Ruabon Landfill Site

Leachate Management Plan v7

January 2023

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1.0 Introduction

1.0.1 The objectives of this leachate management plan (LMP) are;

- To control leachate generation within the landfill;
- To prevent the contamination of ground and surface waters by leachate migration;
- To manage leachate within the landfill in accordance with the relevant conditions of the sites Environmental Permit.

1.0.2 The minimisation of leachate generation and the control of leachate in compliance with the terms of the former Site Licenses and current permit, are integral elements of the risk management measures that willbe incorporated into the operation of the site. This document aims to provide a comprehensive summary of the actions to be undertaken to manage leachate at the site, including criteria to be met and actions required dependent upon the leachate levels and quality actually existing.

1.0.3 This report updates V6 of the LMP, dated 2005.

1.1 Waste Management License / Permit Summary

1.1.1 The Site was previously covered by two adjoining Waste Disposal Licences (WDL's); WMBC L50 and WMBC L82, operated by WRG (Midlands) Ltd and WRG (Northern) Ltd respectively, who are both wholly owned subsidiaries of FCC. It is noted that the operator name on granting of licences were Shanks and McEwan (Midlands) and (Northern) respectively. Following the acquisition of Shanks landfill assets by Waste Recycling Group Ltd (now known as FCC Environment UK Ltd) the company names were changed to WRG (Midlands) and WRG (Northern) Ltd. The legal entities remained the same, with the same company number but names were changed.

1.1.2 A transfer application was submitted NRW in August 2020 to change the operator name from WRG (Northern) Ltd (WMBC L50) to WRG Midlands Ltd – for consistency with WRG Midlands (WMBC L82); the transfer application was determined on the 2nd November 2020, both permits are now operated by WRG Midlands Ltd. The transferred WDL (WMBC L50) is now Environmental Permit EPR/HP3694FJ.

1.2 Previous Requirements and Associated Documents

1.2.1 The Waste Management License for the site WMBC/L50 issued on 4th December 1987, re issued 19th October 1992 and last modified on 31st March 1999 relates to cells 1-9 and contains the following conditions relating to leachate and relevant to the post closure period of the landfill site.

Table 1: Waste Management Licence Conditions Relating to Leachate Management.

Condition	Description	Page
J.4	If any groundwater borehole, leachate well, gas borehole or gas well as required by Conditions J.1 to J.3 of this licence should at any time become unsuitable for sampling, then it shall be made so suitable or replaced within 2 months from the date on which it is first found to be unsuitable.	
J.5	Water levels shall be measured (in cms above the base of the monitoring point and prior to any pumping or purging operations) in all the said groundwater monitoring boreholes and in all the said leachate wells on a monthly frequency. Results of the monitoring shall be recorded in the site diary (see L.6) The written record shall also include the liquid levels referenced to ordnance datum of the base and top of each monitoring point. Monitoring of leachate wells shall not take place within 24 hours of them being pumped.	10
J.6	Water levels shall be measured (in cms. Above the base of the monitoring point) in the sub basal seal monitoring borehole as shown on plan 7 of the approved Working Plan and denoted Borehole No. 10 on a monthly basis. Results of monitoring shall be recorded in the site diary (see L.6) The written record shall also include the liquid levels referenced to ordnance datum of the base and top of each monitoring point.	10

J.7	Water samples shall be taken from each of the said external groundwater monitoring borehole at 3 monthly intervals and at any other times requested by the Waster Regulation Authority. The samples shall be analysed by an accredited analyst for the following parameters and any other parameters as requested by the Waste Regulation Authority. Results of monitoring shall be recorded in the site diary (See L.6) Three Monthly Analysis Alkalinity Ammoniacal Nitrogen BOD Chloride COD Conductivity Dissolved Oxygen (DO) Sodium Potassium Calcium Magnesium PH (field) Phosphate Sulphate Sulphide Total Oxidised Nitrogen Total Organic Carbon (T.O.C)	11
J.9	If the depth of leachate as measured in any leachate monitoring well is found to exceed 2 metres above the level of the base of the site at that point, hereinafter called the trigger level, then leachate shall be removed by pumping until the depth of the leachate falls below that trigger level. The levels shall be recorded in the site diary (see L.6)	11
J.10	Leachate removed as required by condition J.9 of this licence except for those leachates that can be reasonably recycled back into the site at times of high evaporation andtranspiration periods shall be tankered off site to a suitably licensed facility until such time that other methods of leachate disposal have been agreed with the National Rivers Authority and the Waste Regulation Authority (three months in advance of the implementation of any such disposal scheme)	12
J.11	All water level data, leachate level data, and all water and leachate analysis results shall be written into the site diary as required to be kept by Condition L.6. A true copy of the analytical results and other data relating to Conditions J.5, J.6, J7, J.8, J.9 and J,10 shall be forwarded at 3 monthly intervals to the Chief Environmental Health Officer, Guildhall, Rhosddu Road,Wrexham, Clwyd, North Wales. LL11 1AY	
J.12	Each cell shall be engineered to prevent egress of leachate into surface water. In the event of any leachate egress from a defined cell, either through a bund or a cap then the Waste Regulation Authority and National Rivers Authority shall be contacted and a method dealing with the egress agreed in writing with the Waste Regulation Authority	
J.14	The top of each leachate monitoring point shall be covered to prevent entry of waste and unauthorised access. The operator shall at any time during normal working hours open the monitoring chimneys for inspection at the request of an officer of the Waste Regulation Authority.	
J.15	An emergency plan shall be formulated to deal with excessive amounts of leachates that may arise on site. The emergency plan shall be formulated in conjunction with the National Rivers Authority and the Waste Regulation Authority no later than 3 months after issue of this licence. The emergency leachate contingency plan shall be incorporated into the approved working plan for this license.	

1.2.2 The wastes management licence WMBCL/82 issued on 6th July 1994 related to the newer extension (cells 10 and 11) and contained the following conditions relating to leachate and the post closure period of the landfill site:

Table 2: Waste Management Licence Conditions Relating to Leachate Management.

