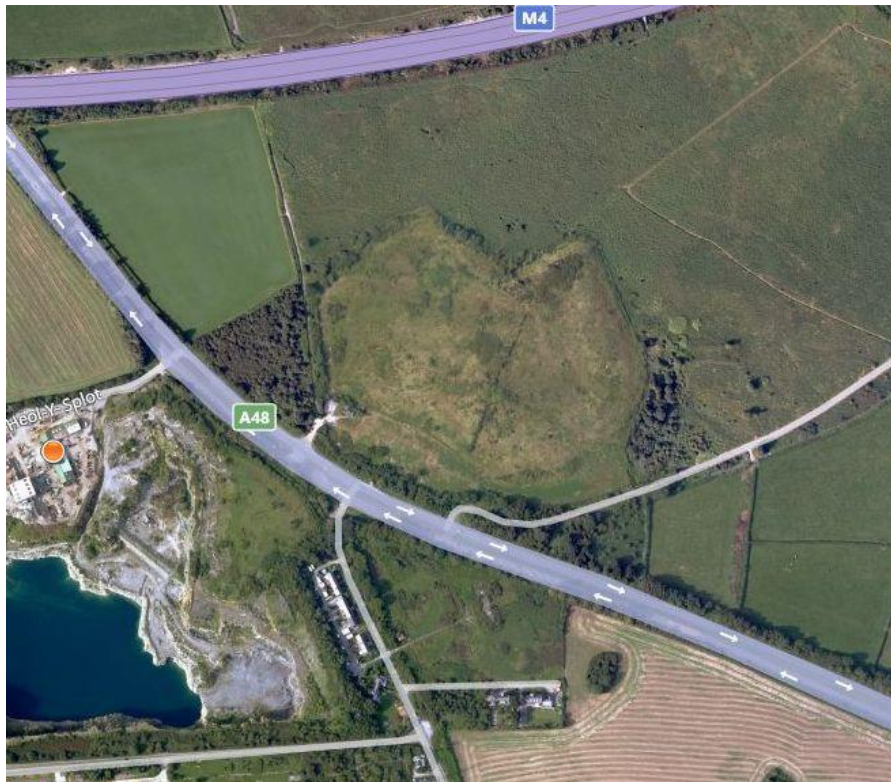


LANDCARE (MANCHESTER) LIMITED **STORMY WEST LANDFILL SITE, PYLE**

Environmental Permit – EAWML34009

ENVIRONMENTAL MONITORING OF WATER QUALITY FOR 2023



MAY 2024

Report Type:		ENVIRONMENTAL	
Report Issue:		FACTUAL/INTERPRETIVE	
Contract:		LAN/SW/1/24	
Reference:		CLOSED LANDFILL SITE	
Action point:			
	Name	Signature	Date
Originator:	P REES	P. Rees	MAY 2024
Title:	HS&E CONSULTANT		
Checked & Approved:	L. Jones EnviResource Consulting Ltd.	L Jones 	JULY 2024
Title:	Director		

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.

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1. SUMMARY

This report has been prepared to present the environmental monitoring information compiled for the 2023 monitoring period. The site monitoring data is presented in comparison 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 any 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 hydrogeological / 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 deterioration in water quality.

It is worthy of note that the local regulators i.e. Natural Resources Wales (NRW) performed a site audit (along with other locations/sites) in March 2022 and the CAR report did not indicate any concerns with the site management/operations at Stormy West.

2. INTRODUCTION

The monitoring of Stormy West Landfill and its environs was transferred in October 2023 from PLR Services to EnviResource Consulting Ltd. Continuity of service and data has been at the forefront of the changeover and this report represents the total dataset and has been prepared (for the whole set) by PLR services in response to the annual requirement of Natural Resources Wales (NRW), incorporated within the Environmental Permit. This report offers an interpretation of the potential impact the Stormy West landfill site may have upon the hydrology and hydrogeology 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 DoE Waste Management Papers (these being the guidance available at the time the site was being operated and needed to comply with), 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 2023 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 hydrogeological pathways present within and beneath the site.

The site, prior to being landfilled, had been a disused limestone quarry (see Appendix A) which has been refilled with household, industrial, commercial and some Special (at that time) Wastes (e.g. ACM's) 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 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 several 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 using active gas wells 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 to flaring/venting the landfill gas 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). Recent indications from analytical results have appeared to show a change in the dynamics of the landfill site possibly due to the changes caused by reduced infiltration by the presence of the solar panel cover. Notwithstanding this the site continues to be monitored and a report issued annually.

