PLR SERVICES
12, MORAWEL,WINCH WEN,
SWANSEA, SA1 7LN.
TEL/FAX: 01792 775404, MOBILE: 07703 470326
E-MAIL: phil@plrservices.co.uk

Ref: EA/LAN/1/2/18 Date: 12/07/18

Natural Resources Wales,
Maes Newydd,
Llandarcy,
Neath Port Talbot,
SA10 6JQ.

Fao: A. Cooper, Environment Officer.

Dear Sir,

Re: Environmental Monitoring Report, Stormy West Landfill Site, Pyle (EAWML 34009).

Please find enclosed a copy of the water quality report of the environmental data collected during 2017 for the above site. This report outlines the potential impact upon the surrounding hydrogeological and hydrological water courses.

The requirement for this type of report had previously been requested under previous site operators and more latterly it has become a requirement for an annual report to be submitted to comply with the Environmental Permit now held by Landcare (Manchester) Limited.

Landcare has commissioned PLR Services to prepare and submit an factual/interpretive report taking due account of historical information about the site and the annual water quality analyses obtained from the various monitoring/sampling points within the landfill site and its surrounding environs.

If you are not the most appropriate recipient of this report, it would be very much appreciated if you could therefore forward this to the person/department and in turn inform myself for future reference.

The format of the report has been based upon that presented within previously submitted to your office and of which no adverse comment has been received to date.

I trust this meets with your requirements but please do not hesitate to contact me if you require further information.

Yours sincerely,

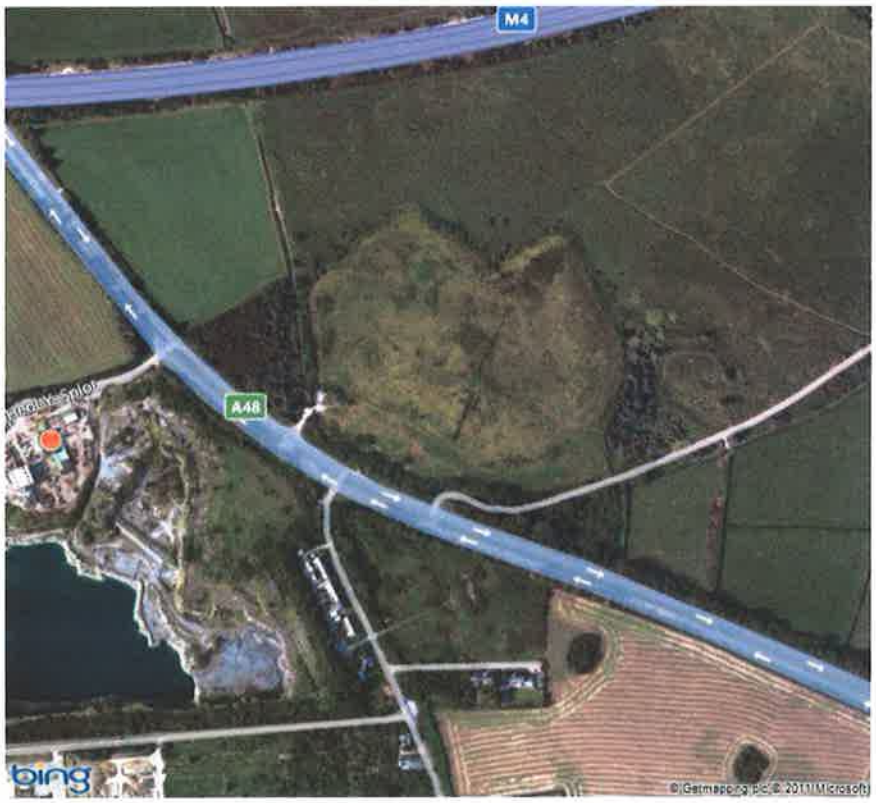
Philip Rees

P.L.Rees, CSci, C.Chem., MRSC, RSP, CMIOSH, CEnv., MCIWM.
enc. Report for 2017.
cc. Landcare, Thornton Cleveleys Office

LANDCARE (MANCHESTER) LIMITED
STORMY WEST LANDFILL SITE, PYLE

Environmental Permit – EAWML34009

ENVIRONMENTAL MONITORING OF WATER QUALITY FOR 2017



MAY 2018

CONTRACT - LAN/SW/2/18

PLR SERVICES

07703 470326

Report Type:		ENVIRONMENTAL	
Report Issue:		FACTUAL/INTERPRETIVE	
Contract:		LAN/SW/2/18	
Reference:		CLOSED LANDFILL SITE	
Action point:			
	Name	***Signature***	***Date***
Originator:	P REES	P. Rees	MAY 2018
Title:	CONSULTANT		
Checked & Approved:	M. BREWSTER		JULY 2018
Title:	ENVIRONMENTAL MONITORING TECHNICIAN	M.Brewster	

The interpretation referenced within this report is in part based upon information, knowledge and results made available from externally supplied sources at the time of the report issue. Full reliance is placed upon the accuracy of such and thus any responsibility for incorrect information supplied from these sources cannot be accepted.

TABLE OF CONTENTS

1. SUMMARY

This report has been prepared to present the environmental monitoring information compiled for the 2017 monitoring period. The site monitoring data is presented compared to appropriate standards for the assessment of water quality and in addition to the data compiled and reported upon in previous monitoring periods.

Therefore this report continues to follow the same format as that presented for previous annual reports and the presentation of data therein and includes:

a. information upon the site,
b. the data compiled,
c. tables of results,
d. comparisons versus respective standards/guidelines issued via EC Directives and UK guidance.

Thus the results obtained and comparisons made continue to indicate that there is currently a low probability that the Stormy West landfill site is or will cause any significant environmental impact due to any emissions and/or discharges.

On comparison with current guidance issued for the assessment of contaminated land e.g. landfill sites, no direct targets/receptors are known to be within the immediate area of this site with no additional/direct development in the vicinity since the previous report.

At the time of the preparation of this report it was not believed that any further external hydreogeological/hydrological assessments have been performed within the immediate vicinity of the landfill site since the last report. Notwithstanding this and reported previously it is understood that some work has been done upon the potential impact of the deepening of quarrying activities within the Cornelly area. However no further information has been made available and thus reliance must be placed upon the operating Company and the Regulators to raise any concerns therein (Ref.1).

The results for the surface water sources e.g. Pyle stream/spring and Kenfig pool are not indicative of a deteriation in water quality.

In addition and it is worthy of note and of which may be further observed there had been a slight variation within the analytical results and limits due to a new test laboratory being assigned for the site analytical needs from December 2016.

