CONCEPTUAL SITE MODEL, ENVIRONMENTAL SETTING AND SITE DESIGN

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4.0 SITE REPORT

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1.0 INTRODUCTION

1.1 Report Context

Enviroarm Limited were instructed by Chadwich Lane Quarry Limited, the owners and operators of Chadwich Lane Quarry to provide supporting information for an environmental permit for the site by way of restoration by inert waste landfilling infilled within designated phases within the planning permission boundary.

This report provides a summary to the geological and hydrogeological setting of the site, the wider environmental setting and considers the operational impacts and installation design by inert landfill and the assessment demonstrates compliance with the Environmental Permitting Regulations 2016 regarding the protection of groundwater which transposes the Groundwater Directive into law for England and Wales.

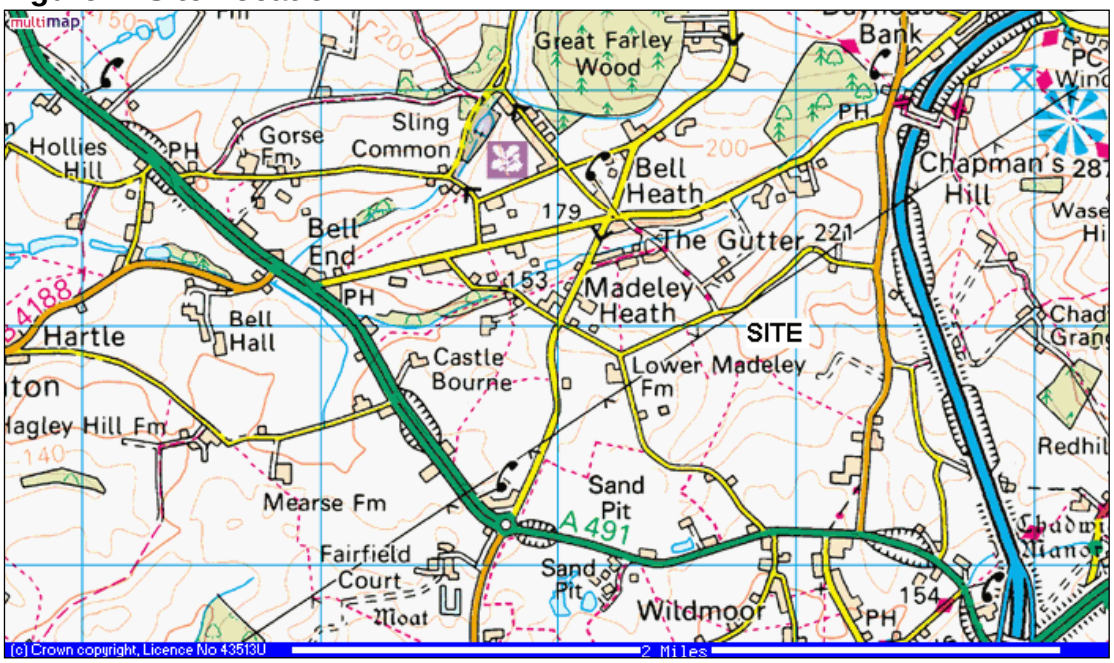
This report supports the Hydrogeological Risk Assessment which covers by way of assessment of Hazardous Substances and Non-Hazardous Polluting Substances, released into the groundwater, the Landfill Gas Risk Assessment and Stability Report.

The site is south-western fringe of Birmingham at National Grid reference SO 395448 276819 is the centre of the site and the site entrance is SO 396373 276818 see Figure 1 and Drawing ESSD 1.

The Site comprises 10.5 hectares of agricultural land located near Bromsgrove, Worcestershire. The Site includes a rectangular area which immediately abuts the former Chadwich Lane Quarry together with a linear strip of land to the south-east of the quarry.

The site is to be infilled specifically with inert waste which complies with the Landfill Tax (Qualifying Material) Order or is to be WRAP compliant and therefore outside the scope of the permit and will take 10 years to infill.

Figure 1: Site Location



The mineral extraction, landfill area covers some 140,000m^2 (14 hectares).

This report presents a review of the Environmental Setting and Site Design in relationship to the surrounding environment and has allowed for the development of a Conceptual Site Model.

This report covers all Phases of the site from the advance works including the surface water area, to the proposed landfill area through to final restoration and requirements for post closure monitoring.

The site is to be infilled specifically with inert waste.

A conceptual site model has been developed and has identified potential contaminant migration pathways. The conceptual site model has been developed on site specific data and local data obtained from the British Geological Survey, The Meteorological Office, The Environment Agency, The Coal Authority, DEFRA, including the MAGIC website, Natural England, English Heritage and data obtained from on-site testing, including; soils, groundwater, air and noise. A risk analysis for impacts on identified receptors has been developed at the Chadwich Lane Quarry Landfill Site based on the factual findings.

1.2 Installation Details

Chadwich Lane Quarry is situated off the south-western fringe of Birmingham at National Grid reference SO 395448 276819 is the centre of the site and the site entrance is SO 396373 276818 see Figure 1 and Drawing ESID 1.

The Installation Boundary has included all of the area for the inert landfill, leading through lockable gates, along a fully concreted access to the site reception area which comprises a reception area and turning area, site offices, weighbridge and wheel wash area, bunded fuel tank area and concreted treatment area before leading to the landfill area. The area covered under the current operations are coloured in yellow on ESSD 2 and the boundary is marked in green.

Figure 2: Aerial view of site

The lowest point of the quarry working is at approximately 162m AOD with a The surrounding site perimeter falls from the original Chadwich Lane site the west at 188m AOD falling to the east at 174m AOD and the site falls from Chadwich Lane southwards.

The entire quarry perimeter is fenced with three strand barbed post and wire fence and has trees on the northern and western boundary. The site security fencing is considered adequate under the provisions of the Mines and Quarries Regulations 1999 in the location. The site has substantial access leading directly off the Money Lane into the site fitted and is fitted with lockable gates. The site is within the entire ownership of Chadwich Lane Quarry Limited.

The gates at the site entrance are locked outside operating hours, and the site has offices and a wheelwash, and the new permit will cover restoration by importation of inert waste.

All of the receptors have been identified on Drawing ESSD 2 and have been summarised on the Table ESSD 2, and this has identified the receptors, there elevation and distance from the landfill boundary, within a 500 metre radius of the site.

A request was also made to Natural England and Worcestershire County Council to identify all habitat sites etc. located within a specified radius of the centre of the site and to English Heritage for ancient monuments and Historic England for listed buildings.

Table ESSD 2: Receptor List identified on ESSD 2.

Type of Receptor	Receptor Name	Location to site	Elevation m AOD
Domestic Dwelling Receptor	**DR1**	Group of houses located 575 metres north of the permit boundary.	179m AOD
Domestic Dwelling Receptor	**DR2**	Group of houses 540 metres north-west of the site.	171m AOD
Domestic Dwelling Receptor	**DR3**	Group of houses 340m north of the site	179m AOD
Domestic Dwelling Receptor	**DR4**	Group of houses 390m north of site	183m AOD
Domestic Dwelling Receptor	**DR5**	Group of houses 345m from site	167m AOD
Domestic Dwelling Receptor	**DR6**	Group of houses located 165m north west of site	167m AOD
Domestic Dwelling Receptor	**DR7**	Farm located 295 metre north -east of site.	190m AOD
Domestic Dwelling Receptor	**DR8**	Group of houses located 490m west of site.	152m AOD
Domestic Dwelling Receptor	**DR9**	Group of houses located 265 metres from site.	170m AOD
Domestic Dwelling Receptor	**DR10**	Houses directly to west of site 25 metres	170m AOD

Domestic Dwelling Receptor	**DR11**	House of side of site 2 m	175m AOD
Domestic Dwelling Receptor	**DR12**	House 335m south of site	335m AOD
Domestic Dwelling Receptor	**DR13**	Houses to south of site 520m	160m AOD
Domestic Dwelling Receptor	**DR14**	Houses to south of site 550m	160m AOD
Surface Water Receptor	**SW1**	A pool to west of site	100m AOD
Surface Water Receptor	**SW2**	A pool east of the site.	320m AOD
Surface Water Receptor	**SW3**	A pool to south of site	180m AOD
Surface Water Receptor	**SW4**	Pond to south Sandy Lane landfill site	570m AOD
Major roads and highways	**H1**	Heath End Road	171m AOD
Major roads and highways	**H2**	Quantry Lane	182m AOD
Major roads and highways	**H3**	Chapel Lane	160m AOD
Major roads and highways	**H4**	Bonfire Hill	172m AOD
Major roads and highways	**H5**	The Gutter	198m AOD
Major roads and highways	**H6**	Chadwich Lane	172m AOD
Major roads and highways	**H7**	Harbour Hill	180m AOD
Major roads and highways	**H8**	Sandy Lane,A491	160m AOD
Commercial Activity	**IR1**	Industrial operations at Chadwich Lane Farm.	155m AOD
Commercial Activity	**IR2**	Works to the east of Sandy Lane site	160m AOD
Closed historic landfills	**CL1**	Chadwich Lane landfill site now under restoration	187 -215m AOD
Closed historic landfill	**CL2**	Sandy Lane landfill site	160-180m AOD

Chadwch Lane Landfill	**PH1**	+	
Sandy Lane Landfill	**PH2**		

The site is within the outer source protection zone (III) but outside the Zone II 400-day travel time zone and is located on a principal aquifer. The indicative flood plain map shows the site to not be within the floodplain.

Based on the results of this investigation, and incorporating previous observations at the site, the likely position of the glacial channel at Madeley Heath can be estimated, though locational uncertainties and the overall lack of detailed stratigraphic information for the site prevent a precise reconstruction.

The channel is aligned NW-SE from Madeley Heath Farm Pit to Money Lane Pit, as first suggested by Barton (1960). It is at least 20m deep and is infilled with bedded sands overlain by coarse gravels and is at least 90m in width (Barton, 1960). The sediments infilling this channel were also present along the eastern side of Chadwich Lane Quarry (locations a-c of Maddy, 1989).