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 earlier DOE Waste Management Papers (WMP) have been referenced to show 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

It is not known whether any recent non-landfill related works/projects have been performed at site since the report prepared from the 2022 data. Thus, the general reference to hydrogeological surveys and groundwater studies (Ref.4) in this area, with regard the landfill operations at that time prevails. These 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 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 accepted 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 referenced earlier e.g. DOE WMP No.4 (Ref.7) and any other 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 regulatory standards i.e. 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.
PLRSERVICES/05/24 ENV		4	LAN/SW/1/24

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 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 seen 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. 2023) 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 2022 and from previous years as shown upon the tabulated results found within the appendices to this report and any trends can be identified as indicated below.

Table 2 **Leachate results**

Determinand Spec. limits	2023	2022	2021	2	0	2	0
PLRSERVICES/05/24 ENV				5			LAN/SW/1/24

Conductivity	LT 4000	5029	720	5698	5	6	6	7
Ammonia (N)	LT 5	278	418	475	3		5	5
Chloride	LT 2000	243	543	593	4		0	3
COD	No spec.limit	443	525	545	5		2	8
TOC	LT 10	45	138	142	1		2	7
Potassium	LT 120	110	175	183	1		8	5

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

NB - Results in bold show an exceedance over the previous annual monitoring period.

A summation of the above information can be concluded by reference to a survey (Ref.9) published by the Environment Agency which had stated 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 seen from the above that the results are in general lower to that determined for 2022, 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 biodegradation 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 determined 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).

Table 3 **Surface Water results**

Determinand	Spec. limits (WQS)	2023	2022	2021	2020
-------------	--------------------	------	------	------	------

Pyle Spring

Conductivity	LT 1000	438	450	468	480
Ammonia (N)	LT 4	0.11	0.19	0.17	0.23
Chloride	LT 200	25	32	31	28
COD	LT 30	14	20	11	12
Copper	LT 1	0.004	0.007	0.005	0.004
Manganese	LT 1	0.004	0.006	0.011	0.01

Determinand.	Spec. limits (WQS)	2023	2022	2021	2020
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Kenfig Pool

Conductivity	LT 1000	255	255	245	230
Ammonia (as N)	LT 4	0.04	0.02	0.05	0.05
Chloride	LT 200	36	39	19	34
COD	LT 30	13	15	12	17
Copper	LT 1	0.01	0.01	0.004	0.02
Manganese	LT 1	0.003	0.003	0.004	0.004

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

NB - Results in bold show an exceedance over the previous annual monitoring period.

From the table of results as observed above it may be deduced there is no significant deviation over the previous years.

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 southwest of the edge of the original quarry workings, but outside of the landfilled area.
- **GW3:** a borehole (b/h1) located near the **site entrance** at the outer extremity of the overall site area but further south than GW2, which again lies southwest of the original landfilled 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) assigned 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.

Although as reported previously it appeared evident that in general the water rest levels in each borehole to be lower than observed in previous monitoring periods fluctuations were observed and possibly linked to the infiltration and as such determinands could well be more concentrated in that they are not being recharged and/or diluted as those results observed in previous monitoring periods. There was little change in the average leachate level for the 2023 monitoring period.

Table 4 presents the depth of the groundwater within the monitoring boreholes at the time of sampling and the indicative leachate level within the gas well.

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

NB - Results in bold show an exceedance over the previous annual monitoring period.

Table 4 **Water Rest Levels**

Date.	A48		GW2		GW3		Leachate Well B5	
	Dip (m)	AoD (m)	Dip (m)	AoD (m)	Dip (m)	AoD (m)	Dip (m)	AoD (m)
21/03/23	10.60	89.60	11.60	89.80	10.3	90.30	13.00	95.00
12/06/23	18.00	82.20	16.70	84.70	19.6	81.00	14.80	93.20
25/09/23	15.00	85.20	13.00	88.40	13.8	86.80	13.40	94.60
10/12/23	7.60	92.60	8.30	93.10	7.6	93.00	14.10	93.90
Mean 2023	12.80	87.40	12.40	89.00	12.8	87.80	13.60	94.40
Mean 2022	19.70	80.50	18.90	82.50	15.1	85.50	14.40	93.60
Mean 2021	17.90	82.30	14.00	87.40	14.5	86.10	14.30	93.70
Mean 2020	14.00	86.20	13.10	88.30	14.9	85.70	14.50	93.50
Mean 2019	15.50	84.70	13.40	88.00	16.9	83.70	14.50	93.50
Well Head		100.20		101.40		100.60		108.00

