AN APPLICATION TO VARY ENVIRONMENTAL PERMIT NUMBER EPR/FB3504FU TO EXTEND THE CURRENTLY PERMITTED AREA TO AUTHORISE THE DEPOSITION OF WASTE ON LAND AS A RECOVERY ACTIVITY TO STABILISE FURTHER QUARRY FACES AT SKIPTON ROCK QUARRY, SKIPTON, NORTH YORKSHIRE INCORPORATING MINOR CHANGES TO THE EXISTING QUARRY FACE STABILISATION WORKS AND TO INCREASE THE MAXIMUM PERMITTTED ANNUAL WASTE INPUT RATE

HYDROGEOLOGICAL RISK ASSESSMENT (HRA) REPORT

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CONTENTS

1.	**Introduction**	**1**
2.	**Summary of the site environmental setting**	**4**
3.	**Qualitative risk screening (Tier 1)**	**8**
	Nature of the hydrogeological risk assessment	8
	Potential risks presented by the site	8
	Sensitivity of the surrounding water environment	9
	Hazards posed and the likelihood of the risk happening	10
	Qualitative risk screening (Tier 1)	10
	Proposed assessment scenarios	11
4.	**Quantitative rogue load assessment methodology**	**13**
5.	**Model input parameters**	**17**
6.	**Modelling results**	**21**
7.	**Water monitoring and compliance limits**	**22**
8.	**Conclusions**	**25**
9.	**References**	**26**

TABLES

Table 1	Source - pathway - receptor linkages in respect of the placement of waste materials at the site
Table 2	Rogue load risk assessment results
Table 3	Updated compliance limits for groundwater monitoring boreholes G3 and G4
Table 4	Updated action levels limits for groundwater monitoring boreholes G3 and G4

FIGURES

Figure 1 Plan showing the environmental monitoring locations (drawing reference TAR/SK/05-26/25537)

Figure 2 Locations of water abstractions in the vicinity of the site (drawing reference TAR/SK/05-26/25542)

Figure 3 Simplified schematic cross section through the waste deposit containing distributed rogue loads (drawing reference TAR/SK/05-26/25538)

APPENDICES

Appendix A Copy of a letter dated 25 July 2024 from the Environment Agency providing pre application advice

Appendix B Updated groundwater level hydrograph

Appendix C Updated rogue load risk assessment spreadsheet

Appendix D Groundwater quality chemographs, monitoring data and summary calculations

This report has been prepared by MJCA with all reasonable skill, care and diligence, and taking account of the Services and the Terms agreed between MJCA and the Client. This report is confidential to the client and MJCA accepts no responsibility whatsoever to third parties to whom this report, or any part thereof, is made known, unless formally agreed by MJCA beforehand. Any such party relies upon the report at their own risk.

1. Introduction

1.1 MJCA is commissioned by Tarmac Trading Limited (Tarmac) to prepare a hydrogeological risk assessment (HRA) report to support an application to vary Environmental Permit Number EPR/FB3504FU (the permit) for the permanent deposit of waste on land as a recovery activity in Areas D and E at Skipton Rock Quarry. Waste is being permanently deposited in Areas D and E as part of earthworks to stabilise quarry faces and restore Areas D and E. It is proposed that the permit will be varied to provide for an easterly extension to the earthworks to stabilise further quarry faces and with some changes necessary to the previously approved restoration scheme in Area E such that the landform created in the easterly extension will integrate with the landform in Area E. The principles of the earthworks in Areas D and E do not change but are extended in an easterly direction. The location of the site, the proposed eastern extension and the environmental monitoring locations are shown on Figure 1.

1.2 The existing permitted site is operated on the principle agreed by the EA that no attenuation layer is needed in the base and sides of the waste deposit. A request for enhanced pre-application advice was submitted to the Environment Agency (EA) in March 2024 to seek confirmation from the EA that the approach adopted in the previous HRA submitted in 2017 (the 2017 HRA)[1] remains acceptable. A draft HRA was submitted in 2024 (the 2024 draft HRA) with the request for pre-application advice. The 2024 draft HRA is based on the 2017 HRA and additional information submitted during the determination of the original EP application including a quantitative rogue load risk assessment[2].

1.3 The pre-application advice is set out in a letter from the EA dated 25 July 2024 a copy of which is reproduced at Appendix A. The advice provides a review of the principles of the 2024 draft HRA. It is stated:

> *"Should an application to extend the site be made, without proposing an attenuation layer where waste is to be placed below the groundwater table the HRA will need to:*

[1] MJCA. 2017. An application for an Environmental Permit to authorise the deposition of waste on land as a recovery activity to stabilise quarry faces at Skipton Rock Quarry, Skipton, North Yorkshire. Appendix E. Hydrogeological risk assessment report. Report reference TAR/SK/AW/5562/01HRA dated December 2017.

[2] MJCA. 2018. Schedule 1 to the e-mail dated 6 July 2018 provided in response to the Schedule 5 Notice dated 18 April 2018. Rogue load risk assessment. Document reference TAR/SK/AW/5562/01/RLA dated July 2018.

a) be consistent with the restricted waste codes and acceptance procedures currently permitted.

b) Show with reference to background groundwater monitoring data relevant to the extension area that it will not cause pollution with reference to the Environmental Permitting Regulations 2016 Schedule 22.

c) Review the monitoring requirements for the site, including the proposed eastern extension to ensure that appropriate substances are monitored and that there are sufficient boreholes present that will be present for the full lifetime of the activity.

1.4 In its letter the EA confirms that the current permit and the waste acceptance procedures (WAP) are considered sufficient for the restricted waste codes that are permitted. With respect to the quantitative rogue load assessment submitted during the determination of the original EP application and updated in the 2024 draft HRA it is stated that the approach adopted is not considered worst case as it is assumed that the rogue load is placed at a distance of 10m from the down hydraulic gradient of the waste mass. The advice provides information and guidance on the possible ranges of leachate quality for assessing accidental rogue load acceptance.

1.5 Based on the advice provided by the EA and consistent with approaches which have been accepted by the EA and/or discussed in detail with the EA during the period since the advice was prepared, the rogue load risk assessment presented in this HRA is substantially revised and is based on a conceptualisation of rogue loads which assumes that if present they could be placed anywhere within the waste mass. This HRA is also based on an updated version to the conceptual site model (CSM) presented in the 2017 ESSD report[3]. With respect to geology, hydrology and hydrogeology updated information relevant to the CSM is presented in Section 2 of this report. The copy of the 2017 ESSD report and a review of the main changes to the 2017 ESSD report are provided at Appendix E and Appendix F to the application report respectively. The updated HRA presented in this report has been prepared with reference to EA guidance[4]. As the proposed development comprises a waste recovery activity rather than a landfill disposal operation and inert waste materials

[3] MJCA. 2017. An application for an Environmental Permit to authorise the deposition of waste on land as a recovery activity to stabilise quarry faces at Skipton Rock Quarry, Skipton, North Yorkshire. Appendix D. Environmental setting and site design report. Report reference TAR/SK/AW/5562/01/ESSD dated December 2017.

[4] https://www.gov.uk/guidance/landfill-operators-environmental-permits/what-to-include-in-your-hydrogeological-risk-assessment

only will be accepted at the site not all sections of the guidance are directly applicable although the general structure has been followed.

2. Summary of the site environmental setting

2.1 A summary of the proposed development is provided in the application report. As stated above a summary of the main changes to the 2017 ESSD report is provided at Appendix F to the application report.

2.2 Summary and updated information with respect to geology, hydrology and hydrogeology is presented in this section of the report:

- Based on published geological information Skipton Rock Quarry predominantly is excavated into limestone of the Carboniferous Chatburn Limestone Formation (formerly the Haw Bank Limestone). The superficial deposits which were present will have been excavated during quarrying activities.

- The bedrock is classified as a Secondary A aquifer and the site and the eastern extension are not located in a groundwater source protection zone (SPZ). The superficial deposits in the vicinity of the site where present are classified as a Secondary undifferentiated aquifer.

- To the north of the site and the eastern extension Haw Beck flows generally in a westerly direction between the site and the eastern extension and the Bolton Abbey Steam Railway. Haw Beck flows parallel to the railway for approximately 1km before flowing under the railway to the south of Embsay shortly after its confluence with Embsay Brook.

- Based on information presented on the GOV.UK website the site and the eastern extension are located in Flood Zone 1 which is defined as land having an annual probability of flooding of less than 1 in 1000.

- Based on information reviewed on Defra's MAGIC website[5] the closest Site of Special Scientific Interest (SSSI) is Holy Well Bridge SSSI which is located approximately 200m to the east of the eastern extension. There are no Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Ramsar Sites, Local Nature Reserves (LNRs) or National Nature Reserves (NNRs) located within 1.5 km of the site or the eastern extension.

[5] https://magic.defra.gov.uk/MagicMap.aspx

2.3 A full description of the site and the surrounding area together with the geological and hydrogeological setting of the site is included in the 2017 ESSD Report which is reproduced at Appendix E to the application report.

2.4 The locations of the water abstractions located within approximately 5km of the site are shown on Figure 2.

- The surface water abstraction nearest to the site is from Haw Beck approximately 140m north west of the site at its closest point. The operator is Tarmac Trading Limited and the use description is process water. There are further surface water abstractions located in Eller Beck approximately 2.6km downstream of the site.

- There is a groundwater abstraction licence number 2/27/15/293 located at the quarry. The licence holder is Tarmac Trading Limited and groundwater is licensed for abstraction from an area of the quarry. Groundwater is abstracted for the purpose of quarry dewatering and under the licence water may also be used as process water and for dust suppression and general or process washing. Based on information provided by the EA there are no other licensed groundwater abstractions within 2km of the site.

- Based on information provided by North Yorkshire Council there may be a Private Water Supply located in the vicinity of High Skibeden Farm located approximately 500m south of the site (reference 7 shown on Figure 2). If the Private Water Supply exists it is unlikely to comprise a receptor relevant to the site as the farm is located up hydraulic gradient of the site.

2.5 A submission in relation to groundwater quality compliance and assessment limits was made on 1 June 2021 (the 2021 submission)[6] pursuant to pre-operational measure reference 1 specified in Table S1.3A of Schedule 1 to EP reference EPR/FB3504FU included a review of available groundwater level monitoring data. Consistent with the information submitted in June 2021 and as shown on Figure 1 surface water monitoring location G1 is located in a water body in the east of the site extension area. Gauge board GBG1 is in the same water body and at the same location as monitoring location G1. Groundwater monitoring borehole G2 is located to the north of the central part of the currently permitted area and groundwater

[6] MJCA. 2021. Skipton Rock Quarry – Environmental Permit reference EPR/FB3504FU – Interim groundwater quality compliance and assessment limits. E-mail to A O'Hare of the Environment Agency dated 1 June 2021.

monitoring boreholes G3 and G4 drilled in February 2021 are located to the north of the western part of the site.

2.6 Groundwater level monitoring has been carried out at borehole G2 generally on a monthly basis since June 2019. Water levels in the water body east of the site have been recorded at gauge board GBG1 generally on a monthly basis since July 2020. Monitoring has also been undertaken consistently at boreholes G3 and G4 since February 2021. For the purpose of preparing the updated HRA the available groundwater level monitoring data for the period up to September 2023 inclusive has been reviewed. A groundwater level hydrograph showing the groundwater levels recorded at and in the vicinity of the site is presented at Appendix B.

2.7 As explained in the 2021 submission it is considered that there may be localised perched or elevated groundwater levels at borehole G2 relative to the groundwater levels recorded in the limestone aquifer at the site which are in the order 5m to 10m lower than the groundwater levels recorded at borehole G2. Consistent with the information presented in the 2021 submission and the updated hydrograph (Appendix B) and the topography at and in the vicinity of the site it is considered that the general direction of groundwater flow at the site is to the west to north west towards and in the direction of flow of Haw Beck. As Haw Beck is underlain by clayey glacial till deposits there may be limited hydraulic continuity between the groundwater in the limestone aquifer and the watercourse.

2.8 There are two landfill sites located to the south of the site comprising a historical landfill and a permitted landfill. It is understood that the permitted Yorwaste Limited Skibeden Quarry Landfill Site accepted household and industrial waste. Based on information provided by the EA the Skibeden Quarry historical landfill first accepted waste in 1989. Based on the information provided in the Envirocheck report at Appendix F to the application report the historical landfill was authorised to accept a wide range of household, commercial and industrial waste types.

2.9 In the 2021 submission it is stated that ground levels to the south of the site are significantly higher than the ground levels at the site and there is a general topographical fall to the west and north west towards Haw Beck. To the south of and within 20m to 70m of the southern boundary of the site ground levels range from approximately 195m above Ordnance Datum (mAOD) to 225mAOD. Based on information obtained by Tarmac in relation to the Yorwaste Limited Skibeden Quarry

Landfill Site located to the south of the western part of the site groundwater levels to the south of the site are in the order of 180mAOD to 190mAOD. Given the location of the off site landfills up hydraulic gradient of the western part of the site and the assumed direction of groundwater flow it is considered that groundwater quality beneath the western part of the site could be affected by the areas of former landfill.

2.10 As explained at Appendix F to the application report the principles of the earthworks in Areas D and E do not change but are extended in an easterly direction. The principles of the design and operation of the site have been accepted by the EA and the EP for the site does not necessitate the placement of an attenuation layer or an engineered barrier at the site. The site is dewatered prior to the deposit of waste materials at the site such that waste materials are not deposited directly into water. The operations in the eastern extension will be consistent with the operation of the site the subject of the EP and the eastern extension is in the same setting as the site the subject of the EP. On this basis no fundamental changes to the design and operation of the site are proposed as part of the development of the eastern extension.

3. Qualitative risk screening (Tier 1)

3.1 The geological, hydrological and hydrogeological setting of the site has been used to identify the relationships between the source, pathways and the identified potential receptors. A CSM summary table including the source – pathway – receptor linkages throughout the lifecycle of the site is presented in Table 1.

Nature of the hydrogeological risk assessment

Potential risks presented by the site

3.2 It is proposed by Tarmac that the EP is varied to extend in an easterly direction the currently permitted infill area. The earthworks to stabilise the further quarry faces and restore Area E and the eastern extension area will necessitate the importation of approximately 430,000m^3 of inert restoration materials.

3.3 Prior to the placement of the imported inert waste materials water bodies located in the extension area will be dewatered such that waste will not be deposited directly into water. The waste materials that will be deposited at the site will comprise imported inert materials. Precipitation infiltrating the imported inert waste materials may migrate to groundwater in the bedrock underlying the site and, when dewatering by the pumping of groundwater ceases, the materials placed in the extension area will be situated above and below the groundwater level.

3.4 Based on the definition specified in Council Directive 1999/31/EC[7] inert waste comprises:

> *"…waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health. The total leachability and pollutant content of the waste and the eco toxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater".*

[7] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste

3.5 The waste types that it is proposed will be accepted are presented at Schedule 2 of the EP. No changes are proposed to the types of waste imported, the activities undertaken under the EP or the existing waste acceptance procedures.

3.6 The waste types accepted will comprise a limited range of inert waste types only. All of the waste types included in the list of wastes specified at Schedule 2 of the EP are included in the 'W*aste that does not need testing"* section in the guidance on Waste acceptance procedures for deposit for recovery on land published by the EA on GOV.UK[8]. Schedule 2 of the EP specifies that:

- waste will not be accepted unless it is from a single source and well characterised and described; and,
- waste will only be accepted if there is no risk of contamination.

On this basis it is considered that the waste does not comprise a contaminant source with the potential to have a significant adverse effect on groundwater quality.

3.7 As stated above waste acceptance procedures will be in place to minimise the risk that unacceptable waste materials will be accepted at the site and procedures will be in place for the rejection of non conforming loads. No wastes will be accepted from contaminated sites. As robust waste acceptance procedures will be implemented the uncertainty with regard to the presence of contaminants in the waste deposited will be low.

Sensitivity of the surrounding water environment

3.8 Consistent with the information presented in Section 2 and at Table 1 the groundwater in the limestone bedrock underlying the site and the surface water body Haw Beck which may be in hydraulic continuity with groundwater are potential receptors for the migration of any contaminants present in the waste. Based on the CSM the site is in a moderately sensitive setting as it is located in a Secondary A aquifer and part of the waste deposit may be below the recovered groundwater table in the long term hence groundwater provides a pathway to surface water receptors in the vicinity of the site.

8 https://www.gov.uk/government/publications/deposit-for-recovery-operators-environmental-permits/waste-acceptance-procedures-for-deposit-for-recovery

3.9 Consistent with the information provided in Section 2 and elsewhere in the application report it is considered that there is no history of potentially contaminative activities at the site which has been used only for mineral extraction activities. There is a history of potentially contaminative activities in the wider area. There are two landfill sites to the south west of the application site, a historical landfill and a permitted landfill. The permitted landfill accepts household and industrial waste. Given the location of the off site landfills up hydraulic gradient of the western part of the site and the assumed direction of groundwater flow it is considered that groundwater quality beneath the western part of the site could be affected by the areas of former landfill.

Hazards posed and the likelihood of the risk happening

3.10 As the restoration materials imported to the site will comprise inert waste only the water that has percolated through the waste mass is unlikely to contain discernible concentrations of hazardous substances and on this basis the concentrations of hazardous substances in groundwater at a relevant compliance point located down hydraulic gradient of the site also will not be discernible. The inert waste deposited at the site is unlikely to contain significant concentrations of non hazardous substances which could give rise to pollution of groundwater. Based on the hydrogeological setting, the waste types that will be accepted and the waste acceptance procedures it is concluded that there is a negligible risk of unacceptable impacts on groundwater or surface water quality. Based on the continuity in the site operations it is concluded that no attenuation layer, sealing liner or capping system is necessary in principle at the proposed extension area.

3.11 Groundwater levels and groundwater quality will be monitored consistent with the varied permit. Updated groundwater compliance and assessment limits are included in this HRA which have been derived taking into account the monitoring undertaken since the permit was issued.

Qualitative risk screening (Tier 1)

3.12 Based on the qualitative risk screening carried out it is considered unlikely that there would be a significant risk from the deposit of inert waste in the extension area to groundwater or surface water receptors. The inert nature of the waste precludes a significant source-pathway-receptor linkage hence it is concluded that there is no significant risk to groundwater quality in the limestone aquifer or to surface water

quality in the Haw Beck from the proposed deposition of inert waste. It is concluded that based on the proposed use of inert waste only there will be no significant risks to human health or to the environment from the proposed development.

Proposed assessment scenarios

3.13 As stated above it is considered that the Tier 1 qualitative risk screening demonstrates that it is unlikely that there would be a significant risk from the deposit of inert waste in the extension area to groundwater or surface water receptors. The EA in its letter of 25 July 2024 confirms that having reviewed the current permit and the WAP these are considered sufficient for the restricted waste codes that are permitted.

3.14 Consistent with the EA's letter and the principles under which the site operates currently it is considered that it would be acceptable to the EA in principle that no attenuation layer is specified in respect of the proposed deposition of waste in the extension area provided that it can be demonstrated with reference to background groundwater monitoring that it will not cause pollution with reference to the Environmental Permitting Regulations 2016 Schedule 22 and that appropriate monitoring of the environmental performance of the site is proposed.

3.15 Based on the EA's letter and the information submitted during the determination of the original EP application it is considered that a quantitative rogue load risk assessment is needed. On this basis it is proposed that an updated quantitative rogue load risk assessment is undertaken assess the scenario in which non compliant waste is accepted at the site. Compared with the quantitative rogue load risk assessment submitted during the determination of the original EP application it is considered that the methodology for undertaking the rogue load risk assessment needs to be updated to take into account the specific comments of the EA in its letter of 25 July 2024 with respect to rogue load risk assessments.

3.16 The quantitative rogue load risk assessment presented in this report is intended to provide an assessment of the potential effects on water quality in the unlikely scenario that a proportion of loads accepted at the site comprise non compliant waste. The rogue load assessment is undertaken as a sensitivity test representing failure of waste acceptance controls. The assessment necessarily considers a scenario in which waste acceptance procedures are not fully effective. This scenario does not

represent the authorised operation of the site but is included to respond to the EA's request for quantitative assessment of potential accidental departures from compliance.

4. Quantitative rogue load assessment methodology

4.1 In its letter of 25 July 2024 the EA specifies with respect to the assessment of rogue loads that:

- The starting point for any inert site is that the residual leachate quality would be that of the inert waste acceptance criteria (WAC) permitted.
- The fate of a range of contaminants in the source term should be assessed by undertaking a risk screen against appropriate water quality standards or natural baseline quality.
- It takes into account the EA's developing work on rogue loads including the possible ranges of concentrations which may be present in rogue loads.
- Consideration is given to modelling the non hazardous substances sulphate, ammoniacal nitrogen and nickel and the hazardous substances arsenic or lead.
- The assessment takes into account the possibility that a rogue load could be placed close to or at the boundary of the waste deposit rather than an arbitrarily specified 10m distance from the down hydraulic gradient edge of the waste deposit.
- That a conceptual drawing and written summary is provided explaining the location of the modelled rogue load within the waste mass.

4.2 The updated rogue load risk assessment methodology adopted in this HRA takes into account the above points and is consistent generally with modelling approaches which have been accepted by the EA in respect of other sites. The rogue load risk assessment has been undertaken using spreadsheet based calculations and the approach adopted to carry out the assessment is consistent generally with the EA Remedial Targets Methodology and EA guidance on preparing hydrogeological risk assessments. A schematic cross section showing the conceptual representation the rogue load scenario is presented as Figure 3. The updated quantitative rogue load risk assessment is presented at Appendix C.

4.3 Water percolating through the restoration materials has the potential to leach substances present in the restoration materials. The mass flux of substances from

the restoration materials will depend on the concentrations of substances leached from the restoration materials (the source) and the rate of percolation (flow) of water through the potential source which comprises the imported restoration materials which will be deposited at the site.

4.4 The rate of flow of water through the source will depend on the rate of infiltration to the source, the hydraulic properties of the source and the local hydrogeology. It is understood that the majority of the restoration materials will be deposited above the groundwater table. On this basis water flowing through the source will comprise rainfall recharge which has percolated through the source. However, as it is expected that dewatering will be necessary to facilitate placement of some of the restoration materials it is possible that some of the waste will be deposited below the elevation to which groundwater will recover following the cessation of dewatering.

4.5 As the permeability of the restoration materials is likely to be lower than the permeability of the limestone in the surrounding in situ aquifer it is considered that the head within the waste mass generally will be higher than the head in the aquifer surrounding the waste mass. On this basis the principal control on flow through the source will remain the amount of infiltration from above rather than any lateral groundwater flow through the lower part of the waste mass where present below the water table. Groundwater in the limestone aquifer will flow round any low permeability waste deposited below the water table. Further information on the hydraulic properties of the restoration materials and the approach to estimating percolation rates and the principles of the site water balance are described below.

4.6 Calculations of the rate of runoff to the restored site and the catchment external to the waste deposited are presented in the *"Infiltration"* worksheet in the spreadsheet presented at Appendix C. The calculations take into account that the amount of runoff and infiltration will vary depending on the time of year. The monthly water balance approach is based on long term mean meteorological conditions published for the Northern England by the Met Office. The approach is consistent with a methodology developed by Thornthwaite and Mather[9] and described in detail in Koerner and Daniel[10]. Runoff rates are calculated using a method published by the National Coal

[9] Thornthwaite, C. W. and Mather, J. R. 1957. The water balance. Drexel Institute of Technology, Publications in Climatology, Volume 8, number 1, Philadelphia, PA

[10] Koerner, R. M. and Daniel, D. E. 1997. Final covers for solid waste landfills and abandoned dumps. American Society of Civil Engineers, Virginia and Thomas Telford, London.

Board[11] which takes into account slope gradient, vegetation type and soil type variations. Ground slope is a key determinant of runoff rate. Where the evapotranspiration value calculated in the *"Infiltration"* worksheet is greater than the water available in the soil matrix for a given month the evapotranspiration value comprises a potential evapotranspiration value and there is no flux of infiltrating rainfall.

4.7 In the "WaterBalance" worksheet the discharge through the base of the waste deposit is estimated based on the percolation rate estimated in the *"Infiltration"* worksheet. In the "WaterBalance" worksheet the aquifer flow is estimated using Darcy's law and an estimate of the thickness of the groundwater mixing zone in the limestone aquifer. A dilution equation shown on the *"ImmediateDilutionModel"* worksheet is used to estimate the concentrations of the substances at a compliance point in the limestone aquifer immediately down hydraulic gradient of the waste and taking into account immediate dilution in the aquifer. On this basis the approach to calculating the groundwater flow is consistent generally with the approach adopted to calculating the steady state dilution in the aquifer as set out in the EA Remedial Targets Methodology. It is assumed that the compliance point for hazardous substances is the groundwater at the down hydraulic gradient edge of the deposited imported materials following immediate dilution in the receiving aquifer. Conservatively the same compliance point is assumed for non hazardous pollutants.

4.8 For the purpose of the modelling it is assumed that non conforming loads potentially could be accepted at the site notwithstanding the waste acceptance procedures that will be in place. It is assumed that overall proportion of rogue loads in the waste mass will be 2% by volume. To take into account the possibility raised by the EA that a rogue load could be placed close to or at the boundary of the waste deposit it is assumed conservatively that approximately 50% of the rogue loads present in the waste mass will be deposited in a 2m thick "higher risk" basal zone in the waste deposit.

4.9 Consistent with the simple assumptions and estimates set out in the *"RogueLoadGeometry"* worksheet presented at Appendix C it is estimated that the equivalent volumetric rogue load proportion in the basal zone of the waste deposit would be 7.25% and on a conservative basis it is assumed for the purpose of the

[11] National Coal Board. 1982. Technical management of water in the coal mining industry. NCB Mining Department. 129pp.

rogue load risk assessment that the proportion of rogue loads is 7.25% rather than the 2% assumed in the waste mass overall. A volumetric rogue load fraction within the basal 2m does not represent a single discrete rogue load. It represents a spatially distributed condition in which a proportion of the waste-aquifer interface is directly affected by non compliant waste. Unless the dimensions of the rogue load are all significantly less than the 2m thickness of the basal "higher risk" zone it is considered highly likely that non compliant waste would intersect the waste-aquifer interface directly. Overall it is considered that this conceptualisation of rogue loads is significantly more conservative than that assumed in the rogue load assessment submitted during the determination of the original EP application and updated in the 2024 draft HRA submitted with the request to the EA for pre application advice.

4.10 The pathway for the migration of contaminants in groundwater is the limestone aquifer. Based on the available information on the groundwater flow regime at and in the vicinity of the site it is considered that groundwater migrating through the deposited waste could migrate down hydraulic gradient. As explained in Section 2 it is considered that the general direction of groundwater flow at the site is to the west to north west towards and in the direction of flow of Haw Beck. As Haw Beck is underlain by clayey glacial till deposits there may be limited hydraulic continuity between the groundwater in the limestone aquifer and the watercourse.

5. Model input parameters

5.1 Where possible the model input parameters are based on site specific data or other relevant sources. Where no site specific data are available professional judgement has been used to select appropriate parameter values based on relevant scientific literature. The model input parameters are presented in the spreadsheet models together with justification for the parameter values selected.

5.2 With respect to the input parameters relevant to the calculation of the flow in the aquifer such as the hydraulic gradient in the aquifer and the hydraulic conductivity of the aquifer these remain consistent with parameter values used in the 2024 draft HRA.

- The hydraulic gradient is estimated based on the fall in groundwater levels from groundwater monitoring borehole G4 to borehole G3. Based on the available monitoring data groundwater levels at boreholes G4 and G3 typically are 152m above Ordnance Datum (mAOD) and 148mAOD respectively and the boreholes are approximately 187m apart. It is assumed that groundwater levels at monitoring location GBG1 may be reduced artificially by groundwater abstraction. These assumptions have been reviewed with reference to an updated hydrograph presented at Appendix B.

- With respect to the hydraulic conductivity of the aquifer it is reported in the minor aquifer properties manual (reference 1) that the Chatburn Limestone comprises a reef limestone and that the hydraulic conductivity of the Carboniferous Limestone aquifer in general is highly variable depending on the degree of solution enhanced fractures and joints. It is reported that the density and size of fractures in the Carboniferous Limestone commonly decreases rapidly with depth, providing an effective aquifer thickness of only 50m to 80m (reference 2). In the minor aquifer properties manual the median of 19 transmissivity values is reported as $18m^2$/day. Assuming an aquifer thickness of 50m this would be equivalent of a permeability of 4.2×10^{-6}m/s. For comparison the range of hydraulic conductivity reported for reef and karstic limestones in Domenico and Schwartz (reference 3) is 1×10^{-6}m/s to 2×10^{-2}m/s.

5.3 Consistent with advice receive from the EA in respect of other sites an updated approach to setting assessment criteria has been adopted compared with that

presented in the rogue load assessment submitted during the determination of the original EP application and in the 2024 draft HRA submitted with the request to the EA for pre-application advice

- For hazardous substances the assessment criterion is the minimum reporting value (MRV) (or the UKTAG Limit of Quantification (LoQ) if lower) except where background concentrations exceed the MRV in which case the assessment criterion is the non outlier maximum background concentration assumed at the down hydraulic gradient edge of the waste deposit.

- For non hazardous substances the assessment criterion is the minimum of the UK Drinking Water Standard (DWS) or Environmental Quality Standard (EQS) except where this is exceeded by background concentrations in which case the assessment criterion is the non outlier maximum background concentration assumed at the down hydraulic gradient edge of the waste deposit.

- Where applicable the EQS values specified in the *"Source"* worksheet are specified taking into account assumptions regarding regional baseline chemistry such as typical calcium carbonate concentrations (fluoride), water hardness (cadmium) and published ambient background concentrations (zinc).

- Where the published EQS values are for the bioavailable concentration, site specific Predicted No Effect Concentrations (PNECs) have been estimated for screening purposes using the published UKTAG M-BAT and Pb Screening Tools.

5.4 With reference to groundwater quality chemographs presented at Appendix D background concentrations have been estimated for the substances for which site specific monitoring data are available. On the chemographs concentrations recorded below the analytical limit are plotted at the detection limit. The groundwater quality dataset has been reviewed for possible outliers and the approach to estimating the mean background concentration and the maximum non outlier background concentration is recorded at Appendix D. A set of interactive chemographs are also provided at Appendix D in a ZIP archive file. The HTML files can be opened in a web browser and are interactive. By hovering over individual data points the relevant date and concentration can be read off. It is possible to zoom in on specific areas of the graphs.

5.5 The imported materials will comprise only inert waste with no suspicion of contamination and there is no expectation that the imported materials will contain discernible concentrations of hazardous substances or significant concentrations of non hazardous pollutants.

- For conforming loads it is assumed conservatively that non hazardous substances are present at the L/S = 10l/kg inert waste leaching limit concentrations[12] expressed in mg/l and that hazardous substances are present at the MRV (or UKTAG LoQ if that is lower).

- Where assumed present the rogue load source is consistent with the "most likely" value specified for all determinands specified in the EA letter dated 25 July 2024 in the table headed *"Possible Range of Leachate Quality for assessing accidental rogue load acceptance"* except for arsenic and nickel for which the most likely value specified exceeds the assumed concentration in conforming waste. For these determinands the maximum value specified by the EA is used.

5.6 It is considered that the concentrations of non hazardous pollutants which are assumed in compliant waste are highly conservative generally. Based on the waste types which will be accepted it is considered likely that the concentrations of non hazardous pollutants will be significantly lower than their respective L/S = 10l/kg inert WAC leaching limit values.

5.7 A quantitative risk screening exercise has been undertaken to identify those substances which may pose the greatest potential risk to groundwater quality. The quantitative risk screening exercise is presented in the *"Source"* worksheet at Appendix C. The source term assumed for the purpose of the screening exercise is the source term assumed for the rogue load risk assessment which has been screened against appropriate water quality standards. As part of the risk screening exercise a risk characterisation ratio (RCR) has been calculated as the assumed source concentration divided by the relevant screening criterion. Only substances that based on EA comments it is considered necessary to model by default or for which the screening RCR exceeds a threshold value of 3 are carried forward to the immediate dilution modelling stage. On this basis the quantitative risk screening is

[12] Council decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC. Official Journal of the European Communities. 2003/33/EC.

used to identify substances which may pose the greatest potential risk to groundwater quality are to take these substances forward for further quantitative assessment.