The south western margin of the deep channel feature may be located in the vicinity of the western edge of Money Lane Pit and to the east of Section 1 (Figure 1). Maddy's (1989) locations d and e are also considered to be outside the deep channel feature. South west of this line, a rather different suite of Pleistocene sediments is present though to not as great a depth comprising sands and gravels, reddish brown diamicton and greyish brown diamicton .

At the present time it remains unclear how these deposits relate to the channel feature and its infill of sands and coarse gravels. If the estimate of the elevation and thickness of the sediments in Money Lane Pit is correct, the deposits to the south west of the channel do not reach the same depth as those in the channel, as Triassic bedrock was observed at 198-194m OD beneath these deposits, while it may be below c.180m in the channel itself.

The north eastern margin of the deep glacial channel may lie approximately along the north eastern edge of Money Lane Pit, based on the observation by Barton (1960, figure 5) that both sides of the channel were visible at Money Lane Pit, though only low confidence can be attached to this interpretation as very little data is available and the GPR survey was inconclusive.

The potential impact of the haul road on the Pleistocene deposits at the site, in particular the channel feature and the infilling sands and gravels for which the SSSI has been designated, can be assessed with regard to the likely position of the channel which has been determined on the basis of this investigation and previous information from the site.

The route of the proposed haul road which links the new extraction area west of Chadwich Lane Quarry to the highway at Money Lane (Figure 1) is divided into five sections. Each section is evaluated in terms of whether it is within, outside or traverses

the margin of the channel feature and the likely impact of the haul road on the underlying deposits (Table 3). The proposed haul road will run on the present ground surface, following stripping and storage of soils. Section D-E has been identified as a possible location for a permanent geological exposure which would require deeper excavation into the deposits.

Based on the available data, the haul road is unlikely to impact on the channel feature and its associated deposits as, for the most part, the route lies outside the probable margins of the channel feature. Section B-C does intersect the projected alignment of the channel, though at a lower elevation and some distance away from the designated SSSI. Section D-E, which runs adjacent to the southern boundary of the SSSI, is underlain by Pleistocene deposits (as exposed in TP 16/1), however these deposits are not thought to be part of the infill of the channel feature.

Section D-E of the haul road was identified as a possible location of a permanent geological exposure. As the channel feature is not present in this area and the deposits are not representative of the infill the channel feature, creating a geological exposure in this area would be of limited value. Moreover, the difficulties of maintaining an open section in unconsolidated Pleistocene sediments would make such an exercise impractical.

The designated SSSI, which falls largely within the boundary of the Chadwich Lane Quarry, has been impacted by mineral extraction, backfilling and restoration. The small triangular area on the southern boundary of the SSSI, an area of some 0.1 ha (c. 4% of the total area of the SSSI) lies outside any of the previous extraction areas and is underlain by intact Pleistocene deposits. However, the deposits in this area, which are typified by TP16/3 and section 1, are not those associated with the channel feature). While this portion of the SSSI does provide a useful intact remnant of the Pleistocene deposits at the site it does not include the main interest for which the site was designated. This area will not be impacted by the haul road and is currently occupied by a small area of woodland.

The site has no recorded RAMSAR, SAC or SPA designations and Fairfield Court is the nearest recorded monument located 1500 metres south-west of the site.

2.0 SOURCE TERM CHARACTERISATION

2.1 The Development of the Installation

All details refer to the appropriate tables, drawings or appendices attached to the report.

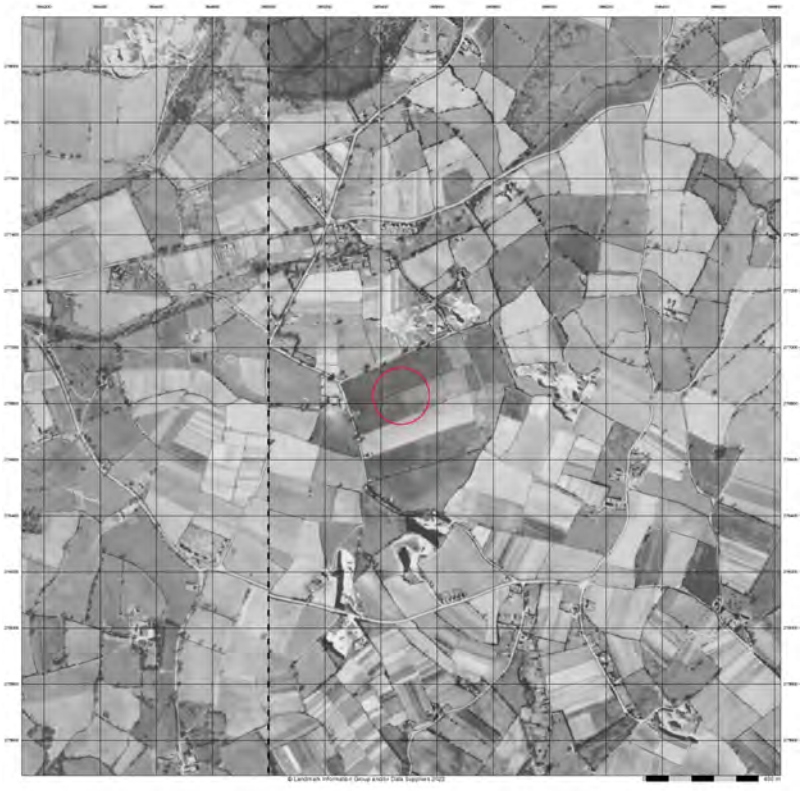
2.1.1 Historical Development

The site has been historically operated to produce sands for the North Worcestershire market since the mid 1980's. Planning permission for the "extraction and sand and gravel" was granted subject to 12 conditions in February 1983. The planning permission was accompanied by a Section 106 agreement relating to access arrangements and the placement of overburden in order to restore the former Madeley Heath Landfill Site.

The planning permission was accompanied by an agreed restoration scheme to return the site to original ground levels using imported waste materials with a long term restoration to agriculture.

Under the Review of Old Mineral Permissions (ROMP) procedures set out in the Environment Act 1995, an application for the determination of new planning conditions to continue extraction and restoration operations at the Chadwich Lane Quarry was granted by Worcestershire County Council in July 1998.

Figure 2: Initial quarrying in 1948



Quarry development is shown in Figures 3 to 8.

Figure 3: Quarrying in 1999

Figure 4: Quarrying in 2005

Figure 5: Quarrying in 2006

Figure 6: Quarrying in 2007

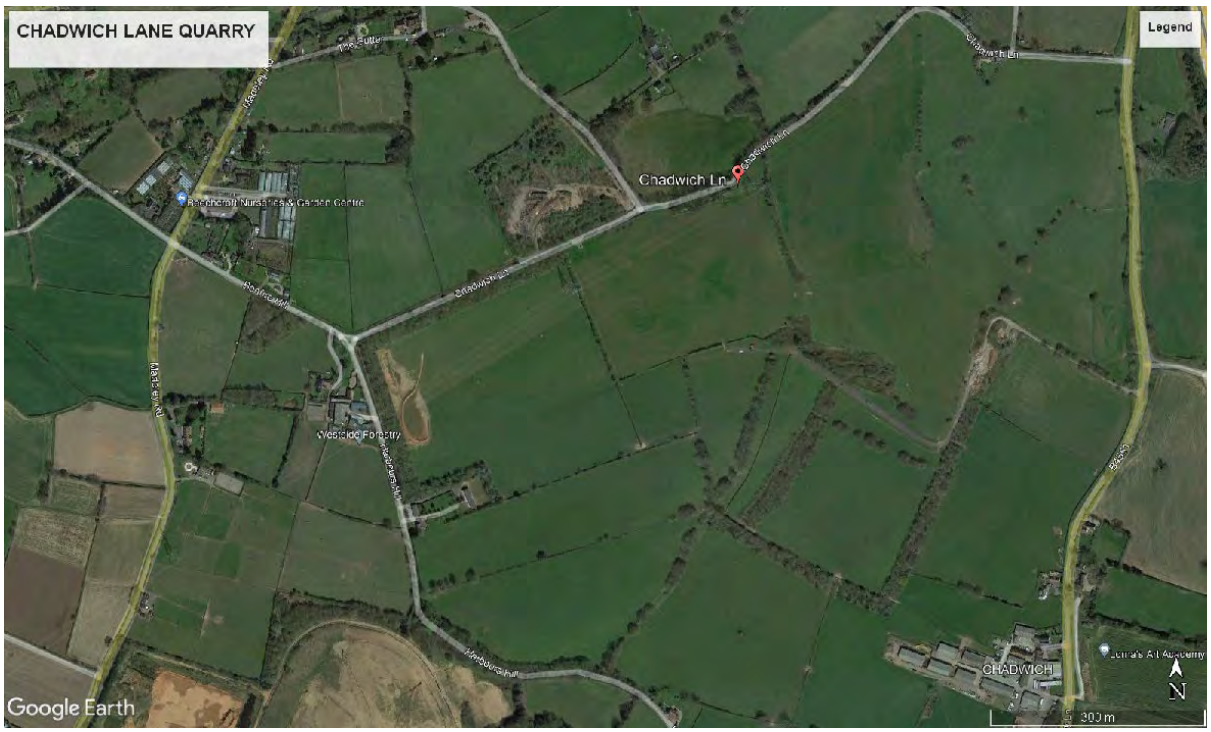


Figure 7: Quarrying in 2012

Figure 8: Quarrying in 2016

Remaining sand deposits are clearly shown on the central and eastern oart of the site.

2.1.2 Proposed Development

This includes details relating to the following.

- The proposed waste types for the landfill area be inert non-reactive wastes which include Tax Qualifying Exempt Materials.
- A skip will be located on site for load rejection.
- The site will have 3 operational phases for the landfill. The time taken for all sand extraction, lining, infilling and restoration is 15 years.
- The final landform and end use is to be agricultural land and areas for biodiversity habitat improvement in accordance with Local Development Framework prepared for Worcestershire County Council.
- The site permit boundary requires an engineered geological barrier.
- No groundwater pumping occurs near to the site and the nearest licensed abstraction is 1500 metres south of the site down hydraulic gradient at Wildmoor.
- The site is within Total Catchment Zone 3 and the groundwater table is not considered to be influenced by pumping at Wildmoor.
- The proposed final landform is to bring the site back to original levels as seen at Drawing ESSD 5.

