# Technical Note

ARUP

4 Pierhead Street
Capital Waterside
Cardiff CF10 4QP
United Kingdom
www.arup.com

**t** +44 29 2047 3727
**f** +44 29 2047 2277

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| Project title | Silent Valley Landfill | Job number | 115825 |
| cc | Noel Chard | File reference | 4.70 |
| Prepared by | Charlie Martin | Date | 12 December 2017 |
| Subject | Review of Environmental Consequence of non-Compliance at GW9 | | |

# 1 Introduction

Silent Valley Landfill was closed in August 2011 and a revised Environmental Permit (EPR/MP3835SV) was issued in March 2016 by NRW when it was accepted that the landfill was in closure and was entering the aftercare period.

This revised permit included three improvement conditions, and in particular two pertaining to the ongoing non-compliance at the monitoring well GW9:

- IC1a required the preparation of a plan for the pumping of groundwater from GW9 to demonstrate any impact on the by this work. This was prepared by Arup (Ref. 1) and approved by NRW in October 2016.
- IC1b requires the subsequent implementation of the approved plan (Ref. 1) and reporting to confirm the effectiveness of the pumping from GW9 and present any proposals for ongoing work to address the non-compliance at GW9.

To undertake the recommendations presented in the IC1a submission it was necessary to undertake a tender process to procure a suitable ground investigation contractor to install the pumping well at GW9, which is located on a steep slope. An initial specification for the works was prepared and discussions with a number of GI contractors undertaken to confirm interest and availability. During this process it became apparent that further drilling works were required around the site, including the replacement of gas and groundwater monitoring wells and the testing and redrilling of a leachate monitoring well on the waste body of the landfill. This required a revision of the specification for the works and a formal tender process was implemented. The results of this are discussed in Section 2.

This note presents a summary of the results of the tender process and a subsequent review of available data with respect to the impact of the ongoing non-compliance at GW9.

# 2 Tender Process

In accordance with the procurement requirements of Silent Valley, six, relatively local, and suitably competent GI contractors were invited to tender for the required drilling works at the landfill. On completion of the tender period only two contractors had responded with a tender. As a consequence, a further three GI contractors were approached – all three of these declined to tender.

This left Silent Valley with a non-compliant tender process. Subsequent to preparation of a tender assessment report, all non-submitting tenderers were contacted again to confirm whether they would reconsider tendering, all confirmed they would not.

In addition, review of the costs associated with the works are higher than expected, and it seems that the inclusion of the differing variety of wells was a factor in both the higher costs and the lack of interest in the contract.

Currently a review of options to split the contract to achieve the most economically reasonable solution to this issue.

However, as a consequence of the non-compliant tender and the high costs associated with the work Arup have undertaken a review of the available environmental monitoring data that has been collected since the issue of the revised permit to confirm whether pumping from GW9 would provide a discernible benefit, this review is presented in the following sections.

# 3 Review of Recent Monitoring Data

Prior to the issue of the revised Environmental Permit Phase 1 of the landfill was recapped, with the capping being completed in September 2015. The previous cap on Phase 1 was found to be not compliant with the requirements of the Landfill Directive and was not preventing ingress of rainwater to the landfill. As part of studies undertaken for Blaenau Gwent CBC a review of the leachate disposed to sewer from the lagoon has been undertaken, this is presented in Section 3.1.

As required by the Environmental Permit, downstream groundwater and surface water monitoring is undertaken regularly. The results of these are presented in the quarterly and annual monitoring reports and are summarised in the following sections.

## 3.1 Review of Leachate Generated by the Site

Daily leachate volume disposed to sewer and rainfall data ranging from 1st April 2013 to 31st October 2017 for the site have been reviewed. Figure 1 presents the leachate volume and rainfall depths between these dates.