Condition	Description	Page
H.2	Each cell shall be engineered to prevent egress of leachate into the surface water. In the event of any leachate egress from a defined cell, either through a bund or a cap, then the Waste Regulation Authority shall be contacted and a method of dealing with the egress shall be agreed in writing with the Waste Regulation Authority.	8
H.17	Leachate monitoring points shall be installed at the locations shown on Drawing No. SME 0001A/020A of the working plan. The structure and method of installation shall be agreed with the W.R.A within 6 months of the date of issue of this licence. The location of additional monitoring points, as reasonably requested by the W.R.A., shall be agreed in writing prior to their installation.	10
H.18	The leachate collection chamber shall be located as shown on drawing No. SME 0001/002/001	10
H.19	The leachate chamber shall be constructed as shown on drawing No, SME 0001/002/001	10
J.1	The design of proposed locations and numbers of all monitoring boreholes wells and other monitoring points on the land shall be submitted by the licence holder to the Waste Regulation Authority for its prior written agreement The agreed locations shall be shown on Drawing No. GAR/031/94 annexed hereto or any subsequently agreed updates and all monitoring shall refer to these designated locations.	11
J.4	If any borehole, well or monitoring point as required by Conditions J.1 to J.3 of this licence should at any time become unsuitable for sampling, then (and unless suitable monitoring points are already available to replace those damaged e.g. if leachate can be monitored from in place gas wells) it shall be made so suitable or replaced within two months from the date on which it is first found to be unsuitable.	12
J.7	All surface water, groundwater, leachate and landfill gas monitoring points shall be clearly marked and identified on site. The method of identification shall be notified to and agreed with the W.R.A.	12
J.8	Monitoring points referred to in Condition J.1 above shall be securely covered and locked to prevent the enter of litter, waste, debris or unauthorised access. The operator shall at any time during normal working hours or during emergencies open the monitoring chimneys and boreholes for inspection at the request of an officer of the Waste Regulation Authority.	12
J.16	Other than in accordance with leachate removal detailed in condition J.21 and J.22 all leachate shall be contained within the current or previously worked cells. Outbreaks of leachate into as yet unlined areas of the site shall be treated as an emergency and any such leachate shall be immediately removed to a leachate collection sump or to a suitably licensed facility. The W.R.A shall be informed of any such emergency within 24 hours of it's occurrence.	13
J.17	The level of leachate, in metres above the base, of all monitoring points and pumping chambers shall be monitored at monthly intervals	13
J.18	Pumping of leachate shall be suspended for at least 24 hours immediately before the monitoring exercise as specified in condition J.17 are carried out	13
J.19	The full depth of all leachate monitoring points and pumping chambers shall be determined at each monitoring exercise to ensure that there are no obstructions.	13
J.21	If the depth of the leachate as measured in any leachate monitoring well is found to exceed 2 metres above the level of the base of the site at that point, hereinafter called the trigger level, then the leachate shall be removed by pumping until the depth of leachate falls below that trigger level. The levels shall be recorded in the site diary (see L.9)	14
J.22	Excess leachate shall only be recirculated within the site in accordance with a scheme agreed in writing with the W.R.A or shall be taken to a suitably licensed treatment facility.	14
J.23	A written record shall be made of the leachate removal exercise, referred to in conditions J.21 and J.22 shall be made to include the following information:- (1) The date and time of removal (2) The location of the pumping point (3) The volume of leachate removed in cubic metres The disposal point of the leachate, including the cell over which it was recirculatedwhere appropriate.	14
J.24	A representative sample of site leachate shall be taken each twelve months and analysed by an accredited analyst for those determinands listed in the agreed working plan. Results of the analysis shall be recorded in the site diary (see L.9)	14

J.25	A leachate contingency plan shall be formulated to deal with excessive amounts of leachate that may arise on site. The plan shall be formulated in conjunction with the National Rivers Authority and the Waste Regulation Authority no later than 3 months after issue of this licence. The leachate contingency plan shall be incorporated into the agreed working plan for this licence and shall be reviewed annually	14
J.26	The records of all leachate monitoring and sampling exercises, including the results of sample analyses, shall be forwarded to the W.R.A to arrive before the date of the next scheduled monitoring unless adverse results are obtained and the licence holder shall then ensure that the analysis is forwarded to the W.R.A. without any undue delay.	14

1.2.3 This Leachate Management Plan provides an update to permit Application Supporting Documents referenced 4915/R/001 to 4915/R/006 (dated July 2020, with updates dated January 2022 based on a Non-Duly made response issued by NRW.

1.2.4 Many of the references detailed in table 1 and 2 above have become obsolete (i.e. references to outdated drawings) however, where applicable the content and detail of these former requirements are contained within this LMP for completeness.

2.0 Leachate Management System.

2.0.1 The existing leachate management system at Ruabon comprise the original cell engineering and some of the original leachate well infrastructure, plus retro drilled leachate wells. Retro drilling of thesame group of leachate wells has taken place on at least three occasions. The retro drilled wells in use today replace four of the historic leachate wells which had become unsuitable.

2.0.2 The site utilises an eductor pump system and electric submersible pumps. Excess leachate is collected at a central location and tankered off site to suitably licensed disposal facilities. Leachate has historically been recirculated back to the newer extension of the site.

2.0.3 Two storage tanks are available for leachate removal, the first is 40m^3 in volume, an additional new tank is 75m^3 in volume. Both tanks are being utilized with a combined capacity of 115m^3.

2.0.4 Leachate removal is facilitated by HGV collection, to lorries remove 28m^3 each (56m^3/day) and collections occur most days Mon-Fri, ~280m^3 of leachate is removed per week.

2.1 Operational / Design Changes

2.1.1 Although originally permitted with a *"2m above the level of the base of the site at that point, hereinafter called the trigger level"* limit the variation application seeks to amend the leachate compliance levels to those outlined in report reference 4915/R/004/01 (Hydrogeological Risk Assessment) based on a risk-based management approach.

2.1.2 The Site is currently consented on the conceptualisation basis of both "geological containment" and additionally "hydraulic containment". The proposal is for operation in line with hydraulic containment for the superficial groundwater system, with the majority of the leachate encapsulated beneath the bedrock interface i.e. contained within the Etruria Marl geological barrier.

2.1.3 The proposed change is to allow for Leachate level control at a higher level. The proposals are specified in table 3 in addition to presenting the current leachate monitoring chambers.

Table 3: Leachate Level Trigger and Control (Action) Limits							
Monitoring Chamber	Base (mAOD)	Datum (mAOD)	Total Depth (m)	2m head (mAOD)	difference in depth (m)	Proposed Compliance Limit (mAOD)	Proposed Action Level (mAOD)
M10	96.00	123.15	27.15	98.00	8.6	106.6	98.0
M1	110.45	124.69	14.69	112.45	1.55	114.0	113.0
M3	112.25	125.41	13.16	114.25	0	114.25	113.25
LMP2R	110.00	126.09	16.09	112.00	2	114.0	113.0
LMP4R	110.08	127.79	17.71	112.08	3.92	116.0	115.0
LMP7R	110.80	129.22	19.14	112.80	6.2	119.0	118.0
LMP6R	111.40	130.74	19.34	113.40	5.6	119.0	118.0
M5	110.50	131.82	21.32	112.50	6.5	119.0	118.0
LMP8R	110.00	132.45	22.45	112.00	13	125.0	124.0
LMP9R	110.30	132.68	22.38	112.30	12.7	125.0	124.0

2.2 Control of Water Ingress

2.2.1 Landfilling operations were originally phased in order to minimise the generation of leachate using water balance techniques to determine the optimum sequence of waste placement. The water balance isa function of the rate of waste input, the absorptive capacity of the waste and the infiltration rate.

2.2.2 The site was engineered in such a way that surface water was separated from waste and then shed from capped areas into the off-site surface water management systems. All phases of the site have been capped with nominal 1m clay and 1m clay rich restoration material. Recent studies have indicated on average a cap thickness of ~1.5m.

2.2.3 The site has a retaining bund wall constructed along the southern field boundary of the site to prevent water entering the site from the adjacent low-lying field. The bund is constructed from clay and is keyed into the Ruabon Marls (former name for Etruria Marl).

