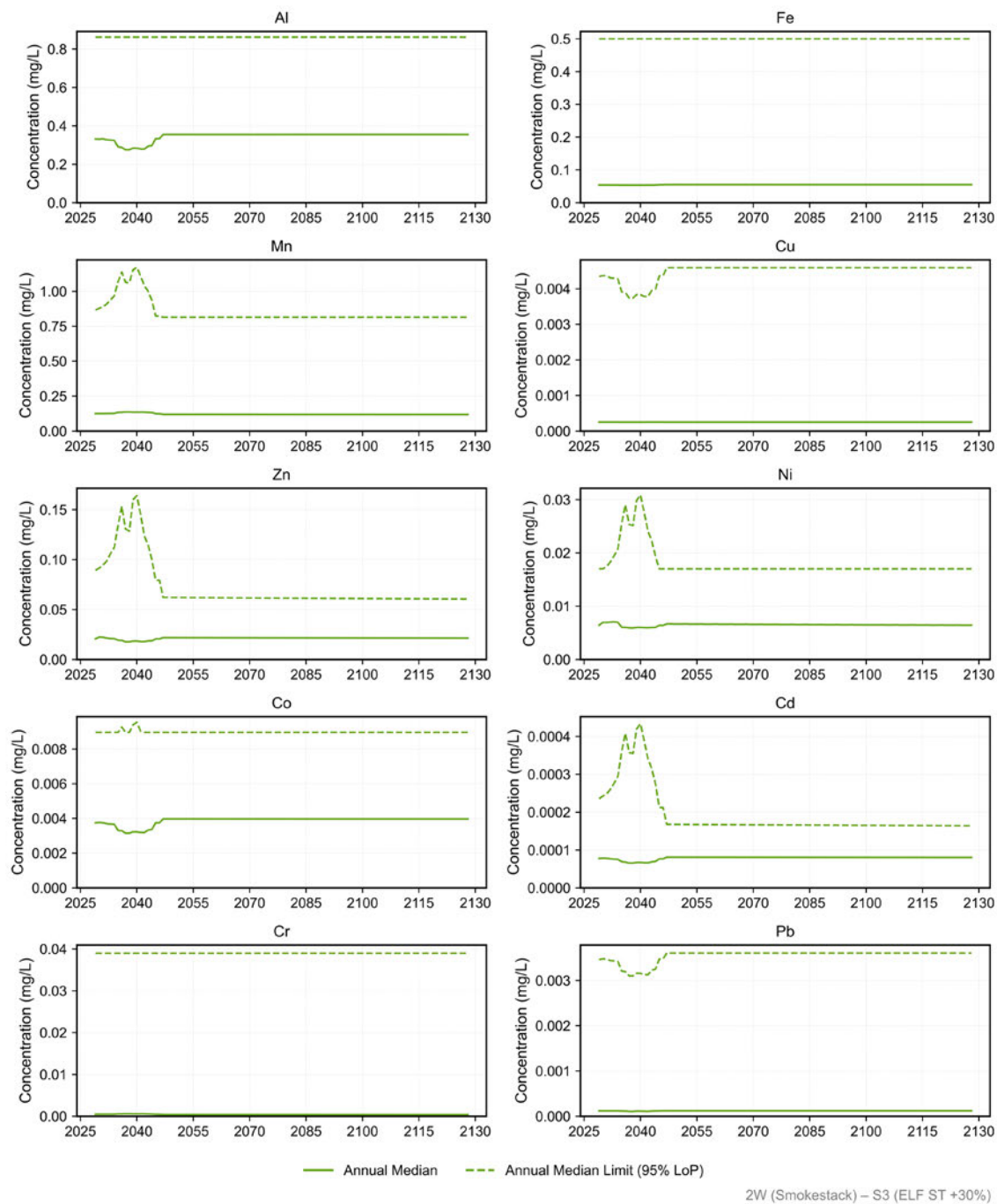


Figure 219: 2W (Smokestack) S2 (Stochastic Rainfall) Elementsmatrix

**Figure 220: 2W (Smokestack) S3 (Elf St +30%) Elementsmatrix**

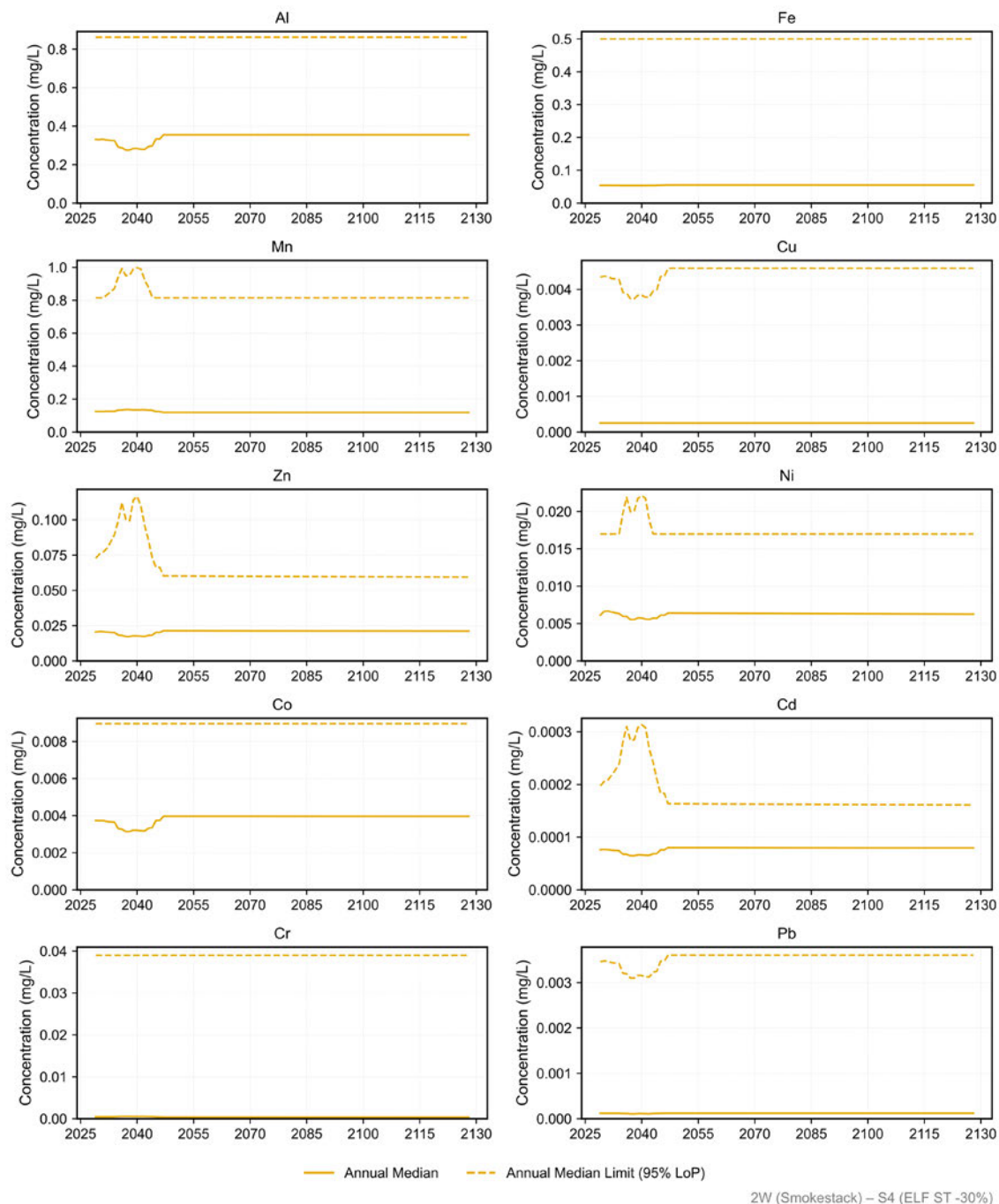


Figure 221: 2W (Smokestack) S4 (Elf St 30%) Elementsmatrix

3.5 ANNUAL MEDIANS (GROUPED SCENARIO)

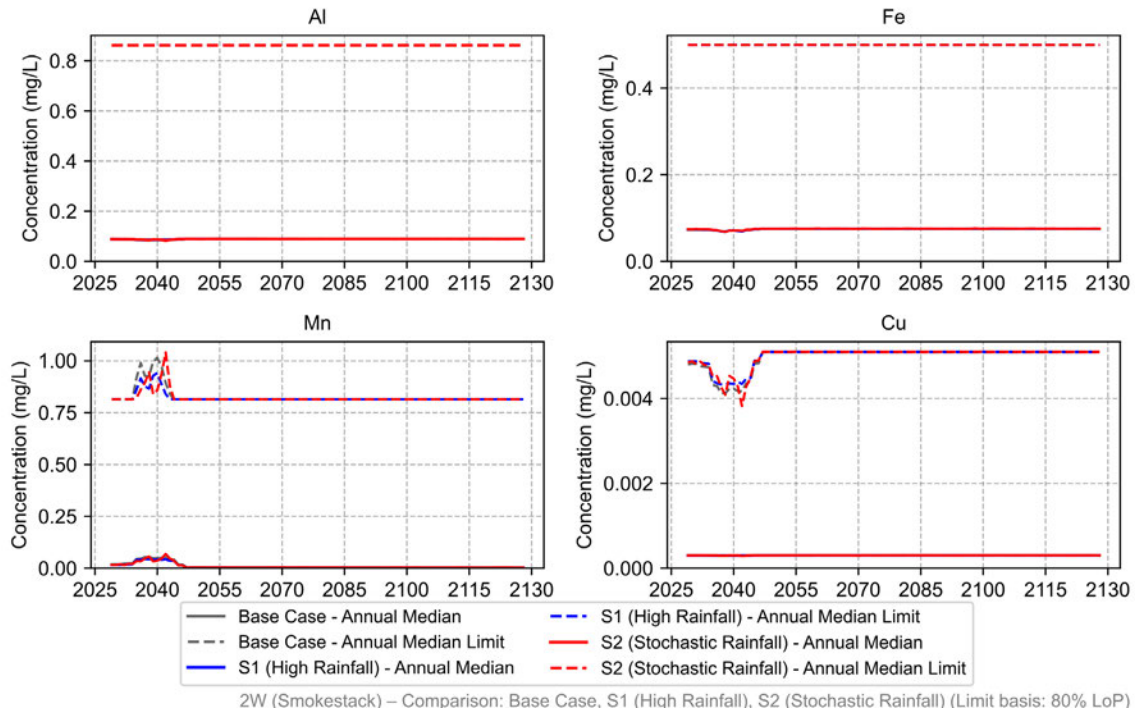


Figure 222: 2W Smokestack Base Case S1 S2 Al Fe Mn Cu Matrix comparison

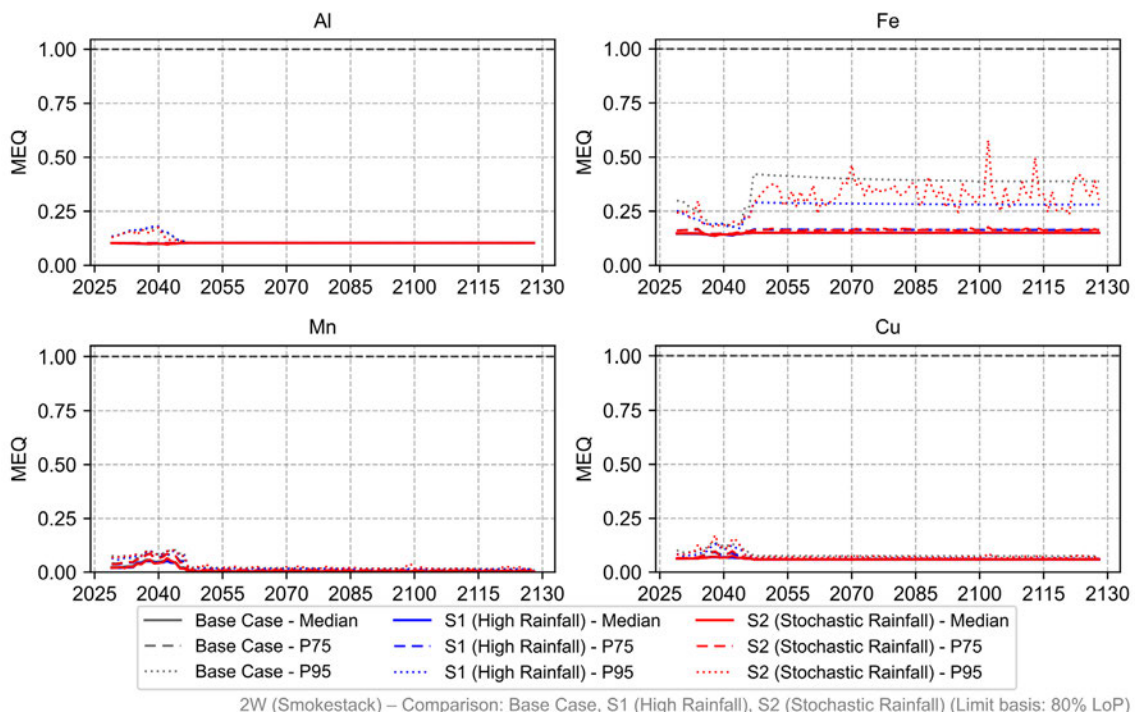
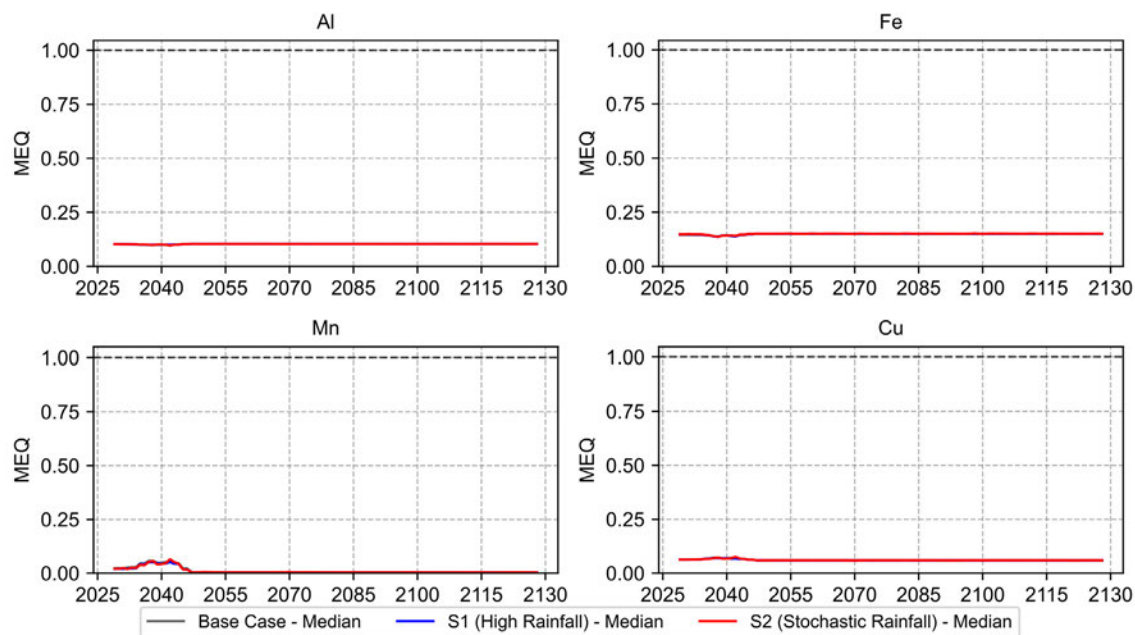
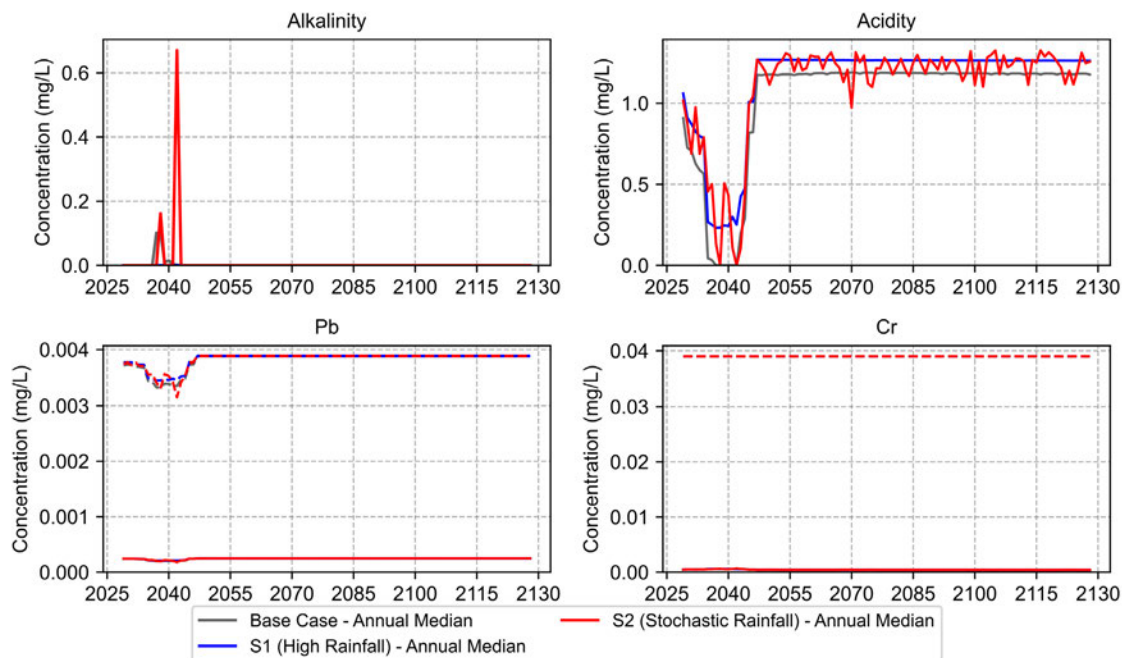


Figure 223: 2W Smokestack Base Case S1 S2 Al Fe Mn Cu Matrix comparison Meq

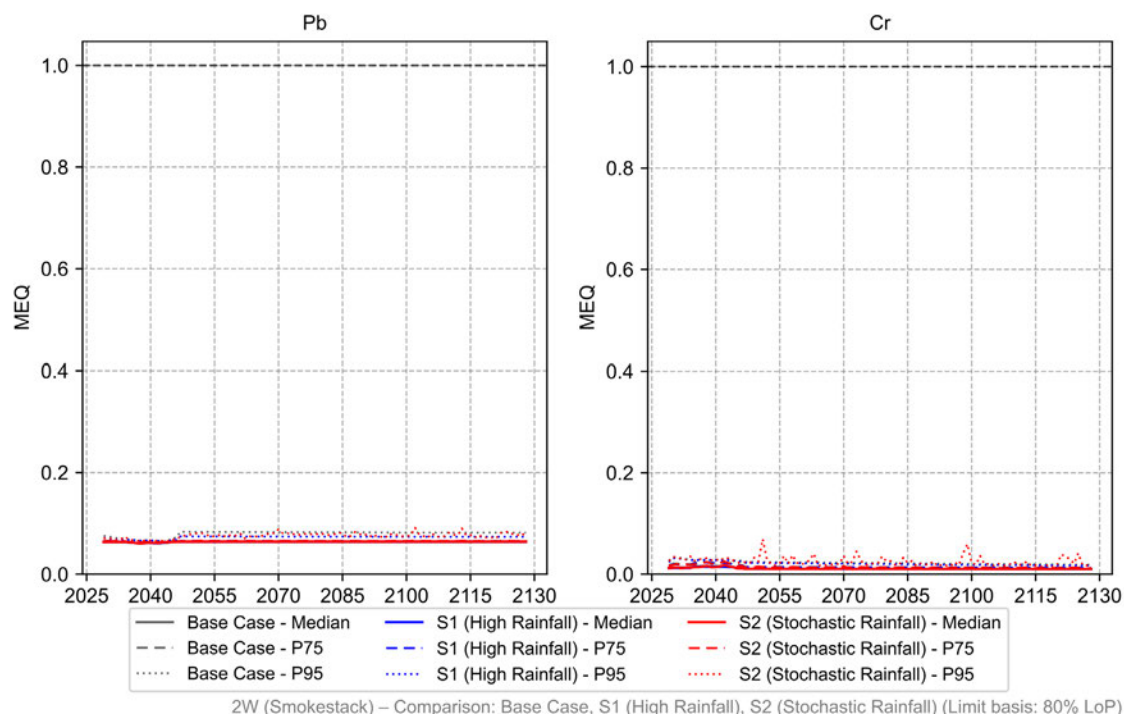


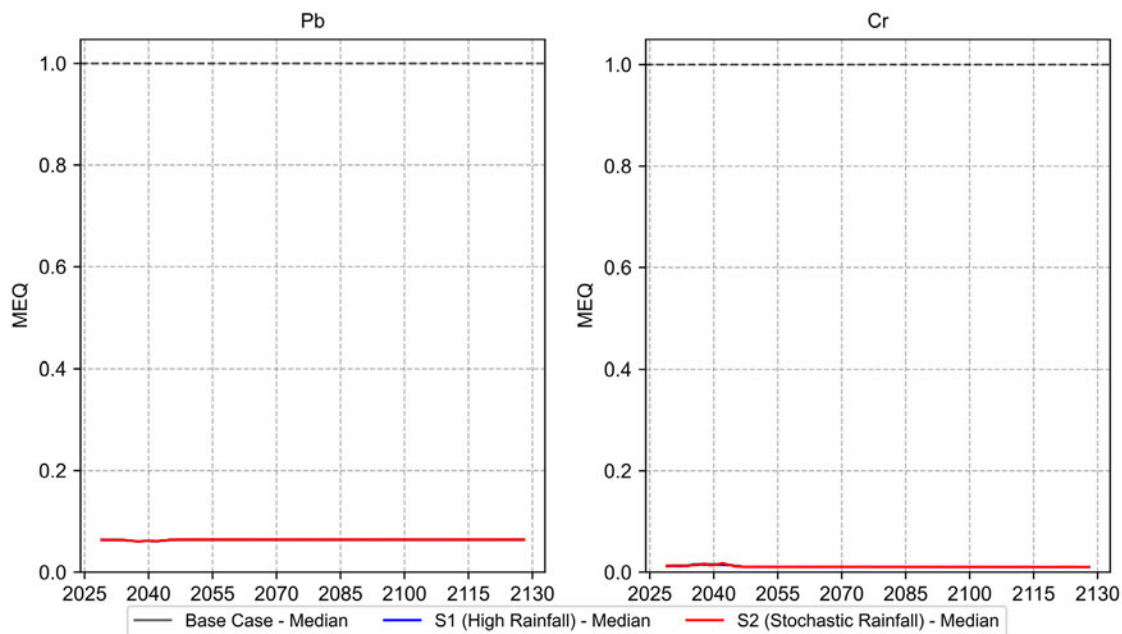
2W (Smokestack) – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 80% LoP)

Figure 224: 2W Smokestack Base Case S1 S2 Al Fe Mn Cu Mxcomp Meq Median Only



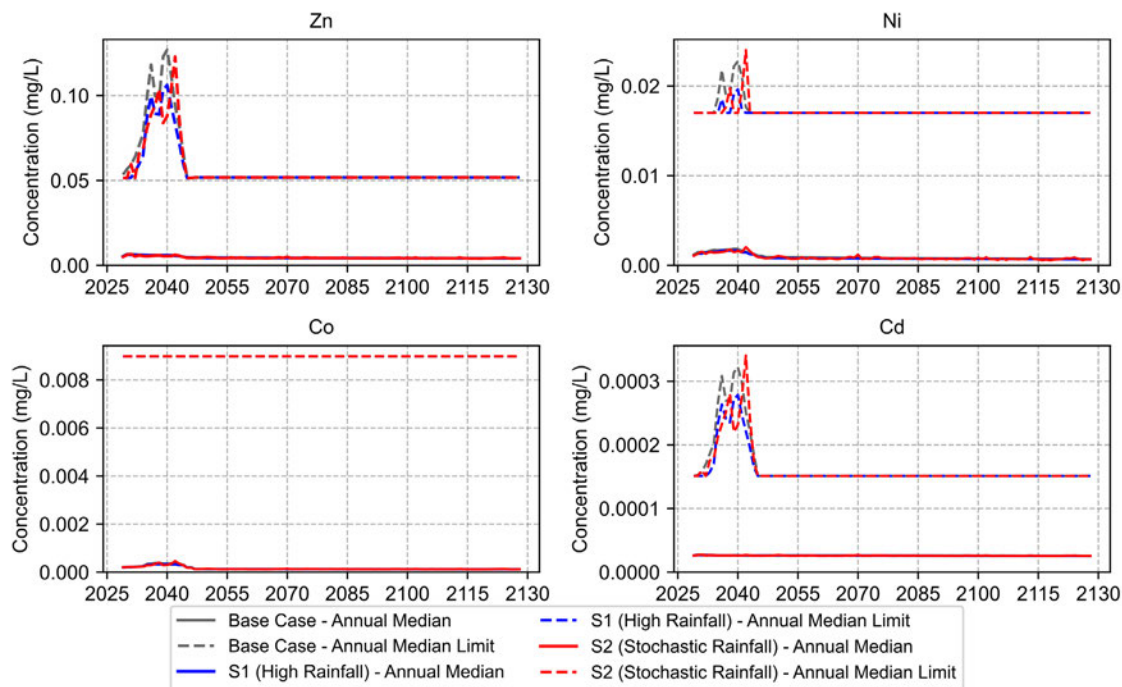
2W (Smokestack) – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 80% LoP)

Figure 225: 2W Smokestack Base Case S1 S2 Alkalinity Acidity Pb Cr Matrix comparison**Figure 226:** 2W Smokestack Base Case S1 S2 Pb Cr Matrix comparison Meq



2W (Smokestack) – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 80% LoP)

Figure 227: 2W Smokestack Base Case S1 S2 Pb Cr Mxcomp Meq Median Only



2W (Smokestack) – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 80% LoP)

Figure 228: 2W Smokestack Base Case S1 S2 Zn Ni Co Cd Matrix comparison

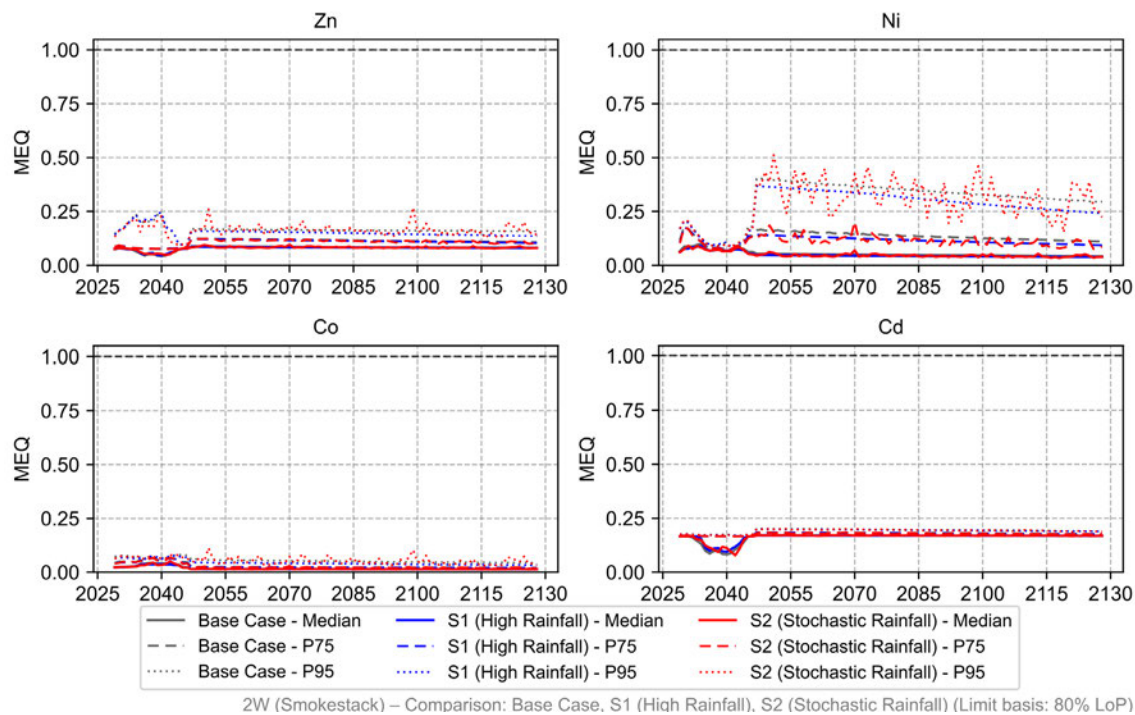


Figure 229: 2W Smokestack Base Case S1 S2 Zn Ni Co Cd Matrix comparison Meq

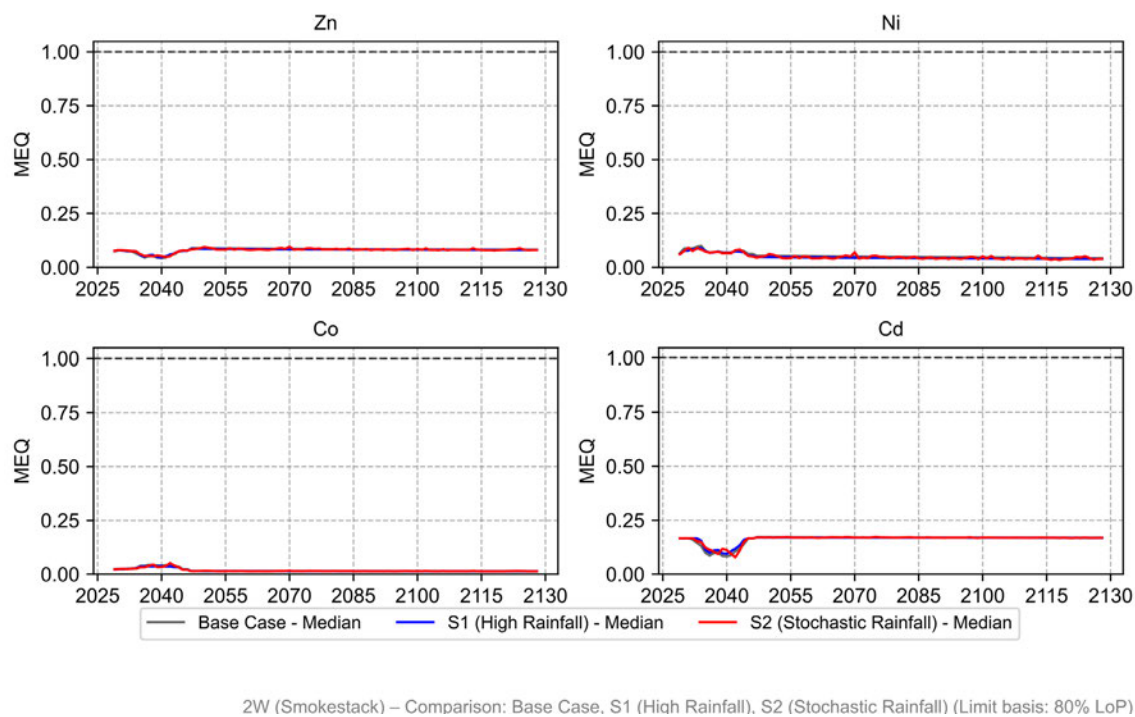


Figure 230: 2W Smokestack Base Case S1 S2 Zn Ni Co Cd Mxcomp Meq Median Only

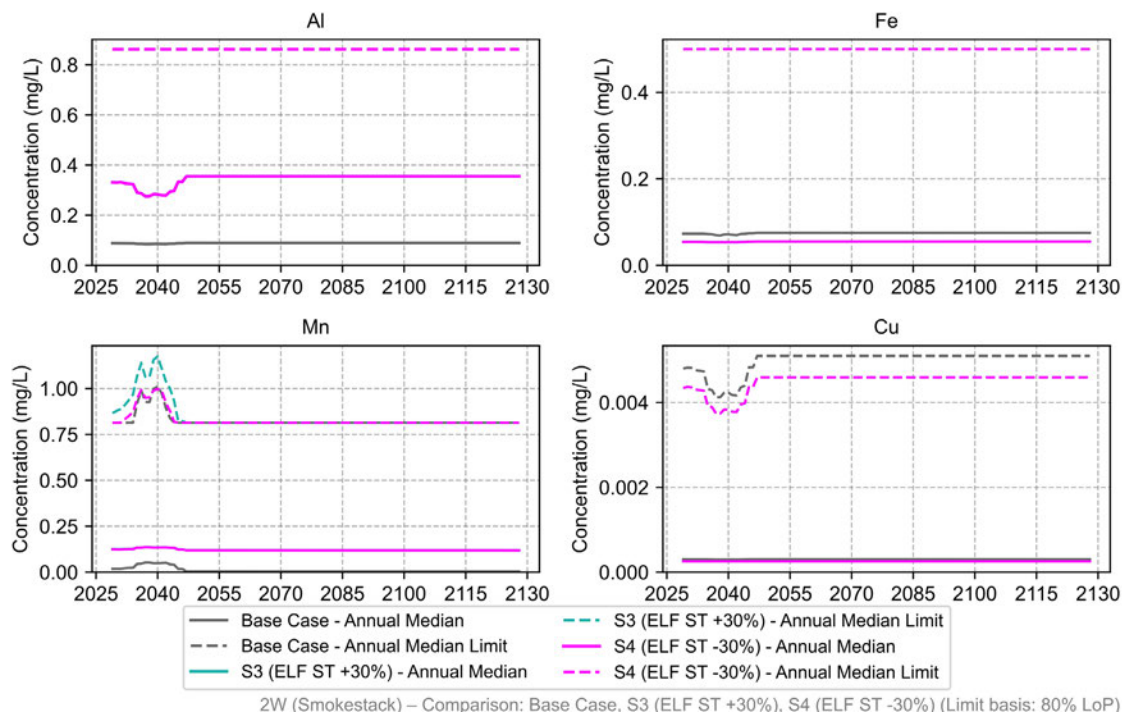


Figure 231: 2W Smokestack Base Case S3 S4 Al Fe Mn Cu Matrix comparison

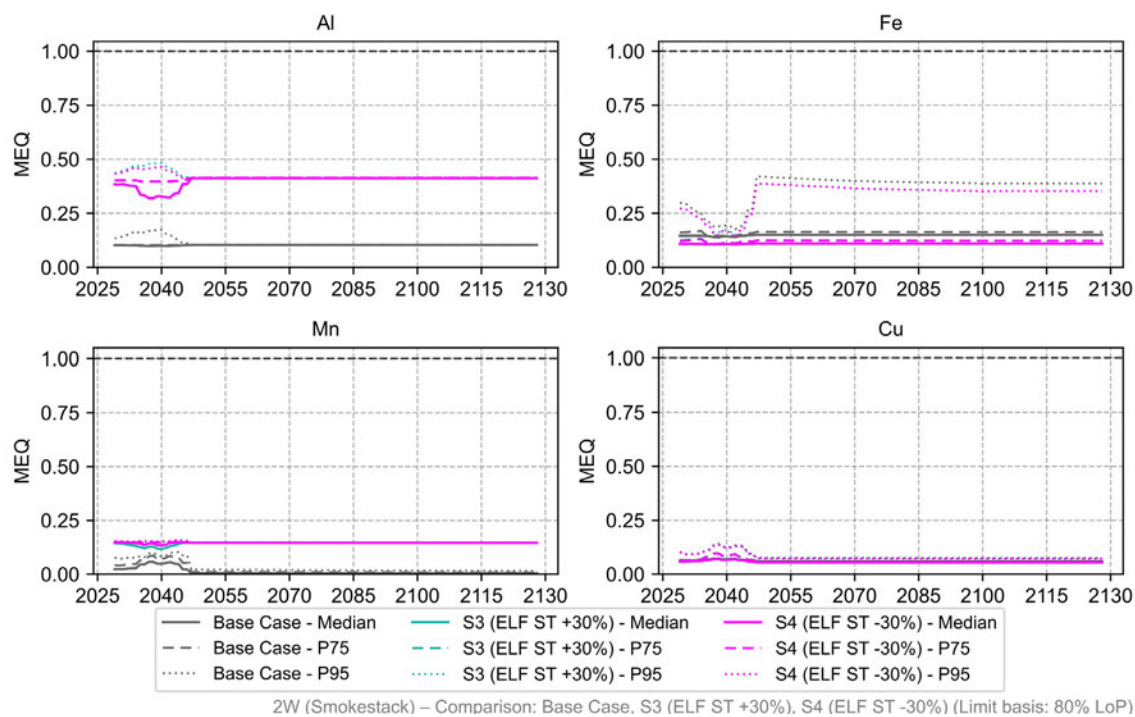
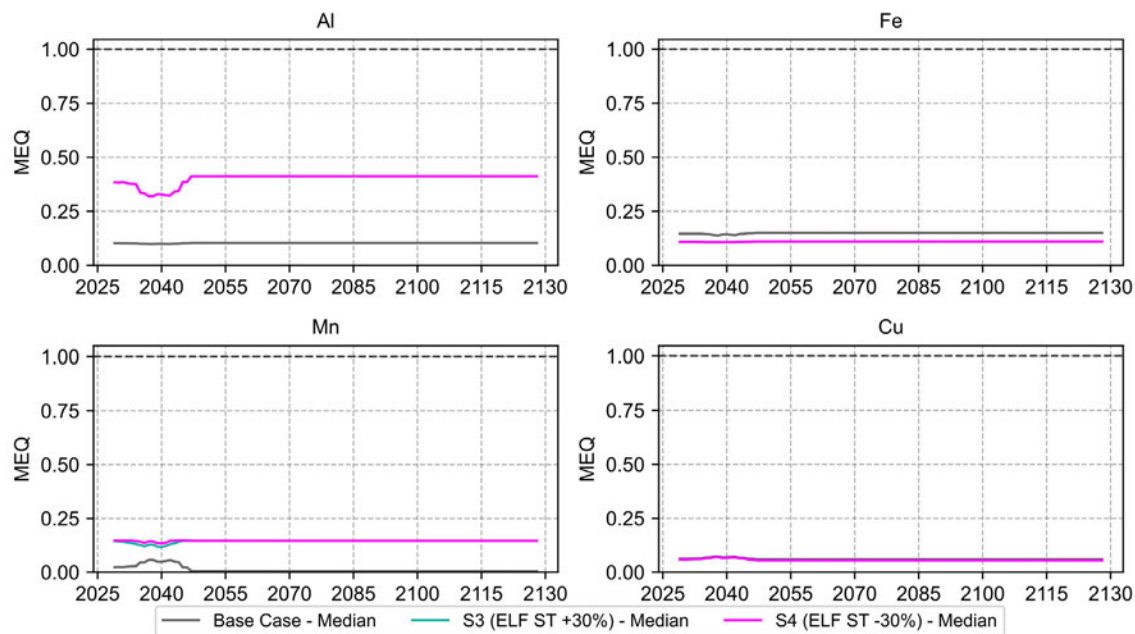
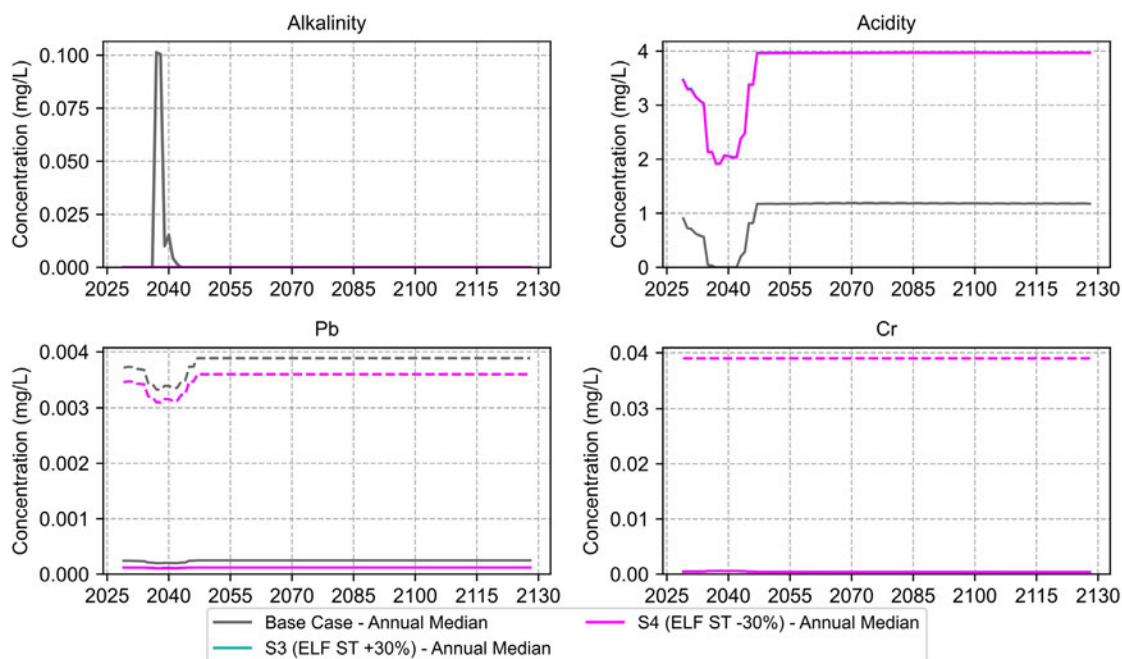


Figure 232: 2W Smokestack Base Case S3 S4 Al Fe Mn Cu Matrix comparison Meq



2W (Smokestack) – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 80% LoP)

Figure 233: 2W Smokestack Base Case S3 S4 Al Fe Mn Cu Mxcomp Meq Median Only



2W (Smokestack) – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 80% LoP)

Figure 234: 2W Smokestack Base Case S3 S4 Alkalinity Acidity Pb Cr Matrix comparison