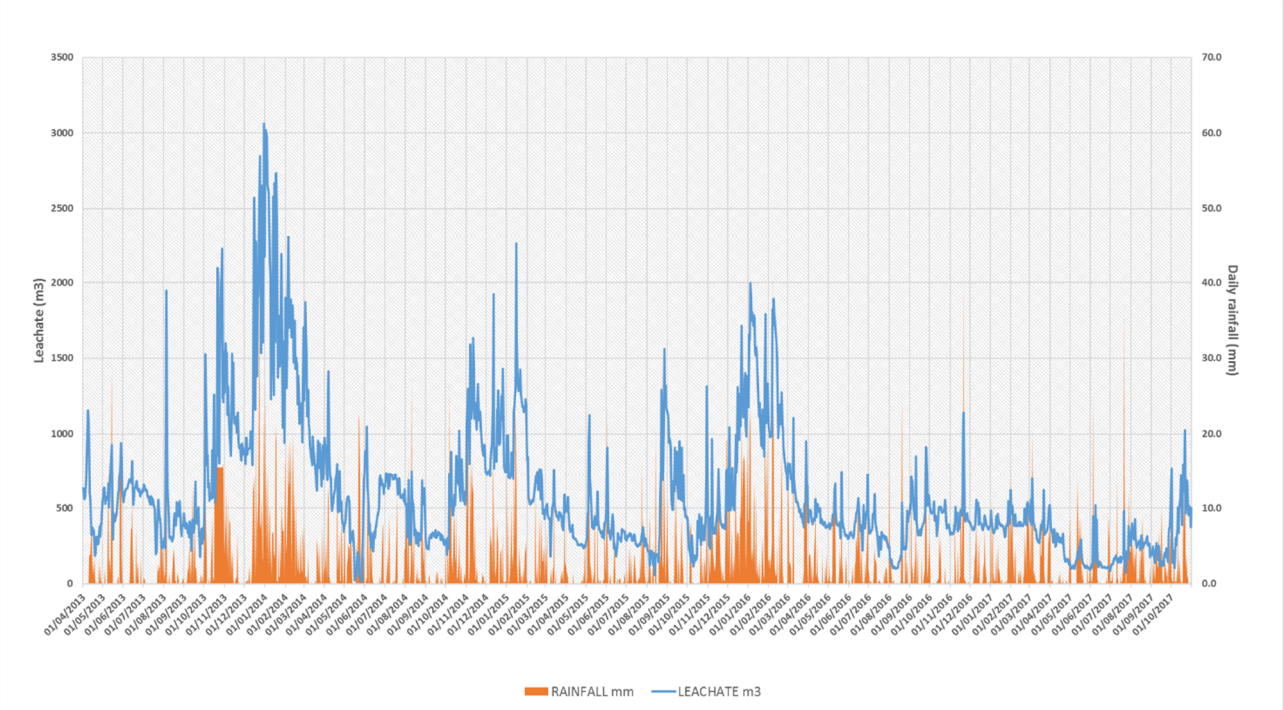



Figure 1 – Graphical presentation of the leachate flow and rainfall between 1/4/13 and 31/10/17

A general reduction in leachate flow can be observed over time, the flow peaks since September 2015 have also been lower than previously recorded. However, without further analysis it is possible that the reduction is not fully attributable to the capping – the correlation could be due to climatic conditions. Similar flow events need to be assessed to make any quantifiable comparison to asses if the capping had any effect.

Records show the wettest months to be between November and January with each peak leachate volume event occurring within these dates (excluding 2017) as shown in Table 1.

Table 1 – Yearly Peak leachate flow events

| Year | Peak Leachate Flow ($m^3/d$) | Date | Number of days with significant rainfall | Rainfall event depth (mm) |
|---|---|---|---|---|
| 2013 | 3062 | 30/12/2013 | 13 | 158.5 |
| 2014 | 3021 | 02/01/2014 | 16 | 196.3 |
| 2015 | 2261 | 15/01/2015 | 10 | 89.8 |
| 2016 | 1997 | 04/01/2016 | 17 | 217.4 |
| 2017* | 1025 | 21/10/2017 | 3 | 38.1 |

* Incomplete records

The peak flow events cannot be examined in isolation as rainfall from previous days could have an impact on the leachate volume. The rainfall events leading to the peaks in 2014 and 2016 are similar in terms of cumulative depth over a similar number of days. The data shows an approximate 33% reduction between the 2014 (pre- capping) and 2016 (post capping) peak events.

The wettest months are November to January each year. Table 2 shows the leachate volumes for this period along with the cumulative rainfall. The flow records for 2017 that have been used for this assessment are incomplete, so the record omits the wettest months of the year; therefore 2017 is not included in the further analysis. However the complete records for 2017 have been recently received and this assessment will be updated in due course to include these.

Table 2 – Leachate flow and rainfall analysis over the wettest months of the year

| Period | | No. of days | Total leachate ($m^3$) | Average Leachate flow ($m^3/d$) | Total rainfall mm | Peak Leachate Flow ($m^3/d$) |
|---|---|---|---|---|---|---|
| 1 | 1/11/13 to 31/1/14 | 92 | 144063 | 1566 | 516 | 3062 |
| 2 | 1/11/14 to 31/1/15 | 92 | 97296 | 1058 | 380 | 2261 |
| 3 | 1/11/15 to 31/1/16 | 92 | 86186 | 937 | 644 | 1997 |
| 4 | 1/11/16 to 31/1/17 | 92 | 38773 | 421 | 229 | 1142 |
| | | | | Difference | | |
| | | Comparison of 1 and 3 | | -40% | +25% | -35% |
| | | Comparison of 2 and 4 | | -60% | -40% | -49% |

It is important to compare on a like-for-like basis. In terms of rainfall depths over November to January, as shown in Table 2; the comparable rainfall depths are identified to be between period 1 and 3 and between period 2 and 4.

**Comparison of 1 and 3**

The rainfall over the period increased by 25% whist the total leachate reduced by 40% and the peak event reduced by 35%.

By analysing the two periods it could be stated that the capping has had an effect on the leachate amount, the amount has reduced whilst the total rainfall has increased.

**Comparison of 2 and 4**

The rainfall over the period decreased by 40% between the two years and the total amount of leachate reduced 60% and the peak event reduced by 49%.

This reduction is consistent with what is observed between period 1 and 3. The average and peak flows are lower post capping. The leachate volume reductions are greater when compared to section 3.1 which could be contributed to less rainfall entering the landfill.

**Analysis of data**

There is direct correlation between the total precipitation and the leachate flow as shown in Figure 1. The leachate is shown to have reduced since Phase 1 of the landfill capping was completed in September 2015.

Due to limited records it is currently difficult to accurately quantify the flow reduction due to the capping and relate the leachate volume based on rainfall events. Further monitoring data is required

## 3.2 Review of Groundwater Quality at GW9.

Groundwater compliance well GW9 is installed in sandstone strata S2-East and is sampled and monitored quarterly in accordance with the Environmental Permit.

The suite of analyses includes landfill leachate species, and the well generally indicates compliance with the set compliance levels for the site. However, the well has historically not complied with the 1mg/l trigger level.

Review of the Mercury, Ammoniacal Nitrogen and Chloride results from GW9 from between January 2015 and December 2015 (monthly readings) and between January 2016 to December 2017 (quarterly readings) is presented in the following sections. The results are presented in Table 3 and Graphical Figures 2 to 4 (2016-2017 data).

### 3.2.1 Mercury

Mercury concentrations between January 2015 and December 2017 were generally recorded at concentrations <LOD (<0.10ug/l).

January 2017 was the only month, over the three-year period, where concentrations of mercury were recorded slightly above the LoD; at a concentration of 0.15ug/l (but still below the 1ug/l EQS and 0.2ug/l site trigger level).

### 3.2.2 Ammoniacal Nitrogen

Over the three-year monitoring period all concentrations of Ammoniacal nitrogen were recorded in excess of the applied trigger level for the site (1mg/l).