2.2.4 At Ruabon, the potential for Groundwater inflow was thought to be minimal due to the minimal water ingress experienced during the clay extraction which predates the landfill. This material is considered as a natural in-situ Geological Barrier. The site also has mine workings adjacent to it, which are thought to have experienced ground water rebound, but the mine is within Coal Measures Strata, and ingress was thought unlikely to occur beneath the landfill site. The mine shaft is located to the southeast of the site, close to the existing surface water settlement lagoon and surface water discharge culvert at approximately SJ30321 44377 and is sealed.

2.2.5 Ruabon has constructed along the southern edge of the landfill, a groundwater interception drain and a surface water interception ditch (exact details unknown). The groundwater interception drain was constructed between the junction between the Ruabon marl under the liner, and the underlying materials, but was thought to be allowing some ingress into the site.

2.2.6 Prior to the planning application for the extension area of the site, an environmental assessment was carried out by Acer Environmental (now Hyder). This reports that the base of the extension area is at around 95m AOD, some 15m below the surrounding groundwater levels and that there is therefore a substantial hydraulic gradient between surrounding groundwater levels and leachate levels in the site in favor of water ingress (assumed to be derived from water in the superficial groundwater system).

2.2.7 In the event of a failure of the groundwater interception drain, it was anticipated by Acer Environmental that the failure would result in either a breach of the liner, or a water logging and eventual groundwater springing of the ground at the edge of the liner. The assessment concluded that these symptoms would be detectable by rising leachate levels within the waste mass in the case of a liner breach, or a building of water levels within the water monitoring boreholes up slope of the western face.

2.2.8 Additionally, as leachate quality is only available form the eductor tank (as a site composite) it is not possible to see if leachate dilution is occurring in this area compared to other areas.

2.2.9 As stated in the LMP (V5), *levels within boreholes around thesouthwestern corner of the site are currently between 120mAOD and 136m AOD (Boreholes 10 to 15), comparable with landfill finished contours, but leachate levels in this corner of the site are not determined as there is no intact infrastructure here, and earlier groundwater level data referenced to ordnance datum is not available. The environmental assessment by Acer Environmental sets out safety margins for risk avoidance, including setting a maximum leachate level of 112m AOD before breakout is anticipated (in the extension area).*

2.2.10 Although this report is not available for review, the boreholes referred to appear to be those to the south adjacent to the cemetery. Report 4915/R/004 details that groundwater levels for the superficial groundwater system reduce from ~130mAOD to 118mAOD (west to east) with a low point of ~113mAOD on the eastern boundary of the extension area. This is not materially different to the proposal within the current variation application, specifically related to this area of site (controlled by leachate removal at M10, see table 3).

2.2.11 Notwithstanding the above, the control of water ingress has been minimised by the installation of a cut-off drain and engineered sidewall and clay cap to lessen infiltration.

2.3 Engineered Leachate Extraction and Collection System

2.3.1 Leachate management at Ruabon has historically been achieved through cell design; water balance calculations being used to determine the maximum basal area of each cell, or phase. The site progressed in 11 cells or phases (cells 10 and 11 were previously considered as a combined cell), see table 4. Each cell base was separately bunded to contain all liquids generated or incident on the cell. The current proposal will ensure the site acts as a singular hydraulic cell.

2.3.2 As detailed in the LMP V5, Cells 1 to 7 reportedly have no basal drainage system or basal drainage layer medium such as gravel. In Cells 8 to 11, the cells are reported to have a radial system of basal drains designed to provide a high permeability pathway for the leachate to the leachate wells, situated at the low point of each cell. The individual sumps in each cell are connected together by pipe work to allow all leachate to be collected at the lowest sump prior to removal. The cell basal liners are constructed from Ruabon Marl, 1m thick with permeability of $1x10^{-9}$ m/s

2.3.3 Some confusion exists as to the identity of Leachate Extraction Chambers that were constructed at the base of the cell before filling. On historic drawings, these are designated ‘LMP’ and today comprise LMP2, LMP6, LMP7 LMP8 and LMP9. Drawing number SMM/GAR/030/91 features a newly opened Cell 5 with spot heights of 109m AOD, and LM5 clearly marked in the base of the cell. The LMP series of wells are taken to be those constructed from the base of the cell upwards. None of these original wells remain intact, but have been replaced several times with retro fitted wells, and a series of retro drilling logs are presented below in Table 4. Other leachate monitoring points are combined gas extraction wells, and are designated GWM. Historical survey drawings refer to these as ‘Gas Well Converted from Manhole’. The location of these wells from historical survey drawings is so close to the original LMP series of wells, that it is suspected that some of the GWM series of wells are in fact the original LMP series of wells that have been redesignated, andas such, some confusion may have arisen during monitoring exercises and affected the quality of the data.

2.3.4 The most recent set of redrilled wells have been designated LMP6R, LMP7R, LMP8R and LMP9R, despite the drill log clearly specifying peg numbers to work from which were designated 'GWMx'

2.3.5 Monitoring points for which data is available are LMP6R, LMP7R, LMP8R, LMP9R, GWM1, GWM3,GWM4, GWM5, GWM6, GWM7, GWM8, GWM9 and GWM10.

Table 4: Monitoring Infrastructure Status

Previous Licensed Area	Cell	Basal Area (m2)	Top (mAOD)	Date of last known Top Datum	Base (mAOD) *from Basal Plan Drawing No. 4300/4*	Existing Monitoring Points	Status
WMBC/L50	1	3394	-	-	-	None	
WMBC/L50	2	10552	-	-	-	None	
WMBC/L50	3	11754	125.41	04/08/2021	110.5	GWM3	Current compliance point
WMBC/L50	4	6760	126.09	04/08/2021	109.6	LMP2	Current compliance point
			124.69	04/08/2021	110	GWM1	Current compliance point
			127.79	04/08/2021	110	GWM4R	Current compliance point
WMBC/L50	5	5498	131.45	04/08/2021	109	GWM5	Current compliance point
WMBC/L50	6	6030	130.74	04/08/2021	111.95	LMP6R	Current compliance point
			131.25	Apr-04	111.95	GWM6	Not in use
WMBC/L50	7	7990	128.85	Apr-04	109	GWM7	Not in use
			128.83	20/07/2005	110.7	LMP7	Not in use
			129.22	04/08/2021	110.7	LMP7R	Current compliance point
WMBC/L50	8	14013	133.20	06/01/2005	109.4	GWM8	Not in use
			133.20	06/01/2005	109.4	LMP8	Not in use
			132.45	04/08/2021	109.4	LMP8R	Current compliance point
WMBC/L50	9	12323	134.00	01/04/2004	110	GWM9	Not in use
			132.68	04/08/2021	110.7	LMP9R	Current compliance point
WMBC/L82	11*	15000	123.15	04/08/2021	96	GWM10	Current compliance point
Totals	11	93314					

* It is possible that the bund walls between cells 10 and 11 being removed, thus making the extension area effectively one cell (note from LMP V5)

2.3.6 Retro-drilled leachate chambers replace the four leachate chambers LMP6, LMP7, LMP8 andLMP9, and are designated LMP6R, LMP7R LMP8R and LMP9R.

2.3.7 Leachate pump status and pump type is detailed in Table 5.

2.3.8 In August 2020, and as part of ongoing open actions with NRW regarding gas migration in the SE extension area, Infinis drilled 7 new in waste gas wells (GW1412, 1413, 1414, 1415, 1416, 1417, and 1418) along the edge of the SE extension to help control routinely elevated perimeter borehole gas in this area. The 7 new gas wells were drilled with a 2m standoff from pit base which were agreed to be eductor pumped as soon as installed. Eductor pumps are installed in each of these wells now and they all discharge leachate to the main storage tanks.