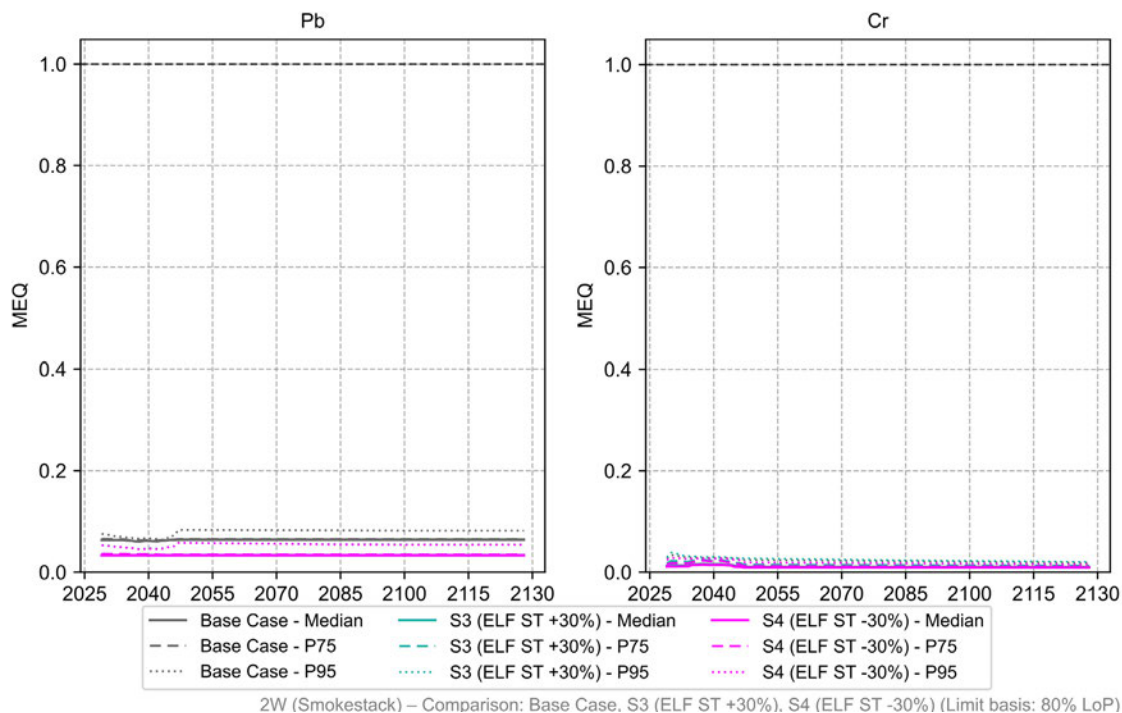


Figure 235: 2W Smokestack Base Case S3 S4 Pb Cr Matrix comparison Meq

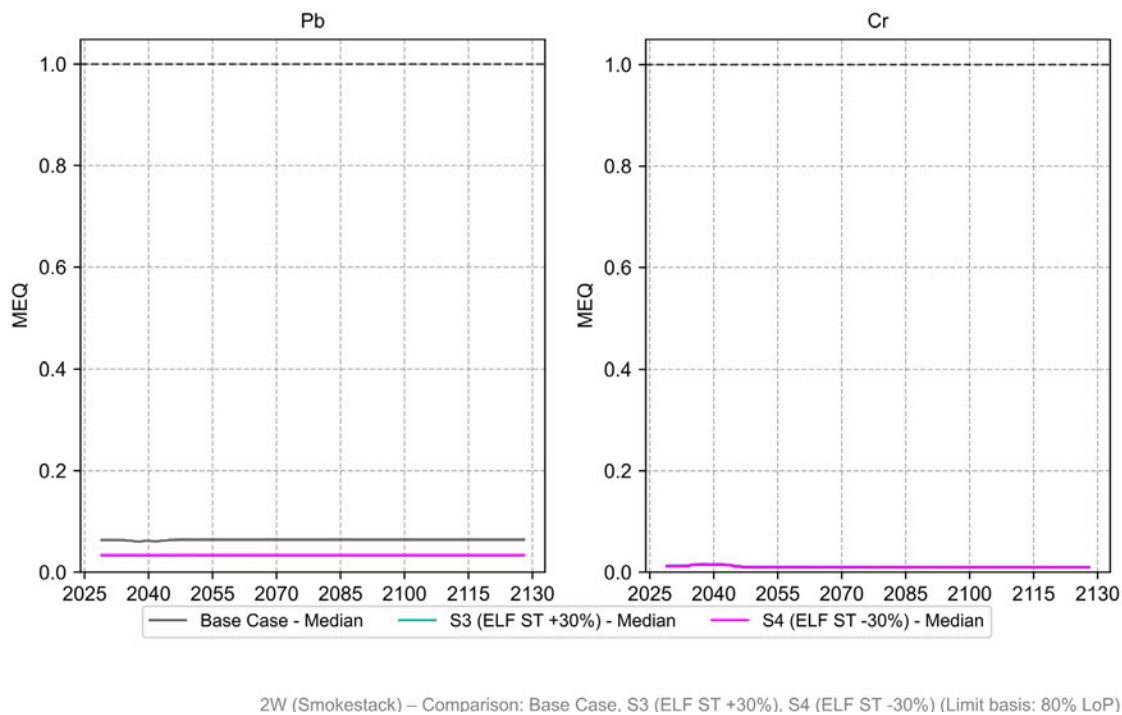


Figure 236: 2W Smokestack Base Case S3 S4 Pb Cr Mxcomp Meq Median Only

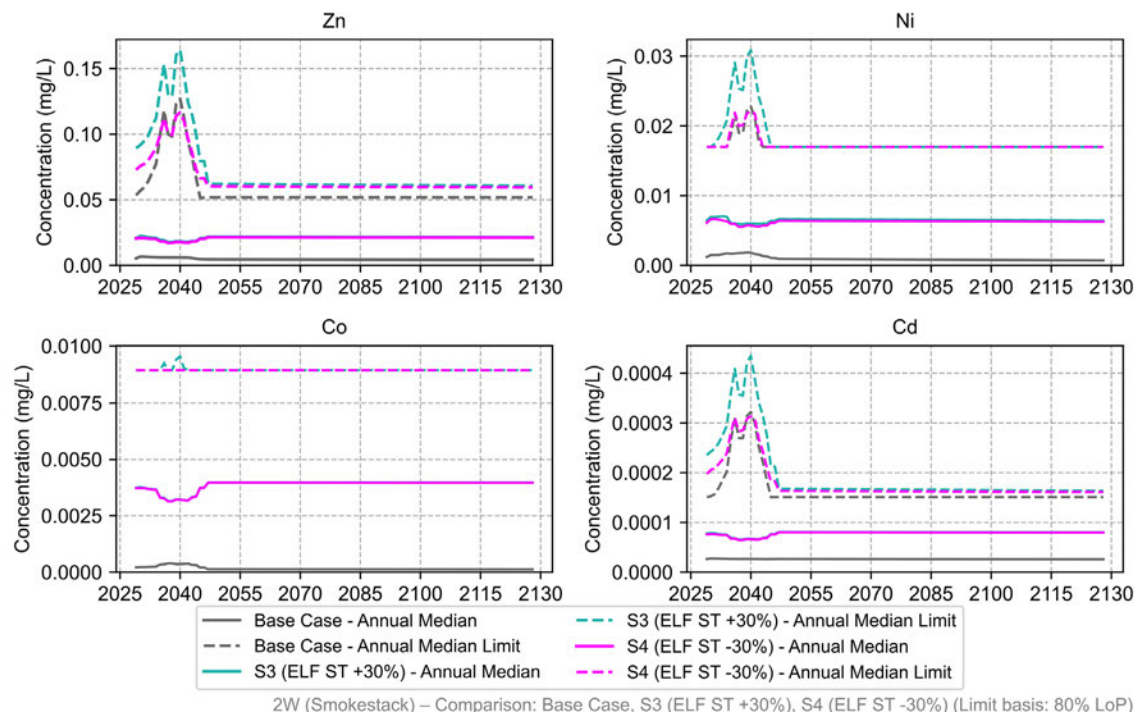


Figure 237: 2W Smokestack Base Case S3 S4 Zn Ni Co Cd Matrix comparison

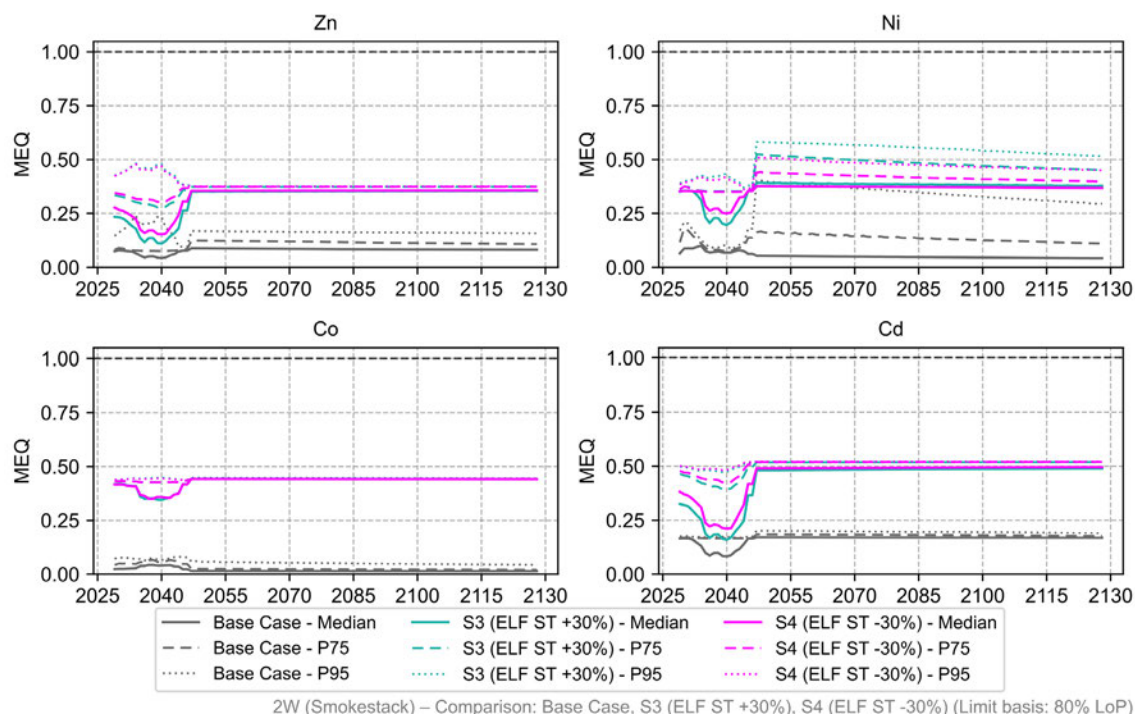
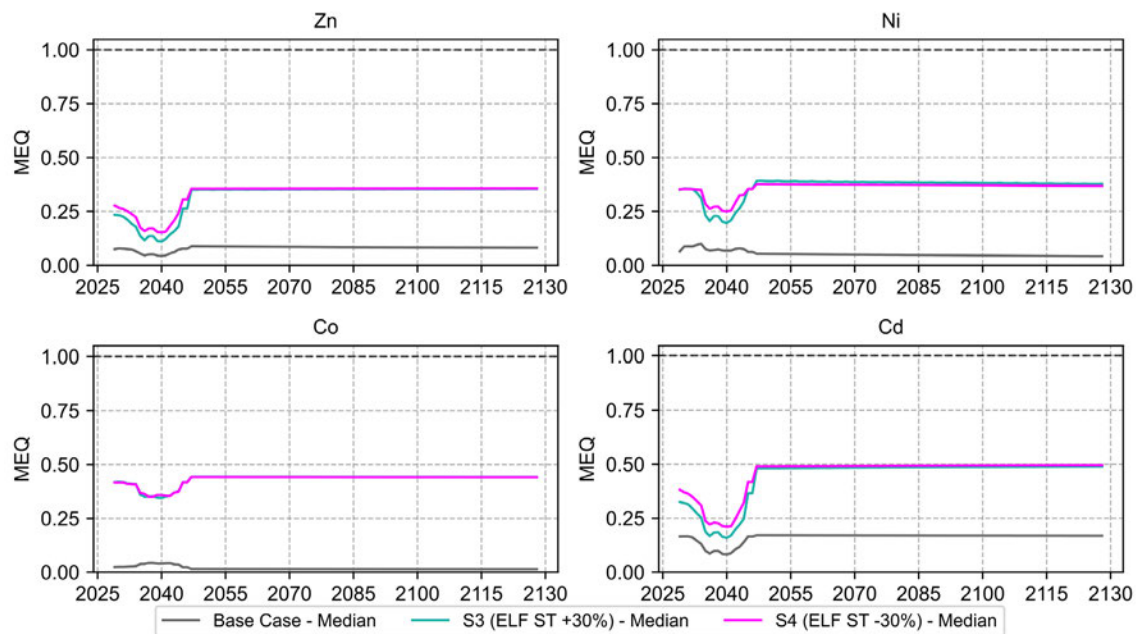
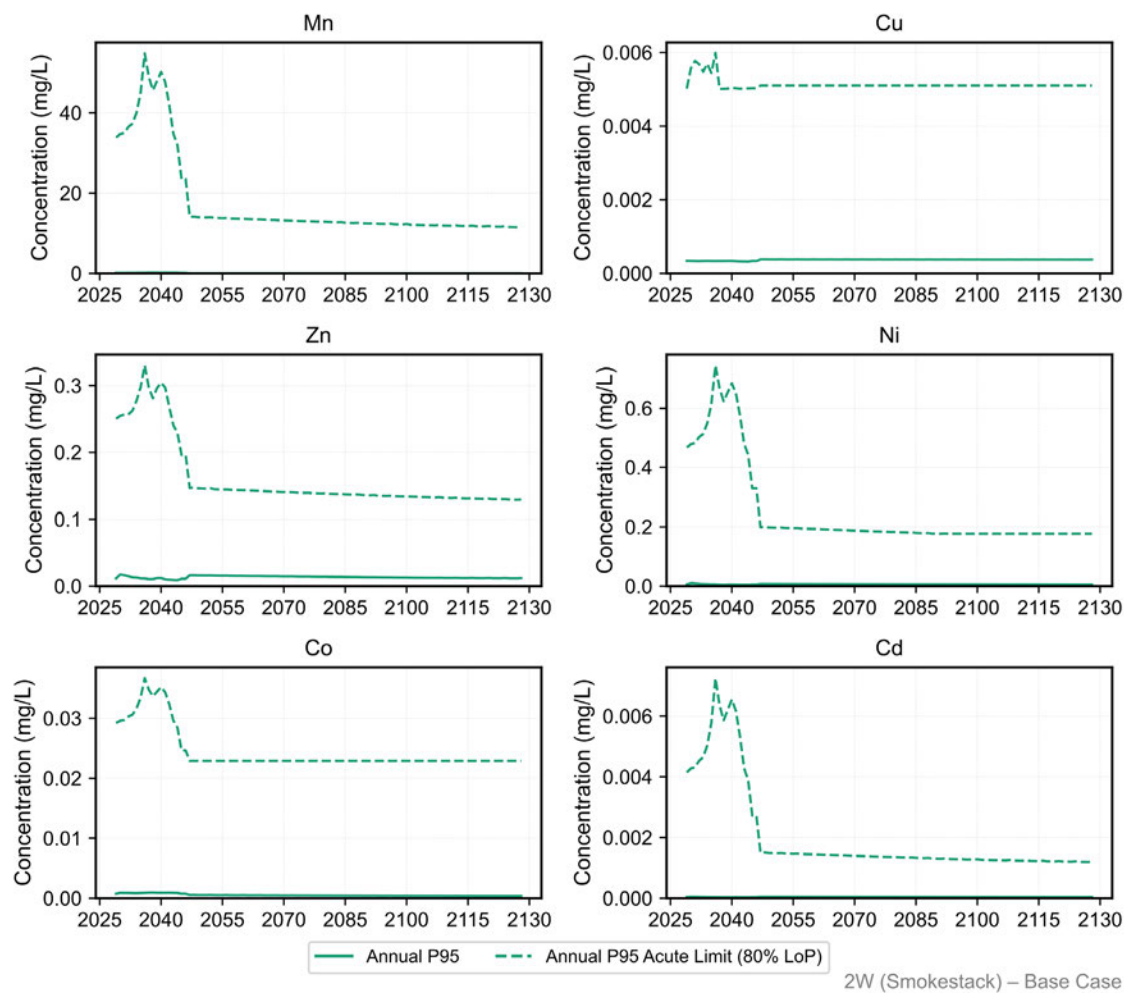


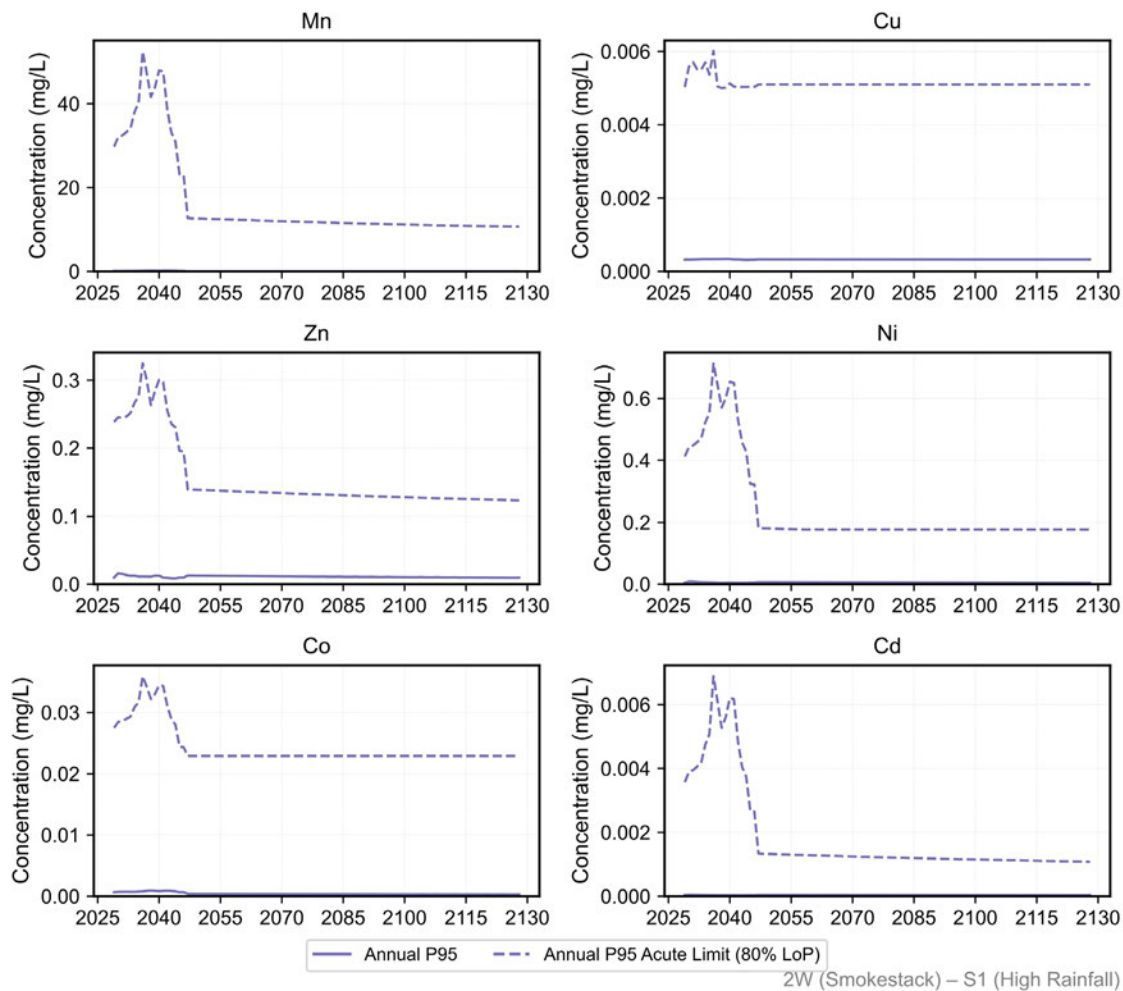
Figure 238: 2W Smokestack Base Case S3 S4 Zn Ni Co Cd Matrix comparison Meq

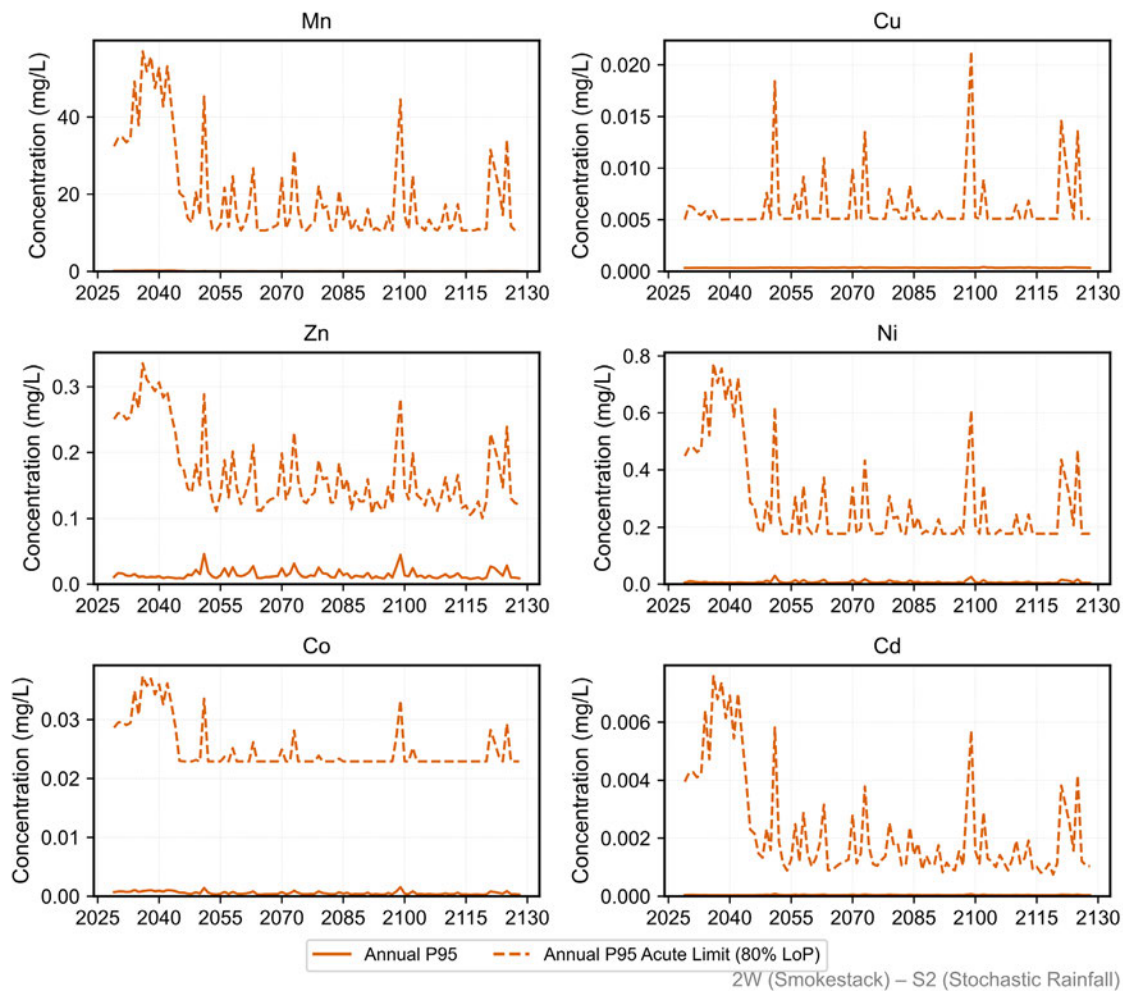


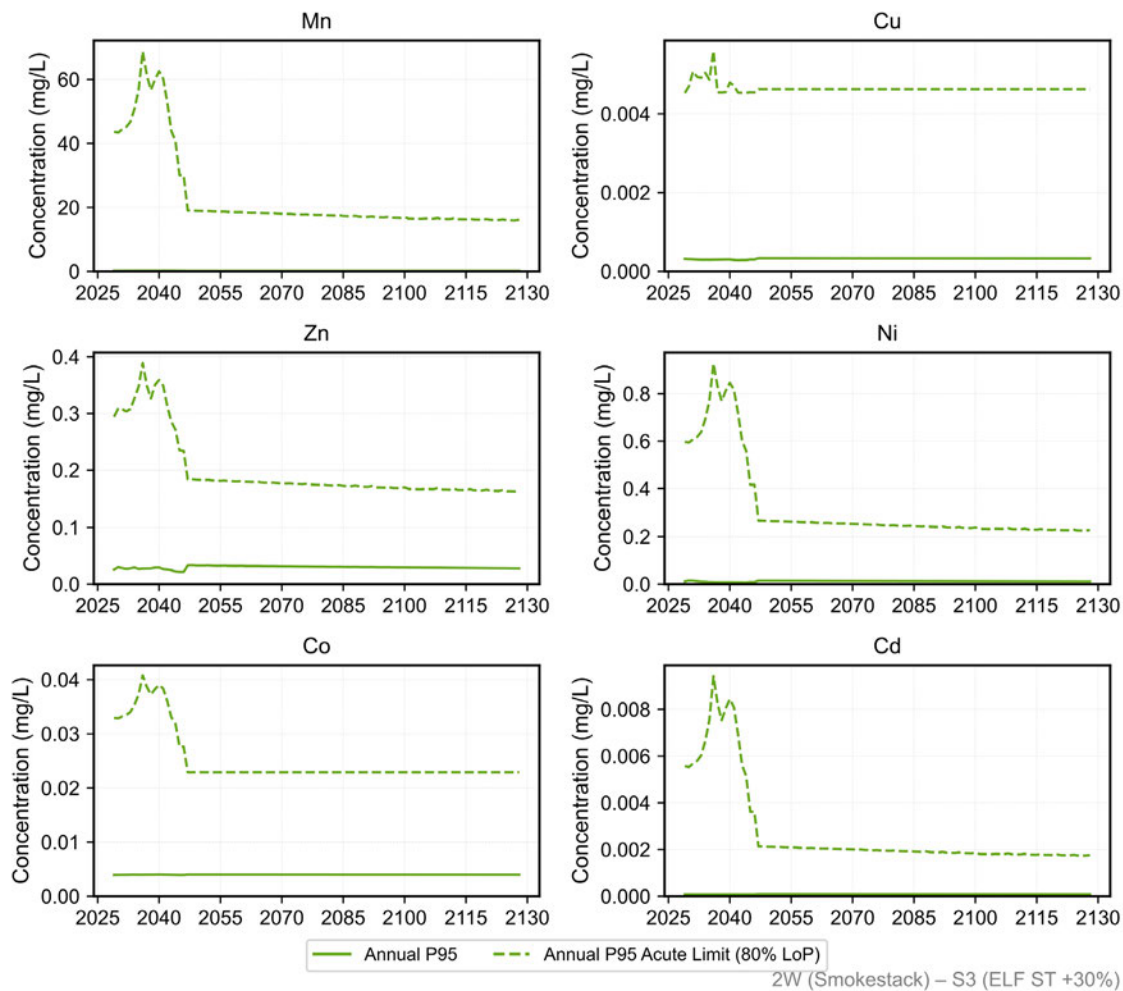
2W (Smokestack) – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 80% LoP)