2. INTRODUCTION

At the request of the management of Landcare (Manchester) Limited, in response to the annual requirement of Natural Resources Wales (NRW), incorporated within the Environmental Permit, this report was prepared by PLR Services. This report was to offer an interpretation of the potential impact the Stormy West landfill site may have upon the hydrology and hydreogeology of the surrounding area.

Thus the monitoring data is presented as a summary of water quality in and around the site boundary, due to it being previously operated as a waste disposal facility and of which has now been restored and is still within the aftercare period.

The analytical results have been reported versus criteria and guidance issued within Waste Management Papers (these being the guidance available at that time the site was being operated and needed to be in compliance), EC directives/publications and UK guidance.

For groundwater the 1998 EC Directive on the Quality of Water Intended for Human Consumption (98/83/EC) which has implemented in England by the Water Supply (Water Quality) Regulations 2000 and in Wales by the Water Supply (Water Quality) Regulations 2001 (Ref.12).

Thus for this monitoring period water quality has been compared with that specified within the schedules of the above drinking water regulations.

The assigned limits for surface water and leachate monitoring results remain in conjunction with that used for previous monitoring periods.

The data collected during the 2017 monitoring period has been reproduced within tables within the appendices.

3. BACKGROUND INFORMATION

The Stormy West Landfill Site had been operated under the principle of dilute and disperse which has allowed the products of the biodegradation of the waste materials to be potentially neutralised by the assimilative capacity of the natural strata and hydreogeological pathways present within and beneath the site.

The site, prior to being landfilled, had been a disused limestone quarry (see Appendix A) and of which has been refilled with household, industrial, commercial and some Special (at that time) Wastes as per the Planning Permission (Ref.2) and Waste Disposal Licence No. 5 (previously the WML) now an Environmental Permit (Ref.3) issued by the then Regulatory Authority, Ogwr Borough Council.

These waste types were disposed of/landfilled between 1985 and 1996 (after which the site closed) and during this period approximately one million cubic metres of void space was landfilled.

Over the life of the site a number of reports had been presented relating to the co-disposal activities and assessments of the impact upon groundwater quality (Ref. 4).

During the early part of the nineties appreciable concentrations of landfill gas were emitted resulting in active gas extraction utilizing active gaswells with extraction and management via a high temperature burner/flare.
In addition, and complimenting this, landfill gas was used for a few years at the mid to back end of the nineties to support combustion within a lime kiln utilisation scheme. Unfortunately this was needed to be stopped due to the problems experienced with the kiln end user and thus the site reverted back to flaring and of which continues to present day.

As the site has now been fully restored, via capping with low permeability clay, with the approval of the planning section of the local authority (Bridgend County Borough Council), ingress of precipitation will be significantly reduced and thus the potential for any adverse environmental impact should be minimal.

During the latter part of 2016 the site was further developed by a sub-contracted Company to install a Solar Panel Electricity Generation System approved by the local Planning Authority in consultation with Natural Resources Wales (NRW).

4. LEGISLATIVE OVERVIEW

The principle environmental legislation governing the operation and any subsequent environmental impact of facilities is that of the Environmental Protection Act 1990 (Ref.5) and regulations issued under it e.g. the Environmental Permit (EP).
In addition publications such as the NRW (ex. EA) guidance documents and previous DOE Waste Management Papers (WMP) as appropriate have been referenced to indicate practices at that time and the minimum monitoring requirements. Related documents also include European Union Directives (see references section). It is worthy of note that this site, due to the date of closure, does not fall under the Landfill Regulations (Ref.6)
As indicated above The 1998 EC Directive on the Quality of Water Intended for Human Consumption (98/83/EC) which has been implemented in England by the Water Supply (Water Quality) Regulations 2000 and in Wales by the Water Supply (Water Quality) Regulations 2001 have been used to for the test results comparison purposes.

5. GENERAL DESCRIPTION OF THE SITE

As indicated earlier it is not known whether any additional surveys have been performed since the report prepared from the 2017 data. Thus the general reference to hydrogeological surveys and groundwater studies (Ref.4) in this area, with regard the landfill operations at that time, indicated that the predominant groundwater flow direction in the vicinity of the Stormy West site is north westwards, or westwards (see figure 1), although there was limited information which has suggested the flow could be reversed under certain circumstances.

This report also suggests that the probable discharge is believed to be the Bristol Channel, with flows passing at depth beneath Kenfig Pool and thus this is the reasoning behind monitoring at this location and a further monitoring point is located at the nearby Pyle Spring surface water sources (see Appendix B).

In addition, from information obtained from within the above report suggests that there is significant attenuation of leachate coupled with a high dilution probability of 500 fold within 400 metres and 1000 fold within 500 metres of the site thus implying limited, if any, impact upon the surrounding water environment.

At the time of the preparation of this report it is understood that there isn't any additional information known to defend or contradict this assessment.

6. MONITORING and SAMPLING DATA

In line with the requirements of NRW the data received from various monitoring points in and around the site generally comply with the guidance documents indicated earlier e.g. DOE WMP No.4 (Ref.7) and any additional determinands requested by NRW (Environment Agency, EA) and the previous regulators i.e. Ogwr Borough Council and/or the National Rivers Authority.

It is worthy of note that the testing protocol has been based, as with previous annual reports, upon the requirements within the then Waste Management Papers (WMP) and the results obtained for these determinands compared with the respective levels/limits published within the reference directives with the groundwater limits being referenced versus the Water Supply/Quality Standards, WQS (Ref.12) and not the EC directive per se as presented within previous annual reports.

The locations of the monitoring/sampling points used routinely to obtain samples are presented in Appendix C.

Thus the historical sampling and testing protocol as previously agreed and maintained by NRW (EA) may be presented below.

Table 1 **Determinands tested for water quality**

Acidity/alkalinity	pH	Conductivity	Cond.
Biological Oxygen Demand	BOD	Oxygen	O2
Chemical Oxygen Demand	COD	Total Organic Carbon	TOC
Ammoniacal Nitrogen	NH4	Total Organic Nitrogen	TON
Nitrate	NO3	Nitrite	NO2
Alkalinity	Alk	Chloride	Cl
Sulphate	SO4	Phosphate	PO4
Sodium	Na	Potassium	K
Copper	Cu	Magnesium	Mg
Calcium	Ca	Zinc	Zn
Cadmium	Cd	Lead	Pb
Chromium	Cr	Manganese	Mn
Iron	Fe	Nickel	Ni
Total Volatile Fatty Acids	VFA		

The frequency of analyses/testing protocol for the determinands continues as:
Leachate – monthly (partial analysis) and quarterly for full analysis at one location,
Groundwater – Quarterly analysis at three locations,
Surface water – Quarterly analysis at the Pyle location,
Surface water - Bi-annual analysis at the Kenfig Pool location.

