

**CLAROCHEM IRELAND LTD**  
**P0125-02**  
**ANNUAL ENVIRONMENTAL REPORT**  
**January 2018 – December 2018**

Date: 25<sup>th</sup> March 2019

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## 1.0 Introduction

### 1.1 COMPANY DETAIL

#### EPA Licence

**Registration No.** : **P0125-02**

**NACE Code** : **2120**

**Coordinates of Location** : **-6.423705304 53.41125191**

**Company Name** : **CLAROCHEM IRELAND  
LIMITED**

**Company Address** : **DAMASTOWN  
MULHUDDART  
DUBLIN 15**

**Tel. No.** : (01) 8206 111

**Fax No.:** (01) 8206 122

**Address of Corporate Body:** AS ABOVE

## 1.2 Company Environmental Policy

Clarochem Ireland Ltd. (formerly Helsinn Chemicals Ireland Ltd) was purpose built in 1993 for the manufacture of bulk pharmaceutical chemicals. In order to reduce the impact of our activities, it is the policy of Clarochem Ireland Ltd.:

- (I) To carry out its actions in a way which safeguards the environment.
- (II) To comply with all National and European Environmental Regulations.
- (III) To comply with the Guiding Principles of the Responsible Care Programme.
- (IV) To progressively reduce environmental impact through prevention, elimination, substitution, and minimization where possible.
- (V) To ensure that the activities of suppliers and contractors are consistent with Clarochem's own Environmental Policy.
- (VI) To ensure that management and employees shall be environmentally aware and adequately trained and equipped to carry out their duties and responsibilities.
- (VII) To communicate this policy to all interested parties and publish an Annual Environmental Report on company performance.
- (VIII) To ensure the Environmental Management System is reviewed annually and that it and any revisions thereto will be brought to the notice of all employees.
- (IX) To set Annual Environmental Objectives and Targets which will be made available to the public.

Each individual manager shall be responsible for implementing this policy in all areas under their control and in particular shall be responsible for communicating the contents to all employees under their control.

The overall responsibility for implementing this policy shall rest with the Managing Director and Plant Director.



## 2.0 SITE DESCRIPTION

Clarochem Ireland Ltd (CCI) is owned by the Italian chemical-pharmaceutical group Medinco, active in the production and supply of generic active ingredients for the pharmaceutical industry. The plant operates according to cGMP procedures, employs 46 people, and produces active pharmaceutical ingredients (API) for the organisation. Medinco Group includes two other manufacturing companies in Northern Italy - Amsa S.p.A., near Como, and Cosma S.p.A., near Bergamo – and a distribution company, Co. Farmaceutica Milanese S.p.A. (CFM) based in Milan, Italy.

The plant operates on a three-shift basis employing people from the surrounding areas which represents an important contribution to the local economy.

The site consists of:

- Administration and finance building
- Internal and external hazardous material storage areas including tank farm
- Production scale manufacturing plant with 48m<sup>3</sup> reactor capacity
- Drying and finishing capabilities including mill, sieve and blender
- QC and R&D Laboratories
- Small scale cGMP Manufacturing plant (30 litre scale)
- Utilities
- Waste water treatment and firewater retention

Clarochem Ireland Limited hold an Industrial Emissions Licence (IED) issued from the Environmental Protection Agency and are accredited to ISO 14001, Environmental Management System Standard.

The volume of product manufactured at CCI increased significantly in 2018, when compared to 2017. There was an increase of approximately 48% in product manufactured year on year. However, in reality 2018 represented a typical year for the site and is comparable with the steady growth observed in 2013-2016. 2017 saw a significant decrease in product volumes which was due to a combination of factors including critical equipment downtimes of more than 2 months and the introduction of a multi-step process for a new product. 2018 saw a return to normal production patterns.

## SECTION 3.0

## MONITORING DATA

### 3.1

### SUMMARY DATA

Table 1  
Table 2  
Table 3

Solvent Management Plan  
Environmental Performance Indicators  
Effluent discharged to foul sewer

### 3.2

### EMISSION DATA

Table 4  
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Table 6  
Table 7  
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Table 9

Emissions to sewer  
Non-compliances to sewer  
Emissions to atmosphere  
Storm water analysis  
Breakdown of Hazardous process waste generated on site  
Quantity of Hazardous waste by EWC number

### 3.6

Table 10

Toxicity Testing  
- *Skeletonema Costatum*  
- *Vibrio fischeri* Microtox

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PRODUCTION DATES FROM		1/1/2018	TO	31/12/2018		
INPUTS		KGS	%	OUTPUTS	KGS	%
METHANOL		249412		PROCESS WASTE	1,843,796	97%
IPA		428433				
ETHANOL		208541				
MIBK		22714		RECOVERED SOLVENTS	62,495	3%
ETHYLACETATE		22519				
ACETONE		117829				
WATER		635438				
NaOH + HCl		142913				
FORMALDEHYDE		25648				
ACETIC ACID		15817				
PPA		54900				
sub total		1,924,164	97%			
<b>RECOVERED SOLVENT USAGE</b>						
ETHANOL RECOVERED/FOR RECOVERY		49193				
Recovered MIBK L-Drop		2745				
sub total		51,938	3%			
<b>TOTAL INPUTS</b>		<b>1,976,102</b>		<b>TOTAL OUTPUTS</b>	<b>1,906,291</b>	
				<b>FUGITIVE EMISSION VALUE</b>		
				(TOTAL INPUT - TOTAL OUTPUT)	69,811	3.66%
				TOTAL EMISSION LIMIT VALUE (EXISTING)		15%

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**Table 1 Solvent Management Plan for manufacture of Pharmaceutical Products (solvent consumption > 50 ton/year)**



YEAR	2013	2014	2015	2016	2017	2018	2013	2014	2015	2016	2017	2018
<b>Kg PRODUCT</b>	<b>252055</b>	<b>399056</b>	<b>516108</b>	<b>640321</b>	<b>518160</b>	<b>765,363</b>	<b>252055</b>	<b>399056</b>	<b>516108</b>	<b>640321</b>	<b>518160</b>	<b>765,363</b>
<b>Kg HAZARDOUS WASTE SHIPPED FOR DISPOSAL (process only)</b>	624,490	906,266	1,281,123	1,714,347	1,795,962	2,297,803	2,478	2,271	2,482	2,677	3,466	3,002
<b>M<sup>3</sup> WATER</b>	5117	4845	6169	5660	8360	8963 <sup>Note 1</sup>	0.020	0.012	0.012	0.009	0.016	0.012
<b>HCMs NITROGEN</b>	231	213	220	392	639	583	0.0009	0.0005	0.0004	0.0006	0.0012	0.0008
<b>KWh GAS</b>	1,568,707	1,824,974	2,332,129	2,226,763	2,327,566	2,609,579	6.224	4.573	4.519	3.478	4.878	3.410
<b>Kg COD</b>	24,761	32,101	41,029	31,607	35,481	41,950	0.098	0.080	0.079	0.049	0.068	0.055
<b>KWh ESB</b>	1,594,357	1,710,826	1,837,548	2,056,206	2,235,117	2,124,691	6.325	4.287	3.560	3.211	4.314	2.776
<b>Kg NON HAZARDOUS WASTE</b>												
General Waste (mt)	36	39	33.2	16.75	3.1	0	0.00014	0.00010	0.00006	0.00003	0.00001	0.00000
Recycled/Recovered (mt)	6.84	4.74	4.04	7.46	32.1	42.1	0.00003	0.00001	0.00001	0.00001	0.00006	0.00005

Note 1: Water consumption figures for Q4 2018 were not available. 2019 water usage is an estimate based on Q1 to Q3 usage.

**Table 2 Environmental Performance Indices**



YEAR	2013	2014	2015	2016	2017	2018	2013	2014	2015	2016	2017	2018
Total Volume (Cubic Meters)	3171	3666.6	3608	3361	4277	4918	0.013	0.009	0.007	0.005	0.008	0.006
Av. Volume/ Month( Cubic Meters)	264	306	301	280	356	410	0.0010	0.0008	0.0006	0.0004	0.0007	0.0005
Av. Volume/ Month as % of Licence Limit	18	20	20	19	24	27	0.00007	0.00005	0.00004	0.00003	0.00005	0.00004
Total C.O.D. (Kg)	24761	32101	41029	31607	35481	41950	0.098	0.080	0.079	0.049	0.068	0.055
Average C.O.D. per Month (Kg)	2063	2675	3419	2634	2957	3496	0.008	0.007	0.007	0.004	0.006	0.005
Average C.O.D. per Month as % of Licence Limit	17	22	28	21	24	28	0.00007	0.00005	0.000	0.00003	0.00005	0.00004

**Table 3: Effluent Discharge to the Foul Sewer.**

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### 3.2 EMISSION DATA

#### 3.2.1 Emission to Sewer

Parameter	Mass Emissions (Kg)	Mass Emissions (Kg)	Licensed Mass Emissions per yr (Kg)
	2017	2018	
Volume (m <sup>3</sup> )	4,277	4,918	-
BOD	13,776	36,464	-
COD	21,201	65,287	-
Suspended Solids	202	332	7,300
Sulphates	363	509	9,125
O.F.G.	258	181	1,825
Total Phosphorus (as P)	76	166	1,825
Phosphates (PO <sub>4</sub> -P)	31	36	913
Total N	187	420	18,250

Table 4: Summary Table for Emissions to Sewer

Emissions to sewer from the Clarochem Ireland site are controlled under Schedule B.3 of the Integrated Pollution Prevention and Control License Register No. P0125-02. The effluent stream is tested for pH, COD and temperature and if within license limits is discharged to sewer.

Date	Non-compliance	Cause	Corrective Action
16/10/2018	Exceedance of ELV Total Phosphorus (as P) Incident Report number: INCI015538	Cleaning of production vessels after phosphorylcholamine production	Change control raised to ensure first aqueous rinse is sent to IBC for hazardous waste disposal

Table 5: Summary of Non-compliances for 2018



### 3.2.2 Emissions to Atmosphere

#### 3.2.2.1 Emission Point: Scrubber Stack P1-S1

Emissions to atmosphere from the Scrubber System are controlled under Schedule B.1.1 of the IPPC license Register No. P0125-02.

Table 6 below outlines the quantities discharged over 2018. The yearly figures are based upon averaged quarterly monitoring data. Mass Emissions for the year were determined by multiplying the Mass Flow figures by the number of hours the process was in operation. As Clarochem operate a batch manufacturing process, the determination of number of hours in the process is difficult. However, for the purposes of this report, a conservative approach is taken, and maximum hours of operation have been used.

Parameter	Mass Emissions (Kg)		Licensed Mass Emissions (Kg) <sup>2</sup>
	2017 <sup>1</sup>	2018 <sup>1</sup>	
Amines	<20	<7	876
Nitrogen oxide (as NO <sub>2</sub> )	<5.73	<8.67	26,280
Chlorides (as HCL)	0.91	2.51	2628
Nitric Acid (as NO <sub>2</sub> )	0.12	0.77	43,800
T.A. Luft Class I Organics	<1	30.51	876
T.A. Luft Class II Organics	0.006	6.62	17,520
T.A. Luft Class III Organics	4,561	714.42	26,280

<sup>1</sup> Average figures are based on quarterly monitoring data x average processing time of class of substance

<sup>2</sup> Licenced mass emissions are based on ELV (kg/hr) x 24 hours x 365 days

**Table 6: Summary Table for Emissions to Atmosphere**

There were no non-compliances in relation to emissions to atmosphere in 2018. Various organic substances are emitted under Class II and Class III. The sum of the Mass Flows of T.A. Luft Class II and Class III do not exceed the Class III limits.

#### 3.2.2.2 Emission Point : Hepa Filtration F1-E1

During 2018, 100% compliance was recorded from Emissions from F1-E1.





### 3.2.3 Storm Water

Storm water from car parks, roofs and non-bunded areas are carefully monitored at Clarochem. Schedule C.2.2 of Licence Register No. P0125-02 outlines the physical/chemical parameters that must be checked. The Storm water discharge point is monitored for odour, clarity and evidence of contamination on a weekly basis. It is further screened monthly for COD and Conductivity.

Continuous pH monitoring outputted to a chart recorder was put in place in 1997. The action limits are 6. – 9.0. Any value outside this range will cause the discharge valve to the river to shut automatically and all surface water is subsequently diverted to the firewater retention pond.

As per condition 6.12.2 of licence register No. P0125-02, a TOC analyser was installed on site to continuously monitor the surface water discharges to the Tolka River at SW-D1.

The TOC analyser is connected to the plant alarm system and diverter valve which allows automatic divert of the storm water to the treatment plant on detection of a high TOC level.

Parameter	pH	COD mg/l	Conductivity mS/cm
15/01/2018	7.6	13	0.340
14/02/2018	7.8	12	0.483
12/03/2018	7.6	15	0.616
12/04/2018	7.6	12	0.447
04/05/2018	7.2	12	0.298
20/06/2018	7.1	61	0.795
13/07/2018	7.5	26	0.625
23/08/2018	7.4	34	0.344
12/09/2018	7.6	4	0.581
18/10/2018	7.7	17	0.701
19/11/2018	7.8	15	0.606
12/12/2018	7.3	15	3.390

**Table 7 Storm Water Analysis 2018**

There were 2 reportable incidents (incident reports No's INC1014444 and INC1014817) in relation to storm water emissions in 2018. Both were in relation to failure of the pH probe on the surface water system. There were no emissions to water during either incident.



### 3.2.4 Groundwater

The groundwater reports for 2018 are included in the appendices to this report.

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### 3.2.5 Waste Generation

Clarochem Ireland Ltd generates hazardous solid and liquid waste and non-hazardous solid waste. In 2018 approximately 2298 metric tons of process hazardous waste was shipped off-site for treatment.

As part of company policy to progressively reduce environmental impact through prevention, elimination, substitution, and minimization waste studies are undertaken to determine opportunities for waste reduction.

Technology	Quantity 2016	Quantity 2017	Quantity 2018
Incineration D10/D13/D15	1035	445	74
Recycling/Regeneration (R1/R2/R3/R4/R5/R12/R13)	679	1351	2223
Reused – on-site	17 mt Ethanol	37 mt Ethanol	2.7 mt MIBK 47.2 mt Ethanol

**Table 8 Approximate Breakdown of Process Hazardous Waste Generated on site**

EWC Number	Total Quantity Shipped in 2016 (mt)	Total Quantity Shipped in 2017 (mt)	Total Quantity Shipped in 2018 (mt)
060101*	0	3.91	0
060106*	0.42	0	0
070501*	459.41	485.87	541.14
070503*	0	0	2.75
070504*	1206.22	1258.63	1664.43
070513*	19.64	15.69	39.80
130110*	0	0.400	3.98
150110*	28.05	29.512	44.02
150202*	0.12	0	0.09
160507*	0.28	0.48	0.27
160508*	0.20	1.08	0.26
200121*	0	0	0.05
200135*	0	0.39	0.99
<b>Total</b>	<b>1714</b>	<b>1796</b>	<b>2298</b>

**Table 9. Total Quantity of Hazardous waste shipped for disposal by European Waste Catalogue (EWC) Number**

Non-Hazardous waste originates primarily from the canteen and various general refuse bins around the site. During 2018, 42.1 mt was collected for recycling/recovery.

A summary of the waste material generated on site and the Waste Undertakers used to dispose of our waste material is detailed in section 5 of this report.



### **3.2.6 NOISE SURVEY** “excerpt from AWN Report LW/18/10118NR01”

#### **DISCUSSION**

A requirement of the EPA NG4 documents is that specific noise levels at noise sensitive locations be measured and/or estimated as part of the annual noise monitoring report.

The survey results in this instance are not considered to represent an accurate measure of site-specific noise emissions from the Clarochem site. This is due to the presence of other noise sources that dominate the total noise climate. Given the difficulty in accurately measuring the site-specific noise at the boundary locations it is considered appropriate to demonstrate that the site specific noise levels are not having a detrimental effect at the nearest NSL.

The assessment method uses the noise level measured near the Southern Boundary during the day time period as an estimate of the site emissions at this location which is then corrected for the additional distance to the nearest noise sensitive location. The predicted plant noise emissions at the NSL is 39dB LAeq,T. It should also be noted that the predicted noise level represents the worst-case scenario where the shielding effect of the buildings within the Clarochem facility and other screening elements within the environment are not taken into account.

The results show that the predicted plant noise levels are within the EPA's daytime criterion of 55dB LAeq(30min) and the night-time noise criteria of 45dB LAeq(30min) at the nearest noise sensitive location.

It is concluded that the facility is operating in compliance with the relevant sections of its Industrial Emissions Licence.





### 3.3 POLLUTION EMISSION REGISTER (PER)

The values for the European Pollutant Release Transfer Register (E-PRTR) have been calculated with regard to the EU guidance document for the implementation of the European Pollutant Release Transfer Register, 2006.

#### *Releases to Air*

Outputs to air arise from licenced emission sources and fugitive emission sources. The licensed emission source arises from P1 scrubber which is the only major solvent emission point on site. Method used is Measurement (M) for P1 scrubber, for which the licence specifies Gas Chromatography.

Fugitive air emissions are determined using Material Balance for solvents used on site, Measurement method: (B)

#### *Releases to Sewer*

Monitoring of effluent is carried out for organic solvents on a quarterly basis. Method used: Measurement: Measurement (M) (OTH) Gas chromatography.

The following E-PRTR categories are not relevant to the site:

- releases to water
- releases to land

The Electronic E-PRTR has been submitted via the Eden portal.





### **3.4 ENERGY AND WATER USE**

Energy consumption is monitored on site by determining the ratio of product manufactured to energy input.

#### **Electricity**

Electricity usage (KwH) per kg of product manufactured has decreased from 4.3 in 2017 to 2.8 in 2018.

#### **Gas**

Gas usage per kg of product has decreased from 4.88 kWh in 2017 to 3.41 kWh in 2018.

#### **Water**

The ratio of water used on site has decreased, 0.016m<sup>3</sup> per kg of product in 2017 to 0.012m<sup>3</sup> per kg of product in 2018.

#### **Audit of Energy Efficiency**

As per Condition 7 of the IPPC licence GCI carried out an audit of the energy efficiency of the site. The audit was carried out in accordance with the guidance published by the Agency; "Guidance Note on Energy Efficiency Auditing".

The Energy Audit was carried out on the 12/07/2007 by Environmental Efficiency, consulting Engineers. A summary of the main report is attached, Document No. 912-02 Version No. 2.00. It includes:

- Table 1 setting out the consumption of the different energy streams on site
- Table 2 setting out the final list of Audit recommendations that could be incorporated into the implementation programme. An overview of the status of the energy management system on the site.
- Any energy performance indicators calculated for the site for the Audit period and previous periods
- A summary of the implication of the Audit Findings



### 3.5 ENVIRONMENTAL INCIDENTS AND COMPLAINTS

During 2018, Clarochem Ireland Ltd did not receive any environmental complaints relating to the operation of the facility.

The Clarochem Incident Form is used to record environmental incidents that result in:

1. an emergency
2. any emission which does not comply with the requirements of the licence
3. any trigger level specified in the licence which is attained or exceeded and
4. any indication that environmental pollution has, or may have, taken place.

Four of the above type of incidents were recorded in 2018, as detailed below:

- INCI015538 detailed in section 3.2.1 of this AER report
- INC1014444 and INC1014817) detailed in section 3.2.3 of this AER report; and,
- INCI014323 – spill of approximately 30kgs of N,N-DIMETHYLISOPROPANOLAMINE on the 30<sup>th</sup> April 2019.

All incidents are closed on the Eden reporting system.



### 3.6 OTHER REPORTS

#### 3.6.1 Toxicity Testing

##### Toxicity to Fish life:

The 2018 results were as in the following Table:

Date:	Test Parameter	Toxic Units
March 2018		
	30 min EC <sub>50</sub> to <i>Vibrio Fischeri</i>	< 2.2
	72h IC <sub>50</sub> to <i>Skeletonema Costatum</i>	17.6
May 2018		
	30 min EC <sub>50</sub> to <i>Vibrio Fischeri</i>	5.3
	72h IC <sub>50</sub> to <i>Skeletonema Costatum</i>	133.3
Sept 2018		
	30 min EC <sub>50</sub> to <i>Vibrio Fischeri</i>	< 22
	72h IC <sub>50</sub> to <i>Skeletonema Costatum</i>	384
Nov 2018		
	30 min EC <sub>50</sub> to <i>Vibrio Fischeri</i>	2.1
	72h IC <sub>50</sub> to <i>Skeletonema Costatum</i>	29.9

Table 10 Effluent Toxicity Test Results

##### Toxicity to Treatment Plant microorganisms (Inhibition of Oxygen Consumption by activated sludge):

Clarochem Ireland Ltd (CCI) discharge trade effluent arising from the manufacturing operation to a sewer connected to Ringsend wastewater treatment plant. The sewer is owned by Irish Water and provides full biological treatment using an activated sludge process. CCI are required to conduct respirometry testing on trade effluent to determine inhibitory effects. The results are as follows:

##### Q1 Sample 2018

The Clarochem Ireland Ltd trade effluent sample tested exhibited no acute inhibition/toxicity to Ringsend activated sludge containing a mixed population of heterotrophic and nitrifying microbes at up to 50 % v/v. The sample had an EC<sub>50</sub> value of "Greater than 50 % concentration v/v", a TU value of "Less than 2" and an Inhibition Threshold of "greater than 50 % v/v".

##### Q2 Sample 2018





The Clarochem Ireland Ltd trade effluent sample tested exhibited no acute inhibition/toxicity to Ringsend activated sludge containing a mixed population of heterotrophic and nitrifying microbes at up to 50 % v/v. The sample had an EC50 value of “Greater than 50 % concentration v/v”, a TU value of “Less than 2” and an Inhibition Threshold of “greater than 50 % v/v”.

#### **Q3 Sample 2018**

The Clarochem Ireland Ltd trade effluent sample tested exhibited no acute inhibition/toxicity to Ringsend activated sludge containing a mixed population of heterotrophic and nitrifying microbes at up to 50 % v/v. The sample had an EC50 value of “Greater than 50 % concentration v/v”, a TU value of “Less than 2” and an Inhibition Threshold of “greater than 50 % v/v”.

#### **Q4 Sample 2018**

The Clarochem Ireland Ltd trade effluent sample tested exhibited no acute inhibition/toxicity to Ringsend activated sludge containing a mixed population of heterotrophic and nitrifying microbes at up to 50 % v/v. The sample had an EC50 value of “Greater than 50 % concentration v/v”, a TU value of “Less than 2” and an Inhibition Threshold of “greater than 50 % v/v”.

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### **3.6.2 Bund Integrity Testing**

There are 3 main bunds on site:

- i) B001 (Caustic tank bund)
- ii) B002 (Tank Farm Bund)
- iii) B003 (Diesel tank bund)

The EPA requires the assessment of all bunded structures on site every 3 years as part of the site's IED licence. Integrity tests, as per British Standard BS8007, were carried out on all 3 bunds in 2016 and are due to be tested again in 2019.

### **3.6.3 ELRA and CRAMP**

An Environmental Liability Risk Assessment and Closure Restoration and Aftercare Management plan has been revised according to EPA Guidance on costing and assessing Environmental Liabilities, 2014.

The plans were submitted to the EPA in July 2018 for review and CCI are still awaiting feedback.

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## 4.0 ENVIRONMENTAL MANAGEMENT

### 4.1 Environmental Management Programme for 2018

#### Environmental Objective: 18-001

Recovery of mother liquor from L-dropropizine recrystallised and re-use in the L-dropropizine crude step.

#### **Description:**

The L-dropropizine process involves two wet steps and one drying step. The first wet step involves the reaction of Phenylpiperazine and R-glycerine monochlorohydrin in water Methanol and MIBK in the presence of sodium hydroxide. In the second wet step the isolated crude product is recrystallized from a mixture of MIBK and water. The recrystallized product is subsequently dried to produce L-Dropropizine API.

The objective will involve recovery of the MIBK and water mother liquor from the recrystallization step and separating off the MIBK and water. The use of the MIBK in the crude step will be evaluated to determine if it is possible to reuse the solvent.

#### **Status:**

Use of recovered MIBK in the L-Dropropizine manufacturing process was successfully demonstrated in a 3-batch validation exercise in the plant. 920kg of recovered MIBK was used in each batch which means that 920kg of fresh MIBK solvent was not required and 920kg of MIBK waste was reused instead of being sent for disposal.

We can expect to produce 10-12 batches in a typical year, so this translates to a reduction in solvent use of 9.2 – 11 MT and a similar reduction in waste volumes.

#### Environmental Objective: 18-002

Standardization of centrifuge loading and washing spin times

#### **Description**

To improve efficiency and consistency it is proposed that the log sheets for the various process steps involving a centrifugation are standardised to include a set spin time for the mother liquor and wash from the centrifuge. This will help to ensure that the spin times are kept to a minimum and hence reduce the energy consumption of the centrifuge per load.

#### **Status:**

This project was placed on hold in 2018.



**Environmental Objective: 18-003**

**Reduce holding time for QC Sampling of Fosfomycin Trometamol Recrystallised**

**Description**

During the production of Fosfomycin Trometamol recrystallised an IPC sample is taken at an early stage in the process and until the result is obtained the process is held at this point. When the IPC sample is taken at night this holding time will be quite long as there is no QC/PD staff on shift.

In order to reduce this holding time and improve the efficiency of the process it is planned to take the sample at the same point, however the process will continue until the final addition of Fosfomycin Trometamol crude at which point the result will be recorded. This will increase the time period in which the analysis can be performed from a single hour to 8 hours and hence will increase the likelihood that a QC/PD staff member will be onsite to perform the analysis. The overall savings would be up to 8 hours of processing time per batch and hence a reduction of 8 hours of resource usage per batch.

**Status:**

Completed in Q1 2018.

**Environmental Objective: 18-004**

**Review metering to help identify high power usage on-site**

**Description**

In the period from 2015 to 2017, there has been an increase of over 20% in electricity usage on-site. This has coincided with no significant increase in production levels in 2015 when compared to 2017.

It is proposed to review the metering on-site to help identify areas of high-power usage and identify possible opportunities to reduce power usage in these areas.

**Status:**

Metering still needs to be completed and this will be an objective again in 2019.

However, CCI did proceed with changing out of lights with LED lights. This will result in the following annual savings:

- 35,000 kw reduction in energy usage (€5,200 per annum);
- Reduction of 19 tonnes in carbon emissions from site





#### 4.2 Environmental Management Programme for 2019

##### Environmental Objective: 19-001

Review metering to help identify high power usage on-site

##### **Description:**

It is proposed to review the metering on-site to help identify areas of high-power usage and identify possible opportunities to reduce power usage in these areas.

##### **Responsibility:**

Action:	Responsibility:	To be Completed by:
Review current metering system on-site	Maintenance	Q1-Q2 2019
Propose additional metering	Maintenance	Q2-Q3 2019
Install new meters and review data	Maintenance	Q3-Q4 2019

##### Environmental Objective: 19-002

Change-over to new Hazardous Waste Vendor

##### **Description:**

To ensure successful changeover to new waste vendor. A waste tendering process with 2 separate hazardous waste vendors was completed in Q4 2018 and a new hazardous waste vendor was selected. The changeover to the new waste vendor is scheduled for Q1 2019.

##### **Responsibility:**

Action:	Responsibility:	To be Completed
Provide all data necessary to new waste vendor to ensure all waste streams are classified correctly.	EHS	Q1
Ensure processes are in place for the following: <ul style="list-style-type: none"><li>Ordering waste shipments</li><li>Invoicing</li><li>Receiving Certs of disposal/Recovery</li></ul>	EHS	Q1
Set up direct TFS for EAP, L-Drop, Pamoic Acid and Sodium Pamoate Waste streams	EHS	Q1-2
Review waste practices on-site and look for potential improvements in e.g. reduce packaging used etc.	EHS	Q2-4



**Environmental Objective: 19-003**

Upgrade Dryer D3 Cooling Heat Exchanger

**Description:**

Upgrade Dryer D3 Cooling Heat Exchanger from an existing 24 Plate unit to a 50 Plate unit which will double the capacity of the Dryer D3 Cooling Heat Exchanger. This in turn improve the Dryer D3 efficiency and increase its throughput.

**Responsibility:**

Action:	Responsibility:	To be Completed
Purchase and install new heat exchanger	Maintenance	Q1 2019
Update P&IDs, Work orders	Maintenance	Q1 2019
Monitor performance of new exchanger and make additional changes if required	Maintenance	Q2 2019

**Environmental Objective: 19-004**

Upgrade Cooling Tower Loop Heat Exchanger

**Description:**

Increase the size of the heat exchanger to get more efficient cooling of reactors in production.

**Responsibility:**

Action:	Responsibility:	To be Completed
Purchase and install new heat exchanger	Maintenance	Q1-Q2 2019
Update P&IDs, Work orders	Maintenance	Q2 2019
Monitor performance of new exchanger and make additional changes if required	Maintenance	Q2-Q3 2019

**Environmental Objective: 19-005**

Update order of additions for Dexketoprofen Trometamol process

**Description:**

Update the order of additions for initial charges to the reactors as an improvement to the safety of the process. The use of the Vacuum Charging System for tromethamine will eliminate a hot transfer which is a significant improvement in terms of safety and environment in terms of reduced resource use.

**Responsibility:**

Action:	Responsibility:	To be Completed
Raise Change control	Production	Q1 2019
Update log-sheets and Process flow diagrams	Production	Q3 2019
Purchase additional VCS	Production	Q3 2019



## 5.0 ENVIRONMENTAL MANAGEMENT

### Summary of 2018 Waste transfer details

List of Waste (LoW)			Next Destination		Final Destination	
LoW Code	LoW Description	Classification	Quantity of waste Tonnes / year	Organisation	Waste Treatment Operation	Waste Treatment Operation
07 05 01*	aqueous washing liquids and mother liquors	Hazardous	0.43	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R12 - Exchange of waste for submission to any of the operations numbered R 1 to R 11	R01 - Use principally as a fuel or other means to generate energy
07 05 01*	aqueous washing liquids and mother liquors	Hazardous	17.83	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R12 - Exchange of waste for submission to any of the operations numbered R 1 to R 11	D10 - Incineration on land
07 05 01*	aqueous washing liquids and mother liquors	Hazardous	520.6	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R01 - Use principally as a fuel or other means to generate energy	-
07 05 01*	aqueous washing liquids and mother liquors	Hazardous	2.28	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R02 - Solvent reclamation/regeneration	-



List of Waste (LoW)				Next Destination		Final Destination	
LoW Code	LoW Description	Classification	Quantity of waste Tonnes / year	Organisation	Waste Treatment Operation	Organisation	Waste Treatment Operation
07 05 03*	organic halogenated solvents, washing liquids and mother liquors	Hazardous	2.75	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R01 - Use principally as a fuel or other means to generate energy	-	
07 05 04*	other organic solvents, washing liquids and mother liquors	Hazardous	0.19	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R12 - Exchange of waste for submission to any of the operations numbered R 1 to R 11	Afvalstoffen Terminal Moerdijk BV	R01 - Use principally as a fuel or other means to generate energy
07 05 04*	other organic solvents, washing liquids and mother liquors	Hazardous	1,184.04	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R02 - Solvent reclamation/regeneration	-	
07 05 04*	other organic solvents, washing liquids and mother liquors	Hazardous	438.65	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R01 - Use principally as a fuel or other means to generate energy	-	
07 05 04*	other organic solvents, washing liquids and mother liquors	Hazardous	41.54	-		Veolia Environmental Services	D10 - Incineration on land

List of Waste (LoW)				Next Destination		Final Destination	
LoW Code	LoW Description	Classification	Quantity of waste Tonnes / year	Organisation	Waste Treatment Operation	Organisation	Waste Treatment Operation
07 05 13*	solid wastes containing hazardous substances	Hazardous	15.03	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R12 - Exchange of waste for submission to any of the operations numbered R 1 to R 11	Afvalstoffen Terminal Moerdijk BV	R01 - Use principally as a fuel or other means to generate energy
07 05 13*	solid wastes containing hazardous substances	Hazardous	12.84	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	D13 - Blending or mixing prior to submission to any of the operations numbered D 1 to D 12	Remondis Sava GmbH	D10 - Incineration on land
07 05 13*	solid wastes containing hazardous substances	Hazardous	11.38	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R13 - Storage of waste pending any of the operations numbered R 1 to R 12 (excluding temporary storage, pending collection, on the site where the waste is produced)	-	
07 05 13*	solid wastes containing hazardous substances	Hazardous	0.55	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R01 - Use principally as a fuel or other means to generate energy	-	



List of Waste (LoW)				Next Destination		Final Destination	
LoW Code	LoW Description	Classification	Quantity of waste Tonnes / year	Organisation	Waste Treatment Operation	Organisation	Waste Treatment Operation
13 01 10*	mineral based non-chlorinated hydraulic oils	Hazardous	3.98	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R02 - Solvent reclamation/regeneration	-	
15 01 10*	packaging containing residues of or contaminated by hazardous substances	Hazardous	2.3	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R12 - Exchange of waste for submission to any of the operations numbered R 1 to R 11	Afvalstoffen Terminal Moerdijk BV	R01 - Use principally as a fuel or other means to generate energy
15 01 10*	packaging containing residues of or contaminated by hazardous substances	Hazardous	1.42	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	D13 - Blending or mixing prior to submission to any of the operations numbered D 1 to D 12	Remondis Sava GmbH	D10 - Incineration on land
15 01 10*	packaging containing residues of or contaminated by hazardous substances	Hazardous	12.13	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R01 - Use principally as a fuel or other means to generate energy	-	
15 01 10*	packaging containing residues of or contaminated by hazardous substances	Hazardous	0.13	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R04 - Recycling/reclamation of metals and metal compounds	-	



List of Waste (LoW)				Next Destination		Final Destination	
LoW Code	LoW Description	Classification	Quantity of waste Tonnes / year	Organisation	Waste Treatment Operation	Organisation	Waste Treatment Operation
15 01 10*	packaging containing residues of or contaminated by hazardous substances	Hazardous	2.17	Rilta Environmental Limited - W0192	R03 - Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes)	-	
15 01 10*	packaging containing residues of or contaminated by hazardous substances	Hazardous	25.88	Rilta Environmental Limited - W0192	R04 - Recycling/reclamation of metals and metal compounds	-	
15 02 02*	absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by hazardous substances	Hazardous	0.09	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R12 - Exchange of waste for submission to any of the operations numbered R 1 to R 11	Afvalstoffen Terminal Moerdijk BV	R01 - Use principally as a fuel or other means to generate energy

List of Waste (LoW)				Next Destination		Final Destination	
LoW Code	LoW Description	Classification	Quantity of waste Tonnes / year	Organisation	Waste Treatment Operation	Organisation	Waste Treatment Operation
16 01 17	ferrous metal	-	1.9	O'Reilly Recycling Ltd.	R04 - Recycling/reclamation of metals and metal compounds	-	
16 01 20	Glass	-	1.62	Glassco Recycling Limited - W0279	R05 - Recycling/reclamation of other inorganic materials	-	
16 05 07*	discarded inorganic chemicals consisting of or containing hazardous substances	Hazardous	0.27	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	D13 - Blending or mixing prior to submission to any of the operations numbered D 1 to D 12	Remondis Sava GmbH	D10 - Incineration on land
16 05 07*	discarded inorganic chemicals consisting of or containing hazardous substances	Hazardous	0	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	D13 - Blending or mixing prior to submission to any of the operations numbered D 1 to D 12	Veolia Environmental Services	D10 - Incineration on land



List of Waste (LoW)				Next Destination		Final Destination	
LoW Code	LoW Description	Classification	Quantity of waste Tonnes / year	Organisation	Waste Treatment Operation	Organisation	Waste Treatment Operation
16 05 08*	discarded organic chemicals consisting of or containing hazardous substances	Hazardous	0.19	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	D13 - Blending or mixing prior to submission to any of the operations numbered D 1 to D 12	Remondis Sava GmbH	D10 - Incineration on land
16 05 08*	discarded organic chemicals consisting of or containing hazardous substances	Hazardous	0.06	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R02 - Solvent reclamation/regeneration	-	
16 05 08*	discarded organic chemicals consisting of or containing hazardous substances	Hazardous	0.02	Veolia Environmental Services Technical Solutions Ltd, Corrin, Fermoy, Cork - W0050	R01 - Use principally as a fuel or other means to generate energy	-	
20 01 21*	Household waste fluorescent lamps and other mercury containing waste	Hazardous	0.05	Irish Lamp Recycling Co. Ltd.	R04 - Recycling/reclamation of metals and metal compounds	-	





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List of Waste (LoW)				Next Destination		Final Destination	
LoW Code	LoW Description	Classification	Quantity of waste Tonnes / year	Organisation	Waste Treatment Operation	Organisation	Waste Treatment Operation
20 01 35* C	Household waste light fittings, hazardous	Hazardous	0.99	Irish Lamp Recycling Co. Ltd.	R05 - Recycling/reclamation of other inorganic materials	-	
20 01 08 A	Household biodegradable kitchen & canteen waste	-	0.12	Key Waste Management Limited - W0045	R03 - Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes)	-	
20 03 01 C	Municipal mixed dry recyclables	-	10.44	Starrus Eco Holdings Limited (Millenium Business Park) - W0183	R03 - Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes)	-	

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List of Waste (LoW)				Next Destination		Final Destination	
LoW Code	LoW Description	Classification	Quantity of waste Tonnes / year	Organisation	Waste Treatment Operation	Organisation	Waste Treatment Operation
20 03 01 C	Municipal mixed dry recyclables	-	3.88	Starrus Eco Holdings Limited - W0261	R03 - Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes)	-	
20 03 07 B	Bulky waste non-household	-	22.27	Starrus Eco Holdings Limited (Millennium Business Park) - W0183	R01 - Use principally as a fuel or other means to generate energy	-	
20 03 07 B	Bulky waste non-household	-	1.84	Starrus Eco Holdings Limited - W0261	R01 - Use principally as a fuel or other means to generate energy	-	



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## **Groundwater Monitoring Reports 2018**

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# Groundwater Monitoring Report

**Q2, June 2018**

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Technical Report Prepared For

**Clarochem Ireland Limited**

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Technical Report Prepared By

**Colm Driver**  
Environmental Consultant

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Our Reference

**CD/12/6379WR15**

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Date of Issue

**16<sup>th</sup> July 2018**

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**Appendix 1** – Groundwater Sampling Field Logs

**Appendix 2** - Laboratory Reports (JEL 18-9327) & (18-43073-1 City Analysts)

## Document History

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Details	Written by	Approved by
Signature		
Name	Colm Driver	Brigitte Priestley
Title	Environmental Consultant	Senior Environmental Consultant
Date	16 <sup>th</sup> July 2018	16 <sup>th</sup> July 2018

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## 1.0 INTRODUCTION

At the request of Clarochem Ireland Limited (Clarochem), AWN Consulting Ltd. (AWN) completed groundwater monitoring in June 2018 (Q2 groundwater monitoring round), as part of the company's annual groundwater monitoring programme for its facility at Clarochem Ireland, Damastown, Mulhuddart, Dublin 15. Groundwater monitoring is undertaken at the site on a quarterly basis, with the first and third quarterly rounds comprising a short suite of analysis and the second and fourth quarterly rounds comprising a broader suite of analysis in order to comply with the sites IED Licence requirements (IED Ref: P0125-02).

This report presents the findings from the **Q2** groundwater monitoring programme undertaken on the 14<sup>th</sup> June 2018 and summarises the trends in groundwater quality. The most recent round of monitoring, prior to June 2018, for the biannual suite of parameters was completed in December 2017.

Since mid-2013, samples for inorganics, organics and hydrocarbons analyses have been sent to Jones Environmental Laboratory (now Exova Jones Environmental), Deeside, UK. Bacteriological analysis is provided by City Analysts Ltd., Pigeon House Road, Ringsend, Dublin 4.

### 1.1 Environmental Setting

According to the Geological Survey of Ireland (GSI) website, the generalised bedrock beneath the site is classified as Dinantian Upper Impure Limestone. According to the Teagasc subsoils map for the area the subsoils are classified as made-ground; however, the subsoils adjacent to the site are classified as till derived chiefly from lower Palaeozoic rocks. The aquifer beneath the site, according to the GSI, is classified as a locally important aquifer which is moderately productive only in local zones. The vulnerability of the aquifer to pollution is classified as high to low as only an interim study took place.

### 1.2 Background Groundwater Quality

As per the conditions of the Clarochem IED licence P0125-02, a groundwater monitoring programme has been undertaken in three monitoring wells (MW-1 to MW-3) at the Clarochem site since 1994. Bacteriological contamination has been a recurring issue at the site along with heavy metal, organic and inorganic contamination. The main source of the bacteriological contamination was from leaks in the process foul sewer line in 2000, 2004 and 2009. The majority of the heavy metal, organic and inorganic contamination has been localised to one area of the site, where the tank farm and waste water treatment plant are located. Since monitoring commenced the most up gradient well, MW-3 has shown evidence of bacteriological, metal, organic and inorganic groundwater contamination indicating an up gradient source of contamination is also impacting the groundwater quality on the site as would be typical of an industrial location.

To further investigate the extent of contamination on site, four additional boreholes (MW-4 to MW-7), were installed in July 2006 and three further boreholes (MW-8 to MW-10), were installed in November 2006. Each borehole was installed with a monitoring standpipe and, at the request of the EPA, all boreholes (MW-1 to MW-10) are now included as part of the IED monitoring programme.

The location of boreholes across the site is shown in Figure 1.



### 1.3 Groundwater Abstraction System

A groundwater abstraction system was installed in February/March 2007, which involved pumping groundwater from MW-1, MW-5 and MW-7 to the adjacent neutralisation pit. The objective of this system was to improve the groundwater quality underlying the site in respect to the contamination identified. The groundwater abstraction programme was extended in April 2009 to include MW-9.

The system consists of compressed air pumps, extracting groundwater from MW-1, MW-5, MW-7 and MW-9 and pumping the extracted water into barrels and then into the neutralisation pit.

### 1.4 Groundwater Flow Direction

A survey of the groundwater flow direction was undertaken by WYG Ireland (WYG) on 22<sup>nd</sup> August 2007, which incorporated boreholes beneath the neighbouring Helsinn Birex site. The survey was undertaken when the pumps were switched off and the groundwater was found to flow in a southerly direction; however, localised lower levels in the water table were noted around MW-5, MW-6 and MW-10, as presented in Figure 2. It would appear that the water table had not recovered fully when the survey was undertaken. The groundwater flow direction with the pumps operating is presented in Figure 3 and in general the groundwater flow direction was similar to that before pumping commenced. However, a cone of depression was noted in the vicinity of the pumped wells, which is representative of the extraction programme.

### 1.5 Helsinn Birex

The neighbouring property to the east of the site is owned by Helsinn Birex. There are three monitoring wells on this site, AGW-1 to AGW-3. AGW-3 is located hydraulically up gradient of the site and is therefore representative of the groundwater quality coming onto the Helsinn Birex site. AGW-1 is located downgradient, adjacent to the western site boundary with Clarochem. AGW-2 is also located downgradient, along the southern site boundary. Elevated parameters including metals and bacteriological parameters have been recorded in the downgradient well nearest to Clarochem.

### 1.6 Pipework and Sumps Integrity Testing

The site has a network of underground pipes and a neutralization pit is located in the area of the waste water treatment plant to treat the waste water. In August 2011 Clarochem installed a double walled polypropylene lined fiberglass tank into the underground neutralization tank, adjacent to MW-1 and MW-5. There is a cavity between the tanks fitted with two highly sensitive float switches to alert to the presence of a leak, should one occur.

As per the requirements of the IED licence, Clarochem is required to carry out integrity testing of the underground effluent and foul sewer pipes at least once every three years. The most recent pipework testing was carried out at the facility in 2014 and subsequent repair works to process lines and manholes were carried out in August 2014 and March 2015. The sites foul drain lines were tested and repaired throughout 2015. The foul lines integrity are tested at regular intervals to ensure there is no damage or leaks within the process lines.

## 1.7 Groundwater Sampling

Groundwater sampling was undertaken in monitoring wells MW-1 to MW-10 by AWN on 14<sup>th</sup> June 2018 using 50mm internal diameter dedicated PVC bailers. In order to ensure a representative sample and the removal of stagnant water from the well, approximately three annular volumes were bailed from each well in accordance with the AWN groundwater sampling protocol. During the June 2018 sampling round, MW-8 was dry and samples could not be recovered for field or lab analysis. It is noted that MW-8 was also dry during the groundwater monitoring round in December 2017.

*In situ* measurements were recorded for temperature, conductivity and pH. Sample bottles were filled directly from the bailer and maintained at <4°C prior to dispatch to the laboratory for analysis. Details of the pH, conductivity and temperature measurements recorded, along with the physical characteristics are included in the monitoring well sampling logs provided in Appendix 1 and discussed in Section 2.2.

Samples were submitted to Exova Jones Environmental Laboratory Ltd, (UKAS accredited laboratory) and analysed for:

- Diesel Range Organics (DRO), Petrol Range Organics (PRO) and mineral oil
- Benzene, Toluene, Ethylbenzene and Xylene (BTEX compounds)
- Volatile Organic Compounds (VOCs)
- Standard chemical analysis (including major anions and cations)
- Individual heavy metals

Samples were sent to City Analysts Limited (INAB accredited laboratory) and analysed for:

- Standard bacteriological analysis.

The above suites of analysis were undertaken in accordance with the requirements of the Clarochem IED licence.

## 2.0 ANALYTICAL RESULTS

### 2.1 Groundwater Standards and Guidelines

The analytical results for the June 2018 monitoring round are presented with historical analytical data in Tables 1 – 4 and Graphs 1 – 6.

The analytical results for the groundwater samples are compared to the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. 9 of 2010) as amended by the European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (S.I. No. 366 of 2016). The Regulations establish a comprehensive system of water quality and quantity objectives for all bodies of groundwater and thereby provide a basis for systems of control for achieving those groundwater objectives, taking into account the requirements of the Water Framework Directive (2000/60/EC) and the Groundwater Directive (2006/118/EC). The threshold values are based on the assessment of the general quality of groundwater in a groundwater body in terms of whether its ability to support human uses has been significantly impaired by pollution. Where there are no threshold values for a parameter the results are compared to the Interim Guideline Values (IGVs) *“Interim report towards setting guideline values for the protection of groundwater in Ireland”*, published by the Environmental Protection Agency (EPA) in June 2003.

The results of the VOC scan are also compared against the Dutch guidelines. The Dutch S-Value is a target concentration and is generally considered to represent typical uncontaminated/background concentrations. The I-Value is an intervention value, above which the need for further investigation or remediation is indicated.

The analytical results from the current monitoring round are also discussed with reference to the results from the previous sampling rounds.

### 2.2 Groundwater Monitoring Field Parameters

#### 2.2.1 pH, Conductivity and Temperature

The pH and conductivity field readings for the June 2018 monitoring round are presented in Tables 1a – 1j. It should be noted values for MW-8 were not recorded due to the fact that the monitoring well was dry at the time of sampling.

The pH readings in all nine wells sampled were within the EPA IGV range of 6.0 - 9.5.

All field conductivity values recorded during the June 2018 Q2 groundwater monitoring round were below the 2010 groundwater threshold value of 1,875  $\mu\text{S}/\text{cm}$ . This is consistent with the previous three groundwater monitoring rounds carried out in July, September and December 2017, respectively. A negligible decrease in conductivity values compared to July 2017 can be seen. This is consistent with the overall decreasing trend observed since the June 2016 high of 2,539  $\mu\text{S}/\text{cm}$  to MW-7 to 1,765  $\mu\text{S}/\text{cm}$  at MW-7 during the current monitoring round.

Typical groundwater temperatures in Ireland range from 10-12°C. Historically there has been seasonal variation in the temperatures recorded on site which is likely due to the shallow nature of the wells reflecting the general air temperature. In June 2018, the highest groundwater temperature was recorded at MW6 with 15°C and the lowest temperature recorded was at MW2 with 11.7°C. The majority of the temperatures recorded was above 12 °C. This reflects the unusual weather Ireland has been



experiencing the last month, with temperatures reaching above 20 °C and very little rainfall.

## 2.2.2 Physical Observations

A orange to brownish tint was noted at all monitoring wells during the current groundwater monitoring round. This is consistent with the previous two monitoring rounds.

A slight chemical or organic smell was detected in the groundwater at MW1, MW-2 & MW-7, which is consistent with previous monitoring rounds. MW-1 & MW-7 consistently exhibit a chemical smell or an organic stagnant odour, while MW-2 intermittently exhibits odour during the groundwater sampling rounds.

## 2.3 Hydrocarbon Parameters

The analytical results for hydrocarbons are presented in Tables 3a – 3j.

### 2.3.1 Mineral Oil

As with the previous three sampling rounds, all wells sampled had mineral oil concentrations below the laboratory detection limit of 10 µg/l.

### 2.3.2 Diesel Range Organics (DRO) and Petrol Range Organics (PRO)

During the current monitoring round (Q2 June 2018), MW-1 recorded a concentration of 190 µg/l which is consistent with the previous monitoring round. MW-5 & MW-7 recorded elevated concentrations of DRO during June 2018 monitoring round with concentrations of 150 µg/l and 140 µg/l, respectively. During previous sampling rounds MW-1 had recorded slightly elevated DRO concentrations (100-860 µg/l) during the period between the September 2013 and June 2017). However, a notable decrease at MW-1 was noted during the groundwater monitoring in December 2017, with recorded concentrations of 180 µg/l.

DRO concentrations were less than the laboratory detection limit (<10 µg/l) in all other wells sampled during the December 2017 & June 2018 sampling rounds.

Petrol Range Organics (PRO) were all less the laboratory detection limit (<10 µg/l) in the majority of the nine wells, with one slightly elevated concentration recorded at MW-7 (140 µg/l).

As detailed in previous reports, these results are considered inconsistent with the results of analyses for mineral oil and VOC's, and are of limited value to the monitoring programme.

### 2.3.3 BTEX Compounds (Benzene, Toluene, Ethylbenzene and Xylene)

BTEX compounds were not detected above the laboratory LOD limit in the majority of the nine groundwater samples analysed. MW-7 recorded slightly elevated concentrations of Ethylbenzene (1 µg/l) and Xylene (2 µg/l).

## 2.4 Volatile Organic Compounds

The results of analysis for VOC compounds are presented in Tables 4a – 4j. The VOC concentrations in eight of the nine samples were less than their laboratory detection limits for all individual parameters analysed. These results are generally

consistent with previous monitoring rounds. A slight increase was detected in MW-7. MW-7 recorded slightly elevated concentrations of Ethylbenzene (1 µg/l) and o Xylene (2 µg/l).