6. Modelling results

6.1 The results of the quantitative rogue load risk assessment are summarised in Table 2. The assessment presents the assumed source concentrations, the relevant assessment criteria, predicted concentrations in groundwater at the down hydraulic gradient edge of the deposited materials following immediate dilution and the ratio of predicted concentrations to the assessment criterion.

6.2 The modelling demonstrates that for all hazardous substances assessed the predicted concentrations in groundwater following immediate dilution are below the relevant assessment criteria. In all cases the predicted concentrations are significantly lower than the minimum reporting values or site specific background based criteria applied.

6.3 For non hazardous substances including sulphate, chloride, ammoniacal nitrogen zinc and nickel the predicted concentrations in groundwater are also below the relevant assessment criteria taking into account background concentrations where applicable.

6.4 The modelling assumes that no attenuation processes occur within the limestone aquifer beyond immediate dilution at the compliance point. In practice, dispersion and geochemical attenuation processes would be expected to further reduce concentrations along groundwater flow paths. On this basis the modelling results are considered conservative.

6.5 Overall the results demonstrate that even under the unlikely scenario of acceptance of rogue loads at the assumed proportions and locations there would be no discernible discharge of hazardous substances to groundwater and no pollution of groundwater by non-hazardous substances.

6.6 Based on the results of the risk assessment it is considered that the site will be compliant with The Environmental Permitting (England and Wales) Regulations 2016 as amended with regard to the relevant provisions of Directive 2006/118/EC of the European Parliament and of the Council on the protection of groundwater against pollution and deterioration (the 2006 Groundwater Directive).

7. Water monitoring and compliance limits

7.1 Two groundwater monitoring boreholes were drilled at the site in February 2021 consistent with a Construction Quality Assurance (CQA) Plan approved by the EA. In the CQA Plan the two additional boreholes are referred to as boreholes G2 and G3 consistent with Figure ESSD 7 (drawing reference TAR/SK/11-18/20909 dated 20 November 2018) referred to in the permit. In 2019 a historical borehole designated G2 was identified at the site. The CQA Validation Report in respect of the February 2021 drilling work records that the borehole referred to as borehole G2 in the CQA Plan has been renamed borehole G4 at the request of Tarmac to avoid duplication of monitoring location references in use at the site. The groundwater monitoring locations shown on Figure 1 and on the updated Figure ESSD 7 presented at Appendix F to the application report are labelled consistent with the updated borehole references.

7.2 Based on the results of the updated rogue load assessment Table ESSD B presented at Appendix F to the application report has been updated. It is proposed that arsenic, cadmium, chromium, copper and lead are added to the list of determinands for which groundwater samples will be analysed.

7.3 The 2021 submission in relation to groundwater quality compliance limits and action levels was made on 1 June 2021 pursuant to Pre-operational measure reference 1 specified in Table S1.3A of Schedule 1 to EP reference EPR/FB3504FU. The EA confirmed acceptance of the compliance limits and action levels in Compliance Assessment Report 404306/0394829 dated 9 June 2021.

7.4 Compliance limits and action levels currently are set for ammoniacal nitrogen, mercury, nickel and zinc concentrations at down hydraulic gradient groundwater monitoring boreholes G3 and G4. It the 2021 submission accepted by the EA it is stated that:

- It is considered that these determinands comprise a representative set of substances taking into account the likely physical and chemical properties of the waste that it is proposed will be deposited at the site.

- As generally high concentrations of chloride and sulphate have been recorded at boreholes G3 and G4 (up to in the order of 600mg/l and 500mg/l respectively) it is

considered that compliance limits and action levels set for chloride and sulphate would be of low sensitivity with regard to any potential changes in groundwater quality at and in the vicinity of the site and would be unlikely to facilitate the prompt identification of adverse trends in groundwater quality following commencement of the importation of waste to the site. It is considered that there would be low utility in using chloride and sulphate concentrations to assess the environmental performance of the site and that other monitoring determinands should be preferred for assessing the environmental performance of the site.

7.5 Updated groundwater quality compliance limits and action levels are proposed in Table 3 and Table 4 respectively. The updated compliance limits and action levels have been derived consistent with the general approach adopted in the 2021 submission accepted by the EA. The calculations on which the compliance limits and action levels are based are presented and summarised in a spreadsheet provided at Appendix D.

7.6 In general the background concentrations of the determinands for which compliance limits and action levels are set are higher at groundwater monitoring boreholes G3 and G4 than at monitoring location G1. On this basis and unless stated otherwise the relevant monitoring locations used in the derivation of the compliance limits and action levels for boreholes G3 and G4 is aggregated groundwater quality monitoring data from boreholes G3 and G4. For zinc the concentrations recorded at monitoring borehole G4 generally are higher than at borehole G3. On this basis the compliance limit and action level for zinc at borehole G4 is based on the monitoring data from borehole G4 only and the compliance limit and action level for zinc at borehole G3 is based on monitoring data from borehole G3 only.

7.7 For ammoniacal nitrogen, mercury, nickel and zinc the compliance limits are set at the mean background concentrations at the relevant monitoring locations plus 3 standard deviations and the action levels are set at the mean background concentrations at the relevant monitoring locations plus 2 standard deviations. As mercury typically is not recorded at concentrations higher than the analytical reporting limit of 0.00003mg/l in boreholes G3 and G4 the compliance limit and action level is set at the analytical reporting limit of 0.00003mg/l.

7.8 Based on the results of the updated rogue load assessment and a review of the available groundwater quality monitoring data it is not considered necessary to

expand the number of substances for which compliance limits and action levels are specified. Taking into account the available site specific background quality it is considered that ammoniacal nitrogen, mercury, nickel and zinc remain a suitable set of substances representative of the likely physical and chemical properties of the waste that it is proposed will be deposited at the site.

8. Conclusions

8.1 Based on the hydrogeological risk assessment presented in this report it is considered that there is no significant risk from the proposed deposition of inert waste to groundwater quality in the vicinity of the site. Based on the environmental setting and the inert nature of the waste materials that will be deposited active long term site management will not be necessary in order to prevent long term groundwater pollution.

8.2 It is demonstrated in the rogue load assessment based on conservative assumptions that there is no significant risk to groundwater quality in the limestone aquifer or to surface water quality in the Haw Beck in the unlikely event that rogue loads comprising waste materials that are not inert are deposited at the site.

8.3 Based on the rogue load assessment presented in this report it is considered that there is no significant risk of discernible discharges of hazardous substances and that there would be no significant pollution by non hazardous pollutants resulting from acceptance of a rogue load at the site consistent with the modelled source term.

8.4 Based on the results of the risk assessment it is considered that the site will be compliant with The Environmental Permitting (England and Wales) Regulations 2016 as amended with regard to the relevant provisions of Directive 2006/118/EC of the European Parliament and of the Council on the protection of groundwater against pollution and deterioration (the 2006 Groundwater Directive).

8.5 Waste acceptance procedures will be implemented to minimise the probability that non inert wastes will be deposited at the site. It is considered that there will be no significant risk to groundwater beneath the site, surface water bodies in the vicinity of the site and groundwater and surface water abstractions in the vicinity of and down hydraulic gradient of the site.

9. References

1. Jones, H K, Morris, B L, Cheney, C S, Brewerton, L J, Merrin, P D, Lewis, M A, MacDonald, A M, Coleby, L M, Talbot, J C, McKenzie, A A, Bird, M J, Cunningham, J, and Robinson, V K. 2000. The physical properties of minor aquifers in England and Wales. British Geological Survey Technical Report, WD/00/4. 234pp. Environment Agency R&D Publication 68.

2. Abesser, C, Shand, P. & Ingram, J, 2005. Baseline Report Series: 22. The Carboniferous Limestone of Northern England. British Geological Survey Commissioned Report No. CR/05/076N.

3. Domenico, P.A. and F.W. Schwartz. 1990. Physical and Chemical Hydrogeology. John Wiley & Sons, New York.

TABLES

Table 1

Source - pathway - receptor linkages in respect of the placement of waste materials at the site

Phase of landfill	Source	Pathway	Receptor
Waste material placement	***Leachate*** Given the inert nature of the waste material that will be deposited at the site the potential for the generation of leachate with the potential to affect water quality adversely is low. During waste placement the groundwater table is depressed as necessary by groundwater pumping. The waste materials will be placed above the depressed groundwater level.	Unsaturated limestone Water management system	Water management system Groundwater in the limestone aquifer and down hydraulic gradient abstractions Haw Beck and surface water abstractions from Haw Beck and downstream
Post waste material placement	***Leachate*** Given the inert nature of the waste material that will be deposited at the site the potential for the generation of leachate with the potential to affect water quality adversely is low. The groundwater level will recover following the cessation of groundwater pumping upon completion of the placement of waste materials.	Groundwater in the limestone aquifer	Groundwater in the limestone aquifer and down hydraulic gradient abstractions Haw Beck and surface water abstractions from Haw Beck and downstream

Table 2

Rogue load risk assessment results

Parameter	Source concentrations, C_{src} (mg/l)	Assessment criterion, *AC* (mg/l)	Assumed background concentrations, C_{bg} (mg/l)	Concentration following immediate dilution in groundwater, C_{aq} (mg/l)	Ratio of predicted concentrations to assessment criterion, C_{aq}/AC
Arsenic	0.0089875	5.00E-03	0.00E+00	3.52E-04	0.07
Cadmium	0.004	2.50E-04	0.00E+00	1.56E-04	0.63
Chromium (III)	0.05	4.70E-03	0.00E+00	1.96E-03	0.42
Copper	0.2	1.36E-02	0.00E+00	7.82E-03	0.58
Lead	0.000693	2.00E-04	0.00E+00	2.71E-05	0.14
Nickel	0.0458	1.14E-02	1.40E-03	3.14E-03	0.27
Zinc	0.4	2.88E-02	4.70E-03	2.02E-02	0.70
Chloride	95.95	2.50E+02	2.37E+01	2.65E+01	0.11
Sulphate	179.75	2.50E+02	1.20E+02	1.23E+02	0.49
Ammoniacal nitrogen	0.58	3.90E-01	5.00E-02	7.07E-02	0.18

Notes:
Values in bold exceed the relevant assessment criterion.

Table 3

Updated compliance limits for groundwater monitoring boreholes G3 and G4

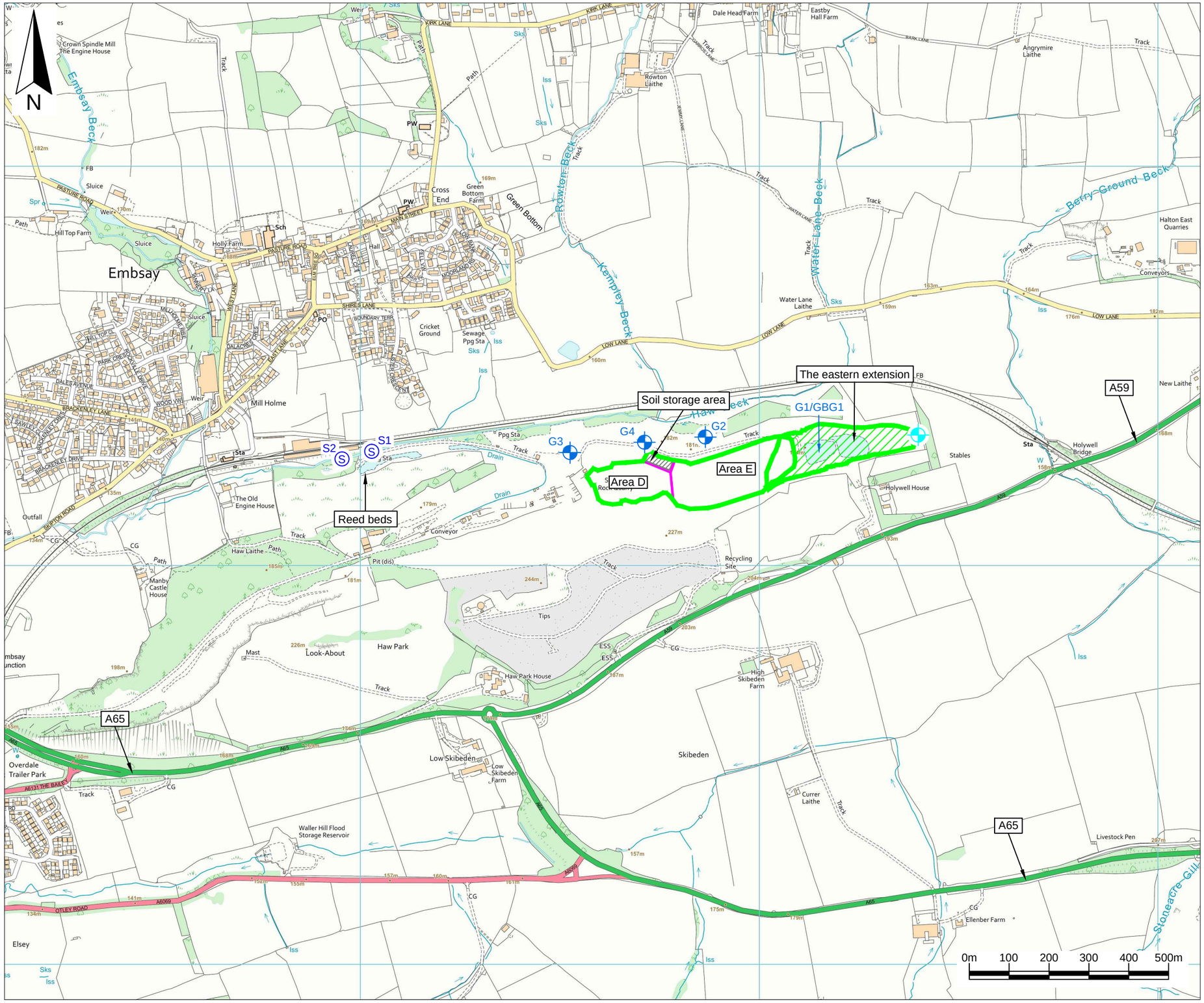
Determinand	Updated compliance limit (mg/l)	
	G3	G4
Ammoniacal nitrogen	0.34	0.34
Mercury	0.00003	0.00003
Nickel	0.010	0.010
Zinc	0.067	0.125

Table 4

Updated action levels for groundwater monitoring boreholes G3 and G4

Determinand	Updated action level (mg/l)	
	G3	G4
Ammoniacal nitrogen	0.24	0.24
Mercury	0.00003	0.00003
Nickel	0.0080	0.0080
Zinc	0.049	0.094

FIGURES



Key / Notes

- Boundary the subject of Environmental Permit reference EPR/FB3504FU
- Proposed variation to Environmental Permit boundary
- Internal site boundary
- S2 — Surface water monitoring locaitons
- G2 — Groundwater monitoring location
- Proposed groundwater monitoring borehole

Rev	Status	Drn	App	Chk	Date
	Final	KR	CJC	CJC	30/06/26

Site: SKIPTON ROCK QUARRY

Client: TARMAC A CRH COMPANY

Title: Plan showing the environmental monitoring locations

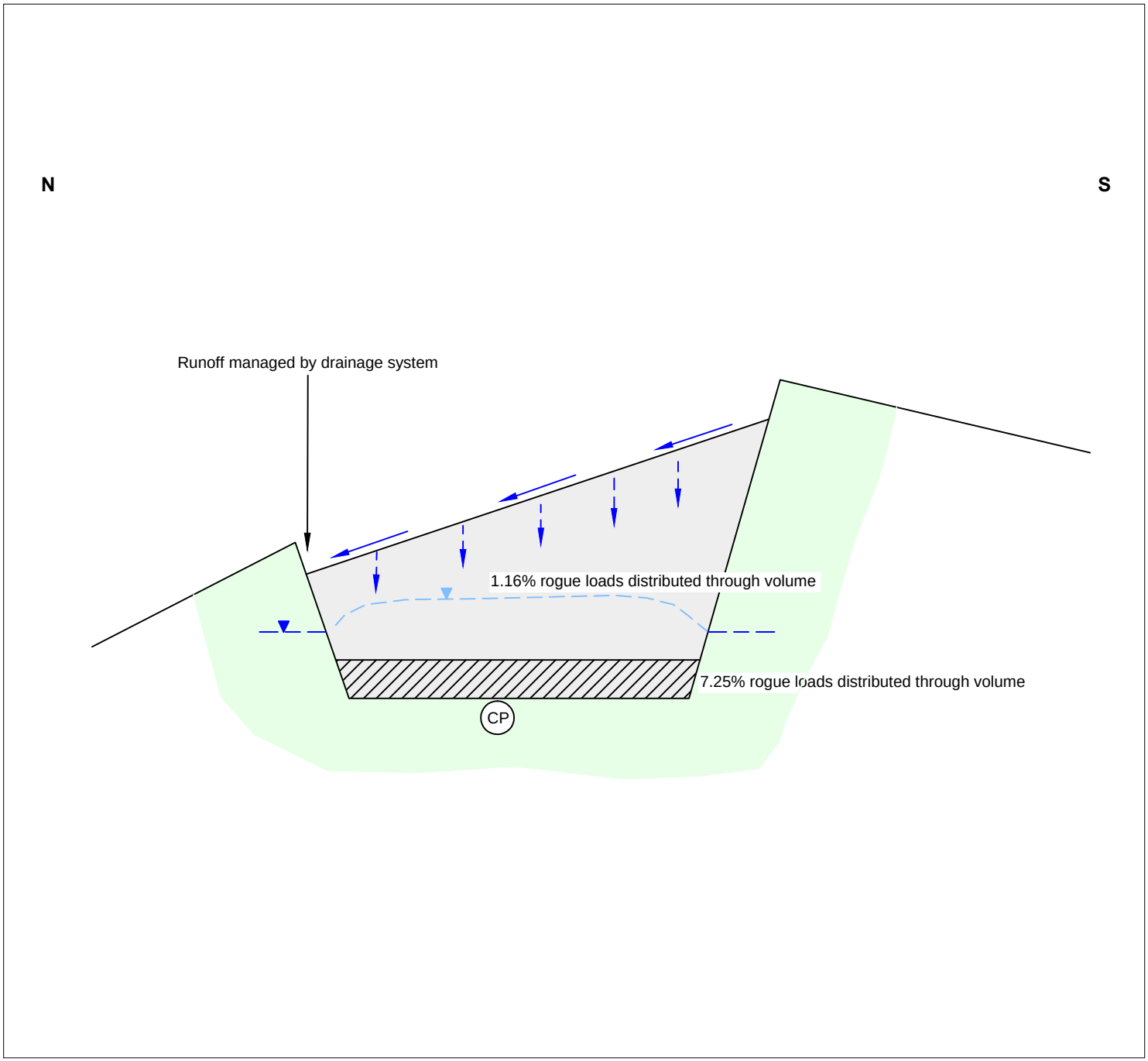
Figure 1

Scale: 1:10,000@A3

Drawing Ref: TAR/SK/05-26/25537

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Key / Notes

- Runoff
- Percolating rainfall
- Restoration materials
- Limestone bedrock
- Groundwater level assumed in the waste deposit
- Indicative assumed restored groundwater level
- 'Higher risk' basal zone in the base of the deposit in which a higher frequency of rogue loads is assumed
- CP — Compliance point assumed in aquifer following immediate dilution

Note:
Groundwater flow is perpendicular to the line of section.

Rev	Status	Drn	App	Chk	Date
	Final	KR	CJC	CJC	30/06/26

SKIPTON ROCK QUARRY

Client: TARMAC A CRH COMPANY

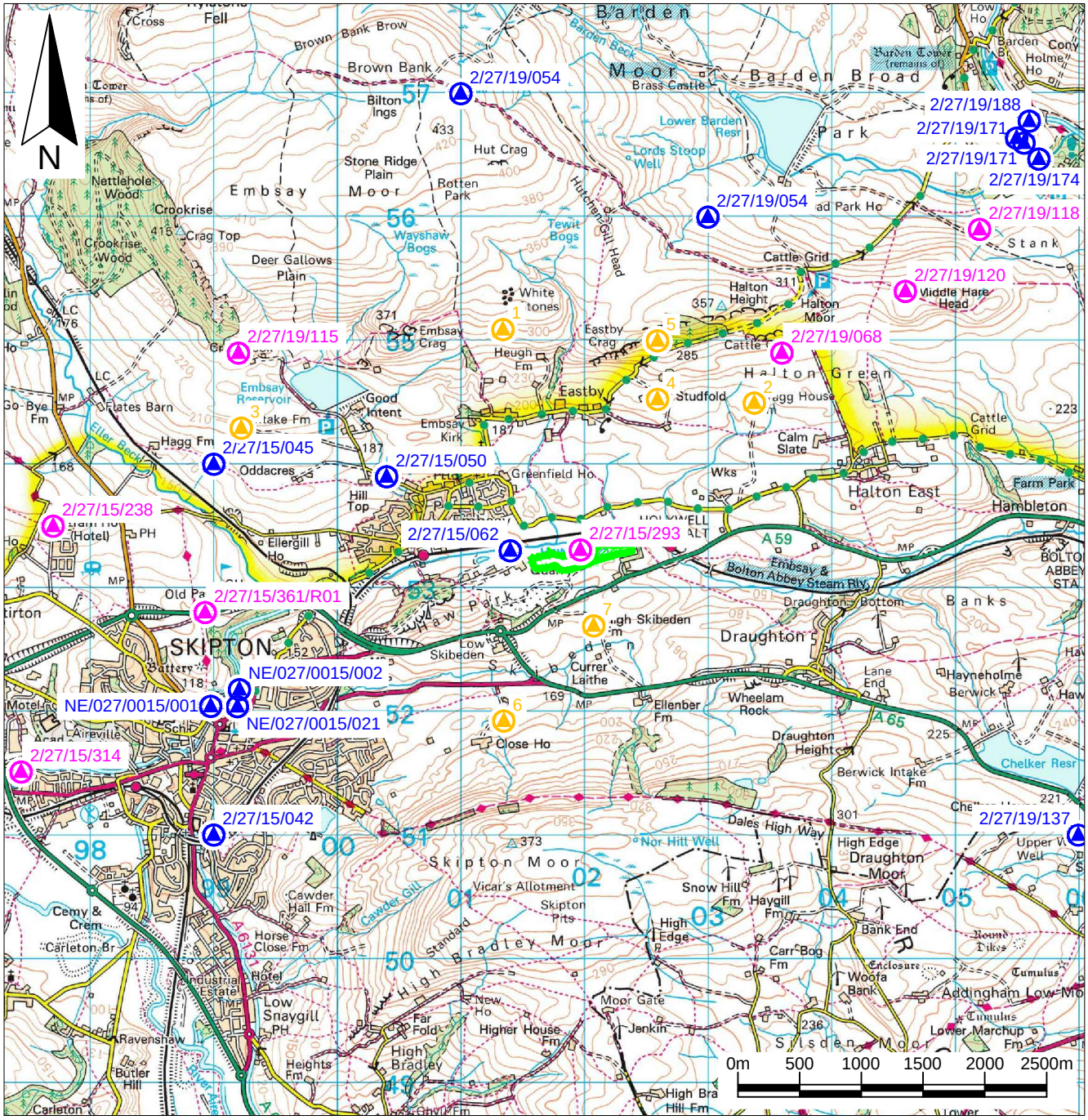
Title: Simplified schematic cross section through the waste deposit containing distributed rogue loads

Figure 3

Scale: NTS

Drawing Ref: TAR/SK/05-26/25538

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Key / Notes

- Boundary the subject of Environmental Permit reference EPR/FB3504FU
- Proposed variation to Environmental Permit boundary
- Approximate location of a licensed groundwater abstraction
- Approximate location of a licensed surface water abstraction
- Private Water Supply

Rev	Status	Drn	App	Chk	Date
	Final	KR	CJC	CJC	30/06/26

Site: SKIPTON ROCK QUARRY

Client: TARMAC A CRH COMPANY

Title: Locations of water abstractions in the vicinity of the site

Figure 2

Scale: 1:50,000@A4

Drawing Ref: TAR/SK/05-26/25542

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APPENDIX A

COPY OF A LETTER DATED 25 JULY 2024 FROM THE ENVIRONMENT AGENCY PROVIDING PRE APPLICATION ADVICE

Environment Agency

Christopher Collinson

Tarmac Trading Limited

Ground Floor T2 Trinity Park, Bickenhill lane, Birmingham, B37 7ES

Our reference: EPR/FB3504FU/P001

Date: 25/07/2024

Dear Christopher Collinson

Pre application advice – Enhanced service

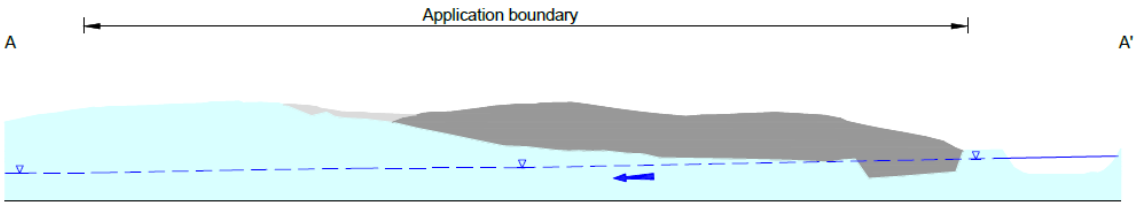
Site: Skipton Rock Quarry, Harrogate Road, Skipton, BD23 6AB

Thank you for your pre application enquiry on 04/03/2024

I am pleased to provide you with your enhanced level of pre-application advice. This advice is based on the information provided on your pre application advice form and documents submitted for review:

- Hydrogeological Risk Assessment TAR/SK/KW/2008/01/HRA March 2024
- Non-Technical Summary TAR/SK/JAD/5700/01/NTS November 2022

Notes on the Draft HRA (Report TAR/SK/KW/20082/01/HRA, dated March 2024)
The cross section provided with the pre-application includes the Drawing ESSD11 (TAR/SK/06-18/20597) – a cross-section which highlights that the proposed Eastern Extension Area - below A' - will place waste below the local groundwater levels (extract from ESSD11 - reproduced below):



The current permit (to the west) has no attenuation layer. Waste is placed when groundwater is reduced (by pumping) to ensure waste is not placed in controlled waters. This is the intended operational procedures within the proposed eastern extension. However, once dewatering by the pumping of groundwater ceases, the materials placed in the extension area some of the waste materials placed will be below the groundwater level (para. 3.3).

The draft HRA states that the site is proposed to be dewatered prior to the deposit of waste materials and that waste materials are not proposed to be deposited directly into water (paras. 2.8 and 3.3).

The wastes proposed to be placed are those currently in the environmental permit and there will be waste acceptance procedures (WAP) in place (para. 3.7). However, the GOT review of the draft HRA highlights that there is no detail relating to the WAP.

Furthermore, our original GOT response to the application for the current permit included a Schedule 5 Notice question requesting the WAP and the review of the subsequent response from the applicant, including the WAP document (see links from supporting documents list above). The WAP was originally deemed appropriate with the following caveat: "ensure waste codes and restrictions are clear in the issued permit" Table S2.1 of the permit, issued 07/05/2019, is reproduced below:

Table S2.1 Permitted waste types and quantities for use of waste in deposit for recovery	
Maximum quantity	**The total quantity of waste accepted at the site shall be less than 455,200 m^3**
Exclusions	**Waste will not be accepted unless it is from a single source and well characterised and described.** **Waste will only be accepted if there is no risk of contamination.**
Waste code	**Description**
01	**WASTES RESULTING FROM EXPLORATION, MINING, QUARRYING, AND PHYSICAL AND CHEMICAL TREATMENT OF MINERALS**
01 01	**wastes from mineral excavation**
01 01 02	wastes from non metalliferous excavation
01 04	**wastes from physical and chemical processing of non-metalliferous minerals**
01 04 08	waste gravel and crushed rocks other than those containing dangerous substances
01 04 09	waste sand and clays
17	**CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)**
17 01	**concrete, bricks, tiles and ceramics**
17 01 01	concrete
17 01 02	bricks
17 01 03	tiles and ceramics
17 01 07	mixtures of concrete, bricks, tiles and ceramics
17 05	**soil (including excavated soil from contaminated sites), stones and dredging spoil**
17 05 04	soil and stones (excluding topsoil and peat)
19	**WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE**
19 12	**wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified**
19 12 09	minerals (for example sand, stones)
20	**MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS**
20 02	**garden and park wastes (including cemetery waste)**
20 02 02	soil and stones

We have reviewed the submitted Waste Acceptance Procedures from the original application as part of this Pre-application process. Our notes on the WAP are summarised below.

Waste Acceptance Procedures

Table 1 of the WAP is the same as that presented in the issued permit (as Table S2.1). All waste will undergo basic characterisation as set out in Table 2 of the applicants WAP (July 2018), and reproduced here below:

WAP Table 2 – Information comprising a level 1 basic characterisation

Information
The source and origin of the waste. Wastes may be accepted provided that the waste is a single stream waste of a single waste type and the waste is from a single source and there is no suspicion of the presence of contamination.
The process producing the waste (including a description of the process, its SIC code and the characteristics of its raw materials and products).
The appearance of the waste including its smell, colour, consistency and physical form.
The Code relevant to the waste under the European Waste Catalogue.

Our review of the WAP (and the current permit) concludes that the provision in the permit of the exclusions in Table S2.1 are sufficient. Our recommendation includes that the compliance and verification testing within the WAP should refer to and comply with Gov.UK guidance "Dispose of Waste to Landfill".

Rogue Load Assessment

Within the HRA (March 2024) Table 2 of Appendix B – provides the Rogue Load Modelling source term, reproduced below. GOT's previous response expressed concerns relating to the Rogue Load assessment. In particular, the location of the Rogue Load "placed in the waste mass at a distance of 10 m from the down hydraulic gradient edge of the waste mass in proximity to the interface between the imported material placed and in situ aquifer material". This is not a worse-case scenario. Any full submission should address this and ideally provide a site-specific diagrammatic explanation of the worse-case placement for the Rogue Load.

Table 2
Source term concentrations assumed in the ConSim rogue loads assessment model

Determinand	Environmental assessment limit (EAL) (mg/l)	EAL source	Source term concentration (mg/l) Minimum/maximum	Probability density function
Hazardous substances				
Mercury	0.00001 [a]	MRV	0.002/0.006 [b]	Uniform
Toluene	0.004 [a]	MRV	16.4/49.3 [c]	Uniform
Non-hazardous pollutants				
Zinc	0.0138 [d] / 3 [e]	EQS / WHO	1.2/3.6 [b]	Uniform
Chloride	250	UK DWS	460/1380 [b]	Uniform
Sulphate	250	UK DWS	1500/4500 [b]	Uniform

Notes:
MRV Minimum reporting value;
EQS Environmental Quality Standard;
UK DWS UK Drinking Water Standard;

[a] The MRVs specified are consistent with MRVs reported in Environmental Agency guidance at https://www.gov.uk/government/publications/values-for-groundwater-risk-assessments/hazardous-substances-to-groundwater-minimum-reporting-values
[b] The minimum concentration comprises the C_0 concentration and the maximum concentration comprises three times the C_0 concentration presented in the EU Commission document for inert WAC (reference 1)
[c] The concentrations are the calculated concentration derived from the solid waste inert WAC concentration for BTEX and three times the calculated concentration respectively (see calculation sheet at Appendix D). The calculated concentrations are analogous with the mean toluene concentrations recorded in 63 leachate samples from a variety of waste types including municipal, mixed MSW and non-hazardous waste types and co-disposal sites (reference 2)
[d] The EAL is set consistent with the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 and comprises a bioavailable limit. Haw Beck is part of the Humber catchment for which an ambient background concentration of 2.9µg/l is specified.
[e] There is no World Health Organisation (WHO) health-based guideline value set for zinc. WHO state that zinc is not of health concern at levels found in drinking water (reference 7). However, based on reference 7 it is understood that drinking water containing zinc at levels above 3 mg/l may not be acceptable to consumers on the basis that it may be considered aesthetically undesirable at concentrations above 3 mg/l.

This suggests it is not possible to predict where the rogue load will be deposited. 10 m from down hydraulic gradient edge of the waste is not realistic as the rogue load could equally be tipped at the down-gradient edge which represents the worst-case scenario. Hence the assessment is actually not conservative.

Our concerns regarding the applicability of the Rogue Load Assessment still exist. Furthermore, recent permitting work by GOT has standardised our request regarding the Rogue Load assessment. Our advice regarding this is presented in the recommendations section.