2.3.9 In September 2020 (25/09/2020) FCC altered the pumping strategy at GWM10 to further help with liquid removal from the SE extension area. GWM10 now contains an eductor pump and a VP4 pneumatic pump.

2.3.10 When the eductor system shuts off with storage tanks full, the air pump in GWM10 activates upon a rising level and begins to pump, discharging leachate to LMP6R which is known to have

a very low recharge rate. When the storage tanks are emptied, the eductor system restarts and the eductor pump in LMP6R clears discharged leachate ready for the cycle to begin once again when the eductor system stops.

Table 5: Installed Leachate Pumps

Licensed Area	Cell	Monitoring Points	Pump Type
WMBC/L50	1	GWM1	Eductor
WMBC/L50	2	GW57	Eductor
WMBC/L50	2	LMP2R	Eductor
WMBC/L50	3	GWM3	Eductor
WMBC/L50	4	GWM4R	Eductor
WMBC/L50	5	GWM5	Eductor
WMBC/L50	6	LMP6R	Eductor / This chamber accepts pneumatic pump discharge from GWM10
WMBC/L50	7	GW14	Eductor
WMBC/L50	7	LMP7R	Eductor
WMBC/L50	8	LMP8R	Eductor
WMBC/L50	9	GW47	Eductor
WMBC/L50	9	LMP9R	Eductor
WMBC/L82	10	GW33R	Eductor
WMBC/L82	10	GW30R	Eductor
WMBC/L82	10	GW26R	Eductor
WMBC/L82	10	GW34	Eductor
WMBC/L82	10	GW67	Eductor
WMBC/L82	11	GW25R	Eductor
WMBC/L82	11	GW31R	Eductor
WMBC/L82	11	GWM10	Eductor pump discharges to storage tank. VP4 pneumatic pump discharges leachate to LMP6R when storage tanks full.
WMBC/L82	11	Horizontal well 37	Eductor
WMBC/L82	11	Horizontal well 38	Eductor
WMBC/L82	11	Horizontal well 40	Eductor
WMBC/L82	11	GW1412	Eductor
WMBC/L82	11	GW1413	Eductor
WMBC/L82	11	GW1414	Eductor
WMBC/L82	11	GW1415	Eductor
WMBC/L82	11	GW1416	Eductor
WMBC/L82	11	GW1417	Eductor
WMBC/L82	11	GW1418	Eductor

2.4 Retro-Drilled Installations - Limitations

2.4.1 For sites that have lost existing leachate collection and monitoring chambers retro-drilling of replacement chambers is often used. However, replacement chambers rarely fully replicate the function of a pre-constructed leachate collection and monitoring well (unless the retro-drilled chamber can be safely installed into the sites constructed basal drainage at its lowest point). Flowof leachate within a site is governed by the transmissivity of the waste. This is usually very low (withporosity's thought to vary somewhere between 2 – 10%) resulting in flow of leachate to retro- installed leachate chambers typically being low (often in the order of 1 – 5m^3/day). Retro-drilled chambers often report monitoring results that require a greater degree of interpretation than simple 'leachate level' or 'head above the base' of the site.

2.4.2 This is explained by considering the 2 types of leachate monitoring or collection chamber that can exist in a landfill site:

1. Chambers that <u>are</u> connected to the cell basal drainage (i.e. built up from the base as waste is placed in the landfill or retro-drilled into the basal drainage).

2. Chambers that are not connected to the cell basal drainage (i.e. installed into the waste fromthe surface, typically by drilling, after or during the placement of waste).

2.4.3 It should be noted that some of the chambers installed at a site could originally be in Group 1 but due to movement of the waste, settlement and collapse / blockage of chambers could move into Group 2.

2.4.4 There are also 2 important distinctions between the construction detail that can be used for chambers that are installed in a site:

a. Chambers that are constructed with a short basal section that is perforated and the remainingupper section with no perforations.
b. Chambers that are constructed with a short upper section (typically from 2m below cap level toground level) that is not perforated and the remaining lower sections all perforated.

2.4.5 Chambers of installation detail Type 'a' are designed to report the effective head of leachate acting above a specific depth (sometimes called a peizometer). Most chambers that are connected to the drainage layer (Group 1) and used for leachate head compliance monitoring are constructed as Type 'a' so that the head acting on the basal drainage and containment levels are monitored.

2.4.6 Chambers of installation detail Type 'b' are designed to report the presence of leachate at any pointthroughout the depth of waste that they intersect and are more commonly used to collect leachate for pumping rather than as compliance monitoring points. Some consequences of these different designs and their use in judging the presence, location and volumes of leachate within the waste mass are as follows:

- Only chambers of Group 1, Type 'a' are capable of informing you of the leachate head actingon the site containment layer.
- Chambers of all other details (Group 1, Type 'b': Group 2, Type 'a': Group 2, Type 'b') only inform you of the presence of liquid within the waste body that they intersect, not whether the head generated by that leachate is acting on the site's containment system.
- If a leachate head is recorded in a chamber of installation detail Type 'b' all this tells you is that leachate is entering the chamber in its upper section faster than it is able to soak away in its lower section. Both the inflow and soak away rates can be extremely low but as long as the inflow is faster than the outflow of leachate the chamber will develop a head of leachate withinit. This head is not necessarily acting on the underlying containment layer and the leachate level it represents does not necessarily exist within the waste body. The conditions that aremost likely to develop within a landfill site will tend to result in this situation of inflow rate exceeding the soak away rate of any liquid present. The lower perforated sections of the chamber are most likely to become blocked due to blinding with finer waste decomposition particles, deposits of 'concretions' and settlement of fine materials than the upper sections. Thisslows the outflow of leachate from the basal sections compared to the upper sections of the chamber. The lower section is also located in waste that is more densely compacted (due to surcharging from the waste deposited above) and therefore possessing a lower permeability than the upper sections, again reducing the outflow rate in comparison to the inflow rate. This type of chamber will therefore fill to the level of perched layers and reports anomalously high leachate levels if not properly understood.

2.4.7 Conversely, if the outflow (soak away) rate for the basal section of the chamber is greater than the inflow rate, then the chamber will never be able to generate a leachate head, regardless of how large the inflow to the chamber is.

2.5 Ruabon Basal Levels

2.5.1 Basal level data for the originally constructed leachate wells is not available from 'As Built' drawingsof constructed cells, as the cells were not constructed under CQA.

2.5.2 The permit details the leachate compliance level to be as set out in condition J.9: If the depth of leachate as measured in anyleachate monitoring well is found to exceed 2 metres above the level of the base of the site at that point, hereinafter called the trigger level, then leachate shall be removed by pumping

until the depth of the leachate falls below that trigger level. The levels shall be recorded in the site diary (see L.6) or condition J.21 If the depth of the leachate as measured in any leachate monitoring well is found to exceed 2 metres above the level ofthe base of the site at that point, hereinafter called the trigger level, then the leachate shall be removed by pumping until the depth of leachate falls below that trigger level. The levels shall be recorded in the site diary (see L.9)

2.5.3 Table 6 presented below is a summary of basal levels and the source of these basal levels. As can be seen from the table the basal measurements can vary by several meters. Basal Plan datum are taken from the Basal Plan drawn by coordinated surveys from historic plans, the figures being only as accurate as drawn contours.

