



## **Three Kings Quarry**

# **Fill Management Plan - Annual Compliance Report 02 April 2012 – 31 May 2015**

**June 2015**

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# 1 Introduction

Winstone Aggregate was granted permit numbers 36221, 36222, 37770 and R/LUC/2009/743 by the Environment Court on 26 July 2011. These consents authorise the rehabilitation of the Three Kings Quarry through filling. The consents were given effect on 2 April 2012.

The objective of the fill operation is to rehabilitate ground levels of the Three Kings Quarry and leave the site stable, safe and fit for subsequent use. The material used to fill the site must therefore be able to achieve the objective in a manner which has no more than minor adverse effects on people or the environment, during and after completion of filling.

In conjunction with the fill consents, the Fill Management Plan sets out how the fill material quality is to be managed and includes the monitoring and reporting implemented to ensure ongoing compliance with the above mentioned consents. In accordance with Condition 27 of the consents the monitoring detailed in the Fill Management Plan is to be complied and reported annually.

Condition 27 reads:

*An Annual Compliance Report shall be submitted to the Manager by 30 June each year which provides an analysis of the results of data collected for the Fill Management Plan and an evaluation of the results in respect of compliance levels. The report shall be prepared by a suitably qualified person to a standard acceptable to the Manager and shall consider all data collected from the commencement date of the Resource Consent and up until 31 May prior to reporting. On the basis of this report the Consent Holder may submit recommended changes to the Fill Management Plan to the Manager for certification.*

This Fill Management Plan - Annual Compliance Report covers the period from the commencement of fill activities on 2 April 2012 to 31 May 2015. The monitoring completed over this period is detailed in the following sections.

## 2 Truck Numbers

The rate of importation of fill (as well as the sale of aggregates) is dictated by the market and the factors that drive projects, the productivity of these projects and their preferred tip sites. Condition 50 puts a limit on the number of trucks that can enter the site per day.

Condition 50 reads:

*In accordance with the details of the resource consent application, no more than 375 trucks shall enter the site per day. A register shall be kept on site which records all truck movements to and from the site, and shall include the*

*category of vehicle, i.e. identification as a four, six or eight wheeler, articulated truck or truck and trailer heavy vehicles and a copy of it shall be submitted to the Manager on a quarterly basis to certify compliance with this condition.*

## **2.1 Results**

Refer to Appendix A for the total number of trucks (both fill and aggregate trucks) that entered site during each day of operation since 2 April 2012. A tally of the classification of each fill truck to enter site per day is provided quarterly to Council and has not been repeated in this report.

## **2.2 Analysis and Evaluation**

The limit of 375 trucks has not been reached or exceeded since the commencement of filling. It has been agreed that the limit of 375 movements into site per day is applied to both fill and aggregate related trucks.

The measures in place to ensure the limit is not exceeded are considered appropriate to manage this requirement over the next 12 months.

## **3 Weighted Rolling Mean Results**

The fill acceptance criteria are split into two threshold groups, both of which must be met. These two groups are the Weighted Rolling Mean Criteria and the Maximum Criteria. These two groups are further divided into two categories: material being placed as deeper fill (greater than 2m from finished level) and that placed as shallow fill (less than 2m from finished level).

Condition 16 provides the specific limits of each criterion. However it is Condition 19 which specifies the required monitoring and compliance standards.

Condition 19 reads:

*The weighted rolling 12-month mean will be updated continuously as sample results are received. If the data reveals that the fill is above 85% of the weighted 12-month mean, the consent holder will report immediately to the Council and continue to report on a monthly basis while the data shows that the fill remains above 85% of the weighted 12-month mean. The consent holder shall take action to ensure that the fill reduces below 85% of the weighted 12-month mean as soon as possible. Once the fill reduces below 85% of the weighted 12-month mean, annual reporting to the Council shall resume.*



### 3.1 Results

The 12-month weighted rolling mean results are provided in Appendix B. For ease of compliance auditing, a percentage of the actual value compared to the Weighted Rolling Mean Criteria is plotted for each parameter for each month since the commencement of filling. The trigger level for each parameter is set at 85% as per Condition 19.

### 3.2 Analysis and Evaluation

The fill that has been placed to date is classified as deeper fill (greater than 2m from finished level).

The results show that each parameter continues to be managed well below the trigger stated in Condition 19.

Careful management of the material accepted against the Weighted Rolling Mean Criteria will see to the ongoing compliance with Condition 19 over the next 12 months.

## 4 Additional Analytical Testing Results

Fill being transported to the Three Kings site is classified as either pre-approved material or non-pre-approved material. In general terms, pre-approved material is that which comes from a site providing more than 200m<sup>3</sup>, is a known ex-horticultural site, is on the Ministry for the Environment Hazardous Activities and Industries List or is from the Auckland City District Plan Central Area Section. Such sources are subject to soil testing and analysis which demonstrates compliance prior to the acceptance of the material onsite. The soil testing provided for pre-approved sites are uploaded into the weighted rolling mean to ensure compliance prior to the approval being issued. Non-pre-approved material is that which has not been subject to pre-approval as less than 200m<sup>3</sup> of material is to be placed onsite from a single source and the source does not fall under any of the other categories provided above.

Each load of fill is inspected prior to the material being placed onsite. The inspection procedure varies depending on if the load is classified as pre-approved or non-pre-approved. Material classified as non-pre-approved is subject to additional analytical testing. Condition 15 specifies the details of this additional testing requirement.

Condition 15 reads:

*If the fill has not previously been tested to at least the same extent by the fill generator as detailed in Condition 14 then the consent holder shall undertake analytical testing of imported fill for the chemical parameters set out in Table 1 at a rate of not less than 1 in every 150 incoming trucks or every 1400 tonnes (whichever comes first).*

In addition, Section 4.3 of the Fill Management Plan details that duplicated sampling is to be undertaken for every tenth load tested under Condition 15 above.

An excerpt of Section 4.3 of the Fill Management Plan in relation to this additional requirement reads:

*A duplicated set of samples will be collected and tested for every tenth load quarantined for analytical testing. The relative percent differences will be calculated between the duplicated samples for each parameter tested.*

Furthermore, additional random analytical testing is completed by Council as per Condition 25.

Condition 25 reads:

*The Consent Holder shall meet the cost of full sampling tests (of no more than two core samples or composite samples on each occasion) to be undertaken twice a year at random intervals by council officers or an independent consultant approved by the Council...*

## **4.1 Results**

### **4.1.1 Additional Sampling of Non-Pre-Approved Loads**

To date, two hundred and twenty-four loads have been sampled and sent for analytical testing as required by Condition 15. The results of these tests are provided in Appendix C. Appendix C is made up of a series of graphs (one graph for each parameter tested) and the results for each test are plotted against a trigger. The trigger is set as the Maximum Criteria for Deeper Fill as defined in Condition 16 for each parameter. Where results have been reported by the laboratory analysis as less than laboratory detection these results have been plotted as half of the laboratory detection value for that parameter; this is a function of the weighted rolling mean calculation. All other results (which are on or above laboratory detection) are plotted as the exact value reported by the laboratory analysis.

### **4.1.2 Duplicate Sampling**

The results of each duplicate sample and the relative percent difference as required by Section 4.3 of the Fill Management Plan are provided in Appendix D.

### **4.1.3 Council Random Sampling**

Council has coordinated six instances of random sampling since the commencement of fill operations. The results of this sampling are provided in Appendix E.

## 4.2 Analysis and Evaluation

### 4.2.1 Additional Sampling of Non-Pre-Approved Loads

The fill associated with this monitoring period is classified as deeper fill as it has been placed greater than two meters from finished level. All the results (as shown in Appendix C) have been compliant with the exception of three loads. The three non-compliant loads are test load numbers 004, 108 and 127. Test load number 004 exceeded the triggers for lead and mercury while test load numbers 108 and 127 both exceeded the trigger for the benzo(a)pyrene equivalence factor. These three exceptions have been reported in previous Fill Management Plan - Annual Compliance Reports and no further exceedances have been recorded during the past last 12 months being 1 June 2014 to 31 May 2015.

The Fill Management Plan clearly layouts the steps to be followed as well as the reporting requirements if the analytical results of a test load are found to be above the acceptance criteria. This system ensures the effects are appropriately managed should such an incident occur in the next 12 months.

### 4.2.2 Duplicate Sampling

The analysis of the relative percent difference from duplicate sampling of test loads has been variable. The observed variability is as expected. This is because the material being disposed at the site is heterogeneous in nature even within a single load. However, the actual results of each duplicated sample have been compliant with the acceptance criteria.

Duplicate sampling as per Section 4.3 of the Fill Management Plan will continue to be undertaken over the next 12 months. The results are expected to remain variable in line with those recorded to date.

### 4.2.3 Council Random Sampling

The results from the random sampling (as shown in Appendix E) have been compliant with the acceptance criteria for the deeper fill with the exception of one of the composites taken on 9 May 2015.

The non-compliant composite from the 9 May 2015 sampling round exceeded the trigger for the benzo(a)pyrene equivalence factor. The steps detailed in Section 4.6 of the Fill Management Plan were generally followed and an investigation of the incident was completed by an independent expert. The resulting report *Three Kings Quarry Failed Biannual Sampling Assessment and Report - 14 January 2015* was provided to Council. Council reviewed these documents and as a result of the minor nature of the exceedance no further action was taken.

With the ongoing management of the acceptance of fill in accordance with the consent conditions and the Fill Management Plan it is expected that the random monitoring result in the next 12 months will continue to be compliant. However, Section 4.6 of the Fill Management Plan details the steps to be followed as well as the reporting requirements

should another result be recorded above the acceptance criteria. This system ensures the effects are appropriately managed should such an incident occur in the next 12 months.

## 5 Groundwater Monitoring

Several conditions within the consents detail the groundwater monitoring requirements in relation to fill activities. The most relevant conditions are Conditions 30, 31 and 75.

Condition 30 reads:

*The consent holder shall install a continuous electrical conductivity and pH meter at the dewatering well head and report the results to the Council as part of the Annual Compliance Report. The independent expert who is appointed to undertake audit sampling in accordance with condition 25 shall review the conductivity and pH results to identify and report on any undesirable trends.*

Condition 31 reads:

*Groundwater monitoring shall be carried out at both the dewatering well and monitoring well BH7 at 109 Landscape Road (i.e. the existing borehole in the network that is used for monitoring groundwater behavior for Auckland Regional Council dewatering permit 12977) in the following way:*

- a) For the first two years after the commencement of the consent, the samples shall be analysed for the chemical constituents listed in Table 3 Condition 32 at quarterly intervals, commencing within three months of the commencement of consent.*
- b) If after the first two years after the commencement of consent no groundwater trigger level has been exceeded then the samples shall be analysed for the chemical constituents listed in Table 3 Condition 32 at six monthly intervals for the remainder of the term of the consent.*

Condition 75 reads:

*Groundwater pumped from the site shall be monitored for suspended solids and turbidity, as part of the contaminant monitoring regime of the associated discharge permit. The concentration of suspended solids in the groundwater being discharged from the site shall not exceed 30 mg/l, and turbidity shall not exceed 30NTU. The results of this sampling shall be provided to the Council on a quarterly basis. Provided that if the groundwater is ever to be used as potable water, that portion being used as potable water shall be subject to a limit of 5mg/l TSS and a turbidity of no more than 5 NTU.*

## **5.1 Results**

### **5.1.1 Continuous Monitoring - Dewatering Well Head**

The electrical conductivity (EC) and pH results from the continuous monitoring at the Dewatering Well Head are provided in Appendix F. The results have been presented as a daily average of the five minute readings. The full data set is available in electronic copy on request. The consent does not set a trigger for EC but Condition 32 details a trigger of below 7 or greater than 8.5 for pH. In addition to the continuous monitoring the results of water sampling for EC and pH at the Dewatering Well Head have also been plotted on the graphs provided in Appendix F.

### **5.1.2 Quarterly/Biannual Monitoring - Dewatering Well Head and Borehole 7**

The required sampling of the groundwater at the Dewatering Well Head and Borehole 7 has been undertaken quarterly between December 2011 and March 2014. Following the March 2014 sampling round approval was granted by Council to reduce the monitoring frequency to biannual as allowed for by Condition 31.

The results of the groundwater sampling are provided in Appendix G.

## **5.2 Analysis and Evaluation**

### **5.2.1 Continuous Monitoring - Dewatering Well Head**

The results to date continue to show variability and a general downward trend for both the EC and pH though the trend it is much more prevalent in the pH results.

Ongoing liaison with the external technician who supplied and is currently maintaining these has found a number of issues relating to the probes themselves as well as the setup in which the probes are housed.

The graphs in general show large jumps when the probes are calibrated with a drift in results daily and between calibrations. As a result of these issues, in early 2015 weekly physical sampling of the bore water in addition to the continuous monitoring was commenced.

The weekly monitoring did not correlate with the continuous monitoring results in both absolute terms and in variability of results (especially with regard to the pH). The probes when tested however had generally retained their calibration. This indicated that there was a problem in the setup of the system in which the probes sit and the water flows through the setup rather than the probes themselves or the quality of the water. The flow of water to the probes was increased in mid-March 2015 and in mid-May 2015 additional earthing of the probes was undertaken.

This has shown positive results with more a more consistent record from the continuous monitors compared with the weekly physical sampling. Until the issue of drift is

satisfactorily addressed, the weekly physical sampling will continue. If the system cannot be rectified, Winstones may look to replace the continuous monitoring with weekly physical sampling through this would be subject to the required consenting avenues.

#### 5.2.2 Quarterly/Biannual Monitoring - Dewatering Well Head and Borehole 7

Six triggers have been recorded as a result of the sampling undertaken since the issuing of fill consents. Each of these triggers were related to zinc levels in Borehole 7. These triggers have been reported in previous Fill Management Plan - Annual Compliance Reports with noting that Borehole 7 currently has no direct groundwater link to Three Kings Quarry. No further exceedances have been recorded during the past last 12 months being 1 June 2014 to 31 May 2015.

Following the March 2014 round of monitoring and in accordance with Condition 31 Council has been notified that the monitoring required by this condition will continue at six monthly intervals. It is expected that the monitoring over in the next 12 months will continue to be compliant. However, Condition 36 details the actions required should a trigger level be recorded.

## 6 Air Quality Monitoring

Condition 46 required the installation of a BAM monitor at the southern boundary of site prior to the commencement of filling. This unit is in addition to the air monitor required by the discharge to air consent held by the site for quarry activities.

The results of air quality monitoring are provided to Council quarterly. Condition 59(g) of the fill consents specifically details that quarterly submission of the air quality monitoring to Council is to continue.

### 6.1 Results

A summary of the results of monitoring since the commencement of fill operations on 2 April 2012 to 31 May 2015 is provided in Appendix H.

### 6.2 Analysis and Evaluation

Since the commencement of fill activities seven events have been recorded by the HiVol monitors above the trigger limit of  $80\mu\text{g}/\text{m}^3$  per 24 hour average. In accordance with the discharge to air consent held by the site each trigger was investigated and a report submitted to Council. It is noted that a number of these triggers were a result of activities unrelated to those undertaken onsite and came from outside of the site boundary.

One of the seven triggers that have been recorded occurred during the past last 12 months being 1 June 2014 to 31 May 2015. The resulting report *Investigation of Total Suspended Particulate Trigger at Three Kings Quarry 12 March 2015* was provided to Council.

It is noted that on 11 February 2015 a new discharge to air consent (40041) was granted. Winstone is currently updating the existing Air Quality Management Plan to reflect the conditions of the new consent. The primary changes will be the removal of HiVol monitoring and a decrease in the trigger level for the BAMs from 80µg/m<sup>3</sup> per 24 hour average to 60µg/m<sup>3</sup>. The Air Quality Management Plan needs to be revised in consultation with the Three Kings Site Liaison Group and the Auckland Council. Winstone are targeting July 2015 for the submission of the updated management plan to the Auckland Council for review. In the interim we continue to monitor via both the HiVols and BAMs. Since the granting of the new discharge to air consent there has been no exceedance by the BAMs of the new trigger level for the BAMs being 60µg/m<sup>3</sup> per 24 hour average.

The ongoing implementation of dust prevention measures and use of early warning monitoring alarms will ensure dust as a result of activities undertaken onsite are appropriately managed.

## 7 Compaction Requirements

Condition 9 states the obligation in regards to compaction requirements.

Condition 9 reads:

*The controlled fill in the upper 5m layer shall be engineered to a compaction and stability standard in accordance with NZS 4431:1989 (Code of practice for Earth Fill for Residential Development) that enables future residential use of the finished landform no longer than 5 years after cessation of filling. This condition may be reviewed where a proposed Plan Change or review (or any resource consent addressing the use of the site as a whole) indicates that future uses will demand a lesser standard of compaction. The consent holder shall provide an annual report to the Manager, or his or her nominee, which contains sufficient detail to confirm the engineering standards required to meet NZS 4431:1989 have been achieved for the fill.*

### 7.1 Results

Geotechnical advice has been sought for guidance into the appropriate placement of fill. Such input will continue as required as filling progresses.

Fill which has been placed and compacted is well below the upper 5m layer threshold. Therefore no further details on compaction standard are available or required at this time. There is no area in the next 12 months expected to be within the upper 5m. However, should the situation change over the next 12 months, appropriate monitoring to demonstrate compliance with the compaction requirements will be implemented.

To date, based on the volume of fill and the current operations, vibration monitoring was assessed as not being required. Nor is it anticipated that vibration monitoring will be

required over the next 12 months. However, should monitoring be needed it will be undertaken in accordance and to ensure compliance with clause 8.8.1 of the Auckland City Operative District Plan.

## 8 Noise Monitoring

Any activity onsite associated with fill operations is not to exceed the noise limits specified in the consent. Monitoring to demonstrate compliance is required by Conditions 52, 53 and 54.

Condition 52 reads:

*Within 3 months of the commencement of the fill activity the consent holder shall submit to Manager a report demonstrating that the activity meets the noise standards outlined in this condition.*

Condition 53 reads:

*The consent holder shall undertake further monitoring confirming compliance with the noise limits when the majority of the fill operation is occurring above RL 70m and following this at a 6 monthly interval.*

Condition 54 reads:

*Should the consent holder propose to use self propelled compaction equipment, a suitably qualified acoustical consultant shall, prior to the equipments use, undertake noise modelling to predict noise levels to demonstrate that the revised fill procedure will not generate noise in excess of the noise limits in Condition 51. Monitoring confirming compliance with the noise limits shall be conducted within one month of implementation of the revised procedures.*

### 8.1 Results

The noise monitoring and reporting required as per Condition 52 was undertaken in July 2012 by an acoustic consultant. The monitoring demonstrated that the fill activities were compliant with the stated noise standard. These details were provided to Council on 26 July 2012.

In regards to Condition 53, the majority of fill levels are expected to continue to be below RL 70m over the next 12 months. Therefore, no further action is required in this regard at this time.

However, as compaction equipment was anticipated to be utilised during the summer of 2015, additional noise modelling was undertaken in accordance with Condition 54. This modelling was submitted to Council on 24 February 2014 to demonstrate that compliance with the noise limits will be maintained. Additional noise monitoring was then undertaken



on 27 February 2015 within one month of the implementation of compaction equipment onsite and these result which showed compliance with the stated noise standard were submitted to Council.

## **9 Conclusion**

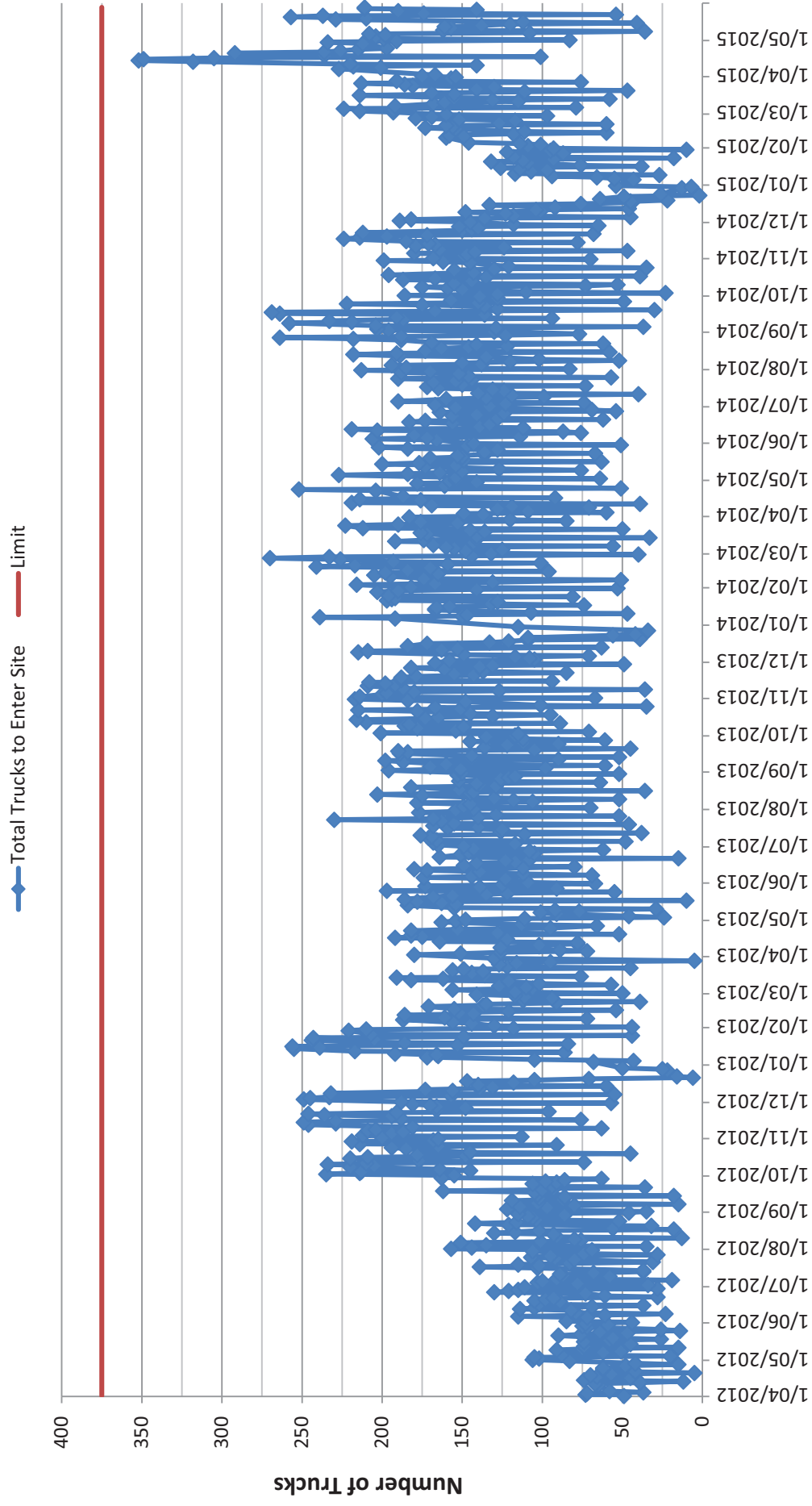
This Fill Management Plan - Annual Compliance Report covering the period 2 April 2012 to 31 May 2015 has been prepared in accordance with permit numbers 36221, 36222, 37770 and R/LUC/2009/743 which authorise the rehabilitation of Three Kings Quarry.

The results and assessments provided since the commencement of filling are in general accordance with the conditions of consent and associated Fill Management Plan. Therefore, as a result of this Fill Management Plan – Annual Compliance Report no changes are recommended to the current version of Fill Management Plan (Revision 4 dated April 2012). However, in order to ensure consistency between all the management plans that the site operate under and to ensure these plans are well aligned with all the consents held by the site a full review of the plans including the Fill Management Plan (Revision 4 dated April 2012) is expected to be undertaken in the next 12 months as resourcing allows. Any changes to the plans are subject to consultation with the Three Kings Site Liaison Group and Council. Final versions of any updates would then be submitted to Council for review.