Tentatively Identified Compound (TIC) analysis was also undertaken at all monitoring wells sampled. No TICs were detected in eight of the nine monitoring wells sampled in June 2018. This is consistent with the previous monitoring round in December 2017. However, MW-7 recorded a slightly elevated concentration of isopropyl alcohol with a 86% match and a concentration of 241.

## **2.5 Total Phenols**

The results for total phenols are presented in Tables 2a – 2j.

The detection limit for total phenols is <0.1 mg/L and the threshold value is <0.0005 mg/L. During the June 2018 monitoring round, phenols were not detected at any of the monitoring locations. This is consistent with December 2017. A concentration of 0.2 mg/L was recorded at MW1 in June 2017 which decreased to below the laboratory's detection limit in December 2017. Phenols have been recorded at MW-7 over recent sampling rounds including December 2016 (0.6mg/L), June 2016 (0.2mg/L), December 2015 (8.7mg/L) and June 2015 (0.3mg/L).

## **2.6 Major Cations and Anions**

The analytical results for major cations and anions are presented in Tables 2a – 2j.

### **2.6.1 Total Hardness**

All monitoring wells exceeded the threshold values for total hardness of 200 mg/L, expect for MW-7 which recorded a concentration of 192 mg/L. This is consistent with the previous two groundwater monitoring rounds – December and June 2017.

The values recorded ranged between concentrations of 192 mg/l at MW-7 to 476 mg/l at MW-3. In the December 2017 round, MW-1 and MW-7 were the only boreholes with a recorded concentration below the threshold value. MW-4, MW-6 and MW-10 show increases when compared to December 2016 results but these are consistent with historical results.

### **2.6.2 Total Alkalinity**

There is no statutory threshold for this parameter under S.I. No. 9 of 2010; however, there should be 'no abnormal change' between reported readings. The highest alkalinity recorded in the June 2018 monitoring round was 1108 mg/l at MW-5. The highest alkalinity recorded in the December 2017 monitoring round was 1432 mg/l at MW-8. As there was no water to be sampled at this location in June 2018 a result is not available for comparison.

The recorded concentrations of the remaining sampled wells during the monitoring round are within a range of between 304 mg/l (MW-1) and 808 mg/l (MW-9). There has been 'no abnormal change' between reported readings.

### **2.6.3 Calcium**

All calcium concentrations recorded during the June 2018 monitoring round were within the EPA IGV threshold value of 200mg/l. Concentrations ranged between 62.3

mg/l at MW-7 to 170.4 mg/l at MW-3. Calcium concentrations have been relatively consistent at all monitoring wells across the monitoring rounds.

#### 2.6.4 Sodium

MW-1 (312.5 mg/l) and MW-7 (162.1 mg/l) were the only locations which recorded sodium concentrations in excess of the EPA IGV threshold value of 150 mg/l<sup>1</sup> during the June 2018 monitoring round. This is consistent with the previous two groundwater monitoring rounds (June & December 2017) concentrations. The results are also consistent with historical sodium results for MW-1 which have exceeded the IGV value on an ongoing basis as is the case at MW-7 (with the exception of the December 2014 and June 2015 monitoring rounds).

Graphs 2a-2d at the end of this report show the historical trends for sodium at MW-1, MW-5, MW-7 and MW-9. Whilst the overall trend for sodium in these wells is downward, MW-1 concentrations have recently shown an upward trend.

#### 2.6.5 Potassium

There was only one exceedance of the EPA IGV threshold value of 5 mg/l for potassium during the June 2018 monitoring round which was recorded at MW-7 (11.6 mg/L). This is consistent with the historical trend whereby potassium concentrations at MW-7 have predominantly exceeded the threshold value, e.g. 6 mg/L in December 2017. A decrease in potassium concentration was noted at MW-1 at 4.2 mg/l in June 2018 and 4.4 mg/l in December 2017. Previously, MW-1 recorded above the threshold value of 5 mg/l in the previous monitoring round (7.1 mg/l in June 2017). A possible trend of seasonal fluctuation in potassium concentrations is also evident in Graph 3, with high concentrations in the summer. However, this trend does not apply to MW1 which has not exceeded 4.3 mg/l in the last six Q1 and Q3 sampling rounds.

#### 2.6.6 Chloride

The threshold value for chloride of 187.5 mg/l was exceeded at two locations during the June 2018 monitoring round. This occurred at MW-1 (247.1 mg/l) where chloride concentrations have been elevated on an ongoing basis and an upward trend in these values is evident since December 2015, and MW-7 (459.1 mg/l) where it appears to be an isolated blip based on previous monitoring results. In comparison, the December 2017 monitoring round recorded one exceedance at MW-1 (320 mg/l).

All other locations were below the threshold value in the June 2018 monitoring round which is consistent with the December 2017 monitoring round.

The chloride concentrations have generally mirrored the increases and decreases in sodium levels across the monitoring wells. Trended concentrations at MW-5 (Graph 2b) show a general decrease in chloride concentrations while MW-9 (Graph 2d) has been relatively stable with some occasional fluctuation, possibly due to seasonality.

<sup>1</sup> Under new legislation - *European Union Environmental Objectives (Groundwater) (Amendment) Regulations* (S.I. No. 366 of 2016) issued in July 2016 - sodium is no longer listed as a parameter for which a GTV is provided. Therefore, the EPA IGV value 150mg/L, which is the same as the original GTV threshold value, will be used for comparative purposes from now on.



### 2.6.7 Nitrate

In June 2018, the nitrate concentration in each of the nine samples was less than the threshold value of 37.5mg/l which is similar to the previous two monitoring rounds in June and December 2017. Historically nitrate concentrations recorded at MW-8 tend to be higher than the other onsite monitoring wells however there have been no recent exceedances of the IGV threshold value.

### 2.6.8 Nitrite

Nitrite results were below the LOD (0.02mg/l) for all locations in June 2018 with the exception of MW-9 (0.11 mg/l) which did not exceed the threshold value of 0.375 mg/l. This is with the result of the previous monitoring round at this location. MW-7 has shown small historical fluctuations in nitrite levels, but recorded a concentration below the LOD in the current monitoring round.

### 2.6.9 Total Ammonia

During June 2018, four locations exceeded the threshold value for total ammonia, MW-1 (3.33 mg/l), MW-2 (0.23 mg/l), MW-5 (1.57 mg/l) & MW-7 (1.15 mg/l). In contrast, during December 2017 monitoring round, two locations exceeded the threshold value for total ammonia, MW-1 (2.63 mg/l) & MW-7 (1.15 mg/l).

Concentrations at MW-1, MW-2 and MW-7 have regularly exceeded the threshold value of 0.175mg/l.

Graph 6 shows trended ammonia concentrations at MW-1, MW-5, MW-7 and MW-9 over the previous decade and identifies spikes in concentration at MW-1 and MW-7 as well as the June 2016 spike at MW-9.

### 2.6.10 Sulphate

There was no recorded exceedance of the threshold value for sulphate of 187.5 mg/l during the June 2018 monitoring round. This is consistent with the December 2017 monitoring round, where there was only one recorded exceedance of the threshold value for sulphate of 187.5 mg/l, which was at MW-7 (224.9 mg/L).

The remaining wells have seen fluctuations over the same sampling period however concentrations are predominantly in compliance with the threshold value.

## 2.7 Individual Heavy Metals

The analytical results for heavy metals are presented in Tables 2a – 2j.

### 2.7.1 Aluminium

Aluminium concentrations were below the LOD in all monitoring wells during the June 2018 groundwater monitoring round. This is consistent with the previous groundwater monitoring round in December 2017. In June 2017, aluminium concentrations were below the LOD in all but one monitoring well, MW-7 (0.32 mg/l). No other exceedances have been noted in any of the other boreholes within the previous seven monitoring rounds.

### 2.7.2 Manganese

Manganese concentrations were below the EPA indicative threshold value of 0.05 mg/l at six of the nine monitoring locations. Manganese concentration were above the threshold value at three monitoring wells: MW-1 (1.834 mg/l), MW-5 (1.242 mg/l) and MW-7 (0.168 mg/l). Concentrations at MW-1 have marginally exceeded the threshold over the previous monitoring rounds.

There was a significant improvement at MW-9 which had recorded a concentration of 5.049 mg/l in June 2016; however, the result in December 2017 and June 2018 was below or just above the LOD.

Graph 5, attached, shows that recent results at MW-3, MW-7 and MW-10 indicates concentrations of manganese have stabilised while levels at MW-1 have been gradually increasing since December 2013 and levels at MW-9 have shown occasional spikes.

### 2.7.3 Iron

Total dissolved iron was recorded below the LOD at seven out of the nine monitoring wells in June 2018. MW1 (0.323 mg/l) and MW-7 (0.168 mg/l) recorded slight elevated concentrations of iron. Total dissolved iron was recorded below the LOD for all monitoring wells in December 2017.

As outlined in the December 2017 report, a seasonal pattern has been noted with higher concentrations typically recorded during summer monitoring and lower concentrations during winter monitoring.

### 2.7.4 Arsenic

Arsenic was recorded below LOD in eight of the nine samples taken during the June 2018 monitoring round. MW-7 recorded a slightly elevated arsenic concentration of 0.0034 mg/l, but this was below the arsenic threshold value. In December 2017 monitoring round, the threshold value was exceeded at two locations, MW-1 (0.0305 mg/l) and MW-7 (0.0094 mg/l). This was consistent with the previous groundwater monitoring round in June 2017. All remaining monitoring wells recorded concentrations below the laboratory limit of detection (LOD).

### 2.7.5 Nickel

All nickel concentrations were below the EPA IGV threshold value of 0.02 mg/l. Concentrations have decreased in MW-7 when compared to results from June 2017.

### 2.7.6 Barium

Barium concentrations exceed the threshold value (0.1 mg/l) at four out of nine monitoring wells during the June 2018 monitoring round. These include; MW-1 (0.381 mg/l), MW-5 (0.204 mg/l), MW7 (0.262 mg/l) and MW-9 (0.102 mg/l). During the June 2018 groundwater monitoring round, concentrations at MW-1 (0.381 mg/l) have decreased when compared to December 2017 (0.890 mg/l), but still exceed the threshold value of 0.1 mg/l for barium. All other results were within the threshold value.

## 2.8 Bacteriological Analysis

Tables 1a – 1j present the bacteriological analysis and Graphs 1a – 1j present the historical trends at each of the boreholes up to and including June 2018 monitoring round. No parameters were analysed for location MW-8 due to inability to collect a sample as the monitoring was dry at the time of sampling.

### 2.8.1 Faecal Coliforms

Faecal coliforms were recorded in five of the nine monitoring wells sampled for this parameter during the June 2018 monitoring round. These were MW-2 (27 cfu/100ml), MW 3 (1 cfu/100ml) MW-5 (23 cfu/100ml), MW-7 (1 cfu/100ml) and MW-9 (2 cfu/100ml). All other results are consistent with previous results.

Historically faecal coliforms have been recorded regularly at most locations.

### 2.8.2 Faecal Streptococci

Faecal streptococci were recorded at six of the nine wells sampled in the June 2018 monitoring round. These were MW-3 (4 cfu/100ml), MW-5 (6 cfu/100ml), MW-6 (1 cfu/100ml), MW-7 (76 cfu/100ml), MW-9 (8 cfu/100ml) and MW-10 (1 cfu/100ml). Results have decreased in concentrations but are generally consistent with the previous monitoring rounds.

### 2.8.3 Total Coliforms

Elevated total coliforms were recorded at eight of the nine monitoring locations in June 2018. The following concentrations were recorded: MW-1 (1,986.3 MPN/100ml), MW-2 (61,310 MPN/100ml), MW-3 (6.3 MPN/100ml), MW-4 (225 MPN/100ml), MW-5 (104,620 MPN/100ml), MW-6 (12 MPN/100ml), MW-7 (1,413.6 MPN/100ml), MW-9 (261 MPN/100ml). MW-10 recorded below the respective LOD and therefore, below the threshold value for total coliforms (0 MPN/100ml).

All other results are broadly consistent with previous monitoring rounds. Total coliforms were recorded in all monitoring locations in June and December 2017.

### 2.8.4 Clostridium Perfringens

Although there is no formal IGV standard for clostridium perfringens, it is generally considered that anything above 0 cfu/100ml is indicative of bacteriological contaminants. During the June 2018 monitoring round clostridium perfringens were detected in five of the nine sampled wells including MW-3 (2 cfu/100ml), MW-5 (10 cfu/100ml), MW-6 (13 cfu/100ml), MW-7 (1 cfu/100ml) and MW-9 (6 cfu/100ml).

Historically clostridium perfringens has been recorded regularly at all of the monitoring wells in varying concentrations. All results were relatively consistent with previous sampling rounds although notably at the lower end of the spectrum.



### 3.0 MAIN FINDINGS AND CONCLUSIONS

- Field observations indicated ongoing contamination at MW-1 and MW-7. In particular, MW-7 had a dark brownish tint and MW-1 had an orange tint.
- All field pH readings were within the EPA IGV range of 6.0 - 9.5. pH. Levels in MW-7 have been elevated during previous monitoring rounds including December 2016, September 2016, March 2016 and December 2015. However, MW-7 was within threshold limits for the third monitoring round in succession.
- BTEX compounds were not detected above the laboratory LOD limit in the majority of the nine groundwater samples analysed. MW-7 recorded slightly elevated concentrations of Ethylbenzene (1 µg/l) and Xylene (2 µg/l). Phenol compounds were not detected above the laboratory LOD limit in any of the nine groundwater samples analysed. No VOCs were recorded above the LOD at eight of the nine monitoring locations, other than the elevated concentrations of Ethylbenzene and o-Xylene at MW-7.
- Analysis of Tentatively Identified Compounds (TIC) did not identify possible Triethylamine in any of the locations. MW-7 recorded a slightly elevated concentration of isopropyl alcohol with an 86% match and a concentration of 241 µg/l.
- Diesel range organics (DRO) were recorded in only three of the monitoring wells (MW-1, MW-5, and MW-7). MW-1 recorded a concentration of 190 µg/l which is consistent with the previous monitoring round. MW-5 & MW-7 recorded elevated concentrations of DRO during June 2018 monitoring round with concentrations of 150 µg/l and 140 µg/l, respectively. Recorded concentrations of Petro. Range Organics (PRO) were less the laboratory detection limit (<10 µg/l) in the majority of the nine wells, with only one slightly elevated concentration recorded at MW-7 (140 µg/l). As detailed in the AWN Contamination Assessment report dated May 2014, elevated levels of DRO and PRO may be misleading. They are considered likely to be indicative of naturally occurring substances rather than fuels or other hydrocarbon sources.
- Levels of manganese, iron, potassium and ammonia at MW-9 appear to be decreasing when compared to that seen in June & December 2017. Ammonia was still elevated above the threshold. Concentrations at MW-1, MW-2 and MW-7 have regularly exceeded the threshold value of 0.175mg/l.
- Barium concentrations exceed the threshold value (0.1 mg/l) at four out of nine monitoring wells during the June 2018 monitoring round. These include; MW-1 (0.381 mg/l), MW-5 (0.204 mg/l), MW7 (0.262 mg/l) and MW-9 (0.102 mg/l). Concentrations at MW-1 (0.381 mg/l) have decreased when compared to December 2017 (0.890 mg/l), but still exceed the threshold value of 0.1 mg/l for barium.
- There continues to be considerable variation in results from bacteriological analysis. Total coliforms were recorded in eight of the nine monitoring wells sampled in June 2018. Faecal coliforms were recorded in five of the nine monitoring wells sampled for this parameter during the June 2018 monitoring round. Historically faecal coliforms have been recorded regularly at most locations. Whilst the coliform count is particularly high at MW-5 during this

sampling round, similar elevated levels have been recorded at this monitoring well as shown in table 1e.

- Whilst bacteriological parameters remain elevated at this site, Clarochem conduct regular integrity testing of all pipelines at the facility in excess of the requirements of the facility's IE licence to ensure any potential failures/leaks are detected at an early stage. All pipelines are tested a minimum of once every three years.

#### 4.0 RECOMMENDATIONS

The majority of the heavy metal, organic and inorganic contamination recorded on site is localised to one area, where the tank farm and waste water treatment plant are located. It is recommended that the operation of the groundwater abstraction programme (MW-1, MW-5, MW-7 and MW-9) is continued with the aim of further improving the groundwater quality in this area.

The results from the June 2018 monitoring indicate that groundwater quality at MW-9 is improving. Ongoing attention is still required at MW-1 and MW-7 in particular where concentrations in a number of parameters remain elevated.

The elevated concentrations of Ethylbenzene and o-Xylene at MW-7 as well as the recorded concentration of isopropyl alcohol are abnormal for this borehole and may be an anomaly in the sampling results. It is recommended that this is further investigated to determine whether a spill has occurred in the vicinity of that well; and further analysis of these parameters be undertaken for MW-7 during the Q3 2018 monitoring round.

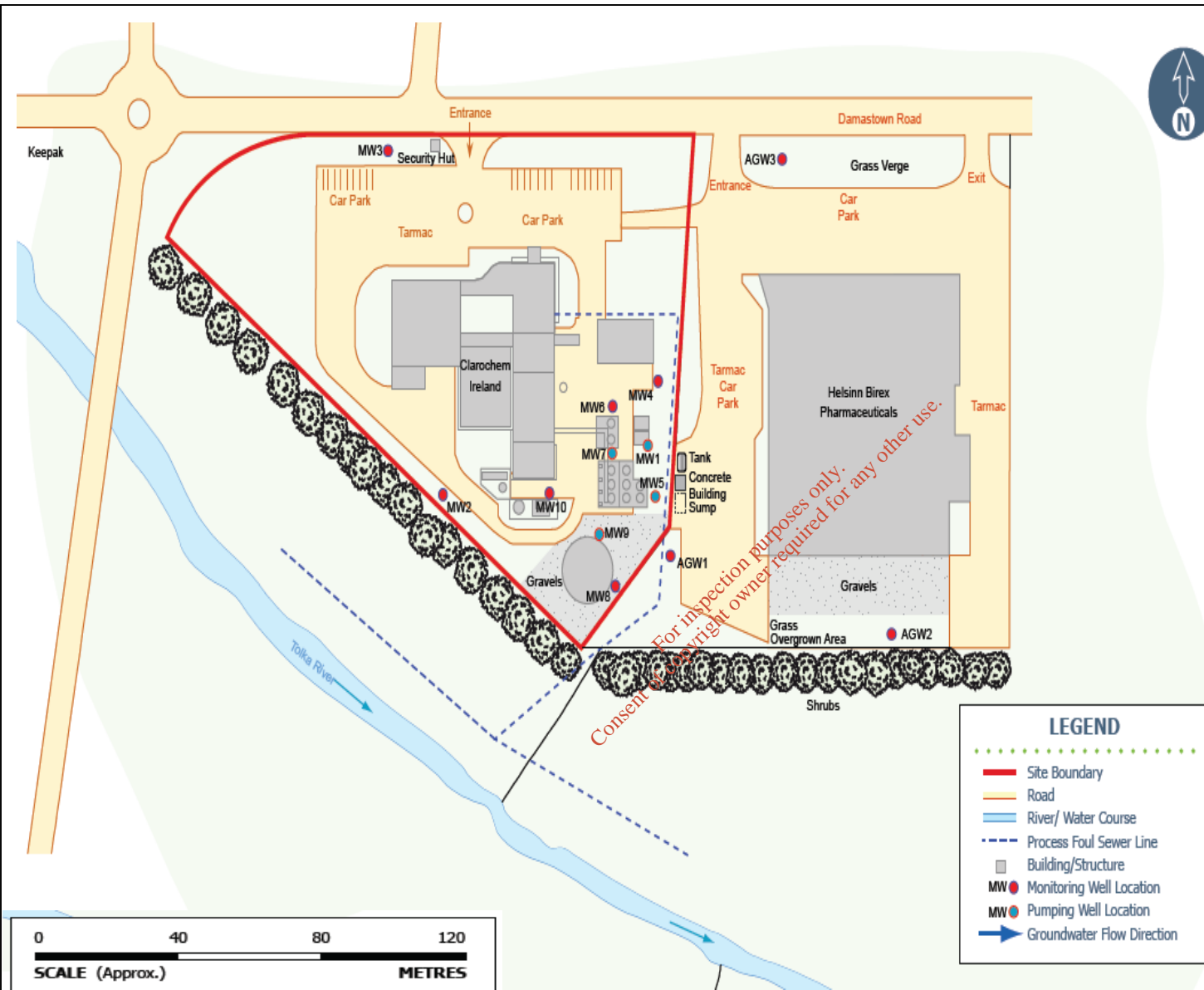
A borehole assessment will be undertaken to reduce the number of boreholes to be sampled during future monitoring rounds on the Clarochem site.

The next round of quarterly monitoring will be undertaken in September 2018. It is anticipated that this monitoring will provide further information regarding the improvements in water quality downgradient from the site.

## FIGURES

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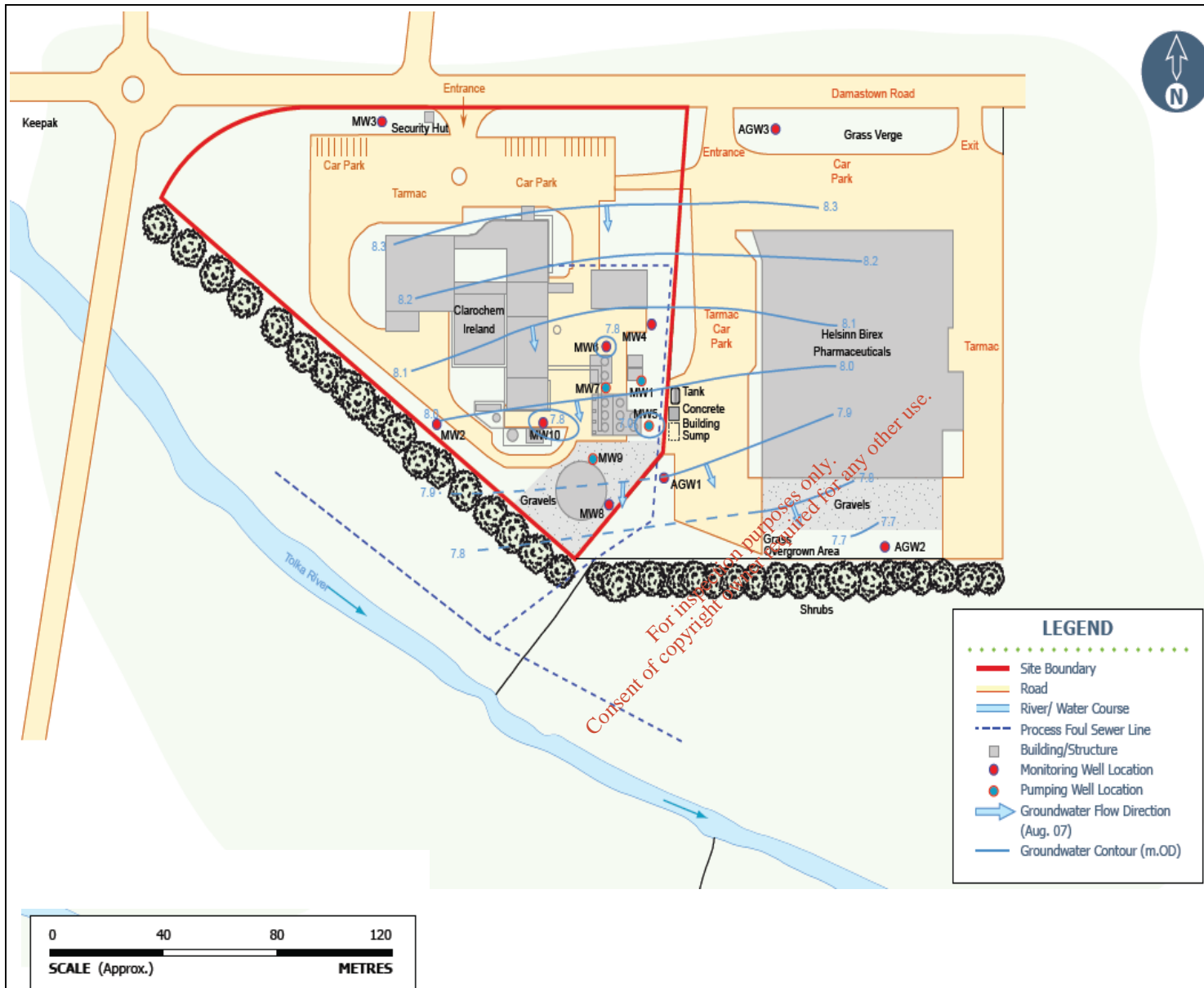
Drawing is for illustrative purposes only

Do Not Scale

**Project:**  
Clarochem Ireland Limited  
GW Monitoring

**Reference:**  
Project No.:12/6379

**Figure 1:**  
Monitoring Well  
Locations



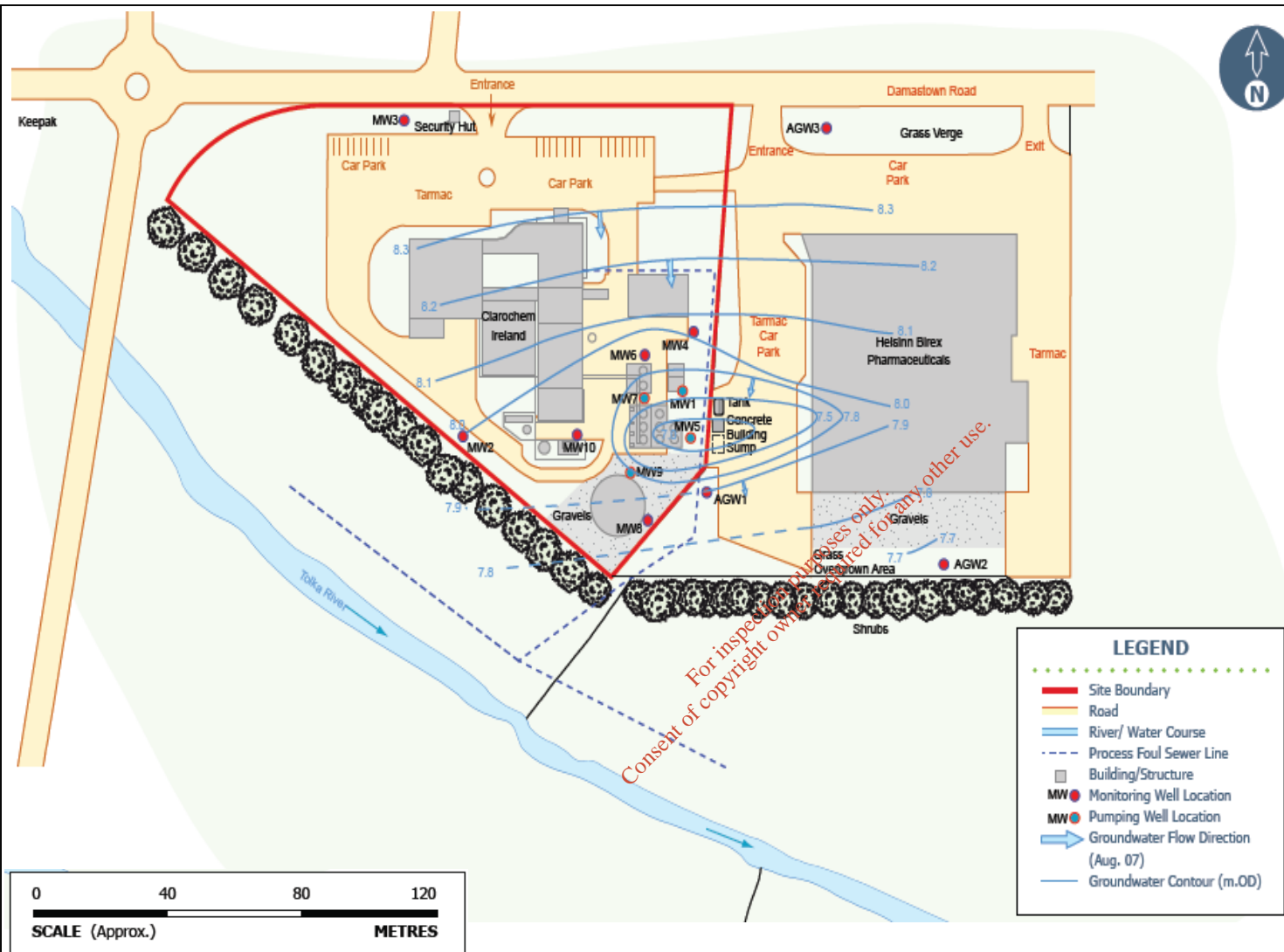
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**Reference:**  
Project No.: 12/6379

**Figure 2:**  
Groundwater Flow  
Direction Before  
Pumping



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**Project:**

Clarochem Ireland Limited  
GW Monitoring

**Reference:**

Project No.: 12/6379

**Figure 3:**

Groundwater Flow  
Direction During  
Pumping

## TABLES

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PARAMETERS	UNIT	MW-1																		Threshold Value
		3/20/2014	6/19/2014	9/30/2014	04/12/2014*	3/26/2015	6/22/2015	9/21/2015	07/12/2015*	3/23/2016	6/30/2016	9/30/2016	12/13/2016	3/30/2017	13-06-2017*	9/14/2017	12/14/2017	2/22/2018	6/14/2018	
Temperature	Units	10	<b><u>13.1</u></b>	<b><u>14.8</u></b>	11.2	<b><u>9.2</u></b>	-	<b><u>13</u></b>	11.1	<b><u>9.2</u></b>	<b><u>12.5</u></b>	<b><u>14.0</u></b>	11.9	10.8	14.5	14.5	11.9	10	<b><u>13.1</u></b>	10-12°C
pH	Units	8.05	7.32	7.36	7.1	7.78	8.21	7.27	8.16	7.78	7.83	7.74	7.64	7.55	7.68	7.73	7.3	7.4	7.6	6 - 9.5
Conductivity	µS/cm	1,473	<b><u>1,971</u></b>	<b><u>1,991</u></b>	1,806	1,671	958	1,717	1,582	1,671	1,867	1,350	1,507	2,273	1,690	1,992	1672	1511	1431	1,875
Sodium	mg/l	<b><u>190.1</u></b>	<b><u>227</u></b>	<b><u>343.4</u></b>	<b><u>275.5</u></b>	<b><u>260.7</u></b>	<b><u>186.9</u></b>	<b><u>349.7</u></b>	<b><u>294.2</u></b>	<b><u>260.7</u></b>	<b><u>256.4</u></b>	<b><u>186.6</u></b>	<b><u>351.2</u></b>	<b><u>296.3</u></b>	<b><u>432.9</u></b>	<b><u>323.1</u></b>	<b><u>312.5</u></b>	<b><u>203.4</u></b>	<b><u>214.2</u></b>	150
Choride	mg/l	<b><u>233.4</u></b>	<b><u>305</u></b>	<b><u>480.2</u></b>	<b><u>374.3</u></b>	<b><u>330.7</u></b>	<b><u>367.4</u></b>	<b><u>417.6</u></b>	29.7	<b><u>330.7</u></b>	<b><u>414.3</u></b>	<b><u>280.6</u></b>	<b><u>483.1</u></b>	<b><u>377.7</u></b>	<b><u>508.5</u></b>	<b><u>453.3</u></b>	<b><u>320</u></b>	<b><u>269.6</u></b>	<b><u>247.1</u></b>	187.5
Clostridium Perfringens	cfu./ml	<1	<1	<1	<1	<1	<1	<b><u>&lt;1</u></b>	<b><u>1</u></b>	<1	<b><u>5</u></b>	<b><u>4</u></b>	<b><u>1</u></b>	<b><u>10</u></b>	<b><u>&lt;1</u></b>	<b><u>2</u></b>	<b><u>10</u></b>	<b><u>14</u></b>	<1	0 counts/ 100ml
Total Coliforms	MPN/100m	<b><u>410</u></b>	<b><u>3</u></b>	<1	<b><u>2,420</u></b>	<b><u>76</u></b>	<1	<b><u>461.1</u></b>	<b><u>7.5</u></b>	<b><u>4.1</u></b>	<b><u>1,000</u></b>	<b><u>241,960</u></b>	<b><u>21,460</u></b>	<b><u>99</u></b>	<b><u>1</u></b>	<b><u>2,000</u></b>	<b><u>49,500</u></b>	<b><u>687</u></b>	<b><u>1,986</u></b>	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<1	<1	<1	<b><u>1</u></b>	<1	<1	<b><u>14.5</u></b>	<1	<1	<b><u>5</u></b>	<b><u>660</u></b>	<b><u>1</u></b>	<b><u>&lt;1</u></b>	<b><u>1</u></b>	<b><u>95</u></b>	<b><u>17</u></b>	<b><u>&lt;1</u></b>	<b><u>&lt;1</u></b>	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<1	<1	<b><u>27</u></b>	<1	<1	<1	1	<b><u>1</u></b>	<1	<b><u>5</u></b>	<b><u>690</u></b>	<b><u>4</u></b>	<b><u>&lt;1</u></b>	<b><u>&lt;1</u></b>	<b><u>170</u></b>	<b><u>350</u></b>	<b><u>3</u></b>	<1	0 counts/ 100ml

**Legend:**

NDP - No Determination Possible by Laboratory

**Results are shaded, bold and underlined where the Threshold Value is exceeded.**

\* Bi-Annual IPPC Groundwater Monitoring Round

-¹ = not analysed

# = Results from re-sampling on 5th October 2017

**AWN CONSULTING**

Clarochem Ireland GW Monitoring

Job No. 12/6379

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PARAMETERS	UNIT	MW-2																		Threshold Value
		3/20/2014	6/19/2014	9/30/2014	04/12/2014*	3/26/2015	6/22/2015	9/21/2015	07/12/2015*	3/23/2016	6/30/2016	9/30/2016	12/13/2016	3/30/2017	13-06-2017*	9/14/2017	12/14/2017	2/22/2018	6/14/2018	
Temperature	Units	-	<b>13.3</b>	<b>14.8</b>	11.3	10.2	<b>13.8</b>	<b>13.8</b>	11	<b>9.3</b>	11.8	<b>13</b>	11.9	10.1	12.5	12.5	11.80	10.10	11.70	10-12°C
pH	Units	7.35	7.09	7.29	6.67	7.36	7.33	7.33	7.33	7.61	7.19	7.09	7.13	6.97	6.9	7.08	7.09	7.28	6.94	6 - 9.5
Conductivity	µS/cm	877	880	822	654	783	775	775	672	704	781	770	665	873	829	888	911	826	866	1,875
Sodium	mg/l	13.3	14.9	15.5	16.3	12.2	16.4	16.4	14.5	12	12.7	11.5	13.6	14.7	15.6	11.4	17.90	13.70	14.80	150
Choride	mg/l	15	17.9	15.2	16.2	25.6	28.5	28.5	29.7	23.7	18.4	14.1	18.7	32.2	22.5	15.2	34.1	20.3	24.1	187.5
Clostridium Perfringens	cfu./ml	<1	<1	<1	<1	<b>1</b>	<b>1</b>	<b>7</b>	<b>1</b>	<b>8</b>	<1	<1	<b>5</b>	<1	<b>1</b>	<1	<1	<b>10</b>	<1	0 counts/ 100ml
Total Coliforms	IPN/100m	<b>630</b>	<b>2,420</b>	<b>12,360</b>	<b>172</b>	<b>&gt;2419.6</b>	<b>&gt;2419.6</b>	<b>&gt;2419.6</b>	<b>&gt;2419.6</b>	<b>241960</b>	<b>6,600</b>	<b>&gt;2419600</b>	<b>54,750</b>	<b>30500</b>	<b>111990</b>	<b>325500</b>	<b>387,300</b>	<b>1,986</b>	<b>61,310</b>	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<b>17</b>	<b>3</b>	<b>1,300</b>	<b>12</b>	<b>35</b>	<b>400</b>	<b>1,000</b>	<b>98,000</b>	<b>46</b>	<b>2</b>	<b>510</b>	<b>950</b>	<b>61</b>	<b>86</b>	<b>860</b>	<b>2,100</b>	<b>20</b>	<b>27</b>	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<1	<1	<b>114</b>	<1	<1	<1	<b>3,600</b>	<b>5</b>	<b>3</b>	<1	<b>181</b>	<b>12</b>	<b>1</b>	<b>52</b>	<b>67</b>	<1	<1	<1	0 counts/ 100ml

**Legend:**

NDP - No Determination Possible by Laboratory

**Results are shaded, bold and underlined where the Threshold Value is exceeded.**

\* Bi-Annual IPPC Groundwater Monitoring Round

-' = not analysed

# = Results from re-sampling on 5th October 2017

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PARAMETERS	UNIT	MW-3																		Threshold Value
		3/20/2014	6/19/2014	9/30/2014	04/12/2014*	3/26/2015	6/22/2015	9/21/2015	07/12/2015*	3/23/2016	6/30/2016	9/30/2016	12/13/2016	3/30/2017	13-06-2017*	9/14/2017	12/14/2017	2/22/2018	6/14/2018	
Temperature	Units	9.5	13	15.3	11.1	10	13.4	14	11.1	8.3	13	12.8	11	10.1	13.2	14.0	10.7	10.8	12.8	10-12°C
pH	Units	7.26	7.14	7.33	7.11	7.3	7.3	6.94	7.53	6.89	7.32	6.99	7.2	7.07	7.06	7.15	7.25	7.32	7.06	6 - 9.5
Conductivity	µS/cm	920	848	864	750	820	828	773	517	651	765	787	600	828	795	906	769	691	864	1,875
Sodium	mg/l	9.2	10.4	10.9	10.9	12	11	10	15.9	10.2	10.2	9.7	9.2	11.4	26.5	10.8	11.40	9.00	10.40	150
Choride	mg/l	12.6	16.6	14.7	15.3	17.3	17.4	15.8	29.7	16.3	18.8	15.1	14.7	24.1	17	15.2	21.2	17.8	19.5	187.5
Clostridium Perfringens	cfu./ml	<1	<1	<1	<1	3	<1	1	49	3.0	<1	<1	<1	<1	2	1	2	5	2	0 counts/ 100ml
Total Coliforms	MPN/100m	200	<1	100	980	>2419.6	62	344.8	123.6	22.8	91.2	7.5	13.4	7.4	195.6	18.5	200.0	142.1	6.3	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	1	<1	4	<1	2	<1	10	4	1.0	<1	<1	<1	<1	<1	11	11.0	1.0	1.0	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<1	<1	1	<1	<1	<1	2	23	<1	1	<1	<1	<1	2	≤1	1,160.0	7.0	4.0	0 counts/ 100ml

**Legend:**

NDP - No Determination Possible by Laboratory

Results are shaded, bold and underlined where the Threshold Value is exceeded.

\* Bi-Annual IPPC Groundwater Monitoring Round

-' = not analysed

# = Results from re-sampling on 5th October 2017

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PARAMETERS	UNIT	MW-4																		Threshold Value
		3/20/2014	6/19/2014	9/30/2014	04/12/2014*	3/26/2015	6/22/2015	9/21/2015	07/12/2015*	3/23/2016	6/30/2016	9/30/2016	12/13/2016	3/30/2017	13-06-2017*	9/14/2017	12/14/2017	2/22/2018	6/14/2018	
Temperature	Units	9.6	14	-	10	10.1	13.2	13	11	8.6	13.4	13.5	10.1	10	13	14	9.0	7.2	14.0	10-12°C
pH	Units	7.61	7.28	7.30	6.89	7.41	7.21	7.15	7.85	7.51	7.32	7.11	7.18	7.25	7.19	7.13	7.32	7.36	7.22	6 - 9.5
Conductivity	µS/cm	463	588	587	538	535	546	612	370	528	568	620	461	627	589	685	613	642	740	1,875
Sodium	mg/l	4.9	7.1	6.8	15.3	9.7	10.9	17.4	6.8	10.1	6.6	8.7	7.6	7.7	9.8	8.2	7.0	7.2	9.8	150
Choride	mg/l	6.8	7.2	7.0	24.5	9.4	9.4	9.5	29.7	12.4	5.1	11.5	9.5	7.8	6.1	6.8	31.5	12.3	22.9	187.5
Clostridium Perfringens	cfu./ml	30	<1	5	<1	<1	6	26	4	10	3	1	3	4	20	<1	<1	144	<1	0 counts/ 100ml
Total Coliforms	MPN/100ml	23,820	345	100	727	816	1,300	>2419.6	298.7	686.7	1,550.0	770.1	686.7	1,553.1	1,046.2	960.6	630	91	225	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	20	19	63	<1	<1	<1	700	81	22.0	120	30.0	4	<1	43	38	9.0	18.0	<1	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<1	20	17	<1	<1	2	83	2	<1	51	2	2	1	77	15	10	9	<1	0 counts/ 100ml
<div><div>Legend:</div><div>NDP - No Determination Possible by Laboratory</div><div>Results are shaded, bold and underlined where the Threshold Value is exceeded.</div><div>* Bi-Annual IPPC Groundwater Monitoring Round</div><div>-' = not analysed</div><div># = Results from re-sampling on 5th October 2017</div></div> <div><div>AWN CONSULTING</div><div>Clarochem Ireland GW Monitoring</div><div>Job No. 12/6379</div></div>																				

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PARAMETERS	UNIT	MW-5																		Threshold Value
		3/20/2014	6/19/2014	9/30/2014	04/12/2014*	3/26/2015	6/22/2015	9/21/2015	07/12/2015*	3/23/2016	6/30/2016	9/30/2016	12/13/2016	3/30/2017	3/30/2017	9/14/2017	12/14/2017	2/22/2018	6/14/2018	
Temperature	Units	<b><u>9.3</u></b>	<b><u>13.5</u></b>	<b><u>15.1</u></b>	<b><u>9.9</u></b>	<b><u>8.6</u></b>	<b><u>12.6</u></b>	<b><u>13.5</u></b>	11.2	9.3	<b><u>14.8</u></b>	<b><u>13.0</u></b>	10.7	10.1	10.1	15.0	10.50	<b><u>9.00</u></b>	<b><u>14.80</u></b>	10-12°C
pH	Units	7.46	7.48	7.55	6.8	7.49	7.2	7.52	7.49	7.36	7.5	7.19	7.43	7.45	7.45	7.49	7.41	7.91	7.67	6 - 9.5
Conductivity	µS/cm	663	928	652	607	1,064	1,187	604	544	1,139	642	1,028	537	792	792	751	733	471	998	1,875
Sodium	mg/l	45.2	85	34.3	22.1	81.3	102	23.4	16.3	108.4	22.2	75.2	26.5	22.4	22.4	18.8	15.3	58.0	95.3	150
Chloride	mg/l	36.3	75.5	24.2	15.2	75.3	83	13.4	29.7	110.9	18.9	75.5	20	16.1	16.1	16.6	10.9	42.2	121.4	187.5
Clostridium Perfringens	cfu./ml	<b><u>28</u></b>	<1	<b><u>3</u></b>	<1	<b><u>33</u></b>	<b><u>3</u></b>	<b><u>61</u></b>	<b><u>18</u></b>	<b><u>31</u></b>	<b><u>16</u></b>	<b><u>5</u></b>	<b><u>5</u></b>	<b><u>16</u></b>	<b><u>16</u></b>	<b><u>2</u></b>	<b><u>23</u></b>	<b><u>194</u></b>	<b><u>10</u></b>	0 counts/ 100ml
Total Coliforms	MPN/100ml	<b><u>241,960</u></b>	<b><u>186</u></b>	<b><u>300</u></b>	<b><u>1,986</u></b>	<b><u>&gt;2419.6</u></b>	<b><u>6</u></b>	<b><u>&gt;2419.6</u></b>	<b><u>&gt;2419.6</u></b>	<b><u>48,840</u></b>	<b><u>17,500</u></b>	<b><u>5,730.0</u></b>	<b><u>6,890</u></b>	<b><u>19,300.0</u></b>	<b><u>19,300.0</u></b>	<b><u>571,700.0</u></b>	<b><u>2,420</u></b>	<b><u>3,550</u></b>	<b><u>104,620</u></b>	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<b><u>21</u></b>	<b><u>64</u></b>	<b><u>81</u></b>	<b><u>8</u></b>	<b><u>1</u></b>	<b><u>3</u></b>	<b><u>1,500</u></b>	<b><u>24,000</u></b>	<b><u>23.0</u></b>	<b><u>62</u></b>	<b><u>12.0</u></b>	<b><u>1,000</u></b>	<b><u>4.0</u></b>	<b><u>4.0</u></b>	<b><u>16,000.0</u></b>	<b><u>16</u></b>	<b><u>5</u></b>	<b><u>23</u></b>	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<b><u>51</u></b>	<b><u>33</u></b>	<b><u>104</u></b>	<1	<1	<1	<b><u>800</u></b>	<b><u>3,700</u></b>	<1	<b><u>21</u></b>	<b><u>10</u></b>	<b><u>20</u></b>	<b><u>&lt;1</u></b>	<b><u>&lt;1</u></b>	<b><u>190</u></b>	<b><u>30</u></b>	<b><u>25</u></b>	<b><u>6</u></b>	0 counts/ 100ml

**Legend:**

NDP - No Determination Possible by Laboratory

**Results are shaded, bold and underlined where the Threshold Value is exceeded.**

\* Bi-Annual IPPC Groundwater Monitoring Round

-' = not analysed

# = Results from re-sampling on 5th October 2017

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PARAMETERS	UNIT	MW-6																		Threshold Value
		3/20/2014	6/19/2014	9/30/2014	04/12/2014*	3/26/2015	6/22/2015	9/21/2015	07/12/2015*	3/23/2016	6/30/2016	9/30/2016	12/13/2016	3/30/2017	13-06-2017*	9/14/2017	12/14/2017	2/22/2018	6/14/2018	
Temperature	Units	8.8	14.1	14.9	9.2	8.1	14	14.2	11.3	8.6	11.6	13.5	10	9.5	14.6	14.1	9	7	15	10-12°C
pH	Units	7.6	7.6	7.61	7.16	7.66	7.47	7.57	8.26	7.75	7.58	7.36	7.57	7.53	7.29	7.49	7.34	7.53	7.42	6 - 9.5
Conductivity	µS/cm	933	1,044	614	265	553	717	534	559	560	786	740	557	811	864	817	758	732	816	1,875
Sodium	mg/l	105.5	137.2	57.4	50	52.5	59.3	92.3	65.2	68.1	58.5	70.4	65.8	61.5	72.7	57.7	56.70	56.0	58.3	150
Choride	mg/l	63.2	87.4	37.0	30.0	36.3	52.7	55.4	29.7	56.5	22.2	70.2	65.4	60.0	70.2	58.7	60.5	58.5	60.3	187.5
Clostridium perfringens	cfu./ml	<1	<1	3	<1	<1	<1	21	<1	8	<1	<1	<1	<1	29	1	450	<1	13	0 counts/ 100ml
Total Coliforms	MPN/100ml	2	5	<1	1,120	43	<1	29.4	2	43	687	72.2	770	<1.0	21	5	2,000	69	12	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<1	1	<1	<1	<1	<1	4	1	<1	3	<1	<1	<1	<10	<1	3	4	<1	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<1	39	10	<1	<1	<1	<1	<1	2	10	2	<1	<1	<10	2	450	8	1	0 counts/ 100ml

**Legend:**

NDP - No Determination Possible by Laboratory

**Results are shaded, bold and underlined where the Threshold Value is exceeded.**

\* Bi-Annual IPPC Groundwater Monitoring Round

- ' = not analysed

# = Results from re-sampling on 5th October 2017

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PARAMETERS	UNIT	MW-7																		Threshold Value
		3/20/2014	6/19/2014	9/30/2014	04/12/2014*	3/26/2015	6/22/2015	9/21/2015	07/12/2015*	3/23/2016	6/30/2016	9/30/2016	12/13/2016	3/30/2017	13-06-2017*	9/14/2017	12/14/2017	2/22/2018	6/14/2018	
Temperature	Units	9.5	14.5	-	8.8	7.6	13.8	-	11	9.1	9.04	-	9.1	9.3	14.3	14.6	9.0	8.0	14.4	10-12°C
pH	Units	9.34	7.85	7.74	7.45	7.97	7.73	9.03	11.42	12.73	8.62	10.22	11.76	8.97	9.29	8.98	7.39	7.7	8.34	6 - 9.5
Conductivity	µS/cm	1,097	249	1,507	890	923	867	892	2,208	2,107	2,539	1,239	1,477	1,028	1,013	917	927	664	1765	1,875
Sodium	mg/l	122.2	435.5	162.8	121.9	104.4	98.4	174.2	385.5	407.5	495.8	297.1	427.9	153.6	166.2	147	162.1	123.3	303.7	150
Choride	mg/l	110.7	629.5	273	141.2	97.6	95.8	102.6	29.7	88.9	652.1	154	186.4	88.8	73.1	73.5	6.8	73.7	459.1	187.5
Clostridium Perfringens	cfu./ml	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	2	<1	7	1	1	31	7	1	0 counts/ 100ml
Total Coliforms	MPN/100m	3	<1	<1	1,300	1	8	70.3	<1	<1	5,794,000	100	57.6	<1.0	92,080.0	2,000.0	1,986	1,120	1,414	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<1	<1	<1	83	<1	2	6.0	<1	<1	<1	120	<1	<1	1,700	260	2	2	1	0 counts/ 100ml
Faecal Streptococci	cfu./ml	25	<1	3	<1	<1	<1	<1	<1	<1	<1	310	<1	<1	9	130	60	1	76	0 counts/ 100ml
<div><div>Legend:</div><div>NDP - No Determination Possible by Laboratory</div><div>Results are shaded, bold and underlined where the Threshold Value is exceeded.</div><div>* Bi-Annual IPPC Groundwater Monitoring Round</div><div>- ' = not analysed</div><div># = Results from re-sampling on 5th October 2017</div></div> <div><div>AWN CONSULTING</div><div>Clarochem Ireland GW Monitoring</div><div>Job No. 12/6379</div></div>																				