Figure 239: 2W Smokestack Base Case S3 S4 Zn Ni Co Cd Mxcomp Meq Median Only

3.6 ANNUAL P95 (SINGLE SCENARIO)**Figure 240: 2W Smokestack Base Case Acute Limits**

**Figure 241:** 2W Smokestack S1 High Rainfall Acute Limits

**Figure 242:** 2W Smokestack S2 Stochastic Rainfall Acute Limits

**Figure 243:** 2W Smokestack S3 Elf St 30 Acute Limits

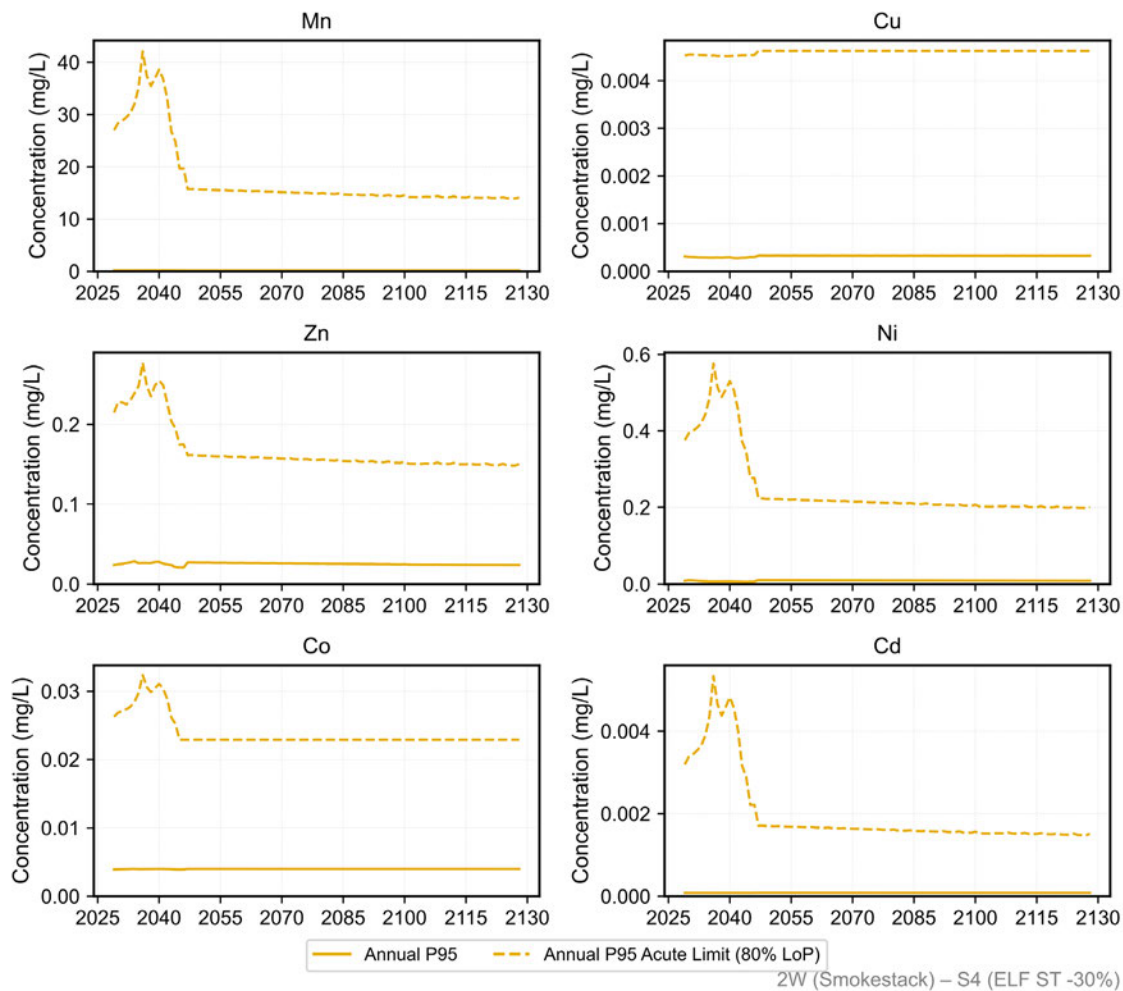


Figure 244: 2W Smokestack S4 Elf St 30 Acute Limits

3.7 ANNUAL P95 (GROUPED SCENARIO)

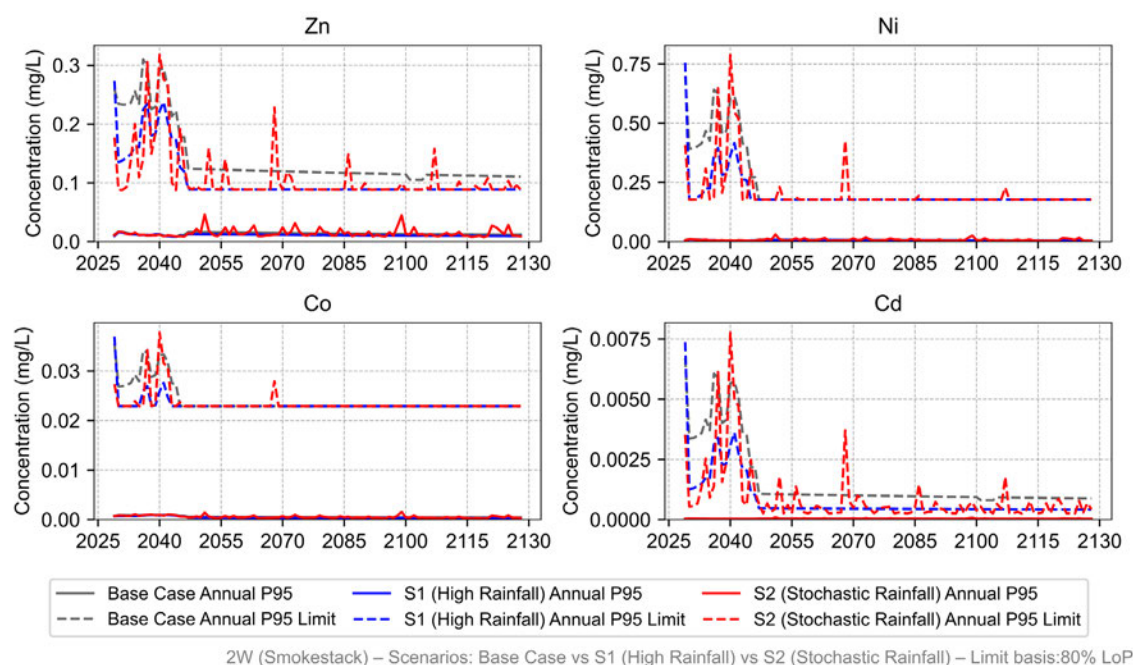


Figure 245: 2W Smokestack Set1 Acute Limits

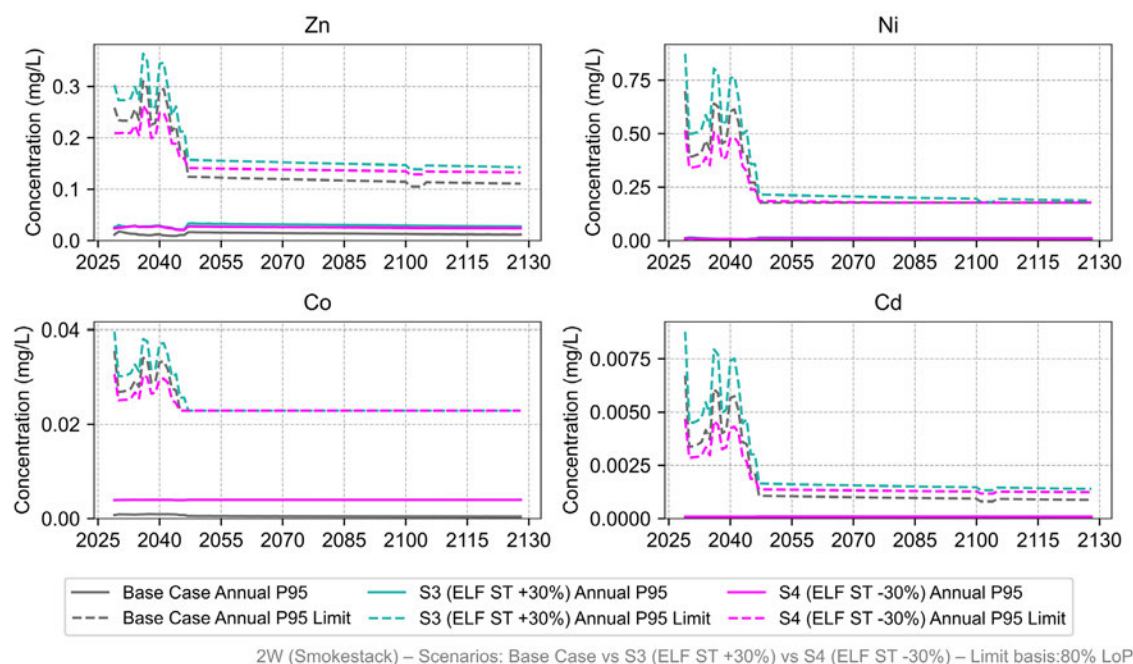


Figure 246: 2W Smokestack Set2 Acute Limits

4. STATION 17W

4.1 30-DAY ROLLING MEDIAN

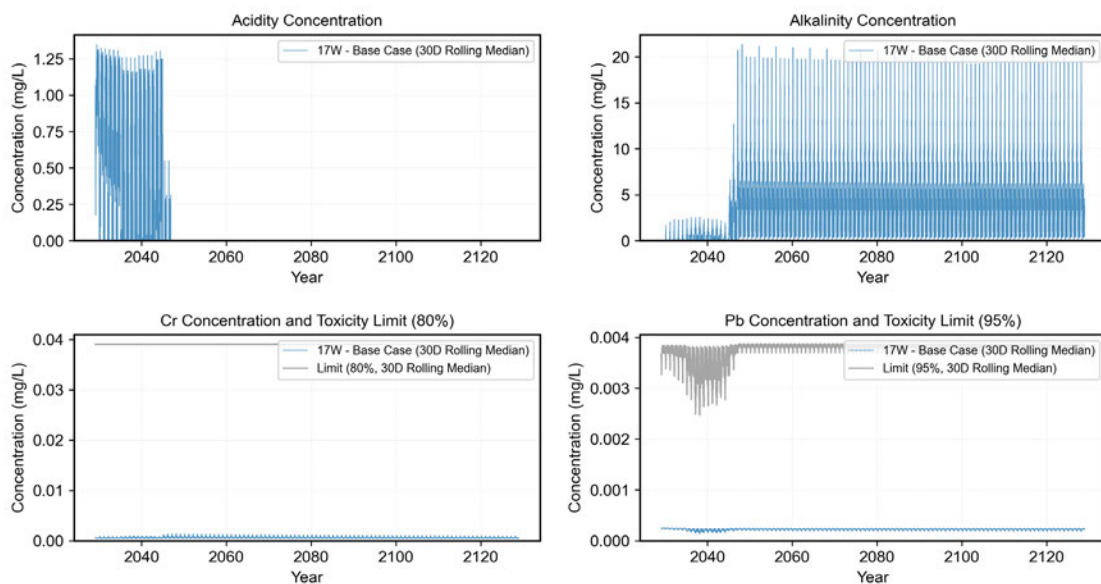


Figure 247: Matrix plot Base Case 17W Acidity Alkalinity Cr Pb

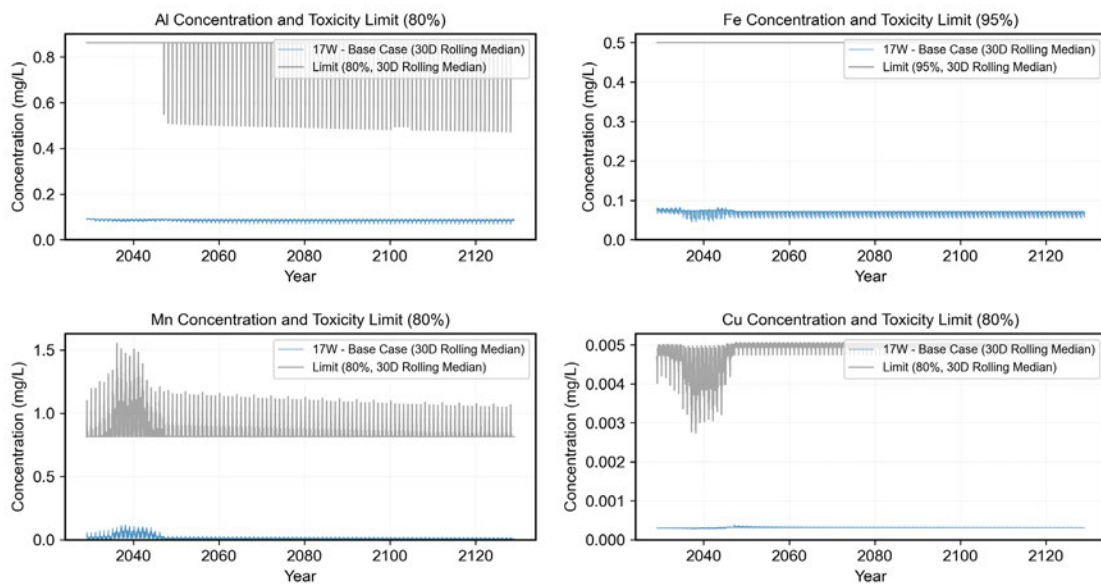


Figure 248: Matrix plot Base Case 17W Al Fe Mn Cu

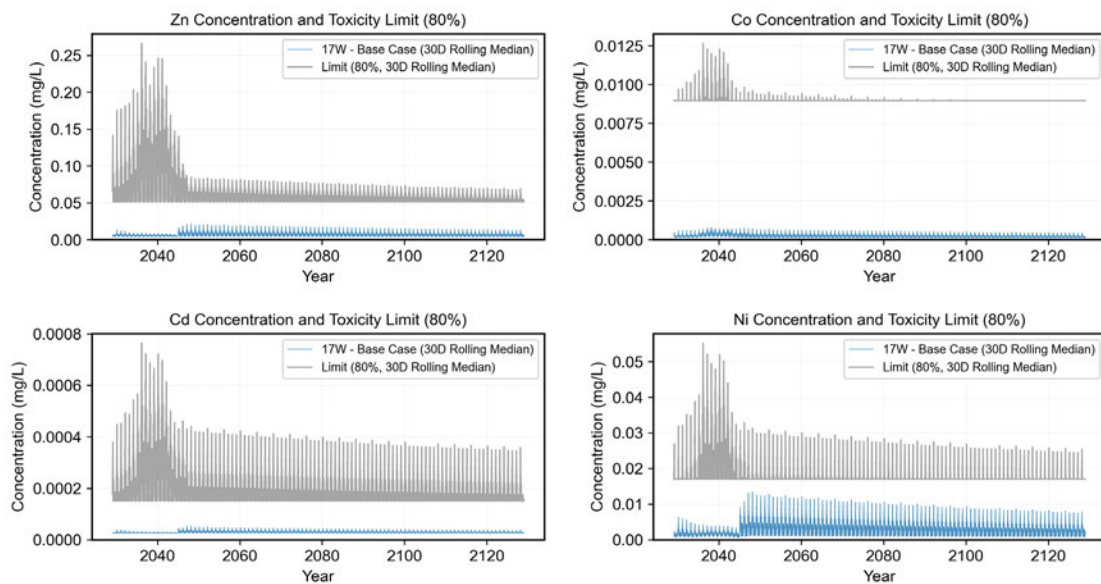


Figure 249: Matrix plot Base Case 17W Zn Co Cd Ni

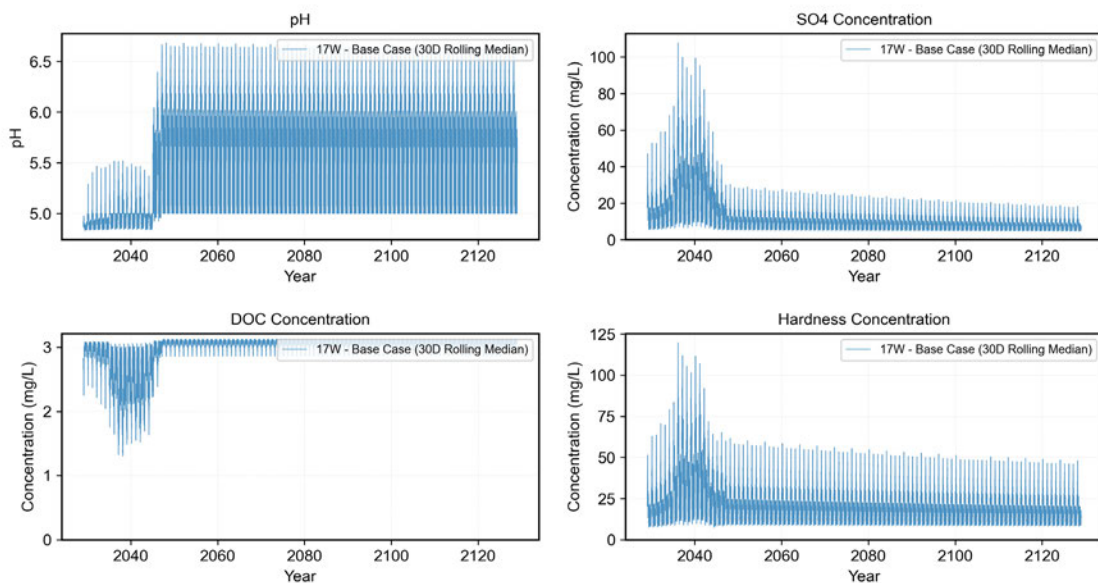


Figure 250: Matrix plot Base Case 17W pH SO4 DOC Hardness

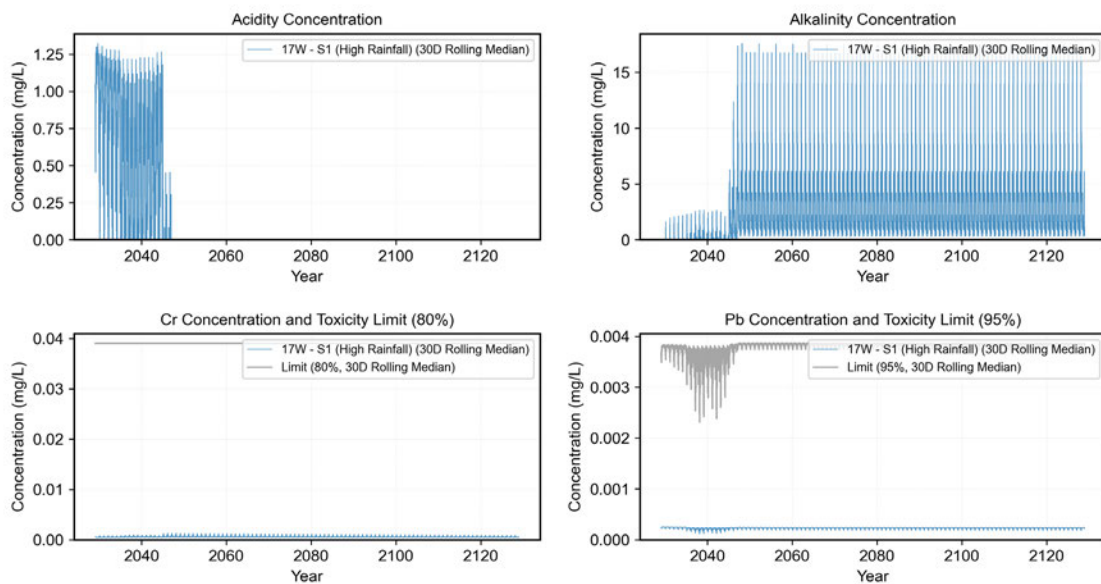


Figure 251: Matrix plot S1 (High Rainfall) 17W Acidity Alkalinity Cr Pb

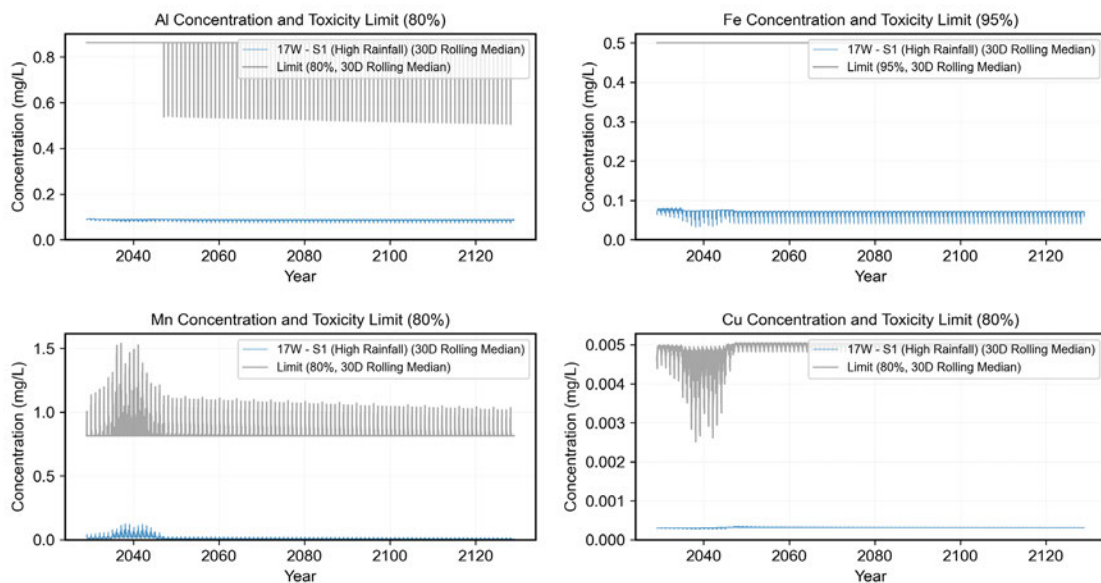


Figure 252: Matrix plot S1 (High Rainfall) 17W Al Fe Mn Cu

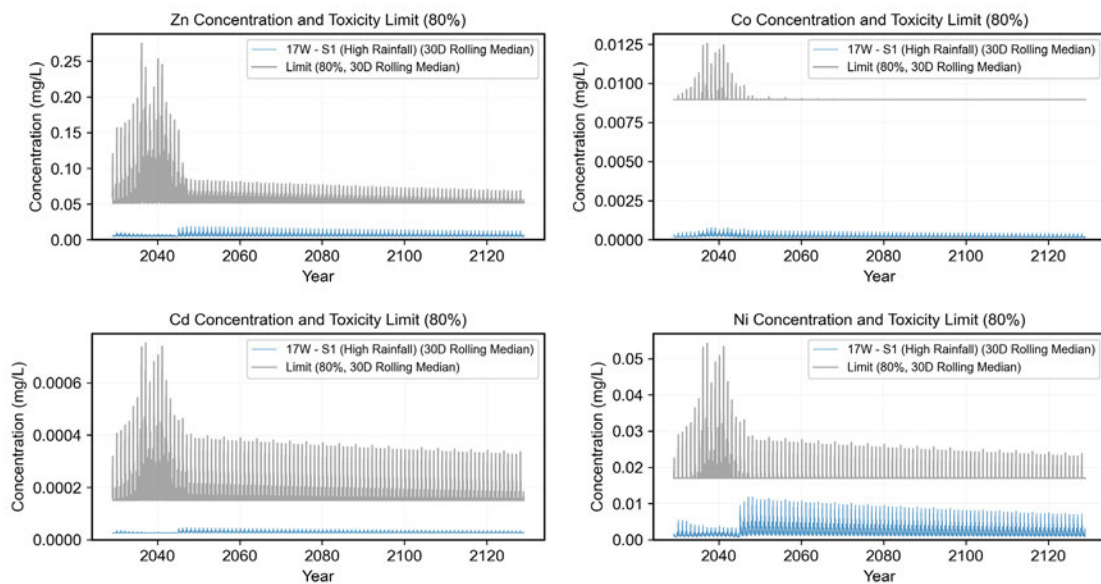


Figure 253: Matrix plot S1 (High Rainfall) 17W Zn Co Cd Ni

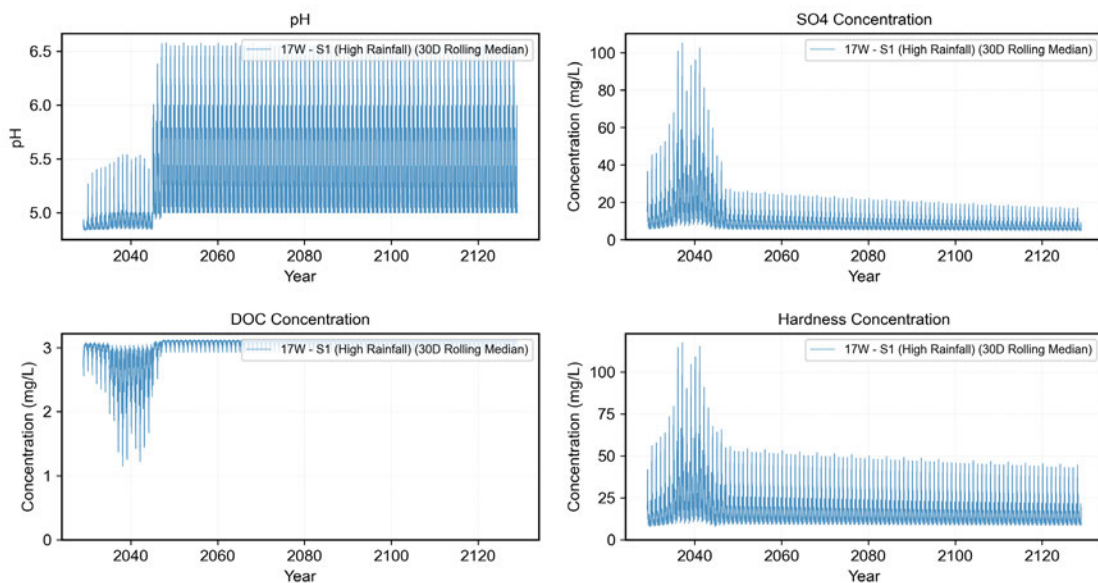


Figure 254: Matrix plot S1 (High Rainfall) 17W pH SO4 DOC Hardness

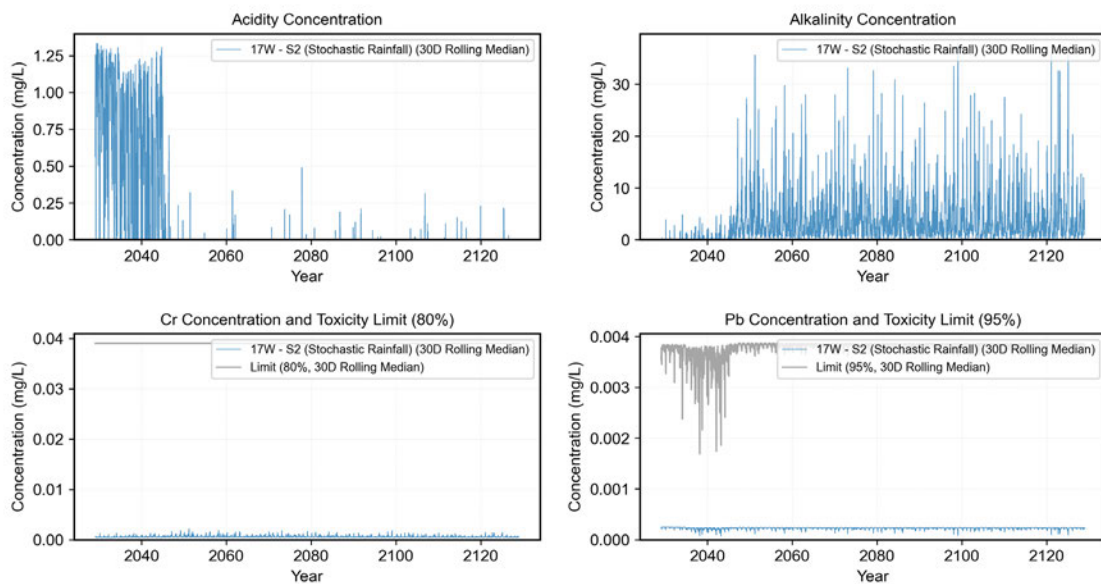


Figure 255: Matrix plot S2 (Stochastic Rainfall) 17W Acidity Alkalinity Cr Pb

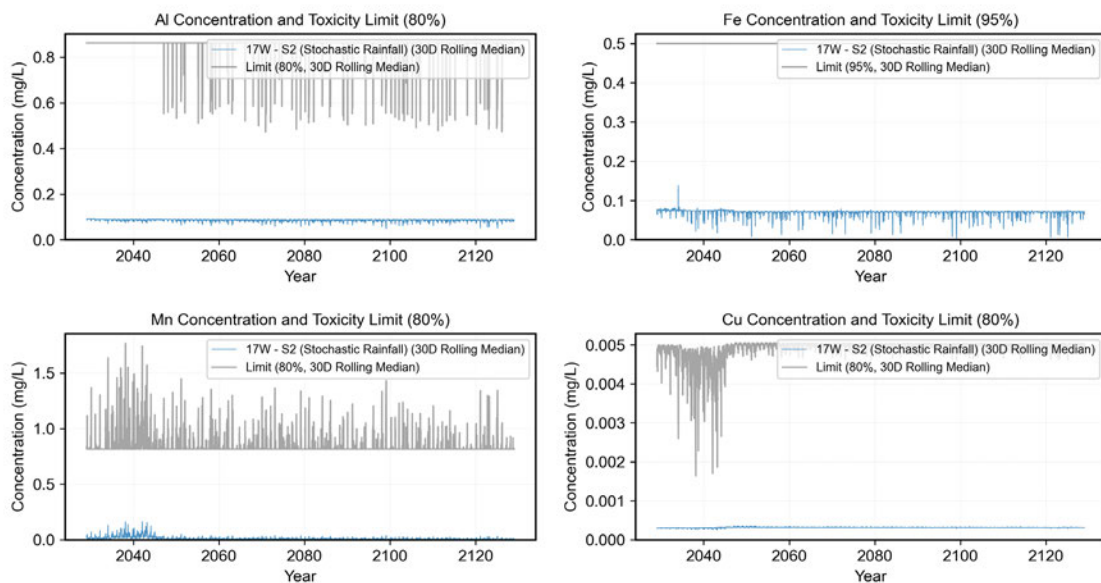


Figure 256: Matrix plot S2 (Stochastic Rainfall) 17W Al Fe Mn Cu

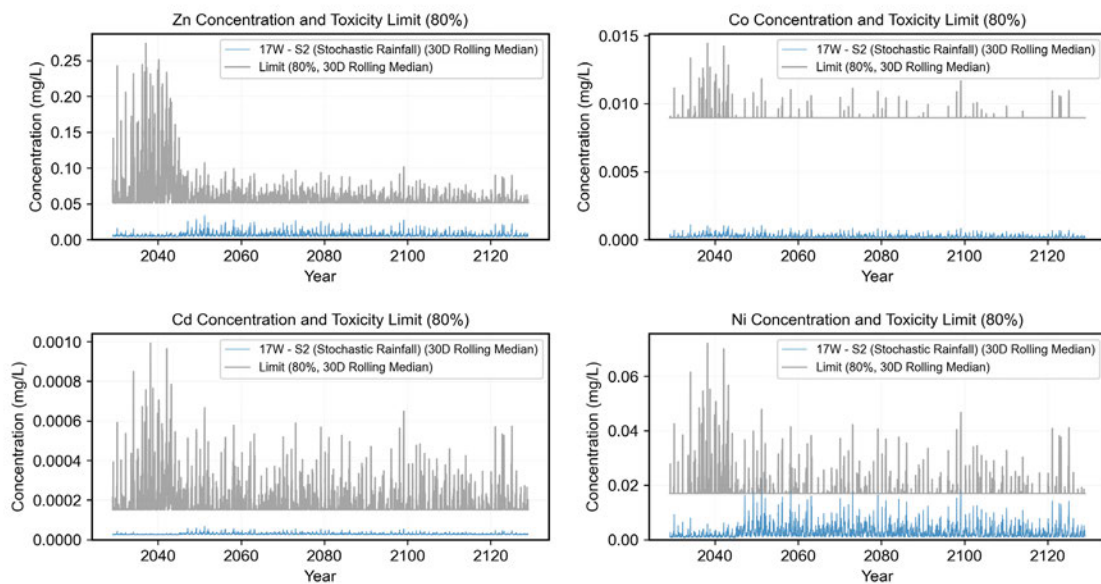


Figure 257: Matrix plot S2 (Stochastic Rainfall) 17W Zn Co Cd Ni

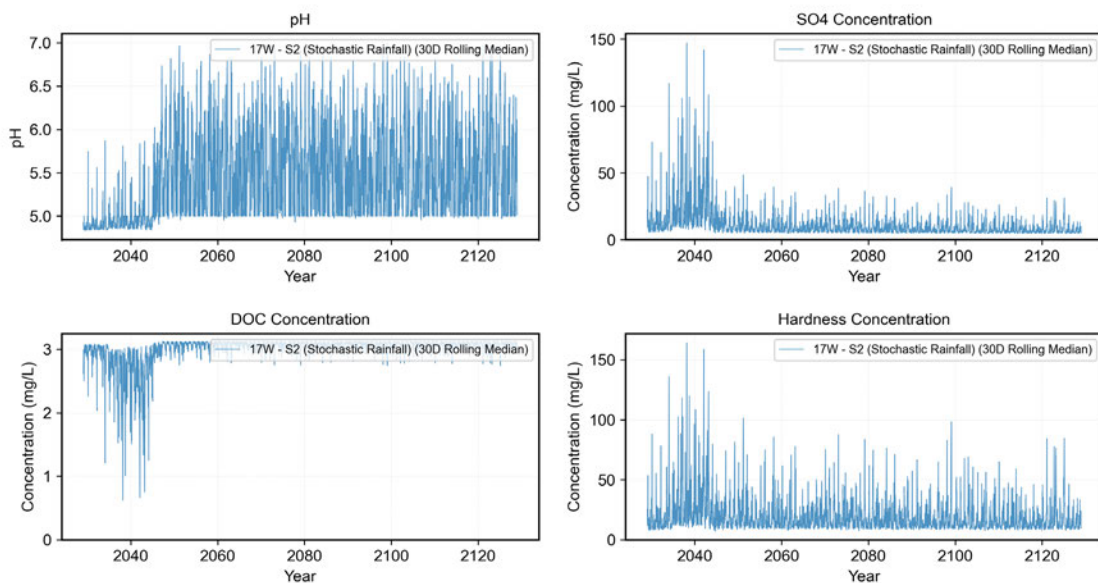


Figure 258: Matrix plot S2 (Stochastic Rainfall) 17W pH SO₄ DOC Hardness

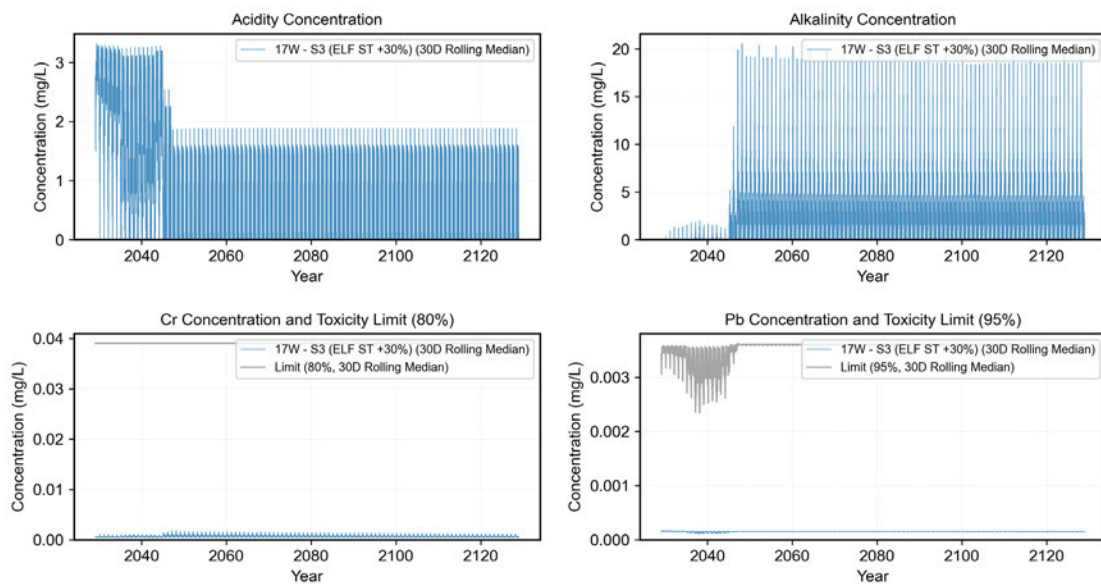


Figure 259: Matrix plot S3 (Elf St +30%) 17W Acidity Alkalinity Cr Pb

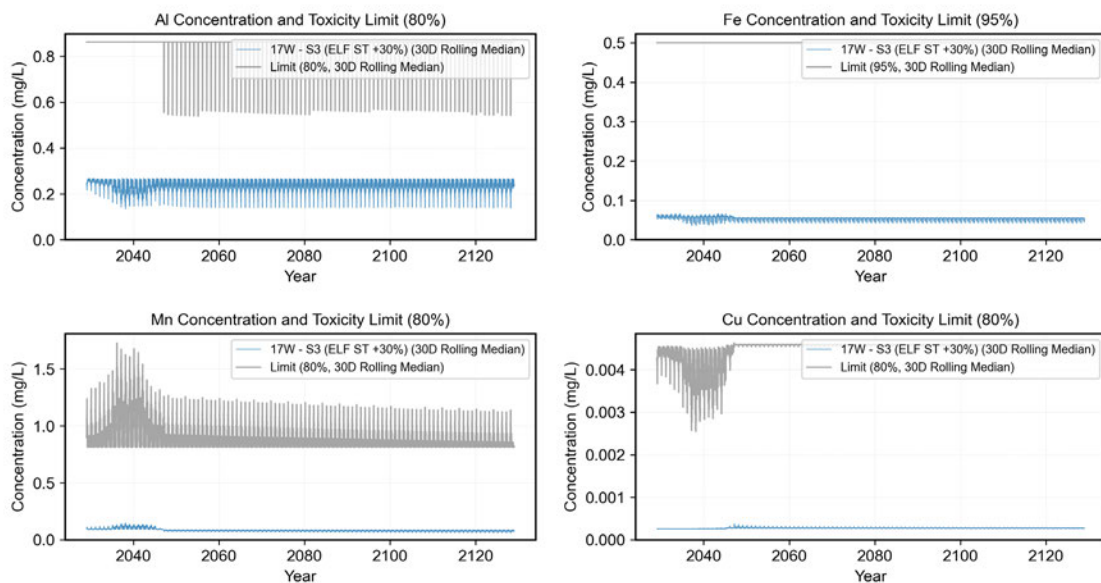


Figure 260: Matrix plot S3 (Elf St +30%) 17W Al Fe Mn Cu

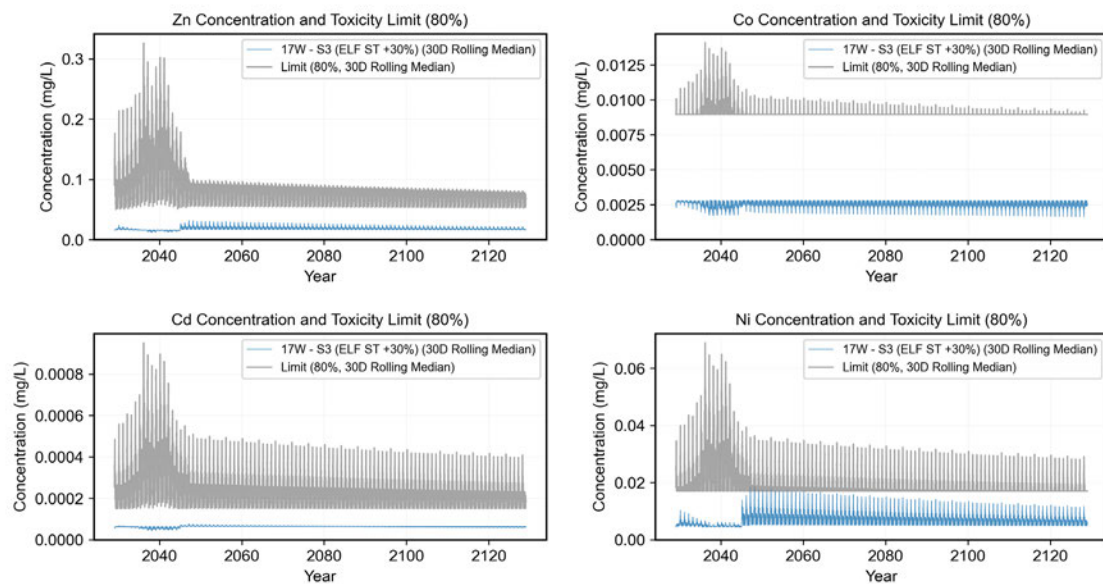


Figure 261: Matrix plot S3 (Elf St +30%) 17W Zn Co Cd Ni

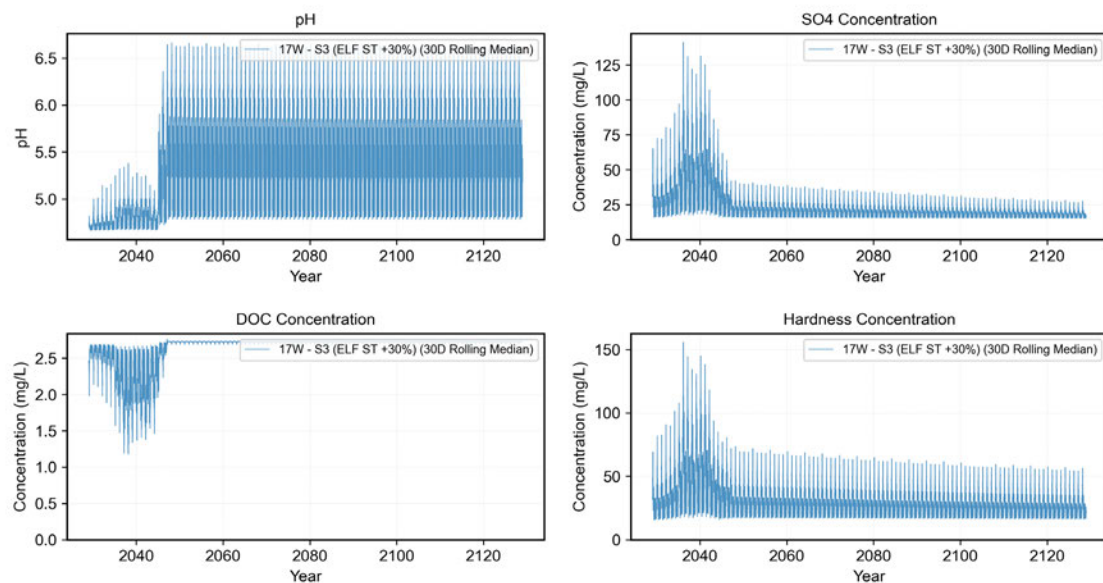


Figure 262: Matrix plot S3 (Elf St +30%) 17W pH SO4 DOC Hardness

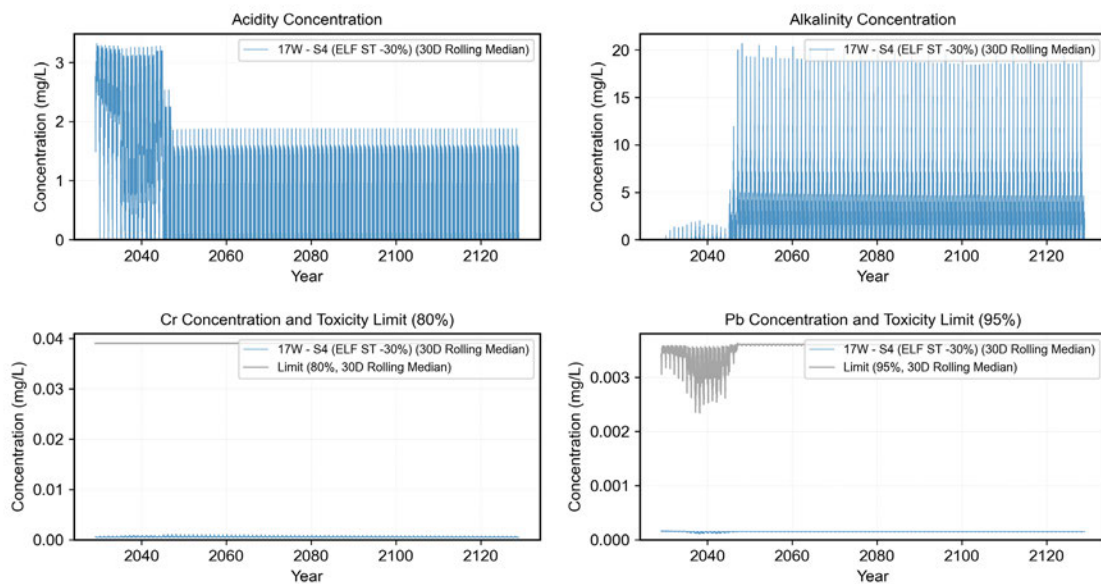


Figure 263: Matrix plot S4 (Elf St 30%) 17W Acidity Alkalinity Cr Pb

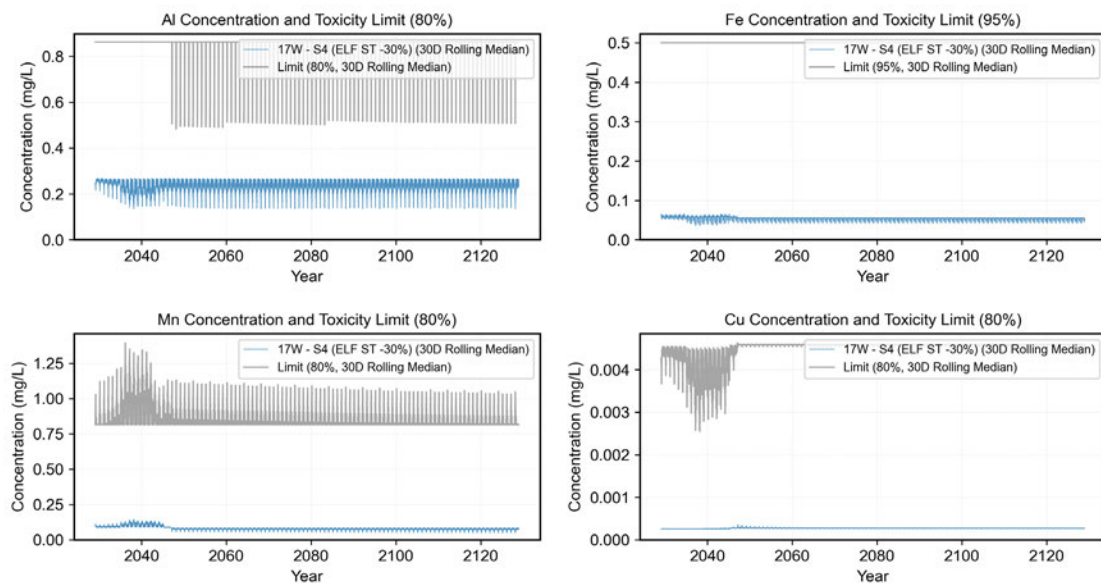


Figure 264: Matrix plot S4 (Elf St 30%) 17W Al Fe Mn Cu

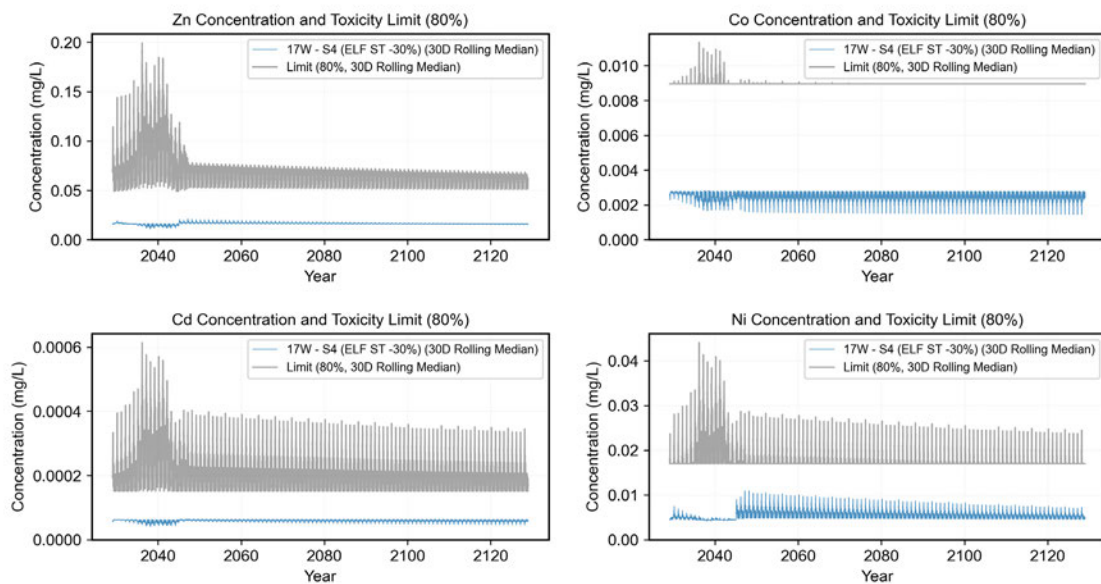


Figure 265: Matrix plot S4 (Elf St 30%) 17W Zn Co Cd Ni

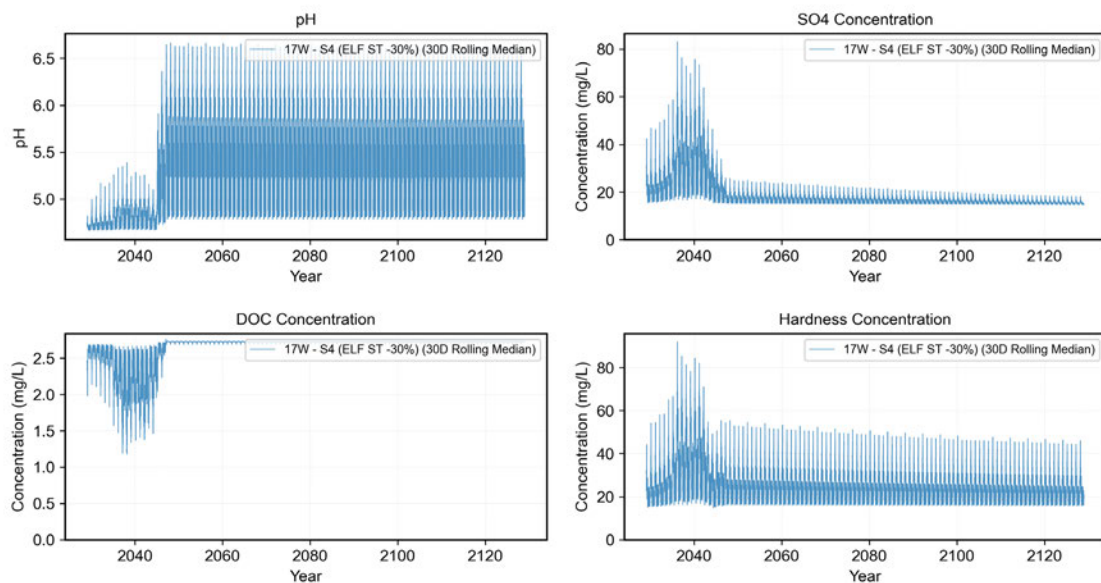
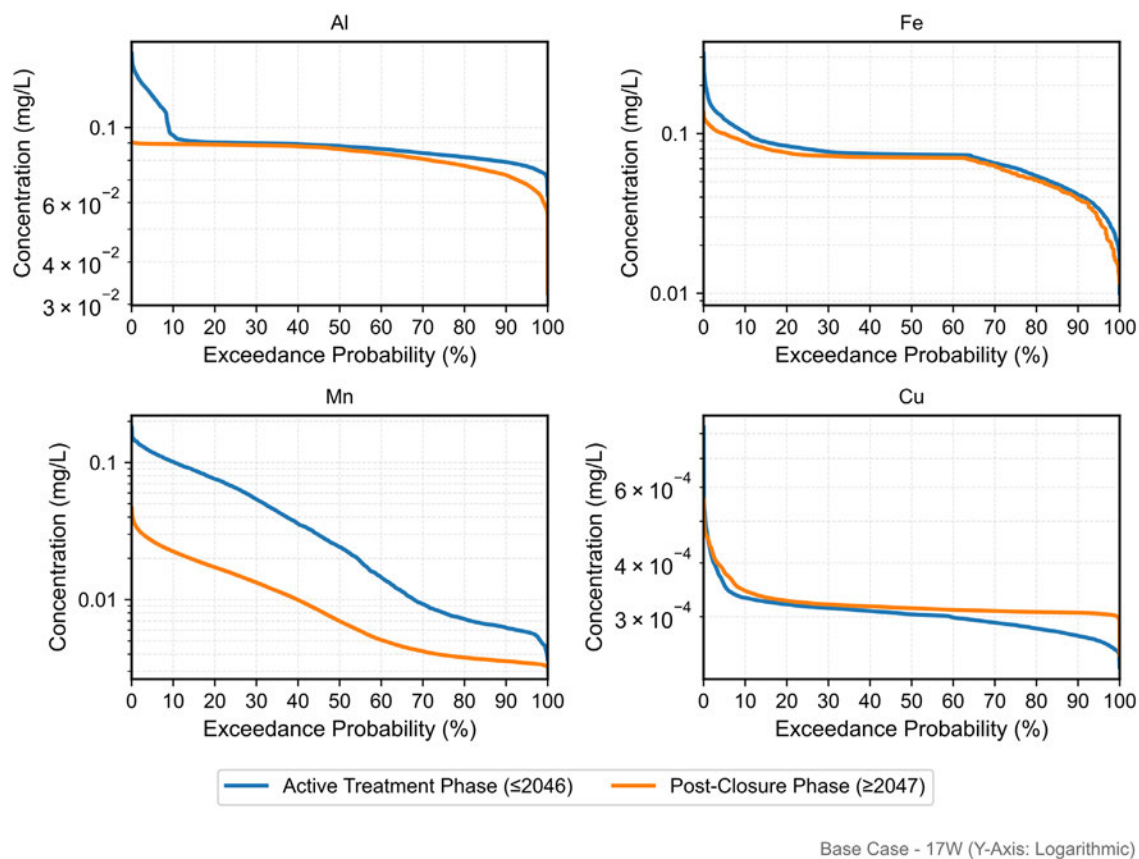


Figure 266: Matrix plot S4 (Elf St 30%) 17W pH SO4 DOC Hardness

4.2 CONCENTRATION EXCEEDANCE (SINGLE SCENARIO)**Figure 267:** Base Case 17W Concentration Exceedance Probability Al Fe Mn Cu

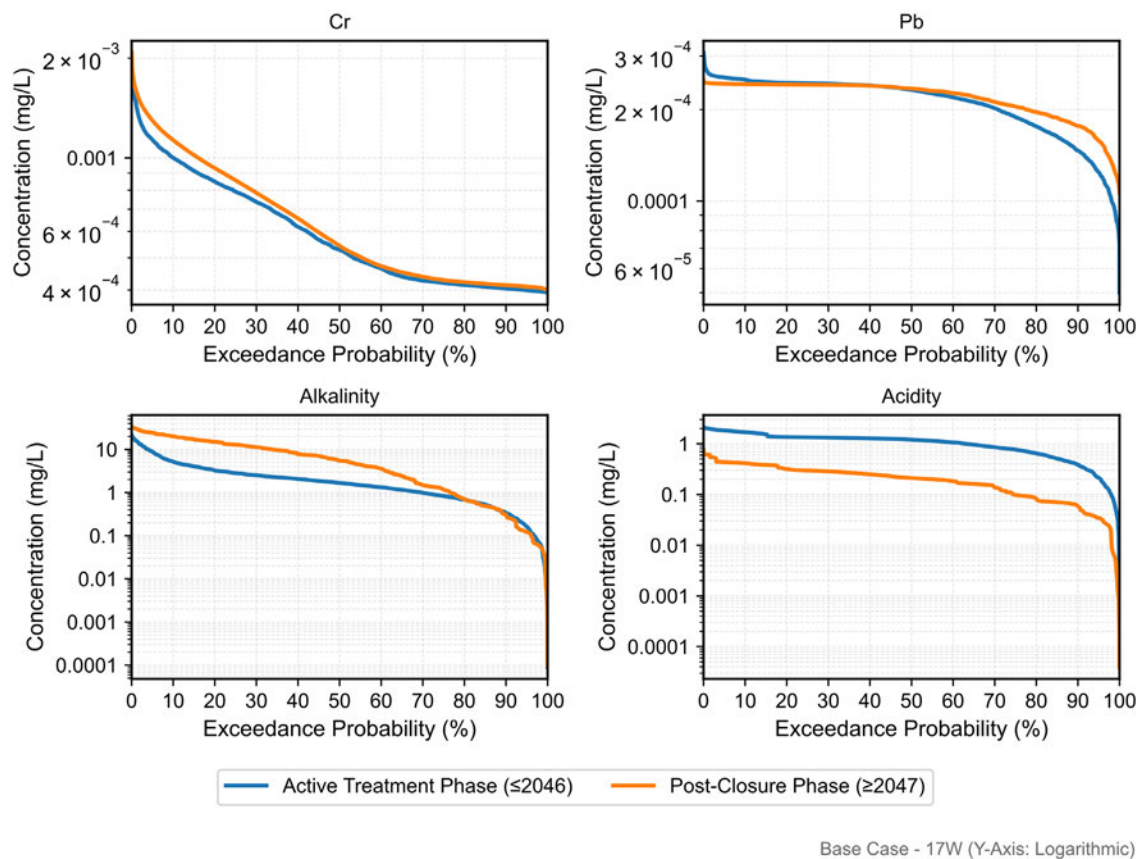


Figure 268: Base Case 17W Concentration Exceedance Probability Cr Pb Alk Acid

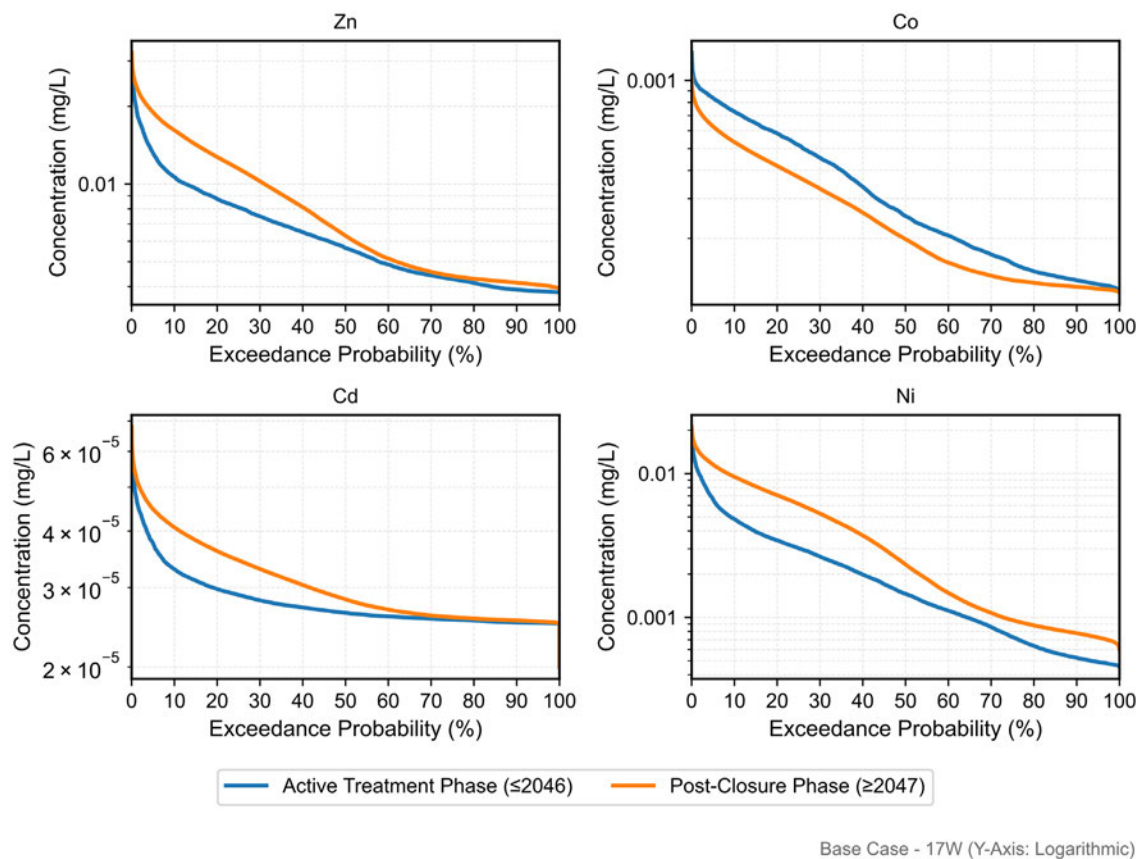


Figure 269: Base Case 17W Concentration Exceedance Probability Zn Co Cd Ni

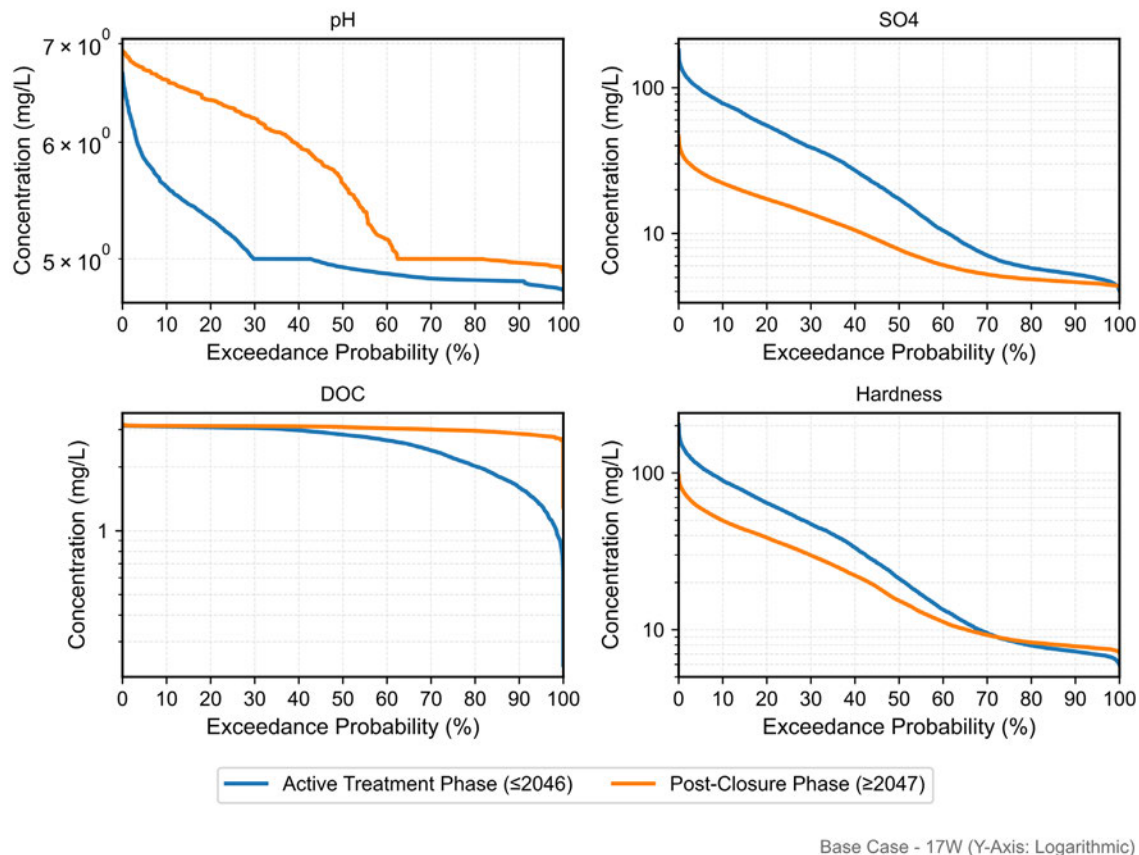


Figure 270: Base Case 17W Concentration Exceedance Probability pH SO4 DOC Hardness

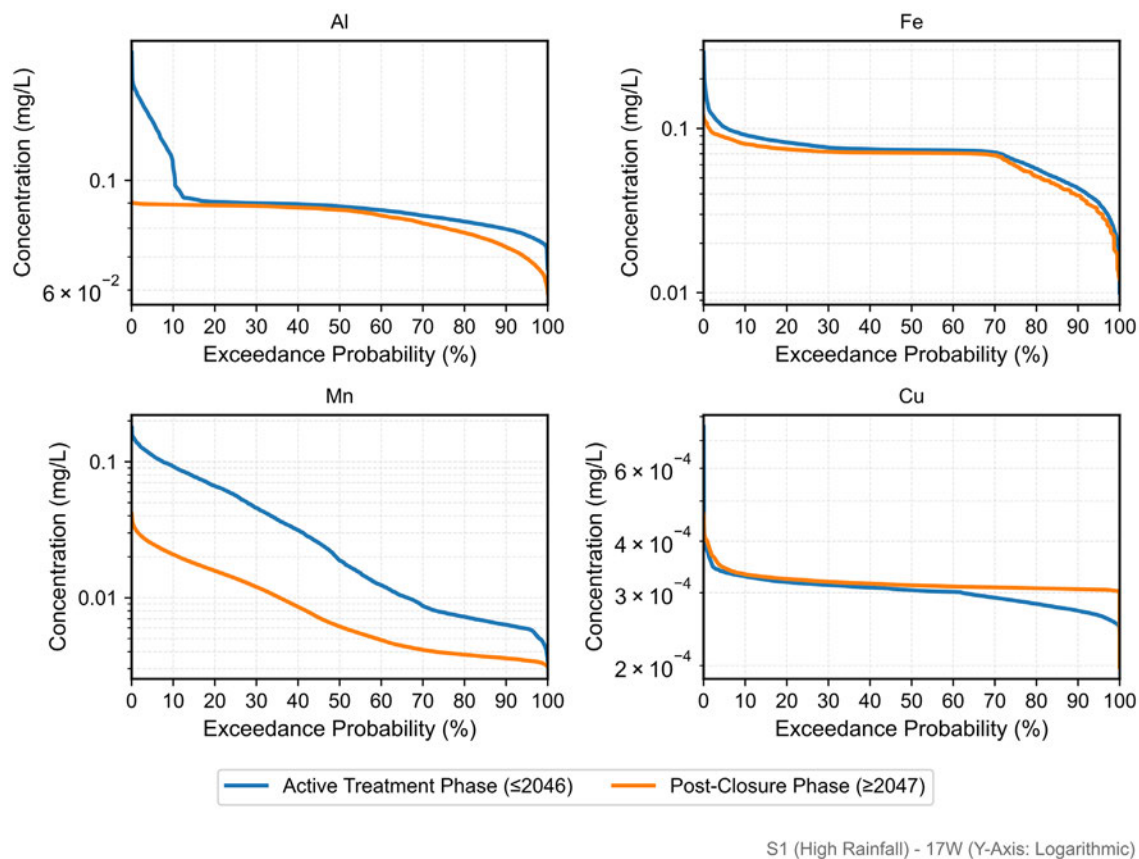


Figure 271: S1 (High Rainfall) 17W Concentration Exceedance Probability Al Fe Mn Cu

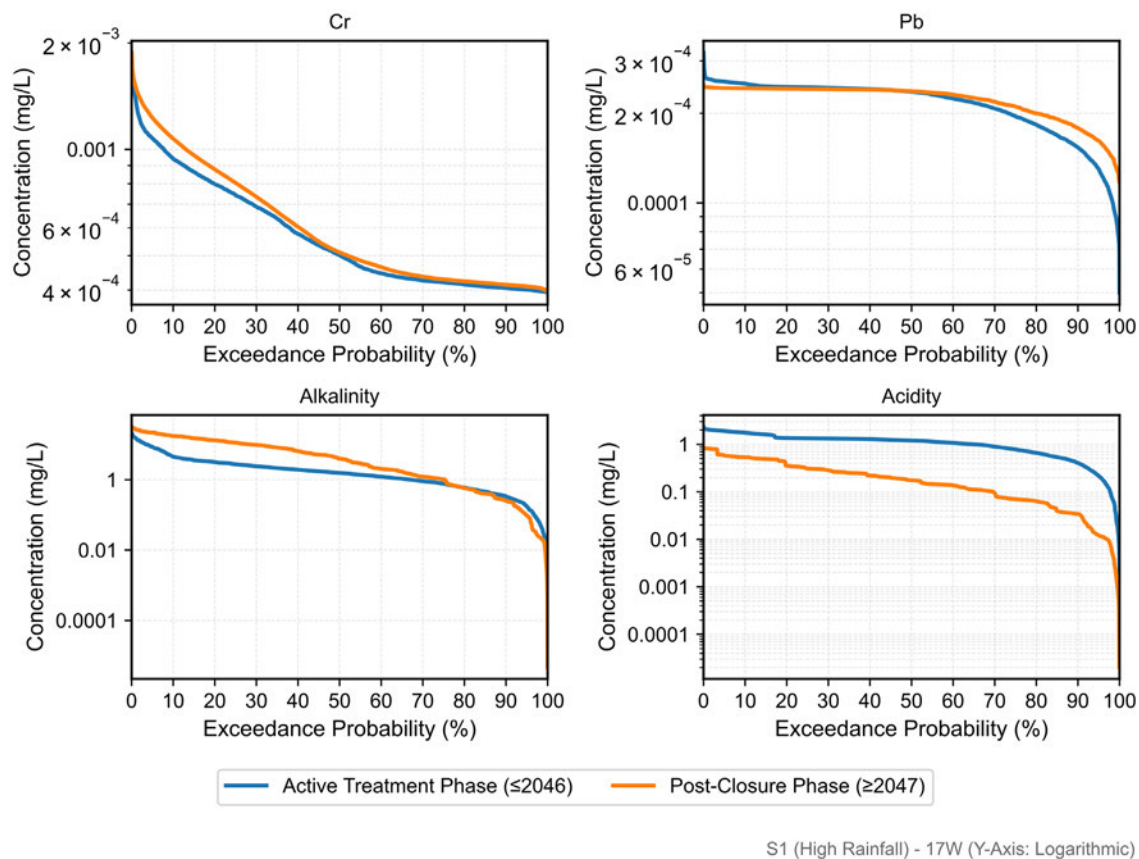


Figure 272: S1 (High Rainfall) 17W Concentration Exceedance Probability Cr Pb Alk Acid

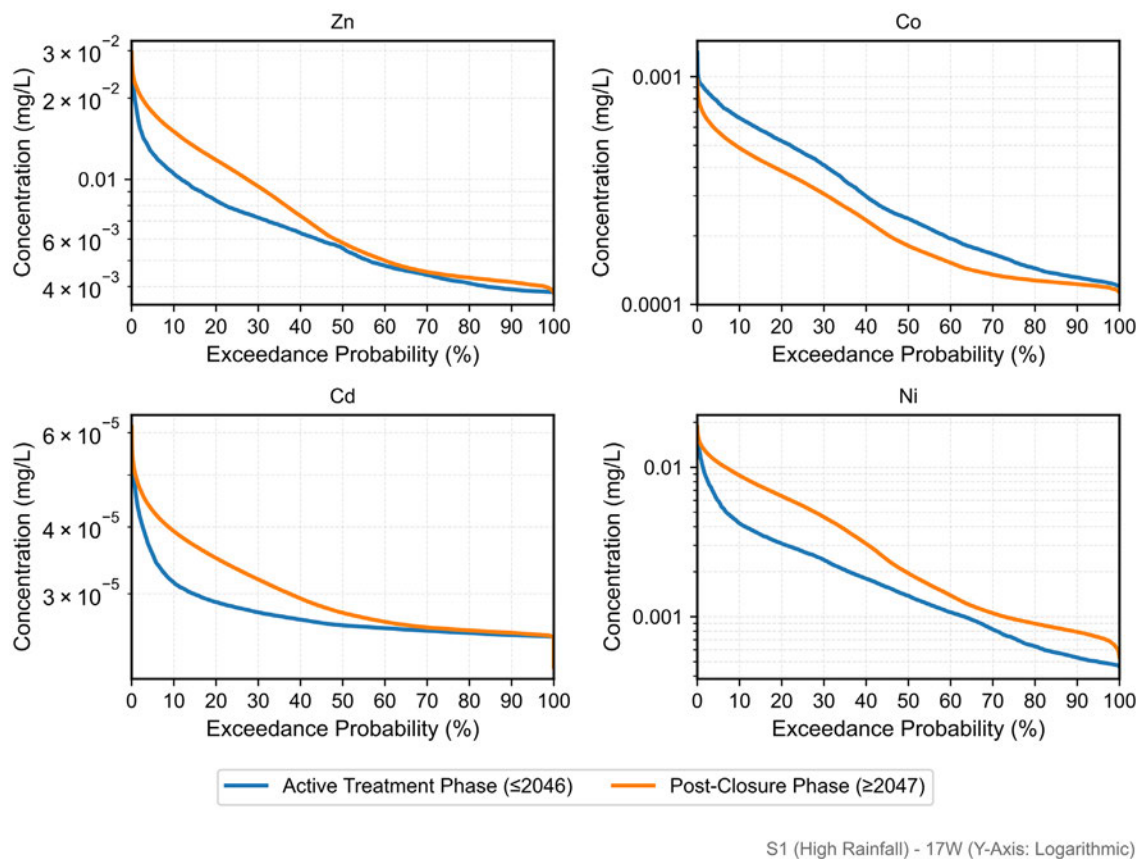


Figure 273: S1 (High Rainfall) 17W Concentration Exceedance Probability Zn Co Cd Ni