Recommendations to the Applicant

The existing permit was issued for the site in 2019 for acceptance of a limited range of waste codes that are those detailed in Waste acceptance procedures for deposit for recovery - GOV.UK (www.gov.uk) as those that do not require the waste producer to test (are from a single waste source, are well characterised and carry no risk of contamination). The waste acceptance procedures agreed committed to this. The application did not propose the use of an attenuation layer in areas where waste would be below the groundwater table on cessation of groundwater pumping but provided a rogue load assessment to assess the risks posed. Downgradient groundwater monitoring and compliance limits were required to validate the assessment of the risks posed to show that the activity did not cause pollution.

Should an application to extend the site be made, without proposing an attenuation layer where waste is to be placed below the groundwater table the HRA will need to:

a) be consistent with the restricted waste codes and acceptance procedures currently permitted.
b) Show with reference to background groundwater monitoring data relevant to the extension area that it will not cause pollution with reference to the Environmental Permitting Regulations 2016 Schedule 22.
c) Review the monitoring requirements for the site, including the proposed eastern extension to ensure that appropriate substances are monitored and that there are sufficient boreholes present that will be present for the full lifetime of the activity.

We recommend that a full application should also address the following:

1. Rogue Load

A. While the starting point for any inert site is that the residual leachate quality would be that of the inert WAC criteria permitted, a consistent approach to rogue load modelling (to assess risk of accidents) is also expected to enable risk assessment of the more soluble and mobile contaminants that could arise from the deposition of more variable soils wastes.

Any quantitative modelling of these sites should consider the fate of a possible range of contaminants within the source term. This should be determined by undertaking a risk screen against appropriate water quality standards or natural baseline quality.

From Environment Agency observation of the fate of soils leachates, the three most mobile contaminants that could leach from deposited soils are: sulphate, ammoniacal nitrogen and nickel (all non-hazardous substances). While likely to be present only at trace concentrations in leachate, selection of one of either arsenic or lead should be used to assess the fate of a nominal hazardous substance in leachate at each site.

From our observations from a limited data set of sites, the following ranges of leachate quality are considered appropriate to represent concentrations likely from the outcome of accidental rogue load acceptance:

Possible Range of Leachate Quality for assessing accidental rogue load acceptance

	Minimum (mg/l)	*Most Likely* (mg/l)	*Maximum* (mg/l)
Arsenic	0.001	0.007	0.06
Lead	0.002	0.007	0.15
Ammoniacal Nitrogen	0.3	8	25
Chloride	100	300	800

Sulphate	200	1200	1800
Nickel	0.002	0.02	0.12

We note that the above advice is developing / emerging work for both industry and the Agency and is limited to date by current guidance stating that leachate quality monitoring is not required at inert landfills.

B. We recommend that the Rogue Load Assessment provides a conceptual drawing and written commentary that highlights how the location of the modelled rogue load presents a worse-case scenario with respect to the post waste placement groundwater levels (unpumped levels). The Rogue load assessment previously submitted, and included in the draft HRA is not worst-case as there is no guarantee that a load will be 10 m from the boundary of the waste mass.

2. Waste Acceptance

We recommend that compliance and verification testing within the WAP should refer to and comply with Gov.UK guidance "Dispose of Waste to Landfill". This will need to include the verification testing that will be undertaken of the material, particularly where this will be placed below the recovered groundwater level.

Disclaimers

The advice given is based on the information you have provided and does not constitute a formal response or decision of the Environment Agency with regard to future permit applications. Any views or opinions expressed are without prejudice to the Environment Agency's formal consideration of any application. Please note that any application is subject to duly making and then full technical checks during determination, and additional information may be required based on your detailed submission and site-specific requirements and the advice given is to address the specific pre-application request.

It is presumed that our published guidance will be followed unless otherwise agreed in writing in this pre-application advice. Links to the published guidance are provided where appropriate in this advice.

Where we have provided advice prior to the completion of a site investigation, installation of infrastructure and/or gathering of further monitoring data that may affect the pre-application conceptual model for the site, you may find it useful to arrange a further pre-application meeting with us to discuss the information gained.

What happens next?

If you submit an environmental permit application then please quote this pre-application reference number: EPR/FB3504FU/P001

If the advice above details using the online digital application form, your application can be submitted using this method. If not, please send your completed application documents via email to:

psc@environment-agency.gov.uk

Please email applications where possible. If email is not possible you can submit by post to:

Environment Agency, Permitting Support Centre, Quadrant 2, 99 Parkway Avenue, Sheffield, S9 4WF

Enhanced pre application cost estimate

At this stage the pre-application advice is expected to cost up to £1,600 plus VAT. An invoice will be sent separately at a later date.

This pre-application request is now closed.

We consider this pre application request is now closed however if you have any questions regarding this letter please contact samuel.andrew@environment-agency.gov.uk

If you require additional enhanced pre-application advice please complete our online form.

We look forward to working with you on this project.

If you have any questions please call 03708 506 506.

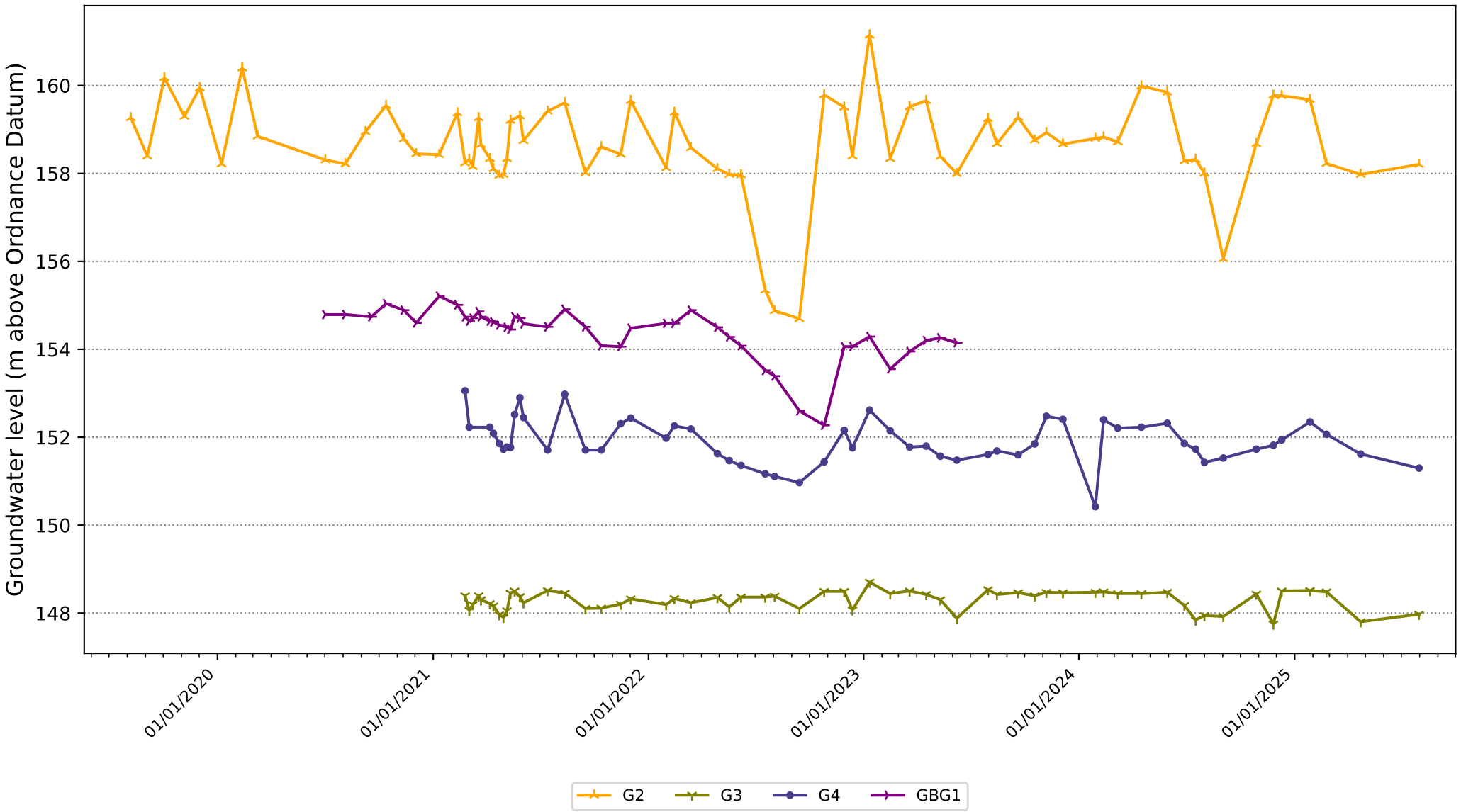
Yours sincerely

Samuel Andrew

samuel.andrew@environment-agency.gov.uk

APPENDIX B

UPDATED GROUNDWATER LEVEL HYDROGRAPH


Graph showing the variation in groundwater levels in the vicinity of Skipton Rock Quarry
Groundwater level (m above Ordnance Datum)
160
158
156
154
152
150
148
01/01/2020
01/01/2021
01/01/2022
01/01/2023
01/01/2024
01/01/2025
G2
G3
G4
GBG1

APPENDIX C

UPDATED ROGUE LOAD RISK ASSESSMENT SPREADSHEET

INFILTRATION WORKSHEET

Key

Inputs

In this worksheet the rate of infiltration to the soils which will overlie the restoration materials.

Parameter	January	February	March	April	May	June	July	August	September	October	November	December	Total	Comments/justification
Average monthly temperature [°C]	3.7	4.3	5.9	7.8	10.9	13.6	15.6	15.4	13.2	9.9	6.5	4.2		Mean monthly temperature for Northern England (Met Office) for the period 1991 to 2026
Monthly heat index [H_m]	0.6	0.8	1.3	2.0	3.2	4.6	5.6	5.5	4.3	2.8	1.5	0.8	32.99	Koerner and Daniel, 1997. Eqn 4.7.
Unadjusted daily potential evapotranspiration [UPET], mm	0.59	0.69	0.96	1.28	1.80	2.27	2.61	2.57	2.19	1.64	1.06	0.67		Koerner and Daniel, 1997. Eqn 4.8
Possible monthly duration of sunlight [N]	22.2	23.4	30.6	34.5	39.9	40.8	41.1	37.5	31.8	27.6	22.8	21.0		Koerner and Daniel, 1997. Table 4.3, NB: use 50deg poleward of 50deg
Potential evapotranspiration [PET], mm	13.2	16.3	29.3	44.2	71.7	92.5	107.2	96.3	69.6	45.2	24.1	14.1	623.55	*PET= UPET x N*
Precipitation [P], mm	92.9	79.3	68.3	66.5	62.4	72.5	80.2	83.2	84.3	101.9	102.6	107.2	1001.11	Mean monthly precipitation for Northern England (Met Office) for the period 1991 to 2026
Runoff coefficient [C]	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78		
Runoff [R], mm	72.4	61.8	53.2	51.8	48.6	56.5	62.6	64.9	65.8	79.5	80.0	83.6	780.86	*R = P x C*
Infiltration [IN], mm	20.4	17.4	15.0	14.6	13.7	15.9	17.6	18.3	18.5	22.4	22.6	23.6	220.24	*IN = P - R*
IN - PET, mm	7.3	1.2	-14.3	-29.5	-58.0	-76.5	-89.5	-78.0	-51.0	-22.8	-1.5	9.5		
Accumulated water loss [WL], mm	0.0	0.0	-14.3	-43.8	-101.8	-178.4	-267.9	-345.9	-396.9	-419.7	-421.2	-421.2		*WL = Sum of neg * IN - PETs*
Water stored (WS), mm	67.5	67.5	54.1	42.7	27.4	20.6	16.8	20.1	30.6	47.4	66.0	67.5		
Change in water storage [CWS], mm	0.0	0.0	-13.4	-11.4	-15.2	-6.9	-3.8	3.3	10.5	16.8	18.6	1.5		
Actual evapotranspiration [AET], mm	13.2	16.3	28.4	26.0	29.0	22.8	21.4	15.0	8.1	5.6	4.0	14.1	203.87	
Percolation [PERC], mm	7.3	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.9	16.38	
Check [CK], mm	92.9	79.3	68.3	66.5	62.4	72.5	80.2	83.2	84.3	101.9	102.6	107.2	1001.11	
Percolation rate [FLUX], m/s	2.8E-09	4.6E-10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.1E-09		

Runoff coefficient (NCB, 1982)	**0.78**	Ground slope:	**0.24**	Based on a general fall of 13m vertical over a 55m horizontal distance (Tarmac drawing reference S137-0058-017 dated 22 November 2022 entitled "Phase Plan Sheet 3 of 3".
		Vegetation type:	**Grassed tip**	
		Soil type:	**Clay**	
Root zone depth, mm	150.0	The assumed thickness of the cover soils over the restoration materials.		
Volumetric water content at field capacity (θ)	0.45	Clay (Koerner and Daniel, 1997 Table 4.5)		
Maximum water storage capacity, mm	67.5	Start water storage calculation on a month where water stored is known or can be calculated (e.g. after winter when there is no soil moisture deficit)		

	Annual	Percentage of precipitation
Precipitation, mm	1001.1	100.0
Runoff, mm	780.9	78.0
Actual evapotranspiration, mm	203.9	20.4
Percolation, mm	16.4	1.6
Ratio of runoff to percolation	47.7	

References

Koerner, R. M. and Daniel, D. E. 1997. Final covers for solid waste landfills and abandoned dumps. American Society of Civil Engineers, Virginia and Thomas Telford, London.
National Coal Board. 1982. Technical management of water in the coal mining industry. NCB Mining Department. 129pp.

WATER BALANCE WORKSHEET

Key
Inputs

Discharge through the base of the waste deposit

The rate of discharge through the base of the waste deposit is estimated as the product of the annual percolation rate and the area of the waste deposit.

Parameter	Symbol	Value	Units	Comments
Percolation rate	P_{src}	0.016	m/year	Percolation rate through the source estimated based on the *"Infiltration"* worksheet
		5.19E-10	m/s	
Area of the base of the waste deposit	A_{src}	32219	m^2	Approximate additional area in which waste will be deposited based on drawing reference TAR/SK/08-25/24907.
		1.67E-05	m^3/s	$Q_{src} = P_{src} * A_{src}$
Discharge through the base of the waste deposit	Q_{src}	5.2E-10	$m^3/m^2.s$ = m/s	Unit conversion
		4.5E-05	m/d	Unit conversion
		16.4	mm/year	Unit conversion

Aquifer flow within the mixing zone

The aquifer flow within the mixing zone is calculated using Darcy's law.

Parameter	Symbol	Value	Units	Comments
Width of the waste deposit	W	114	m	Estimated based on drawing reference TAR/SK/08-25/24907.
Length of the waste deposit	L	360	m	Estimated based on drawing reference TAR/SK/08-25/24907.
Aquifer thickness	t_{aq}	50	m	Assumed aquifer thickness consistent with Abesser *et al.* , 2005.
Mixing zone thickness	M_z	40.1	m	As set out in Table 5.6 to the EA Remedial Targets Methodology report dated 2006. $M_z = \sqrt{0.0112.L^2} + t_{aq}\left[1 - exp\left(\frac{-L.Q_{src}}{K_{aq}.i_{aq}.t_{aq}}\right)\right]$
Cross-sectional area of the mixing zone	A_{aq}	4576	m^2	$W * MIN(t_{aq}, M_z)$
Aquifer hydraulic conductivity	K_{aq}	4.20E-06	m/s	Estimated based on Jones *et al* . 2000.
		0.36	m/d	Unit conversion
Up hydraulic gradient head in the aquifer	h_1	152	m	Based on groundwater levels recorded at borehole G4.
Down hydraulic gradient head in the aquifer	h_2	148	m	Based on groundwater levels recorded at borehole G3.
Distance between the up and down hydraulic gradie	l	187	m	Straight line distance measured between the up and down gradient head contours.
Horizontal hydraulic gradient	i_{aq}	0.02139	-	$i_{aq} = (h_1 - h_2) / l$
Aquifer flow within the mixing zone	Q_{aq}	4.11E-04	m^3/s	$Q_{aq} = K_{aq}.i_{aq}.A_{aq}$
Dilution factor	Q_{aq}/Q_{src}	24.57		

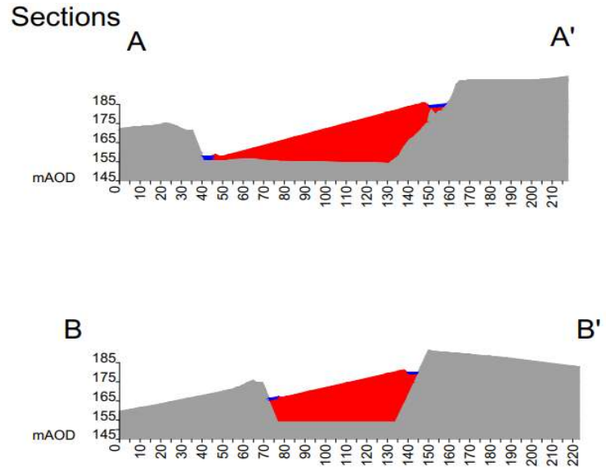
References

Abesser, C, Shand, P. & Ingram, J, 2005. Baseline Report Series: 22. The Carboniferous Limestone of Northern England. British Geological Survey Commissioned Report No. CR/05/076N.

Jones, H K, Morris, B L, Cheney, C S, Brewerton, L J, Merrin, P D, Lewis, M A, MacDonald, A M, Coleby, L M, Talbot, J C, McKenzie, A A, Bird, M J, Cunningham, J, and Robinson, V K. 2000. The physical properties of minor aquifers in England and Wales. British Geological Survey Technical Report, WD/00/4. 234pp. Environment Agency R&D Publication 68.

ROGUE LOAD GEOMETRY WORKSHEET

Cross sections A-A' and B-B' reproduced from Tarmac drawing reference S137-0058-017 dated 22 November 2022 entitled "Phase Plan Sheet 3 of 3".



Section	Estimated minimum infill depth (m)	Estimated maximum infill depth (m)	Length of section (m)	Indicative cross sectional area of section (m^2)	Equivalent thickness assuming constant infill depth (m)
A-A'	2	25	86	1161	13.5
B-B'	11	20	58	899	15.5

Notes
Vertical sides are assumed.
The calculations are indicative and based on a simplified deposit geometry.

For calculation purposes it is assumed that in cross section the deposit can be approximated by a rectangle with the following dimensions and area:

Length (m)	Depth (m)	Area (m^2)
72	14.5	1044

Proportion of rogue loads assumed in the waste mass	2%		Accepted by EA in previous rogue load risk assessments.
Assumed thickness of "higher risk" basal zone in deposit	2	m	The lowest 2m of the deposit.
Proportion of rogue loads assumed "higher risk" basal zone	50%		Proprtion of total proportion of rogue loads
Assumed cross sectional area of high risk zone	144	m^2	Section length * basal zone thickness
Proportion of infill in "higher risk" basal zone	14%		
Equivalent volumetric rogue load proportion in basal zone	**7.25%**		Proportion of rogue loads * proportion in "higher risk" zone / proportion of infill in "higher risk" zone
Equivalent volumetric rogue load proportion above basal zone	1.16%		Proportion of rogue loads * proportion not in "higher risk" zone / proportion of infill not in "higher risk" zone
CHECK proportion of rogue loads overall	2%		Check that the overall proportions make sense

Conservatively the rogue load risk assessment considers the assumed higher frequency of rogue loads present in the basal "higher risk" zone only.

SOURCE WORKSHEET

			Inert waste leaching limit values [A]			Freshwater Environmental Quality Standard (EQS) [I]							Source term concentrations *[the modelled source is the "higher risk" basal 2m zone of the waste deposit]*							
Parameter	**Symbol and notes**	**Category [B, C]**	**L/S = 10l/kg**	**L/S = 10l/kg eluate concentration**	**UK Drinking Water Standard [D]**	**AA-EQS**	**MAC-EQS**	**Minimum reporting value (MRV) or UKTAG Limit of quantification (LoQ) [E, F]**	**Minimum of MRV, DWS and EQS**	**Assessment criterion, *AC***	**Maximum non-outlier background concentration [G]**	**Mean background concentration, C_{bg} [G]**	**Conforming loads [H]**	**Rogue loads [O]**	**Proportion of rogue loads**	**Source concentrations used in model, C_{src}**	**Risk characterisation ratio (RCR), C_{src}/AC**	**Modelled by default**	**Carry parameter forward?**	
Units			mg/kg		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		mg/l	mg/l			
Antimony	Sb	Non hazardous	0.06	0.006	0.005				0.005	0.005	0	0	0.006	0.006	7.25%	0.006	1.2		FALSE	
Arsenic	As	Hazardous	0.5	0.05	0.01	0.05		0.005	0.005	0.005	0	0	0.005	0.06	7.25%	0.0089875	1.8	Yes	TRUE	
Barium	Ba	Non hazardous	20	2							0	0	2	2	7.25%	2			FALSE	
Cadmium	Cd [J]	Non hazardous	0.04	0.004	0.005	0.00025	0.0015		0.00025	0.00025	0	0	0.004	0.004	7.25%	0.004	16.0		TRUE	
Chromium (III)	Cr (III)	Non hazardous	0.5	0.05	0.05	0.0047	0.032		0.0047	0.0047	0	0	0.05	0.05	7.25%	0.05	10.6		TRUE	
Copper	Cu [K]	Non hazardous	2	0.2	2	0.014			0.0136	0.0136	0	0	0.2	0.2	7.25%	0.2	14.7		TRUE	
Lead	Pb [K]	Hazardous	0.5	0.05	0.01	0.005	0.014	0.0002	0.0002	0.0002	0	0	0.0002	0.007	7.25%	0.000693	3.5	Yes	TRUE	
Mercury	Hg	Hazardous	0.01	0.001	0.001		0.00007	0.00001	0.00001	0.00008	0.00008	0	0.00001	0.00001	7.25%	0.00001	0.1		FALSE	
Molybdenum	Mo	Non hazardous	0.5	0.05							0	0	0.05	0.05	7.25%	0.05			FALSE	
Nickel	Ni [K]	Non hazardous	0.4	0.040	0.02	0.011	0.034		0.0114	0.0114	0.004	0.0014	0.04	0.12	7.25%	0.0458	4.0	Yes	TRUE	
Selenium	Se	Non hazardous	0.1	0.01	0.01				0.01	0.01	0	0	0.01	0.01	7.25%	0.01	1.0		FALSE	
Zinc	Zn [K, L]	Non hazardous	4	0.4		0.0288			0.0288	0.0288	0.026	0.0047	0.4	0.4	7.25%	0.4	13.9		TRUE	
Chloride	Cl^-	Non hazardous	800	80	250	250			250	250	41	23.7	80	300	7.25%	95.95	0.4	Yes	TRUE	
Fluoride	F^- [M]	Non hazardous	10	1	1.5	5	15		1.5	1.5	0	0.0	1	1	7.25%	1	0.7		FALSE	
Sulphate	SO_4^{2-}	Non hazardous	1000	100	250	400			250	250	139	120.2	100	1200	7.25%	179.75	0.7	Yes	TRUE	
Phenol index		Non hazardous	1	0.10							0	0	0.1	0.1	7.25%	0.10			FALSE	
Dissolved organic carbon		Non hazardous	500	50							0	0.00	50	50	7.25%	50			FALSE	
Ammoniacal nitrogen		Non hazardous			0.39				0.39	0.39	0.3	0.05	0	8	7.25%	0.58	1.5	Yes	TRUE	

Key: Inputs

Selection of assessment criteria:

RCR threshold: 3.0

Hazardous substances — Assessment criterion is the MRV (or UKTAG LoQ if lower) except where background concentrations exceed the MRV in which case the assessment criterion is the non-outlier maximum background concentration assumed at the down hydraulic gradient edge of the waste deposit.

Non hazardous substance — Assessment criterion is the minimum of the UK DWS or EQS except where this is exceeded by background concentrations in which case the assessment criterion is the non-outlier maximum background concentration assumed at the down hydraulic gradient edge of the waste deposit.

Notes

[A] Council decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC. Official Journal of the European Communities. 2003/33/EC.

[B] "2025 07 15 Confirmed hazardous substances list" https://www.wfduk.org/sites/default/files/Media/JAGDAG/2025%2007%2015%20Confirmed%20hazardous%20substances%20list.pdf

[C] Where a substance has not been determined as a hazardous substance or non hazardous pollutant it is assumed that it is a non hazardous pollutant.

[D] The Water Supply (Water Quality) Regulations 2016 (England) (as amended) https://www.legislation.gov.uk/uksi/2016/614/contents

[E] https://www.gov.uk/government/publications/values-for-groundwater-risk-assessments/hazardous-substances-to-groundwater-minimum-reporting-values

[F] https://wfduk.org/sites/default/files/Media/UKTAG_Technical%20report_GW_Haz-Subs_ForWebfinal.pdf

[G] Based on site specific groundwater quality monitoring data where available. Concentrations recorded below the detection limit are assumed to be absent in groundwater unless otherwise specified.

[H] For conforming loads it is assumed that non-hazardous substances are present at the inert WAC and that hazardous substances are present at the MRV (or UKTAG LoQ if that is lower).

[I] https://assets.publishing.service.gov.uk/media/69cccdc9fda4a131fe8559a7/EQSs_for_inland_freshwaters.ods

[J] The EQS values reported are for a water hardness greater than 200mg/l taking into account regional baseline chemistry.

[K] The published EQS is for the bioavailable concentration. For screening purposes site specific PNECs have been estimated using published M-BAT and Pb Screening Tools.

[L] Bioavailable plus ambient background concentration. Haw Beck is a tributary of the River Aire which is part of the "Ouse, Humber" catchment for which a ambient background of 2.9µg/l is assumed. https://www.wfduk.org/sites/default/files/Media/Environmental%20standards/MBAT%20UKTAG%20Method%20Statement.pdf

[M] The EQS values reported are for greater than 50 milligrams of calcium carbonate per litre of water (mg/l) taking into account regional baseline chemistry.

[O] Where assumed present. Rogue load source is consistent with the "most likely" value specified for all determinands specified in the EA letter dated 26 July 2024 except for arsenic and nickel for which the most likely value specified exceeds the assumed concentration in conforming waste. For these determinands the maximum value specified by the EA is used.

IMMEDIATE DILUTION MODEL WORKSHEET

Estimated concentrations in the aquifer following immediate dilution

$$C_{aq} = \frac{C_{src} \times Q_{src} + C_{bg} \times Q_{aq}}{Q_{src} + Q_{aq}}$$

Where:

C_{aq} is the estimated concentration in the aquifer (mg/l)
C_{src} is the concentration in the source (mg/l).
Q_{src} is the discharge from the imported restoration materials (m^3/s)
C_{bg} is the background concentration in the aquifer (mg/l)
Q_{aq} is the flow in the aquifer not including the flow through the restoration materials (m^3/s)

Parameter	Source concentrations, C_{src} (mg/l)	Assessment criterion, AC (mg/l)	Ratio of source concentration to assessment criterion, C_{src}/AC (mg/l)	Assumed background concentrations, C_{bg} (mg/l)	Concentration following immediate dilution in groundwater, C_{aq} (mg/l)	Ratio of predicted concentrations to assessment criterion, C_{aq}/AC
Arsenic	0.0089875	5.00E-03	1.80	0.00E+00	3.52E-04	0.07
Cadmium	0.004	2.50E-04	16.00	0.00E+00	1.56E-04	0.63
Chromium (III)	0.05	4.70E-03	10.64	0.00E+00	1.96E-03	0.42
Copper	0.2	1.36E-02	14.72	0.00E+00	7.82E-03	0.58
Lead	0.000693	2.00E-04	3.47	0.00E+00	2.71E-05	0.14
Nickel	0.0458	1.14E-02	4.01	1.40E-03	3.14E-03	0.27
Zinc	0.4	2.88E-02	13.87	4.70E-03	2.02E-02	0.70
Chloride	95.95	2.50E+02	0.38	2.37E+01	2.65E+01	0.11
Sulphate	179.75	2.50E+02	0.72	1.20E+02	1.23E+02	0.49
Ammoniacal nitrogen	0.58	3.90E-01	1.49	5.00E-02	7.07E-02	0.18

Notes

Rows for parameters not been taken forward at the quantitative risk screening stage are not shown.

