



**ENVIRONMENTAL PERMIT APPLICATION –
ENVIRONMENTAL SETTING AND SITE DESIGN REPORT**

**HUSBANDS BOSWORTH QUARRY
WELFORD ROAD
HUSBANDS BOSWORTH
LEICESTERSHIRE
LE17 6JH**

**Document Reference: MG1001/07.R0
May 2022**



**Project Quality Assurance
Information Sheet**

**ENVIRONMENTAL SETTING AND SITE DESIGN REPORT
HUSBANDS BOSWORTH QUARRY, WELFORD ROAD, HUSBANDS
BOSWORTH, LEICESTERSHIRE, LE17 6JH**

Report Status : Final
Report Reference : MG1001/07.R0
Report Date : May 2022
Prepared for : Mick George Limited
Prepared by : Sirius Environmental Limited
The Beacon Centre for Enterprise
Dafen
Llanelli
SA14 8LQ

Written by :

**Michael Knott BSc (Hons) MSc FGS AIEMA AssocMCIWM
Environmental Consultant**

Reviewed by :

**Dylan Thomas BSc (Hons) PGDip MCIWM
Principal Environmental Consultant**

Approved by :

**Mark Griffiths BSc (Hons) MSc CEnv MCIWM CGeol
Environmental Director**

Revision	Date	Amendment Details	Author	Reviewer
0	May 2022	First Issue	MK	DT

This report is written for the sole use of Mick George Limited and their appointed agents. No other third party may rely on or reproduce the contents of this report without the written approval of Sirius. If any unauthorised third party comes into possession of this report, they rely upon it entirely at their own risk and the authors do not owe them any Duty of Care or Skill.

**HUSBANDS BOSWORTH QUARRY,
WELFORD ROAD,
HUSBANDS BOSWORTH,
LEICESTERSHIRE
LE17 6JH**

ENVIRONMENTAL PERMIT APPLICATION

ENVIRONMENTAL SETTING AND SITE DESIGN (ESSD)

CONTENTS

1.0	INTRODUCTION.....	1
1.1	Report Context.....	1
1.2	Site Details.....	1
2.0	SOURCE TERM CHARACTERISATION	6
2.1	Site Development.....	6
2.2	Historical Development	6
2.3	Proposed Development.....	7
3.0	PATHWAY AND RECEPTOR.....	10
3.1	Geology	10
3.2	Hydrology	12
3.3	Hydrogeology.....	19
3.4	Man-Made Subsurface Pathways	30
3.5	Receptors and Compliance Points	30
4.0	POLLUTION CONTROL MEASURES	33
4.1	Site Engineering	33
4.2	Restoration Profile	34
4.3	Water Management	34
4.4	Post Closure Controls (Aftercare)	35
5.0	MONITORING	36
5.1	Weather	36
5.2	Gas Monitoring Infrastructure.....	37
5.3	Gas Monitoring	37
6.0	SITE CONDITION REPORT.....	42
6.1	Scope and Objectives	42
6.2	Condition of the Land at Permit Issue	42
6.3	Permitted Activities	47
6.4	Conclusions	47
	REFERENCES	48

LIST OF DRAWINGS

H37/3/21/04	Restoration Scheme
MG1001/14/01	Site Location Plan
MG1001/14/02	Site Boundaries Plan
MG1001/14/03	Environmental Site Setting
MG1001/14/04	Cultural and Natural Heritage
MG1001/14/05	Site Layout and Waste Deposition
MG1001/14/06	Proposed Sidewall Engineering
MG1001/14/07	Monitoring Plan
MG1001/14/08	Regional Hydrogeology
MG1001/14/09	Local Hydrogeology
MG1001/14/10	Sensitive Receptors

LIST OF APPENDICES

Appendix ESSD1	Husbands Bosworth Quarry, Landmark Envirocheck Report
Appendix ESSD2	Husbands Bosworth Quarry Intrusive Site Investigation Borehole Logs
Appendix ESSD3	Private Water Supply Responses
Appendix ESSD4	Husbands Bosworth Quarry Heritage Statement
Appendix ESSD5	Husbands Bosworth Quarry Biodiversity Enhancement Plan and Protected Species Survey Report
Appendix ESSD6	Environment Agency Habitats and Conservation Screening Report
Appendix ESSD7	Husbands Bosworth Quarry Background Ground Gas Monitoring Records (May 2021 to November 2021)
Appendix ESSD8	Husbands Bosworth Quarry Abstraction Licence

LIST OF TABLES

Table ESSD1:	Land uses and relevant distances from the installation (within 1000m)..	3
Table ESSD2:	Development history of site and surrounding land	6
Table ESSD3:	WAC and equivalent worst-case inert waste 'leachate' quality.....	7
Table ESSD4:	Summary of geology in the vicinity of Husbands Bosworth Quarry	11
Table ESSD5:	Summary of active Discharge Consents to surface water within 1km of the site	13
Table ESSD6:	Details of licensed surface water abstraction within 2km of the site	15
Table ESSD7:	Baseline surface water quality summary (statistical outliers removed) between May 2021 and November 2022	17
Table ESSD8:	Statistical summary of monitored groundwater levels within the superficial deposits surrounding Husbands Bosworth Quarry between June 2021 and November 2021 (mAOD)	20
Table ESSD9:	Baseline groundwater quality summary (statistical outliers removed) between May 2021 and November 2021	25
Table ESSD10:	Details of licensed groundwater abstraction within 2km of the site.....	28
Table ESSD11:	Details of Private Water Supplies within 2km of the site.....	29
Table ESSD12:	Summary of active Discharge Consents to groundwater/land within 1km of the site.....	30
Table ESSD13:	Average rainfall and days of rainfall (>1mm) at Church Lawford (1981-2010).....	36
Table ESSD14:	Baseline gas concentration quality summary (statistical outliers removed) between May 2021 and November 2021	38
Table ESSD15:	Proposed action levels and compliance limits for carbon dioxide and methane in boreholes BH1 – BH7	41
Table ESSD16:	Natural Hazard Rating Summary within 250m of the site	44
Table ESSD17:	Summary of waste facilities within 1km of the site boundary.....	45
Table ESSD18:	Summary of active contemporary trade directory entries within 1km of the site.....	45
Table ESSD19:	Pollution Incidents within 500m of the site	46