## **APPENDIX A**

Total Number of Trucks Per Working Day

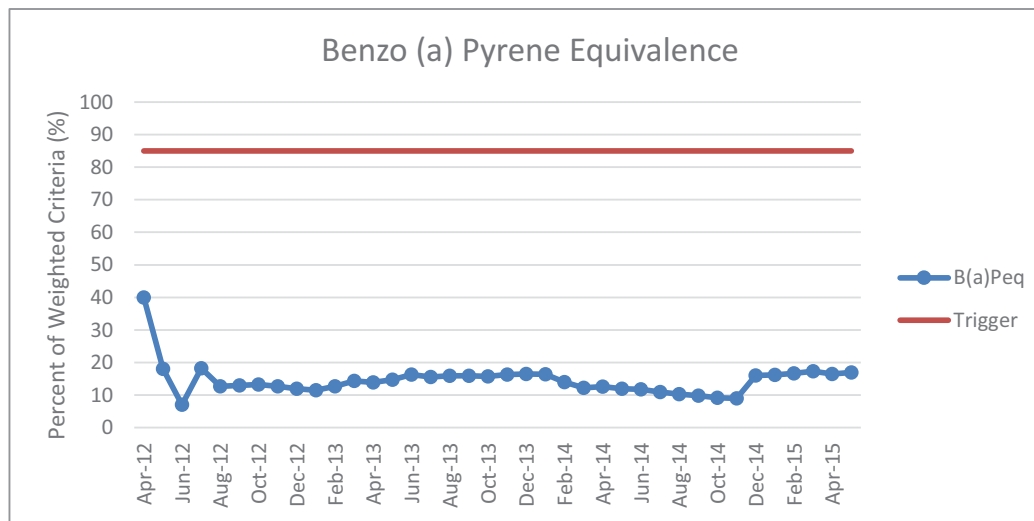
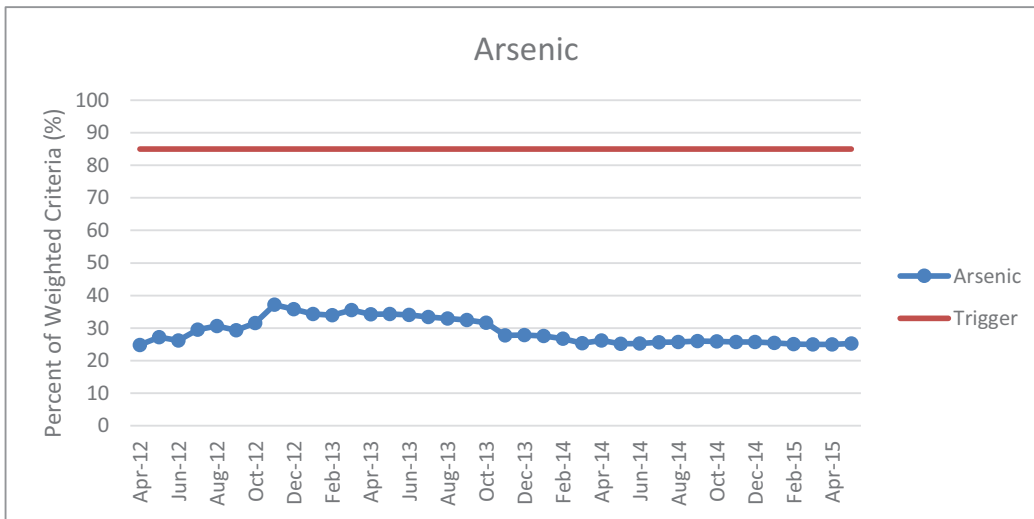
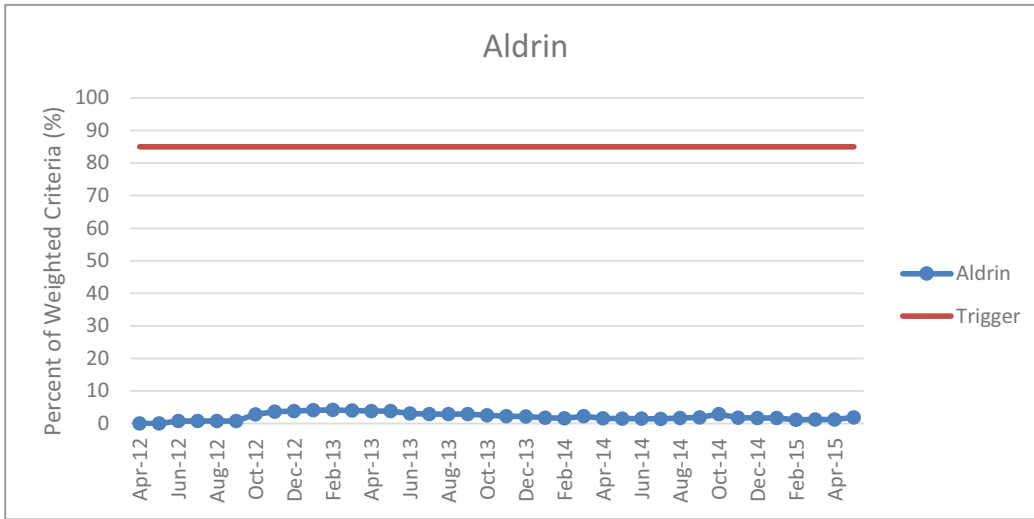
# Total Number of Trucks to Enter Site Per Workings Day



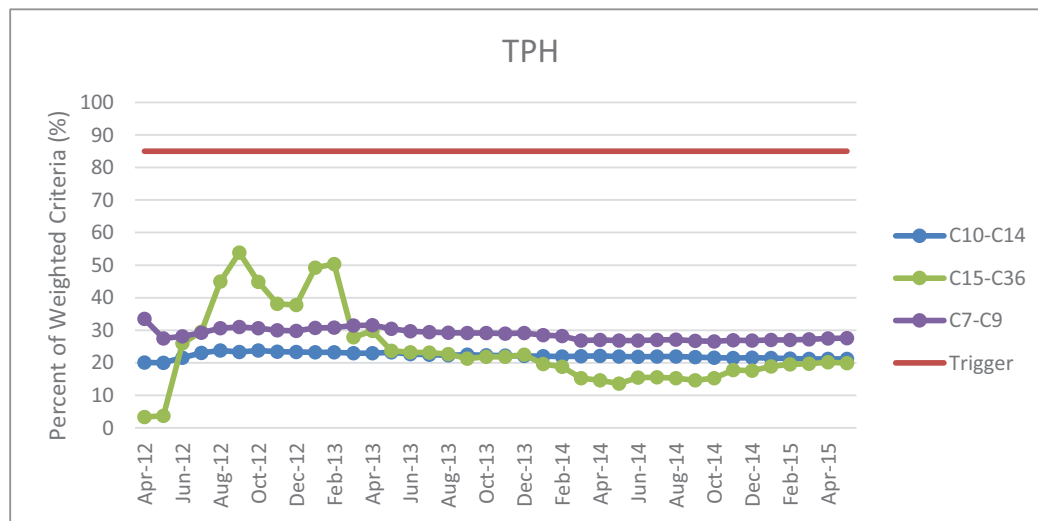
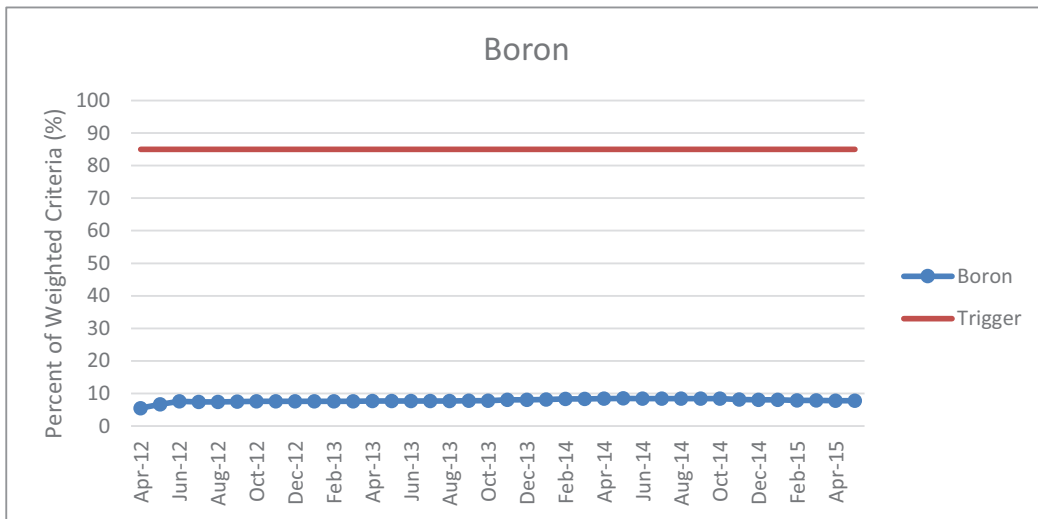
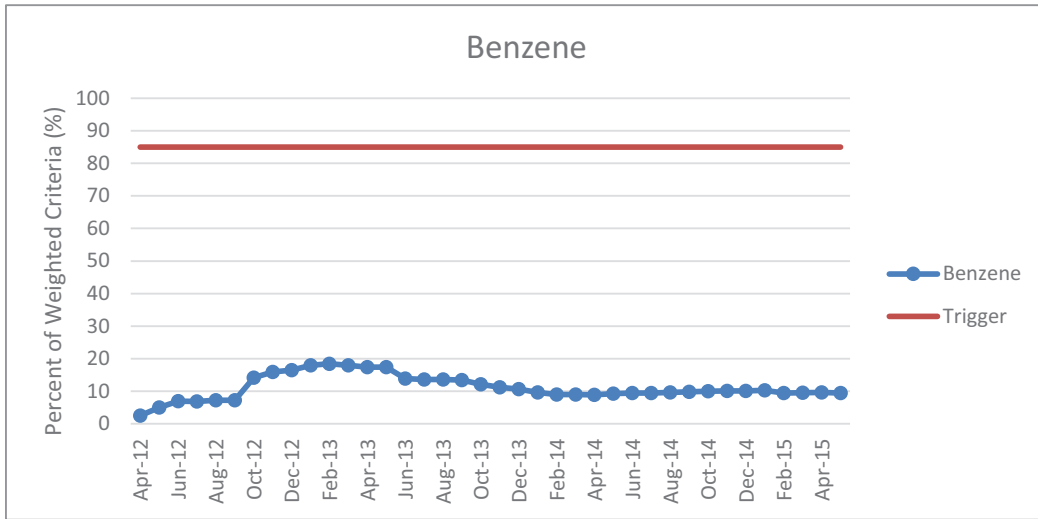
## **APPENDIX B**

Weighted Rolling Mean Values – 12 Month Results

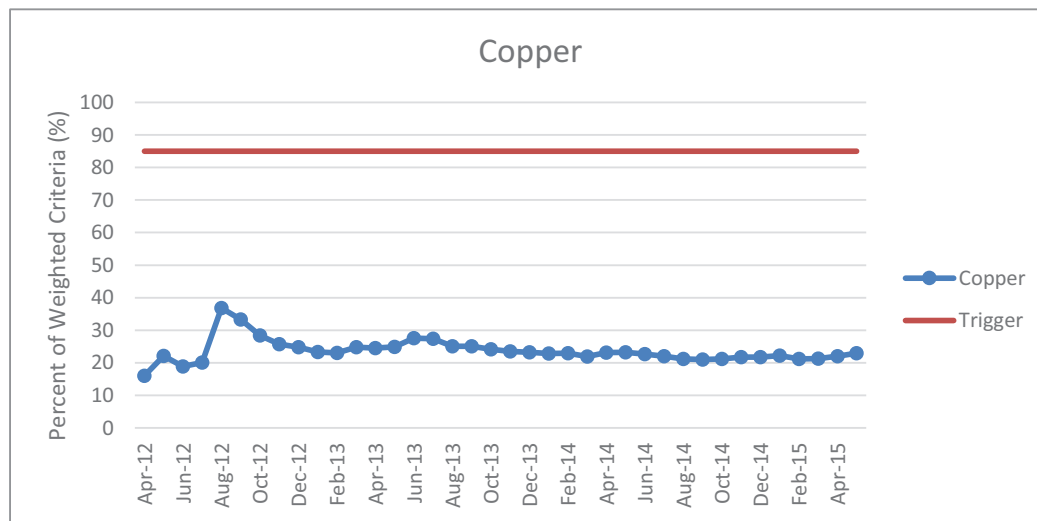
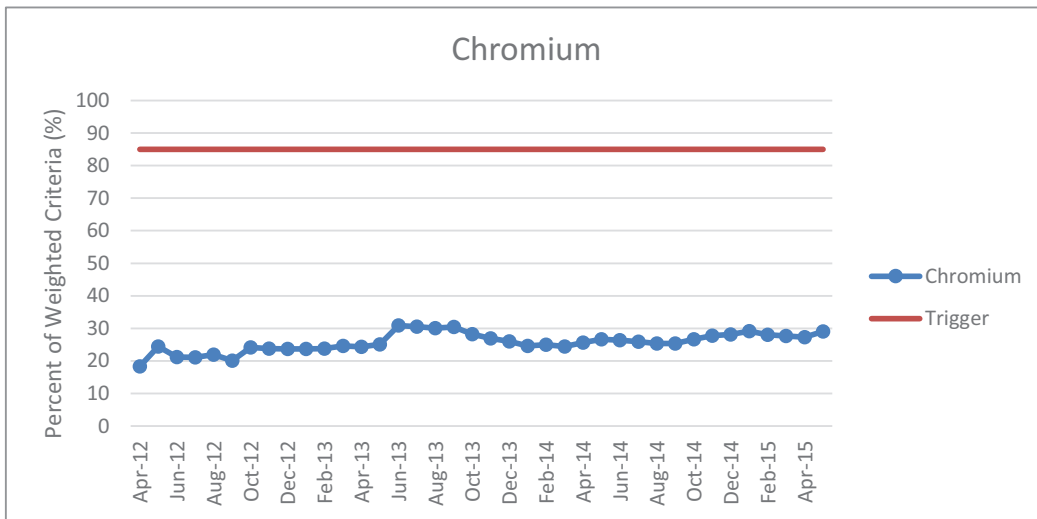
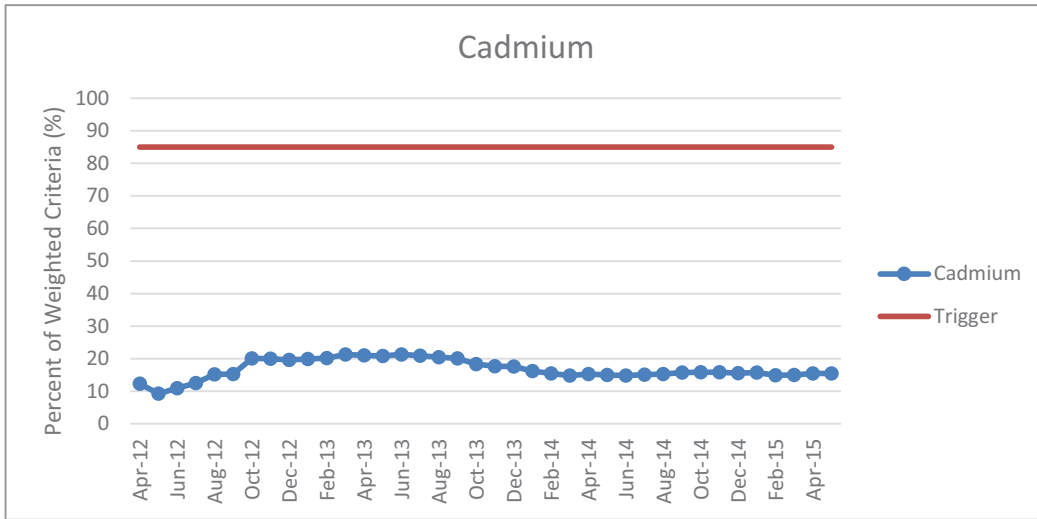
Graphical representation of the 12 month weighted rolling mean results for each of the parameters listed in condition 16 for the period 01 April 2012 to 31 May 2015.



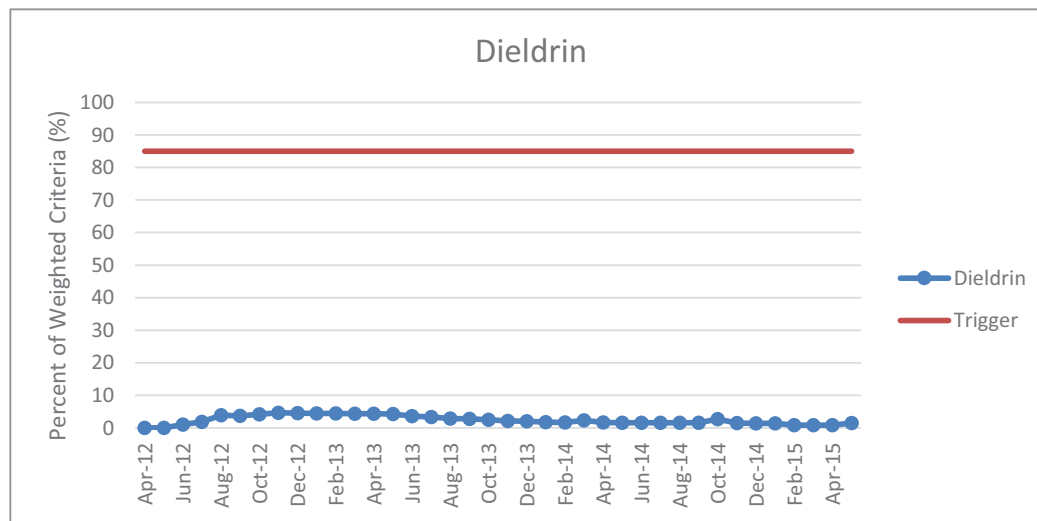
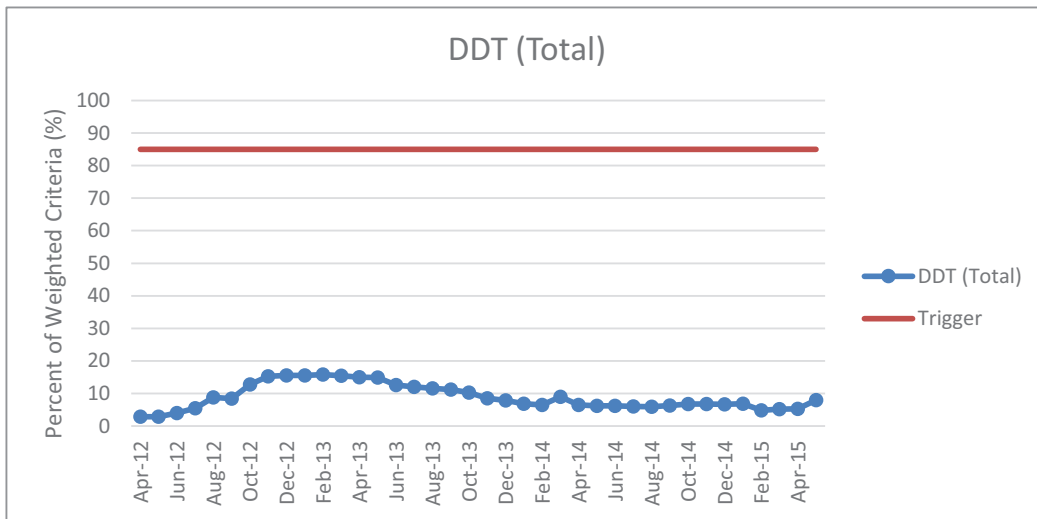
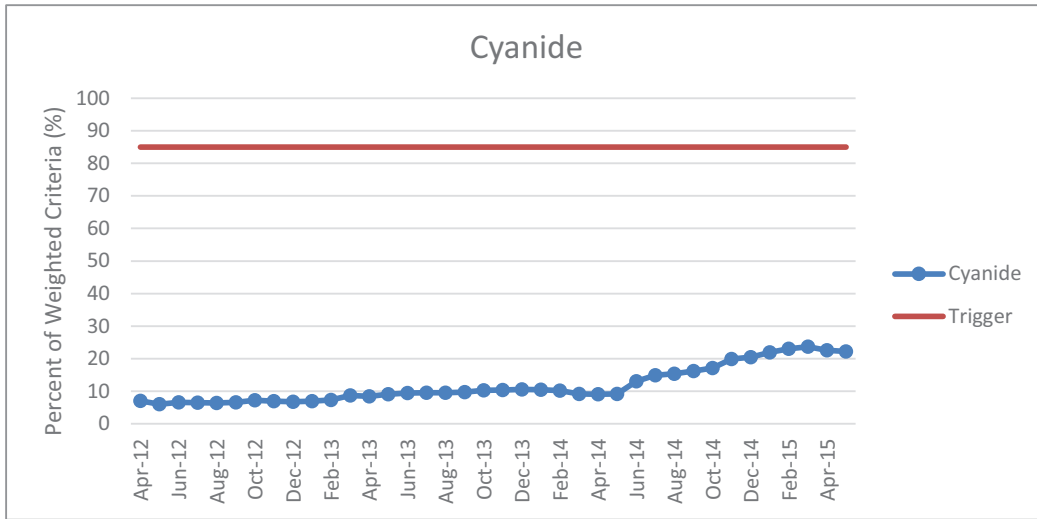
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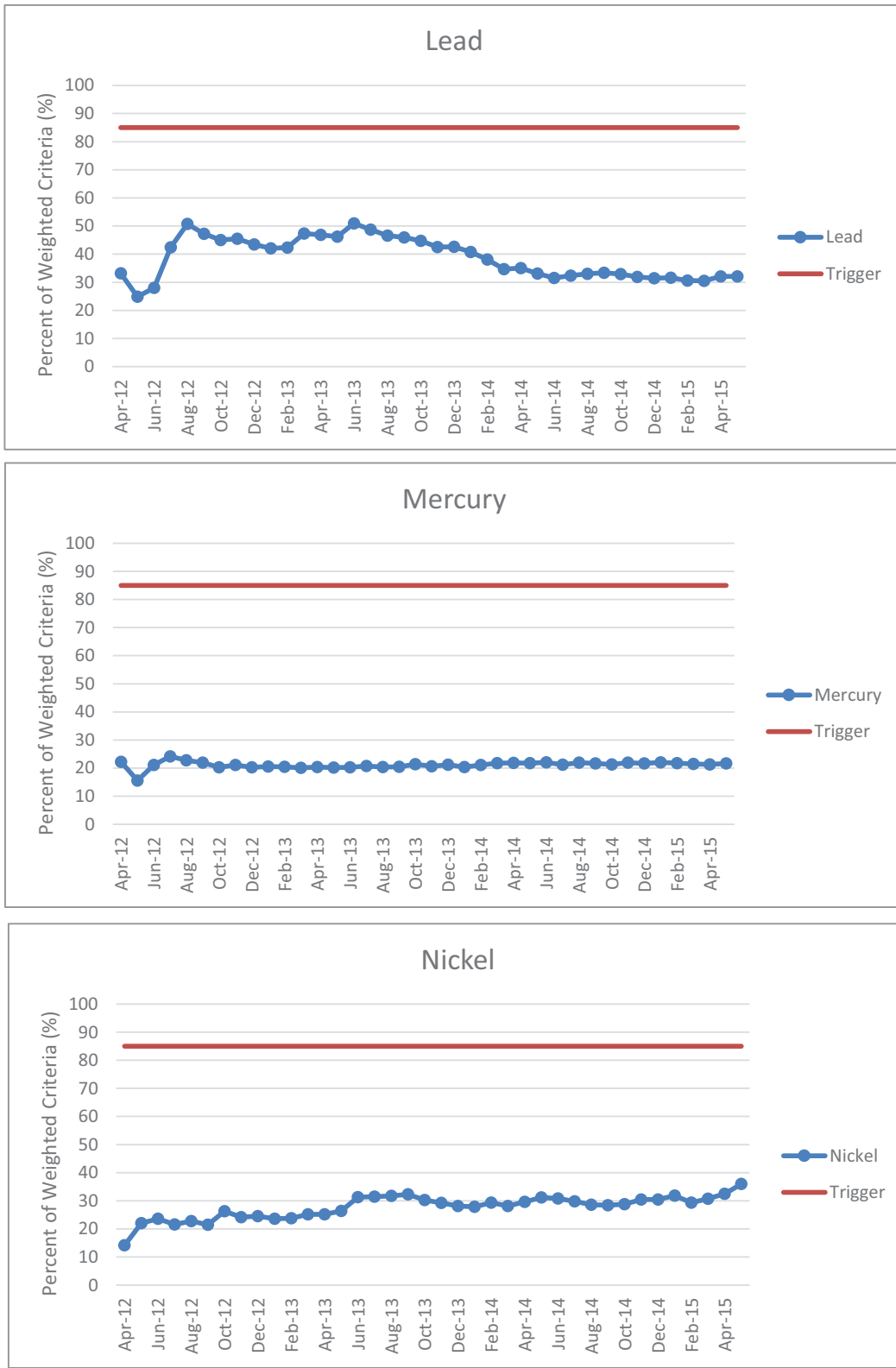


Graphical representation of the 12 month weighted rolling mean results for each of the parameters listed in condition 16 for the period 01 April 2012 to 31 May 2015.

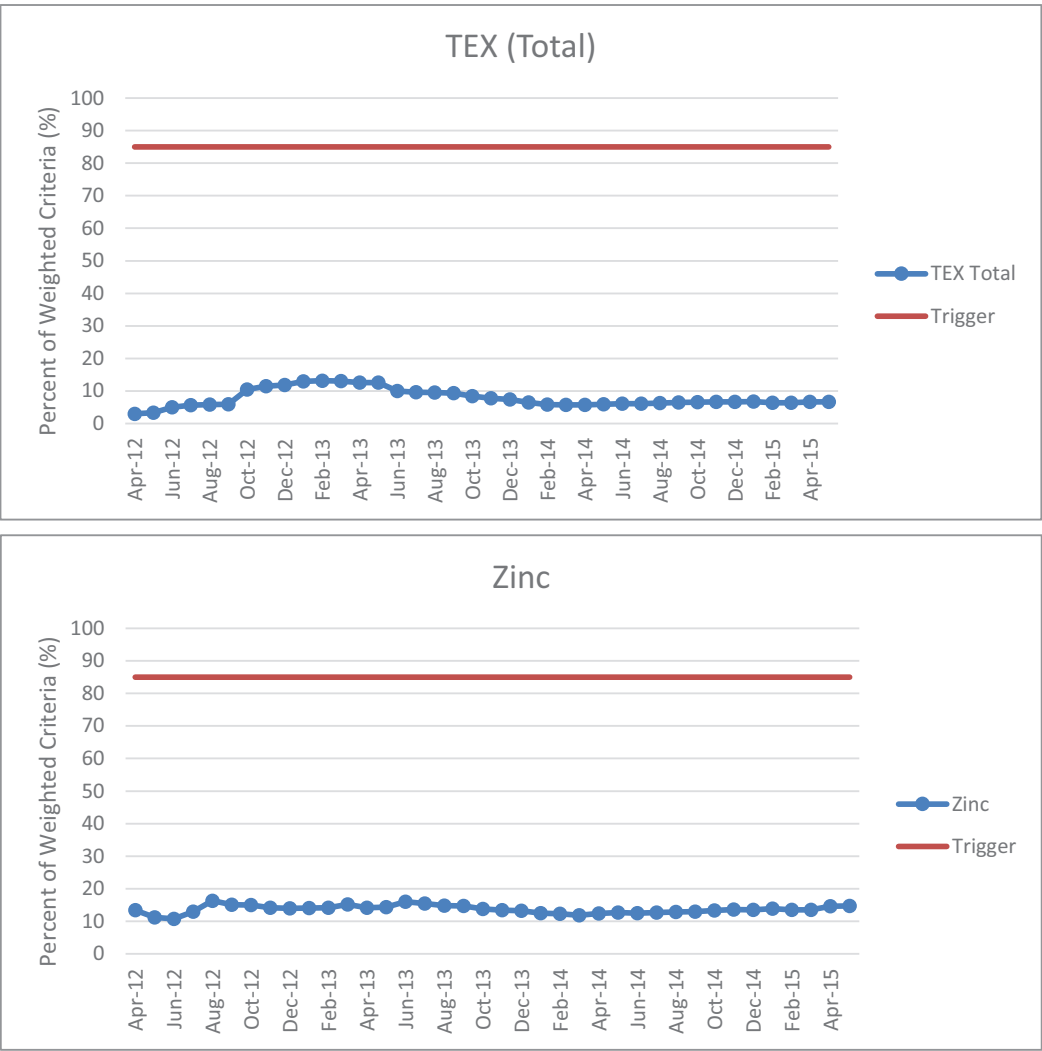




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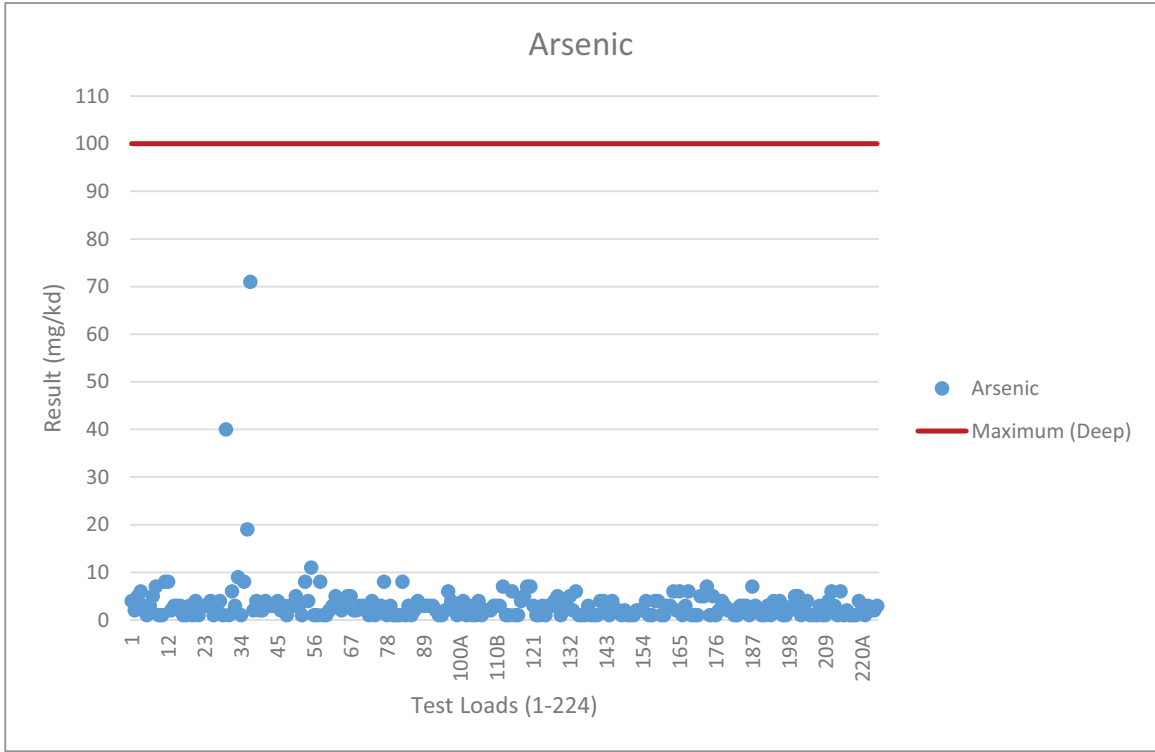
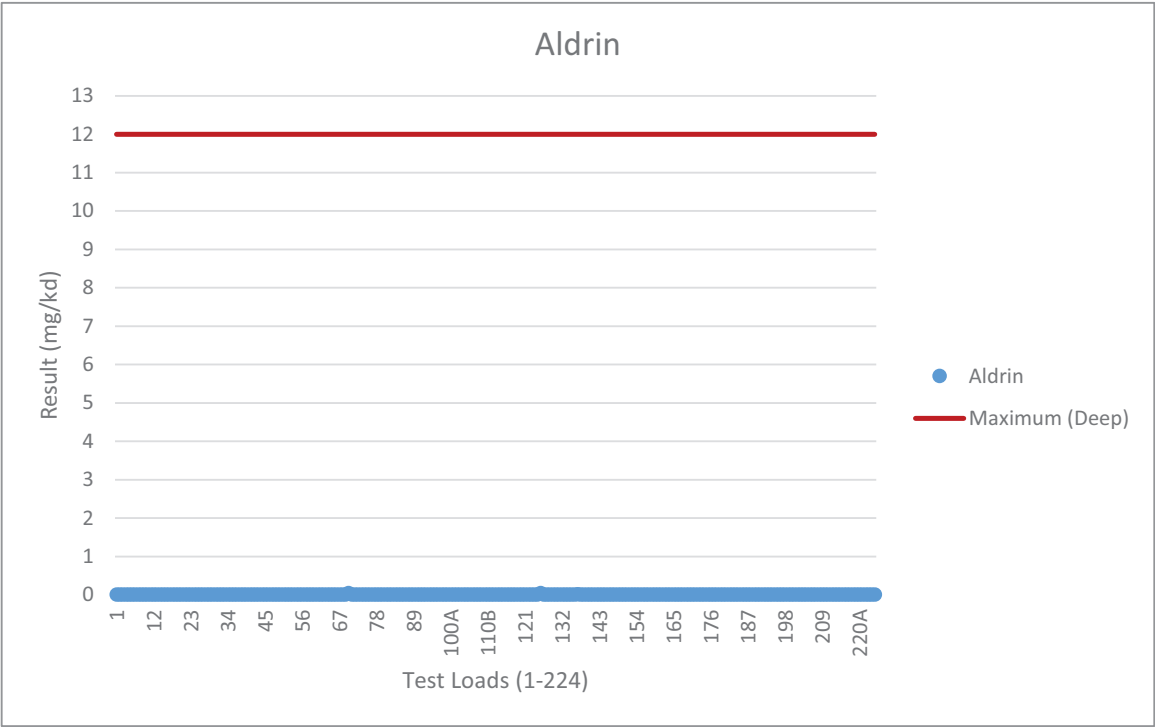
## **APPENDIX C**