Areal values from HadUK-Grid 1km gridded climate data from land surface network
Source: Met Office National Climate Information Centre
Monthly, seasonal and annual total precipitation amount for England N
Areal series, starting in 1836
Last updated 01-Apr-2026 11:35

year	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	win	spr	sum	aut	ann
1836	69.1	66.4	112.5	59.9	8.9	98.6	114.1	58.9	88	84.5	148.8	92.5		181.4	271.5	321.2	1002.1
1837	81.6	87.5	40.9	52.4	33.8	60.8	95.3	64.1	63.3	93.2	82.1	111.1	261.6	127.1	220.2	238.6	866
1838	37.3	41	61.4	56.3	81.6	100.7	89.8	98.1	64.1	101.8	84.1	42.6	189.4	199.4	288.7	250.1	859
1839	62.2	57.1	88.5	25	15.7	103.7	138.1	95.6	130.4	76.3	108.2	75.6	161.8	129.2	337.5	315	976.5
1840	103.7	58.9	12.7	20.1	83.6	70.8	115.9	86.2	100.4	48.4	112.7	23.1	238.3	116.4	272.8	261.5	836.4
1841	68.3	48.5	61.5	45.6	76.5	73.5	103.4	108.9	98.9	153	90.8	99	139.8	183.6	285.8	342.7	1027.7
1842	66.7	37.5	87.2	15	61.8	54.8	94	50.2	66.5	52	102.6	54	203.2	164	199	221	742.3
1843	69.7	59.9	30.8	109.2	92.5	73	99.2	78.5	17	143.2	103	21.9	183.6	232.5	250.7	263.2	897.9
1844	62.7	63.8	80.5	25	8.3	59.2	82.1	77.1	75.8	59.6	64.9	13.1	148.3	113.8	218.4	200.3	672.1
1845	55.2	32.7	69.8	59.9	60.8	87.3	86.8	154.3	72.2	112.9	69.1	123.6	101	190.5	328.4	254.2	984.6
1846	91.2	36.5	69.6	121.1	40	69.1	115.8	91.7	41	145.4	65.7	57.3	251.3	230.7	276.6	252.1	944.4
1847	49.1	46.8	35.1	57	115.5	69	31.3	57.8	67.8	102	95.5	129.6	153.1	207.6	158.1	265.3	856.5
1848	48.6	154.8	107.7	55.1	31.8	140.2	83.5	111.8	84.4	139.2	66.3	81.5	333	194.5	335.5	289.9	1104.8
1849	110.8	35.9	32.3	68.8	58	37.2	98.9	80.6	88	109.1	81.8	90	228.2	159.1	216.7	278.9	891.4
1850	70.1	77.9	21.5	72.9	47	53.9	102.3	80.3	48.8	82.6	95.1	46.6	238.1	141.4	236.4	226.5	799
1851	107.2	49	81.7	47.8	34.7	90.7	94.7	78.5	60.7	74.9	37	36.3	202.8	164.2	263.9	172.6	793.1
1852	127.9	82.1	14.1	15	54.1	104.5	75.4	104.6	101.6	102.6	150.4	159.8	246.3	83.2	284.5	354.7	1092.2
1853	104.1	55.8	42.2	52.4	30.9	76.8	105.4	58.9	70.7	99.5	57.5	37.4	319.7	125.5	241.1	227.7	791.5
1854	88.7	41.1	30.7	18.1	66.6	80.2	69	69.6	46.3	67.2	92.8	104.5	167.2	115.4	218.7	206.3	774.7
1855	23.1	47.4	57	25.5	41.6	83.2	102.8	78.7	21.3	135.5	48.2	42.6	175	124.1	264.7	204.9	706.9
1856	72.8	66.1	10.8	69.5	88.5	75.5	61.7	118.4	105	57.9	44.5	103.9	181.5	168.8	255.5	207.4	874.5
1857	78.2	41.9	69.3	65.2	42	73.9	67.2	128.6	80.4	51.9	53.3	43.7	224	176.4	269.8	185.5	795.5
1858	37	15.1	42.2	51.5	61.9	51.6	78.6	79.3	94	103.8	50.5	76.4	95.8	155.7	209.5	248.3	742
1859	68.5	55.5	88.4	85.4	11	61.5	58.9	98.1	107.3	79.2	78.8	83.6	200.4	184.8	218.4	265.2	876.1
1860	116.3	47.2	89.5	35.1	78.7	128.8	62.6	124.3	62.5	105.1	78.9	90.5	247.1	203.3	315.7	246.6	1019.6
1861	35.9	93.6	105.3	32.6	25.4	68	109.5	76.1	103.9	46.5	144.2	60.4	220	163.3	253.6	294.6	901.3
1862	71.5	29.4	102.8	67	86.2	86.5	82.7	82.2	72.4	129.2	36.7	81.6	161.3	256	251.4	238.3	928.2
1863	129.3	35.7	37.4	47.8	50.2	97.9	38.1	99.7	116.2	123.2	92.7	73.2	246.5	135.4	235.7	332.1	941.3
1864	48.9	63	76.3	39.4	58.2	64.1	32.6	49	85.2	99.3	89.1	80.5	185	173.9	145.7	273.6	785.5
1865	63.3	61.3	41.3	31.6	99.6	23.7	64.9	117.3	17.6	155.2	84.2	48.5	205.1	172.6	205.8	257	808.4
1866	104.1	93.6	62.5	44.5	35.1	83.2	101.7	110.1	149.2	65.3	113.3	100.7	246.1	142	295.1	327.8	1063.3
1867	98.4	63.7	57.3	102.8	59.3	46	100.2	73.9	71.9	77.3	30.8	75.4	262.8	219.4	220.2	180.1	857.2
1868	85.8	72.4	87.5	66.1	36.7	16.8	15.5	93.3	81.1	100.2	64.7	194.7	233.6	190.3	125.6	246	914.8
1869	96	103.5	46.7	56	99.9	38.7	25	50.2	146.8	67.9	94.6	121.4	394.2	202.6	114	309.4	946.9
1870	73.7	61	53	30.7	46.2	53.7	25.5	51.9	53.4	187.9	69.9	91.7	256.2	130	131.1	311.2	798.6
1871	42.4	77.2	41.1	83.1	39.4	83.4	109.2	49.1	123.9	92.1	47.3	74	211.2	163.7	241.7	263.3	862.2
1872	127.9	92	88	81.4	57.9	110.9	127	96.9	144.5	150.6	131.6	120	293.8	227.3	334.8	426.7	1328.7
1873	107.7	33.8	67.6	21.2	58.6	48.1	88.6	95.4	64.6	98.4	63.9	31.9	261.6	147.4	232.1	226.9	779.8
1874	78.2	51.1	63.7	44.6	45.9	28.7	53.6	107	88	115.9	96.7	88.1	161.2	154.2	189.2	300.5	861.4
1875	110.4	33.3	25.6	26.7	46.6	81	112.3	75.2	96.3	125	133.6	57.2	231.8	98.9	268.5	355	923.3
1876	43.1	95.1	98	74.5	24.9	74.4	60.7	74.4	111	70.2	94.9	179.2	195.4	197.4	209.5	276	1000.4
1877	139.4	82.3	81.4	84.8	73.4	57.5	108.8	151.6	84.6	112.1	122.6	84.9	400.9	239.7	317.9	319.3	1183.4
1878	89.6	42.7	40.1	51.5	106.3	78.1	27	145.1	89.3	89.1	105.8	65.9	217.3	197.9	250.3	284.2	930.6
1879	35.3	79.7	47.3	55.8	62.4	115.8	124.6	118.8	71.6	42.7	46.7	51.9	180.8	165.5	359.2	161.1	852.6
1880	16.6	76.6	56.4	58	51.4	79.8	142.6	48.5	121.6	118.5	102.9	116.8	145.1	165.8	270.9	343	989.8
1881	21.5	106.9	94.8	36.1	65.6	68.9	97.5	145.9	83.4	91.2	105.2	97.2	245.3	196.5	312.3	279.7	1014.1
1882	70	64.1	73.7	107	51.8	118.9	120	84	59.5	115.4	128.1	119.4	231.2	232.5	322.9	303	1111.8
1883	112.4	82.3	43.9	52.9	42.9	91.4	97.2	65.1	134.7	110.9	93	67.8	314.1	139.6	253.8	338.6	994.5
1884	126.4	67.6	68.7	45	47.4	23.5	114	39.6	64.7	55.2	47.7	99	261.8	161.1	177.2	167.6	798.9
1885	61	84.1	60.8	56.4	67.4	62.7	37.9	60.5	102.3	139.2	70.6	40.2	244.2	184.7	161.1	312.1	843.2
1886	117.8	27.4	85.3	60.7	121.3	37.3	115.4	53.9	79.9	128.2	87.4	124.1	185.4	267.3	206.5	295.5	1038.5
1887	63	31.8	46.5	37.6	51.1	10.5	46.8	52.5	104.6	67.3	71.9	71.1	218.9	135.2	109.8	243.8	654.6
1888	37.6	35.4	87.6	55.4	30.7	57.3	153.5	78.4	37.8	49.1	145.3	65.3	144.1	173.8	289.3	232.2	833.5
1889	44.6	51.3	78.3	74.7	75.2	16.7	74.4	122.1	54.3	125.6	37.2	62.8	161.1	228.2	213.2	217.2	817.3
1890	107.6	28.1	68.8	28.4	65.3	80.5	72.6	120.6	60.5	59.6	134.1	27.4	198.5	162.5	273.7	254.2	853.5
1891	55.8	5.9	54.4	53.6	68.2	45.7	92.1	156	90.4	111.2	92.2	142.1	89	176.2	293.8	293.7	967.5
1892	63.3	61	31.1	38.1	94.8	101.7	58.6	117.7	95.8	154.9	57.6	42.2	266.3	164	278	308.2	916.6
1893	43.7	108.7	25.2	14.9	53	47.3	88.7	76.6	72.3	75.1	73	93.7	194.6	93.1	212.6	220.3	772.1
1894	85.3	124.8	56.1	50.3	67.2	85.8	81.4	94.3	21.9	119.3	72.8	79.2	303.8	173.6	261.5	214	938.4
1895	96.4	19.5	84	51.6	20.5	56.3	143.7	95.7	30.2	111.2	98.6	84	195.1	156.2	295.7	240	891.8
1896	42.5	36.1	103.1	37.8	17.1	78.3	69.5	60.9	131.2	130.2	41.9	123.2	162.5	158	208.8	303.2	871.8
1897	48.1	74.6	111.8	56.7	41.1	83.1	35.9	110.7	93.9	50.8	90.5	107.8	246	209.6	229.6	235.2	904.9
1898	55.2	63.4	45.2	77.9	68.1	60.7	27.5	112	28.3	113.7	86	97.9	226.4	191.1	200.2	228	835.9
1899	118.3	53	50.7	81.8	88.8	42.1	65.4	33.2	111.7	80.8	66.6	80.5	269.2	221.3	140.7	259.2	873
1900	111.5	115.7	24.6	51.8	47.2	87.9	56.8	145.7	40.3	132.3	92.6	118.9	307.8	123.6	290.5	265.2	1025.4
1901	53.8	45.3	69	54.3	36.9	47.3	61.9	71.7	37.3	75.2	119	123.4	218.1	160.2	180.8	231.6	795.1
1902	53.1	39.1	50.3	51.5	74.6	48.5	73.2	74.4	35.6	87.8	56.1	89.7	215.6	176.4	196.1	179.6	734.1
1903	98.5	83.8	112.6	46.6	81.8	48.8	100.7	117.9	111	219.8	68	59.2	272	241	267.4	398.8	1148.7
1904	83.2	88.9	59.9	60.2	71.5	37.9	57.8	99.2	42.4	36.1	69.7	70.2	231.3	191.6	195	148.2	777
1905	35	43.4	76.5	76.3	27.7	51.6	43.4	102.9	65.9	73.6	116.2	30.6	148.6	180.5	198	255.7	743.2
1906	114.3	65.5	62.9	31.2	100.4	44.5	45.7	92.2	29.2	154.2	97.1	78.3	210.3	194.5	182.4	280.6	915.4
1907	34.9	52.6	66	55.1	102.8	123.1	60.4	81.5	17.8	144.2	76.7	108.7	165.8	223.9	265.1	238.7	923.9
1908	67.8	65.4	93.4	65.6	69.1	43	89.3	82.3	88.8	48.2	61.2	59.5	241.9	228.1	214.5	198.2	833.5
1909	52.2	49.1	101.2	74.4	47.1	75.9	111.9	93.2	63.6	118	34.4	143.3	160.8	222.7	281	216	964.3
1910	97.2	104.3	30.4	70.5	65.8	57.3	97.8	125.5	14.2	75	108.1	101.4	344.8	166.7	280.6	197.3	947.5
1911	46.1	78.8	53.1	53.4	40	97.3	18.3	72.1	76.7	86.8	113.9	148.4	226.3	146.6	187.6	277.4	884.9
1912	97.3	55.5	107.8	13.8	68.6	136.7	111.6	149.2	55.3	96.4	84.5	100.4	301.2	190.2	397.5	236.2	1077.1
1913	104	41.3	111.3	96.6	65.7	50.2	26.4	43.9	57.4	81	84.7	60.8	245.7	273.6	120.5	223.1	823.4
1914	66.8	74.8	88.4	28.7	51.8	61.9	94.9	64	54.4	57.6	121.8	163.5	202.4	169	220.8	233.8	928.7
1915	105.9	115.5	43.2	40.1	42.4	26	121.5	88.4	31.1	38.2	60.4	170.3	384.9	125.7	235.8	129.7	883
1916	71	111.1	91.8	58	78.4	67.1	71.5	77.4	56.6	139.8	106.1	85.2	352.4	228.1	216	302.4	1013.9
1917	80.5	27.2	58.9	57.9	56.1	52.7	37.9	180.1	54.1	126.2	77.7	54.1	192.8	172.9	270.7	257.9	863.2
1918	80.5	87.8	36.9	34.8	62.8	31.5	106.8	76.1	193.1	84.6	55.5	134.1	222.4	134.5	214.4	333.2	984.4
1919	108.2	46.3	106.9	51.9	34.1	36.9	57.7	82.6	56.3	92.3	86.3	131.7	288.6	192.9	177.2	234.9	891.2
1920	106	69.8	94.2	113.6	106	49.9	138.6	54.2	54.2	54	47.4	93.5	307.5	313.8	242.7	155.6	981.5
1921	134.3	8	70.5	33.2	52.8	12	44.1	134.7	36	63.5	60.9	108.5	235.8	156.5	190.9	160.5	758.7
1922	98.1	91.4	61.2	65.6	37.3	50.3	127.7	104.3	91.1	37.2	45.7	118.8	298	164	282.3	174.1	928.7
1923	67.7	132	45	65.7	81.6	26.5	91.3	128.5	94	111.7	120.1	96.2	318.4	192.4	246.3	325.8	1060.2
1924	75.7	28.9	32.3	50.1	124.5	59.4	108.9	96.7	101	112.5	59.8	116.8	200.8	206.8	265.1	273.3	966.6
1925	75.8	119.8	41.6	81.8	105.4	4.9	46.7	88.3	94	100.8	65.8	96.8	312.4	228.7	139.9	260.6	921.6
1926	101.6	84.5	36.2	47.5	70.7	87.4	84.8	89.5	79.7	90.6	133.3	31.3	282.8	154.4	261.7	303.6	937
1927	82.3	46.4	79.8	67.7	44.6	96	100.8	155.9	145.3	84.9	103	58.8	160	192.1	352.6	333.2	1065.4
1928	177.5	86.4	80.9	31.1	38.5	127.4	55.7	128.2	32.4	133.1	131.4	67.2	322.7	150.5	311.2	296.9	1089.6
1929	50.9	24.9	13.1	35.6	49.1	43.2	81.3	99.7	35.3	111.9	151.9	167.5	143	97.7	224.2	299.1	864.3
1930	129.4	24.4	70.7	69.8	42.3	49.7	142.4	132.1	97.4	113.8	115.4	85.9	321.3	182.9	324.2	326.6	1073.4
1931	88.3	84.6	21.4	87.7	73.3	130.2	115.7	113.8	84.9	51.5	135.7	55.3	258.8	182.4	359.7	272	1042.3
1932	91.2	13.1	65.7	78.9	120.8	29.8	108.2	47.5	96.6	139.6	61.7	63.4	159.6	265.4	185.5	297.9	916.6
1933	71.7	105.8	63.4	39.4	59.1	55.5	67.1	37.1	43.6	115.5	66.4	22.3	240.8	161.9	159.7	225.5	746.8

1934	84.6	16.2	75.4	81.9	57.4	53.1	56.4	85.3	74.3	112.1	57.5	139.8	123.1	214.8	194.8	243.9	894
1935	57.1	114.7	30.4	81.5	22.5	89	31.3	58.3	149.4	150.5	127.2	75.5	311.6	134.4	178.6	427.1	987.4
1936	115	72.8	55.4	37.6	36.3	96.5	113.1	58	100.4	81.4	103.3	93.4	263.3	129.3	267.6	285.1	963.1
1937	105.7	120.3	72	77.4	76.1	48.2	67.1	47.4	56.7	66.6	46.3	98	319.3	225.5	162.7	169.7	881.8
1938	106.9	40.4	28.7	10	85.6	88.5	107.5	84.3	59.4	168.9	120.6	114.1	245.3	124.4	280.3	348.8	1014.9
1939	139.9	72.7	73.9	47.8	34.6	75.8	128.8	63.6	40.6	94.1	130.9	59.5	326.6	156.3	268.2	265.5	962
1940	57.5	54.2	80	54.1	33.9	22.1	141.6	36.3	72.3	105.9	134.6	87.7	171.1	168	200	312.8	880.2
1941	70.9	114.6	85.2	42.4	57.4	16.2	62.4	110.7	21.3	115.8	83.2	38.6	273.2	185	189.2	220.3	818.5
1942	99.6	44.3	56.5	41.9	81.5	29.3	87.3	89.7	78.9	96.8	33.4	88.7	182.5	179.9	206.3	209.2	828
1943	128.3	50.9	27.5	49.2	83.4	68.1	58.2	119.8	103	83.3	74	46.7	268	160.2	246.1	260.2	892.4
1944	98.7	55.5	16.1	62.8	56.7	74.8	79.3	82.7	138.7	100.9	158.8	79.9	200.9	135.7	236.8	398.3	1005
1945	102.2	88.4	35.3	54.5	86.9	83.5	58.4	76.2	65.3	118.2	17.5	58.9	270.5	176.7	218.2	201	845.5
1946	89.1	82.9	40.6	38.1	47.8	79.6	101	134.7	136.5	30.1	160.9	94.8	230.9	126.5	315.2	327.6	1036.1
1947	83.3	59.4	138	99.9	60.7	75.1	75.6	7.5	61.3	21.3	103.9	70.5	237.5	298.5	158.1	186.5	856.3
1948	188.8	58.6	44.5	52.2	43.7	121.1	46.4	123.4	82.6	61	56	90.1	317.9	140.4	290.9	199.6	968.4
1949	51.5	50.7	39.5	80	52.5	22.5	69.9	63.7	35.6	112.6	126.4	126.1	192.3	172	156.1	274.5	830.9
1950	54.3	126	45	78.7	49.1	52.1	86	135.2	141.6	60.4	131.6	66.3	306.4	172.7	273.3	333.5	1026.2
1951	83.8	87.8	103.6	56.2	85.8	33.9	60.2	128.9	69.4	31.9	189.3	131.6	237.8	245.6	222.9	290.6	1062.3
1952	83.6	25	59.7	56.4	52	63.2	48.5	89.9	98.8	98.6	70.6	84.4	240.3	168.1	201.7	268.1	830.9
1953	36.1	51.3	23.1	73.4	58	66.9	100.4	100.6	84	54.2	91.1	46	171.8	154.5	267.9	229.2	784.9
1954	76.4	73.1	61.4	18.3	89.3	76.9	89.8	150	111.5	165.7	158.1	110.9	195.5	169	316.7	435.3	1181.4
1955	66.8	59.2	55.4	37.9	81.7	74.7	34.2	30.3	52.4	61	51.4	114.6	236.9	175	139.2	164.7	719.5
1956	111.1	42.6	34.6	42.6	32.3	78.2	114.2	208.7	78.2	61	35.4	96.2	268.3	109.6	401.1	174.6	935.1
1957	83.2	78.2	64.2	14.6	46.9	49.2	107.4	126.2	124.3	90.8	53.5	88.9	257.6	125.7	282.8	268.6	927.4
1958	86.4	126.4	54.7	34.4	92.5	104.3	105.6	89.5	94.3	77.1	29.8	101.6	301.7	181.5	299.3	201.2	996.5
1959	75.4	17.1	46.6	79.1	24.2	60.3	68.7	17.5	15.1	83.4	121	150.1	194.1	149.8	146.6	219.5	758.4
1960	139.3	81.8	43.1	50.2	44.7	33.9	127.7	98.5	81.3	146.4	145.2	103.7	371.2	138	260.1	372.9	1095.9
1961	120.1	67.3	28.6	86.5	48.1	48.5	93.2	105.8	75	118.9	59.9	84.5	291.2	163.2	247.5	253.8	936.4
1962	107.4	57.2	37.8	78.4	72.2	28.6	58.6	132.3	104.4	37.4	62.5	72.7	249.1	188.3	219.6	204.3	849.4
1963	36.7	31.2	88.6	71.5	53.8	97.7	58.5	115.2	83	69.5	155.4	33.1	140.5	213.8	271.4	307.9	894.1
1964	34.8	26.6	90	61.5	55.8	68.5	66.1	72.6	48	56.4	54.8	115.2	94.4	207.4	207.1	159.2	750.2
1965	102.7	23.7	63.4	73.4	67.5	69.4	91.5	80.7	155.2	48.3	119.1	146.9	241.6	204.3	241.5	322.7	1041.8
1966	53.9	134.2	47.2	93	77.1	95.5	73.9	118.6	71.4	100.6	89.7	110.1	335	217.4	287.9	261.7	1065.2
1967	54.9	92.8	56.7	42	145.4	50.5	82.3	108.1	98.9	180.2	88.2	65.2	257.8	244.1	240.9	367.3	1065.2
1968	78	46.5	92.2	61.3	77.5	73.6	100.5	57.5	162.6	109	78.5	68.3	189.8	231	231.6	350.2	1005.6
1969	87.2	70.4	76.6	76.9	97.8	78.8	52.9	63.1	62.6	28.6	157	83.8	225.9	251.4	194.8	248.2	935.8
1970	95.6	80.9	59.7	100.3	18.5	42.8	86.8	79.6	67.5	89.8	141.3	56.2	260.4	178.5	209.2	298.6	919
1971	69.3	46.6	66.5	54.7	51.7	71.1	57.3	132.8	27.8	72	89.3	34.5	172.1	172.9	261.2	189.1	773.6
1972	105.2	63.1	82.5	71.3	79.9	92.3	64.3	38.7	36.7	27.8	116.2	83	202.9	233.7	195.3	180.8	861.2
1973	51.7	45	27.4	74	71.6	49.7	114.3	83.4	70	60.8	50.2	79.1	179.8	173	247.3	181	777.1
1974	118.3	85.1	54.5	14.6	35.7	57	98.8	77.4	119.4	94.5	111.5	99	282.5	104.7	233.2	325.4	965.7
1975	120.7	28.3	57.9	73.1	43.6	28	82.9	65.1	96.9	40.3	65.2	58.2	248	174.5	176	202.3	760
1976	96.3	43.9	52.8	32.8	97.7	20.5	34.6	16.7	160.3	151.4	61.4	75.6	198.4	183.3	71.8	373.2	844.1
1977	99.1	125.6	70.7	64.1	49.1	89.8	31.9	67.7	58.1	82.7	116	86.9	300.3	183.9	189.4	256.8	941.8
1978	116.2	76	85.3	39.6	36.7	65.5	78.7	90.9	92.5	32	80.8	171.5	279.1	161.6	235.1	205.2	965.6
1979	72.6	45.8	130.4	65.6	118.2	40.4	39	107.2	56.6	77.4	113.6	161	289.9	314.2	186.7	247.6	1027.9
1980	93.2	95.2	100.4	9.4	27	138.7	59.6	117	66.6	149.6	112.5	95.1	349.5	136.8	315.2	328.7	1064.3
1981	74.9	62.9	161.8	67	74.1	55.2	62	54.1	137.3	135	99	64.3	232.8	303	171.3	371.3	1047.6
1982	89.2	42.4	97.7	19.6	42.7	135.1	30.5	103.8	71.4	95.7	128.1	105.8	195.9	160	269.4	295.1	961.9
1983	108	44.7	86.6	102.3	109.8	39.8	39	36.9	99.5	101.1	47.9	140.8	258.6	298.8	115.8	248.5	956.6
1984	143.5	57.8	67.1	15.4	39.5	54.8	24.9	66.4	129.4	97.7	155.4	65.2	342.1	121.9	146.1	382.4	916.9
1985	75.8	11.9	70.1	81.3	71.4	65.6	93.6	130.9	78.1	48	88.6	116.1	153	222.8	290.2	214.7	931.5
1986	118.6	26	83	98.7	99.5	47.4	50	122.4	20.2	102.7	106.5	160.3	260.6	281.2	219.8	229.4	1035.1
1987	43.2	57.2	106.4	62.6	47.7	117.3	92.1	88.4	81.8	140.4	74.1	71.7	260.7	216.6	297.9	296.3	982.8
1988	137.2	71.1	102.1	41.5	56.4	35.5	156	97.8	71.9	96.5	60.8	67	280	200	289.4	229.2	993.9
1989	42.3	91.8	93.2	79.6	25.4	69.8	33.2	71.6	24.5	96.1	55.6	94.7	201.1	198.2	174.7	176.1	777.7
1990	134.3	137.5	30.6	35.5	38.9	83.1	41	54.9	57.4	117.4	60.8	123.4	366.4	105	179	235.6	914.7
1991	79	88	77.8	54.3	16.6	80.7	50.3	37.2	53.6	81.8	114.1	80	290.4	148.7	168.2	249.5	813.4
1992	48.4	59	106	79.5	42.7	31.4	81.4	115.5	96.7	90.6	121.9	83.4	187.5	228.2	228.2	309.2	956.5
1993	112.1	17.2	23.5	110	97.5	50.5	82.3	73.7	110.9	67.2	64.3	163.8	212.7	231	206.5	242.4	973
1994	123.5	66.6	99.9	74.3	39.1	42.9	56.8	75.3	101.9	86.3	100	141.1	353.8	213.2	175	288.2	1007.6
1995	150.3	115	73.5	28	52.1	29.5	39.7	12.5	96.4	57.5	76.5	60.1	406.4	153.5	81.7	230.4	791
1996	47	85.4	31	54.6	51.7	35	50.2	76.8	38.8	88.1	120.7	79.9	192.5	137.4	162.1	247.6	759.3
1997	13.1	135.9	43.6	27.1	79.6	128.7	69.4	67.6	47	53.5	89.7	117	228.9	150.3	265.7	190.2	872.2
1998	112.6	34.2	103	114.8	50.2	127.4	79.1	70.2	69.4	165.6	91.3	76.2	263.8	268.1	276.7	326.3	1094
1999	128.7	51.6	96.5	72.2	72	91.5	33.3	82.2	100.2	83.8	68	150.6	256.4	240.7	207	252	1030.5
2000	80.9	88.4	53.2	126.4	73.3	75.3	64.7	74.6	134.8	174	183	114.6	319.9	252.9	214.6	491.8	1243.2
2001	55	102.3	54.7	99.5	37.4	56.6	56.2	92.4	106.1	121.1	68.8	57.7	271.9	191.6	205.3	295.9	907.8
2002	85.2	160.9	48.3	50.8	83.7	70.9	99.9	97.3	38.8	136	125.2	120.5	303.8	182.8	268.1	300	1117.5
2003	85.4	36.8	42.8	45.3	88.4	83.4	67.9	19.1	57.6	47.6	84.1	101.2	242.6	176.5	170.4	189.3	759.6
2004	129.7	65.9	51.6	84	36.2	80.9	76.7	194.5	72.1	139.5	53.8	72.1	296.7	171.8	352	265.4	1056.8
2005	89.5	64.1	49.3	90.4	54.4	54.9	68.4	71	78.7	118.1	93	59.5	225.6	194.2	194.4	289.8	891.4
2006	43.6	58.7	113.5	55.3	107.6	27.1	38.1	114.7	87.2	112	96.9	139.5	161.7	276.4	179.8	296.1	994.1
2007	121.1	81.5	53.1	19.1	83.9	187.6	131.7	55.1	61.3	41	75.9	108.3	342.2	156	374.5	178.2	1019.7
2008	178.2	51.7	92.5	77.4	28.9	86.6	119.3	127.8	122.6	129.2	73.1	77.4	338.2	198.7	333.7	325	1164.6
2009	87	40	46.3	38.4	75	60.3	153.7	86.2	41.5	76.6	204.6	95.6	204.3	159.7	300.1	322.7	1005.1
2010	67.9	66.1	72.7	25.7	24.2	41	96.9	73.9	109.4	80.9	129.6	38.9	229.6	122.7	211.7	320	827.3
2011	77.1	115.6	29.4	21.1	75.7	66.7	76.2	103.5	77.5	93.1	54.9	130.2	231.6	126.2	246.4	225.6	921.1
2012	82	43	25.5	135.5	68.1	167.4	116.7	111.4	131.7	105.8	128.1	160.9	255.2	229.2	395.5	365.6	1276.2
2013	80	44.5	58	33.4	83.8	47.5	78.2	75	57.8	136.2	67.6	114.1	285.4	175.2	200.7	261.7	876.1
2014	145.2	118.4	64.9	48.2	106.1	46.1	60.6	117.7	18	110.1	90.2	102.5	377.7	219.1	224.4	218.3	1027.9
2015	101.8	51.2	73	36.1	105.4	41	90.8	83.9	43.1	69.5	175.7	216.6	255.5	214.5	215.7	288.3	1088
2016	145.1	89.5	75.4	78.4	42.5	93.8	70.3	97.5	69.3	44.3	109	53.1	451.2	196.3	261.6	222.5	968.2
2017	53.7	80.6	97.1	20.6	47.7	121.2	96.8	83	114.2	91.3	92.5	83.9	187.5	165.4	301	298	982.7
2018	105.9	62	91.5	83.4	33.1	29.2	47.3	71.8	87.5	76.1	86.3	102.8	251.8	208	148.2	249.9	876.7
2019	40.3	51.8	125.5	38.3	53.8	113.5	105.3	119.5	143.1	129.4	128.7	93.5	194.8	217.5	338.4	401.3	1142.8
2020	76.6	207	57	13.8	17.2	113.8	98.1	135.3	61.2	141.1	77	135.2	377.1	88	347.1	279.4	1133.2
2021	155	100.9	74.9	12.6	120.1	26.2	86	60.4	63.7	141.3	67	104	391	207.6	172.5	272	1012
2022	39.7	140.6	42.7	35.7	60.1	49.4	47.5	42.7	91.3	130.8	127.3	101.1	284.3	138.5	139.6	349.5	909
2023	102.4	27.1	114.2	66.2	32.1	53.4	157.1	88.2	109.4	158.7	119.8	179	230.5	212.5	298.7	387.9	1207.6
2024	116.4	105.5	92.5	107.2	97	51.8	83.3	68.9	115.3	98	59.6	121.2	400.9	296.7	204	272.9	1116.8
2025	83.1	43.5	26	15.2	45.5	74.2	77.3	35	142.5	89.9	173.2	115.8	247.8	86.8	186.5	405.6	921.2
2026	100.3	103.9	77	319.9													
Mean	92.85556	79.28889	68.26111	66.46389	62.36286	72.49714	80.21429	83.18286	84.30286	101.8857	102.6114	107.18					