1.0 INTRODUCTION

1.1 Report Context

- 1.1.1 Sirius Environmental Limited (Sirius) has been commissioned by Mick George Limited (Mick George) to prepare an Environmental Permit Application to operate an Inert Landfill activity to support the restoration of Husbands Bosworth Quarry, Husbands Bosworth, Leicestershire.
- 1.1.2 As part of this application, it is necessary to prepare a Conceptual Model, Environmental Setting and Site Design (ESSD) Report. This report has been prepared in accordance with Environment Agency's online ESSD template report (published January 2020)
- 1.1.3 The inert waste landfill will fill the void created by ongoing sand and gravel extraction operations. A total landfill void space requiring an approximate volume of restoration material of 1,300,000m³ of inert waste will be imported, which is a low-risk waste type.
- 1.1.4 As part of this application, hydrogeological and stability risk assessments have been carried out. A qualitative environmental risk assessment has also been undertaken. These risk assessments have been completed in accordance with the requirements of the Environmental Permitting (England and Wales) Regulations 2016.
- 1.1.5 This report details the conceptualises the site in terms of the potential source pathway and receptors relationships to support the various risk assessments required to support the Environmental Permit application. These risk assessments (and relevant engineering and environmental controls) are presented in the relevant sections of the main application document.

1.2 Site Details

Location and Access

- 1.2.1 Husbands Bosworth Quarry is located approximately 230m southeast of the village of Husbands Bosworth, Leicestershire. The application site has a postcode of LE17 6JH and is centred on a National Grid Reference: SP 65056 83878. Husbands Bosworth Quarry falls within the Bosworth Estate which covers c.147ha. The Husbands Bosworth Quarry covers c.50ha of the Bosworth of which the landfill footprint will occupy c. 30ha.
- 1.2.2 Access to the site is via Welford Road (A5199) located to the west of the quarry which in turn connects to Station Road (A4304) and the A14.
- 1.2.3 The location of Husbands Bosworth Quarry is presented in **Drawing No. MG1001/14/01**.

Site Classification

- 1.2.4 The application is for the operation of landfill facility for the disposal of inert waste only.

Adjacent Former Waste Management Licences

- 1.2.5 The Envirocheck report presented in **Appendix ESSD1** indicates the presence of one registered active landfill within the proximity to Husbands Bosworth Quarry, and two historical landfill activities.

- 1.2.6 The active landfill recorded in the vicinity of Husbands Bosworth Quarry corresponds to the Husbands Bosworth Landfill Site. The boundary of this landfill site is located approximately 290m to the southwest of Husbands Bosworth Quarry; with the edge of the landfill void approximately 440m to the southwest and is operated as an Inert Landfill by Tarmac Aggregate Limited. The Husbands Bosworth Landfill Site operates under the Environmental Permit Reference EA/EPR/VP3292NK which was first issued in March 2007.
- 1.2.7 The two identified historical landfill facilities correspond to the same area of land and were held by the same licence holder; Redlands Aggregates, albeit at different times. The area of land associated with both historical landfill permits covered approximately 39 hectares and extends into the southwestern portion of the current Husbands Bosworth Quarry; currently housing the Husband Bosworth Quarry site offices and the aggregate grading and bagging plants. The older of the two historic landfill sites (EA Historic Landfill Reference EAHLD01541) commenced operations in February 1985 and was surrendered in November 1993. Published records indicate that inert waste was accepted during the site's operation lifetime and that the last waste input waste accepted in October 1993.
- 1.2.8 The second historic landfill associated licenced to Redlands Aggregates (EA Historic Landfill Reference EAHLD35836) was issued in April 1994 and surrendered in August 1998. No information is available to confirm the type of materials deposited under this landfill licence.
- 1.2.9 Given the age of both landfill licences, it is unlikely that they feature any engineered containment to provide protection to the environment. As such, they have the potential to present an ongoing off-site contaminant source term from the deposited waste.

Site Context

- 1.2.10 Mineral excavation activities within the Bosworth estate are long-established with sand and gravel extraction occurring since 1976. Husbands Bosworth Quarry has operated under numerous planning permissions during its lifespan, which have since expired. Future mineral extraction and process are subject to a new Mineral Planning Consent application (Ref.: 2021/CM/0041/LCC) that is currently being determined by Leicestershire County Council. The Bosworth Estate covers c.147ha of which the inert landfill environmental boundary will occupy c. 44.8ha, as shown in **Drawing No. MG1001/14/02**.
- 1.2.11 Agricultural land provides separation of at least c. 230m between the operational areas of the landfill and the nearest residential receptors around the site.
- 1.2.12 Residential properties are located to the north, northwest and west of the proposed landfill void. The closest residential properties are located c.230m northwest of the proposed quarry void on Butt Lane with other properties located at further distances on roads connecting to Welford Road (A5199) and Kilworth Road (A4304). These roads include Lamma Close, Cherry Tree Lane, School Lane, Marsh Drive and Townend Close. The residential areas in the vicinity of the site typically consist of detached and semi-detached properties.
- 1.2.13 Ancillary operations associated with mineral extraction activities are located within c.285m of the inert landfill void's western boundary.
- 1.2.14 The River Welland and an unnamed tributary extend along Husband Bosworth Quarry's eastern and southern boundaries, respectively. Beyond the River

Welland are large areas of agricultural land which extent for more that 500m from Husbands Bosworth Quarry. Beyond the unnamed tributary to the River Welland also lies open agricultural land which extends c.340m to the south. Beyond this agricultural land lies a grass airfield utilised by light powered aircraft and gliders and an existing inert landfill site operated by Tarmac Aggregates Limited (Permit Ref. EPR/VP3292NK).

1.2.15 The existing site comprises operational mineral extraction areas, areas undergoing restoration, the current mineral processing plant, bagging plant and associated areas of hardstanding and open storage. These operations are set back from main transportation routes and some boundaries are screened behind mature vegetation (including perimeter hedgerows) and developed woodland.

1.2.16 A summary of surrounding land uses, features, classifications, and receptors is included within **Table ESSD1**. These features are visually depicted in **Drawing Nos.: MG1001/14/03** and **MG1001/14/10**.