### Summary of Analytical Test Results

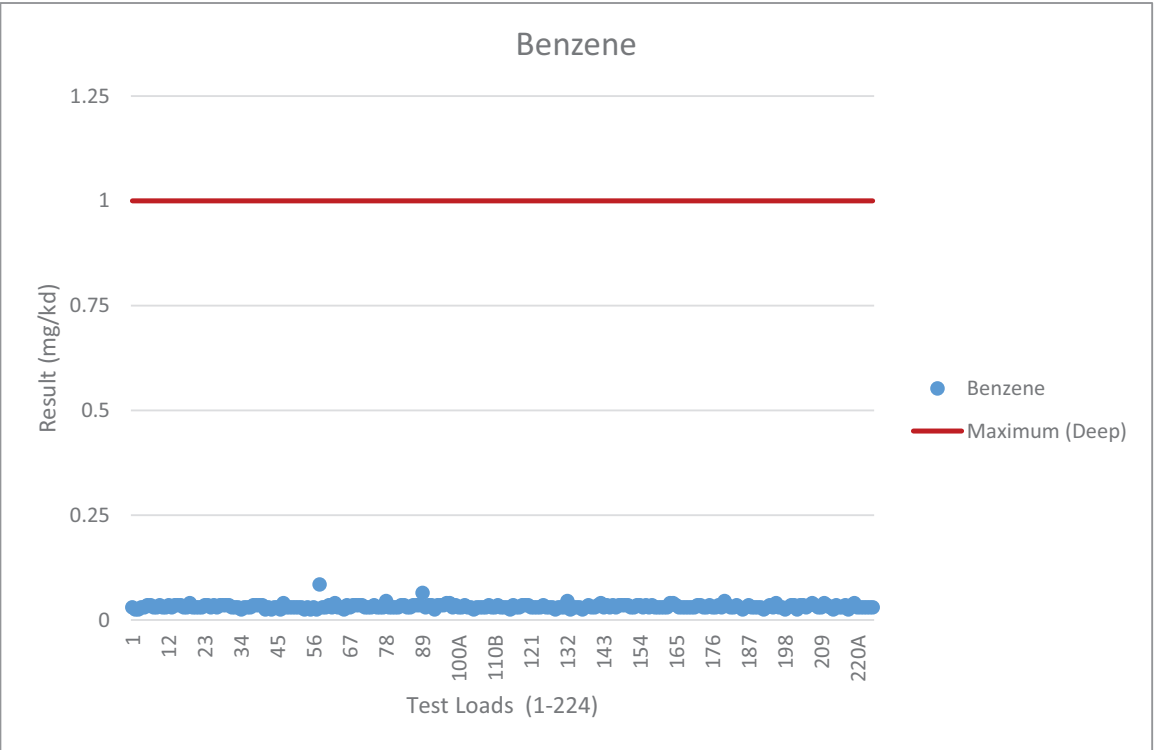
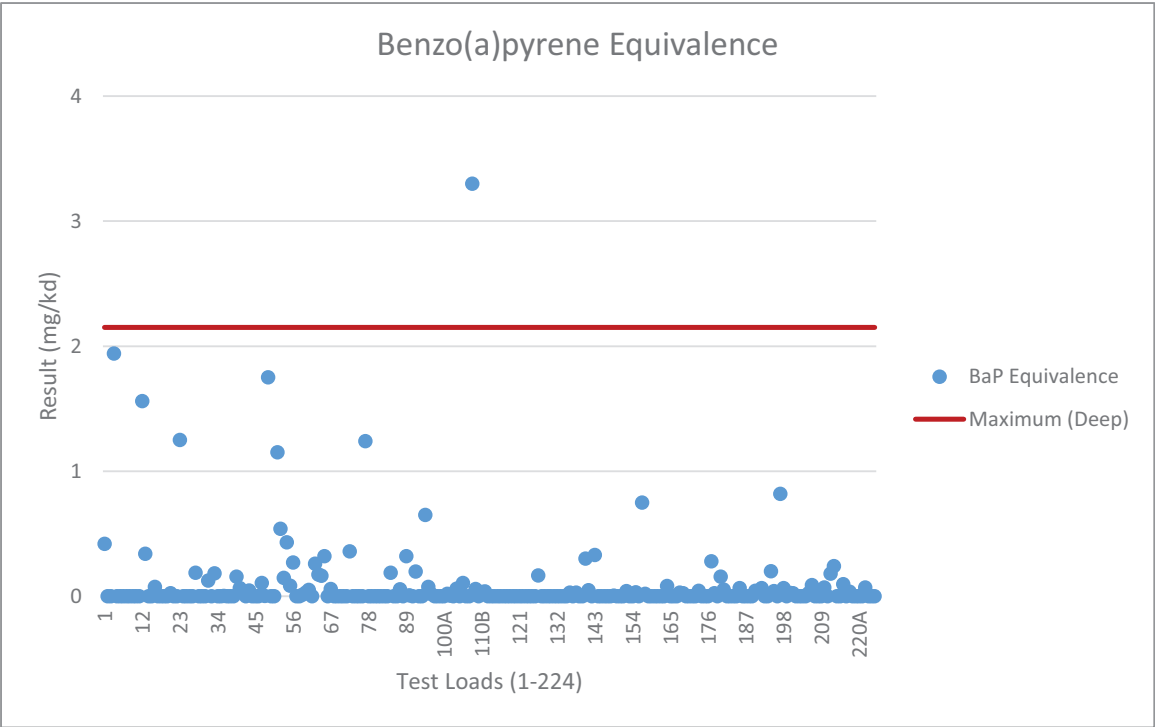




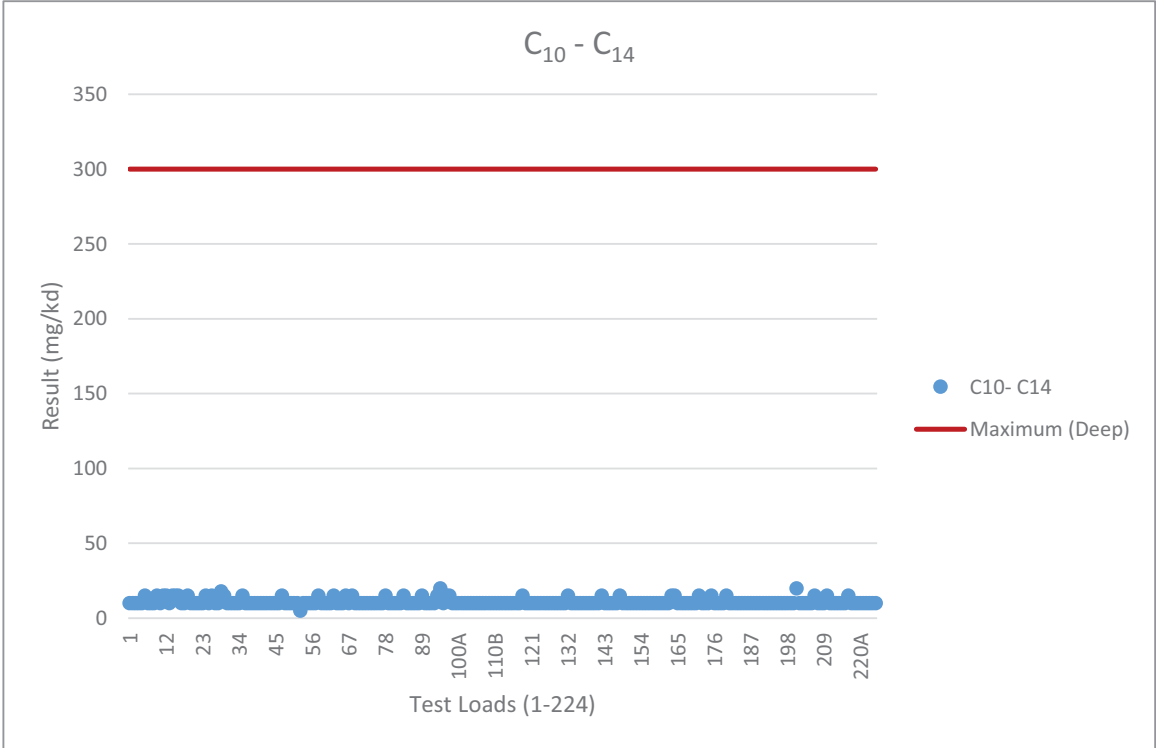
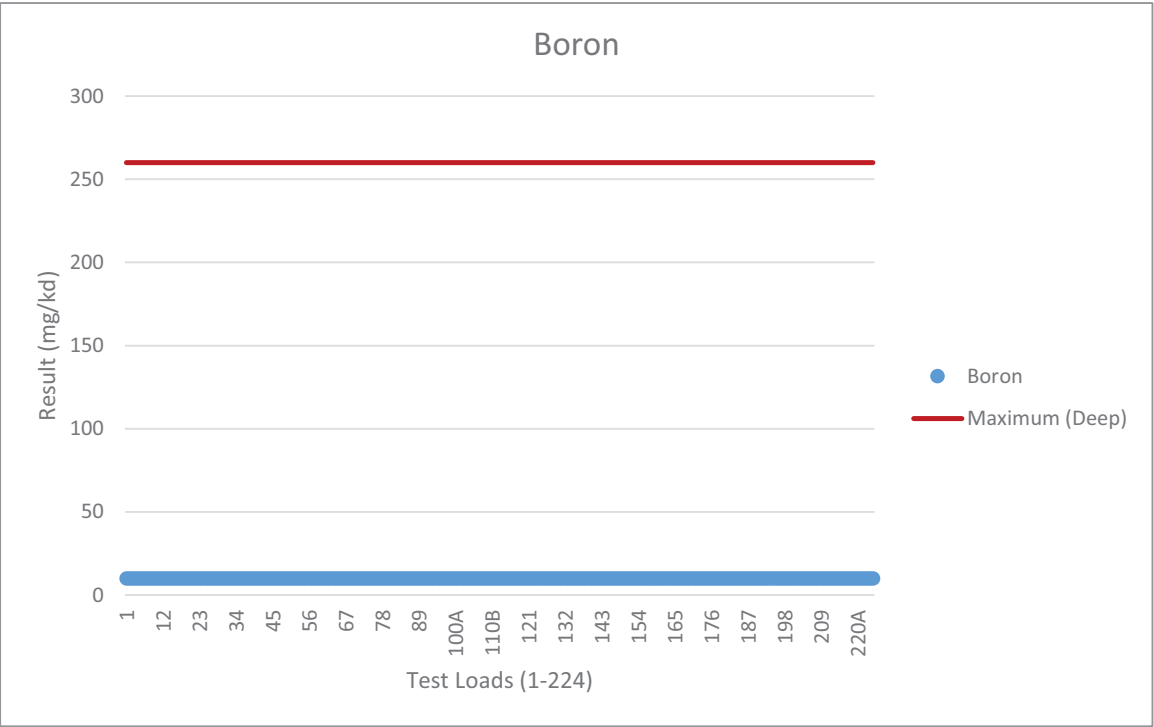
Plotted results of the additional analytical sampling undertaken between 01 April 2012 to 31 May 2015 for each of the parameters listed in condition 16.



Plotted results of the additional analytical sampling undertaken between 01 April 2012 to 31 May 2015 for each of the parameters listed in condition 16.

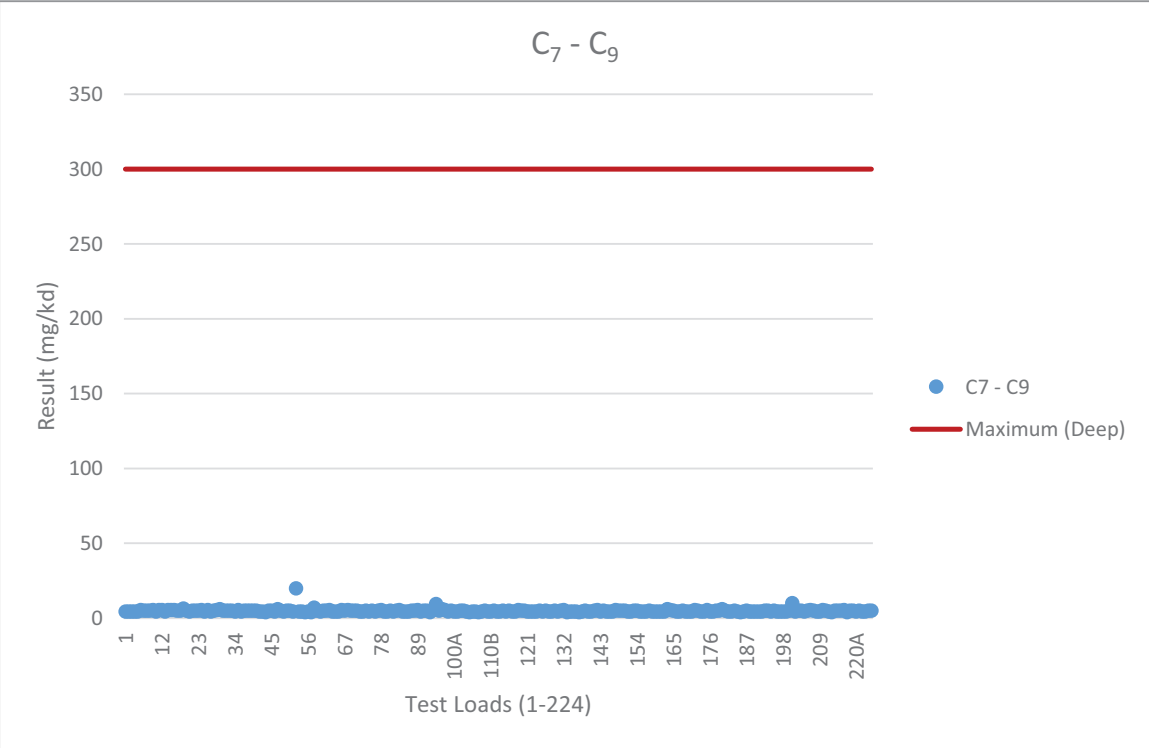
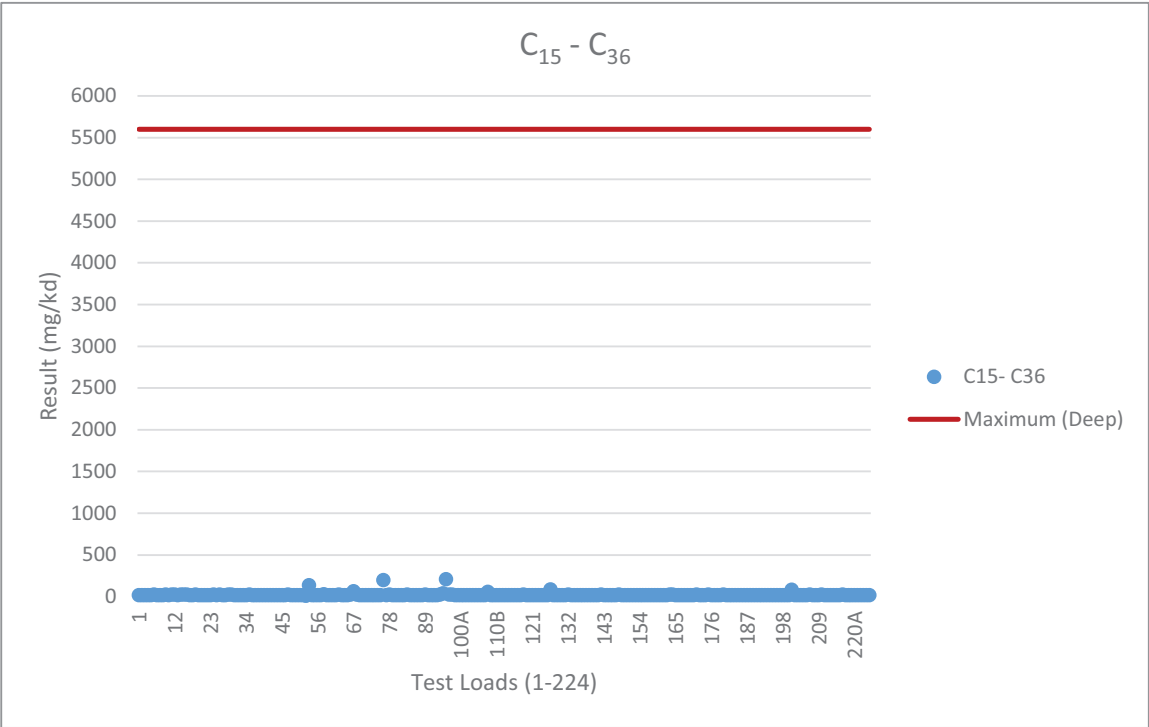


Plotted results of the additional analytical sampling undertaken between 01 April 2012 to 31 May 2015 for each of the parameters listed in condition 16.

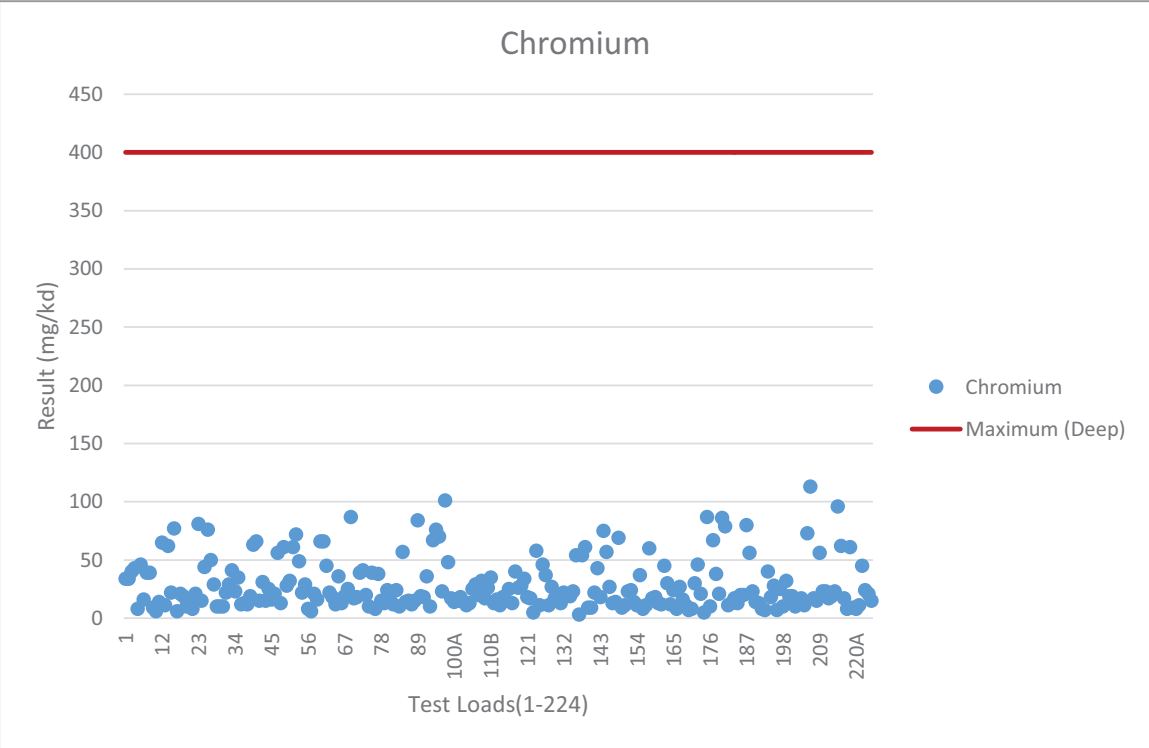
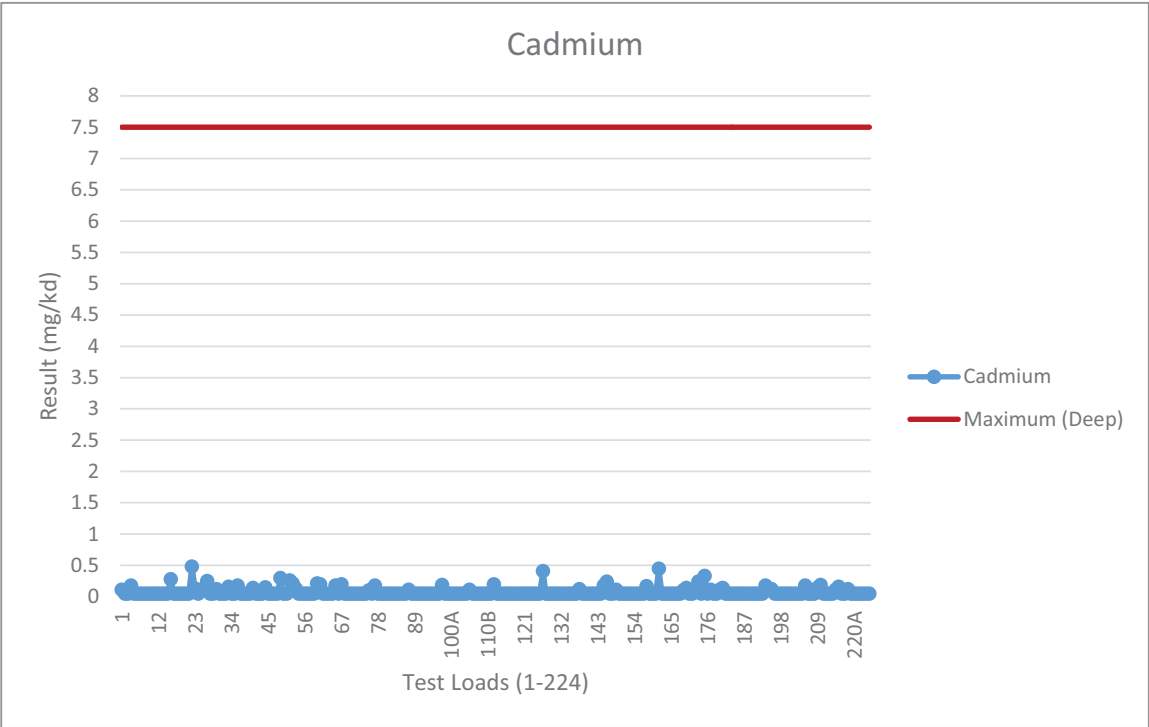




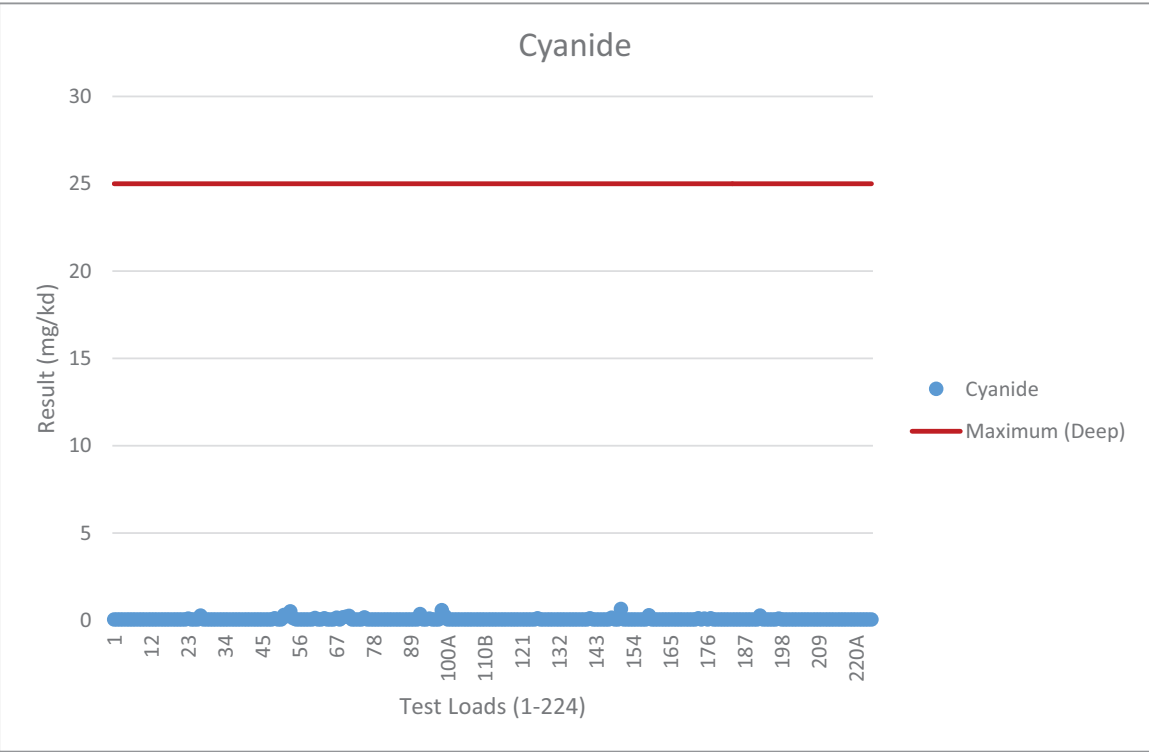
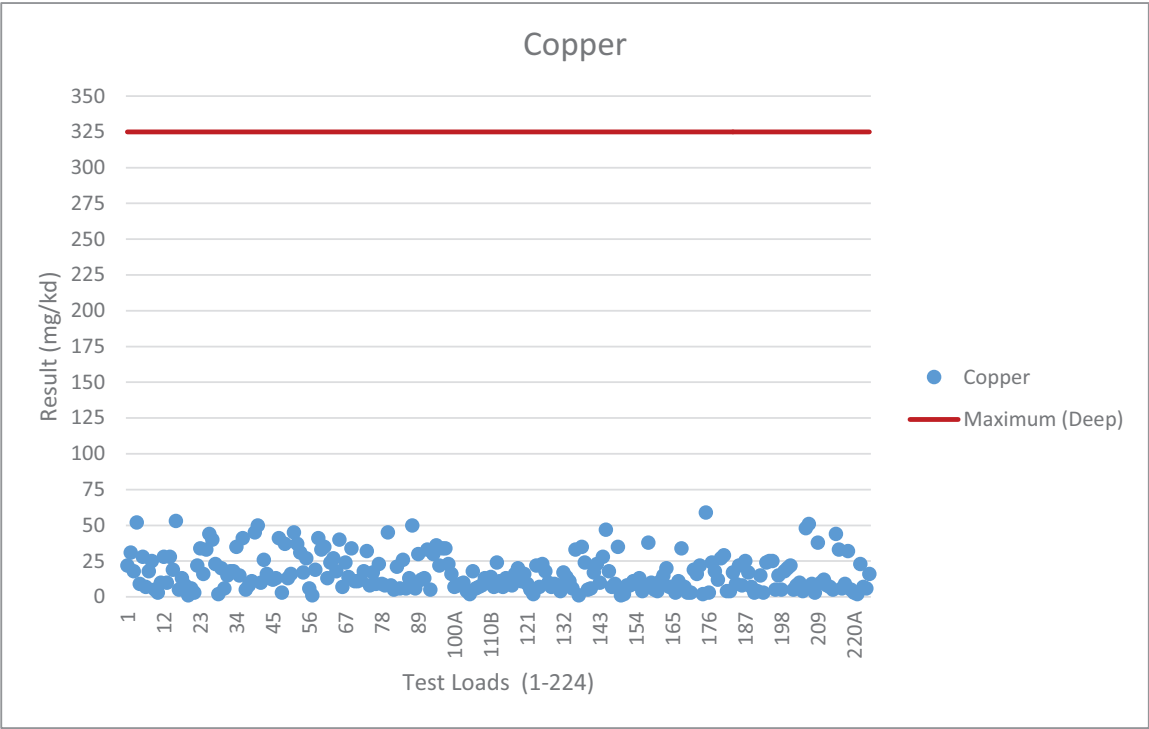
Plotted results of the additional analytical sampling undertaken between 01 April 2012 to 31 May 2015 for each of the parameters listed in condition 16.