Between January 2015 and December 2015, concentrations of Ammoniacal nitrogen were recorded from 23.10mg/l in January 2015, to a maximum concentration of 24.30mg/l in February 2015; decreasing to 5.02mg/l in December 2015.

Concentrations then rise again to 20.3mg/l in January 2016, reducing each month over the 2016-2017 period to 2.12mg/l in October 2017 (recording the lowest value since August 2011). Figure 3 demonstrates a significant reducing trend, with the well now approaching compliance with the trigger level of 1mg/l.

## 3.3 Review of Impact on Nant Merddog

The Nant Merddog is considered to be the primary receptor for any contamination present in groundwater downstream of the landfill. It is monitored on a quarterly basis, in accordance with the requirements of the Environmental Permit, for a number leachate species including ammoniacal nitrogen. In addition, further to studies in 2013, groundwater break outs from S2 strata that discharge to the Nant Merddog have been monitored. The results of these are discussed in the following sections.

### 3.3.1 Monitoring of the Nant Merddog

Review of the surface water monitoring results of SWD and SWD1 that are downstream of the landfill indicates that ammoniacal nitrogen levels have continued to remain below the laboratory detection level of 0.41mg/l throughout 2017, and have done so since 2014.

Chloride and sulphate concentrations have continued to be recorded below their respective EQS freshwater screening levels.

### 3.3.2 Sandstone S2 Breakouts in the SSSI

Monitoring and analysis of Mercury, Ammoniacal Nitrogen, and Chloride were undertaken at monthly intervals between January 2015 and December 2015, and at quarterly intervals between January 2016 and December 2017 at the sampling at locations SW1 to SW10 (downstream of the landfill). Locations SW1 and SW4 are at the sources of the identified breakouts.

The presence of landfill species (ammoniacal nitrogen and chloride) in the surface water breakouts was infrequent, with ammoniacal nitrogen generally below the limits of detection, and no discernible impact on the Nant Merddog has been noted during the monitoring period.

The results are summarised below and shown in Graphical Figures 4 to 6 (2015 data) and Figures 7 to 9 (2016-2017 data).

**Mercury**

All concentrations of mercury were recorded below 0.1ug/l LOD over the 2015 monthly monitoring period and the 2016 – 2017 monitoring period in all surface monitoring wells across the site (SW1 – SW10).

**Ammoniacal Nitrogen**

2015 monthly monitoring of ammoniacal nitrogen was generally recorded all concentrations below the laboratory limit of detection with the exception of two samples from SW4 and SW5 (breakouts) which recorded 1.5 and 0.48mg/l in January 2015 only.

The 2016 - 2017 quarterly monitoring of ammoniacal nitrogen also generally recorded all concentrations below the laboratory limit of detection with the exception of three samples from SW4, SW5 and SW6 which recorded concentrations of 7.72 mg/l (SW4), 5.55 mg/l (SW5), and 2.87 mg/l (SW6), in February 2016 only. These locations are along the same "tributary" to the Nant Merddog, and demonstrate a reduction in ammoniacal nitrogen along its length. Monitoring within the Nant Merddog (both from SW1 – SW10 and SWD and SWD1) has not indicated any discernible impact with ammoniacal nitrogen

Generally, all subsequent concentrations of ammoniacal nitrogen were recorded below the 0.41mg/l LoD.

**Chloride**

All surface water chloride concentrations from 2015 – 2017 were recorded below 76 ug/l (EQS 250mg/l).

### 3.3.3 Biological Assessment of Nant Merddog

Biological monitoring of the Nant Merddog, downstream of the landfill, is undertaken in Spring and Autumn each year since 2010. The latest report for Autumn 2017 has concluded the following:

*"The BMWP and ASPT scores and the continues presence of pollution-sensitive invertebrate families indicate that the Nant Merddog is in good health, which suggests that the stream is presently not negatively affected by current or historical operations at the Site.*

*The BMWP scores recorded during the Autumn 2017 sampling were similar to previous years. All of the 2017 results remain within the 'fairly clean' designation."*

This continued recognition of the site not impacting the Nant Merddog correlates with the available surface water monitoring of the Nant Merddog and the groundwater breakouts.

# 4 Discussions

As presented in the Proposals for Pumping from GW9 June 2016 Silent Valley have undertaken significant investigations and engineering works to address the ongoing non-compliance at GW9, including reinforcement of the pumping system at the toe of the landfill and diversion of eastern gabion mattress lined surface water ditch. In addition, recapping of the Phase 1 has been undertaken (being completed in September 2015) to ensure compliance with the Landfill Directive.

The review of the available leachate volume monitoring data indicates that the capping is likely to have reduced the volume of leachate generated by the site, but further monitoring and assessment is required to confirm how weather conditions impact this conclusion.

All the monitoring data of the Nant Merddog indicates that the site is not impacting the Nant Merddog, and generally the break outs are not demonstrating levels of ammoniacal nitrogen above the limit of detection, and no results in 2017 were above the limit of detection.

The review of GW9 monitoring data is indicating a significant and persistent declining trend in ammoniacal nitrogen concentrations, such that it is now approaching the trigger value of 1mg/l (currently at 2mg/l), and this is expected to be why the breakouts are demonstrating less than

detectable levels of ammoniacal nitrogen. It is likely that this is a function of the improved capping on Phase 1 of the landfill, however, as discussed in Section 3.1 the rainfall on the site has been reduced in 2017 and therefore the reducing concentration trend may not just be due to the completion of the capping.

The review of the results as a whole suggests that, even though there remains a non-compliance with regards to ammoniacal nitrogen at GW9, there is a decreasing potential for the site to impact the Nant Merddog, and currently it is demonstrably not being impacted by the site.

With regards to the proposed pumping from GW9, a key issue is that monitoring of the breakouts is required to demonstrate whether the pumping has an impact. With the results of the monitoring of these breakouts showing, for the significant majority of the time, that the levels of ammoniacal nitrogen are at less than detectable levels, it will not be possible to demonstrate an impact, or not, as the case maybe.