6.1 Leachate samples

There is one leachate monitoring chamber present within the site with its location indicated upon the site plan (attached) although this point from experience has tended to be mostly dry due to dispersal/attenuation. Thus due to this an alternative sampling point has been approved and used in order to obtain a more representative sample of fluid/leachate at the base of the site i.e. gas well B5. Worthy of note is that on dipping this well the level of fluid present has remained relatively constant.

The analytical results are presented in Appendix D and on review of this data it may be observed that elevated results were recorded when compared with the Landfill Completion Criteria presented within WMP No: 26A (Ref.8 and presented within Appendix E).

Throughout the monitoring period (i.e. 2017) elevated results were again obtained for a limited number of determinands when compared to the overall suite of analyses performed. These results may also be compared to those obtained for the year 2016 and from previous years as indicated upon the tabulated results found within the appendices to this report and thus any trends may be determined as indicated below.

Table 2	Leachate results				
Determinand.	**Spec. limits**	**2017**	**2016**	**2015**	**2014**
Conductivity	LT 4000	6799	7322	7012	6967
Ammonia (as N)	LT 5	380	220	316	510
Chloride	LT 2000	653	810	562	717
COD	No specified limit	367	696	557	777
TOC	LT 10	234	151	45	237
Iron	LT 2	1	2	1	1
Potassium	LT 120	190	199	193	221

All results in PPM (mg/litre) except Conductivity (uS/cm) – (LT – Less Than)

A summation of the above information can be concluded by reference to a survey (Ref.9) published by the Environment Agency which had indicated that the three most frequently identified contaminants for a landfill leachate have been detailed as Ammonia, Chloride and Chemical Oxygen Demand (COD).

From the table of results it can be seen that this is indeed the case, although the chloride results fall well below the specified limit, on comparison to the relative standards used for assessment of water quality (see Appendix F).

It may be observed from the above that the results are in general similar to that determined for 2016 and in general appear lower than those observed from annual reports prior to this and as shown upon the table of results for Leachate within the appendices. Therefore it may be deduced that in general there is still a trend of an improvement in leachate quality over that indicated for the preceding year's reports. Nevertheless it is worthy of note that of these it may also be observed that a small number of outlying results are evident upon the tabulated result sheet as presented and may be observed within the appendices.

Previous annual reports had suggested that the possible reason for a reduction year on year may be attributed and explained as:

- the reduction in infiltration through the cap thus not allowing leaching of the residual waste still present,
- the residual waste moving toward the latter stages of waste bio-degradation of the landfill processes (Ref.8) (also evident in the lower concentrations of landfill gas being liberated/emitted).

6.2 Surface water

Two surface water monitoring/sampling points have been identified around the site.

Both these locations have been referred to within Section 3 and are: -

- Kenfig pool — an expanse of still water lying to the west of the landfill site with significant amenity usage.
- Pyle Spring — a small stream which lies north westerly, skirting the edge of the Pyle industrial/factory estate location down strata of the site.

(It is worthy of note that this water source could also be affected by industrial operations being performed upon this estate).

Results obtained from both these sources are generally in compliance with monitoring results determined from previous monitoring periods and within specified limits when compared to the guidance issued within the EC Directive for surface water (Ref.10).

6.3 Groundwater

There are three groundwater (g/w) monitoring/sampling points located around the site. The locations of these have been referred to within Section 3, and can be observed in Appendix C.

These are: -

- A48 — a borehole located adjacent to the **A48** dual carriageway and which lies to the south of the site, and bordering fields used for agriculture.
- GW2 — a borehole (b/h2) located within the site **car park** area and lies to the south west of the edge of the original quarry workings, but outside of the landfilled area.
- GW3 — a borehole (b/h3) located near the **site entrance** at the outer extremity of the overall site area but further south than GW2, which again lies south west of the original filled area.

In general on review of the results it may be observed that for some determinands elevated levels are present within all three boreholes/monitoring points by comparison with the guidance issued within the WQS (Ref.12) employed for this report (previously the EC Directive for groundwater was used, Ref. 11).

However for comparative purposes only those determinands used for previous reporting requirements have still been highlighted albeit they may not necessarily exceed the specified limits now assigned.

As reported previously it is also evident that in general the water rest levels in each borehole appear to be lower than observed in previous monitoring periods and as such any determinands could be more concentrated in that they are not being recharged and/or diluted as those results obtained in previous years. There was no change in the average leachate level for 2017 period.

This table presents the depth of the groundwater within the monitoring boreholes at the time of sampling and the indicative leachate level within the gas well.

Table 3 **Water Rest Levels**

Date.	A48 (AOD)	B/H 2 (AOD)	B/H3 (AOD)	Gas Well B5 (Leachate) (AOD)
27/03/17	11.2 (89.0)	12.5 (88.9)	15.2 (85.4)	14.3 (93.7)
19/06/17	21.2 (79.0)	17.5 (83.9)	25.0 (75.6)	14.7 (93.3)
25/09/17	22.0 (78.2)	15.6 (85.8)	21.6 (79.0)	14.6 (93.4)
04/12/17	10.0 (90.2)	15.0 (86.4)	17.5 (83.1)	15.0 (93.0)
Mean 2017	16.1 (84.1)	15.2 (86.2)	19.8 (80.8)	14.6 (93.4)
Mean 2016	15.4 (84.8)	14.4 (87.0)	18.2 (82.4)	14.6 (93.4)
Mean 2015	14.1 (86.1)	12.8 (88.6)	13.7 (86.9)	14.7 (93.3)
Mean 2014	15.4 (84.8)	15.1 (86.3)	18.8 (81.8)	14.5 (93.5)
Mean 2013	18.6 (81.6)	14.7 (86.7)	17.4 (83.2)	14.8 (93.2)
AOD level	**100.2**	**101.4**	**100.6**	**108**

The following table presents the average water quality results: -

Table 4 **Groundwater levels**

Determinand.	Spec. limits	A48	GW2	GW3
The determinands indicated below are those of which in this and/or previous monitoring reports have exceeded the specified limits assigned at that time:				
Ammon. Nit.	0.5	23#	0.4	0.3
Nitrite	0.5	0.04	0.1	0.1
Potassium	12	25#	4	5
Manganese	0.05	2.0	<0.05	<0.05
Iron	0.2	0.82#	<0.2	<0.2
Calcium	250	<250	<250	<250

* Indicates that only one result exceeds the specified limit for that monitoring period

includes a result which does not follow that expected/outlying (see table of results)

All results in PPM (mg/litre) except Conductivity (uS/cm) – Exceeds 2016 results.