Table ESSD1: Land uses and relevant distances from the installation (within 1000m)

ID	Receptor Name	Type of Receptor	Approximate nearest distance from the operational boundary	Direction from proposed landfill footprint
R1	River Welland	Water Body	Adjacent	East
R2	Welland Waste Management	Commercial / Industrial	580m	Northeast
R3	Peeble Hall	Commercial / Industrial	1000m	Northeast
R4	Woodsite Lodge	Residential	760m	Northeast
R5	Dene Lodge	Residential	910m	Northeast
R6	Theddingworth Road (A4304)	Public Highway	290m	North
R7	Welford Road (A5199)	Public Highway	380m	West
R8	Bosworth Hall (and associated grounds)	Residential / Commercial	Hall: 380m Grounds: Adjacent	North
R9	Sewage Treatment Works	Commercial / Industrial	590m	Northwest
R10	Husbands Bosworth Village	Residential	210m	Northwest
R11	Dairy Farm Day Nursery	Educational	415m	Northwest
R12	Hunters Lodge Care Home	Residential	690m	Northwest
R13	Husbands Bosworth Church of England Primary School	Educational	450m	Northwest
R14	Husbands Bosworth Children's Park & Dog Walking Field	Recreational	510m	West
R15	Husbands Bosworth Medical Centre	Commercial / Industrial	350m	West
R16	Cemetery	Recreational	440m	West
R17	Allotments	Recreational	430m	West
R18	Husbands Bosworth Landfill Site	Commercial / Industrial	290m	Southwest

ID	Receptor Name	Type of Receptor	Approximate nearest distance from the operational boundary	Direction from proposed landfill footprint
R19	Gliding Centre	Recreational	410m	South
R20	NBJ Carpentry	Commercial / Industrial	580m	Southwest
R21	Spring	Spring	400m	West
R22	Spring	Spring	35m	East
R23	Unnamed Stream	Waterbody	Adjacent	South
R24	Gravel Pit Spinney	Woodland (Deciduous)	On-Site	Within
R25	Lodge Spinney	Woodland (Deciduous)	Adjacent	North
R26	Hollow Spinney	Woodland (Deciduous)	75m	East / Southeast
R27	Carland Spinney	Woodland (Deciduous)	285m	Southeast
R28	Unnamed Deciduous Woodland	Woodland (Deciduous)	90m	South
R29	Agricultural Land	Agricultural	Adjacent	All Directions
R30	Public Footpaths & Bridleways	Public Rights of Way	Adjacent	Within
R31	Secondary A / Secondary Undifferentiated Aquifer (Sand and Gravels)	Groundwater	Adjacent	All Directions
R32	Great Crested Newts	Amphibian	On-Site	Within
R33	Sand Martins	Bird	On-Site	Within
R34	Grand Union Canal	Waterbody	810m	North

1.2.17 The distances specified in the **Table ESSD1** represent the distance from the permit boundary to the receptor. In some instances the distance between operation areas of the landfill footprint and the receptors may be greater.

1.2.18 The landfill operations will extend across all areas of the Husbands Bosworth Quarry facility subject to mineral extraction, as illustrated in **Drawing No. MG1001/14/02**.

1.2.19 For the duration of landfill operations (including aftercare) the existing perimeter security fencing and CCTV infrastructure to the wider quarry site will be maintained. The landfill operations will also be supported by the existing weighbridge facilities at the quarry.

Topography

1.2.20 The landfill site is located on the south-eastern side of Husbands Bosworth. The village of Husbands Bosworth is location on a local topographic high with ground levels of c.156mAOD. Natural ground levels at Husbands Bosworth Quarry typically fall from c.150mAOD along the north-western boundary to between c.130mAOD and c.122mAOD along the southern and eastern boundary towards the River Welland.

1.2.21 The quarry will be worked to a maximum depth of c.20m below ground level.

Compliance with landfill development: groundwater risk assessment for leachate (replaces former GPP3 Guidance)

- 1.2.22 The landfill operation at Husbands Bosworth Quarry will only include the disposal of inert wastes. Consequently, as the facility is not located within a Source Protection Zone 1 (SPZ1) it accords with the decision framework for Position Statement E1 under “The Environment Agency’s Approach to Groundwater Protection” (v1.; Nov 2017). Nonetheless, as the landfill is situated sub-water table within a Secondary A aquifer that contributes to baseflow to the River Welland, this triggers the requirement for a Hydrogeological Risk Assessment (HRA) – refer to **Doc. Ref.: MG1001/08**.

2.0 SOURCE TERM CHARACTERISATION

2.1 Site Development

Sources of Information

2.1.1 The baseline of this report has been determined from a review of available published information, including:

- Landmark Envirocheck Report;
- BGS 1:50,000 scale geology maps;
- Environment Agency web-based data; and
- Local Authority Records.

2.2 Historical Development

Historical use of land

2.2.1 The development history of the permitted facility has been established through a review of available historical county series, ordnance survey and online maps. Details of the site history is provided in **Table ESSD2**.

Table ESSD2: Development history of site and surrounding land

Date	On site	Surrounding Land
1885	Application site was largely agricultural land, with the restored Gravel Pit Spinney located in the centre of the application site. Although unnamed, what appeared to be small scale quarrying operations are noted in the south-western corner to the application site.	Local land use to the east, south and west was dominated by agricultural fields. The town of Husbands Bosworth is located to the northwest of the application site. A 'smithy' is indicated to the north of the Site adjacent to the northern area of quarry operations
1901 - 1904	No identifiable changes.	No significant changes
1931	Minor northwards extension of quarry located in the south-western corner of the application site.	No significant changes
1952	No identifiable changes.	Appearance of Airfield located to the south of the application site. No identifiable changes to other surrounding land-use.
1958	No identifiable changes.	Expansion of airfield buildings alongside inclusion of "disused" in map label.
1968	Only western half of application site covered in this period. Expansion of quarry activities in south-wester corner of application site	No significant changes, except for residential development to the west of the airfield.
1973	Only eastern half of application site covered in this period . No identifiable changes.	No significant changes
1987	Only western half of application site covered in this period. No identifiable changes.	No significant changes
1999	Apparent expansion, operation and cessation of mineral extraction activities in both the south-western corner and central section of the application site. Appearance of three water features in south-western corner of application site. No identifiable changes in the north-eastern corner	Appearance of unnamed quarry feature (including surface water lagoon) to the southwest of the application site. No other identifiable changes