Areal values from HadUK-Grid 1km gridded climate data from land surface network
Source: Met Office National Climate Information Centre
Monthly, seasonal and annual mean air temperature for England N
Areal series, starting in 1884
Last updated 01-Apr-2026 11:35

year	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	win	spr	sum	aut	ann
1884	4.9	3.9	4.9	6	9.7	12.6	14.7	15.5	13	8	4.6	2.9		6.88	14.28	8.52	8.4
1885	1.8	4.1	3.2	6.3	7.5	12.4	14.5	12.2	10.7	6.1	4.6	2.7	2.87	5.66	13.01	7.14	7.18
1886	0.8	0.5	2.6	5.9	8.4	11.6	14.2	14.3	12	9.8	5.4	0.9	1.36	5.62	13.39	9.08	7.24
1887	1.3	3.1	3	5.3	8.1	14.1	15.9	13.8	10.4	6.1	3.7	1.8	1.73	5.46	14.61	6.72	7.24
1888	2.5	1.1	1.7	5.1	9.2	11.3	12	12.6	10.8	7.1	6.3	3.9	1.82	5.34	11.98	8.05	6.98
1889	2.7	1.9	3.4	5.7	11.3	14	13.5	13.5	11.3	7.5	5.5	2.4	2.85	6.82	13.66	8.09	7.76
1890	4.5	2.4	5.1	5.6	10.3	12.4	13.1	12.9	13.8	8.7	4.6	-0.5	3.12	7.01	12.81	9.03	7.77
1891	0.8	4	2.7	4.6	8	12.9	13.6	12.9	12.8	8.1	4.3	2.6	1.33	5.08	13.15	8.41	7.29
1892	1.1	2	1.6	5.8	9.8	11.7	12.4	13.6	10.8	5.9	5.2	0.7	1.93	5.74	12.56	7.26	6.72
1893	1.5	3.2	6.1	8.3	11.1	13.8	14.5	16	11.4	8.5	4.3	3.8	1.76	8.49	14.75	8.07	8.56
1894	2	3.5	5.4	8	7.5	12.1	14.7	12.9	10.3	7.7	6.7	3.9	3.09	6.96	13.23	8.22	7.91
1895	-1.1	-2.3	3.9	6.9	10.6	13	13.7	14.6	14.3	5.9	5.9	2.6	0.23	7.12	13.78	8.67	7.38
1896	3.8	3.6	5.1	7.7	10.5	14.5	14.6	12.9	11.7	5.8	3.9	2.8	3.34	7.77	14	7.13	8.09
1897	0.4	4.1	5	5.5	8.3	13.3	14.5	15.2	10.6	8.8	6.6	3.7	2.39	6.27	14.33	8.68	8.02
1898	5.6	3.4	3.2	7	9	12.2	13.6	14.7	13.7	10.2	5.8	5.9	4.26	6.41	13.51	9.92	8.73
1899	3.4	3.6	4.1	6.4	8.2	13.9	15.7	15.9	11.8	8.1	7.7	1.2	4.29	6.23	15.19	9.21	8.36
1900	3.1	0.9	2.6	7	9	13.5	16.2	13.6	12.4	8.3	6	6.2	1.75	6.2	14.42	8.87	8.26
1901	2.5	1.3	3.4	7.2	10.2	12.6	16.6	14.7	12.7	8.3	4.3	2.1	3.38	6.93	14.66	8.44	8.04
1902	3.6	0.3	5.4	6.3	7.4	12.1	13	12.5	11.7	8.5	5.9	3.9	2.05	6.36	12.54	8.73	7.6
1903	2.9	5.8	5.7	5.1	9.3	11.7	13.8	13.1	11.6	8.9	5.2	2.3	4.13	6.7	12.87	8.6	7.95
1904	3.1	2	3.1	7.6	9.4	12.2	15.3	13.8	11.7	8.7	4.6	2.5	2.47	6.71	13.77	8.33	7.85
1905	2.9	3.7	5.6	5.8	9.5	13.3	16	13.5	11.3	6.1	4.1	4.5	3.03	6.96	14.25	7.16	8.05
1906	4.2	1.9	3.9	5.9	9.2	13.1	14.4	15.4	12.8	9.6	6.5	2	3.57	6.34	14.33	9.61	8.28
1907	2.6	1.9	5.3	6.4	9	11.4	12.8	13	12.4	8.7	5.4	3.5	2.19	6.9	12.41	8.81	7.73
1908	1.8	4.1	3	4.9	11.1	12.7	14.4	13.2	12	11.1	6.1	2.7	3.11	6.36	13.44	9.79	8.12
1909	2.3	2.2	2.4	7.5	9.4	10.8	13.5	14.3	10.7	9.1	4	2.5	2.42	6.4	12.86	7.96	7.42
1910	2.1	3.6	5.2	5.9	9.7	13.3	13.1	14.1	11.3	9.7	2.1	5.2	2.69	6.94	13.5	7.74	7.97
1911	3.2	3.7	3.9	6.6	11.6	12.9	16.3	16.5	12.4	8.2	5	4.8	4.03	7.37	15.25	8.5	8.78
1912	2.3	3.9	5.9	7.6	10.3	12.8	14.6	11.8	10.2	7.6	5.3	5.2	3.67	7.96	13.05	7.66	8.13
1913	2.6	3.9	4.7	6.8	10.1	13	13.4	14	13	9.7	7.1	3.9	3.91	7.18	13.46	9.93	8.54
1914	2.8	5.8	4.8	8.6	9.3	13.1	14.8	14.8	12.1	9.3	5.8	3.4	4.13	7.57	14.25	9.1	8.74
1915	2.9	3	4.2	6.7	9	12.8	13.4	14	12.2	8.1	2.2	3.6	3.1	6.62	13.44	7.49	7.7
1916	6.4	2.6	2.1	7	10	10.6	14	15.1	11.8	9.1	6.1	1.5	4.21	6.35	13.26	8.98	8.04
1917	1	0.2	2	4	10.8	13.4	14.8	14.6	13	6.4	7	1.9	0.94	5.62	14.27	8.77	7.46
1918	2.6	5.3	4.7	5.7	11.5	12	14.2	14.9	10.4	8.4	4.4	5.3	3.17	7.34	13.7	7.73	8.3
1919	1.9	1	2.2	6.3	11.7	13	12.7	14.2	11.6	6.9	2.3	3.8	2.79	6.72	13.31	6.93	7.34
1920	3.6	4.7	5.8	6.6	10.3	12.9	13	12.6	11.7	9.5	6.2	3.3	4.05	7.6	12.83	9.15	8.38
1921	5.7	3.8	6	7.1	10.1	13	16.3	13.9	12.9	11.9	3.7	5.6	4.31	7.73	14.4	9.49	9.2
1922	2.1	3	3.5	4.4	11.1	12.3	12.3	12.3	10.9	7.6	5.2	4.6	3.57	6.38	12.32	7.9	7.48
1923	4.8	3.8	5.4	6.1	7.7	11.2	16	13.7	11.2	8.3	2.6	2.3	4.42	6.41	13.64	7.41	7.8
1924	3.1	2.6	2.6	5.7	9.8	12.6	14.1	13	12.2	9	6	6	2.71	6.05	13.23	9.1	8.09
1925	4.1	3.7	4.1	6.2	10.3	13.3	15.8	14.4	10.3	9.2	2.6	1.5	4.61	6.89	14.5	7.35	7.99
1926	3.4	5.2	5.3	8.1	8.6	12.4	15.7	15	12.9	6.9	4.7	3.6	3.35	7.29	14.41	8.14	8.5
1927	3.5	3.3	6	6.6	9	10.8	14.5	14.4	11.3	9.3	5	1.1	3.48	7.23	13.27	8.53	7.94
1928	4	4.6	4.6	7	9.1	11.2	14.5	14.2	11.6	8.8	6.5	2.5	3.2	6.9	13.32	8.95	8.23
1929	0.9	-0.6	5.6	5.3	10	12	14.7	13.9	13.7	8.4	5.5	4.3	1.01	7.02	13.56	9.17	7.87
1930	4.1	1.6	4	7	9.2	13.8	14	14.5	12.3	9.2	5	3.2	3.4	6.72	14.1	8.82	8.19
1931	2.2	2.6	2.6	6.5	10	12.6	14.3	12.9	10.7	7.9	6.5	4.4	2.67	6.38	13.29	8.36	7.8
1932	5.1	3	3.9	5.5	8.9	12.6	14.9	15.4	11.7	7.5	5.6	4.9	4.21	6.11	14.32	8.28	8.29
1933	1.6	3.1	6.1	8	10.6	14.1	16.5	16.3	13.8	9.2	5	1.7	3.23	8.22	15.68	9.31	8.87
1934	3.7	3.9	3.8	6.6	9.9	13.3	16.7	14.1	13.3	9.3	5.3	6.6	3.06	6.79	14.71	9.29	8.91
1935	3.6	4.6	5.7	6.8	8.5	13.7	15.7	15.6	12.1	8.2	5.7	1.8	4.98	7.02	15	8.66	8.52
1936	2.3	1.2	5.6	5.3	9.9	13.1	14.4	14.9	13.4	8.6	4.7	4.2	1.76	6.94	14.16	8.9	8.16
1937	3.9	3.8	2.1	7.6	10.8	12.8	15	15.3	12.1	9.3	4.6	1.9	3.98	6.81	14.37	8.67	8.28
1938	4.6	4.2	8.3	6.8	9.5	12.9	13.8	14.5	12.5	9.3	7.8	3.4	3.54	8.23	13.76	9.87	9
1939	2.8	4.4	4.8	7.4	10.2	12.8	14.4	15.3	13	7.4	7	2.8	3.49	7.45	14.17	9.08	8.52
1940	-2	1.1	4.9	6.9	11.2	15.2	13.9	14	11.3	8.6	5.8	3.3	0.59	7.64	14.34	8.53	7.84
1941	-0.6	1.7	3.6	5.3	8.1	13.4	16.1	13.6	13.7	9.4	5.3	4.7	1.46	5.67	14.4	9.46	7.9
1942	0.2	-0.7	3.5	7.5	9.6	13	14.1	15.1	12.3	9.4	4.5	5.3	1.48	6.9	14.07	8.75	7.88
1943	3.2	5.1	5.7	9.3	10.3	13.2	14.6	14.3	11.9	9.5	5.3	3.1	4.53	8.43	14.02	8.89	8.8
1944	4.8	2.9	4.4	8.7	9.8	12	14.9	15.4	11.2	8.1	5	2.9	3.61	7.62	14.14	8.08	8.36
1945	-0.4	5.9	7.2	8.6	10.5	13.3	15.6	14.5	13	10.6	6.6	3.9	2.73	8.74	14.48	10.11	9.13
1946	2	4.7	4.4	8.8	9.2	12	15	13.3	12.6	8.7	7	2.5	3.5	7.42	13.44	9.41	8.35
1947	1.4	-2.2	1.6	7.2	11.6	14.1	15.5	16.9	13.6	10.1	5.7	4.2	0.67	6.83	15.52	9.81	8.39
1948	3.7	3.7	7	7.8	9.7	12.1	14.5	13.6	12.5	9.1	6.2	4.4	3.85	8.2	13.4	9.28	8.72
1949	4.2	4.6	3.9	8.9	9.9	13.5	15.6	15.4	14.8	10.4	5.6	4.7	4.41	7.55	14.88	10.3	9.34
1950	3.5	3.8	6.4	6.2	9.7	14.8	14.9	14.5	11.7	8.8	4.6	0.3	4.02	7.44	14.69	8.38	8.28
1951	2.4	2.4	2.7	5.6	8.4	12.3	15	13.7	12.9	9	7.2	4.2	1.69	5.59	13.67	9.71	8.02
1952	1.4	2.6	5.3	8.2	11.9	12.9	15.2	14.7	9.9	7.9	3.3	2.2	2.72	8.45	14.28	7.04	7.97
1953	3.1	3.8	5.2	5.8	11.5	12.9	14.4	14.9	12.9	8.7	7.5	5.8	3.03	7.53	14.08	9.7	8.92
1954	2.1	1.1	4.4	6.6	10.1	12.1	13	13.2	11.4	10.6	5.7	5.4	3.07	7.05	12.79	9.26	8.03
1955	1.6	0	2.3	8.2	8.2	12	16.2	16.4	13.2	8.3	6.4	4.2	2.43	6.21	14.88	9.27	8.12
1956	2.3	-0.5	4.9	5.4	10.6	11.8	14.4	12	13	8.6	5.4	4.8	2.04	6.98	12.74	9.02	7.76
1957	4.5	3.6	7.7	7.3	9.2	13.4	15	14	11.1	9.6	5.8	3.6	4.32	8.08	14.15	8.84	8.76
1958	2	3	2.3	6.3	9.6	12.2	14.5	14.7	13.8	9.7	5.3	3.5	2.84	6.05	13.84	9.61	8.11
1959	0.4	3.8	6	8.1	11.3	13.7	15.7	16	13.5	11.4	6	4.8	2.53	8.48	15.17	10.32	9.26
1960	2.9	2.7	4.8	8	11.4	14.6	13.9	13.8	12	9.3	5.7	3	3.46	8.08	14.1	9.03	8.53
1961	2.3	5.5	7.4	8.4	9.6	13.1	13.5	13.9	13.8	9.6	5.3	1.1	3.53	8.46	13.52	9.59	8.64
1962	3.3	3.6	1.6	6.4	9	12.3	13.2	13.1	11.5	9.5	4.4	1.2	2.65	5.67	12.9	8.48	7.46
1963	-1.5	-1.6	4.6	7.1	9.2	13.3	13.8	12.9	11.7	9.7	6.6	2.3	-0.58	6.96	13.33	9.34	7.39
1964	2.8	3.4	3	7.8	11.8	12.4	14.5	14.1	12.7	7.9	6.3	2.4	2.82	7.54	13.67	8.93	8.26
1965	2.3	2.8	3.8	6.9	10.2	13.2	12.5	13.4	11.4	9.9	3.2	2.9	2.48	6.95	13.06	8.22	7.75
1966	1.9	3.7	5.6	5.4	9.9	13.9	13.6	13.4	12.7	8.8	4.7	3.8	2.81	6.97	13.65	8.76	8.15
1967	3.3	4.4	6	6.8	8.7	12.8	15.2	14.4	12.3	9.4	4.3	3.2	3.81	7.16	14.14	8.68	8.43
1968	3.4	1	5.3	7.1	8.4	13.4	13.4	14.2	12.6	11.3	5.5	2.3	2.55	6.94	13.68	9.8	8.17
1969	4.1	-0.3	1.9	6	9.6	12.6	15.4	15.1	12.8	11.7	3.8	2.3	2.1	5.85	14.39	9.47	7.98
1970	2.4	1.6	2.8	5.5	11.4	14.7	14	14.9	13.2	9.5	6	3.6	2.12	6.57	14.52	9.58	8.34
1971	3.5	3.9	4.2	6.6	10.2	11	15.5	14.2	13.1	10.3	5.2	5.9	3.66	7.02	13.58	9.53	8.66
1972	3	3.1	5.1	7.3	9.6	10.9	14.1	13.7	10.6	9.4	5.2	4.4	4	7.33	12.93	8.41	8.05
1973	3.6	3.6	5.6	5.8	10	13.8	14.6	14.7	12.8	8.1	4.7	3.6	3.88	7.17	14.38	8.51	8.45
1974	4.7	4.5	4.5	6.4	9.9	12.2	13.7	14	10.9	6.7	5.3	6.6	4.28	6.95	13.32	7.61	8.31
1975	5.4	3.4	3.7	7.2	8.2	13	15.8	17.3	11.9	8.8	5	4.6	5.21	6.37	15.4	8.59	8.75
1976	4.6	3.8	3.7	6.8	10.4	15.1	16.5	15.8	12	9.5	4.9	1.1	4.36	6.96	15.81	8.8	8.69
1977	1.4	3.2	5.7	6.1	9	11.3	14.4	14.1	11.9	10.5	5.2	4.9	1.87	6.94	13.28	9.22	8.18
1978	1.9	1.1	5.6	5.3	10.3	12.4	13.3	13.8	12.8	10.9	7.4	2.5	2.69	7.09	13.17	10.38	8.15
1979	-1	0.3	3.4	6.4	8.6	13	14.6	13.6	12.1	10.1	5.5	4.4	0.62	6.1	13.75	9.26	7.63
1980	1.4	4.3	3.4	7.7	9.7	12.6	13.5	14.4	13.5	7.7	5.7	4.7	3.33	6.92	13.52	8.97	8.23
1981	3.5	2.3	6.2	6.5	10.4	12.2	14.3	14.8	13.5	6.9	6.5	-0.8	3.54	7.73	13.81	8.95	8.06
1982	1.7	3.9	5	7.6	10.2	13.6	15.1	14.5	13	9.1	6.5	3.1	1.52	7.62	14.41	9.54	8.64

1983	5.4	0.9	5.4	5.4	8.8	12.6	17.2	15.8	12.2	9.2	6.4	4.7	3.2	6.55	15.23	9.3	8.74
1984	2.1	2.6	3.8	7	8.8	13	15.4	15.9	12.3	10	6.9	4.3	3.17	6.5	14.8	9.73	8.52
1985	0.4	1.7	3.7	7.1	9.6	11.2	14.7	13.5	13.3	10.2	2.9	4.9	2.15	6.79	13.16	8.8	7.81
1986	2.2	-1.3	4	4.7	10.2	13.2	14.5	12.2	10.4	9.6	6.7	4.8	2.05	6.34	13.28	8.91	7.66
1987	0.4	2.7	3.2	8.9	8.7	11.3	14.7	14.3	12.2	8.4	5.7	4.9	2.63	6.9	13.43	8.75	7.96
1988	4	3.9	4.9	7.1	10.3	13.4	13.8	14.2	12	9.3	4.6	6.5	4.3	7.44	13.79	8.66	8.69
1989	5.6	5	6	5.4	11.4	13.1	16.5	15.1	13.1	10.5	5.7	3.5	5.72	7.63	14.92	9.78	9.28
1990	5.5	6.1	7.4	7.1	11.2	12.6	15.1	16.6	11.7	10.6	5.9	3.7	4.98	8.56	14.8	9.4	9.48
1991	2	1.3	6.8	6.9	9.9	11	16.4	15.9	13.2	9.2	5.5	4	2.38	7.86	14.45	9.3	8.55
1992	3	4.9	6.2	7.6	11.9	14.6	14.9	14.1	12	6.6	5.9	2.7	3.93	8.58	14.52	8.16	8.71
1993	4.5	4.4	5.6	8.2	9.9	13.4	14	13.2	11.2	7.2	3.6	3.7	3.85	7.9	13.54	7.33	8.26
1994	3.7	1.8	6.2	7.1	9.1	13.1	16.3	14.4	11.3	8.9	8.5	5.1	3.12	7.46	14.6	9.57	8.84
1995	3.1	5.1	4.1	7.6	10.4	12.7	17	17.1	12.5	11.8	6.8	1.5	4.41	7.39	15.65	10.39	9.18
1996	3.5	1.8	3.3	7.4	8.1	12.9	15	15.5	12.5	10.4	4.6	2.4	2.28	6.22	14.45	9.17	8.12
1997	2	5.5	7.2	7.8	10.1	12.6	15.6	17.2	12.7	8.9	7.5	5	3.24	8.38	15.18	9.7	9.38
1998	4.1	7	6.8	6.8	11.6	12.9	14.3	14.5	13.4	9.2	4.9	4.5	5.3	8.41	13.94	9.16	9.19
1999	4.5	4.3	6.3	8.4	11.8	12.7	16.2	14.9	14.6	9.8	6.9	3.3	4.41	8.82	14.61	10.43	9.49
2000	4.2	5.1	6.5	6.9	10.8	13.4	13.9	15.3	13.5	9.2	5.8	4.4	4.19	8.07	14.24	9.49	9.1
2001	2.4	3.1	3.8	6.4	11.3	12.7	15.7	15.5	12.2	12.4	6.8	2.9	3.29	7.17	14.65	10.47	8.8
2002	4.5	5.7	6.4	8.1	11	13.3	14.6	16	13.2	8.6	7.1	4.5	4.31	8.52	14.65	9.6	9.43
2003	3.8	3	6.6	8.8	11.2	14.9	16.4	16.4	13.3	8.2	7.2	3.9	3.77	8.86	15.89	9.54	9.49
2004	4.3	4.6	5.6	8.7	11.1	14.1	14.6	16.3	13.4	9.5	6.8	4.7	4.22	8.47	15	9.91	9.49
2005	5.2	3.7	6.4	7.7	10.2	14.2	15.5	15	13.9	11.8	5.6	3.9	4.57	8.12	14.93	10.43	9.46
2006	3.6	3.5	3.7	7.4	10.9	14.7	18.2	15	15.5	11.8	7.3	5.3	3.66	7.32	16	11.52	9.77
2007	5.9	5	6.2	10.1	10.7	13.8	14.4	14.6	12.9	10.1	6.8	4	5.43	9	14.27	9.94	9.57
2008	5.4	4.7	5.1	6.9	11.9	13	15.5	15.5	12.7	8.8	6.1	3	4.73	7.98	14.67	9.19	9.06
2009	2.7	3.6	6.2	8.9	11	13.6	15.3	15.7	13.3	10.3	7.2	2.1	3.06	8.69	14.89	10.27	9.19
2010	0.7	1.5	5.3	8.1	9.7	14.2	15.8	14.3	13.2	9.4	4.3	-1.2	1.45	7.7	14.81	8.98	7.99
2011	2.9	5.4	5.8	10.7	11.2	13.1	14.3	14.4	14.1	11.3	8.5	4.7	2.27	9.23	13.94	11.28	9.72
2012	4.3	3.8	7.8	6.3	10.4	12.4	14.4	15.4	12.2	8.2	5.8	3.6	4.3	8.18	14.11	8.69	8.73
2013	2.8	2.5	1.8	6.5	9.8	12.9	17.2	15.9	12.7	11.4	5.3	5.6	2.98	6.02	15.37	9.83	8.75
2014	4.6	5.2	6.7	9.3	11.4	14.2	16.5	14.1	13.8	11.1	7.6	4.4	5.12	9.12	14.93	10.83	9.92
2015	3.5	3.5	5.4	7.9	9.7	12.8	14.6	15.1	11.8	10	8.2	8	3.8	7.69	14.19	9.99	9.25
2016	4.5	3.8	5.2	6.4	11.2	13.8	15.6	15.7	15	10	4.6	5.8	5.49	7.59	15.08	9.85	9.32
2017	3.5	5.3	7.5	8.1	12.1	14.7	15.2	14.7	12.7	11.4	5.8	3.8	4.82	9.24	14.88	10	9.6
2018	4	2.1	3.7	8.5	12.2	14.8	17.5	15.7	12.6	9.7	7.3	5.5	3.36	8.14	16.03	9.88	9.53
2019	3.4	6.1	6.8	8.1	10.2	13.2	16.8	16.3	13.1	8.7	5.4	4.9	4.94	8.37	15.44	9.06	9.43
2020	5.6	5.1	5.8	9.2	11.5	14.1	14.5	15.8	12.8	9.4	7.7	4	5.21	8.82	14.81	9.96	9.64
2021	1.9	4	6.7	5.6	9.1	14.5	16.8	15.2	15	11	6.9	4.8	3.3	7.14	15.53	10.99	9.34
2022	4.4	5.7	6.9	8.1	12	14.2	17.1	16.9	13.5	11.6	8	2.8	4.93	9.04	16.1	11.04	10.13
2023	4.5	6	5.9	7.8	11.9	15.7	15.2	15.5	15.5	10.7	6.4	5.7	4.36	8.53	15.46	10.85	10.08
2024	3.9	6.6	6.9	8.3	13.3	13.3	15.2	15.7	12.7	10.5	6.2	6.4	5.39	9.51	14.73	9.8	9.92
2025	2.5	4.6	7.1	9.6	12	15.8	16.8	16.6	13.1	10.5	7.3	6	4.5	9.55	16.42	10.26	10.18
2026	3	5.4	7.3	4.81													
Mean	3.677778	4.297222	5.877778	7.805833	10.87429	13.63714	15.63714	15.41143	13.17429	9.931429	6.462857	4.162857					

APPENDIX D

GROUNDWATER QUALITY CHEMOGRAPHS, MONITORING DATA AND SUMMARY CALCULATIONS

Background concentrations used in the rogue load risk assessment

In general data for borehole G2 is excluded as it is considered that the borehole is not located in the same hydrostratigraphic unit as other locations.
It would appear that there is a source (or sources) of contaminants up hydraulic gradient of the site affecting groundwater quality in boreholes G3 and G4 which is not generally affecting groundwater quality at monitoring loc

Determinand	Dataset and approach used to estimate the mean background concentration	Mean background concentration (mg/l)	Dataset and approach used to estimate the maximum non-outlier background concentration	Maximum non-outlier background concentration (mg/l)
Ammonical nitrogen	Sporadic or isolated peaks are recorded at G3 and G4 and on this basis it is considerd that the groundwater quality recorded at G1 may be more representative of the groundwater flowing under the site than quality and G3 and G4. Mean concentration recorded during the 11 June 2019 to 31 July 2025 period at monitoring location G1.	0.05	Maximum concentration recorded during the period 11 June 2019 to 31 July 2025 at monitoring location G1. Based on an inspection of the dataset no outliers appear to be present.	0.30
Chloride	The datasets for G3 and G4 do not appear consistent with the dataset for up hydraulic gradient location G1. The dataset for G1 varies within a consistent range during the period 11 June 2019 to 1 August 2024. As concentrations appear to increase after this time data collected after 1 August 2024 has been excluded.	23.7	Maximum concentration recorded during the period 11 June 2019 to1 August 2024 at monitoring location G1. Based on an inspection of the dataset no outliers appear to be present.	41.0
Mercury	Most of the recorded values are below the laboratory analytical detection limit. As the detection limit is higher than the minimum reporting value (MRV) it is assumed that the background concentration is zero.	0	The maximum background concentrations recorded at each location are similer except for the isolated value of 0.00033 recorded at G1 on 2 December 2019. It is assumed that this result may be a possible outlier hence it has been excluded from the dataset.	0.00008
Nickel	The datasets for G3 and G4 do not appear consistent with the dataset for location G1. The dataset for G1 varies within a consistent range during the period 11 June 2019 to 31 July 2025. The mean concentration at G1 has been calculated. No outliers appear to be present in the dataset.	0.0014	The maximum concentration at G1 has been calculated. No outliers appear to be present in the dataset.	0.004
Sulphate	The datasets for G3 and G4 do not appear consistent with the dataset for G1. The dataset for G1 varies within a consistent range during the period 11 June 2019 to 14 September 2022 with the exception of the value recorded on 12 May 2021 which is considered a possible outlier. As concentrations appear to increase after 14 September 2022 these values have been excluded in addition to the value recorded on 12 May 2021.	120.2	The maximum concentration at G1 has been calculated using the same dataset as the mean.	139.0
Zinc	There are periods during which the datasets for G3 and G4 do not appear consistent with the dataset for G1. The dataset for G1 varies generally within a consistent range during the period 11 June 2019 to 31 July 2025. The mean concentration at G1 has been calculated. No outliers appear to be present in the dataset.	0.0047	The maximum concentration at G1 has been calculated. No outliers appear to be present in the dataset.	0.026

Derivation of updated groundwater compliance and assessment limits

Compliance limits and action levels are applicable to both borehole G3 and borehole G4 unless otherwise specified.

Determinand	Dataset and approach used	Current action level (mg/l)	Proposed updated action level (mg/l)	Current compliance limit (mg/l)	Proposed updated compliance limit (mg/l)
Ammoniacal nitrogen	For much of the monitoring period the concentrations recorded at G1, G3 and G4 are similar. However, elevated concentrations are recorded in particular at borehole G3 and G4 during 2021. Conservatively it is assumed that an isolated peak concentration of 1.3mg/l recorded at borehole G3 on 1 August 2024 is an outlier. Data from all three boreholes is used except where the results are considered an outlier.	0.52	**0.24**	0.72	**0.34**
Chloride	Generally high concentrations of chloride (up to 600mg/l) have been recorded at boreholes G3 and G4. It is considered that chloride is not an appropriate substance for which to set compliance or assessment limits as it would not facilitate prompt identification of adverse trends in groundwater quality.				
Mercury	Most of the recorded values are below the laboratory analytical detection limit. Although on two occasions concentrations at or slightly higher than the detection limit have been recorded it is unclear whether these results are outliers. It is proposed that the current compliance limit and action are retained.	0.00003	**0.00003**	0.00003	**0.00003**
Nickel	The datasets for G3 and G4 do not appear consistent with the dataset for location G1. Compliance limit and action levels are based on an aggregated dataset for boreholes G3 and G4.	0.012	**0.0080**	0.016	**0.010**
Sulphate	Generally high concentrations of sulphate (up to greater than 700mg/l) have been recorded at boreholes G3 and G4. It is considered that sulphate is not an appropriate substance for which to set compliance or assessment limits as it would not facilitate prompt identification of adverse trends in groundwater quality.				
Zinc	There are periods during which the datasets for G3 and G4 do not appear consistent with the dataset for G1. No outliers appear to be present in the dataset. As concentrations generally are higher at G4 than G3 borehole specific compliance limits and action levels have been calculated.	G3 = 0.012 G4 = 0.063	**G3 = 0.049** **G4 = 0.094**	G3 = 0.016 G4 = 0.083	**G3 = 0.067** **G4 = 0.125**

Ammoniacal nitrogen (mg/l)

Date	G1	G2	G3	G4
11/06/2019	0.05	0.05		
10/07/2019	0.09	0.05		
07/08/2019	0.07	0.05		
04/09/2019	0.17	0.15		
03/10/2019	0.08	0.05		
06/11/2019	0.04	0.04		
02/12/2019	0.09	0.1		
08/01/2020	0.02	0.01		
12/02/2020	0.02	0.01		
09/03/2020	0.02	0.02		
02/07/2020	0.19	0.18		
05/08/2020	0.06	0.02		
08/09/2020	0.02	0.01		
13/10/2020	0.3	3.8		
12/11/2020	0.04	1.8		
03/12/2020	0.2	0.53		
11/01/2021	0.05	0.05		
11/02/2021	0.02	0.02		
03/03/2021	0.01	0.01	0.02	0.5
09/03/2021	0.01	0.01	0.3	0.01
19/03/2021	0.01	0.01	0.01	0.8
23/03/2021	0.02	0.01	0.3	0.02
30/03/2021	0.03	0.01	0.04	0.2
07/04/2021	0.04	0.01	0.2	0.05
13/04/2021	0.09	0.01	0.01	0.01
23/04/2021	0.02	0.01	0.02	0.02
30/04/2021	0.01	0.01	0.03	0.03
06/05/2021	0.04	0.01	0.01	0.01
12/05/2021	0.01	0.04	0.01	0.02
19/05/2021	0.01		0.01	0.01
28/05/2021	0.03	0.01	0.01	0.01
03/06/2021	0.05	0.01	0.05	0.01
08/06/2021	0.01	0.01	0.01	0.01
14/07/2021	0.14	0.18	0.12	0.8
12/08/2021	0.01	0.01	0.03	0.01
16/09/2021	0.06	0.05	0.05	0.01
13/10/2021	0.03	0.01	0.01	0.02
15/11/2021	0.01	0.01	0.01	0.01
02/12/2021	0.02	0.02	0.01	0.01
31/01/2022	0.03	0.01	0.01	0.01
14/02/2022	0.01	0.01	0.01	0.03
14/03/2022	0.03	0.01	0.01	0.01
28/04/2022	0.06	0.01	0.03	0.01
18/05/2022	0.07	0.03	0.2	0.03
07/06/2022	0.04	0.01	0.02	0.01
18/07/2022	0.07	0.01	0.01	0.01
03/08/2022	0.05	0.01	0.04	0.02
14/09/2022	0.02	0.01	0.03	0.01
26/10/2022	0.11	0.01	0.02	0.02
29/11/2022	0.04	0.02	0.03	0.01
13/12/2022		0.01	0.02	0.01
11/01/2023	0.04	0.03	0.03	0.03
15/02/2023	0.01	0.01	0.01	0.01
20/03/2023	0.01	0.01	0.02	0.02
17/04/2023	0.04	0.08	0.01	0.02
11/05/2023	0.2	0.01	0.05	0.01
08/06/2023	0.05	0.02	0.06	0.02
31/07/2023	0.06	0.02	0.02	0.08
15/08/2023	0.05	0.02	0.04	0.03
20/09/2023	0.04	0.01	0.03	0.02
18/10/2023	0.01	0.01	0.01	0.01
07/11/2023	0.03	0.05	0.03	0.01
05/12/2023	0.02	0.01	0.02	0.01
29/01/2024	0.01	0.01	0.02	0.01
12/02/2024	0.03	0.01	0.01	0.01
07/03/2024	0.03	0.02	0.02	0.01
16/04/2024	0.01	0.01	0.01	0.01

30/05/2024	0.02	0.01	0.01	0.01	
28/06/2024	0.04	0.01	0.01	0.01	
17/07/2024	0.03	0.01	0.01	0.01	
01/08/2024	0.07	0.01	1.3	0.01	
02/09/2024	0.03	0.01	0.01	0.01	
28/10/2024	0.07	0.01	0.01	0.01	
26/11/2024	0.05	0.01	0.01	0.01	
10/12/2024	0.01	0.01	0.01	0.01	
27/01/2025	0.02	0.01	0.01	0.01	
24/02/2025	0.01	0.01	0.01	0.01	
23/04/2025	0.02	0.01	0.01	0.01	
31/07/2025	0.01	0.02			**G1, G3, G4**
Minimum	0.01	0.01	0.01	0.01	0.01
Maximum	0.3	3.8	1.3	0.8	0.8
Mean	0.047949	0.102564	0.058	0.052833	0.04614213
Standard deviation (STDEV)	0.051783	0.473663	0.174305	0.155346	0.09746972
Mean + 1*STDEV	0.099731	0.576227	0.232305	0.20818	0.14361186
Mean + 1.5*STDEV	0.125623	0.813059	0.319458	0.285853	0.19234672
Mean + 2*STDEV	0.151514	1.049891	0.406611	0.363526	0.24108158
Mean + 3*STDEV	0.203297	1.523554	0.580916	0.518873	0.3385513

Notes

Units: **mg/l**

Concentrations recorded below the analytical detection limit are assumed present at the detection limit.

Value considered a possible outlier or the detection limit is elevated hence excluded.

Analytical result reported as below the analytical detection limit.

Proposed action level

Proposed compliance limit

Chloride (mg/l)

Date	G1	G2	G3	G4
11/06/2019	27	6		
10/07/2019	29	7		
07/08/2019	29	6		
04/09/2019	28	9		
03/10/2019	25	10		
06/11/2019	18	11		
02/12/2019	18	13		
08/01/2020	18	17		
12/02/2020	18	11		
09/03/2020	16	87		
02/07/2020	23	14		
05/08/2020	23	12		
08/09/2020	25	11		
13/10/2020	22	8		
12/11/2020	21	10		
03/12/2020	22	11		
11/01/2021	21	11		
11/02/2021	19	10		
03/03/2021	21	11	599	113
09/03/2021	20	11	61	596
19/03/2021	21	11	572	68
23/03/2021	20	9	73	545
30/03/2021	21	9	537	50
07/04/2021	22	10	52	570
13/04/2021	22	9	562	66
23/04/2021	22	10	598	58
30/04/2021	22	9	542	57
06/05/2021	23	10	11	46
12/05/2021	8	23	528	61
19/05/2021	24		513	76
28/05/2021	24	8	495	95
03/06/2021	24	8	554	92
08/06/2021	25	8	516	87
14/07/2021	26	9	496	52
12/08/2021	25	4	450	142
16/09/2021	27	10	488	79
13/10/2021	25	8	450	90
15/11/2021	26	6	388	256
02/12/2021	25	4	382	153
31/01/2022	24	7	433	318
14/02/2022	22	8	380	346
14/03/2022	22	8	376	354
28/04/2022	21	7	352	109
18/05/2022	25	7	341	99
07/06/2022	27	8	338	82
18/07/2022	33	7	348	76
03/08/2022	33	8	343	95
14/09/2022	41	9	349	98
26/10/2022	32	7	343	371
29/11/2022	34	5	334	300
13/12/2022		8	322	122
11/01/2023	24	15	307	210
15/02/2023	22	8	302	299
20/03/2023	24	11	307	215
17/04/2023	22	14	316	222
11/05/2023	24	14	306	147
08/06/2023	27	6	285	96
31/07/2023	28	5	40	240
15/08/2023	27	6	207	227
20/09/2023	27	6	246	218
18/10/2023	26	5	243	155
07/11/2023	26	11	241	158
05/12/2023	24	11	234	205
29/01/2024	21	14	198	165
12/02/2024	20	13	192	106
07/03/2024	20	11	193	108
16/04/2024	20	11	161	71

30/05/2024	20	8	154	83	
28/06/2024	21	5	140	96	
17/07/2024	24	7	138	94	
01/08/2024	25	5	146	81	
02/09/2024	72	6	131	72	
28/10/2024	95	5	133	97	
26/11/2024	93	3	121	86	
10/12/2024	86	5	134	60	
27/01/2025	55	13	126	76	
24/02/2025	53	6	128	81	
23/04/2025	56	5	133	67	
31/07/2025	129	53			**G3, G4**
Minimum	8	3	11	46	11
Maximum	129	87	599	596	599
Mean	29.48718	10.53846	306.4667	157.6167	232.0417
Standard deviation (STDEV)	19.38251	10.61326	162.43	127.4472	163.4615
Mean + 1*STDEV	48.86969	21.15172	468.8967	285.0638	395.5032
Mean + 1.5*STDEV	58.56094	26.45836	550.1117	348.7874	477.234
Mean + 2*STDEV	68.2522	31.76499	631.3267	412.511	558.9647
Mean + 3*STDEV	87.63471	42.37825	793.7567	539.9582	722.4262

Notes

Units: **mg/l**

Concentrations recorded below the analytical detection limit are assumed present at the detection limit.