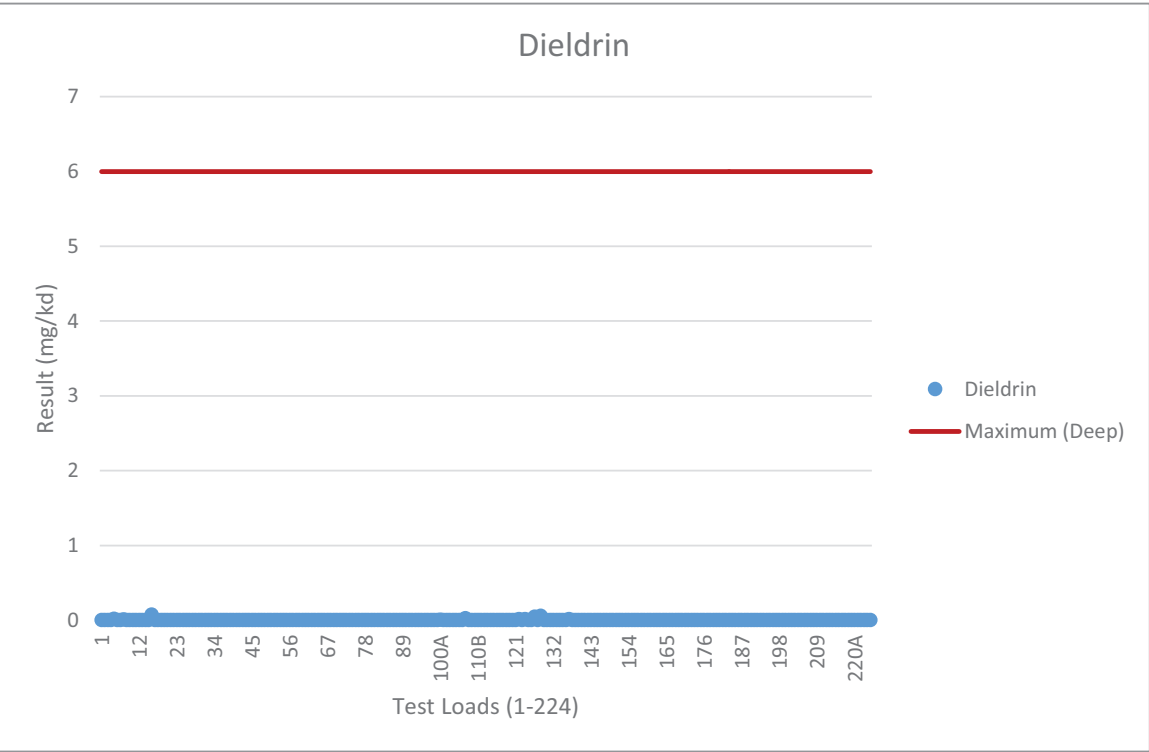
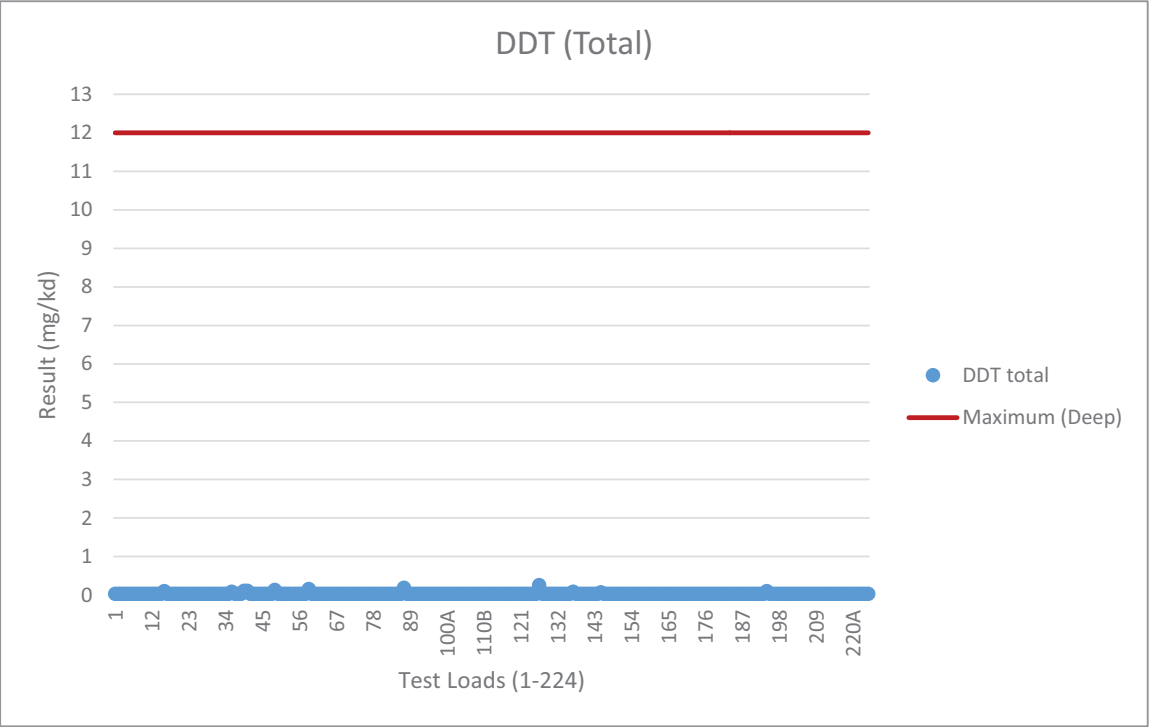
Plotted results of the additional analytical sampling undertaken between 01 April 2012 to 31 May 2015 for each of the parameters listed in condition 16.



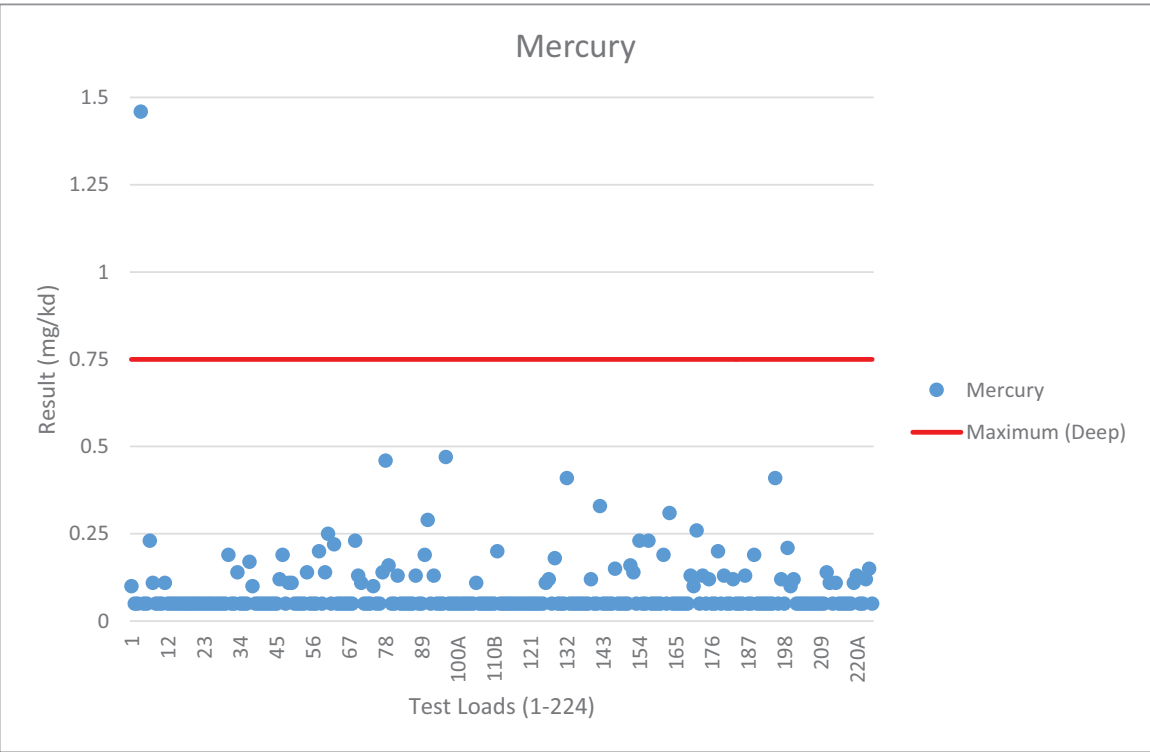
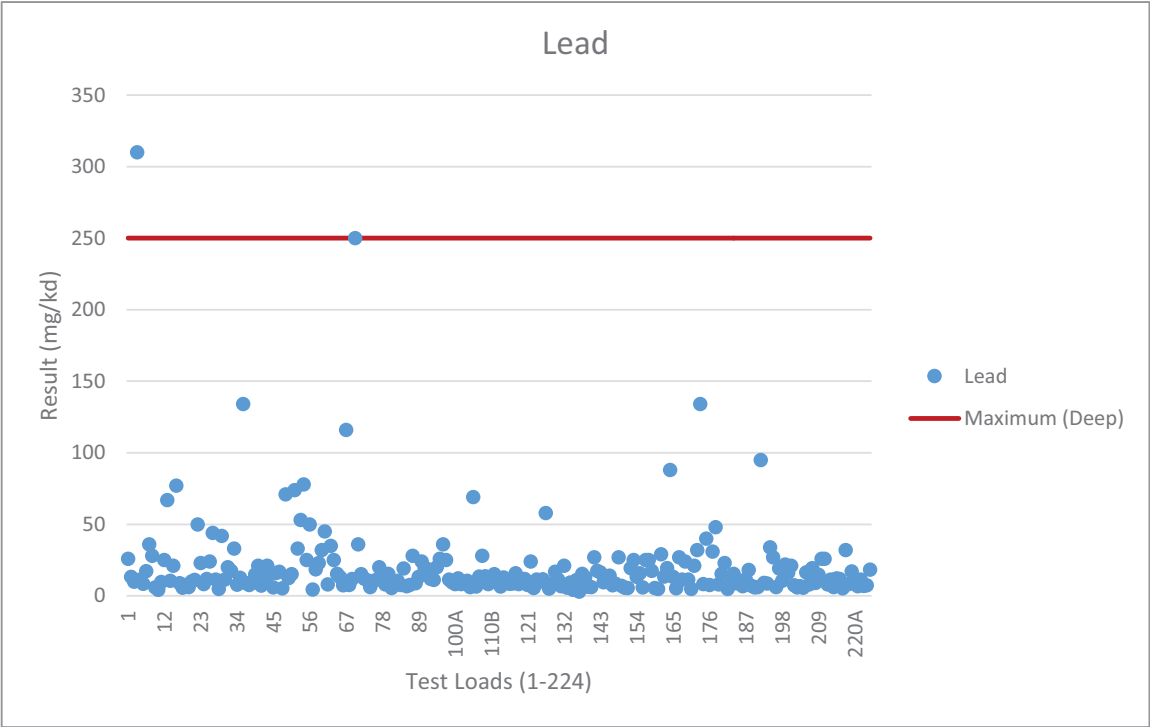
Plotted results of the additional analytical sampling undertaken between 01 April 2012 to 31 May 2015 for each of the parameters listed in condition 16.



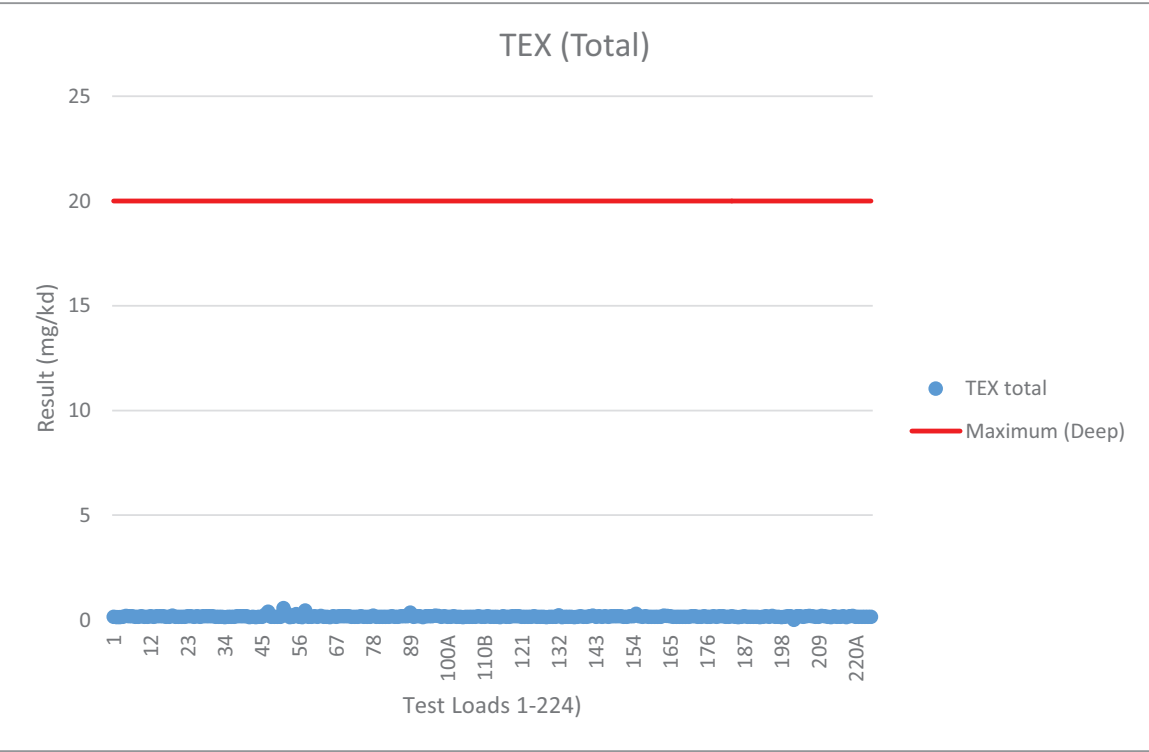
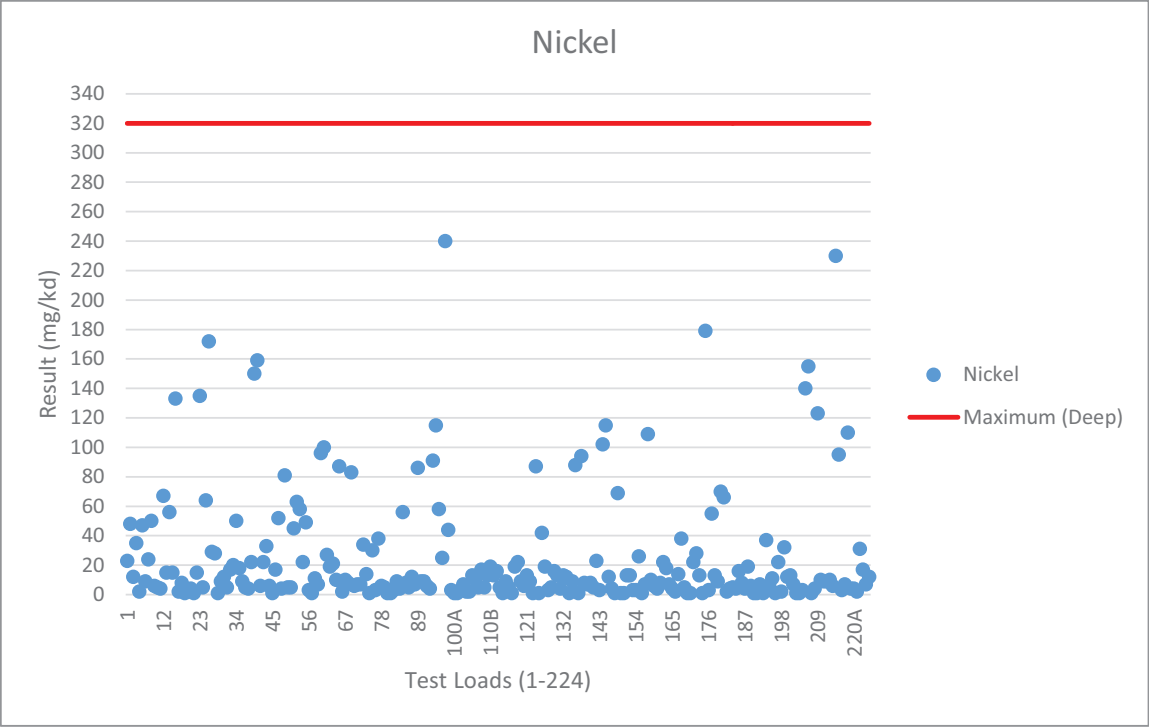
Plotted results of the additional analytical sampling undertaken between 01 April 2012 to 31 May 2015 for each of the parameters listed in condition 16.



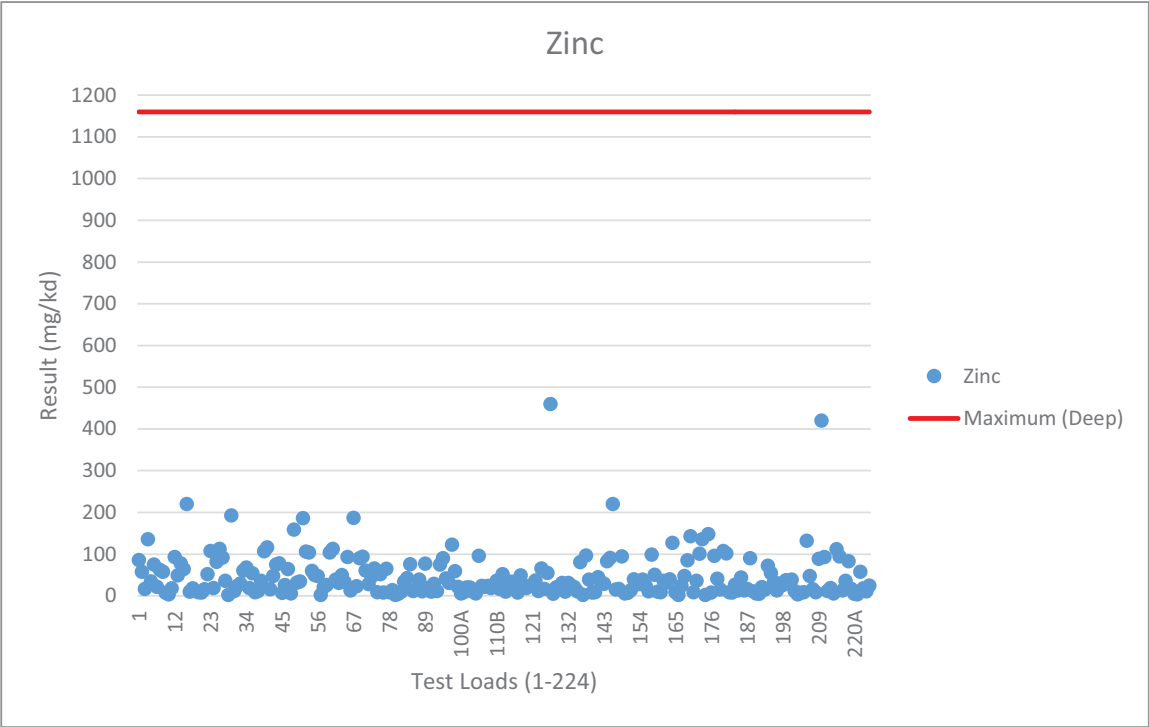
Plotted results of the additional analytical sampling undertaken between 01 April 2012 to 31 May 2015 for each of the parameters listed in condition 16.



Plotted results of the additional analytical sampling undertaken between 01 April 2012 to 31 May 2015 for each of the parameters listed in condition 16.



Plotted results of the additional analytical sampling undertaken between 01 April 2012 to 31 May 2015 for each of the parameters listed in condition 16.



## **APPENDIX D**

### Summary of Duplicate Sample Results



# SUMMARY OF PERCENT COMPARISON OF DUPLICATE ANALYTICAL RESULTS: 010-040

Parameters	3KTL-010A	3KTL-010B	% Comparison of 3KTL-010	3KTL-020A	3KTL-020B	% Comparison of 3KTL-020	3KTL-030A	3KTL-030B	% Comparison of 3KTL-030	3KTL-040A	3KTL-040B	% Comparison of 3KTL-040
Aldrin	<0.010	<0.010	nc	<0.010	<0.011	nc	<0.010	<0.010	nc	<0.010	<0.010	nc
Arsenic	<2	<2	nc	<2	4	67	40	<2	181	2	2	0
Benzo(a)pyrene Equivalence	<0.002	<0.002	nc	<0.002	0.024	169	<0.002	<0.002	nc	0.157	0.064	84
Benzene	<0.07	<0.07	nc	<0.06	<0.06	nc	<0.07	<0.07	nc	<0.07	<0.07	nc
Boron	<20	<20	nc	<20	<20	nc	<20	<20	nc	<20	<20	nc
C10-C14	<30	<20	nc	<20	<20	nc	<30	<20	nc	<20	<20	nc
C15-C36	<50	<40	nc	<40	<40	nc	<50	<40	nc	<40	<40	nc
C7-C9	<11	<9	nc	<10	<9	nc	<12	<10	nc	<10	<10	nc
Cadmium	<0.10	<0.10	nc	<0.10	<0.10	nc	0.12	<0.10	18	<0.10	0.14	33
Chromium	9	6	40	10	11	10	10	10	0	63	66	5
Copper	5	3	50	<2	6	100	20	6	108	45	50	11
Cyanide	<0.10	<0.10	nc	<0.10	<0.10	nc	<0.10	<0.10	nc	<0.10	<0.10	nc
DDT Total	<0.06	<0.06	nc	<0.06	<0.07	nc	<0.06	<0.06	nc	0.11	0.11	0
Dieldrin	<0.010	<0.010	nc	<0.010	<0.011	nc	<0.010	<0.010	nc	<0.010	<0.010	nc
Lead	6	4.3	33	6.1	10.1	49	42	11.5	114	14.9	21	34
Mercury	<0.1	<0.1	nc	<0.10	<0.10	nc	<0.10	0.19	62	<0.10	<0.10	nc
Nickel	6	5	18	2	4	67	9	12	29	150	159	6
TEX Total	<0.35	<0.29	nc	<0.29	<0.3	nc	<0.35	<0.34	nc	<0.34	<0.34	nc
Zinc	7	4	55	9	8	12	193	12	177	107	116	8

## Note:

1. 'nc' (not calculated) is reported if both the results for the parameter has been reported as less than laboratory detection
2. If a result for one of the duplicate samples is given as less than laboratory detection and the other is above laboratory detection the % Comparison reported is calculated by using the value of laboratory detection to the other reported value.

# SUMMARY OF PERCENT COMPARISON OF DUPLICATE ANALYTICAL RESULTS: 050-080

Parameters	3KTL-050A	3KTL-050B	% Comparison of 3KTL-050	3KTL-060A	3KTL-060B	% Comparison of 3KTL-060	3KTL-070A	3KTL-070B	% Comparison of 3KTL-070	3KTL-080A	3KTL-080B	% Comparison of 3KTL-080
Aldrin	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc
Arsenic	3	5	50	1	2	67	3	3	0	<2	<2	nc
Benzo(a)pyrene Equivalence	<0.002	<0.002	nc	0.03	0.05	50	<0.002	<0.002	nc	<0.002	<0.002	nc
Benzene	<0.06	<0.06	nc	<0.06	<0.07	nc	<0.07	<0.07	nc	<0.06	<0.06	nc
Boron	<20	<20	nc	<20	<20	nc	<20	<20	nc	<20	<20	nc
C10-C14	<20	<20	nc	<20	<20	nc	<20	<20	nc	<20	<20	nc
C15-C36	<40	<40	nc	<40	<40	nc	<40	<40	nc	<40	<40	nc
C7-C9	<10	<10	nc	<9	<10	nc	<10	<10	nc	<9	<10	nc
Cadmium	<0.10	<0.10	nc	0.21	0.2	5	<0.10	<0.10	nc	<0.10	<0.10	nc
Chromium	28	32	13	66	66	0	17	18	6	24	15	46
Copper	13	16	21	33	35	6	11	11	0	45	8	140
Cyanide	<0.10	<0.10	nc	<0.10	0.14	33	0.2	0.26	26	<0.10	<0.10	nc
DDT Total	<0.06	<0.06	nc	<0.06	<0.06	nc	<0.06	<0.06	nc	<0.06	<0.06	nc
Dieldrin	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc
Lead	12.4	15.2	20	32	45	34	250	36	150	15.4	5.5	95
Mercury	0.11	<0.10	10	0.14	0.25	56	0.13	0.11	17	<0.10	<0.10	nc
Nickel	5	5	0	96	100	4	6	7	15	<2	<2	nc
TEX Total	<0.30	<0.30	nc	<0.29	<0.35	nc	<0.35	<0.35	nc	<0.30	<0.30	nc
Zinc	32	35	9	104	113	8	94	61	43	<4	5	22

## Note:

1. 'nc' (not calculated) is reported if both the results for the parameter has been reported as less than laboratory detection
2. If a result for one of the duplicate samples is given as less than laboratory detection and the other is above laboratory detection the % Comparison reported is calculated by using the value of laboratory detection to the other reported value.

