Maendy Quarry

IC 4
Review of Monitoring Data and the Restoration Scheme

January 2025

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Date of Issue
January 2025

Quality Assurance

Report Details	
Report Title:	Review of the monitoring data and the Restoration Scheme
Report Date:	January 2025
Report Version:	1.0
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1.0 Introduction

This report fulfils the requirements of Improvement Condition (IC) 4, which forms part of an improvement programme within the site Permit (Ref: AN236801). IC4 requires the 'Operator to submit a report to NRW reviewing monitoring data and make recommendations for improvement works if required. The report shall also review the compliance limits, parameters and monitoring frequencies, two years from completion of the commissioning of the works carried out in accordance with IC3'. The restoration works were completed at Maendy Quarry by December 2022. This document should be read in conjunction with the submissions which were submitted and accepted by NRW, in line with Permit improvement conditions IC1, 2 and 3.

Maendy Quarry (the site) is located approximately 2 km north of the centre of Upper Church Village near Pontypridd in South Wales.

The site comprises two discrete areas known as the western and eastern quarries, separated by a single carriageway road (Maindy Road). The location is centered at NGR ST 075 876.

The western quarry was landfilled between 1966 and closed in 1970 and operated as a dilute and attenuate site in keeping with the practices at the time, the landfilled area within the western quarry has a plan area of approximately 1.7 hectares with a depth of waste estimated at 7m, this is based on interpretation of the extent of quarrying on historical Ordnance Survey maps and borehole drilling logs. The Eastern Quarry was never landfilled. The plan area of the western and eastern quarries combined is approximately 6.1 hectares.

At the western quarry rainfall related site drainage and seepages drain via surface and subsurface pathways both eastwards and westwards. Site drainage and seepages from the western area potentially mix with groundwater beneath Maindy Road which enters the eastern quarry and then a marshy area, and in turn flows under Maindy Road, via pipework, to a weir box, where it discharges to the local surface water network.

The site drainage discharges to surface watercourses and ditches via two permitted points. Surface waters then flow southwards into tributaries of the Nant Ty'r Arlwydd, these are shown on Drawing Maendy_1222-monitoring. The drainage from the western boundary of the western quarry discharges directly into a ditch flowing southwards. The drainage from the eastern quarry discharges subsurface via a pipe which then runs south west beneath a field and emerges into the headwaters of a small stream that flows south and west. Both discharges eventually flow into the Nant Ty'r Arlwydd, approximately 1km from the site, and ultimately into the Nant Clun.

Initially the site discharges were assessed against two separate discharge consents (AN0236801 and AN0236802) in accordance with the Water Resources Act 1991. During 2012 discussions with NRW began, which spanned several years, to determine how the activities on site should be permitted under Environmental Permitting Regulations, it was agreed that the discharges were not considered to be a waste, and a permit allowing discharges to the water environment was therefore considered appropriate.

During these discussions NRW confirmed that the surface water catchment of the Nant Clun had been identified at its lower reaches as failing to meet its desired water quality status. NRW wished to see a general improvement in the drainage from Maendy Quarry as part of the catchment improvement programme being delivered by NRW. This is described in further detail in the application documentation Environmental Permit Variation Application - Summary and Supporting Information, Maendy Quarry 2017, Appendix A.

NRW determined the current permit, on 19th July 2018 (Permit Number: AN236801). The Permit as issued regulates the discharge of rainfall related site drainage arising from the Maendy West Quarry and site drainage from Maendy East Quarry, which replicated and consolidated the historic consents AN0236801 and AN0236802 dated 22/11/2000.

Four improvement conditions were included in Table S1.3 of the Permit to assist in developing an appropriate scheme for the restoration of the site with the intention of encouraging a general improvement of the discharges to support the catchment improvement programme. These are set out in Table 1 below.

Table 1 - Improvement Programme Requirements

<table>
<tr><th>Reference</th><th>Requirement</th><th>Status</th></tr>
<tr><td rowspan="4">A1 Maendy East Quarry

and

A2 Maendy West Quarry</td><td>IC1 - Initial restoration scheme designs submitted to NRW for review 6 months from date permit issued</td><td>Completed</td></tr>
<tr><td>IC2 - Final designs for restoration scheme and an outline construction programme to be completed and approved by NRW 6 months following NRW review/finalising of IC1</td><td>Completed</td></tr>
<tr><td>IC3 - Restoration scheme to be built and commissioned in accordance with outline construction programme agreed in IC2 and no later than 21 months from final approval of IC2, unless otherwise agreed with NRW.</td><td>Completed</td></tr>
<tr><td>IC4 - Operator to submit report to NRW reviewing monitoring data and make recommendations for improvement works if required. The report shall also review the compliance limits, parameters and monitoring frequencies, 2 years from completion of the commissioning of the works carried out in accordance with IC3.</td><td>Covered by this report</td></tr>
</table>

The approach agreed with NRW as part of the improvement programme was that no physical changes were to be made to the site's discharge points or drainage arrangements pertaining to each discharge point, but that additional on site measures were to be installed to improve the overall discharge quality.

The arrangements included an additional wetland to replicate the existing marshy area in the southern area of the eastern quarry. Both the wetland and marshy areas form part of the management of the drainage, and are within the Improvement Area shown on the drawing appended to the 2018 Permit Ref: AN236801. The marshy area, which forms part of the site's management of the drainage collected, is then directed to discharge point MAE001. The site operates in line with the details submitted as part of the Permit variation application and our approved submissions in accordance with IC1 and IC2.

1.2 Works undertaken as part of IC3

The restoration scheme sought to replicate, as far as practical, the existing marshy wetland area on the site, with a view to providing further natural improvement in the water discharged. The premise of the restoration scheme was that the receiving water would benefit most from additional wetland areas during lower flow conditions when higher contaminant loading may occur compared to higher flow conditions when contaminant loading is reduced by additional inputs.

The restoration works that have been completed in the eastern quarry has included:

- the importation of soils, aggregates and wood chip to develop a wetland to replicate the existing marshy area.
- An aggregate reception area and aggregate channel to help direct and distribute flows evenly into the wetland
- The wetland acts to extend contact times between the water and the restoration material to encourage a diverse community of organisms to build up on the media surfaces that are capable of breaking down or transforming a wide variety of substances.

Restoration works in the western area of the site has included:

- the importation of soils, aggregates and wood chip to produce a collection area where drainage is captured and flows into a smaller similar wetland feature to the west of the site.
- An aggregate reception area and aggregate channel to help direct and distribute flows evenly into the wetland
- a pumping chamber and pipework pumps site drainage from the western quarry to the eastern quarry.

Further details of the restoration and works completed can be found in the submissions which have discharged the requirements of IC 1, 2 and 3.

During low to medium flow conditions at the western quarry (flows up to 50m^3/day), all site drainage is directed through the western quarry wetland to the collection areas in the western quarry, and then drains to a sump, before reaching discharge point MAE002. A pump within the sump moves the water over to the eastern quarry reception area, with the water directed through the eastern quarry wetland area and the existing marshy area prior to being discharged at MAE001.

During medium to high flow conditions (volumes above 50m^3/day), the site drainage continues to be pumped from the west quarry to the east quarry (up to 50m^3/day), however during higher rainfall volumes above 50m^3/day are directed through an overflow prior to being discharged via MAE002.

This arrangement is shown in Drawings CE-MQ1458-DW01, CE-MQ1458-DW02, and CE-MQ1458-DW03 submitted and approved via the fulfilment of IC1.

Table 2 below details the approximate timing of the wetland improvement works on site. The works started but were delayed by the lockdown associated with the Covid-19 pandemic, and were completed in December 2022.

Table 2 - Approximate timing of the restoration works at the site

	Commencement	**Completion**
Western Quarry enhancement	November 2020	October 2021
Eastern Quarry Restoration	November 2020	December 2022

2.0 Review of Monitoring Data

Water quality and flow data collected from January 2013 to September 2024 has been considered within this review as it represents conditions before, during and after installation of the restoration scheme. The data has been split into two defined periods, as detailed below:

- Before the completion of the restoration scheme - January 2013 to December 2022
- After the completion of the restoration scheme - January 2023 to September 2024

The data review includes an assessment of the following:

- Flow rates
- Quality and Loading
- Mass

2.1 Flow

Historically flows at the two discharge points were measured using a v-notch weir periodically. Pressure transducers used to measure the height of the water flowing over the v-notch were added, then in February 2022 inline magnetic flow meters were also installed at MAE001, MAE002. Flow meters were also installed on the pumped line from the west to east quarry to further assist in understanding flows. During December 2023 an ultrasonic radar measurement system was added to improve the reliability of flow measurement over the v-notch weir at MAE001 as the previously used pressure transducers encountered fouling issues which meant that data was not always reliable.

When reviewed, flow data collected at the site between April 2019 to March 2023 was not consistent with prior data due to issues with the level measurement system used on the v-notch weir prior to the ultrasonic system being installed. During this period the only data able to be collected were instantaneous manual measurement readings taken when technicians attended site, therefore calculated flows using this data need to be considered in the context of the frequency of monitoring. As part of this assessment the data collected for this period has been adjusted to calibrate the flow using the instantaneous reading in conjunction with a comparison to the reliable historical rainfall and flow data for each discharge. Following this review, data for this period is now more comparable to the observed range of flow previously measured.

Flow data collected is set out graphically in Appendix A.

The flow data prior to the completion of the restoration scheme for the period 2013 to December 2022 is summarised below:

- Flows from 2013 to the autumn of 2016 show a distinct seasonal trend.
- During the period from November 2016 to April 2019 the flows measured are more variable with significantly higher peaks, this period corresponds to generally increasing annual rainfall.

- There is generally a flashy response in which flows peak soon after rainfall events, with limited or no flows during dry weather.
- Average monthly flows and peak flow are generally higher from MAE002 than from MAE001, with the exception of two peaks over the 2018/2019 winter period.

The flow data following the completion of the restoration scheme for the period January 2023 to September 2024 shows the following noting the measurement issues noted above:

- The volumes of site drainage at MAE001 have reduced in relation to peak flows, and at MAE002 the discharge has reduced, which is anticipated to be due to the additional storage provided by the measures installed prior to each discharge point.
- A discharge at MAE002 only occurs when site drainage flows exceed the $50m^3$/day volume pumped from the West Quarry to the East Quarry, as described in Section 1.2. This typically only occurs during the winter months and high rainfall events.
- The increased storage capacity in the wetland restoration area appears to be accommodating some of the fluctuations in site drainage.

Overall, it can be concluded that the site discharges are dominated by rainfall related drainage and runoff. The creation of the wetland has provided a buffer for the flows at the site with the volume of site drainage leaving the site generally having lower peak flows due to the additional storage on site provided by the wetlands.

Since commencing pumping of drainage from the western quarry to the eastern quarry there is a notable reduction in flows leaving the site via MAE002, from January 2023. As a result the discharge from the West Quarry only occurs during the winter months and high rainfall event conditions.

2.2 Quality compliance with table S3.1 of the Permit

The results of the monitoring undertaken in accordance with Table S3.1 of the Permit at the site, show that since the variation of the Permit in 2018 toluene, phenol (total mono) and COD have been consistently measured below the respective permit limits at MAE001 and MAE002. This is shown in Figures 1 to 8 below.

Figure 1

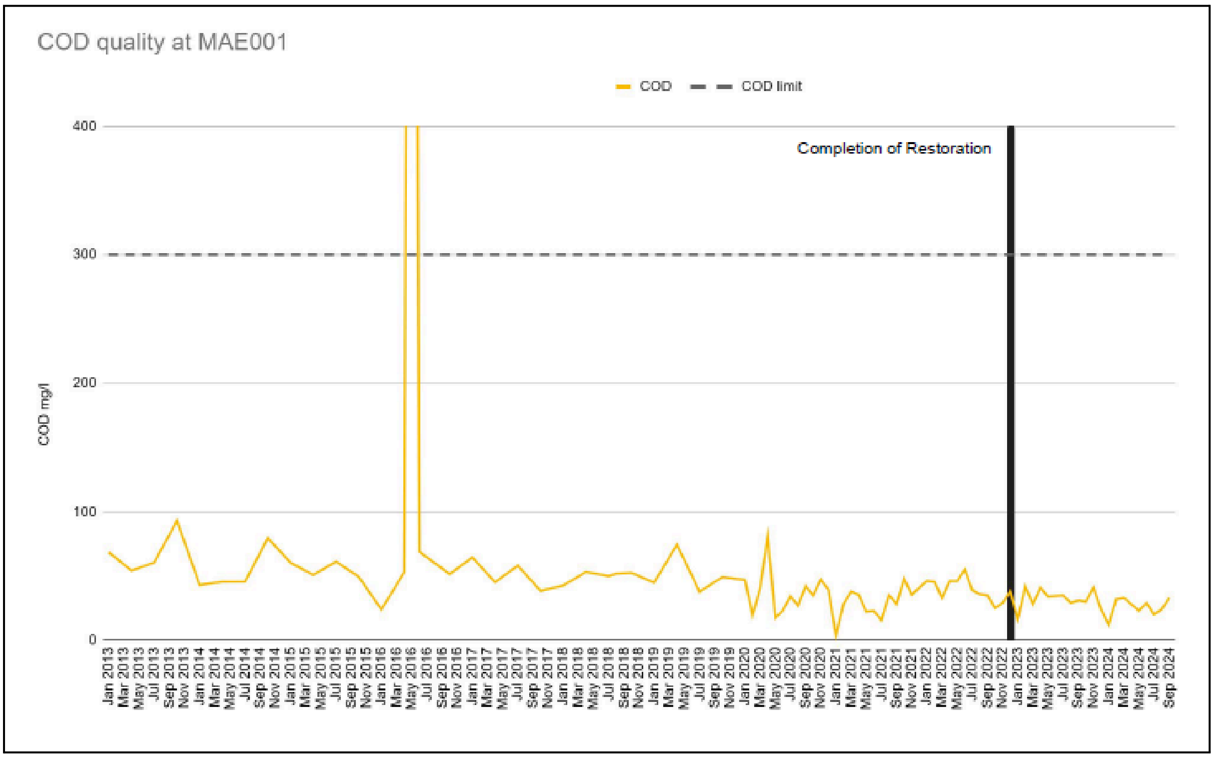


Figure 2

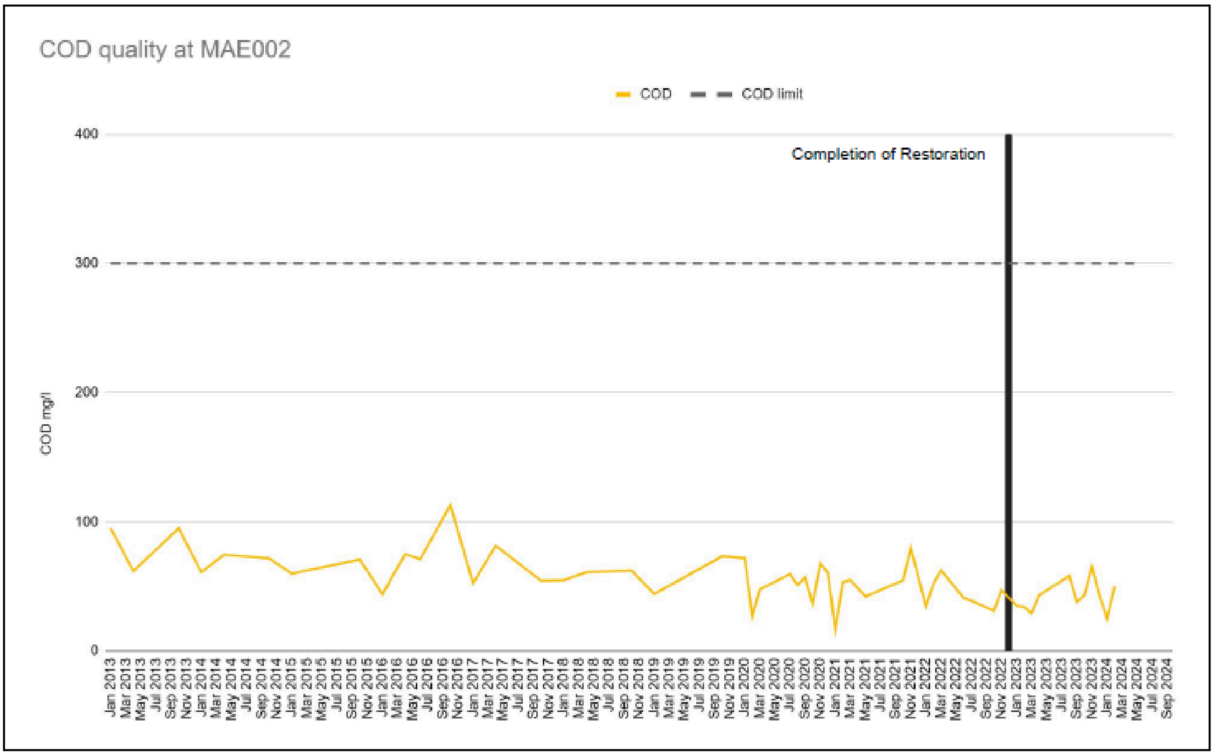


Figure 3

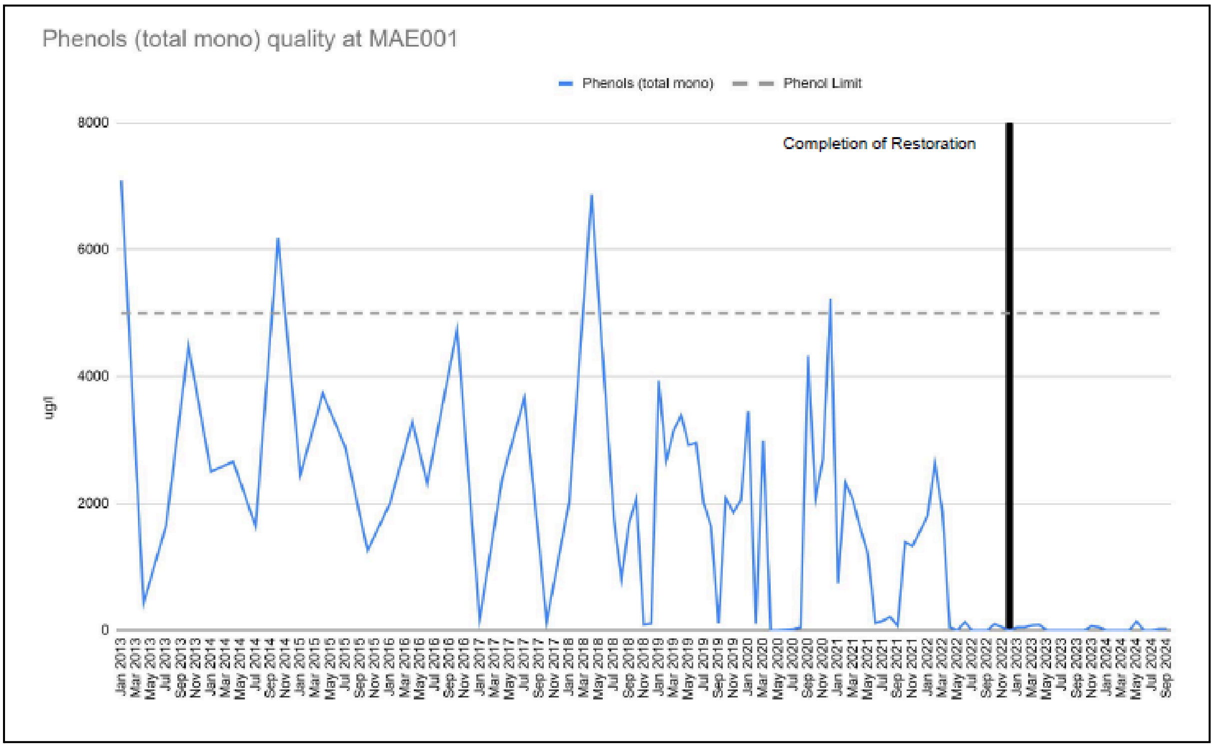


Figure 4

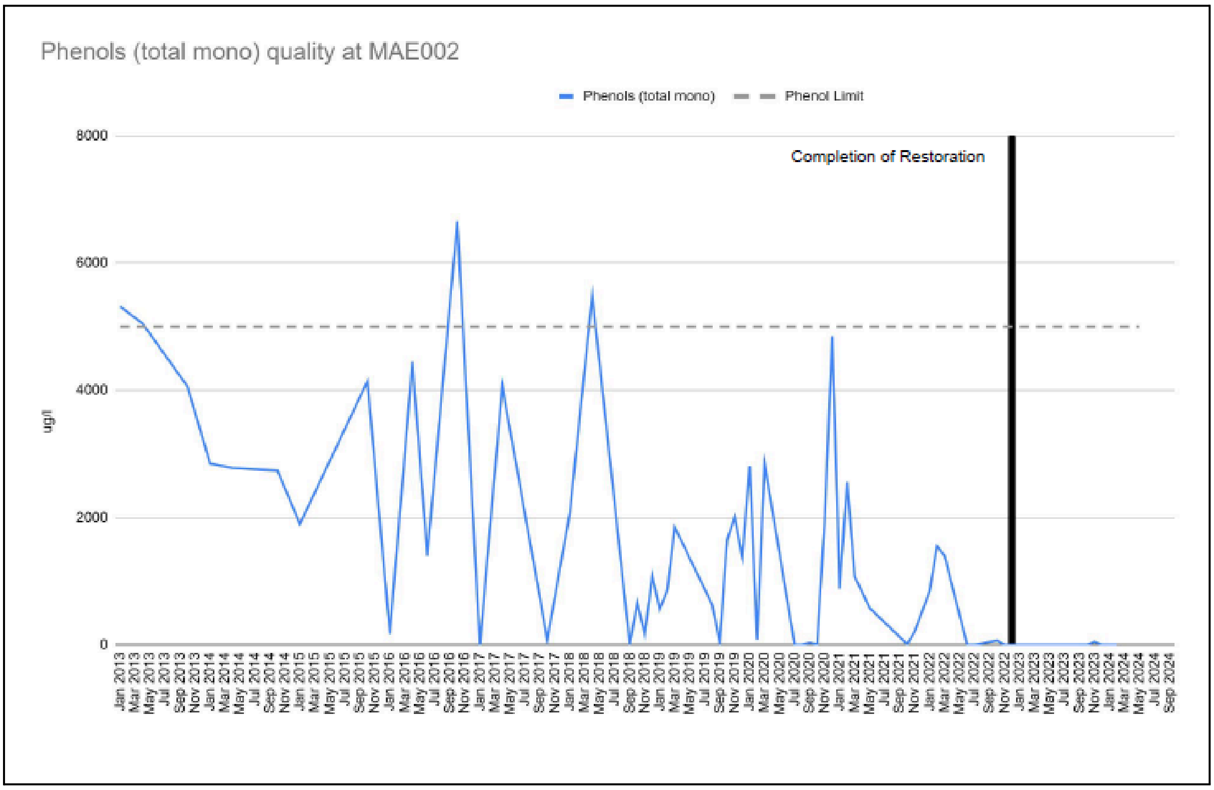


Figure 5

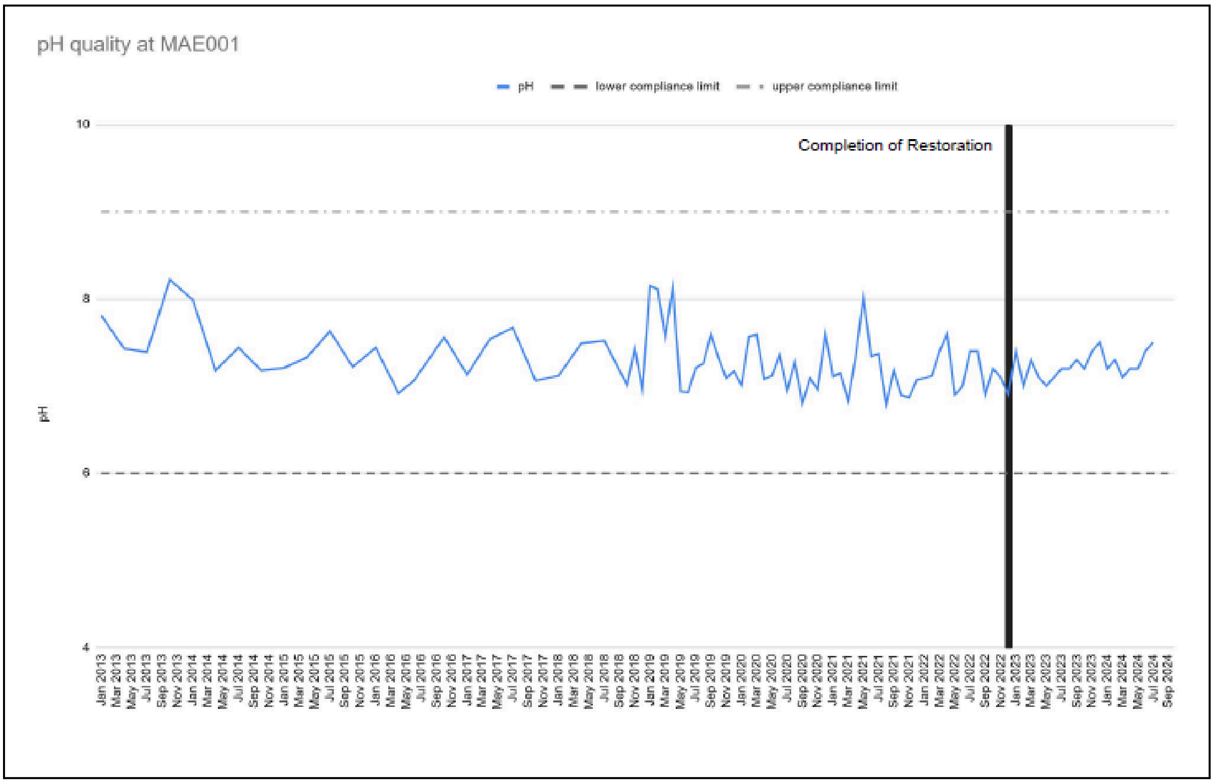


Figure 6

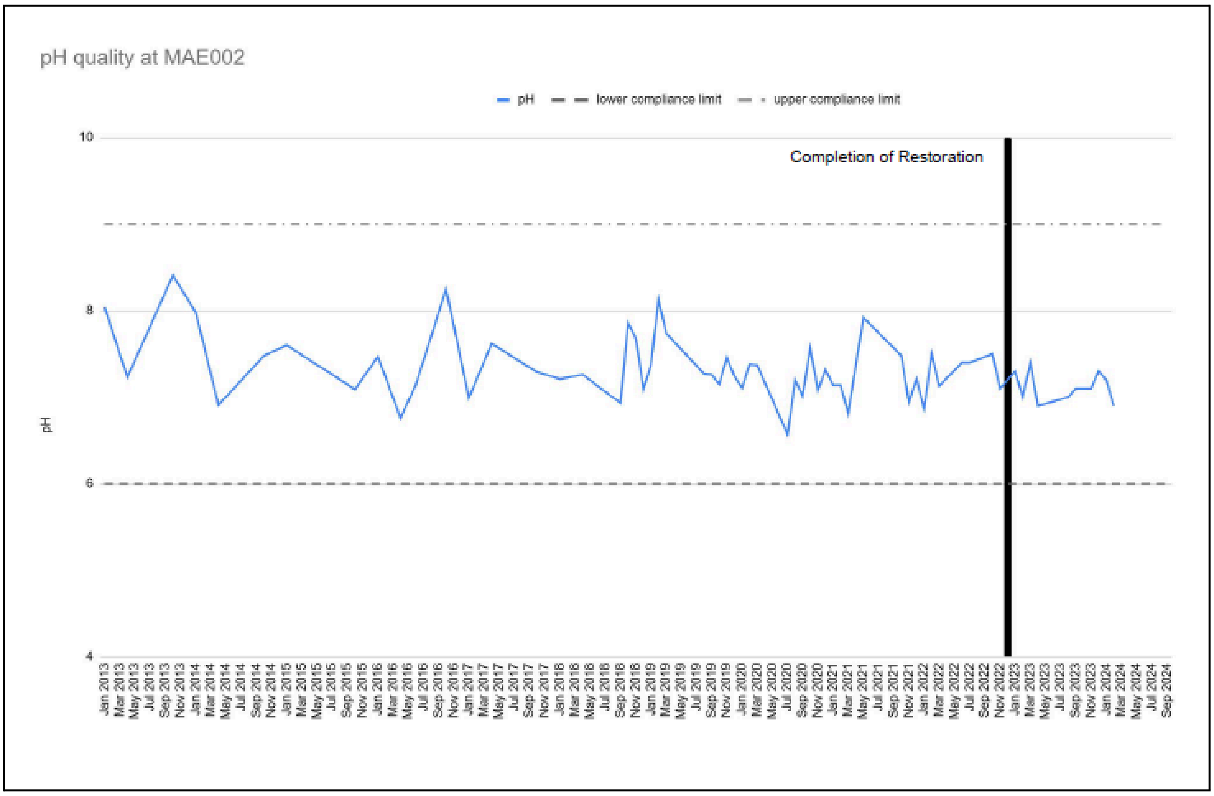


Figure 7

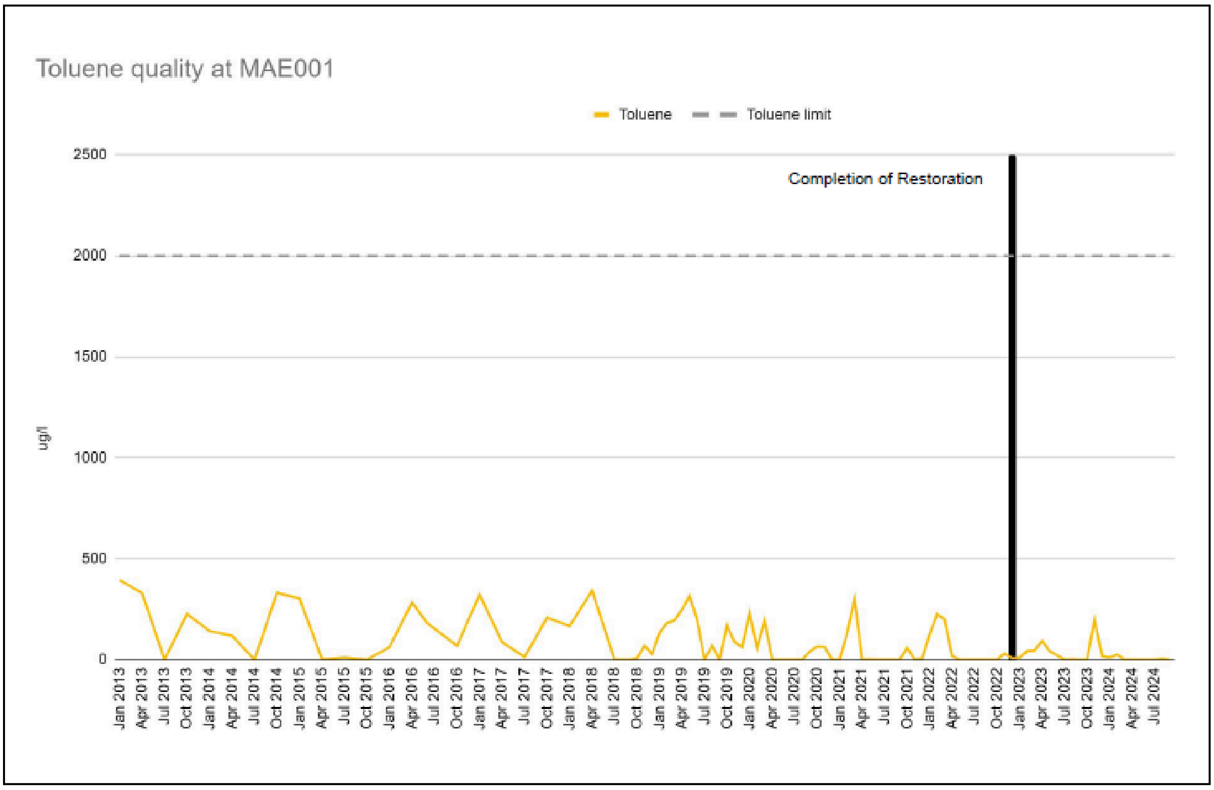
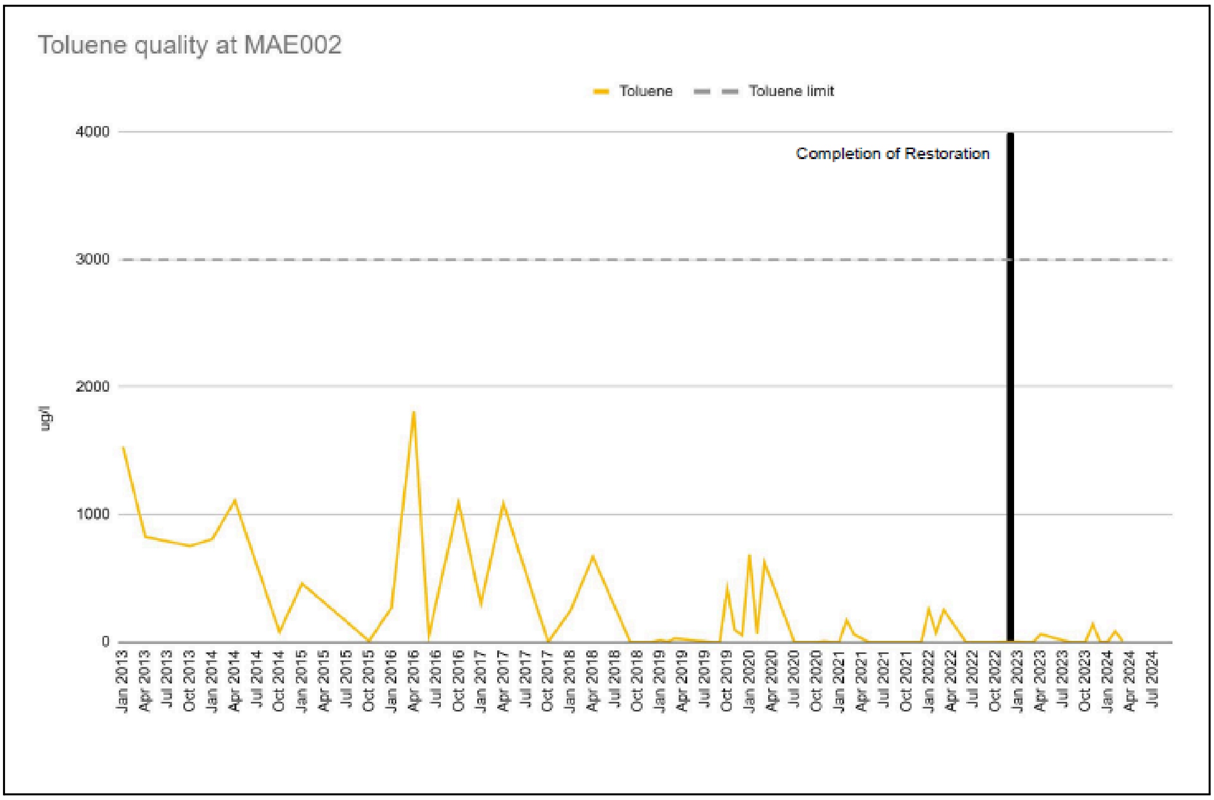


Figure 8



2.3 Quality and Loading Assessment

2.3.1 Quality data collected

The site drainage is monitored on a monthly basis at the site in accordance with the Permit requirements set out in Table S3.1. In addition to the monitoring required by the Permit, analysis of a wider range of determinants has been undertaken to allow an assessment as required by IC4. NRW was informed of this additional monitoring by email on the 10th October 2023.