Table 5 **Groundwater water results**

Determinand.	Spec. limits	2023	2022	2021	2020
A48					
Ammonia (as N)	LT 0.5	20.1	12.6	1.8	0.6
Manganese	LT 0.05	0.81	0.01	0.63	0.02
Potassium	LT 12	13	11	1	7
BH2/GW2					
Ammonia (as N)	LT 0.5	2.8	0.43	0.03	0.1
Manganese	LT 0.05	0.1	0.002	0.003	0.002
Potassium	LT 12	5	4	3	5
BH1/GW3					
Ammonia (as N)	LT 0.5	2	0.02	0.2	2
Manganese	LT 0.05	0.01	0.003	0.07	0.01
Potassium	LT 12	4	4	4	4

The above selected results exhibit limited exceedances of the measured determinands and in comparison to that observed over the last four years.

It may be observed that there is no significant deviation taking due account of any spurious and outlying results as indicated upon the tables of results presented within the appendices.

Results highlighted in bold reflect results above that reported upon that measured in previous years and on reviewing the respective tables of results within the Appendices indicate any spurious/outlying results.

The following table presents the average water quality results: -

Table 6 **Groundwater levels**

Determinand.	Spec. limits	A48	GW2	GW3
---------------------	---------------------	------------	------------	------------

The determinands indicated below are those of which in previous monitoring reports have exceeded the specified limits assigned at that time:

Ammon. Nit.	0.5	20#	2.8	2*#
Potassium	12	13*	5	4
Manganese	0.05	0.81*#	0.1*#	0.003
Iron	0.2	0.02	0.01	0.01

* 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)

Summation- from the table of results it may be observed that there are mean determinand results which have exceeded the specified limits assigned. Notwithstanding this the table depicts those specific determinands identified as indicative of water quality. This demonstrates that the results for water quality do not indicate any significant divergence than that obtained and reported upon previously. In general they show an improvement albeit with limited identifiable outlying results over the comparable results reported for 2022 and earlier monitoring periods (see reports & appendices).

It may also be observed within the results there have been fewer (if any) spurious (outlying #) results obtained which appeared to be elevated but do not show a trend and indeed have returned to that expected, based on previous years' experience, during the monitoring period. However, the A48 results in particular appear to be influenced by the drier periods and thus less dilution due to limited fluid present.

Nevertheless, as experienced in previous monitoring periods there has been a limited number of elevated results existing on comparison to the respective groundwater levels, perhaps indicative and possibly support the premise of potential seasonal variation and/or borehole contamination.

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

7. RECOMMENDATIONS

The results obtained for the year 2023 will again be compared to that compiled for this monitoring period and that of previous years with comparisons displayed upon the tables of results and as presented within previous annual reports, with no levels greater than the previous year.

These will again be further compared for those results to be obtained for the 2024 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 2022 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 relatively constant thus supporting low ingress through the cap.
- From the results presented within the appendices it may be observed that in general the results appear to show an improvement in quality from those obtained in previous reports/years and as in general expected to be the case.
- 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 & subsequently analysed.
- A limited number of spurious/outlying results were observed for 2023 which may well have been previously contributed to elevated results which can skew the overall observation indicating potential improvement. Notwithstanding this however, water quality 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 significant variation observed.
- There is still need 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 continue to review the results for 2024 monitoring period and due to the installation of the solar panels across the site which could further reduce any infiltration of precipitation etc. through the cap and may well influence 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 through the monitoring performed for 2023 and thus does indicate some significant improvement from the 2022 results. Nevertheless, monitoring of water quality is to continue as that performed in previous years in conjunction with the existing Environmental Permit and again a comparison made to those results obtained for the 2024 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