2.5.4 The continuation of base datum surveys will enable further assessment of siltation or collapsed infrastructure in the future.

Table 6: Base Levels as Reported from Ruabon in mAOD - data from 22/10/2021

Leachate Well	Liner Level* (mAOD) *From Site Basal Plan Drawing Number 4300/4*	Chamber field depth (mbgl)	Base Level of Chamber, calculated from Top datum level, m(AOD)
GWM1	110	14.24	110.45
LMP2R	-	16.09	110.00
GWM3	110.5	13.16	112.25
GWM4R	110	17.71	110.08
GWM5	109	20.95	110.5
LMP6R	111.9	19.34	111.40
LMP7R	110.7	18.42	110.80
LMP8R	109.4	22.45	110.6
LMP9R	110.7	22.38	111.6
GWM10	96	27.15	96.0

NOTE:
Basal Levels transferred from original site data have no reference to an original construction drawing or survey undertaken, origin unknown.
*****Liner Levels taken from the Site Basal Plan, as compiled by Co ordinated Surveys April 2004, refer to the **Base of the Site below the monitoring point,** taken from Drawing Number 4300/4, from historically held drawings.
*****Base levels are the 'founding' level of the installation, calculated from drilling logs and are taken from surveyed ground levels at time of installation, to ordnance datum, less the drilled depth.

2.6 Leachate Removal Infrastructure

2.6.1 Leachate is currently removed from the cells by pumping in order to comply with Condition J.9 and J.21 of the sites Waste Management Licences. This is currently achieved using Eductor pumps within the leachate collection/extraction wells and within some gas extraction wells.

Dependent on the effectiveness of pumping of leachate from the leachate extraction and monitoringpoints, the possibility of utilising further gas extraction boreholes to increase the rate of extraction, and control of leachate to agreed levels, will also be considered.

2.6.2 Leachate pumps and associated collection systems must satisfy a number of design criteria forthem to be suitable for leachate pumping on a landfill site:
Leachate Pumps:

2.6.3

i) should be permanent installations so that they do not rely on the chamber being accessibleor there being sufficient manpower to move and re-install on a regular basis
ii) must be easy to install and remove
iii) must be of robust manufacture, ~ body stainless steel, hoses MDPE

iv) have minimum moving parts
v) should be capable of a variable flow rate, as conditions will vary widely throughout the seasonal cycle. A range of from about 60 litres an hour to greater than 1m^3/hour would be realistic for a pump located within a borehole
vi) should be automatic, turning on when leachate is present and off when not present, ideally capable of running dry with no harm being done to its operation or be fitted with sensors to stop operation of the pump in dry conditions
vii) should be capable of being controlled by a remote signal to turn the pump on and off (for instance a signal from a storage tank level sensor to turn on when tank empty and off whentank full)
viii) pump should be designed for low maintenance
ix) should be capable of handling varying quantities of fine material and sludge that often accompanies leachate production, perhaps with additional protection being afforded by filtration
x) must have sufficient power to lift leachate against a head equivalent to the depth of the site and to overcome frictional losses within the collection system to enable leachate to be delivered to the storage tank
xi) should be able to record flow rates so that the effects of pumping on recharge can be seen

Collection Systems:

i) pipe work should be of robust, chemically resistant manufacture, MDPE etc, with a burst pressure in excess of that capable of being delivered by the field pumps pumping against a closed valve
ii) where possible all joints should be welded to avoid leakage
iii) pipelines should be located in such a way as to avoid frequent movement and areas where vehicle movements may crush pipes, where pipelines cross roadways they should be protected from crushing
iv) all pipelines should be clearly labelled or marked out and their locations surveyed and recorded on a site services plan
v) should be fitted with failsafe systems so that field pumping can be stopped and started with signals from storage tank level sensors. This should include an activated valve that stops the collection system discharging to the storage tanks at tank high level or emergency shut-off.

Ruabon landfill has an automated tank storage system at present.

2.7 Leachate Storage and Removal

2.7.1 Leachate removed from the cells can be pumped to the leachate storage tanks. Leachate storage facilities at Ruabon are bunded to 110% of their capacity and currently hold around 40m^3 in volume for the original storage tank with an additional tank of 75m^3 in volume. Both tanks are being utilised.

2.7.2 The storage tanks have an inwards flow meter and a level gauge fitted, and a tanker spill area is also present. The tanks fill to their pre-set maximum level and the system shuts off via automated float control. The floats are situated in the tanks and deactivate pumping when they detect a full tank level. Telemetry data is remotely available from the tanks to assess storage levels of leachate at any time. Storage tanks should be emptied (either to disposal outlet or re-circulation) at a rate that encourages 24/7 field pumping.

2.7.3 No cap recirculation takes place anymore however at Site. The only point recirculated leachate does occur is from is GWM10 (only in exceptional circumstances, i.e. the tanks have not been emptied), this leachate chamber has a VP4 air pump installed alongside the eductor. When the eductor system shuts off with full tanks, the air pump initiates on a rising level and discharges leachate into LMP6R / GWM6 located just outside of the extension area.

2.7.4 Over the preceding 8 years, recirculation was active between 2014 and 2018, the total annual volume of leachate removed by tanker fluctuated between 6,708m^3 and 7,7776m^3. Recirculation ceased in August 2018 with a volume removed of 7,486m^3, during 2020 and 2021 the volumes of 12,257m^3 and 12,740m^3 were removed respectively.

2.8 System Inspection and Maintenance Procedures

2.8.1 The responsibility for system maintenance lies with the Site Manager, aided by the Compliance Advisor.

2.8.2 Maintenance of the pre-engineered leachate containment, collection and monitoring systems should be a priority at the site. The most valuable asset at a site for the control of leachate is a fully functioning engineered leachate management infrastructure. At Ruabon this currently consists ofthe following elements;

- Basal leachate containment system.
- Basal leachate drainage and collection layers.
- Pre-constructed leachate pumping and monitoring chambers replaced by 4 retro-drilled combined leachate pumping/monitoring wells.

2.8.3 Full historic CQA documentation of these elements are not available. Further records should be maintained of the construction details of all retro fitted leachate pumping and monitoring structures to include as a minimum the following information;

- Chamber identification number, location ordnance survey national grid co-ordinates and relevant as-built drawing number reference where available.
- Chamber construction details (cross-section).
- Basal Level referenced to mAOD (either Basal Drainage Invert Level and/or Base of Chamber).
- Top Datum (from where monitoring levels are taken) referenced to mAOD and to a date. This should be compiled into the form of a Top Datum history detailing every change in elevation of the point from which monitoring takes place. Typically the Top Datum for each monitoring point will be determined by surveying.

2.8.4 In regard to operational problems or failure (leachate collection infrastructure, wells or monitoring infrastructure), if found these should be remediated as quickly as possible. The most common form of failure is blockage or collapse of leachate pumping or monitoring structures. Failure of chambers can be identified by comparison of the accessible chamber depth (from 'Dip to Base' that should be regularly monitored) with the as- constructed depth ('Top Datum' in mAOD minus 'Basal Level' in mAOD). Advice on the remediationof blocked and collapsed chambers and the recovery of 'lost' chambers can then be obtained from the Leachate Management Team.