# SUMMARY OF PERCENT COMPARISON OF DUPLICATE ANALYTICAL RESULTS: 090-120

Parameters	3KTL-090A	3KTL-090B	% Comparison of 3KTL-090	3KTL-100A	3KTL-100B	% Comparison of 3KTL-100	3KTL-110A	3KTL-110B	% Comparison of 3KTL-110	3KTL-120A	3KTL-120B	% Comparison of 3KTL-120
Aldrin	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc
Arsenic	3	3	0	3	4	29	3	3	0	7	7	0
Benzo(a)pyrene Equivalence	0.008	<0.002	120	<0.002	0.02	164	<0.002	0.033	177	<0.002	<0.002	nc
Benzene	<0.06	<0.07	nc	<0.06	<0.06	nc	<0.06	<0.06	nc	<0.07	<0.07	nc
Boron	<20	<20	nc	<20	<20	nc	<20	<20	nc	<20	<20	nc
C10-C14	<20	<20	nc	<20	<20	nc	<20	<20	nc	<20	<20	nc
C15-C36	<40	<40	nc	<40	<40	nc	<40	<40	nc	<40	<40	nc
C7-C9	<9	<10	nc	<9	<9	nc	<9	<9	nc	<10	<10	nc
Cadmium	<0.10	<0.10	nc	<0.10	<0.10	nc	<0.10	<0.10	nc	<0.10	<0.10	nc
Chromium	19	18	5	14	15	7	26	35	30	28	34	19
Copper	12	13	8	7	8	13	10	14	33	11	16	37
Cyanide	<0.10	<0.10	nc	<0.10	<0.10	nc	<0.10	<0.10	nc	<0.10	<0.10	nc
DDT Total	<0.06	<0.06	nc	<0.06	<0.06	nc	<0.06	<0.06	nc	<0.06	<0.06	nc
Dieldrin	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc
Lead	24	19.2	22	8.3	12.2	38	8.2	11.6	34	11.9	11.8	1
Mercury	0.19	0.29	42	<0.10	<0.10	nc	<0.10	<0.10	nc	<0.1	<0.1	nc
Nickel	9	9	0	<2	<2	nc	13	19	38	9	6	40
TEX Total	<0.30	<0.34	nc	<0.29	<0.29	nc	<0.30	<0.30	nc	<0.35	<0.34	nc
Zinc	19	10	62	6	9	40	23	36	44	19	24	23

Note:

1. 'nc' (not calculated) is reported if both the results for the parameter has been reported as less than laboratory detection
2. If a result for one of the duplicate samples is given as less than laboratory detection and the other is above laboratory detection the % Comparison reported is calculated by using the value of laboratory detection to the other reported value.

# SUMMARY OF PERCENT COMPARISON OF DUPLICATE ANALYTICAL RESULTS: 130-160

Parameters	3KTL-130A	3KTL-130B	% Comparison of 3KTL-130B	3KTL-140A	3KTL-140B	% Comparison of 3KTL-140B	3KTL-150A	3KTL-150B	% Comparison of 3KTL-150B	3KTL-160A	3KTL-160B	% Comparison of 3KTL-160
Aldrin	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc
Arsenic	<2	2	0	<2	<2	nc	<2	<2	nc	<2	<2	nc
Benzo(a)pyrene Equivalence	<0.002	<0.002	nc	<0.002	0.3	197	<0.002	<0.002	nc	<0.002	<0.002	nc
Benzene	<0.06	<0.06	nc	<0.06	<0.06	nc	<0.07	<0.07	nc	<0.06	<0.06	nc
Boron	<20	<20	nc	<20	<20	nc	<20	<20	nc	<20	<20	nc
C10-C14	<20	<20	nc	<20	<20	nc	<20	<20	nc	<20	<20	nc
C15-C36	<40	<40	nc	<40	<40	nc	<40	<40	nc	<40	<40	nc
C7-C9	<10	<9	nc	<9	<9	nc	<10	<10	nc	<9	<9	nc
Cadmium	<0.10	<0.10	nc	<0.10	<0.10	nc	<0.10	<0.10	nc	<0.10	<0.10	nc
Chromium	17	15	13	9	9	0	9	11	20	18	13	32
Copper	9	8	12	5	6	18	<2	2	0	5	4	22
Cyanide	<0.10	<0.10	nc	<0.10	<0.10	nc	<0.10	0.65	147	<0.10	<0.10	nc
DDT Total	<0.06	<0.06	nc	<0.06	<0.06	nc	<0.06	<0.06	nc	<0.06	<0.06	nc
Dieldrin	0.014	<0.010	33	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.01	<0.01	nc
Lead	16.8	11.3	39	6.4	6.2	3	6.9	5.7	19	5.6	4.9	13
Mercury	<0.10	<0.10	nc	0.12	<0.10	18	<0.10	<0.10	nc	<0.10	<0.10	nc
Nickel	16	13	21	7	8	13	<2	<2	nc	6	4	40
TEX Total	<0.30	<0.29	nc	<0.29	<0.30	nc	<0.35	<0.35	nc	<0.30	<0.30	nc
Zinc	23	31	30	8	9	12	6	7	15	10	9	11

Note:

1. 'nc' (not calculated) is reported if both the results for the parameter has been reported as less than laboratory detection
2. If a result for one of the duplicate samples is given as less than laboratory detection and the other is above laboratory detection the % Comparison reported is calculated by using the value of laboratory detection to the other reported value.

# SUMMARY OF PERCENT COMPARISON OF DUPLICATE ANALYTICAL RESULTS: 170-200

Parameters	3KTL-170A	3KTL-170B	% Comparison of 3KTL-170	3KTL-180A	3KTL-180B	% Comparison of 3KTL-180	3KTL-190A	3KTL-190B	% Comparison of 3KTL-190	3KTL-200A	3KTL-200B	% Comparison of 3KTL-200
Aldrin	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc
Arsenic	<2	<2	nc	2	2	0	<2	<2	nc	5	5	0
Benzo(a)pyrene Equivalence	<0.002	<0.002	nc	0.157	0.052	100	0.043	0.038	12	0.027	0.025	8
Benzene	<0.06	<0.06	nc	<0.09	<0.07	nc	<0.06	<0.06	nc	<0.07	<0.07	nc
Boron	<20	<20	nc	<20	<20	nc	<20	<20	nc	<20	<20	nc
C10-C14	<20	<20	nc	<30	<20	nc	<20	<20	nc	<20	<20	nc
C15-C36	<40	<40	nc	<50	<40	nc	<40	<40	nc	<40	<40	nc
C7-C9	<9	<9	nc	<12	<10	nc	<9	<9	nc	<10	<10	nc
Cadmium	0.14	<0.10	33	0.11	0.14	24	<0.10	<0.10	nc	<0.10	<0.10	nc
Chromium	7	8	13	86	79	8	14	13	7	19	19	0
Copper	3	3	0	27	29	7	3	4	29	20	22	10
Cyanide	<0.10	<0.10	nc	<0.10	<0.10	nc	<0.10	<0.10	nc	<0.10	<0.10	nc
DDT Total	<0.06	<0.06	nc	<0.06	<0.06	nc	<0.06	<0.06	nc	<0.06	<0.06	nc
Dieldrin	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc	<0.010	<0.010	nc
Lead	11.4	4.9	80	15.3	23	40	6	6.2	3	16.3	21	25
Mercury	0.13	0.1	26	0.13	<0.10	26	<0.10	<0.10	nc	0.1	0.12	18
Nickel	<2	<2	nc	70	66	6	<2	<2	nc	12	13	8
TEX Total	<0.30	<0.30	nc	<0.44	<0.34	nc	<0.29	<0.29	nc	<0.35	<0.35	nc
Zinc	143	9	176	108	102	6	6	5	18	35	39	11

Note:

1. 'nc' (not calculated) is reported if both the results for the parameter has been reported as less than laboratory detection
2. If a result for one of the duplicate samples is given as less than laboratory detection and the other is above laboratory detection the % Comparison reported is calculated by using the value of laboratory detection to the other reported value.

# SUMMARY OF PERCENT COMPARISON OF DUPLICATE ANALYTICAL RESULTS: 210-220

Parameters	3KTL-210A	3KTL-210B	% Comparison of 3KTL-210	3KTL-220A	3KTL-220B	% Comparison of 3KTL-220
Aldrin	<0.010	<0.010	nc	<0.010	<0.010	nc
Arsenic	4	6	40	2	<2	0
Benzo(a)pyrene Equivalence	0.069	<0.002	189	<0.002	<0.002	nc
Benzene	<0.08	<0.07	nc	<0.06	<0.06	nc
Boron	<20	<20	nc	<20	<20	nc
C10-C14	<30	<20	nc	<20	<20	nc
C15-C36	<50	<40	nc	<40	<40	nc
C7-C9	<11	<10	nc	<9	<10	nc
Cadmium	0.19	<0.10	62	<0.10	<0.10	nc
Chromium	23	23	0	8	1.1	32
Copper	10	12	18	3	2	40
Cyanide	<0.10	<0.10	nc	<0.10	<0.10	nc
DDT Total	<0.06	<0.06	nc	<0.06	<0.06	nc
Dieldrin	<0.01	<0.01	nc	<0.01	<0.01	nc
Lead	26	26	0	9.7	6.8	35
Mercury	<0.10	0.14	33	0.13	<0.10	26
Nickel	10	9	11	4	2	67
TEX Total	<0.39	<0.35	nc	<0.29	<0.30	nc
Zinc	420	93	127	5	4	22

Note:

1. 'nc' (not calculated) is reported if both the results for the parameter has been reported as less than laboratory detection
2. If a result for one of the duplicate samples is given as less than laboratory detection and the other is above laboratory detection the % Comparison reported is calculated by using the value of laboratory detection to the other reported value.

## **APPENDIX E**

### **Summary of Council Random Sampling Results**

# SUMMARY OF COUNCIL BIENNIAL RANDOM SAMPLING RESULTS

Parameters	Weighted Rolling 12- Month DEEP Criteria	Maximum DEEP Criteria	16/11/2012		26/04/2013		25/11/2013		7/05/2014	
Aldrin	0.7	12	<0.010	<0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic	12	100	2	3	7	<2	4	6	4	4
Benzo(a)pyrene Equivalence	1	2.15	0.26	0.56	<0.09	<0.08	0.2	0.83	0.93	0.35
Benzene	0.4	1	<0.06	<0.05	<0.07	<0.07	<0.05	<0.05	<0.06	<0.07
Boron	130	260	<20	<20	<20	<20	<20	<20	<20	<20
C10-C14	50	300	<20	<20	<30	<20	<20	<20	<20	<20
C15-C36	500	5600	<40	<40	<50	<40	<40	<40	47	<40
C7-C9	20	300	<10	<9	<11	<10	<8	<8	<9	<8
Cadmium	0.65	7.5	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	<0.10	0.11
Chromium	125	400	35	21	na	na	16	23	50	45
Copper	90	325	21	17	8	7	19	23	31	32
Cyanide	1	25	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.16	<0.10
DDT Total	0.7	12	<0.060	<0.066	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060
Dieldrin	0.7	6	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	<0.010	<0.010
Lead	65	250	16.9	22	9.2	13.2	14.6	27	28	34
Mercury	0.45	0.75	<0.10	<0.10	<0.10	0.14	<0.10	<0.10	<0.10	<0.10
Nickel	105	320	31	15	3	4	21	32	65	63
TEX Total	3	20	<0.29	<0.25	<0.35	<0.34	<0.25	<0.25	<0.29	<0.34
Zinc	400	1160	49	42	8	9	56	69	88	81

## Notes:

- 1 All values are in mg/kg.
- 2 na = no result provided
- 3 Red are results above the trigger limit (based on the deeper >2m criteria)



# SUMMARY OF COUNCIL BIENNIAL RANDOM SAMPLING RESULTS

Parameters	Weighted Rolling 12- Month DEEP Criteria	Maximum DEEP Criteria	2/12/2014		9/05/2015	
Aldrin	0.7	12	<0.010	<0.010	<0.010	<0.010
Arsenic	12	100	3	5	3	3
Benzo(a)pyrene Equivalence	1	2.15	3.1	0.29	0.85	0.25
Benzene	0.4	1	<0.06	<0.05	<0.06	<0.07
Boron	130	260	<20	<20	<20	<20
C10-C14	50	300	<20	<20	<20	<20
C15-C36	500	5600	89	<40	76	<40
C7-C9	20	300	<9	<8	<10	<10
Cadmium	0.65	7.5	<0.10	0.13	<0.10	<0.10
Chromium	125	400	65	44	47	66
Copper	90	325	28	30	31	32
Cyanide	1	25	<0.10	<0.10	<0.10	<0.10
DDT Total	0.7	12	<0.060	<0.060	<0.06	<0.06
Dieldrin	0.7	6	<0.010	<0.010	<0.010	<0.010
Lead	65	250	14.1	25	14.5	12.9
Mercury	0.45	0.75	<0.10	<0.10	na	na
Nickel	105	320	43	39	79	83
TEX Total	3	20	<0.29	<0.25	<0.30	<0.34
Zinc	400	1160	47	68	72	76

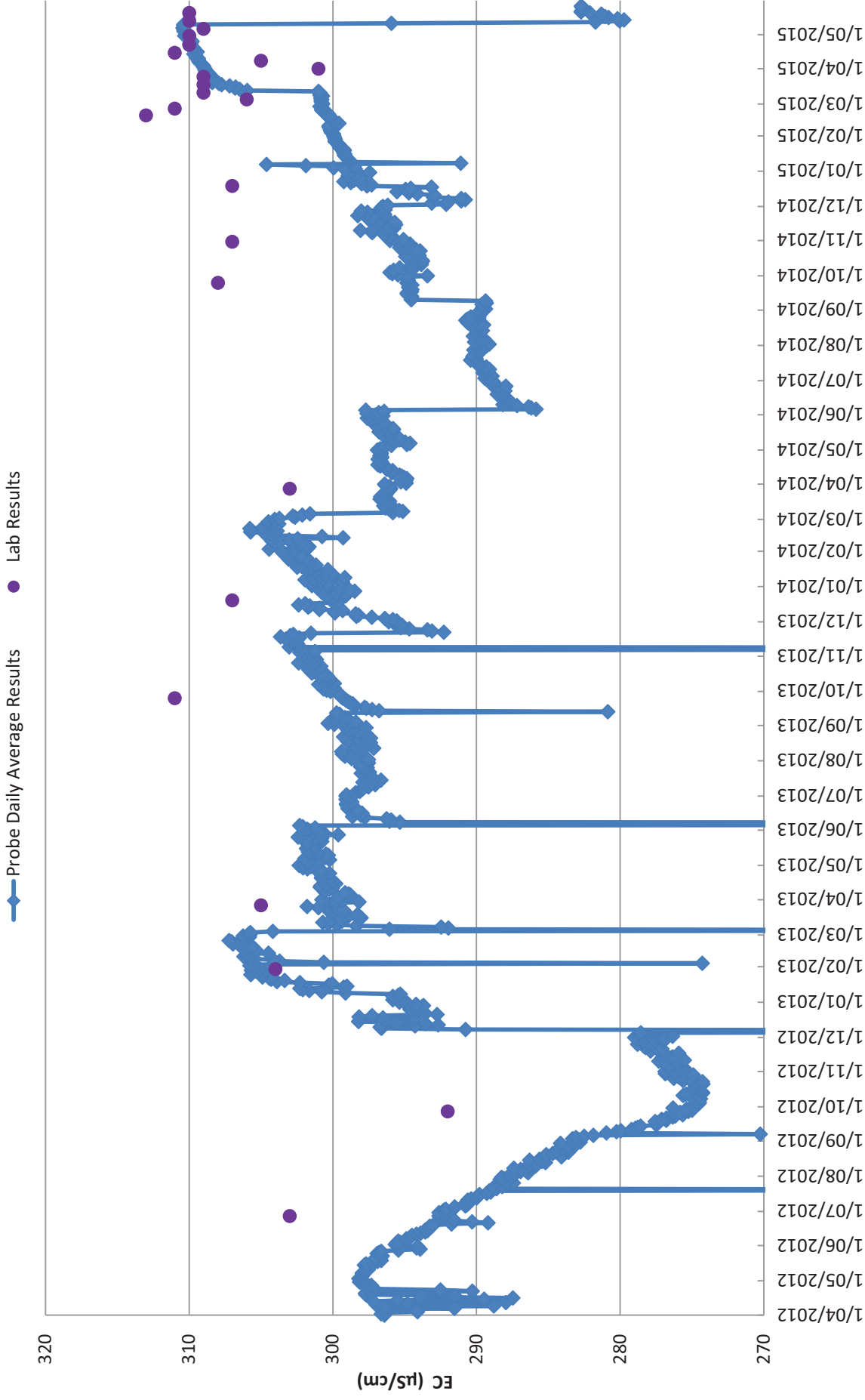
## Notes:

- 1 All values are in mg/kg.
- 2 na = no result provided
- 3 Red are results above the trigger limit (based on the deeper >2m criteria)

## **APPENDIX F**

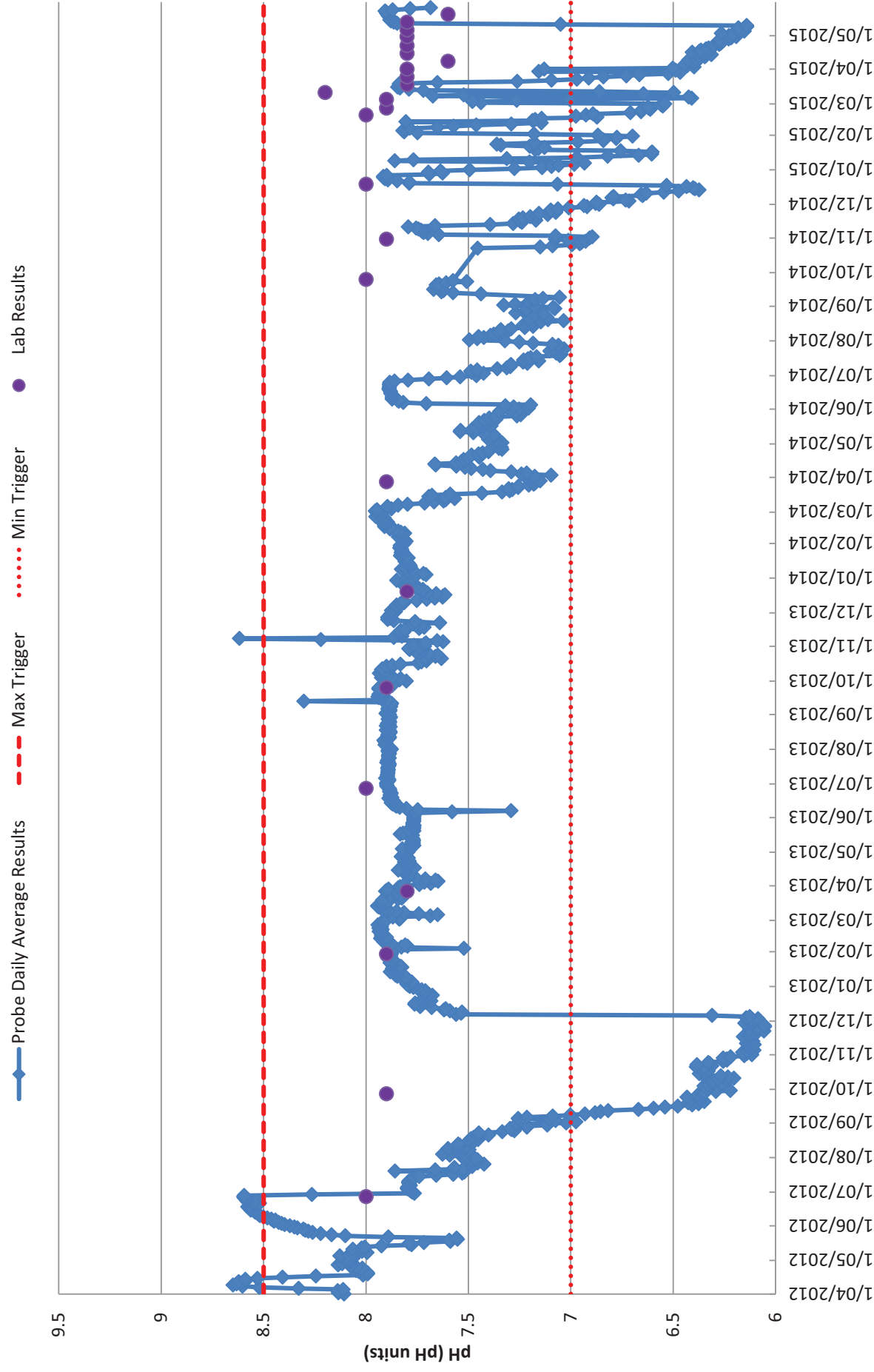
### **Summary of Continuous Monitoring Data**

## Average Daily EC Graph



**Figure 1.** This figure illustrates the average daily electrical conductivity of the water monitored at the dewatering well head as required by condition 30. The daily average is based on the readings logged at 5 minute intervals for each day between 01/04/2012 and 31/05/2015. Also plotted are the laboratory results from additional monitoring undertaken at the dewatering well head.

## Average Daily pH Graph



**Figure 2.** This figure illustrates the average daily pH of the water monitored at the dewatering well head as required by condition 30. The daily average is based on the readings logged at 5 minute intervals for each day between 01/04/2012 and 31/05/2015. Also plotted are the laboratory results from additional monitoring undertaken at the dewatering well head.

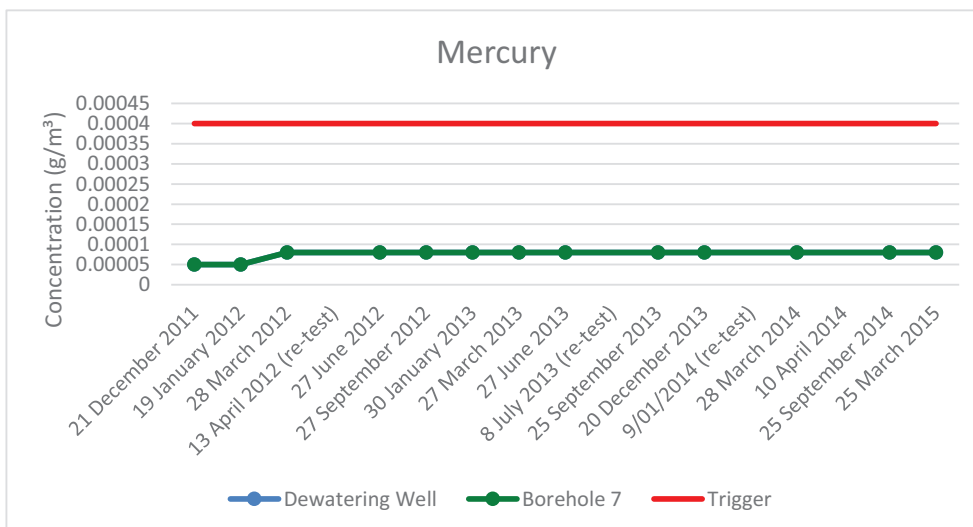
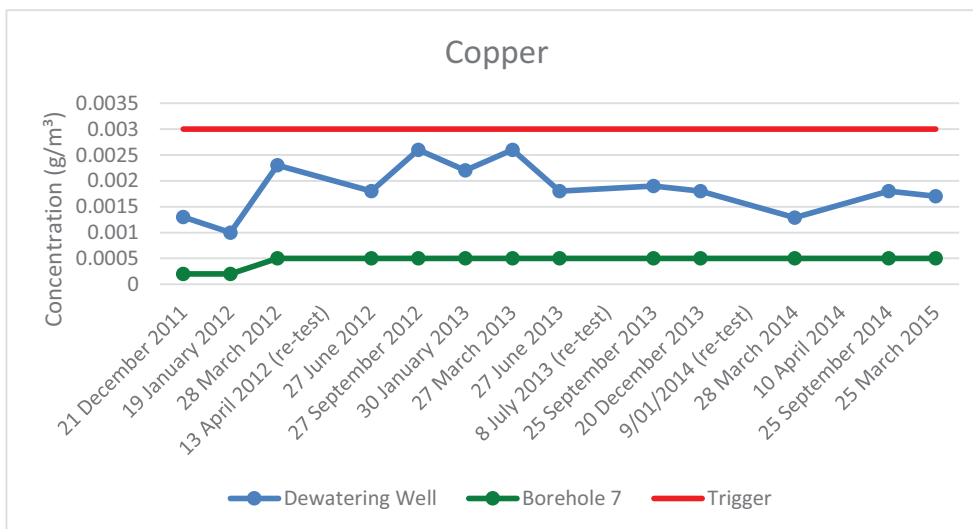
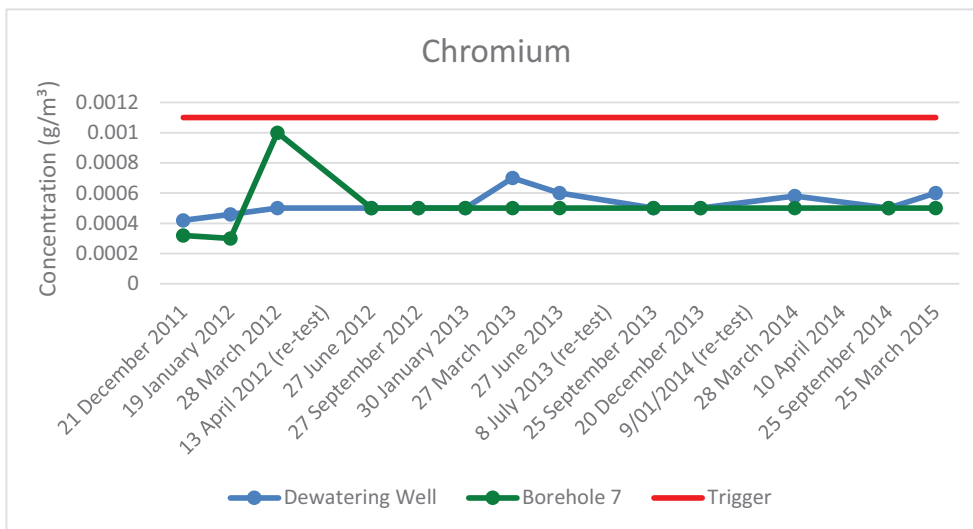
## **APPENDIX G**