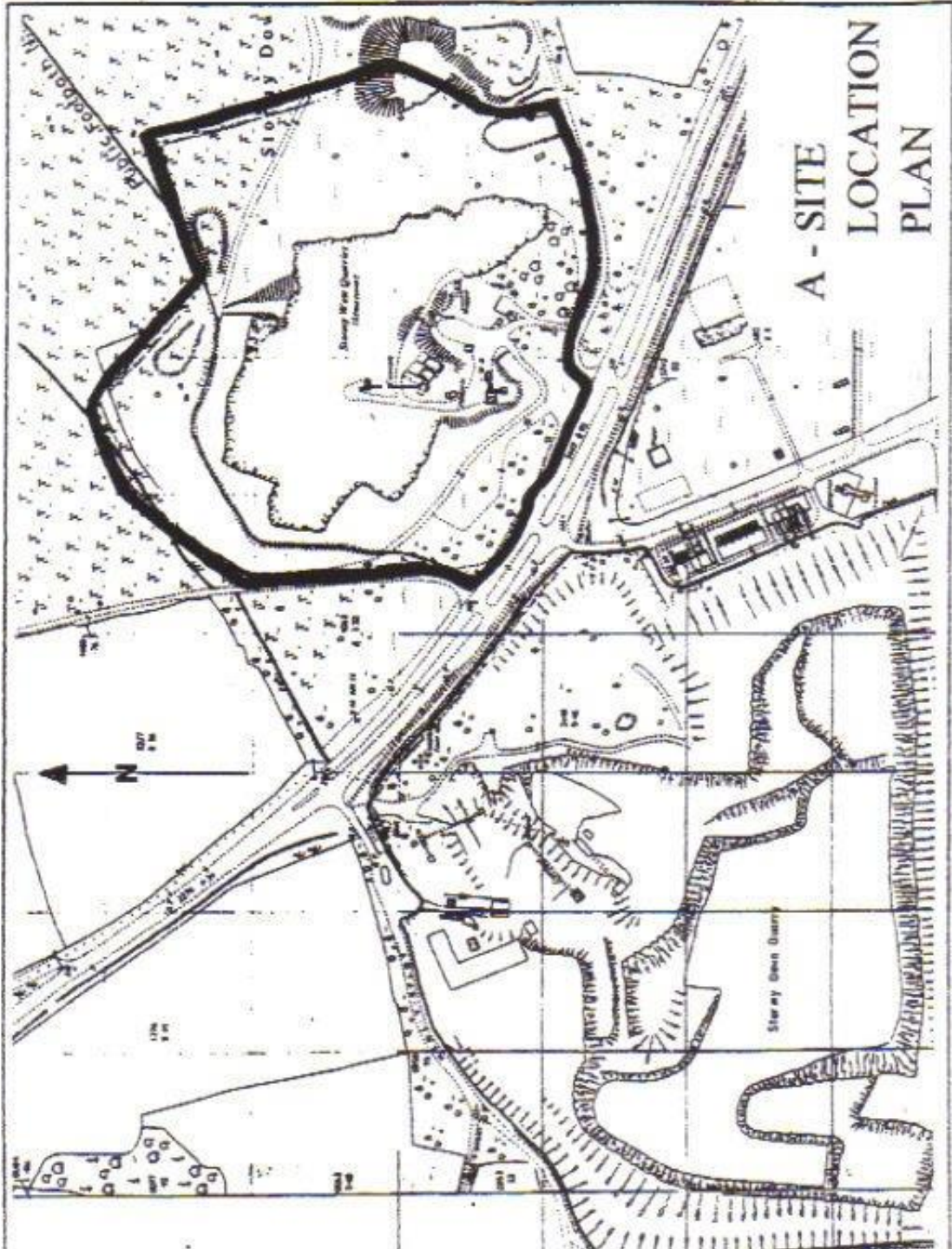
Appendix D - Sampling Point Analytical Results