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PARAMETERS	UNIT	MW-8																		Threshold Value		
		3/20/2014	6/19/2014	9/30/2014	04/12/2014*	3/26/2015	6/22/2015	9/21/2015	07/12/2015*	3/23/2016	6/30/2016	9/30/2016	12/13/2016	3/30/2017	13-06-2017*	3/30/2017	12/14/2017	12/14/2018	6/14/2018			
Temperature	Units	-	13.5	15.4	9.6	9.0	14	-	11.2	7.5	12.3	-	-	9.5	DRY	DRY	10	8	DRY	10-12°C		
pH	Units	-	7.61	7.18	6.7	7.33	7.12	7.24	7.27	7.34	7.29	7.37	7.29	7.05			7.13	7.36		6 - 9.5		
Conductivity	µS/cm	-	561	1,078	929	1,054	1,033	1,070	849	828	842	1046	939	1174			996	1098		1,875		
Sodium	mg/l	-	20.3	24.8	17.8	17.5	19.7	21.6	16.8	15.5	19.2	21	20.1	15.9			19.2	15.5		150		
Choride	mg/l	-	23.6	34.8	25.1	18	22	34.7	29.7	15.2	22.2	35	34.9	22.4			56.2	27.4		187.5		
																	DRY				DRY	
Clostridium Perfringens	cfu./ml	54	<1	68	<1	74	21	-	N/A	640	48	<1	-	76				DRY		57		0 counts/ 100ml
Total Coliforms	MPN/100m	61,310	10	<1	225	17	89	1	N/A	547.5	3,150	>2419.6	8,164	>2419.6						770		0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	19	<1	<1	<1	2	<1	<1	N/A	9	6	29	3	12						14		0 counts/ 100ml
Faecal Streptococci	cfu./ml	3	<1	<1	<1	<1	<1	<1	N/A	46	27	38	-	1	3	0 counts/ 100ml						

**Legend:**

NDP - No Determination Possible by Laboratory

**Results are shaded, bold and underlined where the Threshold Value is exceeded.**

\* Bi-Annual IPPC Groundwater Monitoring Round

- = not analysed

Note 1 - insufficient sample

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PARAMETERS	UNIT	MW-9																		Threshold Value
		3/20/2014	6/19/2014	9/30/2014	04/12/2014*	3/26/2015	6/22/2015	9/21/2015	07/12/2015*	3/23/2016	6/30/2016	9/30/2016	12/13/2016	3/30/2017	13-06-2017*	9/14/2017	12/14/2017	2/22/2018	6/14/2018	
Temperature	Units	9.5	13.5	14.8	10.7	7.5	13.5	14	11.1	8.6	12.9	13	10.5	9.3	12.1	14	10	8	11.9	10-12°C
pH	Units	7.84	7.5	7.68	7.09	7.86	7.55	8.07	7.81	7.50	7.36	7.40	7.67	7.44	7.34	7.61	7.36	7.72	7.44	6 - 9.5
Conductivity	µS/cm	509	707	756	472	469	522	464	323	339	944	479	314	424	483	387	389	350	486	1,875
Sodium	mg/l	11	16.6	17.7	12.1	10	13.4	12.1	6.8	8.1	15.2	7.5	10.4	7.4	7.2	5.1	6.0	5.9	12.2	150
Choride	mg/l	6.3	7.7	24.3	6.8	5.8	7.1	7.1	29.7	5.9	10.9	3.2	5.9	5.5	4.1	2.1	4.5	5.8	20.9	187.5
Clostridium Perfringens	cfu./ml	5	<1	<1	<1	3	7	69	6	<1	1	2	3	1	2	<1	<1	570	6	0 counts/ 100ml
Total Coliforms	MPN/100ml	2	17	100	1,046	1,046	228	2613	6	48.1	1,414	510	3,360	<1.0	41,060	111,200	17,270	22,470	261	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	3	14	<1	<1	<1	<1	8	9	<1	21	10	2	<1	<1	45,000	12	<1	2	0 counts/ 100ml
Faecal Streptococci	cfu./ml	1	<1	<1	<1	<1	<1	17	5	<1	12	31	<1	<1	<1	200	860	59	8	0 counts/ 100ml

**Legend:**

NDP - No Determination Possible by Laboratory

**Results are shaded, bold and underlined where the Threshold Value is exceeded.**

\* Bi-Annual IPPC Groundwater Monitoring Round

- = not analysed

# = Results from re-sampling on 5th October 2017

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PARAMETERS	UNIT	MW-10																		Threshold Value
		3/20/2014	6/19/2014	9/30/2014	04/12/2014*	3/26/2015	6/22/2015	9/21/2015	07/12/2015*	3/23/2016	6/30/2016	9/30/2016	12/13/2016	3/30/2017	13-06-2017*	9/14/2017	12/14/2017	2/22/2018	6/14/2018	
Temperature	Units	<b>9.6</b>	<b>13.5</b>	<b>14</b>	<b>10.7</b>	<b>9.1</b>	<b>14</b>	<b>14</b>	11.2	8.6	<b>15</b>	<b>13.8</b>	<u>10.2</u>	<u>10.5</u>	<u>14.7</u>	16	11.5	<b>7.5</b>	<b>14.1</b>	10-12°C
pH	Units	7.71	7.61	7.68	7.15	7.73	7.8	7.79	7.73	7.10	7.62	7.58	7.48	7.39	7.43	7.64	7.28	7.79	7.57	6 - 9.5
Conductivity	µS/cm	507	561	523	390	500	552	254	411	515	402	411	447	508	453	384	692	560	683	1,875
Sodium	mg/l	10.9	12.4	12.2	9	12.2	12.8	23.1	12	12.9	6.3	9.8	11.4	11.1	13.3	10.4	13.5	13.1	14.8	150
Choride	mg/l	18	25.9	19.4	12.6	19.8	23.6	8.4	29.7	27.4	10.2	17.8	25.8	20.6	25.6	14.9	27.4	25.3	27.7	187.5
Clostridium Perfringens	cfu./ml	<1	<1	<1	<1	<b>1</b>	<1	<b>14</b>	<b>1</b>	<b>9</b>	<b>6</b>	<b>1</b>	<1	1	<1	1	<1	<b>17</b>	<b>1</b>	0 counts/ 100ml
Total Coliforms	IPN/100m	<b>4</b>	<1	<1	<b>1,553</b>	<b>1</b>	<1	<b>20</b>	<1	<1	<b>291</b>	<b>7.5</b>	<b>27.9</b>	<b>&lt;1.0</b>	<b>1.0</b>	<b>14.5</b>	<100	<b>16</b>	<1	0 counts/ 100ml
Faecal Coliforms/ E Col	cfu./ml	<1	<1	<1	<1	<1	<1	<1	<1	<1	<b>56</b>	<1	<b>6</b>	<b>&lt;1</b>	<b>1</b>	<b>10</b>	<1	<1	<1	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<1	<1	<1	<1	<1	<1	<1	<1	<1	<b>49</b>	<1	<1	<1	<1	120	<b>330</b>	<b>4</b>	<b>1</b>	0 counts/ 100ml

**Legend:**  
NDP - No Determination Possible by Laboratory  
**Results are shaded, bold and underlined where the Threshold Value is exceeded.**  
\* Bi-Annual IPPC Groundwater Monitoring Round  
- ' = not analysed  
# = Results from re-sampling on 5th October 2017

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PARAMETERS	UNIT	MW-1									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
BOD	mg/l	11	22	37	24	19	24	85	43	29	-
COD	mg/l	34	40	59	45	28	58	153	59	63	-
Dissolved Oxygen	mg/l	2	6	5	2	5	4	2	5	<1	-
Total Organic Carbon	C mg/l	20	18	13	17	19	24	32	4	6	No Abnormal Change
Chloride	Cl mg/l	305	374	367	293	414	483.1	508.5	0.4	247.1	187.5
Fluoride	F mg/l	<0.3	<0.3	<0.3	0.3	<0.3	<0.3	0.3	320	<0.3	1 <sup>1</sup>
Sulphate	SO4 mg/l	48.9	45.71	3.98	9.38	7.81	10.9	20.1	40.2	46.3	187.5
Nitrate	NO3 mg/l	0.7	<0.2	<0.2	0.8	0.3	<0.2	3.6	0.3	<0.2	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.08	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.375
Total Ammonia	NH4 mg/l	3.64	2.9	4.47	4.88	3.99	4.53	2.65	2.63	3.33	0.175
Total Oxidised Nitrogen	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.8	<0.2	<0.2	-
Total Hardness	CaCO3 mg/l	155	230	137	164	177	196	387	269	263	200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	135	191	146	197	201	173	273	248	-
Total Alkalinity	CaCO3 mg/l	138	254	272	504	220	202	396	384	304	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.03	<0.01	0.037
Total Phenols	mg/l	0.2	<0.1*	<0.1*	<0.1*	<0.5*	<0.1*	0.2	<0.1	<0.15	0.0005 <sup>1</sup>
Metals											
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<20	<20	<20	0.15
Arsenic	As mg/l	<0.0025	0.0224	0.0199	0.0218	0.0175	0.0065	0.0113	0.0305	<2.5	0.0075
Barium	Ba mg/l	0.163	0.222	0.164	0.206	0.222	0.243	2.37	0.089	0.381	0.1
Boron	B mg/l	<0.012	<0.012	<0.012	0.019	0.018	0.012	0.022	0.026	0.023	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.005	<0.005	<0.005	<0.005	<0.5	<0.5	0.003
Calcium	Ca mg/l	56.3	82.3	49	57.3	61.5	69.4	136.5	94.5	92.2	200 <sup>1</sup>
Chromium	Cr mg/l	<0.015	<0.015	<0.015	<0.0015	<0.0015	<0.0015	<0.0015	<1.5	<1.5	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	<2	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<7	<7	1.5
Iron	Fe mg/l	0.226	0.382	0.071	0.46	0.16	<0.02	3.798	3724	0.323	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	3.5	5.7	3.5	4.7	5.5	5.3	10.8	7.7	7.7	50 <sup>1</sup>
Manganese	Mn mg/l	0.532	0.601	0.684	0.685	0.873	1.025	1.031	1.381	1.834	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<1	<1	0.00075
Nickel	Ni mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	<2	0.02 <sup>1*</sup>
Phosphorus	P mg/l	0.006	5	0.026	32	29	0.008	0.032	48	0.017	-
Potassium	K mg/l	3.9	4.3	4.1	3.7	3.4	4.4	7.1	4.4	4.2	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Sodium	Na mg/l	227	276	187	294	256	351.2	432.9	312.5	214.2	150 <sup>1*</sup>
Strontium	Sr mg/l	0.313	0.441	0.281	0.353	0.391	0.434	1.59	0.557	0.479	-
Tin	Sn mg/l	0.032	0.019	0.008	<0.005	0.006	0.005	0.008	<0.005	<0.005	-
Zinc	Zn mg/l	<0.003	<0.003	<0.003	<0.003	0.004	<0.003	<0.003	<0.003	<0.003	0.075 <sup>2</sup>

Legend:

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>\*</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

Results are shaded and in bold where they exceed the Threshold Value

\*= Detection Limit above guideline value

`<` = concentration is below the LOD for the parameter

AWN Consulting Ltd.  
Clarochem Ireland Limited GW Monitoring  
Project No. 12/6379

PARAMETERS	UNIT	MW-2									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
BOD	mg/l	2	3	5	24	2	1	<1	<1	<1	-
COD	mg/l	47	7	28	45	8	17	<7	18	17	-
Dissolved Oxygen	mg/l	4	7	3	5	8	8	7	11	8	-
Total Organic Carbon	C mg/l	6	7	<2	17	8	3	11	2	<2	No Abnormal Change
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>1</sup>
Chloride	Cl mg/l	17.9	16.2	28.5	36.2	18.4	18.7	22.5	34.1	24.1	187.5
Sulphate	SO4 mg/l	69.17	32.76	39.01	65.45	83.51	205.5	89	40.2	91.2	187.5
Nitrate	NO3 mg/l	0.8	<0.2	<0.2	1.3	0.5	2.1	5.9	0.3	<0.2	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.1	0.03	0.1	0.53	<0.02	<0.02	0.03	0.375
Total Ammonia	NH4 mg/l	0.34	0.28	0.68	0.07	0.61	0.78	0.06	0.06	0.23	0.175
Total Oxidised Nitrogen	mg/l	<0.2	<0.2	<0.2	0.3	<0.2	0.6	1.3	<0.2	<0.2	-
Total Hardness	CaCO3 mg/l	470	424	452	437	439	513	387	493	460	200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	158	470	146	466	519	179	440	462	-
Total Alkalinity	CaCO3 mg/l	416	254	468	504	368	390	360	344	382	No Abnormal Change
Total Cyanide	mg/l	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1	<0.1	<0.15	0.0005 <sup>1</sup>
Metals											
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<20	<20	0.15
Arsenic	As mg/l	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<2.5	<2.5	0.0075
Barium	Ba mg/l	0.062	0.111	0.103	0.06	0.073	0.078	0.063	0.085	0.073	0.1
Boron	B mg/l	0.016	0.018	0.028	0.037	0.027	0.022	0.04	0.042	0.021	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	0.0006	<0.0005	<0.0005	<0.0005	<0.5	1.2	0.003
Calcium	Ca mg/l	170	155	163.5	159	157.5	184.3	166.8	180.2	166.5	200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.015	<0.015	<0.015	<0.015	<0.015	<1.5	<1.5	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	<2	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<7	<7	1.5
Iron	Fe mg/l	<0.020	<0.020	1.216	<0.020	0.118	<0.020	<0.020	<20	<20	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	11.1	8.7	10.2	9.4	10.7	12.4	9.7	10.2	10.4	50 <sup>1</sup>
Manganese	Mn mg/l	0.92	2.016	3.695	0.185	3.876	<0.002	<0.002	<2	0.049	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<1	<1	0.00075
Nickel	Ni mg/l	0.005	0.005	0.005	<0.002	0.006	0.003	<0.002	2	0.005	0.02 <sup>1*</sup>
Phosphorus	P mg/l	<0.005	0.016	0.013	22	12	0.012	0.012	34	0.009	-
Potassium	K mg/l	1.9	2	2.1	1.6	1.5	1.5	0.8	0.8	1.1	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<3	<3	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	-
Sodium	Na mg/l	14.9	16.3	16.4	14.5	12.7	13.6	15.6	17.9	14.8	150 <sup>1*</sup>
Strontium	Sr mg/l	0.555	0.449	0.54	0.497	0.553	0.643	0.514	0.518	0.532	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	Zn mg/l	<0.003	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.075 <sup>2</sup>

Legend:

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>\*</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

Results are shaded and in bold where they exceed the Threshold Value

\*= Detection Limit above guideline value

'<' = concentration is below the LOD for the parameter

AWN Consulting Ltd.

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379



PARAMETERS	UNIT	MW-3									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
BOD	mg/l	<1	<1	2	<1	<1	<1	<1	1	<1	-
COD	mg/l	9	<7	12	<7	<7	<7	<7	32	<7	-
Dissolved Oxygen	mg/l	5	9	6	8	9	7	6	11	9	-
Total Organic Carbon	C mg/l	<2	2	<2	<2	3	<2	4	<2	<2	No Abnormal Change
Chloride	Cl mg/l	16.6	15.3	17.4	24.8	18.8	14.7	17	21.2	19.5	187.5
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>1</sup>
Sulphate	SO4 mg/l	146.72	126.13	130.65	88.04	121.1	179.7	138.9	169.8	143.9	187.5
Nitrate	NO3 mg/l	0.8	<0.2	<0.2	0.8	0.3	<0.2	<0.2	<0.2	<0.2	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.375
Total Ammonia	NH4 mg/l	0.07	0.06	0.06	<0.03	0.07	0.06	<0.03	<0.03	<0.03	0.175
Total Oxidised Nitrogen	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-
Total Hardness	CaCO3 mg/l	467	451	452	352	426	441	400	409	476	200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	234	495	397	462	464	230	424	440	-
Total Alkalinity	CaCO3 mg/l	312	330	364	272	314	278	248	242	326	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1	<0.1	<0.15	0.0005 <sup>1</sup>
Metals											
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<20	<20	0.15
Arsenic	As mg/l	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<2.5	<2.5	0.0075
Barium	Ba mg/l	0.070	0.046	0.072	0.027	0.081	0.047	0.031	0.032	0.055	0.1
Boron	B mg/l	0.034	0.016	0.032	0.012	0.031	0.019	0.023	0.027	0.027	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.5	<0.5	0.003
Calcium	Ca mg/l	165.6	163.4	160.8	126.3	151.4	157.8	143.7	148.1	170.4	200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	0.035	0.005	<0.0015	<0.0015	<0.0015	<1.5	<1.5	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	<2	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<7	<7	1.5
Iron	Fe mg/l	<0.020	<0.020	0.174	<0.020	0.085	<0.020	<0.020	<20	<20	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	12.7	10.2	11.9	8.7	11.2	11.0	9.7	9.3	12	50 <sup>1</sup>
Manganese	Mn mg/l	0.420	<0.002	0.385	<0.002	0.305	0.005	0.034	<2	0.022	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<1	<1	0.00075
Nickel	Ni mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	<2	0.02 <sup>1*</sup>
Phosphorus	P mg/l	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	8	<5	-
Potassium	K mg/l	0.4	0.4	0.6	0.2	0.5	0.4	2.7	0.5	0.5	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<3	<3	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	-
Sodium	Na mg/l	10.4	10.9	11	15.9	10.2	9.2	26.5	11.4	10.4	150 <sup>1*</sup>
Strontium	Sr mg/l	0.466	0.648	0.494	0.679	0.532	0.738	0.759	0.714	0.559	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	Zn mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.075 <sup>2</sup>

Legend:

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

\* = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

Results are shaded and in bold where they exceed the Threshold Value

\*= Detection Limit above guideline value

'<' = concentration is below the LOD for the parameter

AWN Consulting Ltd.

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

PARAMETERS	UNIT	MW-4									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
BOD	mg/l	<1	<1	<1	<1	<1	<1	1	1	<1	-
COD	mg/l	39	<7	<7	12	<7	<7	<7	32	<7	-
Dissolved Oxygen	mg/l	5	9	7	9	9	6	7	11	9	-
Total Organic Carbon	C mg/l	<2	2	<2	<2	3	<2	5	<2	<2	No Abnormal Change
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	22.9	1 <sup>1</sup>
Chloride	Cl mg/l	7.2	24.5	83	5.1	5.1	9.5	6.1	31.5	<0.3	187.5
Sulphate	SO4 mg/l	41.78	71.85	44.03	31.32	41.2	62.7	66	133.4	80.3	187.5
Nitrate	NO3 mg/l	0.8	<0.2	0.3	1.2	0.5	1.6	2.5	5.1	<0.2	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.375
Total Ammonia	NH4 mg/l	0.08	0.05	0.05	<0.03	0.04	0.04	0.05	0.05	0.04	0.175
Total Oxidised Nitrogen	mg/l	<0.2	<0.2	<0.2	0.3	<0.2	0.3	0.6	1.2	<0.2	-
Total Hardness	CaCO3 mg/l	314	355	309	219	303	320	327	328	416	200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	160	309	257	311	357	120	327	373	-
Total Alkalinity	CaCO3 mg/l	454	306	406	156	688	900	328	270	752	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.15	0.0005 <sup>1</sup>
Metals											
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.02	<0.02	<0.02	<20	<20	0.15
Arsenic	As mg/l	<0.0025	0.0031	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<2.5	<2.5	0.0075
Barium	Ba mg/l	0.044	0.039	0.033	0.017	0.029	0.027	0.027	0.026	0.04	0.1
Boron	B mg/l	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<12	<12	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.005	<0.005	<0.5	<0.5	0.003
Calcium	Ca mg/l	117.9	134.7	116.8	82.7	114.4	120.0	123	123.9	156.8	200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<1.5	<1.5	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	<2	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<7	<7	1.5
Iron	Fe mg/l	<0.020	<0.020	<0.020	<0.020	<0.02	<0.02	<0.02	<20	<20	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	4.5	4.4	4.1	2.8	4.1	4.7	4.6	4.4	5.6	50 <sup>1</sup>
Manganese	Mn mg/l	0.269	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	<2	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<1	<1	0.00075
Nickel	Ni mg/l	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	<2	0.02 <sup>1*</sup>
Phosphorus	P mg/l	<0.005	0.008	0.005	0.005	0.005	<0.005	<0.005	9	0.007	-
Potassium	K mg/l	0.3	0.3	0.3	0.2	0.2	0.2	0.8	0.2	0.3	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	0.004	<0.003	<3	<3	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	-
Sodium	Na mg/l	7.1	15.3	10.9	6.8	6.6	7.6	9.8	7	9.8	150 <sup>1*</sup>
Strontium	Sr mg/l	0.461	0.518	0.492	0.355	0.503	0.506	0.523	0.466	0.613	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	-
Zinc	Zn mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<3	<3	0.075 <sup>2</sup>

Legend:

- = Not available / not analysed  
mg/l - milligrams per litre  
(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>\*</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

Results are shaded and in bold where they exceed the Threshold Value

\*= Detection Limit above guideline value

'<' = concentration is below the LOD for the parameter

AWN Consulting Ltd.  
Clarochem Ireland Limited GW Monitoring  
Project No. 12/6379

PARAMETERS	UNIT	MW-5									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	6/13/2017	6/14/2018	
BOD	mg/l	<1	<1	2.0	<1	<1	<1	<1	<1	14	-
COD	mg/l	19	<7	15	9	15	<7	19	20	29	-
Dissolved Oxygen	mg/l	7	9	7	9	9	9	6	10	4	-
Total Organic Carbon	C mg/l	4	2	<2	<2	5	<2	5	<2	6	No Abnormal Change
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>1</sup>
Sulphate	SO4 mg/l	124.31	74.56	119.21	92.28	66.49	166.1	101.3	156.8	121.4	187.5
Chloride	Cl mg/l	75.5	15.2	52.7	5.1	18.9	20.0	16	10.9	54.8	187.5
Nitrate	NO3 mg/l	0.8	1.2	<0.2	1.2	1.2	0.5	2.7	0.8	0.5	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	0.375
Total Ammonia	NH4 mg/l	0.11	0.05	0.05	<0.03	0.04	0.05	0.06	0.04	1.57	0.175
Total Oxidised Nitrogen	mg/l	<0.2	0.3	<0.2	0.5	0.3	<0.2	0.6	<0.2	<0.2	-
Total Hardness	CaCO3 mg/l	400	383	428	363	265	349	333	380	251	200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	131	142	404	283	343	277	400	242	-
Total Alkalinity	CaCO3 mg/l	354	364	464	274	248	248	270	264	1108	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.15	0.0005 <sup>1</sup>
Metals											
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.02	<0.020	<0.020	<20	<20	0.15
Arsenic	As mg/l	<0.0025	0.0025	<0.0025	<0.0025	0.0025	<0.0025	<0.0025	<2.5	<2.5	0.0075
Barium	Ba mg/l	0.06	0.046	0.069	0.04	0.033	0.047	0.035	0.046	0.204	0.1
Boron	B mg/l	<0.012	<0.012	0.024	0.026	0.02	<0.012	0.028	0.029	0.034	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	0.006	<0.0005	<0.0005	<0.0005	<0.5	<0.5	0.003
Calcium	Ca mg/l	140.6	138.1	150.8	129.6	95.3	123.6	118.5	134.6	81.7	200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.0015	<0.0015	0.0026	<0.0015	<0.0015	<1.5	<1.5	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	<2	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<7	<7	1.5
Iron	Fe mg/l	<0.020	<0.020	0.025	<0.020	<0.02	<0.020	<0.020	<20	<20	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	11.6	5.9	12.2	9.3	6.4	9.6	8.8	10.3	11.1	50 <sup>1</sup>
Manganese	Mn mg/l	0.693	<0.002	0.507	0.113	0.055	<0.002	<0.002	<2	1.242	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.00075
Nickel	Ni mg/l	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	0.007	0.02 <sup>1*</sup>
Phosphorus	P mg/l	<0.005	0.015	0.009	0.012	0.018	0.011	0.022	0.031	0.006	-
Potassium	K mg/l	2	1.8	2.2	1.8	1.7	1.7	2.2	2.3	2.8	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	0.008	0.008	<3	<3	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	-
Sodium	Na mg/l	85	22.1	102	16.3	22.2	26.5	19.1	15.3	95.3	150 <sup>1*</sup>
Strontium	Sr mg/l	0.75	0.679	0.872	0.674	0.498	0.695	0.607	0.667	0.755	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.021	<0.005	<0.005	-
Zinc	Zn mg/l	<0.003	<0.003	0.005	0.005	<0.003	0.064	<0.003	<0.003	<0.003	0.075 <sup>2</sup>

Legend:

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>\*</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

**Results are shaded and in bold where they exceed the Threshold Value**

\*= Detection Limit above guideline value

'<' = concentration is below the LOD for the parameter

**AWN Consulting Ltd.**  
Clarochem Ireland Limited GW Monitoring  
Project No. 12/6379

PARAMETERS	UNIT	MW-6									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
BOD	mg/l	14	<1	5	6	<1	<1	5	2	2	-
COD	mg/l	19	<7	12	11	<7	<7	<7	46	9	-
Dissolved Oxygen	mg/l	6	9	8	8	8	8	6	11	9	-
Total Organic Carbon	C mg/l	12	3	<2	<2	2	<2	6	<2	<2	No Abnormal Change
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>1</sup>
Sulphate	SO4 mg/l	138.42	81.94	97.25	97.54	101.09	125.9	126.5	123.7	60.3	187.5
Chloride	Cl mg/l	87.4	30	95.8	58.4	58.5	65.4	70.2	56.7	128	187.5
Nitrate	NO3 mg/l	1.8	4.2	2.1	1.9	0.6	0.4	0.9	0.8	2.5	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.09	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.375
Total Ammonia	NH4 mg/l	2.5	0.11	0.09	0.11	0.09	0.05	0.1	0.07	0.05	0.175
Total Oxidised Nitrogen	mg/l	0.4	0.9	0.5	0.4	<0.2	<0.2	0.2	<0.2	0.6	-
Total Hardness	CaCO3 mg/l	273	205	206	219	245	255	299	279	282	200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	116	237	248	256	260	185	268	277	-
Total Alkalinity	CaCO3 mg/l	282	216	362	128	834	610	240	710	486	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.15	0.0005 <sup>1</sup>
Metals											
Aluminium	Al mg/l	<0.020	<0.020	<0.020	0.097	<0.020	<0.020	<0.020	<20	<20	0.15
Arsenic	As mg/l	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<2.5	<2.5	0.0075
Barium	Ba mg/l	0.082	0.04	0.048	0.047	0.06	0.06	0.06	0.058	0.068	0.1
Boron	B mg/l	0.022	<0.012	0.031	0.028	0.02	<0.012	0.024	0.025	0.029	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.5	<0.5	0.003
Calcium	Ca mg/l	98.7	75.2	75.7	79.3	87.9	91.5	106.5	100	101.2	200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<1.5	<1.5	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	<2	-
Copper	Cu mg/l	<.007	<.007	<0.007	<0.007	<0.007	<0.007	<0.007	<7	<7	1.5
Iron	Fe mg/l	<0.020	<0.020	<0.020	0.193	<0.020	<0.020	<0.020	<20	<20	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	6.3	4	4.1	4.9	5.9	6.3	7.8	7.0	6.8	50 <sup>1</sup>
Manganese	Mn mg/l	0.412	<0.002	0.257	0.295	0.38	<0.002	<0.002	<2	0.033	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<1	<1	0.00075
Nickel	Ni mg/l	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	<2	0.02 <sup>1*</sup>
Phosphorus	P mg/l	0.234	0.144	0.162	0.161	0.102	0.080	0.051	0.057	0.056	-
Potassium	K mg/l	2	1.5	1.6	1.6	1.5	1.3	1.4	1.4	1.6	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<3	<3	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	-
Sodium	Na mg/l	137.2	50	59.3	65.2	66.1	65.8	72.7	60.5	58.3	150 <sup>1*</sup>
Strontium	Sr mg/l	0.332	0.224	0.251	0.219	0.309	0.319	0.0374	0.308	0.345	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	-
Zinc	Zn mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<3	<3	0.075 <sup>2</sup>

Legend:

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>\*</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

Results are shaded and in bold where they exceed the Threshold Value

\*= Detection Limit above guideline value

'<' = concentration is below the LOD for the parameter

AWN Consulting Ltd.

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379



PARAMETERS	UNIT	MW-7									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
BOD	mg/l	83	2	<1	56	13	13	2	4	23	-
COD	mg/l	186	11	21	280	30	64	18	13	75	-
Dissolved Oxygen	mg/l	1	8	10	7	8	8	<1	9	5	-
Total Organic Carbon	C mg/l	<b>51</b>	9	6	<b>73</b>	9	18	9	2	19	No Abnormal Change
Chloride	Cl mg/l	<b>629.5</b>	141.2	95.8	167.5	<b>652.1</b>	186.4	73.1	6.8	<b>459.1</b>	<b>187.5</b>
Fluoride	F mg/l	0.6	<0.3	<0.3	<0.3	<0.3	0.3	<0.3	<0.3	<0.3	<b>1<sup>1</sup></b>
Sulphate	SO4 mg/l	57.79	161.1	128.87	110.28	102.72	178.9	169.3	91.8	53.5	<b>187.5</b>
Nitrate	NO3 mg/l	0.9	<0.2	<0.2	0.7	0.4	<0.2	<0.2	3.9	<0.2	<b>37.5</b>
Nitrite	NO2 mg/l	<0.02	<0.02	0.14	0.04	0.09	<0.02	0.06	<0.02	<0.02	<b>0.375</b>
Total Ammonia	NH4 mg/l	<b>30.07</b>	0.09	<b>0.84</b>	<b>2.8</b>	<b>1.69</b>	<b>4.04</b>	<b>1.29</b>	<b>1.15</b>	<b>3.68</b>	<b>0.175</b>
Total Oxidised Nitrogen	mg/l	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.9	<0.2	-
Non-Carbonate Hardness	CaCO3 mg/l	-	185	232	23	120	20	8	99	192	-
Total Hardness	CaCO3 mg/l	<b>334</b>	<b>257</b>	<b>219</b>	23	145	21	161	91	193	<b>200<sup>1</sup></b>
Total Alkalinity	CaCO3 mg/l	318	162	180	382	154	466	262	150	192	No Abnormal Change
Total Cyanide	mg/l	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	<b>0.037</b>
Total Phenols	mg/l	<b>1.9</b>	<0.1*	<b>0.3</b>	<b>8.7</b>	<b>0.2</b>	<b>0.6</b>	<0.1*	<0.1*	<0.15	<b>0.0005<sup>1</sup></b>
Metals											
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<b>1.151</b>	0.03	<b>0.341</b>	<b>0.032</b>	<20	<20	<b>0.15</b>
Arsenic	As mg/l	<b>0.0081</b>	<b>0.0077</b>	0.0069	<b>0.0499</b>	<b>0.015</b>	<b>0.0609</b>	<b>0.0186</b>	<b>0.0094</b>	<b>3.4</b>	<b>0.0075</b>
Barium	Ba mg/l	<b>0.442</b>	0.095	0.082	0.018	<b>0.181</b>	0.024	0.163	0.066	<b>0.262</b>	<b>0.1</b>
Boron	B mg/l	0.053	0.022	0.037	0.067	0.038	0.047	0.057	0.032	0.038	<b>0.75</b>
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.5	<0.5	<b>0.003</b>
Calcium	Ca mg/l	114	89.2	75.9	8.7	35.9	7.8	52.8	31.0	62.3	<b>200<sup>1</sup></b>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<1.5	<1.5	<b>0.037</b>
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	<2	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	0.015	<0.007	<0.007	<0.007	<7	<7	<b>1.5</b>
Iron	Fe mg/l	0.136	<0.020	<0.020	0.076	<0.020	<0.020	<0.020	25	0.138	<b>0.2<sup>1</sup></b>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<b>0.021</b>	<0.005	<0.005	<0.005	<5	<5	<b>0.0075<sup>2</sup></b>
Magnesium	Mg mg/l	11.6	8	6.9	0.2	3.7	0.4	7	3.3	8.7	<b>50<sup>1</sup></b>
Manganese	Mn mg/l	<b>0.537</b>	<b>0.263</b>	<b>0.197</b>	<0.002	0.011	<0.002	0.022	0.003	<b>0.168</b>	<b>0.05<sup>1</sup></b>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<1	<1	<b>0.00075</b>
Nickel	Ni mg/l	<0.002	0.002	<0.002	0.015	0.002	0.017	0.003	<2	0.003	<b>0.02<sup>1*</sup></b>
Phosphorus	P mg/l	0.398	0.09	0.127	0.162	0.167	0.144	0.204	303	0.214	-
Potassium	K mg/l	<b>12.7</b>	<b>6</b>	<b>6.6</b>	4.3	<b>10.8</b>	5.0	6	6.0	<b>11.9</b>	<b>5<sup>1</sup></b>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	0.005	<0.003	<3	<3	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	-
Sodium	Na mg/l	<b>435.5</b>	121.9	98.4	<b>385.5</b>	<b>495.8</b>	<b>427.9</b>	<b>166.2</b>	<b>162.1</b>	<b>303.7</b>	<b>150<sup>1*</sup></b>
Strontium	Sr mg/l	3.165	2.453	2.128	0.206	1.715	0.319	2.022	0.807	2.7	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	-
Zinc	Zn mg/l	<0.003	0.008	<0.003	0.007	<0.003	0.007	0.004	<3	0.005	<b>0.075<sup>2</sup></b>

Legend:

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>‡</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

**Results are shaded and in bold where they exceed the Threshold Value**

\*= Detection Limit above guideline value

`<' = concentration is below the LOD for the parameter

AWN Consulting Ltd.

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

PARAMETERS	UNIT	MW-8								Threshold Values	
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017		6/14/2018
BOD	mg/l	<1	<1	5	<1	<1	-	DRY	<1	DRY	-
COD	mg/l	17	<7	129	22	17	-		240		-
Dissolved Oxygen	mg/l	6	9	10	7	8	-		9		-
Total Organic Carbon	C mg/l	4	5	<2	<2	15	-		<2		No Abnormal Change
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3		<0.3		1 <sup>1</sup>
Chloride	Cl mg/l	23.6	25.1	22	29.7	22.2	34.9		56.2		187.5
Sulphate	SO4 mg/l	116.71	110.97	99.66	141.89	88.82	91.9		224.9		187.5
Nitrate	NO3 mg/l	18.5	13.8	12.5	22.9	7	0.4		<0.2		37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.08	<0.02	0.02	<0.02		0.05		0.375
Total Ammonia	NH4 mg/l	1.17	0.09	0.09	0.11	0.15	0.08		<0.03		0.175
Total Oxidised Nitrogen	mg/l	4.2	3.1	2.8	5.2	1.6	<0.2		<0.2		-
Total Hardness	CaCO3 mg/l	753	606	708	546	508	-		519		200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	218	337	546	545	-		255		-
Total Alkalinity	CaCO3 mg/l	1866	532	3768	282	7646	1830		1432		No Abnormal Change
Total Cyanide	mg/l	0.01	<0.01	<0.01	0.01	<0.01	<0.01		<0.01		0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	-	<0.1*	0.0005 <sup>1</sup>		
Metals											
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.02	<0.02	DRY	<20	DRY	0.15
Arsenic	As mg/l	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025		<2.5		0.0075
Barium	Ba mg/l	0.074	0.054	0.071	0.06	0.069	0.110		0.081		0.1
Boron	B mg/l	0.033	0.016	0.028	0.033	0.029	0.020		0.04		0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.5		0.003
Calcium	Ca mg/l	279.3	223	263	199.5	181.8	167.2		187.7		200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015		<1.5		0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002		<2		-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007		<7		1.5
Iron	Fe mg/l	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020		<20		0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	0.006	<0.005	<0.005		<5		0.0075 <sup>2</sup>
Magnesium	Mg mg/l	13	11.8	12.1	11.2	12.7	13.2		11.8		50 <sup>1</sup>
Manganese	Mn mg/l	0.021	<0.002	0.724	0.093	2.021	0.048		<2		0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*		<1		0.00075
Nickel	Ni mg/l	0.005	0.002	<0.002	0.002	0.006	0.011		0.005		0.02 <sup>1*</sup>
Phosphorus	P mg/l	0.009	0.011	<0.005	0.009	0.01	0.01		0.019		-
Potassium	K mg/l	0.8	0.7	0.7	1.8	1.1	1.7		3.5		5 <sup>1</sup>
Selenium	Se mg/l	<0.003	0.009	<0.003	<0.003	<0.003	<0.003		<3		-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<5		-
Sodium	Na mg/l	20.3	17.8	19.7	16.8	19.2	20.1		19.2		150 <sup>1*</sup>
Strontium	Sr mg/l	0.832	0.706	0.725	0.651	0.671	0.642		0.632		-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<5		-
Zinc	Zn mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003		<3		0.075 <sup>2</sup>

Legend:

- = Not available / not analysed  
mg/l - milligrams per litre  
(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

\* = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

Results are shaded and in bold where they exceed the Threshold Value

\*= Detection Limit above guideline value

`<' = concentration is below the LOD for the parameter

AWN Consulting Ltd.

Clarochem Ireland Limited GW Monitoring  
Project No. 12/6379

PARAMETERS	UNIT	MW-9									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
BOD	mg/l	<1	<1	4	<1	261	2	<1	<1	<1	-
COD	mg/l	30	<7	46	9	454	11	14	9	7	-
Dissolved Oxygen	mg/l	5	9	8	8	4	6	6	11	7	-
Total Organic Carbon	C mg/l	2	3	<2	<2	166	<2	2	<2	<2	No Abnormal Change
Fluoride	F mg/l	0.3	<0.3	<0.3	<0.3	0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>1</sup>
Chloride	Cl mg/l	7.7	6.8	7.1	5.3	10.9	5.9	4.1	4.5	20.9	187.5
Sulphate	SO4 mg/l	166.01	109.78	105.56	75.3	12.69	62.8	58.6	41.6	47.8	187.5
Nitrate	NO3 mg/l	7.4	1.8	3.1	3.6	1.2	0.6	10.8	3.9	1.9	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.07	<0.02	0.21	<0.02	<0.02	<0.02	0.11	0.375
Total Ammonia	NH4 mg/l	0.05	0.05	0.06	0.06	13.5	0.37	0.19	0.09	0.08	0.175
Total Oxidised Nitrogen	mg/l	1.7	0.4	0.7	0.8	0.3	<0.2	2.4	0.9	0.5	-
Non-Carbonate Hardness	CaCO3 mg/l	-	183	303	233	490	263	100	205	232	-
Total Hardness	CaCO3 mg/l	332	282	285	172	422	258	221	187	219	200 <sup>1</sup>
Total Alkalinity	CaCO3 mg/l	592	228	294	136	538	678	234	174	808	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.15	0.0005 <sup>1</sup>
Metals											
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.02	<0.02	<0.02	<20	<20	0.15
Arsenic	As mg/l	<0.0025	<0.0025	<0.0025	<0.0025	0.0052	<0.0025	<0.0025	<2.5	<2.5	0.0075
Barium	Ba mg/l	0.035	0.034	0.045	0.029	0.203	0.111	0.053	0.046	0.102	0.1
Boron	B mg/l	0.017	<0.012	0.021	0.016	0.021	<0.012	0.013	0.013	<12	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.5	<0.5	0.003
Calcium	Ca mg/l	112.8	97.1	95.2	81.3	139	85.5	77.6	65.2	78.8	200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	0.0055	<0.0015	<0.0015	<0.0015	<0.0015	<1.5	<1.5	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.003	<0.002	<0.002	<2	<2	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<7	<7	1.5
Iron	Fe mg/l	0.029	<0.020	<0.020	<0.020	3.07	<0.020	<0.020	<20	<20	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	11.9	9.4	11.2	4.6	17.8	10.5	6.4	5.7	8.3	50 <sup>1</sup>
Manganese	Mn mg/l	<0.002	<0.002	0.025	<0.002	5.049	<0.002	<0.002	<2	0.003	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<1	<1	0.00075
Nickel	Ni mg/l	<0.002	<0.002	<0.002	<0.002	0.008	0.003	<0.002	<2	0.003	0.02 <sup>1*</sup>
Phosphorus	P mg/l	0.006	0.007	<0.005	0.011	0.027	<0.005	<0.005	11	0.006	-
Potassium	K mg/l	3	3.4	3.1	4.1	5.2	2.4	2.6	2	2.3	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<3	<3	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	-
Sodium	Na mg/l	16.6	12.1	13.4	6.8	15.2	10.4	7.2	6	12.2	150 <sup>1*</sup>
Strontium	Sr mg/l	1.269	0.877	0.917	0.721	1.439	0.858	0.765	0.575	0.725	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	0.006	-
Zinc	Zn mg/l	<0.003	<0.003	<0.003	0.003	<0.003	<0.003	<0.003	<3	<3	0.075 <sup>2</sup>

Legend:

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

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^<' = concentration is below the LOD for the parameter

AWN Consulting Ltd.

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

PARAMETERS	UNIT	MW-10									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
BOD	mg/l	<1	<1	2	<1	<1	<1	<1	<1	<1	-
COD	mg/l	54	<7	16	16	8	<7	<7	<7	<7	-
Dissolved Oxygen	mg/l	5	10	7	8	8	5	6	11	9	-
Total Organic Carbon	C mg/l	<2	2	<2	<2	2	<2	25.6	<2	<2	No Abnormal Change
Chloride	Cl mg/l	25.9	12.6	23.6	19.1	10.2	25.8	3	27.4	27.7	187.5
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>1</sup>
Sulphate	SO4 mg/l	75.96	40.73	85.85	65.28	36.82	99.1	110	135.6	120.1	187.5
Nitrate	NO3 mg/l	2.6	1	1.8	4.2	1.7	0.4	1.6	1.2	2.4	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.375
Total Ammonia	NH4 mg/l	0.05	0.04	0.03	0.04	<0.03	0.04	0.05	0.04	0.07	0.175
Total Oxidised Nitrogen	mg/l	0.6	0.2	0.4	0.9	0.4	<0.2	0.4	0.3	0.5	-
Total Hardness	CaCO3 mg/l	260	182	262	307	130	306	323	345	324	200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	101	296	242	186	299	190	355	299	-
Total Alkalinity	CaCO3 mg/l	276	172	396	278	260	588	278	286	310	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.15	0.0005 <sup>1</sup>
Metals											
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.020	<0.040	<0.020	<20	<20	0.15
Arsenic	As mg/l	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.005	<0.0025	<2.5	<2.5	0.0075
Barium	Ba mg/l	0.053	0.029	0.049	0.071	0.025	0.090	0.071	0.094	0.066	0.1
Boron	B mg/l	<0.012	<0.012	<0.012	0.023	<0.012	<0.024	0.02	0.022	0.019	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.001	<0.0005	<0.5	<0.5	0.003
Calcium	Ca mg/l	88.9	63.4	90.1	105	44.5	105.1	110.3	118.5	111	200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.003	<0.0015	<1.5	<1.5	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.004	<0.002	<2	<2	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.014	<0.007	<7	<7	1.5
Iron	Fe mg/l	<0.020	<0.020	<0.020	<0.020	<0.020	<0.040	<0.020	<20	<20	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010*	<0.005	<5	<5	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	8.9	5.7	8.7	10.5	4.4	10.4	11.3	11.6	11.1	50 <sup>1</sup>
Manganese	Mn mg/l	0.02	<0.002	0.011	0.137	0.013	<0.004	0.013	<2	<2	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.002*	<0.001*	<1	<1	0.00075
Nickel	Ni mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.004	<0.002	<2	<2	0.02 <sup>1*</sup>
Phosphorus	P mg/l/l	0.013	0.015	0.012	0.009	0.018	<0.010	0.013	0.018	0.015	-
Potassium	K mg/l	2	1.6	2.1	2	1.4	1.9	2	2	2.3	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	0.004	<0.003	<0.003	<0.003	<0.006	<0.003	<3	<3	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	-
Sodium	Na mg/l	12.4	9	12.8	12	6.3	11.4	13.3	13.5	14.8	150 <sup>1*</sup>
Strontium	Sr mg/l	0.316	0.197	0.313	0.363	0.158	0.356	0.38	0.382	0.381	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	<5	-
Zinc	Zn mg/l	<0.003	<0.003	<0.003	<0.003	0.003	<0.006	<0.003	<3	<3	0.075 <sup>2</sup>

Legend:

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>\*</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

Results are shaded and in bold where they exceed the Threshold Value

\*= Detection Limit above guideline value

'<' = concentration is below the LOD for the parameter

Note: analysis for MW-10 was undertaken using x2 dilution for a number of the metal parameters and therefore the LOD is twice that of the analysis for the other samples.