### Groundwater Monitoring Data

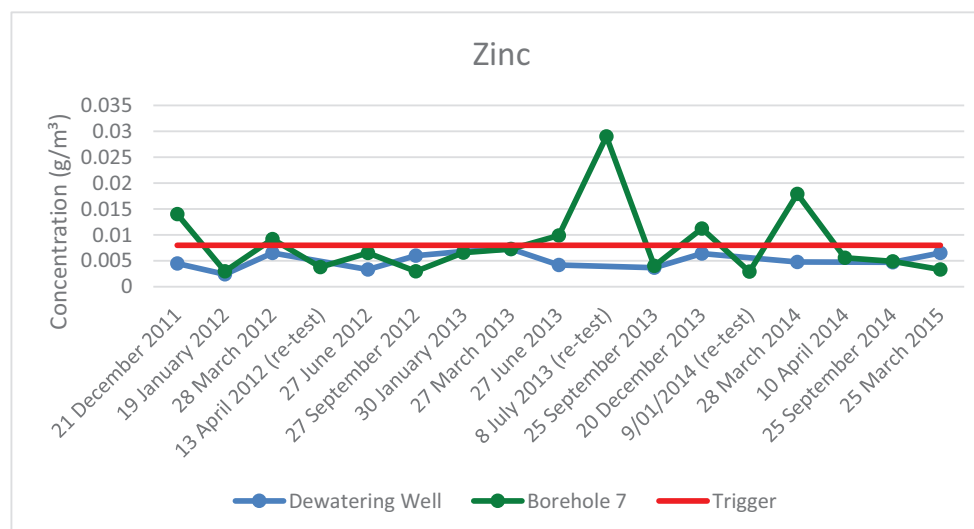
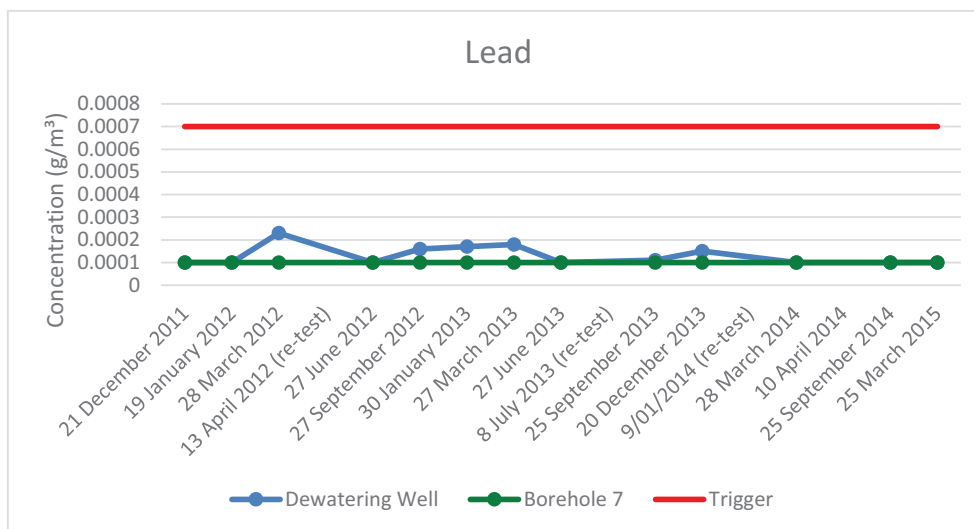
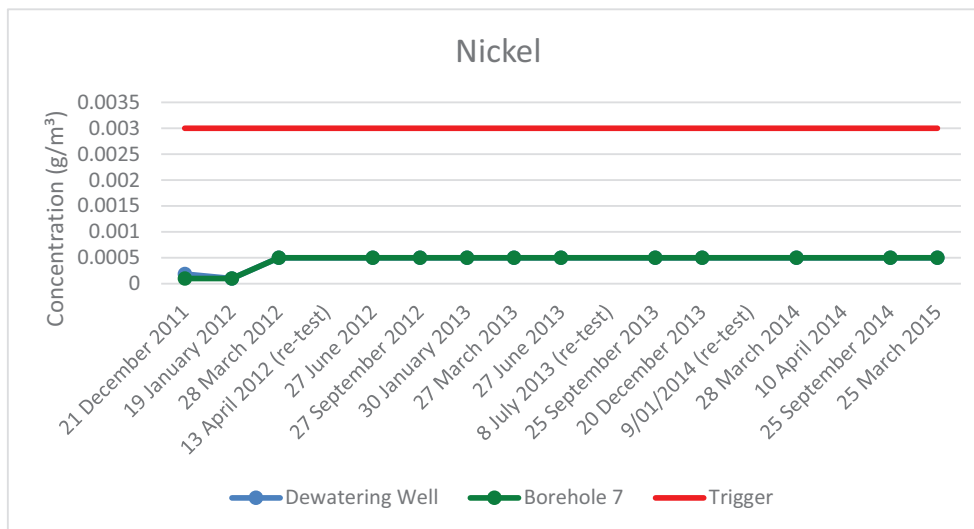
**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**

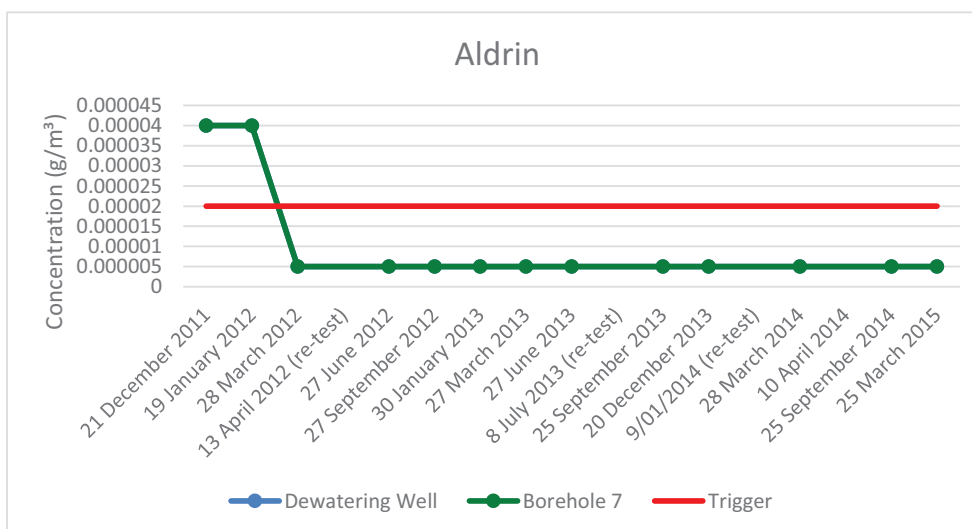
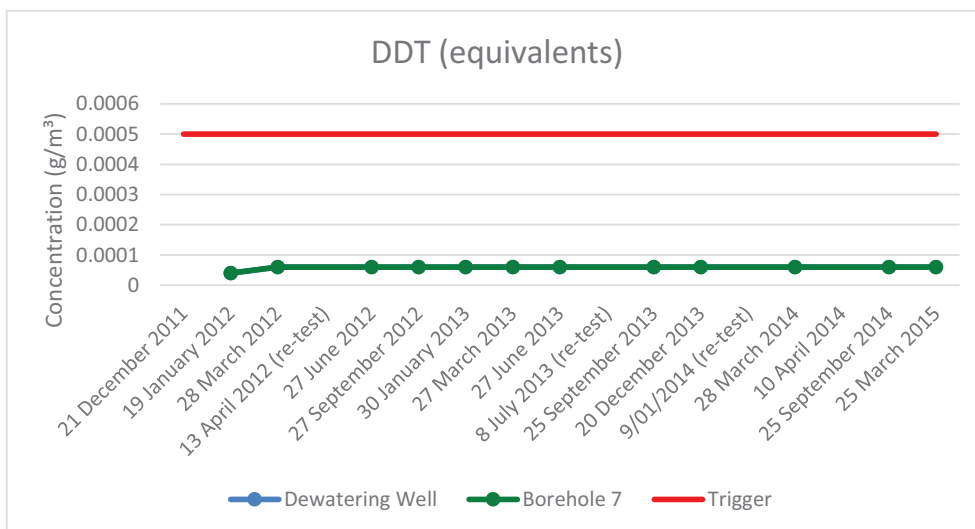
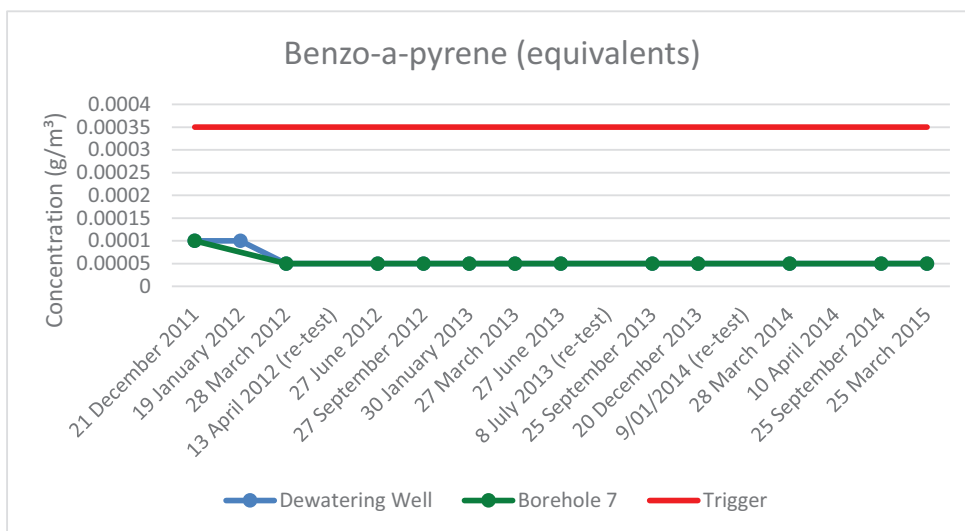


**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**

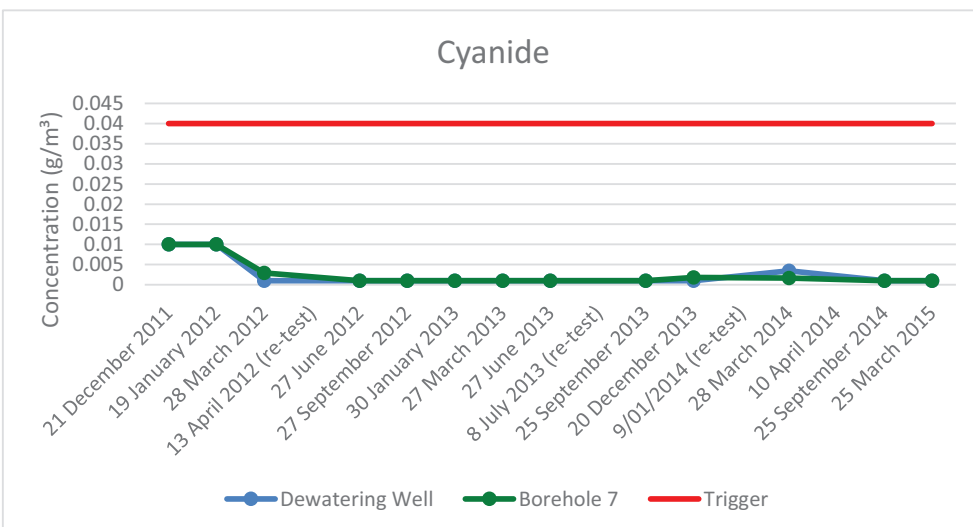
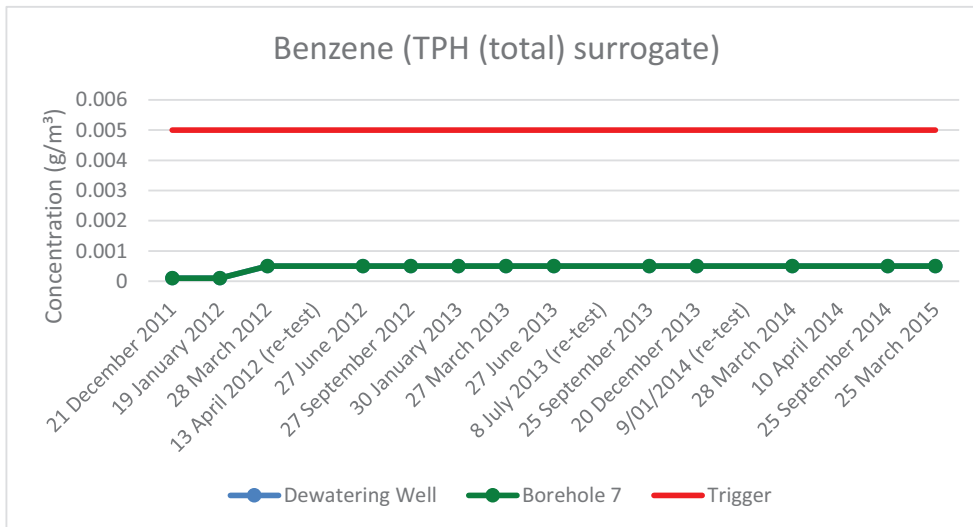
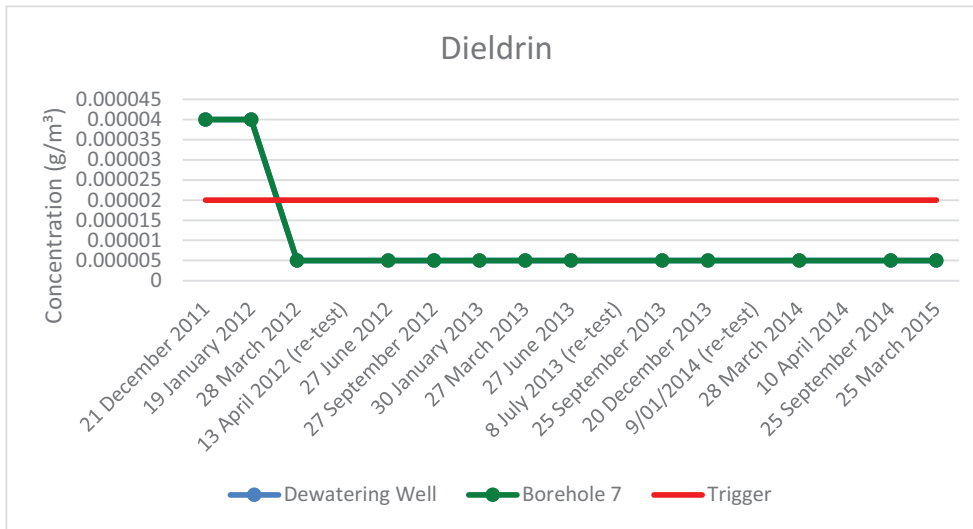




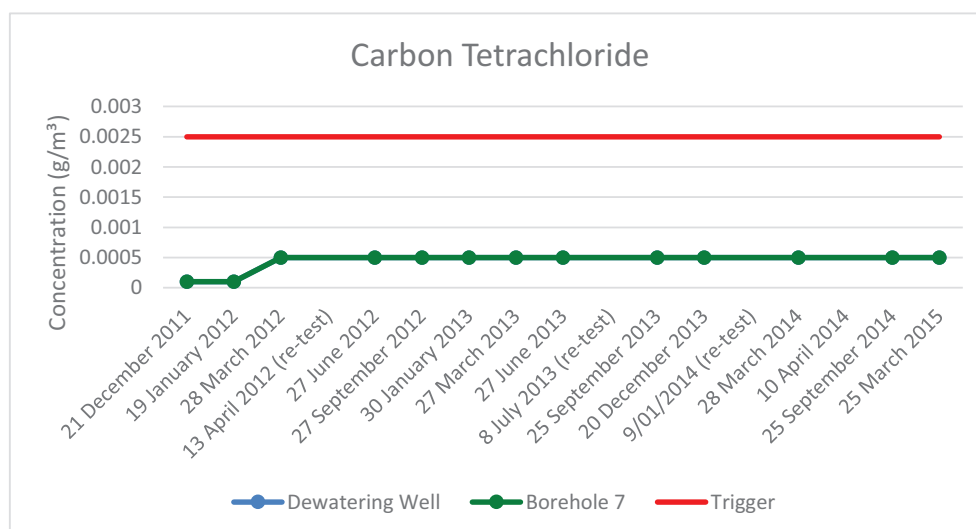
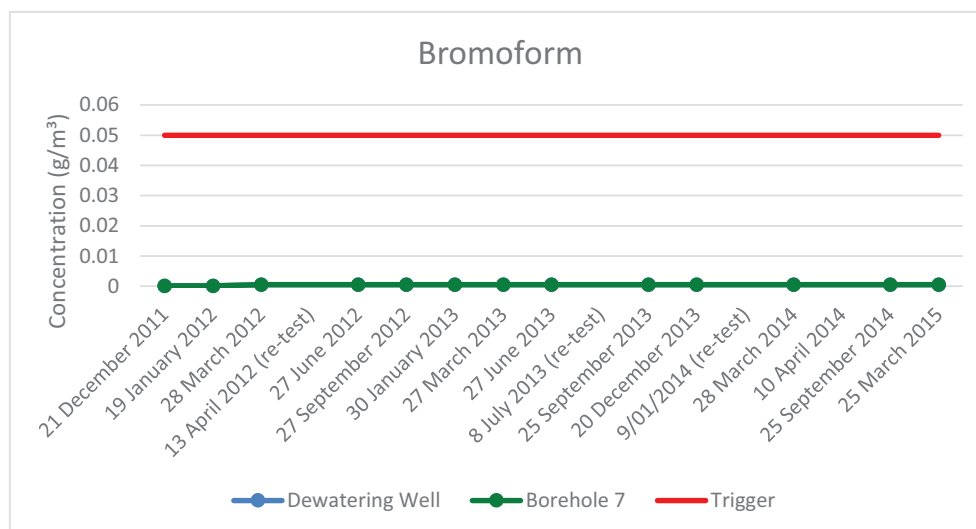
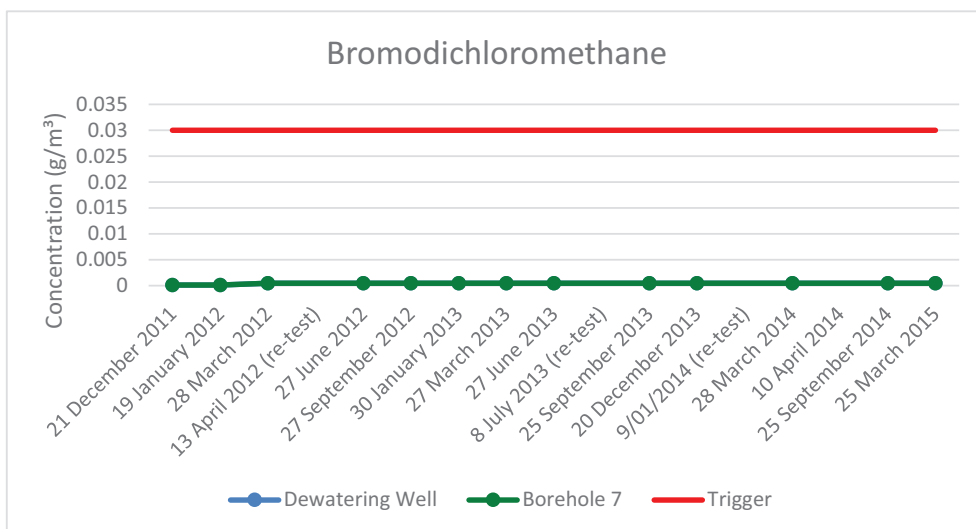
**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



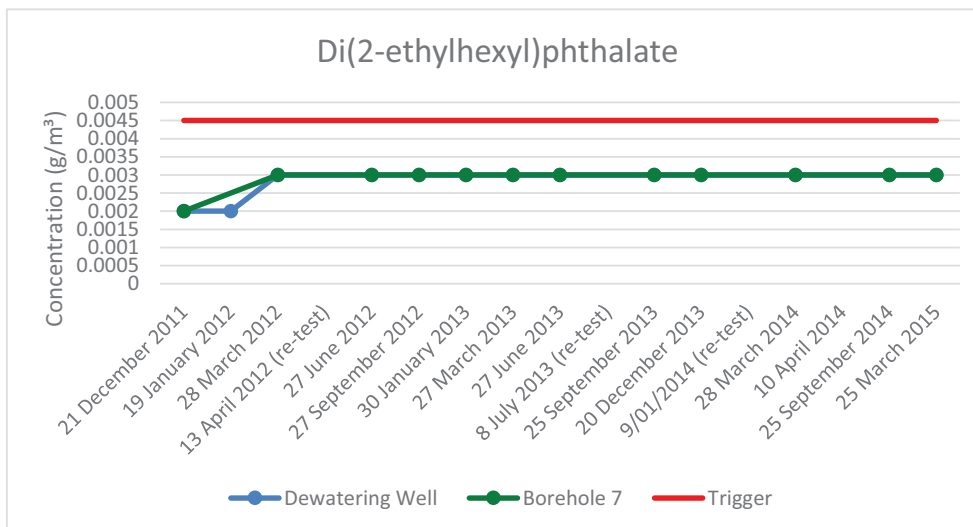
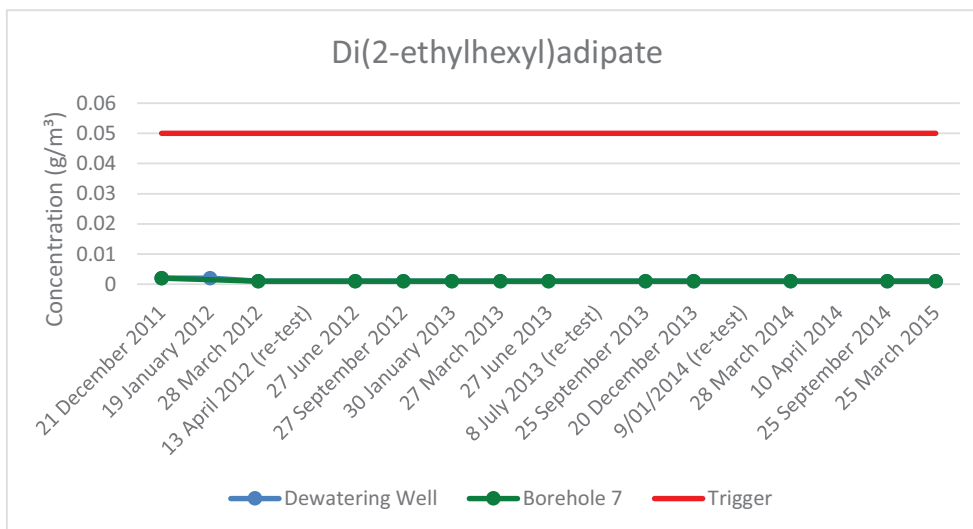
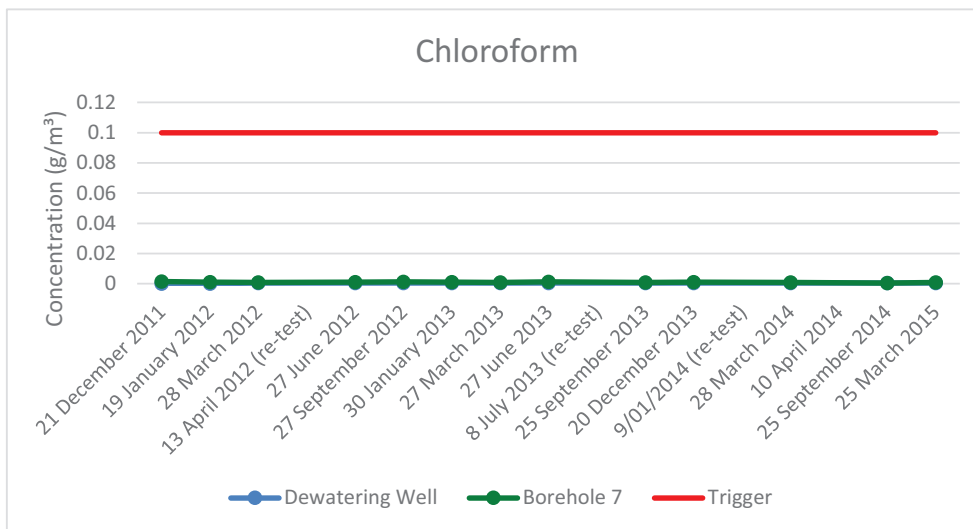
**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



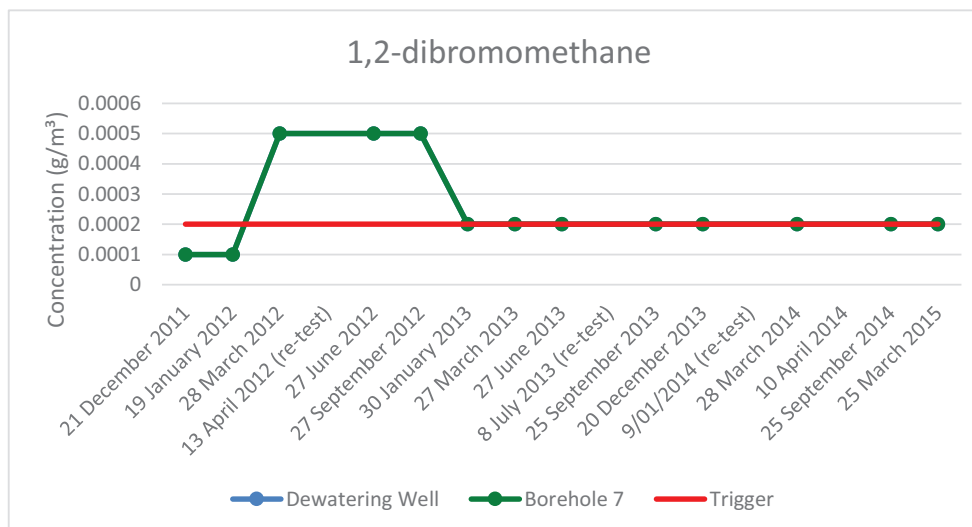
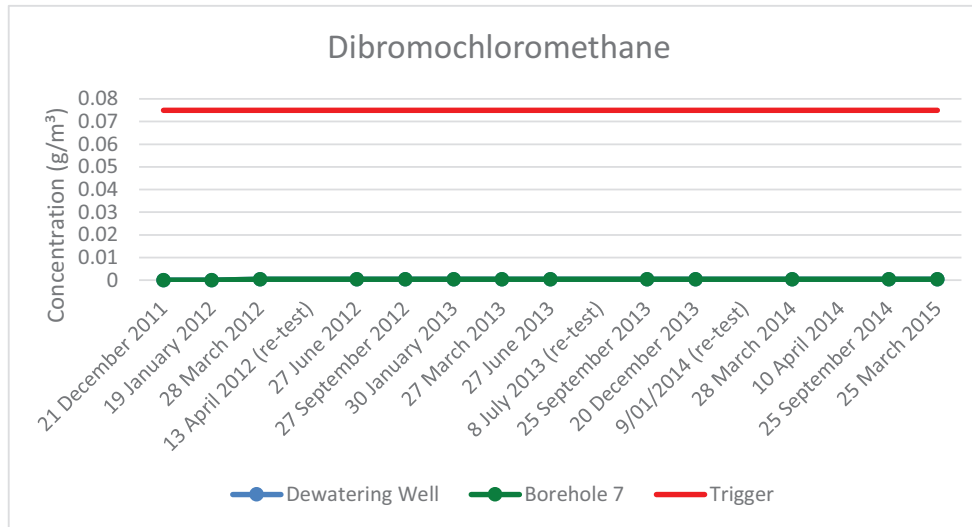
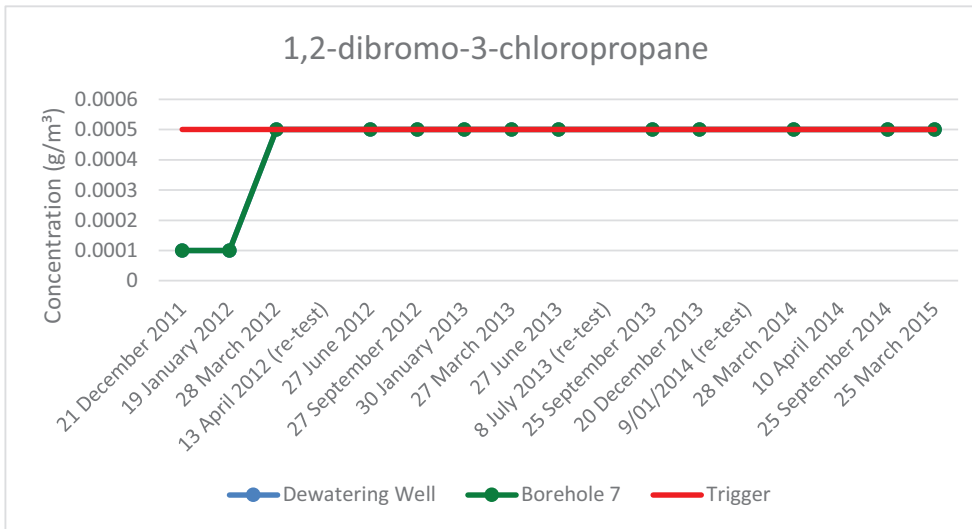
**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