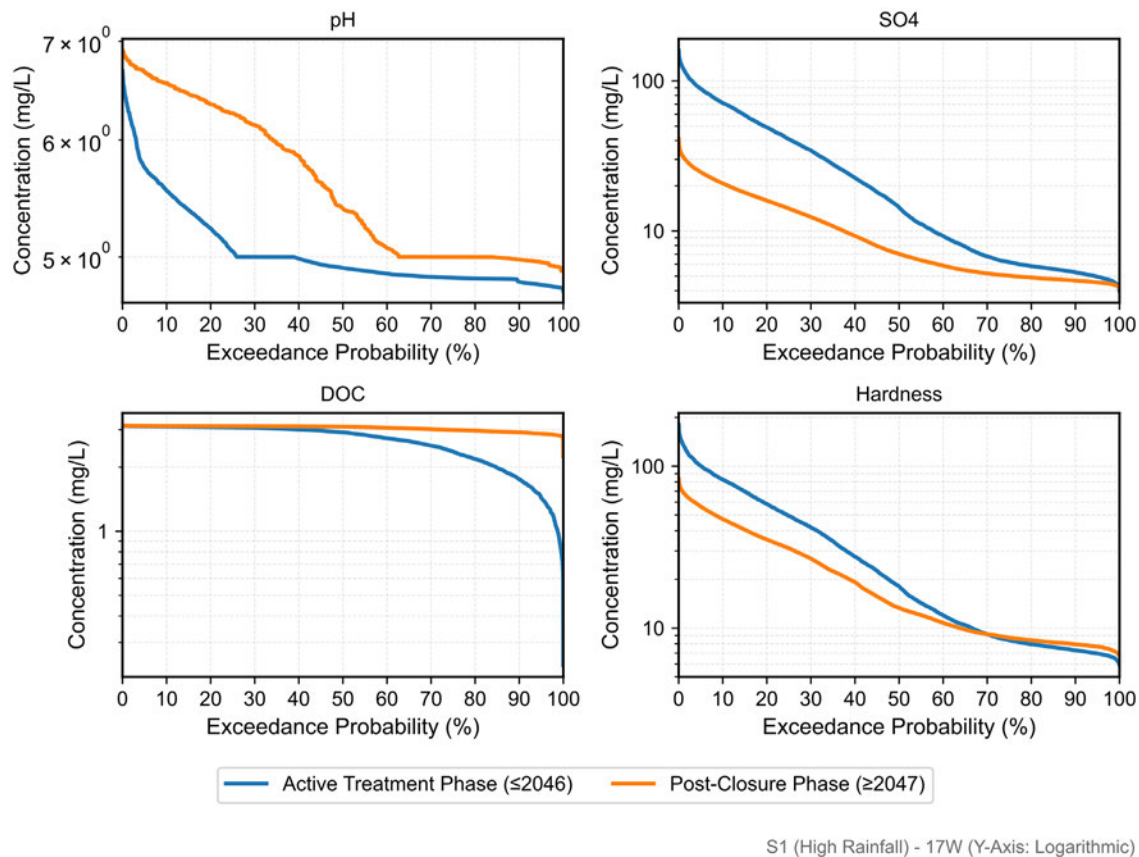


Figure 274: S1 (High Rainfall) 17W Concentration Exceedance Probability pH SO₄ DOC Hardness

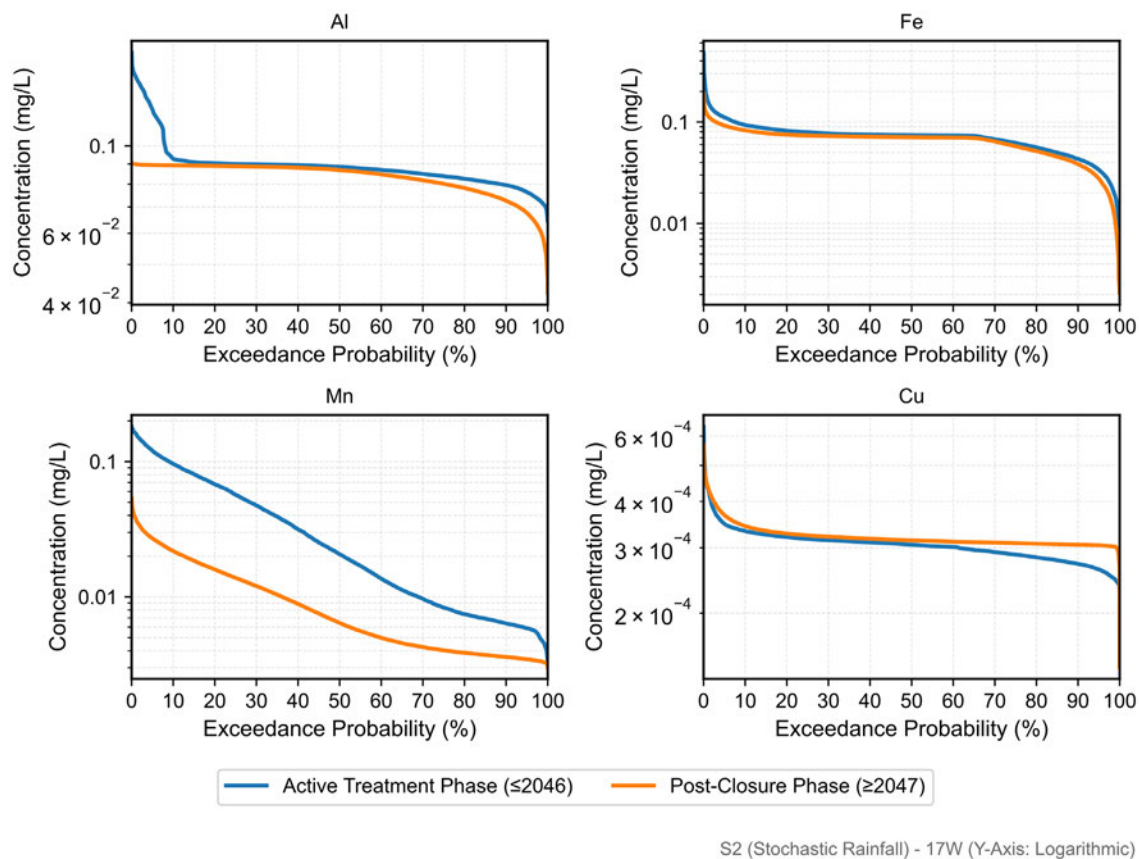


Figure 275: S2 (Stochastic Rainfall) 17W Concentration Exceedance Probability Al Fe Mn Cu

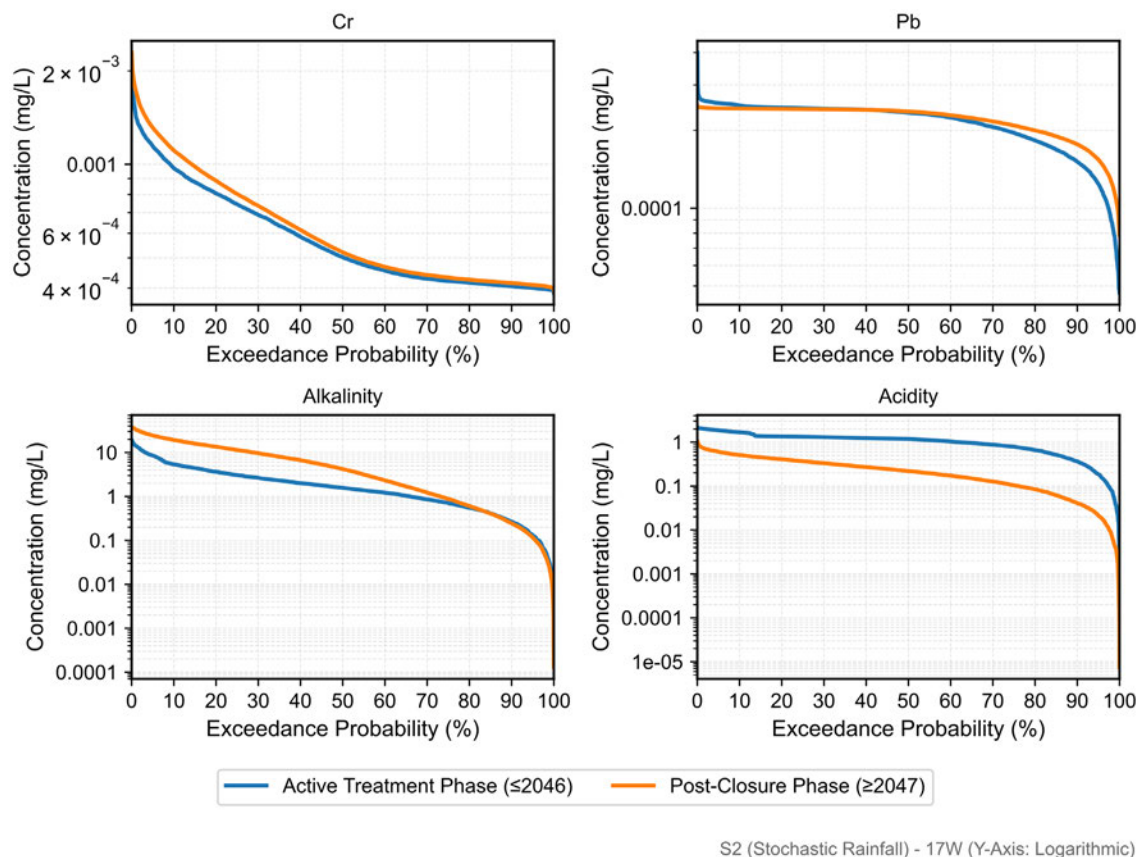


Figure 276: S2 (Stochastic Rainfall) 17W Concentration Exceedance Probability Cr Pb Alk Acid

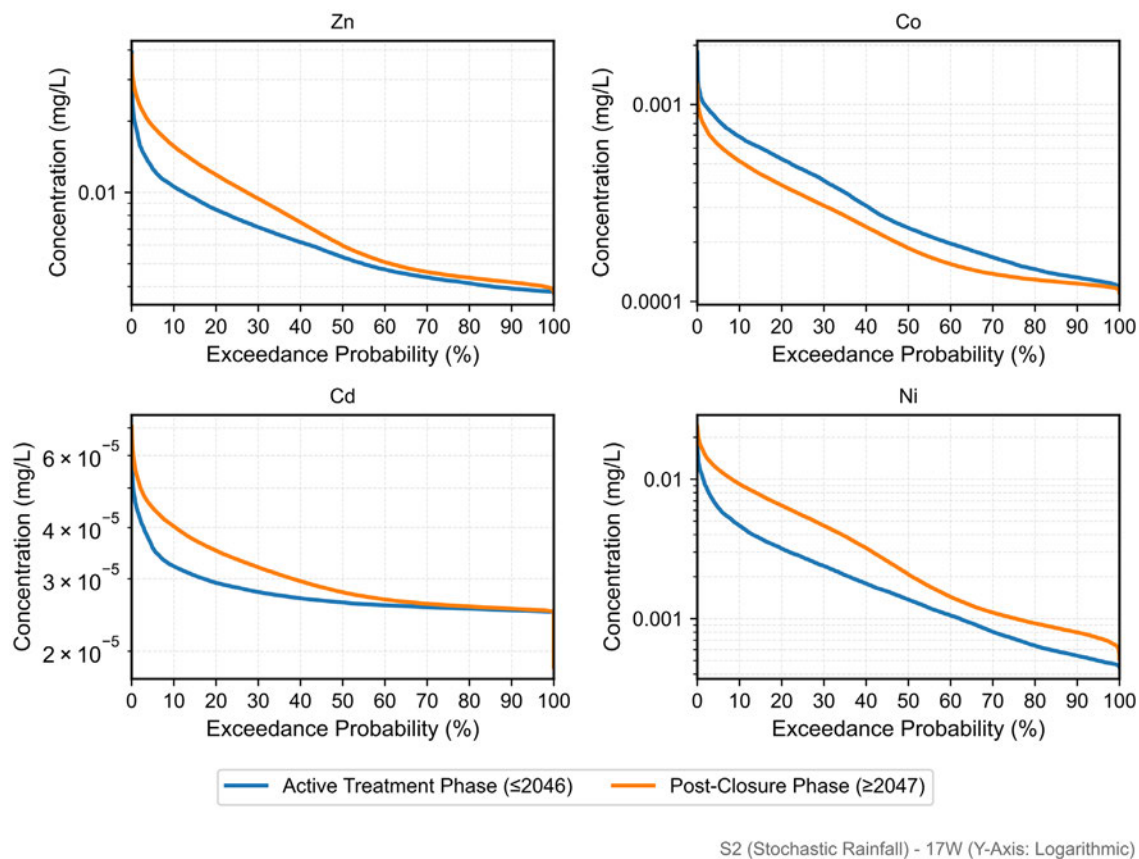


Figure 277: S2 (Stochastic Rainfall) 17W Concentration Exceedance Probability Zn Co Cd Ni

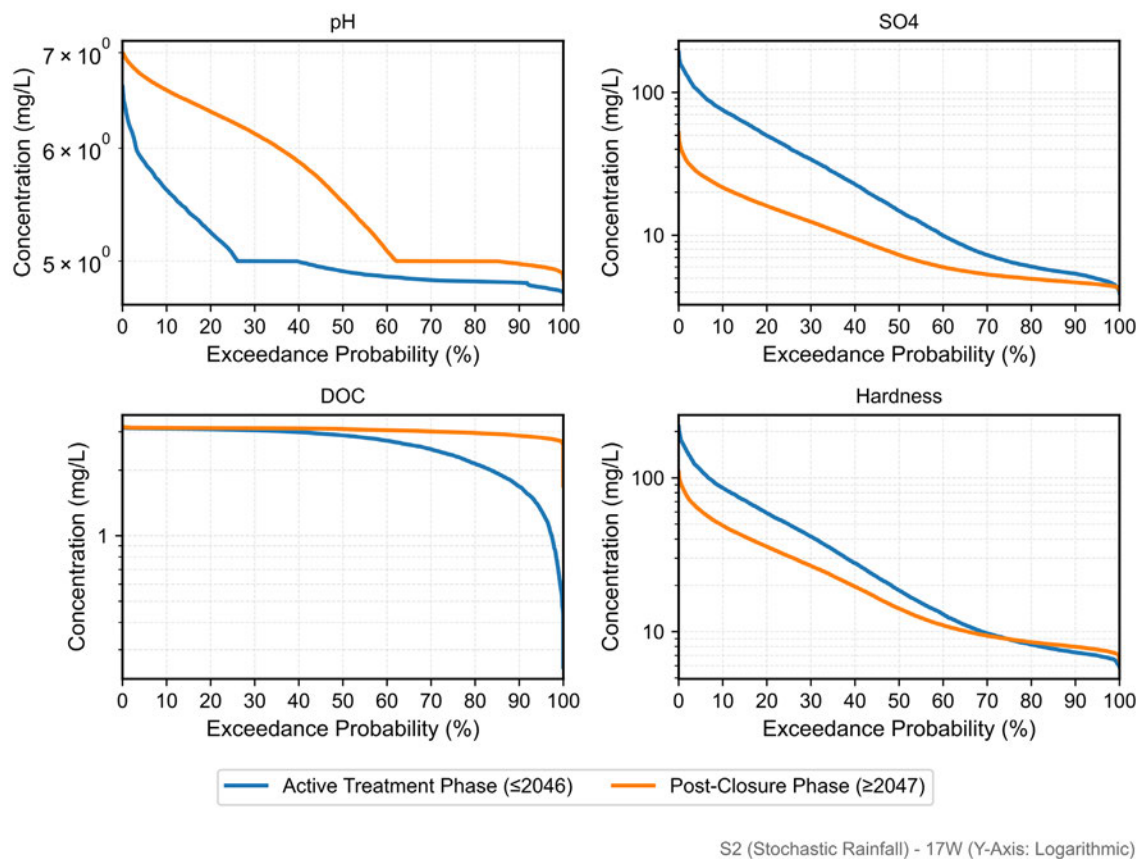


Figure 278: S2 (Stochastic Rainfall) 17W Concentration Exceedance Probability pH SO₄ DOC Hardness

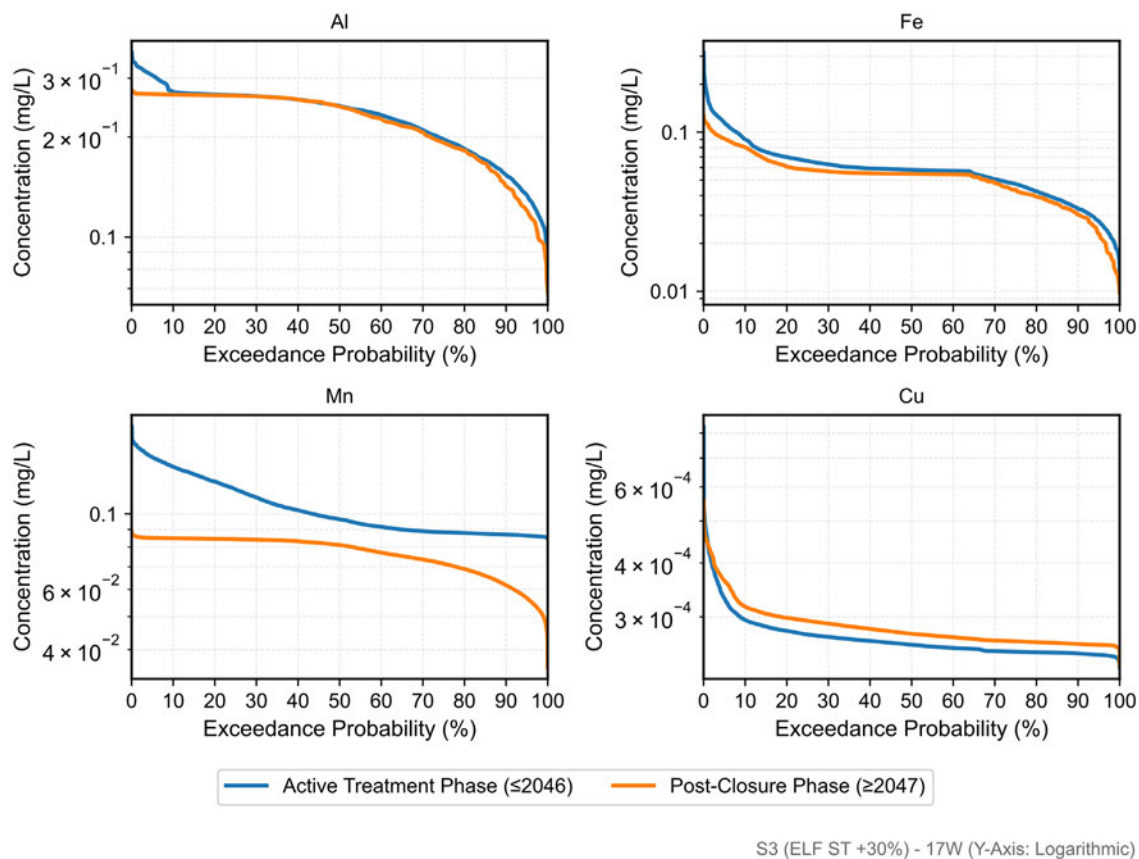


Figure 279: S3 (Elf St +30%) 17W Concentration Exceedance Probability Al Fe Mn Cu

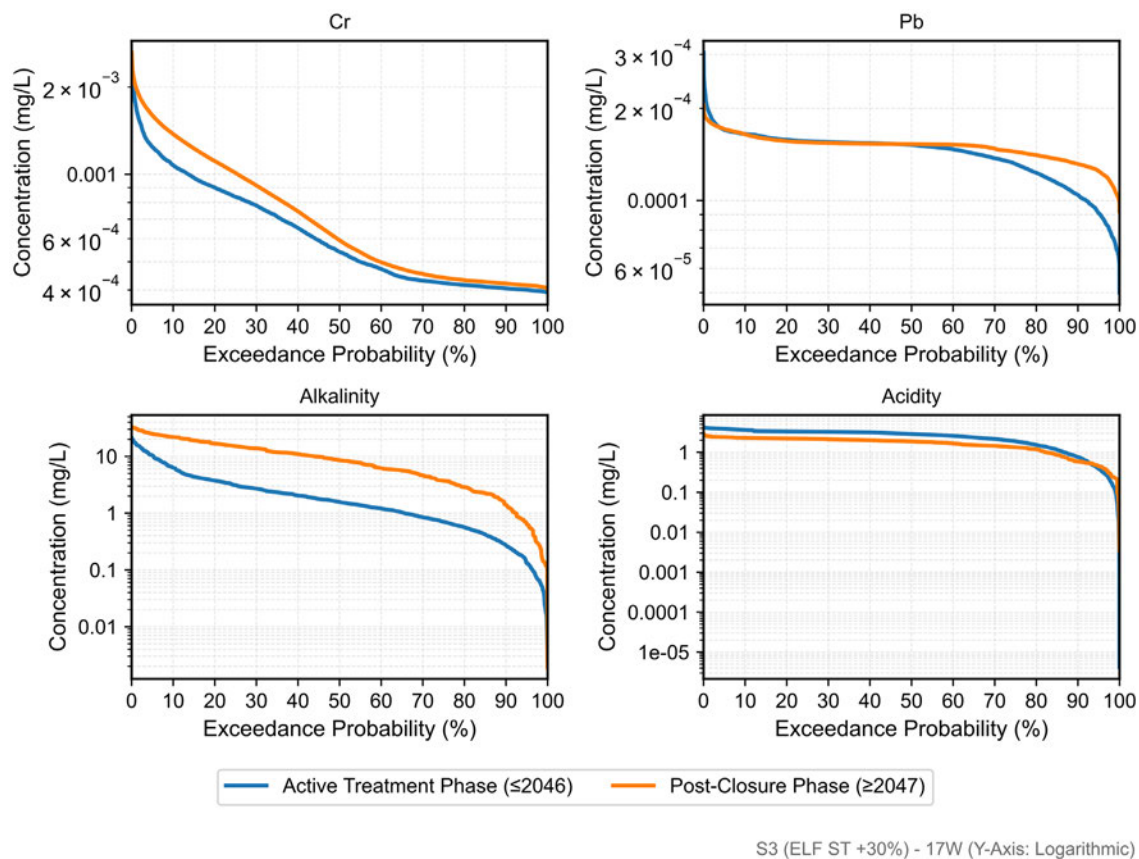


Figure 280: S3 (Elf St +30%) 17W Concentration Exceedance Probability Cr Pb Alk Acid

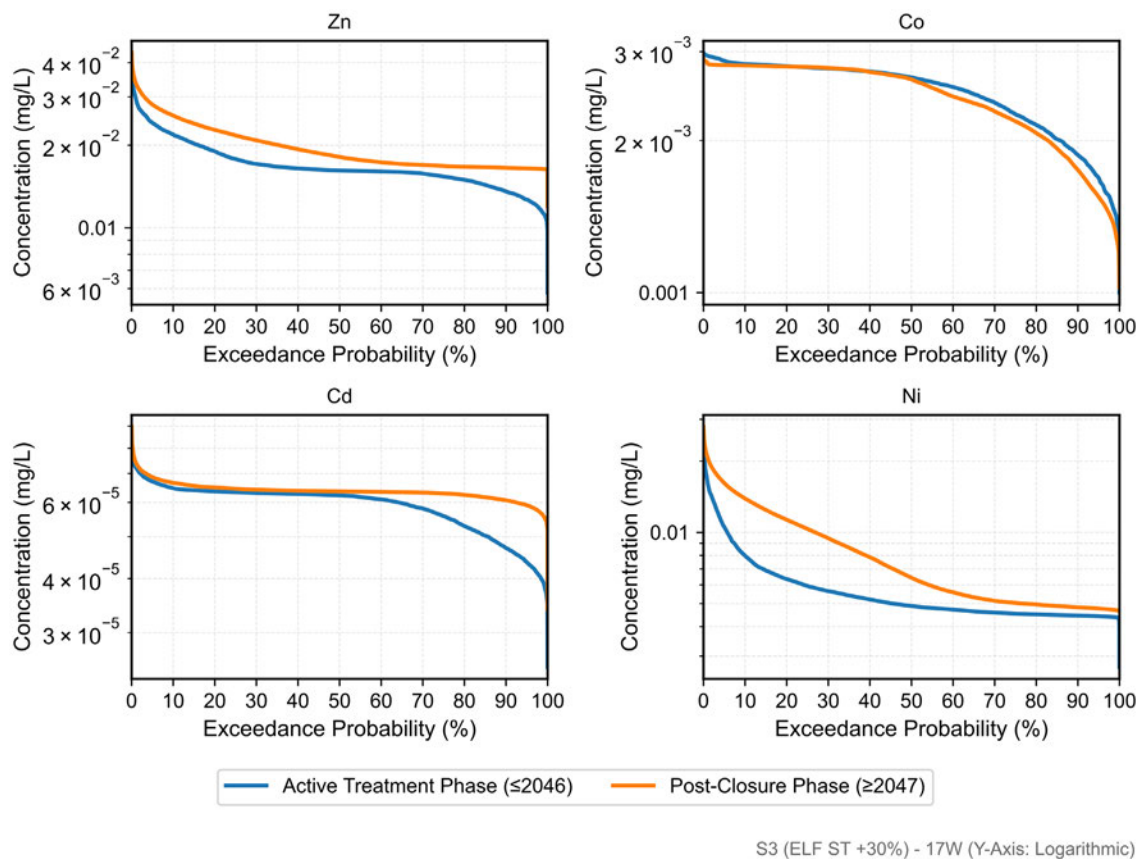


Figure 281: S3 (Elf St +30%) 17W Concentration Exceedance Probability Zn Co Cd Ni

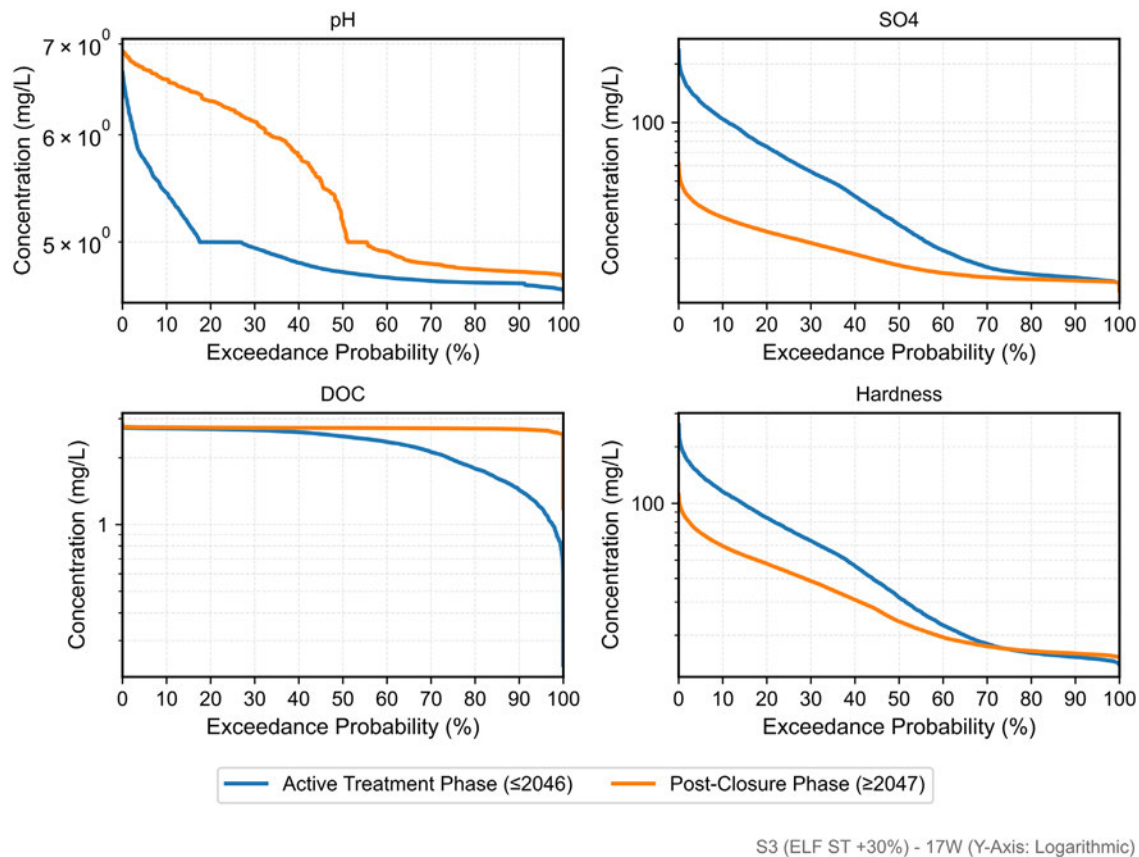
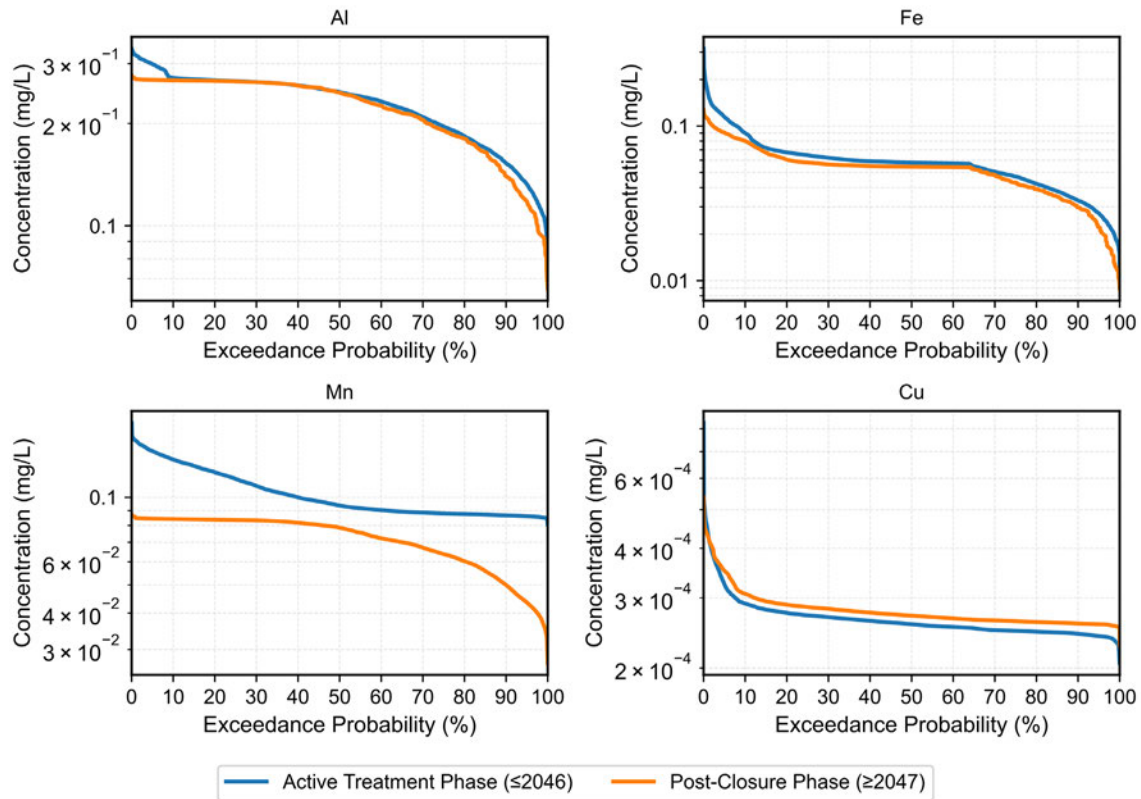


Figure 282: S3 (Elf St +30%) 17W Concentration Exceedance Probability pH SO₄ DOC Hardness



S4 (ELF ST -30%) - 17W (Y-Axis: Logarithmic)

Figure 283: S4 (Elf St 30%) 17W Concentration Exceedance Probability Al Fe Mn Cu

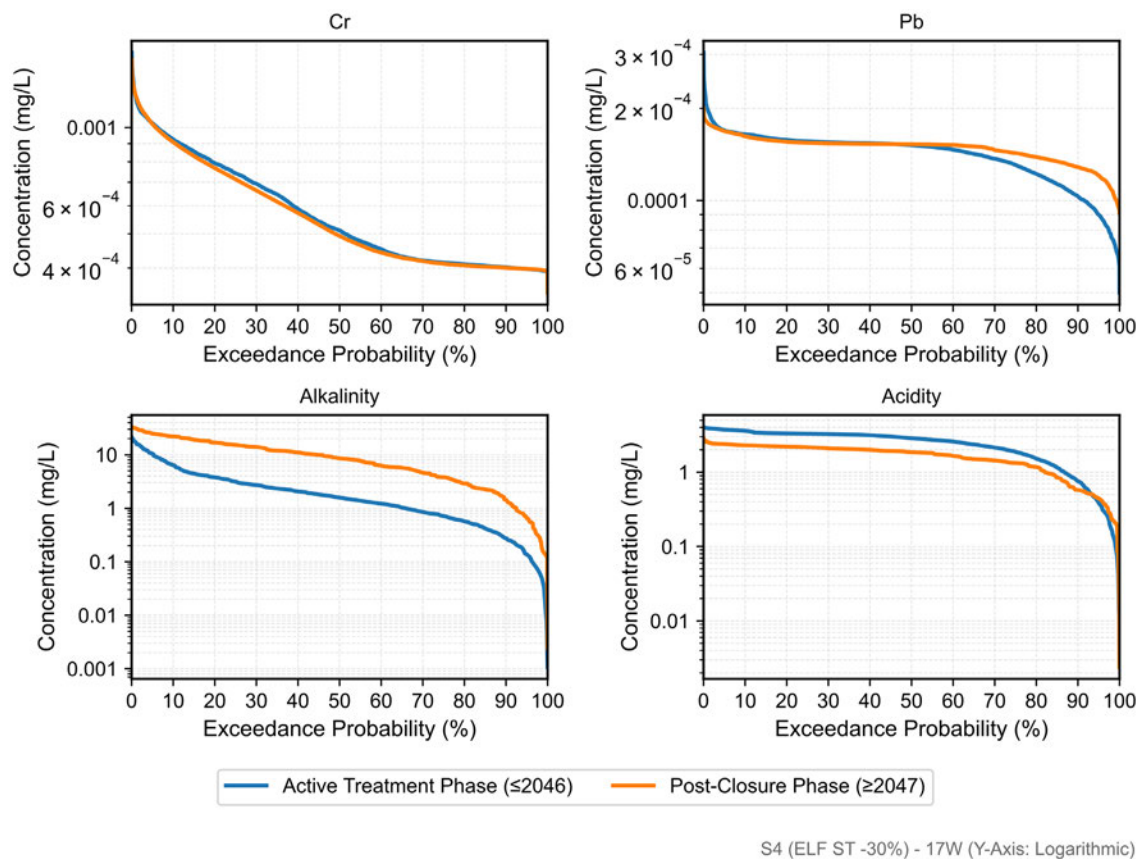


Figure 284: S4 (Elf St 30%) 17W Concentration Exceedance Probability Cr Pb Alk Acid

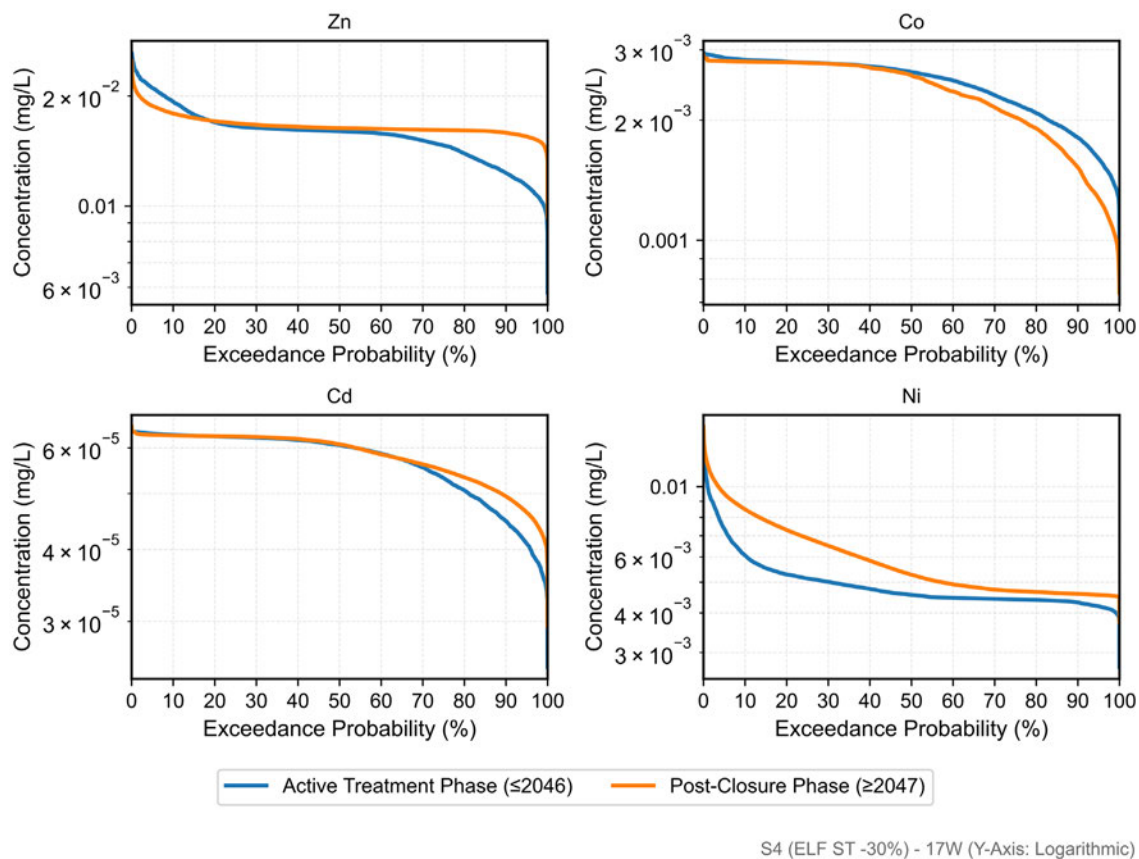


Figure 285: S4 (Elf St 30%) 17W Concentration Exceedance Probability Zn Co Cd Ni

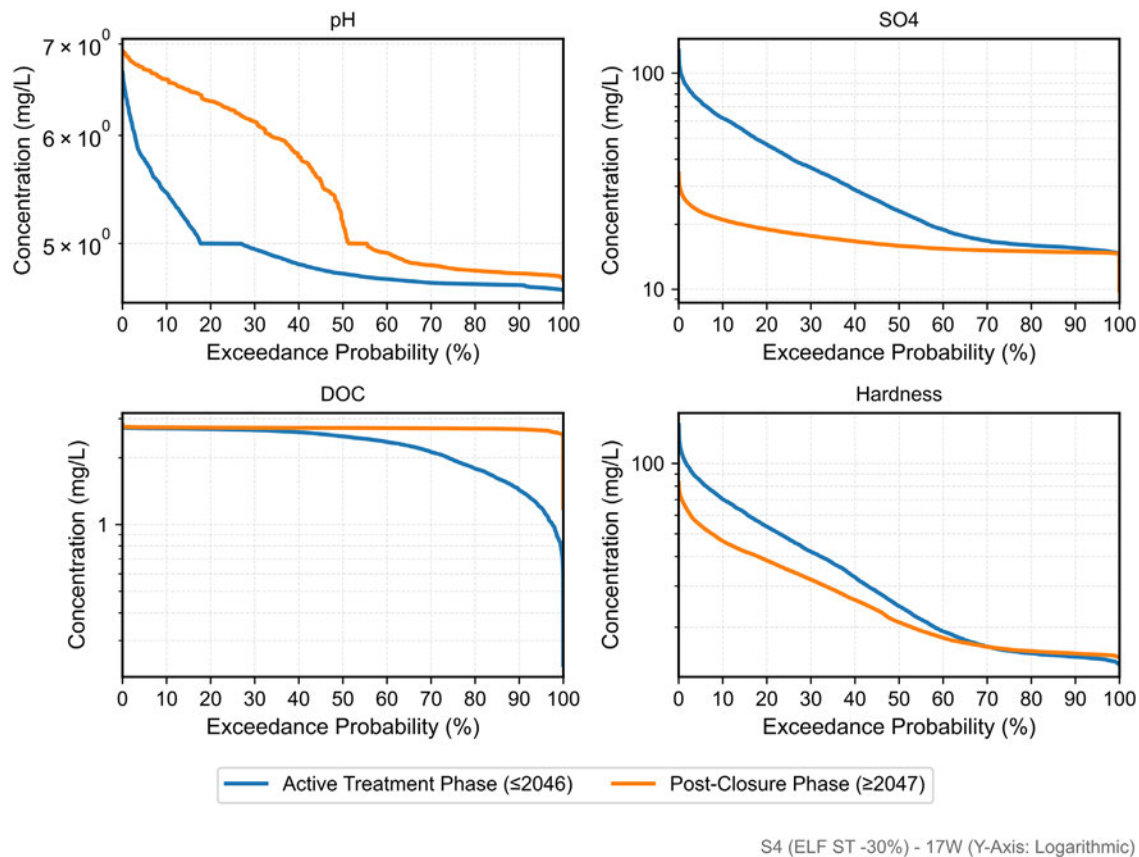
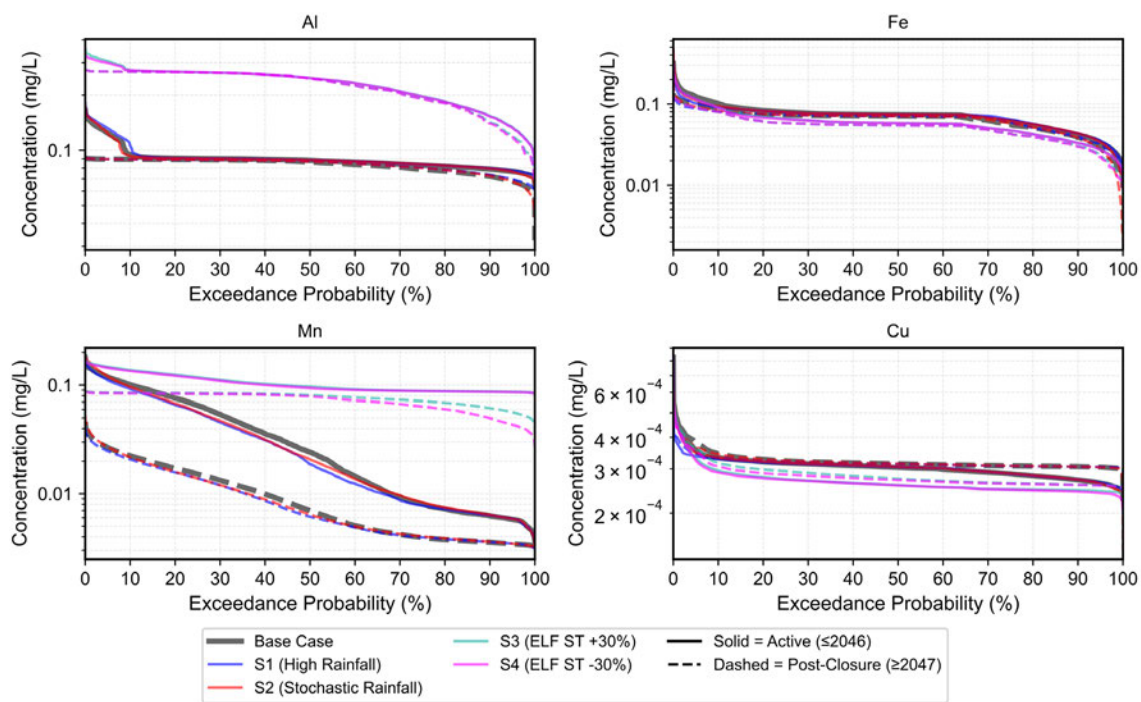


Figure 286: S4 (Elf St 30%) 17W Concentration Exceedance Probability pH SO4 DOC Hardness

4.3 CONCENTRATION EXCEEDANCE (MULTI SCENARIO)



Station: 17W (Y-Axis: Log)

Figure 287: 17W Matrix Plot Scenarios 5 Al Fe Mn Cu Concentration Exceedance Probability

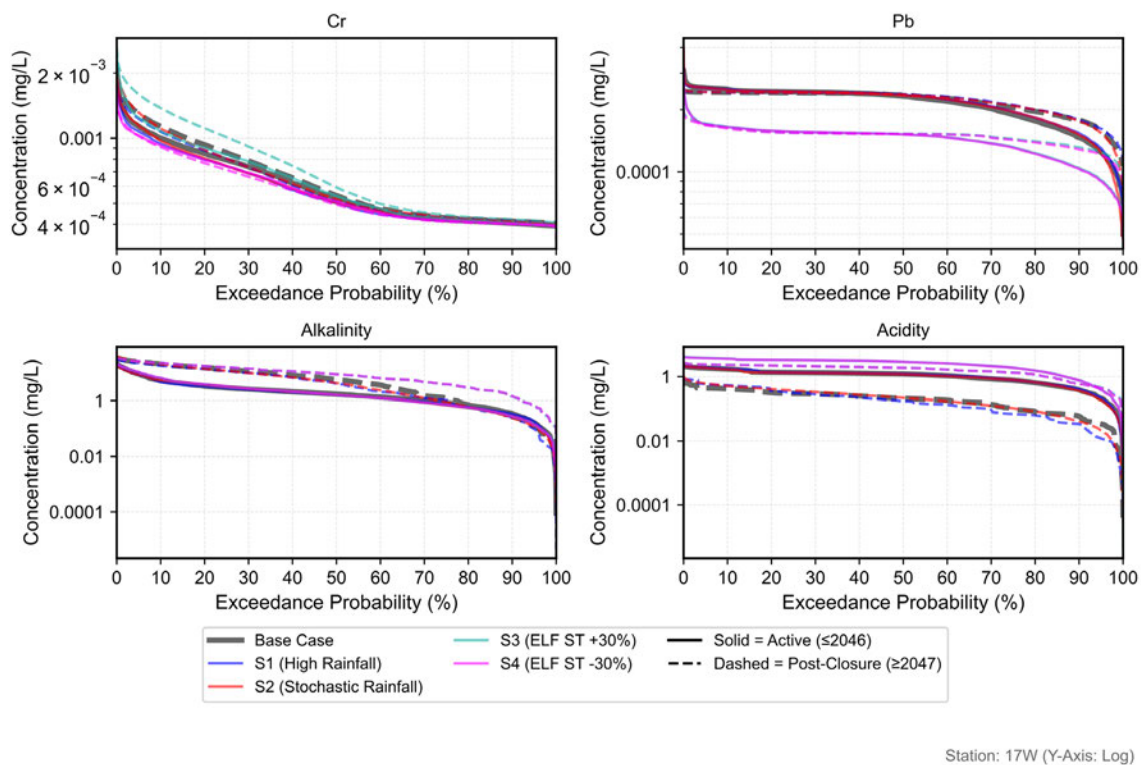


Figure 288: 17W Matrix Plot Scenarios 5 Cr Pb Alk Acid Concentration Exceedance Probability