The determinants included in the additional monitoring are detailed in Table 3 below, and were chosen to represent a range of substances that may be associated with the wastes deposited in the landfill.

Table 3 - Additional determinants analysis

Group	Substance
BTEX	Benzene, Toluene, Ethylbenzene,Xylene Total (m,p,o)
Metals	Arsenic, Cadmium, Chromium, Copper, Iron,Lead, Mercury, Nickel, Zinc
PAH	Naphthalene
Solvents	1,1-Dichloroethane, 1,2-Dichloroethane,1,2-Dichloropropane, Chloroethane,cis-1,2-Dichloroethene, Dichloromethane,trans-1,2-Dichloroethene, Vinyl Chloride, 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, 1,3,5-Trichlorobenzene,1,2,3-Trichlorobenzene, 1,2,4-Trichlorobenzene, Chlorobenzene
Pesticides	Pentachlorophenol
Phenols	Phenols (total mono)
Others	Ammoniacal Nitrogen, Chloride, COD
Additional Determinands	1,1,1-Trichloroethane, 1,1,2-Trichloroethane, 1,2-Dichlorobenzene, Alkalinity, BOD, Calcium, Cresols, Electrical Conductivity, Magnesium, Manganese, pH, Phenol, Potassium,Sodium, Sulphate, Tetrachloroethene, TOC, TON, Trichloroethene

Determinands in red are required by the Permit

A graphical summary of the key determinants within the site drainage is included in Appendix B. The graphs have been divided by discharge point and by chemical grouping as detailed in Table 3 above.

The quality data collected at the site is summarised in Table 4 (MAE001) and Table 5 MAE002) below. These tables provide statistical analysis to assist interpretation of the data. Where there have been no results above the limit of detection, the data has been 'greyed out'. No background quality data has been collected throughout the period before and after implementation of the restoration work. It is intended that a location in the surface water network is established where additional data will be acquired for comparison purposes.

Table 4 - Summary of the quality monitoring undertaken at MAE001

	MAE001 (Prior to wetland improvement)					MAE001 (After wetland improvement)				
Contaminant	**no.samples**	**<LoD**	**Min**	**Ave**	**Max**	**no.samples**	**<LoD**	**Min**	**Ave**	**Max**
Benzene ug/l	60	20	0.5	66.69	238	20	10	0.5	21.30	113
Ethylbenzene ug/l	60	31	0.25	60.20	332	20	19	0.25	1.99	35.1
Toluene ug/l	81	20	0.5	103.18	395	20	9	0.5	25.13	198
Xylene ug/l	5	0	1	39.02	110	15	0	1	63.73	454
Arsenic ug/l	45	6	0.5	1.66	14.3	15	14	0.5	0.53	1
Cadmium ug/l	24	1	0.01	0.25	0.938	15	3	0.01	0.06	0.28
Chromium ug/l	41	4	0.0015	2.34	10.7	15	14	0.5	0.53	1
Copper ug/l	41	13	0.5	2.97	14	15	13	0.5	0.63	2
Iron ug/l	47	0	0.05	23.36	98.3	15	0	0.23	3.21	7.86
Lead ug/l	40	33	0.25	0.7	3.07	15	13	0.0001	0.51	1
Mercury ug/l	22	22	0.000005	0	0.015	13	12	0.015	0.03	0.15
Nickel ug/l	24	0	1	4.75	46.3	15	0	0.5	2.37	5
Zinc ug/l	45	0	3.42	44.25	400	15	0	4	21.87	78
Naphthalene ug/l	54	0	0.5	30.67	151	15	2	0.005	8.08	38.9
1,1-Dichloroethane ug/l	54	0	0.5	2.82	12.8	15	0	0.5	6.00	45
1,2-Dichloroethane ug/l	54	46	0.5	0.93	16.9	15	10	0.5	1.67	7
1,2-Dichloropropane ug/l	54	49	0.5	0.55	1	15	15	0.5	0.50	0.5
Chloroethane ug/l	54	42	0.5	3.59	12.2	15	13	2.5	2.97	6
cis-1,2-Dichloroethene ug/l	54	23	0.5	3.09	19.4	15	7	0.5	6.17	58
Dichloromethane ug/l	54	54	1.5	1.76	3.36	15	15	2.5	2.50	2.5
trans-1,2-Dichloroethene ug/l	53	48	0.5	0.55	1	15	15	0.5	0.50	0.5
Vinyl Chloride ug/l	54	22	0.5	3.95	13.8	15	10	0.5	3.00	13
1,2,4-Trimethylbenzene ug/l	54	13	0.5	3.06	8.15	15	8	0.5	4.13	43
1,3,5-Trichlorobenzene ug/l	39	13	0.005	0.34	0.5	15	14	0.005	0.03	0.2
1,3,5-Trimethylbenzene ug/l	54	22	0.3	1.17	2.68	15	8	0.3	1.32	11.6
1,1,1-Trichloroethane ug/l	54	49	0.5	0.55	1	15	14	0.5	0.60	2
1,2,3-Trichlorobenzene ug/l	32	32	0.005	0.37	1	10	10	0.0173	0.32	2.5
1,2,4-Trichlorobenzene ug/l	35	35	0.01	0.46	1	10	10	0.0635	0.43	2.5
Chlorobenzene ug/l	54	11	0.5	22.13	66.1	15	7	0.5	3.37	21
Pentachlorophenol ug/l	13	4	0.01	0.51	1	2	2	0.02	0.02	0.02
Phenols (total mono) ug/l	80	11	2.5	1953.06	7090	20	13	2.5	29.25	140
Ammoniacal Nitrogen mg/l	47	1	0.1	2.22	4.52	15	1	0.04	0.81	1.8
Chloride mg/l	47	0	9.4	41.22	76	15	0	12	23.07	44
COD mg/l	70	0	3.5	65.47	1500	20	0	12	29.25	42

Table 5 - Summary of the quality monitoring undertaken at MAE002

	MAE002 (Prior to wetland improvement)					MAE002 (After wetland improvement)				
Contaminant	**no.samples**	**<LoD**	**Min**	**Av**	**Max**	**no.samples**	**<LoD**	**Min**	**Av**	**Max**
Benzene ug/l	40	0	0.5	92.65	356	11	0	0.5	17.41	94
Ethylbenzene ug/l	40	4	0.25	276.16	1270	11	10	0.25	8.78	94.1
Toluene ug/l	56	0	0.5	374.70	2170	11	0	0.5	26.95	138
Xylene ug/l	4	0	1	44.75	176	7	0	1	144	429
Arsenic ug/l	31	0	0.5	1.76	8.11	7	0	0.5	0.5	0.5
Cadmium ug/l	15	15	0.09	0.23	0.25	7	6	0.01	0.15	0.53
Chromium ug/l	28	0	0.5	2.5	13.6	7	0	0.5	0.5	0.5
Copper ug/l	28	0	0.5	3.49	8.27	7	0	0.5	2.5	11
Iron ug/l	33	1	0.07	28.96	110	7	0	1.29	4.03	6.43
Lead ug/l	27	2	0.25	0.68	2	7	0	0.5	0.57	1
Mercury ug/l	17	17	0.000005	0	0.015	6	6	0.015	0.02	0.015
Nickel ug/l	15	0	4	8.67	23.8	7	0	0.5	7.07	12
Zinc ug/l	31	0	3	38.69	207	7	0	10	27.71	62
Naphthalene ug/l	38	2	0.005	13.78	67.8	7	3	0.005	8.21	25.1
1,1-Dichloroethane ug/l	38	0	0.5	8.28	47.6	7	0	5	22.43	43
1,2-Dichloroethane ug/l	38	0	0.5	0.95	7.89	7	0	0.5	2.43	6
1,2-Dichloropropane ug/l	38	0	0.5	0.55	1	7	0	0.5	0.5	0.5
Chloroethane ug/l	38	0	0.5	14.18	88.4	7	0	2.5	3	6
cis-1,2-Dichloroethene ug/l	38	0	0.5	26.89	96.2	7	0	0.5	21.07	53
Dichloromethane ug/l	38	0	1.5	1.71	3	7	0	2.5	2.5	2.5
trans-1,2-Dichloroethene ug/l	38	0	0.5	0.55	1	7	0	0.5	0.5	0.5
Vinyl Chloride ug/l	38	0	0.5	9.31	51.7	7	0	0.5	3	8
1,2,4-Trimethylbenzene ug/l	38	0	0.5	32.56	111	7	0	0.5	12.57	40
1,3,5-Trichlorobenzene ug/l	26	8	0.005	0.37	0.997	7	7	0.005	0.08	0.42
1,3,5-Trimethylbenzene ug/l	38	2	0.3	9.67	30.2	7	1	0.3	4.49	11.3
1,1,1-Trichloroethane ug/l	38	0	0.5	1.26	6.14	7	0	0.5	1	2
1,2,3-Trichlorobenzene ug/l	23	8	0.005	0.38	1	7	7	0.0437	0.15	0.2525
1,2,4-Trichlorobenzene ug/l	26	8	0.01	0.81	2.65	7	5	0.1096	0.41	0.807
Chlorobenzene ug/l	38	0	0.5	9.47	30.2	7	0	0.5	1.71	5
Pentachlorophenol ug/l	9	3	0.01	2.07	6.04	0	0	0	0	0
Phenols (total mono) ug/l	55	1	0.25	1830.87	6660	11	0	2.5	6.82	50
Ammoniacal Nitrogen mg/l	33	9	0.03	1.19	3.06	7	3	0.3	0.49	0.8
Chloride mg/l	33	0	7.5	18.32	27.1	7	0	9	13.43	16
COD mg/l	46	0	15.8	62.22	126	11	0	25	42.09	65

PCB monitoring has also been undertaken during this period of data collection, the PCB analysis included EC7 and WHO 12 congeners and was undertaken at MAE001 and MAE002.

- EC-7 congeners are selected by the EU as key indicators as they make up 20% by weight of PCBs in commercial mixtures, they have a wide chlorination range, and one dioxin-like congener is included. The EC7 are more likely to be found in environmental samples and at higher concentrations compared to the WHO-12.
- The WHO-12 are the dioxin-like and most toxic of the PCBs for evaluation and used in human health risk assessments.

The PCB congeners (EC-7 and WHO-12) described above have been monitored on seven occasions with none detected in the discharges following the completion of the restoration scheme. The results of the monitoring undertaken are detailed in Appendix C.

2.2.2 Loading Calculation

Using the flow and quality data collected, discussed in sections 2.1 and 2.2.1, a load assessment for each of the discharge points has been calculated on a quarterly basis which allows consideration of seasonal conditions. A graphical summary of the loading for each of the chemical groups is presented in Appendix D. In this assessment values below the LOD have been included at half of the LOD, which is a conservative approach.

2.2.3 Review of water quality data and loading calculations

The assessment of data has been undertaken for each of the groups identified in Table 3. As the chlorinated, organic and aromatic chlorinated solvents have generally shown similar trends, they have been considered together as one group (solvents). The quality and loading trends for each contaminant group are broadly similar so have been assessed collectively, however any differences are detailed below.

The graphical summaries of the quality and loading data are presented in appendices B and D respectively, however figures 9 to 12 below demonstrate the wider quality of the discharges.

Prior to the restoration scheme there appears to be a seasonal trend with higher concentrations and flows, leading to higher loadings in the discharges during months with higher rainfall. Following the restoration scheme it is evident that some seasonal effect can be seen, however there is a step change in loading at both discharges, which are likely to be due to both flow routing and retention/attenuation in the eastern quarry as a result of the capacity of the wetland.

The following observations can also be made:

- There has been no change in the fact that higher concentrations have been observed at MAE002 compared to MAE001, both prior and following the restoration works.

- Following completion of the restoration works there has been no change in the fact that:
    - Many of the metals (arsenic, cadmium, chromium, copper, lead and mercury) were recorded at low concentrations - typically less than 25 ug/l. Iron and zinc show higher and more variable concentrations, with iron naturally present in the water network surrounding the site.
    - Naphthalene, phenol (total mono) and chlorobenzene were measured at higher concentrations in MAE001 compared to MAE002.
- On two occasions (November 2023 and February 2024, both post restoration work) higher concentrations for naphthalene were observed and correlate with seasonal weather conditions, however subsequent monitoring shows concentrations are stable within the observed range.
- There was a set of unusually higher concentrations observed in November 2023 for a limited number of determinands (cis-1,2-Dichloroethene, 1,1-Dichloroethane, 1,2,4-Trimethylbenzene and 1,3,5-Trimethylbenzene), however subsequent monitoring shows concentrations return to within the observed range, indicating this may have been anomalous.
- Following completion of the restoration scheme there has been a continued notable reduction in ammoniacal nitrogen, chloride and COD.

Figure 9

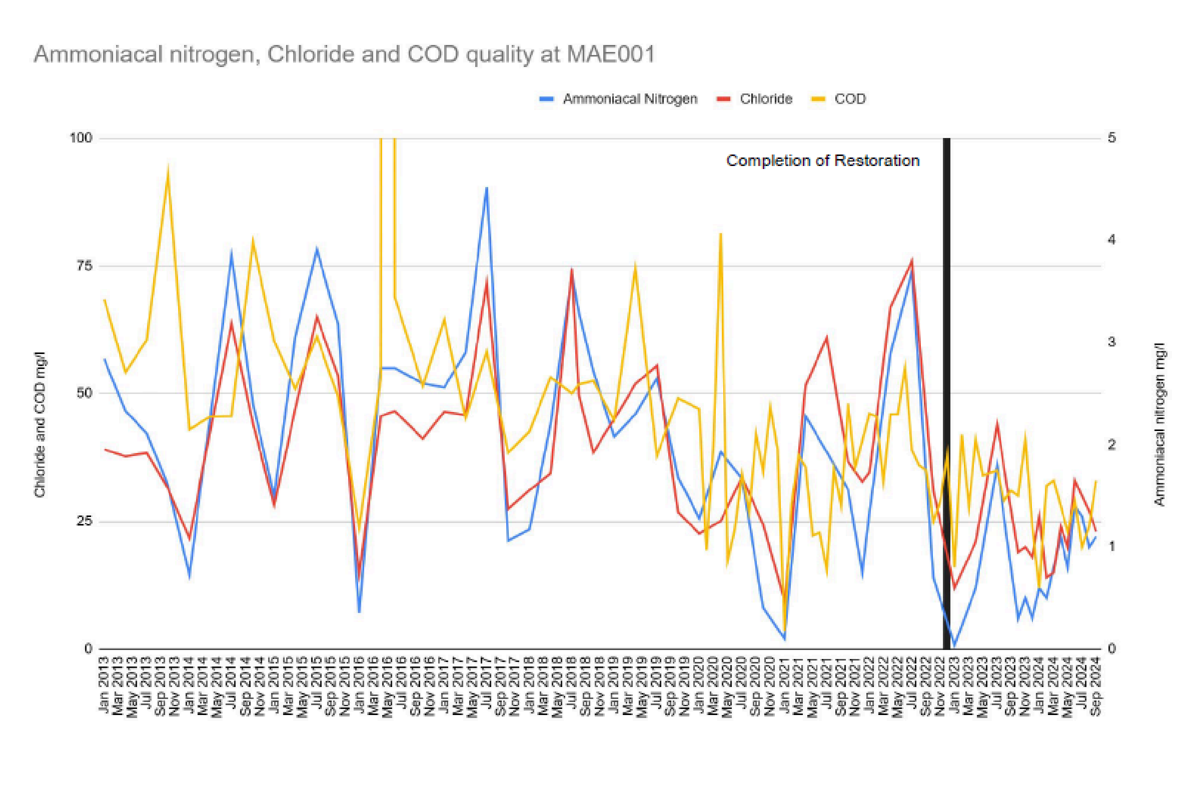


Figure 10

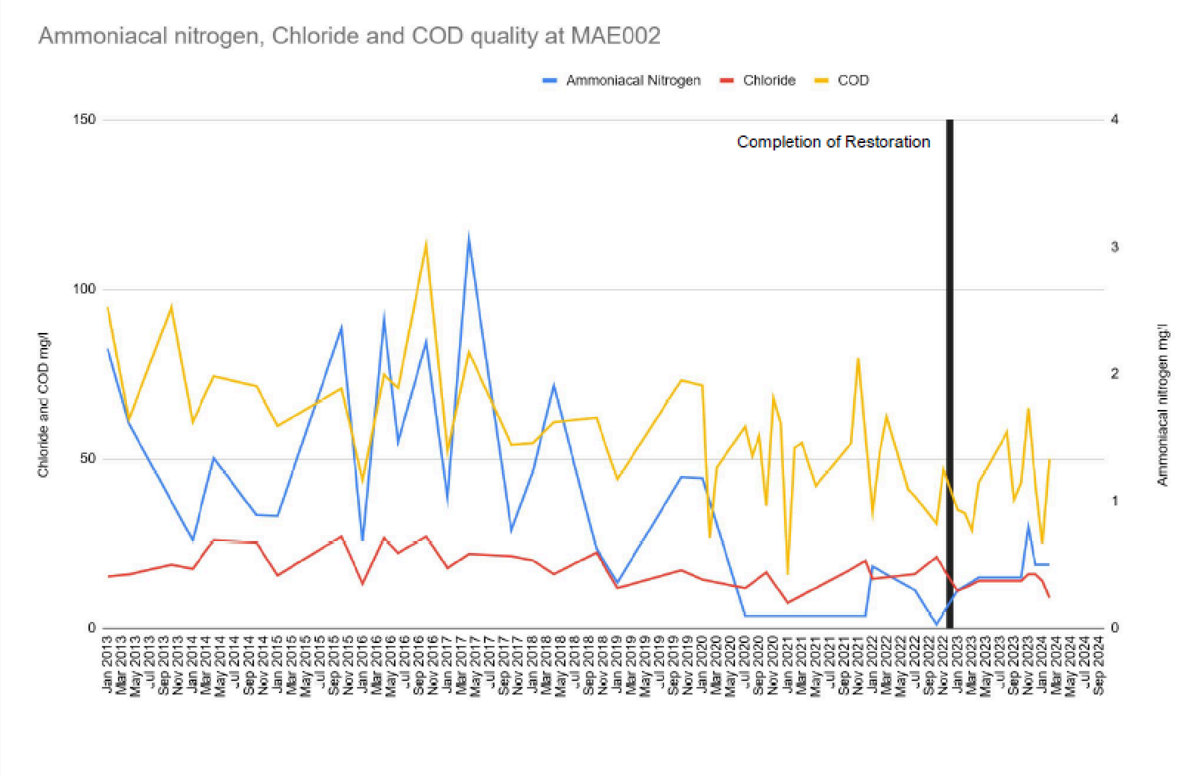


Figure 11

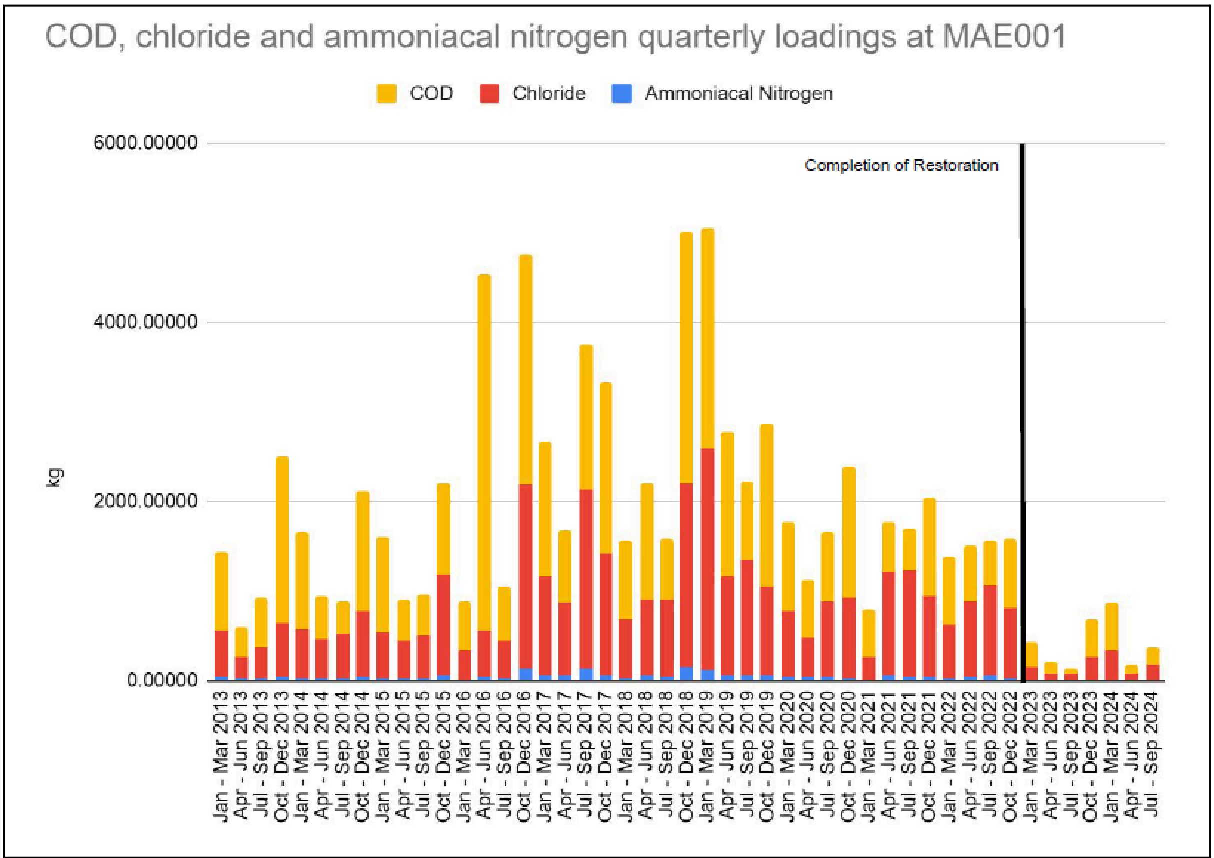
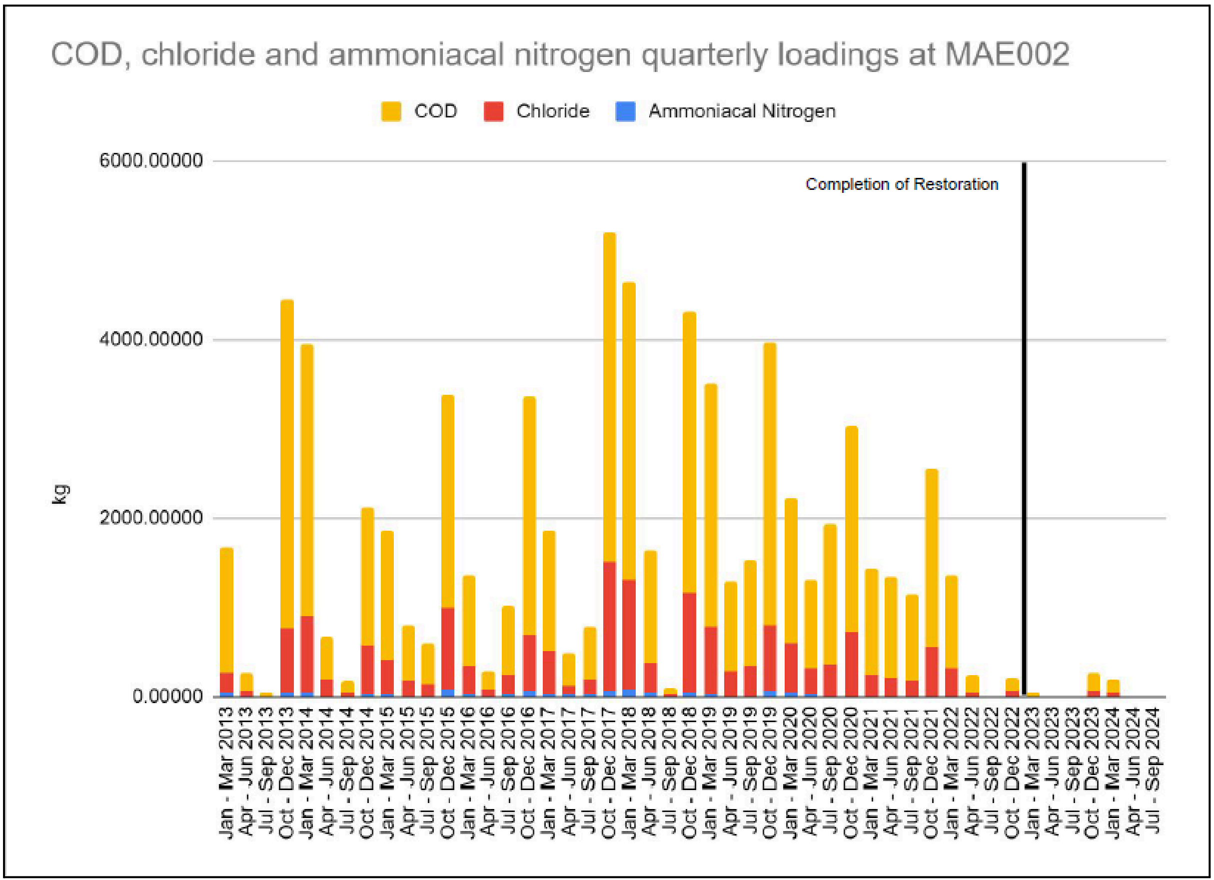


Figure 12



In summary, since the completion of the restoration schemes, a significant proportion of results are reported as less than the limit of detection(<LOD) i.e. not detected.

Following the completion of the restoration scheme it was only possible to collect samples for analysis at MAE002 when a discharge was taking place. Since February 2024 no site drainage has been discharging at MAE002 at the time of the monthly monitoring visits, this is because of the routing of flows from the western quarry to the eastern wetland.

There has been an overall reduction in loading for a number of substances and a significant decline in concentrations at both discharges following the improvement works. It is evident from figures 11 and 12 that the contaminant loading leaving the site has reduced. This demonstrates that the restoration scheme has achieved the design goals set out in IC2.

2.2.4 Mass

In addition to the loading calculations the total mass of determinants leaving the site has also been considered. The mass has been calculated as an average daily value. Tables 6 and 7 summarises this for the groups of contaminants set out in Table 3. A graphical summary for each of the chemical groups is presented in Figures 13 to 30. In the assessment values below the LOD have been included at half of the LOD, which is conservative.

In order to consider performance over time a comparison of the data is presented on an annual basis from the date the works were completed on site, noting some effects of the measures implemented were potentially supporting improvements prior to the date the works were completed.

Table 6 - Summary of average daily mass leaving the site at MAE001

Mass - daily average - kg/day				
Group (range of determinands as Table 3)	**2022** (kg/day)	**2023** (kg/day)	**2024** (kg/day)	**Variance 2022** (prior to works completed) **vs 2024**
BTEX	0.0289	0.0202	0.0042	-85%
Metals	0.0060	0.0026	0.0023	-62%
PAH	0.00087	0.00073	0.00133	-16%*
Solvents	0.0062	0.0055	0.0018	-71%
Pesticides	0.00004	0.000002	0.000002	-95%
Phenols	0.11652	0.0046	0.00099	-99%
Others (COD, NH, Cl)	16.53	4.00	3.79	-77%

* variance comparison undertaken between 2022 to 2023 due to increased limit of detection reported by the lab as a result of dilution and interference noted in 2024

Table 7- Summary of average daily mass leaving the site at MAE002

Mass - daily average kg/day				
Group (range of determinands as Table 3)	**2022** (kg/day)	**2023** (kg/day)	**2024** (kg/day)	**Variance 2022** (prior to works completed) **vs 2024** (kg/day)
BTEX	0.0309	0.0041	0.0018	-94%
Metals	0.0034	0.0006	0.0002	-94%
PAH	0.00021	0.00008	0.00014	-33%
Solvents	0.0018	0.0014	0.0003	-83%
Pesticides	0.00033	0.0001	0.00006	-82%
Phenols	0.08983	0.00026	0.00002	-99%
Others	4.95	0.80	0.51	-90%

As shown in tables 6 and 7 above the average daily values at both MAE001 and MAE002 have reduced considerably following the completion of the works in December 2022. A further reduction of mass has been observed when comparing data from 2023 to 2024. It should be noted that this assessment does not consider background conditions.