2.8.5 The above procedures are important for both the correct reporting of leachate levels and also forthe control of risks associated with the management of leachate at landfill sites.

- Knowledge of the elevation and construction of the base of the site is critically important for calculation of the head of leachate present above the site containment systems. For sites where compliance is regulated on this; data records of Basal Levels are essential. It is not possible to correctly monitor leachate levels without the survey information detailed above. For instance, if a leachate chamber is raised by 10m but the 'Top Datum' is not increased, leachate levels referred to mAOD will appear to be 10m below actual levels. This can lead to problems with compliance (i.e. not being able to prove correct leachate levels), problems with permitting (i.e. Hydrogeological Risk Assessments depend on comparison of leachate levels to surrounding groundwater levels) and problems with leachate management (i.e. leachate levels may be closer to breaching containment than expected).
- Knowledge of which chambers control leachate in which areas of the site and also an understanding of which chambers re-charge at high rates is also helpful in deciding which areas are critical to leachate level control. If details of construction and design philosophy of particular features of the leachate management infrastructure are lost then important control measures may be neglected. This can lead to breaches in leachate containment. For instance, if leachate drains fall to a particular sump to enable effective pumping and the location of the sump is subsequently 'lost', saturation of specific areas of waste with leachate can occur.

2.8.6 For sites that have lost existing leachate collection and monitoring chambers retro-drilling of replacement chambers is often used. Should retro-drilling of leachate chambers to close to thebase of the site be required it should be undertaken with extreme caution. Knowledge of the depth to base of the site at the point where retro-drilling is to take place is important for 2 main reasons;

1. To avoid breaching site containment by puncturing the base of the site with over deep

installations.

2. To avoid setting compliance levels for retro-installed leachate monitoring and collection infrastructure that is not achievable due to a lack of site depth in that area.

2.8.7 If the relevant engineering detail is not available to determine the design and elevation of the baseof the site the following steps should be taken. It is very important to undertake this work prior toany retro-drilling. The intention is to discover if any existing site infrastructure is still connected tothe drainage systems and/or to discover if any existing infrastructure extends to below compliance levels, thus being useful for monitoring or achieving compliance. Failing this, the presence of waste to below compliance levels needs to be confidently predicted to enable safe installation of retro- drilled wells:

1) Internal desk study – to find copies of all relevant documentation that may contain descriptions of or plans showing basal levels and/or construction details of cells. This should includesearches of all active and archive data / document stores for Site Licenses, Working Plans, CQA Documents, Site Surveys and Reg. 15 / Hydrogeological Risk Assessments.
2) External desk study – contact should be made with all contractors and consultants who may have worked on relevant jobs at site to find relevant information. Viewing of the Environment Agency's Public Register records for the relevant site license should be undertaken and where appropriate copies taken.

2.8.8 If the required information is still not available from desk studies site investigations should then be considered. Site investigations should also be undertaken if leachate pumping and monitoring structures have been lost. All existing structures located within the waste mass should be investigated to discover their as-constructed depth. If this information is not available all such structures should be assessed for their current accessible deepest point. This may entail dipping, drainage-rod / piezo-pipe or camera surveys especially if the intention is to find out if structures can be used to accommodate leachate pumping to below a set level.

2.8.9 As a last resort retro-drilling of leachate monitoring and pumping chambers may be necessary without the benefit of as-built cell information. If this is the case maximum drilling depths should be assigned based on the maximum known or provable depth of waste. Stand-offs from external wasteflanks should also be left by assuming a minimum of a 1:3 slope on batters. This must be done to avoid installation of over deep wells that would risk breaching site containment. However, wheneverretro-drilling in areas where as-built cell details are not available it must always be considered that basal cell topography may not be simple and that structures such as inter-cell bunds or geological features that have been engineered around may locally elevate the site base.

2.8.10 Should blockages be discovered in leachate collection and monitoring wells several techniques are available to remediate these problems. These range from removal of silts, sludges and rubble blocking bases of chambers, removal of large objects such as abandoned pumps or collapsed re- enforcement rings, reforming of collapsed chamber sleeves using piling techniques or re-lining of partially collapsed chambers.

2.8.11 All of the equipment used within the leachate management system is regularly inspected, where possible, and maintained and repaired as necessary. Inspectionand maintenance activities include the following actions:-

- Inspection of drainage blanket and collection pipework during placement of the initial lift of waste in the base of each cell, to ensure that any damage is identified and remedial action taken (all works now completed);
- Weekly inspection of leachate chambers for evidence of damage and the repair of damaged items to ensure that the integrity of the system is maintained;
- Review and assessment of leachate extraction and monitoring riser pipes to assess suitability for use, and retro-drilling of pipes where excessive deflections or blockages occur;
- Removal of leachate abstraction pumps at intervals recommended by supplier, for cleaning inspection, maintenance and repair;
- Inspection of leachate carrier pipework for evidence of damage and leaks;
- Inspection and remedial measures (e.g. jetting or use of a 'guzzler') to extraction pipework, when necessary, to maintain the ability to reduce leachate levels.

2.8.12 In addition to the regular routine of maintenance, further assessment and additional measures, if

required, would be triggered by the leachate monitoring action plan.

2.8.13 Abnormal / unexpected changes in leachate level are unlikely once management of levels at the proposed and agreed limit is maintained. Ongoing dipping and field inspections will continue, any recognised changes in level will initiate the following:

- The well will be re-measured as soon as possible after receipt of the data;
- if the re-measurement does not exceed the compliance limits then no further action will be taken.
- If the level is exceeded then the pump service contractor (Landfill Projects) will be contacted as soon as possible, typically within 24hrs of detecting an elevated level. The pump will be removed and inspected and if necessary, replaced. Dipping of the chamber 24hrs after this work is completed should determine if level reduction, or further elevation has occurred. If the level is not responding as intended, further investigation into pumping from the affected chamber will ensue. Investigations into potential pipework blockages, kinks, or damage should be considered.

NRW will be informed, and actions will be considered as described below:

- Increasing the frequency of leachate level and quality monitoring;
- Increasing the frequency of groundwater level and quality monitoring; and
- Consider installing additional leachate abstraction wells.
- The findings of the investigations and any proposed further action will be reported to NRW for agreement.

2.8.14 In addition to the above, the Emergency Leachate Contingency Plan is contained within the Working Plan for Closed Site Operations, Issued 13/03/01 which deals with actions to be taken in the event of a leachate breakout being discovered. In the event of a breakout being discovered, the following action will be taken:

- The breakout will be bunded using suitable materials and / or the emergency spill kit to prevent contamination to the surface water collection systems.
- The leak will be traced back to it's origin and the leak repaired. The repair being dependant on the nature of the outbreak and in agreement with NRW
- The repair will be monitored on a daily basis for a period of two working weeks to ensure the repair has been effective
- Should the repair prove ineffective, the leak will be channelled to the nearest leachate eductor point to ensure it is controlled within the leachate recirculation system using suitable pipe work to the same specification as the existing system
- In the event of the nearest eductor abstraction point being unsuitable, an additional eductor abstraction point will be constructed in agreement with NRW

2.8.15 With a potential impact to controlled waters, in the event of leachate outbreak, the following actions would be considered after NRW are informed, actions will be considered as described below:

- Increasing the frequency of leachate level and quality monitoring;
- Increasing the frequency of groundwater and surface water quality monitoring; and
- Consider installing additional leachate abstraction wells.
- The findings of the investigations and any proposed further action will be reported to NRW for agreement.