2.2 Installation Engineering

2.2.1 Groundwater Management System

Groundwater management is not required during the operation of the site as the site is to be operated above the water table.

2.2.2 Basal Lining System

It is proposed to re-work the on-site silts to produce a low permeability geological barrier which will be placed in accordance with the Construction Quality Assurance Plan placed in 270mm-300mm layers and compacted as per the Highways Specification. The Source Testing of the Clay Permeability is presented at Appendix ESSD 2.

The Construction Quality Assurance Plan is presented at Appendix ESSD 3 detailing the method of construction and the standards and testing frequency.

The cells construction shall consist of a basal and side wall seal constructed above the prepared formation level from suitable low permeability material placed and compacted in layers. The thickness of mineral lining shall be a minimum of 1.0m.

The lining material shall be free of unsuitable material and a summary of the design specification is required to meet the following requirements:

i) Permeability ≤1 x10^{-7} m/s BS: 1377: 1990: Part 6: Method 6
ii) Plasticity Index <65% BS: 1377: 1990: Part 2: Methods 4.3 and 5.3
iii) Plasticity Index >10% BS: 1377: 1990: Part 2: Methods 4.3 and 5.3
iv) Clay Content (0.002mm) >8% BS: 1377: 1990: Part 2
v) Percentage Fines >20% BS: 1377: 1990: Part 2
vi) Maximum particle size >187mm* BS: 1377: 1990: Part 2
vii) Percentage Gravel(>5mm) ≥30% BS: 1377: 1990: Part 2
viii)Liquid Limit <90% BS: 1377: 1990: Part 2: Methods 4.3 and 5.3
ix) Shear Strength >50kN/m^2 BS: 1377: 1990: Part 9

2.2.3 Side Slope Lining System

It is proposed to re-work the on-site silts to produce a low permeability geological barrier which will be placed in accordance with the Construction Quality Assurance Plan placed in 270mm-300mm layers and compacted as per the Highways Specification. The Source Testing of the Clay Permeability is presented at Appendix ESSD 2.

The Construction Quality Assurance Plan is presented at Appendix ESSD 5 detailing the method of construction and the standards and testing frequency.

The cells construction shall consist of a basal and side wall seal constructed above the prepared formation level from suitable low permeability material placed and compacted in layers. The thickness of mineral lining shall be a minimum of 1.0m.

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viii)Liquid Limit <90% BS: 1377: 1990: Part 2: Methods 4.3 and 5.3
ix) Shear Strength >50kN/m^2 BS: 1377: 1990: Part 9

The side slope will be stable as this will be formed either by a “Christmas tree” liner, i.e. creating an engineered bund some 2 to 3 metres in height and some 3 metres wide and thus only ever 2-3 metres in advance of the inert landfill or the inert landfill will form a stable valley into which silt can be pumped.

2.2.3 Leachate Drainage System

A leachate drainage system is not required at an inert landfill site.

2.2.4 Capping System

An engineered capping system is not required at an inert landfill site.

2.2.5 Restoration and Aftercare

Soils will be stored and placed in accordance with the specification set out in MAFF Good Soil Guide using on site soils.

Sub soils and top soils or soil substitutes will be placed directly above the finished inert landfilling.

2.3 Leachate Management and Monitoring Infrastructure

2.3.1 Leachate Generation

Leachate monitoring is a not a requirement at inert landfill sites. The site is designed as a fully contained landfill above the unsaturated zone

2.3.2 Leachate Management

The Hydrogeological Risk Assessment has demonstrated that the site is unlikely to generate significant leachate and will have no detrimental impact on groundwater quality.

2.4 Landfill Gas Management and Monitoring Infrastructure

2.4.1 Landfill Gas Generation

The likelihood of gas production based on the Landfill Gas Risk Assessment is very low and it is recommended that internal gas monitoring points are constructed to monitor for potential internal soil gas production volume and flow.

There is no requirement for gas extraction due to the low organic fraction nature of the inert waste and therefore there will be little gas production and not enough gas for gas engines or flaring.

2.4.2 Landfill Gas Management

There is no proposed collection and extraction of landfill gas due to the inert nature of the waste and based on the Landfill Gas Risk Assessment.

There is no requirement for treatment and disposal of the landfill gas including the utilisation plant.

No gas will be flared or utilised on site. No landfill gas will emitted via sidewalls or the cap.

2.4.3 Landfill Gas Monitoring Infrastructure

Gas monitoring boreholes have been constructed around the outside of the landfill site and the locations are shown on Drawing ESSD 7. Gas monitoring will be carried out on a monthly basis at each of the external gas monitoring points using an infra-red gas analyser.

External gas monitoring is from the seven combined groundwater and gas boreholes.

Internal gas monitoring points are presented on Drawing ESSD 7 and are based on 2 monitoring points per hectare.

Sampling will be undertaken by staff appropriately trained in environmental monitoring procedures, and who are familiar with the equipment and its limitations. The Company warrants that the personnel engaged in monitoring activities are trained to undertake the task. These will comprise the companies own technical personnel, the site manager or nominated deputy, following appropriate training by technical personnel. All monitoring staff undergo a period of job training and in addition external courses are used to supplement internal training. Results will be validated by the sampling personnel detailed above. Gas monitoring boreholes and gas monitoring points are summarised in Table ESSD 3 below:

Table ESSD 3: The nature and location of perimeter gas monitoring points

Phase 1		Monitoring Point in waste	Design detail on ESID 7
Phase 2	**LMP2.1,2.2**	Monitoring Point in waste	Design detail on ESID 7
Phase 3	**LPM3.1,3.2**	Monitoring Point in waste	Design detail n ESID 7
Perimeter	**BH 3,4,5**	Monitoring Borehole outside waste. Combined gas and groundwater	Design detail on ESID 7

2.4.4 Gas Monitoring

The gas monitoring frequency and determined range has been developed based on the landfill gas risk assessment and is summarised below in Table ESSD 4.

Table ESSD 4: Monitoring frequencies for landfill gas

Determinands	Monitoring Frequencies	Units and Accuracies
Methane (CH_4)	Quarterly	%v/v ±0.5%
Carbon Dioxide (CO_2)	Quarterly	%v/v ±0.5%
Carbon Monoxide (CH_4)	Quarterly	-
Oxygen (O_2)	Quarterly	%v/v ±0.5%
Atmospheric Pressure	Quarterly	±1 mb
Differential pressure	Quarterly	±0.1 mb
Meteorological Data	Quarterly	-

2.4.5 Making and submission of records

Records will be kept on site of determinands analysed, date of sampling, sampler, results, units.

A copy of the results of sampling and analysis will be forwarded to the Agency every quarter.

2.5 Surface Water Management System

Surface water is not discharged from site. In the event that water is to be removed off site it will be via the discharge consent.

2.6 Groundwater Management and Monitoring

It is essential to monitor groundwater adjacent to the site for quality to assess the integrity of the performance of the site and to ensure that there is no impact on groundwater.

2.6.1 Groundwater Level and Quality Monitoring

Boreholes are located both up and down hydraulic gradient. Borehole locations are presented on Drawing ESSD 10. The nature and location of the groundwater monitoring boreholes is set out on Table ESSD 5.

Table ESID 5: Groundwater Monitoring Borehole Locations

Perimeter	**BH 5**	Perimeter Up Hydraulic Gradient	Level and Quality
Perimeter	**BH 4**	Perimeter Down Hydraulic Gradient	Level and Quality
Perimeter	**BH 3**	Perimeter Down Hydraulic Gradient	Level and Quality

It is recommended that the compliance levels are reviewed on a six yearly basis in line with the HRA review period or as appropriate. If, for example, the

compliance levels are exceeded on three consecutive times, then this should be highlighted and discussed within any annual review of monitoring data. Such an occurrence may be the result of contaminant breakthrough or a change in the up-gradient groundwater quality.

The groundwater sampling regime is set out in Table ESSD 6 and is based on the Environment Agency Regulatory Position Statement-Landfill monitoring and reporting standards.

Table ESSD 6: Groundwater Monitoring Parameters

Parameter	Closure/ Aftercare	
	Quarterly	Annually
Water Level	•	•
pH	•	•
Electrical conductivity 20^{o}C	•	•
Ammoniacal nitrogen	•	•
Chloride	•	•
Sulphate	•	•
Alkalinity	•	•
Sodium	•	•
Potassium	•	•
Calcium	•	•
Magnesium	•	•
Iron	•	•
Manganese	•	•
Copper	•	•
Chromium	•	•
Lead	•	•
Nickel	•	•
Zinc	•	•
TPH	•	•
PAH	•	•
Phenol	•	•
Hazardous Substance Scan	Annual for first six years	Six Yearly

Detailed sampling methodologies are set out in the Groundwater Monitoring Plan. Sampling will be undertaken by staff appropriately trained in environmental monitoring procedures, and who are familiar with the equipment and its limitations. The Company warrants that the personnel engaged in monitoring activities are trained to undertake the task. These will comprise the companies own technical personnel, the site manager or nominated deputy, following appropriate training by technical personnel. All monitoring staff undergo a period of job training and in addition external courses are used to supplement internal training. Results will be validated by the sampling personnel detailed above.

2.6.2 Submission of Data

All data from the groundwater monitoring will be stored on the in house electronic database. This database will enable reports to be issued detailing trigger breaches and standard quarterly and annual reports plus laboratory

reports. Reports will be provided in a standard PDF format to the Environment Agency.

2.7 Post Closure Controls

Groundwater and Leachate

Completion relating to hydrogeological risks will have been achieved when there is no unacceptable risk of pollution from the landfill, i.e. when the site can comply with the requirements of the Groundwater Regulations without the need for any active site management and during the three year post closure monitoring the results show the groundwater quality remains at or below the trigger levels.

The modelling has assumed 3 years of management after infilling.

Groundwater monitoring will continue for the period based on an annual sampling rounds from the four key target down gradient boreholes.

Landfill Gas

Landfill gas utilisation and flaring is not considered necessary at the site long term based on the Landfill Gas Risk Assessment and again only requires monitoring for the three year post closure monitoring.