Figure 13

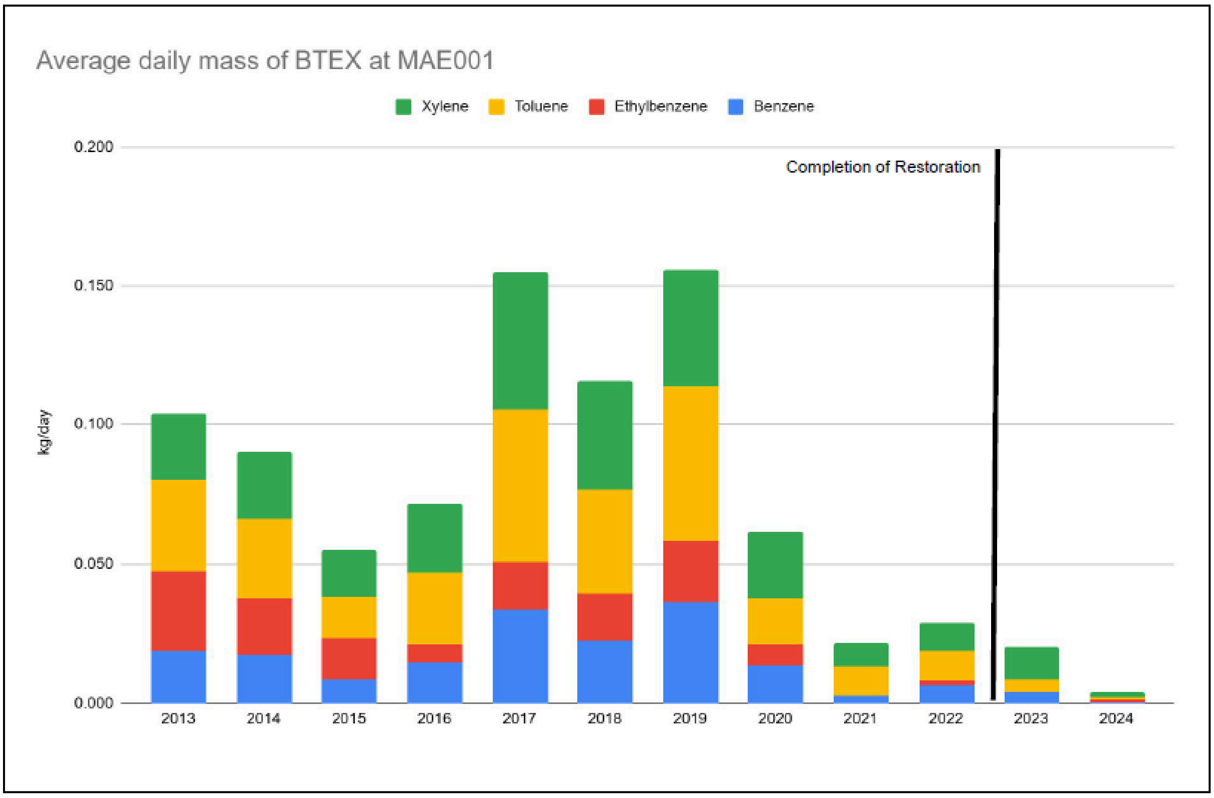


Figure 14

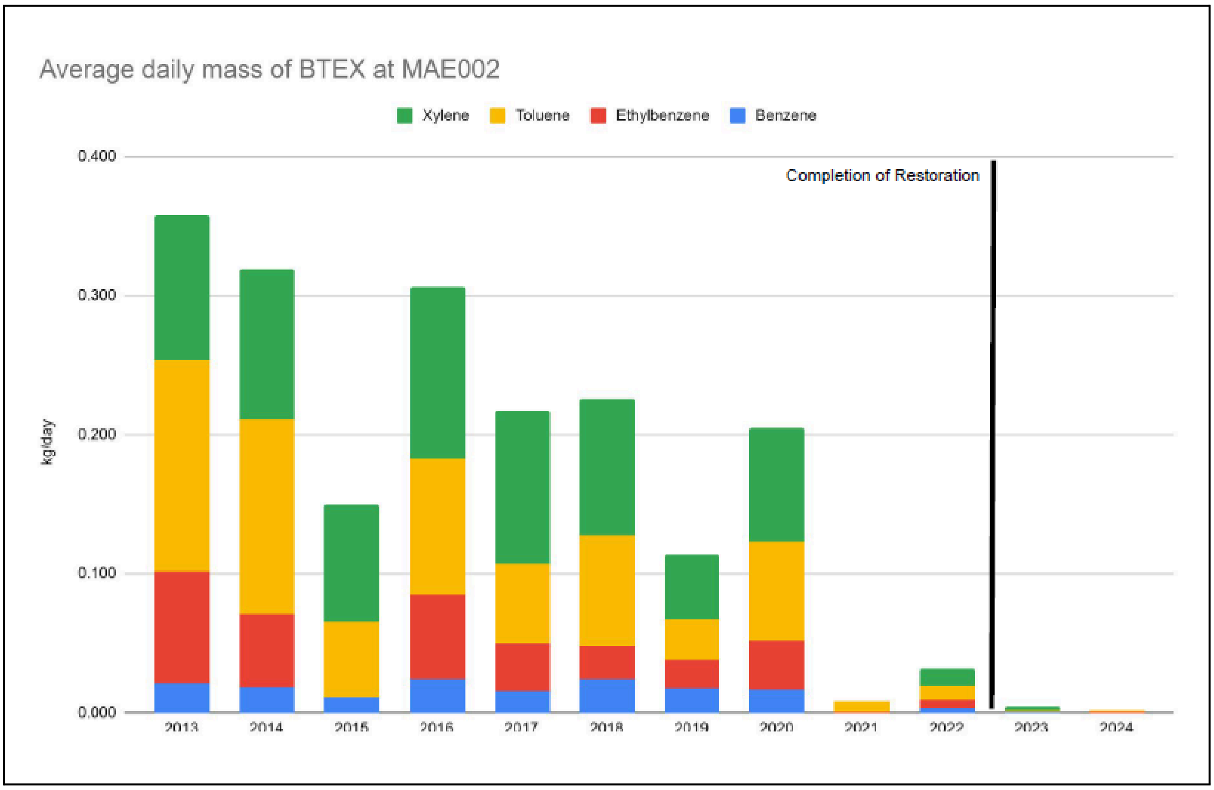


Figure 15

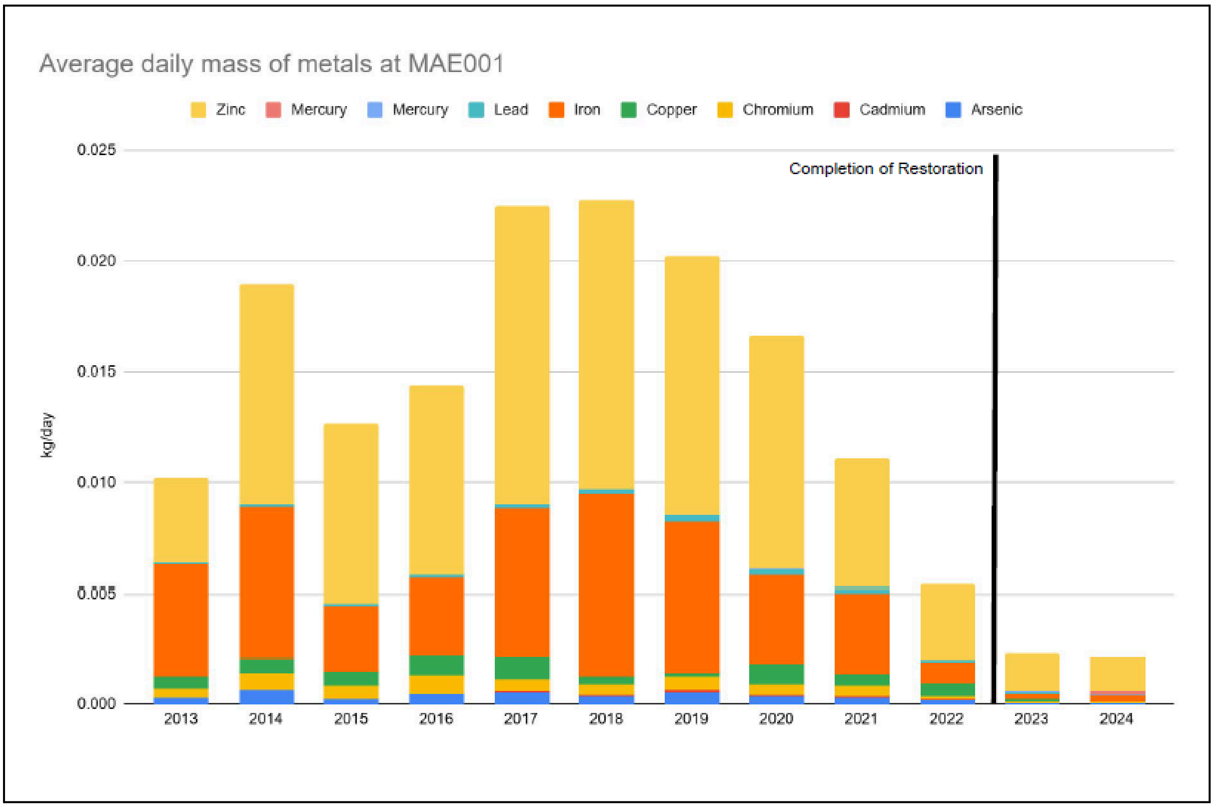


Figure 16

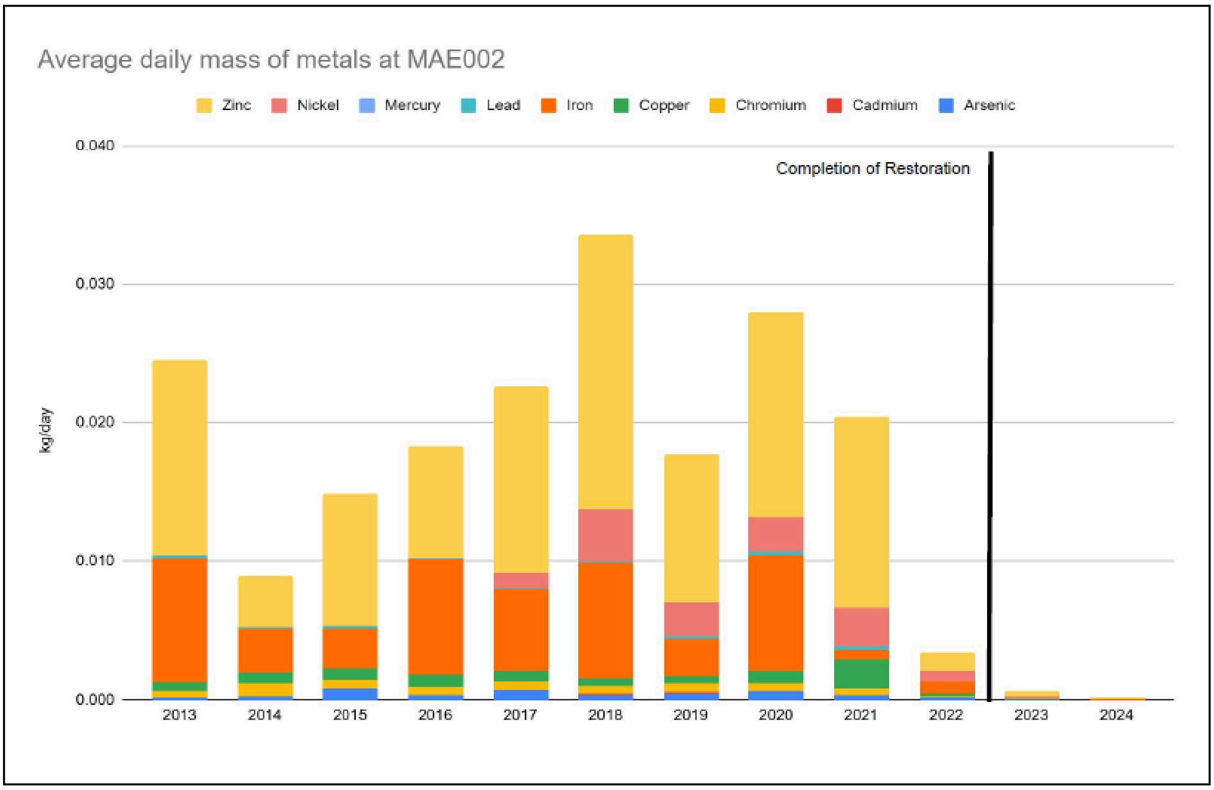


Figure 17

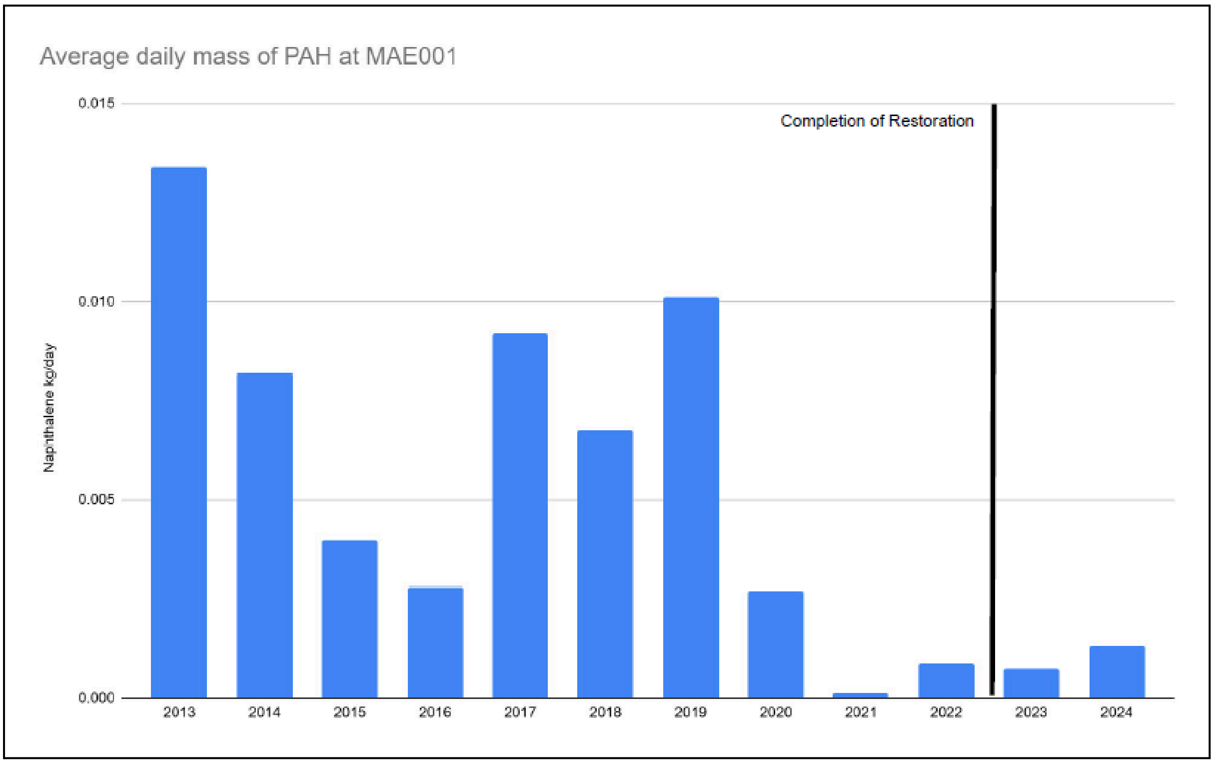


Figure 18

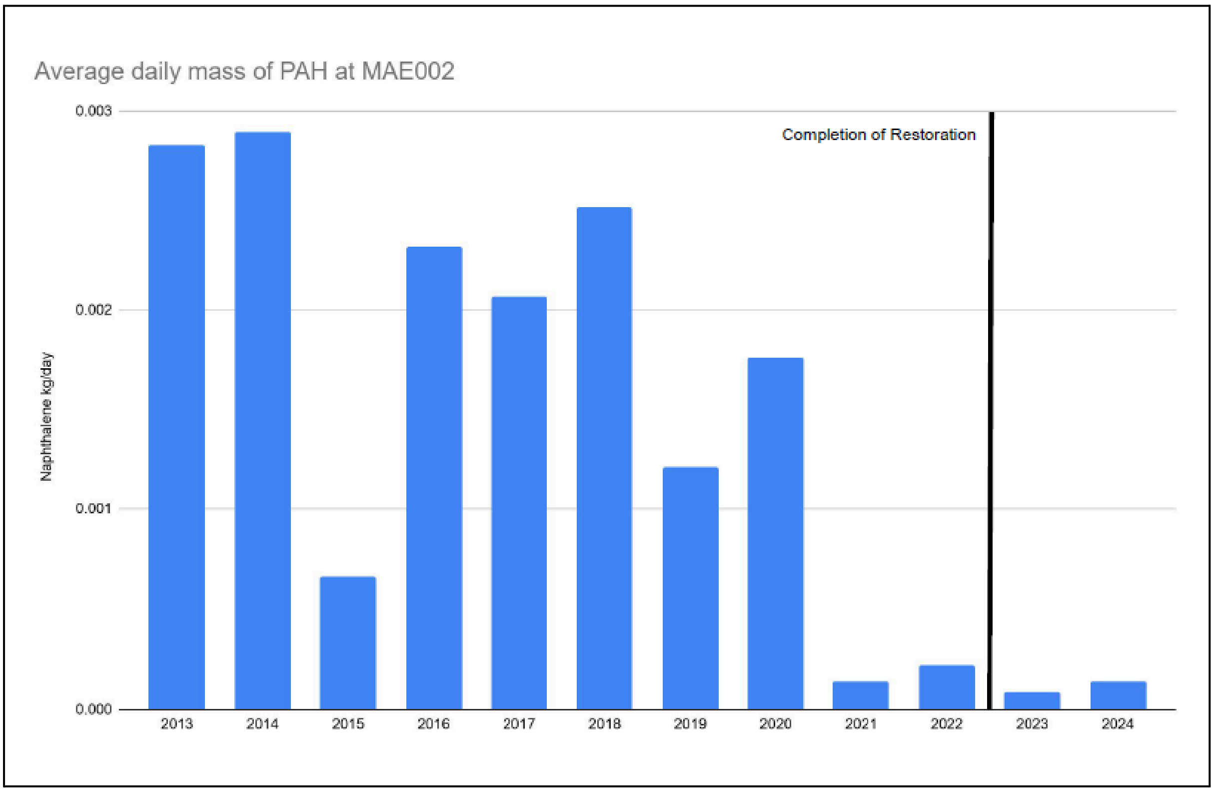


Figure 19

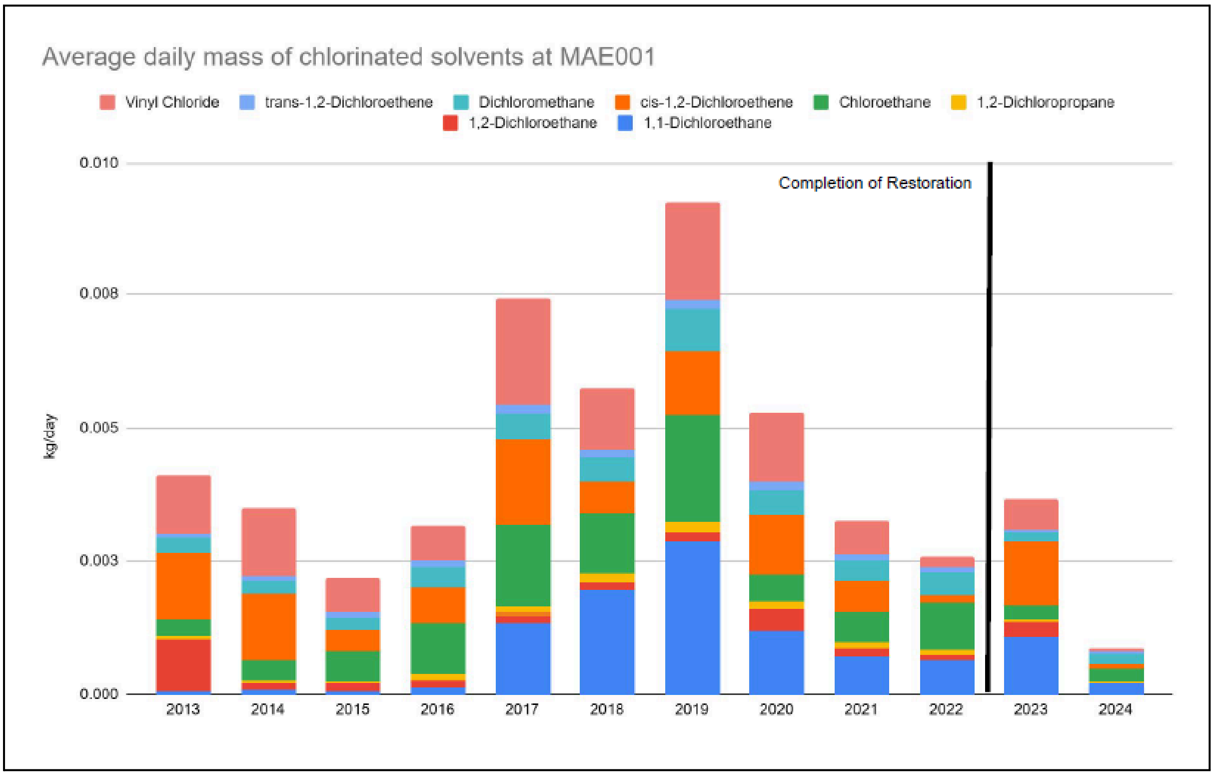


Figure 20

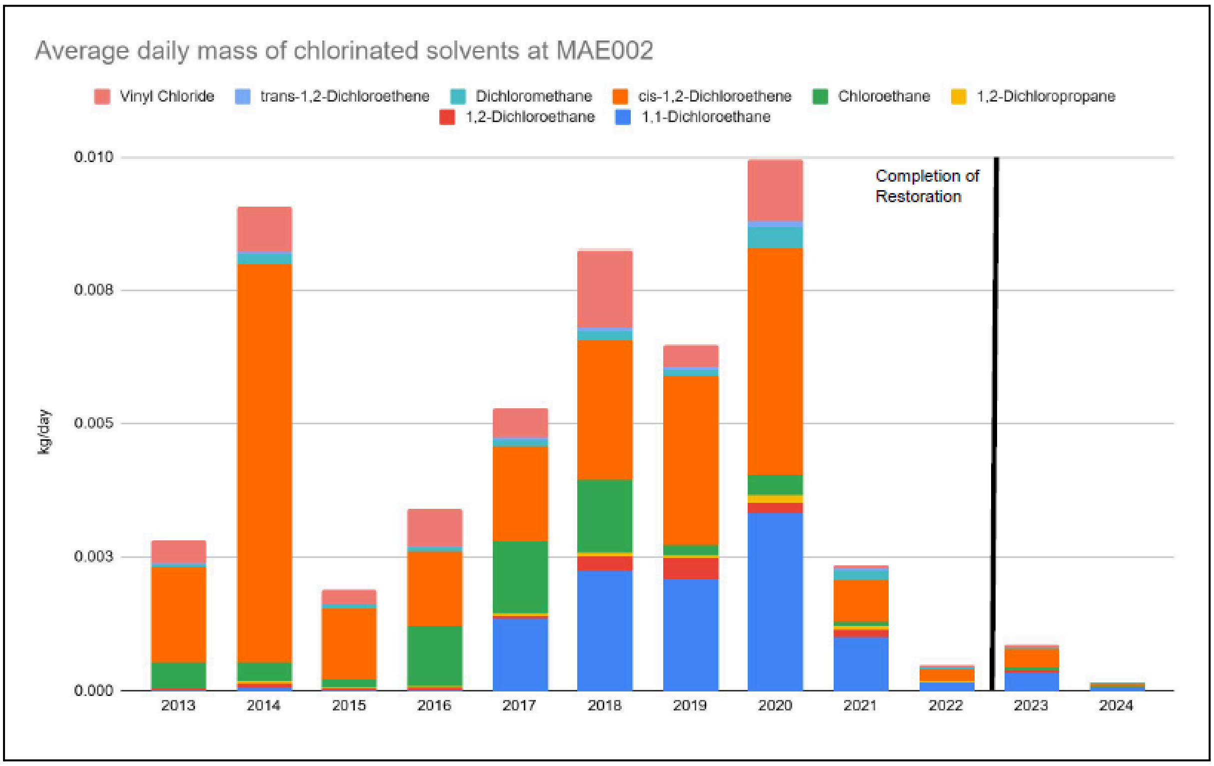


Figure 21

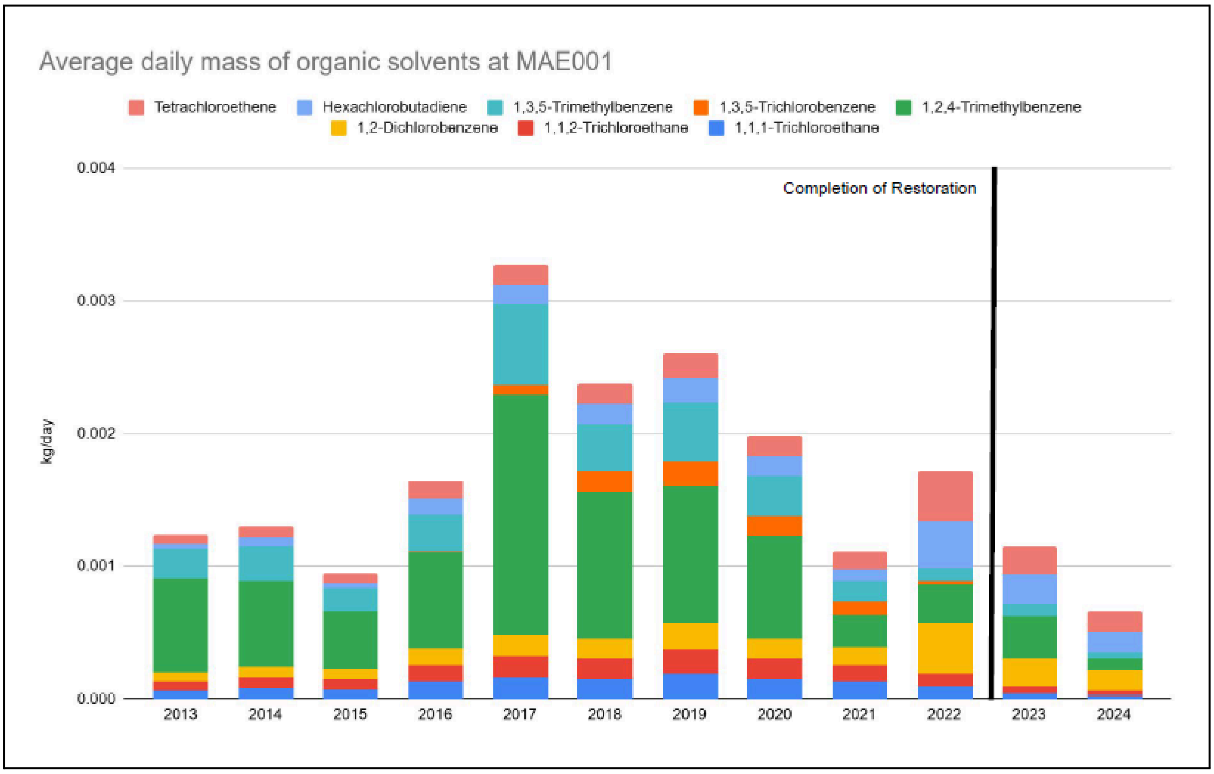


Figure 22

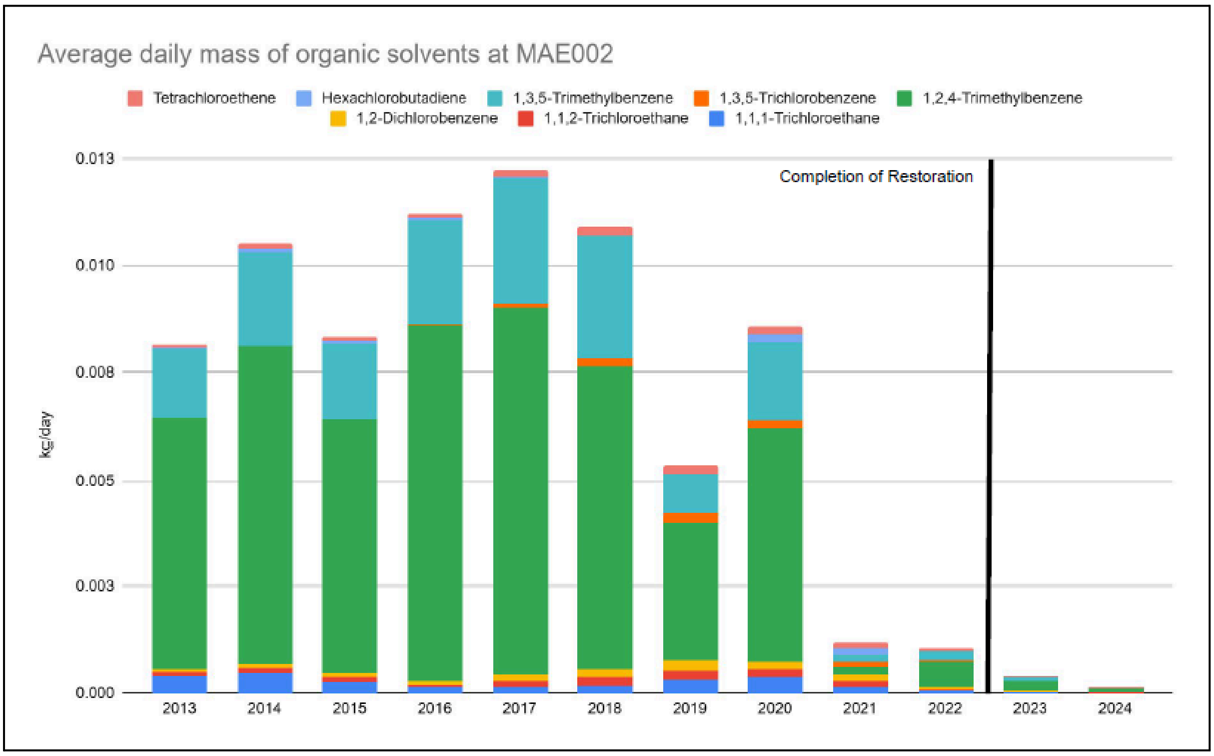


Figure 23

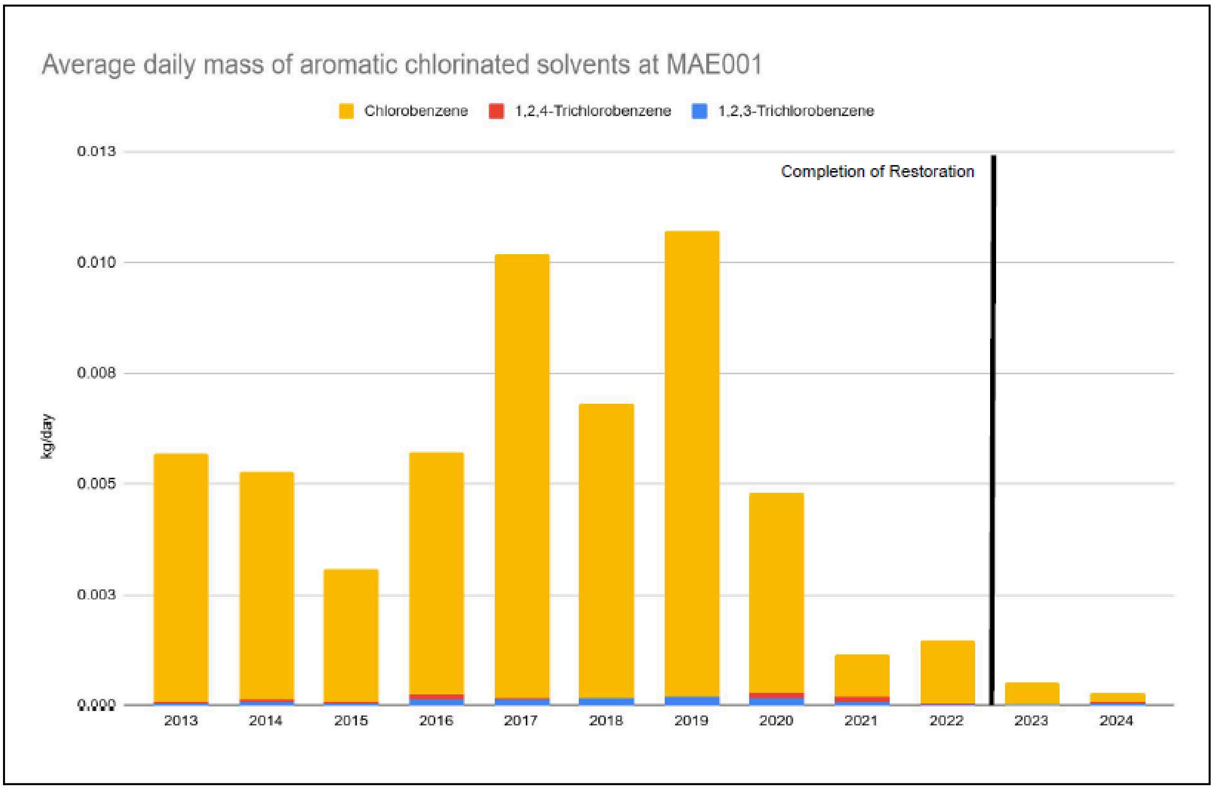


Figure 24

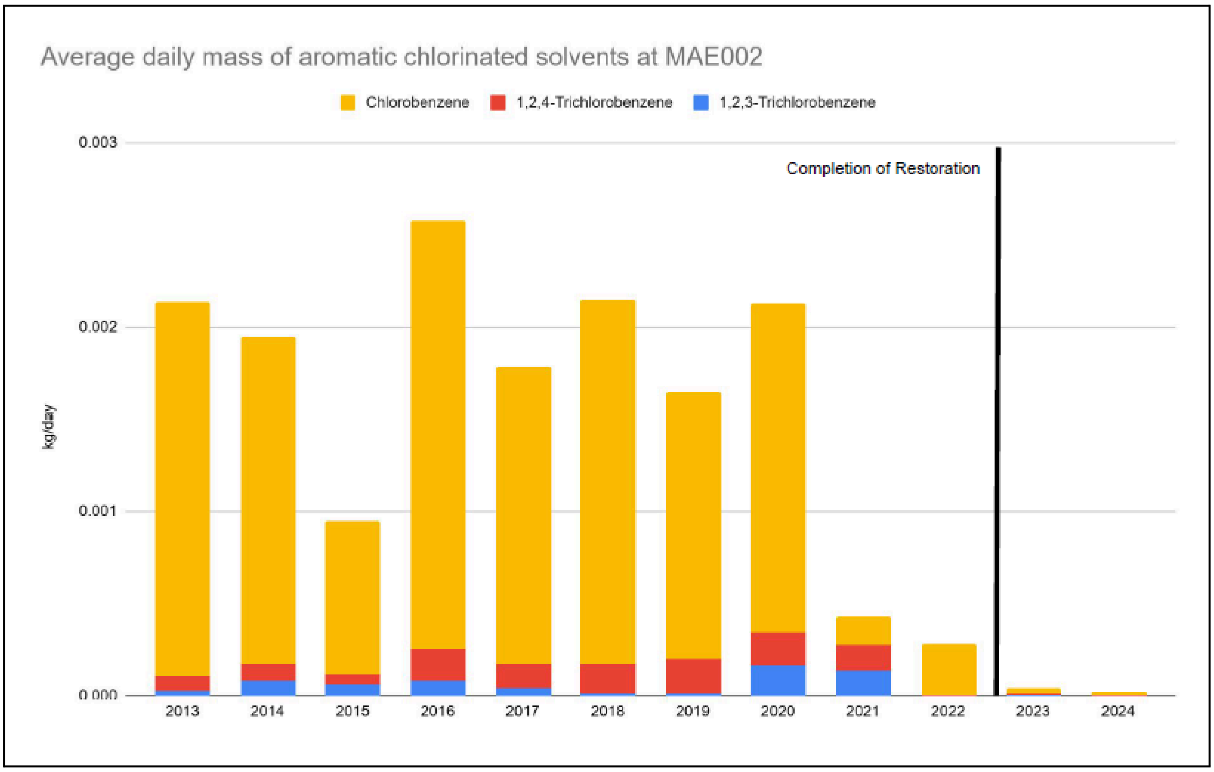


Figure 25

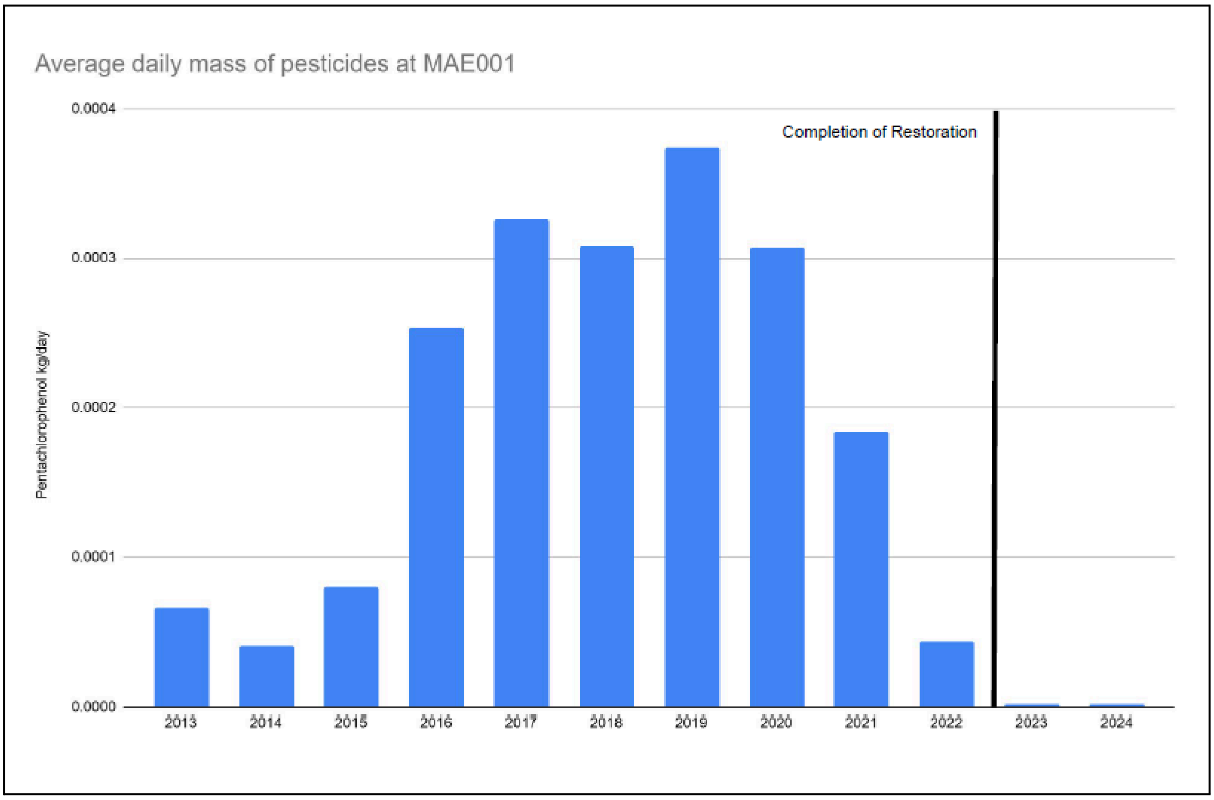


Figure 26

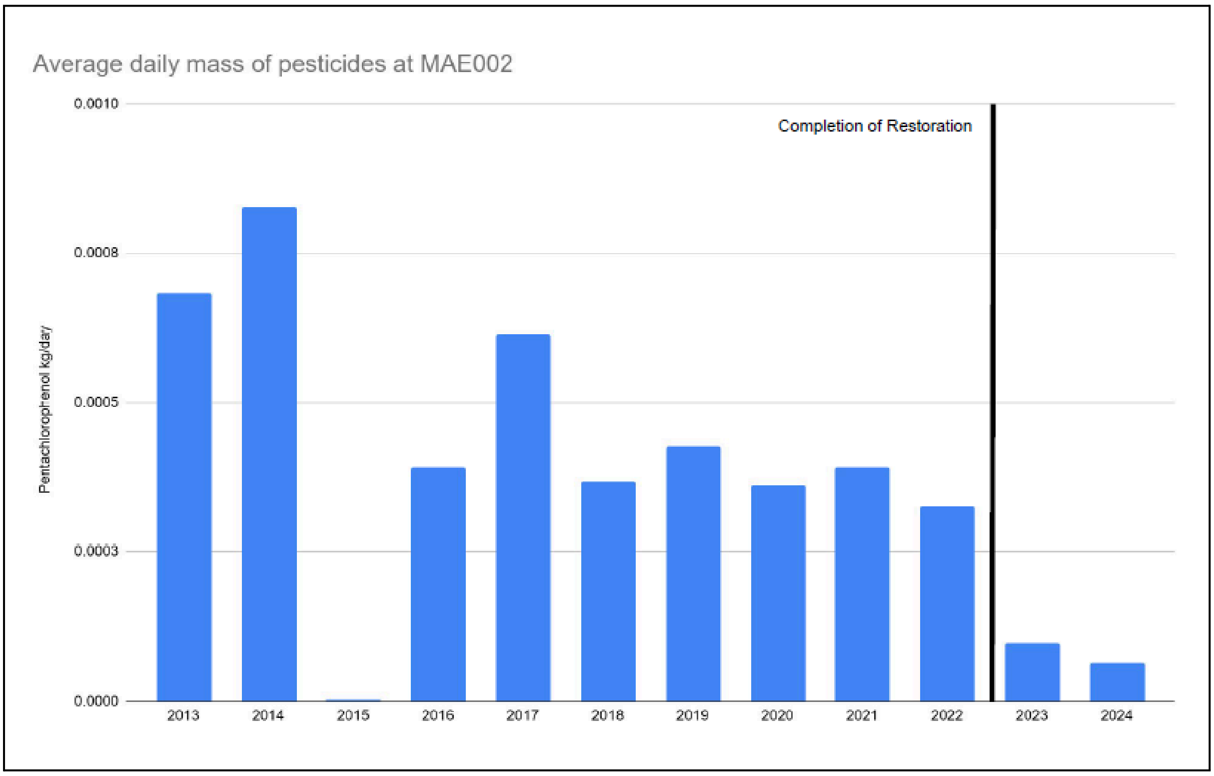


Figure 27

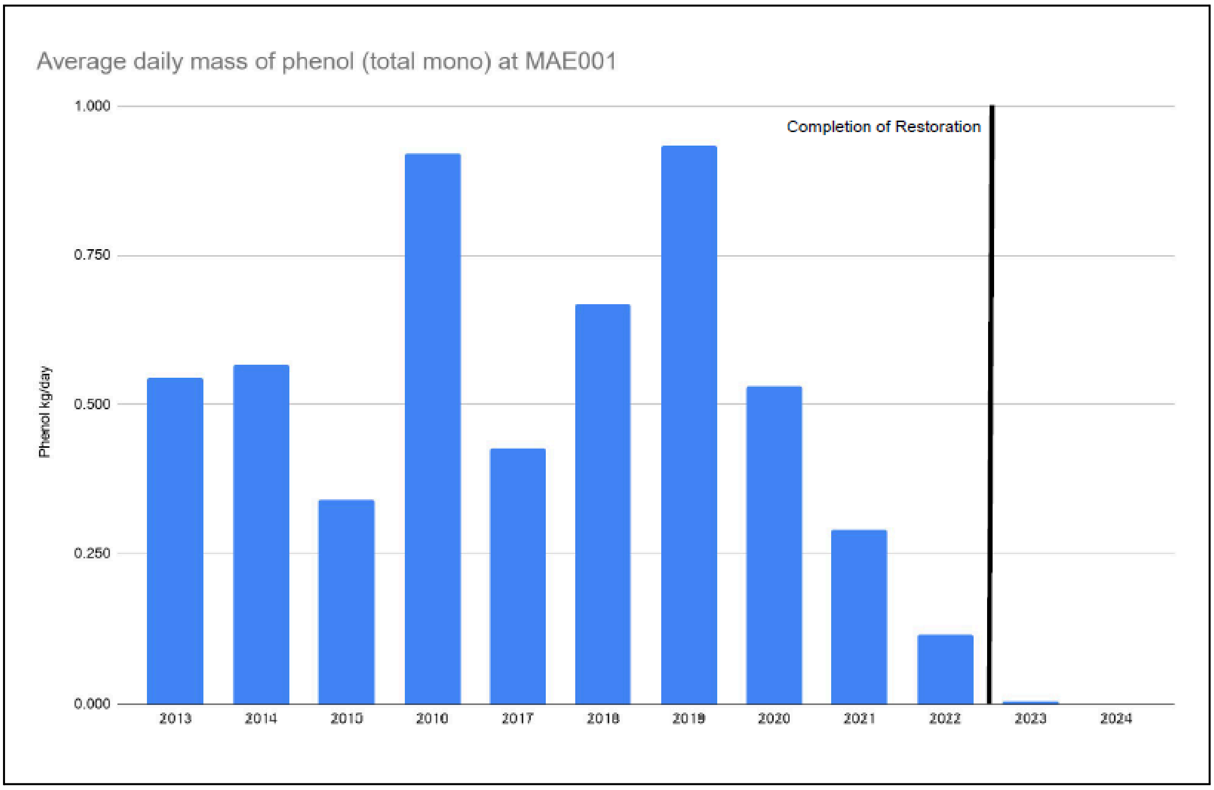


Figure 28

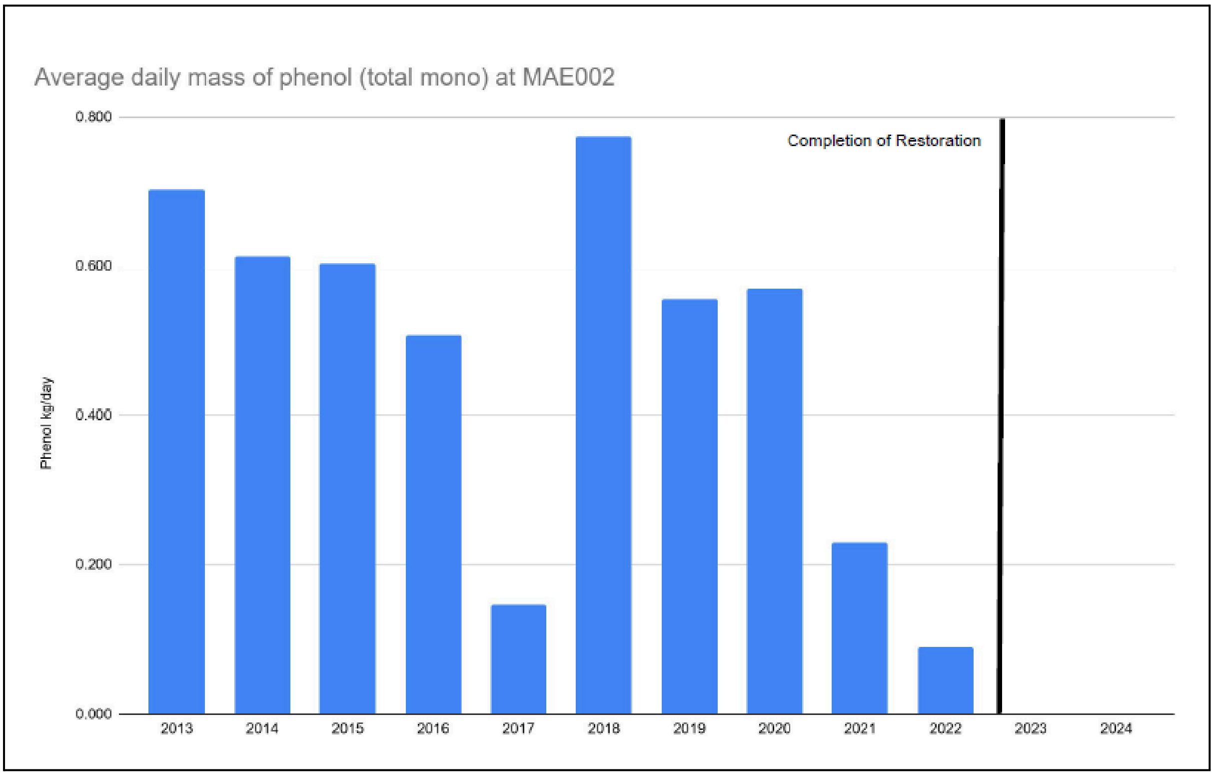


Figure 29

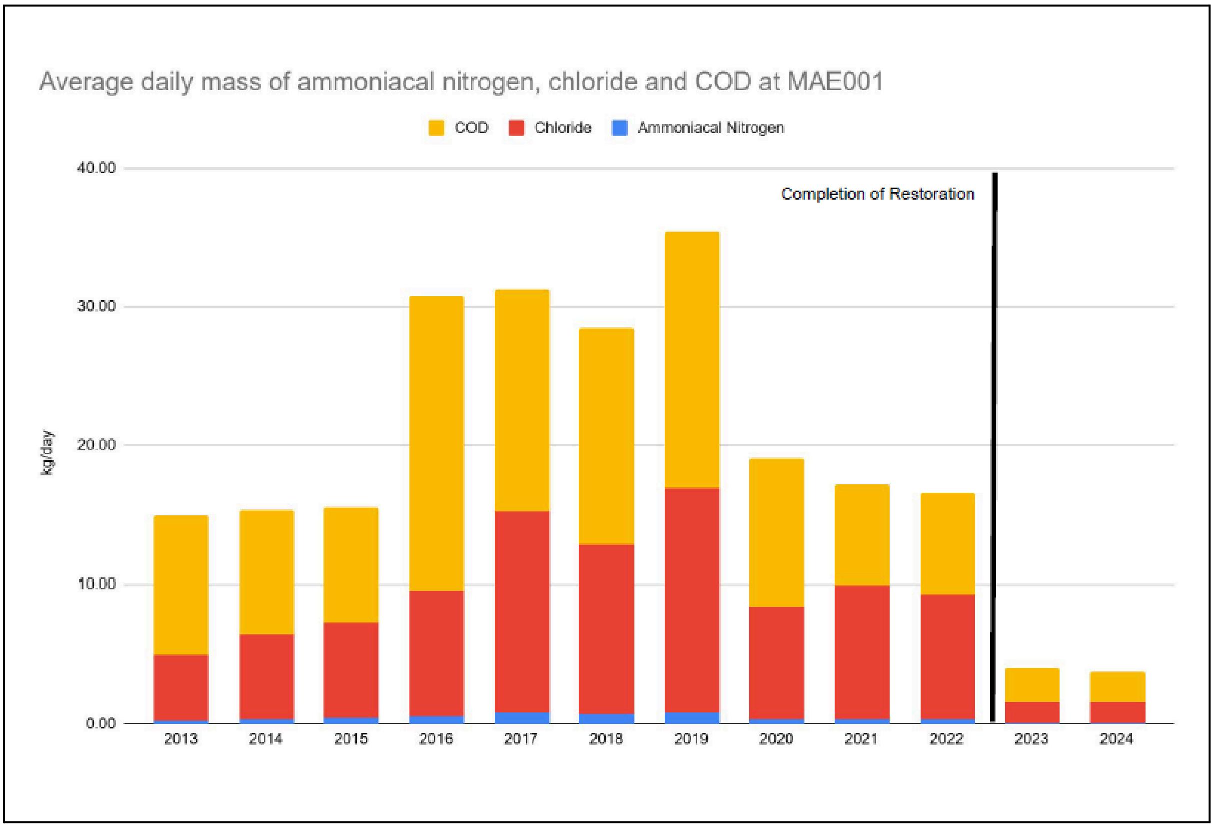
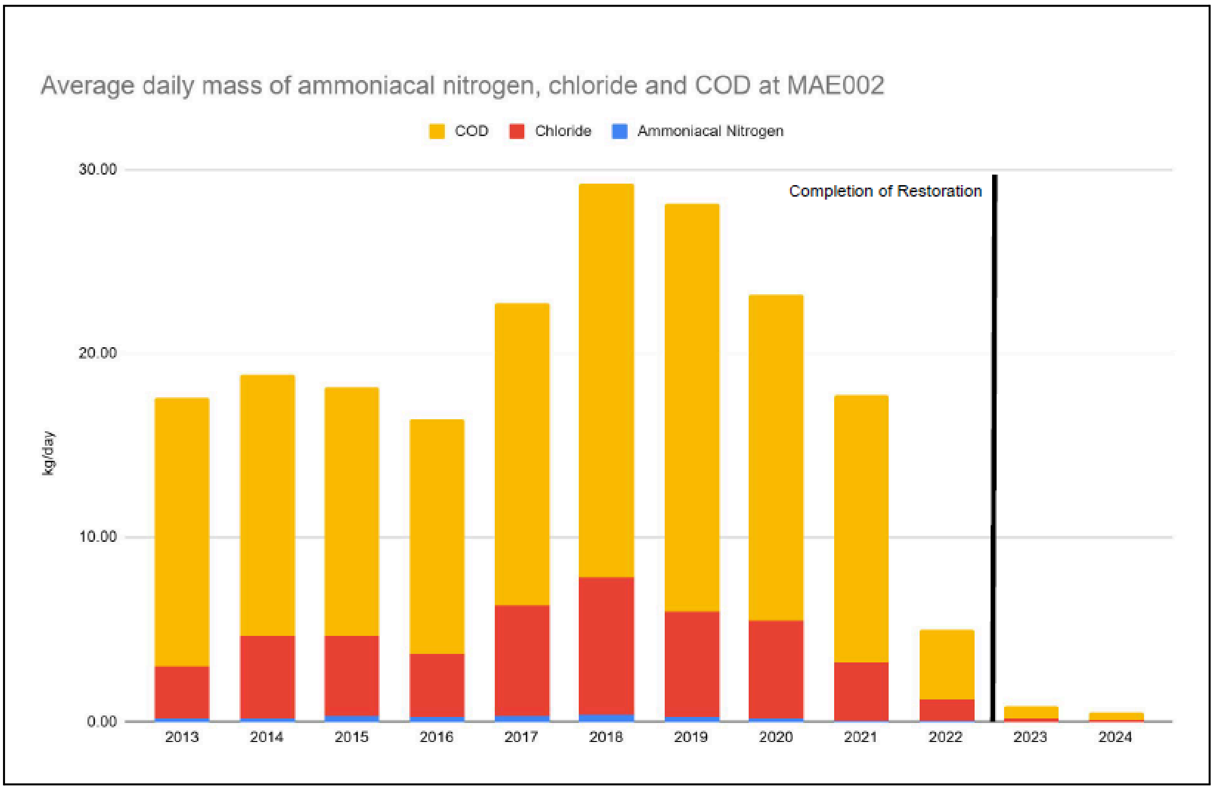


Figure 30



3.0 Review of compliance limits, parameters and frequencies

3.1 Performance of the discharges

The discharges from Maendy are regulated under Environmental Permit AN0236801, which was issued by NRW on 19th July 2018. The permit sets out compliance limits to be met at MAE001 and MAE002 for a range of substances on a monthly basis. These are set out in Table S3.1 of the Permit and are set out in Table 8 below.

Table 8 - Environmental permit compliance limits

Parameter	Limit mg/l	Limit of effective range	Compliance Statistic
COD	300	Average of 12 consecutive samples at monthly intervals	Mean
Phenols (total mono)	5	Average of 12 consecutive samples at monthly intervals	Mean
pH	6 to 9	Average of 12 consecutive samples at monthly intervals	Min and Max
Toluene	2 (MAE001) 3 (MAE002)	Average of 12 consecutive samples at monthly intervals	Mean
Visible oil or grease	No significant trace present	Average of 12 consecutive samples at monthly intervals	Mean

The limits specified in the table above are calculated as an average of 12 consecutive samples taken at monthly intervals.

Graphically displayed time series plots for COD, phenols (total mono), pH and toluene at the two permitted discharge points are presented in Figures 1 to 8 in Section 2.2.

The data confirms that since the Permit was issued in 2018, all results have been compliant with the permit limits set out above. Furthermore it has been demonstrated that there has been an improvement in terms of the quality of the discharges.

In order to provide further insight into the performance of water discharges from the site, data collected from MAE001 and MAE002, following the completion of the restoration improvements, have been compared against Best Available Technique Associated Emission Level values (BAT AEL) for direct discharges. It should be noted that these limits are not applicable to the site activities and are only being used to benchmark water quality performance.

Table 9 below compares the maximum concentrations recorded for the period January 2023 to September 2024 against the maximum value set out in Table 6.1 of the BAT conclusions document. As can be seen for the substances where data was available the maximum values recorded are below the BAT AEL limits.

Table 9 - BAT AEL assessment

Sample Point	Substance	No. tests	No. tests <LoD	Maximum value recorded	BAT AEL - direct discharge
MAE001	Arsenic (ug/l)	15	14	1	100
	Cadmium (ug/l)	15	3	0.28	100
	Chromium (ug/l)	15	14	1	300
	Copper (ug/l)	15	13	2	500
	Lead (ug/l)	15	13	1	300
	Nickel (ug/l)	15	0	5	1000
	Mercury (ug/l)	13	12	0.15	10
	Zinc (ug/l)	15	0	78	2000
	COD (mg/l)	20	0	42	300
	Phenol (ug/l)	20	13	140	300
MAE002	Arsenic (ug/l)	7	0	0.5	100
	Cadmium (ug/l)	7	6	0.53	100
	Chromium (ug/l)	7	0	0.5	300
	Copper (ug/l)	7	0	11	500
	Lead (ug/l)	7	0	1	300
	Nickel (ug/l)	7	0	12	1000
	Mercury (ug/l)	6	6	0.015	10
	Zinc (ug/l)	7	0	62	2000
	TOC (mg/l)	7	7	27.9	100
	COD (mg/l)	11	0	65	300
	Phenol (ug/l)	11	0	50	300

3.2 Downstream water quality

The primary driver for requiring an improvement in the quality of the discharges at Maendy was that the surface water catchment of the Nant Clun had been identified by NRW as failing to meet its desired water quality status at its lower reaches. NRW wished to see a general improvement in the drainage from Maendy Quarry as part of the catchment improvement programme being delivered by NRW.

Veolia has undertaken surface water monitoring at offsite location MAE017, which monitors the downstream confluence of the drainage features that accept the discharges from

MAE001 & MAE002. This location is on the Nant Ty'r Arlwydd which then flows eventually into the Nant Clun. The location of MAE017 is set out in Drawing Ref: Maendy_1222_Monitoring Data.

The data set out in Table 10 compares water quality at MAE017 against the maximum allowable concentration (MAC) for freshwater bodies. The data collected for the period following the completion of the restoration works shows that the maximum concentrations within the water quality at MAE017 are below their respective MAC values. Therefore there is no discernible impact on surface water quality in the receiving waters.

Table 10 - MAE017 water quality

Substance	MAC EQS	Maximum concentration recorded (Jan 2023 to Sept 2024)
1,2-Dichlorobenzene ug/l	200	2.5
Benzene ug/l	50	0.5
Cadmium ug/l	1.5	0.32
Lead ug/l	14	3
Mercury ug/l	0.07	0.015
Naphthalene ug/l	130	0.005
Nickel ug/l	34	3
Phenol ug/l	46	0.25
Toluene ug/l	380	0.5

3.3 Assessment Values

Improvement Condition 4 requires that a review of the performance of the restoration works is completed and that further recommendations / improvements are made. The assessment completed in Section 3 demonstrates that all results have been compliant with the permit limits since the permit was issued in 2018.