Value considered a possible outlier or the detection limit is elevated hence excluded.

Analytical result reported as below the analytical detection limit.

Mercury (mg/l)

Date	G1	G2	G3	G4
11/06/2019	0.00005	0.00005		
10/07/2019	0.00005	0.00005		
07/08/2019	0.00005	0.00005		
04/09/2019	0.00005	0.00005		
03/10/2019	0.00003	0.00003		
06/11/2019	0.00003	0.00003		
02/12/2019	0.00033	8.00E-05		
08/01/2020	0.00003	0.00003		
12/02/2020	0.00003	0.00003		
09/03/2020	0.00003	0.00003		
02/07/2020	0.00003	0.00003		
05/08/2020	0.00003	0.00003		
08/09/2020	0.00003	0.00003		
13/10/2020	0.00003	0.00003		
12/11/2020	0.00003	0.00003		
03/12/2020	0.00003	0.00003		
11/01/2021	0.00003	4.00E-05		
11/02/2021	0.00003	7.00E-05		
03/03/2021	0.00003	0.00003	0.00003	0.00003
09/03/2021	0.00003	0.00003	0.00003	0.00003
19/03/2021	0.00003	0.00003	0.00003	0.00003
23/03/2021	0.00003	0.00003	0.00003	0.00003
30/03/2021	0.00003	0.00003	0.00003	0.00003
07/04/2021	0.00003	0.00003	0.00003	0.00003
13/04/2021	0.00003	0.00003	0.00003	0.00003
23/04/2021	0.00003	0.00003	0.00003	0.00003
30/04/2021	0.00003	0.00003	0.00003	0.00003
06/05/2021	0.00003	0.00003	0.00003	0.00003
12/05/2021	0.00003	0.00003	0.00003	0.00003
19/05/2021	0.00003		0.00003	0.00003
28/05/2021	0.00003	0.00003	0.00003	0.00003
03/06/2021	0.00003	0.00003	0.00003	0.00003
08/06/2021	3.00E-05	0.00003	0.00003	0.00003
14/07/2021	0.00003	0.00003	0.00003	0.00003
12/08/2021	0.00003	0.00003	0.00003	0.00003
16/09/2021	0.00003	0.00003	0.00003	0.00003
13/10/2021	0.00003	0.00003	0.00003	0.00003
15/11/2021	0.00003	0.00003	0.00003	0.00003
02/12/2021	0.00003	0.00003	0.00003	0.00003
31/01/2022	0.00003	0.00003	0.00003	0.00003
14/02/2022	0.00003	0.00003	0.00003	0.00003
14/03/2022	0.00003	0.00003	0.00003	0.00003
28/04/2022	0.00003	0.00003	0.00003	0.00003
18/05/2022	0.00003	0.00003	0.00003	0.00003
07/06/2022	0.00003	0.00003	0.00003	0.00003
18/07/2022	0.00003	0.00003	0.00003	0.00003
03/08/2022	0.00003	0.00003	0.00003	0.00003
14/09/2022	0.00003	0.00003	0.00003	0.00003
26/10/2022	0.00003	0.00003	0.00003	0.00003
29/11/2022	0.00003	0.00003	0.00003	0.00003
13/12/2022		0.00003	0.00003	0.00003
11/01/2023	0.00003	0.00003	0.00003	0.00003
15/02/2023	0.00003	0.00003	0.00003	0.00003
20/03/2023	0.00003	0.00003	0.00003	0.00003
17/04/2023	0.00003	0.00003	0.00003	0.00003
11/05/2023	0.00003	0.00003	0.00003	0.00003
08/06/2023	0.00003	0.00003	0.00003	0.00003
31/07/2023	0.00003	0.00003	0.00003	0.00003
15/08/2023	0.00003	0.00003	0.00003	0.00003
20/09/2023	0.00003	0.00003	0.00003	0.00003
18/10/2023	0.00003	0.00003	0.00003	0.00003
07/11/2023	0.00003	0.00003	0.00003	0.00003
05/12/2023	0.00003	0.00003	0.00003	0.00003
29/01/2024	0.00003	0.00003	0.00003	0.00003
12/02/2024	5.00E-05	4.00E-05	3.00E-05	4.00E-05
07/03/2024	0.00003	0.00003	0.00003	0.00003
16/04/2024	0.00003	0.00003	0.00003	0.00003

30/05/2024	0.00003	0.00003	7.00E-05	5.00E-05	
28/06/2024	0.00003	0.00003	0.00003	0.00003	
17/07/2024	0.00003	0.00003	0.00003	0.00003	
01/08/2024	0.00003	0.00003	0.00003	0.00003	
02/09/2024	0.00003	0.00003	0.00003	0.00003	
28/10/2024	0.00003	0.00003	0.00003	0.00003	
26/11/2024	0.00003	0.00003	0.00003	0.00003	
10/12/2024	3.00E-05	0.00003	0.00003	0.00003	
27/01/2025	0.00003	0.00003	0.00003	0.00003	
24/02/2025	0.00003	0.00003	0.00003	0.00003	
23/04/2025	0.00003	0.00003	0.00003	0.00003	
31/07/2025	0.00003	0.00003			**G3, G4**
Minimum	0.00003	0.00003	0.00003	0.00003	0.00003
Maximum	0.00033	0.00008	0.00007	0.00005	0.00007
Mean	3.51282E-05	3.24359E-05	3.06667E-05	0.0000305	3.05833E-05
Standard deviation (STDE	3.41784E-05	8.40314E-06	5.16398E-06	2.86711E-06	4.1598E-06
Mean + 1*STDEV	6.93066E-05	4.0839E-05	3.58306E-05	3.33671E-05	3.47431E-05
Mean + 1.5*STDEV	8.63959E-05	4.50406E-05	3.84126E-05	3.48007E-05	3.6823E-05
Mean + 2*STDEV	0.000103485	4.92422E-05	4.09946E-05	3.62342E-05	3.89029E-05
Mean + 3*STDEV	0.000137663	5.76453E-05	4.61586E-05	3.91013E-05	4.30627E-05

Notes

Units: **mg/l**

Concentrations recorded below the analytical detection limit are assumed present at the detection limit.

Value considered a possible outlier or the detection limit is elevated hence excluded.

Analytical result reported as below the analytical detection limit.

Nickel (mg/l)

Date	G1	G2	G3	G4
11/06/2019	0.002	0.001		
10/07/2019	0.002	0.001		
07/08/2019	0.002	0.002		
04/09/2019	0.003	0.002		
03/10/2019	0.001	0.001		
06/11/2019	0.001	0.001		
02/12/2019	0.001	0.001		
08/01/2020	0.001	0.001		
12/02/2020	0.001	0.001		
09/03/2020	0.001	0.002		
02/07/2020	0.001	0.001		
05/08/2020	0.001	0.001		
08/09/2020	0.002	0.001		
13/10/2020	0.002	0.001		
12/11/2020	0.001	0.001		
03/12/2020	0.001	0.002		
11/01/2021	0.001	0.002		
11/02/2021	0.001	0.001		
03/03/2021	0.001	0.002	0.003	0.006
09/03/2021	0.001	0.003	0.007	0.003
19/03/2021	0.001	0.002	0.003	0.011
23/03/2021	0.001	0.003	0.009	0.003
30/03/2021	0.001	0.002	0.002	0.014
07/04/2021	0.001	0.001	0.01	0.003
13/04/2021	0.001	0.002	0.004	0.009
23/04/2021	0.001	0.001	0.004	0.006
30/04/2021	0.001	0.002	0.003	0.006
06/05/2021	0.001	0.001	0.001	0.008
12/05/2021	0.001	0.001	0.003	0.007
19/05/2021	0.001		0.003	0.011
28/05/2021	0.001	0.001	0.003	0.006
03/06/2021	0.001	0.001	0.002	0.006
08/06/2021	0.001	0.002	0.003	0.006
14/07/2021	0.001	0.001	0.002	0.006
12/08/2021	0.001	0.001	0.003	0.006
16/09/2021	0.001	0.001	0.003	0.005
13/10/2021	0.001	0.001	0.004	0.005
15/11/2021	0.001	0.001	0.003	0.006
02/12/2021	0.001	0.001	0.003	0.004
31/01/2022	0.002	0.001	0.003	0.005
14/02/2022	0.001	0.001	0.002	0.004
14/03/2022	0.001	0.001	0.003	0.004
28/04/2022	0.001	0.001	0.002	0.003
18/05/2022	0.001	0.001	0.002	0.003
07/06/2022	0.001	0.001	0.004	0.005
18/07/2022	0.002	0.001	0.003	0.004
03/08/2022	0.002	0.001	0.003	0.004
14/09/2022	0.003	0.003	0.004	0.005
26/10/2022	0.004	0.001	0.002	0.005
29/11/2022	0.001	0.001	0.002	0.003
13/12/2022		0.001	0.002	0.004
11/01/2023	0.002	0.001	0.002	0.002
15/02/2023	0.002	0.001	0.002	0.003
20/03/2023	0.002	0.002	0.003	0.004
17/04/2023	0.002	0.001	0.002	0.002
11/05/2023	0.002	0.001	0.003	0.003
08/06/2023	0.001	0.001	0.003	0.003
31/07/2023	0.001	0.001	0.001	0.004
15/08/2023	0.001	0.001	0.001	0.004
20/09/2023	0.001	0.001	0.003	0.004
18/10/2023	0.001	0.001	0.001	0.002
07/11/2023	0.001	0.002	0.001	0.002
05/12/2023	0.001	0.001	0.001	0.003
29/01/2024	0.001	0.001	0.001	0.001
12/02/2024	0.002	0.001	0.001	0.001
07/03/2024	0.001	0.001	0.001	0.001
16/04/2024	0.001	0.002	0.002	0.002

30/05/2024	0.001	0.001	0.002	0.002	
28/06/2024	0.002	0.001	0.002	0.003	
17/07/2024	0.002	0.002	0.003	0.003	
01/08/2024	0.001	0.001	0.002	0.001	
02/09/2024	0.002	0.002	0.003	0.003	
28/10/2024	0.003	0.001	0.001	0.003	
26/11/2024	0.003	0.001	0.001	0.002	
10/12/2024	0.003	0.001	0.001	0.002	
27/01/2025	0.002	0.001	0.001	0.001	
24/02/2025	0.002	0.001	0.001	0.002	
23/04/2025	0.002	0.001	0.002	0.003	
31/07/2025	0.002	0.003			**G3, G4**
Minimum	0.001	0.001	0.001	0.001	0.001
Maximum	0.004	0.003	0.01	0.014	0.014
Mean	0.001436	0.001308	0.002617	0.0042	0.003408
Standard deviation (STD	0.000676	0.000565	0.001698	0.00255	0.002299
Mean + 1*STDEV	0.002112	0.001873	0.004315	0.00675	0.005707
Mean + 1.5*STDEV	0.00245	0.002156	0.005164	0.008025	0.006857
Mean + 2*STDEV	0.002788	0.002438	0.006013	0.0093	0.008006
Mean + 3*STDEV	0.003464	0.003004	0.007712	0.01185	0.010305

Notes

Units: **mg/l**

Concentrations recorded below the analytical detection limit are assumed present at the detection limit.

Value considered a possible outlier or the detection limit is elevated hence excluded.

Analytical result reported as below the analytical detection limit.

Proposed action level

Proposed compliance limit

Sulphate (mg/l)

Date	G1	G2	G3	G4
11/06/2019	130	430		
10/07/2019	120	420		
07/08/2019	110	370		
04/09/2019	120	390		
03/10/2019	122	103		
06/11/2019	126	76		
02/12/2019	129	104		
08/01/2020	121	264		
12/02/2020	120	64		
09/03/2020	117	287		
02/07/2020	120	364		
05/08/2020	119	352		
08/09/2020	111	274		
13/10/2020	111	272		
12/11/2020	109	99		
03/12/2020	118	268		
11/01/2021	121	285		
11/02/2021	126	84		
03/03/2021	120	316	371	457
09/03/2021	126	356	389	388
19/03/2021	117	143	378	428
23/03/2021	125	225	513	424
30/03/2021	113	152	365	388
07/04/2021	116	246	442	430
13/04/2021	125	344	419	503
23/04/2021	118	370	424	465
30/04/2021	120	394	375	454
06/05/2021	115	408	373	400
12/05/2021	290	126	388	530
19/05/2021	120		432	573
28/05/2021	121	98	438	609
03/06/2021	123	171	390	634
08/06/2021	132	294	447	603
14/07/2021	113	352	400	412
12/08/2021	109	80	391	573
16/09/2021	128	397	390	434
13/10/2021	116	360	499	570
15/11/2021	106	334	432	493
02/12/2021	113	105	479	548
31/01/2022	133	345	385	548
14/02/2022	128	67	398	488
14/03/2022	110	198	367	444
28/04/2022	136	432	379	521
18/05/2022	116	395	347	406
07/06/2022	110	418	319	437
18/07/2022	139	411	430	540
03/08/2022	131	285	447	566
14/09/2022	119	265	350	520
26/10/2022	207	379	401	731
29/11/2022	200	321	347	514
13/12/2022		455	409	596
11/01/2023	174	66	390	394
15/02/2023	186	405	402	496
20/03/2023	157	150	371	372
17/04/2023	162	72	375	410
11/05/2023	154	72	338	396
08/06/2023	147	383	303	360
31/07/2023	138	276	254	443
15/08/2023	129	315	303	492
20/09/2023	164	430	337	508
18/10/2023	157	325	309	441
07/11/2023	204	159	319	415
05/12/2023	193	227	307	451
29/01/2024	196	52	301	333
12/02/2024	187	61	308	242
07/03/2024	176	94	289	264
16/04/2024	169	159	306	239

30/05/2024	166	84	277	268	
28/06/2024	161	297	291	330	
17/07/2024	175	386	332	413	
01/08/2024	174	381	302	408	
02/09/2024	293	398	289	378	
28/10/2024	390	297	343	435	
26/11/2024	412	324	427	357	
10/12/2024	419	293	345	338	
27/01/2025	343	60	298	289	
24/02/2025	325	310	352	385	
23/04/2025	401	455	337	433	
31/07/2025	317	427			**G3, G4**
Minimum	106	52	254	239	239
Maximum	419	455	513	731	731
Mean	161.7179	265.4615	368.65	448.6167	408.6333
Standard deviation (STDEV)	76.51023	127.5724	57.04468	99.55394	90.21822
Mean + 1*STDEV	238.2282	393.0339	425.6947	548.1706	498.8515
Mean + 1.5*STDEV	276.4833	456.8202	454.217	597.9476	543.9607
Mean + 2*STDEV	314.7384	520.6064	482.7394	647.7245	589.0698
Mean + 3*STDEV	391.2486	648.1788	539.784	747.2785	679.288

Notes

Units: **mg/l**

Concentrations recorded below the analytical detection limit are assumed present at the detection limit.

Value considered a possible outlier or the detection limit is elevated hence excluded.

Analytical result reported as below the analytical detection limit.

Zinc (mg/l)

Date	G1	G2	G3	G4
11/06/2019	0.004	0.007		
10/07/2019	0.009	0.008		
07/08/2019	0.007	0.006		
04/09/2019	0.007	0.006		
03/10/2019	0.002	0.008		
06/11/2019	0.002	0.003		
02/12/2019	0.002	0.003		
08/01/2020	0.002	0.003		
12/02/2020	0.002	0.002		
09/03/2020	0.002	0.01		
02/07/2020	0.002	0.003		
05/08/2020	0.002	0.004		
08/09/2020	0.004	0.005		
13/10/2020	0.004	0.002		
12/11/2020	0.002	0.003		
03/12/2020	0.003	0.004		
11/01/2021	0.004	0.018		
11/02/2021	0.002	0.004		
03/03/2021	0.005	0.026	0.006	0.013
09/03/2021	0.009	0.003	0.012	0.007
19/03/2021	0.004	0.008	0.008	0.012
23/03/2021	0.007	0.002	0.006	0.007
30/03/2021	0.015	0.006	0.006	0.074
07/04/2021	0.002	0.002	0.012	0.012
13/04/2021	0.002	0.004	0.009	0.017
23/04/2021	0.002	0.002	0.012	0.034
30/04/2021	0.002	0.002	0.008	0.032
06/05/2021	0.002	0.003	0.003	0.027
12/05/2021	0.003	0.002	0.011	0.032
19/05/2021	0.002		0.008	0.021
28/05/2021	0.002	0.004	0.043	0.107
03/06/2021	0.002	0.003	0.006	0.009
08/06/2021	0.002	0.002	0.137	0.066
14/07/2021	0.002	0.004	0.012	0.012
12/08/2021	0.002	0.005	0.01	0.012
16/09/2021	0.003	0.004	0.017	0.028
13/10/2021	0.004	0.006	0.025	0.203
15/11/2021	0.002	0.003	0.017	0.057
02/12/2021	0.002	0.005	0.025	0.022
31/01/2022	0.003	0.005	0.013	0.062
14/02/2022	0.004	0.012	0.017	0.048
14/03/2022	0.006	0.004	0.019	0.039
28/04/2022	0.011	0.004	0.008	0.005
18/05/2022	0.026	0.016	0.036	0.021
07/06/2022	0.002	0.004	0.015	0.058
18/07/2022	0.007	0.004	0.012	0.049
03/08/2022	0.006	0.005	0.016	0.075
14/09/2022	0.006	0.007	0.017	0.077
26/10/2022	0.007	0.003	0.008	0.044
29/11/2022	0.002	0.006	0.009	0.029
13/12/2022		0.006	0.027	0.072
11/01/2023	0.013	0.113	0.013	0.014
15/02/2023	0.005	0.006	0.016	0.018
20/03/2023	0.003	0.006	0.015	0.014
17/04/2023	0.005	0.007	0.011	0.023
11/05/2023	0.003	0.005	0.012	0.026
08/06/2023	0.002	0.004	0.014	0.025
31/07/2023	0.002	0.003	0.003	0.027
15/08/2023	0.002	0.007	0.006	0.029
20/09/2023	0.003	0.004	0.009	0.027
18/10/2023	0.002	0.005	0.005	0.017
07/11/2023	0.003	0.008	0.01	0.017
05/12/2023	0.003	0.005	0.008	0.016
29/01/2024	0.003	0.004	0.006	0.007
12/02/2024	0.004	0.007	0.012	0.002
07/03/2024	0.002	0.003	0.006	0.01
16/04/2024	0.005	0.009	0.009	0.008

30/05/2024	0.005	0.007	0.01	0.012	
28/06/2024	0.007	0.005	0.008	0.019	
17/07/2024	0.003	0.018	0.014	0.035	
01/08/2024	0.002	0.006	0.015	0.027	
02/09/2024	0.006	0.006	0.012	0.026	
28/10/2024	0.013	0.004	0.007	0.021	
26/11/2024	0.008	0.004	0.007	0.012	
10/12/2024	0.009	0.005	0.015	0.023	
27/01/2025	0.014	0.013	0.011	0.013	
24/02/2025	0.008	0.008	0.008	0.016	
23/04/2025	0.002	0.005	0.013	0.019	
31/07/2025	0.01	0.038			**G3, G4**
Minimum	0.002	0.002	0.003	0.002	0.002
Maximum	0.026	0.113	0.137	0.203	0.203
Mean	0.004679	0.007513	0.014417	0.031433	0.022925
Standard deviation (STDEV)	0.004008	0.013255	0.017609	0.031261	0.026669
Mean + 1*STDEV	0.008688	0.020768	0.032026	0.062694	0.049594
Mean + 1.5*STDEV	0.010692	0.027396	0.04083	0.078324	0.062929
Mean + 2*STDEV	0.012696	0.034024	0.049635	0.093955	0.076263
Mean + 3*STDEV	0.016704	0.047279	0.067244	0.125216	0.102933

Notes

Units: **mg/l**

Concentrations recorded below the analytical detection limit are assumed present at the detection limit.

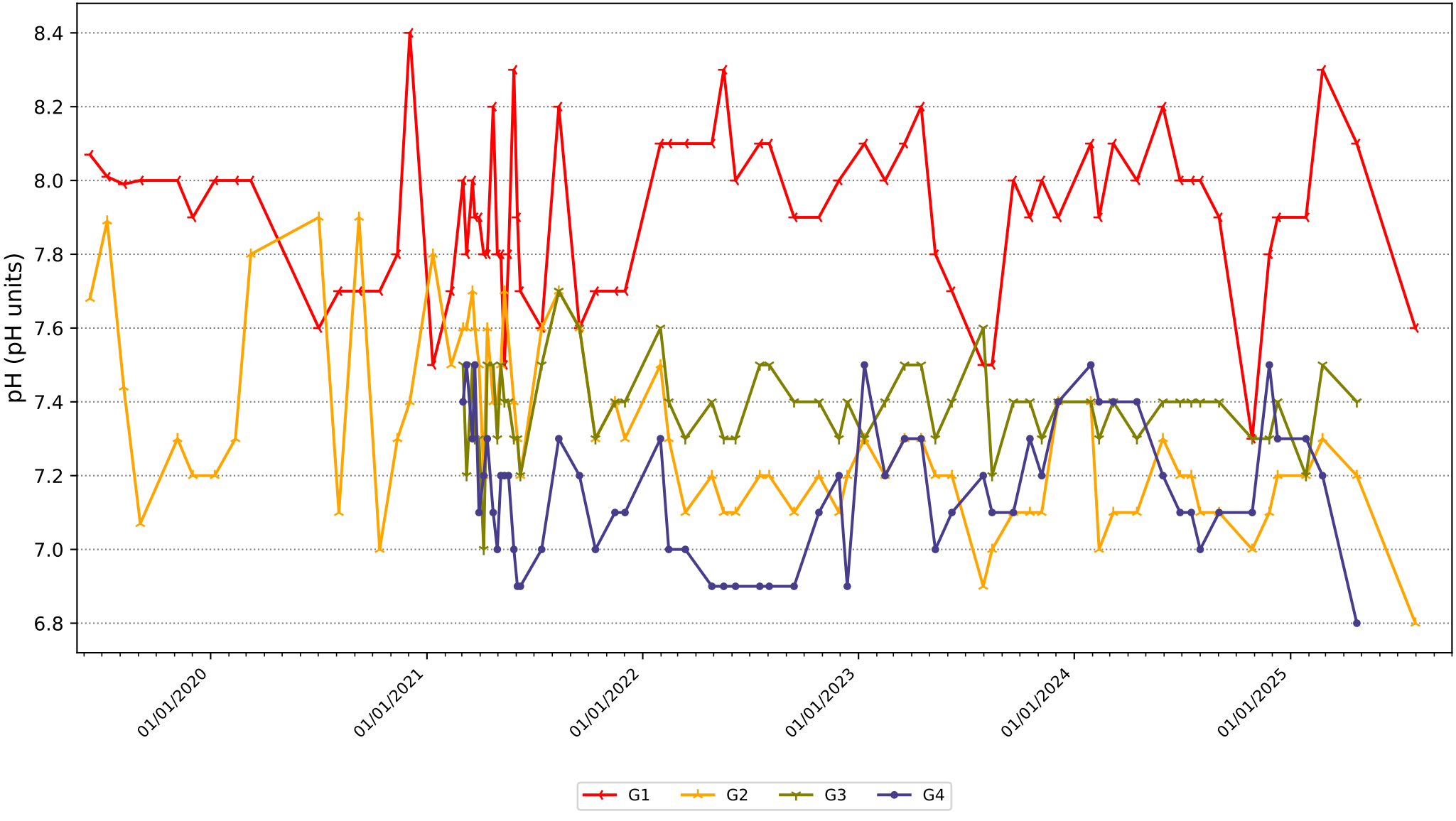
Value considered a possible outlier or the detection limit is elevated hence excluded.

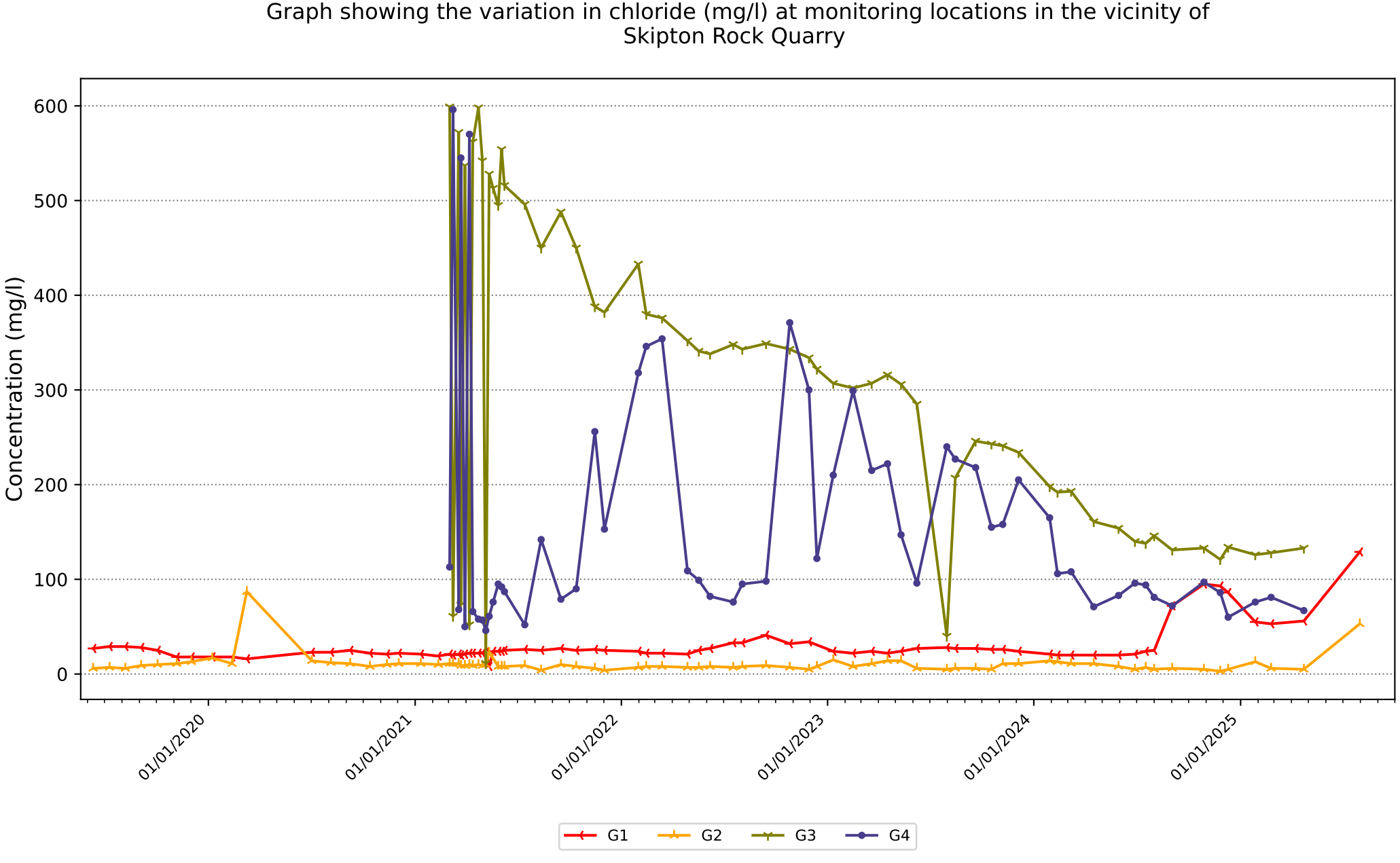
Analytical result reported as below the analytical detection limit.