Date	On site	Surrounding Land
2022	<p>There was a reduction in the number of surface water features in the south-western corner of the application site to two.</p> <p>Multiple surface water features appeared in the central portion of the application site.</p> <p>No identifiable changes in the north-eastern corner</p>	<p>No significant changes aside from the appearance of small housing estates to the west (Marsh Drive) and northwest (unnamed road connected to Butt Lane) of the application site .</p>

2.3 Proposed Development

2.3.1 The proposed development is for the infilling of the quarry void using inert materials to reach final restoration levels which tie into the surrounding topographic profile. The final restoration scheme will contain landforms that will provide recreational benefits to the local community, as well as pasture and biodiversity improvements. **Drawing No. H37/3/21/04** depicts the proposed land-use for Husbands Bosworth Quarry once restoration activities have been completed.

2.3.2 To achieve the restoration scheme, c.1,300,000 m³ of inert material will be deposited over an anticipated period of 8 years.

Proposed Waste Types

2.3.3 A full list of waste to be accepted at the site is presented in Appendix MP1 of the accompanying Management Plan (*Document Ref.: MG1001/06*). The facility will accept up to 175,000m³ (350,000 tonnes) of waste per annum for disposal.

2.3.4 Only inert wastes that accord with the standard criteria set out in Section 2.1 of the Annex to the Council Decision of 19 December 2002 will be accepted for deposit at the site. The waste materials will be suitable for their intended purpose from a chemical, physical and biological perspective, which will be appropriately characterised and verified prior to deposit at the site.

2.3.5 The upper limits to the leachable and pollutant content of the inert wastes are determined by a ratio of 10 litres of distilled water to 1 kg of waste, with the result quoted as concentration per unit of mass i.e. mg/kg. The WAC leachable limits for inert waste and their equivalent concentration per liquid volume are presented in **Table ESSD3**. These concentrations are considered to be representative of a worst-case leachate source term for an inert landfill facility.

Table ESSD3: WAC and equivalent worst-case inert waste 'leachate' quality

Parameter	Inert Waste WAC (L/S 10L/S 10l/kg) [mg/kg]	Equivalent Liquid Concentration [mg/l]
Arsenic	1.5	0.15
Barium	60	6
Cadmium	0.12	0.012
Chromium	1.5	0.15
Copper	6	0.6
Mercury	0.01	0.001
Molybdenum	1.5	0.15
Nickel	1.2	0.12
Lead	1.5	0.15
Antimony	0.18	0.018
Selenium	0.3	0.03
Zinc	12	1.2
Chloride	2400	240
Fluoride	30	3
Sulphate	3000	300
Phenol Index	3	0.3

Phasing

- 2.3.6 The restoration of Husbands Bosworth Quarry will commence in parallel with ongoing mineral extraction and processing operation for a period of time, with landfilling then continuing in isolation until to achieve the final landform.
- 2.3.7 Mineral extraction and restoration of the quarry will progress with a total of seven key phases. Five of the phases correspond to the extension area located to the northeast of Husbands Bosworth Quarry. These five phases will be initially subject to mineral extraction and subsequently restored via landfilling of selected inert waste.
- 2.3.8 The sixth phase corresponds the existing void located in the centre of Husbands Bosworth Quarry. As mineral extraction has previously been undertaken within this phase, it will be subject to the removal of any remaining mineral deposits, reworking of existing overburden deposits and restoration through landfilling of selected inert waste. However, this area will also provide the support water management activities to support the mineral extraction and processing and quarry restoration activities through the facility's operation life.
- 2.3.9 The seventh phase corresponds to the area located to the southwest of Husbands Bosworth Quarry within which the site offices, associated equipment (e.g. weighbridge) and mineral processing equipment are located. The seventh phase will not be subject to new mineral extraction and only requires restoration.
- 2.3.10 Unlike the sixth phase, a significant proportion of restoration of the seventh phase has already been completed via the deposition of site-derived overburden. Consequently, restoration of this area will be achieved through the redistribution and deposition of site-derived materials and topped up with selected imported soils (if required).
- 2.3.11 In the event that suitable waste materials are required to supplement the restoration of the mineral processing area (Phase 7). The required supporting documentation will be prepared and submitted to the Environment Agency for approval once the scope of any such activities is confirmed.
- 2.3.12 The location of each of these phases are illustrated in **Drawing No. MG1001/14/05**.

Hydrogeological Risk Screening

- 2.3.13 Schedule 22 from The Environmental Permitted (England and Wales) Regulations 2016 covers all aspects in relation to groundwater activities. The regulations provide a consolidated system of environmental permitting relating to the relevant functions, granting of an environmental permit as well as the groundwater activities for which a permit may be granted.
- 2.3.14 The landfill operations at Husbands Bosworth Quarry constitute a Groundwater Activity under Schedule 22 of EPR2016 on the basis that it has the potential to lead to the direct and indirect discharge of pollutants to groundwater.

Final Landform and After-use

- 2.3.15 The proposed restored scheme is compliant with the Leicestershire Minerals and Waste Local Plan and will generate landscape and ecological gains, thereby improving the local environment and satisfying creative conservation policies.
- 2.3.16 The restoration scheme will restore the landscape of the entire quarry site and its environs back to a historic character, which assimilates with the parkland to the north and northeast and the wider rural, agricultural landscape character of the district, restoring a larger-scale, landscape wide habitat structure, characteristic of and consistent with the historic landscape associated with Bosworth Hall.
- 2.3.17 The restoration scheme is presented in **Drawing No. H37/3/21/04** with final quarry restoration levels integrating into the surrounding topographic profile. The aim of the restoration scheme for the quarry site and its environs is to create a wide range of historic landscape features and habitats which will integrate into the existing landscape and complement local and national biodiversity objectives and will include:
- Herb-rich grassland;
 - Parkland with scattered broadleaved specimen trees;
 - Broadleaved woodland;
 - Scrub habitat;
 - Hedgerows;
 - Open Ditches;
 - Bird, amphibian and mammal habitats; and
 - Seasonal Water Feature.