The nature of the waste should only allow for a nominal amount of settlement and the pre and post settlement levels are set as one and the same. Any low spots that form will be made good with importation of additional soils.

Gas monitoring will be carried out on a monthly basis for two years then dropping off to quarterly monitoring or until successful surrender is achieved.

Stability and Settlement

The final surcharged and post-settlement restoration levels are shown in Drawing number ESSD 5, which is one and the same due to the inactive nature of the waste. A surcharge to accommodate settlement will therefore not be required.

The remainder of the post closure based on the risk assessments is for monitoring to ensure that the waste mass remains stable and that the leachate head does not increase above the design limit and therefore that no leachate removal is required.

Annual site surveys will be carried out using fixed settlement locations to measure settlement of the site once the site is completed.

Mining Subsidence

Likelihood of mining related subsidence is not considered an issue and was reviewed as part of the Stability Risk Assessment.

Restoration, Aftercare and Completion Phase

The site will be restored in accordance with the planning permission and maintained under a five year aftercare program under the Town and Country Planning Act 1991.The grassland and tree planting areas after the five years are completely self- sustaining without requirement for any further aftercare provision.

Monitoring

Features to be monitored for the purpose of closure include
Landfill Gas
Settlement Rate-Annual
Stability Observations-Annual
Groundwater Level- As per Groundwater Monitoring Plan
Groundwater Quality-As per Groundwater Monitoring Plan
Leachate Levels-As per Leachate Monitoring Plan

3.0 PATHWAY AND RECEPTOR TERM CHARACTERISATION

3.1 Climate

The Company intend to obtain data from the on-site weather station at the site and evaporation data from Birmingham Airport.

Meteorological office readings are available locally from Edgbaston for the period 2003 to 2012 with all gaps obtained at Winterbourne University and Coleshill. The typical monthly average rainfall range is between 37.21 and 80.9mm with an overall average per month of 56mm, see Appendix ESID 6.

The number of hours of sunshine range from 44.3 in December to 181 hours in June with a temperature range of 3.3ºC to 15.6ºC. There are very large ranges observed from one year to the next. This is illustrated in the table contained as Appendix ESSD 6.

Wind roses from the Meteorological Office at Birmingham Airport are shown in Appendix ESSD 6. They indicate winds predominately from the south-west, which are particularly strong in winter. The long-term average potential evapotranspiration, obtained from the Met Office data presented at Appendix ESSD 6 indicates evapotranspiration at 516mm per annum and a total rainfall of 680 leaving a total annual rainfall of 164mm per annum. The sides of the landfill and the final landform will shade areas from the sun, rain or wind. Because of this, the evaporation rates will vary from place to place within the site itself.

3.2 Geology

REGIONAL GEOLOGY

General

The greater part of the district is underlain by Triassic Strata belonging to the Sherwood Sandstone, Mercia Mudstone and Penarth Groups. Deposition took place under generally arid and semiarid conditions, in a low-latitude continental interior.

Most of the strata are red as a result of the diagenetic alternation of iron oxide (haematite) of detrital ferromagnesian silicates and iron bearing clay minerals, and is summarised on Geological sketch plan and British Geological Maps contained in the Hydrogeological Report.

Sherwood Sandstone Group

The site lies within this group. The Sherwood Sandstone Group was formally introduced for the formations that comprise the arenaceous lower part of the Triassic succession throughout Britain. This sequence was subdivided into

three formations renamed recently (Warrington et al 1980), which are the basis for this report. An additional formation, the Quartzite Breccia, which locally underlies the Kidderminster formation and is therefore included as follows:

SUBDIVISIONS OF THE SHERWOOD SANDSTONE

HULL 1869	Warrington 1980
Lower Keuper Sandstone	Bromsgrove Sandstone
Upper Mottled Sandstone	Wildmoor Sandstone
Bunter Pebble Beds	Kidderminster Formation
	Quartzite Breccia

Deposition of the Sherwood Sandstone Group was controlled by palaegeographical changes initiated during the Permian. A series of troughs and ridges were formed, orientated roughly north-south in response to east west tensional stresses in the region of the North Atlantic. One such trough was the Worcester Basin.

The down-warping of the Worcester Basin resulted in a river system bringing detritus from as far south as Brittany. The lower fluvial part of the Kidderminster Formation is restricted to the Basin area, while the Quartzite Breccia formed as a scree deposit on the eastern flank. This ridge was soon inundated by the upper part of the Kidderminster formation. The Sherwood Sandstone Group is about 700m thick in the west of the district.

Wildmoor Sandstone

The name Wildmoor Sandstone was introduced for beds formerly termed Upper Mottled Sandstone. This formation consists predominantly of sandstone and provides the well-known moulding sands quarried around Wildmoor. The Wildmoor Sandstone is dominated by remarkably uniform, very weakly cemented, fine grained, silty, micaceous sandstone. The formation includes upward fining rhythms which commence with a medium too coarse grained or pebbly sandstone and pass upwards through cross-bedded, fine grained sandstones into plainer bedded fine-grained sandstones and mudstones. The Wildmoor Sandstone rests conformably upon the Kidderminster Formation from which it is distinguished by its fine grain and foxy red colouration.

Chester Formation

This name was introduced (Warrington et al, 1980) for the succession of sandstones with subordinate siltstones and mudstones is comparatively fossiliferous. There are three distinct lithologies formalised as the Burcot, Finstall and Sugarbrook members of the formation.

The formation comprises a sequence of upward fining sedimentary cycles.in the lower part of the formation they consist of coarse sandstones with a basal

conglomerate or breccia bed. Grain size reduces upwards through the formation and siltstones and mudstones become more common.

The site exposure is that of the Burcot Member which are structureless red-brown sandstones and include only minor beds of siltstone and mudstone.

Structure

The site sits between two structural areas; the Worcester Basin and the Lickey Ridge. The Worcester Basin is a major Triassic basin, floored by Precambrian and Lower Palaeozoic rocks, its eastern end bounded by the Lickey End Fault, this is to the west of the site. The Lickey End Fault continues north west to join the Western Boundary Fault of the South Staffordshire Coalfield.

The site is bound on the east by the Longbridge fault which runs north south.

The strata dip south westerly where it and the Lickey End Fault becomes the Inkberrow Fault, which continues down to the Haselor Hill Fault outside Evesham.

Superficial Deposits

Till and Glaciofluvial Deposits are located to the east of the site.

LOCAL GEOLOGY

The Chadwich Lane Quarry is located in sands of the Wildmoor Sandstone. The quarry consists of a uniform, brownish red sandstone. The sandstone is medium too coarse grained, micaceous and feldspathic. Cross bedding has been observed which suggests fluvial deposition.

The strata dips south easterly. The local strata dips at approximately 7°.

The Local geology is also presented at Figure 9 for reference below showing the position of the fault in the quarry. The solid geological map is presented at Drawing ESSD 8