Summation- from the table of results it may be observed that again there are only a very limited number of determinand results exceeding the specified limits assigned. Excepting the above highlighted results the water quality may also be generally observed to show a slight improvement albeit with identifiable outlying results over the comparable results obtained over that of 2016 and in more recent years (see reports & appendices).

It may also be observed upon the tables of results there have been a few spurious (outlying #) results obtained which are elevated but do not show a trend and indeed have returned to that expected, based on previous years experience, during the monitoring period.

Nevertheless as experienced previously, elevated results exist on comparison to the respective groundwater levels, perhaps indicative and possibly support the premise of potential seasonal variation and/or borehole contamination. This is more so apparent within the A48 groundwater whereupon elevated results were determined during the period June to September corresponding to reduced levels within the borehole and thus allowing concentration effects.

The results of the remaining determinands are below specified limits and these may be observed upon the table of results within the appendices.

7. RECOMMENDATIONS

The results obtained for the year 2017 should again be compared to that compiled for the last few years which are displayed upon the tables of results and as presented within previous annual reports.

These will again be further compared for those results to be obtained for the 2018 monitoring period and beyond when these become available and thus any trends identified.

8. CONCLUSION/ASSESSMENT

- No significant concentrations of toxic and/or phytotoxic determinands have been identified within the samples. Results do not exhibit any significant divergence in groundwater quality from that presented within the 2016 and previous reports for those more mobile and soluble determinands.
- The overall leachate concentration does not exhibit any significant divergence from the Completion Criteria as presented within WMP 26A. Notwithstanding this, it is evident that there is some reduction of the concentrations of a significant number of leachate determinands as reported upon/indicated upon the table of results.
- Under current legislative guidance for the assessment of contaminated sites, e.g. landfill sites, no direct targets/receptors are known to exist within the immediate vicinity of the site.
- As the landfill site has been restored and covered with an engineered cap, of low permeable materials, further water ingress should continue to be significantly reduced and thus the potential for leachate minimised. In addition it may be observed that the leachate rest level has again remained constant thus supporting low ingress through the cap.
- From the results presented within the appendices it may be observed that in general the results are indicating an improvement in quality from those obtained in previous reports/years.
- Notwithstanding this some seasonal variance may still be observed upon the table of results

and possibly linked to the groundwater levels when the samples are taken/analysed.

- Any spurious/outlying results highlighted may have also caused elevated results which can skew the overall observation indicating improvement however these will continue to be monitored as per the monthly/quarterly sampling and testing protocols.
- Thus future monitoring will allow a continuation to compile and compare monitoring results with completion criteria, water quality standards and previous annual monitoring results and to highlight any key variation observed.
- To question results that on reflection do not follow typical trends and to arrange re-testing and/or re-sampling based upon the frequency of the testing schedule wherever this is possible and where significant and prudent to do so.
- To review the results for 2018 due to the installation of the solar panels across the site which could further reduce any infiltration of precipitation etc. through the cap and affecting the level of determinands being assessed.

Summation- On review of the results obtained to date it may be deduced that the site does not exhibit any significant environmental impact upon the water quality in and around the site. Indeed on comparison with the results presented from the late nineties to date, where applicable, water quality has generally remained relatively unchanged although the monitoring performed for 2017 does not immediately indicate any significant improvement from the 2016 results.

Nevertheless monitoring of water quality is to continue as that performed in previous years and again a comparison made to those results obtained for the 2018 monitoring period.

9. REFERENCES

1. Environmental Impact Assessment – Cornelly Quarry – NTS 5440
2. Planning Permission 92/0174
3. Environmental Permit SW/WML 34009 (previously Waste Disposal Licence No.5)
4. Assessment of Groundwater Quality, WRC Report No. CO 2081-m/1 (6/89)
5. Environmental Protection Act 1990
6. Landfill Regulations 2002
7. DOE - Licensing of Waste Management Facilities, WMP 4
8. DOE – Landfill Completion, WMP 26A
9. Groundwater Pollution, EA (1997)
10. EC Directive, EC 75/440/EEC (1975)
11. EC Directive, EC 80/778/EEC (1980)
12. The Water Supply (Water Quality) Regulations 2000 (SI2000 No. 3184) and
    The Water Supply (Water Quality) Regulations 2001 (WSI2001 No. 3911 (W.323))