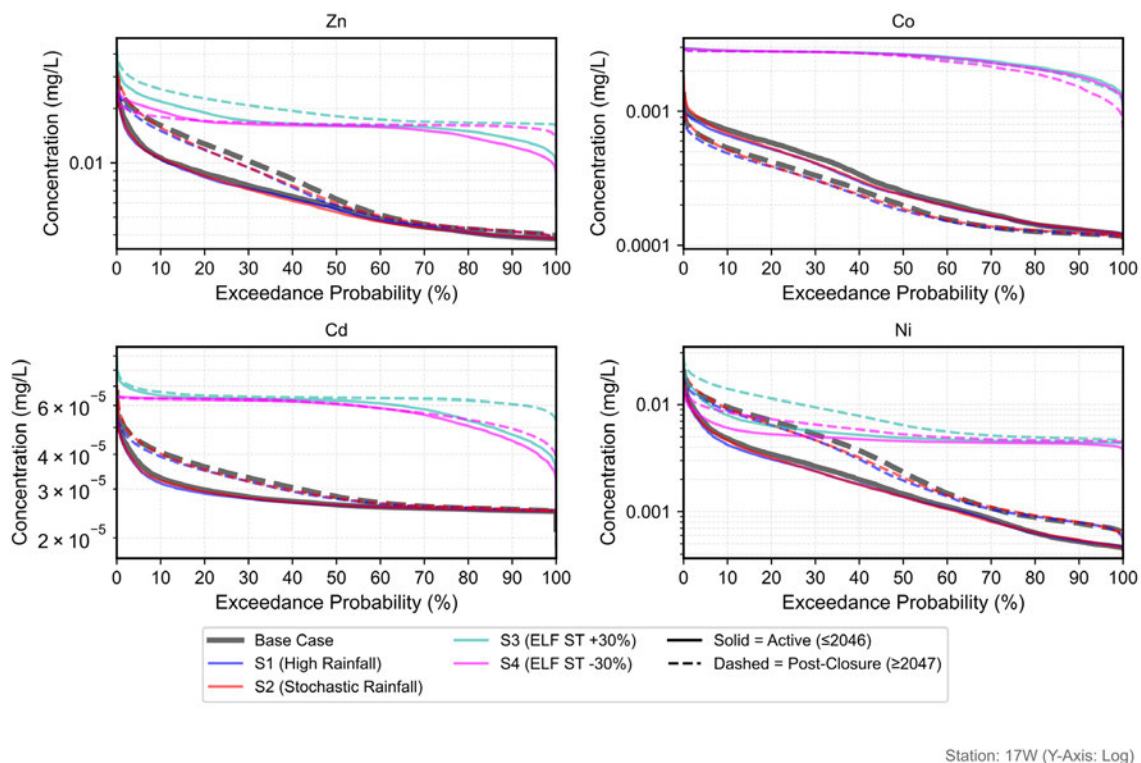
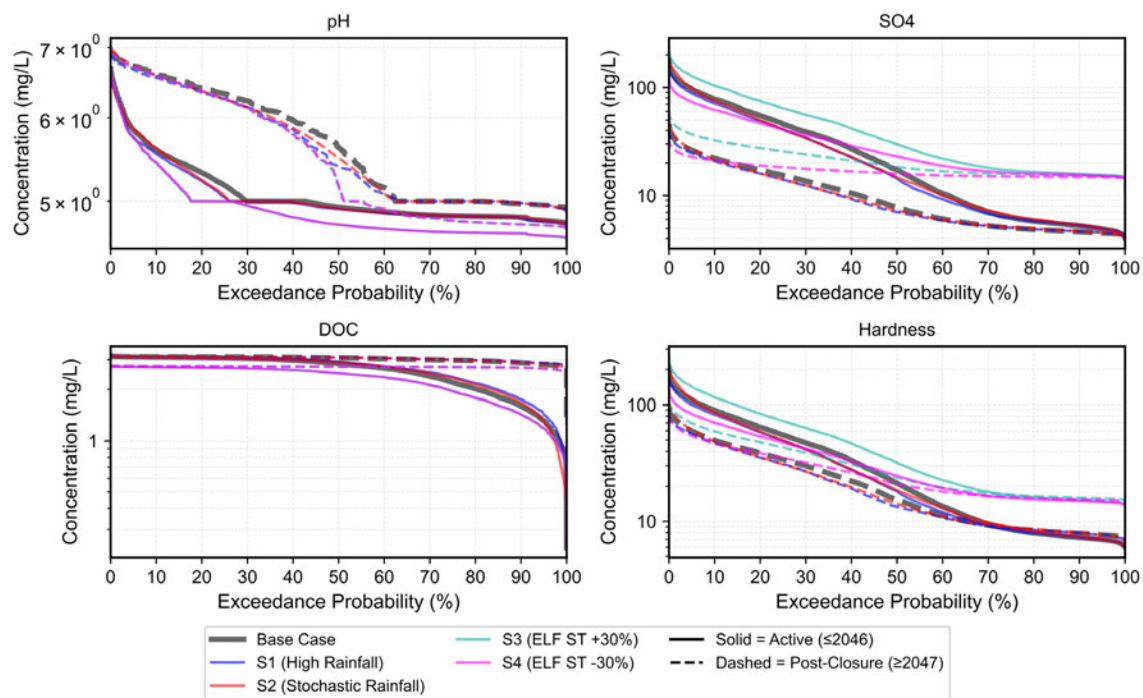


Figure 289: 17W Matrix Plot Scenarios 5 Zn Co Cd Ni Concentration Exceedance Probability

Station: 17W (Y-Axis: Log)

Figure 290: 17W Matrix Plot Scenarios 5 pH SO4 DOC Hardness Concentration Exceedance Probability

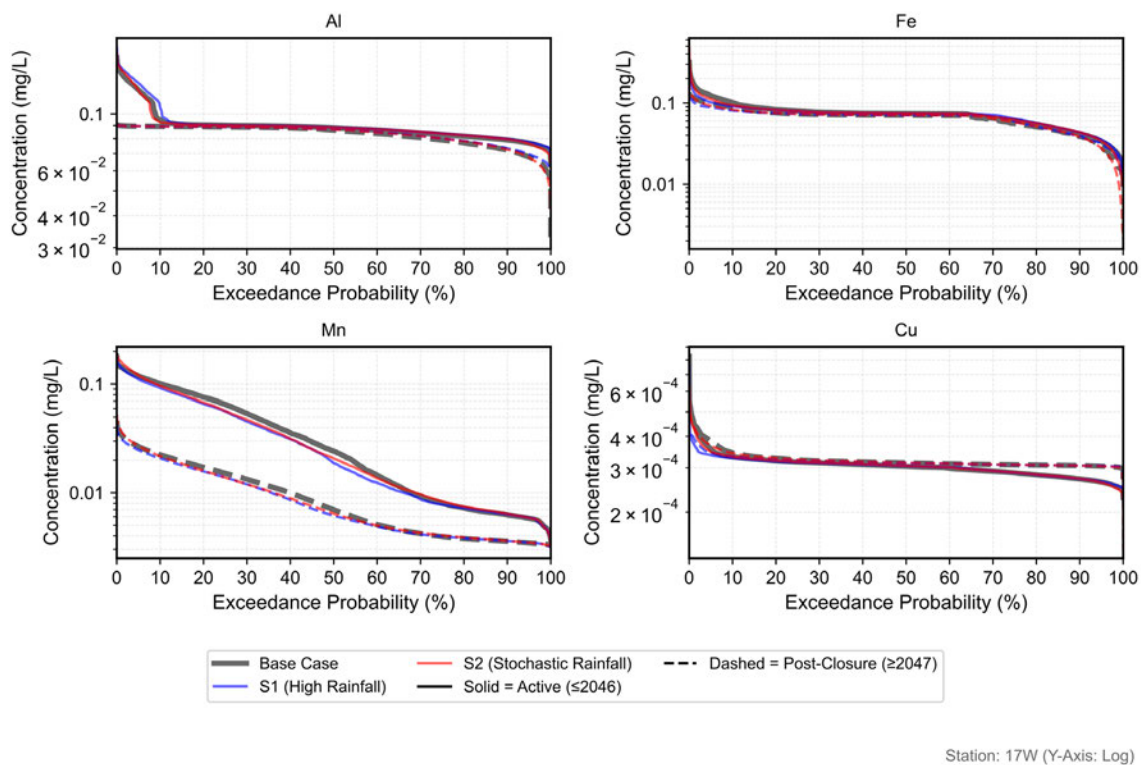
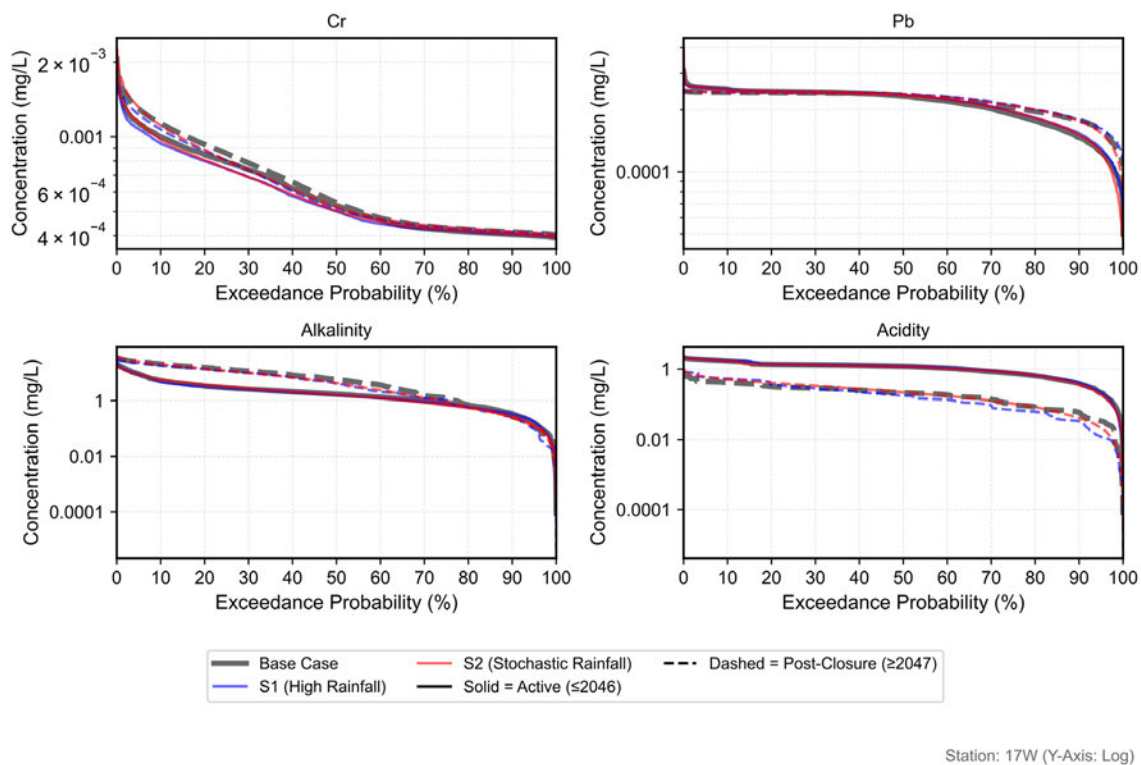
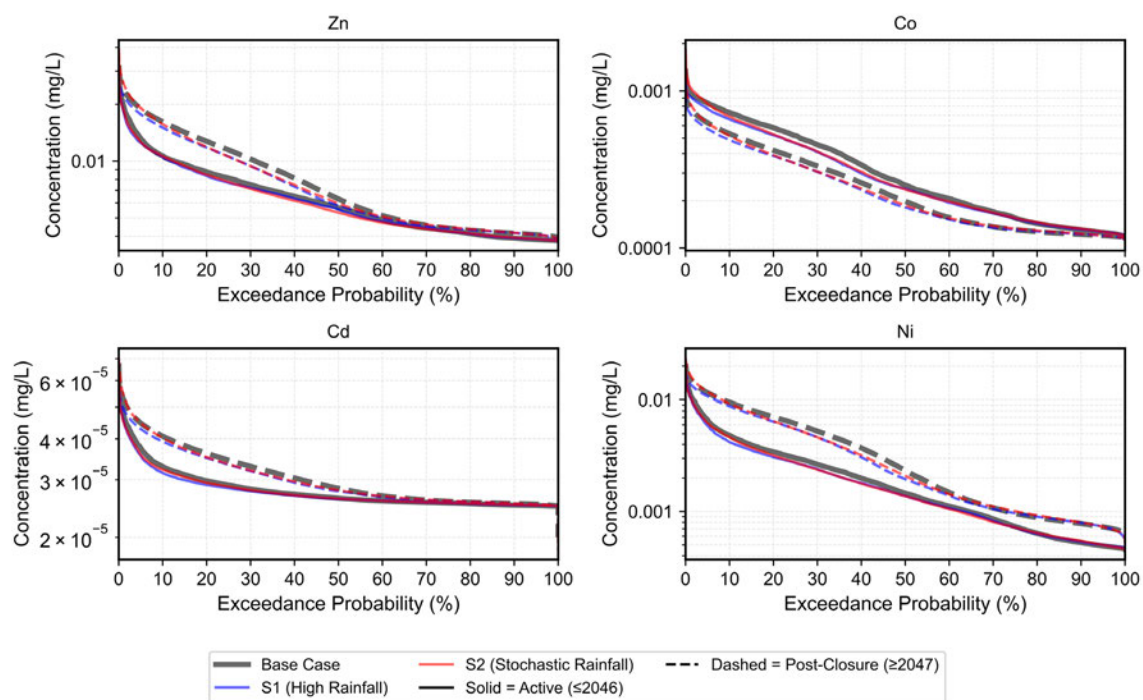
**Figure 291:** 17W Rainfall Comp Al Fe Mn Cu Concentration Exceedance Probability

Figure 292: 17W Rainfall Comp Cr Pb Alk Acid Concentration Exceedance Probability

Station: 17W (Y-Axis: Log)

Figure 293: 17W Rainfall Comp Zn Co Cd Ni Concentration Exceedance Probability

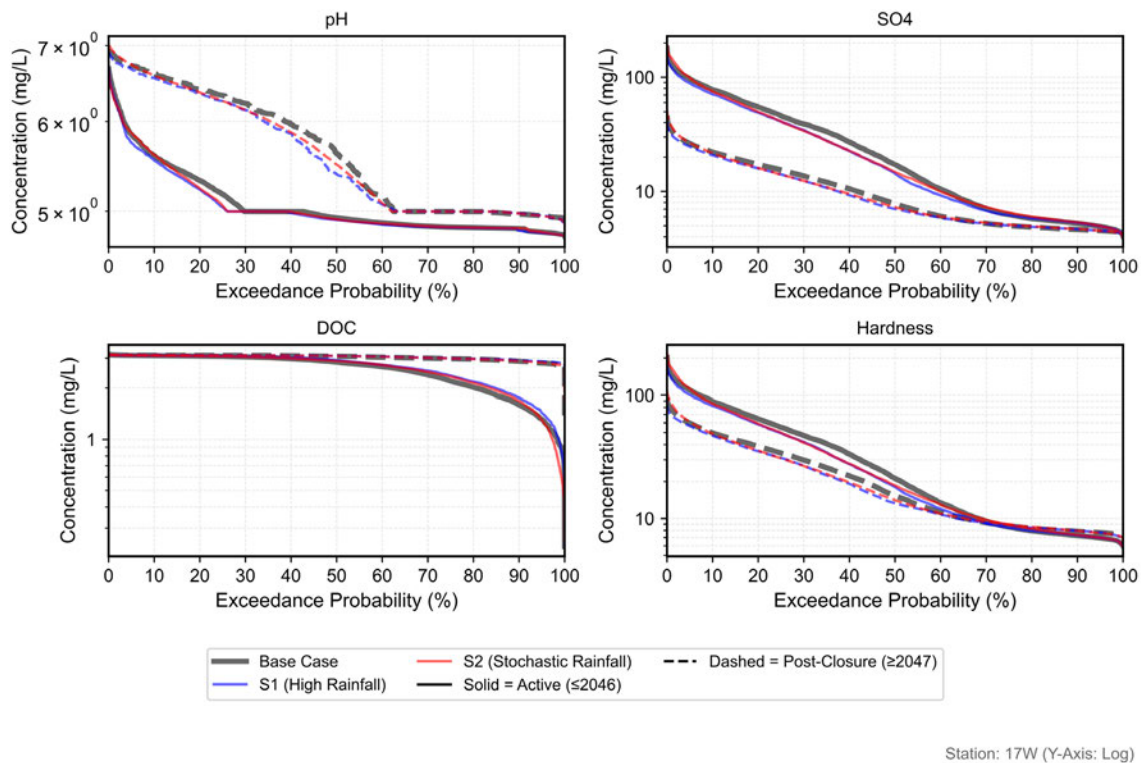


Figure 294: 17W Rainfall Comp pH SO₄ DOC Hardness Concentration Exceedance Probability

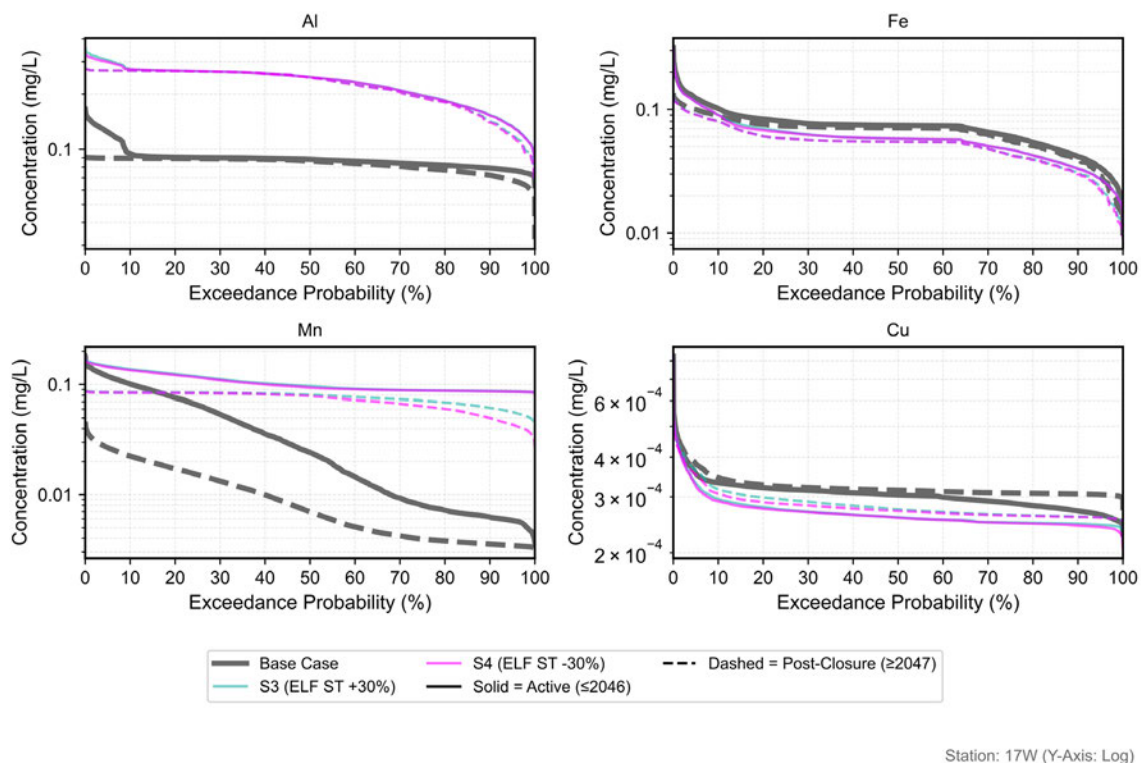
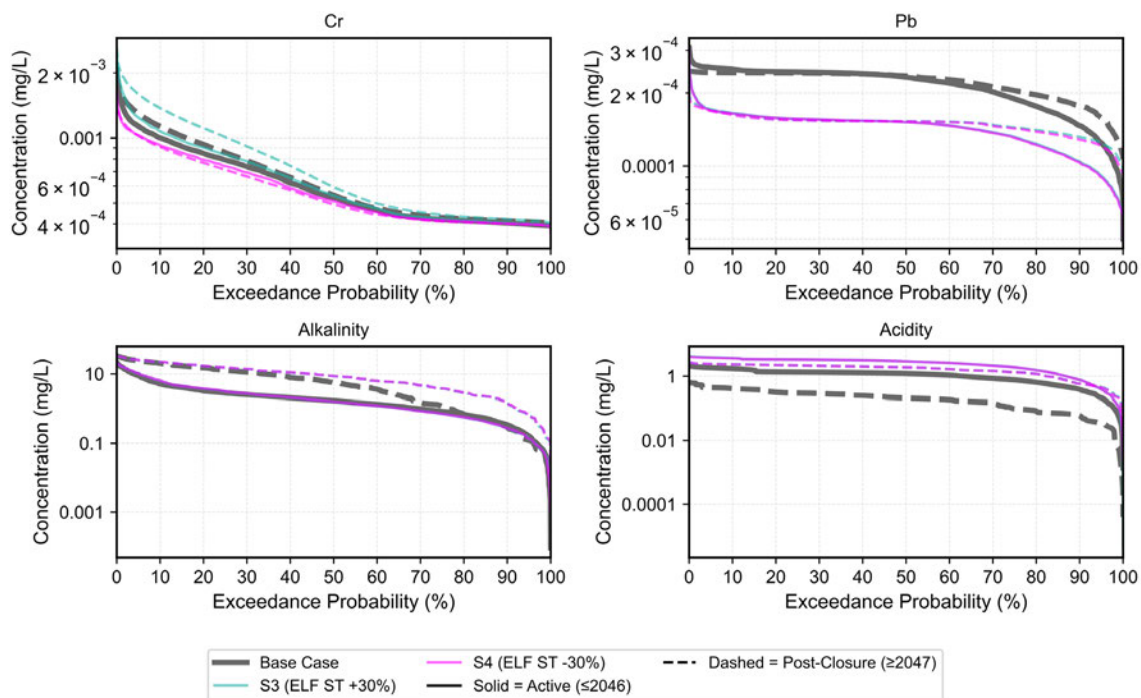


Figure 295: 17W St Comp Al Fe Mn Cu Concentration Exceedance Probability

Station: 17W (Y-Axis: Log)

Figure 296: 17W St Comp Cr Pb Alk Acid Concentration Exceedance Probability

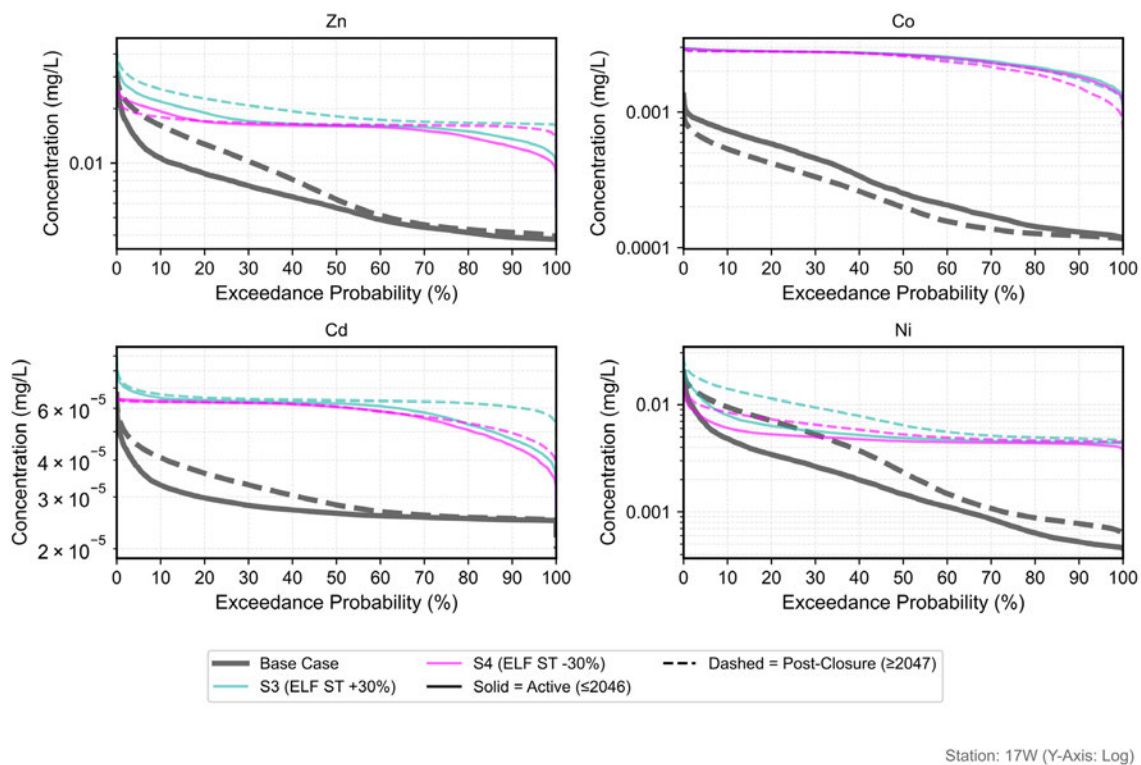


Figure 297: 17W St Comp Zn Co Cd Ni Concentration Exceedance Probability

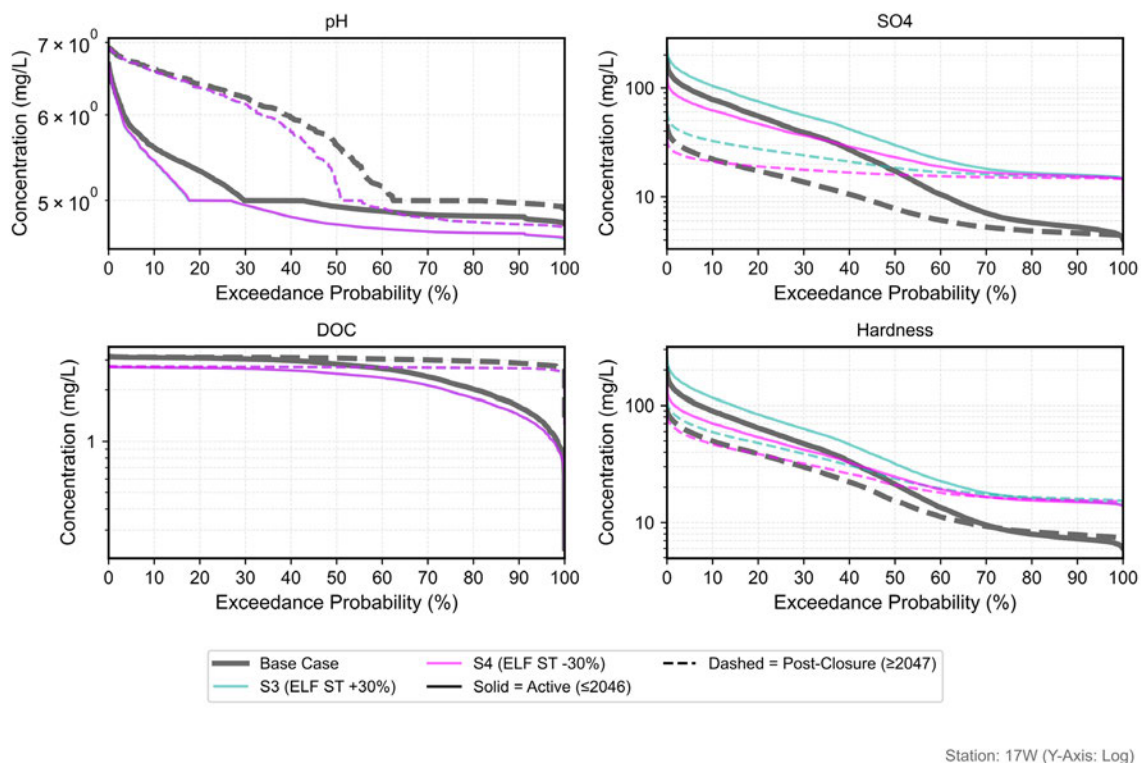
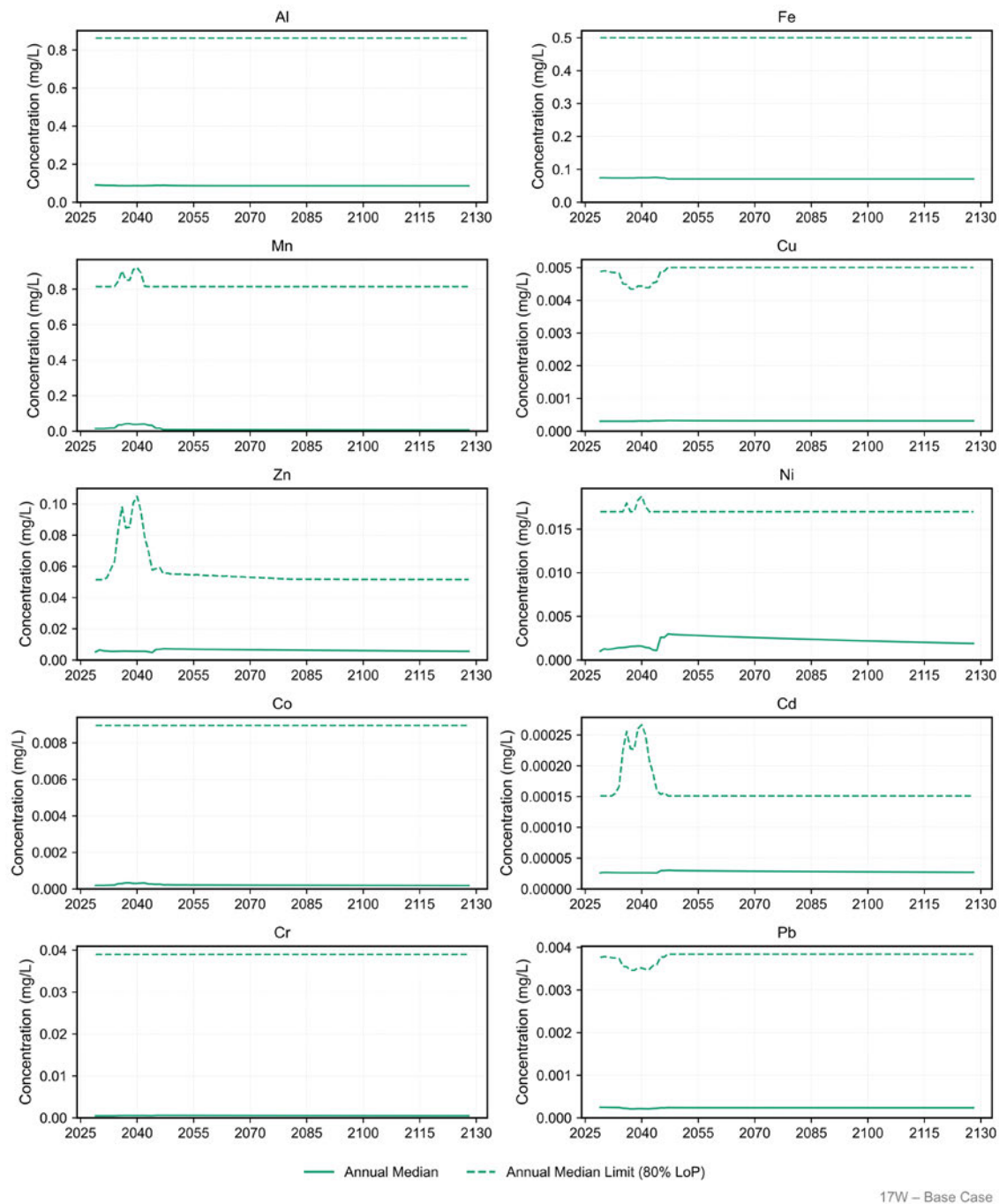
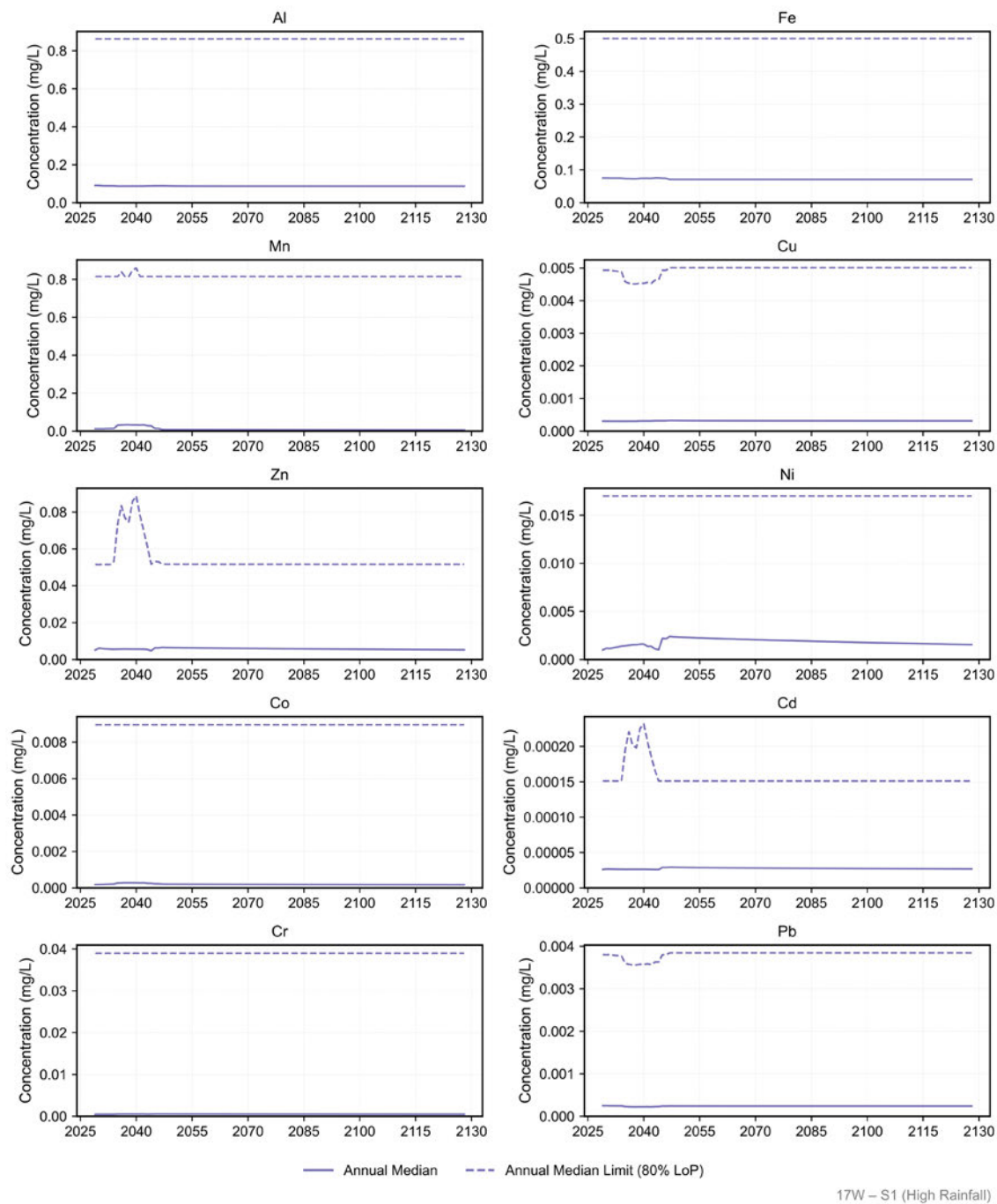
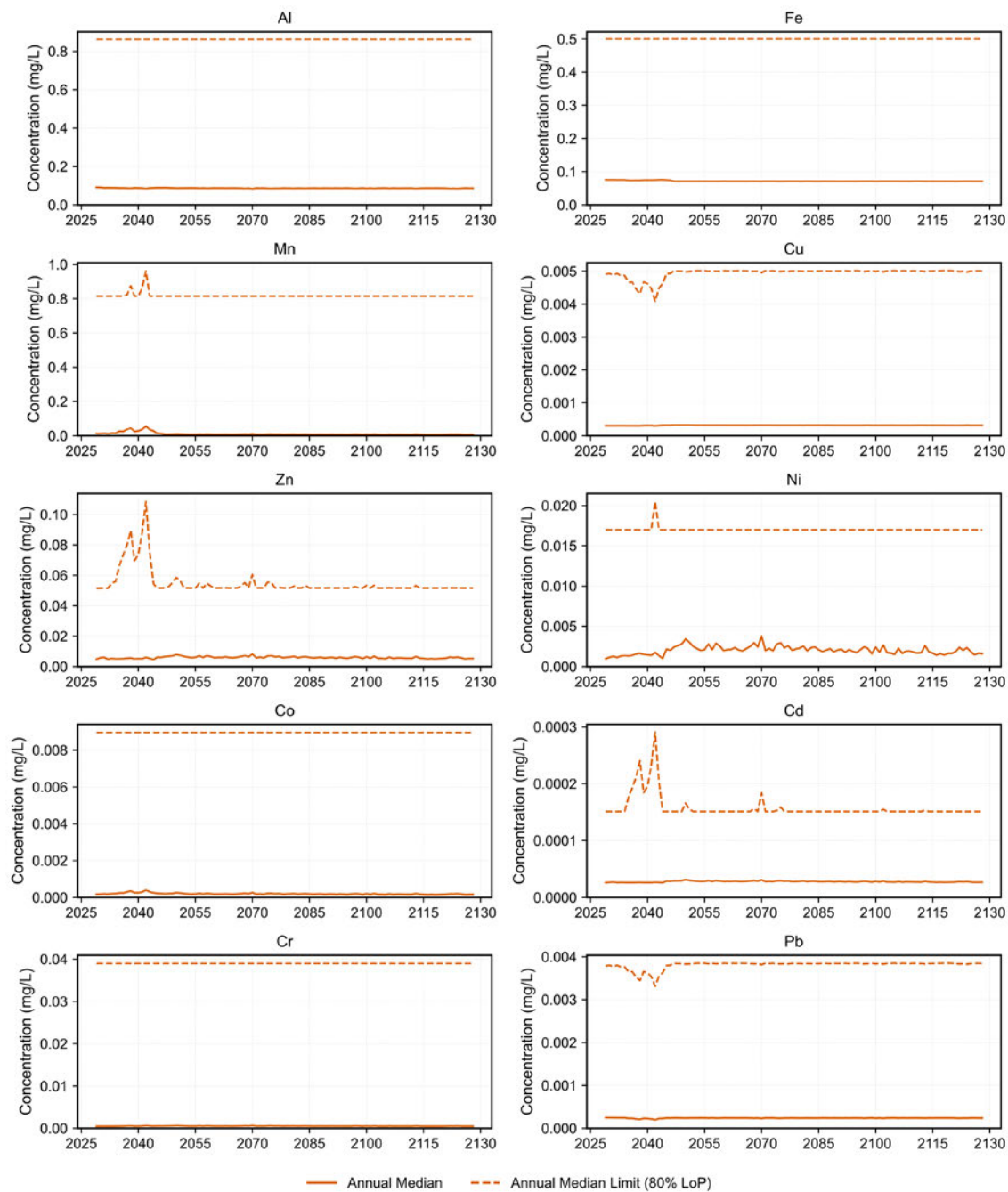


Figure 298: 17W St Comp pH SO4 DOC Hardness Concentration Exceedance Probability**4.4 ANNUAL MEDIANS (SINGLE SCENARIO)****Figure 299:** 17W Base Case Elements matrix

**Figure 300: 17W S1 (High Rainfall) Elements matrix**



17W – S2 (Stochastic Rainfall)

Figure 301: 17W S2 (Stochastic Rainfall) Elements matrix

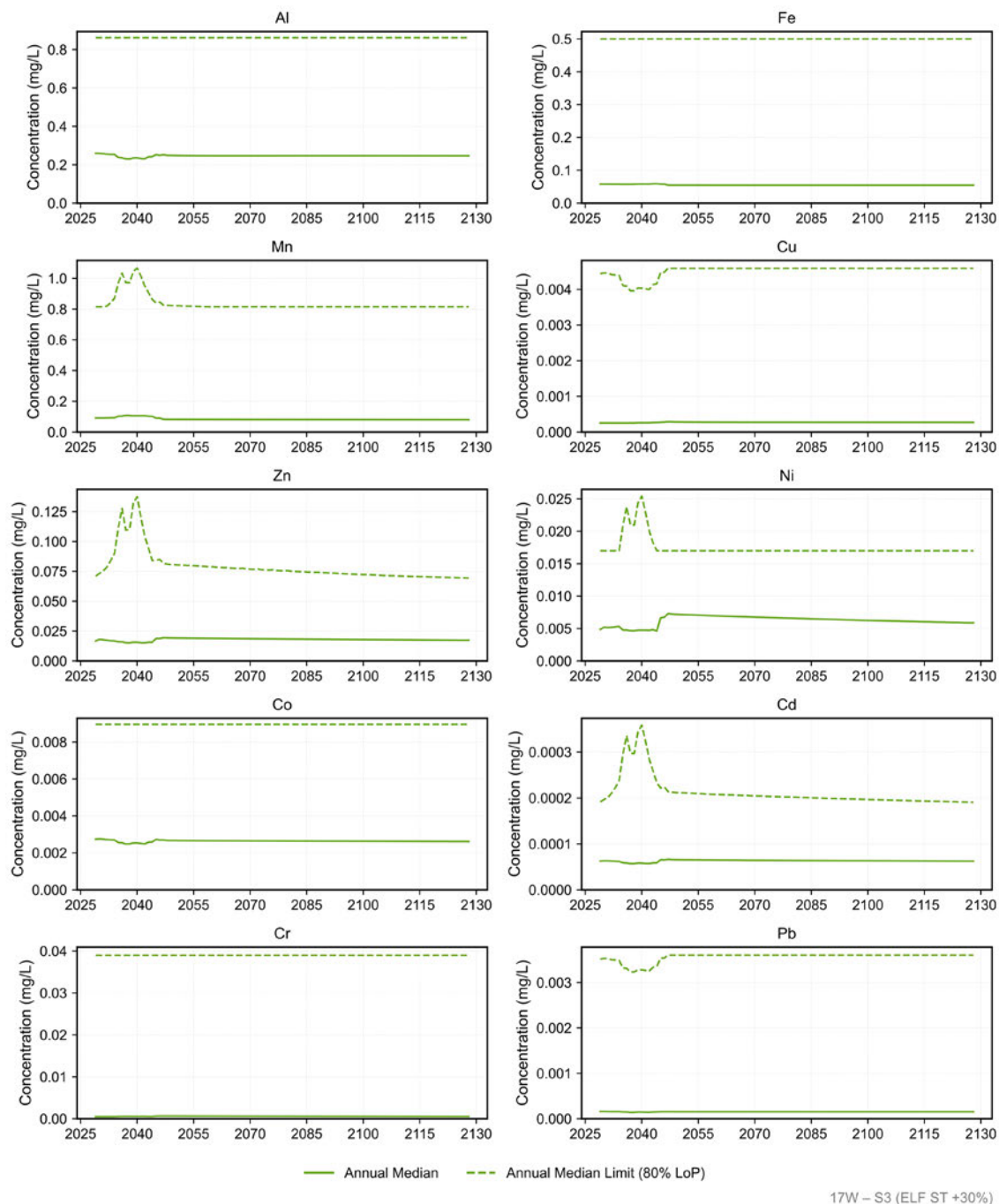
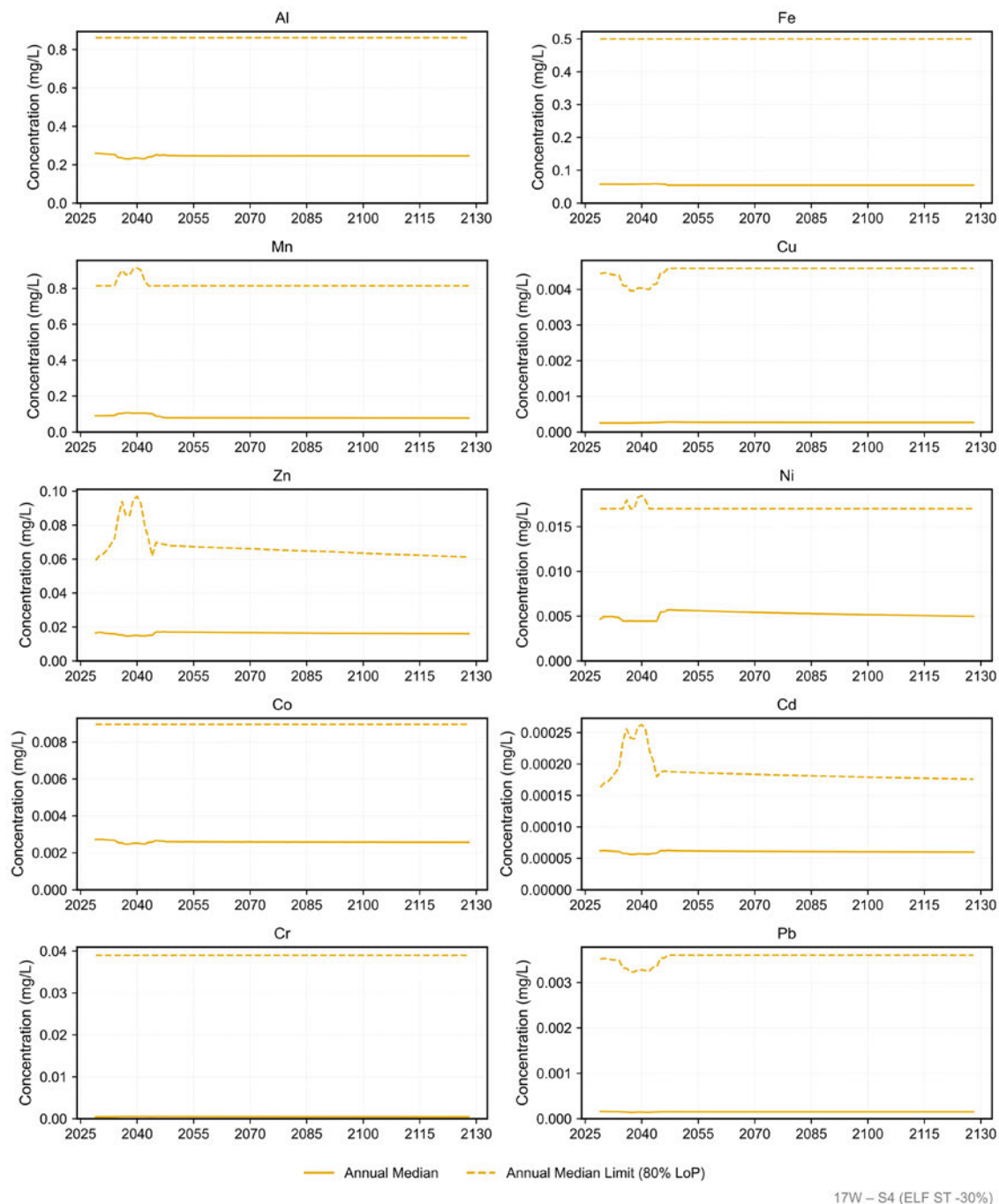