Therefore, on consideration of the benefit of, and what may be demonstrated by, pumping from GW9 the latest data suggests that no benefit will be gained from it.

# 5 Recommendations

In light of the results presented in this note we recommend that the requirement to undertake pumping from GW9 is, at a minimum postponed for further review after an extended monitoring period, or removed completely.

To support this proposed we recommend that we continue monitoring of GW9, the Nant Merddog and the breakouts in accordance with the Environmental Permit. In particular undertake monitoring of the breakouts for a further twenty four months and then undertake a further review of the available data to confirm whether the monitoring of the breakouts can be reduced in frequency and number.

**DOCUMENT CHECKING (not mandatory for File Note)**

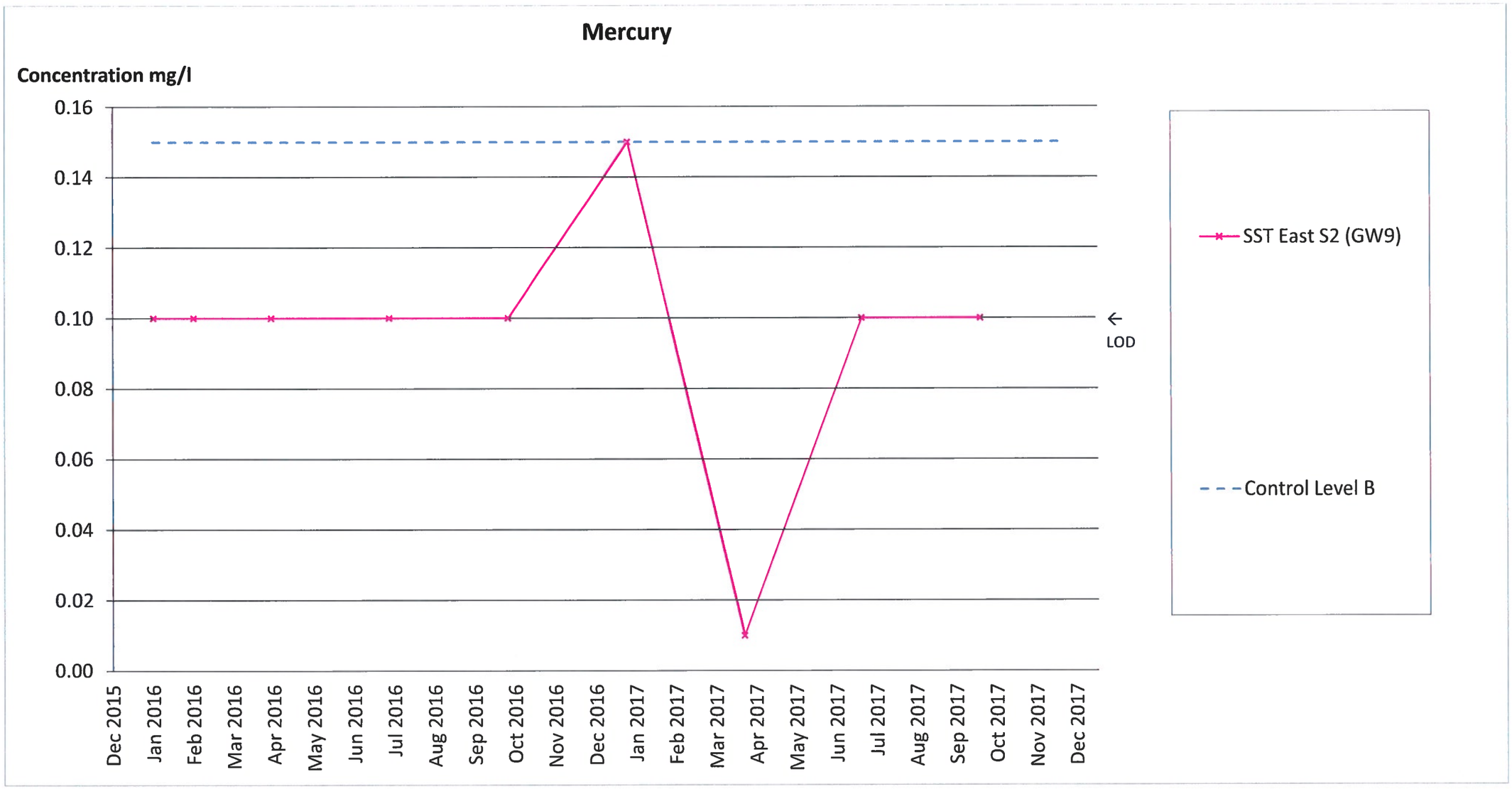
| | Prepared by | Checked by | Approved by |
|---|---|---|---|
| Name | Charlie Martin | Lisa Dymock | Charlie Martin |
| Signature | | | |