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Table 3a: Hydrocarbon Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-1									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	-	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	170	170	150	<10	100	240	860	180	<b>190</b>	-
Petrol Range Organics	µg/l	14	104	355	450	208	97	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	2.5	<1.5	<2.1	<3	<3	<3	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

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Table 3b: Hydrocarbon Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-2									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	150	<10	<10	<10	<10	<10	-
Petrol Range Organics	µg/l	<10	<10	18	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	12.3	<0.5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<3	<3	<3	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

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Table 3c: Hydrocarbon Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-3									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<3	<3	<3	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

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Table 3d: Hydrocarbon Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-4									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
Mineral Oil	µg/l	<10	940	<10	<10	<10	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	1440	<10	<10	<10	<10	<10	<10	<10	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<3	<3	<3	<3	10 <sup>1</sup>

**Legend:**  
µg/l - micrograms per litre (parts per billion)  
Results are compared to the Groundwater Regulations 2010  
<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)  
<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016  
**Results are shaded and in bold where they exceed the Threshold Value**  
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Table 3e: Hydrocarbon Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-5									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<b>150</b>	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<3	<3	<3	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

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Table 3f: Hydrocarbon Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-6									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	-	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	<10	120	<10	<10	<10	<10	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<3	<3	<3	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

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Table 3g: Hydrocarbon Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-7									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	160	<10	<10	250	10	<10	<10	<10	<b>140</b>	-
Petrol Range Organics	µg/l	143	<10	<10	4971	181	514	<10	<10	<b>140</b>	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	1.60	<0.5	<1	<1	<1	1.0	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	5	<1.5	<3	<3	<3	2.0	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

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Table 3h: Hydrocarbon Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-8									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	12/14/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	<10	-	-	<10	-	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	<10	<10	-	-	<10	-	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	-	-	<10	-	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	<0.5	-	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	-	-	<5	-	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	<0.5	-	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	-	-	<1.5	-	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

- = Well Dry

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

Results are shaded and in bold where they exceed the Threshold Value

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Table 3i: Hydrocarbon Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-9									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	0	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	<10	100	<10	<10	<10	<10	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<3	<3	<3	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

- = Well Dry

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

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Table 3j: Hydrocarbon Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-10									Threshold Values
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	-	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	<10	140	<10	<10	<10	<10	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1 or <0.5	<3	<3	<3	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

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Table 4a: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-1								
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<2	<2	<2	<4	<4	<4	<4
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3
1,2,4-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dibromoethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<5	<5	<5	<5
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<0.1
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<2
o Xylene	µg/l	<0.5	<0.5	1.5	<0.5	1.1	<1	<1	<1	<3
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<1
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<2
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<3
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<2
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<3
trans 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<5
trans 1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<3
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<2
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VOC TICs				ND			ND	ND		ND
Acetone	µg/l					118				

Legend:

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Dutch S-Value:** Target Value

**Dutch I-Value:** Intervention Value

Results are underlined where they exceed the Dutch S-Value

Results are bold where they exceed the Dutch I-Value

Results are shaded and in bold where they exceed the Threshold Value

Threshold Values	Dutch Guidelines	
	S - value	I - value
500 <sup>1</sup>	-	-
-	-	-
30 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
0.4 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
2.25	0.01	400
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
0.75	0.2	30
-	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
-	-	-
12 <sup>1</sup>	1	40
-	-	-
-	-	-
-	-	-
-	-	-
15 <sup>2</sup>	0.01	1000
10 <sup>1</sup>	0.2	150
0.1 <sup>1</sup>	-	-
-	-	-
1	0.01	70
-	-	-
10 <sup>1</sup>	0.2	70
10 <sup>1</sup>	0.2	70
-	-	-
-	-	-
-	0.5	300
-	-	-
7.5 <sup>2</sup>	0.01	40
525	0.2	1000
-	-	-
-	-	-
7.5 <sup>2</sup>	0.01	500
-	-	-
0.375	-	0.7
-	-	-
-	-	-

**AWN Consulting**

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

Table 4a: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-2								
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3
1,2,4-Trimethylbenzene	µg/l	<3	<3	<2	<3	<3	<3	<3	<3	<3
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2
1,2-Dibromoethane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dichloromethane	µg/l	<3	<3	<3	<3	<5	<5	<5	<5	<5
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Toluene	µg/l	<0.5	<0.5	12.3	<0.5	<5	<5	<5	<5	<5
trans 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
trans 1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VOC TICs				NA			ND	ND	ND	ND

**Legend:**  
ND = TICS analysed - not detected  
µg/l - micrograms per litre (parts per billion)  
Results are compared to the Groundwater Regulations 2010  
<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)  
<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016  
**Dutch S-Value:** Target Value  
**Dutch I-Value:** Intervention Value  
Results are underlined where they exceed the Dutch S-Value  
Results are bold where they exceed the Dutch I-Value  
Results are shaded and in bold where they exceed the Thresh

Threshold Values	Dutch Guidelines	
	S - value	I - value
500 <sup>1</sup>	-	-
-	-	-
-	-	-
30 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
0.4 <sup>1</sup>	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
2.25	0.01	400
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
0.75	0.2	30
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
-	-	-
12 <sup>1</sup>	1	40
-	-	-
-	-	-
-	-	-
-	-	-
15 <sup>2</sup>	0.01	1000
10 <sup>1</sup>	0.2	150
0.1 <sup>1</sup>	-	-
-	-	-
1	0.01	70
-	-	-
10 <sup>1</sup>	0.2	70
10 <sup>1</sup>	0.2	70
-	-	-
-	-	-
-	0.5	300
-	-	-
7.5 <sup>2</sup>	0.01	40
525	0.2	1000
-	-	-
-	-	-
7.5 <sup>2</sup>	0.01	500
-	-	-
0.375	-	0.7

**AWN Consulting**  
Clarochem Ireland Limited GW Monitoring  
  
Project No. 12/6379

Table 4c: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-3								
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3
1,2,4-Trimethylbenzene	µg/l	<3	<3	<2	<3	<3	<3	<3	<3	<3
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2
1,2-Dibromoethane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5
trans 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
trans 1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VOC TICs				NA			ND	ND	ND	ND

**Legend:**  
ND = TICS analysed - not detected  
µg/l - micrograms per litre (parts per billion)  
Results are compared to the Groundwater Regulations 2010  
<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)  
<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016  
**Dutch S-Value:** Target Value  
**Dutch I-Value:** Intervention Value  
Results are underlined where they exceed the Dutch S-Value  
Results are bold where they exceed the Dutch I-Value  
Results are shaded and in bold where they exceed the Thresh

Threshold Values	Dutch Guidelines	
	S - value	I - value
500 <sup>1</sup>	-	-
-	-	-
-	-	-
30 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
0.4 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
2.25	0.01	400
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
0.75	0.2	30
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
-	-	-
12 <sup>1</sup>	1	40
-	-	-
-	-	-
-	-	-
15 <sup>2</sup>	0.01	1000
10 <sup>1</sup>	0.2	150
0.1 <sup>1</sup>	-	-
-	-	-
1	0.01	70
-	-	-
10 <sup>1</sup>	0.2	70
10 <sup>1</sup>	0.2	70
-	-	-
-	-	-
-	0.5	300
-	-	-
7.5 <sup>2</sup>	0.01	40
525	0.2	1000
-	-	-
-	-	-
7.5 <sup>2</sup>	0.01	500
-	-	-
0.375	-	0.7

**AWN Consulting**  
Clarochem Ireland Limited GW Monitoring  
  
Project No. 12/6379

Table 4d: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-4								
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3
1,2,4-Trimethylbenzene	µg/l	<3	<3	<2	<3	<3	<3	<3	<3	<3
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2
1,2-Dibromoethane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dichloromethane	µg/l	<3	<3	<3	<3	<5	<5	<5	<5	<5
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5
trans 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
trans 1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VOC TICs				ND			ND	ND	ND	ND

**Legend:**  
ND = TICS analysed - not detected  
µg/l - micrograms per litre (parts per billion)  
Results are compared to the Groundwater Regulations 2010  
<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)  
<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016  
**Dutch S-Value:** Target Value  
**Dutch I-Value:** Intervention Value  
Results are underlined where they exceed the Dutch S-Value  
Results are bold where they exceed the Dutch I-Value  
Results are shaded and in bold where they exceed the Threshc

Threshold Values	Dutch Guidelines	
	S - value	I - value
500 <sup>1</sup>	-	-
-	-	-
-	-	-
30 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
0.4 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
2.25	0.01	400
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
0.75	0.2	30
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
-	-	-
12 <sup>1</sup>	1	40
-	-	-
-	-	-
-	-	-
-	-	-
15 <sup>2</sup>	0.01	1000
10 <sup>1</sup>	0.2	150
0.1 <sup>1</sup>	-	-
-	-	-
1	0.01	70
-	-	-
10 <sup>1</sup>	0.2	70
10 <sup>1</sup>	0.2	70
-	-	-
-	-	-
-	0.5	300
-	-	-
7.5 <sup>2</sup>	0.01	40
525	0.2	1000
-	-	-
-	-	-
7.5 <sup>2</sup>	0.01	500
-	-	-
0.375	-	0.7

**AWN Consulting**  
Clarochem Ireland Limited GW Monitoring  
  
Project No. 12/6379



Table 4e: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-5								
		6/19/2014	12/4/2014	6/26/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3
1,2,4-Trimethylbenzene	µg/l	<3	<3	<2	<3	<3	<3	<3	<3	<3
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2
1,2-Dibromoethane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dichloromethane	µg/l	<3	<3	<3	<3	<5	<5	<5	<5	<5
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5
trans 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
trans 1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VOC TICs				NA			ND	ND	ND	ND

Legend:

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Dutch S-Value:** Target Value

**Dutch I-Value:** Intervention Value

Results are underlined where they exceed the Dutch S-Value

Results are bold where they exceed the Dutch I-Value

Results are shaded and in bold where they exceed the Thresh

Threshold Values	Dutch Guidelines	
	S - value	I - value
500 <sup>1</sup>	-	-
-	-	-
-	-	-
30 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
0.4 <sup>1</sup>	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
2.25	0.01	400
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
0.75	0.2	30
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
-	-	-
12 <sup>1</sup>	1	40
-	-	-
-	-	-
-	-	-
-	-	-
15 <sup>2</sup>	0.01	1000
10 <sup>1</sup>	0.2	150
0.1 <sup>1</sup>	-	-
-	-	-
1	0.01	70
-	-	-
10 <sup>1</sup>	0.2	70
10 <sup>1</sup>	0.2	70
-	-	-
-	-	-
-	0.5	300
-	-	-
7.5 <sup>2</sup>	0.01	40
525	0.2	1000
-	-	-
-	-	-
7.5 <sup>2</sup>	0.01	500
-	-	-
0.375	-	0.7

AWN Consulting

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

Table 4f: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-6								
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3
1,2,4-Trimethylbenzene	µg/l	<3	<3	<2	<3	<3	<3	<3	<3	<3
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2
1,2-Dibromoethane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<5	<5	<5	<5
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5
trans 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
trans 1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VOC TICs				NA			ND	ND	ND	ND

**Legend:**  
ND = TICS analysed - not detected  
µg/l - micrograms per litre (parts per billion)  
Results are compared to the Groundwater Regulations 2010  
<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)  
<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016  
**Dutch S-Value:** Target Value  
**Dutch I-Value:** Intervention Value  
Results are underlined where they exceed the Dutch S-Value  
Results are bold where they exceed the Dutch I-Value  
Results are shaded and in bold where they exceed the Threshold Value

Threshold Values	Dutch Guidelines	
	S - value	I - value
500 <sup>1</sup>	-	-
-	-	-
-	-	-
30 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
0.4 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
2.25	0.01	400
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
0.75	0.2	30
-	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
-	-	-
12 <sup>1</sup>	1	40
-	-	-
-	-	-
-	-	-
15 <sup>2</sup>	0.01	1000
10 <sup>1</sup>	0.2	150
0.1 <sup>1</sup>	-	-
-	-	-
1	0.01	70
-	-	-
10 <sup>1</sup>	0.2	70
10 <sup>1</sup>	0.2	70
-	-	-
-	-	-
-	0.5	300
-	-	-
7.5 <sup>2</sup>	0.01	40
525	0.2	1000
-	-	-
-	-	-
7.5 <sup>2</sup>	0.01	500
-	-	-
0.375	-	0.7

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Clarochem Ireland Limited GW Monitoring  
  
Project No. 12/6379

Table 4g: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-7								
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3
1,2,4-Trimethylbenzene	µg/l	<3	<3	<2	<3	<3	<3	<3	<3	<3
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2
1,2-Dibromoethane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<5	<5	<5	<5
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	1.6	<0.5	<1	<1	<1	1
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
o Xylene	µg/l	<0.5	<0.5	<0.5	4	<0.5	<1	<1	<1	2
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5
trans-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
trans-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VOC TICs								ND		
Acetone	µg/l					179				
Triethylamine	µg/l						261			
Isopropyl Alcohol	ug/l									241

Legend:

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

Dutch S-Value: Target Value

Dutch I-Value: Intervention Value

Results are underlined where they exceed the Dutch S-Value

Results are bold where they exceed the Dutch I-Value

Results are shaded and in bold where they exceed the Thresho

Threshold Values	Dutch Guidelines	
	S - value	I - value
500 <sup>1</sup>	-	-
-	-	-
-	-	-
30 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
0.4 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
2.25	0.01	400
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
0.75	0.2	30
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
-	-	-
12 <sup>1</sup>	1	40
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
15 <sup>2</sup>	0.01	1000
10 <sup>1</sup>	0.2	150
0.1 <sup>1</sup>	-	-
-	-	-
1	0.01	70
-	-	-
10 <sup>1</sup>	0.2	70
10 <sup>1</sup>	0.2	70
-	-	-
-	-	-
-	0.5	300
-	-	-
7.5 <sup>2</sup>	0.01	40
525	0.2	1000
-	-	-
-	-	-
7.5 <sup>2</sup>	0.01	500
-	-	-
0.375	-	0.7
-	-	-
-	-	-
-	-	-

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Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

Table 4h: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-8								
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	-	-	<4	-
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	-	-	<2	-
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
1,2,4-Trichlorobenzene	µg/l	<3	<3	<3	<2	<3	-	-	<3	-
1,2,4-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
1,2-Dibromoethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	-	-	<1	-
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	<0.5	-
Bromobenzene	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
Bromoform	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
Bromomethane	µg/l	<1	<1	<1	<1	<1	-	-	<1	-
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
Chloroethane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
Chloroform	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
Chloromethane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
cis 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
Dibromomethane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
Dichloromethane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	<0.5	-
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
Naphthalene	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	<0.5	-
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	-	-	<1	-
Propylbenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
Styrene	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	-	-	<5	-
trans 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
trans 1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	-	-	<2	-
Trichloroethene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	-
VOC TICs		ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend:

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Dutch S-Value:** Target Value

**Dutch I-Value:** Intervention Value

Results are underlined where they exceed the Dutch S-Value

Results are bold where they exceed the Dutch I-Value

Results are shaded and in bold where they exceed the Threshold

Threshold Values	Dutch Guidelines	
	S - value	I - value
500 <sup>1</sup>	-	-
-	-	-
-	-	-
30 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
0.4 <sup>1</sup>	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
2.25	0.01	400
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
0.75	0.2	30
-	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
-	-	-
12 <sup>1</sup>	1	40
-	-	-
-	-	-
-	-	-
-	-	-
15 <sup>2</sup>	0.01	1000
10 <sup>1</sup>	0.2	150
0.1 <sup>1</sup>	-	-
-	-	-
1	0.01	70
-	-	-
10 <sup>1</sup>	0.2	70
10 <sup>1</sup>	0.2	70
-	-	-
-	-	-
-	0.5	300
-	-	-
7.5 <sup>2</sup>	0.01	40
525	0.2	1000
-	-	-
-	-	-
7.5 <sup>2</sup>	0.01	500
-	-	-
0.375	-	0.7

AWN Consulting

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

Table 4i: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-9								
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,4-Trichlorobenzene	µg/l	<3	<3	<3	<2	<3	<3	<3	<3	<3
1,2,4-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dibromoethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<5	<5	<5	<5
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5
trans 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
trans 1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VOC TICs				NA			ND	ND	ND	ND

Legend:

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

Dutch S-Value: Target Value

Dutch I-Value: Intervention Value

Results are underlined where they exceed the Dutch S-Value

Results are bold where they exceed the Dutch I-Value

Results are shaded and in bold where they exceed the Threshold

Threshold Values	Dutch Guidelines	
	S - value	I - value
500 <sup>1</sup>	-	-
-	-	-
-	-	-
30 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
0.4 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
2.25	0.01	400
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
0.75	0.2	30
-	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
-	-	-
12 <sup>1</sup>	1	40
-	-	-
-	-	-
-	-	-
15 <sup>2</sup>	0.01	1000
10 <sup>1</sup>	0.2	150
0.1 <sup>1</sup>	-	-
-	-	-
1	0.01	70
-	-	-
10 <sup>1</sup>	0.2	70
10 <sup>1</sup>	0.2	70
-	-	-
-	-	-
-	0.5	300
-	-	-
7.5 <sup>2</sup>	0.01	40
525	0.2	1000
-	-	-
-	-	-
7.5 <sup>2</sup>	0.01	500
-	-	-
0.375	-	0.7

AWN Consulting

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379



Table 4j: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - June 2018

Parameter	Units	MW-10								
		6/19/2014	12/4/2014	6/22/2015	12/7/2015	6/30/2016	12/13/2016	6/13/2017	12/14/2017	6/14/2018
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2,4-Trichlorobenzene	µg/l	<3	<3	<3	<2	<3	<3	<3	<3	<3
1,2,4-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dibromoethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Dichloromethane	µg/l	<3	<3	<3	<3	<5	<5	<5	<5	<5
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5
trans 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
trans 1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
VOC TICs				NA			ND	ND	ND	ND

Legend:

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Dutch S-Value:** Target Value

**Dutch I-Value:** Intervention Value

Results are underlined where they exceed the Dutch S-Value

Results are bold where they exceed the Dutch I-Value

Results are shaded and in bold where they exceed the Threshold

Threshold Values	Dutch Guidelines	
	S - value	I - value
500 <sup>1</sup>	-	-
-	-	-
-	-	-
30 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
0.4 <sup>1</sup>	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
2.25	0.01	400
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
0.75	0.2	30
-	-	-
-	-	-
-	-	-
-	-	-
10 <sup>1</sup>	-	-
-	-	-
12 <sup>1</sup>	1	40
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
15 <sup>2</sup>	0.01	1000
10 <sup>1</sup>	0.2	150
0.1 <sup>1</sup>	-	-
-	-	-
1	0.01	70
-	-	-
10 <sup>1</sup>	0.2	70
10 <sup>1</sup>	0.2	70
-	-	-
-	-	-
-	0.5	300
-	-	-
7.5 <sup>2</sup>	0.01	40
525	0.2	1000
-	-	-
-	-	-
7.5 <sup>2</sup>	0.01	500
-	-	-
0.375	-	0.7

AWN Consulting

Clarochem Ireland Limited GW Monitoring

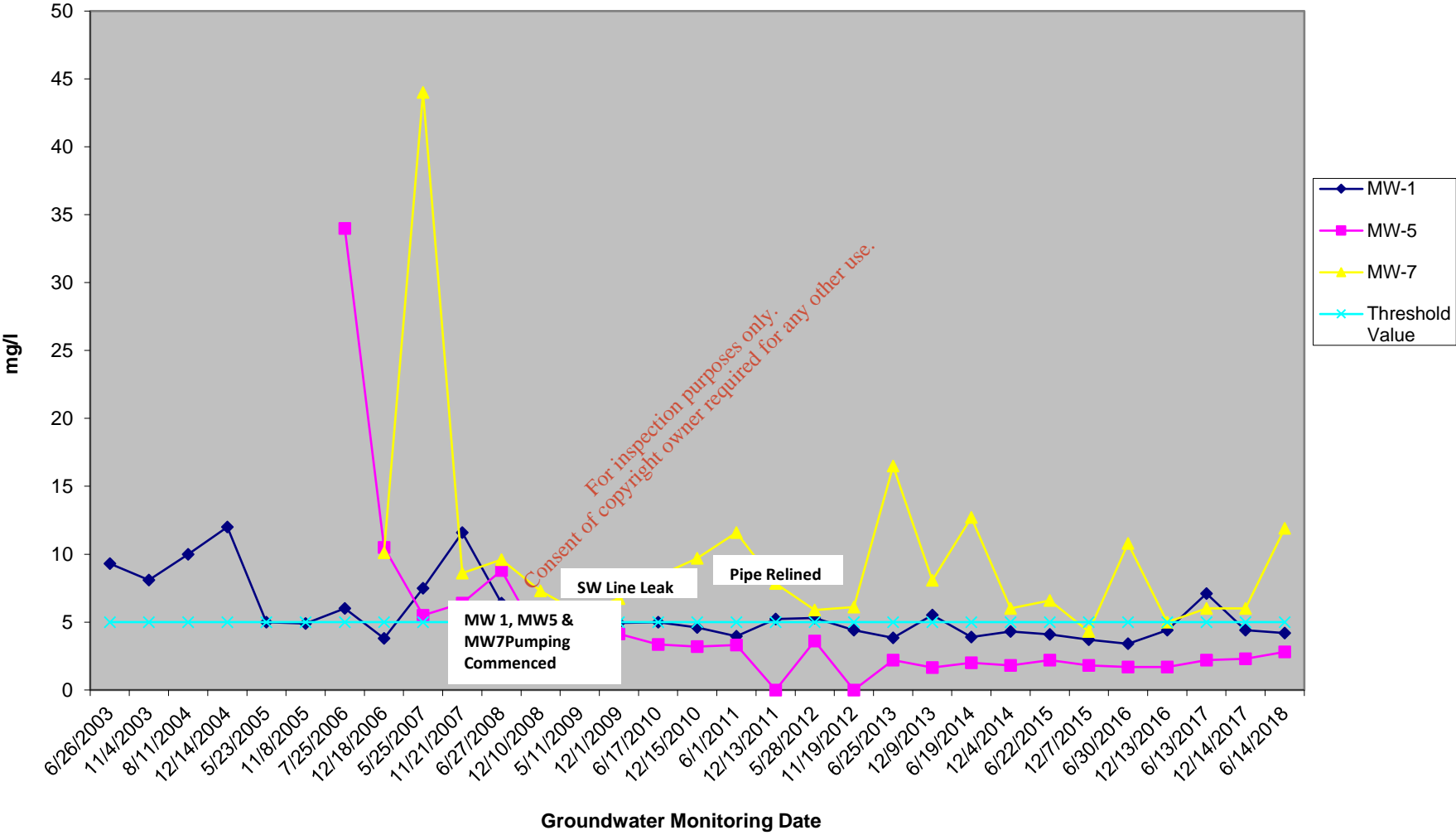
Project No. 12/6379

## GRAPHS

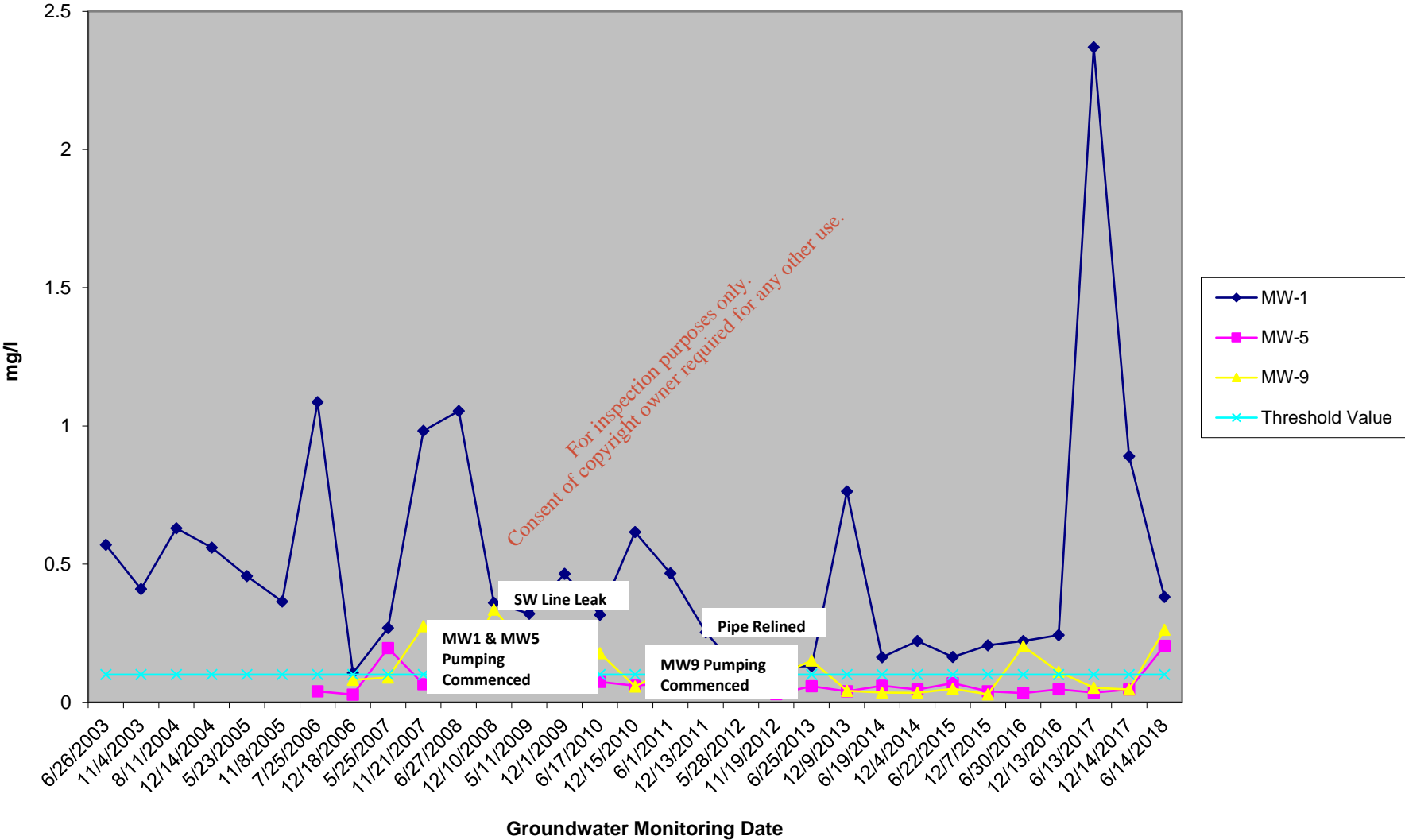
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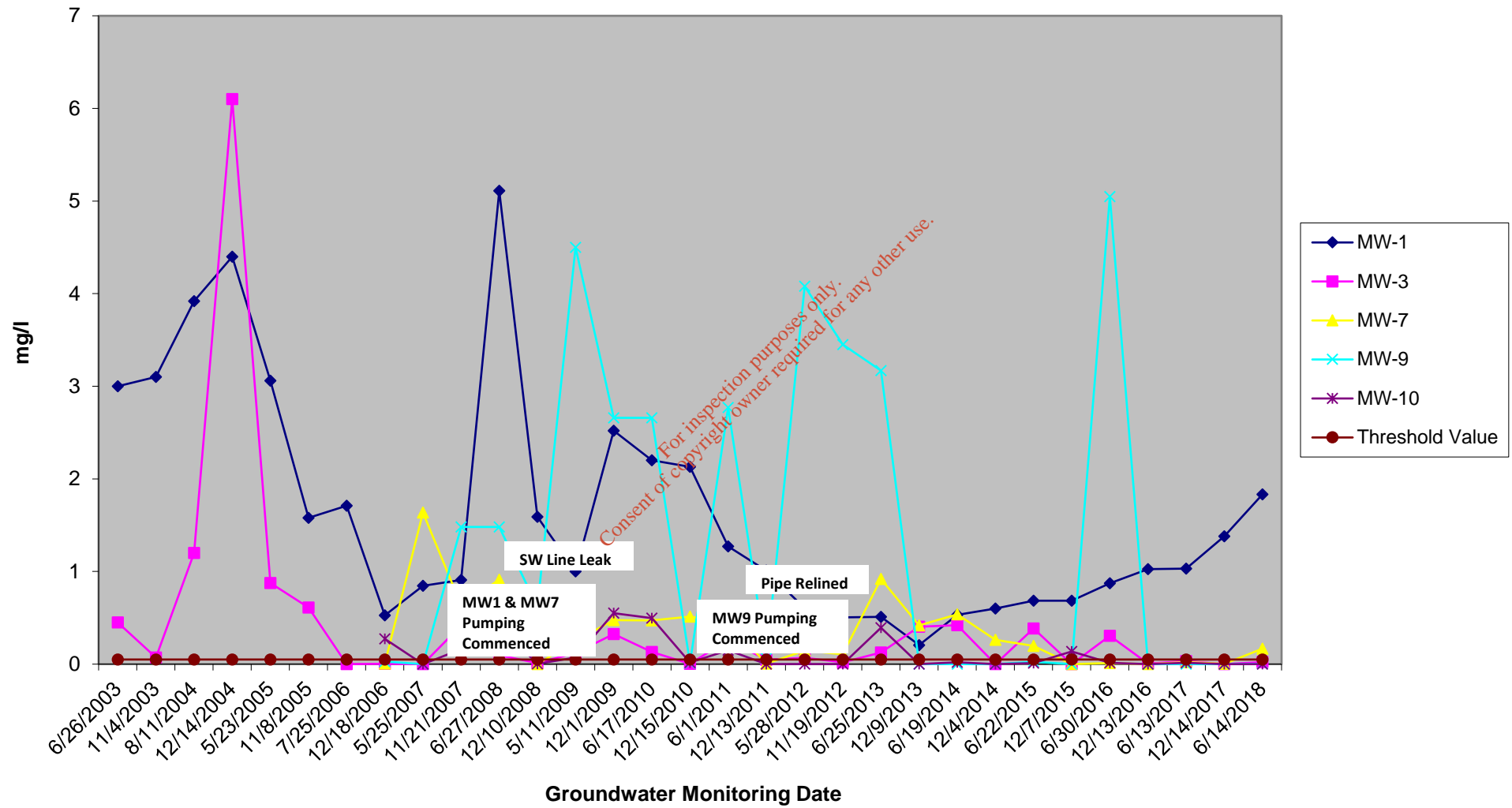
Graph 3 - MW-1, MW-5, MW-7 - Potassium



Graph 4 - MW-1, MW-5 & MW-9 - Barium

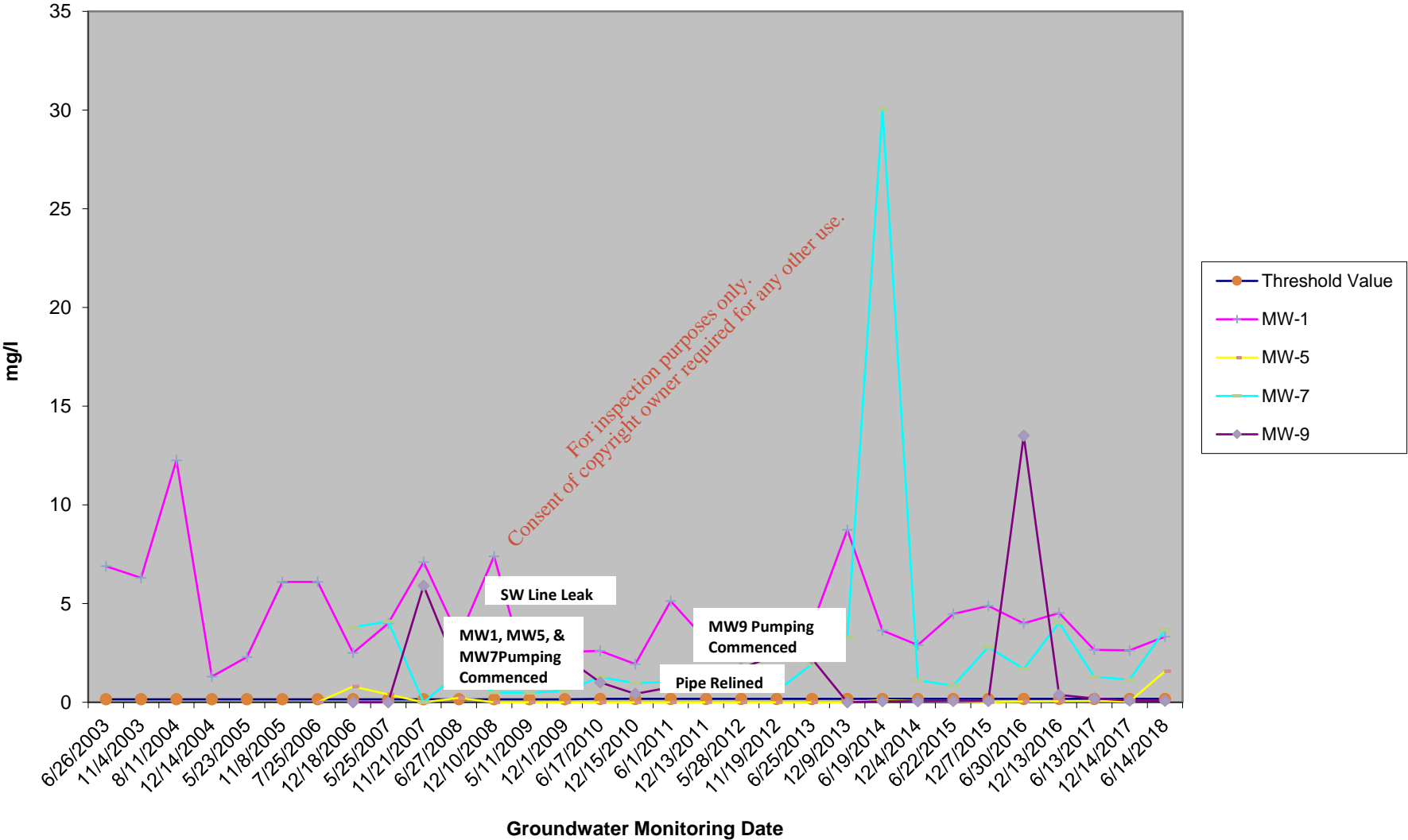


Graph 5 - MW-1, MW-3, MW-7, MW-9, MW-10 - Manganese

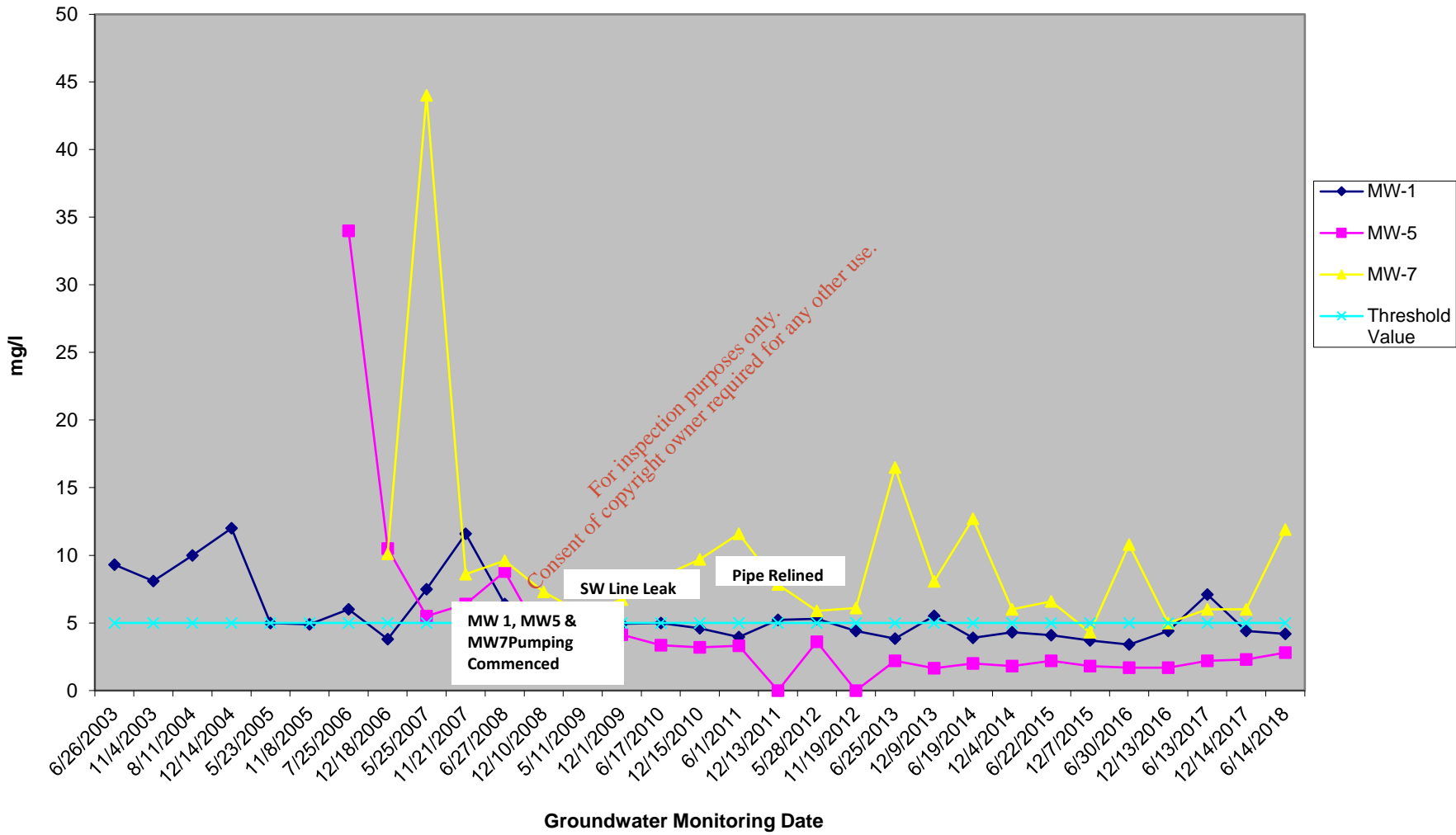




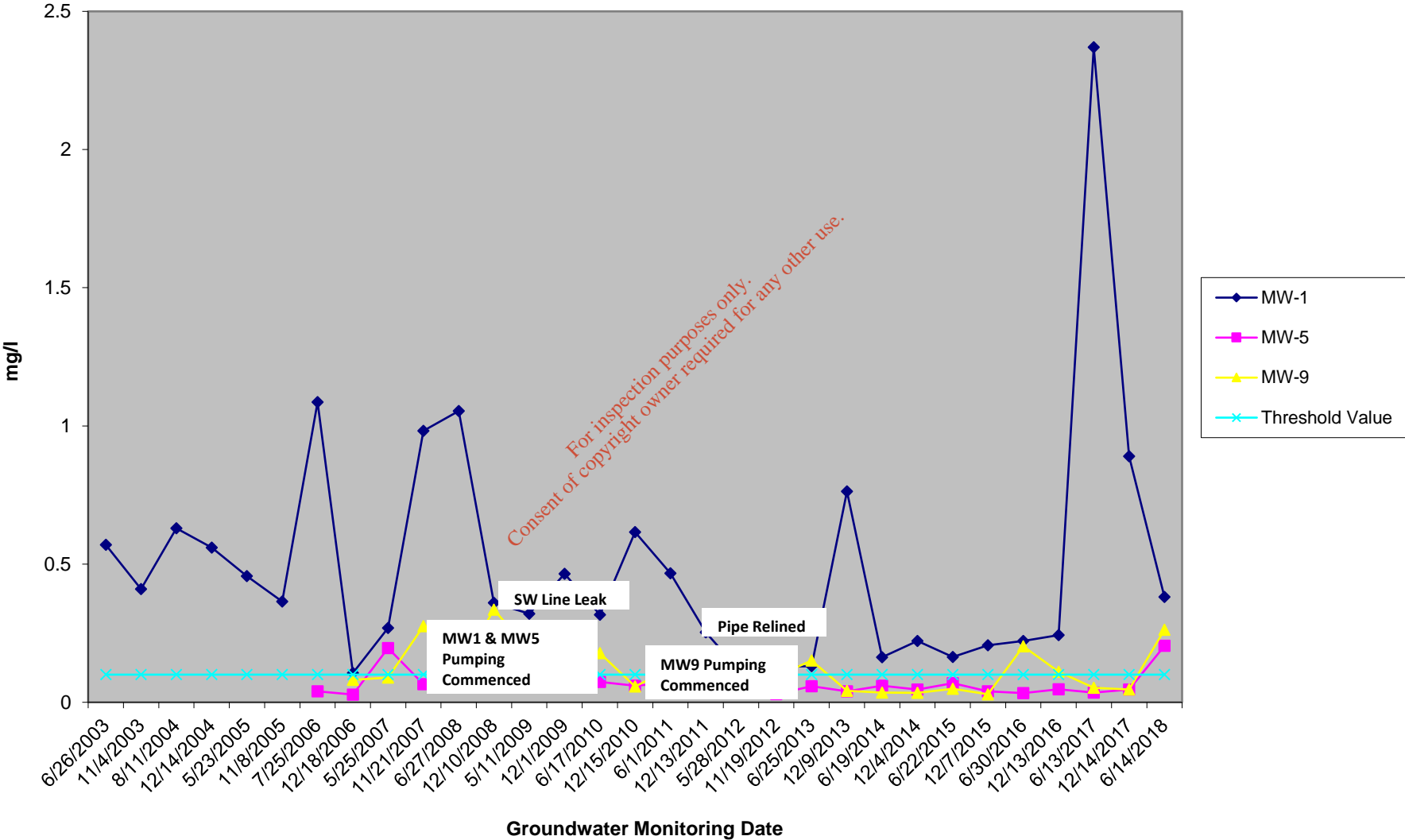
Graph 6 - MW-1, MW-5, MW-7, MW-9 - Total Ammonia



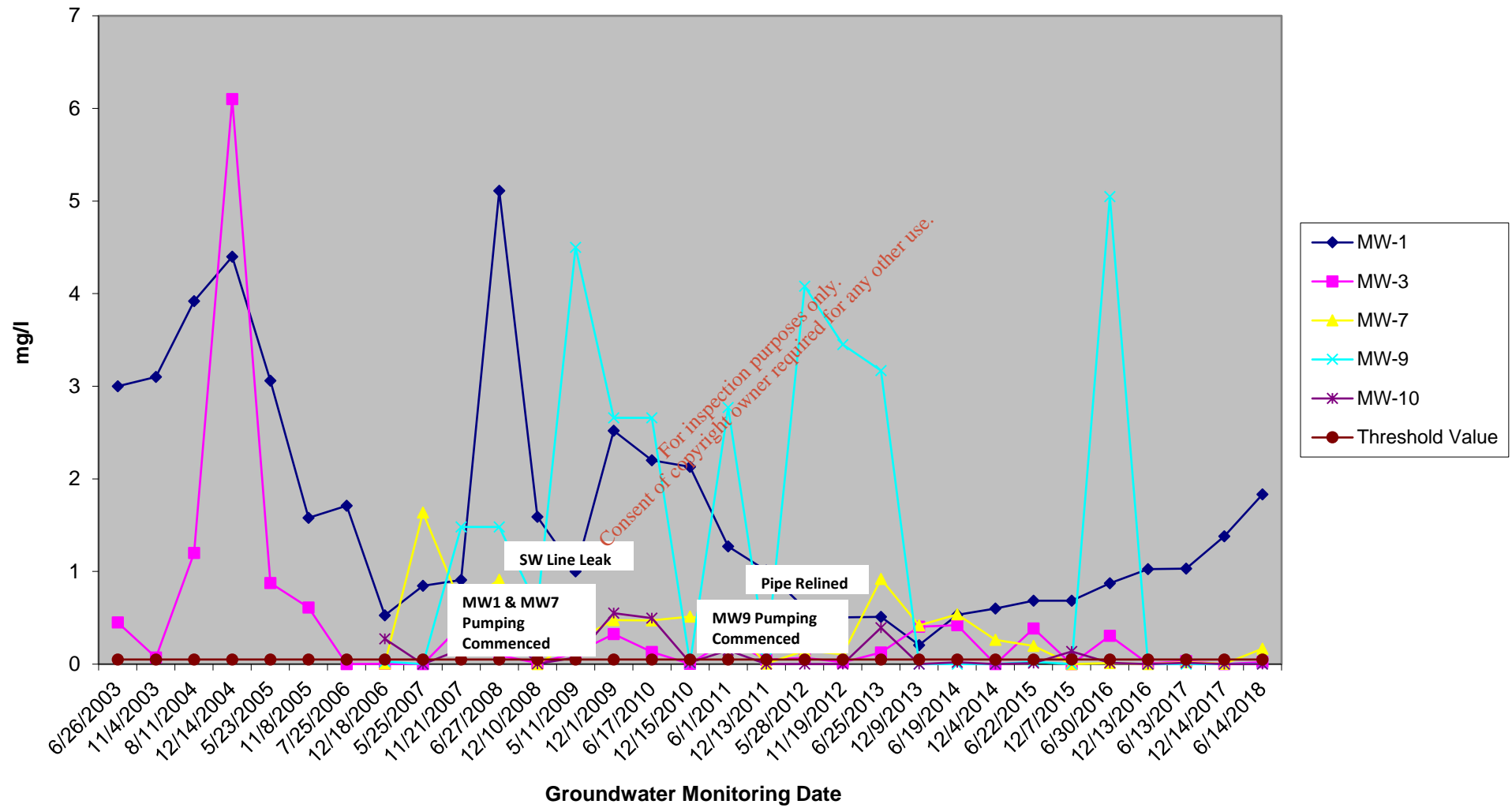
Graph 3 - MW-1, MW-5, MW-7 - Potassium



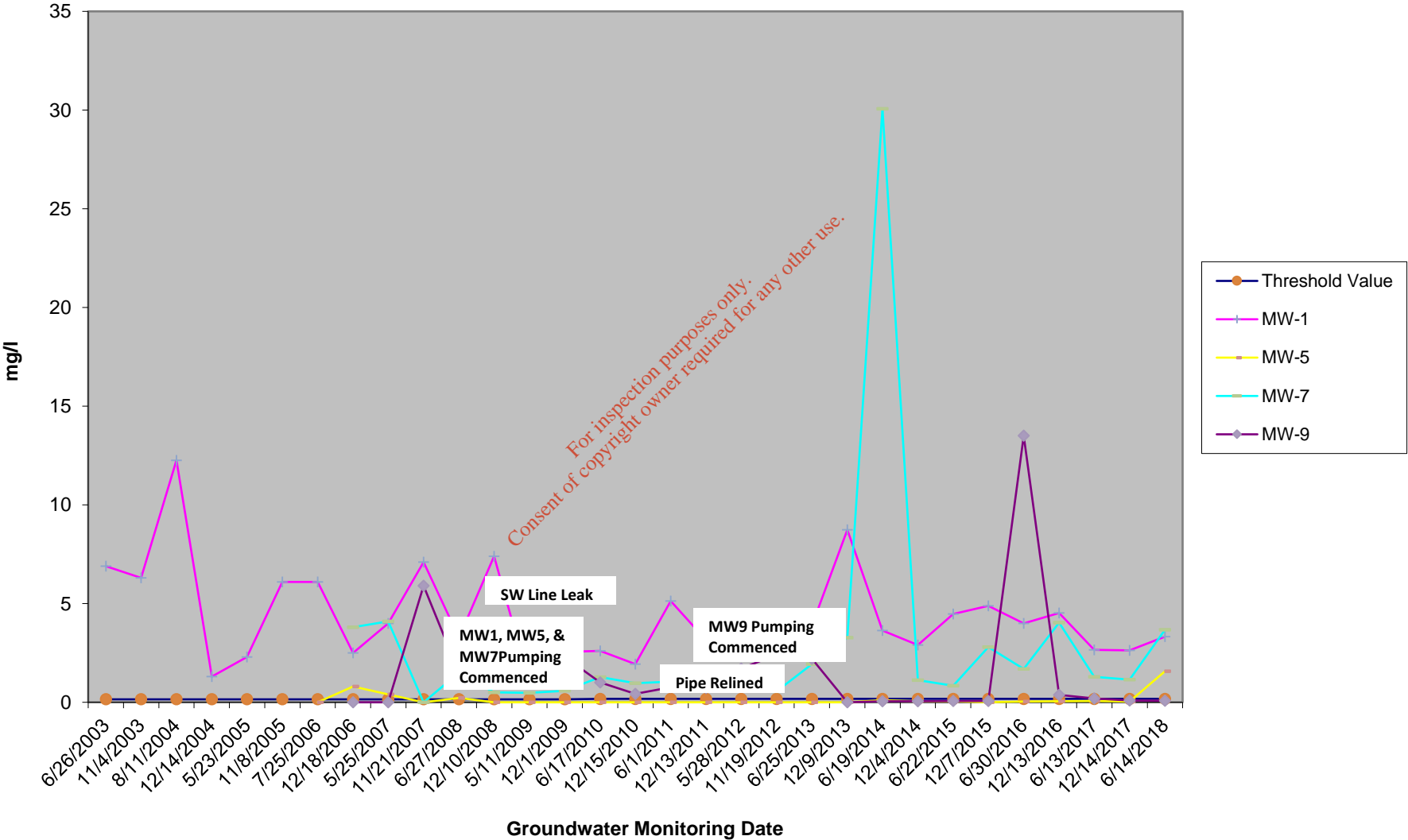
Graph 4 - MW-1, MW-5 & MW-9 - Barium



Graph 5 - MW-1, MW-3, MW-7, MW-9, MW-10 - Manganese



Graph 6 - MW-1, MW-5, MW-7, MW-9 - Total Ammonia





## APPENDIX 1

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# Groundwater Monitoring Record Sheet



The Tecpro Building,  
Clonshaugh Business & Technology Park,  
Dublin 17, Ireland.

T: + 353 1 847 4220  
F: + 353 1 847 4257  
E: info@awnconsulting.com  
W: www.awnconsulting.com

Client	Clarochem Ireland Limited	
Project	Quarterly Groundwater Monitoring - June 2018	
Contract No.	12_6379	
Date/Time	14/06/2018	
Weather Conditions	Sunny	
Purging equipment (bailer/inertial tubing and pump/other)	Dedicated PVC Bailer	

Location	Damastown, Mulhuddart, Dublin 15	Engineer(s)	
----------	----------------------------------	-------------	--

QA Procedures for Multi-meter			
Last Field Calibration	Date:		Time:
Last Full Calibration			

Borehole Number				
MW1	MW2	MW3	MW4	MW5

Groundwater Monitoring					
Depth from TOC to static water level (m)	4	1.6	1.77	1.18	Pumping
Total well depth from TOC (m)	4.63	5.56	4.03	1.97	3.22
Casing recess: ground level to TOC (m)					
well volume in Well & Sandpack - see below					

Water Quality Measurements						
	Volume Removed	No. of Volumes				
Temp (°C)	1	13.1	11.7	12.8	14	15
	2					
	3					
pH	1	7.56	6.94	7.06	7.22	7.67
	2					
	3					
Specific Conductivity (uS/cm)	1	1,431	866	864	740	998
	2					
	3					

Sample Observations						
Colour	Orange Tint	Brownish tint	Brown tint	Brownish	Brownish	
Odour Present	Chem	Slightly organic	None	None	None	
Sediment/Precipitate						
Free Product						
Hydrocarbon Sheen						
Well Purged Dry						

Any other field observations	
------------------------------	--

ONE WELL VOLUME (50mm diameter casing)	BS 10175
Terrier Borehole with 50mm Pipe	4l/m
6" Borehole with 50mm Pipe	5.5l/m
6" Borehole with 100mm Pipe	11.5l/m
8" Borehole with 50mm Pipe	8.25l/m
8" Borehole with 100mm Pipe	14.25l/m

**Note :** Purging should continue until Removal of at least three well volumes, or pH, conductivity and temperature readings have stabilised (any two successive reading are within 10% of eachother). If well is not recovering and it is not possible to meet these criteria then a grab sample should be obtained.

# Groundwater Monitoring Record Sheet



The Tecpro Building,  
Clonsillaugh Business & Technology Park,  
Dublin 17, Ireland.

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E: info@awnconsulting.com  
W: www.awnconsulting.com

Client	Clarochem Ireland Limited
Project	Quarterly Groundwater Monitoring - June 2018
Contract No.	12_6379
Date/Time	14/06/2018
Weather Conditions	Sunny
Purging equipment (bailer/inertial tubing and pump/other)	Dedicated PVC Bailer

Location	Damastown, Mulhuddart, Dublin 15	Engineer(s)	
----------	----------------------------------	-------------	--

QA Procedures for Multi-meter			
Last Field Calibration	Date:		Time:
Last Full Calibration			

Borehole Number				
MW6	MW7	MW8	MW9	MW10

Groundwater Monitoring					
Depth from TOC to static water level (m)	1	1.2	DRY	1.2	1.28
Total well depth from TOC (m)	1.74	2.03	2.44	4.7	2.99
Casing recess: ground level to TOC (m)					
well volume in Well & Sandpack - see below					

Water Quality Measurements						
	Volume Removed	No. of Volumes				
Temp (°C)		15	14.4	No Sample	11.9	14.1
pH		7.42	8.34	No Sample	7.44	7.57
Specific Conductivity (uS/cm)		816	1,765	No Sample	486	683

Sample Observations					
Colour	Brownish	Brownish	Brownish	Brownish	Brownish
Odour Present	None	Organic	None	None	None
Sediment/Precipitate					
Free Product					
Hydrocarbon Sheen					
Well Purged Dry					

Any other field observations	
------------------------------	--

ONE WELL VOLUME (50mm diameter casing)	BS 10175
Terrier Borehole with 50mm Pipe	4l/m
6" Borehole with 50mm Pipe	5.5l/m
6" Borehole with 100mm Pipe	11.5l/m
8" Borehole with 50mm Pipe	8.25l/m
8" Borehole with 100mm Pipe	14.25l/m

**Note :** Purging should continue until Removal of at least three well volumes, or pH, conductivity and temperature readings have stabilised (any two successive reading are within 10% of each other). If well is not recovering and it is not possible to meet these criteria then a grab sample should be obtained.