Figure 302: 17W S3 (Elf St +30%) Elements matrix

**Figure 303: 17W S4 (Elf St 30%) Elements matrix**

4.5 ANNUAL MEDIANS (GROUPED SCENARIO)

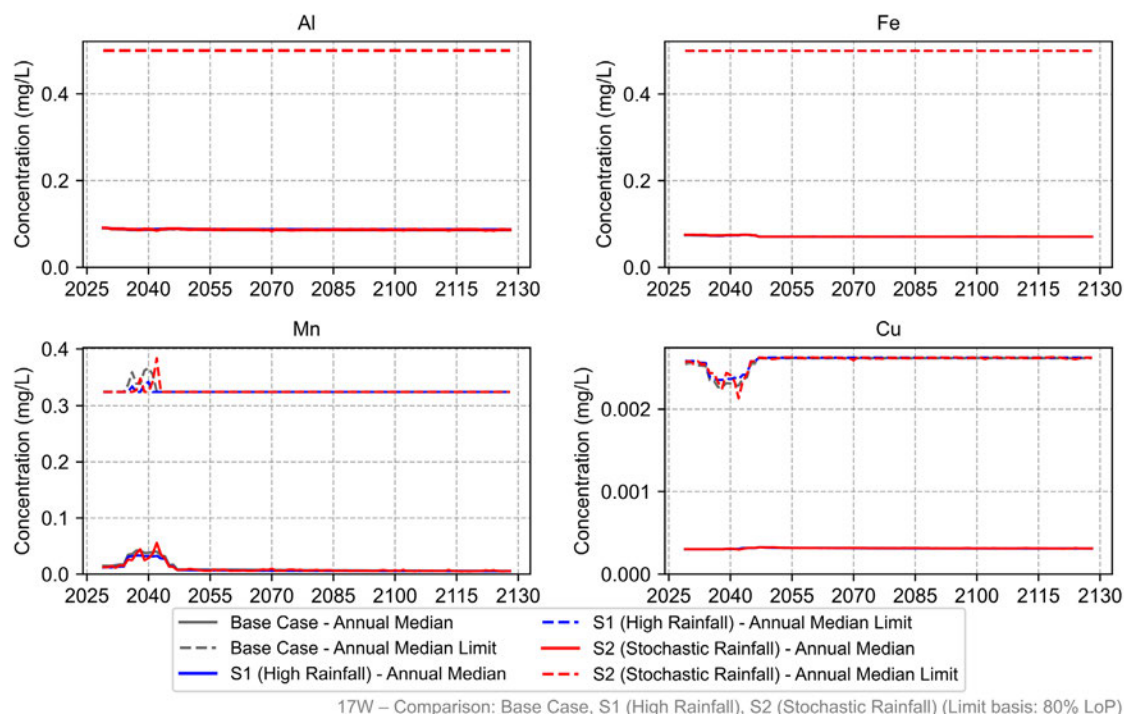


Figure 304: 17W Base Case S1 S2 Al Fe Mn Cu Matrix comparison

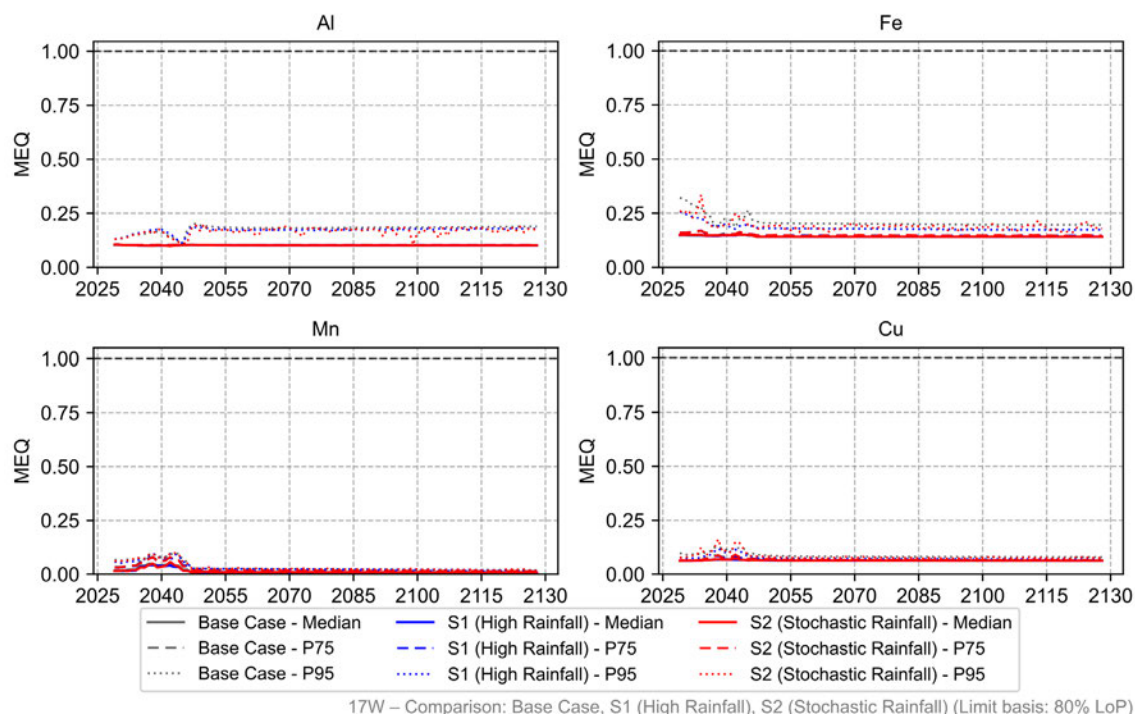
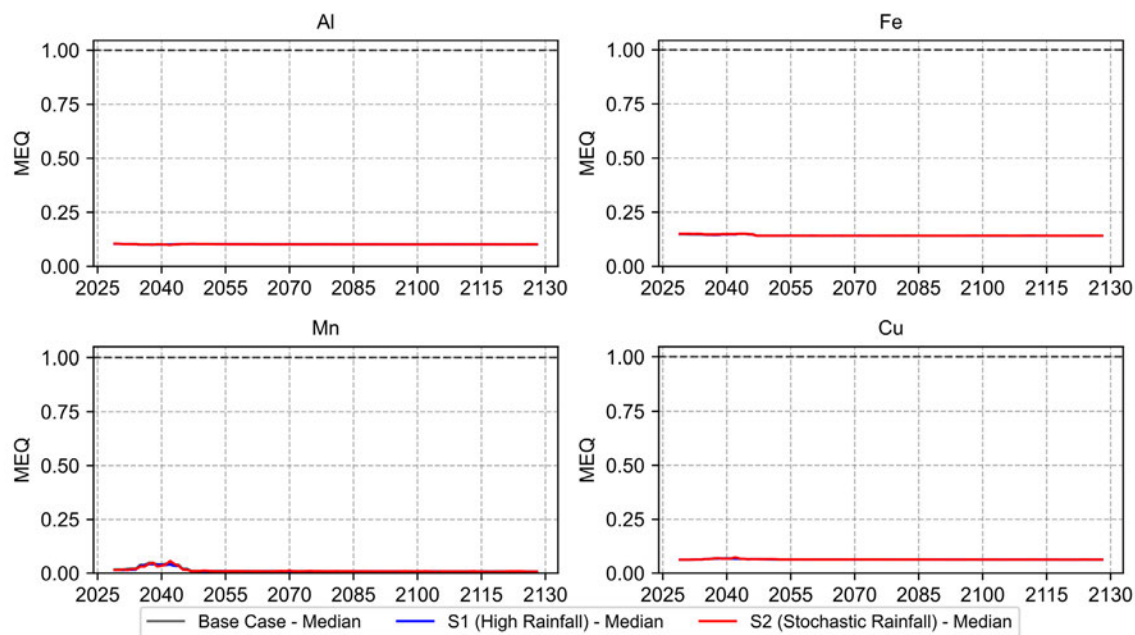
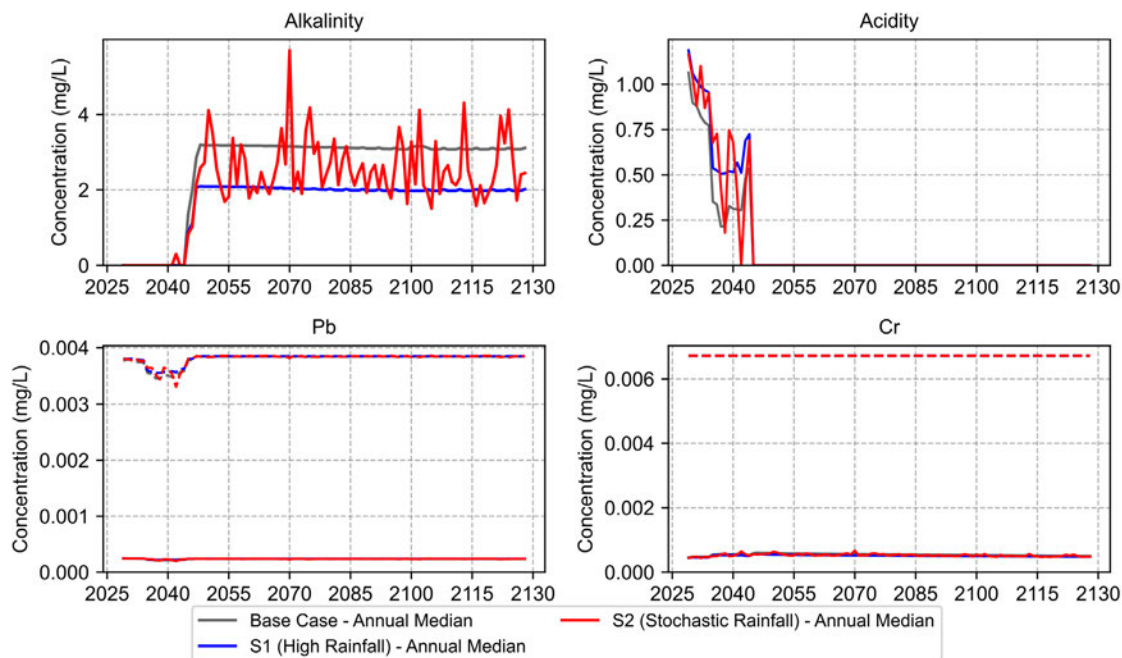


Figure 305: 17W Base Case S1 S2 Al Fe Mn Cu Matrix comparison Meq

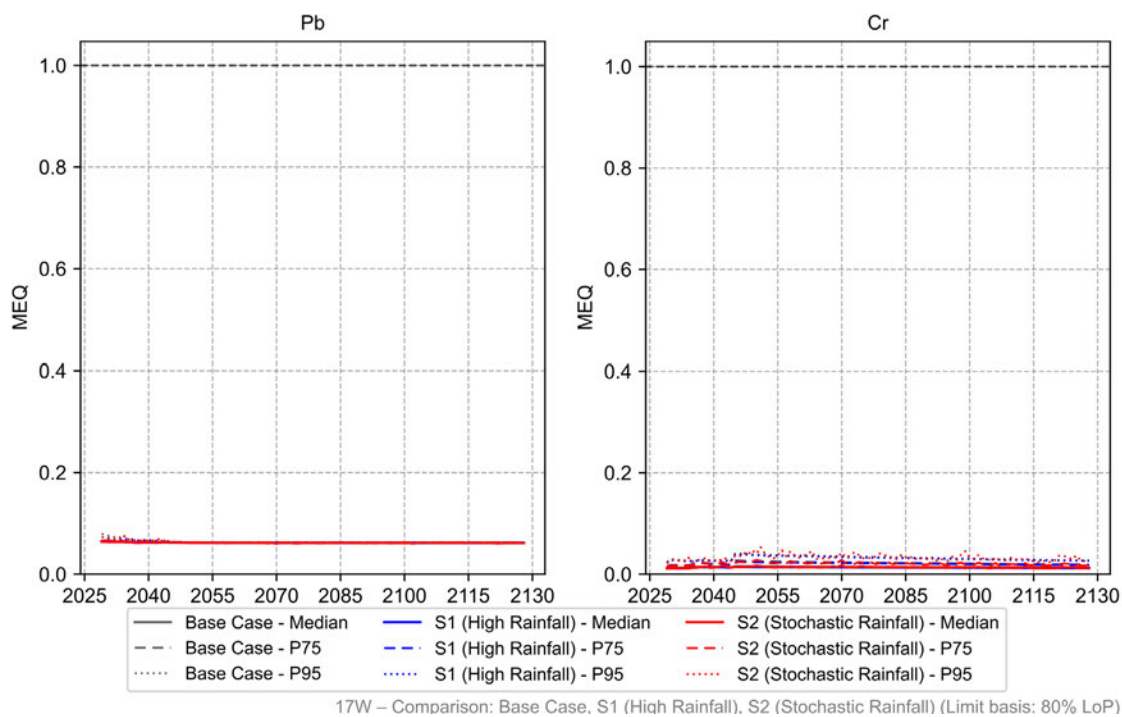


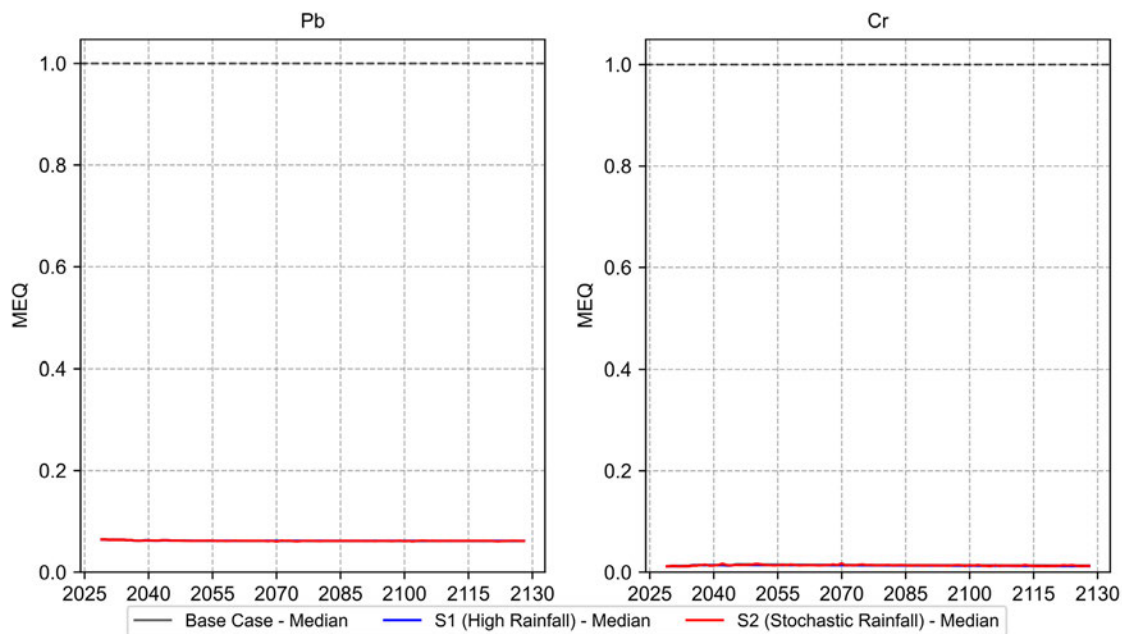
17W – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 80% LoP)

Figure 306: 17W Base Case S1 S2 Al Fe Mn Cu Mxcomp Meq Median Only



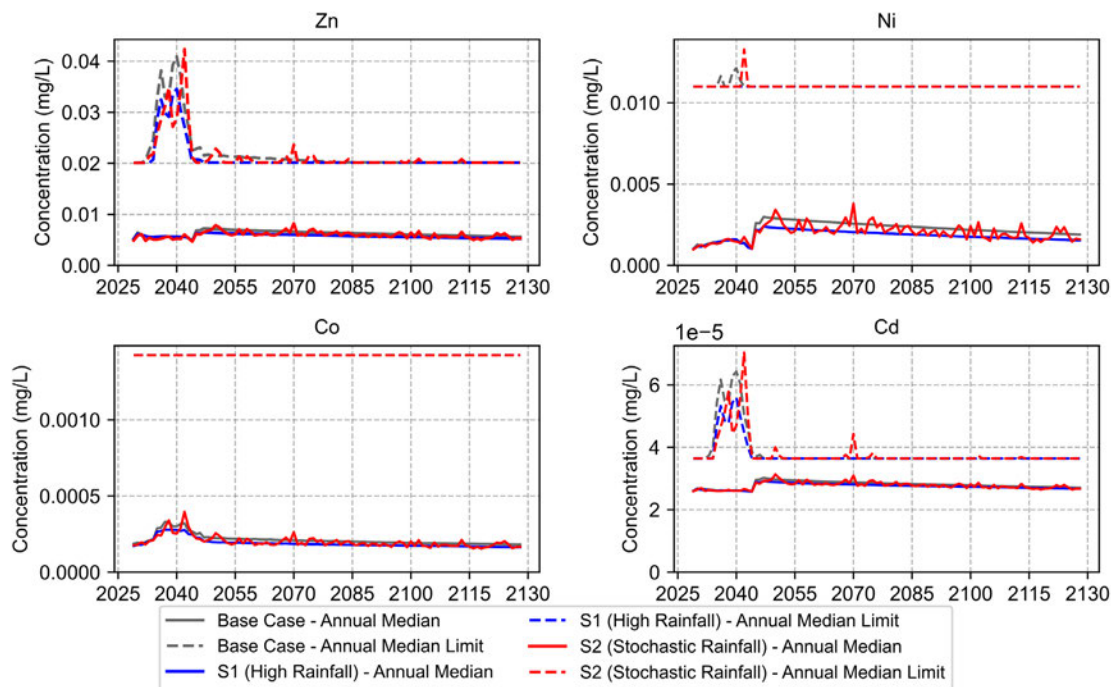
17W – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 80% LoP)

Figure 307: 17W Base Case S1 S2 Alkalinity Acidity Pb Cr Matrix comparison**Figure 308:** 17W Base Case S1 S2 Pb Cr Matrix comparison Meq



17W – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 80% LoP)

Figure 309: 17W Base Case S1 S2 Pb Cr Mxcomp Meq Median Only



17W – Comparison: Base Case, S1 (High Rainfall), S2 (Stochastic Rainfall) (Limit basis: 80% LoP)

Figure 310: 17W Base Case S1 S2 Zn Ni Co Cd Matrix comparison

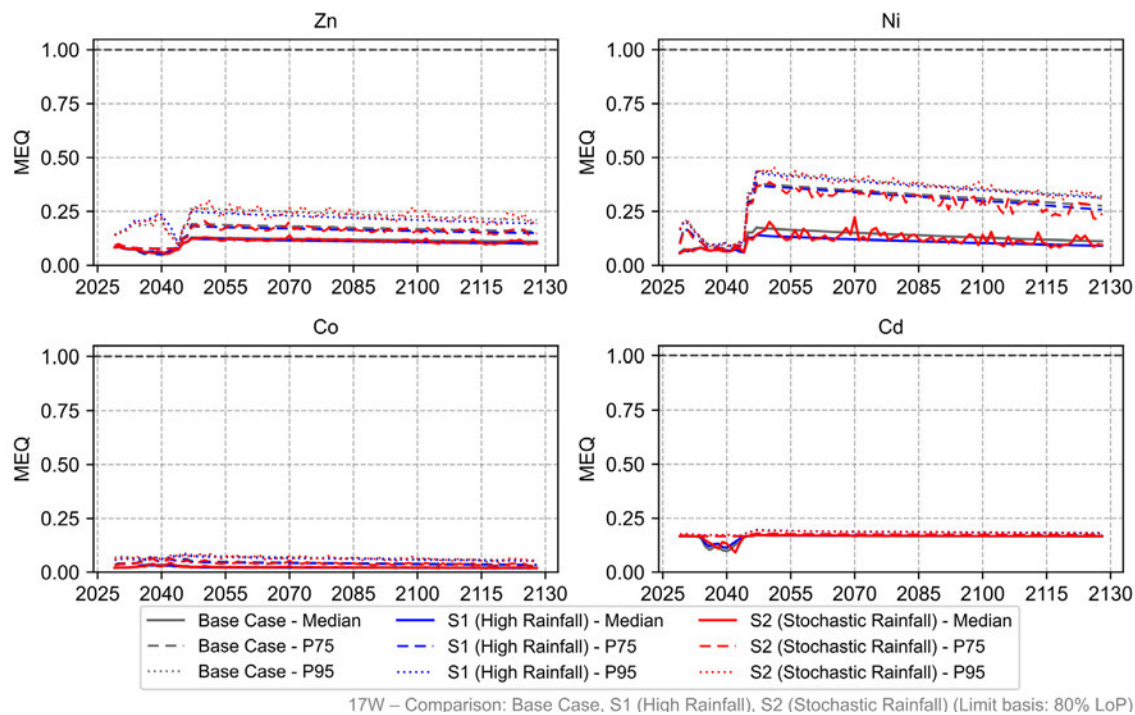


Figure 311: 17W Base Case S1 S2 Zn Ni Co Cd Matrix comparison Meq

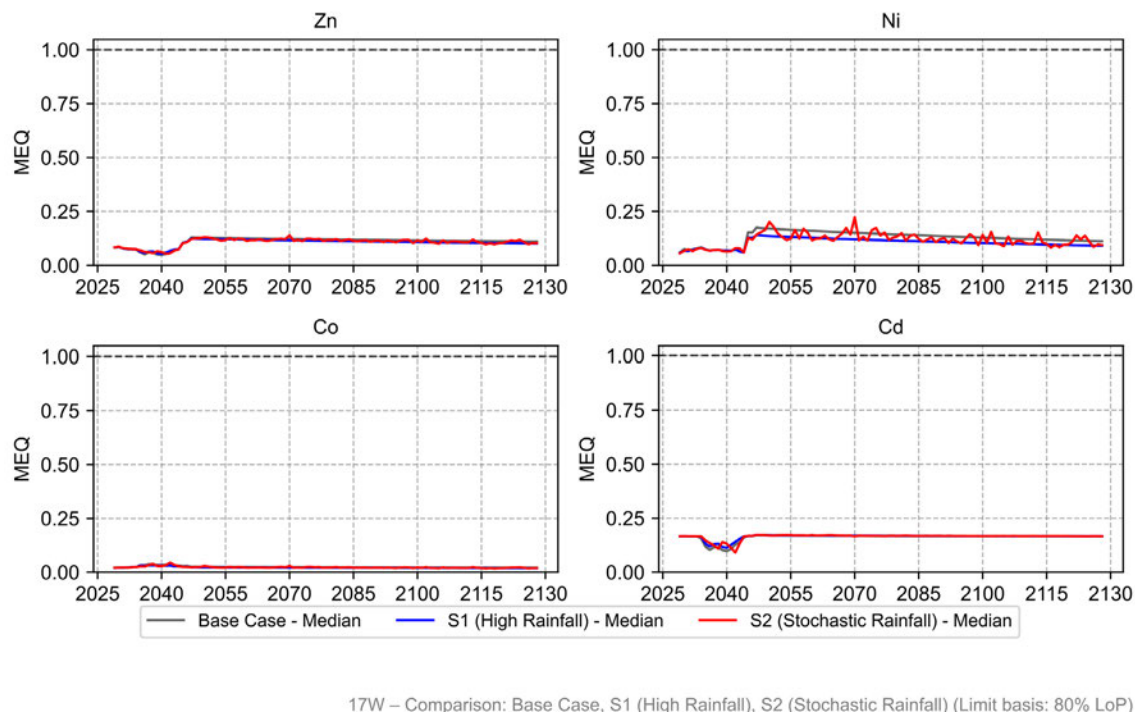


Figure 312: 17W Base Case S1 S2 Zn Ni Co Cd Mxcomp Meq Median Only

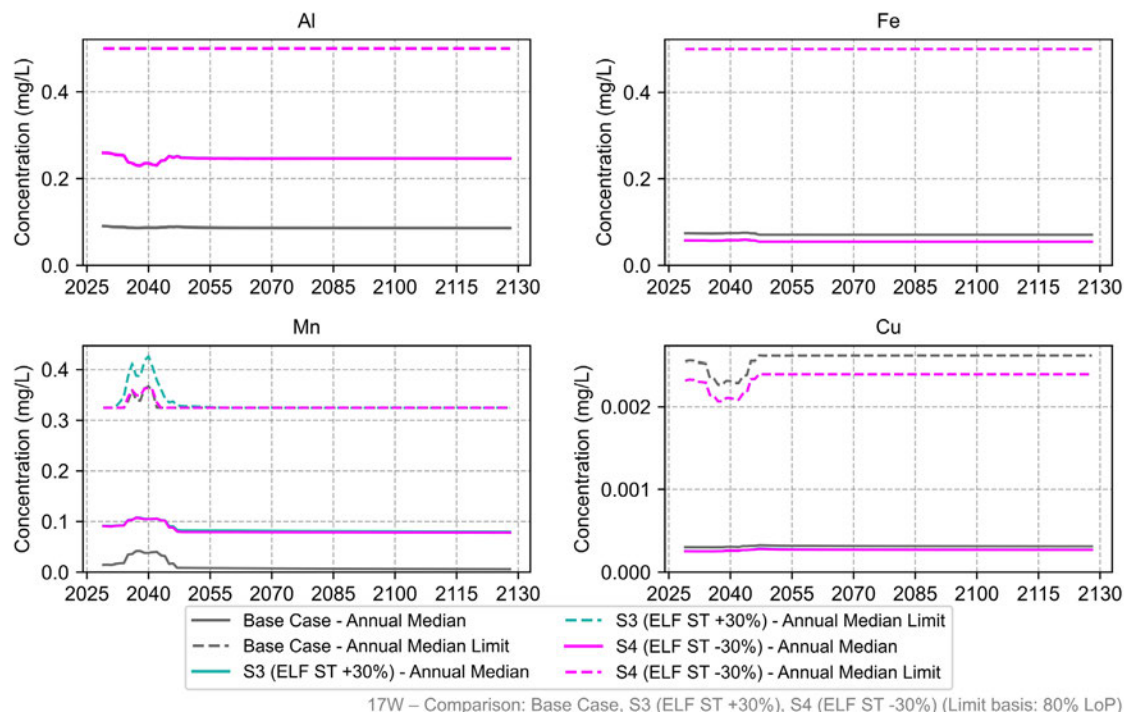


Figure 313: 17W Base Case S3 S4 Al Fe Mn Cu Matrix comparison

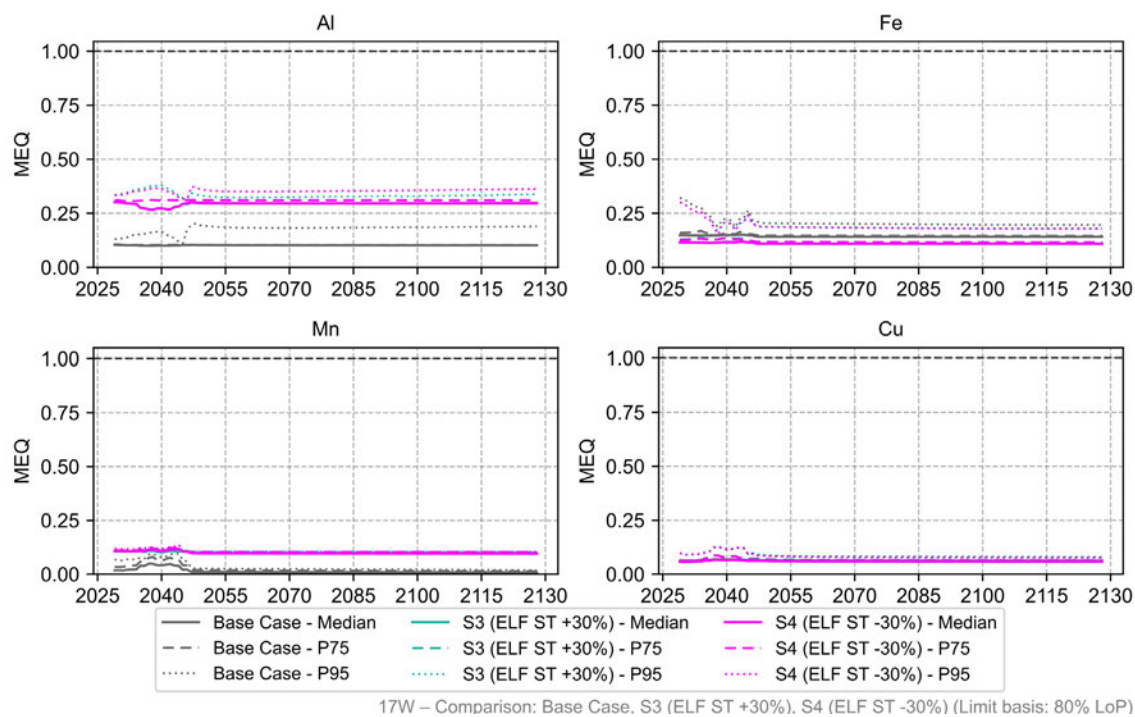
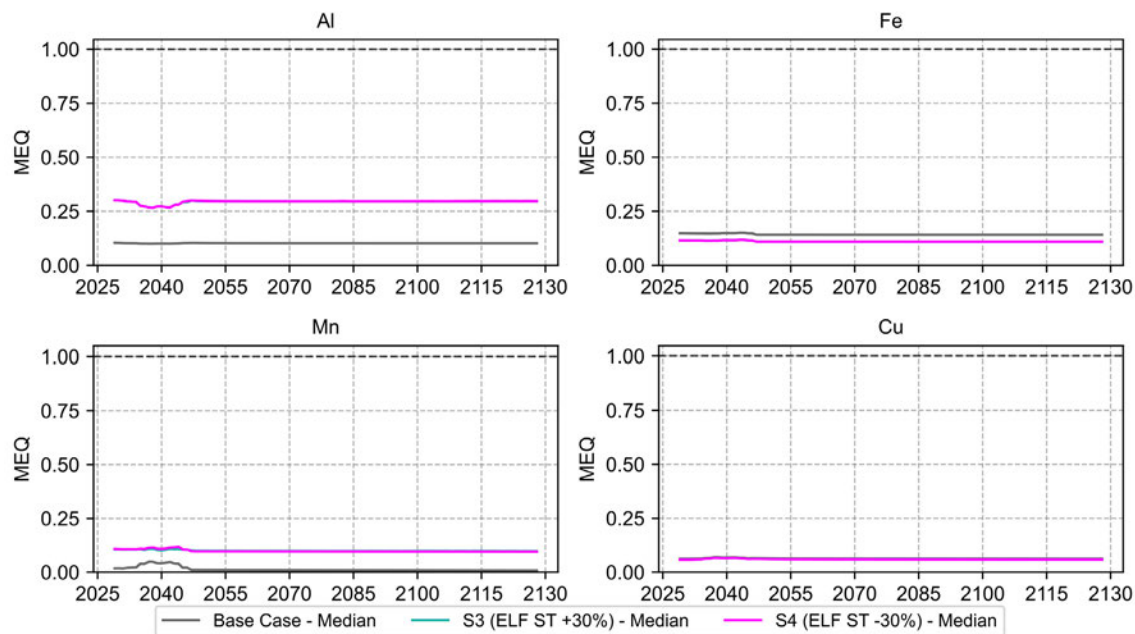
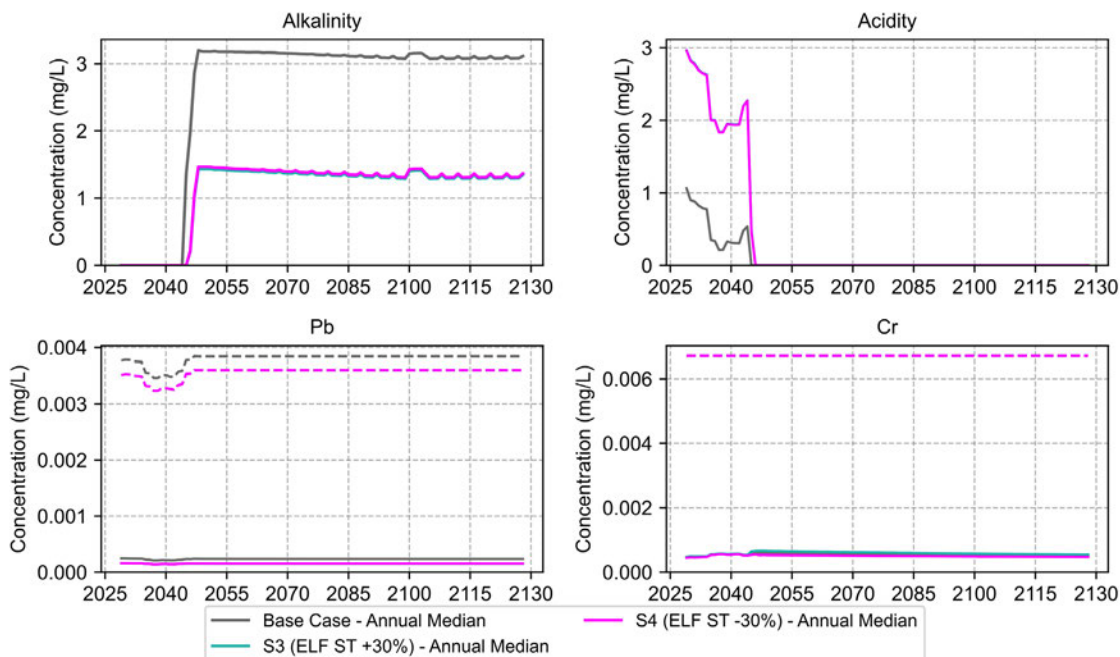


Figure 314: 17W Base Case S3 S4 Al Fe Mn Cu Matrix comparison Meq



17W – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 80% LoP)

Figure 315: 17W Base Case S3 S4 Al Fe Mn Cu Mxcomp Meq Median Only



17W – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 80% LoP)

Figure 316: 17W Base Case S3 S4 Alkalinity Acidity Pb Cr Matrix comparison

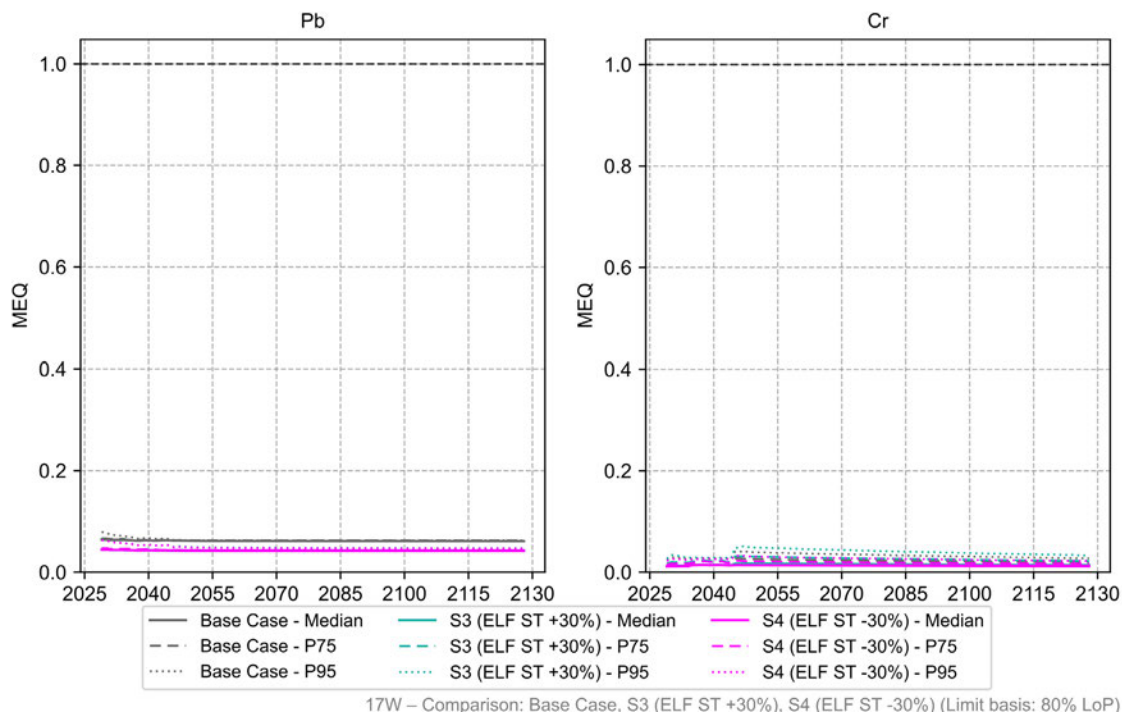


Figure 317: 17W Base Case S3 S4 Pb Cr Matrix comparison Meq

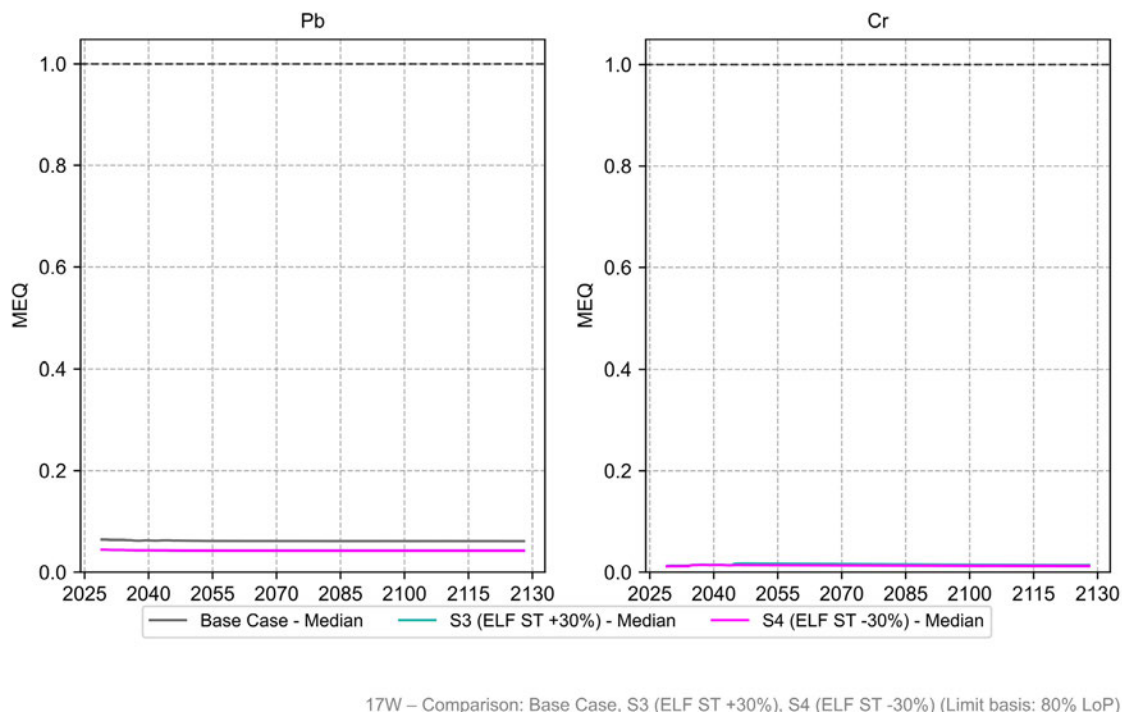


Figure 318: 17W Base Case S3 S4 Pb Cr Mxcomp Meq Median Only

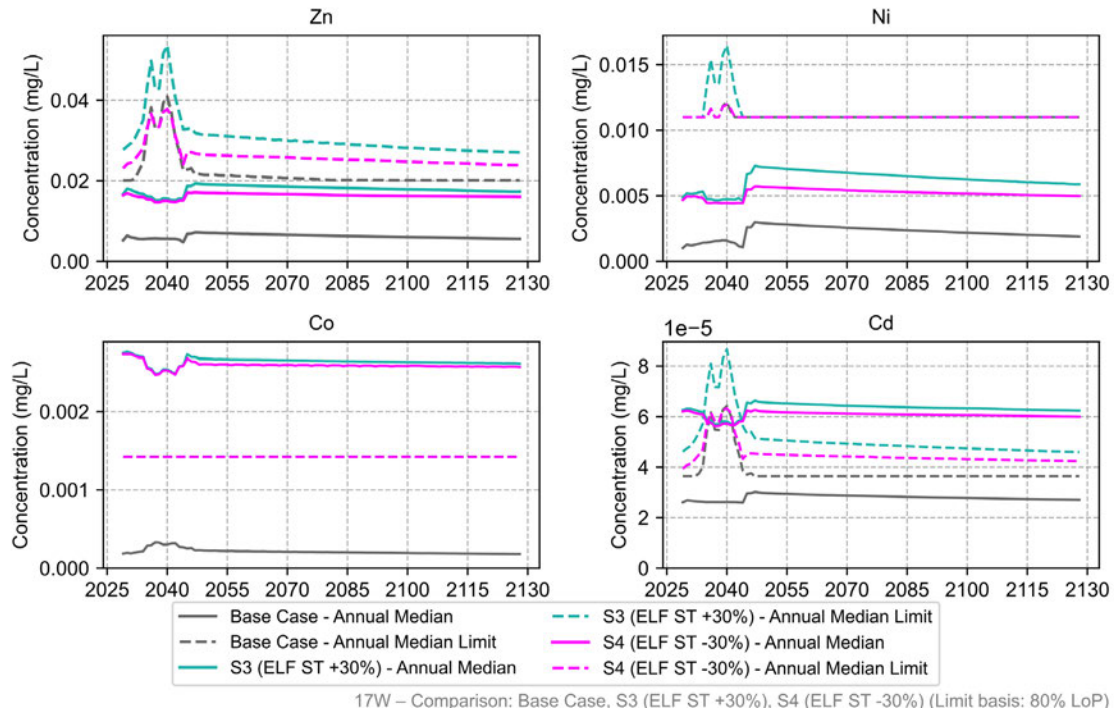


Figure 319: 17W Base Case S3 S4 Zn Ni Co Cd Matrix comparison

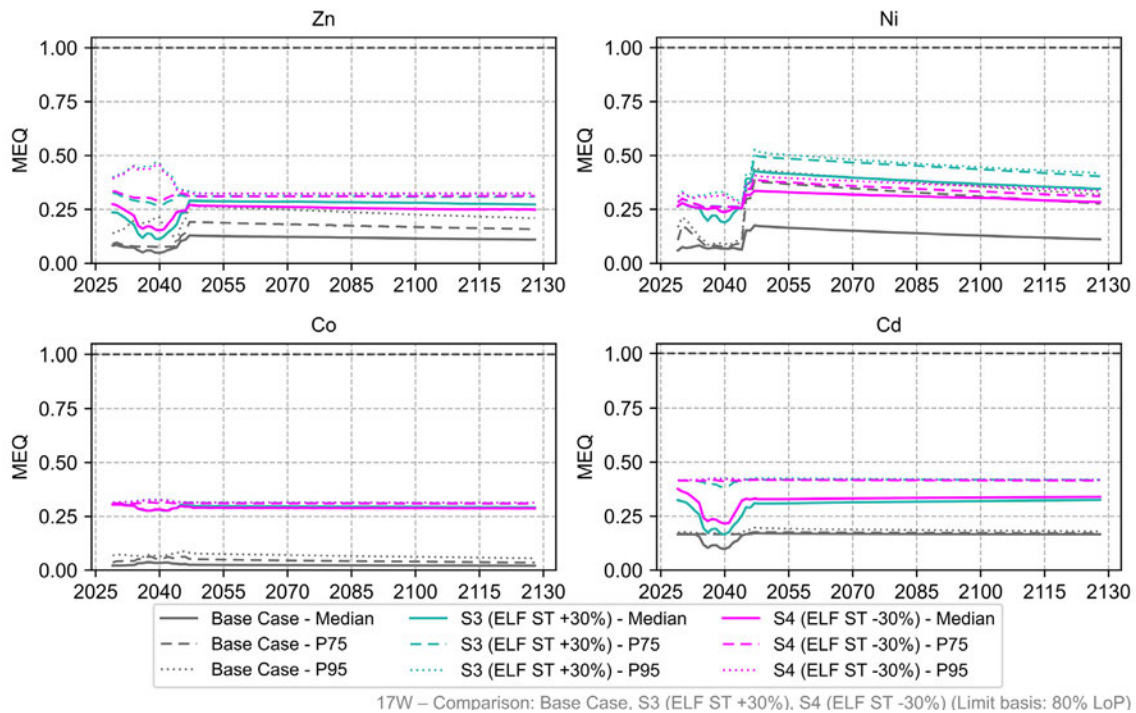
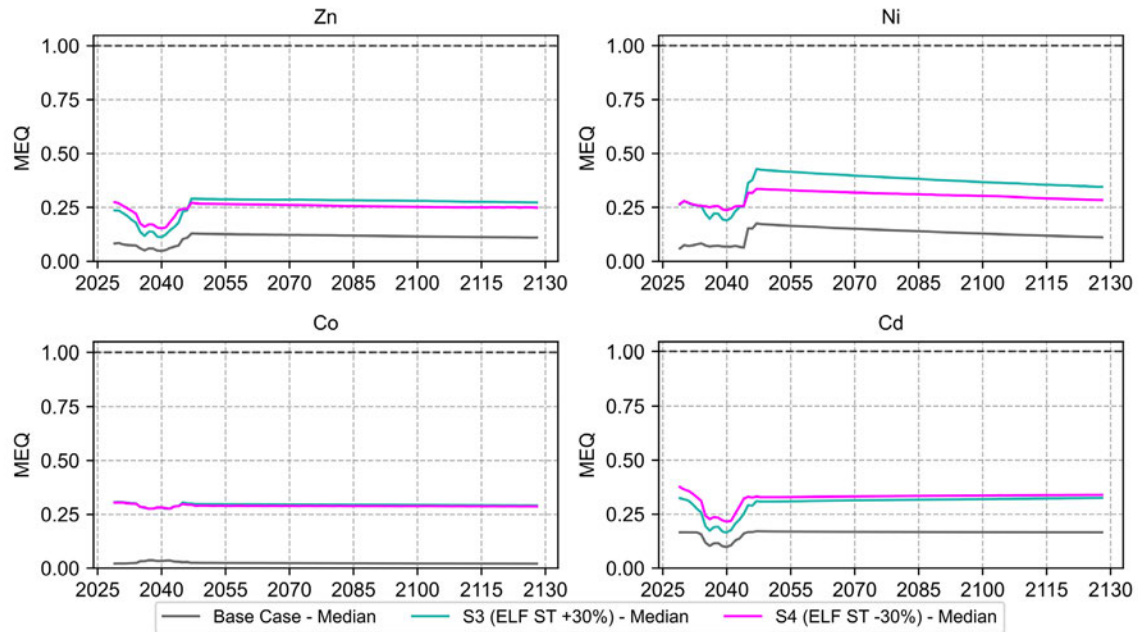
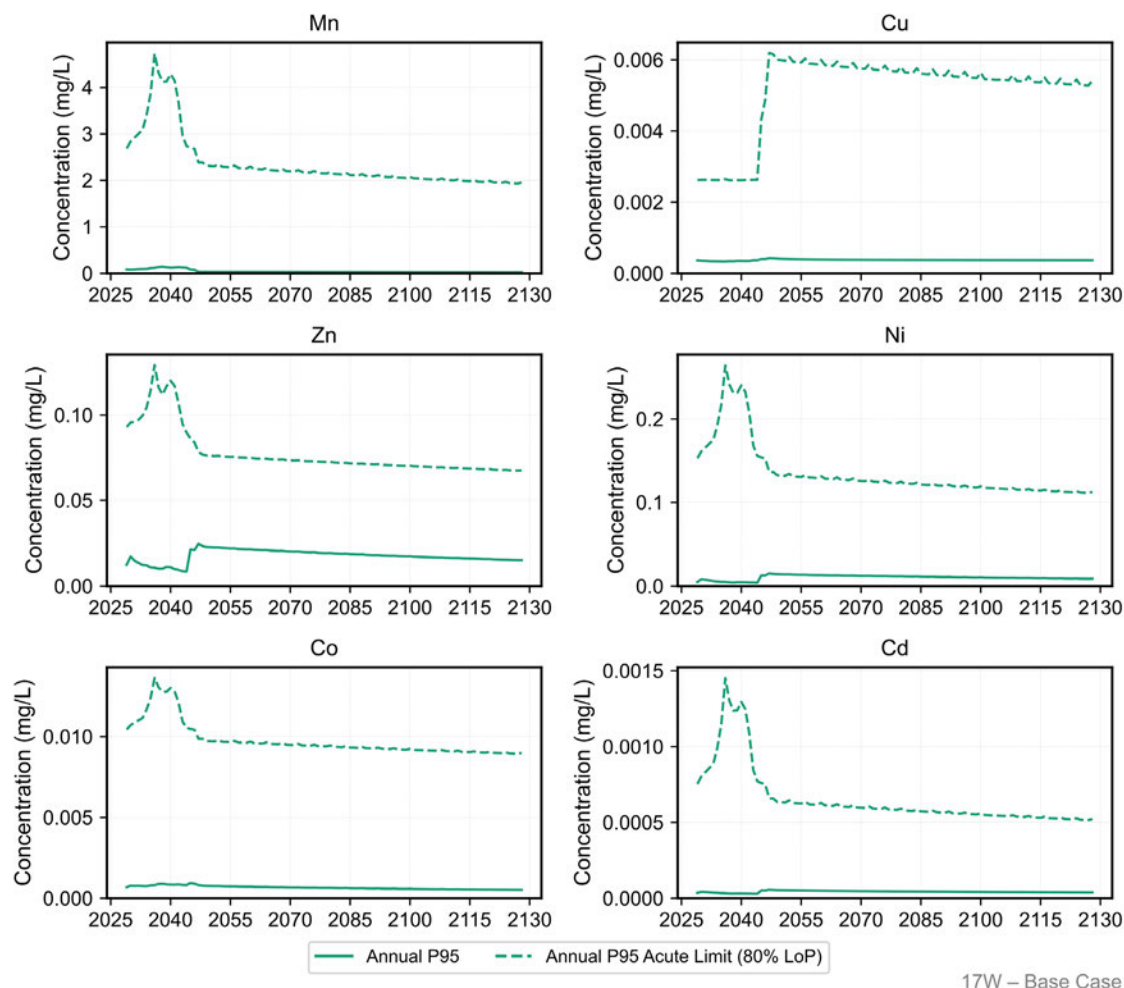