2.8.16 Extreme weather events are uncommon, however, to mitigate against low temperatures and potential freezing of pipe lines, these are lagged at Site to avoid such issues. To mitigate against access issues, grit bins are provided to enable access during days where sub-zero temperatures are encountered. This is to enable Site operatives to visit site and to continue with operational duties.

2.8.17 If excessive standing water (through prolonged rainfall / seasonal events) is experienced in the Site main access area, water pumps are available at the entrance to remove excess water, again

to allow Site operatives and leachate removal vehicles access to the site at all times for operational duties.

3.0 Monitoring

3.0.1 The leachate monitoring system will:

- Determine the head of leachate and quality of leachate in each cell;
- Help determine the stage of waste decomposition;
- Determine appropriate leachate management measures;
- Ensure that the control criteria and trigger levels are not exceeded; and
- Identify when relevant completion criteria are satisfied.

3.1 Leachate Level and Quality Monitoring

3.1.1 Monitoring of leachate levels are required on a regular basis to determine if the site is being maintained in accordance with its Waste Management Licences / Environmental Permit. The leachate level compliance points and frequency of monitoring will be in accordance with the schedule currently agreed withNRW for the site. Should any levels be reported that exceed the Compliance Level then the Leachate Contingency Action Plan should be enacted. Leachate Level monitoring information should include:

Dip to Leachate, Dip to Base, Field Leachate Head, volume removed by pump, as pulse counter or flow meter reading, for all Leachate Collection Points in cells where leachate is extracted).

3.1.2 Leachate quality monitoring should be undertaken at the frequency and for the parameters in accordance with the schedule currently agreed with NRW for the site.

3.1.3 In addition to the monitoring required by NRW it is recommended that additional leachate monitoring takes place at the site, especially when leachate is being pumped for off-site disposal or re-circulated. Should leachate re-circulation take place on the site the additional monitoring should be considered.

3.1.4 To ensure that any re-circulation system is performing correctly the system will need to be regularly monitored. The re-circulation system can be divided into 2 parts, leachate extraction (monitor draw down of leachate) and leachate absorption (monitor accumulation of leachate). The following monitoring should then be undertaken:

Draw Down Monitoring:

Structures in cells fitted with leachate pumps from which leachate is being removed need to be monitored weekly as follows:

- Weekly Dip to Leachate, Dip to Base, Field Leachate Head, Pulse Count or flow meter reading (all Leachate Collection Points in cells where leachate is extracted).

This monitoring will enable an assessment of the rate at which leachate levels are falling to be made.

Re-circulation Monitoring:

Chambers and selected structures in cells into which leachate is being re-circulated need to be regularly monitored to ensure that perched levels are not forming adjacent to waste batters and cell perimeters. Gas wells and other such non-pumped structures should be selected so that all external waste batters / cell perimeters adjacent to the site boundary have at least 1 monitoring point. In addition, waste batters and perimeters of cells should be inspected for signs of leachate breakout.

3.1.5 Should rapid increases in leachate levels be noted, leachate levels close to the surface or evidence of leachate seepage at cell perimeters be observed all re-circulation of leachate should cease and the situation be re-assessed before recommencing re-circulation. In addition, the flow of leachate into each of the chosen re-circulation points (whether that be via flow meters fitted to pipelines or by recording number of bowser loads for direct application to freshly tipped waste) needs recording on a daily basis. Leachate levels within re-circulation points also needs daily monitoring and the inflows adjusting accordingly should they be found to be filling too rapidly (turn down input rate) or remaining dry (turn up input rate).

- Daily visual inspection of all batters and perimeters (all perimeters and batters).

- Daily records made of volumes re-circulated (either in bowsers or through sub surface systems).
- Daily inspection / dipping of all re-circulation points and adjustments to inflow rates made and recorded.
- Weekly Dip to Leachate, Dip to Base, Field Head (all Leachate Collection Points and selected gas wells in cells where leachate is re-circulated).

3.1.6 The information collected should be used to make operational decisions regarding the need to increase or decrease the rate of re-circulation of leachate. On an annual basis the information collected should be reviewed to ensure that the rate of reduction of leachate levels is occurring and that areas into which it is being re-circulated are not flooding. Leachate chemistry data should also be assessed to ensure that no detrimental effects are being reported to leachate strength and that the methanogenic / acetogenic nature of the waste is not being affected. This information should form part of the site annual environmental report.

3.1.7 If leachate is being tankered from site the daily number of tankers and their volumes also needs to be recorded and basic leachate quality sampled on a regular basis from the disposal tanks.

3.1.8 Sampling frequencies and determinands may be modified and adjusted as appropriate as part of an on-going and regular review of the Leachate Management Plan or as part of the regular environmental monitoring review. Additional determinands may be considered dependent upon the results of the current monitoring regime and any changes to the waste types deposited. The frequency of testing and/or number of determinands may be reduced in consultation with NRW.

4.0 Compliance Levels

4.0.1 The site licence requirement is to try to maintain leachate heads at 2m above the base of the site at that point. (Condition J.9 and J.21) This condition was written at a time before landfilling operation commenced, and was based on a freeboard below the height that the original clay quarry was deemed to be at risk of brimming. (Overflowing the clay excavation depth). In addition it is possible that Groundwater conditions around the site have changed since infilling began and also the original array of leachate chambers has been lost. Any compliance levels suggested therefore need to recognise both the potential risk to the environment from advective and diffusive flow, seepage and leaking at the surface and the current condition of installed abstraction infrastructure. The need to maintain a particular leachate head therefore needs to be balanced against the risk associated with replacing wells close to the site base. It is therefore recommended that a 3 pronged approach be taken to defining and achieving suitable sustainable compliance levels at the site as follows;

i. Reduce levels in all wells to their lowest practical level.
ii. Undertake a Hydrogeological Risk Assessment for the site with the primary aim of quantifying suitable leachate compliance levels that balance the risks associated with leachate leakage and installing replacement wells close to the site liner.
iii. Install new or remediate existing suitable infrastructure to achieve compliance levels defined as a result of the HRA proposed above.

4.0.2 In recent years the original leachate chambers have failed and have been replaced by retro-drilled installations. These wells have been installed into the waste with a ‘stand-off’ between the base of the drilled hole and the landfill liner. This has been done in an attempt to install a well that is able to maintain a leachate level that is as close to the 2m head above liner level as possible whist not compromising the site lining system during installation. Thisis especially important at Ruabon where the base of the site is not accurately known.