## APPENDIX 2

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# Exova Jones Environmental

Registered Address : Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian, EH28 8PL

Unit 3 Deeside Point  
Zone 3  
Deeside Industrial Park  
Deeside  
CH5 2UA

AWN Consulting  
Tecpro Building  
Clonshaugh Business & Technology Park  
Dublin  
Dublin 17  
Ireland

Tel: +44 (0) 1244 833780

Fax: +44 (0) 1244 833781



4225

<b>Attention :</b>	Brigette Priestley
<b>Date :</b>	29th June, 2018
<b>Your reference :</b>	12/6379
<b>Our reference :</b>	Test Report 18/9327 Batch 1
<b>Location :</b>	Damastown
<b>Date samples received :</b>	15th June, 2018
<b>Status :</b>	Final report
<b>Issue :</b>	1

Nine samples were received for analysis on 15th June, 2018 of which nine were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

## Compiled By:

**Lucas Halliwell**  
Project Co-ordinator



**Client Name:** AWN Consulting  
**Reference:** 12/6379  
**Location:** Damastown  
**Contact:** Brigitte Priestley  
**JE Job No.:** 18/9327

**Report : Liquid**

**Liquids/products:** V=40ml vial, G=glass bottle, P=plastic bottle  
H=H<sub>2</sub>SO<sub>4</sub>, Z=ZnAc, N=NaOH, HN=HNO<sub>3</sub>

J E Sample No.	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27		Please see attached notes for all abbreviations and acronyms		
Sample ID	MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW9	MW10				
Depth													
COC No / misc													
Containers	P BOD G	P BOD G	P BOD G	P BOD G	P BOD G	P BOD G	P BOD G	P BOD G	P BOD G				
Sample Date	14/06/2018	14/06/2018	14/06/2018	14/06/2018	14/06/2018	14/06/2018	14/06/2018	14/06/2018	14/06/2018				
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water				
Batch Number	1	1	1	1	1	1	1	1	1				
Date of Receipt	15/06/2018	15/06/2018	15/06/2018	15/06/2018	15/06/2018	15/06/2018	15/06/2018	15/06/2018	15/06/2018		LOD/LOR	Units	Method No.
Dissolved Aluminium #	<20	<20	<20	<20	<20	<20	<20	<20	<20		<20	ug/l	TM30/PM14
Dissolved Arsenic #	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	3.4	<2.5	<2.5		<2.5	ug/l	TM30/PM14
Dissolved Barium #	381	73	55	40	204	68	262	102	66		<3	ug/l	TM30/PM14
Dissolved Boron	23	21	27	<12	34	29	38	<12	19		<12	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM30/PM14
Dissolved Calcium #	92.2	166.5	170.4	156.8	81.7	101.2	62.3	78.8	111.0		<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5		<1.5	ug/l	TM30/PM14
Dissolved Cobalt #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM30/PM14
Dissolved Copper #	<7	<7	<7	<7	<7	<7	<7	<7	<7		<7	ug/l	TM30/PM14
Total Dissolved Iron #	323	<20	<20	<20	<20	<20	138	<20	<20		<20	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM30/PM14
Dissolved Magnesium #	7.7	10.4	12.0	5.6	11.1	6.8	8.7	8.3	11.1		<0.1	mg/l	TM30/PM14
Dissolved Manganese #	1834	49	22	<2	1242	36	168	3	<2		<2	ug/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM30/PM14
Dissolved Nickel #	<2	5	<2	<2	7	<2	3	3	<2		<2	ug/l	TM30/PM14
Dissolved Phosphorus #	17	9	<5	7	6	56	214	6	15		<5	ug/l	TM30/PM14
Dissolved Potassium #	4.2	1.1	0.5	0.3	2.8	1.6	11.9	2.3	2.3		<0.1	mg/l	TM30/PM14
Dissolved Selenium #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM30/PM14
Dissolved Silver	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM30/PM14
Dissolved Sodium #	214.2 <sup>AA</sup>	14.8	10.4	9.8	95.3	58.3	303.7 <sup>AA</sup>	12.2	14.8		<0.1	mg/l	TM30/PM14
Dissolved Strontium	479	532	559	613	755	345	2700 <sup>AA</sup>	725	381		<5	ug/l	TM30/PM14
Dissolved Tin	<5	<5	<5	<5	<5	<5	<5	6	<5		<5	ug/l	TM30/PM14
Dissolved Zinc #	<3	<3	<3	<3	<3	<3	5	<3	<3		<3	ug/l	TM30/PM14
Non Carbonate Hardness (permanent) (as CaCO <sub>3</sub> )	248	462	440	373	242	277	193	219	299		<1	mg/l	TM30/PM0
Total Hardness Dissolved (as CaCO <sub>3</sub> )	263	460	476	416	251	282	192	232	324		<1	mg/l	TM30/PM14
VOC TICs	ND	ND	ND	ND	ND	ND	See Attached	ND	ND			None	TM15/PM10
Methyl Tertiary Butyl Ether #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	ug/l	TM15/PM10
Benzene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM15/PM10
Toluene #	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM15/PM10
Ethylbenzene #	<1	<1	<1	<1	<1	<1	1	<1	<1		<1	ug/l	TM15/PM10
p/m-Xylene #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
o-Xylene #	<1	<1	<1	<1	<1	<1	2	<1	<1		<1	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	93	94	96	93	95	95	99	95	95		<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	101	100	99	101	103	99	103	103	98		<0	%	TM15/PM10
EPH (C8-C40) #	190	<10	<10	<10	150	<10	140	<10	<10		<10	ug/l	TM5/PM30
C8-C40 Mineral Oil (Calculation)	<10	<10	<10	<10	<10	<10	140	<10	<10		<10	ug/l	TM5/PM30
GRO (>C4-C8) #	<10	<10	<10	<10	<10	<10	182	<10	<10		<10	ug/l	TM36/PM12
GRO (>C8-C12) #	<10	<10	<10	<10	<10	<10	48	<10	<10		<10	ug/l	TM36/PM12
GRO (>C4-C12) #	<10	<10	<10	<10	<10	<10	230	<10	<10		<10	ug/l	TM36/PM12
Total Phenols HPLC	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15		<0.15	mg/l	TM26/PM0

Please include all sections of this report if it is reproduced

Please see attached notes for all abbreviations and acronyms

**Client Name:** AWN Consulting  
**Reference:** 12/6379  
**Location:** Damastown  
**Contact:** Brigitte Priestley  
**JE Job No.:** 18/9327

**VOC Report :** Liquid

J E Sample No.	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27		Please see attached notes for all abbreviations and acronyms		
Sample ID	MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW9	MW10				
Depth													
COC No / misc													
Containers	P BOD G	P BOD G	P BOD G	P BOD G	P BOD G	P BOD G	P BOD G	P BOD G	P BOD G				
Sample Date	14/06/2018	14/06/2018	14/06/2018	14/06/2018	14/06/2018	14/06/2018	14/06/2018	14/06/2018	14/06/2018				
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water				
Batch Number	1	1	1	1	1	1	1	1	1				
Date of Receipt	15/06/2018	15/06/2018	15/06/2018	15/06/2018	15/06/2018	15/06/2018	15/06/2018	15/06/2018	15/06/2018		LOD/LOR	Units	Method No.
VOC MS													
Dichlorodifluoromethane	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Methyl Tertiary Butyl Ether #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	ug/l	TM15/PM10
Chloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Vinyl Chloride #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	ug/l	TM15/PM10
Bromomethane	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM15/PM10
Chloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Trichlorofluoromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Dichloromethane (DCM) #	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,1-Dichloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
2,2-Dichloropropane	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM15/PM10
Bromochloromethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Chloroform #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,1,1-Trichloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,1-Dichloropropene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Carbon tetrachloride #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2-Dichloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Benzene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM15/PM10
Trichloroethene (TCE) #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,2-Dichloropropane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Dibromomethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Bromodichloromethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
cis-1-3-Dichloropropene	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Toluene #	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM15/PM10
trans-1-3-Dichloropropene	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,1,2-Trichloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,3-Dichloropropane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Dibromochloromethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2-Dibromoethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Chlorobenzene #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,1,1,2-Tetrachloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Ethylbenzene #	<1	<1	<1	<1	<1	<1	1	<1	<1		<1	ug/l	TM15/PM10
p/m-Xylene #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
o-Xylene #	<1	<1	<1	<1	<1	<1	2	<1	<1		<1	ug/l	TM15/PM10
Styrene	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Bromoform #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
Isopropylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,1,2,2-Tetrachloroethane	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	ug/l	TM15/PM10
Bromobenzene #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2,3-Trichloropropane #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Propylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
2-Chlorotoluene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
4-Chlorotoluene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
tert-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,2,4-Trimethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
sec-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
4-Isopropyltoluene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,3-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,4-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
n-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,2-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
1,2-Dibromo-3-chloropropane	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2,4-Trichlorobenzene	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Hexachlorobutadiene	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Naphthalene	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
1,2,3-Trichlorobenzene	<3	<3	<3	<3	<3	<3	<3	<3	<3		<3	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	93	94	96	93	95	95	99	95	95		<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	101	100	99	101	103	99	103	103	98		<0	%	TM15/PM10

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*Exova Jones Environmental*

<b>Job number:</b>	18/9327
<b>Sample number:</b>	21
<b>Sample identity:</b>	MW7
<b>Sample depth:</b>	
<b>Sample Type:</b>	Ground Water
<b>Units:</b>	ug/l

**Method:** VOC  
**Matrix:** Liquid

**Note:** Only samples with TICs (if requested) are reported. If TICs were requested but no compounds found they are not reported.

[illegible]

**Matrix : Liquid**

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QF-PM 3.1.11 v3

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## NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 18/9327

### SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

### WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

### DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

### SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

### DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

### BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

### NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

### REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

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**ABBREVIATIONS and ACRONYMS USED**

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to an Exova Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x5 Dilution

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JE Job No: 18/9327

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.				
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM0	No preparation is required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM0	No preparation is required.	Yes			

JE Job No: 18/9327

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM57	Modified US EPA Method 410.4. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometrically.	PM0	No preparation is required.	Yes			
TM58	Modified USEPA methods 405.1 and BS 5667-3. Measurement of Biochemical Oxygen Demand. When cBOD (Carbonaceous BOD) is requested a nitrification inhibitor is added which prevents the oxidation of reduced forms of nitrogen, such as ammonia, nitrite and organic nitrogen which exert a nitrogenous demand.	PM0	No preparation is required.	Yes			
TM59	Determination of Dissolved Oxygen using the Hach HQ30D Oxygen Meter	PM0	No preparation is required.				
TM60	Modified USEPA 9060. Determination of TOC by calculation from Total Carbon and Inorganic Carbon using a TOC analyser, the carbon in the sample is converted to CO <sub>2</sub> and then passed through a non-dispersive infrared gas analyser (NDIR).	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM75	Modified US EPA method 310.1. Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1. Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM89	Modified USEPA method OIA-1667. Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis.	PM0	No preparation is required.	Yes			
TM173	Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 340.2	PM0	No preparation is required.				

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Dublin  
17

## **Certificate Of Analysis**

**Job Number:** 18-43073

**Issue Number:** 1

**Report Date:** 19 June 2018

**Site:** Not Applicable

**PO Number:** Not Supplied

**Date Samples Received:** 14/06/2018

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Please find attached the results for the samples received at our laboratory on 14/06/2018.

Should you have any queries regarding the report or require any further services, we would be happy to discuss your requirements. For additional information about the company please log-on to our website at the above address.

Thank you for choosing City Analysts Limited. We look forward to assisting you again.

**Authorised By:**



Shane Reynolds  
Laboratory Manager

**Authorised Date:** 19 June 2018

### **Notes:**

Results relate only to the items tested.

Information on methods of analysis and performance characteristics is available on request.

Any opinions or interpretations indicated are outside the scope of our INAB accreditation.

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**Report Reference:** 18-43073

**Report Version:** 1

**Site:** Not Applicable

**Sample Description:** MW-1

**Date of Sampling:** 14/06/2018

**Sample Type:** Ground

**Date Sample Received:** 14/06/2018

**Lab Reference Number:** 399998

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	14/06/2018	Clostridium perfringens	< 1	cfu/100ml	-
D/D1201#	14/06/2018	Coliforms	1986.3	MPN/100ml	-
D/D1201#	14/06/2018	E.coli	< 1.0	MPN/100ml	-
D/D3221#	14/06/2018	Faecal Coliforms	< 1	cfu/100ml	-
D/D1205	14/06/2018	Faecal Streptococci	< 1	cfu/100ml	-

# = INAB Accredited, U = UKAS Accredited, \* = Subcontracted

**Note:**

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

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TVC - Total viable count

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**Report Reference:** 18-43073

**Report Version:** 1

**Site:** Not Applicable

**Sample Description:** MW-2

**Date of Sampling:** 14/06/2018

**Sample Type:** Ground

**Date Sample Received:** 14/06/2018

**Lab Reference Number:** 399999

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	14/06/2018	Clostridium perfringens	< 1	cfu/100ml	-
D/D1201#	14/06/2018	Coliforms	61310.0	MPN/100ml	-
D/D1201#	14/06/2018	E.coli	4.0	MPN/100ml	-
D/D3221#	14/06/2018	Faecal Coliforms	23	cfu/100ml	-
D/D1205	14/06/2018	Faecal Streptococci	< 1	cfu/100ml	-

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#### Note:

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

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**Report Reference:** 18-43073

**Report Version:** 1

**Site:** Not Applicable

**Sample Description:** MW-3

**Date of Sampling:** 14/06/2018

**Sample Type:** Ground

**Date Sample Received:** 14/06/2018

**Lab Reference Number:** 400000

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	14/06/2018	Clostridium perfringens	2	cfu/100ml	-
D/D1201#	14/06/2018	Coliforms	6.3	MPN/100ml	-
D/D1201#	14/06/2018	E.coli	< 1.0	MPN/100ml	-
D/D3221#	14/06/2018	Faecal Coliforms	1	cfu/100ml	-
D/D1205	14/06/2018	Faecal Streptococci	4	cfu/100ml	-

# = INAB Accredited, U = UKAS Accredited, \* = Subcontracted

#### Note:

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

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**Report Reference:** 18-43073

**Report Version:** 1

**Site:** Not Applicable

**Sample Description:** MW-4

**Date of Sampling:** 14/06/2018

**Sample Type:** Ground

**Date Sample Received:** 14/06/2018

**Lab Reference Number:** 400001

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	14/06/2018	Clostridium perfringens	< 1	cfu/100ml	-
D/D1201#	14/06/2018	Coliforms	224.7	MPN/100ml	-
D/D1201#	14/06/2018	E.coli	< 1.0	MPN/100ml	-
D/D3221#	14/06/2018	Faecal Coliforms	< 1	cfu/100ml	-
D/D1205	14/06/2018	Faecal Streptococci	< 1	cfu/100ml	-

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**Note:**

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.

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**Report Reference:** 18-43073

**Report Version:** 1

**Site:** Not Applicable

**Sample Description:** MW-5

**Date of Sampling:** 14/06/2018

**Sample Type:** Ground

**Date Sample Received:** 14/06/2018

**Lab Reference Number:** 400002

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	14/06/2018	Clostridium perfringens	10	cfu/100ml	-
D/D1201#	14/06/2018	Coliforms	104620.0	MPN/100ml	-
D/D1201#	14/06/2018	E.coli	< 1.0	MPN/100ml	-
D/D3221#	14/06/2018	Faecal Coliforms	23	cfu/100ml	-
D/D1205	14/06/2018	Faecal Streptococci	6	cfu/100ml	-

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#### Note:

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**Report Reference:** 18-43073

**Report Version:** 1

**Site:** Not Applicable

**Sample Description:** MW-6

**Date of Sampling:** 14/06/2018

**Sample Type:** Ground

**Date Sample Received:** 14/06/2018

**Lab Reference Number:** 400003

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	14/06/2018	Clostridium perfringens	13	cfu/100ml	-
D/D1201#	14/06/2018	Coliforms	12.1	MPN/100ml	-
D/D1201#	14/06/2018	E.coli	< 1.0	MPN/100ml	-
D/D3221#	14/06/2018	Faecal Coliforms	< 1	cfu/100ml	-
D/D1205	14/06/2018	Faecal Streptococci	1	cfu/100ml	-

# = INAB Accredited, U = UKAS Accredited, \* = Subcontracted

#### Note:

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.

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**Report Reference:** 18-43073

**Report Version:** 1

**Site:** Not Applicable

**Sample Description:** MW-7

**Date of Sampling:** 14/06/2018

**Sample Type:** Ground

**Date Sample Received:** 14/06/2018

**Lab Reference Number:** 400004

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	14/06/2018	Clostridium perfringens	1	cfu/100ml	-
D/D1201#	14/06/2018	Coliforms	1413.6	MPN/100ml	-
D/D1201#	14/06/2018	E.coli	1.0	MPN/100ml	-
D/D3221#	14/06/2018	Faecal Coliforms	< 1	cfu/100ml	-
D/D1205	14/06/2018	Faecal Streptococci	76	cfu/100ml	-

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**Note:**

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**Report Reference:** 18-43073

**Report Version:** 1

**Site:** Not Applicable

**Sample Description:** MW-9

**Date of Sampling:** 14/06/2018

**Sample Type:** Ground

**Date Sample Received:** 14/06/2018

**Lab Reference Number:** 400005

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	14/06/2018	Clostridium perfringens	6	cfu/100ml	-
D/D1201#	14/06/2018	Coliforms	261.3	MPN/100ml	-
D/D1201#	14/06/2018	E.coli	< 1.0	MPN/100ml	-
D/D3221#	14/06/2018	Faecal Coliforms	2	cfu/100ml	-
D/D1205	14/06/2018	Faecal Streptococci	8	cfu/100ml	-

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#### Note:

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

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**Report Reference:** 18-43073

**Report Version:** 1

**Site:** Not Applicable

**Sample Description:** MW-10

**Date of Sampling:** 14/06/2018

**Sample Type:** Ground

**Date Sample Received:** 14/06/2018

**Lab Reference Number:** 400006

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	14/06/2018	Clostridium perfringens	1	cfu/100ml	-
D/D1201#	14/06/2018	Coliforms	< 1.0	MPN/100ml	-
D/D1201#	14/06/2018	E.coli	< 1.0	MPN/100ml	-
D/D3221#	14/06/2018	Faecal Coliforms	< 1	cfu/100ml	-
D/D1205	14/06/2018	Faecal Streptococci	1	cfu/100ml	-

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**Note:**

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For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.

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TVC - Total viable count

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# Groundwater Monitoring Report

## Q4, December 2018

---

Technical Report Prepared For

**Clarochem Ireland Limited**

---

Technical Report Prepared By

**Marcelo Allende**  
Environmental Consultant

---

Our Reference

MA/12/6379WR16

---

Date of Issue

21<sup>th</sup> February 2019

---

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AWN Consulting Limited  
Registered in Ireland No. 319812  
Directors: F Callaghan, C Dilworth,  
T Donnelly, T Hayes, D Kelly, E Porter

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Figure 2 – Site Plan Showing Groundwater Flow Direction Before Pumping

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**Appendix 1** – Groundwater Sampling Field Logs

**Appendix 2** – Laboratory Reports (JEL 18-19889) & (18-50240-1 City Analysts)

## Document History

Document Reference		Original Issue Date	
MA/12/6379WR16		21 <sup>th</sup> February 2019	
Revision Level	Revision Date	Description	Sections Affected

## Record of Approval

Details	Written by	Approved by
Signature		
Name	Marcelo Allende	Brigitte Priestley
Title	Environmental Consultant	Senior Environmental Consultant
Date	21 <sup>th</sup> February 2019	21 <sup>th</sup> February 2019

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## 1.0 INTRODUCTION

At the request of Clarochem Ireland Limited (Clarochem), AWN Consulting Ltd. (AWN) completed groundwater monitoring in December 2018 (Q4 groundwater monitoring round), as part of the company's annual groundwater monitoring programme for its facility at Clarochem Ireland, Damastown, Mulhuddart, Dublin 15. Groundwater monitoring is undertaken at the site on a quarterly basis, with the first and third quarterly rounds comprising a short suite of analysis and the second and fourth quarterly rounds comprising a broader suite of analysis in order to comply with the sites IED Licence requirements (IED Ref: P0125-02).

This report presents the findings from the **Q4** groundwater monitoring programme undertaken on the 6<sup>th</sup> December 2018 and summarises the trends in groundwater quality. The most recent round of monitoring, prior to December 2018, for the biannual suite of parameters was completed in June 2018.

Since mid-2013, samples for inorganics, organics and hydrocarbons analyses have been sent to Jones Environmental Laboratory (now Exova Jones Environmental), Deeside, UK. Bacteriological analysis is provided by City Analysts Ltd., Pigeon House Road, Ringsend, Dublin 4.

### 1.1 Environmental Setting

According to the Geological Survey of Ireland (GSI) website, the generalised bedrock beneath the site is classified as Dinantian Upper Impure Limestone. According to the Teagasc subsoils map for the area the subsoils are classified as made-ground; however, the subsoils adjacent to the site are classified as till derived chiefly from lower Palaeozoic rocks. The aquifer beneath the site, according to the GSI is classified as "a locally important aquifer which is moderately productive only in local zones". The vulnerability of the aquifer to pollution is classified as "high to low" as only an interim study took place.

### 1.2 Background Groundwater Quality

As per the conditions of the Clarochem IED licence P0125-02, a groundwater monitoring programme has been undertaken in three monitoring wells (MW-1 to MW-3) at the Clarochem site since 1994. Bacteriological contamination has been a recurring issue at the site along with heavy metal, organic and inorganic contamination. The major source of the bacteriological contamination was from leaks in the process foul sewer line in 2000, 2004 and 2009. The majority of the heavy metal, organic and inorganic contamination has been localised to one area of the site, where the tank farm and waste water treatment plant are located. Since monitoring commenced the most up gradient well, MW-3 has shown evidence of bacteriological, metal, organic and inorganic groundwater contamination indicating an up gradient source of contamination is also impacting the groundwater quality on the site. Other upgradient potential sources exist.

To further investigate the extent of contamination on site, four additional boreholes (MW-4 to MW-7), were installed in July 2006 and three further boreholes (MW-8 to MW-10), were installed in November 2006. Each borehole was installed with a monitoring standpipe and, at the request of the EPA, all boreholes (MW-1 to MW-10) are now included as part of the IED monitoring programme.

The location of boreholes across the site is shown in Figure 1.

### 1.3 Groundwater Abstraction System

A groundwater abstraction system was installed in February/March 2007, which involves pumping groundwater from MW-1, MW-5 and MW-7 to the adjacent neutralisation pit. The objective of the system is to improve the groundwater quality underlying the site in respect to the contamination identified. The groundwater abstraction programme was extended in April 2009 to include MW-9. The system consists of compressed air pumps, extracting groundwater from MW-1, MW-5, MW-7 and MW-9 and pumping the extracted water to barrels and then into the neutralisation pit.

### 1.4 Groundwater Flow Direction

A survey of the groundwater flow direction was undertaken by WYG Ireland (WYG) on 22<sup>nd</sup> August 2007, which incorporated boreholes beneath the neighbouring Helsinn Birex site. The survey was undertaken when the pumps were switched off and the groundwater was found to flow in a southerly direction; however, localised lower levels in the water table were noted around MW-5, MW-6 and MW-10, as presented in Figure 2. It would appear that the water table had not recovered fully when the survey was undertaken. The groundwater flow direction with the pumps operating is presented in Figure 3 and in general the groundwater flow direction was similar to that before pumping commenced; however, a cone of depression was noted in the vicinity of the pumped wells, which is representative of the extraction programme.

### 1.5 Helsinn Birex

The neighbouring property to the east of the site is owned by Helsinn Birex. There are three monitoring wells on this site, AGW-1 to AGW-3. AGW-3 is located hydraulically up gradient of the site and is therefore representative of the groundwater quality coming onto the Helsinn Birex site. AGW-1 is located downgradient, adjacent to the western site boundary with Clarochem. AGW-2 is also located downgradient, along the southern site boundary. Elevated parameters including metals and bacteriological parameters have been recorded in the downgradient well nearest to Clarochem.

### 1.6 Pipework and Sumps Integrity Testing

The site has a network of underground pipes and a neutralisation pit is located in the area of the waste water treatment plant to treat the waste water. In August 2011 Clarochem installed a double walled polypropylene lined fiberglass tank into the underground neutralization tank, adjacent to MW-1 and MW-5. There is a cavity between the tanks fitted with two highly sensitive float switches to alert to the presence of a leak, should one occur.

As per the requirements of the IED licence, Clarochem is required to carry out integrity testing of the underground effluent and foul sewer pipes at least once every three years. The most recent storm water lines testing was carried out at the facility in June 2016 and subsequent repair works were completed in January 2017. The sites foul drain lines were tested and repaired in February 2018. Process drain lines tested and passed in July 2017. The foul lines integrity are tested at regular intervals to ensure there is no damage or leaks within the process lines.

## 1.7 Groundwater Sampling

Groundwater sampling was undertaken in monitoring wells MW-1 to MW-10 by AWN on 6<sup>th</sup> December 2018 using 50mm internal diameter dedicated PVC bailers. In order to ensure a representative sample and the removal of stagnant water from the well, approximately three annular volumes were bailed from each well in accordance with the AWN groundwater sampling protocol. The samples were all filtered, according with the requirements for metal analysis.

During December 2018 sampling MW-8 was dry and samples could not be recovered for field or lab analysis. Also, MW-8 was dry during the groundwater monitoring round in June 2018.

*In situ* measurements were recorded for temperature, conductivity and pH. Sample bottles were filled directly from the bailer and maintained at <4°C prior to dispatch to the laboratory for analysis. Details of the pH, conductivity and temperature measurements recorded, along with the physical characteristics are included in the monitoring well sampling logs provided in Appendix 1 and discussed in Section 2.2.

Samples were submitted to Exova Jones Environmental Laboratory Ltd, (UKAS accredited laboratory) and analysed for:

- Diesel Range Organics (DRO), Petrol Range Organics (PRO) and mineral oil
- Benzene, Toluene, Ethylbenzene and Xylene (BTEX compounds)
- Volatile Organic Compounds (VOCs)
- Standard chemical analysis (including major anions and cations)
- Individual heavy metals

Samples were sent to City Analysts Limited (INAB accredited laboratory) and analysed for:

- Standard bacteriological analysis.

The above suites of analysis were undertaken in accordance with the requirements of the Clarochem IED licence.

The following table exhibits the field parameters measured on site during the monitoring round in December 2018, as well as the depth of the boreholes, which was measured during the monitoring round in June 2018.

Classification	Well ID	pH	Temperature (°C)	Specific Conductivity (µS/cm)	Total Well Depth (mbgl) (As measured on June 2018)
Shallow	MW1	7.42	11.5	1,309	4.63
	MW2	6.78	11.9	915	5.56
	MW3	7.02	11.5	612	4.03
	MW4	7.02	11.5	413	1.97
	MW5	7.62	11.5	761	3.22
	MW6	7.14	11.2	548	1.74
	MW7*	7.70	11.2	570	2.03
	MW8	n.d.	n.d.	n.d.	2.44
	MW9	7.40	11.5	322	4.70
	MW10	7.31	11.2	488	2.99

**Table 1.1** Field parameters obtained during December 2018 and depth of each Monitoring Well

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## 2.0 ANALYTICAL RESULTS

### 2.1 Groundwater Standards, Guidelines and Threshold Values

The analytical results for the December 2018 monitoring round are presented with historical analytical data in Tables 1 – 4 and Graphs 1 – 6.

The analytical results for the groundwater samples are compared to the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. 9 of 2010) as amended by the European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (S.I. No. 366 of 2016). The Regulations establish a comprehensive system of water quality and quantity objectives for all bodies of groundwater and thereby provide a basis for systems of control for achieving those groundwater objectives, taking into account the requirements of the Water Framework Directive (2000/60/EC) and the Groundwater Directive (2006/118/EC). The threshold values are based on the assessment of the general quality of groundwater in a groundwater body in terms of whether its ability to support human uses has been significantly impaired by pollution. Where there are no threshold values for a parameter the results are compared to the Interim Guideline Values (IGVs) *“Interim report towards setting guideline values for the protection of groundwater in Ireland”*, published by the Environmental Protection Agency (EPA) in June 2003.

The analytical results from the current monitoring round are also discussed with reference to the results from the previous sampling rounds.

### 2.2 Groundwater Monitoring Field Parameters

#### 2.2.1 pH, Conductivity and Temperature

The pH and conductivity field readings for the December 2018 monitoring round are presented in Tables 1a – 1j. It should be noted values for MW-8 were not recorded due to the monitoring well being dry at time of sampling.

The pH readings in all nine wells sampled were within the EPA IGV range of 6.0 - 9.5.

All field conductivity values recorded during the December 2018 Q4 groundwater monitoring round were below the 2010 groundwater threshold value of 1,875  $\mu\text{S}/\text{cm}$ . This is consistent with the previous three groundwater monitoring rounds carried out in September 2017, December 2017 and June 2018, respectively.

Typical groundwater temperatures in Ireland range from 10-12°C. Historically there has been seasonal variation in the temperatures recorded on site which is likely due to the shallow nature of the wells reflecting the general air temperature which was reflected in the monitoring of June 2018. In December 2018, all the temperatures recorded were between 11.5°C and 12°C.

#### 2.2.2 Physical Observations

A orange to brownish tint was noted at all monitoring wells during the current groundwater monitoring round, with the exception of MW-7, which presented a slight black tint. This is consistent with the previous three monitoring rounds.

A slight chemical or organic smell was detected in the groundwater at MW1 & MW-7, which is consistent with previous monitoring rounds. MW-2, which intermittently

exhibits odour during the groundwater sampling rounds, did not present odour during December 2018. MW-1 & MW-7 consistently exhibit a chemical smell or an organic stagnant odour.

## **2.3 Hydrocarbon Parameters**

The analytical results for hydrocarbons are presented in Tables 3a – 3j.

### **2.3.1 Mineral Oil**

As with the previous three sampling rounds, all wells sampled had mineral oil concentrations below the laboratory detection limit of 10 µg/l.

### **2.3.2 Diesel Range Organics (DRO) and Petrol Range Organics (PRO)**

During the current monitoring round (Q4 December 2018), MW-1 recorded a concentration of 100 µg/l which represents a decrease in comparison to the previous monitoring round. During previous sampling rounds MW-1 had recorded slightly elevated DRO concentrations (100-860 µg/l during the period between the September 2013 and June 2017). However, a notable decrease has been noted since the groundwater monitoring in December 2017.

DRO concentrations were less than the laboratory detection limit (<10 µg/l) in all other wells sampled during the December 2018 sampling, including MW-5 & MW-7, which recorded elevated concentrations of DRO during June 2018.

Petrol Range Organics (PRO) were less than the laboratory detection limit (<10 µg/l) in all of wells including MW-7 which recorded concentrations of PRO during December 2018.

As detailed in previous reports, these results are considered inconsistent with the results of analyses for mineral oil and VOC's, and are of limited value to the monitoring programme.

### **2.3.3 BTEX Compounds (Benzene, Toluene, Ethylbenzene and Xylene)**

BTEX compounds were not detected above the laboratory LOD limit in any of the nine groundwater samples analysed, including MW-7 which recorded concentrations of Ethylbenzene and Xylene during December 2018.

## **2.4 Volatile Organic Compounds**

The results of analysis for VOC compounds are presented in Tables 4a – 4j. The VOC concentrations in all of samples were less than their laboratory detection limits for all individual parameters analysed, including MW-7, which recorded concentrations of Ethylbenzene and Xylene during December 2018. These results are generally consistent with previous monitoring rounds.

Tentatively Identified Compound (TIC) analysis was also undertaken at all monitoring wells sampled. No TICs were detected in all of the nine monitoring wells sampled in December 2018, including MW-7, which recorded a slightly elevated concentration of isopropyl alcohol during June 2018. These results are consistent with previous monitoring rounds.



## 2.5 Total Phenols

The results for total phenols are presented in Tables 2a – 2j.

The detection limit for total phenols is <0.1 mg/L and the threshold value is <0.0005 mg/L, according to the Interim Guideline Values published by EPA (2003). During the December 2018 monitoring round, phenols were not detected at any of the monitoring locations. This is consistent with June 2018. A concentration of 0.2 mg/L was recorded at MW1 in June 2017 which decreased to below the laboratory's detection limit in all the next monitoring rounds. Phenols had been recorded at MW-7 over recent sampling rounds including December 2016 (0.6mg/L), June 2016 (0.2mg/L), December 2015 (8.7mg/L) and June 2015 (0.3mg/L) which decreased to below the laboratory's detection limit in all the next monitoring rounds.

## 2.6 Major Cations and Anions

The analytical results for major cations and anions are presented in Tables 2a – 2j.

### 2.6.1 Total Hardness

All monitoring wells exceeded the threshold values for total hardness of 200 mg/L. This is consistent with the previous two groundwater monitoring rounds – December 2017 and June 2018, except for MW-7, which recorded concentrations below the threshold value.

The values recorded ranged between concentrations of 228 mg/l at MW-9 to 979 mg/l at MW-2. In the June 2018 round, MW-7 was the only borehole with a recorded concentration below the threshold value. All the results are consistent with historical results. However, MW-2 show increases when compared to its historical trend.

### 2.6.2 Total Alkalinity

There is no statutory threshold for this parameter under S.I. No. 9 of 2010 however, there should be 'no abnormal change' between reported readings. The highest alkalinity recorded in the December 2018 monitoring round was 582 mg/l at MW-5. The highest alkalinity recorded in the June 2017 monitoring round was 1108 mg/l at MW-5.

The recorded concentrations of the remaining sampled wells during the monitoring round are within a range of between 204 mg/l (MW-7) and 498 mg/l (MW-6). There has not been 'no abnormal change' between reported readings.

### 2.6.3 Calcium

All calcium concentrations recorded during the June 2018 monitoring round were within the EPA IGV threshold value of 200mg/l, except for MW-2, which recorded 370.3 mg/l. The concentrations of the remaining sampled wells ranged between 72.3 mg/l at MW-9 to 158.5 mg/l at MW-5. Calcium concentrations have been relatively consistent at all monitoring wells across the monitoring rounds.

## 2.6.4 Sodium

MW-1 (195.9 mg/l) was the only locations which recorded sodium concentrations in excess of the EPA IGV threshold value of 150 mg/l<sup>1</sup> during the December 2018 monitoring round. This is consistent with the previous two groundwater monitoring round (December 2017 and June 2018) concentrations, with the exception of MW-7, which had had an historical trend above the threshold value. The results are consistent with historical sodium results for MW-1 which have exceeded the IGV value on an ongoing basis.

Graphs 2a-2d at the end of this report show the historical trends for sodium at MW-1, MW-5, MW-7 and MW-9. The overall trend during 2018 was a notorious upward from December 2017 to June 2018 and a subsequent downward of concentrations with the exception of MW-1, whose concentrations have shown a downward trend. z

## 2.6.5 Potassium

There were no exceedances of the EPA IGV threshold value of 5 mg/l for potassium during the December 2018 monitoring round with the exception of MW-7 (11.4 mg/L). This is consistent with the historical trend whereby potassium concentrations at MW-7 have predominantly exceeded the threshold value, e.g. 11.4 mg/L in June 2018. A possible trend of seasonal fluctuation in potassium concentrations is also evident in Graph 3, with high concentrations in the summer. However, this is trend does not apply to MW1 which, with the exception of June 2017, has not exceeded 4.3 mg/l in the last eight Q1 and Q3 sampling rounds.

## 2.6.6 Chloride

The threshold value for chloride of 187.5 mg/l was exceeded at one location during the December 2018 monitoring round. This occurred at MW-1 (214.2 mg/l) where chloride concentrations have been elevated on an ongoing basis although an downward trend in these values is evident since June 2017. In comparison, June 2018 monitoring round recorded two exceedances at MW-1 and MW-7 (247.1 and 459.1 mg/l respectively).

All other locations were below the threshold value in the December 2018 monitoring round which is consistent with the June 2018 monitoring round.

The chloride concentrations have generally mirrored the increases and decreases in sodium levels across the monitoring wells. Trended concentrations at MW-5 (Graph 2b) show an evident fluctuation in chloride concentrations after December 2017 while MW-9 (Graph 2d) has been relatively stable with some occasional fluctuation, possibly due to seasonality.

## 2.6.7 Nitrate

In December 2018, the nitrate concentration in each of the nine samples was less than the threshold value of 37.5 mg/l. The exception was MW-7, which recorded 54.8 mg/l. There were no exceedances of the IGV threshold value in the previous two monitoring rounds in December 2017 and June 2018. Historically nitrate concentrations recorded at MW-8 tend to be higher than the other onsite monitoring

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<sup>1</sup> Under new legislation - *European Union Environmental Objectives (Groundwater) (Amendment) Regulations* (S.I. No. 366 of 2016) issued in July 2016 - sodium is no longer listed as a parameter for which a GTV is provided. Therefore, the EPA IGV value 150mg/L, which is the same as the original GTV threshold value, will be used for comparative purposes from now on.

wells. However, as there was no water to be sampled at this location in December 2018 a result is not available for comparison.

## 2.6.8 Nitrite

Nitrite results in December 2018 were below the IGTV threshold value (0.375 mg/l) with the exception of MW-7 (3.51 mg/l). All the remaining wells recorded concentrations below LOD (0.02 mg/l) with the exception of MW-1 (0.17 mg/l). MW-7 has shown small historical fluctuations in nitrite levels.

## 2.6.9 Total Ammonia

During December 2018, two locations exceeded the threshold value for total ammonia, MW-1 (2.56 mg/l) & MW-7 (1.06 mg/l). In contrast, during June 2018 monitoring round, four locations exceeded the threshold value for total ammonia, MW-1 (3.33 mg/l), MW-2 (0.23 mg/l), MW-5 (1.57 mg/l) & MW-7 (3.68 mg/l).

Concentrations at MW-1, MW-2 and MW-7 have regularly exceeded the threshold value of 0.175mg/l.

Graph 6 shows trended ammonia concentrations at MW-1, MW-5, MW-7 and MW-9 over the previous decade and identifies spikes in concentration at MW-1 and MW-7 as well as the June 2016 spike at MW-9.

## 2.6.10 Sulphate

MW-2 and MW-5 exceeded the threshold value for sulphate of 187.5 mg/l during the December 2018 monitoring round (228.2 and 236.5 mg/l respectively). During the June 2018 monitoring round, no recorded exceedance of the threshold value for sulphate of 187.5 mg/l.

The remaining wells have seen fluctuations over the same sampling period however concentrations are predominantly in compliance with the threshold value.

## 2.7 Individual Heavy Metals

The analytical results for heavy metals are presented in Tables 2a – 2j. It is noted that these are natural constituents of clay and can be slightly elevated as a result of variance in filtering.

### 2.7.1 Aluminium

Aluminium concentrations were below the threshold value of 0.15 mg/l in all monitoring wells during the December 2018 groundwater monitoring round, with the exception of MW-4 (0.177 mg/l). In MW-2, MW-3 and MW-7 the records were below the LOD (0.02 mg/l). The previous groundwater monitoring round in June 2018 recorded all the concentrations below of LOD. Historically, aluminium concentrations recorded at all the boreholes were below LOD, with the exception of MW-7 which fluctuated between exceedance of threshold value and below of LOD, and MW-6 with one record in December 2015 over the LOD (0.097 mg/l).

### 2.7.2 Manganese

Manganese concentrations were below the EPA indicative threshold value of 0.05 mg/l at six of the nine monitoring locations. Manganese concentration were above the threshold value at three monitoring wells: MW-1 (1.315 mg/l), MW-6 (0.278 mg/l)

and MW-7 (0.07 mg/l). Concentrations at MW-1 have marginally exceeded the threshold over the previous monitoring rounds.

There was a significant improvement at MW-9 which had recorded a concentration of 5.049 mg/l in June 2016; however, the result in June and December 2018 was above the LOD.

Graph 5, attached, shows that recent results at MW-3, MW-7 and MW-10 indicates concentrations of manganese have stabilised while levels at MW-1 have been gradually increasing since December 2013, with a slight decrease in December 2018 and levels at MW-9 have shown occasional spikes.

### **2.7.3 Iron**

Total dissolved iron was recorded below the LOD at eight out of the nine monitoring wells in December 2018. MW-1 (0.449 mg/l) recorded slight elevated concentrations of iron. Total dissolved iron was recorded below the LOD for all monitoring wells in June 2018, with the exception of MW-1 and MW-7 (0.323 and 0.138 mg/l respectively).

As outlined in the June 2018 report, a seasonal pattern has been noted with higher concentrations typically recorded during summer monitoring and lower concentrations during winter monitoring.

### **2.7.4 Arsenic**

Arsenic was recorded below LOD in seven of the nine samples taken during the December 2018 monitoring round. MW-1 recorded an arsenic concentration of 0.0123 mg/l, over the threshold value (0.0075 mg/l). MW-7 recorded a concentration of 0.0054 mg/l, but below the arsenic threshold value. In June 2018 monitoring round, all the records were below the threshold value, but MW-1 recorded a concentration of 0.0034 mg/l. This was consistent with the previous groundwater monitoring round in June 2017. All remaining monitoring wells have recorded concentrations below the laboratory limit of detection (LOD).

### **2.7.5 Nickel**

All nickel concentrations were below the EPA IGV threshold value of 0.02 mg/l. MW-7 and MW-9 recorded a value of 0.003 mg/l. The remaining samples were below the LOD. Concentrations have decreased in MW-7 when compared to results from December 2016. The results in December 2018 are generally consistent with the previous monitoring round in June 2018.

### **2.7.6 Barium**

Barium concentrations exceed the threshold value (0.1 mg/l) at three out of nine monitoring wells during the December 2018 monitoring round. These include; MW-1 (0.258 mg/l), MW-2 (0.107 mg/l), and MW-9 (0.109 mg/l). MW-1 has shown a downward trend since June 2017, when recorded a concentration of 2.37 mg/l. All other results were within the threshold value.

## **2.8 Bacteriological Analysis**

Tables 1a – 1j present the bacteriological analysis and Graphs 1a – 1j present the historical trends at each of the boreholes up to and including December 2018

monitoring round. No parameters were analysed for location MW-8 due to inability to collect a sample as the monitoring was dry at the time of sampling.

Though there is no formal legislative standard for coliforms other than in drinking water legislation.

### 2.8.1 Faecal Coliforms

Faecal coliforms were recorded in four of the nine monitoring wells sampled for this parameter during the December 2018 monitoring round. These were MW-1 (6 cfu/100ml), MW-2 (3 cfu/100ml), MW-4 (9 cfu/100ml) and MW-5 (8 cfu/100ml). All other results are consistent with previous results.

Historically faecal coliforms have been recorded regularly at most locations.

### 2.8.2 Faecal Streptococci

Faecal streptococci were recorded at eight of the nine wells sampled in the December 2018 monitoring round. These were MW-1 (7 cfu/100ml), MW-2 (28 cfu/100ml), MW-3 (10 cfu/100ml), MW-4 (3 cfu/100ml), MW-5 (15 cfu/100ml), MW-6 (4 cfu/100ml), MW-7 (9 cfu/100ml), and MW-9 (2 cfu/100ml). Results have decreased in concentrations but are generally consistent with the previous monitoring rounds.

### 2.8.3 Total Coliforms

Elevated total coliforms were recorded at all monitoring locations in December 2018. The following concentrations were recorded: MW-1 (11,300.0 MPN/100ml), MW-2 (108,900 MPN/100ml), MW-3 (111.2 MPN/100ml), MW-4 (228 MPN/100ml), MW-5 (28,510 MPN/100ml), MW-6 (27 MPN/100ml), MW-7 (173,290 MPN/100ml), MW-9 (10 MPN/100ml) and MW-10 (2 MPN/100ml).

All the results are broadly consistent with previous monitoring rounds. Total coliforms were recorded in all monitoring locations in June 2018, with the exception of MW-10, with a concentration below the respective LOD (1 MPN/100ml).

### 2.8.4 Clostridium Perfringens

It is generally considered that anything above 0 cfu/100ml is indicative of bacteriological contaminants. During the December 2018 monitoring round clostridium perfringens were detected in six of the nine sampled wells including MW-1 (19 cfu/100ml), MW-2 (57 cfu/100ml), MW-3 (5 cfu/100ml), MW-5 (21 cfu/100ml), MW-6 (14 cfu/100ml), and MW-7 (3 cfu/100ml).

Historically clostridium perfringens has been recorded regularly at all of the monitoring wells in varying concentrations. All results were relatively consistent with previous sampling rounds although notably at the lower end of the spectrum.

### 3.0 MAIN FINDINGS AND CONCLUSIONS

- Field observations indicated ongoing contamination at MW-1 and MW-7. In particular, MW-7 had a slight black tint and MW-1 had an orange tint.
- All field pH readings were within the EPA IGV range of 6.0 - 9.5. pH levels in MW-7 have been elevated during previous monitoring rounds including December 2016, September 2016, March 2016 and December 2015. However, MW-7 was within threshold limits for the fourth monitoring round in succession.
- BTEX compounds were not detected above the laboratory LOD limit in any of the nine groundwater samples analysed. Diesel range organics (DRO) were recorded in only one of the monitoring wells, MW-1, which recorded a concentration of 100 µg/l which is consistent with the previous monitoring round.. Petrol Range Organics (PRO) were all less the laboratory detection limit (<10 µg/l) in the nine wells. As detailed in the AWN Contamination Assessment report dated May 2014, elevated levels of DRO and PRO may be misleading. They are considered likely to be indicative of naturally occurring substances rather than fuels or other hydrocarbon sources.
- Phenols compounds were not detected above the laboratory LOD limit in any of the nine groundwater samples analysed.
- No VOCs were recorded above the LOD at all sampled locations. Analysis of Tentatively Identified Compounds (TIC) did not identify possible Triethylamine in any of the locations.
- Levels of manganese, iron, potassium and ammonia at MW-9 appear to be decreasing when compared to that seen in June & December 2017. Ammonia records are below the threshold in the last three monitoring rounds. Concentrations at MW-1, MW-2 and MW-7 have regularly exceeded the threshold value of 0.175mg/l.
- Barium concentrations exceed the threshold value (0.1 mg/l) at three out of eight wells sampled during the December 2018 monitoring round. These include; MW-1 (0.258 mg/l), MW-2 (0.107 mg/l), and MW-9 (0.109 mg/l). MW-1 has shown a downward trend since June 2017, when recorded a concentration of 2.37 mg/l, but still exceeds the threshold value of 0.1 mg/l for barium.
- There continues to be considerable variation in results from bacteriological analysis. Total coliforms were recorded in all of the monitoring wells sampled in December 2018. Faecal coliforms were recorded in four of the nine monitoring wells sampled for this parameter during the December 2018 monitoring round. Historically faecal coliforms have been recorded regularly at most locations.
- Whilst bacteriological parameters remain elevated at this site, Clarochem conduct integrity testing of all pipelines at the facility in excess of the requirements of the facility licence to ensure any potential failures/leaks are detected at an early stage. All pipelines are tested a minimum of once every three years.



## 4.0 RECOMMENDATIONS

The majority of the heavy metal, organic and inorganic contamination recorded on site is localised to one area of the site, where the tank farm and waste water treatment plant are located. It is recommended that the operation of the groundwater abstraction programme (MW-1, MW-5, MW-7 and MW-9) is continued with the aim of further improving the groundwater quality in this area.

The results from the December 2018 monitoring indicate that groundwater quality at MW-9 is improving. Ongoing attention is still required at MW-1 and MW-7 in particular where concentrations in a number of non hazardous parameters remain elevated.

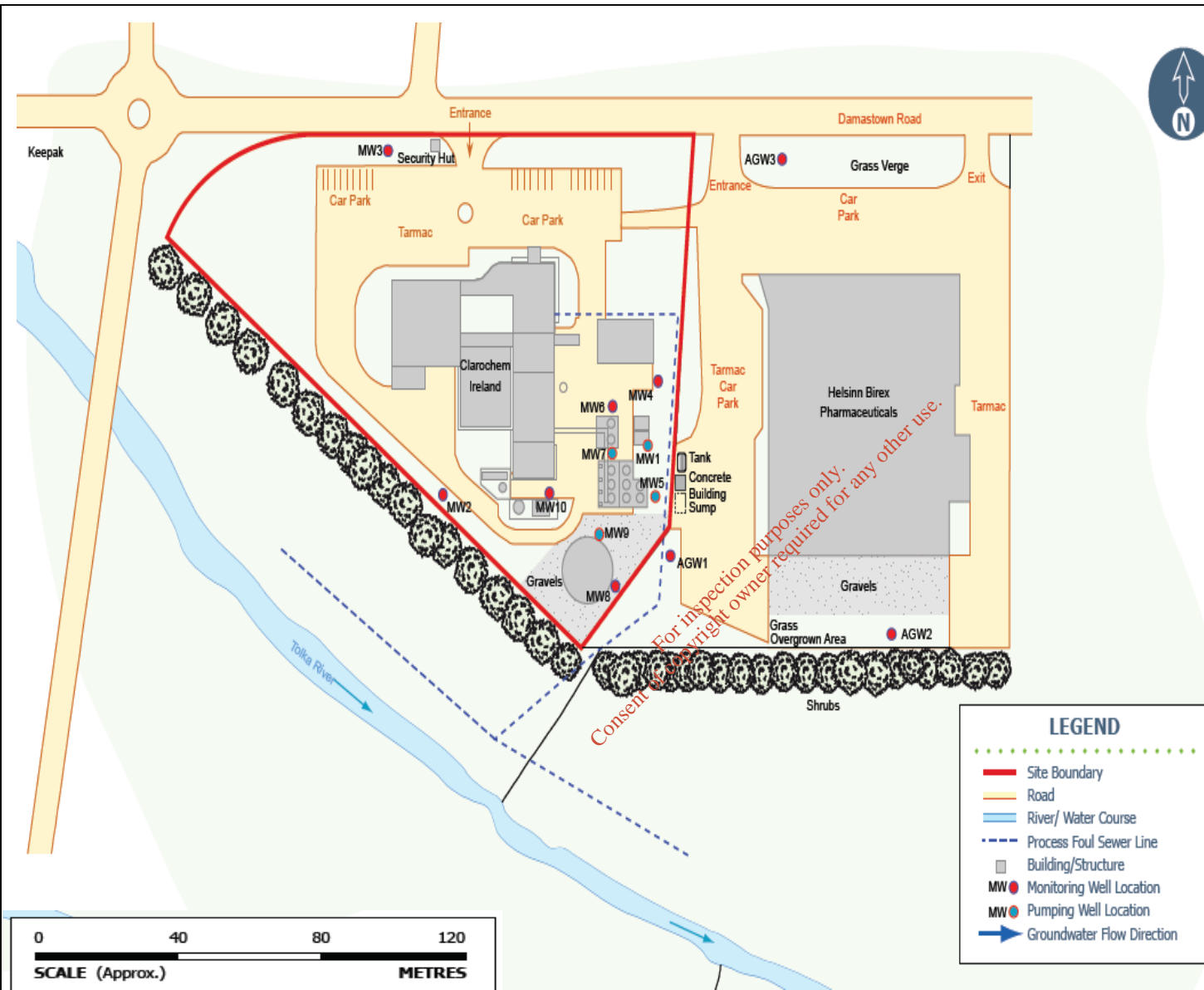
As these are non hazardous chemicals, an assessment of the number of sample locations for ongoing trend assessment is being carried out.

The next round of quarterly monitoring will be undertaken in March 2019. It is anticipated that this monitoring will provide further information regarding the improvements in water quality downgradient from the site.