*Table 3: Groundwater monitoring Hg, NH3 and Cl results 2015 – 2017*

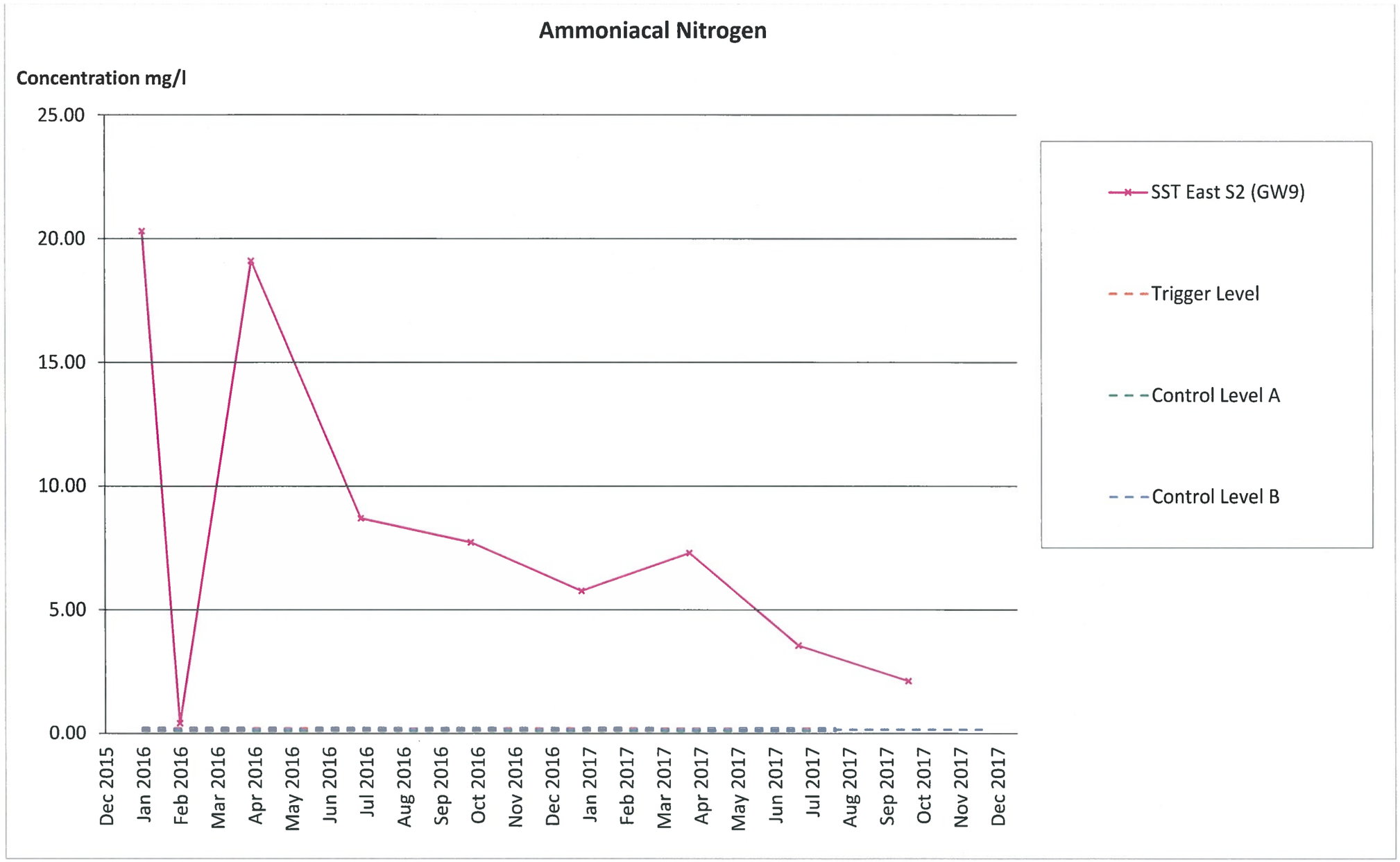
| Location | Month | Date | Test reference number | | Mercury, filtrate as Hg | | Ammoniacal Nitrogen as N | Unionised Ammoniacal Nitrogen *** | Chloride as Cl |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | ug/l | | mg/l | mg/l | mg/l |
| | **Trigger Level** | | | | **(0.2[a])** | | **1** | **--** | **250** |
| | **Control Level A** | | | | **(0.1[aa])** | | **0.8** | **--** | **210** |
| | **Control Level B** | | | | **(0.15[aa])** | | **0.9** | **--** | **230** |
| | **EQS Freshwater** | | | | **1** | | **--** | **0.015** | **250** |
| | **Assessment Level** | | | | **--** | | | **--** | **--** |
| GW9 | Jan-15 | 26/01/15 | 14443312 | < | 0.10 | | 23.10 | 0.1082 | 111.0 |
| | Feb-15 | 24/02/15 | 14490094 | < | 0.10 | | 24.30 | 0.1130 | 91.6 |
| | Mar-15 | 23/03/15 | 14531482 | < | 0.10 | | 19.40 | 0.1845 | 82.3 |
| | Apr-15 | 27/04/15 | 14581003 | < | 0.10 | | 21.90 | 0.3381 | 122.0 |
| | May-15 | 26/05/15 | 14623512 | < | 0.10 | | 16.50 | 0.0677 | 94.8 |
| | Jun-15 | 01/07/15 | 14680369 | < | 0.10 | | 15.40 | 0.0991 | 103.0 |
| | Jul-15 | 28/07/15 | 14732222 | < | 0.10 | | 15.90 | 0.1001 | 112.0 |
| | Aug-15 | 26/08/15 | 14790176 | < | 0.10 | | 12.30 | 0.2817 | 82.4 |
| | Sep-15 | 29/09/15 | 14855295 | < | 0.10 | | 7.46 | 0.3148 | 46.7 |
| | Oct-15 | 27/10/15 | 14911981 | < | 0.10 | | 9.37 | 0.0483 | 60.6 |
| | Nov-15 | 24/11/15 | 14969670 | < | 0.10 | | 5.48 | 0.0102 | 27.2 |
| | Dec-15 | 16/12/15 | 15019631 | < | 0.10 | | 5.02 | 0.1182 | 34.9 |
| | Jan-16 | 26/01/2016 | 15089704 | < | 0.1 | | 20.3 | 0.3761 | 104 |
| | Feb-16 | 23/02/2016 | 15140305 | < | 0.1 | < | 0.41 | 0.0011 | 22 |
| | Mar-16 | | | | | | | | |
| | Apr-16 | 06/04/2016 | 15220451 | < | 0.1 | | 19.1 | 0.6545 | 97.5 |
| | May-16 | | Quarterly | | | | | | |
| | Jun-16 | | | | | | | | |
| | Jul-16 | 02/08/2016 | 15464945 | < | 0.1 | | 8.7 | 0.0258 | 56.3 |
| | Aug-16 | | Quarterly | | | | | | |
| | Sep-16 | | | | | | | | |
| | Oct-16 | 25/10/2016 | 15644810 | < | 0.1 | | 7.73 | 0.0344 | 41.5 |
| | Nov-16 | | Quarterly | | | | | | |
| | Dec-16 | | | | | | | | |
| | Jan-17 | 30/01/2017 | 15849043 | | 0.15 | | 5.77 | 0.0081 | 38.3 |
| | Feb-17 | | Quarterly | | | | | | |
| | Mar-17 | | | | | | | | |
| | Apr-17 | 24/04/2017 | 16040352 | < | 0.01 | | 7.3 | 0.0105 | 59.8 |
| | May-17 | | Quarterly | | | | | | |
| | Jun-17 | | | | | | | | |
| | Jul-17 | 01/08/2017 | 16290507 | < | 0.1 | | 3.56 | 0.0063 | 49 |
| | Aug-17 | | Quarterly | | | | | | |
| | Sep-17 | | | | | | | | |
| | Oct-17 | 24/10/2017 | 16530931 | < | 0.1 | | 2.12 | 0.0121 | 47.7 |
| | Nov-17 | | Quarterly | | | | | | |
| | Dec-17 | | | | | | | | |