Appendix E - Example Completion Criteria for Leachates

Appendix F - Standards Used for Assessment of Water Quality

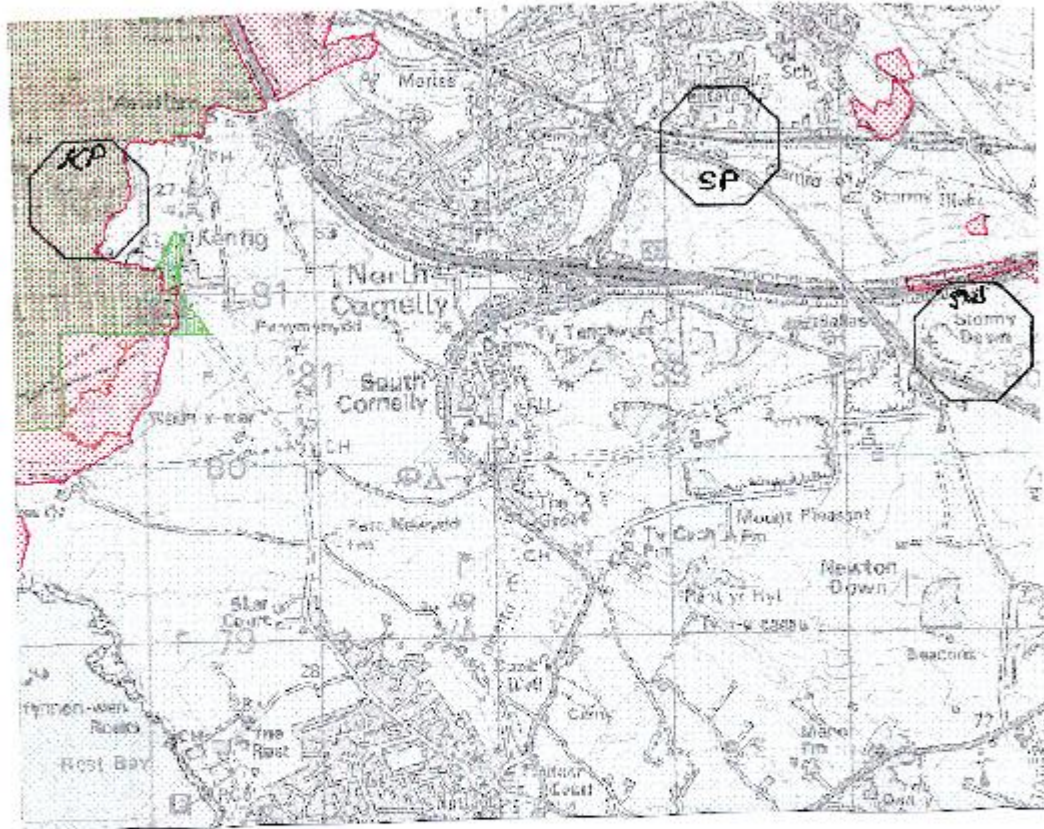
APPENDIX A

SITE LOCATION PLAN



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

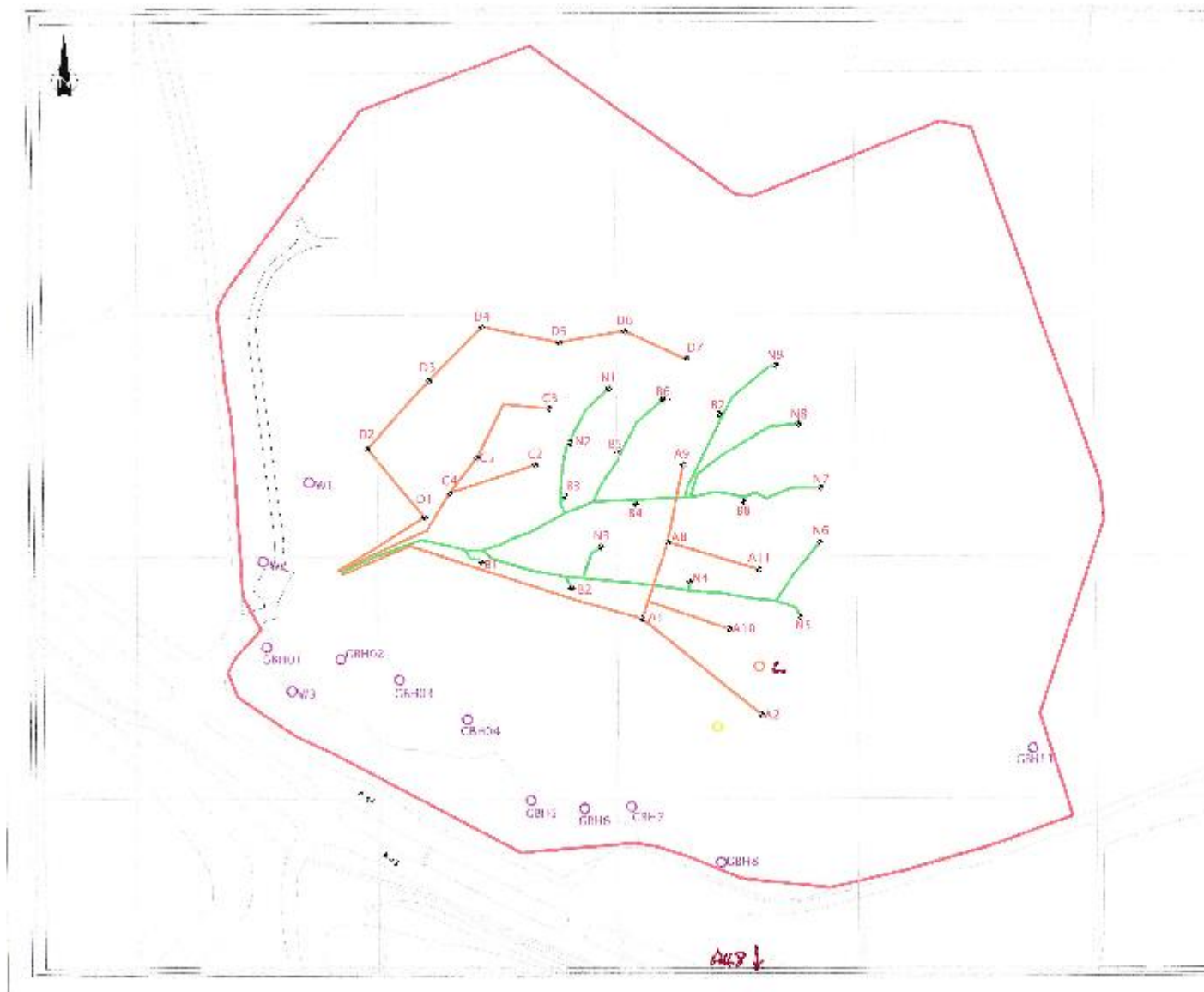
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APPENDIX C