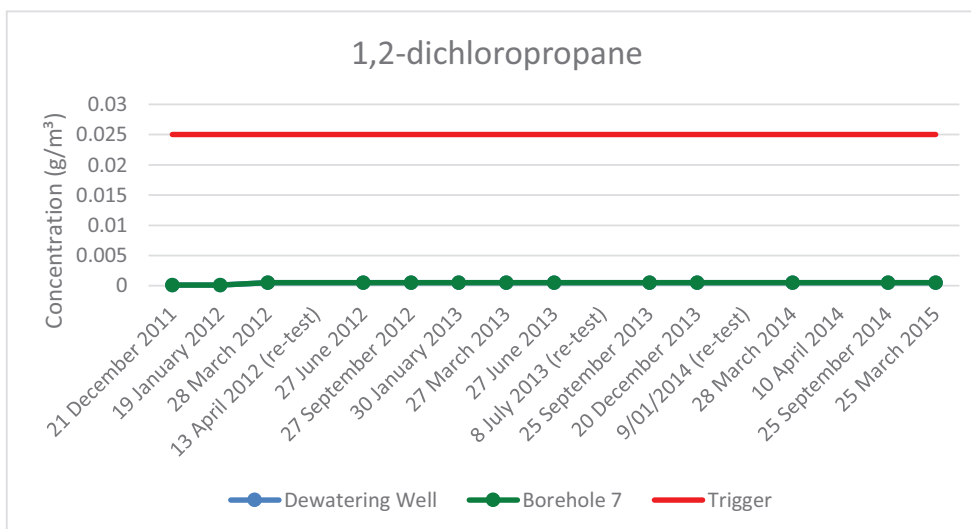
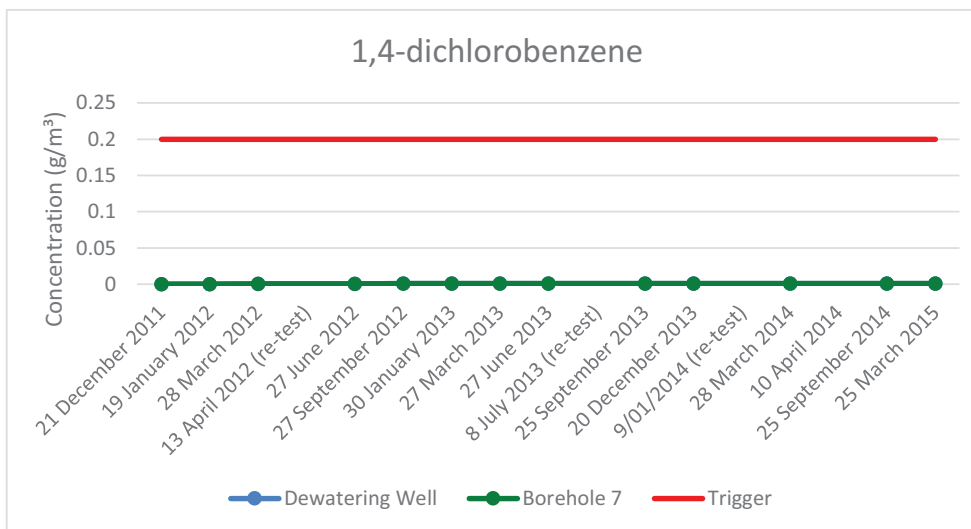
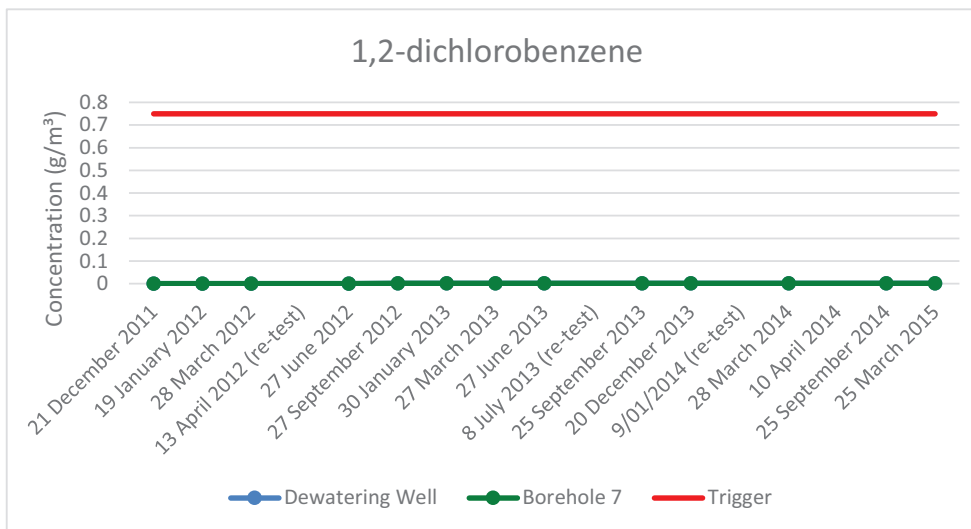
**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



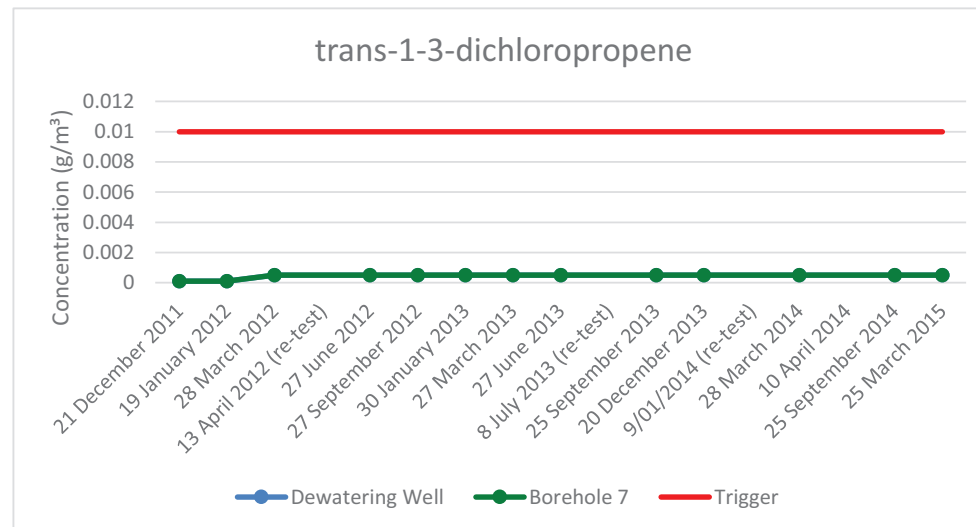
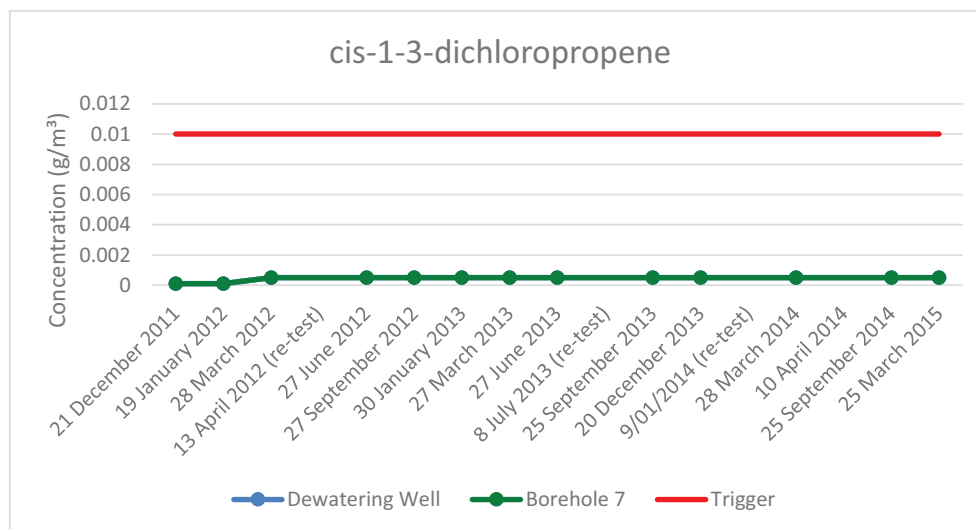
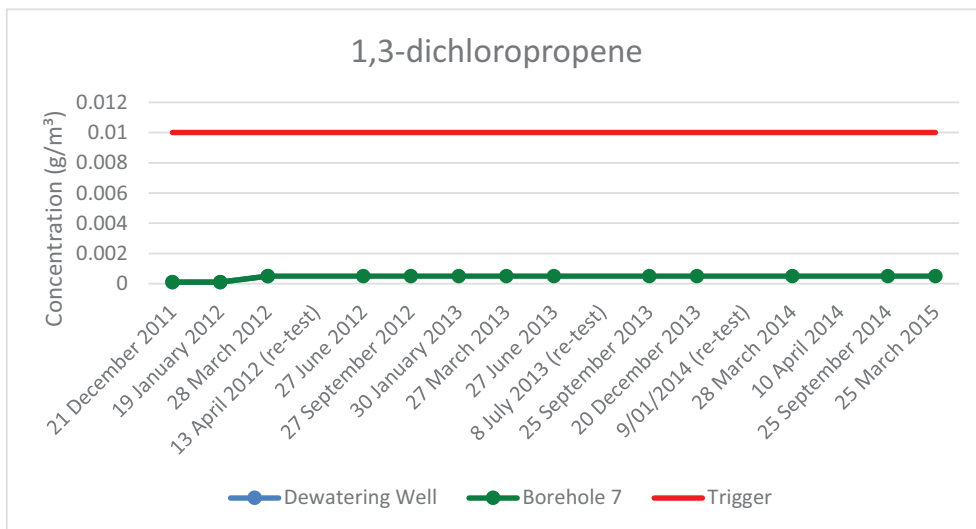
**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



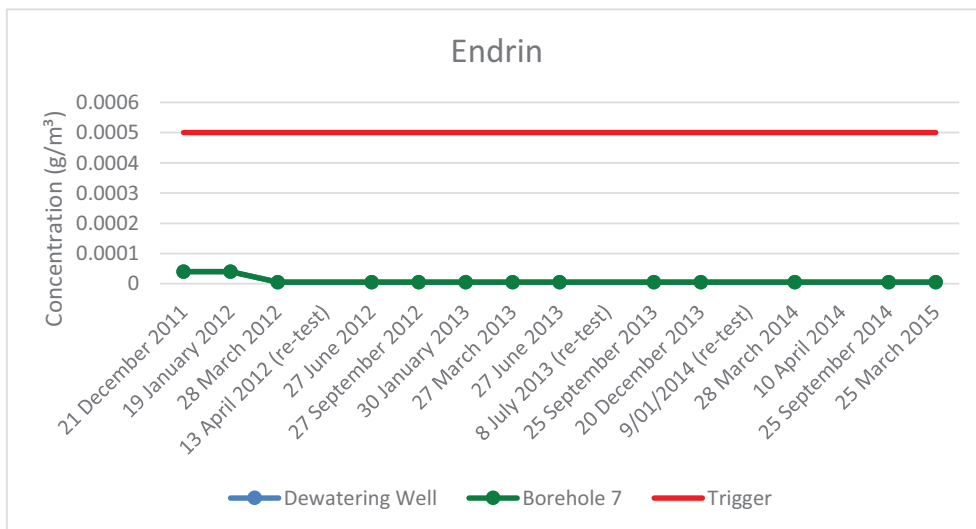
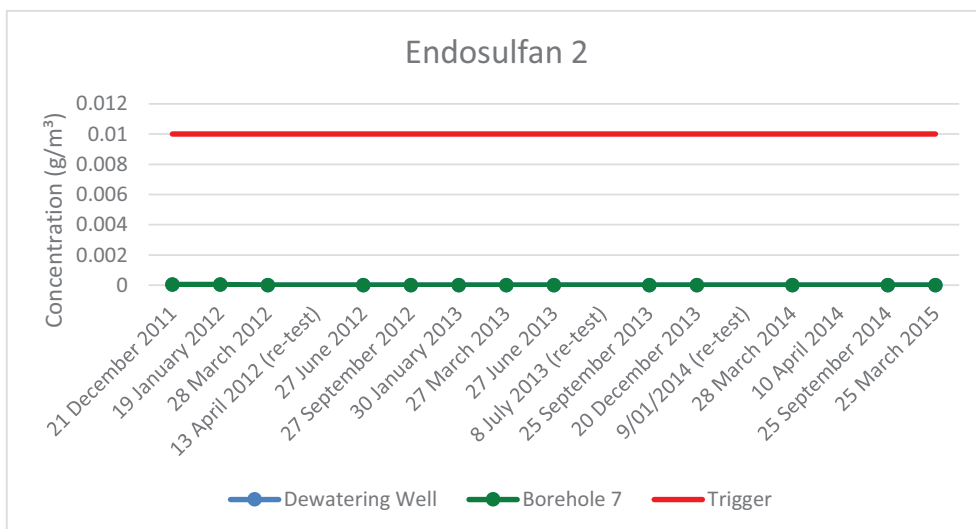
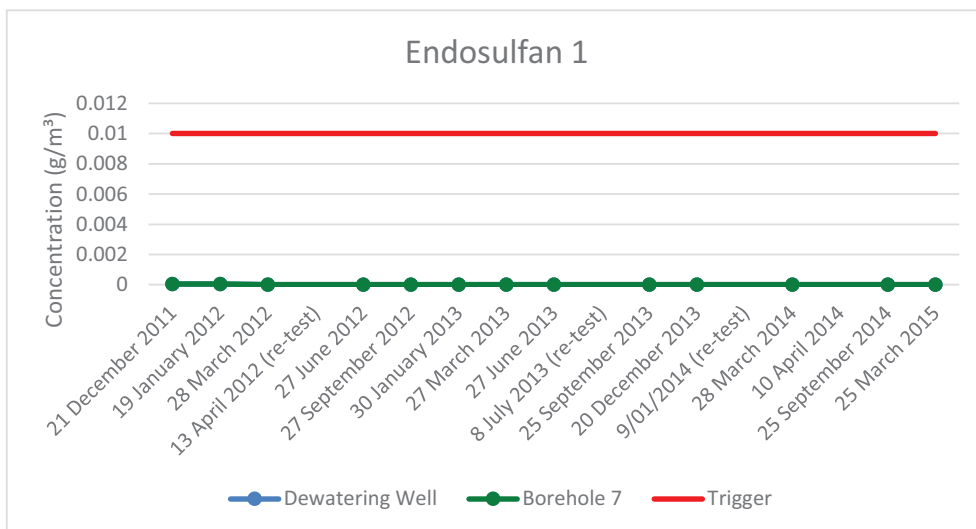
**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**

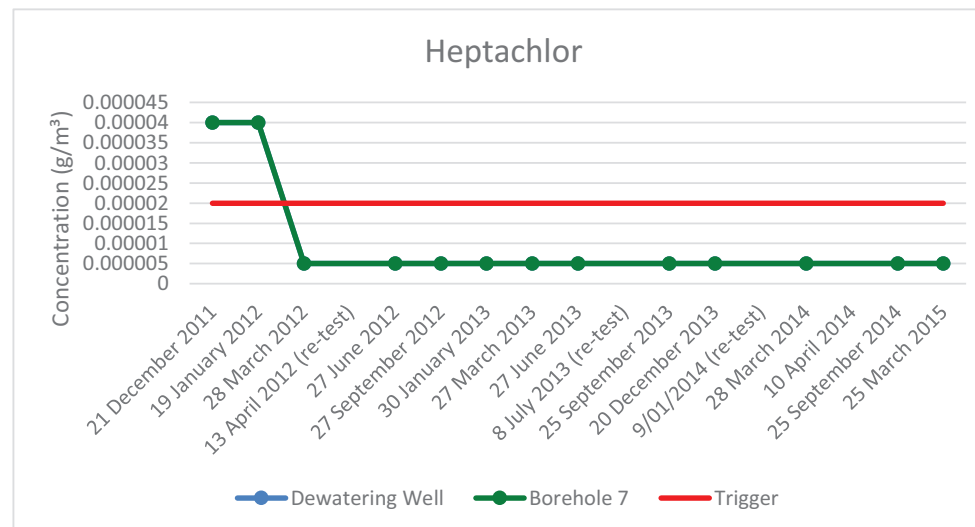
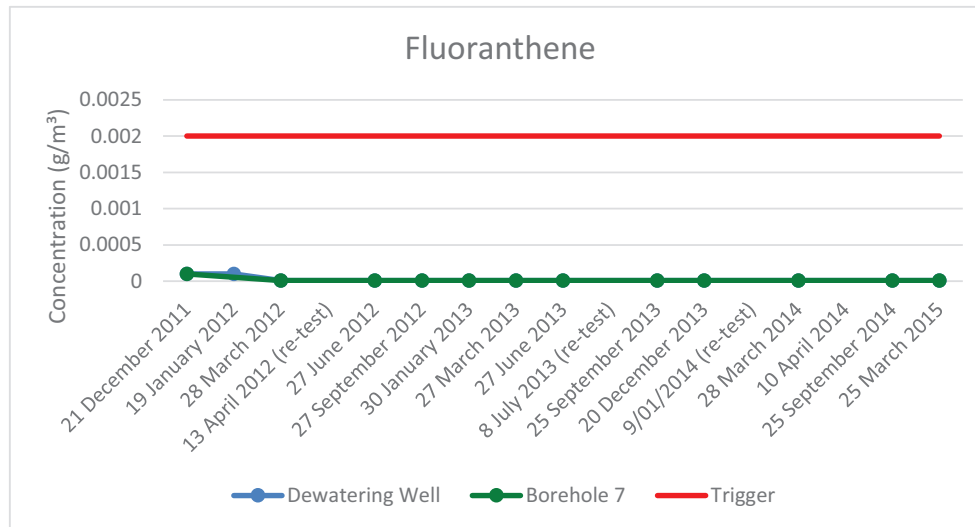
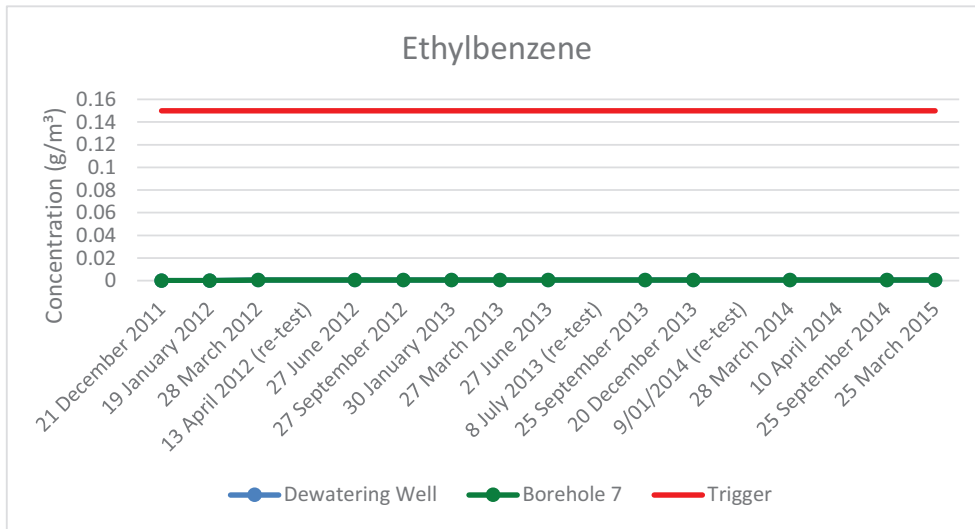


**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**

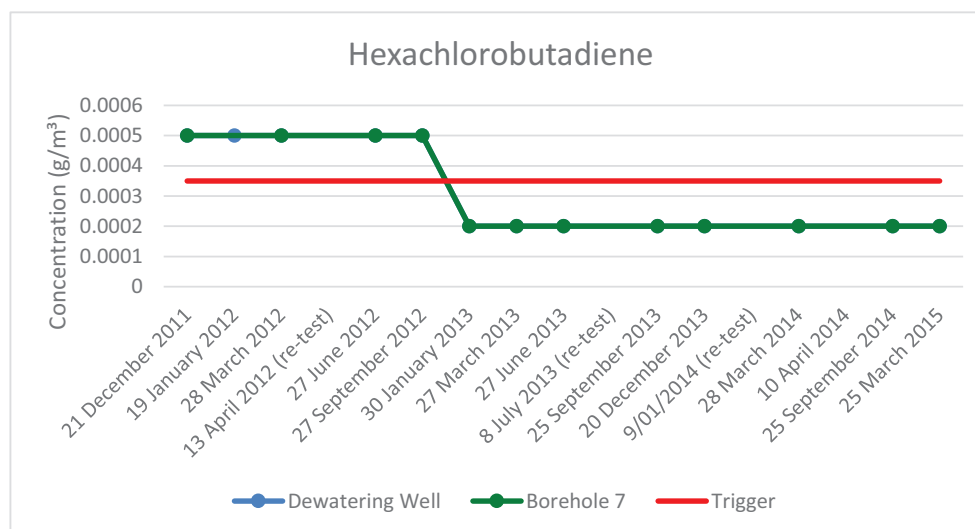
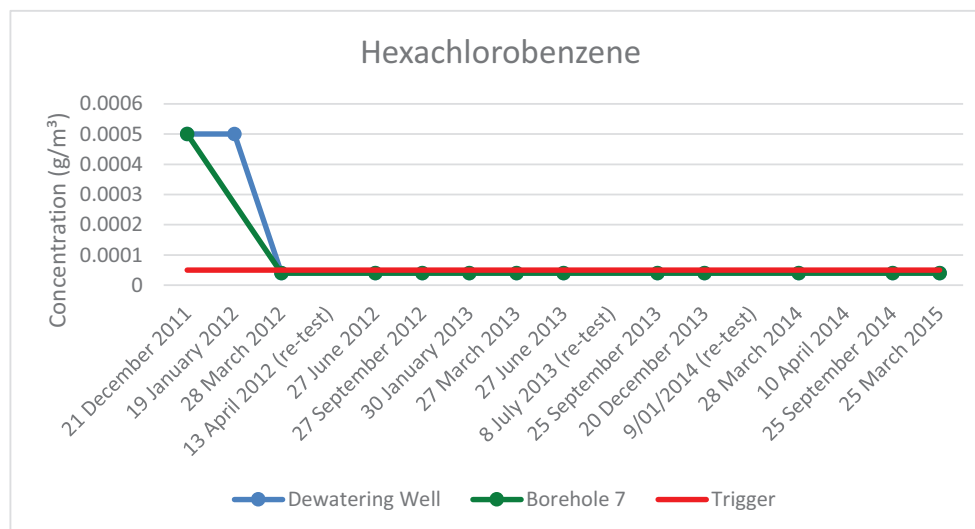
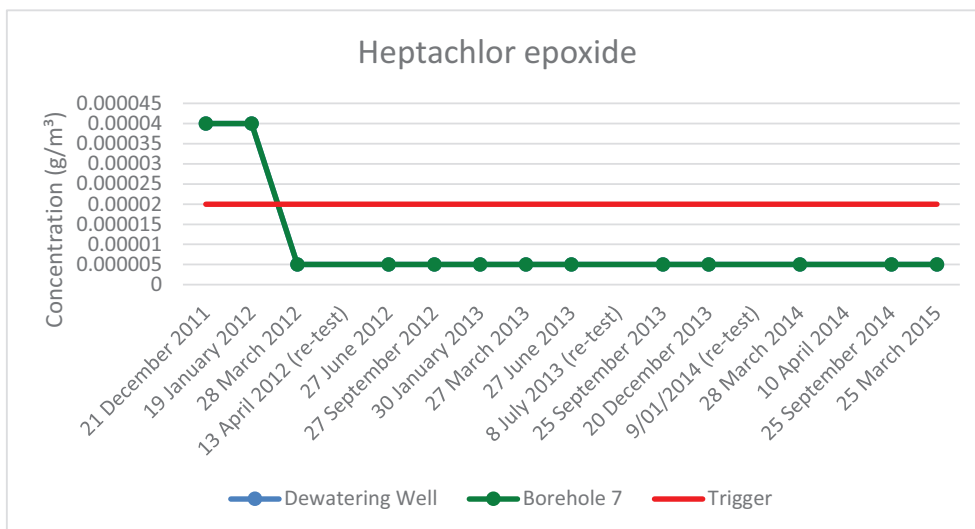




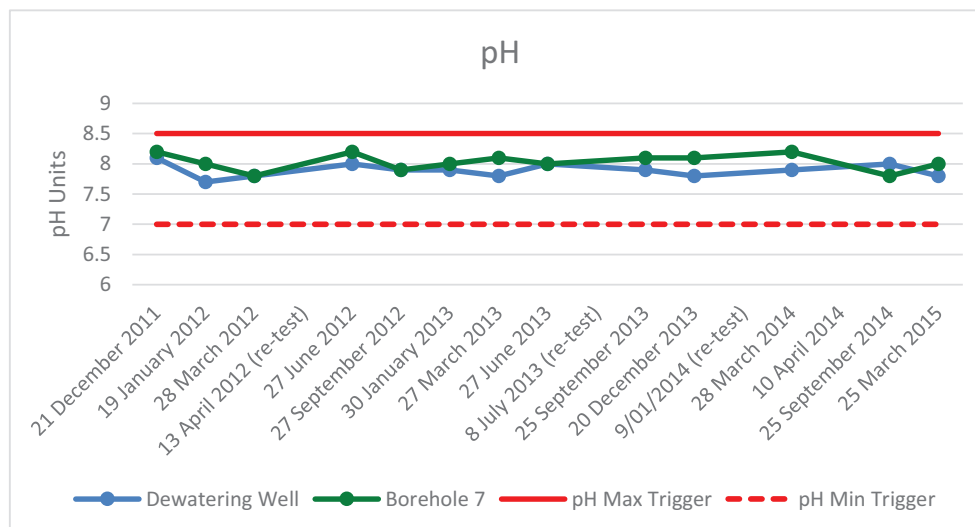
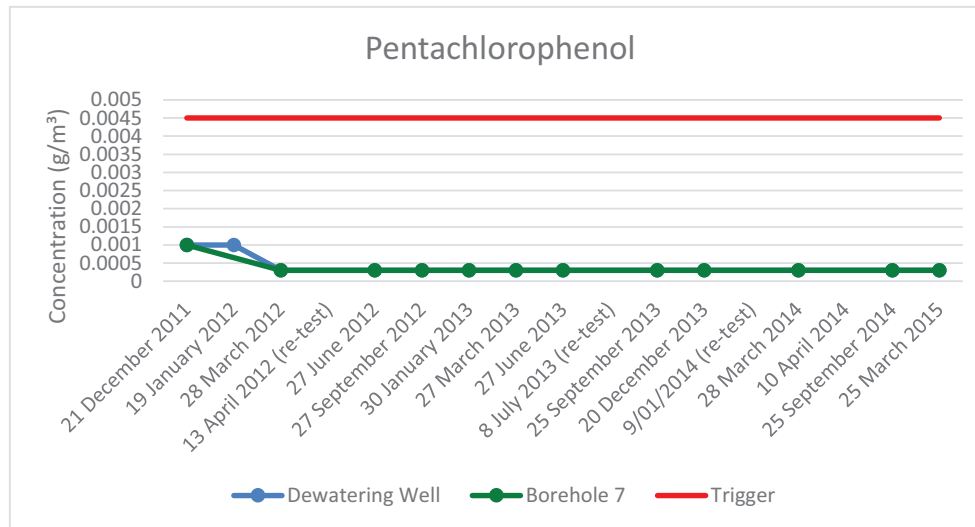
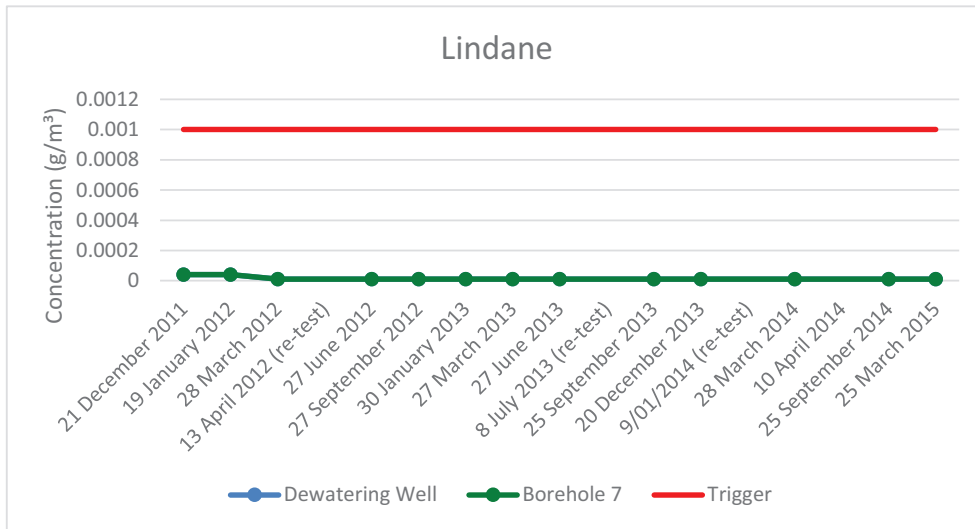
**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