Exceedance of Control Level
Exceedance of Trigger Level
Exceedance of freshwater EQS
Exceedance of Assessment Level

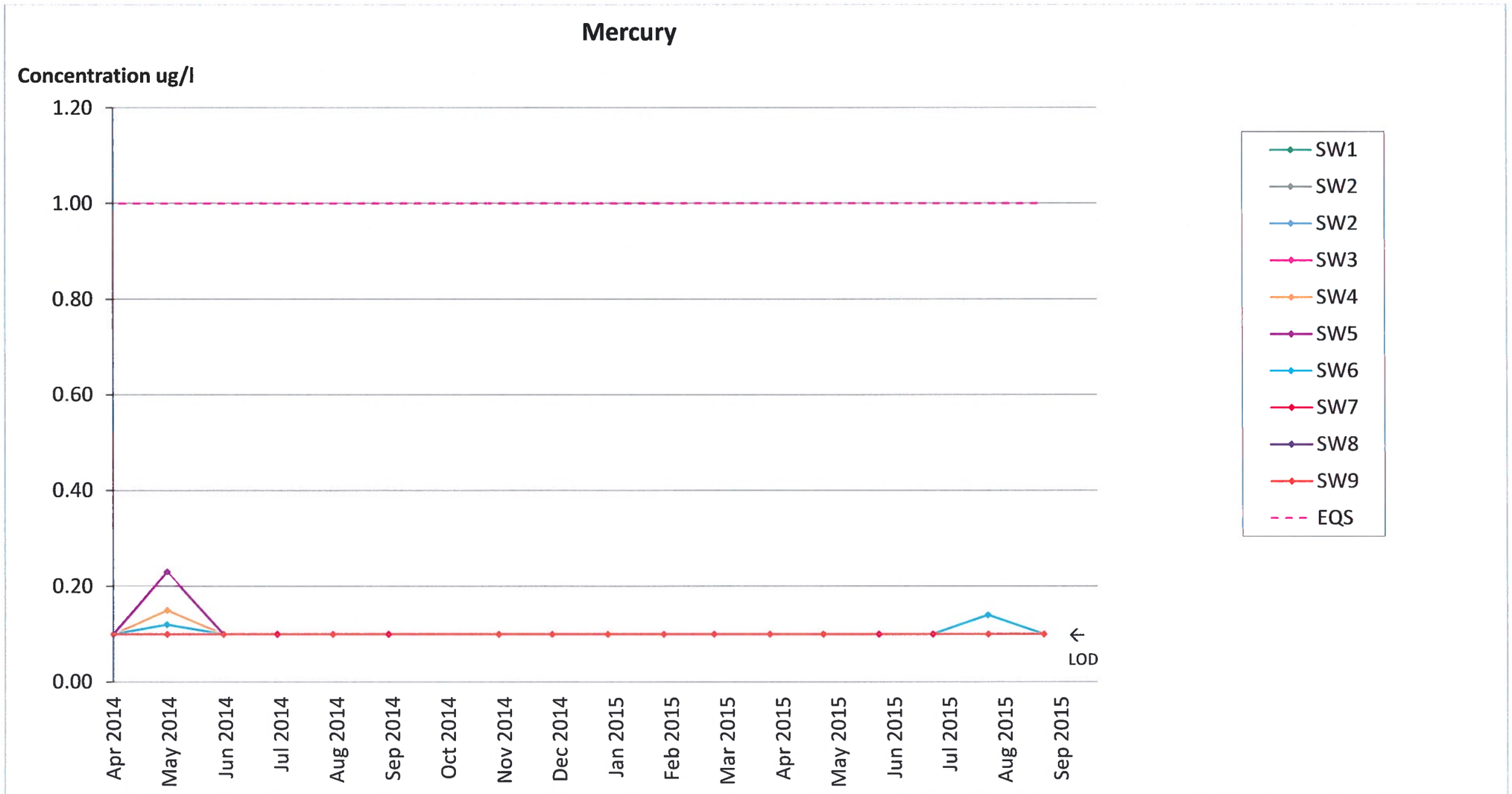
## Fig. 2 GW9 compliance well 2016 - 2017 GW Data