Figure 9: Bedrock Geology

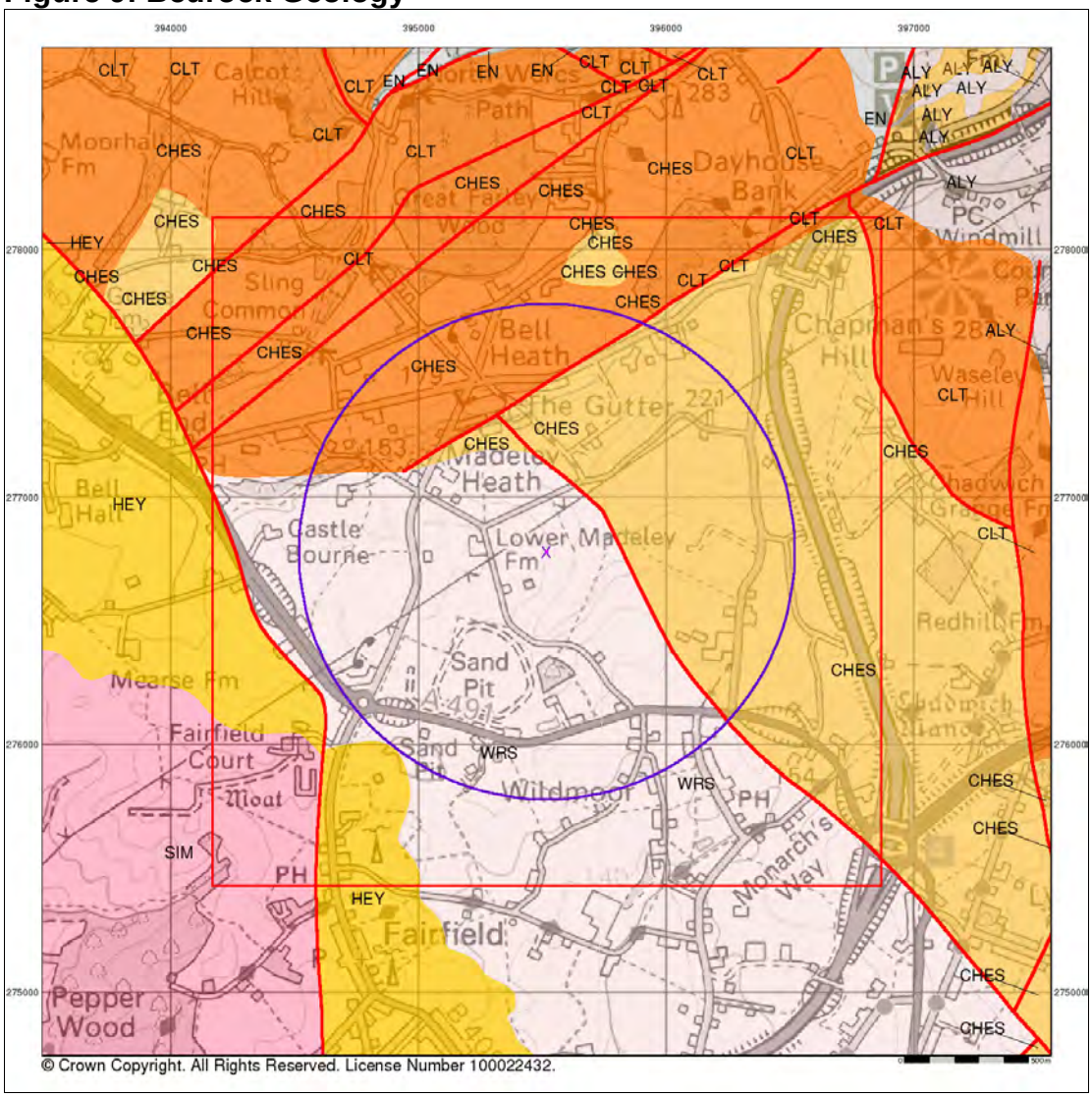
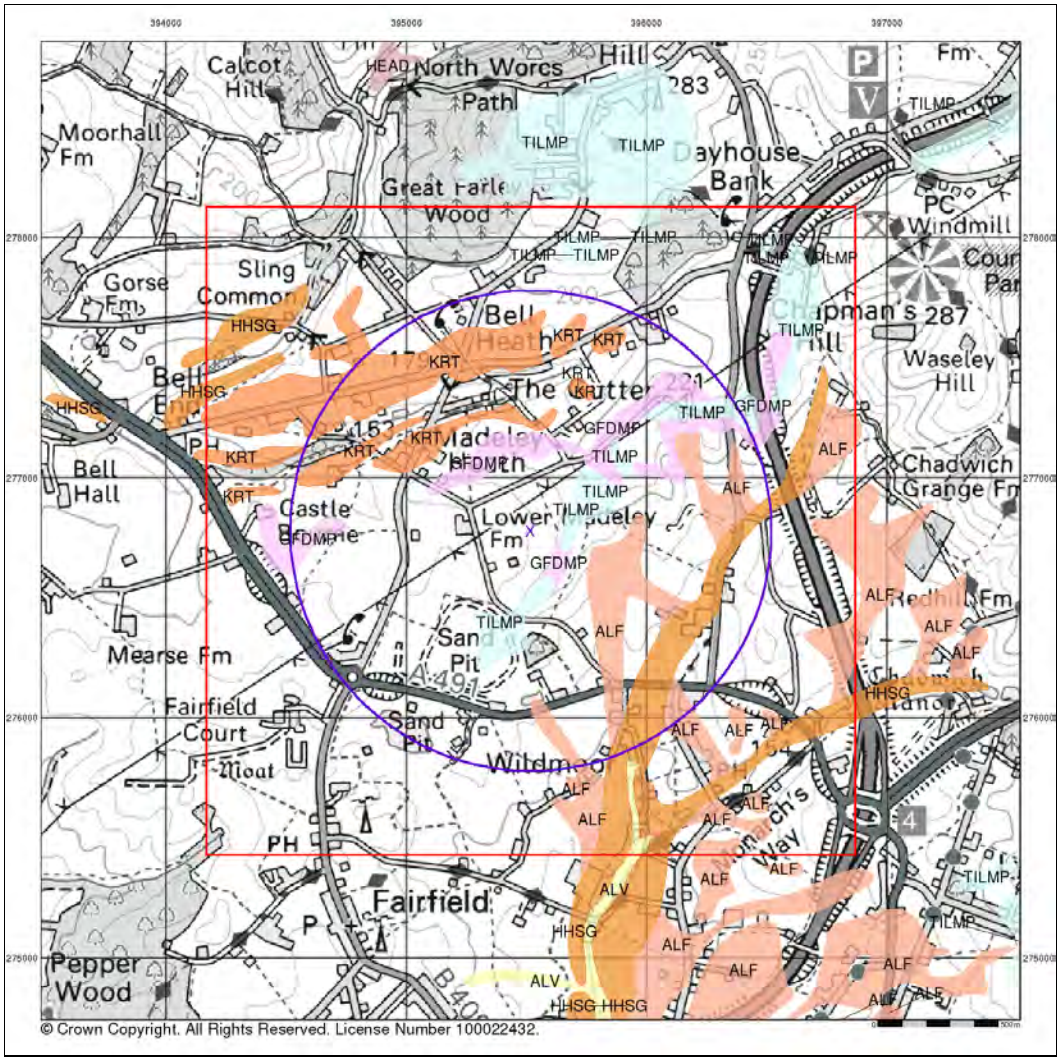


Figure 9 shows the site to consist of Wildmoor Sandstone.

The site has no superficial covering. The superficial geological map is presented at Figure 10.

Figure 10: Superficial Geology



The Superficial Geological Plan is presented at Drawing ESSD 8.

A conceptual geological cross-sectional plan is presented as Drawing ESSD 11.

SITE INVESTIGATIONS

Five groundwater monitoring boreholes have been drilled around the site as part of the hydrogeological investigations.

Clay samples have been taken from the site as part of the Source Evaluation testing for the geological barrier, see Appendix ESSD 2.

3.3 Man-made Subsurface Pathways

The following man made subsurface pathways have been identified;

- No field drains exist in any of the fields around the site.
- Mine workings do not occur in the area of the site with no underground saline of coal workings present.
- No services run through the proposed extraction area and landfill area.
- High pressure gas mains are not located near to the site.

3.4 Hydrology

The site is located on a bedrock Principal aquifer with rock deposits having high intergranular permeability, and providing a high level of water storage. They may support water supply and or river base flow on a strategic scale. Areas of secondary A aquifer (supporting water supplies (locally) are located up hydraulic gradient north east of the site and a Secondary B aquifer (predominantly lower permeability with limited storage and flow is located to the south west as the Mercia Mudstone Group.

On a regional scale, the River Stour flows southwards into the River Severn, which flows south through the Worcester Basin.

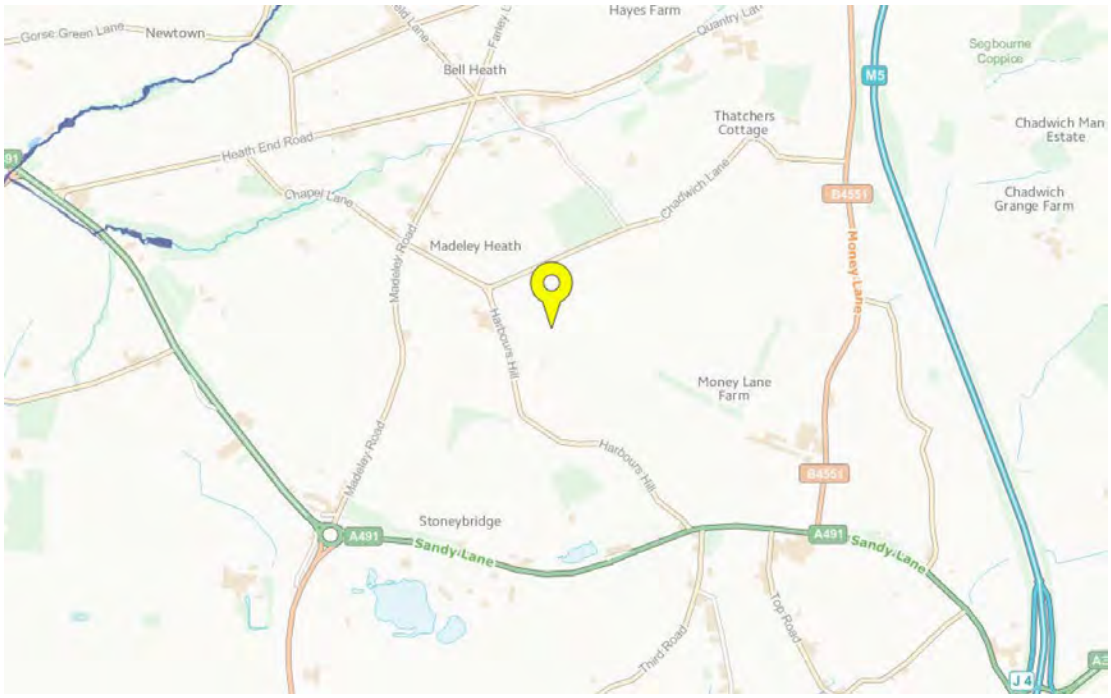
The local topography is strongly influenced by the geology. The main watercourse nearest the site is to the north.

Only a small number of ponds and pools are located nearby with the two being down gradient of the site, the smallest one being some 500 metres from the site and the main one 1200 metres from the site boundary.

No watercourse runs through the site and the main watercourses are of considerable distance from the site. Local drainage around the site follows the topography in a westerly direction as surface water flow over agricultural grazing land.

The site is not within a Flood Zone. The local indicative flood map is presented as Figure 11 and shown in detail on Drawing ESSD 9.

Figure 11: Indicative Flood Zone Map



3.5 Hydrogeology

3.5.1 Aquifer Characteristics

General Hydrogeology

The regional supplies come from the Sherwood Sandstone in the Trias. The district lies mostly within Hydrometric Areas 54 and 28 and the water resources are administered by Severn Trent Water Company PLC. In the Trias, the Kidderminster Formation, Wildmoor Sandstone and Bromsgrove Sandstone generally form a single aquifer although it may contain aquicludes. Severn Trent Water Company PLC have de-limited a particularly effective aquiclude towards the top of the Kidderminster Formation which causes groundwater differences of more than 20 metres.

Most of the boreholes penetrating the Triassic sandstones are for public supply.

In the aquifer outcrop, the groundwater quality is usually good, the total hardness (as $CaC0_3$) being generally between 100 and 300 mg/l, this is largely carbonate hardness and chloride ion concentrations do not usually exceed 30mg/l, this is true right across to and under Kidderminster with deep boreholes having concentrations of 230mg/l of $CaC0_3$. The nitrate concentration can locally exceed 50mg/l (as $N0_3$), but it is rare to find significant concentrations of nitrate in the confined aquifer or beneath thin drift.