3.0 PATHWAY AND RECEPTOR

3.1 Geology

3.1.1 The geology of Husbands Bosworth Quarry is taken from:

- the British Geological Survey (BGS) 1:50,000 scale Sheet 170 (Market Harborough) solid and drift edition;
- the logs of the gas and groundwater monitoring boreholes and mineral investigation boreholes installed around the perimeter of and within Husbands Bosworth Quarry (**Appendix ESSD2**);
- the logs of historical boreholes drilled at and in the vicinity of the site (available from BGS Onshore Viewer);

3.1.2 Where unworked, superficial deposits at and surrounding the application site comprise diamicton moraines of till with outwash sand and gravel deposits, particularly around the west and north of the quarry void. Sand and gravel superficial deposits; comprising of River Terrace and Glaciofluvial deposits, are located around the eastern and southern edges of the application site. These deposits are indicated to be associated with local watercourses. Additionally, alluvium is associated with the River Welland and its tributaries is present to the north, south, and east of the Husbands Bosworth Quarry site.

3.1.3 Husbands Bosworth Quarry operations exist due to the local presence of the superficial sand and gravel deposits. The exposures worked at Husbands Bosworth Quarry are located beneath up to c.10m of overburden.

3.1.4 An area classified as artificial ground is indicated adjacent to the south-western boundary of the proposed landfill void. Review of the highlighted area confirmed that the indicated area correlates to the Mineral Processing Area associated with Husbands Bosworth Quarry. The nature of the artificial ground is designated as “worked ground (undivided) – void”.

3.1.5 The bedrock geology of the application site and the surrounding area comprises of the Dyrham Formation and the Charmouth Mudstone Formation; both part of the Lias Group.

3.1.6 The Dyrham Formation consists of pale to dark grey and greenish grey, silty and sandy mudstone, with interbeds of silt or very fine-grained sand (locally muddy or silty).

3.1.7 The Charmouth Mudstone Formation underlies the Dyrham Formation and is comprised of dark grey laminated shales, and dark, pale and bluish grey mudstones. Additionally, the Charmouth Mudstone Formation contains locally concretionary and tabular limestone beds and phosphatic or ironstone nodules in some areas.

3.1.8 The geology within the vicinity of the site is shown in the geological maps which accompany of the Landmark Envirocheck Report presented in **Appendix ESSD1**. A summary of the stratigraphy present within vicinity of the quarry; derived from borehole logs generated during the installation of mineral investigation boreholes in September/October 2020 and peripheral gas and groundwater monitoring wells in April 2021 and, is provided in **Table ESSD4**.

Table ESSD4: Summary of geology in the vicinity of Husbands Bosworth Quarry

Unit	Description	Proven Thickness (m) ¹
Topsoil	Silty sand locally gravelly sand	0 – 2
Glacial Till	Poorly sorted gravel clasts in a clayey sand to sandy clay matrix	2 – 10
Glaciofluvial Deposits	Mostly coarse-grained sediments (i.e. sand and gravel) with some finer-grained layers (i.e. clay and silt). Sand and gravel, locally with lenses of silt, clay, or organic material.	1 – 20
Alluvium	Soft to firm consolidated, compressible silty clay, with possibility to contain layers of silt, sand, peat, and basal gravel.	Not Encountered
River Terrace Deposits	Mostly coarse-grained sediments (i.e. sand and gravel) with some finer-grained layers (i.e. clay and silt).	Not Encountered
Dyrham Formation (Lias Group)	Silty and sandy mudstone, with interbeds of silt or very fine-grained sand,	Base not proven
Charmouth Mudstone Formation (Lias Group)	Laminated shales, and dark, pale and bluish grey mudstones; locally concretionary and tabular limestone beds.	Base not proven

¹Thicknesses where unit has been encountered through local investigations

- 3.1.9 As depicted in **Table ESSD4** the thickness of superficial deposits varies significantly across Husbands Bosworth Quarry. The glaciofluvial sand and gravel deposits are at their thickest within the main quarry footprint and thin significantly beyond the edge of the quarry, with limited lateral extent beyond the quarry footprint, as depicted by BGS 1:50k mapping. As the thickness of the glaciofluvial deposits thin they are overlain with an increasing thickness of clay-rich glacial till deposits.
- 3.1.10 The Dyrham Formation of the Lias Group was proven at the base of the superficial drift deposits in all boreholes surrounding the Husbands Bosworth Quarry void; although the base of this unit was not proven. The Dyrham Formation strata are described as pale to dark grey and greenish grey, silty and sandy mudstone, with interbeds of silt or very fine-grained sand (locally muddy or silty), weathering yellow. This description correlates to the description contained in the borehole installation logs presented in **Appendix ESSD2** identify this lithology which records the presence of “silty clay”. Published lithological descriptions also indicate that the Dyrham Formation is visible micaceous with impersistent beds or doggers of ferruginous limestone (some ooidal) and sandstone, which tend to occur at the top of sedimentary cycles. Sporadic large cementstone nodules are also noted.
- 3.1.11 The Charmouth Mudstone Formation of the Lias Group underlies the Dyrham Formation and was not encountered during the installation of on-site monitoring or mineral investigation boreholes. The Charmouth Mudstone Formation strata are described as dark grey laminated shales, and dark, pale and bluish grey mudstones, with locally concretionary and tabular limestone beds; formed of argillaceous limestone, phosphatic or ironstone (sideritic mudstone) nodules in some areas. Organic-rich paper shales are also recorded at some levels as well as finely sandy beds in lower part in some locations.
- 3.1.12 Publicly accessible BGS borehole records are limited in the vicinity of Husbands Bosworth Quarry. A historical borehole record exists for a 13.11m deep borehole (SP68SE6) drilled in 1955 and located c.160m to the east of Husbands Bosworth Quarry; to the east of the River Welland. The log broadly correlates to the thicknesses recorded in the site-specific borehole logs and suggests the

presence of Drift to a thickness of 35ft (10.7m) underlain by “Blue clay” with a minimum thickness of 8ft4in (2.5m).