4.1 Proposed Compliance Levels

4.1.1 Proposed levels for the leachate wells based on the Hydrogeological Risk Assessment is provided in table 3.

4.1.2 Action levels have been set at “compliance limit” minus 1m.

4.2 Compliance Level Contingency Action Plan

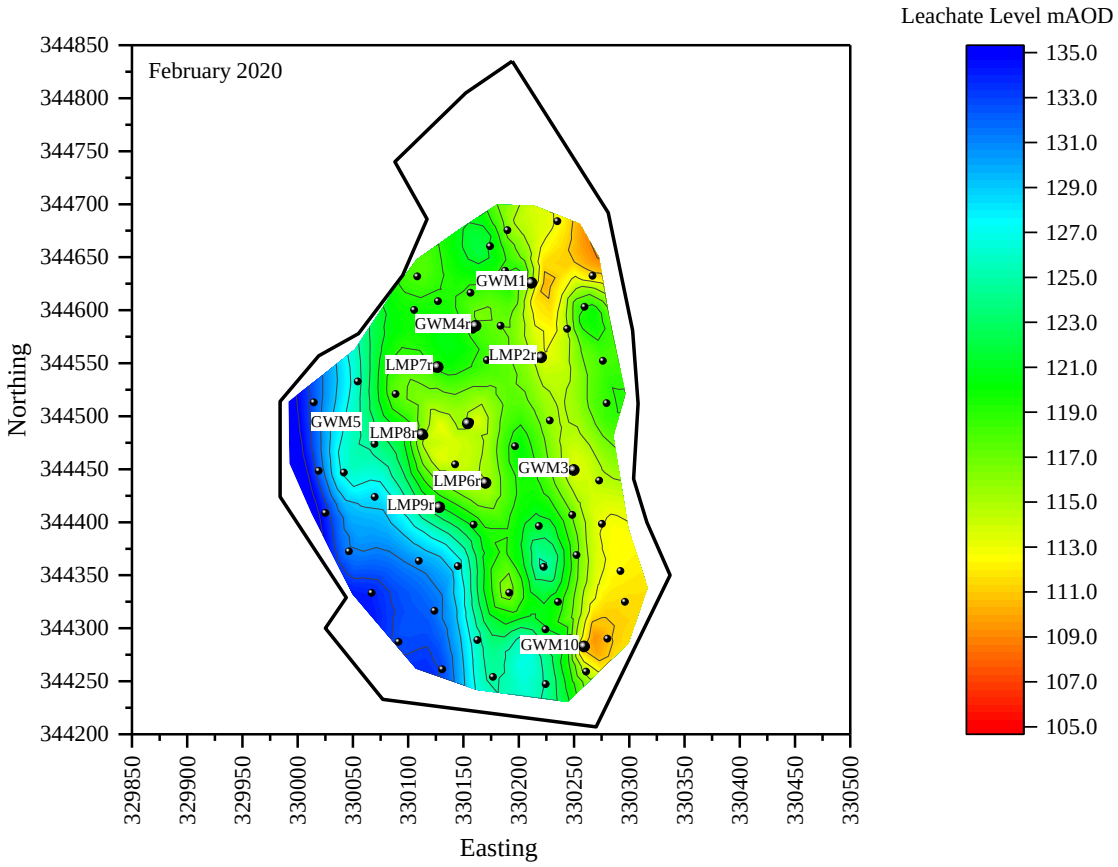
4.2.1 In the event that Compliance levels are exceeded at the designated monitoring locations, the various actions that may be appropriate are detailed below:

i) Advise Site Management
ii) Confirm by repeat sampling and analysis
iii) Advise WRG Regional Environment Manager
iv) Follow WRG Escalation Procedure
v) Advise NRW
vi) Review existing monitoring information
vii) Review site management and operations, implement actions to prevent future breach of compliance levels
viii) Review the assumptions incorporated into the site conceptual model
ix) Review existing hydrogeological risk assessments
x) If risks are unacceptable, set in place procedures for implementing corrective measures in consultation with or required by NRW

4.1.2 In the event of leachate levels being confirmed as exceeding the compliance level, the likely outcome of any investigations will be to increase the rate of leachate disposal from the site. This will be achieved by actions such as installing pumping to any suitable installations in the waste as necessary. Consideration will be given to the need to install additional leachate extraction pumps and installation of pumps with greater pump rates.

5.0 Review of Leachate Level Monitoring Data

5.0.1 Leachate levels were reviewed at the time of application report production in early 2021, the figure below indicated the leachate levels in February 2020.



5.0.2 A current review has been undertaken and is presented in table 7 below.

Table 7: Current Leachate Levels (mAOD) – June 2021 – December 2021

Leachate Well	December 2021 (mAOD)	June 2021 – December 2021 (average), mAOD	Proposed Compliance limit (mAOD)
GWM1	111.27	111.54	114
LMP2R	111.52	111.60	114
GWM3	113.92	113.88	114.25
GWM4R	110.66	111.01	116
GWM5	111.09	111.57	119
LMP6R	113.33	113.05	119
LMP7R	111.18	111.37	119
LMP8R	111.74	111.65	125
LMP9R	111.91	111.90	125
GWM10	97.53	97.71	106.6

6.0 Calculation of Excess Leachate

6.0.1 Using the leachate levels reported recently from the site, the data collated in table 7 indicates that there is no requirement for additional leachate removal in accordance with the proposal contained within the current permit variation application.

6.0.2 At present, a previously calculated infiltration through the cap was calculated at 5,110m^3/yr, this is half the volume that has been removed over the past 2 years. This information indicates that the infrastructure is capable of managing leachate level in the site irrespective of the actual compliance limit. The data reviewed over the preceding 6 months indicates that levels are being maintained by the extraction system.

7.0 Leachate Management Strategy

7.0.1.1 Daily Records:

7.0.1.1.1 Volume discharged from site

7.0.1.2 Weekly Leachate Monitoring Exercise:

7.0.1.2.1 Dip to Liquid, Dip to Base, Pulse count or flow meter reading, all dips referenced to mAOD

7.0.1.3 Weekly Borehole Monitoring Exercise:

7.0.1.3.1 Dip to Liquid, Dip to Base, water temperature, all dips referenced to mAOD for all boreholes representative of local groundwater levels in the south west corner of the site.

7.0.1.4 **Monthly Leachate Quality Sampling Exercise, from each leachate well:**

7.0.1.4.1 Carried out for the determinands mentioned in Condition J.7 of License L/50, and also to include temperature in degrees Celsius.

7.0.4 Pumping systems should be maintained such that pumpingcontinues automatically from leachate wells to storage tanks for off- site tankered disposal to suitably licensed disposal facilities, without the need for manual intervention. For this reason, an extra leachate storage tank has been included at site.

7.1 Off-Site Disposal of Leachate

7.1.1 Leachate should be disposed of off-site from all cells that report a leachate level in excess of the Compliance Levels. It is noted however that the proposal ensures that the site acts as one hydraulic cell.

7.1.2 Should off-site leachate disposal be required the leachate should be pumped to storage tanks for bulking up prior to tankering off-site. Leachate storage tanks should be set up as described in 2.7 and they should be located in an area that is easily and safely accessible by road going tankers.

7.1.3 Leachate should be disposed of to a suitably licensed treatment facility and records kept of quantities disposed.

7.1.4 Leachate disposal should continue to maintain control below approved Compliance Levels.

7.2 Further Actions

7.2.1 No further actions are proposed at this time, this LMP will be updated again post determination of the ongoing permit application.