In order to assist in understanding the performance of the discharges, assessment values for the parameters currently in the permit have been derived. These will be used as a tool to assess whether the site measures continue to perform in line with expectations.

These assessment values have been derived using the approach outlined in Environment Agency R&D document P1-471, as referenced in LFTGN02. The assessment values are set out in Table 9 below and are summarised graphically in Figures 31, 32 and 33 below. These assessment levels will be incorporated into the site's management systems and will be reviewed periodically and revised if deemed necessary.

Table 11 Assessment Values

Discharge point	Parameter	Assessment value
MAE001	COD mg/l	100
	Phenols (total mono) ug/l	2
	pH	6 to 9
	Toluene ug/l	400
MAE002	COD mg/l	150
	Phenols (total mono) ug/l	2
	pH	6 to 9
	Toluene ug/l	400

Figure 31

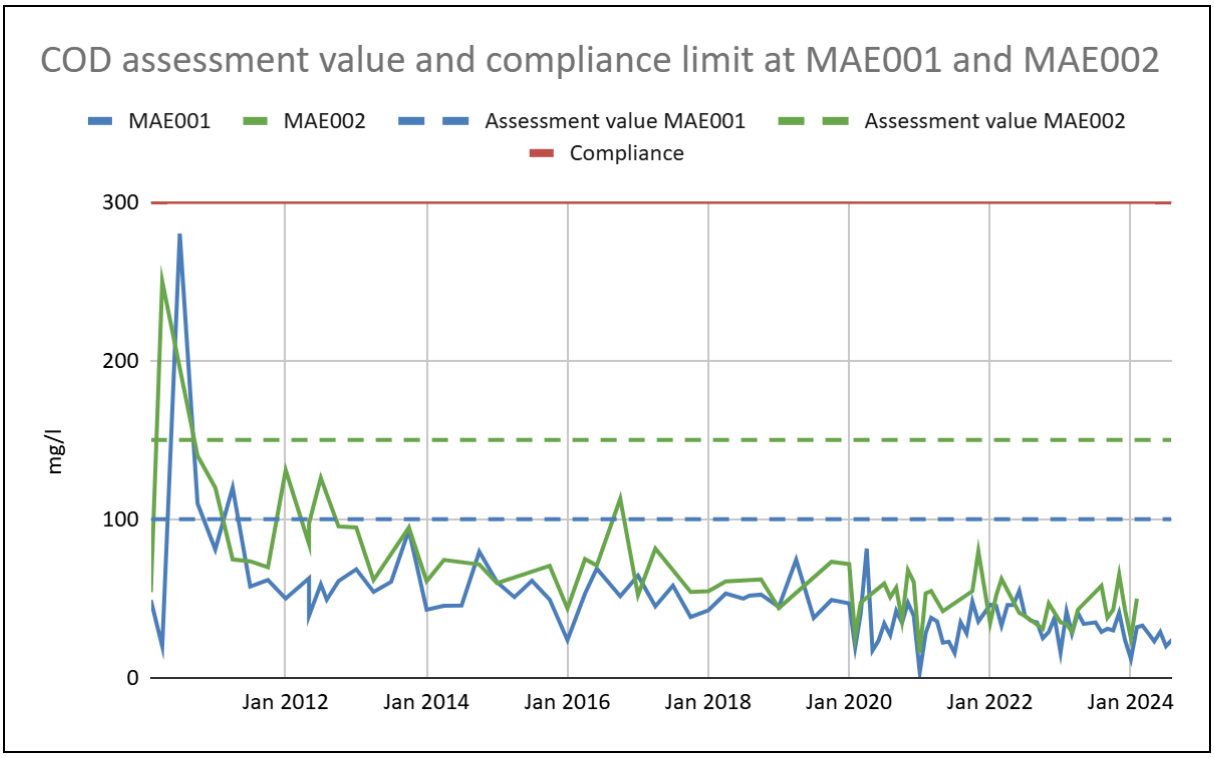


Figure 32

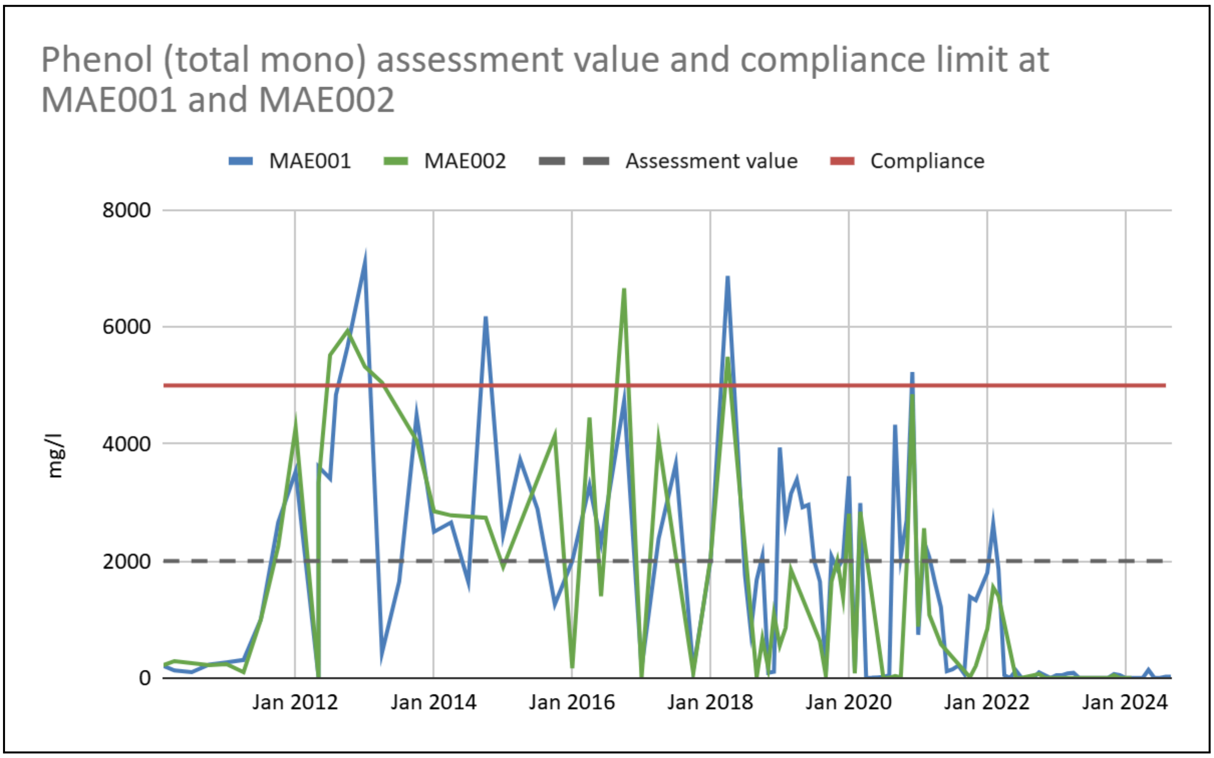
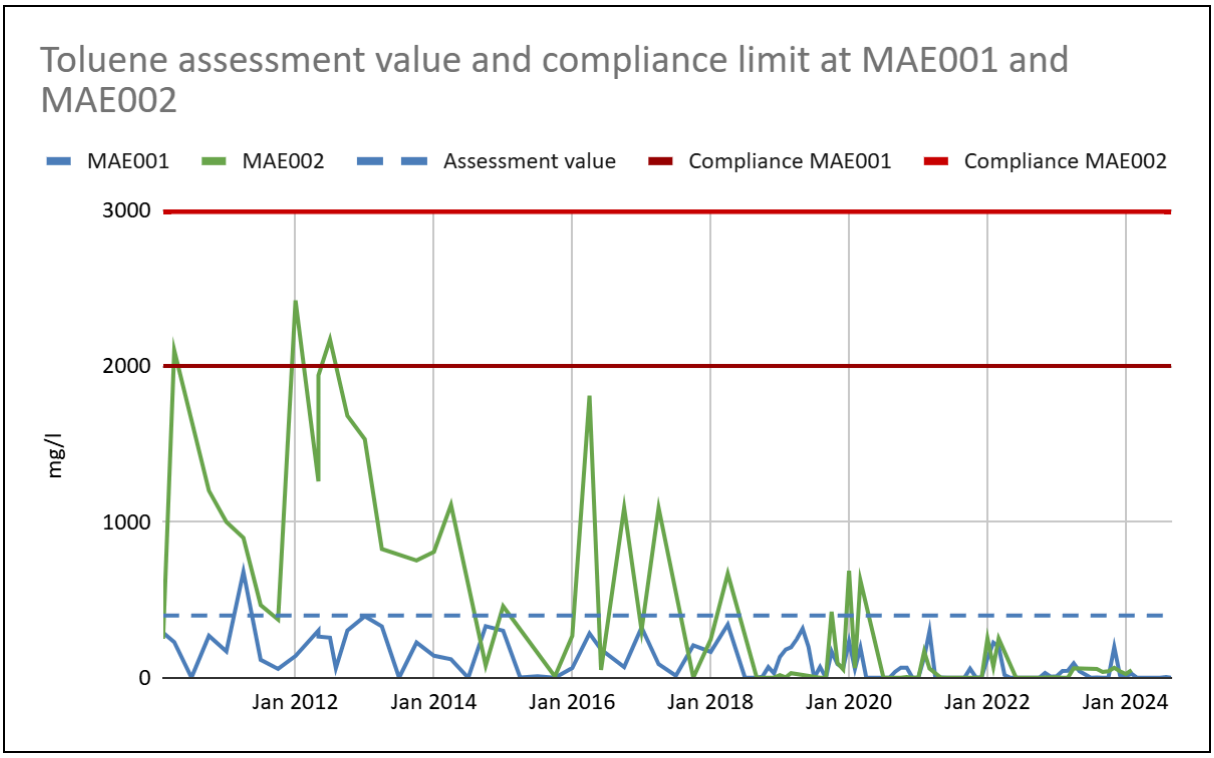


Figure 33



3.4 Proposed Monitoring

In addition to deriving assessment values, key substances from Table 3 will continue to be monitored to measure the ongoing performance of the restoration works alongside the monitoring required by the Permit. The following key substances have been selected to represent the groups in table 3:

- Ammoniacal nitrogen - inorganic cation
- Chloride - inorganic anion
- Naphthalene - hydrophobic organic chemical
- Chromium - highly mobile metallic ion
- Mercury - less mobile metallic ion
- 1,2-Dichloroethane - chlorinated solvent
- 1,3,5-Trichlorobenzene - organic solvent
- 1,2,3-Trichlorobenzene - aromatic chlorinated solvent

By undertaking the monitoring of key substances alongside the existing Permit monitoring, will assist in assessing changes in performance that may require further assessment and action.

4.0 Summary

The primary driver for requiring an improvement in the quality of the discharges at Maendy was that the surface water catchment of the Nant Clun had been identified by NRW as failing to meet its desired water quality status at its lower reaches. NRW wished to see a general improvement in the drainage from Maendy Quarry as part of the catchment improvement programme being delivered by NRW.

Further to completion of the works required by the improvement programme set out in the Permit, there has been ongoing monitoring of the performance of the discharges to support this report (required in accordance with Improvement Condition 4).

The data acquired from this monitoring is set out in the above sections of this report and is summarised graphically.

The data shows that as a result of the works undertaken in the eastern and western quarries that there has been an improvement in the quality of the site drainage at MAE001 and MAE002.

Proposals for future monitoring and assessment of the discharges have been proposed in Section 3.

5.0 Recommendations

In recognition of the need to continue to comply with the Permit the following measures will be considered:

1. Monitoring of the discharges will be undertaken in line with the proposals set out in Section 3 of this report.

2. General maintenance will be undertaken including
    a. Inspection of the collection sump and pre settlement trap to ensure no sediment or debris has impeded the performance
    b. Removal of any sediment or debris within the collection sump
    c. Ongoing maintenance of the planting in the wetland

3. Other potential options to support the continued performance monitoring and compliance:
    a. Establish background surface water quality for comparison purposes
    b. Review the baseline pumping set rate of $2m^3$/hr from the west quarry collection sump that is being pumped to the east quarry
    c. Investigate the wetland media (trial pits) to determine if the flow through the wetland is performing efficiently, to maximise the media depth/area and ensure it is not becoming clogged or short cutting by via preferential routes
    d. As part of the wetland trial trial pit investigation, review the water distribution within the wetland to determine if the full depth of media within the wetland is utilised.

4. If warranted by the above investigation and ongoing monitoring:
    a. If there is an identified reduction in performance of the wetlands consider reworking the wetland media to promote improved attenuation of drainage from the site through the wetland media, and if deemed appropriate introduction of additional media
    b. If following a) above there are ongoing concerns about performance consider replacing the wetland media in stages and consider changing the proportions of wood chip, aggregates and soil
    c. consider increasing the outlet bund level from the wetland into the marsh area to further maximise the capacity and retention within the wetland
    d. In the event there is a reduction in performance of the eastern quarry wetland during low flows, consider the recirculation of site drainage from the downstream end of wetland area in the eastern quarry back into the upstream area top of the eastern quarry wetland during low flow conditions to increase retention time and improve attenuation through the wetland.

Legend

- Site Boundary
- Surface Water
- Pipe or sub-surface flow
- Surface Water Location (MAE001)

Rev	Description of revision	Drawn	Chkd	App	Date

VEOLIA

Norwood Industrial Estate,
Rotherham Road,
Killamarsh, Sheffield, S21 2DR

Project

MAENDY

Title

Maendy Monitoring Point Locations

	Initials	Date	Scale	Sheet size
Drawn	AP	17/01/25	NTS	A3
Checked				
Approved			© Copyright Reserved	

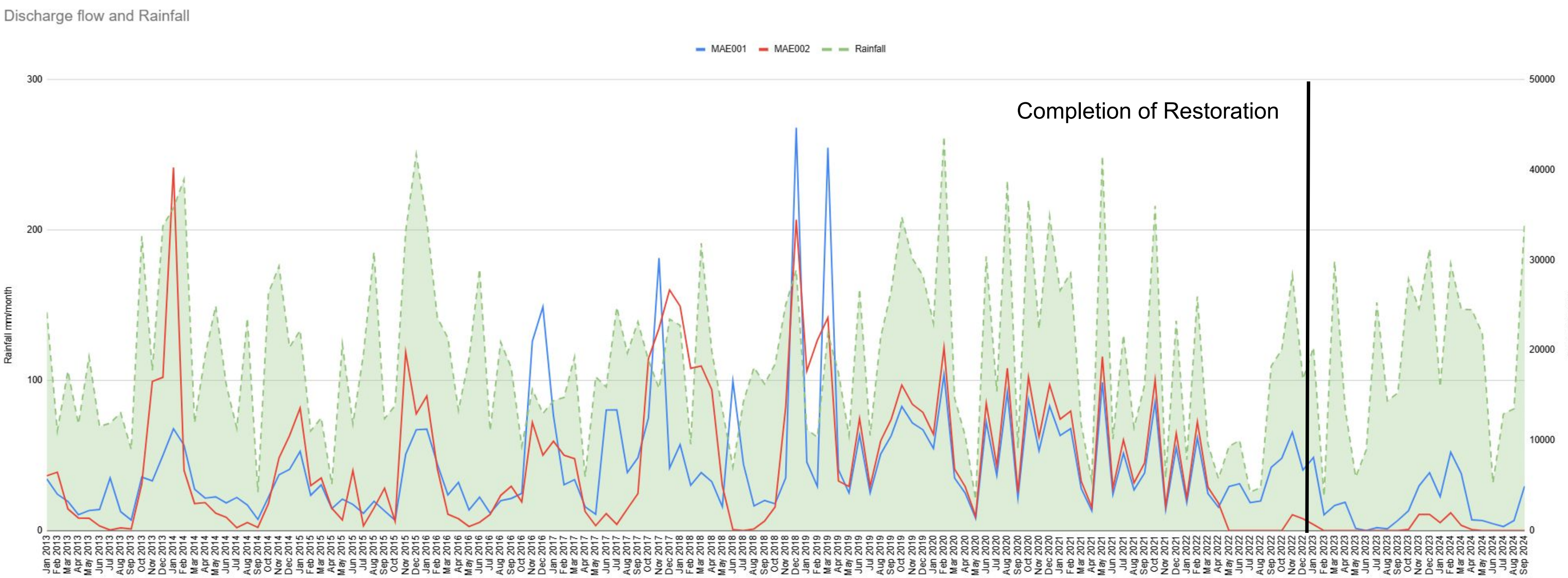
Job No.