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## FIGURES

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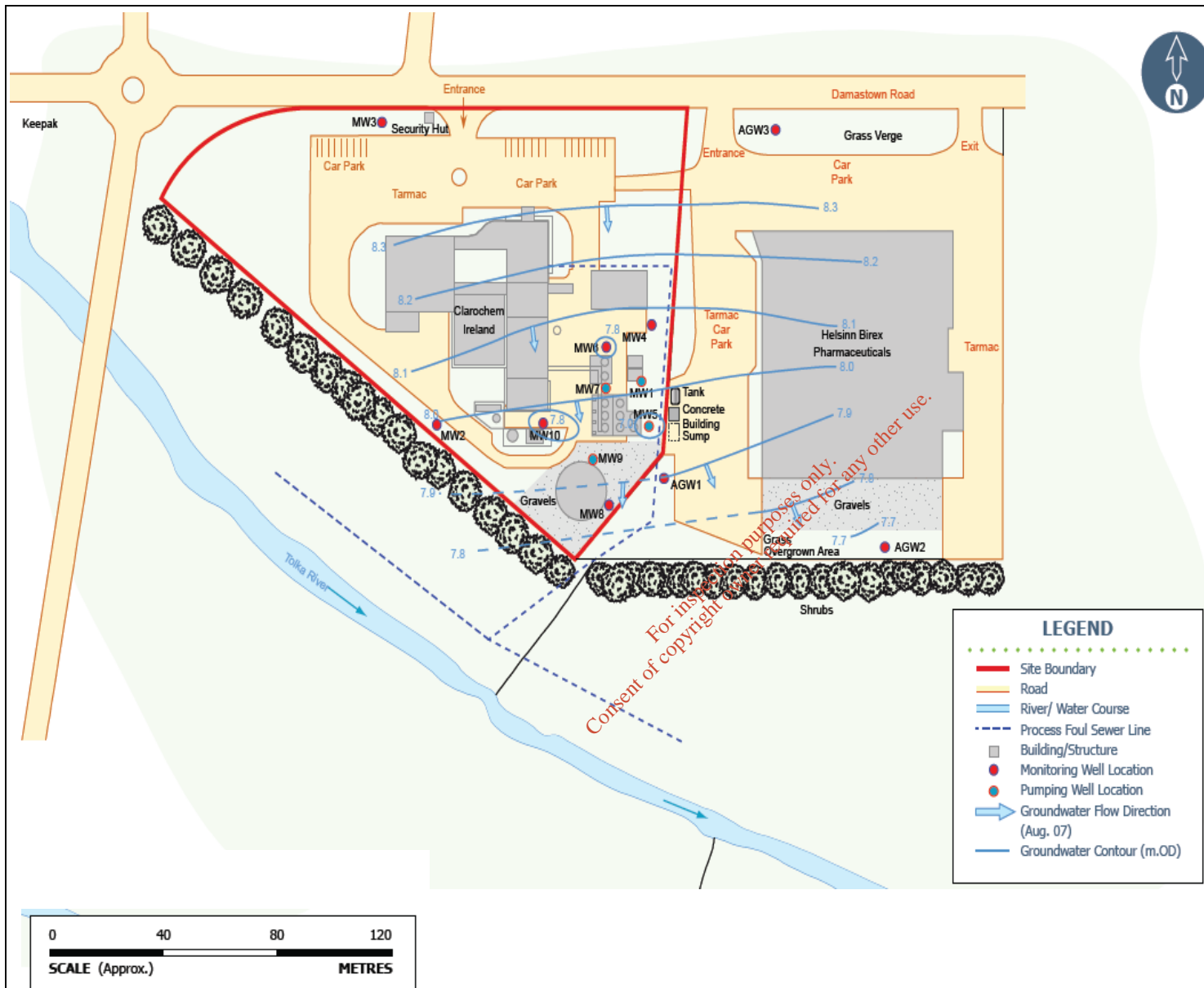
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Do Not Scale

**Project:**  
Clarochem Ireland Limited  
GW Monitoring

**Reference:**  
Project No.:12/6379

**Figure 1:**  
Monitoring Well  
Locations



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**Project:**

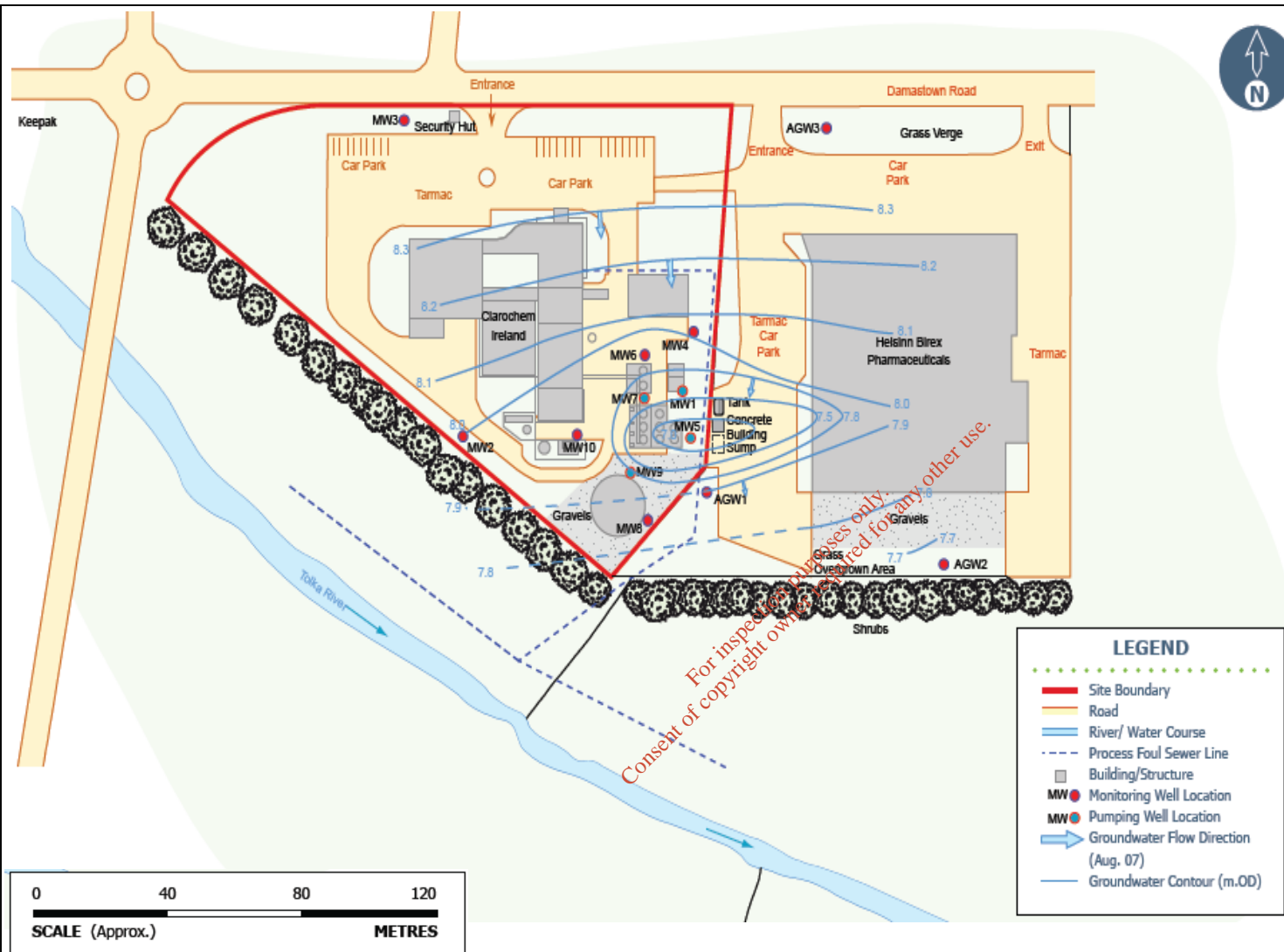
Clarochem Ireland Limited  
GW Monitoring

**Reference:**

Project No.: 12/6379

**Figure 2:**

Groundwater Flow  
Direction Before  
Pumping



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**Project:**

Clarochem Ireland Limited  
GW Monitoring

**Reference:**

Project No.: 12/6379

**Figure 3:**

Groundwater Flow  
Direction During  
Pumping

## TABLES

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PARAMETERS	UNIT	MW-1																				Threshold Value
		20/03/2014	19/06/2014	30/09/2014	04/12/2014*	26/03/2015	22/06/2015	21/09/2015	07/12/2015*	23/03/2016	30/06/2016	30/09/2016	13/12/2016	30/03/2017	13-06-2017*	14/09/2017	14/12/2017	22/02/2018	14/06/2018	27/09/2018	06/12/2018	
Temperature	Units	10	<b><u>13.1</u></b>	<b><u>14.8</u></b>	11.2	<b><u>9.2</u></b>	-	<b><u>13</u></b>	11.1	<b><u>9.2</u></b>	<b><u>12.5</u></b>	<b><u>14.0</u></b>	11.9	10.8	<b><u>14.5</u></b>	<b><u>14.5</u></b>	11.9	10	<b><u>13.1</u></b>	<b><u>14</u></b>	11.5	10-12°C
pH	Units	8.05	7.32	7.36	7.1	7.78	8.21	7.27	8.16	7.78	7.83	7.74	7.64	7.55	7.68	7.73	7.3	7.4	7.6	7.66	7.24	6 - 9.5
Conductivity	µS/cm	1,473	<b><u>1,971</u></b>	<b><u>1,991</u></b>	1,806	1,671	958	1,717	1,582	1,671	1,867	1,350	1,507	2,273	1,690	1,992	1,672	1,511	1,431	1,858	1,196	1,875
Sodium	mg/l	<b><u>190.1</u></b>	<b><u>227</u></b>	<b><u>343.4</u></b>	<b><u>275.5</u></b>	<b><u>260.7</u></b>	<b><u>186.9</u></b>	<b><u>349.7</u></b>	<b><u>294.2</u></b>	<b><u>260.7</u></b>	<b><u>256.4</u></b>	<b><u>186.6</u></b>	<b><u>351.2</u></b>	<b><u>296.3</u></b>	<b><u>432.9</u></b>	<b><u>323.1</u></b>	<b><u>312.5</u></b>	<b><u>203.4</u></b>	<b><u>214.2</u></b>	<b><u>380.2</u></b>	<b><u>195.9</u></b>	150
Choride	mg/l	<b><u>233.4</u></b>	<b><u>305</u></b>	<b><u>480.2</u></b>	<b><u>374.3</u></b>	<b><u>330.7</u></b>	<b><u>367.4</u></b>	<b><u>417.6</u></b>	29.7	<b><u>330.7</u></b>	<b><u>414.3</u></b>	<b><u>280.6</u></b>	<b><u>483.1</u></b>	<b><u>377.7</u></b>	<b><u>508.5</u></b>	<b><u>453.3</u></b>	<b><u>320</u></b>	<b><u>269.6</u></b>	<b><u>247.1</u></b>	<b><u>290.7</u></b>	<b><u>214.2</u></b>	187.5
Clostridium Perfringens	cfu./ml	<1	<1	<1	<1	<1	<1	<1	<b><u>1</u></b>	<1	<b><u>5</u></b>	<b><u>4</u></b>	<b><u>1</u></b>	<b><u>10</u></b>	<1	<b><u>2</u></b>	<b><u>10</u></b>	<b><u>14</u></b>	<1	<1	<b><u>19</u></b>	0 counts/ 100ml
Total Coliforms	MPN/100ml	<b><u>410</u></b>	<b><u>3</u></b>	<1	<b><u>2,420</u></b>	<b><u>76</u></b>	<1	<b><u>461.1</u></b>	<b><u>7.5</u></b>	<b><u>4.1</u></b>	<b><u>1,000</u></b>	<b><u>241,960</u></b>	<b><u>21,460</u></b>	<b><u>99</u></b>	<b><u>1</u></b>	<b><u>2,000</u></b>	<b><u>49,500</u></b>	<b><u>687</u></b>	<b><u>1,986</u></b>	<b><u>12,390</u></b>	<b><u>11,300</u></b>	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<1	<1	<1	<b><u>1</u></b>	<1	<1	<b><u>14.5</u></b>	<1	<1	<b><u>5</u></b>	<b><u>660</u></b>	<b><u>1</u></b>	<b><u>&lt;1</u></b>	<b><u>1</u></b>	<b><u>95</u></b>	<b><u>17</u></b>	<b><u>&lt;1</u></b>	<b><u>&lt;1</u></b>	<b><u>39</u></b>	<b><u>6</u></b>	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<1	<1	<b><u>27</u></b>	<1	<1	<1	<b><u>1</u></b>	<b><u>1</u></b>	<1	<b><u>5</u></b>	<b><u>690</u></b>	<b><u>4</u></b>	<b><u>&lt;1</u></b>	<b><u>&lt;1</u></b>	<b><u>170</u></b>	<b><u>350</u></b>	<b><u>3</u></b>	<1	<b><u>44</u></b>	<b><u>7</u></b>	0 counts/ 100ml
<div><div>Legend:</div><div>NDP - No Determination Possible by Laboratory</div><div>Results are shaded, bold and underlined where the Threshold Value is exceeded.</div><div>* Bi-Annual IPPC Groundwater Monitoring Round</div><div>-' = not analysed</div><div># = Results from re-sampling on 5th October 2017</div></div>																						
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PARAMETERS	UNIT	MW-2																				Threshold Value
		20/03/2014	19/06/2014	30/09/2014	04/12/2014*	26/03/2015	22/06/2015	21/09/2015	07/12/2015*	23/03/2016	30/06/2016	30/09/2016	13/12/2016	30/03/2017	13-06-2017*	14/09/2017	14/12/2017	22/02/2018	14/06/2018	27/09/2018	06/12/2018	
Temperature	Units	-	<b><u>13.3</u></b>	<b><u>14.8</u></b>	11.3	10.2	<b><u>13.8</u></b>	<b><u>13.8</u></b>	11	<b><u>9.3</u></b>	11.8	<b><u>13</u></b>	11.9	10.1	<b><u>12.5</u></b>	<b><u>12.5</u></b>	11.80	10.10	11.70	<b><u>13.1</u></b>	11.90	10-12°C
pH	Units	7.35	7.09	7.29	6.67	7.36	7.33	7.33	7.33	7.61	7.19	7.09	7.13	6.97	6.9	7.08	7.09	7.28	6.94	6.88	7.41	6 - 9.5
Conductivity	µS/cm	877	880	822	654	783	775	775	672	704	781	770	665	873	829	888	911	826	866	832	1088	1,875
Sodium	mg/l	13.3	14.9	15.5	16.3	12.2	16.4	16.4	14.5	12	12.7	11.5	13.6	14.7	15.6	11.4	17.90	13.70	14.80	13.50	16.20	150
Choride	mg/l	15	17.9	15.2	16.2	25.6	28.5	28.5	29.7	23.7	18.4	14.1	18.7	32.2	22.5	15.2	34.1	20.3	24.1	17.9	44.2	187.5
Clostridium Perfringens	cfu./ml	<1	<1	<1	<1	<b><u>1</u></b>	<b><u>1</u></b>	<b><u>7</u></b>	<b><u>1</u></b>	<b><u>8</u></b>	<1	<1	<b><u>5</u></b>	<1	<b><u>1</u></b>	<1	<b><u>≤1</u></b>	<b><u>10</u></b>	<b><u>≤1</u></b>	<b><u>3</u></b>	<b><u>57</u></b>	0 counts/ 100ml
Total Coliforms	MPN/100ml	<b><u>630</u></b>	<b><u>2,420</u></b>	<b><u>12,360</u></b>	<b><u>172</u></b>	<b><u>&gt;2419.6</u></b>	<b><u>&gt;2419.6</u></b>	<b><u>&gt;2419.6</u></b>	<b><u>&gt;2419.6</u></b>	<b><u>241960</u></b>	<b><u>6,600</u></b>	<b><u>&gt;2419600</u></b>	<b><u>54,750</u></b>	<b><u>30500</u></b>	<b><u>111990</u></b>	<b><u>325500</u></b>	<b><u>387,300</u></b>	<b><u>1,986</u></b>	<b><u>61,310</u></b>	<b><u>13,550</u></b>	<b><u>108,900</u></b>	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<b><u>17</u></b>	<b><u>3</u></b>	<b><u>1,300</u></b>	<b><u>12</u></b>	<b><u>35</u></b>	<b><u>400</u></b>	<b><u>1,000</u></b>	<b><u>98,000</u></b>	<b><u>46</u></b>	<b><u>2</u></b>	<b><u>510</u></b>	<b><u>950</u></b>	<b><u>61</u></b>	<b><u>86</u></b>	<b><u>860</u></b>	<b><u>2,100</u></b>	<b><u>20</u></b>	<b><u>27</u></b>	<b><u>21</u></b>	<b><u>3</u></b>	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<1	<1	<b><u>114</u></b>	<1	<1	<1	<b><u>3,600</u></b>	<b><u>5</u></b>	<b><u>3</u></b>	<1	<b><u>181</u></b>	<b><u>12</u></b>	<b><u>1</u></b>	<b><u>52</u></b>	<b><u>67</u></b>	<1	<1	<1	<b><u>38,500</u></b>	<b><u>28</u></b>	0 counts/ 100ml

**Legend:**

NDP - No Determination Possible by Laboratory

**Results are shaded, bold and underlined where the Threshold Value is exceeded.**

\* Bi-Annual IPPC Groundwater Monitoring Round

-¹ = not analysed

# = Results from re-sampling on 5th October 2017

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PARAMETERS	UNIT	MW-3																				Threshold Value
		20/03/2014	19/06/2014	30/09/2014	04/12/2014*	26/03/2015	22/06/2015	21/09/2015	07/12/2015*	23/03/2016	30/06/2016	30/09/2016	13/12/2016	30/03/2017	13-06-2017*	14/09/2017	14/12/2017	22/02/2018	14/06/2018	27/09/2018	06/12/2018	
Temperature	Units	9.5	<u>13</u>	<u>15.3</u>	11.1	10	<u>13.4</u>	<u>14</u>	11.1	<u>8.3</u>	<u>13</u>	<u>12.8</u>	11	10.1	<u>13.2</u>	<u>14</u>	10.7	10.8	<u>12.8</u>	<u>13.0</u>	11.5	10-12°C
pH	Units	7.26	7.14	7.33	7.11	7.3	7.3	6.94	7.53	6.89	7.32	6.99	7.2	7.07	7.06	7.15	7.25	7.32	7.06	7.11	7.29	6 - 9.5
Conductivity	µS/cm	920	848	864	750	820	828	773	517	651	765	787	600	828	795	906	769	691	864	823	761	1,875
Sodium	mg/l	9.2	10.4	10.9	10.9	12	11	10	15.9	10.2	10.2	9.7	9.2	11.4	26.5	10.8	11.40	9.00	10.40	11.40	12.40	150
Choride	mg/l	12.6	16.6	14.7	15.3	17.3	17.4	15.8	29.7	16.3	18.8	15.1	14.7	24.1	17	15.2	21.2	17.8	19.5	21.3	32.5	187.5
Clostridium Perfringens	cfu./ml	<1	<1	<1	<1	<u>3</u>	<1	<u>1</u>	<u>49</u>	<u>3</u>	<1	<1	<1	<1	<u>2</u>	<u>1</u>	<u>2</u>	<u>5</u>	<u>2</u>	<1	<u>5</u>	0 counts/ 100ml
Total Coliforms	MPN/100ml	<u>200</u>	<1	<u>100</u>	<u>980</u>	<u>&gt;2419.6</u>	<u>62</u>	<u>344.8</u>	<u>123.6</u>	<u>22.8</u>	<u>91.2</u>	<u>7.5</u>	<u>13.4</u>	<u>7.4</u>	<u>195.6</u>	<u>18.5</u>	<u>200</u>	<u>142.1</u>	<u>6.3</u>	<1	<u>111.2</u>	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<u>1</u>	<1	<u>4</u>	<1	<u>2</u>	<1	<u>10</u>	<u>4</u>	<u>1</u>	<1	<1	<1	<1	<1	<u>11.0</u>	<u>11</u>	<u>1</u>	<u>1</u>	<1	<1	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<1	<1	<u>1</u>	<1	<1	<1	<u>2</u>	<u>23</u>	<1	<u>1</u>	<1	<1	<1	<u>2</u>	<u>≤1</u>	<u>1,160</u>	<u>7</u>	<u>4</u>	<1	<u>10</u>	0 counts/ 100ml

**Legend:**

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PARAMETERS	UNIT	MW-4																				Threshold Value
		20/03/2014	19/06/2014	30/09/2014	04/12/2014*	26/03/2015	22/06/2015	21/09/2015	07/12/2015*	23/03/2016	30/06/2016	30/09/2016	13/12/2016	30/03/2017	13-06-2017*	14/09/2017	14/12/2017	22/02/2018	14/06/2018	27/09/2018	06/12/2018	
Temperature	Units	<b><u>9.6</u></b>	<b><u>14</u></b>	-	10	10.1	<b><u>13.2</u></b>	<b><u>13</u></b>	11	8.6	<b><u>13.4</u></b>	<b><u>13.5</u></b>	10.1	10	<b><u>13</u></b>	<b><u>14</u></b>	<b><u>9.0</u></b>	<b><u>7.2</u></b>	<b><u>14.0</u></b>	<b><u>13.8</u></b>	11.5	10-12°C
pH	Units	7.61	7.28	7.30	6.89	7.41	7.21	7.15	7.85	7.51	7.32	7.11	7.18	7.25	7.19	7.13	7.32	7.36	7.22	7.21	7.25	6 - 9.5
Conductivity	µS/cm	463	588	587	538	535	546	612	370	528	568	620	461	627	589	685	613	642	740	728	483	1,875
Sodium	mg/l	4.9	7.1	6.8	15.3	9.7	10.9	17.4	6.8	10.1	6.6	8.7	7.6	7.7	9.8	8.2	7.0	7.2	9.8	9.7	6.7	150
Choride	mg/l	6.8	7.2	7.0	24.5	9.4	9.4	9.5	29.7	12.4	5.1	11.5	9.5	7.8	6.1	6.8	31.5	12.3	22.9	18.2	8.6	187.5
Clostridium Perfringens	cfu./ml	<b><u>30</u></b>	<1	<b><u>5</u></b>	<1	<1	<b><u>6</u></b>	<b><u>26</u></b>	<b><u>4</u></b>	<b><u>10</u></b>	<b><u>3</u></b>	<b><u>1</u></b>	<b><u>3</u></b>	<b><u>4</u></b>	<b><u>20</u></b>	<1	<1	<b><u>144</u></b>	<1	<1	<1	0 counts/ 100ml
Total Coliforms	MPN/100ml	<b><u>23,820</u></b>	<b><u>345</u></b>	<b><u>100</u></b>	<b><u>727</u></b>	<b><u>816</u></b>	<b><u>1,300</u></b>	<b><u>&gt;2419.6</u></b>	<b><u>298.7</u></b>	<b><u>686.7</u></b>	<b><u>1,550</u></b>	<b><u>770.1</u></b>	<b><u>686.7</u></b>	<b><u>1,553.1</u></b>	<b><u>1,046.2</u></b>	<b><u>960.6</u></b>	<b><u>630</u></b>	<b><u>91</u></b>	<b><u>225</u></b>	<b><u>29</u></b>	<b><u>228</u></b>	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<b><u>20</u></b>	<b><u>19</u></b>	<b><u>63</u></b>	<1	<1	<1	<b><u>700</u></b>	<b><u>81</u></b>	<b><u>22.0</u></b>	<b><u>120</u></b>	<b><u>30</u></b>	<b><u>4</u></b>	<1	<b><u>43</u></b>	<b><u>38</u></b>	<b><u>9</u></b>	<b><u>18</u></b>	<1	<1	<b><u>9</u></b>	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<1	<b><u>20</u></b>	<b><u>17</u></b>	<1	<1	<b><u>2</u></b>	<b><u>83</u></b>	<b><u>2</u></b>	<1	<b><u>51</u></b>	<b><u>2</u></b>	<b><u>2</u></b>	<b><u>1</u></b>	<b><u>77</u></b>	<b><u>15</u></b>	<b><u>10</u></b>	<b><u>9</u></b>	<1	<1	<b><u>3</u></b>	0 counts/ 100ml

**Legend:**

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- ' = not analysed

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PARAMETERS	UNIT	MW-5																				Threshold Value
		20/03/2014	19/06/2014	30/09/2014	04/12/2014*	26/03/2015	22/06/2015	21/09/2015	07/12/2015*	23/03/2016	30/06/2016	30/09/2016	13/12/2016	30/03/2017	13-06-2017*	14/09/2017	14/12/2017	22/02/2018	14/06/2018	27/09/2018	06/12/2018	
Temperature	Units	<b><u>9.3</u></b>	<b><u>13.5</u></b>	<b><u>15.1</u></b>	<b><u>9.9</u></b>	<b><u>8.6</u></b>	<b><u>12.6</u></b>	<b><u>13.5</u></b>	11.2	9.3	<b><u>14.8</u></b>	<b><u>13.0</u></b>	10.7	10.1	<b><u>14.5</u></b>	<b><u>15.0</u></b>	10.50	<b><u>9.00</u></b>	<b><u>14.80</u></b>	<b><u>14</u></b>	11.5	10-12°C
pH	Units	7.46	7.48	7.55	6.8	7.49	7.2	7.52	7.49	7.36	7.5	7.19	7.43	7.45	7.37	7.49	7.41	7.91	7.67	7.64	7.47	6 - 9.5
Conductivity	µS/cm	663	928	652	607	1,064	1,187	604	544	1,139	642	1,028	537	792	783	751	733	471	998	933	881	1,875
Sodium	mg/l	45.2	85	34.3	22.1	81.3	102	23.4	16.3	108.4	22.2	75.2	26.5	22.4	19.1	18.8	15.3	58.0	95.3	126.3	26.6	150
Choride	mg/l	36.3	75.5	24.2	15.2	75.3	83	13.4	29.7	110.9	18.9	75.5	20	16.1	16.0	16.6	10.9	42.2	121.4	97.6	46.6	187.5
Clostridium Perfringens	cfu./ml	<b><u>28</u></b>	<1	<b><u>3</u></b>	<1	<b><u>33</u></b>	<b><u>3</u></b>	<b><u>61</u></b>	<b><u>18</u></b>	<b><u>31</u></b>	<b><u>16</u></b>	<b><u>5</u></b>	<b><u>5</u></b>	<b><u>16</u></b>	<b><u>38</u></b>	<b><u>2</u></b>	<b><u>23</u></b>	<b><u>194</u></b>	<b><u>10</u></b>	<b><u>2</u></b>	<b><u>21</u></b>	0 counts/ 100ml
Total Coliforms	MPN/100ml	<b><u>241,960</u></b>	<b><u>186</u></b>	<b><u>300</u></b>	<b><u>1,986</u></b>	<b><u>&gt;2419.6</u></b>	<b><u>6</u></b>	<b><u>&gt;2419.6</u></b>	<b><u>&gt;2419.6</u></b>	<b><u>48,840</u></b>	<b><u>17,500</u></b>	<b><u>5,730</u></b>	<b><u>6,890</u></b>	<b><u>19,300</u></b>	<b><u>193,500</u></b>	<b><u>571,700</u></b>	<b><u>2,420</u></b>	<b><u>3,550</u></b>	<b><u>104,620</u></b>	<b><u>2,420</u></b>	<b><u>28,510</u></b>	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<b><u>21</u></b>	<b><u>64</u></b>	<b><u>81</u></b>	<b><u>8</u></b>	<b><u>1</u></b>	<b><u>3</u></b>	<b><u>1,500</u></b>	<b><u>24,000</u></b>	<b><u>23.0</u></b>	<b><u>62</u></b>	<b><u>12.0</u></b>	<b><u>1,000</u></b>	<b><u>4.0</u></b>	<b><u>4,400</u></b>	<b><u>16,000</u></b>	<b><u>16</u></b>	<b><u>5</u></b>	<b><u>23</u></b>	<b><u>3,766</u></b>	<b><u>8</u></b>	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<b><u>51</u></b>	<b><u>33</u></b>	<b><u>104</u></b>	<1	<1	<1	<b><u>800</u></b>	<b><u>3,700</u></b>	<1	<b><u>21</u></b>	<b><u>10</u></b>	<b><u>20</u></b>	<1	<b><u>26</u></b>	<b><u>190</u></b>	<b><u>30</u></b>	<b><u>25</u></b>	<b><u>6</u></b>	<b><u>155</u></b>	<b><u>15</u></b>	0 counts/ 100ml
<div><div>Legend:</div><div>NDP - No Determination Possible by Laboratory</div><div>Results are shaded, bold and underlined where the Threshold Value is exceeded.</div><div>* Bi-Annual IPPC Groundwater Monitoring Round</div><div>- ' = not analysed</div><div># = Results from re-sampling on 5th October 2017</div></div>																						<div><div>AWN CONSULTING</div><div>Clarochem Ireland GW Monitoring</div><div>Job No. 12/6379</div></div>

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PARAMETERS	UNIT	MW-6																				Threshold Value
		20/03/2014	19/06/2014	30/09/2014	04/12/2014*	26/03/2015	22/06/2015	21/09/2015	07/12/2015*	23/03/2016	30/06/2016	30/09/2016	13/12/2016	30/03/2017	13-06-2017*	14/09/2017	14/12/2017	22/02/2018	14/06/2018	27/09/2018	06/12/2018	
Temperature	Units	<b><u>8.8</u></b>	<b><u>14.1</u></b>	<b><u>14.9</u></b>	<b><u>9.2</u></b>	<b><u>8.1</u></b>	<b><u>14</u></b>	<b><u>14.2</u></b>	11.3	<b><u>8.6</u></b>	11.6	<b><u>13.5</u></b>	10	<b><u>9.5</u></b>	<b><u>14.6</u></b>	<b><u>14.1</u></b>	<b><u>9</u></b>	<b><u>7</u></b>	<b><u>15</u></b>	<b><u>13.8</u></b>	11.2	10-12°C
pH	Units	7.6	7.6	7.61	7.16	7.66	7.47	7.57	8.26	7.75	7.58	7.36	7.57	7.53	7.29	7.49	7.34	7.53	7.42	7.43	7.29	6 - 9.5
Conductivity	µS/cm	933	1,044	614	265	553	717	534	559	560	786	740	557	811	864	817	758	732	816	847	642	1,875
Sodium	mg/l	105.5	137.2	57.4	50	52.5	59.3	92.3	65.2	68.1	58.5	70.4	65.8	61.5	72.7	57.7	56.70	56.0	58.3	69.8	52.2	150
Choride	mg/l	63.2	87.4	37.0	30.0	36.3	52.7	55.4	29.7	56.5	22.2	70.2	65.4	60.0	70.2	58.7	60.5	58.5	60.3	60.5	52.2	187.5
Clostridium perfringens	cfu./ml	<1	<1	<b><u>3</u></b>	<1	<1	<1	<b><u>21</u></b>	<1	<b><u>8</u></b>	<1	<1	<1	<1	<b><u>29</u></b>	<b><u>1</u></b>	<b><u>450</u></b>	<1	<b><u>13</u></b>	<b><u>5</u></b>	<b><u>14</u></b>	0 counts/ 100ml
Total Coliforms	MPN/100ml	<b><u>2</u></b>	<b><u>5</u></b>	<1	<b><u>1,120</u></b>	<b><u>43</u></b>	<1	<b><u>29.4</u></b>	<b><u>2</u></b>	<b><u>43</u></b>	<b><u>687</u></b>	<b><u>72.2</u></b>	<b><u>770</u></b>	<1	<b><u>21</u></b>	<b><u>5</u></b>	<b><u>2,000</u></b>	<b><u>69</u></b>	<b><u>12</u></b>	<b><u>4</u></b>	<b><u>27</u></b>	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<1	<b><u>1</u></b>	<1	<1	<1	<1	<b><u>4</u></b>	<b><u>1</u></b>	<1	<b><u>3</u></b>	<1	<1	<1	<1	<1	<b><u>3</u></b>	<b><u>4</u></b>	<1	<b><u>1</u></b>	<1	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<1	<b><u>39</u></b>	<b><u>10</u></b>	<1	<1	<1	<1	<1	<b><u>2</u></b>	<b><u>10</u></b>	<b><u>2</u></b>	<1	<1	<1	<b><u>2</u></b>	<b><u>450</u></b>	<b><u>8</u></b>	<b><u>1</u></b>	<1	<b><u>4</u></b>	0 counts/ 100ml

**Legend:**

NDP - No Determination Possible by Laboratory

**Results are shaded, bold and underlined where the Threshold Value is exceeded.**

\* Bi-Annual IPPC Groundwater Monitoring Round

-' = not analysed

# = Results from re-sampling on 5th October 2017

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PARAMETERS	UNIT	MW-7																				Threshold Value
		20/03/2014	19/06/2014	30/09/2014	04/12/2014*	26/03/2015	22/06/2015	21/09/2015	07/12/2015*	23/03/2016	30/06/2016	30/09/2016	13/12/2016	30/03/2017	13-06-2017*	14/09/2017	14/12/2017	22/02/2018	14/06/2018	27/09/2018	06/12/2018	
Temperature	Units	<b><u>9.5</u></b>	<b><u>14.5</u></b>	-	<b><u>8.8</u></b>	<b><u>7.6</u></b>	<b><u>13.8</u></b>	-	11	<b><u>9.1</u></b>	<b><u>9.04</u></b>	-	<b><u>9.1</u></b>	<b><u>9.3</u></b>	<b><u>14.3</u></b>	<b><u>14.6</u></b>	<b><u>9.0</u></b>	<b><u>8.0</u></b>	<b><u>14.4</u></b>	<b><u>13.7</u></b>	11.2	10-12°C
pH	Units	9.34	7.85	7.74	7.45	7.97	7.73	9.03	<b><u>11.42</u></b>	<b><u>12.73</u></b>	8.62	<b><u>10.22</u></b>	<b><u>11.76</u></b>	8.97	9.29	8.98	7.39	7.7	8.34	8.29	7.23	6 - 9.5
Conductivity	µS/cm	1,097	249	1,507	890	923	867	892	<b><u>2,208</u></b>	<b><u>2,107</u></b>	<b><u>2,539</u></b>	1,239	1,477	1,028	1,013	917	927	664	1765	1517	865	1,875
Sodium	mg/l	122.2	<b><u>435.5</u></b>	<b><u>162.8</u></b>	121.9	104.4	98.4	<b><u>174.2</u></b>	<b><u>385.5</u></b>	<b><u>407.5</u></b>	<b><u>495.8</u></b>	<b><u>297.1</u></b>	<b><u>427.9</u></b>	<b><u>153.6</u></b>	<b><u>166.2</u></b>	<b><u>147</u></b>	<b><u>162.1</u></b>	123.3	<b><u>303.7</u></b>	<b><u>341.3</u></b>	84.0	150
Choride	mg/l	110.7	<b><u>629.5</u></b>	<b><u>273</u></b>	141.2	97.6	95.8	102.6	29.7	88.9	<b><u>652.1</u></b>	154	186.4	88.8	73.1	73.5	6.8	73.7	459.1	103.8	41.8	187.5
Clostridium Perfringens	cfu./ml	<1	<1	<1	<1	<1	<b><u>1</u></b>	<1	<1	<1	<1	<b><u>2</u></b>	<1	<b><u>7</u></b>	<b><u>1</u></b>	<b><u>1</u></b>	<b><u>31</u></b>	<b><u>7</u></b>	<b><u>1</u></b>	<b><u>6</u></b>	<b><u>3</u></b>	0 counts/ 100ml
Total Coliforms	MPN/100ml	<b><u>3</u></b>	<1	<1	<b><u>1,300</u></b>	<b><u>1</u></b>	<b><u>8</u></b>	<b><u>70.3</u></b>	<1	<1	<b><u>5,794,000</u></b>	<b><u>100</u></b>	<b><u>57.6</u></b>	<b><u>&lt;1.0</u></b>	<b><u>92,080</u></b>	<b><u>2,000</u></b>	<b><u>1,986</u></b>	<b><u>1,120</u></b>	<b><u>1,414</u></b>	<b><u>2,419</u></b>	<b><u>173,290</u></b>	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<1	<1	<1	<b><u>83</u></b>	<1	<b><u>2</u></b>	<b><u>6.0</u></b>	<1	<1	<1	<b><u>120</u></b>	<1	<1	<b><u>1,700</u></b>	<b><u>260</u></b>	<b><u>2</u></b>	<b><u>2</u></b>	<b><u>1</u></b>	<1	<1	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<b><u>25</u></b>	<1	<b><u>3</u></b>	<1	<1	<1	<1	<1	<1	<1	<b><u>310</u></b>	<1	<1	<b><u>9</u></b>	<b><u>130</u></b>	<b><u>60</u></b>	<b><u>1</u></b>	<b><u>76</u></b>	<b><u>62</u></b>	<b><u>9</u></b>	0 counts/ 100ml

**Legend:**

NDP - No Determination Possible by Laboratory

**Results are shaded, bold and underlined where the Threshold Value is exceeded.**

\* Bi-Annual IPPC Groundwater Monitoring Round

- ' = not analysed

# = Results from re-sampling on 5th October 2017

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PARAMETERS	UNIT	MW-8																			Threshold Value						
		20/03/2014	19/06/2014	30/09/2014	04/12/2014*	26/03/2015	22/06/2015	21/09/2015	07/12/2015*	23/03/2016	30/06/2016	30/09/2016	13/12/2016	30/03/2017	13-06-2017*	30/03/2017	14/12/2017	14/12/2018	14/06/2018	27/09/2018		06/12/2018					
Temperature	Units	-	<u>13.5</u>	<u>15.4</u>	<u>9.6</u>	<u>9.0</u>	<u>14</u>	-	11.2	<u>7.5</u>	<u>12.3</u>	-	-	<u>9.5</u>	DRY	DRY	10	<u>8</u>	DRY	DRY	DRY	10-12°C					
pH	Units	-	7.61	7.18	6.7	7.33	7.12	7.24	7.27	7.34	7.29	7.37	7.29	7.05			7.13	7.36				6 - 9.5					
Conductivity	µS/cm	-	561	1,078	929	1,054	1,033	1,070	849	828	842	1046	939	1174			996	1098				1,875					
Sodium	mg/l	-	20.3	24.8	17.8	17.5	19.7	21.6	16.8	15.5	19.2	21	20.1	15.9			19.2	15.5				150					
Choride	mg/l	-	23.6	34.8	25.1	18	22	34.7	29.7	15.2	22.2	35	34.9	22.4			56.2	27.4				187.5					
Clostridium Perfringens	cfu./ml	<u>54</u>	<1	<u>68</u>	<1	<u>74</u>	<u>21</u>	-	N/A	<u>640</u>	<u>48</u>	<1	-	<u>76</u>			DRY	DRY				DRY	DRY	DRY	DRY	0 counts/ 100ml	
Total Coliforms	MPN/100ml	<u>61,310</u>	<u>10</u>	<1	<u>225</u>	<u>17</u>	<u>89</u>	<u>1</u>	N/A	<u>547.5</u>	<u>3,150</u>	<u>&gt;2419.6</u>	<u>8,164</u>	<u>&gt;2419.6</u>												<u>770</u>	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<u>19</u>	<1	<1	<1	<u>2</u>	<1	<1	N/A	<u>9</u>	<u>6</u>	<u>29</u>	<u>3</u>	<u>12</u>												<u>14</u>	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<u>3</u>	<1	<1	<1	<1	<1	<1	N/A	<u>46</u>	<u>27</u>	<u>38</u>	-	<u>1</u>	<u>3</u>	0 counts/ 100ml											

**Legend:**

NDP - No Determination Possible by Laboratory

**Results are shaded, bold and underlined where the Threshold Value is exceeded.**

\* Bi-Annual IPPC Groundwater Monitoring Round

- ' = not analysed

Note 1 - insufficient sample

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PARAMETERS	UNIT	MW-9																				Threshold Value
		20/03/2014	19/06/2014	30/09/2014	04/12/2014*	26/03/2015	22/06/2015	21/09/2015	07/12/2015*	23/03/2016	30/06/2016	30/09/2016	13/12/2016	30/03/2017	13-06-2017*	14/09/2017	14/12/2017	22/02/2018	14/06/2018	27/09/2018	06/12/2018	
Temperature	Units	<b><u>9.5</u></b>	<b><u>13.5</u></b>	<b><u>14.8</u></b>	<b><u>10.7</u></b>	<b><u>7.5</u></b>	<b><u>13.5</u></b>	<b><u>14</u></b>	11.1	<b><u>8.6</u></b>	<b><u>12.9</u></b>	<b><u>13</u></b>	10.5	<b><u>9.3</u></b>	<b><u>12.1</u></b>	<b><u>14</u></b>	10	<b><u>8</u></b>	11.9	<b><u>13.2</u></b>	11.5	10-12°C
pH	Units	7.84	7.5	7.68	7.09	7.86	7.55	8.07	7.81	7.50	7.36	7.40	7.67	7.44	7.34	7.61	7.36	7.72	7.44	7.14	7.3	6 - 9.5
Conductivity	µS/cm	509	707	756	472	469	522	464	323	339	944	479	314	424	483	387	389	350	486	574.5	454	1,875
Sodium	mg/l	11	16.6	17.7	12.1	10	13.4	12.1	6.8	8.1	15.2	7.5	10.4	7.4	7.2	5.1	6.0	5.9	12.2	10.7	10.8	150
Choride	mg/l	6.3	7.7	24.3	6.8	5.8	7.1	7.1	29.7	5.9	10.9	3.2	5.9	5.5	4.1	2.1	4.5	5.8	20.9	7.4	8.5	187.5
Clostridium Perfringens	cfu./ml	<b><u>5</u></b>	<1	<1	<1	<b><u>3</u></b>	<b><u>7</u></b>	<b><u>69</u></b>	<b><u>6</u></b>	<1	<b><u>1</u></b>	<b><u>2</u></b>	<b><u>3</u></b>	<b><u>1</u></b>	<b><u>2</u></b>	<1	<1	<b><u>570</u></b>	<b><u>6</u></b>	<1	<1	0 counts/ 100ml
Total Coliforms	MPN/100ml	<b><u>2</u></b>	<b><u>17</u></b>	<b><u>100</u></b>	<b><u>1,046</u></b>	<b><u>1,046</u></b>	<b><u>228</u></b>	<b><u>2613</u></b>	<b><u>6</u></b>	<b><u>48.1</u></b>	<b><u>1,414</u></b>	<b><u>510</u></b>	<b><u>3,360</u></b>	<1	<b><u>41,060</u></b>	<b><u>111,200</u></b>	<b><u>17,270</u></b>	<b><u>22,470</u></b>	<b><u>261</u></b>	<b><u>89</u></b>	<b><u>10</u></b>	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<b><u>3</u></b>	<b><u>14</u></b>	<1	<1	<1	<1	<b><u>8</u></b>	<b><u>9</u></b>	<1	<b><u>21</u></b>	<b><u>10</u></b>	<b><u>2</u></b>	<1	<1	<b><u>45,000</u></b>	<b><u>12</u></b>	<1	<b><u>2</u></b>	<b><u>17</u></b>	<1	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<b><u>1</u></b>	<1	<1	<1	<1	<1	17	<b><u>5</u></b>	<1	<b><u>12</u></b>	<b><u>31</u></b>	<1	<1	<1	<b><u>200</u></b>	<b><u>860</u></b>	<b><u>59</u></b>	<b><u>8</u></b>	<b><u>6</u></b>	<b><u>2</u></b>	0 counts/ 100ml

**Legend:**

NDP - No Determination Possible by Laboratory

**Results are shaded, bold and underlined where the Threshold Value is exceeded.**

\* Bi-Annual IPPC Groundwater Monitoring Round

- ' = not analysed

# = Results from re-sampling on 5th October 2017

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PARAMETERS	UNIT	MW-10																				Threshold Value
		20/03/2014	19/06/2014	30/09/2014	04/12/2014*	26/03/2015	22/06/2015	21/09/2015	07/12/2015*	23/03/2016	30/06/2016	30/09/2016	13/12/2016	30/03/2017	13-06-2017*	14/09/2017	14/12/2017	22/02/2018	14/06/2018	27/09/2018	06/12/2018	
Temperature	Units	<b><u>9.6</u></b>	<b><u>13.5</u></b>	<b><u>14</u></b>	<b><u>10.7</u></b>	<b><u>9.1</u></b>	<b><u>14</u></b>	<b><u>14</u></b>	11.2	<b><u>8.6</u></b>	<b><u>15</u></b>	<b><u>13.8</u></b>	<b><u>10.2</u></b>	<b><u>10.5</u></b>	<b><u>14.7</u></b>	<b><u>16</u></b>	11.5	<b><u>7.5</u></b>	<b><u>14.1</u></b>	<b><u>13.8</u></b>	11.2	10-12°C
pH	Units	7.71	7.61	7.68	7.15	7.73	7.8	7.79	7.73	7.10	7.62	7.58	7.48	7.39	7.43	7.64	7.28	7.79	7.57	7.42	7.82	6 - 9.5
Conductivity	µS/cm	507	561	523	390	500	552	254	411	515	402	411	447	508	453	384	692	560	683	689	753	1,875
Sodium	mg/l	10.9	12.4	12.2	9	12.2	12.8	23.1	12	12.9	6.3	9.8	11.4	11.1	13.3	10.4	13.5	13.1	14.8	14.7	14.4	150
Choride	mg/l	18	25.9	19.4	12.6	19.8	23.6	8.4	29.7	27.4	10.2	17.8	25.8	20.6	25.6	14.9	27.4	25.3	27.7	23.7	26.8	187.5
Clostridium Perfringens	cfu./ml	<1	<1	<1	<1	<b><u>1</u></b>	<1	<b><u>14</u></b>	<b><u>1</u></b>	<b><u>9</u></b>	<b><u>6</u></b>	<b><u>1</u></b>	<1	1	<1	<b><u>1</u></b>	<1	<b><u>17</u></b>	<b><u>1</u></b>	<b><u>1</u></b>	<1	0 counts/ 100ml
Total Coliforms	MPN/100ml	<b><u>4</u></b>	<1	<1	<b><u>1,553</u></b>	<b><u>1</u></b>	<1	<b><u>20</u></b>	<1	<1	<b><u>291</u></b>	<b><u>7.5</u></b>	<b><u>27.9</u></b>	<1	<b><u>1</u></b>	<b><u>14.5</u></b>	<100	<b><u>16</u></b>	<1	<b><u>1</u></b>	<b><u>2</u></b>	0 counts/ 100ml
Faecal Coliforms/ E Coli	cfu./ml	<1	<1	<1	<1	<1	<1	<1	<1	<1	<b><u>56</u></b>	<1	<b><u>6</u></b>	<1	<b><u>1</u></b>	<b><u>10</u></b>	<1	<1	<1	<1	<1	0 counts/ 100ml
Faecal Streptococci	cfu./ml	<1	<1	<1	<1	<1	<1	<1	<1	<1	<b><u>49</u></b>	<1	<1	<1	<1	<b><u>120</u></b>	<b><u>330</u></b>	<b><u>4</u></b>	<b><u>1</u></b>	<b><u>3</u></b>	<1	0 counts/ 100ml

**Legend:**

NDP - No Determination Possible by Laboratory

**Results are shaded, bold and underlined where the Threshold Value is exceeded.**

\* Bi-Annual IPPC Groundwater Monitoring Round

- ' = not analysed

# = Results from re-sampling on 5th October 2017

**AWN CONSULTING**

Clarochem Ireland GW Monitoring

Job No. 12/6379

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PARAMETERS	UNIT	MW-1										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
BOD	mg/l	11	22	37	24	19	24	85	43	29	18	-
COD	mg/l	34	40	59	45	28	58	153	59	63	40	-
Dissolved Oxygen	mg/l	2	6	5	2	5	4	2	5	<1	6	-
Total Organic Carbon	C mg/l	20	18	13	17	19	24	32	4	6	6	No Abnormal Change
Chloride	Cl mg/l	<b>305</b>	<b>374</b>	<b>367</b>	<b>293</b>	<b>414</b>	<b>483.1</b>	<b>508.5</b>	<b>320</b>	<b>247.1</b>	<b>214.2</b>	<b>187.5</b>
Fluoride	F mg/l	<0.3	<0.3	<0.3	0.3	<0.3	<0.3	0.3	0.4	<0.3	0.3	1 <sup>+</sup>
Sulphate	SO4 mg/l	48.9	45.71	3.98	9.38	7.81	10.9	20.1	40.2	46.3	159.5	<b>187.5</b>
Nitrate	NO3 mg/l	0.7	<0.2	<0.2	0.8	0.3	<0.2	3.6	0.3	<0.2	<0.2	<b>37.5</b>
Nitrite	NO2 mg/l	<0.02	<0.02	0.08	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.17	<b>0.375</b>
Total Ammonia	NH4 mg/l	<b>3.64</b>	<b>2.9</b>	<b>4.47</b>	<b>4.88</b>	<b>3.99</b>	<b>4.53</b>	<b>2.65</b>	<b>2.63</b>	<b>3.33</b>	<b>2.56</b>	<b>0.175</b>
Total Oxidised Nitrogen	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.8	<0.2	<0.2	<0.2	-
Total Hardness	CaCO3 mg/l	155	<b>230</b>	137	164	177	196	<b>387</b>	<b>269</b>	<b>263</b>	<b>260</b>	<b>200<sup>+</sup></b>
Non-Carbonate Hardness	CaCO3 mg/l	-	135	191	146	197	201	173	273	248	275	-
Total Alkalinity	CaCO3 mg/l	138	254	272	<b>504</b>	220	202	396	384	304	272	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.03	<0.01	<0.01	<b>0.037</b>
Total Phenols	mg/l	<b>0.2</b>	<0.1*	<0.1*	<0.1*	<0.5*	<0.1*	<b>0.2</b>	<0.1*	<0.15*	<0.15*	<b>0.0005<sup>+</sup></b>
Metals												
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.037	<b>0.15</b>
Arsenic	As mg/l	<0.0025	<b>0.0224</b>	<b>0.0199</b>	<b>0.0218</b>	<b>0.0175</b>	0.0065	0.0113	0.0305	<0.0025	<b>0.0123</b>	<b>0.0075</b>
Barium	Ba mg/l	<b>0.163</b>	<b>0.222</b>	<b>0.164</b>	<b>0.206</b>	<b>0.222</b>	<b>0.243</b>	<b>2.37</b>	<b>0.89</b>	<b>0.381</b>	<b>0.258</b>	<b>0.1</b>
Boron	B mg/l	<0.012	<0.012	<0.012	0.019	0.018	0.012	0.022	0.026	0.023	0.025	<b>0.75</b>
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<b>0.003</b>
Calcium	Ca mg/l	56.3	82.3	49	57.7	61.5	69.4	136.5	94.5	92.2	91	<b>200<sup>+</sup></b>
Chromium	Cr mg/l	<0.015	<0.015	<0.015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<b>0.037</b>
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<b>1.5</b>
Iron	Fe mg/l	<b>0.226</b>	<b>0.382</b>	0.071	<b>0.46</b>	0.16	<0.02	<b>3.798</b>	<b>3.724</b>	<b>0.323</b>	<b>0.449</b>	<b>0.2<sup>+</sup></b>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<b>0.0075<sup>2</sup></b>
Magnesium	Mg mg/l	3.5	5.7	3.5	4.7	5.5	5.3	10.8	7.7	7.7	7.7	<b>50<sup>+</sup></b>
Manganese	Mn mg/l	<b>0.532</b>	<b>0.601</b>	<b>0.684</b>	<b>0.685</b>	<b>0.873</b>	<b>1.025</b>	<b>1.031</b>	<b>1.381</b>	<b>1.834</b>	<b>1.315</b>	<b>0.05<sup>+</sup></b>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<b>0.00075</b>
Nickel	Ni mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.003	<0.004	<0.002	<b>0.02<sup>++</sup></b>
Phosphorus	P mg/l	0.006	0.005	0.026	0.032	0.029	0.008	0.032	0.048	0.017	0.025	-
Potassium	K mg/l	3.9	4.3	4.1	3.7	3.4	4.4	<b>7.1</b>	4.4	4.2	4.2	<b>5<sup>+</sup></b>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Sodium	Na mg/l	<b>227</b>	<b>276</b>	<b>187</b>	<b>294</b>	<b>256</b>	<b>351.2</b>	<b>432.9</b>	<b>312.5</b>	<b>214.2</b>	<b>195.9</b>	<b>150<sup>++</sup></b>
Strontium	Sr mg/l	0.313	0.441	0.281	0.353	0.391	0.434	1.59	0.557	0.479	0.621	-
Tin	Sn mg/l	0.032	0.019	0.008	<0.005	0.006	0.005	0.008	<0.005	<0.005	<0.005	-
Zinc	Zn mg/l	<0.003	<0.003	<0.003	<0.003	0.004	<0.003	<0.003	<0.003	<0.003	0.016	<b>0.075<sup>2</sup></b>

Legend:

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>+</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

**Results are shaded and in bold where they exceed the Threshold Value**

\*= Detection Limit above guideline value

`<' = concentration is below the LOD for the parameter

AWN Consulting Ltd.