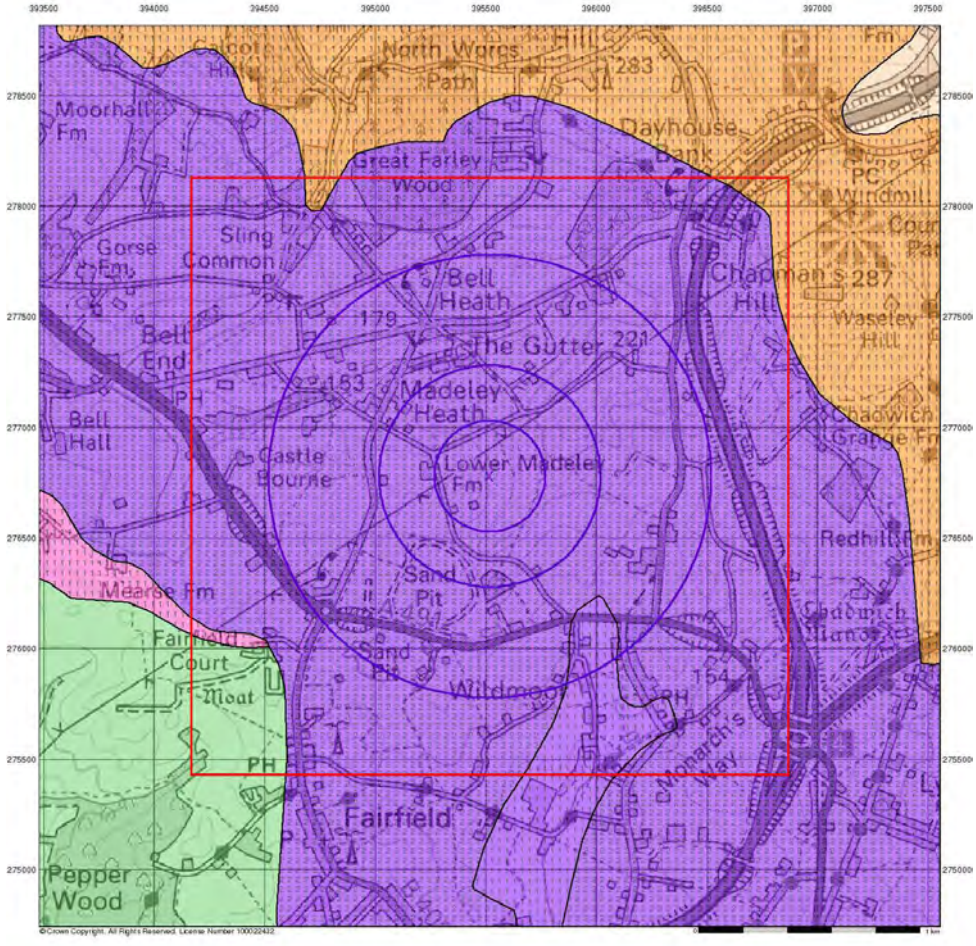
From 1st April 2010 new aquifer designations replace the old system of classifying aquifers as Major, Minor and Non-Aquifer. This new system is in line with our Groundwater Protection Policy (GP3) and the Water Framework Directive (WFD) and is based on British Geological Survey mapping.

The site is located on a bedrock Principal aquifer with rock deposits having high intergranular permeability, and providing a high level of water storage. They may support water supply and or river base flow on a strategic scale. Areas of secondary A aquifer (supporting water supplies (locally) are located up hydraulic gradient north east of the site and a Secondary B aquifer (predominantly lower permeability with limited storage and flow is located to the south west as the Mercia Mudstone Group.

The site is located within a Total Protection Zone (Zone 3). The nearest outer SPZ (SPZII) is located circa 1500m to the south of the permit boundary and the abstraction borehole is 1680metres from the site as shown in Figure 13.

Figure 12 shows the bedrock geology aquifer designation for the site. The dark purple area represents the Sherwood Sandstone major aquifer with the brown areas being secondary aquifer of the Mercia Mudstone Group.

Figure 12: Aquifer designation map for Solid Geology



A shallow groundwater gradient of 0.0143m/m has been calculated from the available groundwater elevations, with the prevailing groundwater flow direction to the south. Groundwater elevations and interpolated potentiometric surface plots are presented on Drawing ESSD 11.

BGS data for the Wildmoor borehole ranges from 5.037 x 10^{-7}m/s to 2.8 x 10^{-6}m/s, presented at Appendix ESSD1. It is noted that the 400-day travel time range would be approximately 1m/d or 1.15 x10^{-5}m/s using a conservative assessment. Appendix ESSD 4 contains original packer tests carried out at Chadwich Lane which shows permeability values of 2.02 x 10^{-6}m/s to 8.8 x10^{-6}m/s.

The regional supplies come from the Sherwood Sandstone in the Trias. The water resources are administered by Severn Trent Water. In the Trias, the Chester Formation, and all sub-units form a single aquifer, although it may contain aquicludes.

Figure 13: Source Protection Zones

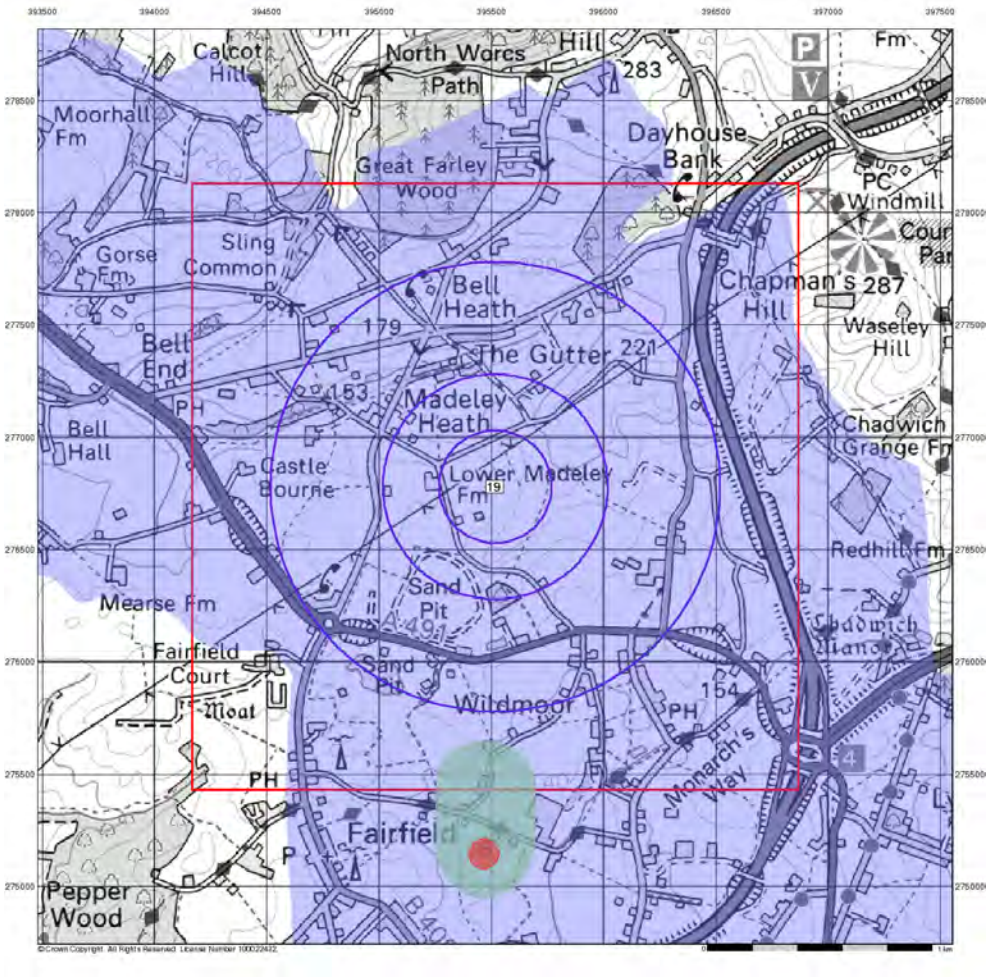


Table ESSD 7 shows the groundwater and surface water abstraction boreholes located nearest to the site. The main public abstraction boreholes are at Fairfield,1500

metres south of the site and an alleviation borehole at Meadow Farm 1900 metres south at Battlefield Brook.

Table ESSD 7: Abstraction Licence Details

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
17	**Water Abstractions** Operator: Beechcroft Nurseries Licence Number: 18/54/06/0295 Permit Version: 100 Location: Beechcroft Nurseries, Belbroughton - Borehole Authority: Environment Agency, Midlands Region Abstraction: General Agriculture: Spray Irrigation - Direct Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Beechcroft Nurseries, Belbroughton - B/H Authorised Start: 01 March Authorised End: 31 October Permit Start Date: 21st December 1994 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	A13NW (NW)	451	2	395190 277090
17	**Water Abstractions** Operator: Beechcroft Nurseries Licence Number: Md/054/0006/016 Permit Version: 1 Location: Beechcroft Nurseries, Belbroughton - Borehole Authority: Environment Agency, Midlands Region Abstraction: General Agriculture: Spray Irrigation - Direct Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Land At Beechfield Nurseries, Stourbridge Authorised Start: 01 March Authorised End: 31 October Permit Start Date: 1st April 2014 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 10m	A13NW (NW)	457	2	395182 277091
17	**Water Abstractions** Operator: Beechcroft Nurseries Licence Number: 18/54/06/0295/2 Permit Version: 1 Location: Beechcroft Nurseries, Belbroughton - Borehole Authority: Environment Agency, Midlands Region Abstraction: General Agriculture: Spray Irrigation - Direct Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Land At Beechfield Nurseries, Stourbridge Authorised Start: 01 March Authorised End: 31 October Permit Start Date: 1st April 2006 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 10m	A13NW (NW)	457	2	395182 277091
	Water Abstractions Operator: F R & B Lees Licence Number: 18/54/07/0168 Permit Version: 100 Location: Top Lane, Wildmoor - Battlefield Brook Authority: Environment Agency, Midlands Region Abstraction: General Agriculture: Spray Irrigation - Direct Abstraction Type: Water may be abstracted from a single point Source: Surface Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Top Lane, Wildmoor,Bromsgrove - Battlefield Brook Authorised Start: 01 April Authorised End: 31 March Permit Start Date: 1st April 2003 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	A4NE (SE)	1364	2	396200 275600