Drawing No. MAE_MON_01_25

Revision 0

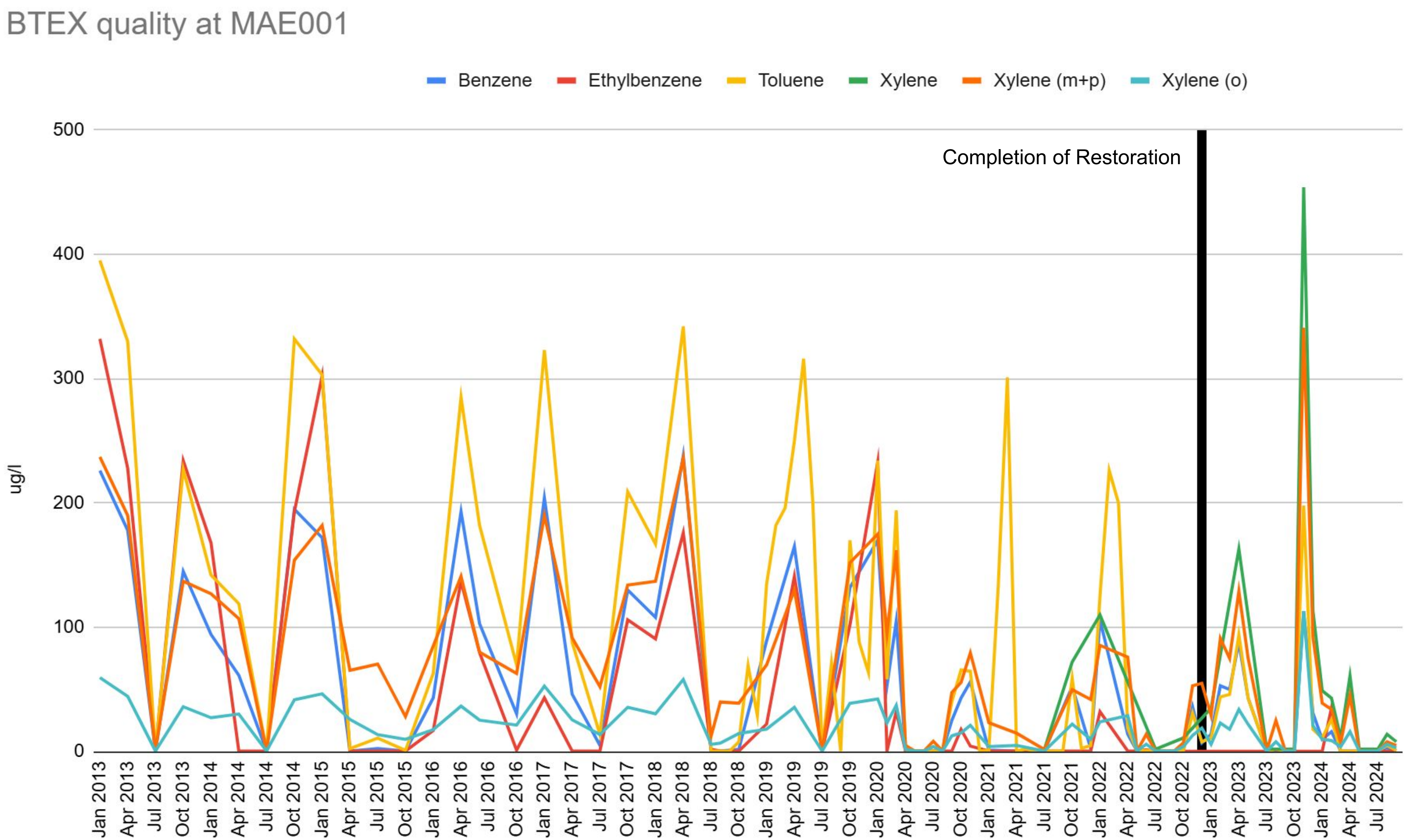
Appendix A

Graphical Summary of the flow monitoring


Discharge flow and Rainfall
MAE001
MAE002
Rainfall
Rainfall mm/month
Flow m3/month
300
200
100
0
50000
40000
30000
20000
10000
0
Completion of Restoration

Appendix B

Graphical summary of the quality of the site drainage


BTEX quality at MAE001
Benzene
Ethylbenzene
Toluene
Xylene
Xylene (m+p)
Xylene (o)
Completion of Restoration
ug/l
500
400
300
200
100
0
Jan 2013
Apr 2013
Jul 2013
Oct 2013
Jan 2014
Apr 2014
Jul 2014
Oct 2014
Jan 2015
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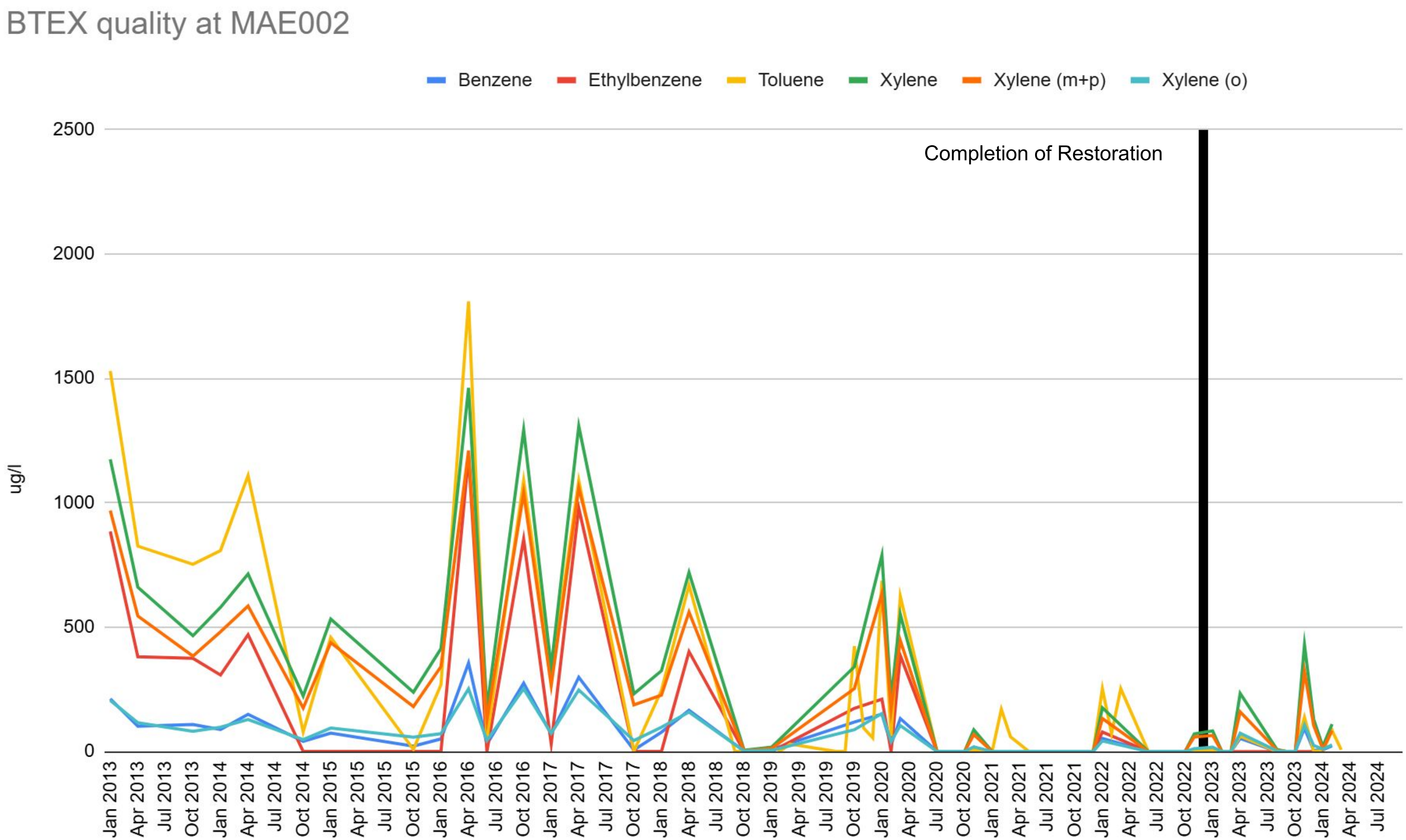
BTEX quality at MAE002
Benzene
Ethylbenzene
Toluene
Xylene
Xylene (m+p)
Xylene (o)
Completion of Restoration
ug/l
2500
2000
1500
1000
500
0
Jan 2013
Apr 2013
Jul 2013
Oct 2013
Jan 2014
Apr 2014
Jul 2014
Oct 2014
Jan 2015
Apr 2015
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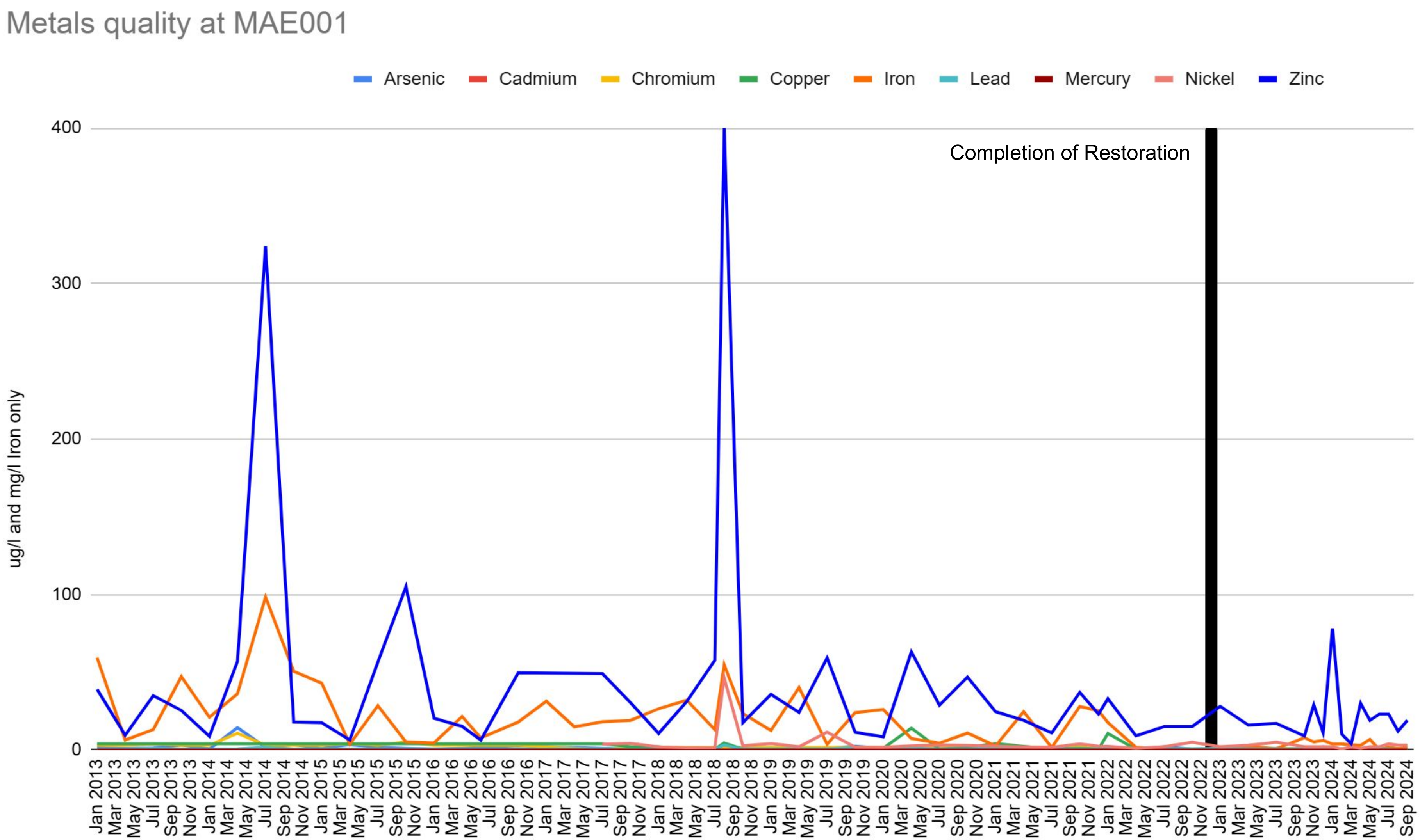
Metals quality at MAE001
Arsenic
Cadmium
Chromium
Copper
Iron
Lead
Mercury
Nickel
Zinc
Completion of Restoration
ug/l and mg/l Iron only
400
300
200
100
0
Jan 2013
Mar 2013
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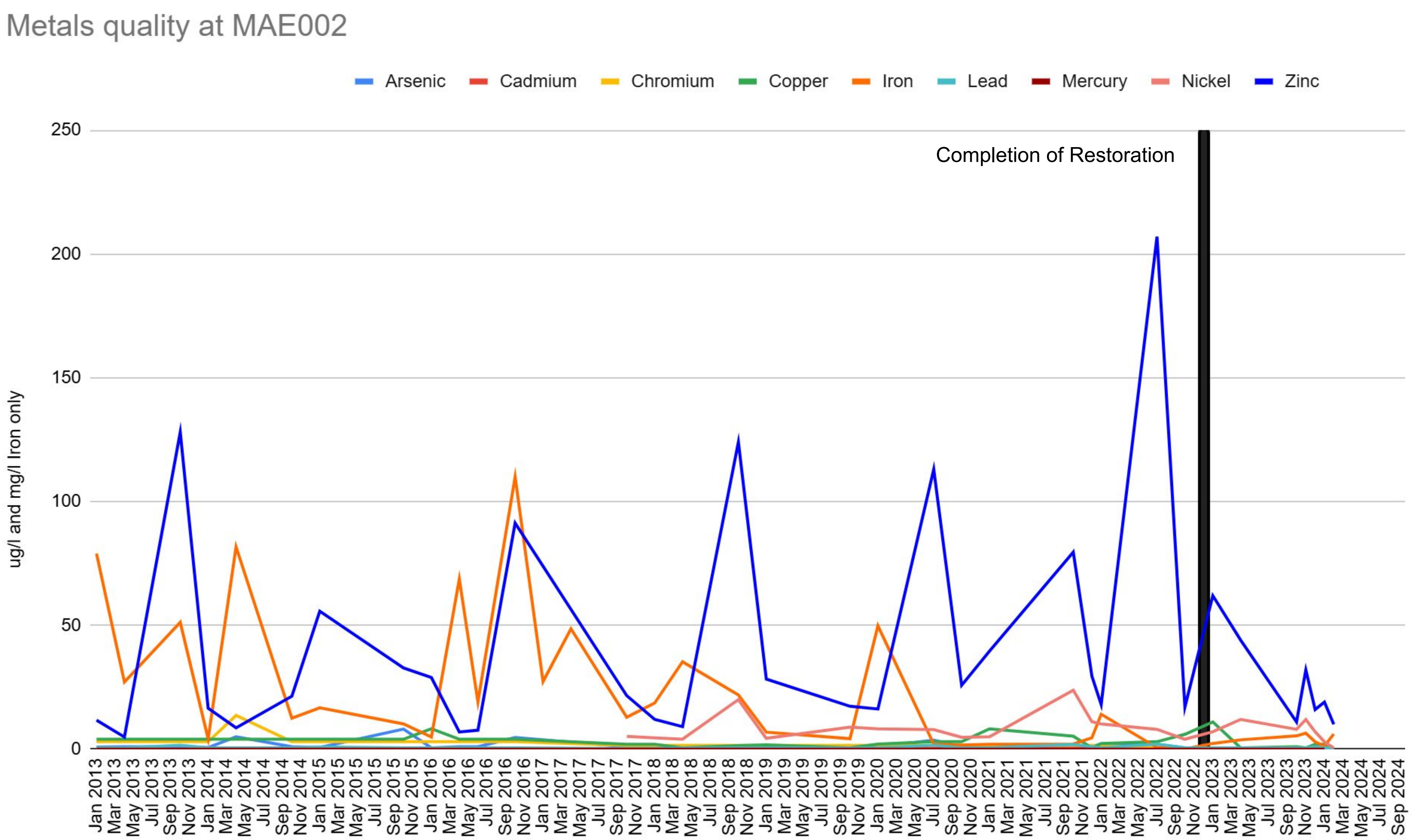

Metals quality at MAE002
Arsenic
Cadmium
Chromium
Copper
Iron
Lead
Mercury
Nickel
Zinc
ug/l and mg/l Iron only
Completion of Restoration
250
200
150
100
50
0
Jan 2013
Mar 2013
May 2013
Jul 2013
Sep 2013
Nov 2013
Jan 2014
Mar 2014
May 2014
Jul 2014
Sep 2014
Nov 2014
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May 2024
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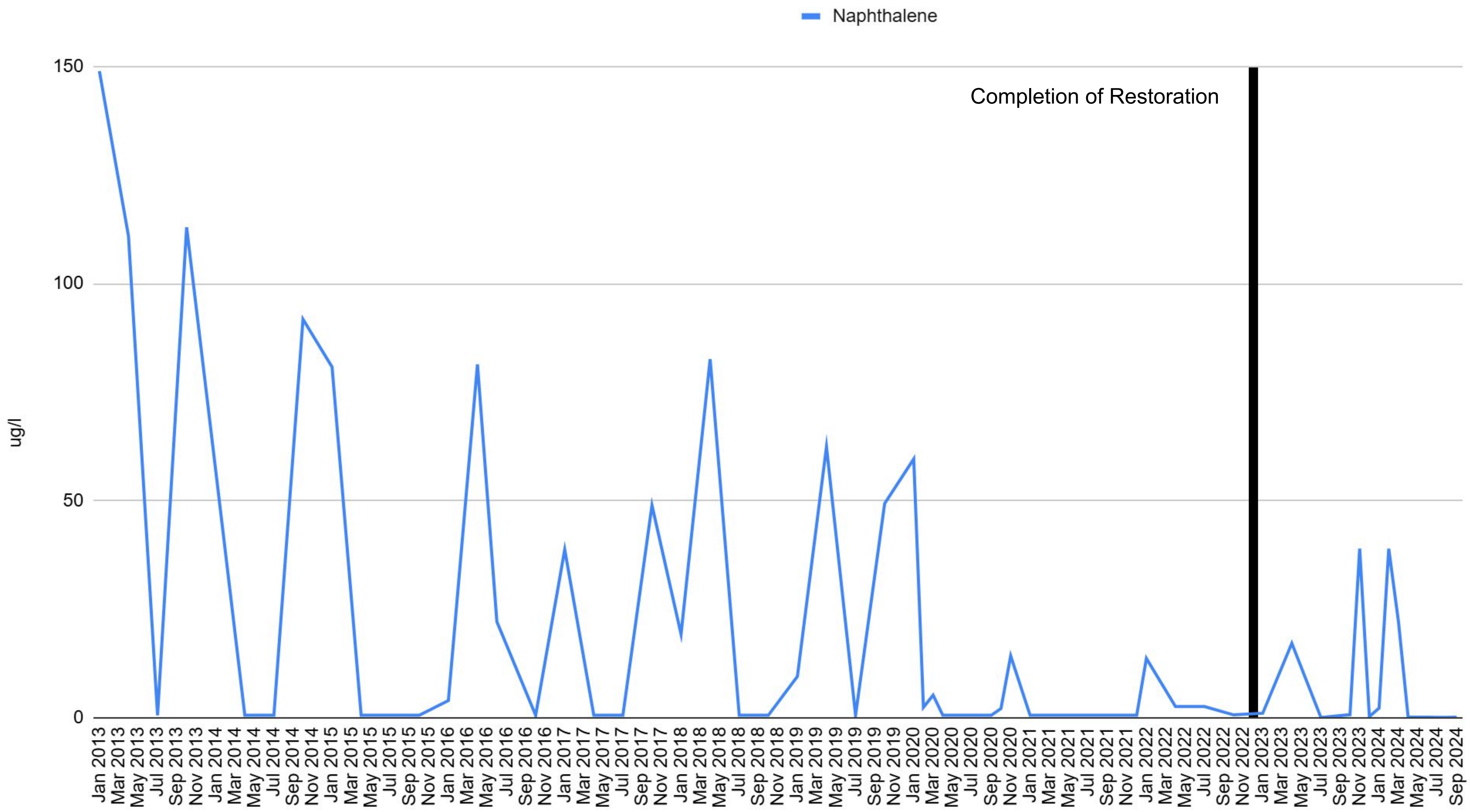
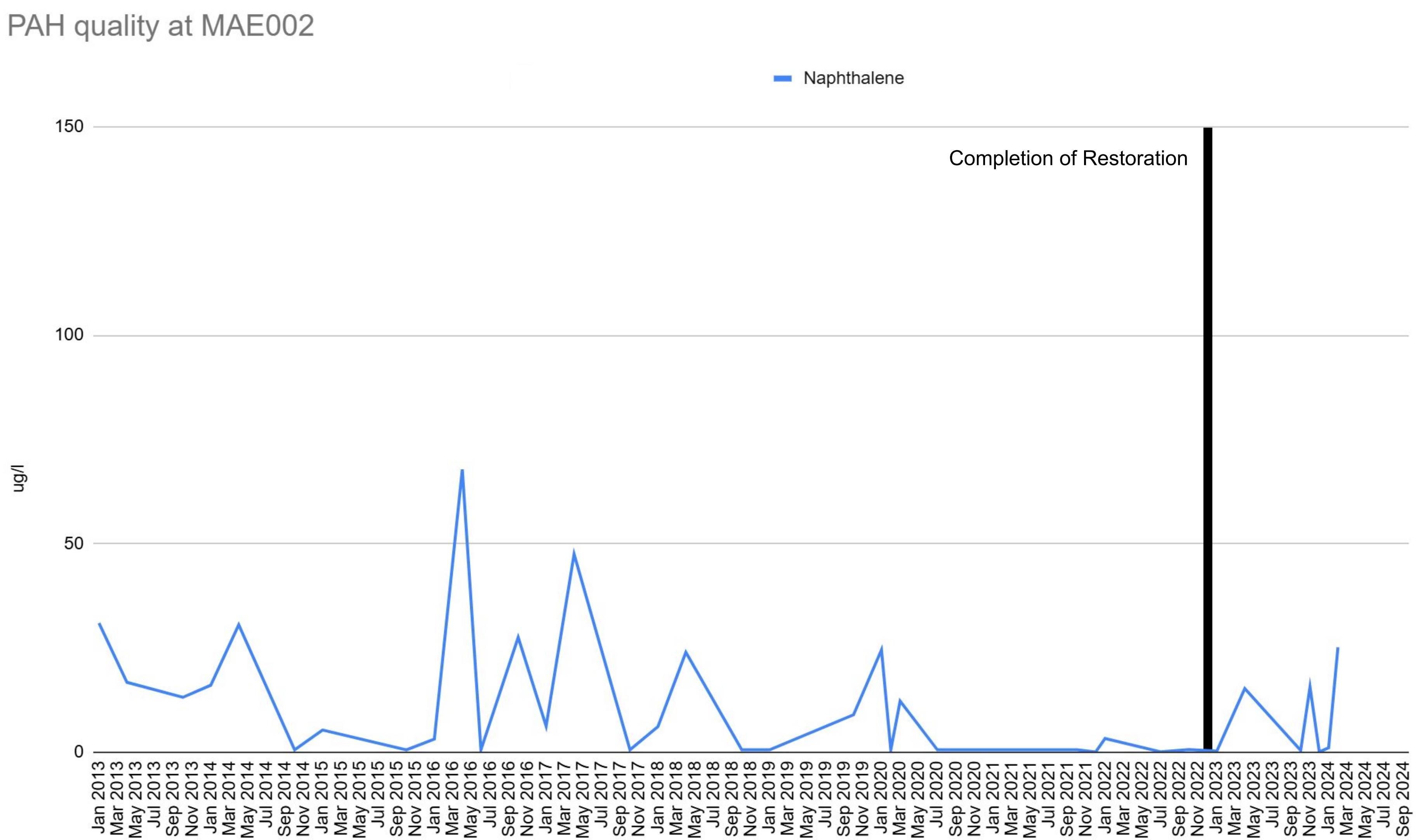
Sep 2024

PAH quality at MAE001




PAH quality at MAE002
Naphthalene
150
100
50
0
ug/l
Completion of Restoration
Jan 2013
Mar 2013
May 2013
Jul 2013
Sep 2013
Nov 2013
Jan 2014
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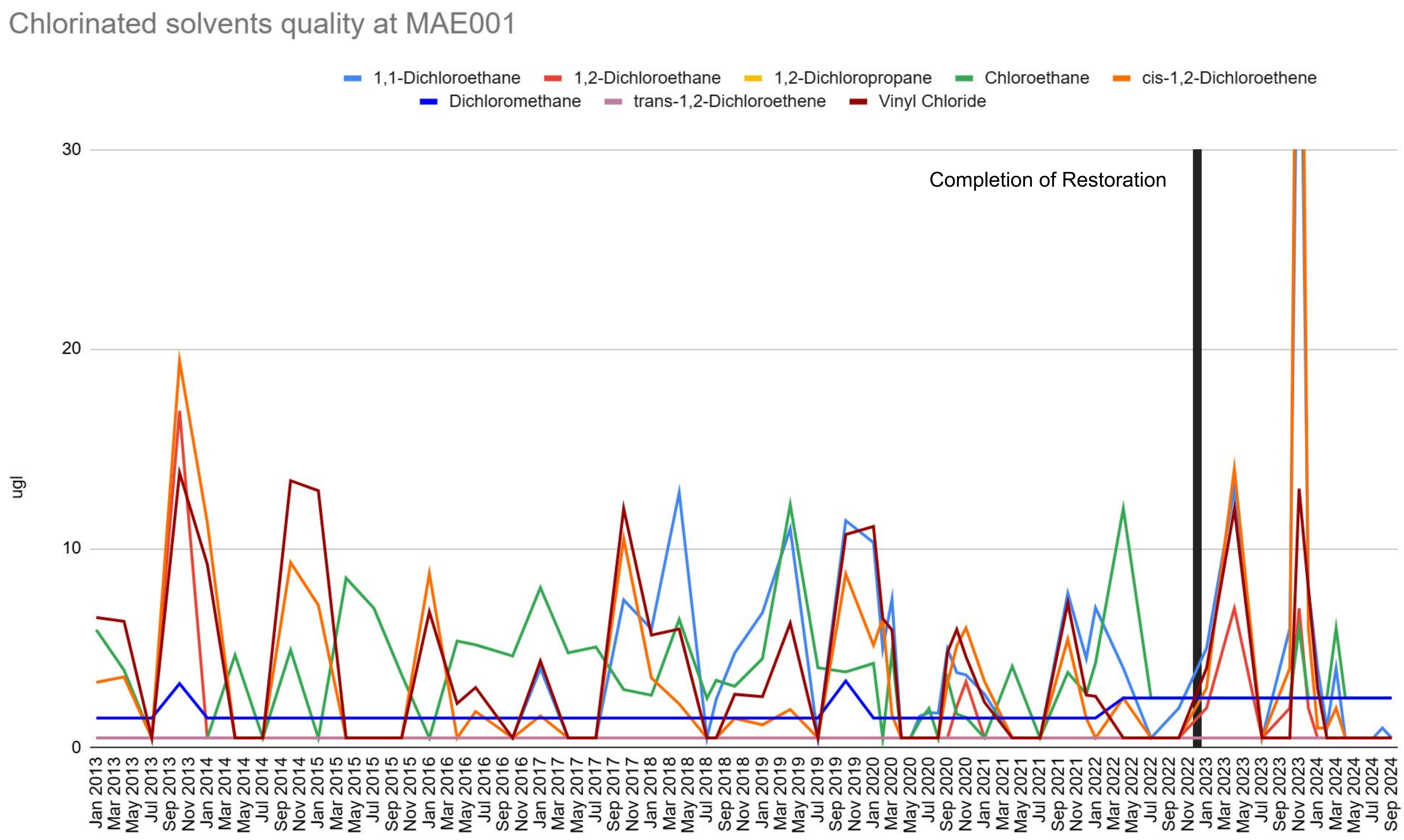
Jul 2024
Sep 2024


Chlorinated solvents quality at MAE001
1,1-Dichloroethane
1,2-Dichloroethane
1,2-Dichloropropane
Chloroethane
cis-1,2-Dichloroethene
Dichloromethane
trans-1,2-Dichloroethene
Vinyl Chloride
ugl
30
20
10
0
Completion of Restoration
Jan 2013
Mar 2013
May 2013
Jul 2013
Sep 2013
Nov 2013
Jan 2014
Mar 2014
May 2014
Jul 2014
Sep 2014
Nov 2014
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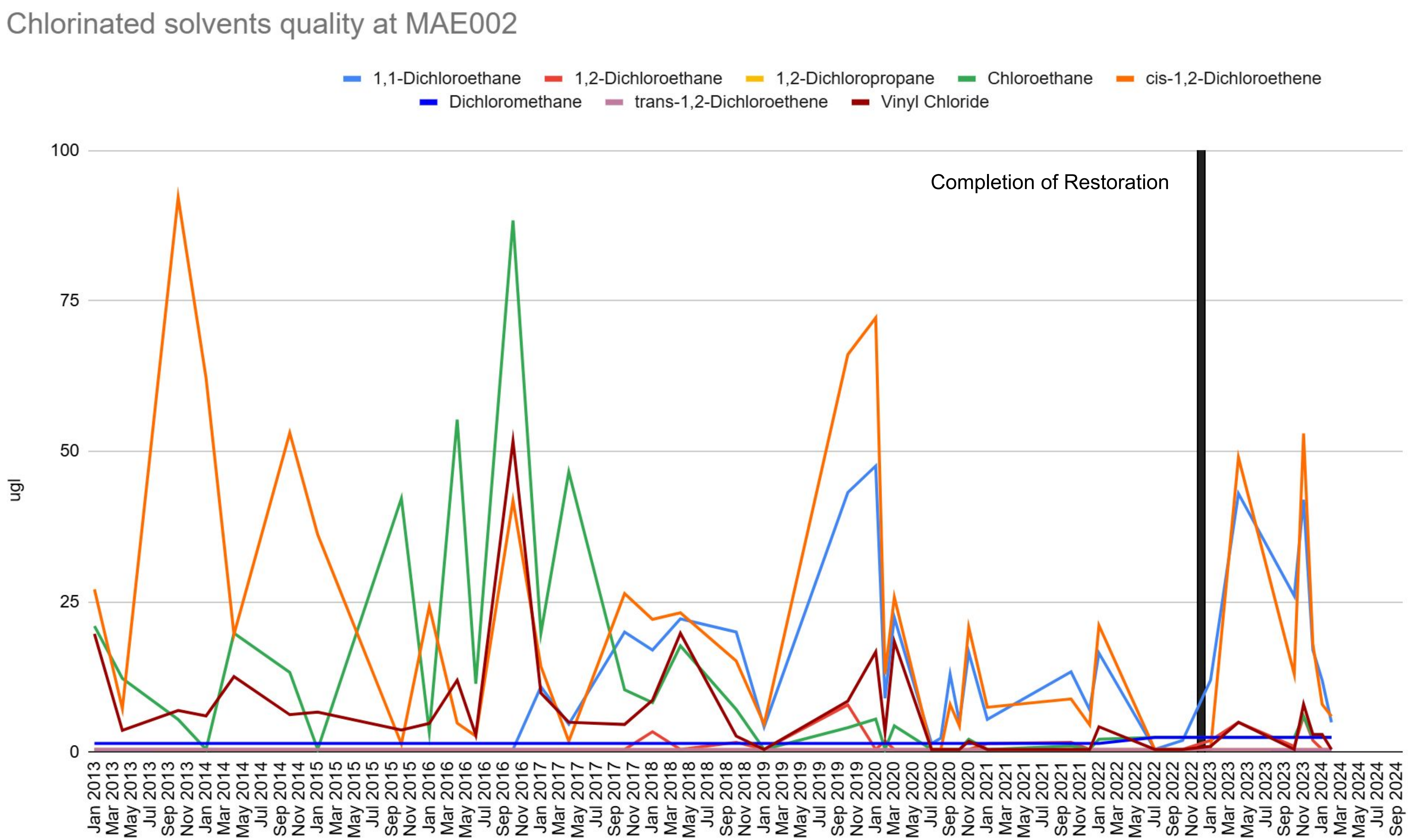
Sep 2024



Chlorinated solvents quality at MAE002
1,1-Dichloroethane
1,2-Dichloroethane
1,2-Dichloropropane
Chloroethane
cis-1,2-Dichloroethene
Dichloromethane
trans-1,2-Dichloroethene
Vinyl Chloride
ugl
100
75
50
25
0
Completion of Restoration
Jan 2013
Mar 2013
May 2013
Jul 2013
Sep 2013
Nov 2013
Jan 2014
Mar 2014
May 2014
Jul 2014
Sep 2014
Nov 2014
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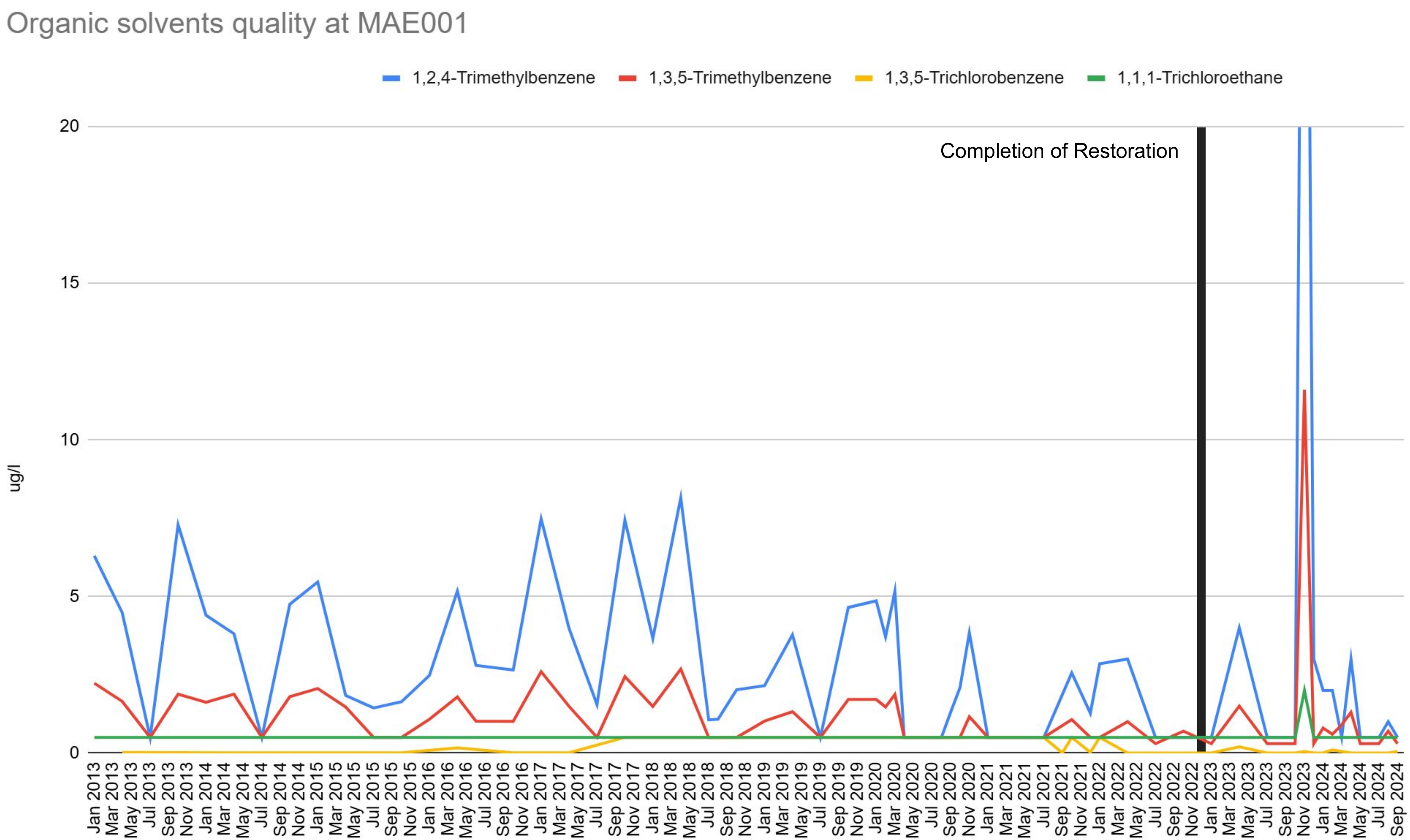