- 3.1.13 As discussed previously, the site-specific exploratory borehole logs, publicly available borehole records and published geological maps indicates that the identified superficial glaciofluvial deposits are not laterally continuous and are instead concentrated within a discrete “scour” feature formed within the Dyrham and Charmouth Mudstone Formations.
- 3.1.14 The mineral extraction operations will exploit the sand and gravel reserves with the consented area (principally comprising glaciofluvial deposits together with limited overlying exposures of river terrace, alluvial and glacial till deposits, where they overlie), down to the underlying bedrock units.

3.2 Hydrology

- 3.2.1 The hydrology of the quarry is taken from Ordnance Survey topographical maps, water quality monitoring undertaken in the vicinity of the application site, information provided by the Environment Agency and information provided by Mick George regarding their water management scheme in the current extraction area in the application site. The main hydrological features in the vicinity of the proposed quarry are shown on **Drawing Nos. MG1001/14/08 and MG1001/14/09.**
- 3.2.2 The application site is located in the headwaters of the River Welland catchment area. The River Welland rises approximately 2.6km southeast of the quarry from where it flows west then north before flowing east passing approximately 50m to the southeast of the landfill footprint. Two unnamed tributaries flow into the River Welland are located within the vicinity of the proposed site.
- 3.2.3 The first tributary is located along the southern boundary of the Husbands Bosworth Quarry Mineral Processing Area and flows eastwards into the River Welland c.110m to the south of the landfill footprint.
- 3.2.4 The second tributary is located to the north of the Husbands Bosworth Quarry and flows in a north-easterly direction into the River Welland c.310m to the northeast of the landfill footprint.
- 3.2.5 Surface water run-off and groundwater seepage collected within the site boundary is managed within a series of holding lagoons located across the existing Husbands Bosworth Quarry void.
- 3.2.6 In order to ensure any surface or pumped ground water is discharged from the site in a controlled manner, the water treatment area will consist of a series of ponds interlinked with relatively small diameter culverts to ensure the through flow of water is controlled to existing “greenfield” run-off rates. This will enable any silt or suspended solids to settle out prior to the water being discharged to the River Welland. Such facilities will be installed from the outset of the project. A temporary water treatment pond may be established in the base of the quarry workings to settle out any suspended solids prior to the water being pumped to the required discharge point.
- 3.2.7 As restoration of the site progresses, a series of permanent surface water attenuation ponds and drainage ditches will be progressively established. These features will cater for increased surface water flows, allowing for future climate change, following the site’s restoration scheme, and will ensure that surface water discharges are maintained at greenfield rates. The attenuation ponds and

ditches will form part of and be incorporated into, the overall site restoration scheme.

3.2.8 There is a total of 12 active licenced discharges to surface water within 1km of the landfill. Summary details are presented in **Table ESSD5**. Two consented discharges relate to the quarry/mineral activities at Husbands Bosworth Quarry which discharge into the River Welland. The first of the two discharges is located along the eastern edge of the proposed landfill void with the second located along the southern boundary of the landfill site. Visual depictions of their locations are presented in **Drawing No. MG1001/14/08**. In addition to the two aforementioned discharge consents there are four other consented discharges to the River Welland and its tributaries within 1km of the application site, three of which are located upstream of the proposed landfill site.

Table ESSD5: Summary of active Discharge Consents to surface water within 1km of the site

Location	Details
Husbands Bosworth Quarry, Welford Road, Husbands Bosworth, Lutterworth, Leicestershire, LE17 6JH Distance 0m E NGR: 465299, 283911	Operator: Mick George Limited Property Type: MINERAL/GRAVEL EXTRACTION/QUARRYING Catchment Area: Upper River Welland (Market Harborough) Ref: EPRZP3724XU Discharge Type: Trade Discharge - Mineral Workings Discharge Environment: Freshwater Stream/River Receiving Water: River Welland Status: New issued under EPR 2010
Husbands Bosworth Quarry, Welford Road, Husbands Bosworth, Lutterworth, Leicestershire, LE17 6JH Distance 0m SE NGR: 464940, 283510	Operator: Mick George Limited Property Type: MINERAL/GRAVEL EXTRACTION/QUARRYING Catchment Area: Upper River Welland (Market Harborough) Ref: PRNNF12734 Discharge Type: Trade Discharge - Mineral Workings Discharge Environment: Freshwater Stream/River Receiving Water: Tributary of River Welland Status: New Consent (Water Resources Act 1991, Section 88 & Schedule 10 as amended by Environment Act 1995)
Husbands Bosworth Quarry, Welford Road, Husbands Bosworth, Lutterworth, Leicestershire, LE17 6JH Distance 37m SW NGR: 464500, 283440	Operator: Lafarge Aggregates Ltd Property: MINERAL/GRAVEL EXTRACTION/QUARRYING Catchment Area: Upper River Welland (Market Harborough) Ref: PRNNF04317 Discharge Type: Trade Discharge – Mineral Workings Discharge Environment: Freshwater Stream/River Receiving Water: Trib River Welland Status: Varied by Application - (Water Resources Act 1991, Schedule 10 as amended by Environment Act 1995)
Husbands Bosworth Airfield, Lutterworth, Leics Distance: 400m, SE NGR: 464980, 283020	Operator: Coventry Gliding Club Ltd Property Type: WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Catchment Area: Upper River Welland (Market Harborough) Ref: PR5NF632 Discharge Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Discharge Environment: Freshwater Stream/River Receiving Water: Trib River Welland Status: Pre National Rivers Authority Legislation where issue date < 01/09/1989
Thistledown 38 Welford Road, Husbands Bosworth, Lutterworth, Leicestershire, LE17 6JX Distance: 400m, SE NGR: 464980, 283020	Operator: N Hankin Property Type: WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Catchment Area: Not Given Ref: PRNNF12099 Discharge Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Discharge Environment: Onto Land Receiving Water: Unnamed Field Ditch Status: Post National Rivers Authority Legislation where issue date > 31/08/1989