APPENDICES

Appendix A - Site Location Plan

Appendix B - Site Area Map

Appendix C - Monitoring/Sampling Points

Appendix D - Sampling Point Analytical Results

Appendix E - Example Completion Criteria for Leachates

Appendix F - Standards Used for Assessment of Water Quality

APPENDIX A

SITE LOCATION PLAN

A - SITE LOCATION PLAN

APPENDIX B

SITE AREA MAP

KEY

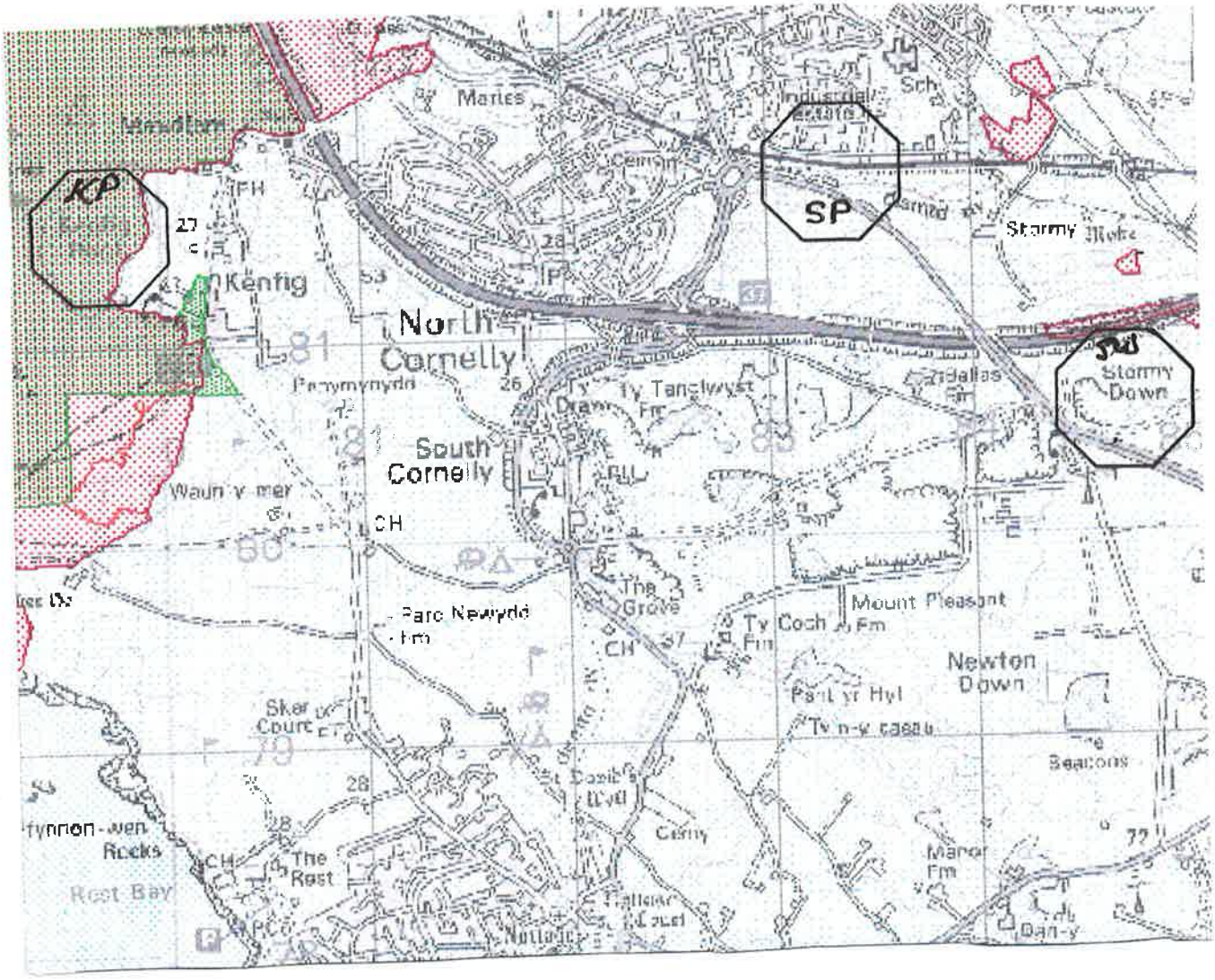
KP - indicates location of Kenfig Pool

SP – indicates location of Spring water at Pyle industrial estate

SW – indicates location of the Stormy West landfill site

APPENDIX B

SITE AREA MAP



KEY

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APPENDIX C

MONITORING/SAMPLING POINTS

Points
and Sampling
C - Monitoring

APPENDIX D

SAMPLING POINT ANALYTICAL RESULTS

Water Analysis 2017 **Stormy West Landfill Site - Stormy Down**

Borehole No. A48

	Sampling Date	WQS	27.03.2017	19.06.2017	25.09.2017	04.12.17	2017 Mean	2016 Mean	2015 Mean	2014 Mean	2013 Mean
Units	Determinands										
pH Units	pH	**6.5 to 10**	7.2	7.4	7.2	7.1	7.2	7.0	6.9	7.0	7.3
uS/cm	Conductivity @ 20c	**2500**	1000	1500	1600	1100	1300	1173	1417	1089	1195
mg/l O	Oxygen (Dissolved)		9	4	6	7	6.5	6.3	5.1	2.1	1.8
mg/l	Total Organic Carbon		2.3	8	19	2	7.8	5.0	0.4	8.5	6.0
mg/l O	COD (Total)		14	27	47	15	25.8	24.0	16.3	17.5	nr
mg/l N	Nitrogen Ammoniacal	**0.5**	0.015	**38**	**54.0**	0.02	**23.0**	**17.2**	**12.1**	**9.1**	**17.5**
mg/l N	Total Oxidised Nitrogen		2.1	2	1	4	2.3	1.0	0.0	1.9	4.3
mg/l N	Nitrate	**50**	2	2	1	4	2.4	<1	<1	5	4
mg/l N	Nitrite	**0.5**	0.1	0.02	0.06	0.01	0.04	0.01	**12.3**	**2.8**	<0.025
mg/l CaCO3	Alkalinity total		450	680	830	440	600	514	460	481	471
mg/l	Chloride	**250**	90	96	99	110	99	76	107	86	106
mg/l O	BOD total+ATU		<1	7	5	1	3.3	4.5	4.5	1.8	nr
mg/l	Sulphate	**250**	120	92	110	137	115	91	111	102	118
mg/l	Sodium	**200**	53	68	110	58	72	50	67	37	64
mg/l	Potassium	**12**	5	**34**	**52**	7	**25**	**15**	**13**	11	**15**
mg/l	Copper	**2**	0.005	0.004	0.002	0.002	0.003	<2	<2	1	<0.009
mg/l	Magnesium	**50**	11	20	24	11	17	15	15	13	13
mg/l	Calcium	**250**	150	130	160	160	150	**296**	166	156	166
mg/l	Zinc	**5**	0.01	0.01	0.01	0.01	0.009	0.005	0.003	4	<0.018
mg/l	Cadmium	**0.005**	0.0001	0.0001	0.00002	0.00004	0.0001	<0.005	<0.005	<1	<0.0006
mg/l	Lead	**0.025**	0.0008	<0.0002	<0.0002	0.0008	0.0004	0.0002	<0.025	nr	<0.006
mg/l	Chromium	**0.05**	0.01	0.001	0.001	0.001	0.003	0.0004	0.002	1	<0.002
mg/l	Manganese	**0.05**	0.003	**4.7**	**3.40**	0.004	**2.03**	**6.70**	**0.50**	nr	**1.31**
mg/l	Iron	**0.2**	0.01	**1.3**	**1.9**	0.06	**0.82**	0.01	0.07	**0.7**	**1.4**
mg/l	Nickel	**0.02**	<0.0005	**0.04**	**0.03**	0.001	0.02	0.01	0.004	nr	0.01
mg/l	Volatile fatty acids		<10	<10	<10	<10	<10	<81	<81	<81	<20
mg/l	Phosphate		0.13	0.2	0.13	<0.062	0.1	1.7	0.0	0.5	<1.2
Metres	Depth - BH AOD 100.2		11.2	21.2	22	10	16.1	15.4	14.1	15.4	18.6

MEAN Average result based upon actual figures (not using < results)