Organic solvents quality at MAE001
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
1,3,5-Trichlorobenzene
1,1,1-Trichloroethane
Completion of Restoration
ug/l
0
5
10
15
20
Jan 2013
Mar 2013
May 2013
Jul 2013
Sep 2013
Nov 2013
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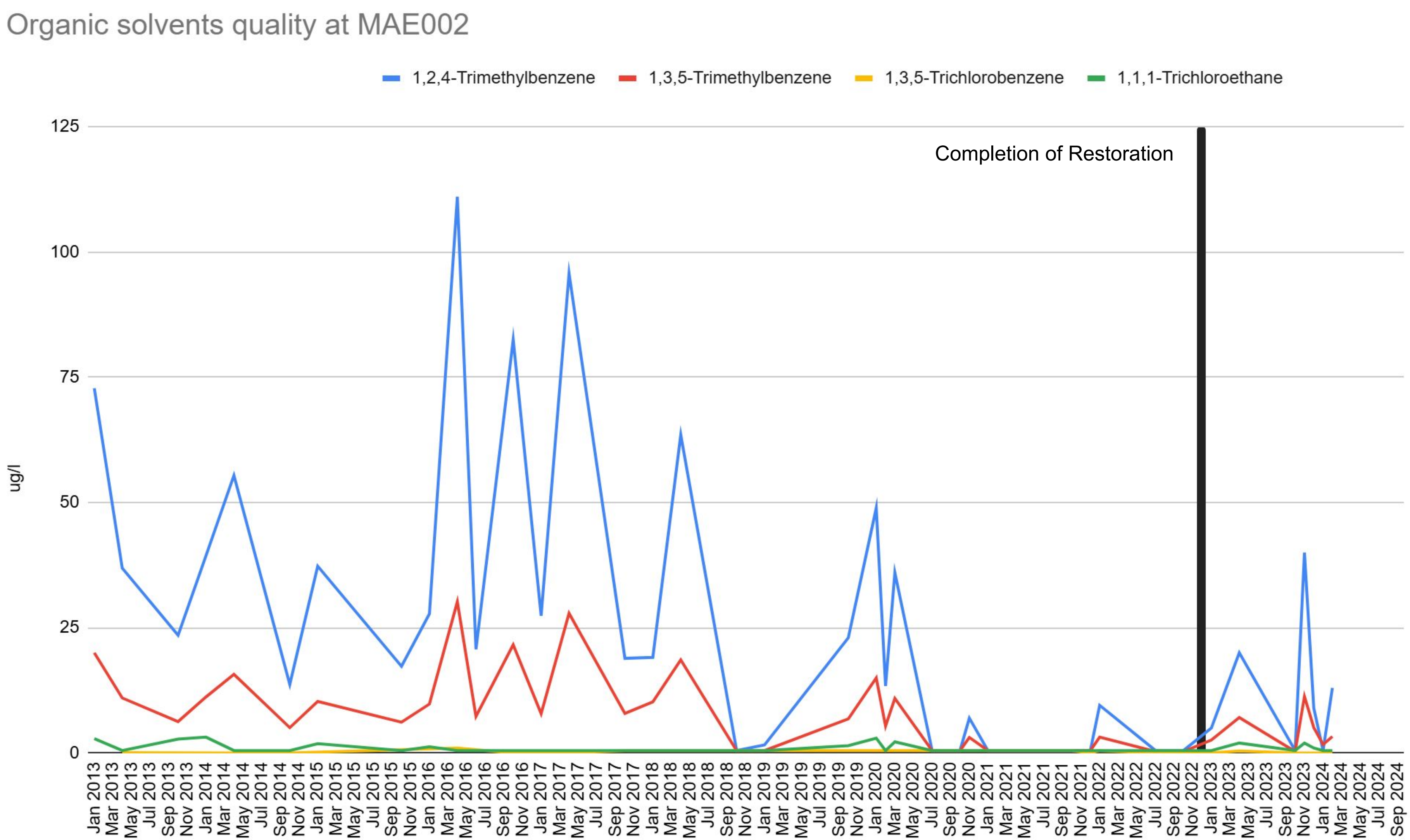
Sep 2024


Organic solvents quality at MAE002
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
1,3,5-Trichlorobenzene
1,1,1-Trichloroethane
ug/l
125
100
75
50
25
0
Completion of Restoration
Jan 2013
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May 2013
Jul 2013
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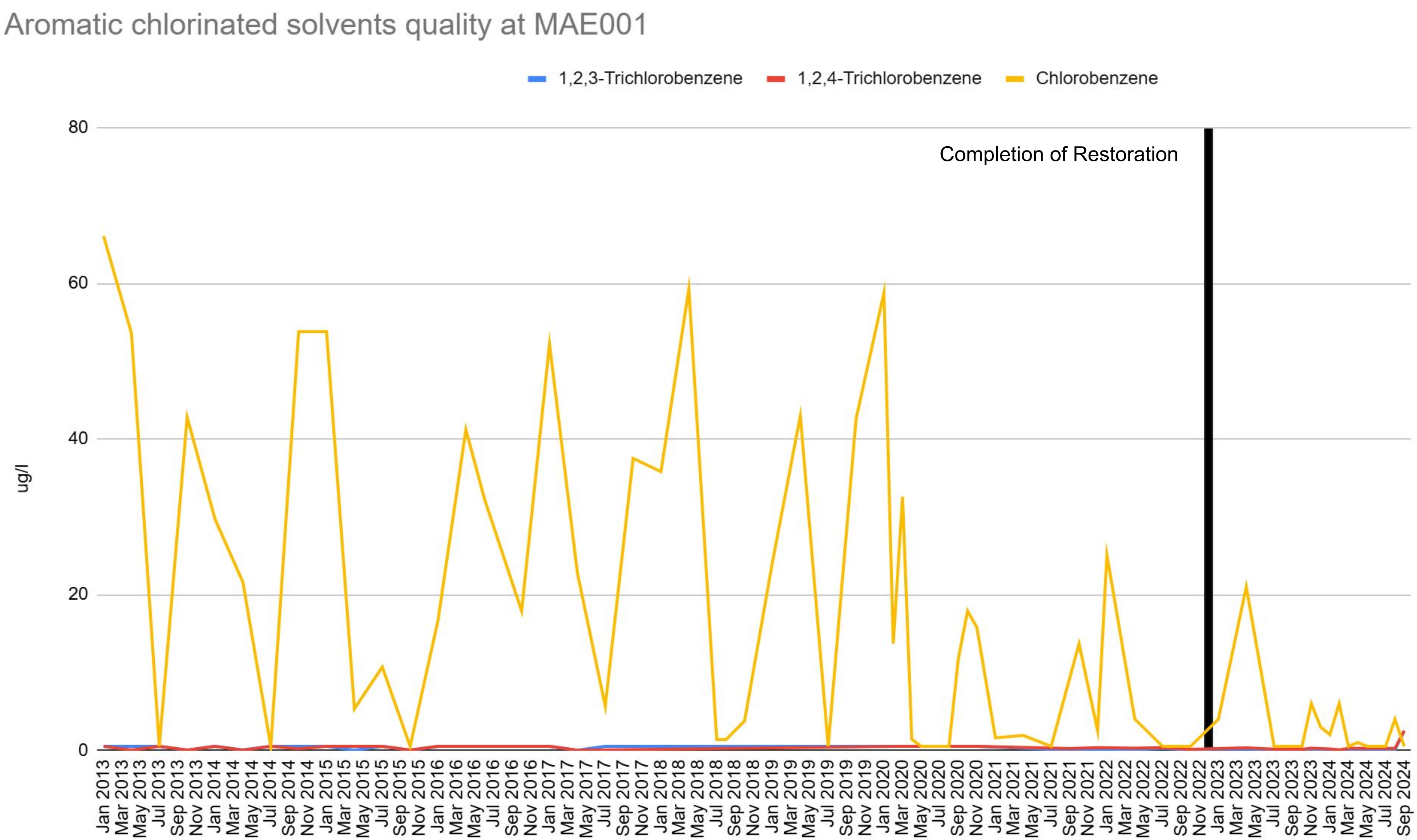
Aromatic chlorinated solvents quality at MAE001
1,2,3-Trichlorobenzene
1,2,4-Trichlorobenzene
Chlorobenzene
Completion of Restoration
ug/l
80
60
40
20
0
Jan 2013
Mar 2013
May 2013
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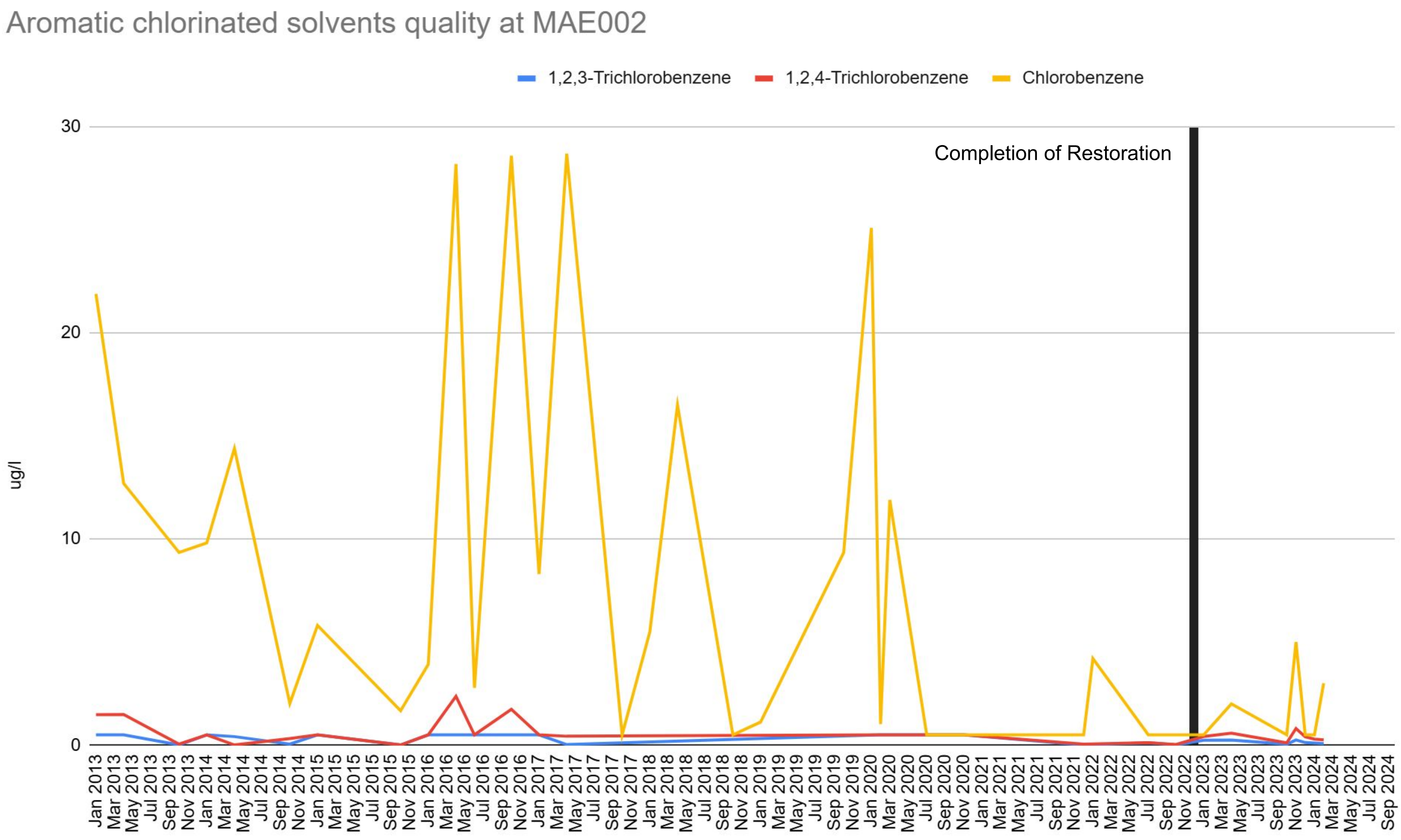

Aromatic chlorinated solvents quality at MAE002
1,2,3-Trichlorobenzene
1,2,4-Trichlorobenzene
Chlorobenzene
Completion of Restoration
ug/l
30
20
10
0
Jan 2013
Mar 2013
May 2013
Jul 2013
Sep 2013
Nov 2013
Jan 2014
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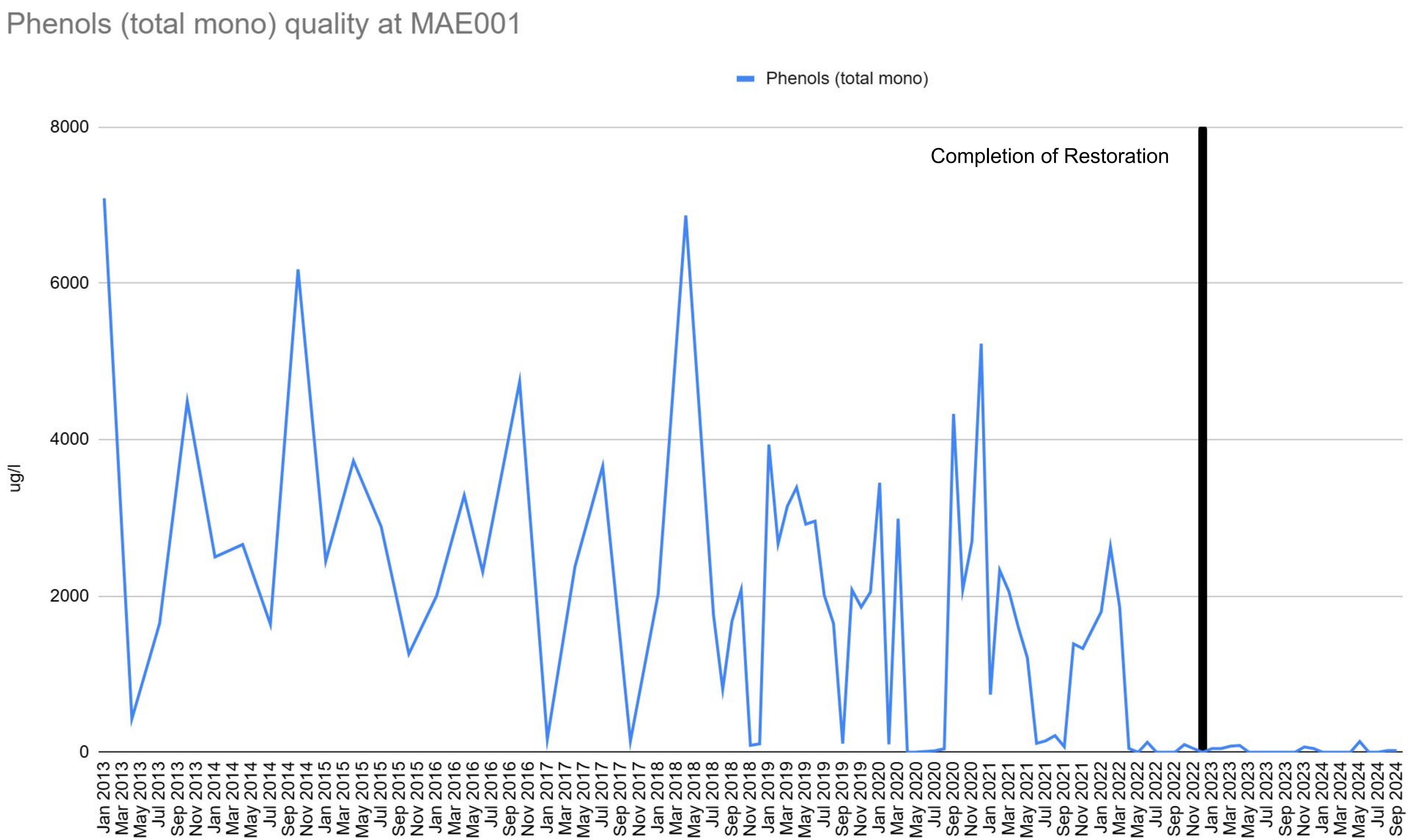

Phenols (total mono) quality at MAE001
Phenols (total mono)
Completion of Restoration
ug/l
8000
6000
4000
2000
0
Jan 2013
Mar 2013
May 2013
Jul 2013
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Nov 2013
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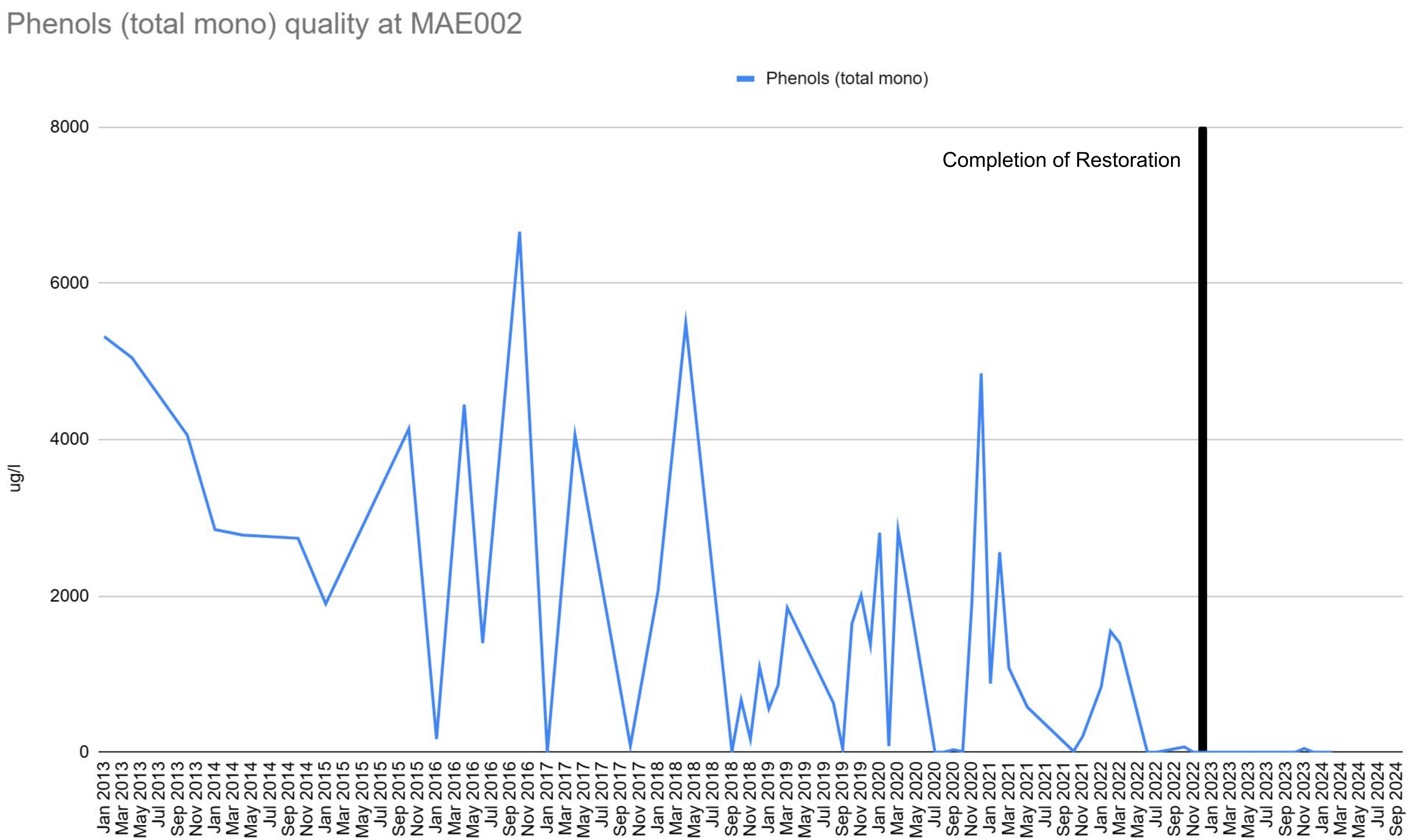

Phenols (total mono) quality at MAE002
Phenols (total mono)
Completion of Restoration
ug/l
8000
6000
4000
2000
0
Jan 2013
Mar 2013
May 2013
Jul 2013
Sep 2013
Nov 2013
Jan 2014
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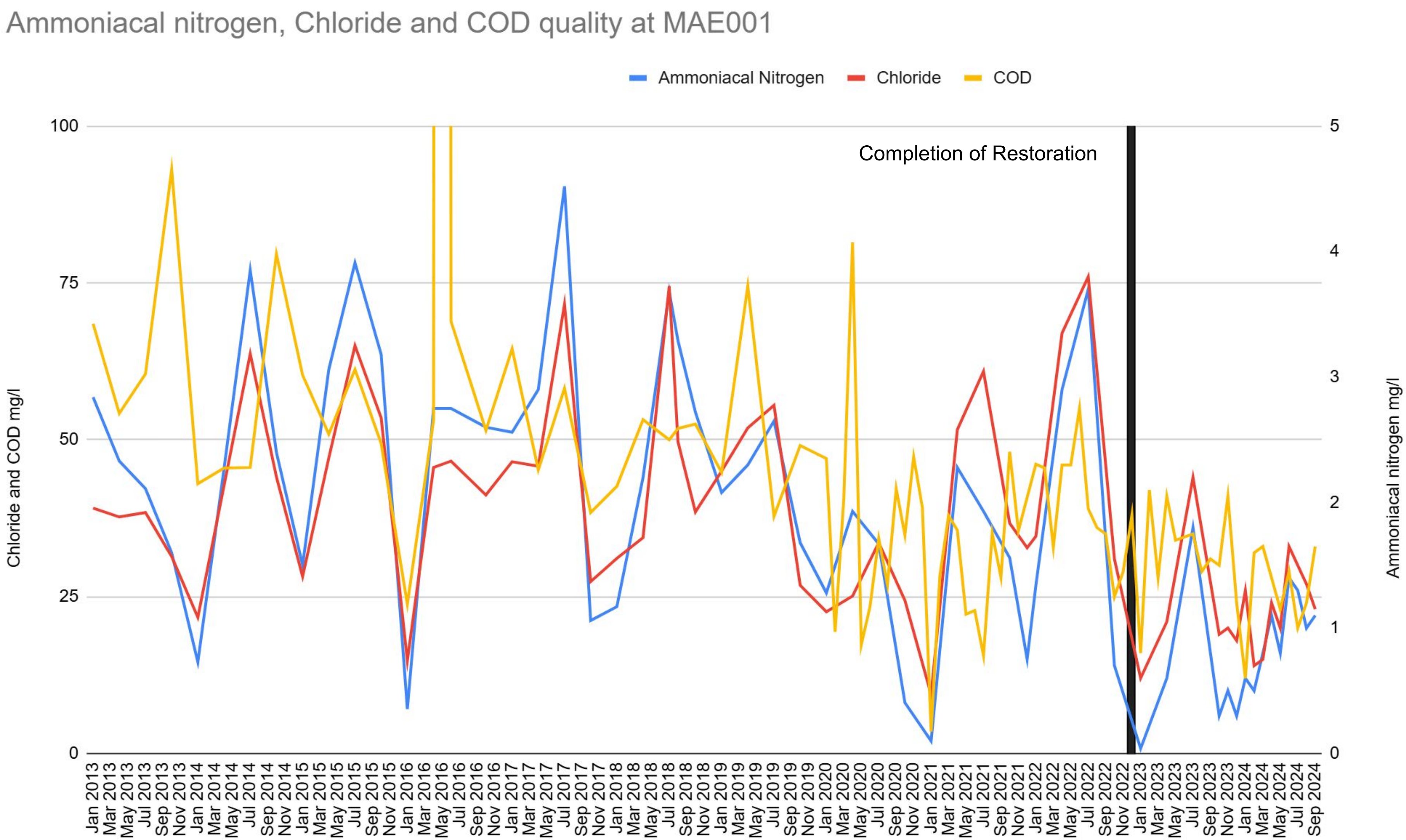
Sep 2024


Ammoniacal nitrogen, Chloride and COD quality at MAE001
Ammoniacal Nitrogen
Chloride
COD
Completion of Restoration
Chloride and COD mg/l
Ammoniacal nitrogen mg/l
100
75
50
25
0
5
4
3
2
1
0
Jan 2013
Mar 2013
May 2013
Jul 2013
Sep 2013
Nov 2013
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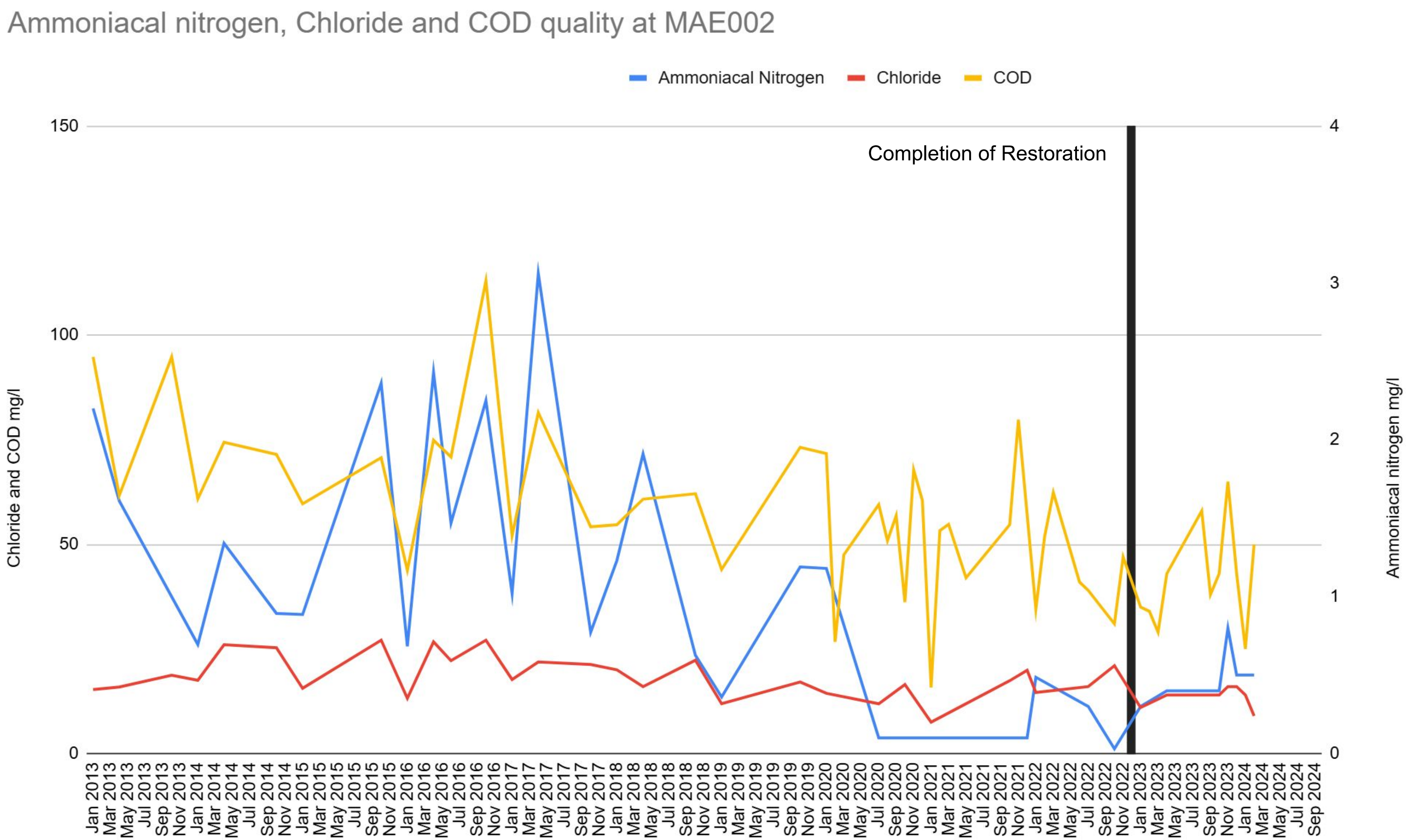
Ammoniacal nitrogen, Chloride and COD quality at MAE002
Ammoniacal Nitrogen
Chloride
COD
Completion of Restoration
Chloride and COD mg/l
Ammoniacal nitrogen mg/l
150
100
50
0
4
3
2
1
0
Jan 2013
Mar 2013
May 2013
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Nov 2022
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Mar 2024
May 2024
Jul 2024
Sep 2024

Appendix C

PCB quality of the site drainage

PCB quality at MAE001

PCB congener	12/01/2023	04/04/2023	12/07/2023	26/10/2023	23/01/2024	28/02/2024	29/04/2024	22/07/2024
101	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01	<0.01
105	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
114	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
118	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
123	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
126	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
138	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01	<0.01
153	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01	<0.01
156	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1		
157	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
167	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
169	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
180	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01	<0.01
189	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
28	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01	<0.01
52	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.01	<0.01
77	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
81	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01

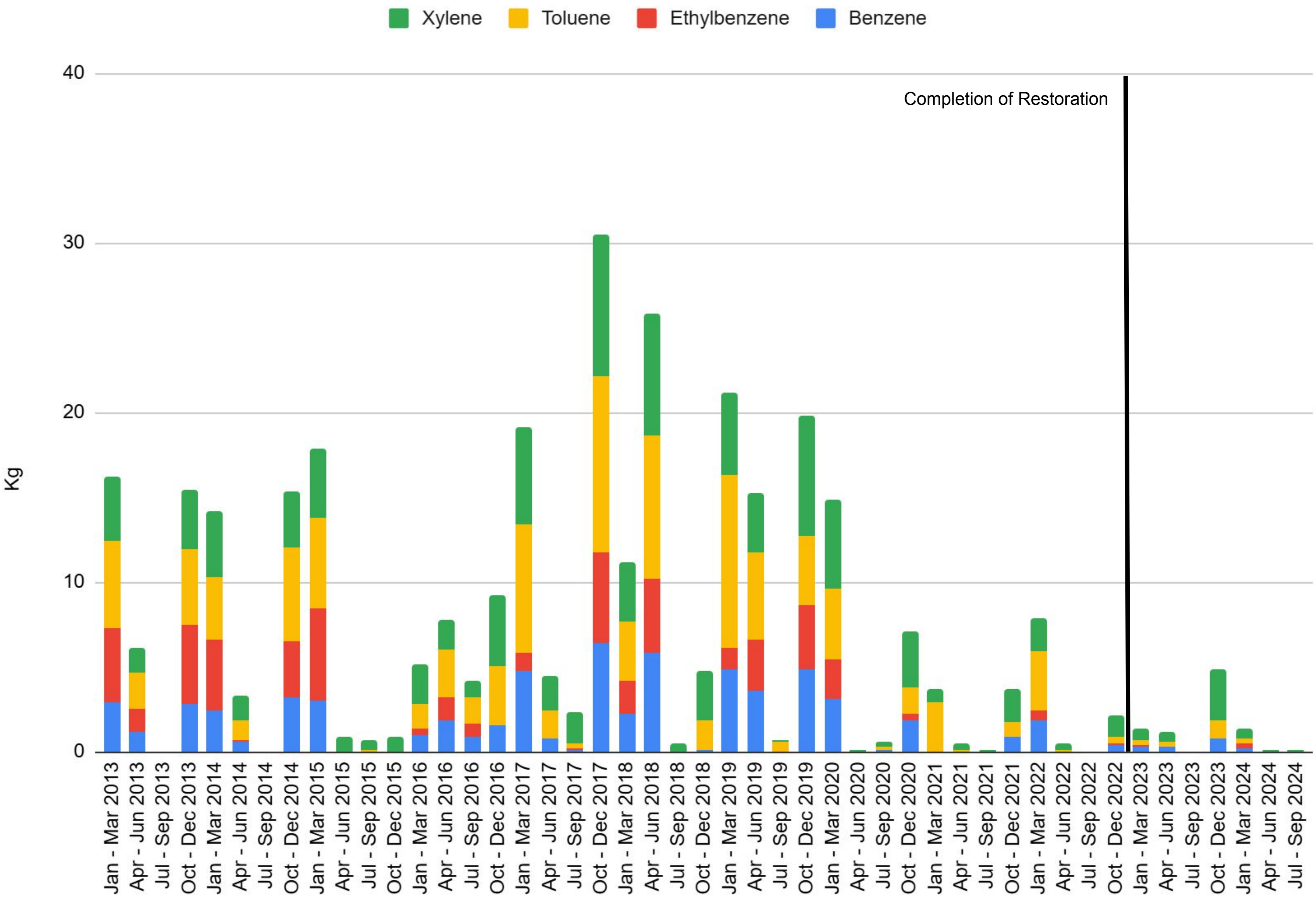
PCB quality at MAE002

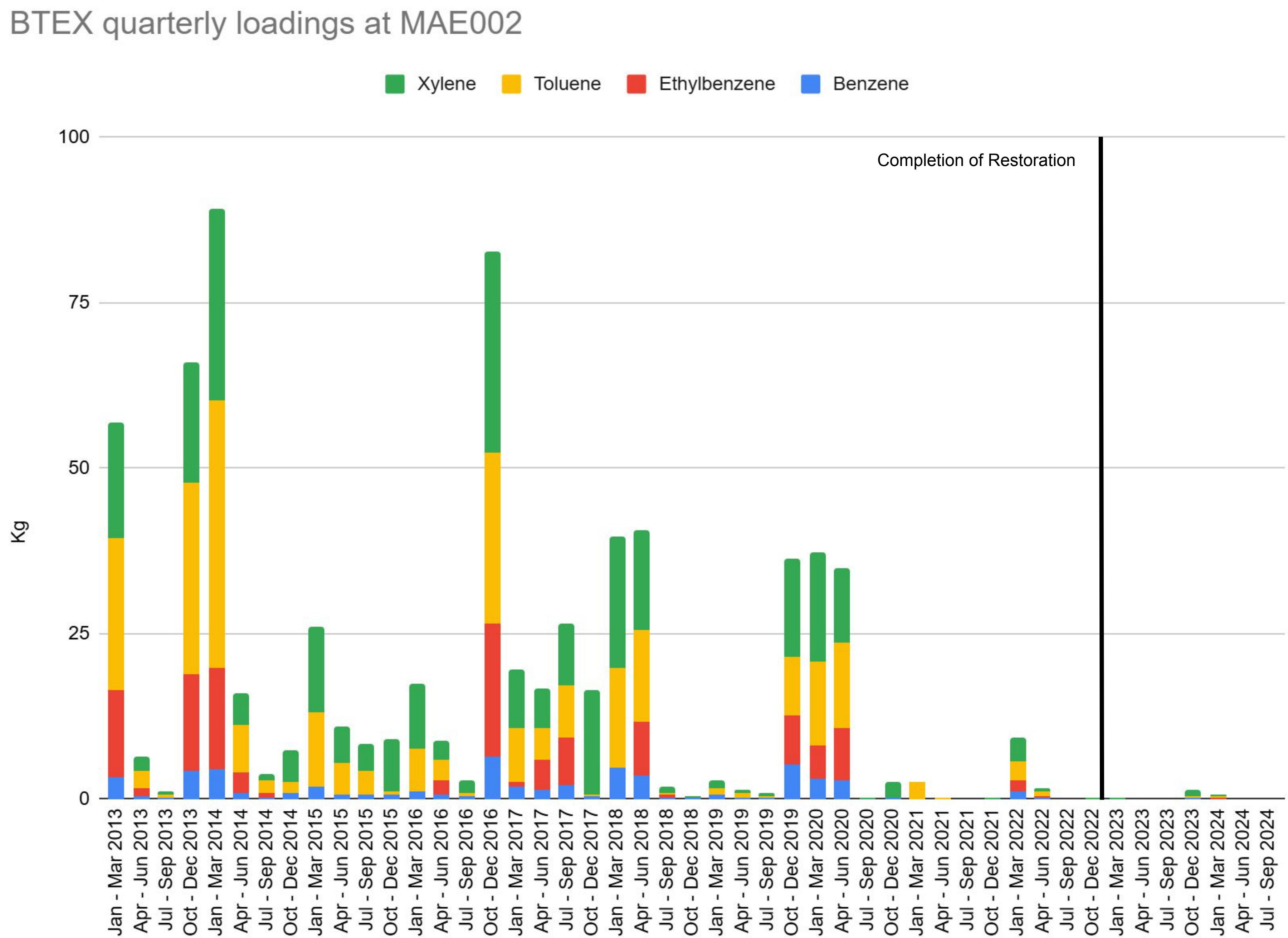
PCB congener	12/01/2023	04/04/2023	26/10/2023	23/01/2024	28/02/2024
101	<0.01	<0.01	<0.01	<0.01	<0.01
105	<0.01	<0.01	<0.01	<0.01	<0.1
114	<0.01	<0.01	<0.01	<0.01	<0.1
118	<0.01	<0.01	<0.01	<0.01	<0.1
123	<0.01	<0.01	<0.01	<0.01	<0.1
126	<0.01	<0.01	<0.01	<0.01	<0.1
138	<0.01	<0.01	<0.01	<0.01	<0.01
153	<0.01	<0.01	<0.01	<0.01	<0.01
156	<0.01	<0.01	<0.01	<0.01	<0.1
157	<0.01	<0.01	<0.01	<0.01	<0.1
167	<0.01	<0.01	<0.01	<0.01	<0.1
169	<0.01	<0.01	<0.01	<0.01	<0.1
180	<0.01	<0.01	<0.01	<0.01	<0.01
189	<0.01	<0.01	<0.01	<0.01	<0.1
28	<0.01	<0.01	<0.01	<0.01	<0.01
52	<0.01	<0.01	<0.01	<0.01	<0.01
77	<0.01	<0.01	<0.01	<0.01	<0.1
81	<0.01	<0.01	<0.01	<0.01	<0.1