Location	Details
Stud Farm, Husbands Bosworth Estate, Husbands Bosworth Estate Distance: 599m, NW NGR: 464000, 284001	Operator: Leicestershire County Council Property Type: DOMESTIC PROPERTY (SINGLE) (INCL FARM HOUSE) Catchment Area: Avon (Hampshire Upper) Ref: DS/141 Discharge Type: Trade Discharge - Process Water Discharge Environment: Freshwater Stream/River Receiving Water: Receiving Water Not Defined Status: Pre National Rivers Authority Legislation where issue date < 01/09/1989
Wheeler Cottages, Husbands Bosworth Estate, Husbands Bosworth Estate Distance: 599m, NW NGR: 464000, 284000	Operator: Leicestershire County Council Property Type: Undefined Or Other Catchment Area: Uncategorised Lower Severn Ref: DS/139 Discharge Type: Non Water Company (Private) Sewage Discharge Environment: Unknown Receiving Water: Receiving Water Not Defined Status: Pre National Rivers Authority Legislation where issue date < 01/09/1989
An Stp Serving Packs Hill Farm Packs Hill Farm, Station Road, Husbands Bosworth, Leicestershire, LE17 6JN Distance: 644m, SW NGR: 463980, 283110	Operator: Languard Ltd Property Type: FARMS (NOT HOUSE)/CROP + ANIMAL REARING/PLANT NURSERY Catchment Area: Avon (Hampshire Upper) Ref: S/10/26780/S Discharge Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Discharge Environment: Freshwater Stream/River Receiving Water: Un-Named Trib River Avon Status: New Consent (Water Resources Act 1991, Section 88 & Schedule 10 as amended by Environment Act 1995)
Honey Pot Farm, Husbands Bosworth Distance: 753m, N NGR: 465050, 285130	Operator: Messrs Garner & Wade Property Type: Undefined Or Other Catchment Area: Not Supplied Ref: PR5NF372 Discharge Type: Trade Effluent Discharge Environment: Freshwater Stream/River Receiving Water: Unknown Trib Status: Pre National Rivers Authority Legislation where issue date < 01/09/1989
Husbands Bosworth Stw, Husbands Bosworth, Lutterworth, LE17 6LY Distance: 852m, NW NGR: 464200, 284800	Operator: Anglian Water Services Limited Property Type: WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Catchment Area: Upper River Welland (Market Harborough) Ref: AW5NF771 Discharge Type: Sewage Discharges - Final/Treated Effluent - Water Company Discharge Environment: Canal Receiving Water: Grand Union Canal Nt Status: Modified (Water Resources Act 1991, Schedule 10 as amended by Environment Act 1995)
Husbands Bosworth Stw, Husbands Bosworth, Lutterworth, LE17 Distance: 852m, NW NGR: 464200, 284800	Operator: Anglian Water Services Ltd. Property Type: Sewage Disposal Works - Water Company Catchment Area: Upper River Welland (Market Harborough) Ref: AW5NF5307 Discharge Type: Sewage Discharges - Final/Treated Effluent - Water Company Discharge Environment: Canal Receiving Water: Grand Union Canal Nt Status: Pre National Rivers Authority Legislation where issue date < 01/09/1989
Broxhill Barns At Pebble Hall Farm Theddingworth Road, Marston Trussell, Leicestershire, LE17 6NJ Distance: 671m, NE NGR: 466090, 284670	Operator: Roger Clark Property Type: Domestic Property (Single) Catchment Area: Upper River Welland (Market Harborough) Ref: PRNNF12745 Discharge Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Discharge Environment: Freshwater Stream/River Receiving Water: River Welland Status: New Consent (Water Resources Act 1991, Section 88 & Schedule 10 as amended by Environment Act 1995)

3.2.9 Based on the information presented on the Environment Agency Catchment Data Explorer website under the Water Framework Directive classification the ecological quality of the River Welland is was last reported in 2019 as 'poor',

whilst chemical quality was recorded as 'fail'¹. The poor biological classification was awarded due to the poor fish biological quality elements and poor phosphate physio-chemical quality. The chemical status failed due to mercury and polybrominated diphenyl ether (PBDE) concentrations. All other priority hazardous pollutant concentrations achieved 'good' status threshold.

- 3.2.10 A review of available geological and hydrogeological records undertaken as part of this Environmental Permit Application has identified that the aforementioned surface water features are hydraulically connected to the groundwater present within the superficial sand and gravel deposits that underlie and surround the landfill footprint.
- 3.2.11 All on-site run-off associated with the site offices, mineral processing activities, quarry void and storage areas will be collected by the site's drainage system and is directed into settlement ponds. The run-off is then held within these ponds and either utilised as process water on-site operations, following which it is treated and discharged into the via one of two licensed and monitored discharge points. The first monitored discharge point (Ref: PRNNF12734) discharges into a tributary of the River Welland whilst the second discharge point (Ref: EPR/ZP3724XU) discharges directly into the River Welland. Copies of these discharge consents are included in Appendix MP3 of the accompanying Management Plan (*Document Ref.: MG1001/06*).
- 3.2.12 It was noted that overland flow to surrounding surface water features is permitted around Husbands Bosworth Quarry, however, the areas where this is permitted are not areas associated with main site operations/proposed landfilling operations and instead comprise of landscaped/vegetated surfaces and ancillary transport routes (site access road).
- 3.2.13 There three active licensed surface water abstractions within 2km of the proposed Husbands Bosworth Quarry Landfill Site, details of which are summarised in **Table ESSD6**. The details of this licensed surface water abstraction are presented in **Appendix ESSD1**. The approximate locations of this surface water abstraction is shown on **Drawing No. MG1001/14/08**. There are no other active licensed surface water abstractions within 2km of the application site.

Table ESSD6: Details of licensed surface water abstraction within 2km of the site

Location	Details
River Welland - Sibbertoft Distance: 1457 SE NGR: 466700, 283300	Operator: J H Hart License No: 5/31/02/*S/0031 Abstraction: Amenity: Make-Up Or Top Up Water Abstraction type: Water may be abstracted from a single point Source: Surface
River Welland - Sibbertoft Distance: 1461 SE NGR: 466700, 283295	Operator: J H Hart License No: 5/31/02/*S/031 Abstraction: Fill Etc Reservoir Transfer Abstraction type: Not Supplied Source: Stream
Spring Fed Ditch , HUSBANDS BOSWORTH Distance: 1811 NW NGR: 463800, 285700	Operator: O N Garner License No: 5/31/02/*I/027 Abstraction: Impounding Abstraction type: Not Supplied Source: Stream

- 3.2.14 There are no water dependent Sites of Special Scientific Interest within c. 2km of the application site.