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	Water Abstractions Operator: Bournville Village & National Trust Licence Number: 18/54/07/0022 Permit Version: 100 Location: Grange Farm - Borehole Authority: Environment Agency, Midlands Region Abstraction: General Farming And Domestic Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Grange Farm - Borehole Authorised Start: 01 April Authorised End: 31 March Permit Start Date: 7th February 1966 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 10m	A20SE (E)	1446	2	396900 277200
	Water Abstractions Operator: Severn Trent Water Limited Licence Number: 18/54/07/0134 Permit Version: 101 Location: Wildmoor,Bromsgrove - 2 Boreholes Authority: Environment Agency, Midlands Region Abstraction: Public Water Supply: Potable Water Supply - Direct Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Wildmoor - 2 Boreholes Authorised Start: 01 April Authorised End: 31 March Permit Start Date: 22nd October 2010 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	A3SW (S)	1681	2	395500 275100
	Water Abstractions Operator: Severn Trent Water Limited Licence Number: 18/54/07/0134 Permit Version: 102 Location: Wildmoor,Bromsgrove - 2 Boreholes Authority: Environment Agency, Midlands Region Abstraction: Public Water Supply: Potable Water Supply - Direct Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Wildmoor - 2 Boreholes Authorised Start: 01 April Authorised End: 31 March Permit Start Date: 22nd October 2010 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	A3SW (S)	1681	2	395500 275100
	Water Abstractions Operator: Severn Trent Water Limited Licence Number: 18/54/07/0134 Permit Version: 100 Location: Wildmoor,Bromsgrove - 2 Boreholes Authority: Environment Agency, Midlands Region Abstraction: Public Water Supply: Potable Water Supply - Direct Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Wildmoor - 2 Boreholes Authorised Start: 01 April Authorised End: 31 March Permit Start Date: 1st April 2002 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 10m	A3SW (S)	1681	2	395500 275100

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	Water Abstractions Operator: Bournville Village Trust & The National Trust Licence Number: 18/54/07/0171 Permit Version: 100 Location: Rabbit Hill,Rubery - Two Spring Fed Reservoirs Authority: Environment Agency, Midlands Region Abstraction: General Farming And Domestic Abstraction Type: Water may be abstracted from a single point Source: Surface Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Rabbit Hill, Chadwich Estate,Rubery - Reservoir Authorised Start: 01 April Authorised End: 31 March Permit Start Date: 13th April 1966 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	A15NE (E)	1688	2	397200 276900
	Water Abstractions Operator: Mr L J Cadbury Licence Number: 18/54/06/0035 Permit Version: 100 Location: Gorse Farm - Well Authority: Environment Agency, Midlands Region Abstraction: General Farming And Domestic Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Gorse Farm - Well Authorised Start: 01 April Authorised End: 31 March Permit Start Date: 1st March 1966 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 10m	A21NE (NW)	1887	2	394400 278300
	Water Abstractions Operator: Messrs W E Monk & Son Licence Number: 18/54/07/0047 Permit Version: 100 Location: Chadwick Manor Farm - Spring Pool Authority: Environment Agency, Midlands Region Abstraction: General Farming And Domestic Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Chadwick Manor Farm - Spring Pool Authorised Start: 01 April Authorised End: 31 March Permit Start Date: 1st April 2000 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	(E)	1909	2	397300 276100
	Water Abstractions Operator: Severn Trent Water Limited Licence Number: Md/054/0007/003 Permit Version: 2 Location: Meadow Farm Alleviation Borehole Authority: Environment Agency, Midlands Region Abstraction: Environmental: Remedial River/Wetland Support: Transfer Between Sources Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Battlefield Brook At Meadow Farm, Wildmoor, Bromsgrove Authorised Start: 01 April Authorised End: 31 March Permit Start Date: 22nd October 2010 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 10m	(S)	1988	2	395680 274800

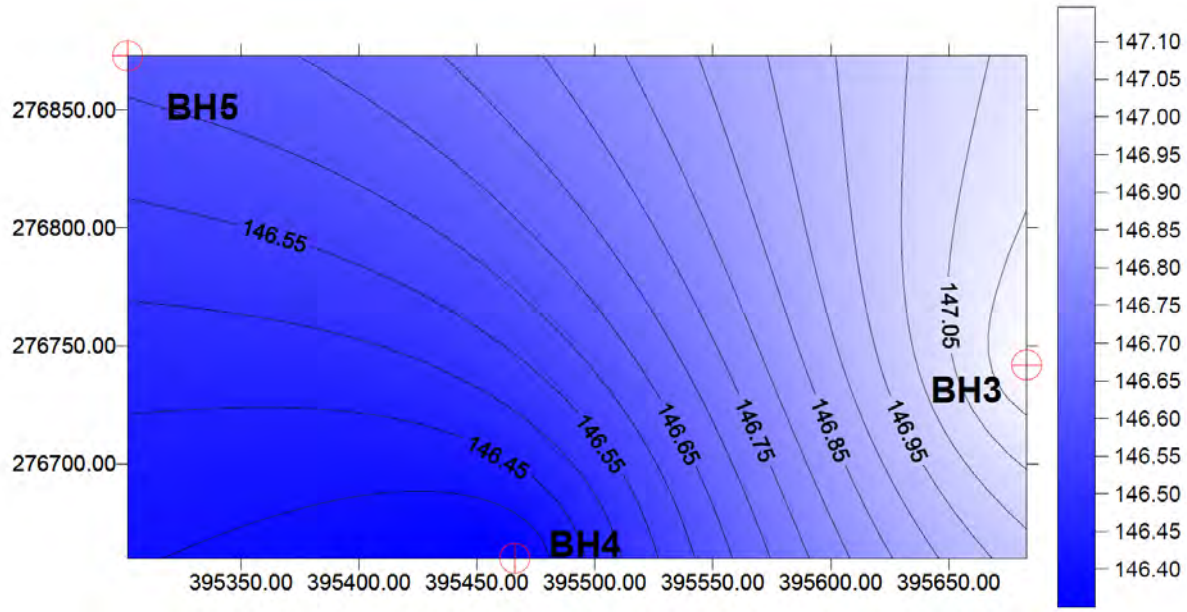
Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	Water Abstractions Operator: Severn Trent Water Limited Licence Number: Md/054/0007/003 Permit Version: 3 Location: Meadow Farm Alleviation Borehole Authority: Environment Agency, Midlands Region Abstraction: Environmental: Remedial River/Wetland Support: Transfer Between Sources Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Battlefield Brook At Meadow Farm, Wildmoor, Bromsgrove Authorised Start: 01 April Authorised End: 31 March Permit Start Date: 22nd October 2010 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 10m	(S)	1988	2	395680 274800
	Water Abstractions Operator: Severn Trent Water Limited Licence Number: Md/054/0007/003 Permit Version: 1 Location: Meadow Farm Alleviation Borehole Authority: Environment Agency, Midlands Region Abstraction: Environmental: Remedial River/Wetland Support: Transfer Between Sources Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Battlefield Brook At Meadow Farm, Wildmoor, Bromsgrove Authorised Start: 01 April Authorised End: 31 March Permit Start Date: 22nd January 2010 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 10m	(S)	1988	2	395680 274800
	Water Abstractions Operator: Severn Trent Water Limited Licence Number: 18/54/07/0266 Permit Version: 1 Location: Meadow Farm Alleviation Borehole Authority: Environment Agency, Midlands Region Abstraction: Environmental: Remedial River/Wetland Support: Transfer Between Sources Abstraction Type: Water may be abstracted from a single point Source: Groundwater Daily Rate (m3): Not Supplied Yearly Rate (m3): Not Supplied Details: Battlefield Brook At Meadow Farm, Wildmoor, Bromsgrove Authorised Start: 01 April Authorised End: 31 March Permit Start Date: 1st April 2006 Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 10m	(S)	1988	2	395680 274800

3.5.2 Groundwater Flow

Groundwater levels have been monitored on site since the initial installation of the boreholes and the results are presented in the HRA and are summarised as a hydrograph at Appendix ESSD 7.

The groundwater flow is south eastwards and is presented at Figure 14 and the groundwater flows are presented at Drawing ESSD 11.

Figure 14: Groundwater contour model (average values)



3.5.3 Groundwater Quality

In accordance with the requirements for compliance levels as defined in Paragraph 4(c) of Annex III of the Landfill Directive, compliance limits have been established for targeted non-hazardous substances, with compliance limits set for hazardous substances.

The compliance levels for the hazardous substances are defined by the limits of analytical detection.

The groundwater certificates for the sampling is, presented at Appendix ESSD 9 and the spreadsheet setting out the Compliance Limit calculations is also set out in Appendix ESSD9 and the summary values are presented at Table ESSD 8.

The compliance limits have been set for the targeted down hydraulic gradient boreholes as the average value plus three times the standard deviation.

Table ESSD 8: Compliance Limits

BH4	Cd	Cu	Cr	Hg	Zn	Chloride	Sulphate	Ammonia
8/4/2022	0.0006	0.009	0.002	0.0002	0.018	13.7	51.6	0.06
17/5/2022	0.0007	0.009	0.002	0.0001	0.018	13.5	52.7	0.06
27/6/2022	0.0011	0.009	0.013	0.0001	0.044	13.1	51.0	0.06
18/7/2022	0.0006	0.009	0.009	0.0002	0.018	13.2	44.8	0.06
18/8/2022	0.0006	0.009	0.002	0.0001	0.018	11.9	48.0	0.06
13/9/2022	0.0009	0.012	0.019	0.0001	0.018	12.1	44.9	0.06
Mean	0.00075	0.0095	0.00783	0.000133	0.022	12.91	48.83	0.006
Std	0.0002	0.0012	0.0071	0.000051	0.01	0.744	3.456	0
3 Std	0.0006	0.0036	0.0213	0.000153	0.03	2.232	10.368	0
Compliance Level	**0.00135**	**0.0131**	**0.029**	**0.00028**	**0.052**	**15.142**	**59.198**	**0.006**