Appendix D

Graphical summary of loading

BTEX quarterly loadings at MAE001




BTEX quarterly loadings at MAE002
Xylene
Toluene
Ethylbenzene
Benzene
Kg
100
75
50
25
0
Completion of Restoration
Jan - Mar 2013
Apr - Jun 2013
Jul - Sep 2013
Oct - Dec 2013
Jan - Mar 2014
Apr - Jun 2014
Jul - Sep 2014
Oct - Dec 2014
Jan - Mar 2015
Apr - Jun 2015
Jul - Sep 2015
Oct - Dec 2015
Jan - Mar 2016
Apr - Jun 2016
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Oct - Dec 2016
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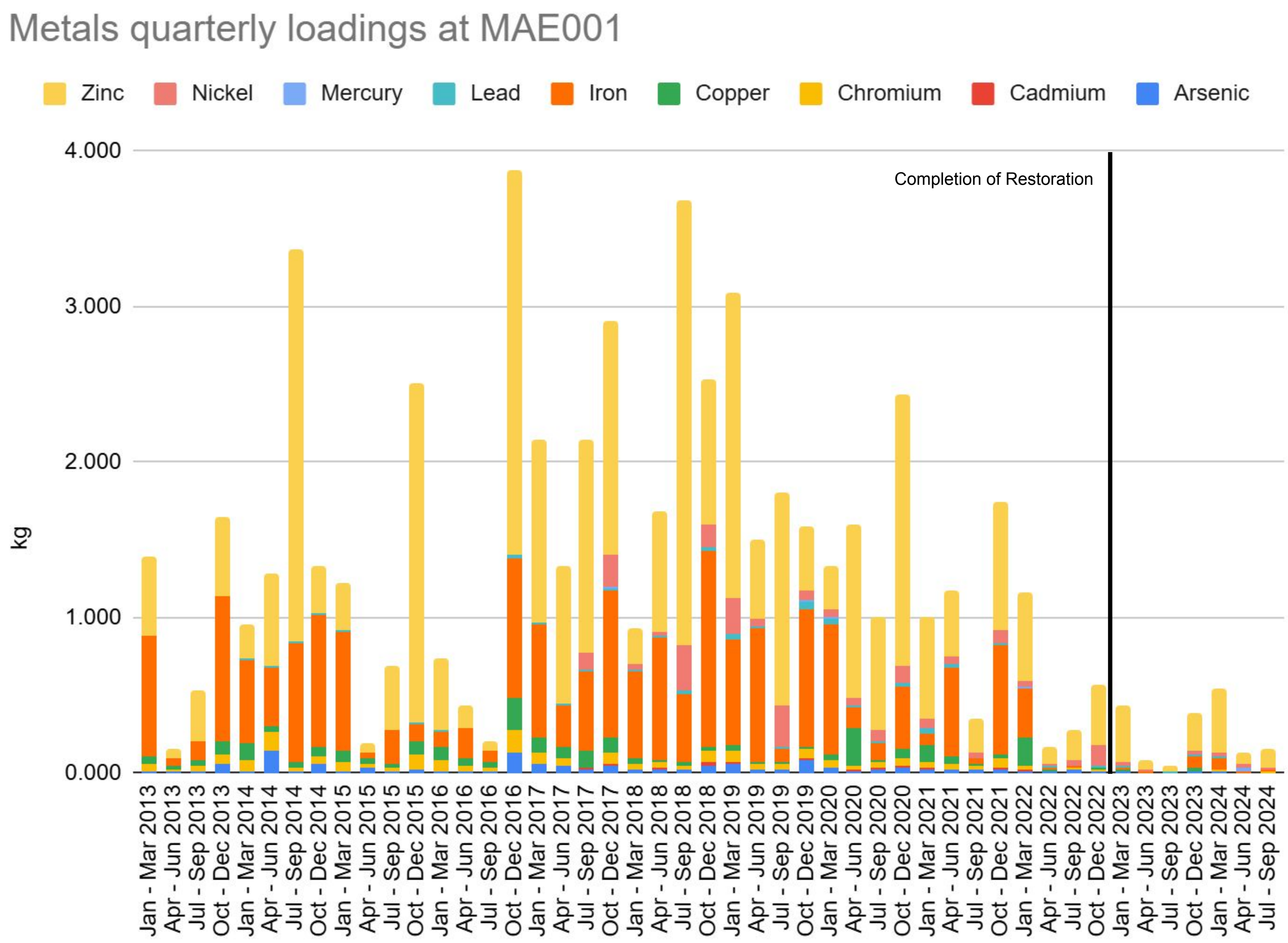
Jul - Sep 2021
Oct - Dec 2021
Jan - Mar 2022
Apr - Jun 2022
Jul - Sep 2022
Oct - Dec 2022
Jan - Mar 2023
Apr - Jun 2023
Jul - Sep 2023
Oct - Dec 2023
Jan - Mar 2024
Apr - Jun 2024
Jul - Sep 2024



Metals quarterly loadings at MAE001
Zinc
Nickel
Mercury
Lead
Iron
Copper
Chromium
Cadmium
Arsenic
kg
4.000
3.000
2.000
1.000
0.000
Completion of Restoration
Jan - Mar 2013
Apr - Jun 2013
Jul - Sep 2013
Oct - Dec 2013
Jan - Mar 2014
Apr - Jun 2014
Jul - Sep 2014
Oct - Dec 2014
Jan - Mar 2015
Apr - Jun 2015
Jul - Sep 2015
Oct - Dec 2015
Jan - Mar 2016
Apr - Jun 2016
Jul - Sep 2016
Oct - Dec 2016
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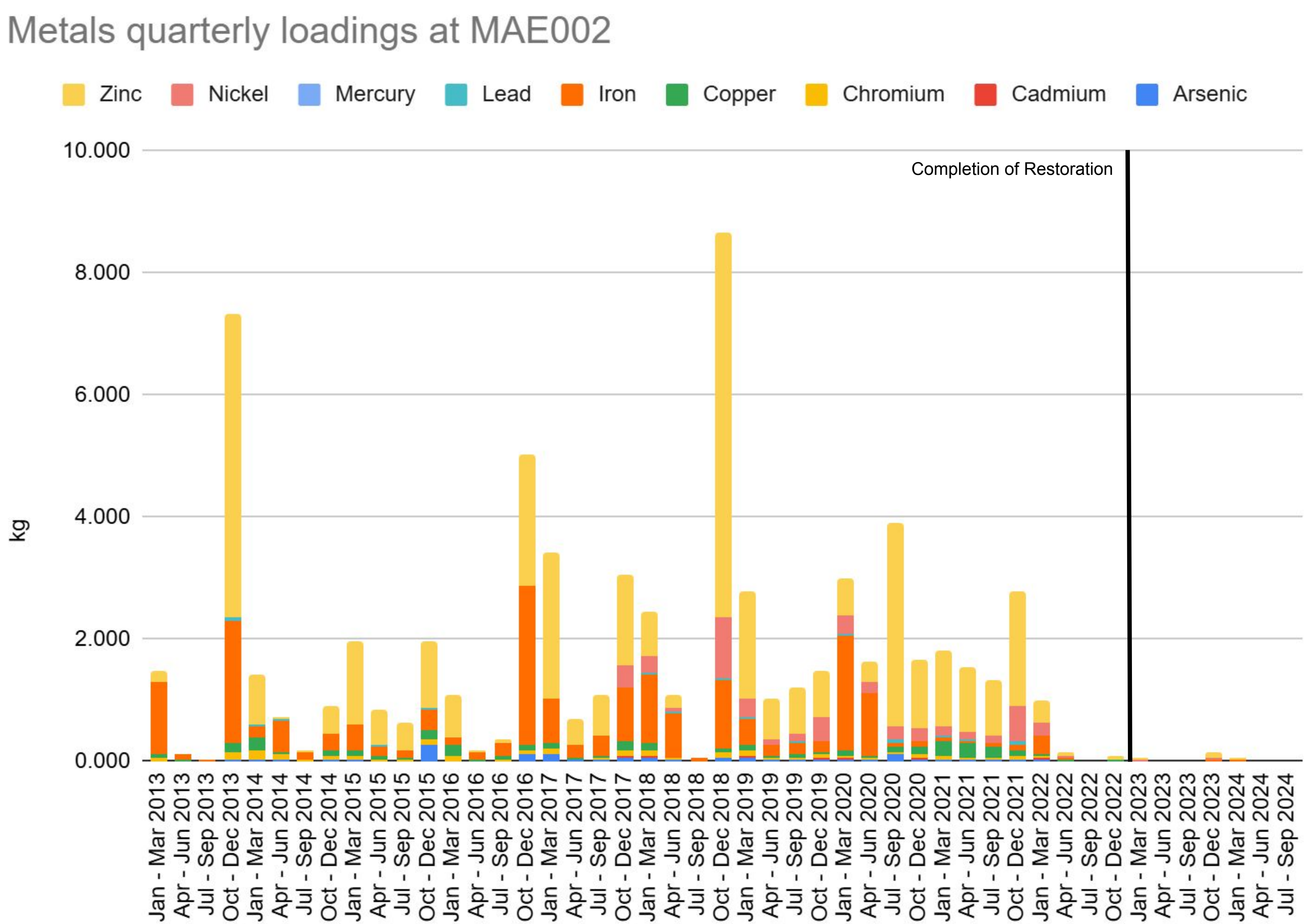
Metals quarterly loadings at MAE002
Zinc
Nickel
Mercury
Lead
Iron
Copper
Chromium
Cadmium
Arsenic
kg
10.000
8.000
6.000
4.000
2.000
0.000
Completion of Restoration
Jan - Mar 2013
Apr - Jun 2013
Jul - Sep 2013
Oct - Dec 2013
Jan - Mar 2014
Apr - Jun 2014
Jul - Sep 2014
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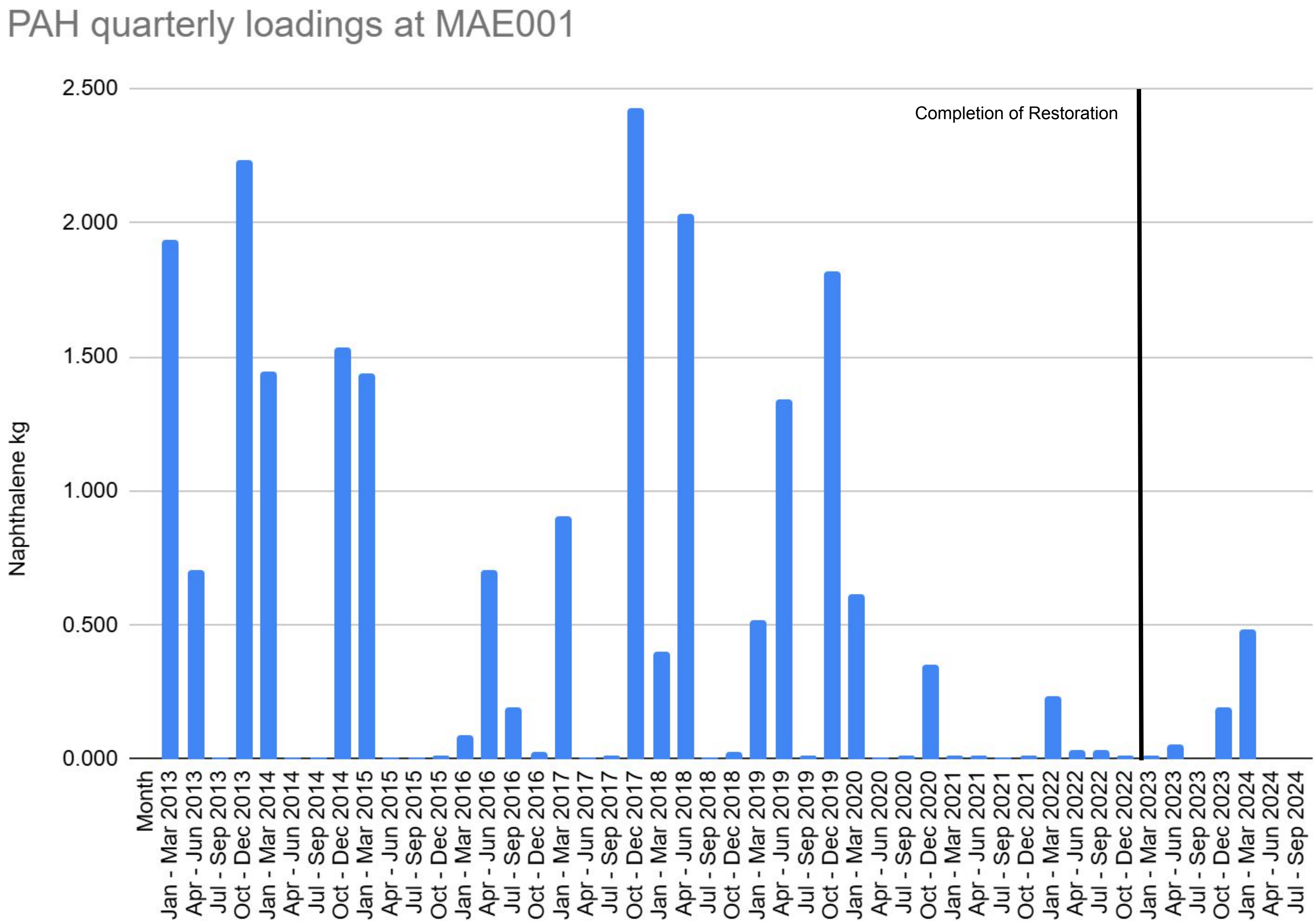

PAH quarterly loadings at MAE001
Naphthalene kg
2.500
2.000
1.500
1.000
0.500
0.000
Completion of Restoration
Month
Jan - Mar 2013
Apr - Jun 2013
Jul - Sep 2013
Oct - Dec 2013
Jan - Mar 2014
Apr - Jun 2014
Jul - Sep 2014
Oct - Dec 2014
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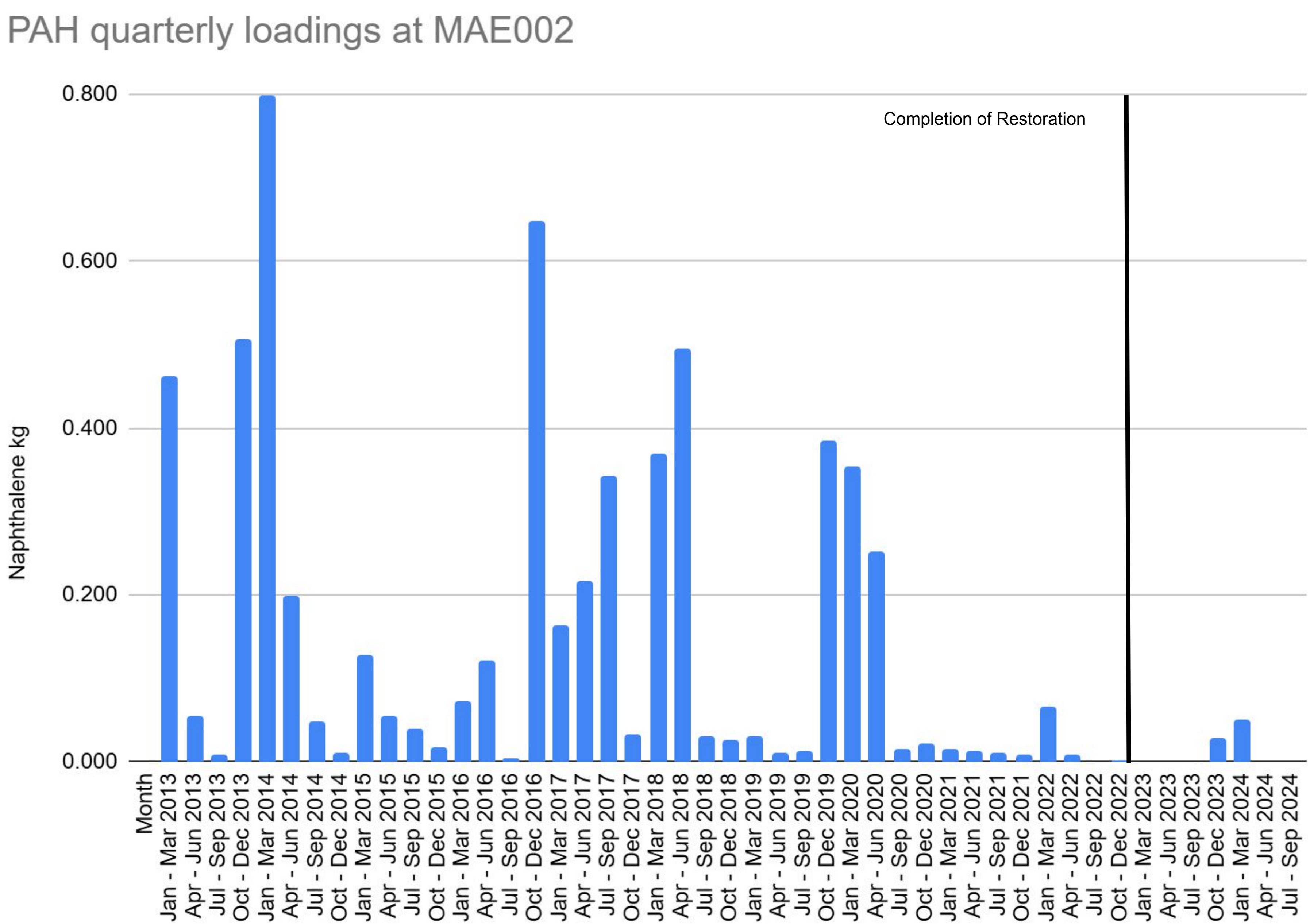

PAH quarterly loadings at MAE002
Naphthalene kg
0.800
0.600
0.400
0.200
0.000
Completion of Restoration
Month
Jan - Mar 2013
Apr - Jun 2013
Jul - Sep 2013
Oct - Dec 2013
Jan - Mar 2014
Apr - Jun 2014
Jul - Sep 2014
Oct - Dec 2014
Jan - Mar 2015
Apr - Jun 2015
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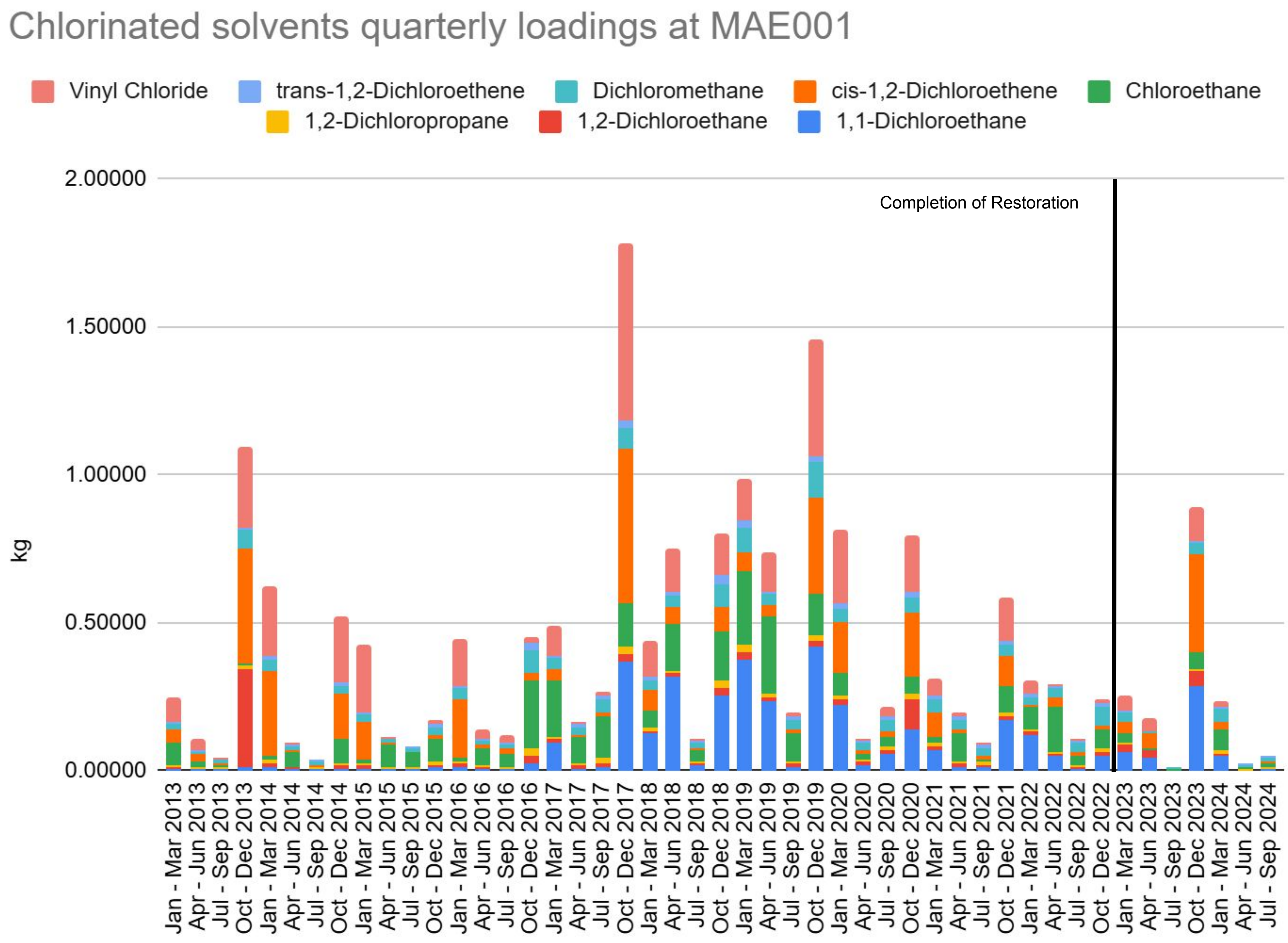
Jul - Sep 2024



Chlorinated solvents quarterly loadings at MAE001
Vinyl Chloride
trans-1,2-Dichloroethene
Dichloromethane
cis-1,2-Dichloroethene
Chloroethane
1,2-Dichloropropane
1,2-Dichloroethane
1,1-Dichloroethane
Completion of Restoration
kg
2.00000
1.50000
1.00000
0.50000
0.00000
Jan - Mar 2013
Apr - Jun 2013
Jul - Sep 2013
Oct - Dec 2013
Jan - Mar 2014
Apr - Jun 2014
Jul - Sep 2014
Oct - Dec 2014
Jan - Mar 2015
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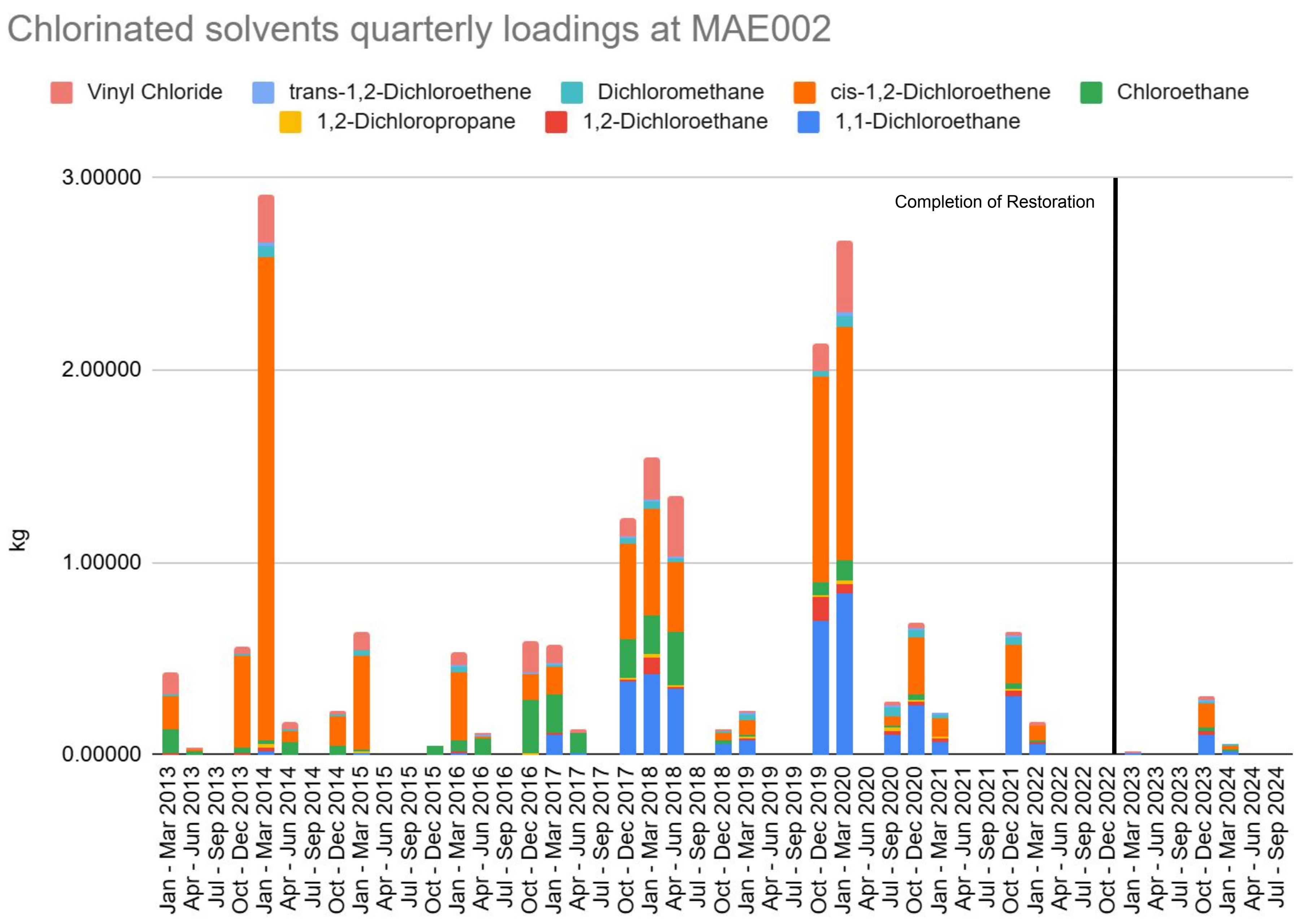
Jan - Mar 2024
Apr - Jun 2024
Jul - Sep 2024



Chlorinated solvents quarterly loadings at MAE002
Vinyl Chloride
trans-1,2-Dichloroethene
Dichloromethane
cis-1,2-Dichloroethene
Chloroethane
1,2-Dichloropropane
1,2-Dichloroethane
1,1-Dichloroethane
kg
3.00000
2.00000
1.00000
0.00000
Completion of Restoration
Jan - Mar 2013
Apr - Jun 2013
Jul - Sep 2013
Oct - Dec 2013
Jan - Mar 2014
Apr - Jun 2014
Jul - Sep 2014
Oct - Dec 2014
Jan - Mar 2015
Apr - Jun 2015
Jul - Sep 2015
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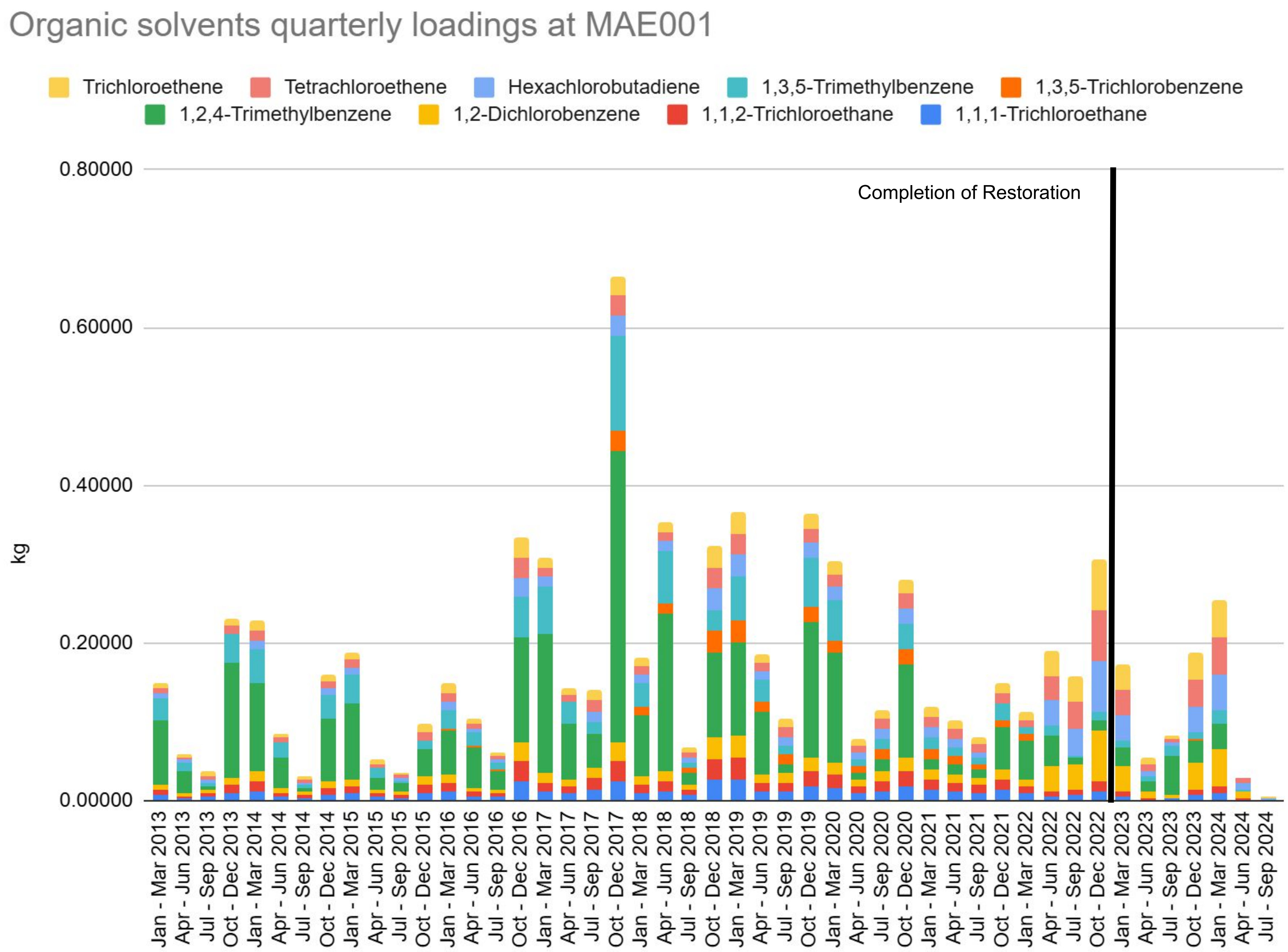
Jan - Mar 2024
Apr - Jun 2024
Jul - Sep 2024