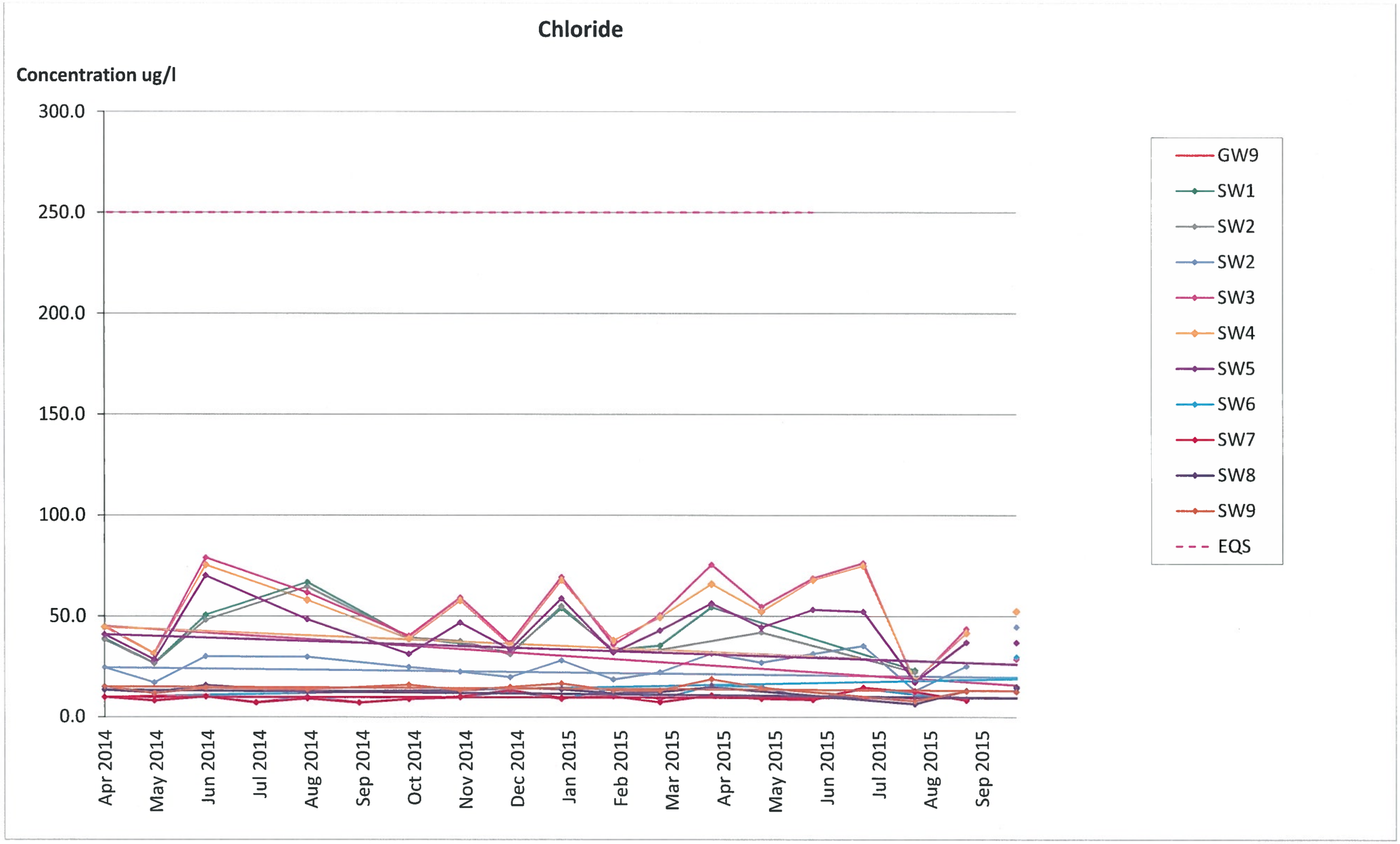
## Fig. 3 GW9 compliance well 2016 - 2017 GW Data



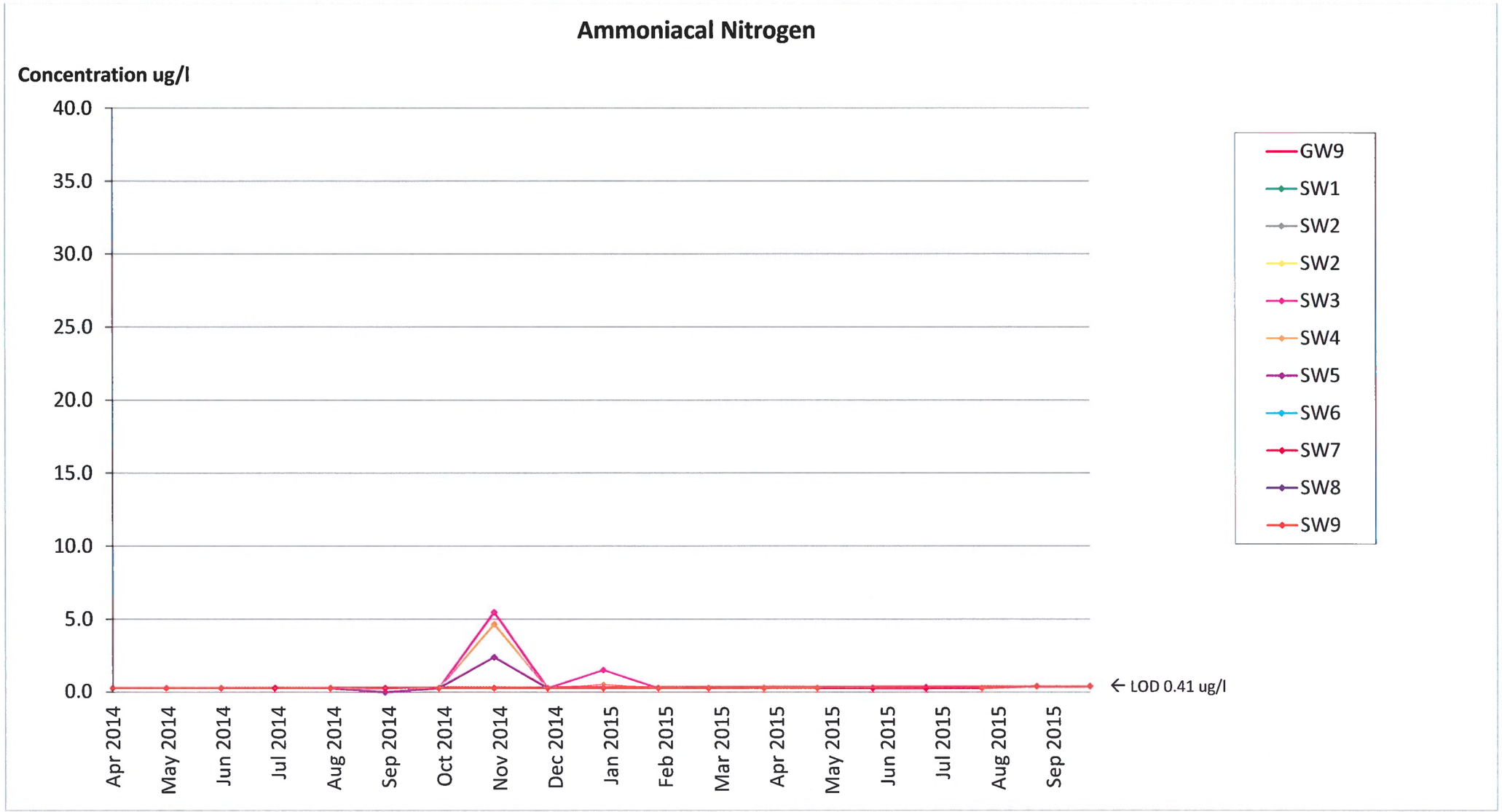
## Fig.4 Break Out Monitoring Results, Mercury 2014 - 2015