BH4	Cd	Cu	Cr	Hg	Zn	Chloride	Sulphate	Ammonia
8/4/2022	0.0006	0.009	0.002	0.0002	0.018	13.7	51.6	0.06
17/5/2022	0.0007	0.009	0.002	0.0001	0.018	13.5	52.7	0.06
27/6/2022	0.0011	0.009	0.013	0.0001	0.044	13.1	51.0	0.06
18/7/2022	0.0006	0.009	0.009	0.0002	0.018	13.2	44.8	0.06
18/8/2022	0.0006	0.009	0.002	0.0001	0.018	11.9	48.0	0.06
13/9/2022	0.0009	0.012	0.019	0.0001	0.018	12.1	44.9	0.06
Mean	0.00075	0.0095	0.00783	0.000133	0.022	12.91	48.83	0.006
Std	0.0002	0.0012	0.0071	0.000051	0.01	0.744	3.456	0
3 Std	0.0006	0.0036	0.0213	0.000153	0.03	2.232	10.368	0
Compliance Level	**0.00135**	**0.0131**	**0.029**	**0.00028**	**0.052**	**15.142**	**59.198**	**0.006**

BH5	Cd	Cu	Cr	Hg	Zn	Chloride	Sulphate	Ammonia
8/4/2022	0.0006	0.009	0.002	0.00139	0.018	33.0	55.2	0.06
17/5/2022	0.0006	0.023	0.002	0.0001	0.020	36.5	58.8	0.06
27/6/2022	0.0006	0.009	0.002	0.0001	0.018	34.2	55.2	0.06
18/7/2022	0.0006	0.009	0.002	0.0002	0.018	35.2	56.3	0.06
18/8/2022	0.0006	0.009	0.002	0.0001	0.018	33.6	53.4	0.06
13/9/2022	0.0008	0.011	0.014	0.0001	0.020	34.8	53.3	0.07
Mean	0.00063	0.0116	0.004	0.00033	0.0186	34.55	55.36	0.061
Std	0.000816	0.0056	0.0048	0.00052	0.001	1.242	2.042	0.004
3 Std	0.002448	0.0168	0.0144	0.00156	0.003	3.726	6.126	0.012
Compliance Level	**0.000307**	**0.0284**	**0.0184**	**0.00019**	**0.0216**	**38.27**	**61.486**	**0.073**

3.6 Off-site Landfill Gas Monitoring

Natural background gas concentrations have been carried out over a period of time from the outside groundwater monitoring boreholes to establish a baseline concentration. The boreholes have shown no presence of methane levels, most.

Carbon dioxide has been recorded in all of the boreholes. The six data sets allow for baseline values to be obtained.

Off-site gas monitoring details are presented at Appendix ESSD 10.

3.7 Receptors and Compliance Points

This section details the specific receptors identified and compliance points that have been set in the various risk assessments.

Groundwater

For Hazardous Substances, the receptor/compliance point will need to be the point at which the substance will enter the groundwater below or adjacent to the site. This can be monitored from Boreholes 2, 3 ,4 and 5 which are all down hydraulic gradient. Compliance limits have been set in the Hydrogeological Risk Assessment and are summarised in Table ESSD 6.

For Non-Hazardous Polluting Substances, the primary receptor/compliance point will normally be the downstream boundary of the site at Boreholes 2, 3, 4 and 5. Compliance limits have been set and are presented at Table ESSD 8.

Surface Water

There is no direct discharge of water from the site and any future requirements for discharge will be direct through the sewer having obtained a trade effluent discharge consent from Severn Trent Water PLC.

The silt pond water will be periodically monitored for basic parameters as a quality environmental check using hand held calibrated meters for pH, conductivity, total dissolved solids, and redox.

Landfill Gas

The site will accept inert waste which produces extremely low concentrations of methane and low concentrations of carbon dioxide. The global impact is therefore considered as negligible from the waste mass.

Key receptors have been identified and gas monitoring boreholes have been located near to identified receptors based on level of risk.

Amenity (Nuisance and Health Issues).

Due to the site accepting only inert waste for landfill and no nearby residential receptors dust monitoring is not considered a requirement for the site.

Habitats (where required)

An ecological screening was not requested from the Environment Agency. The site is not designated a Local Wildlife Site, devoid of trees and grass except for the boundary which is to remain unchanged and is not within a RAMSAR, SAC or SPA. The site has now SSSI designation.

4.0 SITE REPORT

The Environmental Permitting Regulations require that a permit application must be accompanied by a (Baseline) Site Condition Report, which describes the condition of the whole site, not just the landfill. Operators are required in particular to "*identify any substances in, on, or under land which may constitute a pollution risk*"

This Site Report gives a factual "baseline" account of the land.

4.1 Introduction and Background Information

Site details

Chadwich Lane Quarry is situated off the Money Lane, Belbroughton, some 1,500 metres north west of Catshill and 3,200 metres north west of Bromsgrove in the County of Worcestershire at National Grid Reference SO 95073 75940, see Figure 1 and Drawing ESSD 1.

The site is surrounded with large areas of agricultural land.

Outline of proposed development

This includes details relating to the following.

- The proposed waste types for the landfill area be inert non-reactive wastes which include Tax Qualifying Exempt Materials.
- A non-hazardous waste treatment facility will be operated to process construction and demolition wastes to recovery secondary aggregates. The site will have a washing plant, mobile crushers and screeners. This site will also be used for decontamination of the historic deposited wastes on site.
- A skip will be located on site for load rejection.
- The site will have 3 operational phases in the base to complete the landfill final landform. The time taken for all sand extraction, lining, infilling and restoration is 15 years.
- The final landform and end use is to be agriculture in accordance with Local Development Framework prepared for Worcestershire County Council.
- The site permit boundary requires an engineered geological barrier.
- Quarrying of sand is to continue on site.

- No groundwater pumping occurs near to the site and the nearest licensed abstraction is 1500metres south of the site located at Fairfield.

- The site is within the outer Source Protection Zone and groundwater levels are not influenced by draw down from the Public Supply Boreholes and the site will be designed and operated on the principles of engineered liner with an unsaturated zone.

- The proposed final landform is a field to encourage surface water run-off from the restored areas and is presented at Drawing ESSD 5.

Any former land-uses that may give rise to potential sources of non-landfill related contamination

The Chadwich Lane Quarry was operated between 2000 and 2013. A former landfill site was operated to the east of Chadwich Lane. An area to the east of the Chadwich Lane Quarry was used by the Hereford and Worcestershire County Council for the disposal of household waste, which was restored in 2000, Chadwich Lane Quarry. The Council also ad a site at thew DGutter to the north of the site.

Sources of Information

i. The Environment Agency;
ii. The British Geological Survey records and publications;
iii. The Ordnance Survey.
iv. Worcestershire County Council
v. DEFRA Magic Site
vi. National Air Quality Standards
vii. Natural England and English Heritage
viii Envirocheck

Geology and hydrogeology

The Chadwich Lane Quarry is located in sands of the Wildmoor Sandstone. The quarry consists of a uniform, brownish red sandstone. The sandstone is medium too coarse grained, micaceous and feldspathic. Cross bedding has been observed which suggests fluvial deposition.

Groundwater monitoring of levels has been undertaken in 2022.

The site is located within a Total Protection Zone (Zone 3). The nearest outer SPZ (SPZII) is located circa. 283m to the south east of the permit boundary and the abstraction borehole is 924metres from the site.

Archive search and land-use chronology

The site has been used as quarry for sand extraction since 2021.

Other industrial activities have been permitted along the northern perimeter and the site has been subject to former illegal waste disposal operations.

Any history of incidents

There are no records of pollution incidents relating to this facility from the Envirocheck search, however the site investigations have identified previously illegally deposited inert and non-hazardous waste in the northern section of the site.

4.2 Objectives of this Assessment

Context within EP regime

Monitoring records for the site have been assessed together with site investigations to define the initial site conditions and to allow for baselines to be set and for action and trigger levels to be set for groundwater, leachate, landfill gas and particulate matter.

Description of general approach

The Environment Agency Template has been used for the “Conceptual Model, Environmental Setting and Design” section of the Environmental Permit variation application for the landfill has been used. It has been designed to describe the site conceptual model and setting for the site.

The site conceptual model has provided an understanding of the installation in its environmental setting and consideration of the design and operation of the site at the time of the application. This report addresses the source terms of the risk (i.e. waste), all pathways and receptors and has been used as a basis for commencing the risk assessments.

The final conceptual model report has been prepared on the basis of the findings of the component risk assessments (e.g. hydrogeology, stability, landfill gas, nuisance and amenity) required under this EP Application.

Different types of contaminants to be considered

The site will accept non-hazardous waste for treatment principally as demolition and construction materials and inert waste will be landfilled at the site. The Groundwater Regulations will therefore apply to this site.

The site area requires the construction of an engineered artificial geological barrier using clay type materials to the base and sides to achieve a minimum target permeability of 1×10^{-7}m/s.

4.3 Site Investigation (Data Collection) Details

Description of site investigation and related work activities.

Specific site investigations have been carried out with regard to the local hydrogeology of the site. As part of these site investigations, boreholes have been drilled and borehole logs produced at each stage.

Description of laboratory analysis

This includes permeability of the soil, attenuation properties of the soil, groundwater quality, groundwater levels, groundwater quality, site levels, and gas concentrations outside the site.

4.4 Summary of Site Investigation and Analysis Findings

On-site observations

Physical observations of the base and sides of the landfill site have been observed during walk over surveys.

Site survey

Detailed groundwater level monitoring has taken place in 2022 to establish the groundwater levels and full detailed surveys have been carried out of the site to provide detailed topographic information.

In-situ testing results

The permeability testing of the silt, and soakaway tests and historic packer tests have been used for on-site bedrock permeability and has also been tested for ionic exchange capacity.

Monitoring data

This includes, groundwater level monitoring, groundwater quality testing, permeability testing of the site, dust monitoring, noise monitoring, landfill gas monitoring.

4.5 Data Interpretation

Proposal of baseline conditions for the site.

Compliance limits for groundwater are set in Table ESSD8 and landfill gas data and upper limits are set out at Appendix ESD10. Background gas monitoring and groundwater monitoring has been carried out.

4.6 Conclusions

The Chadwich Lane Quarry landfill site to be operated as an inert landfill site, with the inert wastes deposited into separate engineered cells. The site is to have an engineered Geological Barrier constructed under an approved CQA regime.

The site is to be operated under a Permit issued under the Environmental Permitting Regulations 2016.