Organic solvents quarterly loadings at MAE001
Trichloroethene
Tetrachloroethene
Hexachlorobutadiene
1,3,5-Trimethylbenzene
1,3,5-Trichlorobenzene
1,2,4-Trimethylbenzene
1,2-Dichlorobenzene
1,1,2-Trichloroethane
1,1,1-Trichloroethane
0.80000
0.60000
0.40000
0.20000
0.00000
kg
Completion of Restoration
Jan - Mar 2013
Apr - Jun 2013
Jul - Sep 2013
Oct - Dec 2013
Jan - Mar 2014
Apr - Jun 2014
Jul - Sep 2014
Oct - Dec 2014
Jan - Mar 2015
Apr - Jun 2015
Jul - Sep 2015
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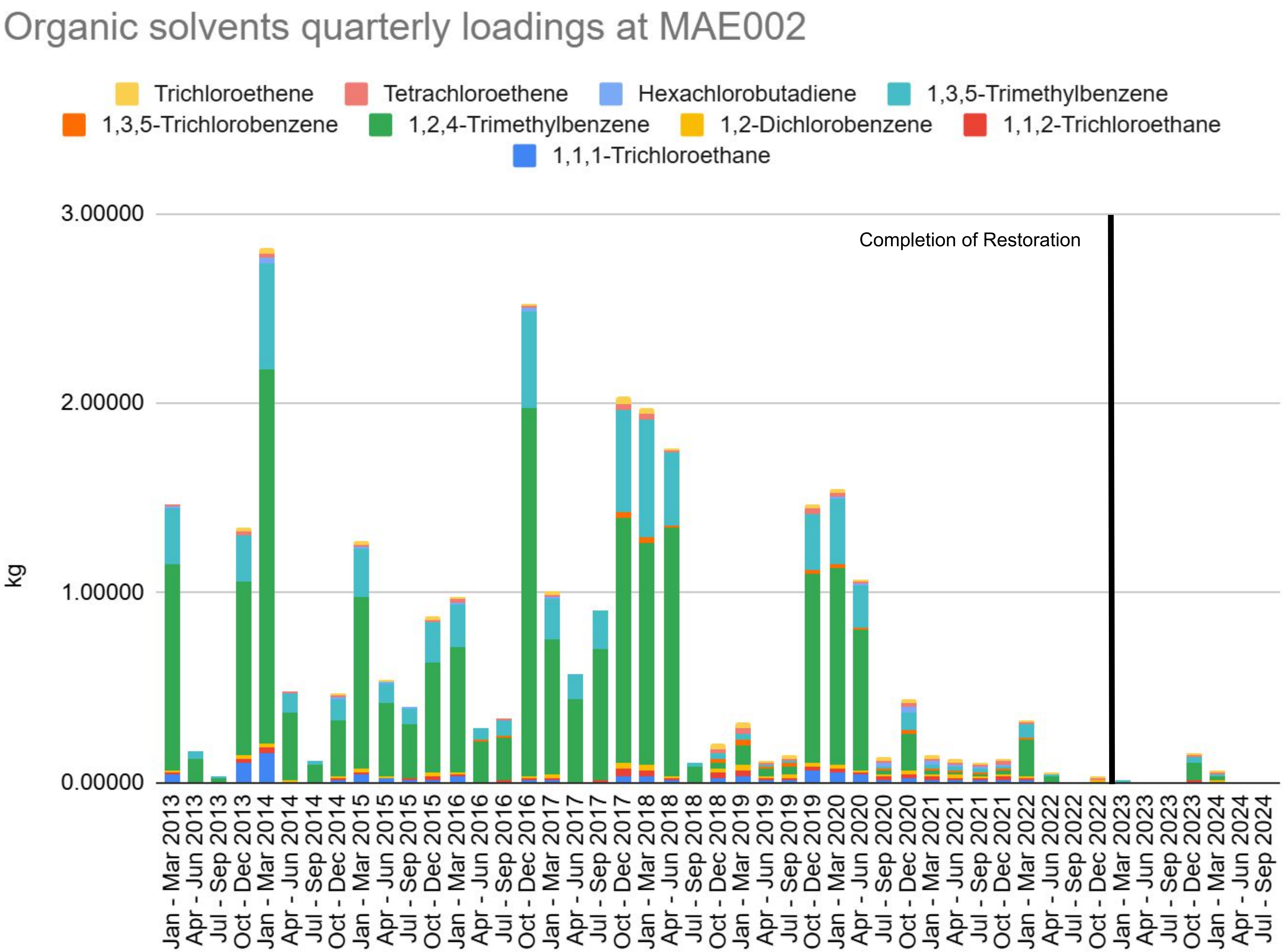

Organic solvents quarterly loadings at MAE002
Trichloroethene
Tetrachloroethene
Hexachlorobutadiene
1,3,5-Trimethylbenzene
1,3,5-Trichlorobenzene
1,2,4-Trimethylbenzene
1,2-Dichlorobenzene
1,1,2-Trichloroethane
1,1,1-Trichloroethane
3.00000
2.00000
1.00000
0.00000
kg
Completion of Restoration
Jan - Mar 2013
Apr - Jun 2013
Jul - Sep 2013
Oct - Dec 2013
Jan - Mar 2014
Apr - Jun 2014
Jul - Sep 2014
Oct - Dec 2014
Jan - Mar 2015
Apr - Jun 2015
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Apr - Jun 2024
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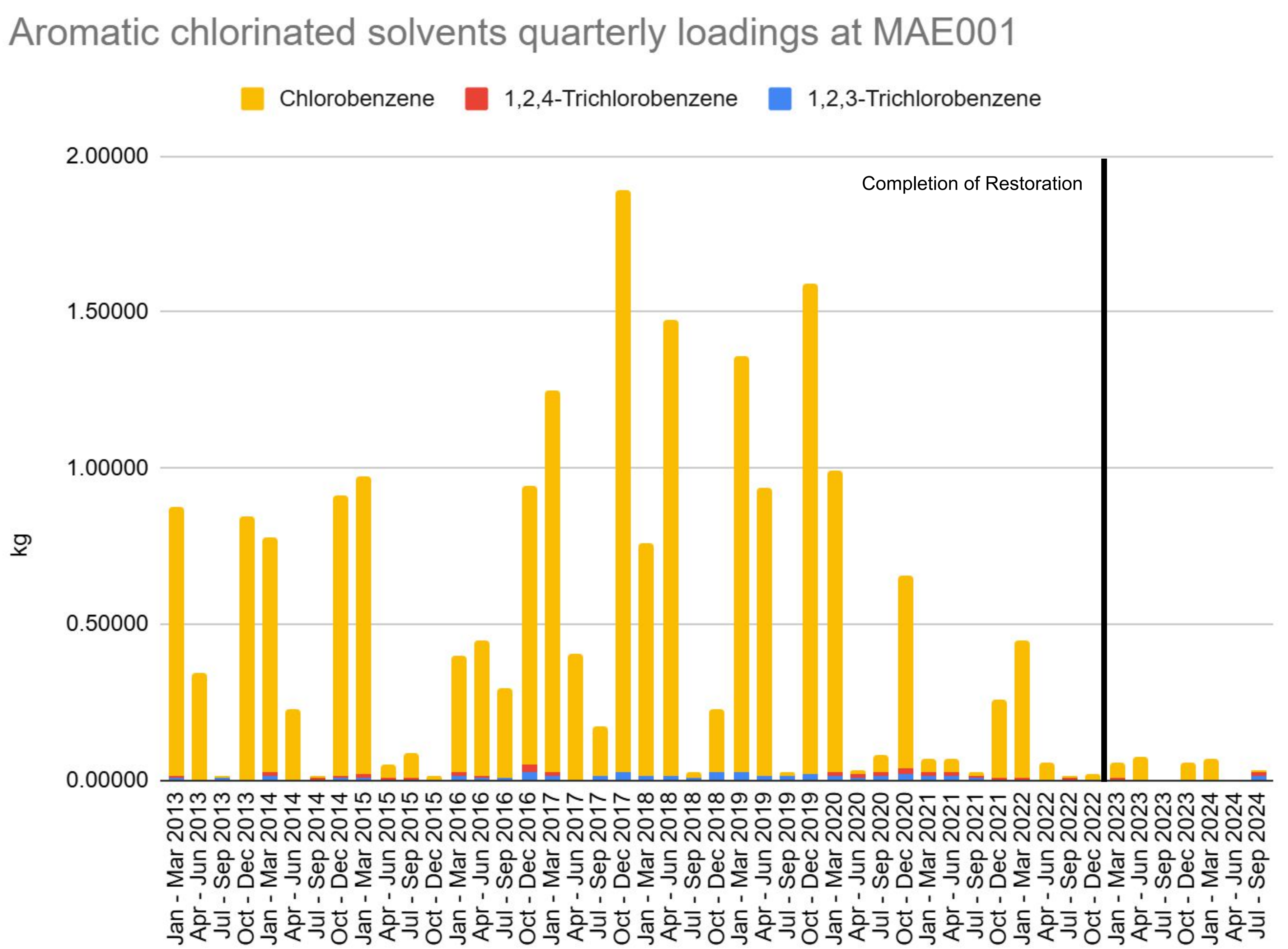
Aromatic chlorinated solvents quarterly loadings at MAE001
Chlorobenzene
1,2,4-Trichlorobenzene
1,2,3-Trichlorobenzene
Completion of Restoration
kg
2.00000
1.50000
1.00000
0.50000
0.00000
Jan - Mar 2013
Apr - Jun 2013
Jul - Sep 2013
Oct - Dec 2013
Jan - Mar 2014
Apr - Jun 2014
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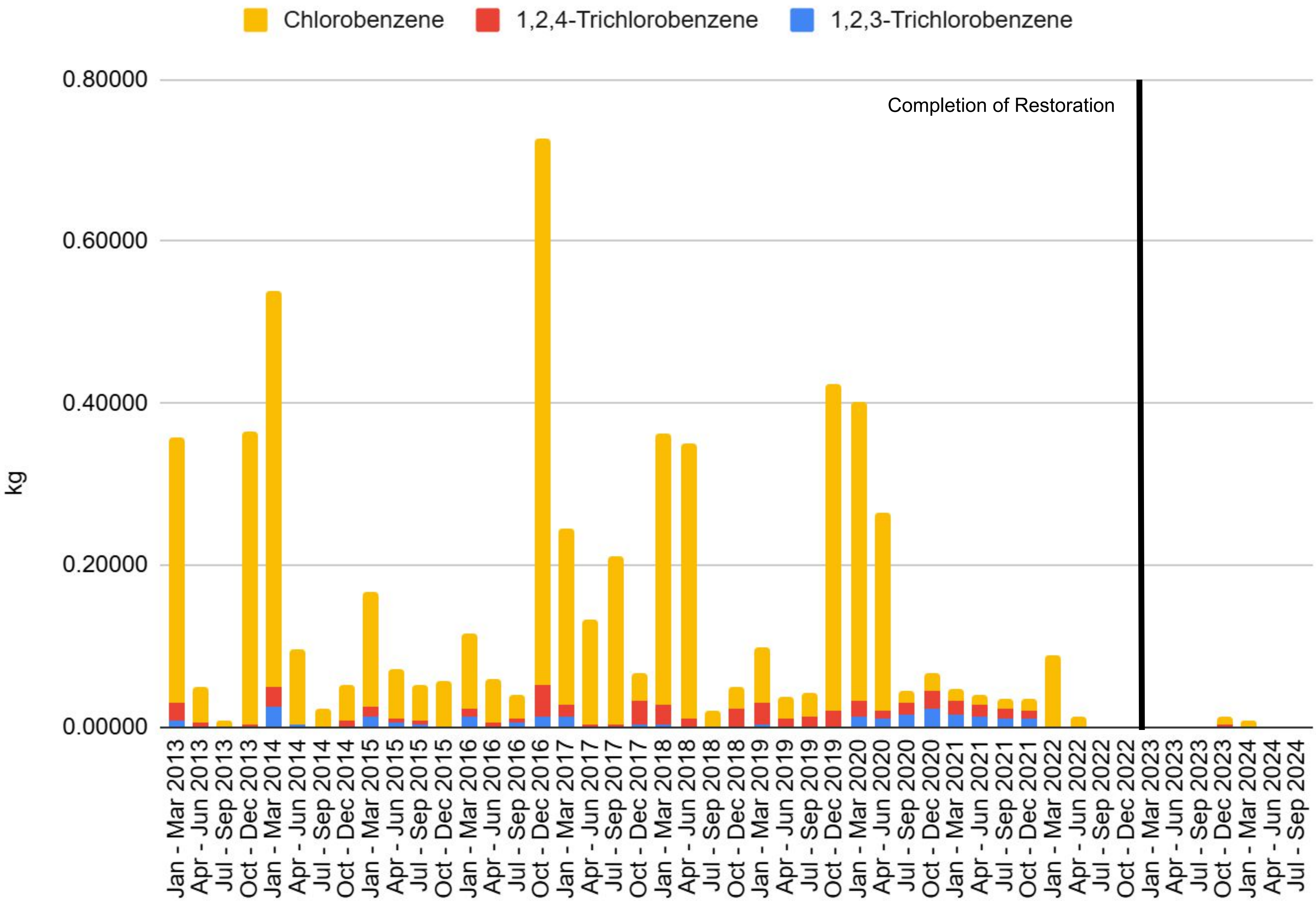
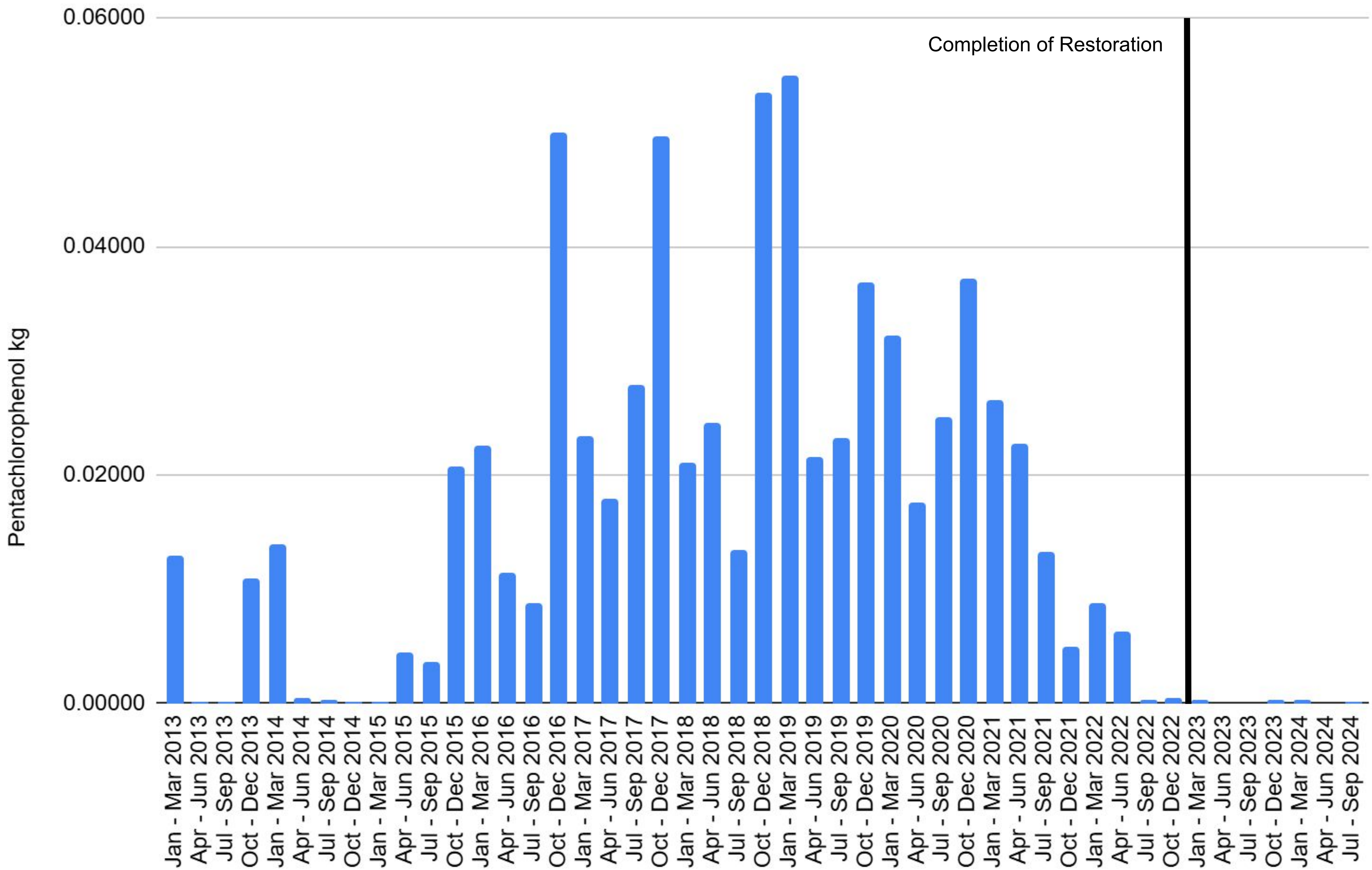
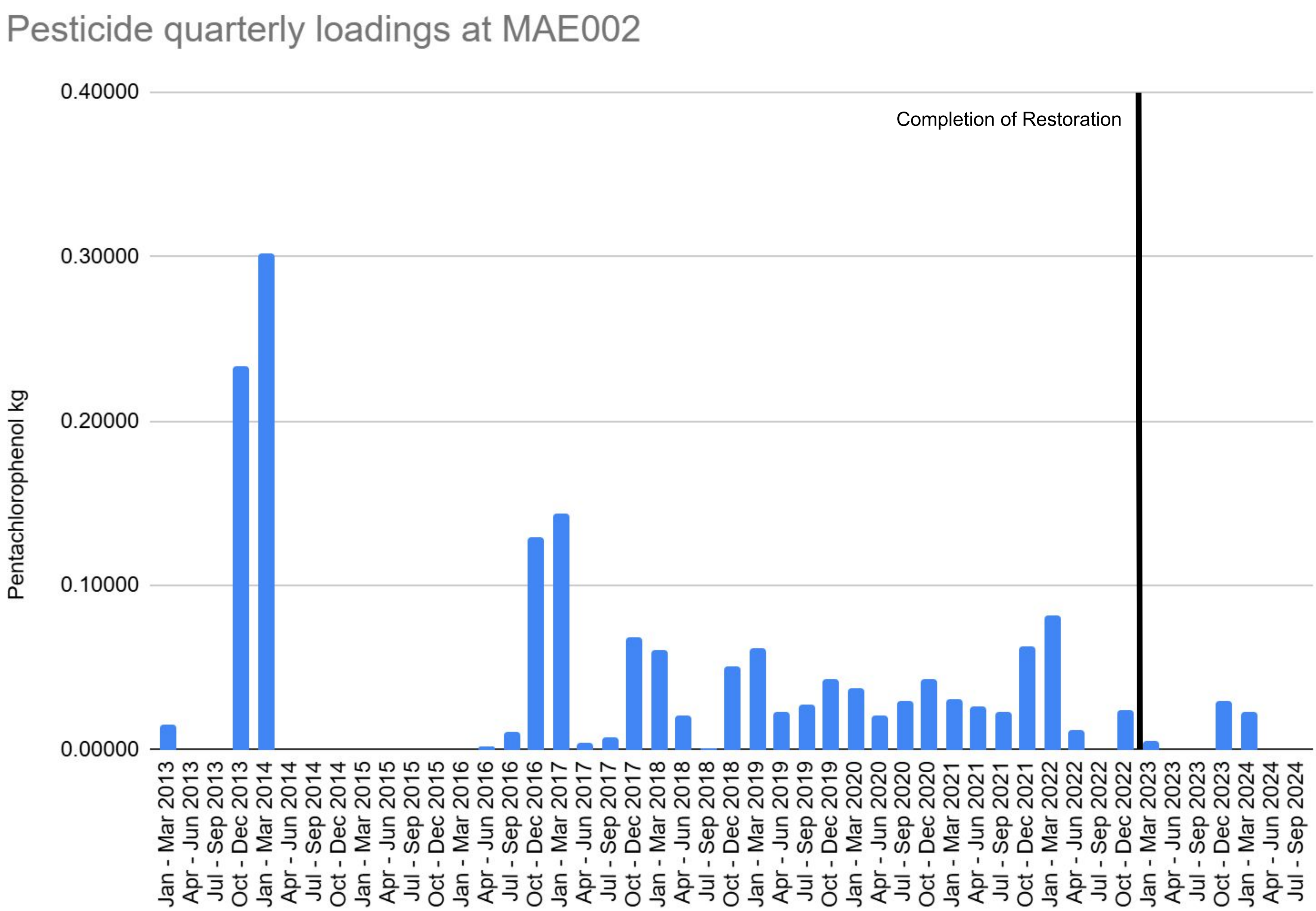
Aromatic chlorinated solvents quarterly loadings at MAE002



Pesticide quarterly loadings at MAE001





Pesticide quarterly loadings at MAE002
Pentachlorophenol kg
0.40000
0.30000
0.20000
0.10000
0.00000
Completion of Restoration
Jan - Mar 2013
Apr - Jun 2013
Jul - Sep 2013
Oct - Dec 2013
Jan - Mar 2014
Apr - Jun 2014
Jul - Sep 2014
Oct - Dec 2014
Jan - Mar 2015
Apr - Jun 2015
Jul - Sep 2015
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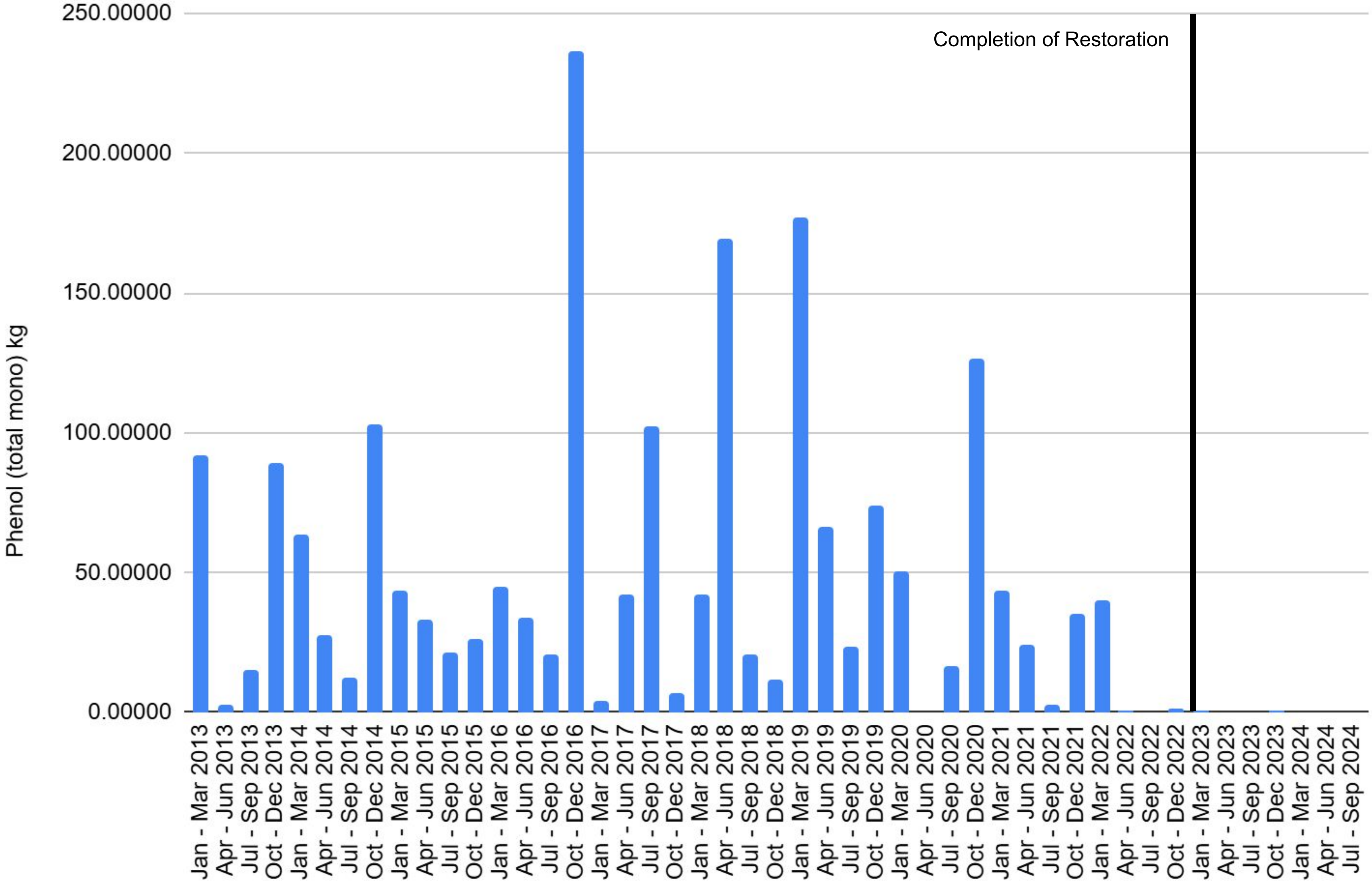
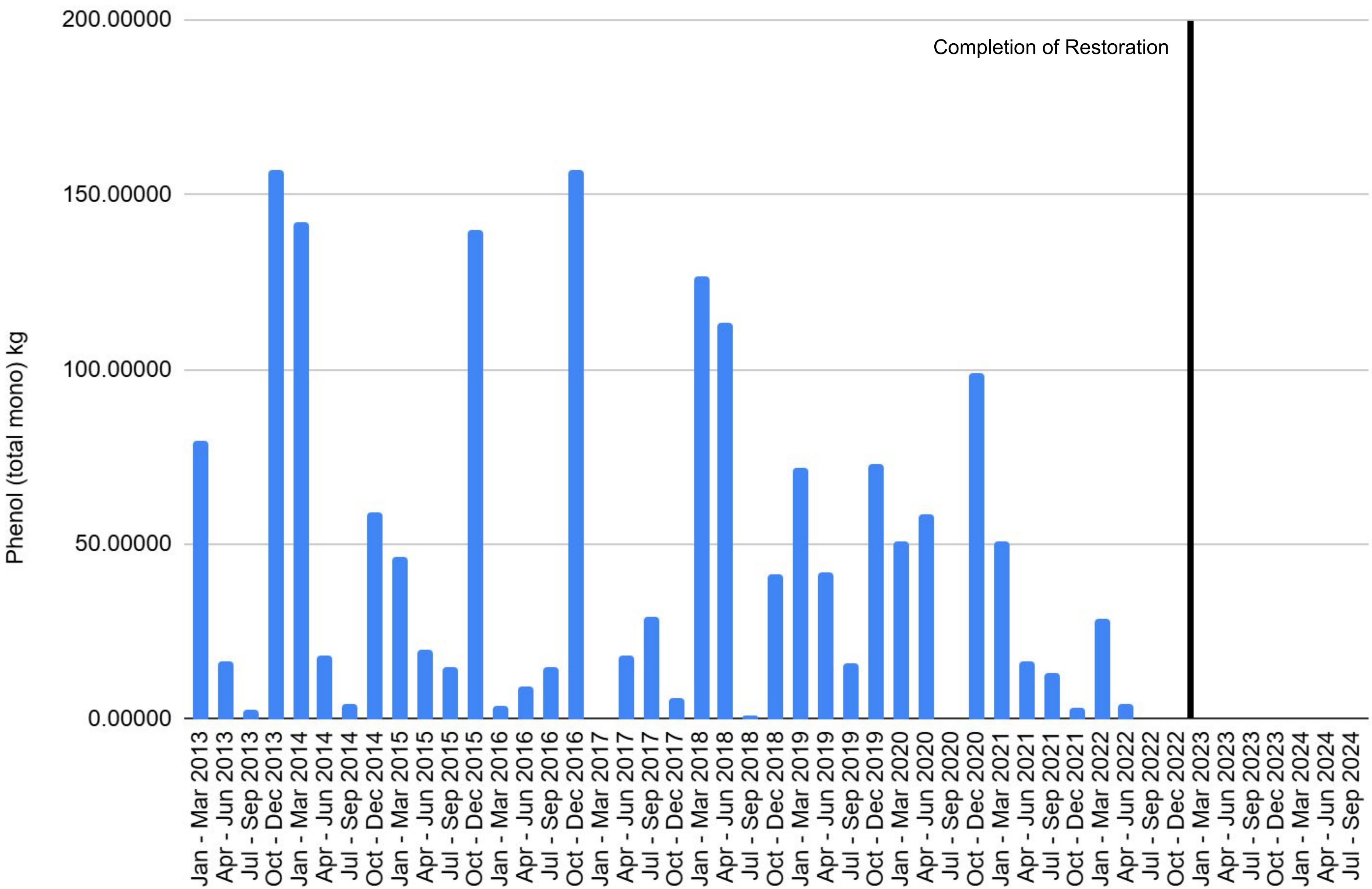
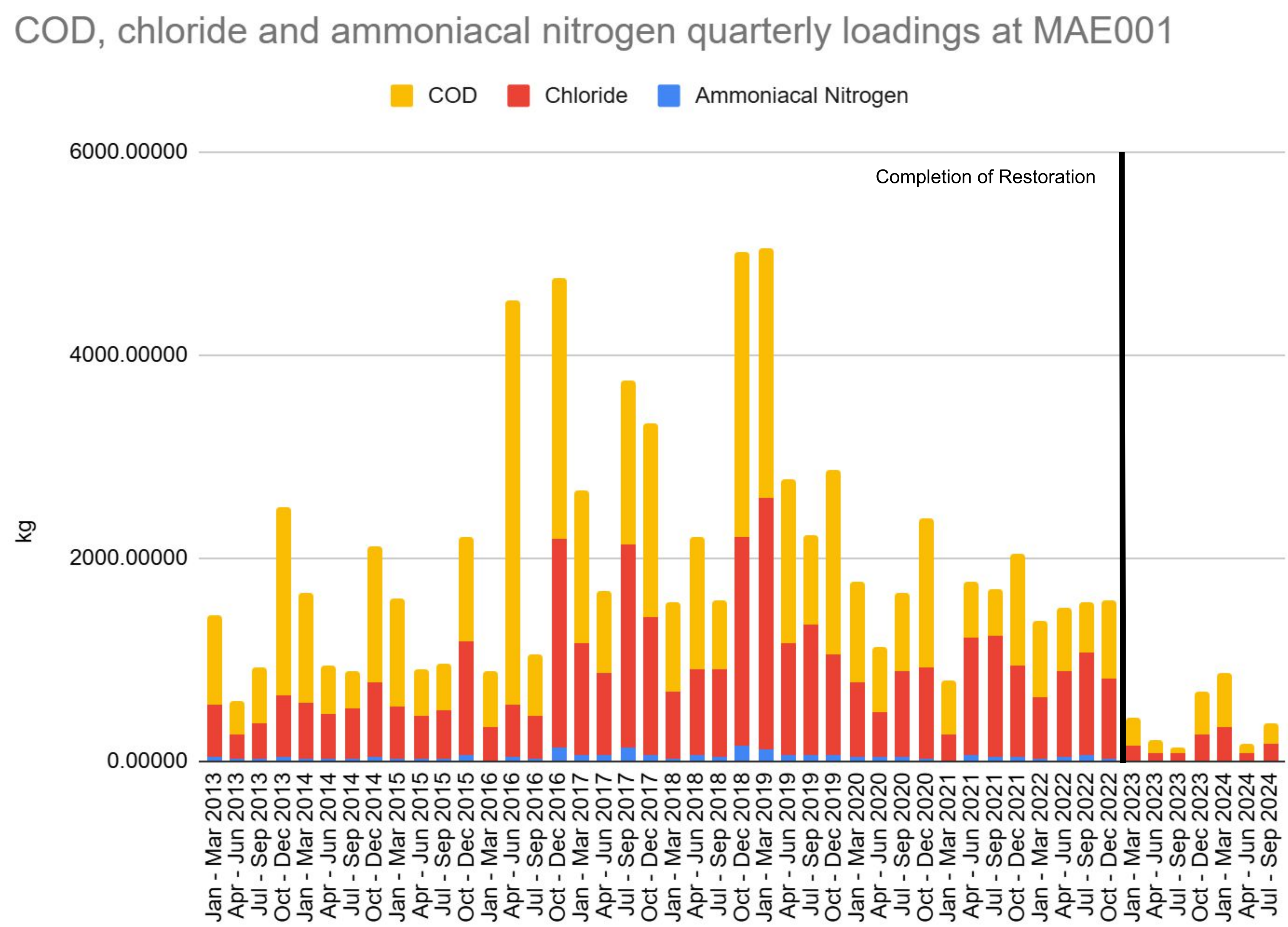
Phenol (total mono) quarterly loadings at MAE001



Phenol quarterly (total mono) loadings at MAE002





COD, chloride and ammoniacal nitrogen quarterly loadings at MAE001
COD
Chloride
Ammoniacal Nitrogen
6000.00000
4000.00000
2000.00000
0.00000
kg
Completion of Restoration
Jan - Mar 2013
Apr - Jun 2013
Jul - Sep 2013
Oct - Dec 2013
Jan - Mar 2014
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Apr - Jun 2015
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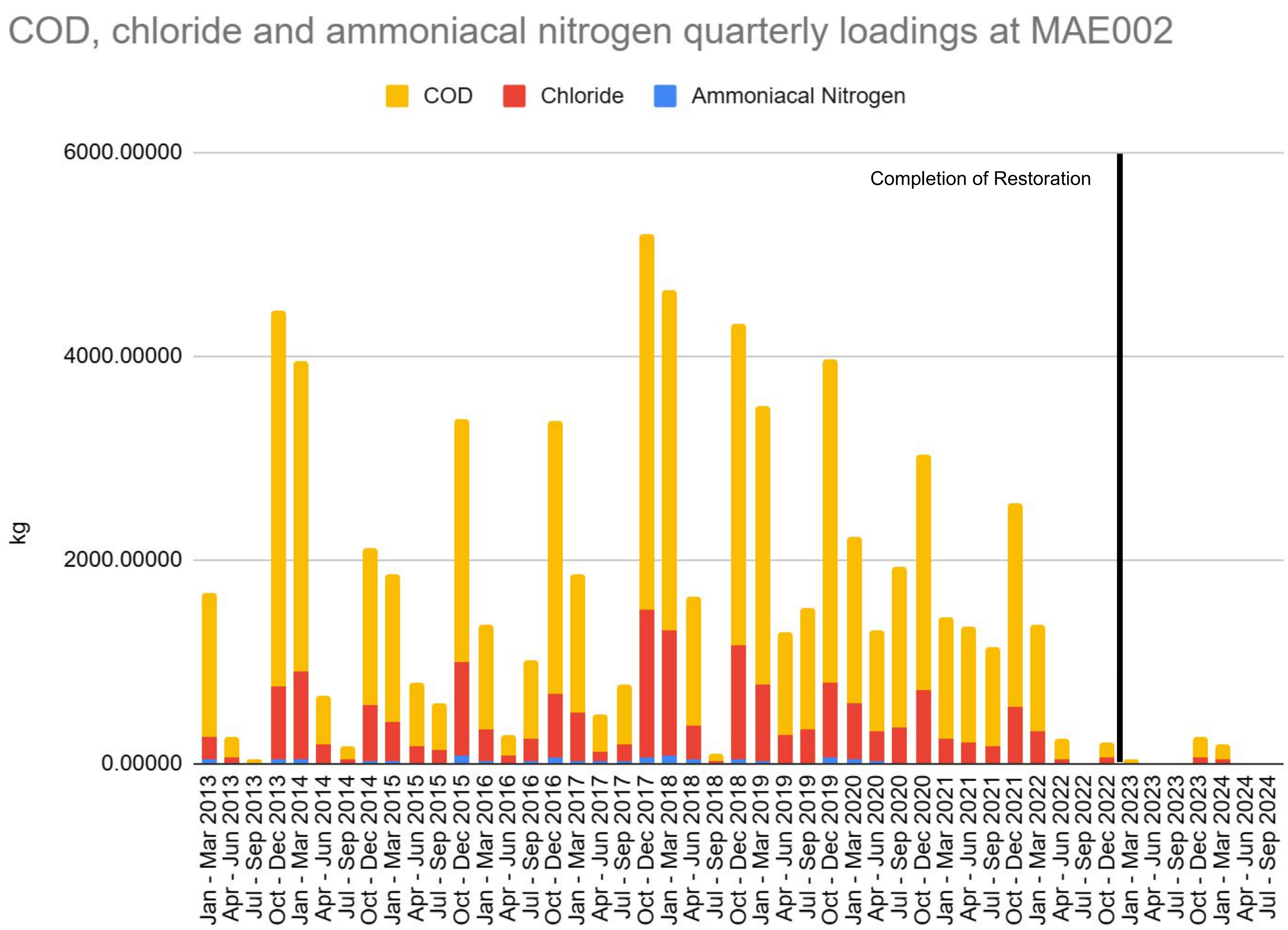
COD, chloride and ammoniacal nitrogen quarterly loadings at MAE002
COD
Chloride
Ammoniacal Nitrogen
kg
6000.00000
4000.00000
2000.00000
0.00000
Completion of Restoration
Jan - Mar 2013
Apr - Jun 2013
Jul - Sep 2013
Oct - Dec 2013
Jan - Mar 2014
Apr - Jun 2014
Jul - Sep 2014
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