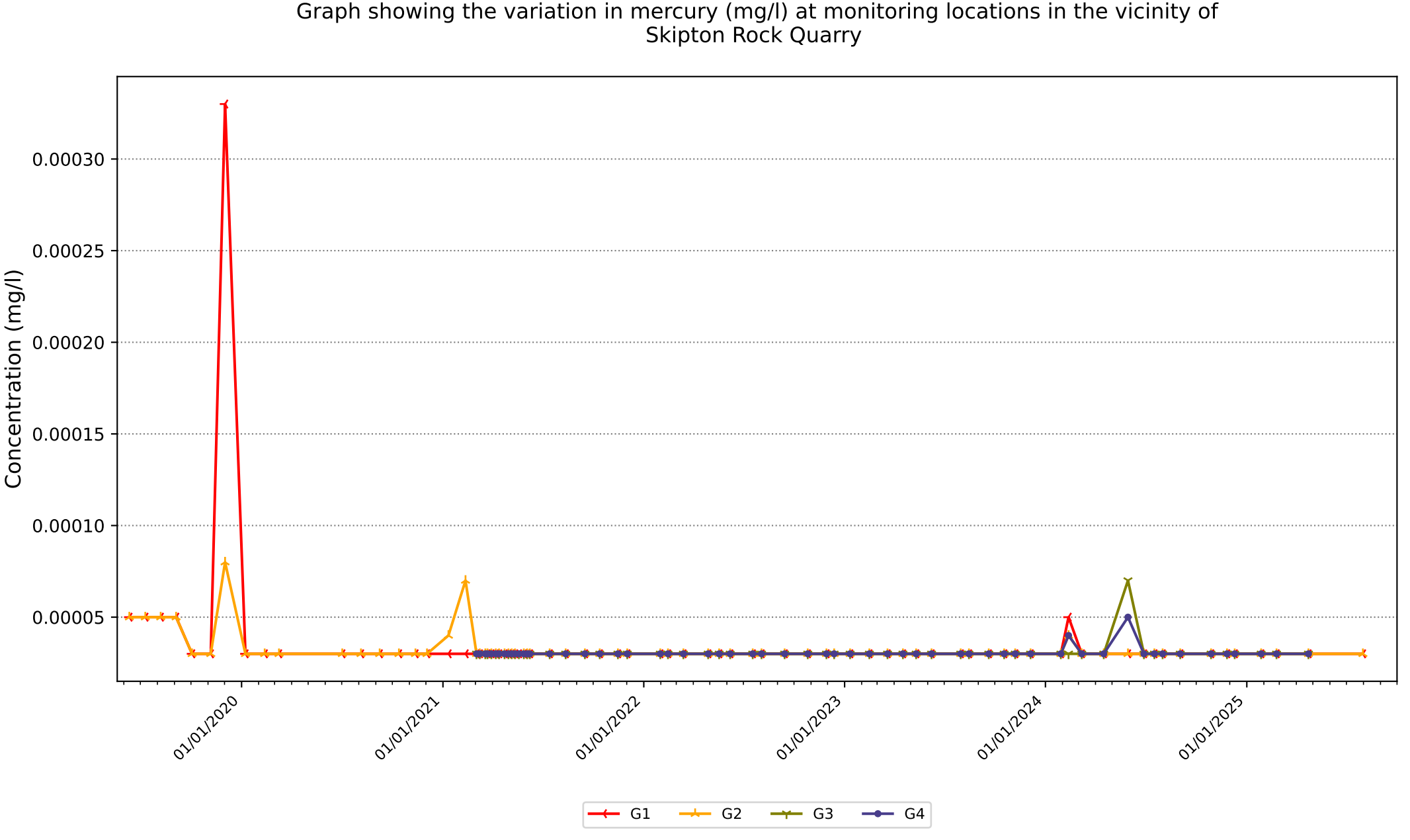
Proposed action level

Proposed compliance limit

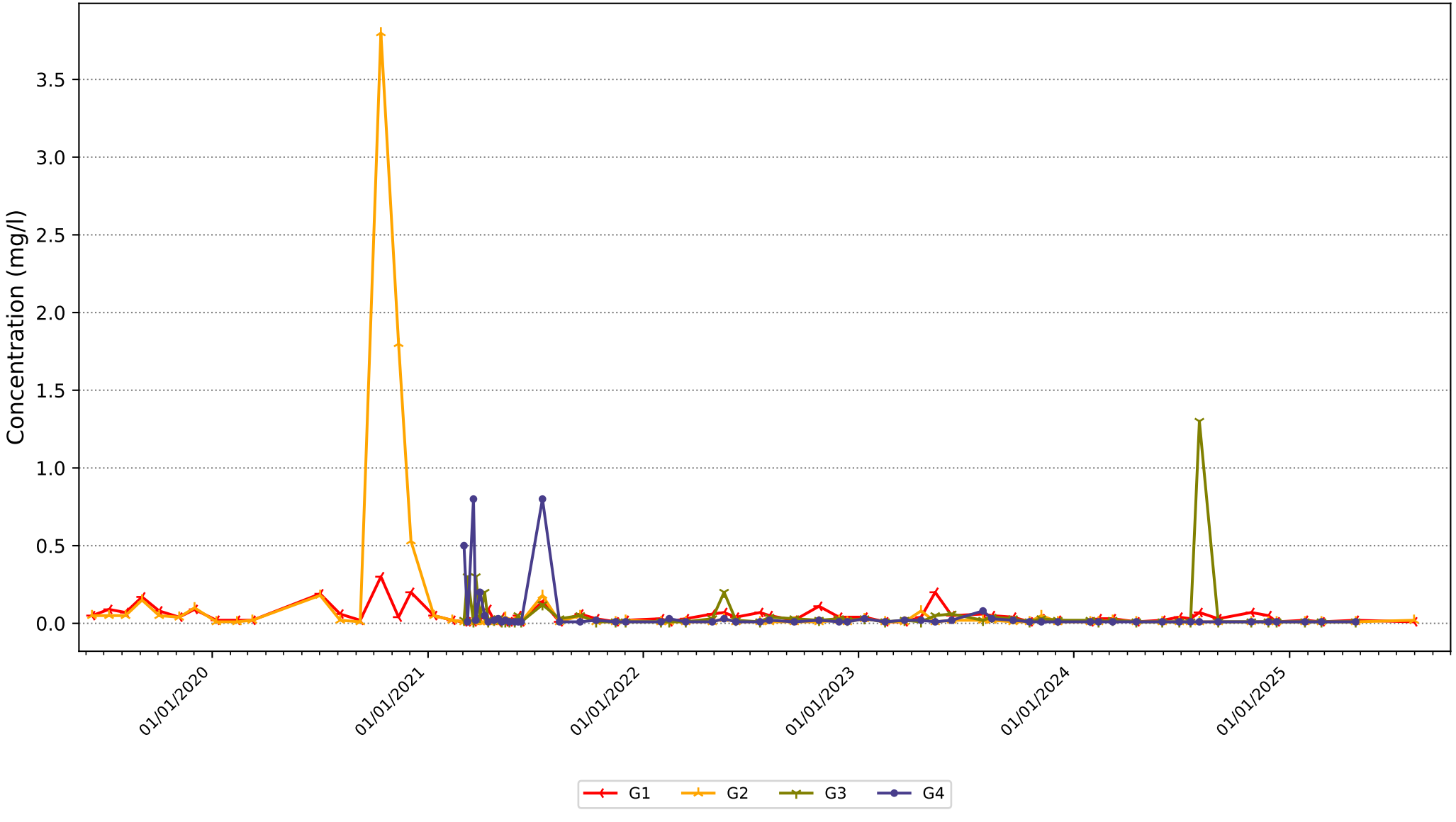
Graph showing the variation in pH (ph units) at monitoring locations in the vicinity of Skipton Rock Quarry

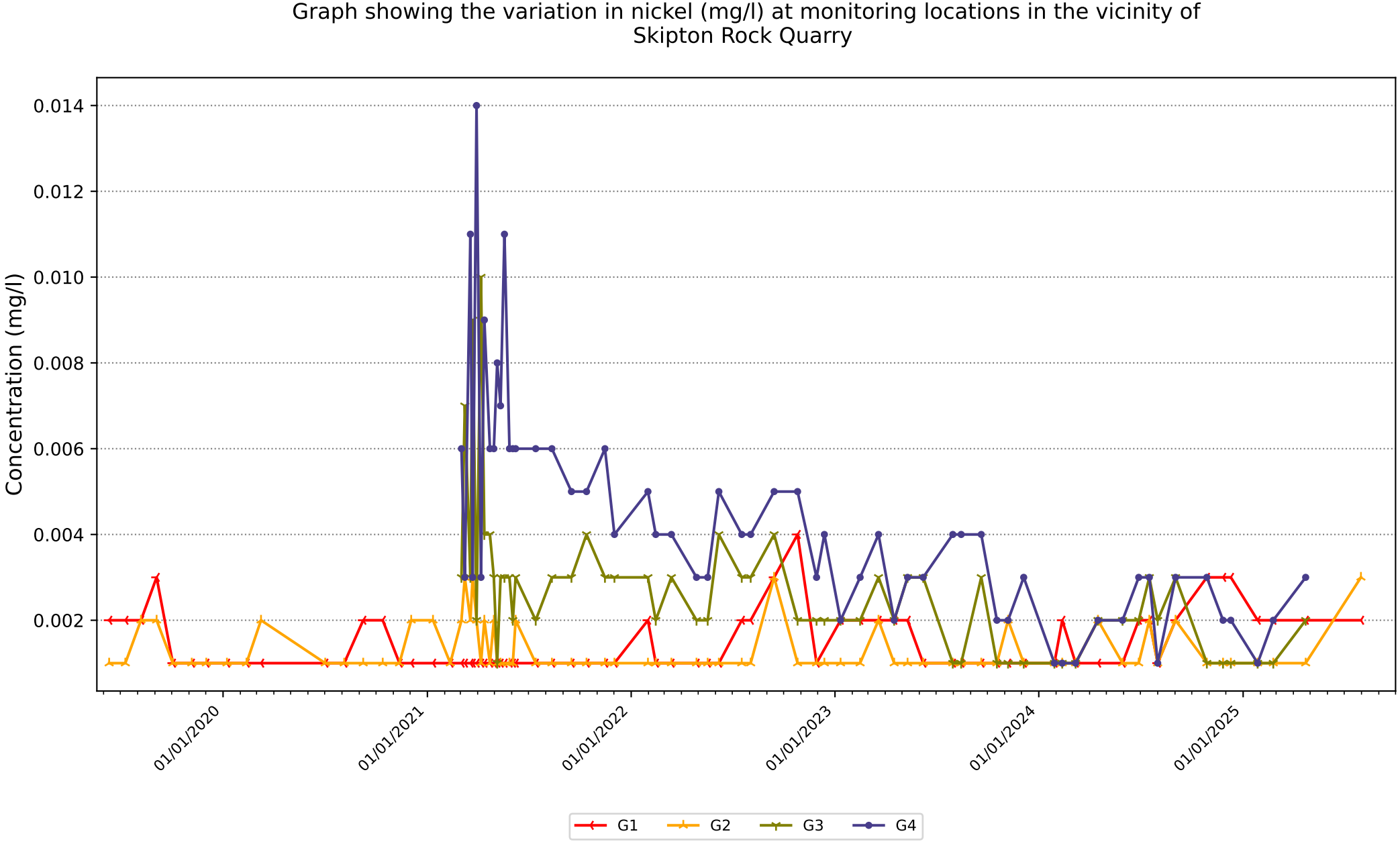


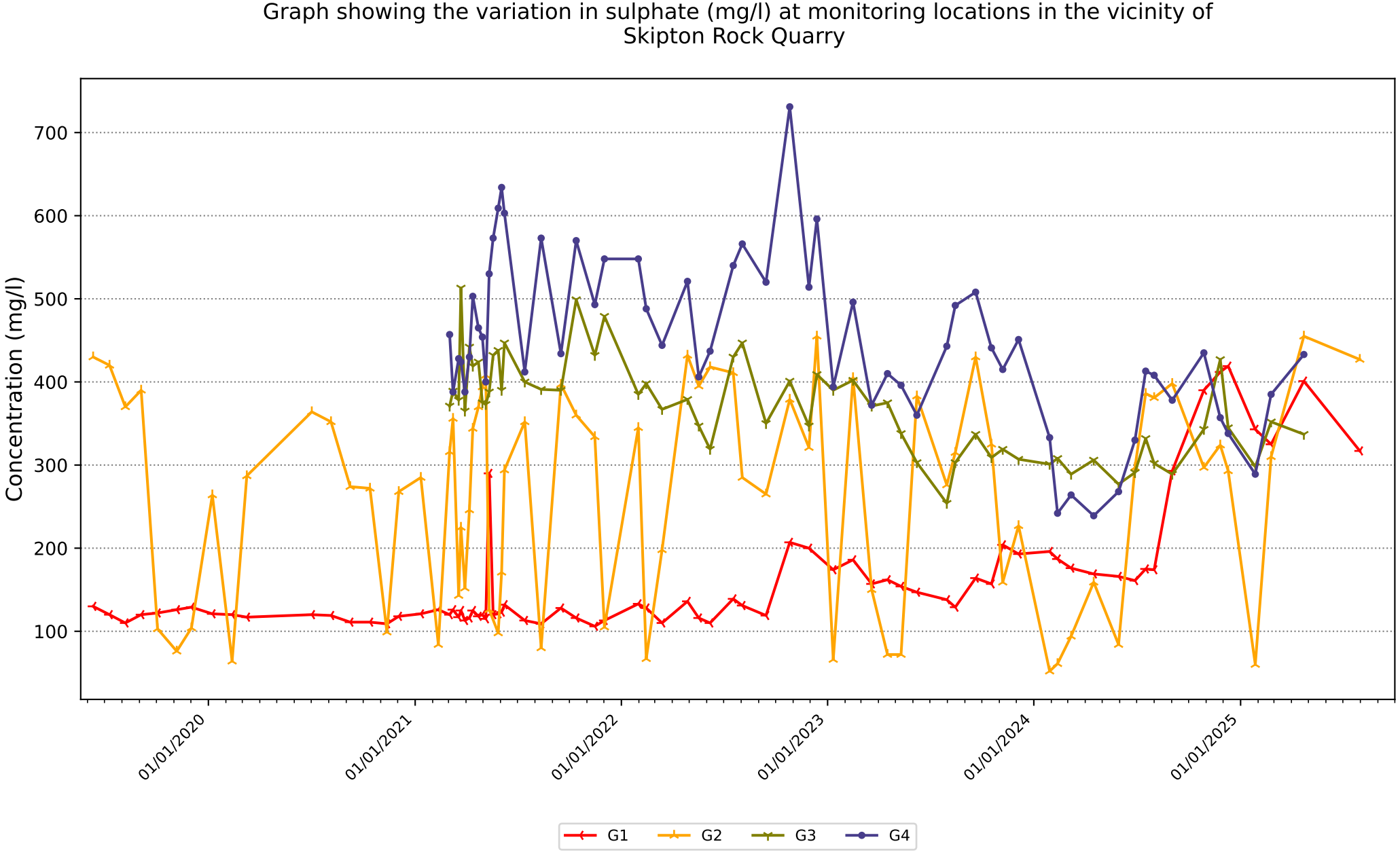

Graph showing the variation in chloride (mg/l) at monitoring locations in the vicinity of Skipton Rock Quarry
Concentration (mg/l)
600
500
400
300
200
100
0
01/01/2020
01/01/2021
01/01/2022
01/01/2023
01/01/2024
01/01/2025
G1
G2
G3
G4

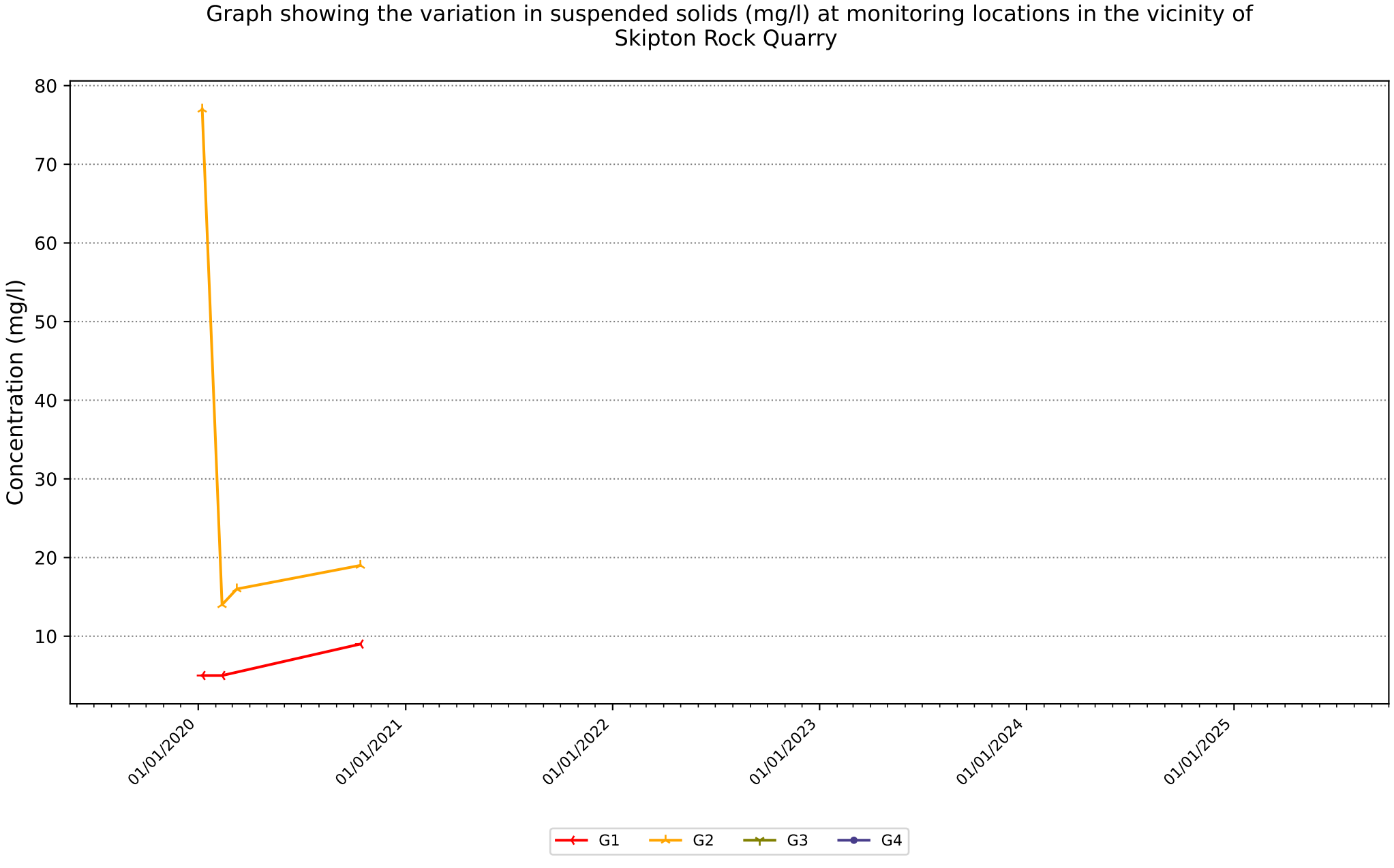

Graph showing the variation in mercury (mg/l) at monitoring locations in the vicinity of Skipton Rock Quarry
Concentration (mg/l)
0.00030
0.00025
0.00020
0.00015
0.00010
0.00005
01/01/2020
01/01/2021
01/01/2022
01/01/2023
01/01/2024
01/01/2025
G1
G2
G3
G4

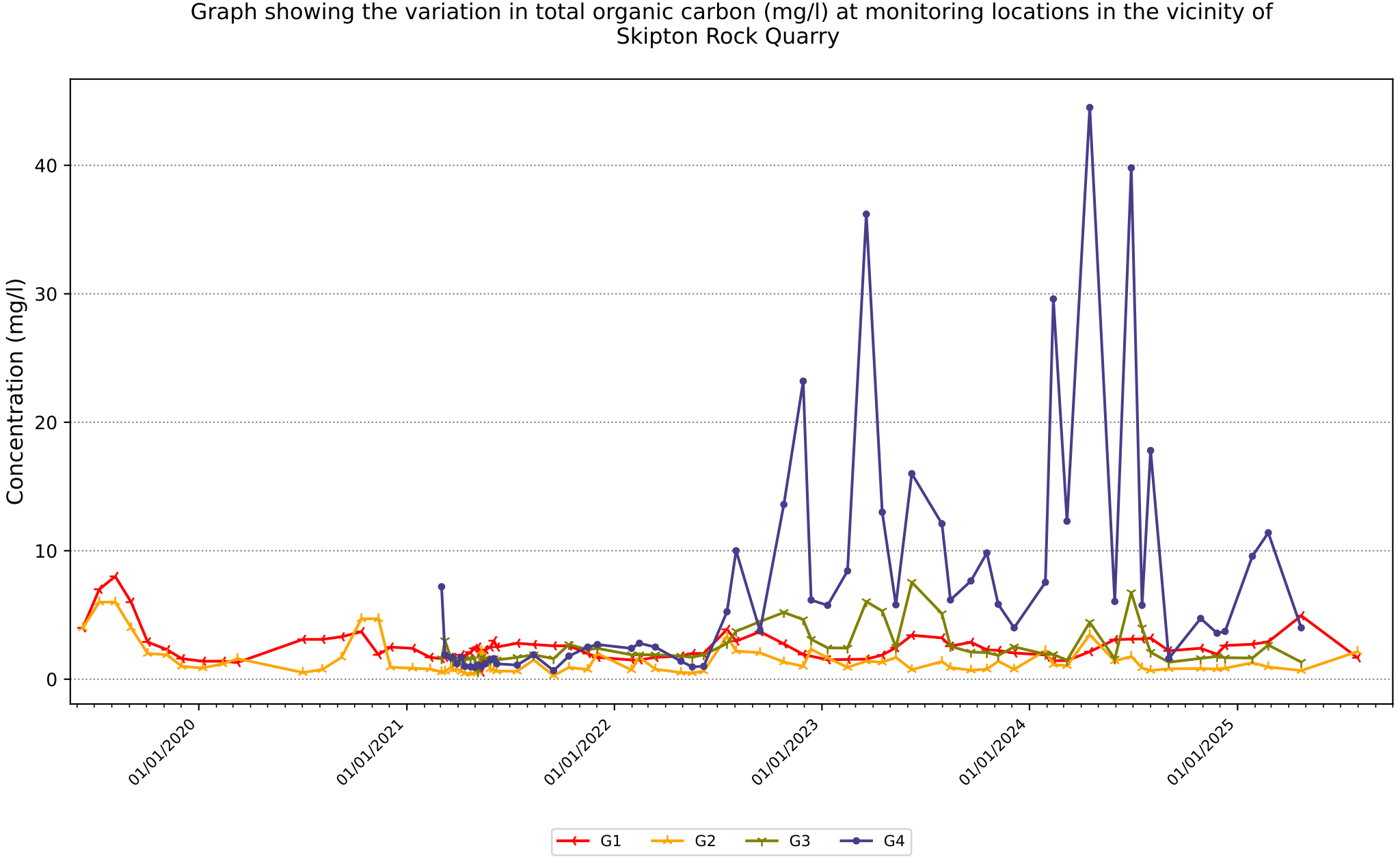
Graph showing the variation in ammoniacal nitrogen (mg/l) at monitoring locations in the vicinity of Skipton Rock Quarry

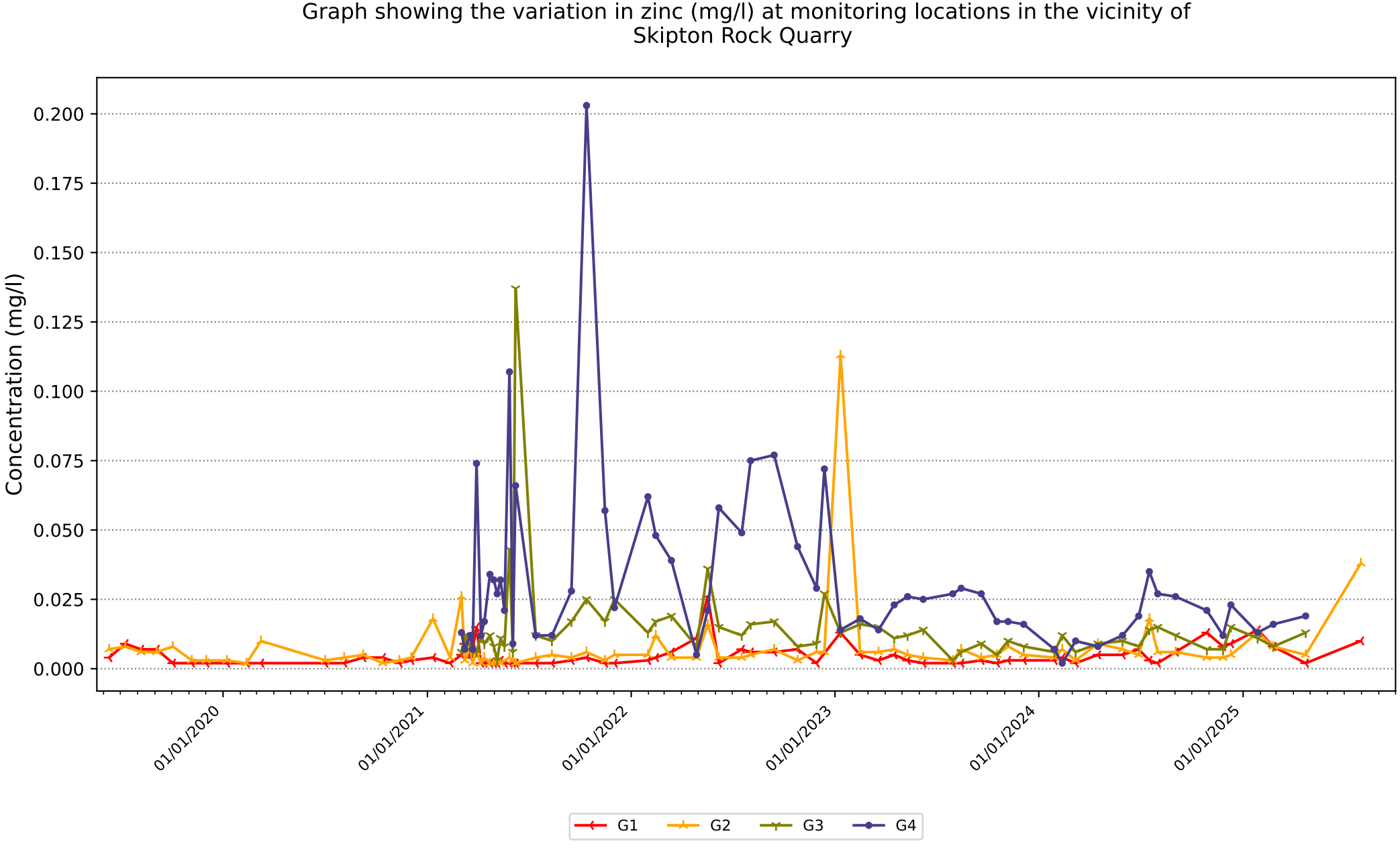


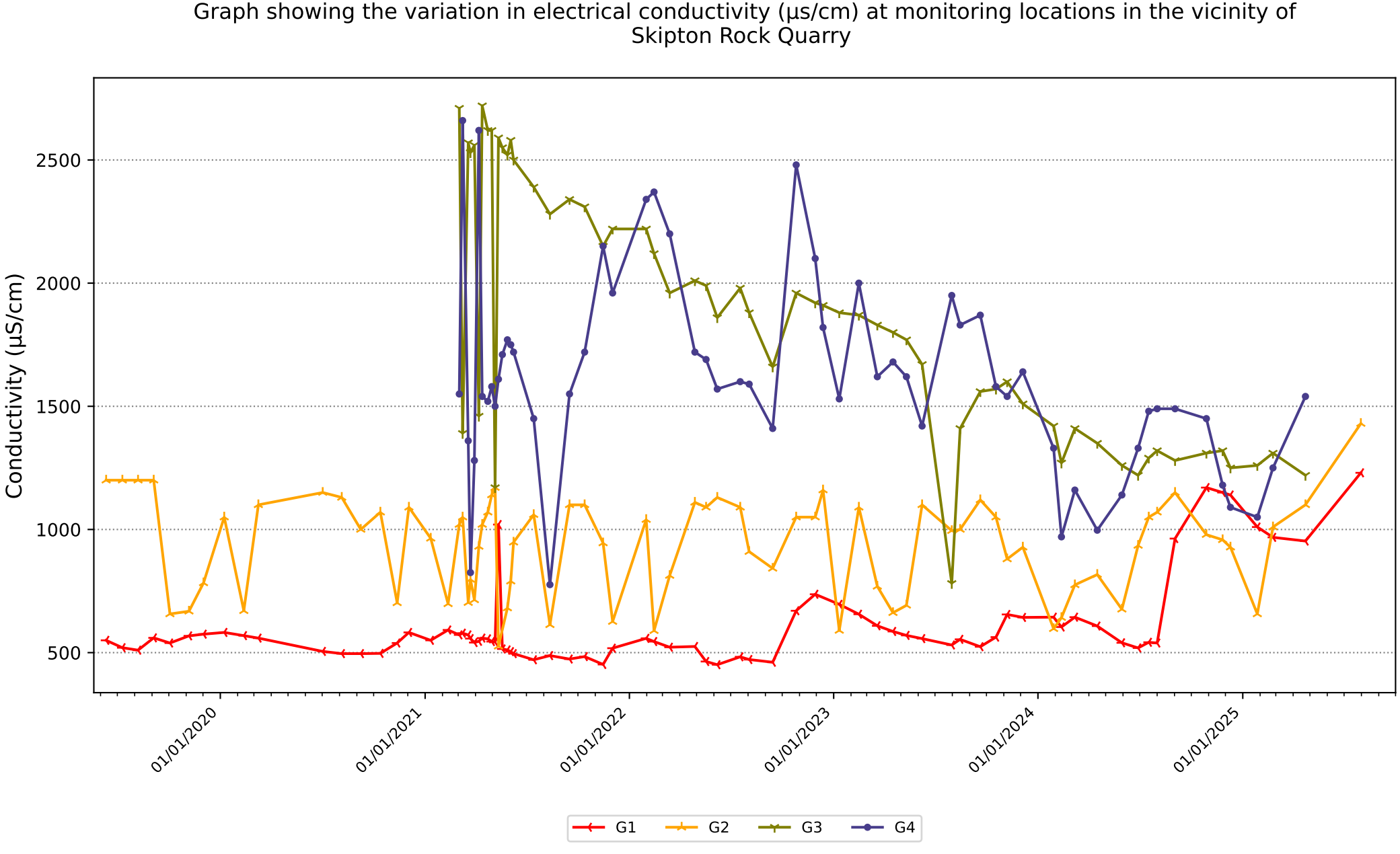

Graph showing the variation in nickel (mg/l) at monitoring locations in the vicinity of Skipton Rock Quarry
Concentration (mg/l)
0.014
0.012
0.010
0.008
0.006
0.004
0.002
01/01/2020
01/01/2021
01/01/2022
01/01/2023
01/01/2024
01/01/2025
G1
G2
G3
G4

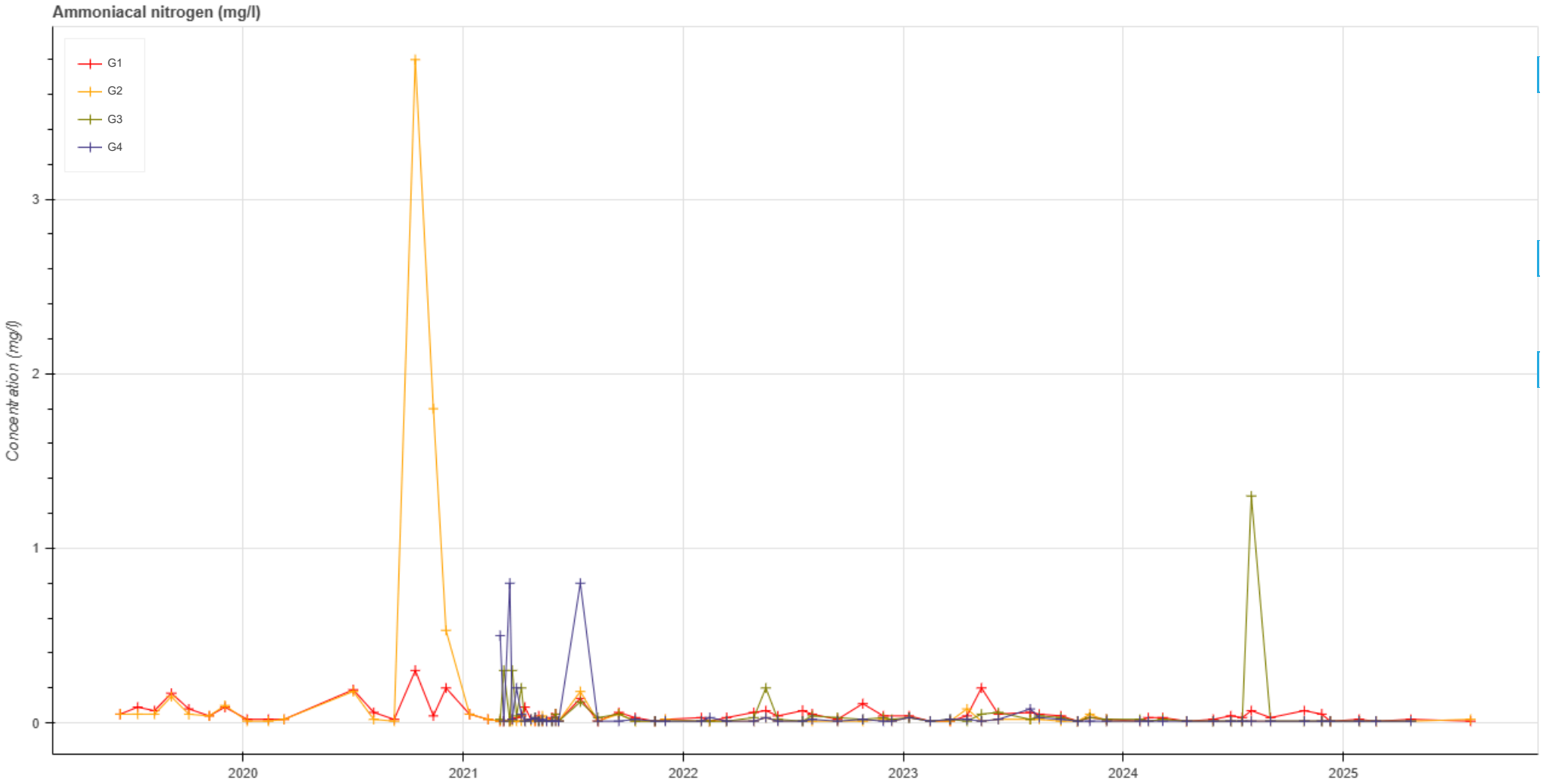

Graph showing the variation in sulphate (mg/l) at monitoring locations in the vicinity of Skipton Rock Quarry
Concentration (mg/l)
700
600
500
400
300
200
100
01/01/2020
01/01/2021
01/01/2022
01/01/2023
01/01/2024
01/01/2025
G1
G2
G3
G4