## Fig. 5 Break Out Monitoring Results, Chloride 2014 - 2015

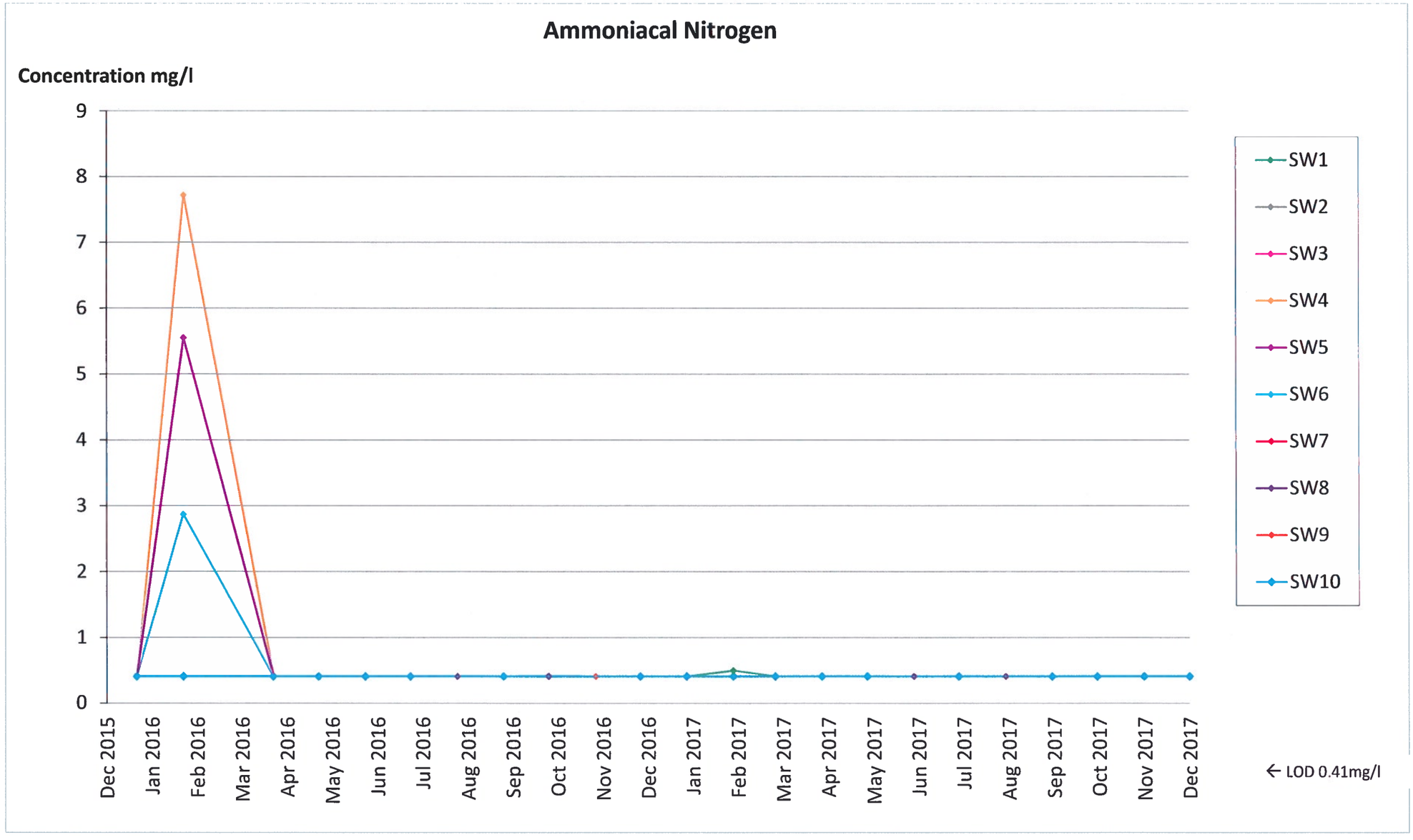


## Fig. 6 Break Out Monitoring Results, Ammoniacal Nitrogen 2014 - 2015



## Fig. 7 Break Out Monitoring Results, Mercury 2016 - 2017

## Fig. 8 Break Out Monitoring Results, Ammonical Nitrogen 2016 - 2017



## Fig. 9 Break Out Monitoring Results, Chloride 2016 - 2017