WQS Water Quality Standard based upon Water Supply (Water Quality) Regulations

Spurious results not following the norm/expected result compared with others of the same period and previous results

nr - no result

12/2016 - change of test laboratory

Water Analysis 2017 **Stormy West Landfill Site - Stormy Down**

Borehole No.2 (GW2) - Car park

	Sampling Date	WQS	27.03.2017	19.06.2017	25.09.2017	04.12.2017	2017 Mean	2016 Mean	2015 Mean	2014 Mean	2013 Mean
Units	Determinands										
	pH	**6.5 to10.0**	7.5	7.6	8.1	7.4	7.7	7.3	7.1	7.1	7.5
uS/cm	Conductivity @ 20c	**2500**	420	710	480	550	540	605	604	649	607
mg/l O	Oxygen (Dissolved)		9	6	8	8	7.8	7.5	6.4	5.8	4.8
mg/l	Total Organic Carbon		6	2	5	2	4	1.3	0.5	0.8	2.8
mg/l O	COD (Total)		77	77	9	39	51	nr	nr	nr	nr
mg/l N	Nitrogen Ammoniacal	**0.5**	<0.0015	**1.5**	0.06	0.022	0.4	**0.6**	**1.2**	0.1	**1.1**
mg/l N	Total Oxidised Nitrogen		1	3	1	1.4	1.6	1.8	0.2	1.7	1.1
mg/l N	Nitrate	**50**	0.9	2	1	1.3	1.3	4	4.0	5.8	1.1
mg/l N	Nitrite	**0.5**	0.04	0.26	0.03	0.02	0.1	**3.3**	**0.8**	**1.6**	<0.025
mg/l CaCO3	Alkalinity total		160	210	240	270	220	297	280	352	336
mg/l	Chloride	**250**	25	34	14	24	24	25	26	22	18
mg/l O	BOD total+ATU		<1	5	<1	2	1.8	1.3	5.8	nr	nr
mg/l	Sulphate	**250**	17	50	27	38	33	25	22	31	20
mg/l	Sodium	**200**	14	23	16	15	17	17	17	13	12
mg/l	Potassium	**12**	2	6	5	4	4	5	5	4	4
mg/l	Copper	**2**	0.007	0.0029	0.04	0.0030	0.01	<0.009	<0.009	<0.009	<0.009
mg/l	Magnesium	**50**	5	10	8	8	8	8	9	8	8
mg/l	Calcium	**250**	59	59	78	120	79	107	113	111	121
mg/l	Zinc	**5**	0.005	0.011	0.003	0.006	0.006	0.001	0.004	2	<0.018
mg/l	Cadmium	**0.005**	0.00002	0.00011	0.00003	0.0001	0.0001	<0.00007	<0.00007	<1	<0.0006
mg/l	Lead	**0.025**	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	0.001	nr	<0.006
mg/l	Chromium	**0.05**	0.0016	0.002	0.0001	0.0001	0.001	0.001	0.003	**4.25**	<0.002
mg/l	Manganese	**0.05**	0.0016	0.0007	0.0001	0.005	0.002	0.002	0.04	nr	**0.06**
mg/l	Iron	**0.2**	<0.004	0.004	<0.004	**0.32**	0.1	**2.0**	0.1	**0.5**	<0.2
mg/l	Nickel	**0.02**	0.001	0.002	<0.0005	<0.0005	0.001	0.001	0.001	nr	<0.02
mg/l	Volatile fatty acids		<10	<10	<10	<10	<10	<81	<81	<81	<20
mg/l	Phosphate		0.032	0.13	<0.002	0.078	0.06	0.60	0.00	0.04	<0.1
Metres	Depth - BH AOD 101.4		12.5	17.5	15.6	15	15.2	14.4	12.8	15.1	14.7

MEAN Average result based upon actual figures (not using < results) Bold indicates WQS exceeded nr - no result

WQS Water Quality Standard based upon Water Supply (Water Quality) Regulations 12/16 - Change of test laboratory

Spurious results not following the norm/expected result compared with others of the same period and previous results

Water Analysis 2017 **Stormy West Landfill Site - Stormy Down**

Borehole No.3 (GW3) - Entrance

	Sampling Date	WQS	27.03.2017	19.06.2017	25.09.2017	04.12.2017	2017 Mean	2016 Mean	2015 Mean	2014 Mean	2013 Mean
Units	Determinands										
pH Units	pH	**6.5 to10.0**	7.2	7.3	8	7.2	7.4	7.0	6.9	6.7	7.3
uS/cm	Conductivity @ 20c	**2500**	740	990	830	830	848	944	939	861	764
mg/l O	Oxygen (Dissolved)		8	5	8	8	7.3	6.5	6.5	5.0	2.8
mg/l	Total Organic Carbon		5	5	2	3	4	2	0	5	2
mg/l O	COD (Total)		11	9	6	14	10	16.5	14	11.5	nr
mg/l N	Nitrogen Ammoniacal	**0.5**	0.02	**0.97**	0.2	<0.015	0.3	**0.9**	0.4	**0.6**	**0.8**
mg/l N	Total Oxidised Nitrogen		2	4	4.0	5.0	3.8	3.2	0.2	0.9	1.3
mg/l N	Nitrate	**50**	2	4	4	3	3	14	2	4	1.3
mg/l N	Nitrite	**0.5**	0.01	0.14	0.03	0.02	0.1	0.4	**4.3**	**0.7**	<0.025
mg/l CaCO3	Alkalinity total		250	400	480	450	395	442	427	451	407
mg/l	Chloride	**250**	52	58	45	30	46	45	44	30	21
mg/l O	BOD total+ATU		<1	4	<1	<1	<2	<2	<2	<2	nr
mg/l	Sulphate	**250**	63	74	50	84	130	119	138	121	120
mg/l	Sodium	**200**	29	35	32	18	29	27	34	31	13
mg/l	Potassium	**12**	4	6	6	5	5	6	5	5	4
mg/l	Copper	**2**	0.002	0.002	0.003	0.002	0.002	0.003	0.3	1	<0.009
mg/l	Magnesium	**50**	10	13	11	11	11	12	13	12	10
mg/l	Calcium	**250**	100	160	140	190	148	171	179	155	145
mg/l	Zinc	**5**	0.008	0.0032	0.01	0.009	0.007	0.003	0.002	<5	<0.02
mg/l	Cadmium	**0.005**	0.00001	0.00001	0.011	0.00008	0.003	0.0011	<1	<1	<0.0006
mg/l	Lead	**0.025**	0.002	<0.0002	0.007	<0.0002	<0.002	<0.025	<0.025	nr	<0.006
mg/l	Chromium	**0.05**	0.007	0.001	0.001	0.001	0.01	<0.05	<0.05	<1	<0.002
mg/l	Manganese	**0.05**	0.007	0.001	0.031	0.0003	0.01	**0.14**	**0.24**	nr	**0.34**
mg/l	Iron	**0.2**	<0.004	0.014	0.1	**0.28**	0.10	**4.01**	0.01	**0.7**	**0.3**
mg/l	Nickel	**0.02**	0.001	0.002	0.001	0.005	0.002	0.009	0.002	nr	0.003
mg/l	Volatile fatty acids		<10	<10	<50	<10	<50	<81	<81	<81	<20
mg/l	Phosphate		0.18	0.14	<0.02	<0.062	0.08	<0.05	<0.05	<0.05	<1.2
Metres	Depth - BH AOD 100.6		15.2	25	21.6	17.5	19.8	18.2	13.7	18.8	17.4