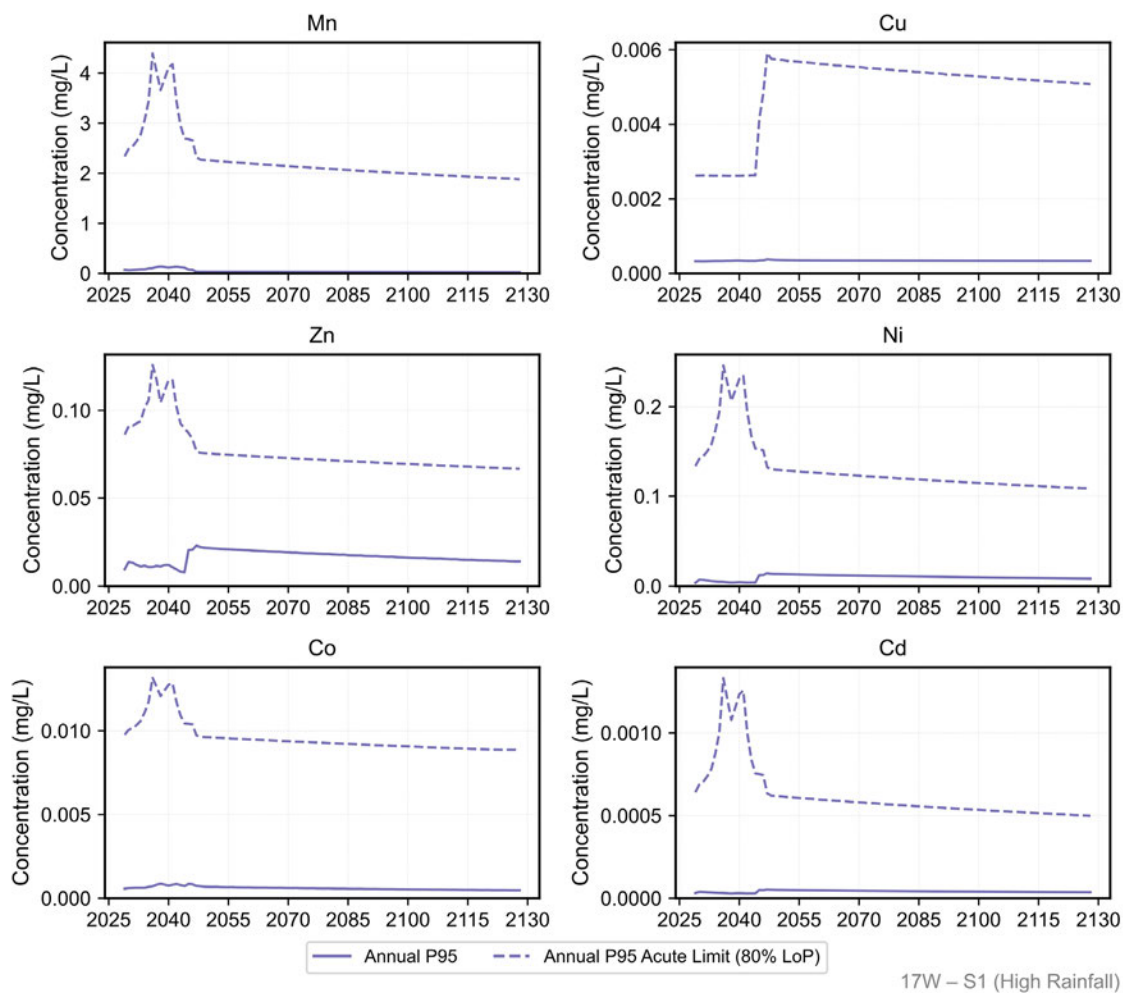
Figure 320: 17W Base Case S3 S4 Zn Ni Co Cd Matrix comparison Meq

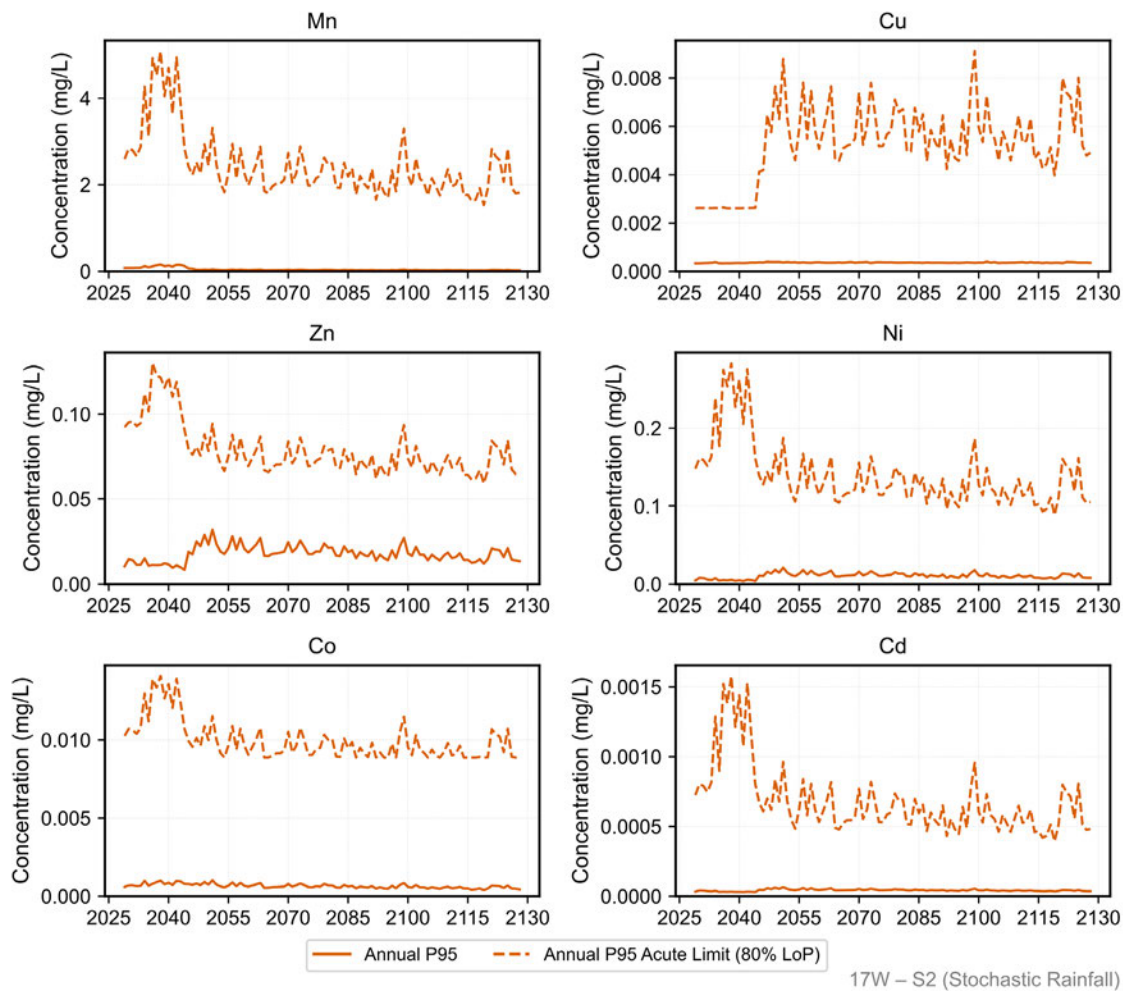


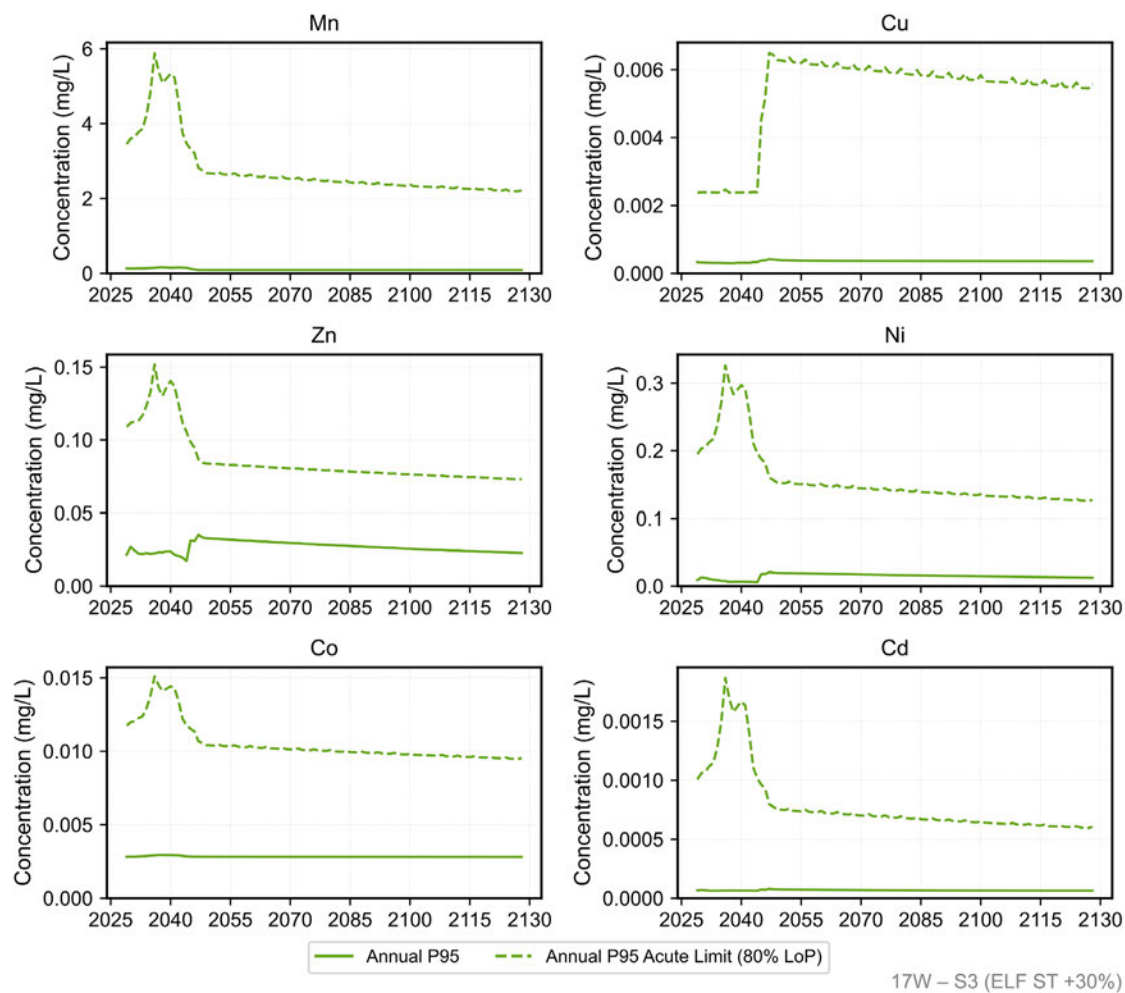
17W – Comparison: Base Case, S3 (ELF ST +30%), S4 (ELF ST -30%) (Limit basis: 80% LoP)

Figure 321: 17W Base Case S3 S4 Zn Ni Co Cd Mxcomp Meq Median Only

4.6 ANNUAL P95 (SINGLE SCENARIO)**Figure 322: 17W Base Case Acute Limits**

**Figure 323:** 17W S1 High Rainfall Acute Limits

**Figure 324:** 17W S2 Stochastic Rainfall Acute Limits

**Figure 325:** 17W S3 Elf St 30 Acute Limits

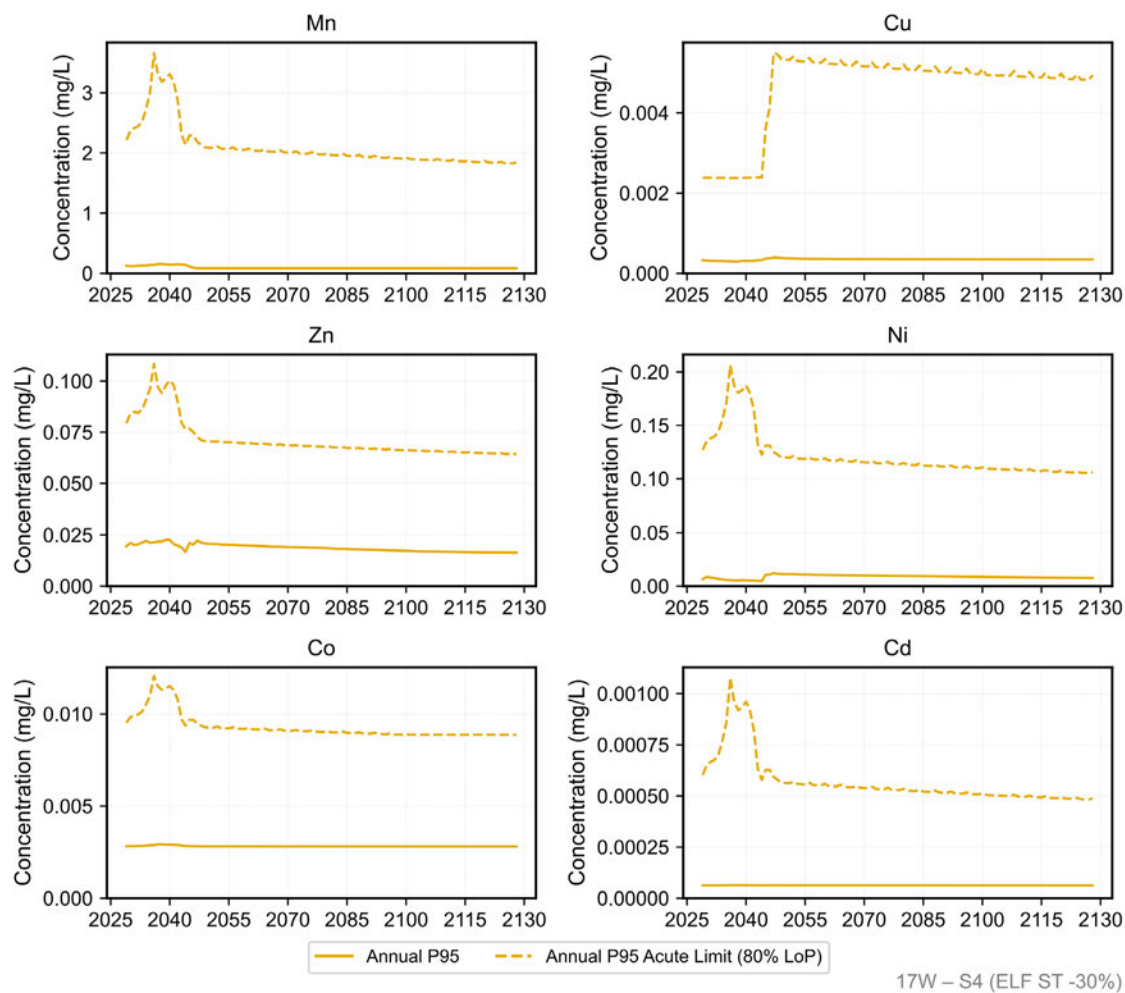


Figure 326: 17W S4 Elf St 30 Acute Limits

4.7 ANNUAL P95 (GROUPED SCENARIO)

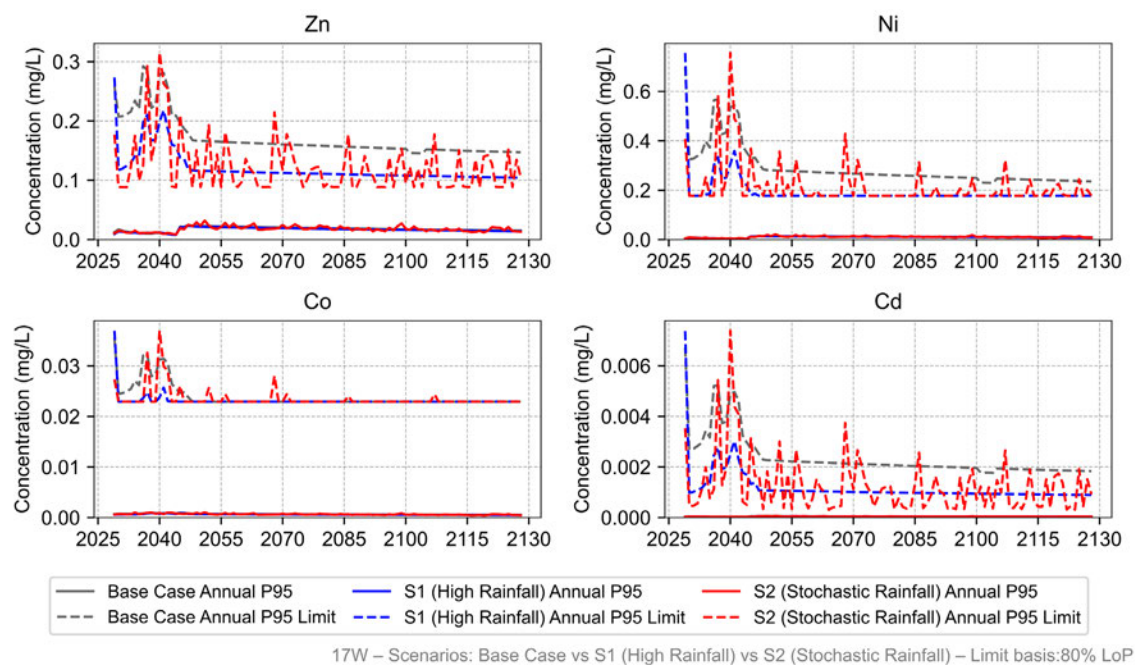


Figure 327: 17W Set1 Acute Limits

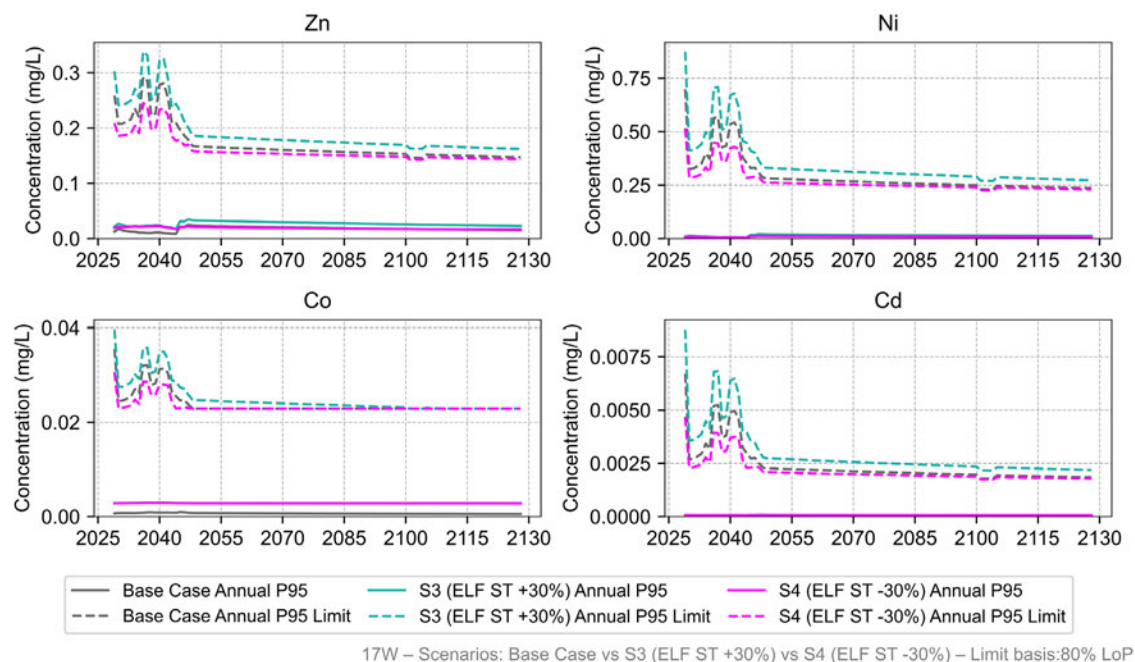


Figure 328: 17W Set2 Acute Limits

5. TOTAL SUSPENDED SOLIDS (TSS) PLOTS

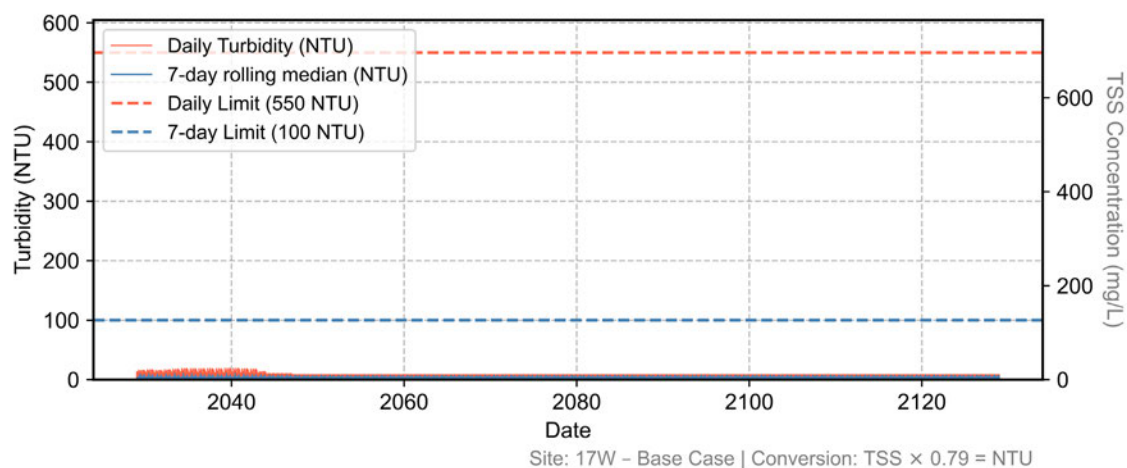


Figure 329: Tss Base Case 17W 20290101 21290102

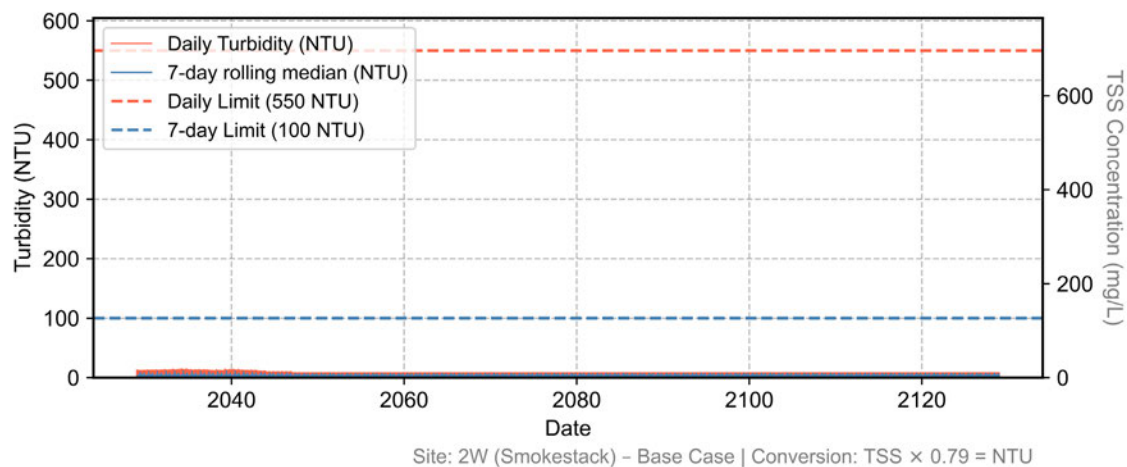


Figure 330: Tss Base Case 2W (Smokestack) 20290101 21290102

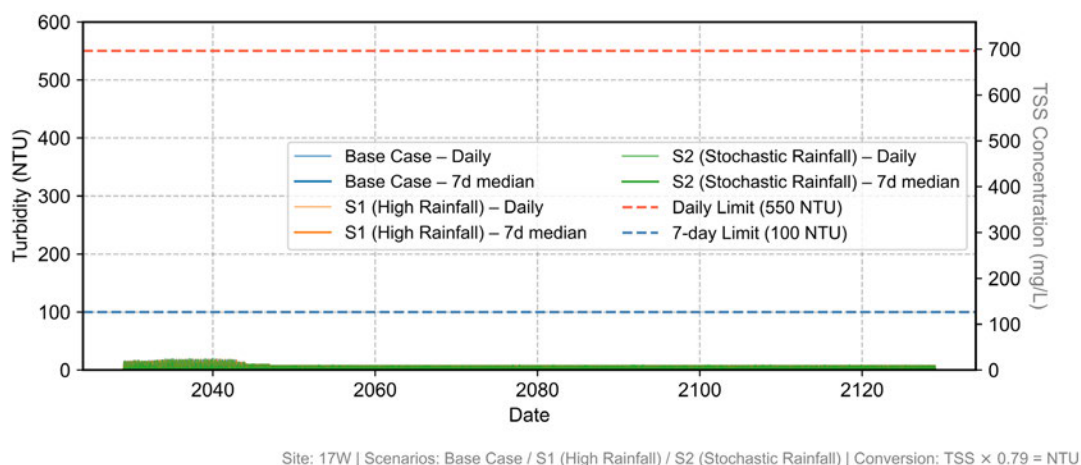


Figure 331: Tss Base Case S1 (High Rainfall) S2 (Stochastic Rainfall) 17W 20290101 21290102 Step100

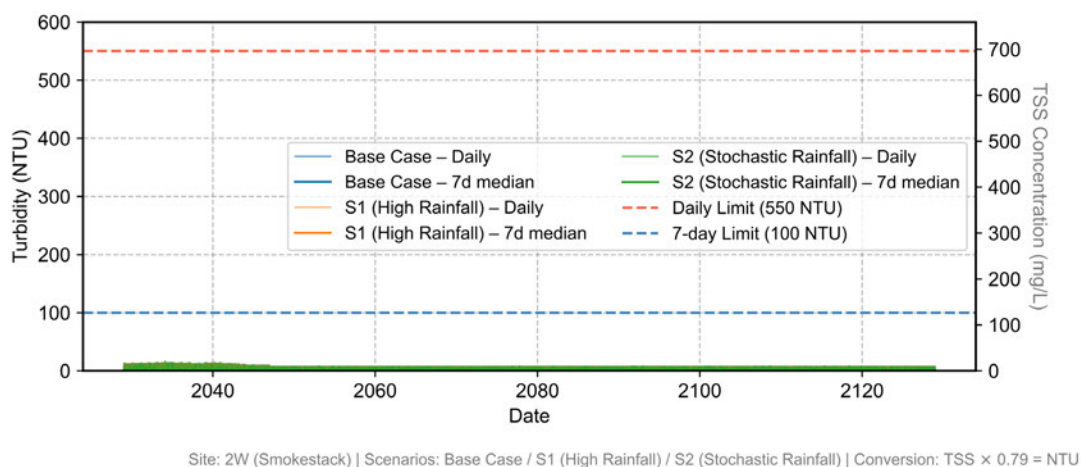


Figure 332: Tss Base Case S1 (High Rainfall) S2 (Stochastic Rainfall) 2W (Smokestack) 20290101 21290102 Step100

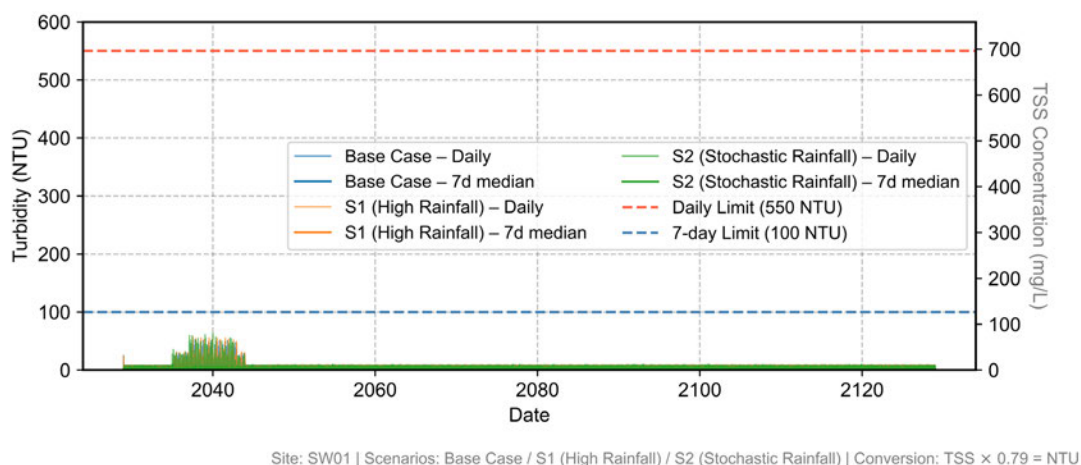


Figure 333: Tss Base Case S1 (High Rainfall) S2 (Stochastic Rainfall) SW01 20290101 21290102 Step100

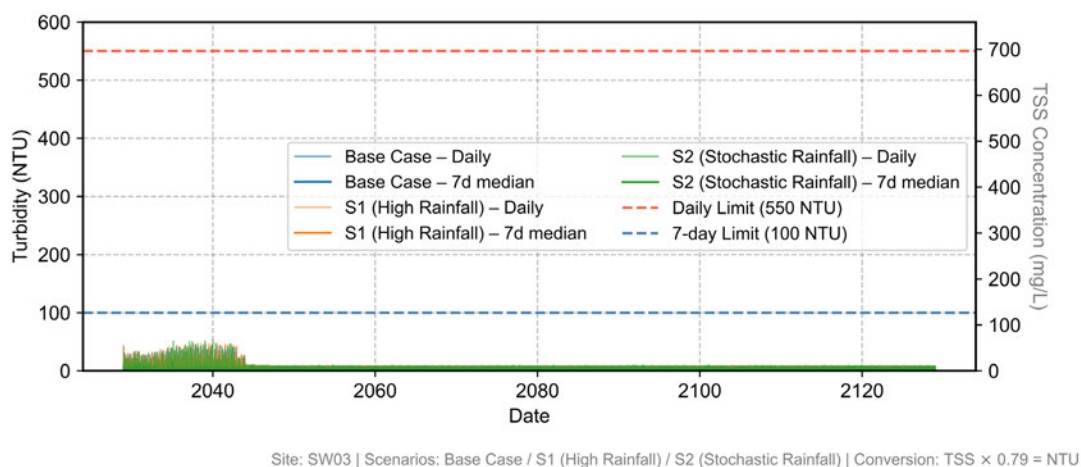


Figure 334: Tss Base Case S1 (High Rainfall) S2 (Stochastic Rainfall) SW03 20290101 21290102 Step100