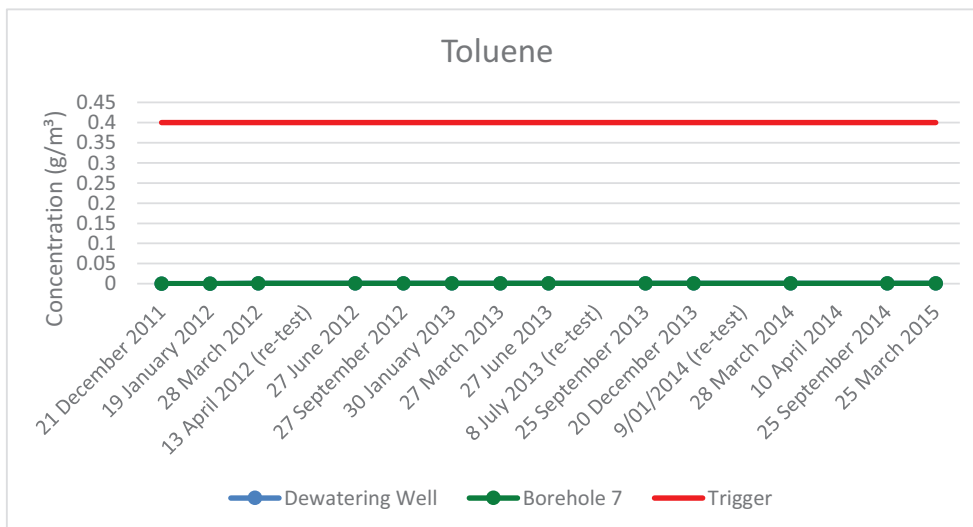
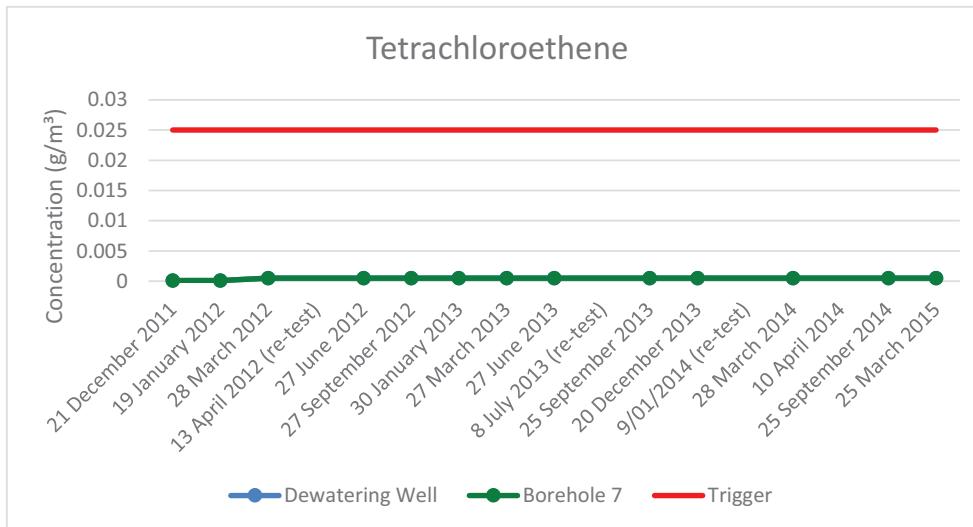
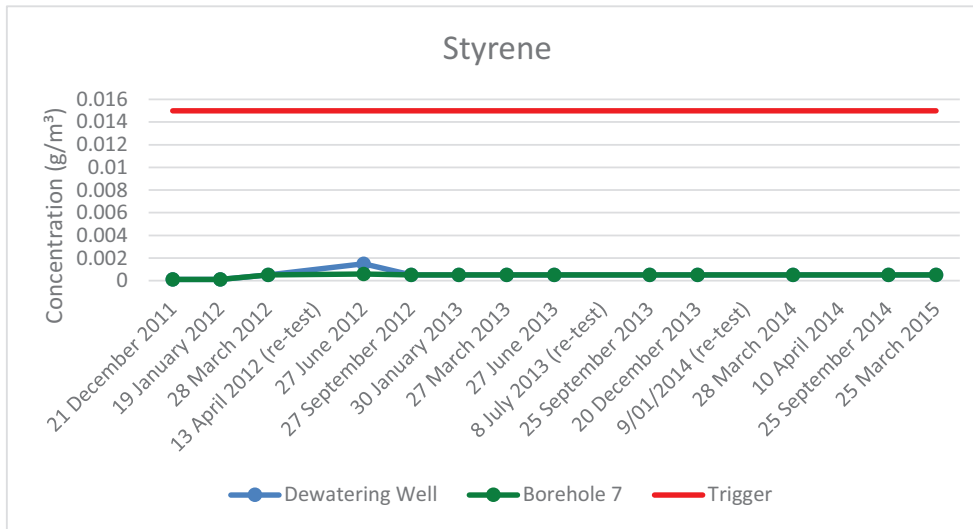
**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



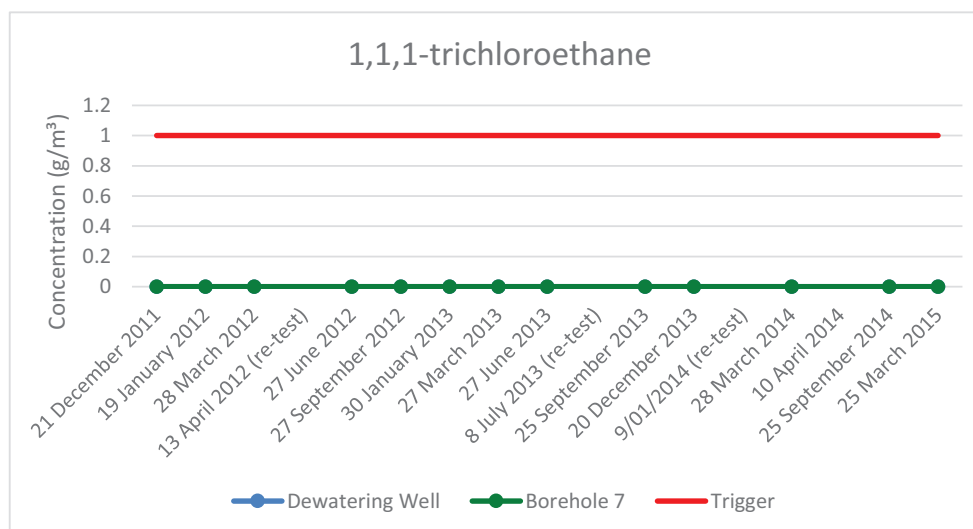
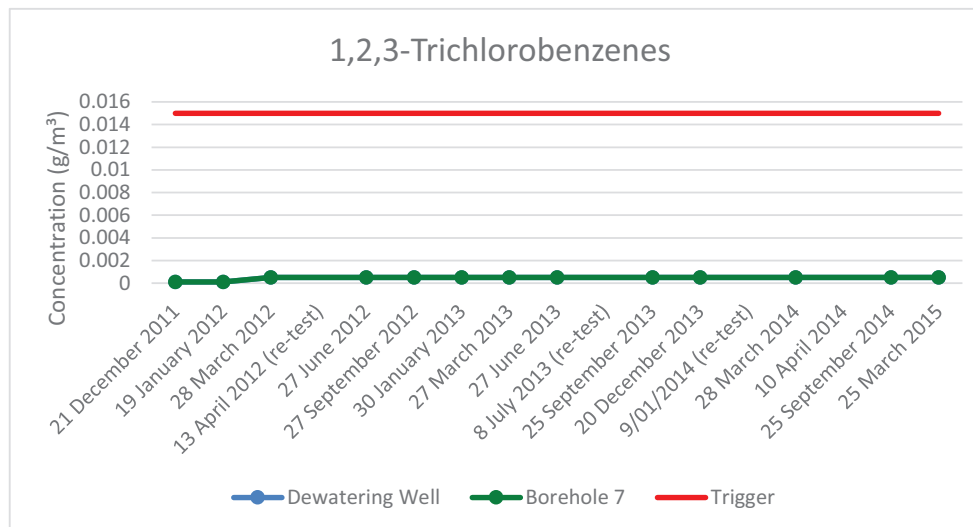
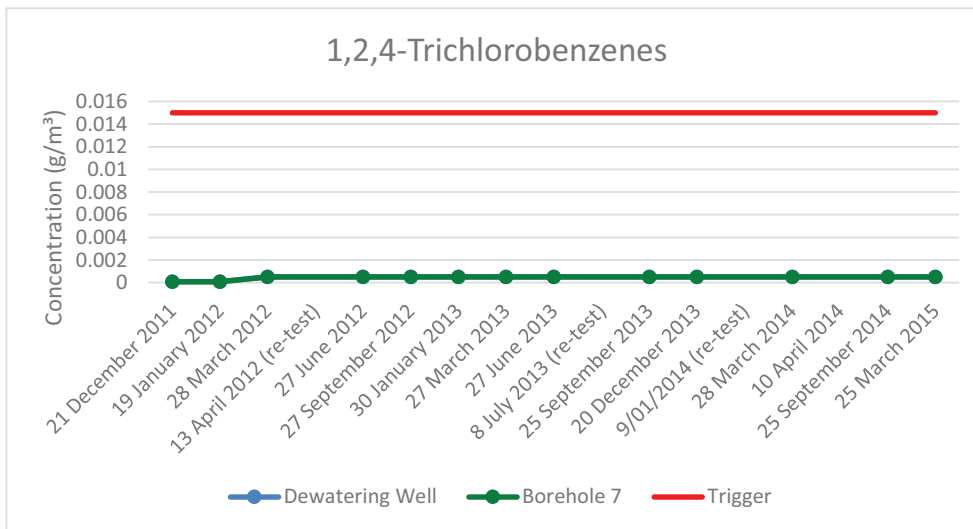
**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



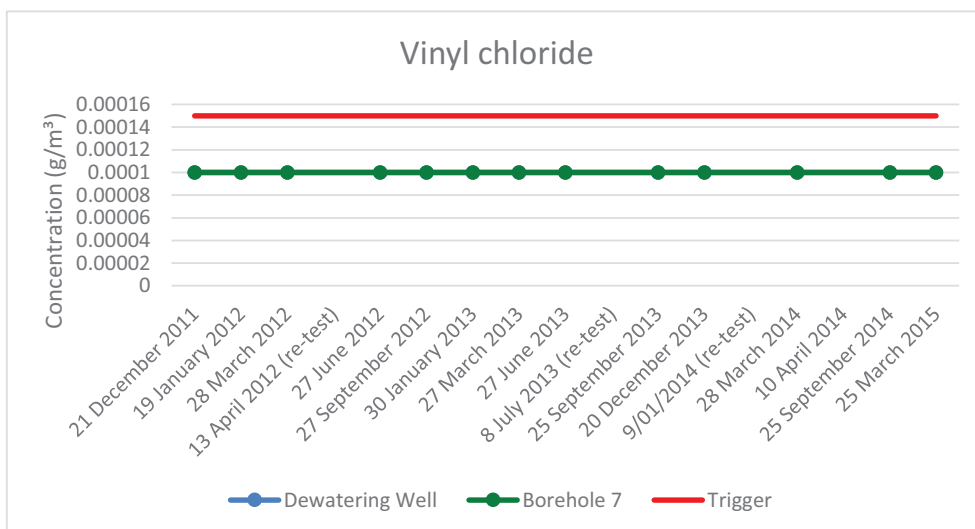
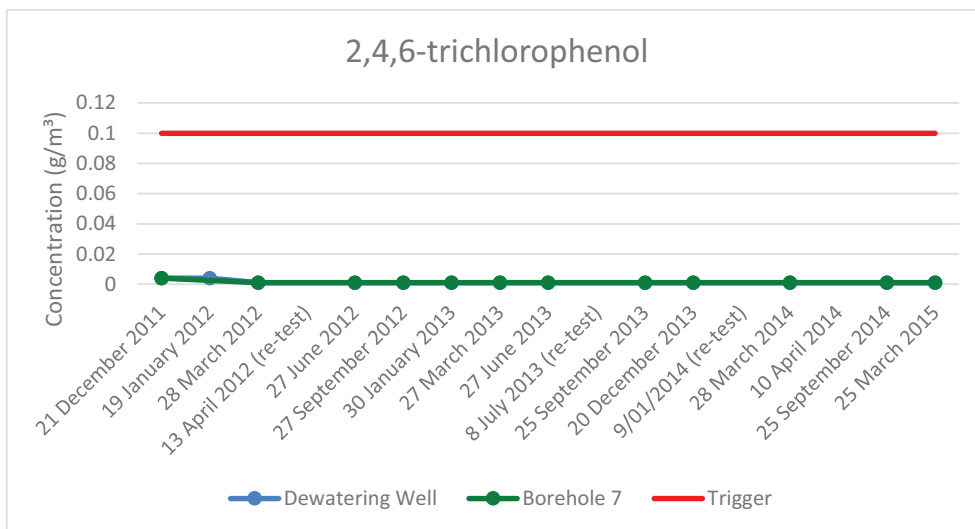
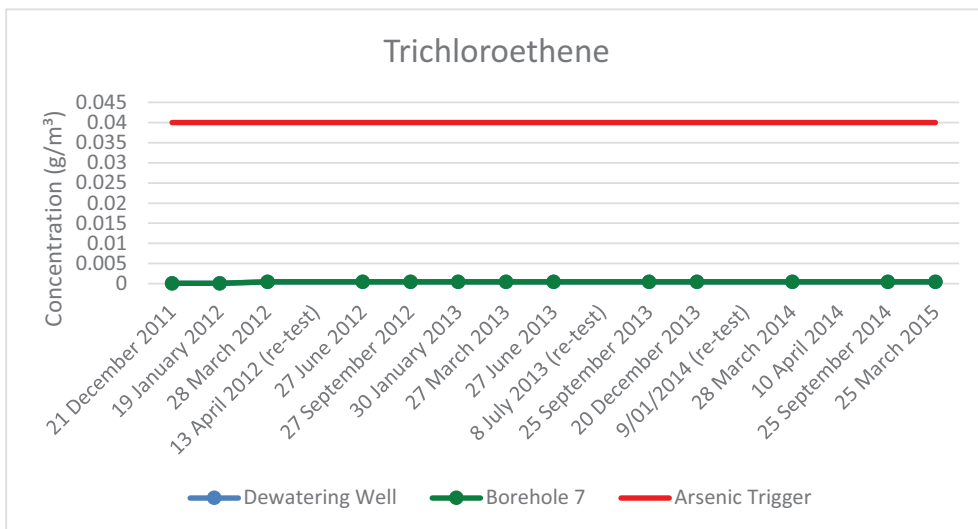
**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



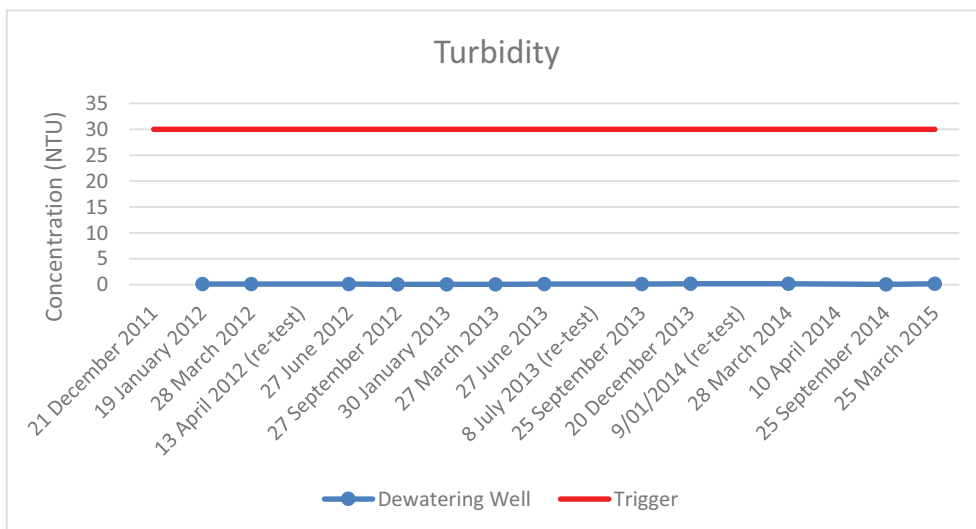
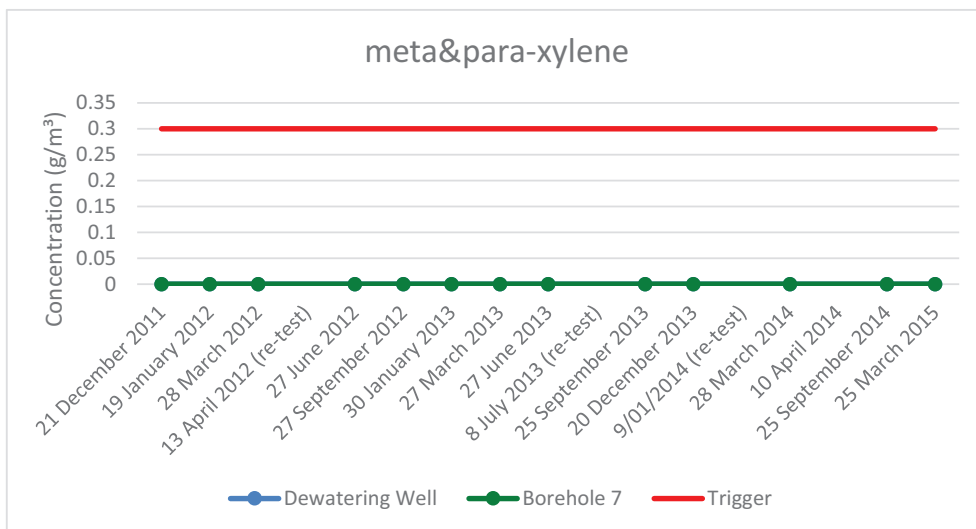
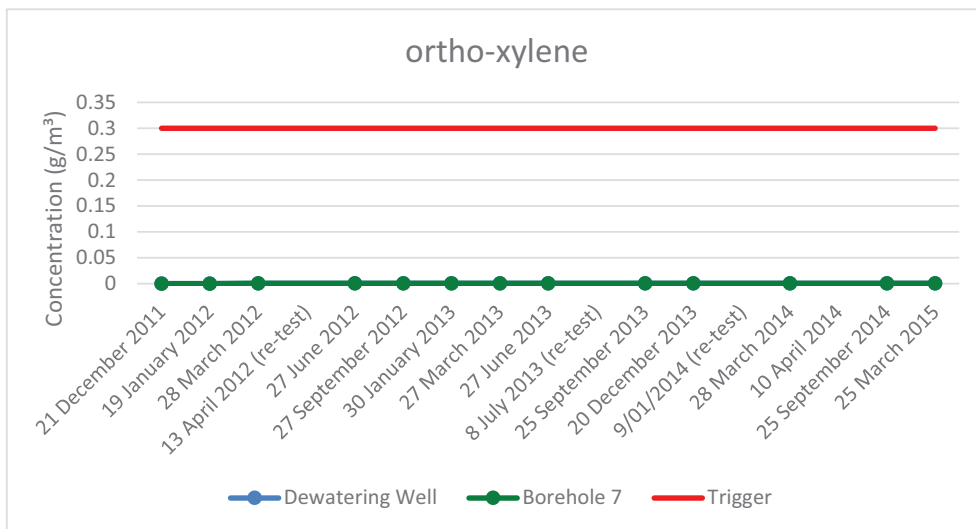
**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



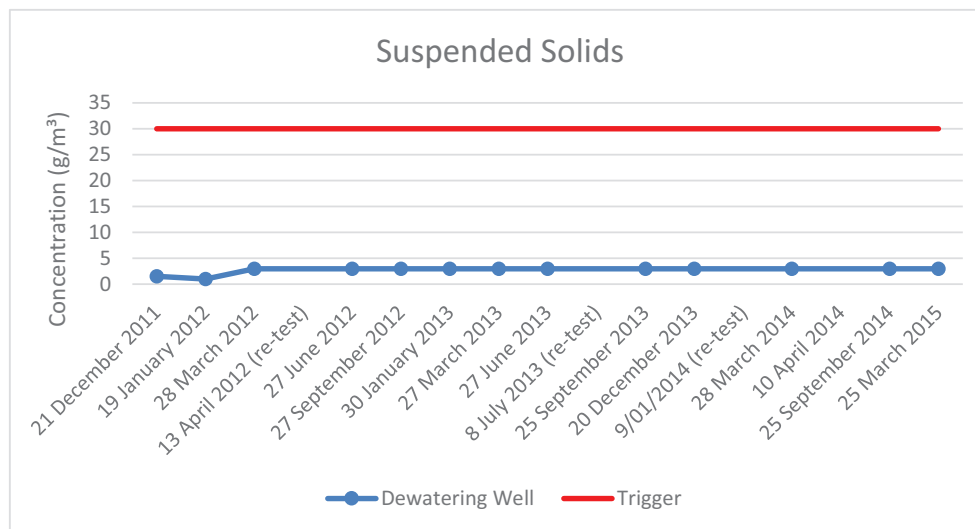
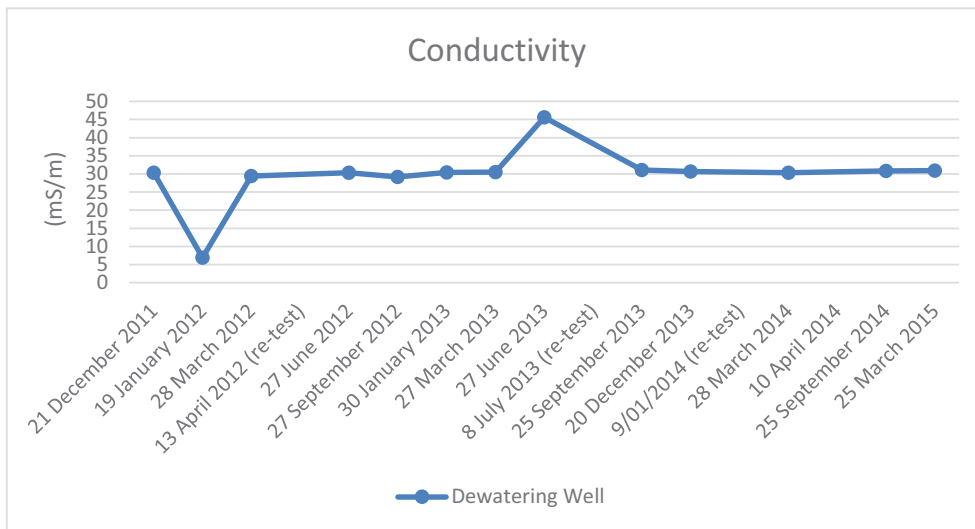
**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**



**Graphical representation of the results of the groundwater chemistry monitoring required by condition 31 for the period 01 April 2012 to 31 May 2015.**

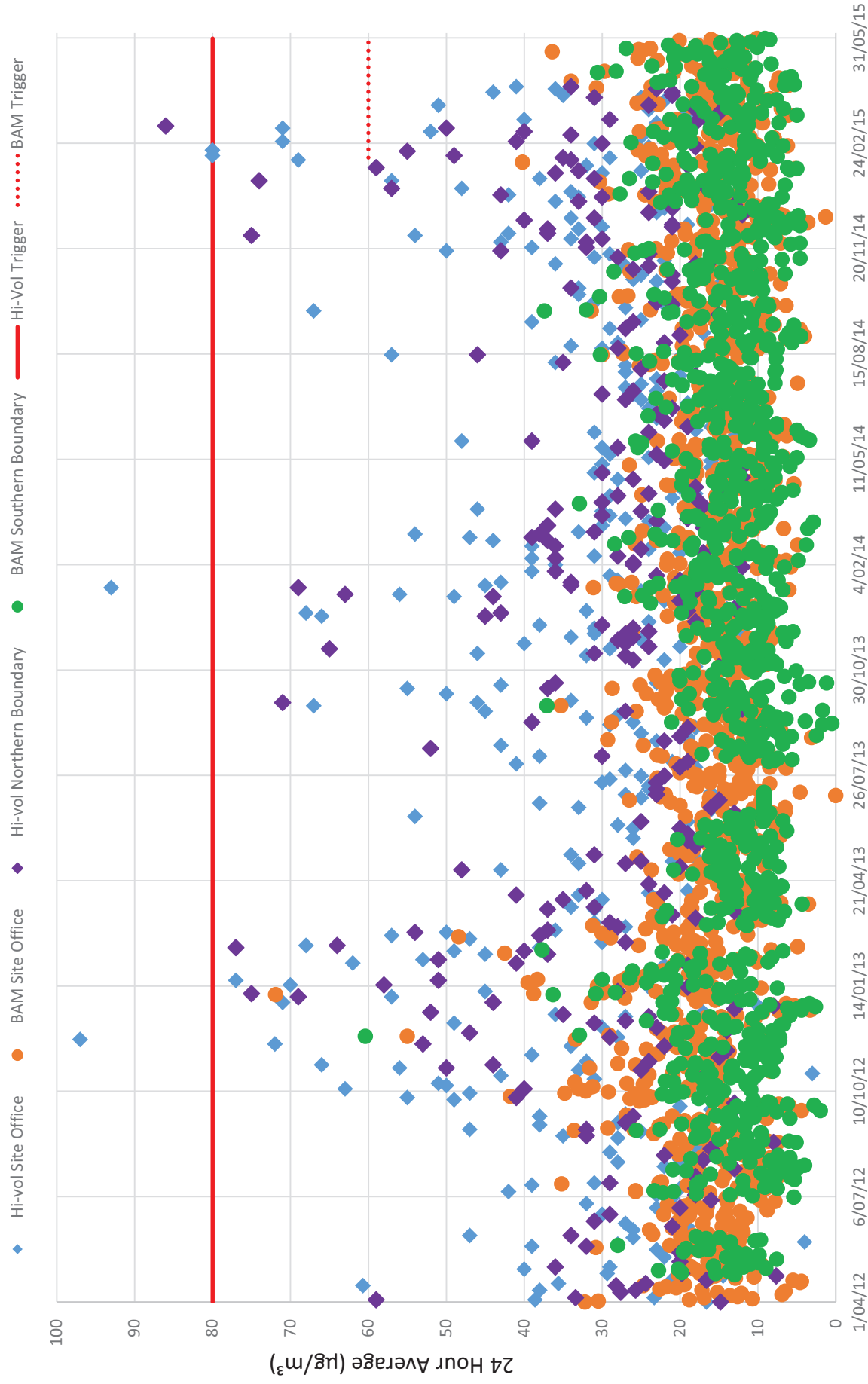




## **APPENDIX H**

### **Air Monitoring Results**

# Daily Air Monitoring Results



**Figure 1.** This figure illustrates the 24 hour average air monitoring results for each of the onsite monitoring devices for the period 01/02/2012 and 30/05/2015. On 11/02/2015 a new air discharge permit was issued with a reduced trigger for the BAMs and discontinuation of the HiVol monitoring. There are four events that plot off the above figure. These are as follows: 254 $\mu\text{g}/\text{m}^3$  on 18/10/2012, 2169 $\mu\text{g}/\text{m}^3$  on 13/11/2012 and 1035 $\mu\text{g}/\text{m}^3$  on 27/11/2012 recorded at the Hi-Vol Northern Boundary plus 119 $\mu\text{g}/\text{m}^3$  on 08/01/2013 recorded at the Hi-Vol Office Site.