MEAN Average result based upon actual figures (not using < results) Bold indicates WQS exceeded nr - no result

WQS Water Quality Standard based upon Water Supply (Water Quality) Regulations 12/16 - Change of test laboratory

Spurious results not following the norm/expected result compared with others of the same period and previous results

Water Analysis 2017
Surface Water - Pyle

Stormy West Landfill Site - Stormy Down

	Sampling Date	WQS	27.03.2017	19.06.2017	25.09.2017	04.12.2017	Mean 2017	Mean 2016	Mean 2015	Mean 2014	Mean 2013
Units	Determinands										
pH Units	pH	5.5 to 9 g	7.9	8.2	8.4	8	8.1	7.8	7.7	7.8	8.3
uS/cm	Conductivity @ 20c	1000 g	510	530	460	530	508	586	510	530	488
mg/l O	Oxygen (Dissolved)		10	8	8	10	9	7	7	9	4.8
mg/l	Total Organic Carbon		3	3	6	3	4	3	nr	nr	nr
mg/l O	COD (Total)	30 g	9	7	10	5	8	11	9	15	7
mg/l N	Nitrogen Ammoniacal	4	0.016	0.011	0.059	0.21	0.07	0.17	0.45	<0.27	<0.27
mg/l N	Total Oxidised Nitrogen		3	<0.3	2	2	1.8	1.3	1	nr	nr
mg/l N	Nitrate		3	0.02	2	2	2	12	6.5	10.3	2.2
mg/l N	Nitrite		0.051	0.041	0.014	0.022	0.032	0.008	4.250	5.375	0.04
mg/l CaCO3	Alkalinity total		210	270	230	250	240	235	216	261	241
mg/l	Chloride	200 g	30	29	24	31	29	27	26	28	24
mg/l O	BOD total+ATU		1	4	<1	1.4	1.6	1	3.25	0	nr
mg/l	Sulphate	250	17	16	16	15.6	16	15	16	21	16
mg/l	Sodium		18	16	19	17	18	17	17	204	12
mg/l	Potassium		3	4	5	3	4	4	4	3	4
mg/l	Copper	1 g	0.004	0.0054	0.005	0.004	0.005	0.001	0.002	0.3	nr
mg/l	Magnesium		10	11	8	9	10	10	9	10	9
mg/l	Calcium		74	82	75	100	83	89	83	82	89
mg/l	Zinc	5	0.004	0.011	0.004	0.004	0.01	5	0	1	nr
mg/l	Cadmium	0.005	<0.00007	0.00004	<0.00002	<0.00002	0.00001	0.0000075	0	0	nr
mg/l	Lead	0.05	0.0003	0.009	0.00500	<0.0002	<0.05	<0.05	0	0	nr
mg/l	Chromium	0.05	0.0074	0.0004	0.0004	0.0008	0.00225	0.00008	0.0015	**3.5**	nr
mg/l	Manganese	1 g	0.008	0.01	0.002	0.01	0.01	<0.0007	nr	nr	0.13
mg/l	Iron	2	25	0.063	0.02	0.0017	**6.3**	**6.3**	0.1	0.5	0.8
mg/l	Nickel		0.07	0.001	0.0009	0.0011	0.02	<0.0005	nr	nr	nr
mg/l	Volatile fatty acids		<10	<10	<10	<10	<10	<20	<20	<20	<20
mg/l	Phosphate		0.13	<1	1.5	0.28	0.5	<1.2	<1.2	<1.2	<1.2

MEAN Average result based upon actual figures (not using < results) nr no result

WQS EC Directive (75/440/EEC, g-guide)

Bold results indicates WQS exceeded 12/06 - Change of test laboratory

Spurious results not following the norm/expected result compared with others of the same period and previous results

Water Analysis 2017 **Stormy West Landfill Site - Stormy Down**

Surface Water - Kenfig Pool

	Sampling Date	WQS	27.03.2017	19.06.2017	25.09.2017	04.12.2017	Mean 2017	Mean 2016	Mean 2015	Mean 2014	Mean 2013
Units	Determinands		no sample		no sample						
pH Units	pH	5.5 to 9 g		8.4		8	8.2	8.4	7.8	8.3	8.1
uS/cm	Conductivity @ 20c	1000 g		210		270	240	264	281	172	204
mg/l O	Oxygen (Dissolved)			8		10	9	8	7	8	9
mg/l	Total Organic Carbon			9		7	8.0	nr	nr	5.7	nr
mg/l O	COD (Total)	30 g		18		15	17	27	17	8	20
mg/l N	Nitrogen Ammoniacal	4		0.035		0.2	0.1	<0.1	<0.1	0.1	<0.27
mg/l N	Total Oxidised Nitrogen			<0.3		<0.3	<0.3	<1	<1	0.03	nr
mg/l N	Nitrate			0.05		0.2	0.1	<1	<1	<0.3	<0.4
mg/l N	Nitrite			0.009		0.019	0.01	<1	<1	<0.05	<0.025
mg/l CaCO3	Alkalinity total			44		89	67	88	77	84	77
mg/l	Chloride	200 g		37		36	37	34	34	34	27
mg/l O	BOD total+ATU			6		2	4	<2	<2	<2	nr
mg/l	Sulphate	250		2.9		3.4	3	<10	<10	10	3
mg/l	Sodium			20		20	20	21	21	17	14
mg/l	Potassium			0.4		2	1.2	1.5	1.0	1.0	0.7
mg/l	Copper	1 g		0.009		0.004	0.01	<0.0004	<0.0004	<1	nr
mg/l	Magnesium			4		4	4	5	5	3	4
mg/l	Calcium			15		31	23	24	27	24	25
mg/l	Zinc	5		0.003		0.003	0.003	<0.001	<0.001	3	nr
mg/l	Cadmium	0.005		<0.00002		<0.00002	<0.00002	<0.00007	<0.00007	<1	nr
mg/l	Lead	0.05		0.0004		0.003	0.002	<0.0002	<0.0002	nr	nr
mg/l	Chromium	0.05		0.0002		0.0002	0.0002	<0.0002	<0.0002	**4.33**	nr
mg/l	Manganese	1 g		0.018		0.012	0.02	<0.001	<0.001	nr	0.02
mg/l	Iron	2		0.12		0.13	0.1	<3	<3	0.03	<0.23
mg/l	Nickel			0.0008		<0.0005	<0.0005	<0.0005	<0.0005	nr	nr
mg/l	Volatile fatty acids			<10		<10	<10	<91	<91	<81	<20
mg/l	Phosphate			<0.062		0.16	<1	<1	<1	<0.05	<1.2

MEAN Average result based upon actual figures (not using < results)

WQS EC Directive (75/440/EEC, g-guide)