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

PARAMETERS	UNIT	MW-2										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
BOD	mg/l	2	3	5	24	2	1	<1	<1	<1	<1	-
COD	mg/l	47	7	28	45	8	17	<7	18	17	34	-
Dissolved Oxygen	mg/l	4	7	3	5	8	8	7	11	8	9	-
Total Organic Carbon	C mg/l	6	7	<2	17	8	3	11	2	<2	4	No Abnormal Change
Chloride	Cl mg/l	17.9	16.2	28.5	36.2	18.4	18.7	22.5	34.1	24.1	44.2	187.5
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>1</sup>
Sulphate	SO4 mg/l	69.17	32.76	39.01	65.45	83.51	205.5	89	40.2	91.2	228.2	187.5
Nitrate	NO3 mg/l	0.8	<0.2	<0.2	1.3	0.5	2.1	5.9	0.3	<0.2	5.6	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.1	0.03	0.1	0.53	<0.02	<0.02	0.03	<0.02	0.375
Total Ammonia	NH4 mg/l	0.34	0.28	0.68	0.07	0.61	0.78	0.06	0.06	0.23	0.08	0.175
Total Oxidised Nitrogen	mg/l	<0.2	<0.2	<0.2	0.3	<0.2	0.6	1.3	<0.2	<0.2	1.2	-
Total Hardness	CaCO3 mg/l	470	424	452	437	439	513	387	493	460	979	200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	158	470	146	466	519	179	440	462	725	-
Total Alkalinity	CaCO3 mg/l	416	254	468	504	368	390	360	344	382	396	No Abnormal Change
Total Cyanide	mg/l	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.15*	<0.15*	0.0005 <sup>1</sup>
Metals												
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.15
Arsenic	As mg/l	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0075
Barium	Ba mg/l	0.062	0.111	0.103	0.06	0.073	0.078	0.063	0.085	0.073	0.107	0.1
Boron	B mg/l	0.016	0.018	0.028	0.037	0.027	0.022	0.04	0.042	0.021	0.034	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	0.0006	<0.0005	<0.0005	<0.0005	<0.0005	1.2	<0.0005	0.003
Calcium	Ca mg/l	170	155	163.5	159	157.5	184.3	166.8	180.2	166.5	370.3	200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	0.0071	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	1.5
Iron	Fe mg/l	<0.020	<0.020	1.216	<0.020	0.118	<0.020	<0.020	<0.020	<0.020	<0.02	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	11.1	8.7	10.2	9.4	10.7	12.4	9.7	10.2	10.4	12.6	50 <sup>1</sup>
Manganese	Mn mg/l	0.92	2.016	3.695	0.185	3.876	<0.002	<0.002	<2	0.049	0.008	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.00075
Nickel	Ni mg/l	0.005	0.005	0.005	<0.002	0.006	0.003	<0.002	<0.002	0.005	<0.002	0.02 <sup>1**</sup>
Phosphorus	P mg/l	<0.005	0.016	0.013	0.022	0.012	0.012	0.012	0.034	0.009	0.017	-
Potassium	K mg/l	1.9	2	2.1	1.6	1.5	1.5	0.8	0.8	1.1	1	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Sodium	Na mg/l	14.9	16.3	16.4	14.5	12.7	13.6	15.6	17.9	14.8	16.2	150 <sup>1**</sup>
Strontium	Sr mg/l	0.555	0.449	0.54	0.497	0.553	0.643	0.514	0.518	0.532	1.113	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	Zn mg/l	<0.003	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.075 <sup>1</sup>

Legend:

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>¥</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

Results are shaded and in bold where they exceed the Threshold Value

\*= Detection Limit above guideline value

`<` = concentration is below the LOD for the parameter

AWN Consulting Ltd.

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379



PARAMETERS	UNIT	MW-3										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
BOD	mg/l	<1	<1	2	<1	<1	<1	<1	1	<1	<1	-
COD	mg/l	9	<7	12	<7	<7	<7	<7	32	<7	34	-
Dissolved Oxygen	mg/l	5	9	6	8	9	7	6	11	9	10	-
Total Organic Carbon	C mg/l	<2	2	<2	<2	3	<2	4	<2	<2	<2	No Abnormal Change
Chloride	Cl mg/l	16.6	15.3	17.4	24.8	18.8	14.7	17	21.2	19.5	32.5	187.5
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>1</sup>
Sulphate	SO4 mg/l	146.72	126.13	130.65	88.04	121.1	179.7	138.9	169.8	143.9	161.9	187.5
Nitrate	NO3 mg/l	0.8	<0.2	<0.2	0.8	0.3	<0.2	<0.2	<0.2	<0.2	2	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.375
Total Ammonia	NH4 mg/l	0.07	0.06	0.06	<0.03	0.07	0.06	<0.03	<0.03	<0.03	<0.03	0.175
Total Oxidised Nitrogen	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	-
Total Hardness	CaCO3 mg/l	467	451	452	352	426	441	400	409	476	423	200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	234	495	397	462	464	230	424	440	409	-
Total Alkalinity	CaCO3 mg/l	312	330	364	272	314	278	248	242	326	260	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.15*	<0.15*	0.0005 <sup>1</sup>
Metals												
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.02	0.15
Arsenic	As mg/l	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0075
Barium	Ba mg/l	0.070	0.046	0.072	0.027	0.081	0.047	0.031	0.032	0.055	0.039	0.1
Boron	B mg/l	0.034	0.016	0.032	<0.012	0.031	0.019	0.023	0.027	0.027	0.019	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.003
Calcium	Ca mg/l	165.6	163.4	160.8	126.3	151.4	157.8	143.7	148.1	170.4	153.3	200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	0.035	0.005	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	0.0065	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	1.5
Iron	Fe mg/l	<0.020	<0.020	0.174	<0.020	0.085	<0.020	<0.020	<0.020	<0.020	<0.02	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	12.7	10.2	11.9	8.7	11.2	11	9.7	9.3	12	9.5	50 <sup>1</sup>
Manganese	Mn mg/l	0.420	<0.002	0.385	<0.002	0.305	0.005	0.034	<2	0.022	0.012	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.00075
Nickel	Ni mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.02 <sup>1*</sup>
Phosphorus	P mg/l	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	0.008	<0.005	<0.005	-
Potassium	K mg/l	0.4	0.4	0.6	0.2	0.5	0.4	2.7	0.5	0.5	0.4	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.006	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Sodium	Na mg/l	10.4	10.9	11	15.9	10.2	9.2	26.5	11.4	10.4	12.4	150 <sup>1*</sup>
Strontium	Sr mg/l	0.466	0.648	0.494	0.679	0.532	0.738	0.759	0.714	0.559	0.836	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	Zn mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.075 <sup>1</sup>

Legend:

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>\*</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

Results are shaded and in bold where they exceed the Threshold Value

\*= Detection Limit above guideline value

'<' = concentration is below the LOD for the parameter

AWN Consulting Ltd.

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

PARAMETERS	UNIT	MW-4										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
BOD	mg/l	<1	<1	<1	<1	<1	<1	1	1	<1	<1	-
COD	mg/l	39	<7	<7	12	<7	<7	<7	32	<7	21	-
Dissolved Oxygen	mg/l	5	9	7	9	9	6	7	11	9	10	-
Total Organic Carbon	C mg/l	<2	2	<2	<2	3	<2	5	<2	<2	<2	No Abnormal Change
Chloride	Cl mg/l	7.2	24.5	83	5.1	5.1	9.5	6.1	31.5	22.9	8.6	187.5
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>1</sup>
Sulphate	SO4 mg/l	41.78	71.85	44.03	31.32	41.2	62.7	66	133.4	80.3	70	187.5
Nitrate	NO3 mg/l	0.8	<0.2	0.3	1.2	0.5	1.6	2.5	5.1	<0.2	2.4	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.375
Total Ammonia	NH4 mg/l	0.08	0.05	0.05	<0.03	0.04	0.04	0.05	0.05	0.04	<0.03	0.175
Total Oxidised Nitrogen	mg/l	<0.2	<0.2	<0.2	0.3	<0.2	0.3	0.6	1.2	<0.2	0.5	-
Total Hardness	CaCO3 mg/l	314	355	309	219	303	320	327	328	416	266	200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	160	309	257	311	357	120	327	373	215	-
Total Alkalinity	CaCO3 mg/l	454	306	406	156	688	900	328	270	752	306	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.15*	<0.15*	0.0005 <sup>1</sup>
Metals												
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.02	<0.02	<0.02	<0.02	<0.02	0.177	0.15
Arsenic	As mg/l	<0.0025	0.0031	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0075
Barium	Ba mg/l	0.044	0.039	0.033	0.017	0.029	0.027	0.027	0.026	0.04	0.023	0.1
Boron	B mg/l	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.005	<0.005	<0.005	<0.005	<0.0005	0.003
Calcium	Ca mg/l	117.9	134.7	116.8	82.7	114.4	120	123	123.9	156.8	100.4	200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	1.5
Iron	Fe mg/l	<0.020	<0.020	<0.020	<0.020	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	4.5	4.4	4.1	2.8	4.1	4.7	4.6	4.4	5.6	3.6	50 <sup>1</sup>
Manganese	Mn mg/l	0.269	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.00075
Nickel	Ni mg/l	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.02 <sup>1*</sup>
Phosphorus	P mg/l	<0.005	0.008	0.005	0.005	0.005	<0.005	<0.005	0.009	0.007	<0.005	-
Potassium	K mg/l	0.3	0.3	0.3	0.2	0.2	0.2	0.8	0.2	0.3	0.1	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	0.004	<0.003	<0.003	<0.003	0.005	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Sodium	Na mg/l	7.1	15.3	10.9	6.8	6.6	7.6	9.8	7	9.8	6.7	150 <sup>1*</sup>
Strontium	Sr mg/l	0.461	0.518	0.492	0.355	0.503	0.506	0.523	0.466	0.613	0.622	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	Zn mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.075 <sup>1</sup>

Legend:

- = Not available / not analysed  
mg/l - milligrams per litre  
(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>\*</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

Results are shaded and in bold where they exceed the Threshold Value

\*= Detection Limit above guideline value

'<' = concentration is below the LOD for the parameter

AWN Consulting Ltd.

Clarochem Ireland Limited GW Monitoring  
Project No. 12/6379

PARAMETERS	UNIT	MW-5										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	13/06/2017	14/06/2018	06/12/2018	
BOD	mg/l	<1	<1	2.0	<1	<1	<1	<1	<1	14	1	-
COD	mg/l	19	<7	15	9	15	<7	19	20	29	31	-
Dissolved Oxygen	mg/l	7	9	7	9	9	9	6	10	4	7	-
Total Organic Carbon	C mg/l	4	2	<2	<2	5	<2	5	<2	6	3	No Abnormal Change
Chloride	Cl mg/l	75.5	15.2	52.7	5.1	18.9	20	16	10.9	54.8	46.6	187.5
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>1</sup>
Sulphate	SO4 mg/l	124.31	74.56	119.21	92.28	66.49	166.1	101.3	156.8	121.4	236.5	187.5
Nitrate	NO3 mg/l	0.8	1.2	<0.2	1.2	1.2	0.5	2.7	0.8	0.5	4.9	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	0.375
Total Ammonia	NH4 mg/l	0.11	0.05	0.05	<0.03	0.04	0.05	0.06	0.04	1.57	0.06	0.175
Total Oxidised Nitrogen	mg/l	<0.2	0.3	<0.2	0.5	0.3	<0.2	0.6	<0.2	<0.2	1.1	-
Total Hardness	CaCO3 mg/l	400	383	428	363	265	349	333	380	251	456	200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	131	142	404	283	343	277	400	242	348	-
Total Alkalinity	CaCO3 mg/l	354	364	464	274	248	248	270	264	1108	582	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.15*	<0.15*	0.0005 <sup>1</sup>
Metals												
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.02	<0.020	<0.020	<0.020	<0.020	0.052	0.15
Arsenic	As mg/l	<0.0025	0.0025	<0.0025	<0.0025	0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0075
Barium	Ba mg/l	0.06	0.046	0.069	0.04	0.033	0.047	0.035	0.046	0.204	0.08	0.1
Boron	B mg/l	<0.012	<0.012	0.024	0.026	0.02	<0.012	0.028	0.029	0.034	0.032	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	0.006	<0.0005	<0.0005	<0.0005	<0.0006	<0.0007	<0.0005	0.003
Calcium	Ca mg/l	140.6	138.1	150.8	129.6	95.3	123.6	118.5	134.6	81.7	158.5	200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.0015	<0.0015	0.0026	<0.0015	<0.0015	<0.0015	<0.0015	0.0056	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	1.5
Iron	Fe mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	11.6	5.9	12.2	9.3	6.4	9.6	8.8	10.3	11.1	14.3	50 <sup>1</sup>
Manganese	Mn mg/l	0.693	<0.002	0.507	0.113	0.055	<0.002	<0.002	<2	1.242	0.01	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.00075
Nickel	Ni mg/l	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<2	0.007	<0.002	0.02 <sup>1*</sup>
Phosphorus	P mg/l	<0.005	0.015	0.009	0.012	0.018	0.011	0.022	0.031	0.006	0.029	-
Potassium	K mg/l	2	1.8	2.2	1.8	1.7	1.7	2.2	2.3	2.8	3.1	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	0.008	0.008	<0.003	<0.003	0.027	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Sodium	Na mg/l	85	22.1	102	16.3	22.2	26.5	19.1	15.3	95.3	26.6	150 <sup>1*</sup>
Strontium	Sr mg/l	0.75	0.679	0.872	0.674	0.498	0.695	0.607	0.667	0.755	1.194	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.021	<0.005	<0.005	<0.005	-
Zinc	Zn mg/l	<0.003	<0.003	0.005	0.005	<0.003	0.064	<0.003	<0.003	<0.003	0.01	0.075 <sup>1</sup>

Legend:

- = Not available / not analysed  
mg/l - milligrams per litre  
(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>\*</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

Results are shaded and in bold where they exceed the Threshold Value

\*= Detection Limit above guideline value

'<' = concentration is below the LOD for the parameter

AWN Consulting Ltd.

Clarochem Ireland Limited GW Monitoring  
Project No. 12/6379

PARAMETERS	UNIT	MW-6										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
BOD	mg/l	14	<1	5	6	<1	<1	5	2	2	1	-
COD	mg/l	19	<7	12	11	<7	<7	<7	46	9	18	-
Dissolved Oxygen	mg/l	6	9	8	8	8	8	6	11	9	10	-
Total Organic Carbon	C mg/l	12	3	<2	<2	2	<2	6	<2	<2	<2	No Abnormal Change
Chloride	Cl mg/l	87.4	30	95.8	58.4	58.5	65.4	70.2	56.7	60.3	52.2	187.5
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>1</sup>
Sulphate	SO4 mg/l	138.42	81.94	97.25	97.54	101.09	125.9	126.5	123.7	128	108	187.5
Nitrate	NO3 mg/l	1.8	4.2	2.1	1.9	0.6	0.4	0.9	0.8	2.5	3.2	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.09	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.375
Total Ammonia	NH4 mg/l	2.5	0.11	0.09	0.11	0.09	0.05	0.1	0.07	0.05	0.05	0.175
Total Oxidised Nitrogen	mg/l	0.4	0.9	0.5	0.4	<0.2	<0.2	0.2	<0.2	0.6	0.7	-
Total Hardness	CaCO3 mg/l	273	205	206	219	245	255	299	279	282	264	200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	116	237	248	256	260	185	268	277	142	-
Total Alkalinity	CaCO3 mg/l	282	216	362	128	834	610	240	710	486	498	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.15*	<0.15*	0.0005 <sup>1</sup>
Metals												
Aluminium	Al mg/l	<0.020	<0.020	<0.020	0.097	<0.020	<0.020	<0.020	<0.020	<0.020	0.025	0.15
Arsenic	As mg/l	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0075
Barium	Ba mg/l	0.082	0.04	0.048	0.047	0.06	0.06	0.06	0.058	0.068	0.058	0.1
Boron	B mg/l	0.022	<0.012	0.031	0.028	<0.012	<0.012	0.024	0.025	0.029	0.017	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.003
Calcium	Ca mg/l	98.7	75.2	75.7	79.3	87.9	91.5	106.5	100	101.2	94	200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
Copper	Cu mg/l	<.007	<.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	1.5
Iron	Fe mg/l	<0.020	<0.020	<0.020	0.193	<0.020	<0.020	<0.020	<0.020	<0.020	<0.02	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	6.3	4	4.1	4.9	5.9	6.3	7.8	7	6.8	6.8	50 <sup>1</sup>
Manganese	Mn mg/l	0.412	<0.002	0.257	0.295	0.38	<0.002	<0.002	<0.003	0.033	0.278	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.00075
Nickel	Ni mg/l	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.02 <sup>1*</sup>
Phosphorus	P mg/l	0.234	0.144	0.162	0.161	0.102	0.08	0.051	0.057	0.056	0.065	-
Potassium	K mg/l	2	1.5	1.6	1.6	1.5	1.3	1.4	1.4	1.6	1.2	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Sodium	Na mg/l	137.2	50	59.3	65.2	66.1	65.8	72.7	60.5	58.3	52.2	150 <sup>1*</sup>
Strontium	Sr mg/l	0.332	0.224	0.251	0.219	0.309	0.319	0.0374	0.308	0.345	0.528	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	Zn mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.009	0.075 <sup>1</sup>

Legend:

- = Not available / not analysed  
mg/l - milligrams per litre  
(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>\*</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

Results are shaded and in bold where they exceed the Threshold Value

\*= Detection Limit above guideline value

`<` = concentration is below the LOD for the parameter

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Clarochem Ireland Limited GW Monitoring  
Project No. 12/6379

PARAMETERS	UNIT	MW-7										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
BOD	mg/l	83	2	<1	56	13	13	2	4	23	2	-
COD	mg/l	186	11	21	280	30	64	18	13	75	40	-
Dissolved Oxygen	mg/l	1	8	10	7	8	8	<1	9	5	9	-
Total Organic Carbon	C mg/l	<b>51</b>	9	6	<b>73</b>	9	18	9	2	19	4	No Abnormal Change
Chloride	Cl mg/l	<b>629.5</b>	141.2	95.8	167.5	<b>652.1</b>	186.4	73.1	6.8	<b>459.1</b>	41.8	187.5
Fluoride	F mg/l	0.6	<0.3	<0.3	<0.3	<0.3	0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>+</sup>
Sulphate	SO4 mg/l	57.79	161.1	128.87	110.28	102.72	178.9	169.3	91.8	53.5	184.2	187.5
Nitrate	NO3 mg/l	0.9	<0.2	<0.2	0.7	0.4	<0.2	<0.2	3.9	<0.2	<b>54.8</b>	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.14	0.04	0.09	<0.02	0.06	<0.02	<0.02	<b>3.51</b>	0.375
Total Ammonia	NH4 mg/l	<b>30.07</b>	0.09	<b>0.84</b>	<b>2.8</b>	<b>1.69</b>	<b>4.04</b>	<b>1.29</b>	<b>1.15</b>	<b>3.68</b>	<b>1.06</b>	0.175
Total Oxidised Nitrogen	mg/l	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.9	<0.2	13.4	-
Total Hardness	CaCO3 mg/l	<b>334</b>	<b>257</b>	<b>219</b>	23	145	21	161	91	192	<b>273</b>	200 <sup>+</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	185	232	23	120	20	8	99	193	115	-
Total Alkalinity	CaCO3 mg/l	318	162	180	382	154	466	262	150	192	204	No Abnormal Change
Total Cyanide	mg/l	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	<0.01	0.037
Total Phenols	mg/l	<b>1.9</b>	<0.1*	<b>0.3</b>	<b>8.7</b>	<b>0.2</b>	<b>0.6</b>	<0.1*	<0.1*	<0.15*	<0.15*	0.0005 <sup>+</sup>
Metals												
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<b>1.151</b>	0.03	<b>0.341</b>	<b>0.032</b>	<0.02	<0.02	<0.02	0.15
Arsenic	As mg/l	<b>0.0081</b>	<b>0.0077</b>	0.0069	<b>0.0499</b>	<b>0.015</b>	<b>0.0609</b>	<b>0.0186</b>	<b>0.0094</b>	0.0034	0.0054	0.0075
Barium	Ba mg/l	<b>0.442</b>	0.095	0.082	0.018	<b>0.181</b>	0.024	<b>0.163</b>	0.066	<b>0.262</b>	0.073	0.1
Boron	B mg/l	0.053	0.022	0.037	0.067	0.038	0.047	0.057	0.032	0.038	0.031	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.003
Calcium	Ca mg/l	114	89.2	75.9	8.7	35.9	7.8	52.8	31	62.3	91.4	200 <sup>+</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<b>0.0076</b>	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	0.015	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	1.5
Iron	Fe mg/l	0.136	<0.020	<0.020	0.076	<0.020	<0.020	<0.020	25	0.138	<0.02	0.2 <sup>+</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<b>0.021</b>	<0.005	<0.005	<0.005	<5	<5	<0.005	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	11.6	8	6.9	0.2	3.7	0.4	7	3.3	8.7	10.5	50 <sup>+</sup>
Manganese	Mn mg/l	<b>0.537</b>	<b>0.263</b>	<b>0.197</b>	<0.002	0.011	<0.002	0.022	0.003	<b>0.168</b>	<b>0.07</b>	0.05 <sup>+</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.00075
Nickel	Ni mg/l	<0.002	0.002	<0.002	0.015	0.002	0.017	0.003	<0.002	0.003	0.003	0.02 <sup>++</sup>
Phosphorus	P mg/l	0.398	0.09	0.127	0.162	0.167	0.144	0.204	303	0.214	0.138	-
Potassium	K mg/l	<b>12.7</b>	<b>6</b>	<b>6.6</b>	4.3	<b>10.8</b>	5	<b>6</b>	<b>6</b>	<b>11.9</b>	<b>11.4</b>	5 <sup>+</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	0.005	<0.003	<0.003	<0.003	<0.003	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Sodium	Na mg/l	<b>435.5</b>	121.9	98.4	<b>385.5</b>	<b>495.8</b>	<b>427.9</b>	<b>166.2</b>	<b>162.1</b>	<b>303.7</b>	84	150 <sup>++</sup>
Strontium	Sr mg/l	3.165	2.453	2.128	0.206	1.715	0.319	2.022	0.807	2.7	2.396	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.006	<0.007	<0.005	-
Zinc	Zn mg/l	<0.003	0.008	<0.003	0.007	<0.003	0.007	0.004	<0.003	0.005	0.027	0.075 <sup>+</sup>

Legend:

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>+</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

**Results are shaded and in bold where they exceed the Threshold Value**

\*= Detection Limit above guideline value

'<' = concentration is below the LOD for the parameter

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Clarochem Ireland Limited GW Monitoring

Project No. 12/6379



PARAMETERS	UNIT	MW-8										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
BOD	mg/l	<1	<1	5	<1	<1	-	DRY	<1	DRY	DRY	-
COD	mg/l	17	<7	129	22	17	-		240			-
Dissolved Oxygen	mg/l	6	9	10	7	8	-		9			-
Total Organic Carbon	C mg/l	4	5	<2	<2	15	-		<2			No Abnormal Change
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3		<0.3			1 <sup>1</sup>
Chloride	Cl mg/l	23.6	25.1	22	29.7	22.2	34.9		56.2			187.5
Sulphate	SO4 mg/l	116.71	110.97	99.66	141.89	88.82	91.9		224.9			187.5
Nitrate	NO3 mg/l	18.5	13.8	12.5	22.9	7	0.4		<0.2			37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.08	<0.02	0.02	<0.02		0.05			0.375
Total Ammonia	NH4 mg/l	1.17	0.09	0.09	0.11	0.15	0.08		<0.03			0.175
Total Oxidised Nitrogen	mg/l	4.2	3.1	2.8	5.2	1.6	<0.2		<0.2			-
Total Hardness	CaCO3 mg/l	753	606	708	546	508	-		519			200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	218	337	546	545	-		255			-
Total Alkalinity	CaCO3 mg/l	1866	532	3768	282	7646	1830		1432			No Abnormal Change
Total Cyanide	mg/l	0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.037			
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	-	<0.1*	0.0005 <sup>1</sup>			
Metals												
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.02	<0.02	DRY	<20	DRY	DRY	0.15
Arsenic	As mg/l	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025		<2.5			0.0075
Barium	Ba mg/l	0.074	0.054	0.071	0.06	0.069	0.11		0.081			0.1
Boron	B mg/l	0.033	0.016	0.028	0.033	0.029	0.02		0.04			0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.5			0.003
Calcium	Ca mg/l	279.3	223	263	199.5	181.8	167.2		187.7			200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015		<1.5			0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002		<2			-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007		<7			1.5
Iron	Fe mg/l	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020		<20			0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	0.006	<0.005	<0.005		<5			0.0075 <sup>2</sup>
Magnesium	Mg mg/l	13	11.8	12.1	11.2	12.7	13.2		11.8			50 <sup>1</sup>
Manganese	Mn mg/l	0.021	<0.002	0.724	0.093	2.021	0.048		<2			0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*		<1			0.00075
Nickel	Ni mg/l	0.005	0.002	<0.002	0.002	0.006	0.011	0.005	0.02 <sup>1*</sup>			
Phosphorus	P mg/l	0.009	0.011	<0.005	0.009	0.01	0.01	0.019	-			
Potassium	K mg/l	0.8	0.7	0.7	1.8	1.1	1.7	3.5	5 <sup>1</sup>			
Selenium	Se mg/l	<0.003	0.009	<0.003	<0.003	<0.003	<0.003	<3	-			
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	-			
Sodium	Na mg/l	20.3	17.8	19.7	16.8	19.2	20.1	19.2	150 <sup>1*</sup>			
Strontium	Sr mg/l	0.832	0.706	0.725	0.651	0.671	0.642	0.632	-			
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<5	-			
Zinc	Zn mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<3	0.075 <sup>2</sup>			

Legend:

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>\*</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

Results are shaded and in bold where they exceed the Threshold Value

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'<' = concentration is below the LOD for the parameter

AWN Consulting Ltd.

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379



PARAMETERS	UNIT	MW-9										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
BOD	mg/l	<1	<1	4	<1	261	2	<1	<1	<1	<1	-
COD	mg/l	30	<7	46	9	454	11	14	9	7	25	-
Dissolved Oxygen	mg/l	5	9	8	8	4	6	6	11	7	9	-
Total Organic Carbon	C mg/l	2	3	<2	<2	166	<2	2	<2	<2	<2	No Abnormal Change
Chloride	Cl mg/l	7.7	6.8	7.1	5.3	10.9	5.9	4.1	4.5	20.9	8.5	187.5
Fluoride	F mg/l	0.3	<0.3	<0.3	<0.3	0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>1</sup>
Sulphate	SO4 mg/l	166.01	109.78	105.56	75.3	12.69	62.8	58.6	41.6	47.8	70	187.5
Nitrate	NO3 mg/l	7.4	1.8	3.1	3.6	1.2	0.6	10.8	3.9	1.9	5.1	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.07	<0.02	0.21	<0.02	<0.02	<0.02	0.11	<0.02	0.375
Total Ammonia	NH4 mg/l	0.05	0.05	0.06	0.06	13.5	0.37	0.19	0.09	0.08	0.07	0.175
Total Oxidised Nitrogen	mg/l	1.7	0.4	0.7	0.8	0.3	<0.2	2.4	0.9	0.5	1.2	-
Total Hardness	CaCO3 mg/l	332	282	285	172	422	258	221	187	232	228	200 <sup>+</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	183	303	233	490	263	100	205	219	87	-
Total Alkalinity	CaCO3 mg/l	592	228	294	136	538	678	234	174	808	352	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.15*	<0.15*	0.0005 <sup>1</sup>
Metals												
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.02	<0.02	<0.02	<0.02	<0.02	0.039	0.15
Arsenic	As mg/l	<0.0025	<0.0025	<0.0025	<0.0025	0.0052	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0075
Barium	Ba mg/l	0.035	0.034	0.045	0.029	0.203	0.111	0.053	0.046	0.102	0.109	0.1
Boron	B mg/l	0.017	<0.012	0.021	0.016	0.021	<0.012	0.013	0.013	<0.012	0.026	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.003
Calcium	Ca mg/l	112.8	97.1	95.2	61.1	139	85.5	77.6	65.2	78.8	72.3	200 <sup>+</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	0.0055	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.003	<0.002	<0.002	<0.002	<0.002	<0.002	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	1.5
Iron	Fe mg/l	0.029	<0.020	<0.020	<0.020	3.07	<0.020	<0.020	<0.020	<0.020	<0.02	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	11.9	9.4	11.2	4.6	17.8	10.5	6.4	5.7	8.3	11.3	50 <sup>+</sup>
Manganese	Mn mg/l	<0.002	<0.002	0.025	<0.002	5.049	<0.002	<0.002	<0.002	0.003	0.576	0.05 <sup>+</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	0.00075
Nickel	Ni mg/l	<0.002	<0.002	<0.002	<0.002	0.008	0.003	<0.002	<0.002	0.003	0.003	0.02 <sup>1*</sup>
Phosphorus	P mg/l	0.006	0.007	<0.005	0.011	0.027	<0.005	<0.005	0.011	0.006	<0.005	-
Potassium	K mg/l	3	3.4	3.1	4.1	5.2	2.4	2.6	2	2.3	2.1	5 <sup>+</sup>
Selenium	Se mg/l	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Sodium	Na mg/l	16.6	12.1	13.4	6.8	15.2	10.4	7.2	6	12.2	10.8	150 <sup>1*</sup>
Strontium	Sr mg/l	1.269	0.877	0.917	0.721	1.439	0.858	0.765	0.575	0.725	0.951	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	-
Zinc	Zn mg/l	<0.003	<0.003	<0.003	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.075 <sup>+</sup>

Legend:

- = Not available / not analysed  
mg/l - milligrams per litre  
(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

<sup>¥</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.

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Project No. 12/6379

PARAMETERS	UNIT	MW-10										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
BOD	mg/l	<1	<1	2	<1	<1	<1	<1	<1	<1	<1	-
COD	mg/l	54	<7	16	16	8	<7	<7	<7	<7	20	-
Dissolved Oxygen	mg/l	5	10	7	8	8	5	6	11	9	9	-
Total Organic Carbon	C mg/l	<2	2	<2	<2	2	<2	25.6	<2	<2	<2	No Abnormal Change
Chloride	Cl mg/l	25.9	12.6	23.6	19.1	10.2	25.8	3	27.4	27.7	26.8	187.5
Fluoride	F mg/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1 <sup>1</sup>
Sulphate	SO4 mg/l	75.96	40.73	85.85	65.28	36.82	99.1	110	135.6	120.1	150	187.5
Nitrate	NO3 mg/l	2.6	1	1.8	4.2	1.7	0.4	1.6	1.2	2.4	1.9	37.5
Nitrite	NO2 mg/l	<0.02	<0.02	0.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.375
Total Ammonia	NH4 mg/l	0.05	0.04	0.03	0.04	<0.03	0.04	0.05	0.04	0.07	<0.03	0.175
Total Oxidised Nitrogen	mg/l	0.6	0.2	0.4	0.9	0.4	<0.2	0.4	0.3	0.5	0.4	-
Total Hardness	CaCO3 mg/l	260	182	262	307	130	306	323	345	324	361	200 <sup>1</sup>
Non-Carbonate Hardness	CaCO3 mg/l	-	101	296	242	186	299	190	355	299	181	-
Total Alkalinity	CaCO3 mg/l	276	172	396	278	260	588	278	286	310	260	No Abnormal Change
Total Cyanide	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.037
Total Phenols	mg/l	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.1*	<0.15*	<0.15*	0.0005 <sup>1</sup>
Metals												
Aluminium	Al mg/l	<0.020	<0.020	<0.020	<0.020	<0.020	<0.040	<0.020	<0.020	<0.020	0.048	0.15
Arsenic	As mg/l	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.005	<0.0025	<0.0025	<0.0025	<0.0025	0.0075
Barium	Ba mg/l	0.053	0.029	0.049	0.071	0.025	0.09	0.071	0.094	0.066	0.097	0.1
Boron	B mg/l	<0.012	<0.012	<0.012	0.023	<0.012	<0.024	0.02	0.022	0.019	0.019	0.75
Cadmium	Cd mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.003
Calcium	Ca mg/l	88.9	63.4	90.1	105	44.5	105.1	110.3	118.5	111	124.1	200 <sup>1</sup>
Chromium	Cr mg/l	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.003	<0.0015	<0.0015	<0.0015	0.0113	0.037
Cobalt	Co mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.004	<0.002	<0.002	<0.002	<0.002	-
Copper	Cu mg/l	<0.007	<0.007	<0.007	<0.007	<0.007	<0.014	<0.007	<0.007	<0.007	<0.007	1.5
Iron	Fe mg/l	<0.020	<0.020	<0.020	<0.020	<0.020	<0.040	<0.02	<0.02	<0.02	<0.02	0.2 <sup>1</sup>
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.010*	<0.005	<0.005	<0.005	<0.005	0.0075 <sup>2</sup>
Magnesium	Mg mg/l	8.9	5.7	8.7	10.5	4.4	10.4	11.3	11.6	11.1	12.2	50 <sup>1</sup>
Manganese	Mn mg/l	0.02	<0.002	0.011	0.137	0.013	<0.004	0.013	<0.002	<0.002	0.087	0.05 <sup>1</sup>
Mercury	Hg mg/l	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.002*	<0.001*	<0.001*	<0.001*	<0.001*	0.00075
Nickel	Ni mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.02 <sup>1*</sup>
Phosphorus	P mg/l	0.013	0.015	0.012	0.009	0.018	<0.010	0.013	0.018	0.015	0.009	-
Potassium	K mg/l	2	1.6	2.1	2	1.4	1.9	2	2	2.3	1.9	5 <sup>1</sup>
Selenium	Se mg/l	<0.003	0.004	<0.003	<0.003	<0.003	<0.006	<0.003	<0.003	<0.003	<0.003	-
Silver	Ag mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Sodium	Na mg/l	12.4	9	12.8	12	6.3	11.4	13.3	13.5	14.8	14.4	150 <sup>1*</sup>
Strontium	Sr mg/l	0.316	0.197	0.313	0.363	0.158	0.356	0.38	0.382	0.381	0.651	-
Tin	Sn mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	Zn mg/l	<0.003	<0.003	<0.003	<0.003	0.003	<0.006	<0.003	<0.003	<0.003	<0.003	0.075 <sup>2</sup>

**Legend:**

- = Not available / not analysed

mg/l - milligrams per litre

(Results are compared to the Groundwater Regulations 2010)

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016<sup>\*</sup> = Under new Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016 sodium and nickel are no longer listed as parameters for which a GTV is provided. As such, the EPA's 2003 IGVs have been applied.**Results are shaded and in bold where they exceed the Threshold Value**

\* = Detection Limit above guideline value

'&lt;' = concentration is below the LOD for the parameter

Note: analysis for MW-10 was undertaken using x2 dilution for a number of the metal parameters and therefore the LOD is twice that of the analysis for the other samples.

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Table 3a: Hydrocarbon Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-1										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	-	<10	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	170	170	150	<10	100	240	860	180	190	100	-
Petrol Range Organics	µg/l	14	104	355	450	208	97	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	2.5	<1.5	<2.1	<3	<3	<3	<3	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

Results are shaded and in bold where they exceed the Threshold Value

Results are shaded only to indicate presence of DROs and PROs

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Table 3b: Hydrocarbon Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-2										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	150	<10	<10	<10	<10	<10	<10	-
Petrol Range Organics	µg/l	<10	<10	18	<10	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	12.3	<0.5	<5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<3	<3	<3	<3	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

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Table 3c: Hydrocarbon Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-3										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<3	<3	<3	<3	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

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Table 3d: Hydrocarbon Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-4										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
Mineral Oil	µg/l	<10	940	<10	<10	<10	<10	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	1440	<10	<10	<10	<10	<10	<10	<10	<10	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<3	<3	<3	<3	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

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Table 3e: Hydrocarbon Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-5										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	150	<10	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<3	<3	<3	<3	<3	10 <sup>1</sup>

**Legend:**  
µg/l - micrograms per litre (parts per billion)  
Results are compared to the Groundwater Regulations 2010  
<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)  
<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

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Table 3f: Hydrocarbon Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-6										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	-	<10	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	<10	120	<10	<10	<10	<10	<10	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<3	<3	<3	<3	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

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Table 3g: Hydrocarbon Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-7										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<b>140</b>	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	160	<10	<10	250	10	<10	<10	<10	140	<10	-
Petrol Range Organics	µg/l	143	<10	<10	4971	181	514	<10	<10	230	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	1.60	<0.5	<1	<1	<1	1.0	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	5	<1.5	<3	<3	<3	2.0	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

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Table 3h: Hydrocarbon Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-8										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	<10	-	-	<10	-	-	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	<10	<10	-	-	<10	-	-	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	-	-	<10	-	-	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	<0.5	-	-	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	-	-	<5	-	-	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	<0.5	-	-	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	-	-	<1.5	-	-	10 <sup>1</sup>

**Legend:**

µg/l - micrograms per litre (parts per billion)

- = Well Dry

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

Results are shaded only to indicate presence of DROs and PROs

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Table 3i: Hydrocarbon Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-9										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	<10	100	<10	<10	<10	<10	<10	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<3	<3	<3	<3	<3	10 <sup>1</sup>

Legend:

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

Results are shaded and in bold where they exceed the Threshold Value

Results are shaded only to indicate presence of DROs and PROs

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Table 3j: Hydrocarbon Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-10										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
Mineral Oil	µg/l	<10	<10	<10	<10	-	<10	<10	<10	<10	<10	10 <sup>1</sup>
Diesel Range Organics	µg/l	<10	<10	<10	<10	140	<10	<10	<10	<10	<10	-
Petrol Range Organics	µg/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Xylene	µg/l	<1.5	<1.5	<1.5	<1.5	<1 or <0.5	<3	<3	<3	<3	<3	10 <sup>1</sup>

**Legend:**  
µg/l - micrograms per litre (parts per billion)  
Results are compared to the Groundwater Regulations 2010  
<sup>1</sup> = EPA IGVs Environmental Protection Agency (EPA) Guidelines (2003)  
<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**  
Results are shaded only to indicate presence of DROs and PROs

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Table 4a: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-1										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2	<2	500 <sup>1</sup>
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<2	<2	<2	<4	<4	<4	<4	<4	
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	30 <sup>1</sup>
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3	<3	0.4 <sup>1</sup>
1,2,4-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dibromoethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	10 <sup>1</sup>
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.25
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	10 <sup>1</sup>
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	12 <sup>1</sup>
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<5	<5	<5	<5	<5	15 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	0.1 <sup>1</sup>
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	1
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
o Xylene	µg/l	<0.5	<0.5	1.5	<0.5	1.1	<1	<1	<1	<3	<1	10 <sup>1</sup>
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2	<2	10 <sup>1</sup>
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<3	<2	-
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<2	<3	-
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525
trans-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
trans-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.375
VOC TICs				ND			ND	ND		ND	ND	
Acetone	µg/l					118						-

**Legend:**

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

**AWN Consulting**

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

Table 4b: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-2										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2	<2	500 <sup>1</sup>
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4	<4	-
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	30 <sup>1</sup>
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3	<3	0.4 <sup>1</sup>
1,2,4-Trimethylbenzene	µg/l	<3	<3	<2	<3	<3	<3	<3	<3	<3	<3	-
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dibromoethane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	10 <sup>1</sup>
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.25
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	10 <sup>1</sup>
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	12 <sup>1</sup>
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<5	<5	<5	<5	<5	15 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	0.1 <sup>1</sup>
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	1
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2	<2	10 <sup>1</sup>
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Toluene	µg/l	<0.5	<0.5	12.3	<0.5	<5	<5	<5	<5	<5	<5	525
trans 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
trans 1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.375
VOC TICs				NA			ND	ND	ND	ND	ND	

**Legend:**

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

**AWN Consulting**

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

Table 4c: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-3										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2	<2	500 <sup>1</sup>
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4	<4	-
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	30 <sup>1</sup>
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3	<3	0.4 <sup>1</sup>
1,2,4-Trimethylbenzene	µg/l	<3	<3	<2	<3	<3	<3	<3	<3	<3	<3	-
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dibromoethane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	10 <sup>1</sup>
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.25
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	10 <sup>1</sup>
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	12 <sup>1</sup>
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<5	<5	<5	<5	<5	15 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	0.1 <sup>1</sup>
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	1
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2	<2	10 <sup>1</sup>
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525
trans-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
trans-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.375
VOC TICs				NA			ND	ND	ND	ND	ND	

**Legend:**

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

**AWN Consulting**

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

Table 4d: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-4										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2	<2	500 <sup>1</sup>
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4	<4	-
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	30 <sup>1</sup>
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3	<3	0.4 <sup>1</sup>
1,2,4-Trimethylbenzene	µg/l	<3	<3	<2	<3	<3	<3	<3	<3	<3	<3	-
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dibromoethane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	10 <sup>1</sup>
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.25
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	10 <sup>1</sup>
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	12 <sup>1</sup>
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<5	<5	<5	<5	<5	15 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	0.1 <sup>1</sup>
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	1
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2	<2	10 <sup>1</sup>
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525
trans 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
trans 1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.375
VOC TICs				ND			ND	ND	ND	ND	ND	

**Legend:**

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

**AWN Consulting**

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

Table 4e: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-5										Threshold Values
		19/06/2014	04/12/2014	26/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2	<2	500 <sup>1</sup>
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4	<4	-
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	30 <sup>1</sup>
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3	<3	0.4 <sup>1</sup>
1,2,4-Trimethylbenzene	µg/l	<3	<3	<2	<3	<3	<3	<3	<3	<3	<3	-
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dibromoethane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	10 <sup>1</sup>
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.25
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	10 <sup>1</sup>
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	12 <sup>1</sup>
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<5	<5	<5	<5	<5	15 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	0.1 <sup>1</sup>
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	1
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2	<2	10 <sup>1</sup>
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525
trans 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
trans 1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.375
VOC TICs				NA			ND	ND	ND	ND	ND	

**Legend:**

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

**AWN Consulting**

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

Table 4f: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-6										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2	<2	500 <sup>1</sup>
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4	<4	-
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	30 <sup>1</sup>
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3	<3	0.4 <sup>1</sup>
1,2,4-Trimethylbenzene	µg/l	<3	<3	<2	<3	<3	<3	<3	<3	<3	<3	-
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dibromoethane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	10 <sup>1</sup>
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.25
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	10 <sup>1</sup>
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	12 <sup>1</sup>
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<5	<5	<5	<5	<5	15 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	0.1 <sup>1</sup>
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	1
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2	<2	10 <sup>1</sup>
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525
trans-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
trans-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.375
VOC TICs				NA			ND	ND	ND	ND	ND	

**Legend:**

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

**AWN Consulting**

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379



Table 4g: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-7										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2	<2	500 <sup>1</sup>
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4	<4	
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	30 <sup>1</sup>
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,4-Trichlorobenzene	µg/l	<3	<3	<2	<2	<3	<3	<3	<3	<3	<3	0.4 <sup>1</sup>
1,2,4-Trimethylbenzene	µg/l	<3	<3	<2	<3	<3	<3	<3	<3	<3	<3	-
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dibromoethane	µg/l	<2	<2	<3	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	10 <sup>1</sup>
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.25
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	10 <sup>1</sup>
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	12 <sup>1</sup>
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<5	<5	<5	<5	<5	15 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	1.6	<0.5	<1	<1	<1	1	<1	10 <sup>1</sup>
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	0.1 <sup>1</sup>
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	1
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
o Xylene	µg/l	<0.5	<0.5	<0.5	4	<0.5	<1	<1	<1	2	<1	10 <sup>1</sup>
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2	<2	10 <sup>1</sup>
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525
trans 1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
trans 1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.375
VOC TICs								ND			ND	
Acetone	µg/l					179						-
Triethylamine	µg/l						261					-
Isopropyl Alcohol	ug/l									241		-

Legend:

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

Results are shaded and in bold where they exceed the Threshold Value

AWN Consulting

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

Table 4h: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-8										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	-	-	<4	-	-	500 <sup>1</sup>
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	-	-	<2	-	-	
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	30 <sup>1</sup>
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
1,2,4-Trichlorobenzene	µg/l	<3	<3	<3	<2	<3	-	-	<3	-	-	0.4 <sup>1</sup>
1,2,4-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
1,2-Dibromoethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	10 <sup>1</sup>
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	2.25
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	-	-	<1	-	-	-
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	<0.5	-	-	0.75
Bromobenzene	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
Bromoform	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
Bromomethane	µg/l	<1	<1	<1	<1	<1	-	-	<1	-	-	-
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	10 <sup>1</sup>
Chloroethane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
Chloroform	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	12 <sup>1</sup>
Chloromethane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
cis-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
Dibromomethane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
Dichloromethane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	15 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	<0.5	-	-	10 <sup>1</sup>
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	0.1 <sup>1</sup>
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
Naphthalene	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	1
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	<0.5	-	-	10 <sup>1</sup>
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	-	-	<1	-	-	10 <sup>1</sup>
Propylbenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
Styrene	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	7.5 <sup>2</sup>
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	-	-	<5	-	-	525
trans-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
trans-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	-	-	<2	-	-	-
Trichloroethene	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	7.5 <sup>2</sup>
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	-	-	<3	-	-	-
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	-	-	0.375
VOC TICs		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	

**Legend:**

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

**AWN Consulting**

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

Table 4i: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-9										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2	<2	500 <sup>1</sup>
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4	<4	-
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	30 <sup>1</sup>
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,4-Trichlorobenzene	µg/l	<3	<3	<3	<2	<3	<3	<3	<3	<3	<3	0.4 <sup>1</sup>
1,2,4-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dibromoethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	10 <sup>1</sup>
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.25
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	10 <sup>1</sup>
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	12 <sup>1</sup>
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<5	<5	<5	<5	<5	15 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	0.1 <sup>1</sup>
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	1
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2	<2	10 <sup>1</sup>
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525
trans-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
trans-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.375
VOC TICs				NA			ND	ND	ND	ND	ND	

**Legend:**

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

**AWN Consulting**

Clarochem Ireland Limited GW Monitoring

Project No. 12/6379

Table 4j: Volatile Organic Compounds (VOCs) Analytical Results to Date - Clarochem - December 2018

Parameter	Units	MW-10										Threshold Values
		19/06/2014	04/12/2014	22/06/2015	07/12/2015	30/06/2016	13/12/2016	13/06/2017	14/12/2017	14/06/2018	06/12/2018	
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<4	<2	<2	<2	<2	<2	500 <sup>1</sup>
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<2	<2	<4	<4	<4	<4	<4	
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	30 <sup>1</sup>
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2,4-Trichlorobenzene	µg/l	<3	<3	<3	<2	<3	<3	<3	<3	<3	<3	0.4 <sup>1</sup>
1,2,4-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dibromoethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	10 <sup>1</sup>
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.25
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
4-Isopropyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.75
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
Carbon tetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	10 <sup>1</sup>
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	12 <sup>1</sup>
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<5	<5	<5	<5	<5	15 <sup>2</sup>
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	0.1 <sup>1</sup>
Isopropyl benzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Naphthalene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	1
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
o Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<1	<1	<1	<1	10 <sup>1</sup>
p/m Xylenes	µg/l	<1	<1	<1	<1	<1	<2	<2	<2	<2	<2	10 <sup>1</sup>
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
tert-butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<5	<5	<5	<5	<5	<5	525
trans-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
trans-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	7.5 <sup>2</sup>
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	-
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.375
VOC TICs				NA			ND	ND	ND	ND	ND	

**Legend:**

ND = TICS analysed - not detected

µg/l - micrograms per litre (parts per billion)

Results are compared to the Groundwater Regulations 2010

<sup>1</sup> = The Environmental Protection Agency (EPA) Guidelines (2003)

<sup>2</sup> = New or ammended value from Groundwater Regulations (S.I. No. 366 of 2016) issued July 2016