MONITORING/SAMPLING POINTS



APPENDIX D

SAMPLING POINT ANALYTICAL RESULTS

APPENDIX E

EXAMPLE COMPLETION CRITERIA FOR LEACHATES

APPENDIX E

Example Completion Criteria for Leachates

Determinand	Concentration	
pH	6.5 - 8.5	
Conductivity	4000	$\mu\text{S/cm}$
Chloride	2000	$\text{mg l}^{-1} \text{Cl}^-$
Sulphate	2500	$\text{mg l}^{-1} \text{SO}_4^{2-}$
Calcium	1000	$\text{mg l}^{-1} \text{Ca}^{2+}$
Magnesium	500	$\text{mg l}^{-1} \text{Mg}^{2+}$
Sodium	1500	$\text{mg l}^{-1} \text{Na}^+$
Potassium	120	$\text{mg l}^{-1} \text{K}^+$
Aluminium	2	$\text{mg l}^{-1} \text{Al}^{3+}$
Nitrate	500	$\text{mg l}^{-1} \text{NO}_3^-$
Nitrite	1	$\text{mg l}^{-1} \text{NO}_2^-$
Ammonia	5	$\text{mg l}^{-1} \text{NH}_4^+$
Total Organic Carbon	10	$\text{mg l}^{-1} \text{C}$
Iron	2	$\text{mg l}^{-1} \text{Fe}$
Manganese	0.5	$\text{mg l}^{-1} \text{Mn}$
Copper	1	$\text{mg l}^{-1} \text{Cu}$
Zinc	1	$\text{mg l}^{-1} \text{Zn}$
Phosphorus	10	$\text{mg l}^{-1} \text{P}_2\text{O}_5$
Fluoride	10	$\text{mg l}^{-1} \text{F}^-$
Barium	1	$\text{mg l}^{-1} \text{Ba}$
Silver	0.1	$\text{mg l}^{-1} \text{Ag}$
Arsenic	0.5	$\text{mg l}^{-1} \text{As}$
Cadmium	0.05	$\text{mg l}^{-1} \text{Cd}$
Cyanides	0.5	$\text{mg l}^{-1} \text{CN}^-$
Chromium	0.5	$\text{mg l}^{-1} \text{Cr}$
Mercury	0.01	$\text{mg l}^{-1} \text{Hg}$
Nickel	0.5	$\text{mg l}^{-1} \text{Ni}$
Lead	0.5	$\text{mg l}^{-1} \text{Pb}$
Antimony	0.1	$\text{mg l}^{-1} \text{Sb}$
Selenium	0.1	$\text{mg l}^{-1} \text{Se}$
Mineral Oils	0.1	mg l^{-1}
Phenols	0.005	$\text{mg l}^{-1} \text{C}_6\text{H}_5\text{OH}$
Organochlorine compounds other than pesticides	0.01	mg l^{-1}
Pesticides		
- individually	0.001	mg l^{-1}
- collectively	0.005	mg l^{-1}
PAHs	0.002	mg l^{-1}

Assumptions

1. The leachate will enter groundwater.
2. Local water quality objectives are set for potable supply.
3. A minimum dilution factor of 10 is expected.
4. There is no significant unsaturated zone attenuation.

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