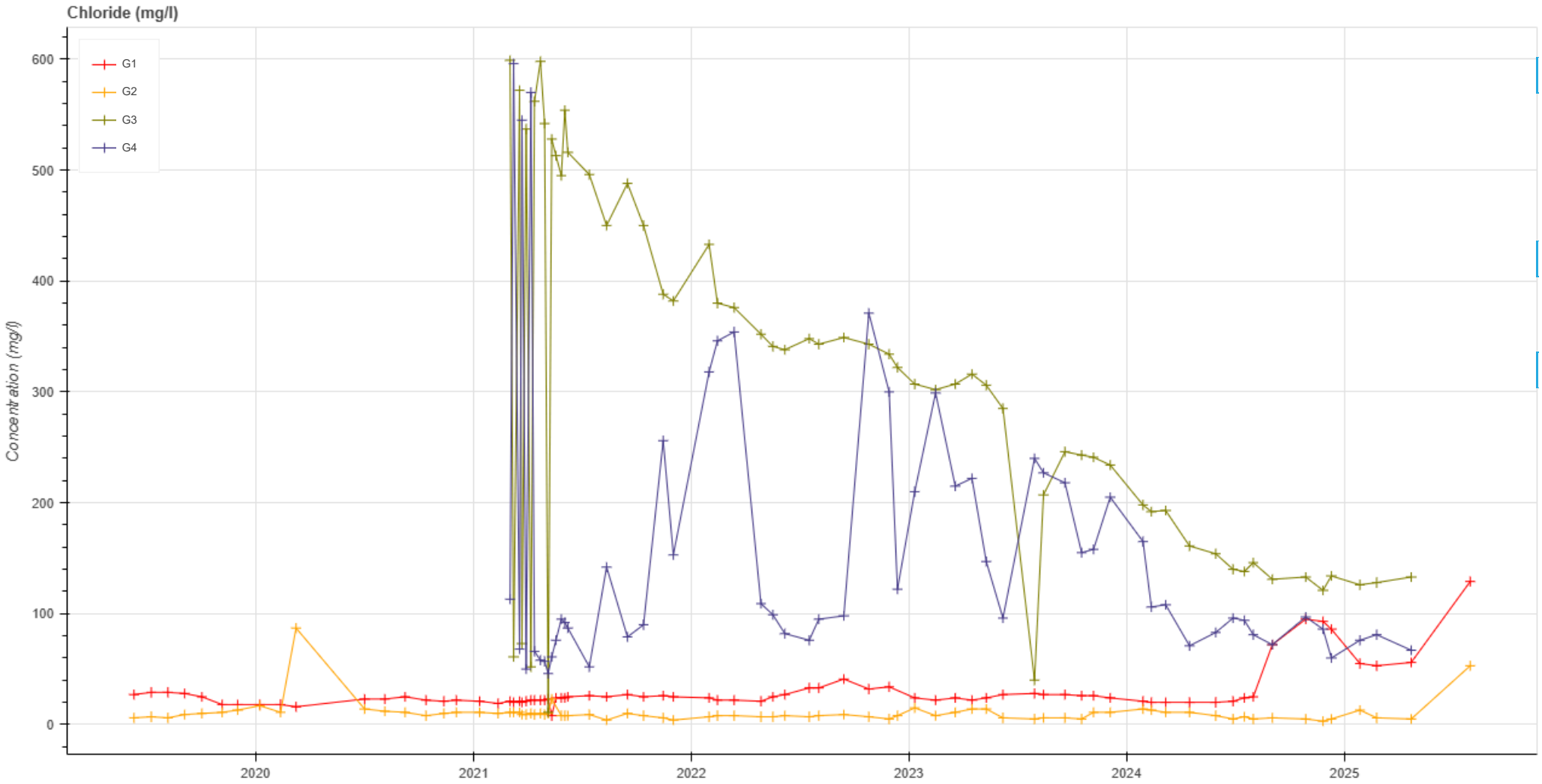

Graph showing the variation in suspended solids (mg/l) at monitoring locations in the vicinity of Skipton Rock Quarry
Concentration (mg/l)
80
70
60
50
40
30
20
10
01/01/2020
01/01/2021
01/01/2022
01/01/2023
01/01/2024
01/01/2025
G1
G2
G3
G4

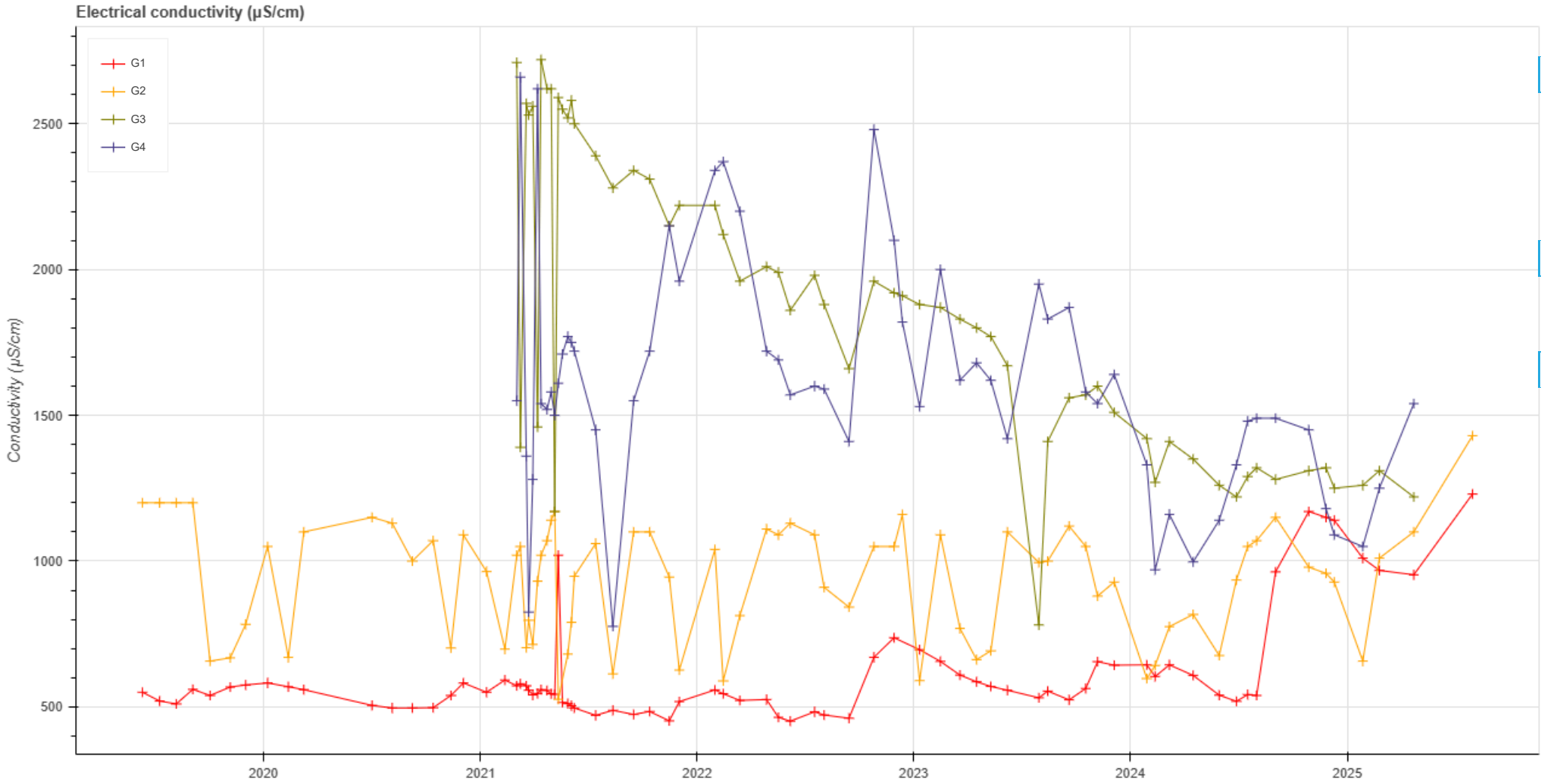

Graph showing the variation in total organic carbon (mg/l) at monitoring locations in the vicinity of Skipton Rock Quarry
Concentration (mg/l)
0
10
20
30
40
01/01/2020
01/01/2021
01/01/2022
01/01/2023
01/01/2024
01/01/2025
G1
G2
G3
G4


Graph showing the variation in zinc (mg/l) at monitoring locations in the vicinity of Skipton Rock Quarry
Concentration (mg/l)
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
01/01/2020
01/01/2021
01/01/2022
01/01/2023
01/01/2024
01/01/2025
G1
G2
G3
G4

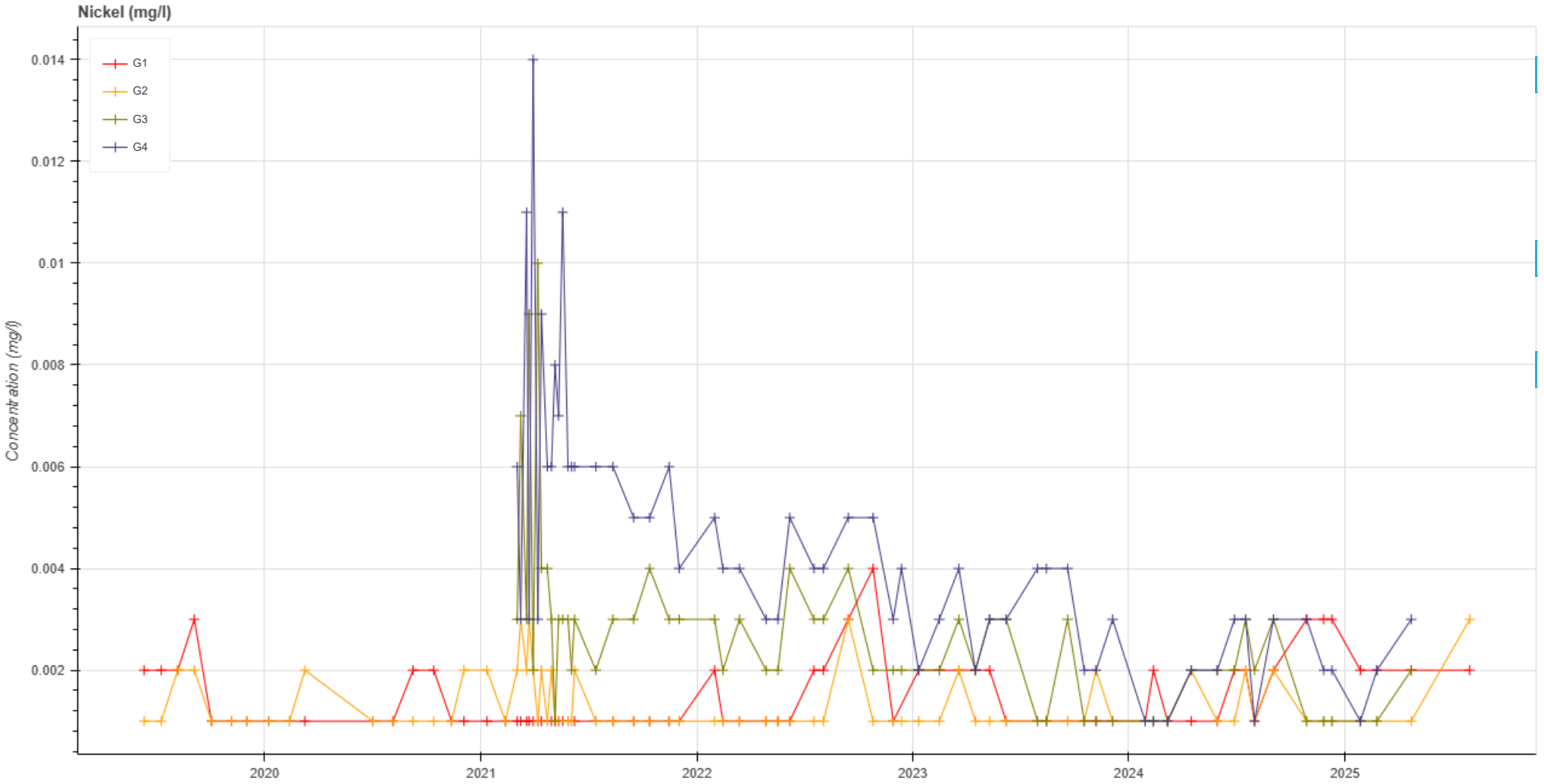

Graph showing the variation in electrical conductivity (µs/cm) at monitoring locations in the vicinity of Skipton Rock Quarry
Conductivity (µS/cm)
2500
2000
1500
1000
500
01/01/2020
01/01/2021
01/01/2022
01/01/2023
01/01/2024
01/01/2025
G1
G2
G3
G4

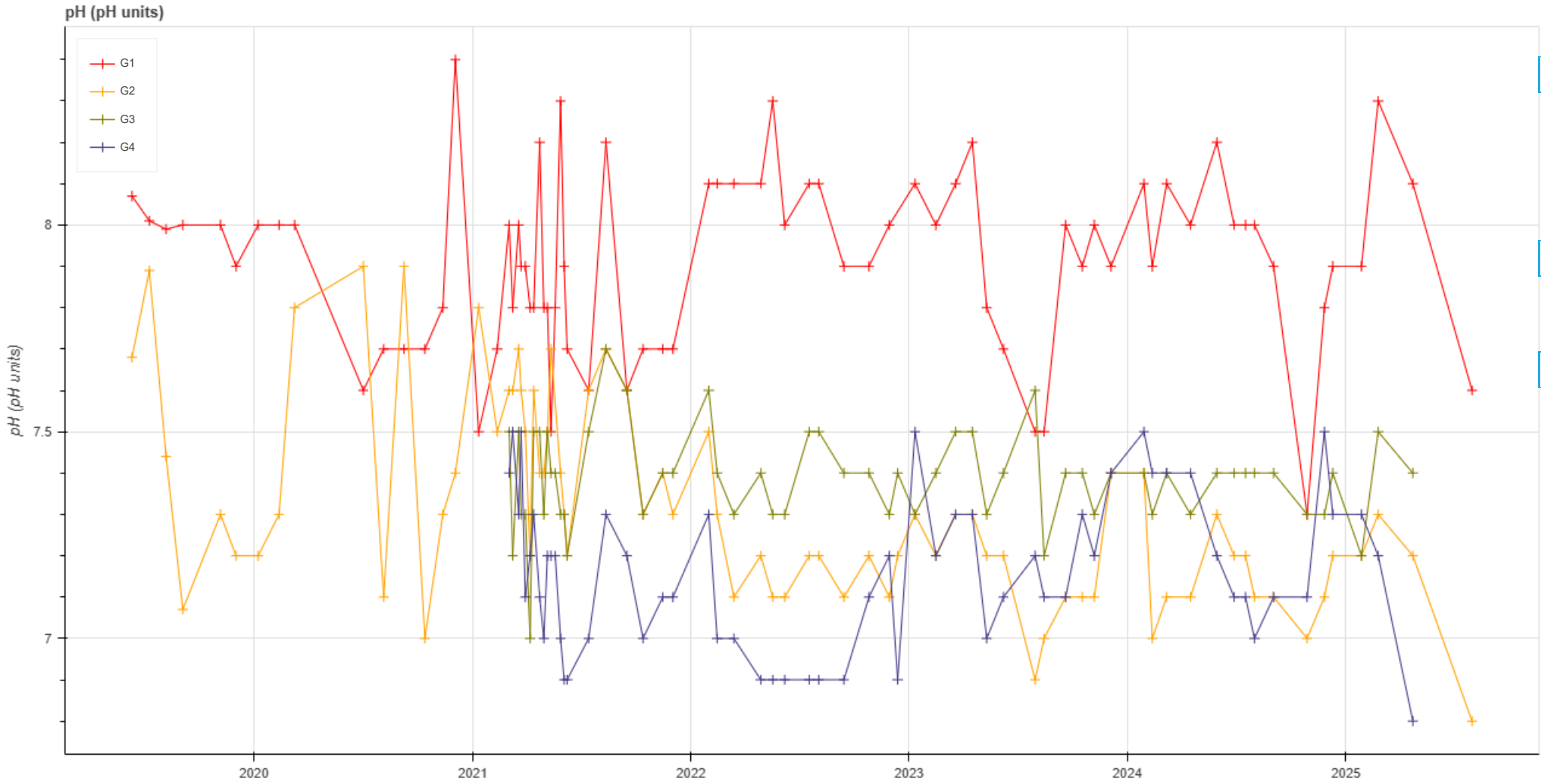

Ammoniacal nitrogen (mg/l)
G1
G2
G3
G4
Concentration (mg/l)
0
1
2
3
2020
2021
2022
2023
2024
2025

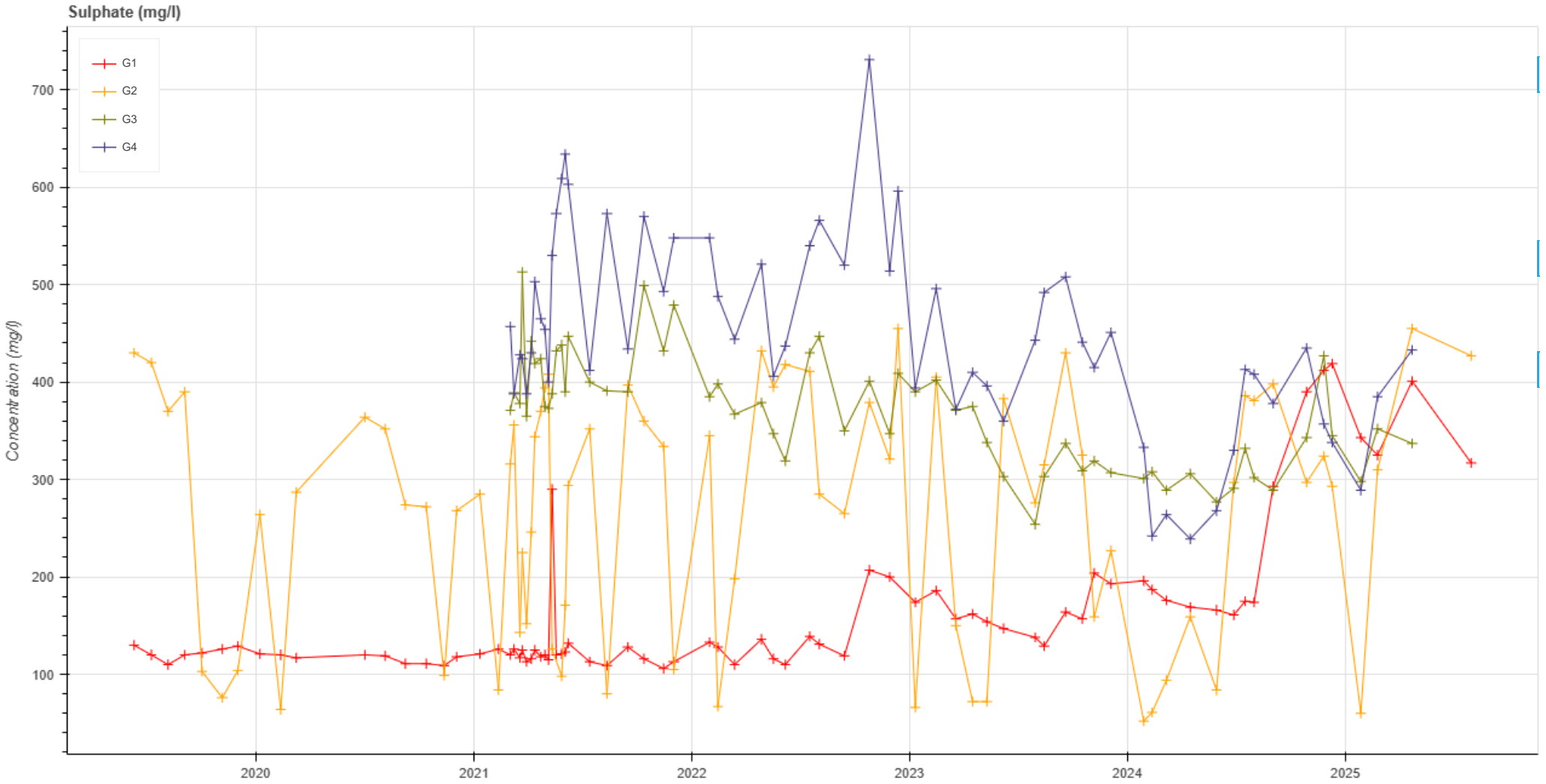

Chloride (mg/l)
G1
G2
G3
G4
Concentration (mg/l)
600
500
400
300
200
100
0
2020
2021
2022
2023
2024
2025

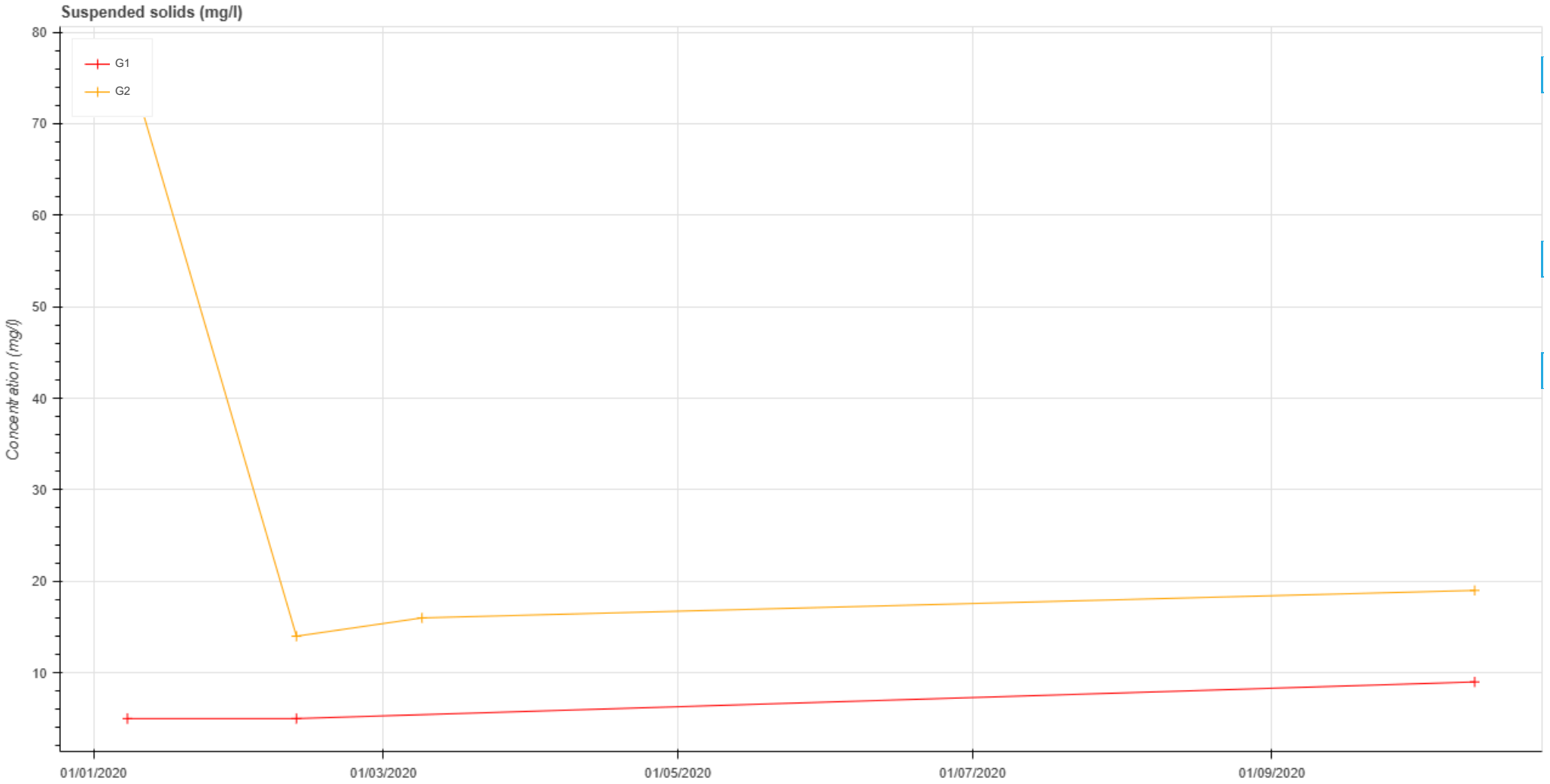

Electrical conductivity (µS/cm)
G1
G2
G3
G4
Conductivity (µS/cm)
2500
2000
1500
1000
500
2020
2021
2022
2023
2024
2025

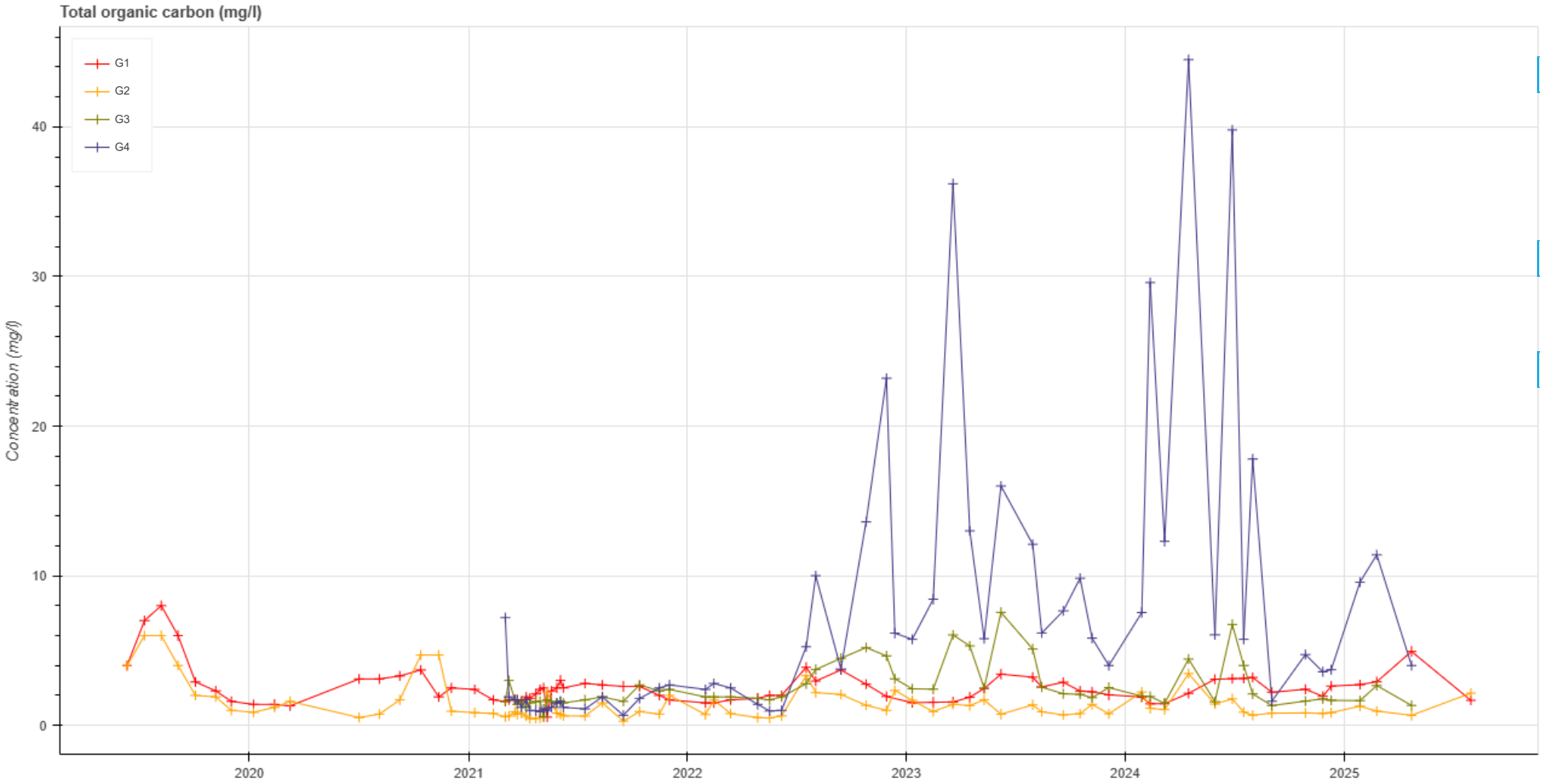

Mercury (mg/l)
G1
G2
G3
G4
3.000e−4
2.500e−4
2.000e−4
1.500e−4
1.000e−4
5.000e−5
Concentration (mg/l)
2020
2021
2022
2023
2024
2025

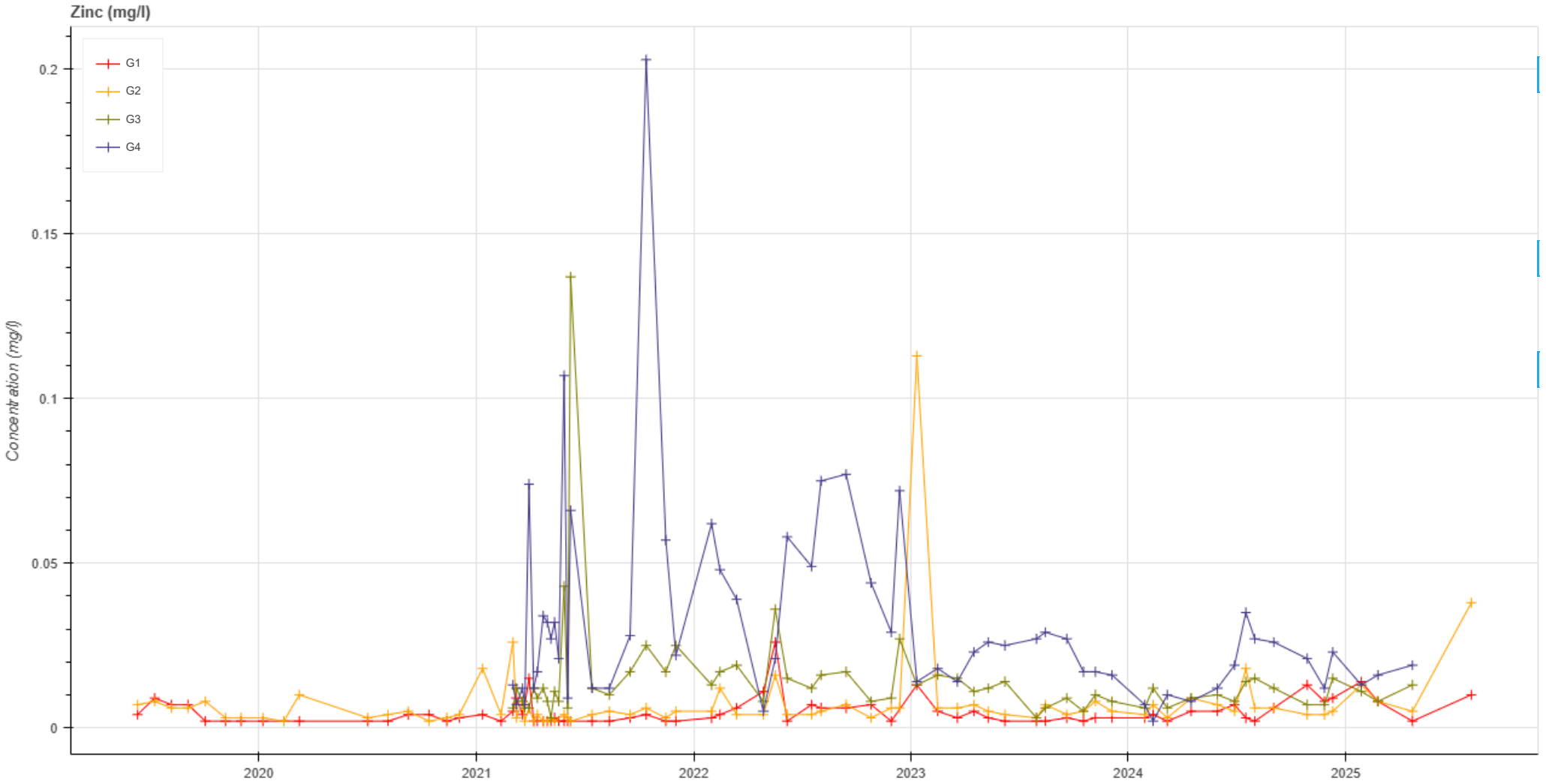

Nickel (mg/l)
G1
G2
G3
G4
0.014
0.012
0.01
0.008
0.006
0.004
0.002
Concentration (mg/l)
2020
2021
2022
2023
2024
2025


pH (pH units)
G1
G2
G3
G4
pH (pH units)
8
7.5
7
2020
2021
2022
2023
2024
2025


Sulphate (mg/l)
G1
G2
G3
G4
Concentration (mg/l)
700
600
500
400
300
200
100
2020
2021
2022
2023
2024
2025


Suspended solids (mg/l)
G1
G2
Concentration (mg/l)
80
70
60
50
40
30
20
10
01/01/2020
01/03/2020
01/05/2020
01/07/2020
01/09/2020


Total organic carbon (mg/l)
G1
G2
G3
G4
Concentration (mg/l)
0
10
20
30
40
2020
2021
2022
2023
2024
2025


Zinc (mg/l)
G1
G2
G3
G4
Concentration (mg/l)
0.2
0.15
0.1
0.05
0
2020
2021
2022
2023
2024
2025