Bold results indicates WQS exceeded

nr no result

na not applicable

12/2016 - Change of test laboratory

Water Analysis 2017 **Stormy West Landfill Site - Stormy Down**

Leachate

	Sampling Date	L/F Comp.	25.01.16	14.02.17	27.03.17	21.04.17	23.05.17	19.06.17	28.07.17	25.08.17	25.09.17	23.10.17	29.11.17	04.12.17	Mean 17	Mean 16	Mean 15	Mean 14	Mean 13	Mean 12	Mean 11	Mean 10
Units	Determinands																					
pH Units	pH	6.5 - 8.5	6.8	7.3	7.6	7.5	7.6	7.9	7.1	7.6	7.5	7.2	7.4	7.4	7.4	7.3	7.3	7.2	7.4	7.5	7.5	7.4
uS/cm	Conductivity @ 20c	4000	**7000**	**7200**	**6800**	**9230**	**9040**	**8700**	3110	**5780**	**4500**	**6000**	**7430**	**6800**	**6799**	**7322**	**7012**	**6967**	**7243**	**6200**	**5993**	**5993**
mg/l O	Oxygen (Dissolved)	.			8			3			5			4	5	5.75	2					
mg/l O	BOD total+ATU	.			27			26			6			14	18	11	13	8	44	16	41	43
mg/l O	COD (Total)	.			510			58			300			600	367	696	557	777	751	686	869	1082
mg/l CaCO3	Alkalinity total	.			3700			4200			2300			5700	3975	3186	2231	3516	2650	2068	2658	3019
mg/l N	Ammonia as N	5			**510**			**380**			250			**380**	**380**	**220**	**316**	**510**	**415**	**362**	**408**	**479**
mg/l N	Total Oxidised Nitrogen	.			1			1			0.4			0.4	0.7	0.3	0	0.1	0.2	8.1	0.1	0.0
mg/l	Chloride	2000			640			950			380			640	653	810	562	717	536	400	494	589
mg/l	Sulphate	2500			14			17			26			14	17.8	37.0	146.5	8.0	9.3	<5	<5	<5
mg/l	Total Organic Carbon	10			**202**			**215**			**126**			**159**	**234**	**201**	**45**	**237**	**107**	**78**	**131**	**187**
mg/l	Cadmium	0.05			<0.00002			<0.00002			0.00002			0.00002	0.00002	0.00003	0.00000	<1	<0.0006		0.0013	0.0010
mg/l	Chromium	0.5			0.0006			0.009			0.0025			0.0045	0.004	0.03	0.01	**19**	0.01	0.01	0.02	0.03
mg/l	Lead	0.5			0.0005			0.001			0.0009			0.00	0.001	0.002	0.00	nr	0.04	<0.006	0.1	0.1
mg/l	Copper	1			<0.0005			0.004			0.0008			0.0022	0.002	0.002	0.001	2	<0.009	<0.009	0.02	0.03
mg/l	Nickel	0.5			0.0022			0.032			0.01			0.02	0.02	0.03	0.02	nr	0.03	0.02	0.0	0.0
mg/l	Zinc	1			0.002			0.008			0.009			0.002	0.005	0.005	0.004	**21**	0.02	0.02	0.1	0.2
mg/l	Iron	2			0.54			0.012			**3**			0.6	1	2	1	1	**5.3**	**2.3**	**5.5**	**7.3**
mg/l	Manganese	0.5			0.015			0.2			0.1			0.1	0.1	0.2	0.1	nr	**1.4**	0.2	0.2	0.3
mg/l	Sodium	1500			340			660			410			660	518	648	645	422	512	410	423	527
mg/l	Potassium	120			**200**			**200**			**150**			**210**	**190**	**199**	**193**	**221**	**185**	**143**	**170**	**196**
mg/l	Calcium	1000			97			71			130			100	100	1040	117	97	121	116	131	129
mg/l	Magnesium	500			78			75			52			80	71	67	66	68	48	48	47	48
mg/l	Volatile fatty acids				24			19			<50			<50	<50	<91	<81	<81	<20	<20	<20	<20
mg/l	Phosphate				3			4.2			0.84			2.5	2.6	1.9	0.0	3.7	1.7	1.5	2.2	2.4
Metres	Depth - BH AOD 108		14	14.1	14.3	14.7	14.5	14.7	14.8	14.8	15	15	14.8	14.8	14.6	14.6	14.7	14.5	14.8	14.8	15.1	15.2

MEAN Average result based on actual figures (not less than <) . nr - no result

L/F Comp. Landfill Completion criteria (as WMP26A).

Results in bold indicate result exceeds standard.

BH - B5 taken as leachate sample/depth

Spurious results not following the norm/expected result compared with others of the same period and previous results

APPENDIX E

EXAMPLE COMPLETION CRITERIA FOR LEACHATES

APPENDIX F

STANDARDS USED FOR ASSESSMENT OF WATER QUALITY

Determinand	Units	Leachate		Groundwater		Surface water	
pH	units	6.5 to 8.5		6.5 to 10.0		5.5 to 9(g)	
Conductivity	us/cm	4000		2500		1000 (g)	
Dissolved O2	mg/l O	n/a		n/a		n/a	
BOD	mg/l O	n/a		n/a		<7 (g)	
COD	mg/l O	n/a		n/a		30 (g)	
Alkalinity	mg/l CaCO3	n/a		n/a		n/a	
Ammoniacal N	mg/l N	5		0.5		4	
TON	mg/l N	n/a		n/a		n/a	
Nitrate	mg/l N	500		50		n/a	
Nitrite	mg/l N	1		0.5		n/a	
Chloride	mg/l	2000		250		200 (g)	
Sulphate	mg/l	2500		250		250	
Sodium	mg/l	1500		200		n/a	
Potassium	mg/l	120		12		n/a	
Copper	mg/l	1		2		1 (g)	
Magnesium	mg/l	500		0.05		n	
Calcium	mg/l	1000		250		n	
Zinc	mg/l	1		5		5	
Cadmium	mg/l	0.05		0.005		0.005	
Lead	mg/l	0.5		0.025		0.05	
Chromium	mg/l	0.5		0.05		0.05	
Manganese	mg/l	0.5		0.05		1 (g)	
Iron	mg/l	2		0.2		2	
Nickel	mg/l	0.5		0.02		n/a	
Volatile fatty Acids	mg/l	n/a		n/a		n/a	
Phosphate	mg/l	n/a		n/a		n/a	
TOC	mg/l	10		n/a		n/a	

Limits derived from the following guidance/regulations:
Leachate - example completion criteria - WMP No. 26A
Groundwater - Water Supply (Water Quality) Regulations
Surface water - EC Directive 75/440/EEC