**Results are shaded and in bold where they exceed the Threshold Value**

**AWN Consulting**

Clarochem Ireland Limited GW Monitoring

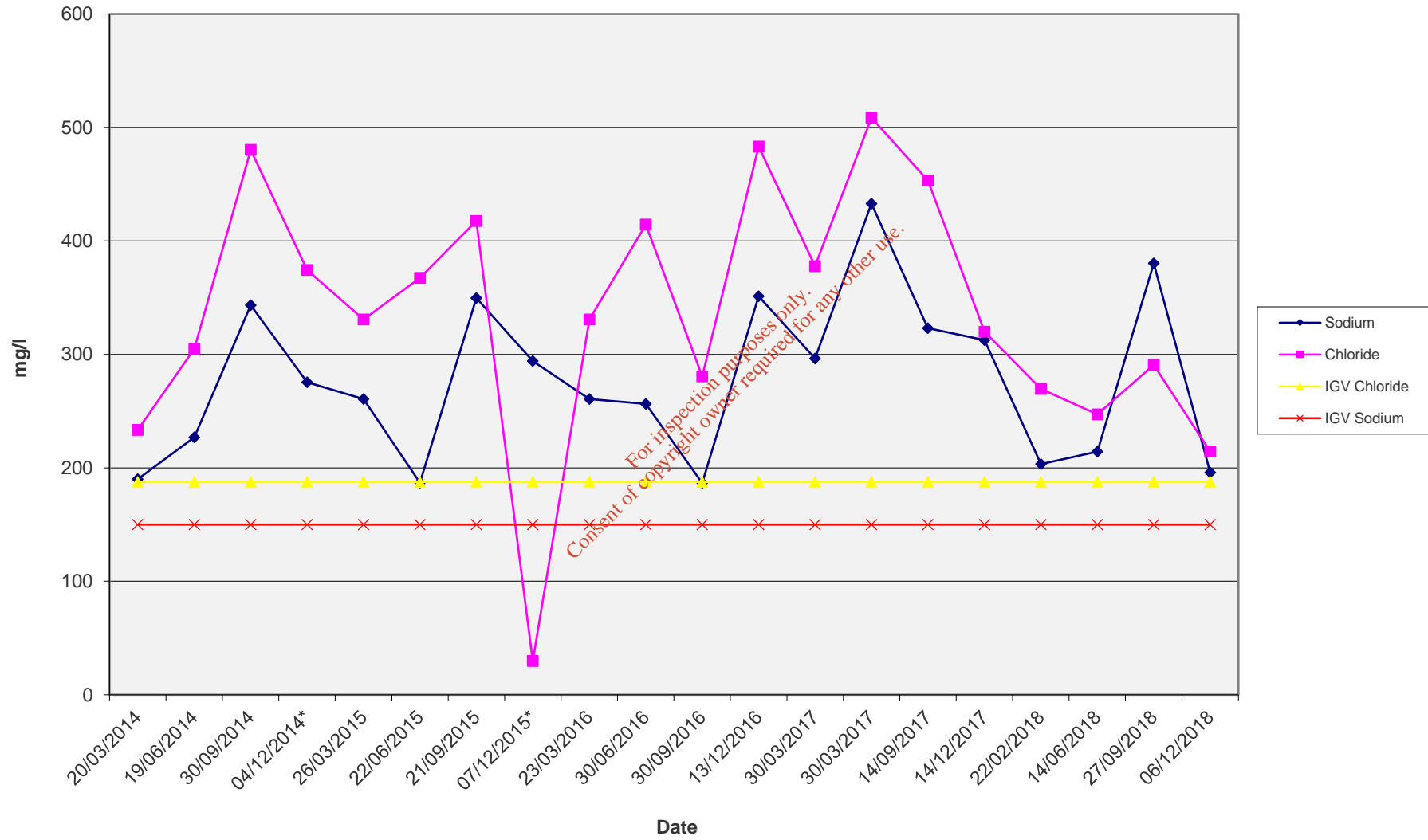
Project No. 12/6379

## GRAPHS

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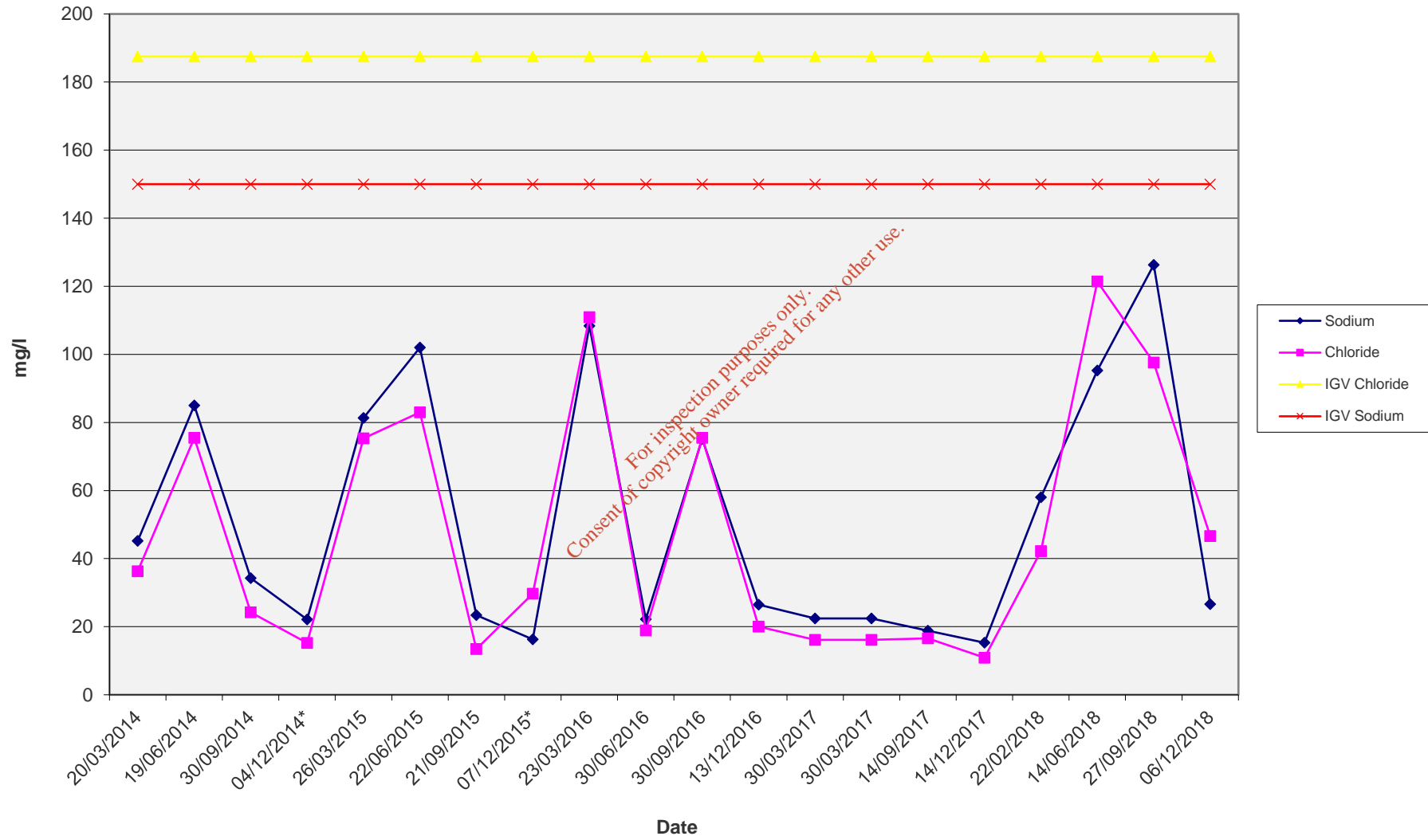


# MW-1

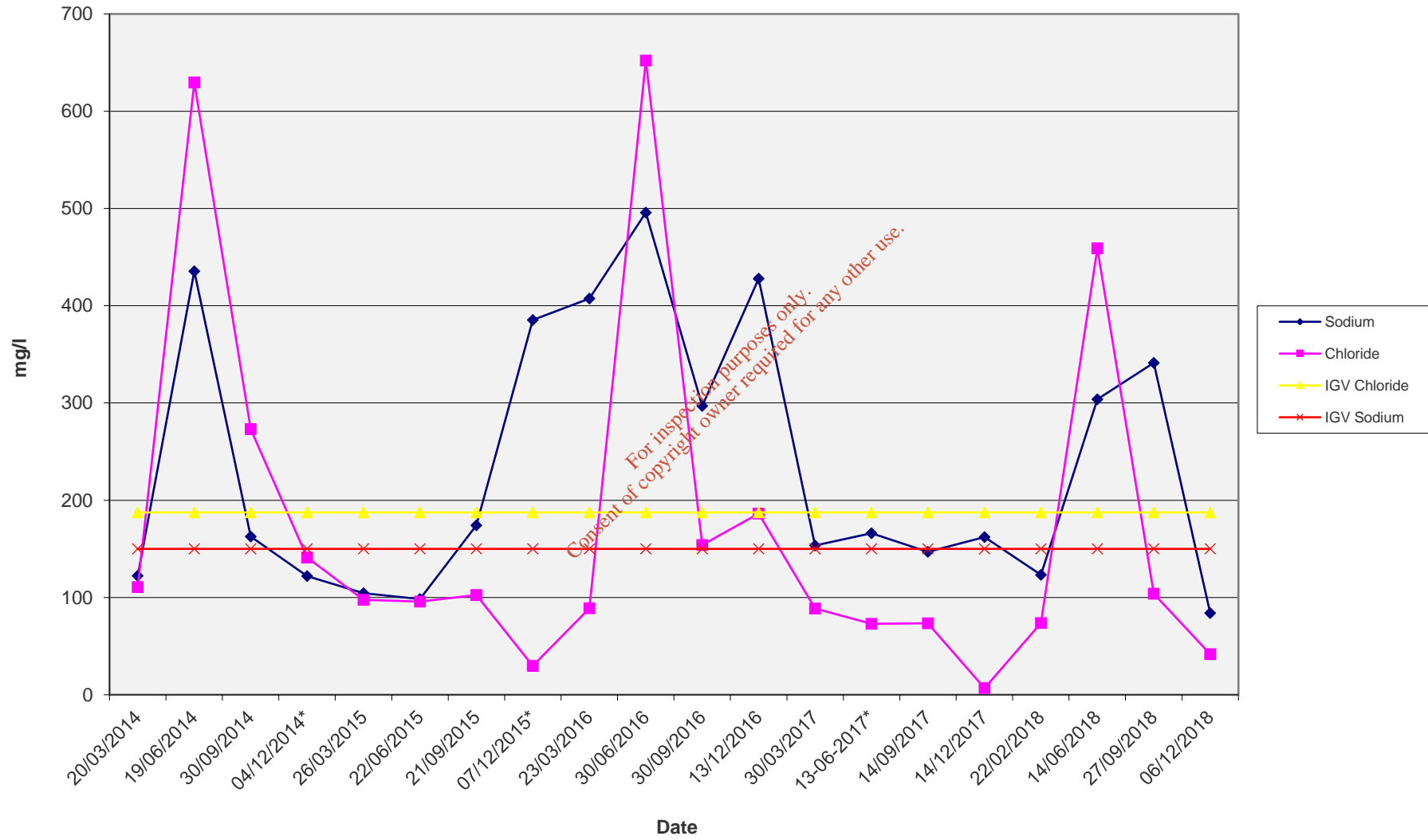




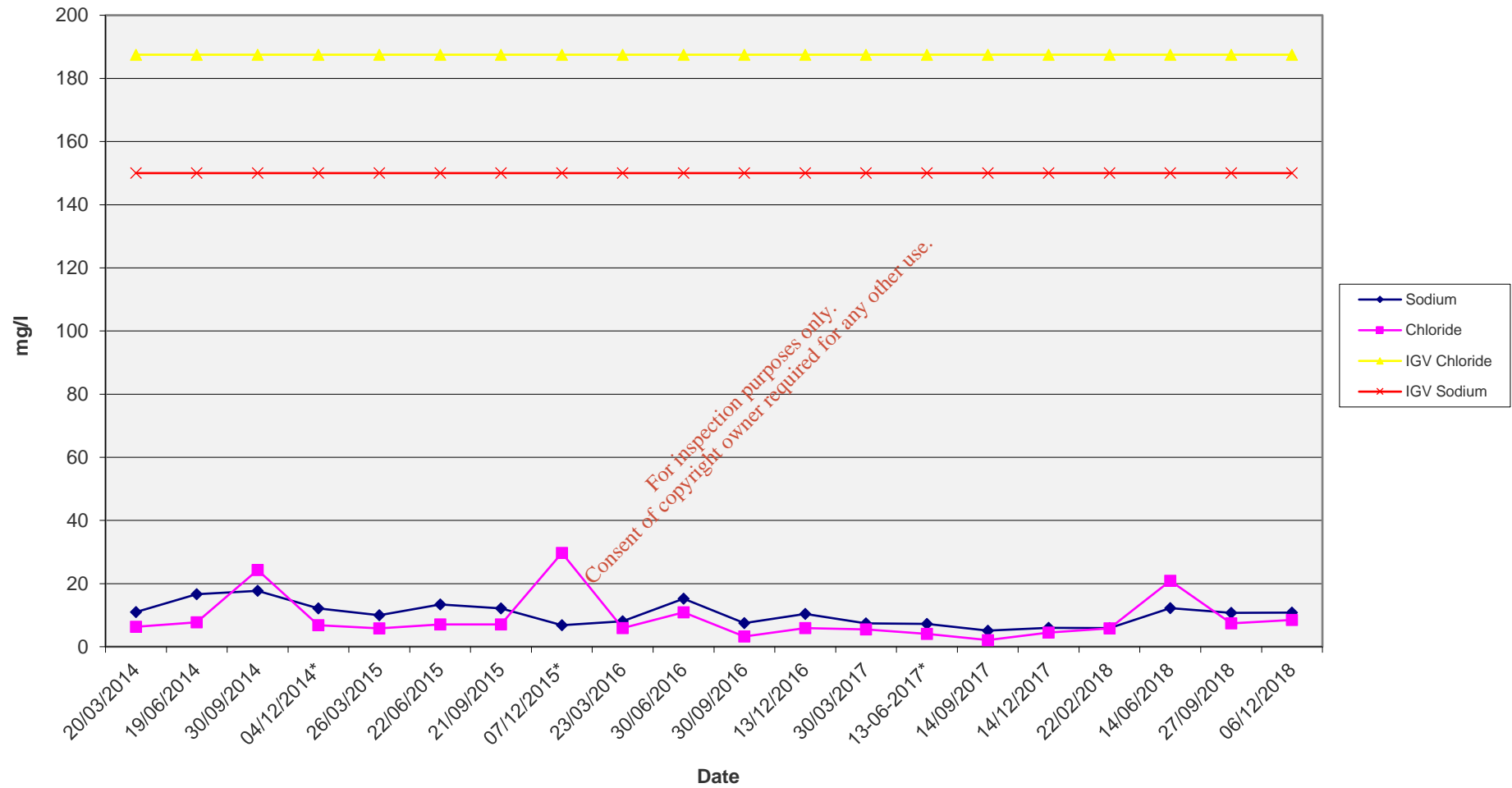
# MW-5



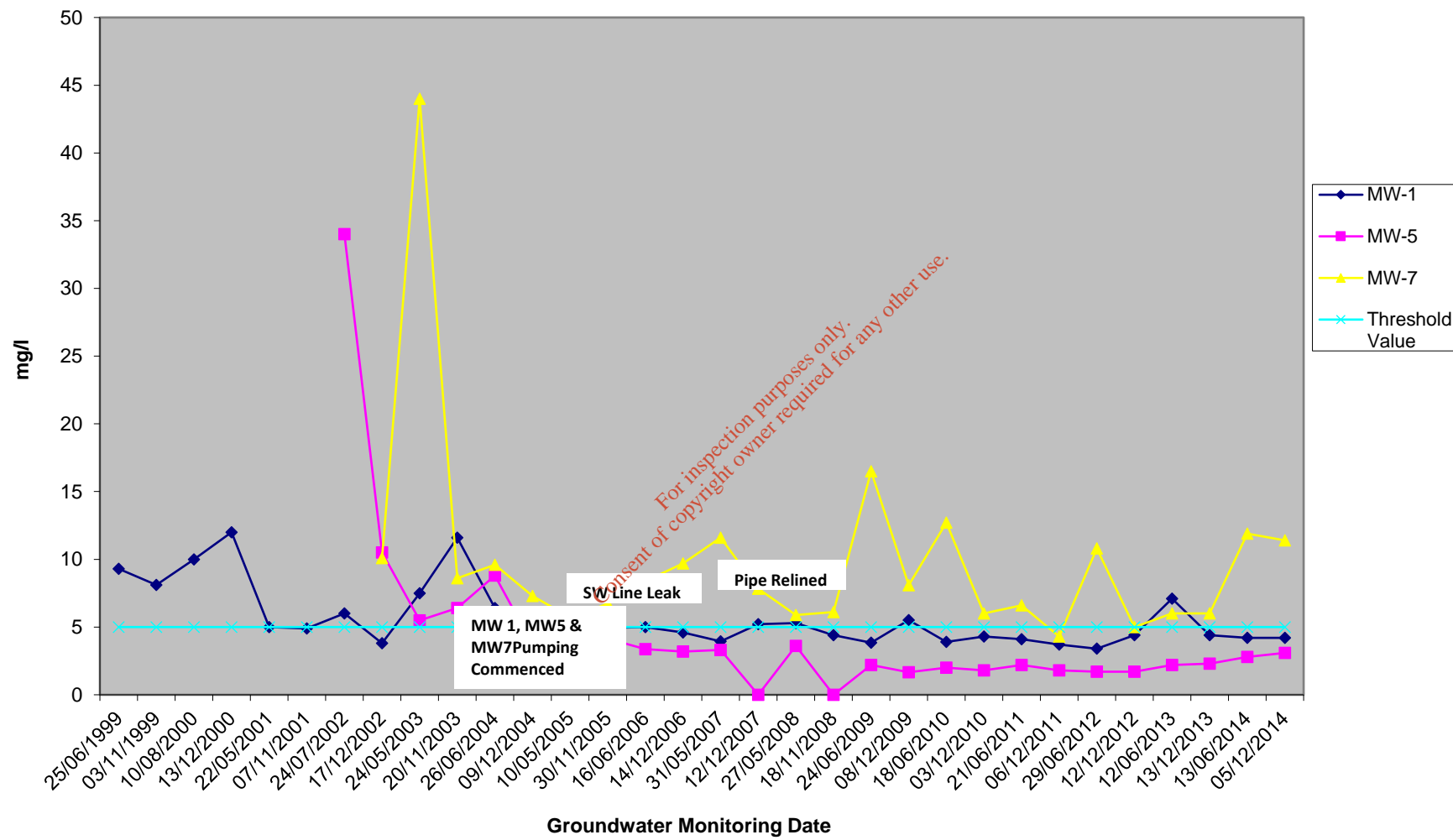
# MW-7



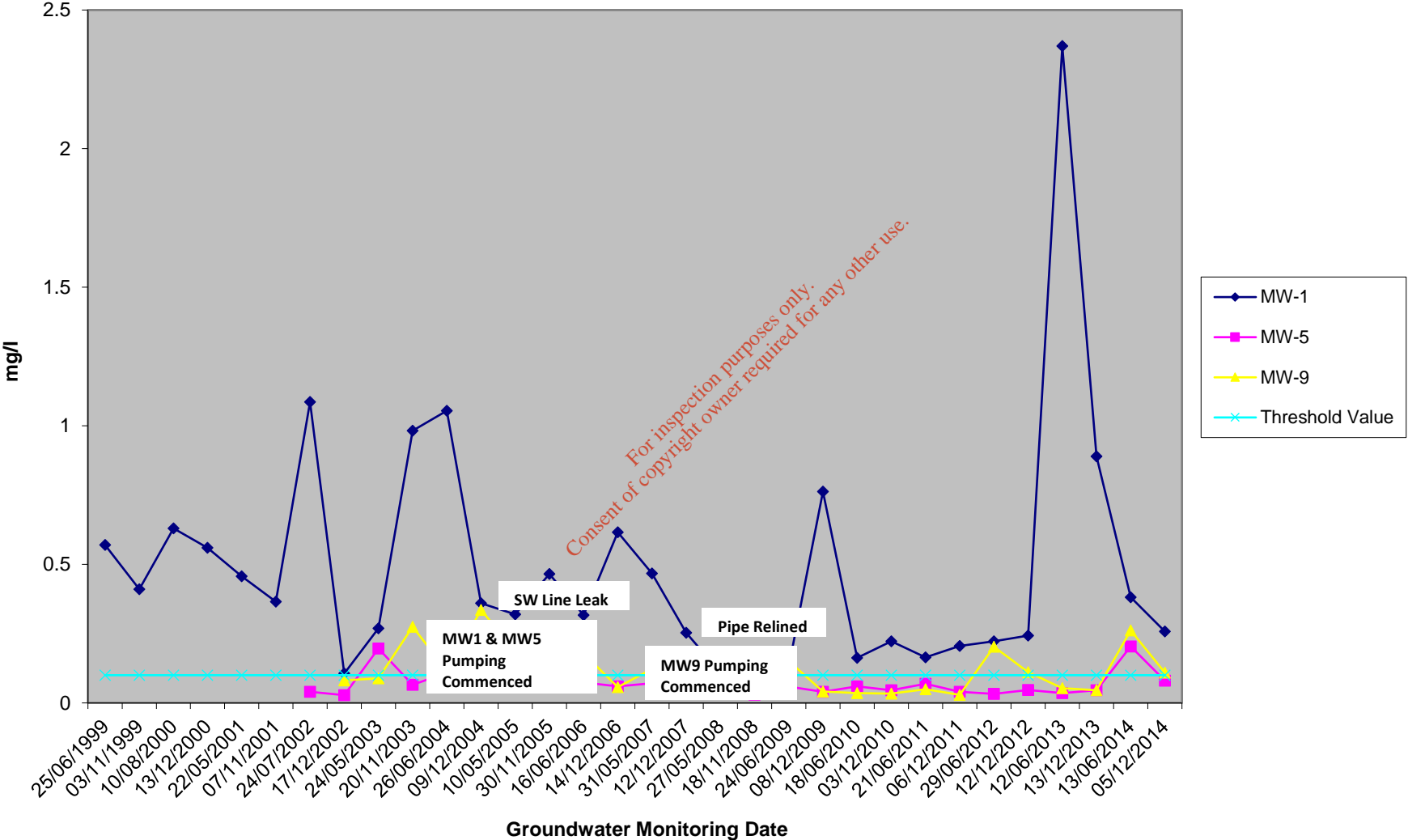
# MW-9



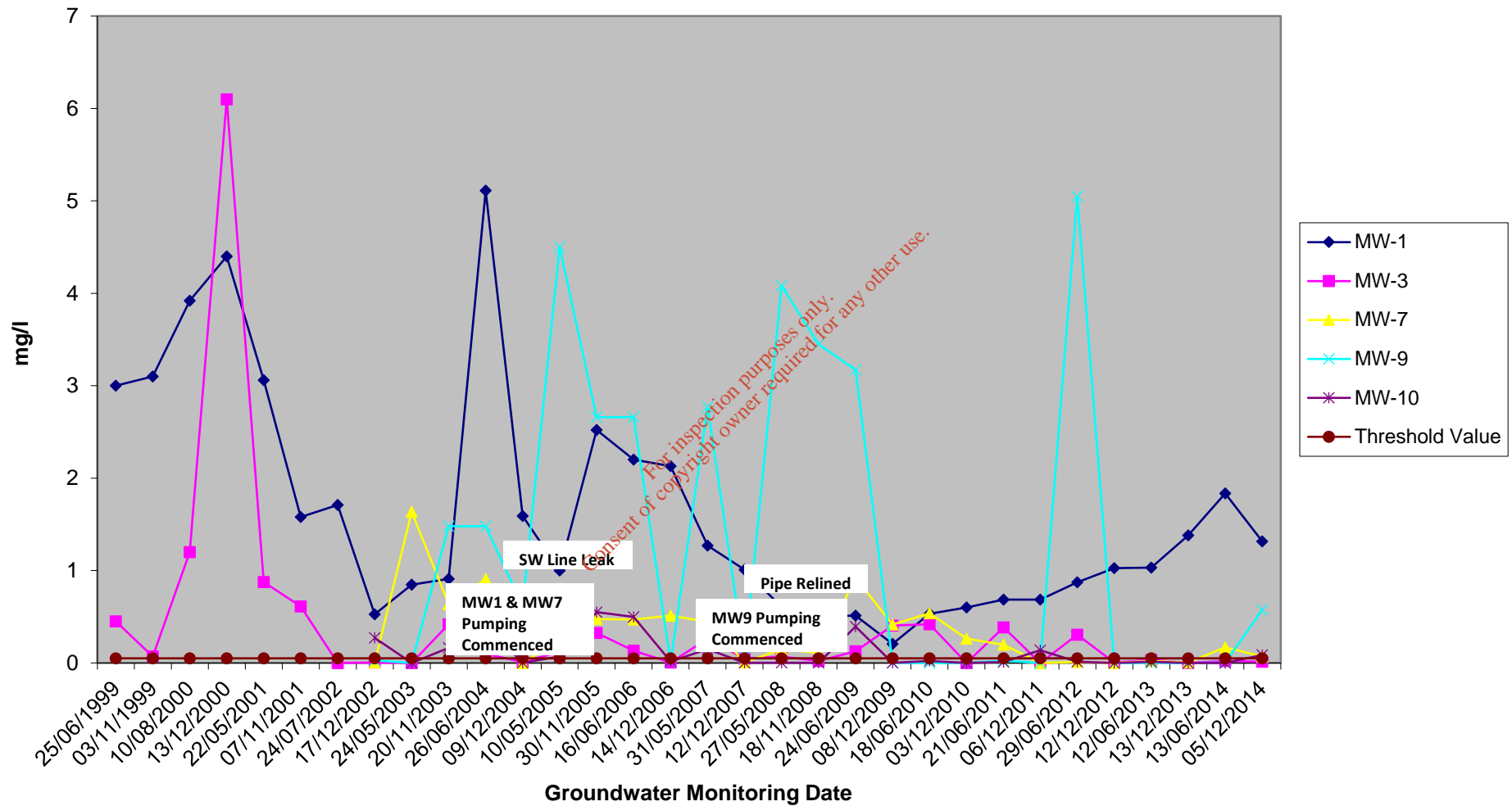
Graph 3 - MW-1, MW-5, MW-7 - Potassium



Graph 4 - MW-1, MW-5 & MW-9 - Barium

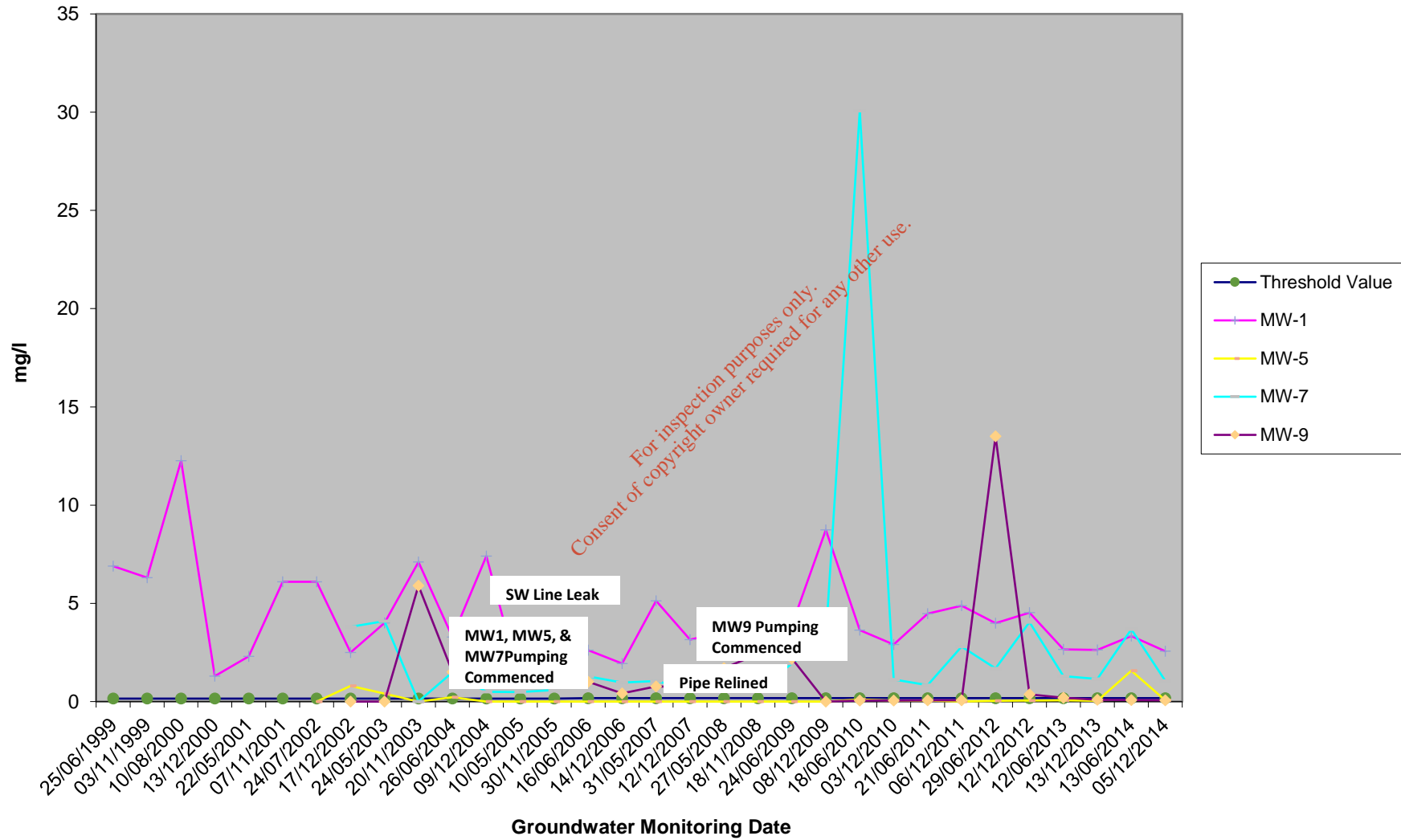


Graph 5 - MW-1, MW-3, MW-7, MW-9, MW-10 - Manganese





Graph 6 - MW-1, MW-5, MW-7, MW-9 - Total Ammonia



## APPENDIX 1

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# Groundwater Monitoring Record Sheet



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W: www.awnconsulting.com

Client	Clarochem Ireland Limited
Project	Quarterly Groundwater Monitoring - December 2018
Contract No.	12_6379
Date/Time	06/12/2018
Weather Conditions	Cloudy
Purging equipment (bailer/inertial tubing and pump/other)	Dedicated PVC Bailer

Location	Damastown, Mulhuddart, Dublin 15	Engineer(s)	
----------	----------------------------------	-------------	--

QA Procedures for Multi-meter			
Last Field Calibration	Date:		Time:
Last Full Calibration			

Borehole Number				
MW1	MW2	MW3	MW4	MW5

Groundwater Monitoring					
Depth from TOC to static water level (m)	Pumping	0.79	1.38	0.6	Pumping
Total well depth from TOC (m)	4.63	5.56	4.03	1.97	3.22
Casing recess: ground level to TOC (m)					
well volume in Well & Sandpack - see below					

Water Quality Measurements						
	Volume Removed	No. of Volumes				
Temp (°C)		1	11.5	11.9	11.5	11.5
		2				
		3				
pH		1	7.42	6.78	7.02	7.62
		2				
		3				
Specific Conductivity (uS/cm)		1	1,309	915	612	413
		2				
		3				

Sample Observations						
	Colour	Orangeish	Brown tint	Brown tint	Brown tint	Brownish
	Chem / Organic	None	None	None	None	None
	Odour Present					
	Sediment/Precipitate					
	Free Product					
	Hydrocarbon Sheen					
	Well Purged Dry					

Any other field observations	
------------------------------	--

ONE WELL VOLUME (50mm diameter casing)	BS 10175
Terrier Borehole with 50mm Pipe	4l/m
6" Borehole with 50mm Pipe	5.5l/m
6" Borehole with 100mm Pipe	11.5l/m
8" Borehole with 50mm Pipe	8.25l/m
8" Borehole with 100mm Pipe	14.25l/m
<b>Note :</b> Purging should continue until Removal of at least three well volumes, or pH, conductivity and temperature readings have stabilised (any two successive reading are within 10% of eachother). If well is not recovering and it is not possible to meet these criteria then a grab sample should be obtained.	

# Groundwater Monitoring Record Sheet



The Tecpro Building,  
Clonsilla Business & Technology Park,  
Dublin 17, Ireland.

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Client	Clarochem Ireland Limited
Project	Quarterly Groundwater Monitoring - December 2018
Contract No.	12_6379
Date/Time	06/12/2018
Weather Conditions	Cloudy
Purging equipment (bailer/inertial tubing and pump/other)	Dedicated PVC Bailer

Location	Damastown, Mulhuddart, Dublin 15	Engineer(s)	
----------	----------------------------------	-------------	--

QA Procedures for Multi-meter			
Last Field Calibration	Date:		Time:
Last Full Calibration			

Borehole Number				
MW6	MW7	MW8	MW9	MW10

Groundwater Monitoring				
Depth from TOC to static water level (m)	0.56	Pumping	DRY	0.61
Total well depth from TOC (m)	2.4	2.03	2.44	4.7
Casing recess: ground level to TOC (m)				
well volume in Well & Sandpack - see below				

Water Quality Measurements						
	Volume Removed	No. of Volumes				
Temp (°C)		1	11.2	11.2	No Sample	11.5
		2				
		3				
pH		1	7.14	7.7	No Sample	7.4
		2				
		3				
Specific Conductivity (uS/cm)		1	548	570	No Sample	322
		2				
		3				

Sample Observations					
	Colour	Brown tint	Slight Black	No Sample	Brown tint
	Odour Present	None	V Slight chem	No Sample	None
	Sediment/Precipitate				
	Free Product				
	Hydrocarbon Sheen				
	Well Purged Dry				

Any other field observations	
------------------------------	--

ONE WELL VOLUME (50mm diameter casing)	BS 10175
Terrier Borehole with 50mm Pipe	4l/m
6" Borehole with 50mm Pipe	5.5l/m
6" Borehole with 100mm Pipe	11.5l/m
8" Borehole with 50mm Pipe	8.25l/m
8" Borehole with 100mm Pipe	14.25l/m
<b>Note :</b> Purging should continue until Removal of at least three well volumes, or pH, conductivity and temperature readings have stabilised (any two successive reading are within 10% of eachother). If well is not recovering and it is not possible to meet these criteria then a grab sample should be obtained.	

## APPENDIX 2

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# Exova Jones Environmental

Registered Office: Exova Environmental UK Limited, 10 Lower Grosvenor Place, London, SW1W 0EN. Reg No. 11371415

Unit 3 Deeside Point  
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Deeside  
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AWN Consulting  
Tecpro Building  
Clonshaugh Business & Technology Park  
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Dublin 17  
Ireland

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4225

**Attention :** Brigette Priestley  
**Date :** 21st December, 2018  
**Your reference :** 12/6379  
**Our reference :** Test Report 18/19889 Batch 1  
**Location :** Dublin  
**Date samples received :** 7th December, 2018  
**Status :** Final report  
**Issue :** 1

Nine samples were received for analysis on 7th December, 2018 of which nine were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**Compiled By:**

**Lucas Halliwell**  
Project Co-ordinator



**Client Name:** AWN Consulting  
**Reference:** 12/6379  
**Location:** Dublin  
**Contact:** Brigitte Priestley  
**JE Job No.:** 18/19889

**Report : Liquid**

**Liquids/products:** V=40ml vial, G=glass bottle, P=plastic bottle  
H=H<sub>2</sub>SO<sub>4</sub>, Z=ZnAc, N=NaOH, HN=HNO<sub>3</sub>

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64	65-72		Please see attached notes for all abbreviations and acronyms		
Sample ID	MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW9	MW10				
Depth													
COC No / misc													
Containers	V H HN P BOD G	V H HN P BOD G	V H HN P BOD G	V H HN P BOD G	V H HN P BOD G	V H HN P BOD G	V H HN P BOD G	V H HN P BOD G	V H HN P BOD G				
Sample Date	06/12/2018	06/12/2018	06/12/2018	06/12/2018	06/12/2018	06/12/2018	06/12/2018	06/12/2018	06/12/2018				
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water				
Batch Number	1	1	1	1	1	1	1	1	1				
Date of Receipt	07/12/2018	07/12/2018	07/12/2018	07/12/2018	07/12/2018	07/12/2018	07/12/2018	07/12/2018	07/12/2018				
											LOD/LOR	Units	Method No.
Dissolved Aluminium #	37	<20	<20	177	52	25	<20	39	48		<20	ug/l	TM30/PM14
Dissolved Arsenic #	12.3	<2.5	<2.5	<2.5	<2.5	<2.5	5.4	<2.5	<2.5		<2.5	ug/l	TM30/PM14
Dissolved Barium #	258	107	39	23	80	58	73	109	97		<3	ug/l	TM30/PM14
Dissolved Boron	25	34	19	<12	32	17	31	26	19		<12	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM30/PM14
Dissolved Calcium #	91.0	370.3 <sup>AA</sup>	153.3	100.4	158.5	94.0	91.4	72.3	124.1		<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5	7.1	6.5	<1.5	5.6	<1.5	7.6	<1.5	11.3		<1.5	ug/l	TM30/PM14
Dissolved Cobalt #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM30/PM14
Dissolved Copper #	<7	<7	<7	<7	<7	<7	<7	<7	<7		<7	ug/l	TM30/PM14
Total Dissolved Iron #	449	<20	<20	<20	<20	<20	<20	<20	<20		<20	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM30/PM14
Dissolved Magnesium #	7.7	12.6	9.5	3.6	14.3	6.8	10.5	11.3	12.2		<0.1	mg/l	TM30/PM14
Dissolved Manganese #	1315	8	12	<2	10	27	70	576	87		<2	ug/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM30/PM14
Dissolved Nickel #	<2	<2	<2	<2	<2	<2	3	3	<2		<2	ug/l	TM30/PM14
Dissolved Phosphorus #	25	17	<5	<5	29	65	138	<5	9		<5	ug/l	TM30/PM14
Dissolved Potassium #	4.2	1.0	0.4	0.1	3	1.2	11.4	2.1	1.9		<0.1	mg/l	TM30/PM14
Dissolved Selenium #	<3	<3	6	5	27	<3	<3	<3	<3		<3	ug/l	TM30/PM14
Dissolved Silver	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM30/PM14
Dissolved Sodium #	195.9	16.2	12.4	6.7	26.6	52.2	84.0	10.8	14.4		<0.1	mg/l	TM30/PM14
Dissolved Strontium	621	1113	836	622	1194	528	2396	951	651		<5	ug/l	TM30/PM14
Dissolved Tin	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM30/PM14
Dissolved Zinc #	16	<3	<3	<3	10	9	27	<3	<3		<3	ug/l	TM30/PM14
Non Carbonate Hardness (permanent) (as CaCO <sub>3</sub> )	275	725	409	215	348	142	115	87	181		<1	mg/l	TM30/PM0
Total Hardness Dissolved (as CaCO <sub>3</sub> )	260	979 <sup>AA</sup>	423	266	456	264	273	228	361		<1	mg/l	TM30/PM14
VOC TICs	ND	ND	ND	ND	ND	ND	ND	ND	ND			None	TM15/PM10
Methyl Tertiary Butyl Ether #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	ug/l	TM15/PM10
Benzene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	ug/l	TM15/PM10
Toluene #	<5	<5	<5	<5	<5	<5	<5	<5	<5		<5	ug/l	TM15/PM10
Ethylbenzene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM15/PM10
p/m-Xylene #	<2	<2	<2	<2	<2	<2	<2	<2	<2		<2	ug/l	TM15/PM10
o-Xylene #	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	114	117	121	119	117	120	119	115	105		<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	117	114	116	120	117	116	120	112	108		<0	%	TM15/PM10
EPH (C8-C40) #	100	<10	<10 <sup>SV</sup>	<10	<10	<10	<10	<10	<10		<10	ug/l	TM5/PM30
C8-C40 Mineral Oil (Calculation)	<10	<10	<10	<10	<10	<10	<10	<10	<10		<10	ug/l	TM5/PM30
GRO (>C4-C8) #	<10	<10	<10	<10	<10	<10	<10	<10	<10		<10	ug/l	TM36/PM12
GRO (>C8-C12) #	<10	<10	<10	<10	<10	<10	<10	<10	<10		<10	ug/l	TM36/PM12
GRO (>C4-C12) #	<10	<10	<10	<10	<10	<10	<10	<10	<10		<10	ug/l	TM36/PM12
Total Phenols HPLC	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15		<0.15	mg/l	TM26/PM0

Please include all sections of this report if it is reproduced

Please see attached notes for all abbreviations and acronyms

Client Name: AWN Consulting  
Reference: 12/6379  
Location: Dublin  
Contact: Brigitte Priestley  
JE Job No.: 18/19889

VOC Report : Liquid

J E Sample No.	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64	65-72		Please see attached notes for all abbreviations and acronyms		
Sample ID	MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW9	MW10				
Depth													
COC No / misc													
Containers	V H H N P BOD G	V H H N P BOD G	V H H N P BOD G	V H H N P BOD G	V H H N P BOD G	V H H N P BOD G	V H H N P BOD G	V H H N P BOD G	V H H N P BOD G	V H H N P BOD G			
Sample Date	06/12/2018	06/12/2018	06/12/2018	06/12/2018	06/12/2018	06/12/2018	06/12/2018	06/12/2018	06/12/2018	06/12/2018			
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	07/12/2018	07/12/2018	07/12/2018	07/12/2018	07/12/2018	07/12/2018	07/12/2018	07/12/2018	07/12/2018	07/12/2018	LOD/LOR	Units	Method No.
VOC MS													
Dichlorodifluoromethane	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Methyl Tertiary Butyl Ether #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ug/l	TM15/PM10
Chloromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Vinyl Chloride #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ug/l	TM15/PM10
Bromomethane	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	ug/l	TM15/PM10
Chloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Trichlorofluoromethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Dichloromethane (DCM) #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/l	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,1-Dichloroethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
2,2-Dichloropropane	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	ug/l	TM15/PM10
Bromochloromethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Chloroform #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,1,1-Trichloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,1-Dichloropropene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Carbon tetrachloride #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,2-Dichloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Benzene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	ug/l	TM15/PM10
Trichloroethene (TCE) #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,2-Dichloropropane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Dibromomethane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Bromodichloromethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
cis-1-3-Dichloropropene	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Toluene #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/l	TM15/PM10
trans-1-3-Dichloropropene	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,1,2-Trichloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,3-Dichloropropane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Dibromochloromethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,2-Dibromoethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Chlorobenzene #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,1,1,2-Tetrachloroethane #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Ethylbenzene #	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	ug/l	TM15/PM10
p/m-Xylene #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
o-Xylene #	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	ug/l	TM15/PM10
Styrene	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Bromoform #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Isopropylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,1,2,2-Tetrachloroethane	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	ug/l	TM15/PM10
Bromobenzene #	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,2,3-Trichloropropane #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Propylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
2-Chlorotoluene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
4-Chlorotoluene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
tert-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,2,4-Trimethylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
sec-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
4-Isopropyltoluene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,3-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,4-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
n-Butylbenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,2-Dichlorobenzene #	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,2-Dibromo-3-chloropropane	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,2,4-Trichlorobenzene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Hexachlorobutadiene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Naphthalene	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,2,3-Trichlorobenzene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	114	117	121	119	117	120	119	115	105		<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	117	114	116	120	117	116	120	112	108		<0	%	TM15/PM10

Please include all sections of this report if it is reproduced

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EPA Export 30-03-2019:03:37:18

# NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 18/19889

## SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

## WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

## DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

## SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

## DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

## BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

## NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

## REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

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**ABBREVIATIONS and ACRONYMS USED**

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to an Exova Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x5 Dilution

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JE Job No: 18/19889

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.				
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM0	No preparation is required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GC/FID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM0	No preparation is required.	Yes			

JE Job No: 18/19889

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM57	Modified US EPA Method 410.4. Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometrically.	PM0	No preparation is required.	Yes			
TM58	APHA Standard Methods for the extraction of water and waste water (SMEWW) 5210B. Comparable with ISO 5815:1989. Measurement of Biochemical Oxygen Demand. When cBOD (Carbonaceous BOD) is requested a nitrification inhibitor is added which prevents the oxidation of reduced forms of nitrogen, such as ammonia, nitrite and organic nitrogen which exert a nitrogenous demand.	PM0	No preparation is required.	Yes			
TM59	Determination of Dissolved Oxygen using the Hach HQ30D Oxygen Meter	PM0	No preparation is required.				
TM60	TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060, APHA Standard Methods for Examination of Water and Wastewater 5310B, ASTM D 7573, and USEPA 415.1.	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM75	Modified US EPA method 310.1. Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1. Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM89	Modified USEPA method OIA-1667. Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis.	PM0	No preparation is required.	Yes			
TM173	Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 340.2	PM0	No preparation is required.				

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17

**Certificate Of Analysis**

**Job Number:** 18-50240

**Issue Number:** 1

**Report Date:** 13 December 2018

**Site:** Clonee

**PO Number:** 12/6379

**Date Samples Received:** 06/12/2018

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Please find attached the results for the samples received at our laboratory on 06/12/2018.

Should you have any queries regarding the report or require any further services, we would be happy to discuss your requirements. For additional information about the company please log-on to our website at the above address.

Thank you for choosing City Analysts Limited. We look forward to assisting you again.

**Authorised By:**



Shane Reynolds  
Laboratory Manager

**Authorised Date:** 13 December 2018

**Notes:**

Results relate only to the items tested.

Information on methods of analysis and performance characteristics is available on request.

Any opinions or interpretations indicated are outside the scope of our INAB accreditation.

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**Report Reference:** 18-50240

**Report Version:** 1

**Site:** Clonee

**Sample Description:** MW1

**Date of Sampling:** 06/12/2018

**Sample Type:** Ground

**Date Sample Received:** 06/12/2018

**Lab Reference Number:** 421375

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	06/12/2018	Clostridium perfringens	19	cfu/100ml	-
D/D1201#	06/12/2018	Coliforms	11300.0	MPN/100ml	-
D/D1201#	06/12/2018	E.coli	4.1	MPN/100ml	-
D/D3221#	06/12/2018	Faecal Coliforms	6	cfu/100ml	-
D/D1205	06/12/2018	Faecal Streptococci	7	cfu/100ml	-

# = INAB Accredited, U = UKAS Accredited, \* = Subcontracted

**Note:**

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.

NAC & ATC - No abnormal change and acceptable to customers.

TVC - Total viable count

Site D = Analysed at City Analysts Dublin. Site S = Analysed at City Analysts Shannon

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**Report Reference:** 18-50240

**Report Version:** 1

**Site:** Clonee

**Sample Description:** MW2

**Date of Sampling:** 06/12/2018

**Sample Type:** Ground

**Date Sample Received:** 06/12/2018

**Lab Reference Number:** 421376

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	06/12/2018	Clostridium perfringens	57	cfu/100ml	-
D/D1201#	06/12/2018	Coliforms	108900.0	MPN/100ml	-
D/D1201#	06/12/2018	E.coli	3.1	MPN/100ml	-
D/D3221#	06/12/2018	Faecal Coliforms	3	cfu/100ml	-
D/D1205	06/12/2018	Faecal Streptococci	28	cfu/100ml	-

# = INAB Accredited, U = UKAS Accredited, \* = Subcontracted

#### Note:

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**Report Reference:** 18-50240

**Report Version:** 1

**Site:** Clonee

**Sample Description:** MW3

**Date of Sampling:** 06/12/2018

**Sample Type:** Ground

**Date Sample Received:** 06/12/2018

**Lab Reference Number:** 421377

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	06/12/2018	Clostridium perfringens	5	cfu/100ml	-
D/D1201#	06/12/2018	Coliforms	111.2	MPN/100ml	-
D/D1201#	06/12/2018	E.coli	< 1.0	MPN/100ml	-
D/D3221#	06/12/2018	Faecal Coliforms	< 1	cfu/100ml	-
D/D1205	06/12/2018	Faecal Streptococci	10	cfu/100ml	-

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#### Note:

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**Report Reference:** 18-50240

**Report Version:** 1

**Site:** Clonee

**Sample Description:** MW4

**Date of Sampling:** 06/12/2018

**Sample Type:** Ground

**Date Sample Received:** 06/12/2018

**Lab Reference Number:** 421378

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	06/12/2018	Clostridium perfringens	< 1	cfu/100ml	-
D/D1201#	06/12/2018	Coliforms	228.2	MPN/100ml	-
D/D1201#	06/12/2018	E.coli	7.4	MPN/100ml	-
D/D3221#	06/12/2018	Faecal Coliforms	9	cfu/100ml	-
D/D1205	06/12/2018	Faecal Streptococci	3	cfu/100ml	-

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**Note:**

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**Report Reference:** 18-50240

**Report Version:** 1

**Site:** Clonee

**Sample Description:** MW5

**Date of Sampling:** 06/12/2018

**Sample Type:** Ground

**Date Sample Received:** 06/12/2018

**Lab Reference Number:** 421379

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	06/12/2018	Clostridium perfringens	21	cfu/100ml	-
D/D1201#	06/12/2018	Coliforms	28510.0	MPN/100ml	-
D/D1201#	06/12/2018	E.coli	10.3	MPN/100ml	-
D/D3221#	06/12/2018	Faecal Coliforms	8	cfu/100ml	-
D/D1205	06/12/2018	Faecal Streptococci	15	cfu/100ml	-

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**Report Reference:** 18-50240

**Report Version:** 1

**Site:** Clonee

**Sample Description:** MW6

**Date of Sampling:** 06/12/2018

**Sample Type:** Ground

**Date Sample Received:** 06/12/2018

**Lab Reference Number:** 421380

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	06/12/2018	Clostridium perfringens	14	cfu/100ml	-
D/D1201#	06/12/2018	Coliforms	27.2	MPN/100ml	-
D/D1201#	06/12/2018	E.coli	< 1.0	MPN/100ml	-
D/D3221#	06/12/2018	Faecal Coliforms	< 1	cfu/100ml	-
D/D1205	06/12/2018	Faecal Streptococci	4	cfu/100ml	-

# = INAB Accredited, U = UKAS Accredited, \* = Subcontracted

#### Note:

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For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.

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**Report Reference:** 18-50240

**Report Version:** 1

**Site:** Clonee

**Sample Description:** MW7

**Date of Sampling:** 06/12/2018

**Sample Type:** Ground

**Date Sample Received:** 06/12/2018

**Lab Reference Number:** 421381

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	06/12/2018	Clostridium perfringens	3	cfu/100ml	-
D/D1201#	06/12/2018	Coliforms	173290.0	MPN/100ml	-
D/D1201#	06/12/2018	E.coli	< 1.0	MPN/100ml	-
D/D3221#	06/12/2018	Faecal Coliforms	< 1	cfu/100ml	-
D/D1205	06/12/2018	Faecal Streptococci	9	cfu/100ml	-

# = INAB Accredited, U = UKAS Accredited, \* = Subcontracted

#### Note:

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.

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**Report Reference:** 18-50240

**Report Version:** 1

**Site:** Clonee

**Sample Description:** MW9

**Date of Sampling:** 06/12/2018

**Sample Type:** Ground

**Date Sample Received:** 06/12/2018

**Lab Reference Number:** 421383

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	06/12/2018	Clostridium perfringens	< 1	cfu/100ml	-
D/D1201#	06/12/2018	Coliforms	9.5	MPN/100ml	-
D/D1201#	06/12/2018	E.coli	< 1.0	MPN/100ml	-
D/D3221#	06/12/2018	Faecal Coliforms	< 1	cfu/100ml	-
D/D1205	06/12/2018	Faecal Streptococci	2	cfu/100ml	-

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#### Note:

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For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.

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**Report Reference:** 18-50240

**Report Version:** 1

**Site:** Clonee

**Sample Description:** MW10

**Date of Sampling:** 06/12/2018

**Sample Type:** Ground

**Date Sample Received:** 06/12/2018

**Lab Reference Number:** 421384

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1214#	06/12/2018	Clostridium perfringens	< 1	cfu/100ml	-
D/D1201#	06/12/2018	Coliforms	2.0	MPN/100ml	-
D/D1201#	06/12/2018	E.coli	< 1.0	MPN/100ml	-
D/D3221#	06/12/2018	Faecal Coliforms	< 1	cfu/100ml	-
D/D1205	06/12/2018	Faecal Streptococci	< 1	cfu/100ml	-

# = INAB Accredited, U = UKAS Accredited, \* = Subcontracted

#### Note:

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.

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