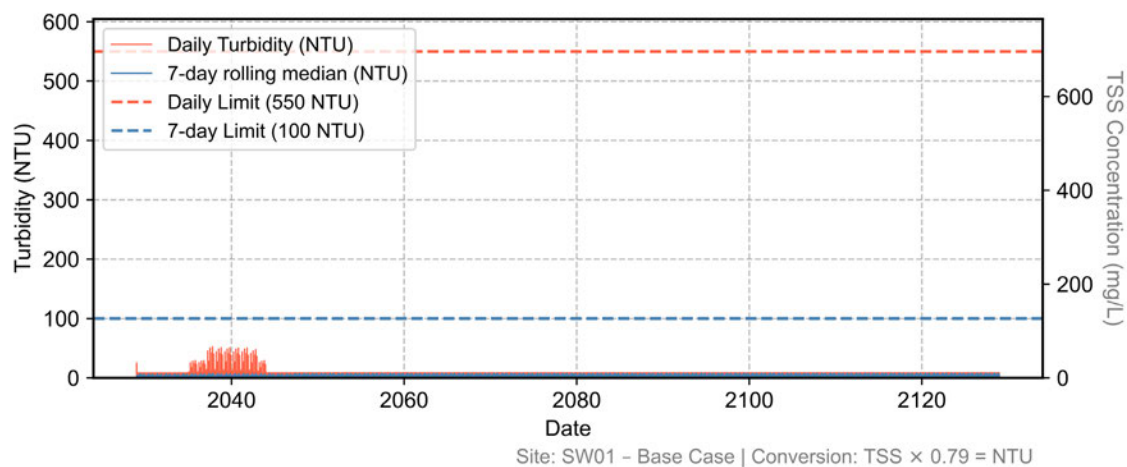


Figure 335: Tss Base Case SW01 20290101 21290102

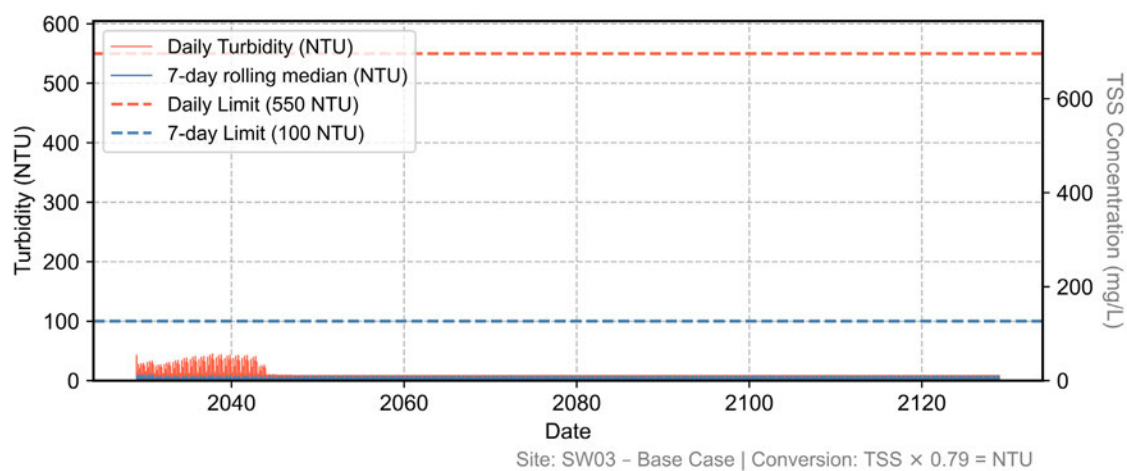


Figure 336: Tss Base Case SW03 20290101 21290102

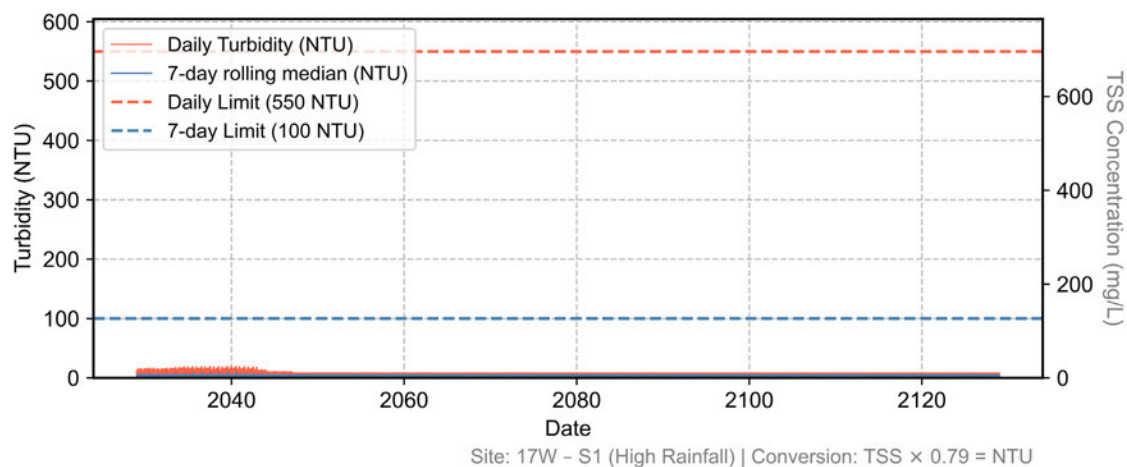


Figure 337: Tss S1 (High Rainfall) 17W 20290101 21290102

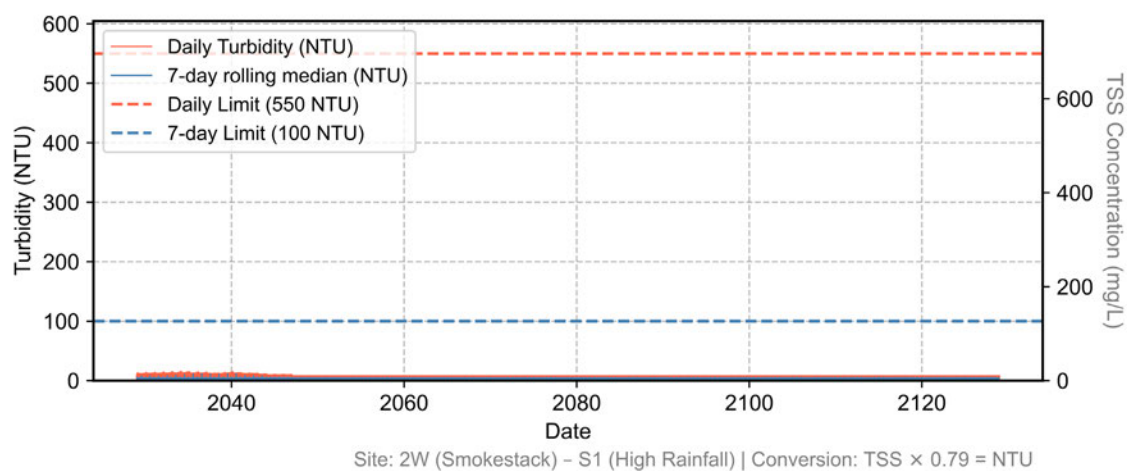


Figure 338: Tss S1 (High Rainfall) 2W (Smokestack) 20290101 21290102

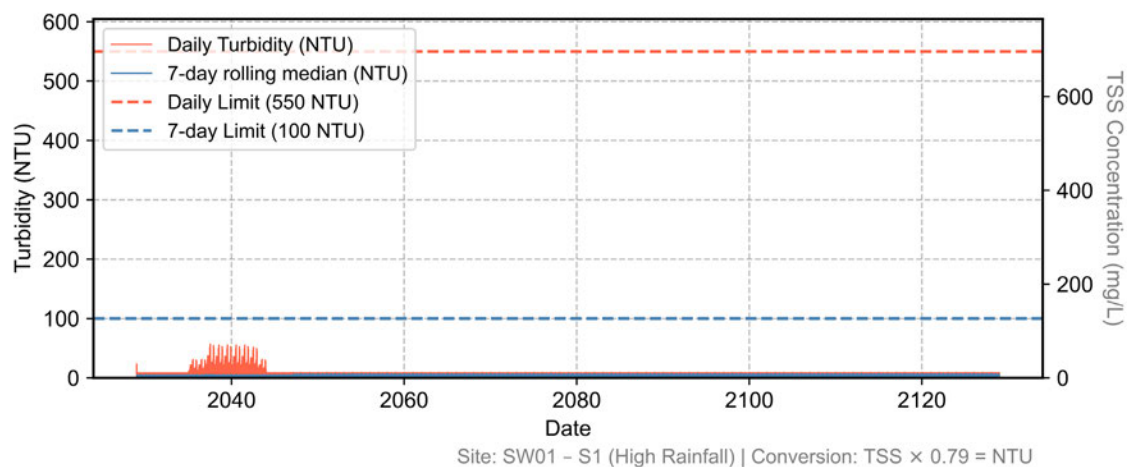


Figure 339: Tss S1 (High Rainfall) SW01 20290101 21290102

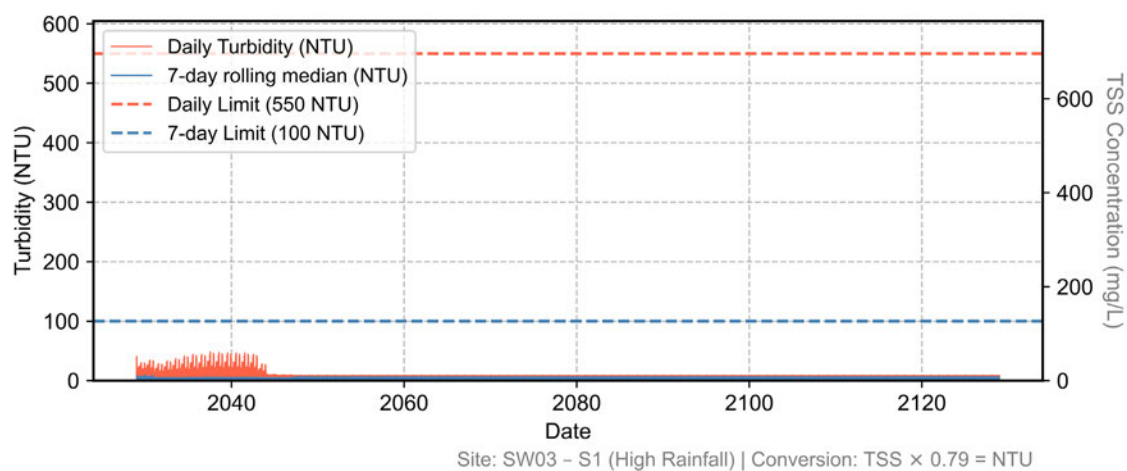


Figure 340: Tss S1 (High Rainfall) SW03 20290101 21290102

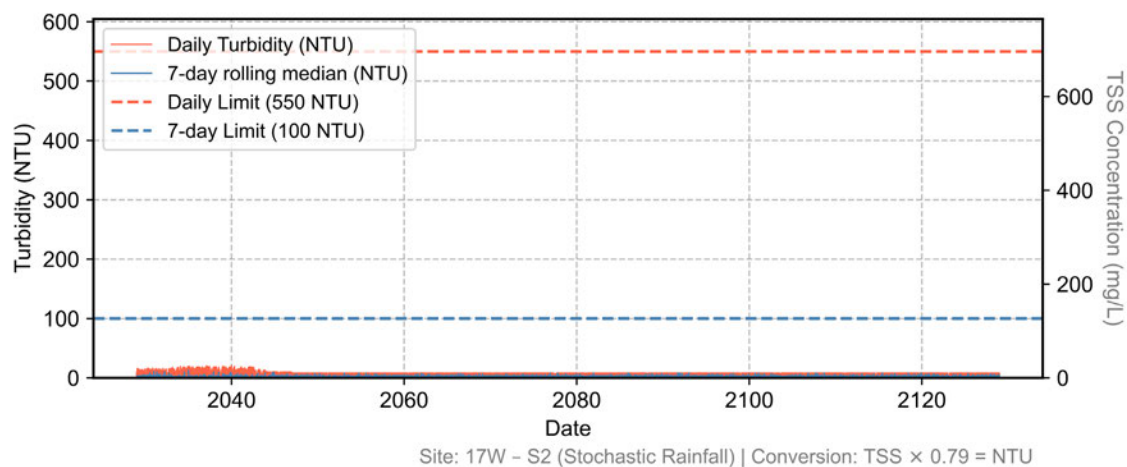


Figure 341: Tss S2 (Stochastic Rainfall) 17W 20290101 21290102

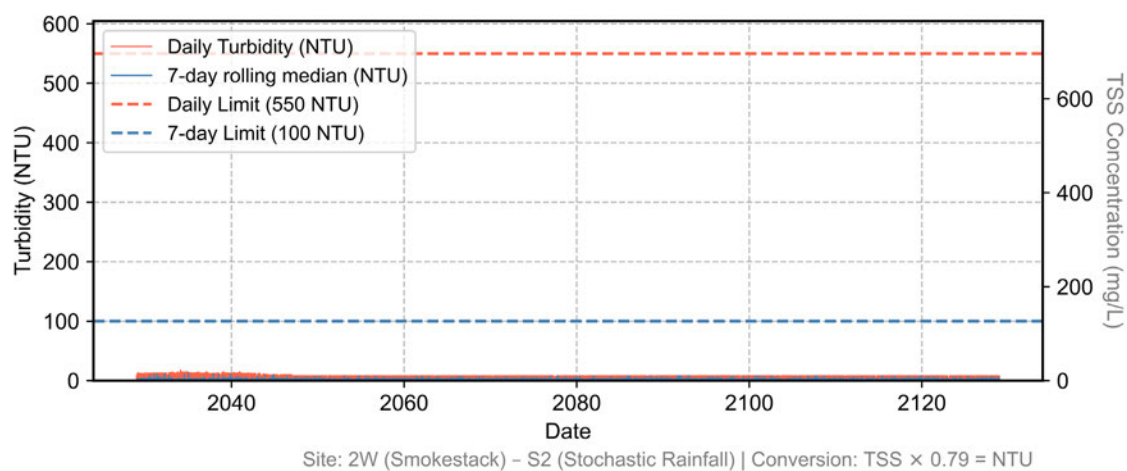


Figure 342: Tss S2 (Stochastic Rainfall) 2W (Smokestack) 20290101 21290102

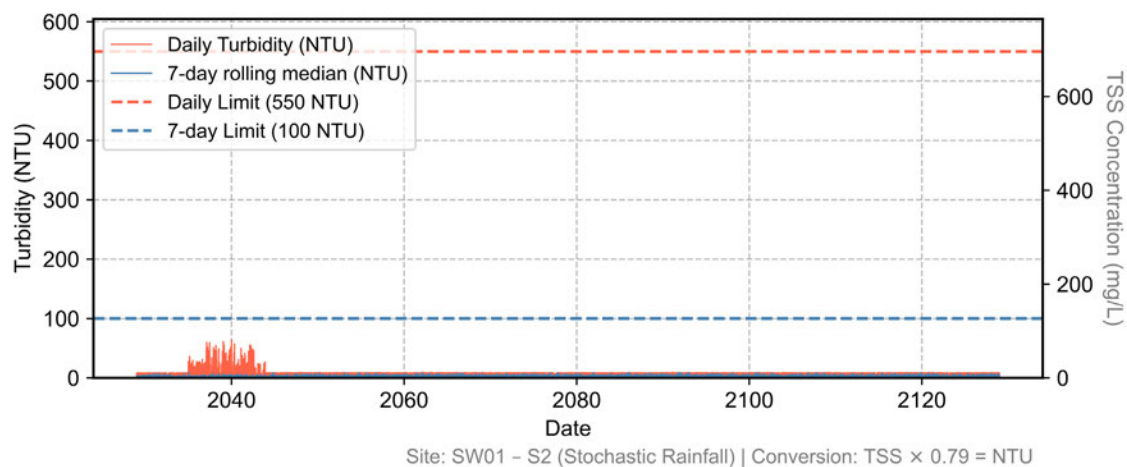


Figure 343: Tss S2 (Stochastic Rainfall) SW01 20290101 21290102

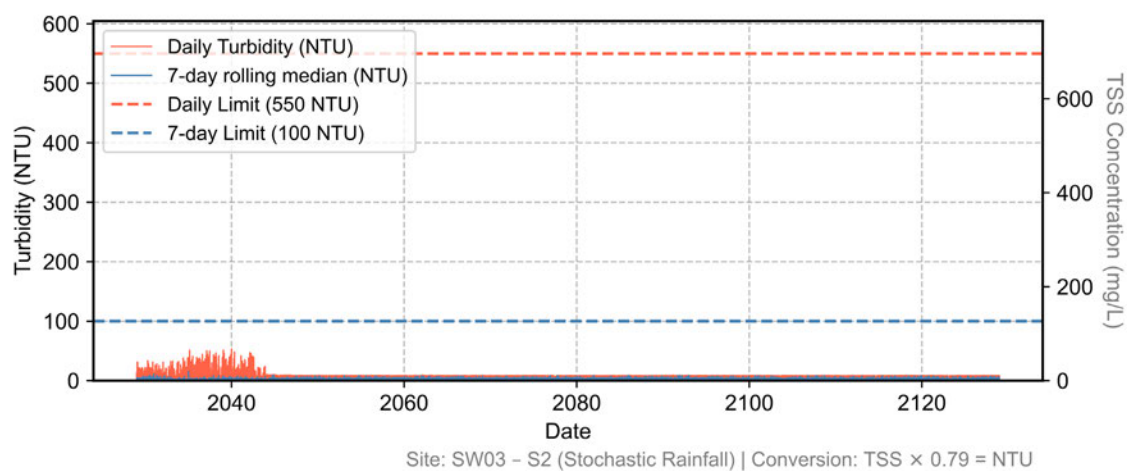


Figure 344: Tss S2 (Stochastic Rainfall) SW03 20290101 21290102

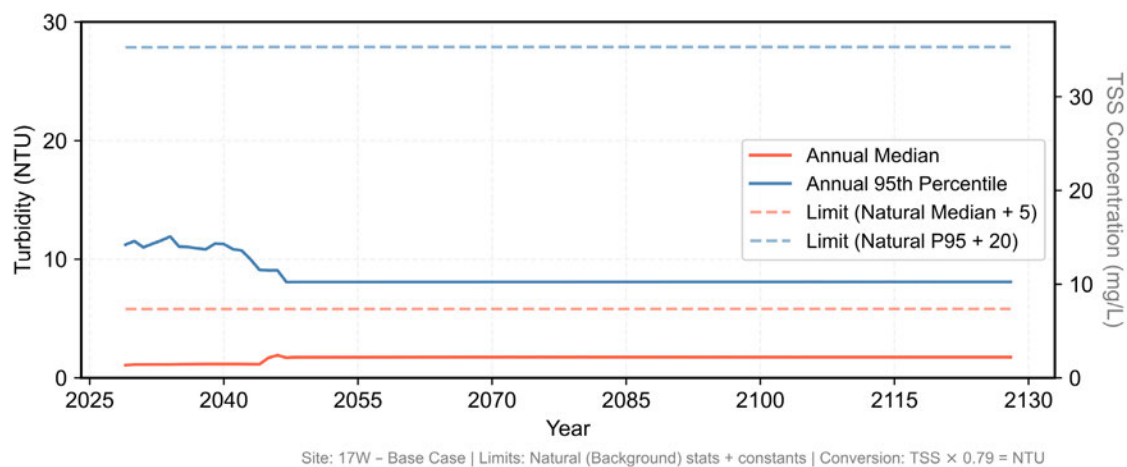


Figure 345: Tss Stats Base Case 17W 2029 2128 Step10

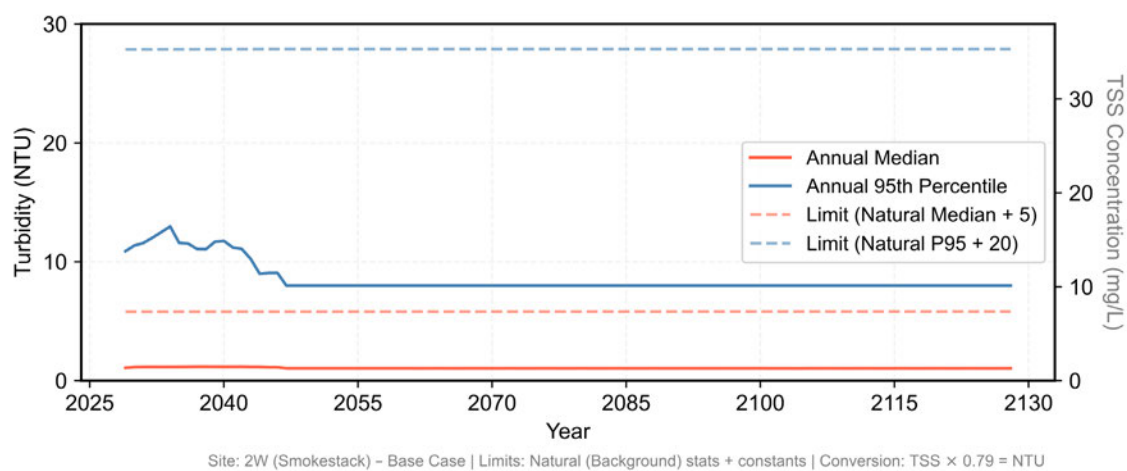


Figure 346: Tss Stats Base Case 2W (Smokestack) 2029 2128 Step10

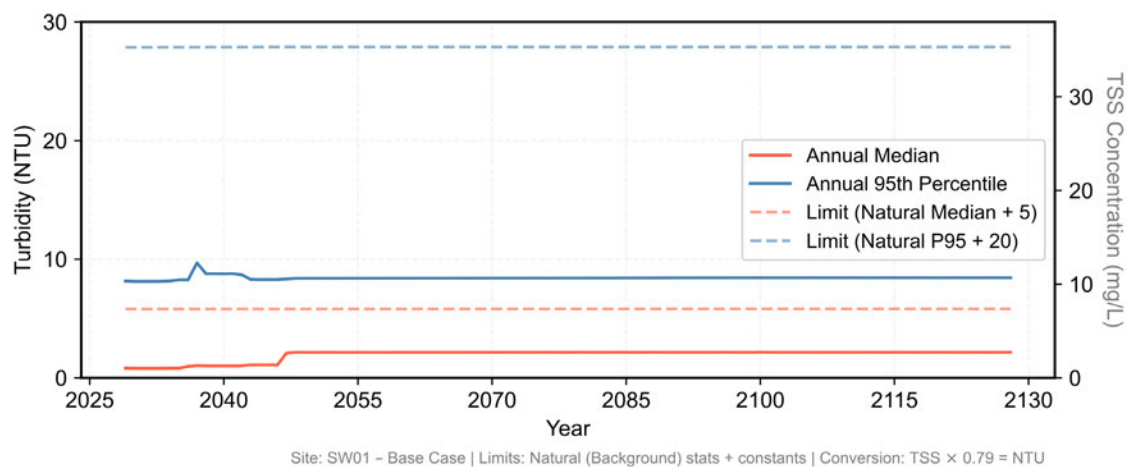


Figure 347: Tss Stats Base Case SW01 2029 2128 Step10

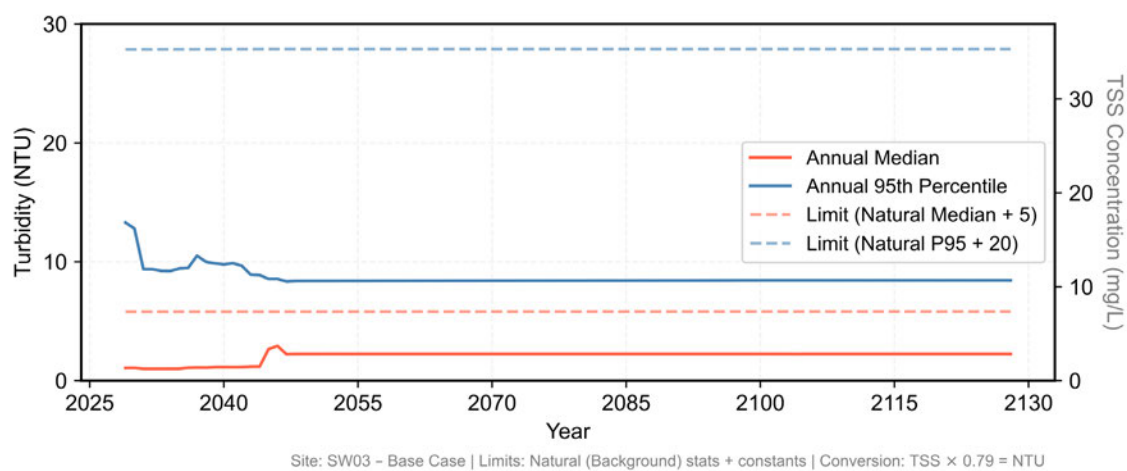


Figure 348: Tss Stats Base Case SW03 2029 2128 Step10

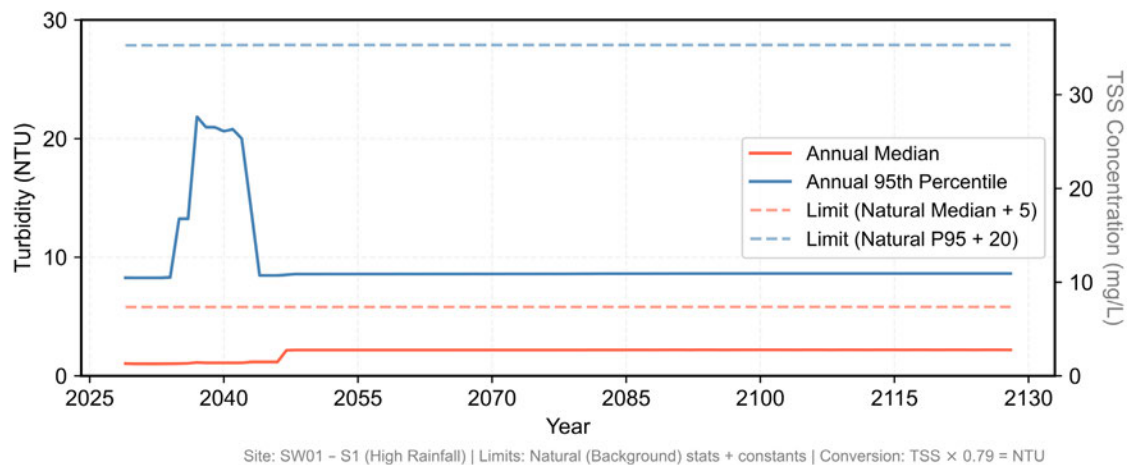


Figure 349: Tss Stats S1 (High Rainfall) SW01 2029 2128 Step10

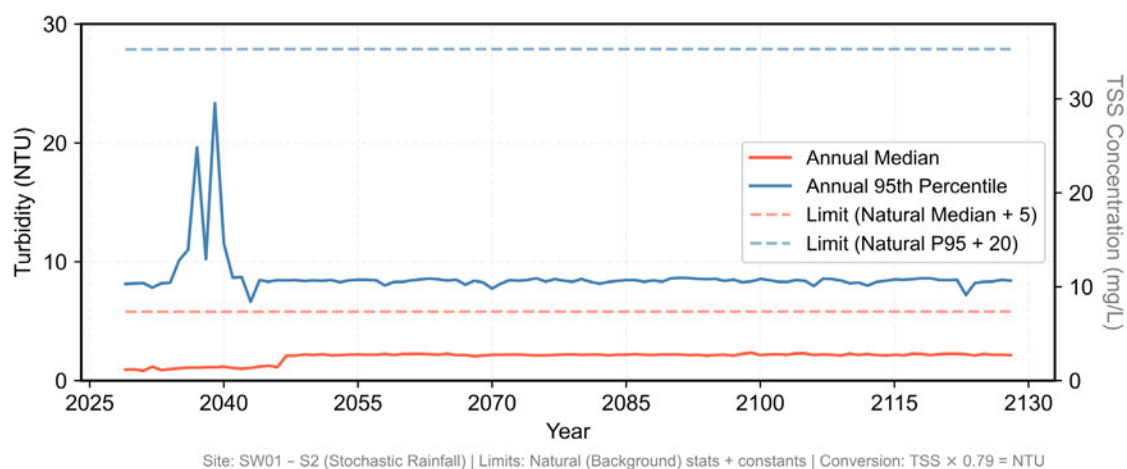


Figure 350: Tss Stats S2 (Stochastic Rainfall) SW01 2029 2128 Step10

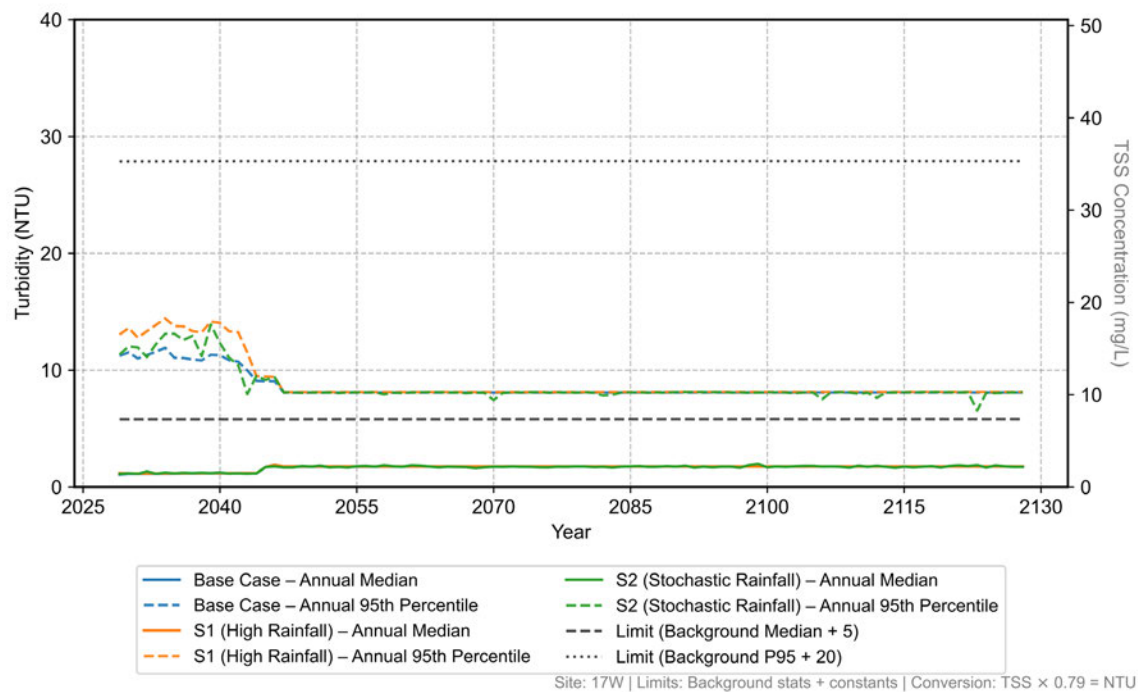


Figure 351: Tss Stats Multi Base Case S1 (High Rainfall) S2 (Stochastic Rainfall) 17W 2029 2128 Step10

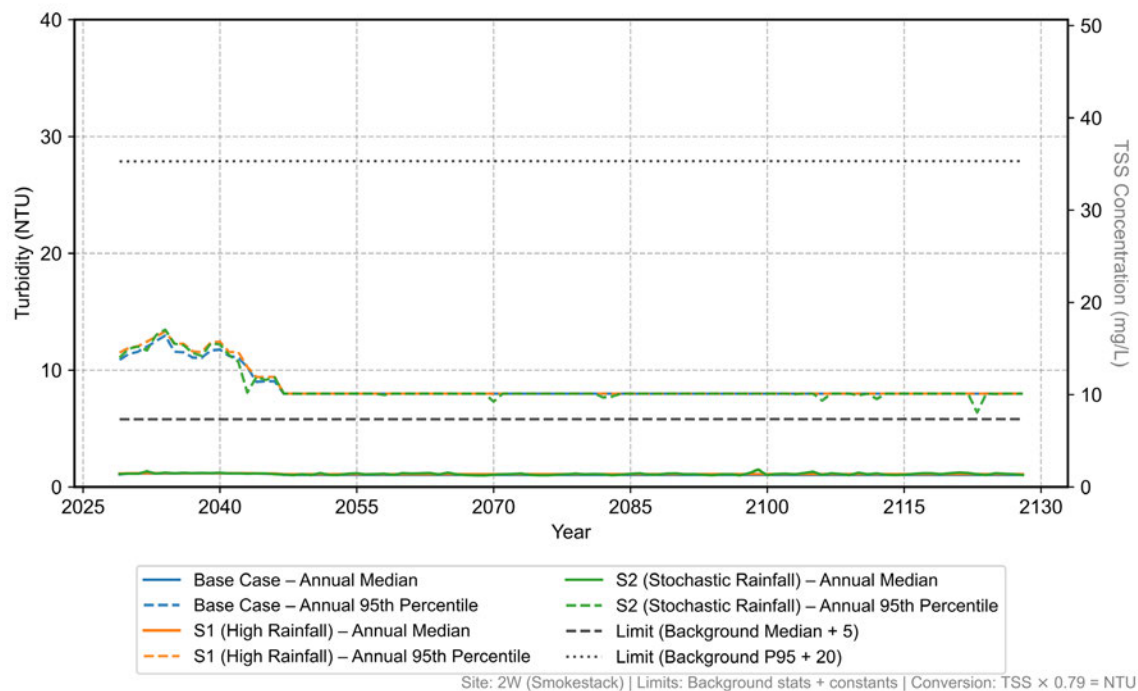


Figure 352: Tss Stats Multi Base Case S1 (High Rainfall) S2 (Stochastic Rainfall) 2W (Smokestack) 2029 2128 Step10

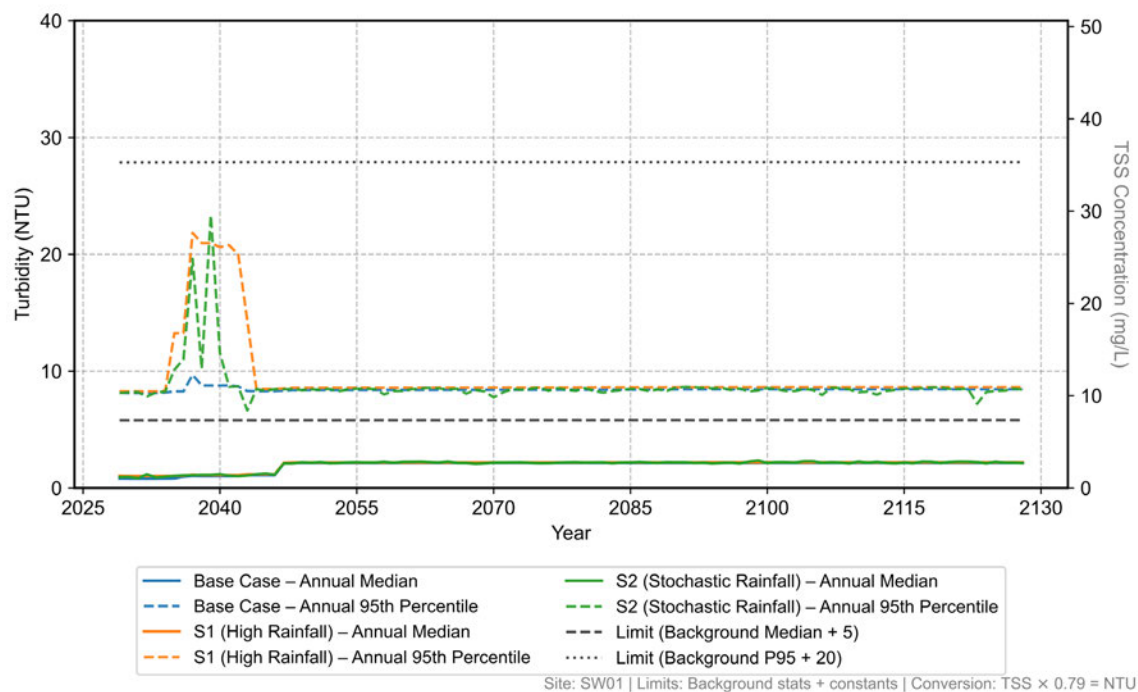


Figure 353: Tss Stats Multi Base Case S1 (High Rainfall) S2 (Stochastic Rainfall) SW01 2029 2128 Step10

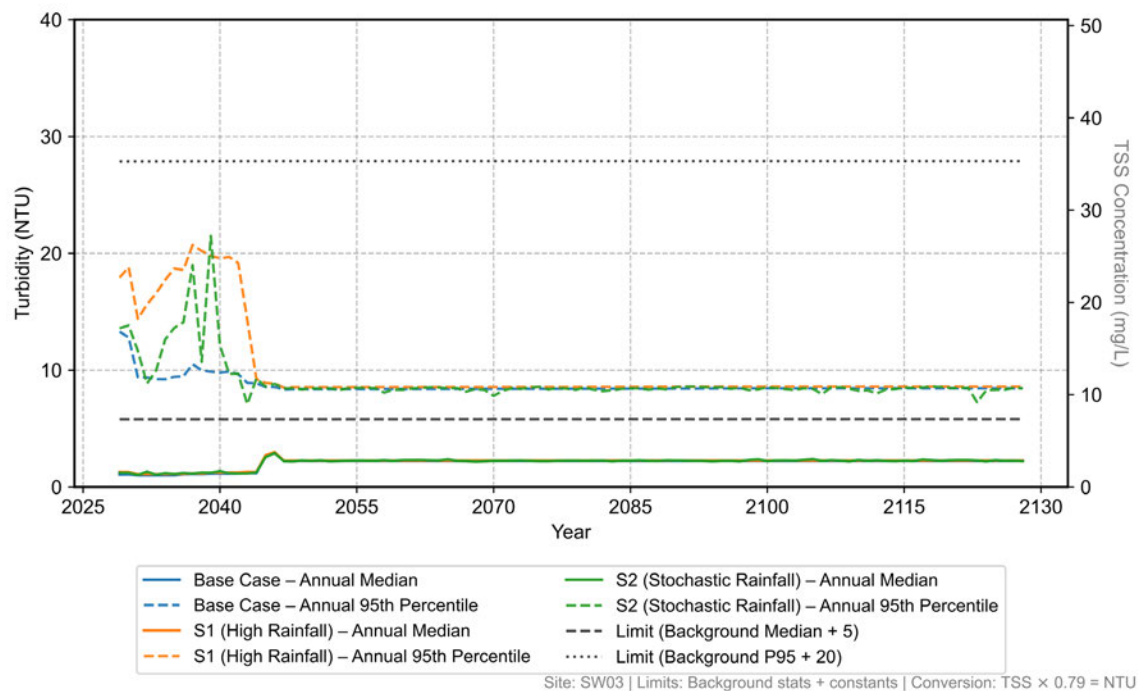


Figure 354: Tss Stats Multi Base Case S1 (High Rainfall) S2 (Stochastic Rainfall) SW03 2029
2128 Step10

6. WATER TREATMENT PLANT INFLOWS

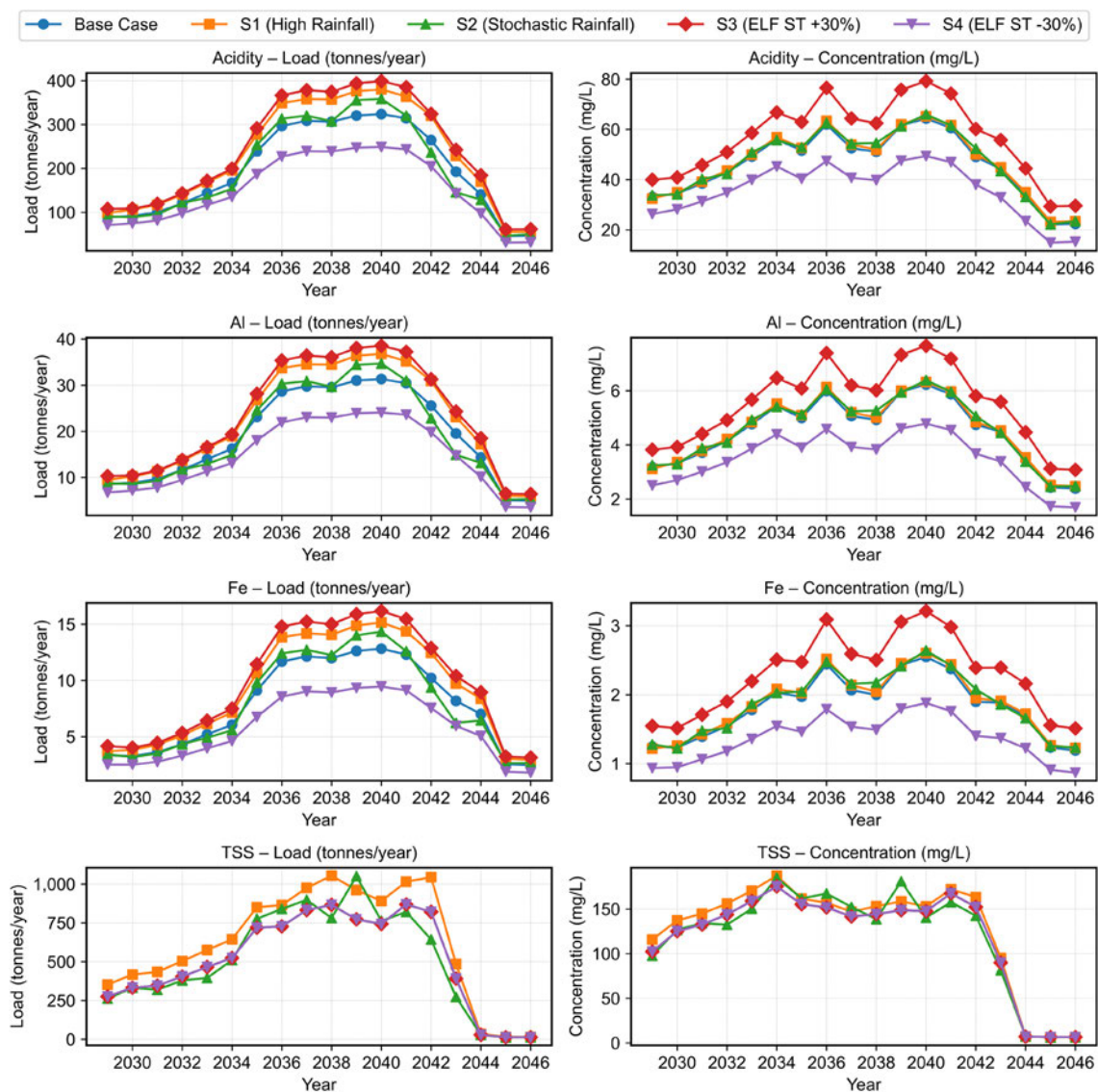
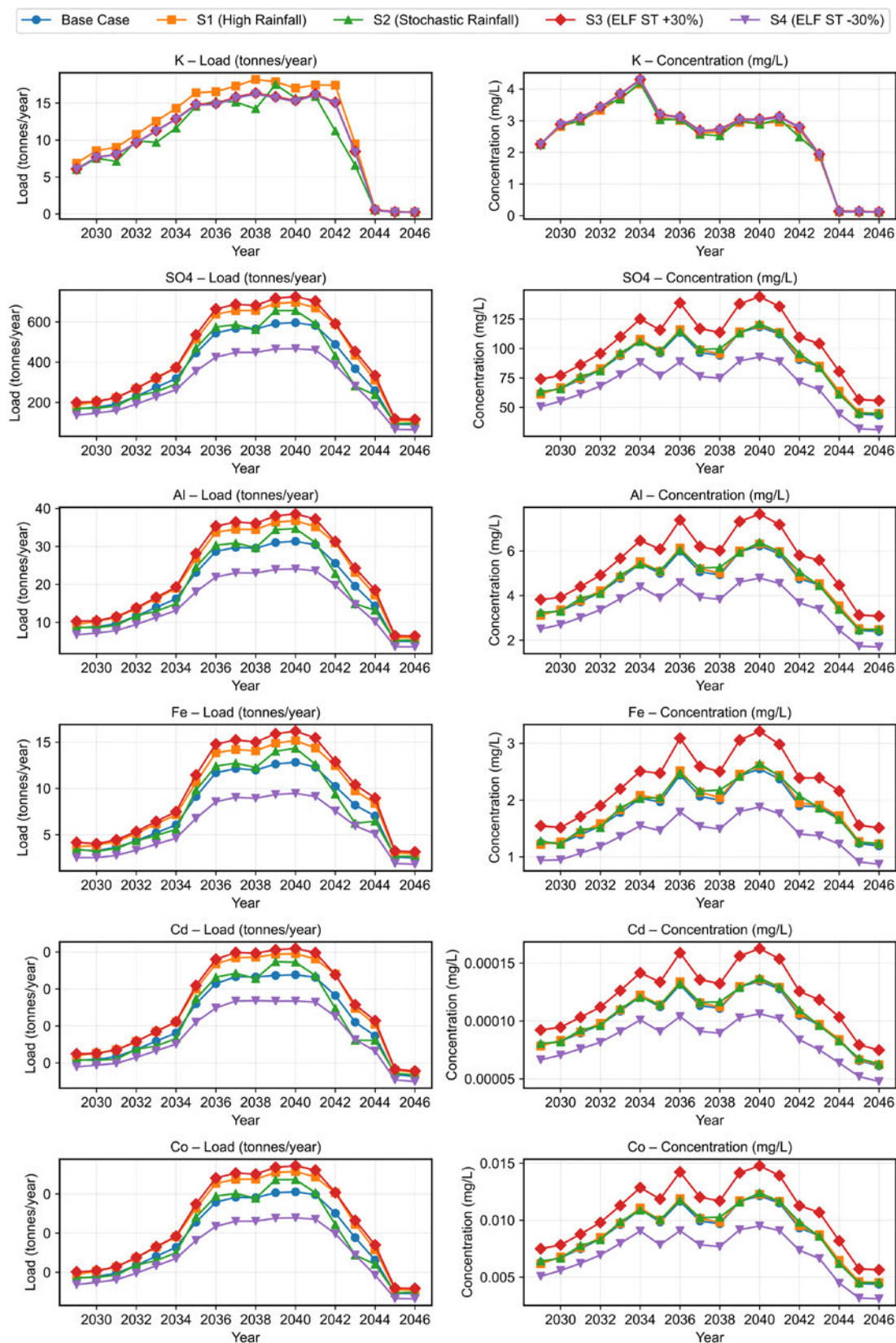


Figure 355: WTP Scenarios Inflows Acidity, Al, Fe, and TSS

Figure 356: WTP Scenarios Inflows K, SO₄, Al, Fe, Cd, Co.

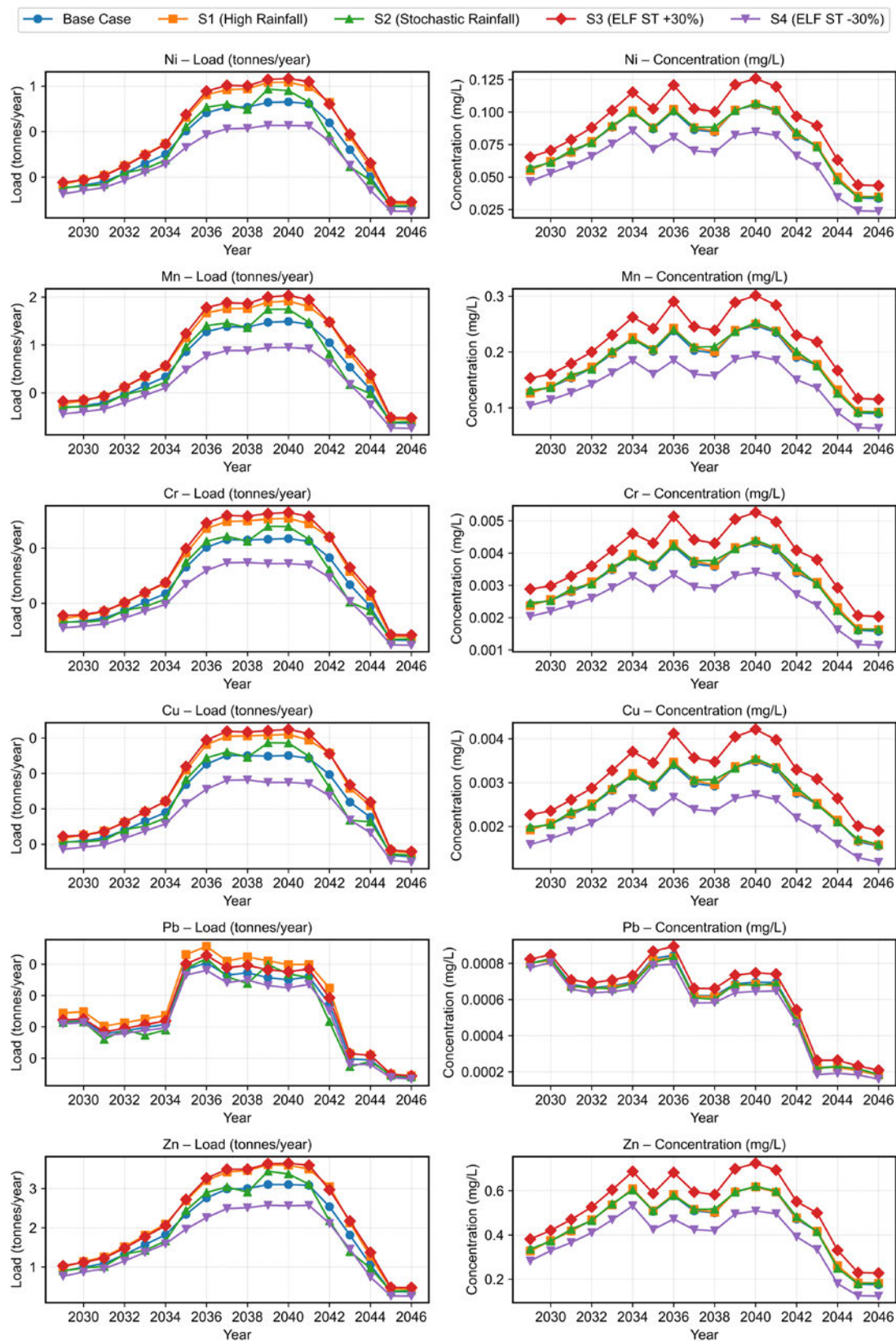


Figure 357: WTP Scenarios Inflows Ni, Mn, Cr, Cu, Pb, Zn.

7. EXCEEDANCE FREQUENCIES

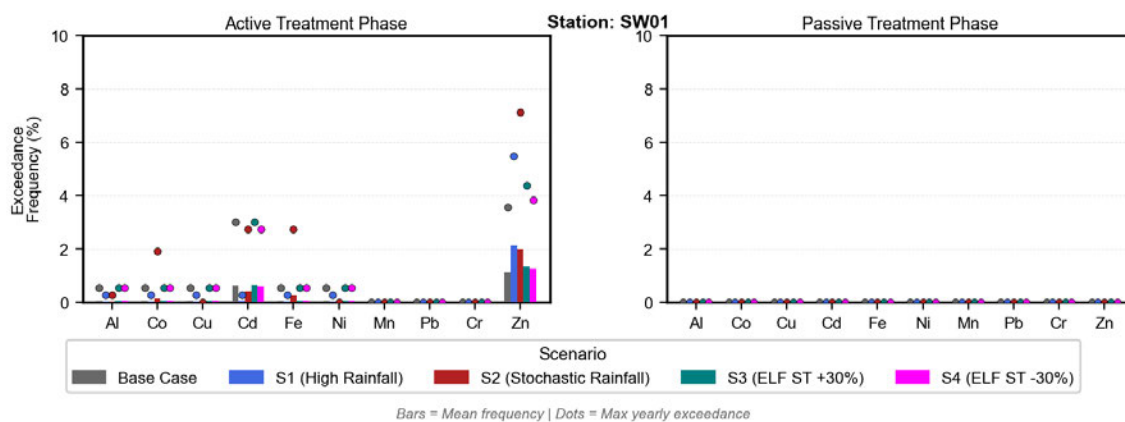


Figure 358: SW01 Scenarios Chronic Exceedance Frequencies.

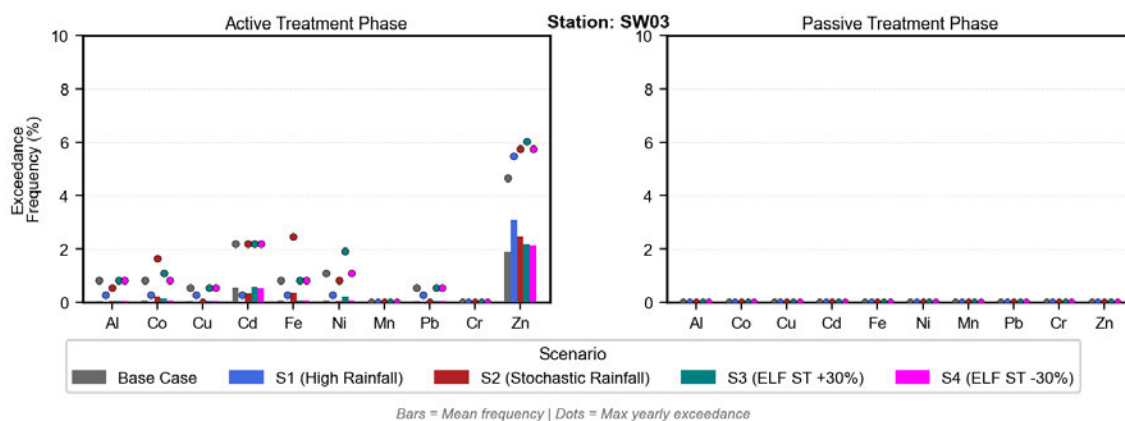


Figure 359: SW03 Scenarios Chronic Exceedance Frequencies.

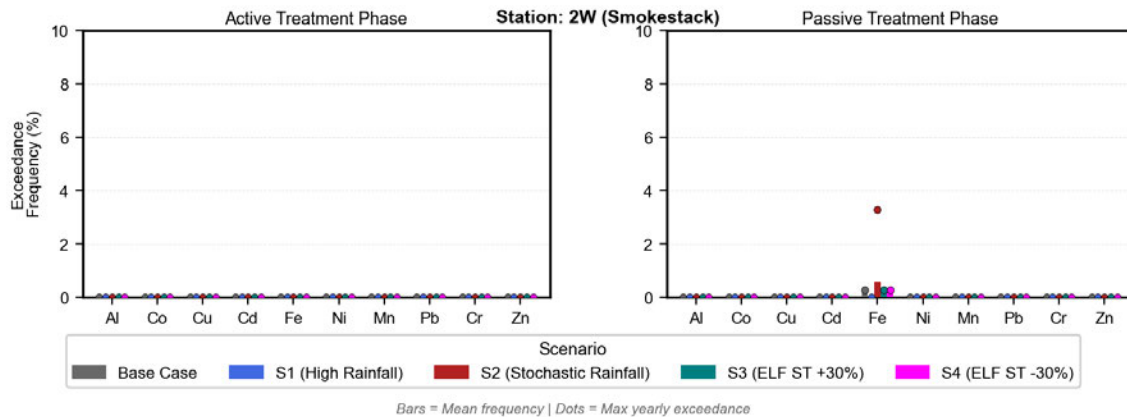


Figure 360: 17W Scenarios Chronic Exceedance Frequencies.

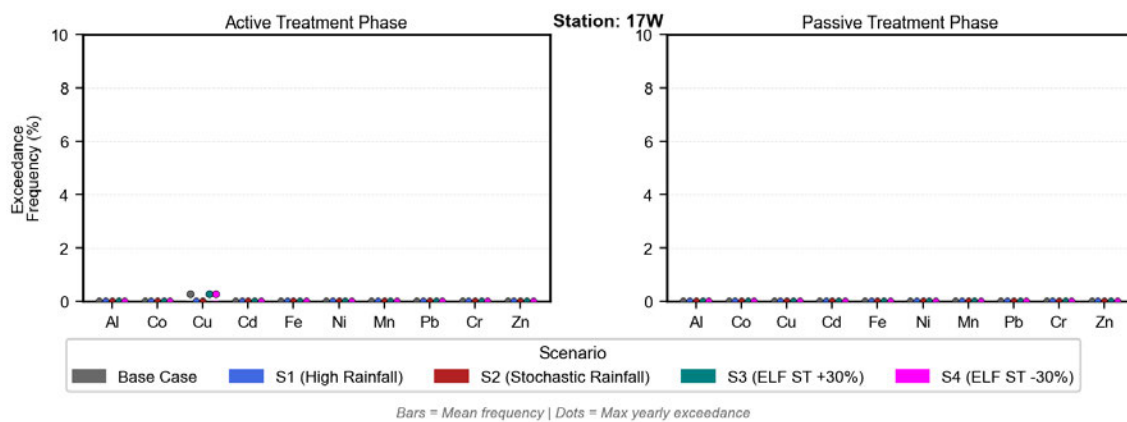


Figure 361: 17W Scenarios Chronic Exceedance Frequencies.

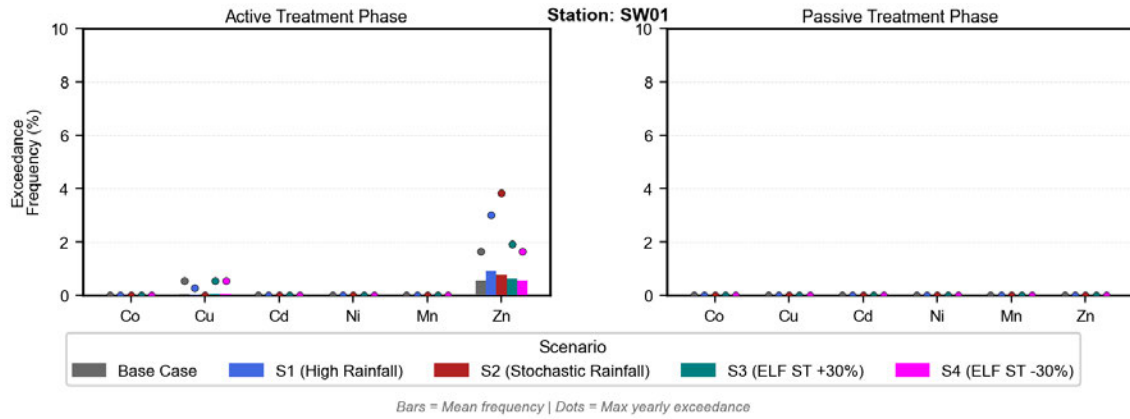


Figure 362: SW01 Scenarios Acute Exceedance Frequencies.

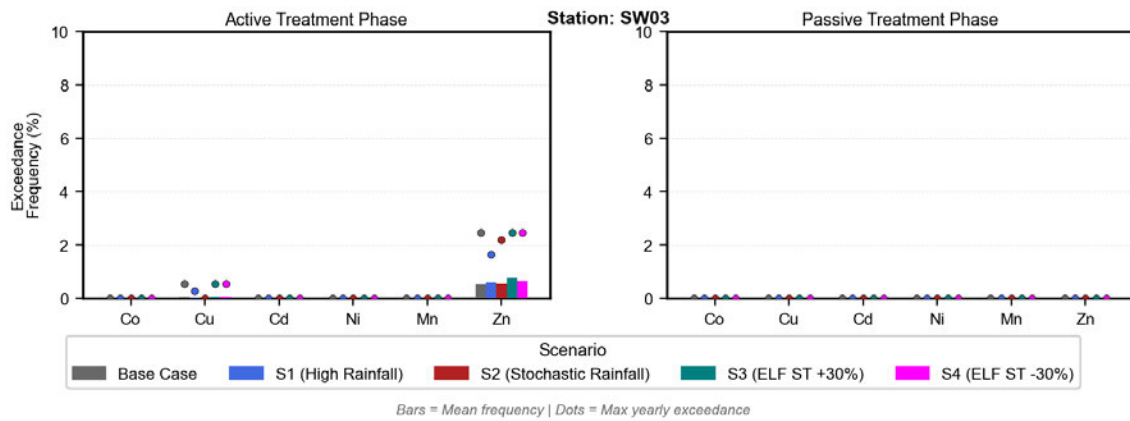


Figure 363: SW03 Scenarios Acute Exceedance Frequencies.

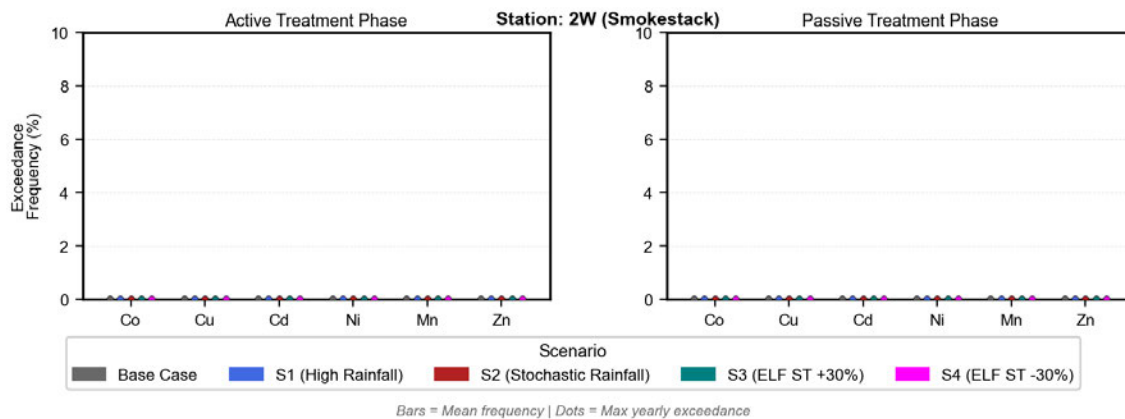


Figure 364: 2W Scenarios Acute Exceedance Frequencies.

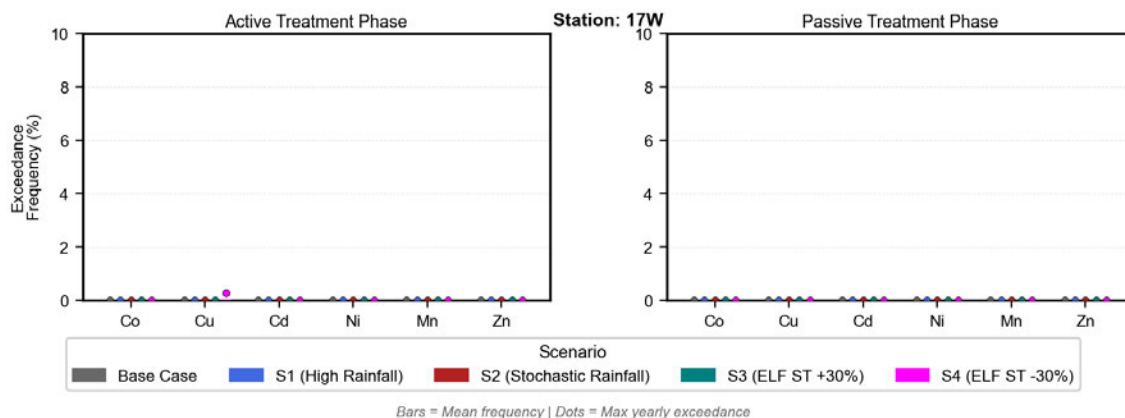


Figure 365: 17W Scenarios Acute Exceedance Frequencies.



MINE WASTE MANAGEMENT

GREENROAD GROUP

APPENDIX W LIMITATIONS

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