¹ Ecological and chemical status' quoted are based on the results from the 2019 cycle.

Surface Water Quality

- 3.2.15 Whilst there are no water dependent Sites of Special Scientific Interest within c. 2km of the application site, surface water quality monitoring has been undertaken to determine baseline conditions ahead prior to the commencement of inert landfill activities.
- 3.2.16 Surface water quality data has been collected monthly since May 2021 to establish baseline surface water quality conditions. A statistical summary of groundwater quality within the superficial deposits between May 2021 and November 2022 is presented in **Table ESSD7**. Full datasets and time-series charts are presented in Appendix HRA3 of the accompanying Hydrogeological Risk Assessment (*Document Ref.: MG1001/08*).
- 3.2.17 To identify whether the existing site operations have any pre-existing impacts on baseline surface quality, the surface water monitoring points were separated into two categories determined by their location to the site relative to the local surface water flow regime. The first category is the upgradient monitoring points and consists of SW1 and SW3. The second category is downgradient monitoring points and comprise SW2 and SW4.
- 3.2.18 It is noted that during the monitoring period there was insufficient water at SW3 to facilitate the collection of samples for analysis. Additionally, the other surface water monitoring points were recorded as having insufficient flow for sampling during certain monitoring rounds. This also reduced the number of samples that could be collected for hydrogeochemical analysis during the monitoring period. This is observed in the first recorded datapoint presented in the accompanying spreadsheets. Whilst surface water monitoring commenced in May 2021, the first sample was collected in June 2021 due to there being insufficient flow in the fluvial channel in May 2021.
- 3.2.19 The initial statistical analysis of surface water monitoring points indicates that for a large number of the monitored determinands, no significant variations in upgradient and downgradient recorded concentrations are observed. However, variation in recorded concentrations was noted in a small number of the recorded parameters, namely, total suspended solids, alkalinity, chloride, and sulphate.
- 3.2.20 It is noted that upgradient concentrations for the abovementioned four determinands are higher than those recorded downgradient. The largest discrepancy between upgradient and downgradient concentrations is observed in the total suspended solids concentrations, where upgradient concentrations are at least four times as high as those recorded downgradient.
- 3.2.21 Examination of the land-use surrounding the upgradient monitoring point SW1 identified three surface water discharges in the vicinity of this monitoring point. Two of the identified surface water discharges correlate to mineral workings discharges associated with the existing mineral working operations within Husbands Bosworth Quarry and the existing Inert Landfill Site located to the southwest of the proposed Inert Landfill Site. The third surface water correlates to the treated sewage/effluent discharge associated with the airfield.
- 3.2.22 In light of the observed reduced total suspended solids, alkalinity, chloride and sulphate concentrations at the downgradient monitoring points, it is considered that the concentrations recorded at SW1 undergo an element of dilution prior to arriving at the downgradient monitoring points (SW2 and SW4).

Table ESSD7: Baseline surface water quality summary (statistical outliers removed) between May 2021 and November 2022

Statistic	Suspended Solids (mg/l)	Alkalinity (mg/l)	Arsenic (µg/l)	Cadmium (µg/l)	Chloride (mg/l)	Chromium (µg/l)	Copper (µg/l)	Fluoride (mg/l)	Lead (µg/l)	Mercury (µg/l)	Nickel (µg/l)	Phenol (mg/l)	Sulphate (mg/l)	Zinc (µg/l)
SW1														
Min	140	210	0.75	<0.11	43	<20	1.9	0.2	<0.5	<0.01	1.6	<0.03	70	<2.5
Mean	277	350	1.14	<0.11	63	<20	2.4	0.22	3.3	<0.01	2	<0.03	74	4.1
Max	480	530	1.7	<0.11	76	<20	3	0.24	9.1	<0.01	2.5	<0.03	82	5.6
Stdev	180	164	0.5	0	18	0	0.6	0.03	5	0	0.5	0	7	2
Count	3	3	3	3	3	3	3	2	3	3	3	3	3	3
SW2														
Min	36	150	1.2	<0.11	38	<20	1.9	0.19	<0.5	<0.01	0.84	<0.03	56	<2.5
Mean	55	330	1.3	<0.11	41	<20	2.2	0.2	<0.5	<0.01	1.18	<0.03	68	<2.5
Max	88	530	1.5	<0.11	45	<20	2.6	0.2	<0.5	<0.01	1.7	<0.03	75	<2.5
Stdev	28	191	0.17	0	4	0	0.4	0.01	0	0	0.46	0	11	0
Count	3	3	3	3	3	3	3	2	3	3	3	3	3	3
SW3														
Min	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stdev	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Count	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW4														
Min	12	150	1.1	<0.11	38	<20	2	0.19	<0.5	<0.01	0.96	<0.03	56	<2.5
Mean	16	330	1.3	<0.11	40	<20	2.2	0.2	<0.5	<0.01	1.21	<0.03	70	<2.5
Max	22	530	1.4	<0.11	44	<20	2.3	0.2	<0.5	<0.01	1.7	<0.03	81	<2.5
Stdev	5	191	0.17	0	3	0	0.2	0.01	0	0	0.42	0	13	0
Count	3	3	3	3	3	3	3	2	3	3	3	3	3	3

Statistic	Suspended Solids (mg/l)	Alkalinity (mg/l)	Arsenic (µg/l)	Cadmium (µg/l)	Chloride (mg/l)	Chromium (µg/l)	Copper (µg/l)	Fluoride (mg/l)	Lead (µg/l)	Mercury (µg/l)	Nickel (µg/l)	Phenol (mg/l)	Sulphate (mg/l)	Zinc (µg/l)
Upgradient Monitoring Points (SW1 and SW3)														
Min	140	210	0.75	<0.11	43	<20	1.9	0.2	<0.5	<0.01	1.6	<0.03	70	<2.5
Mean	277	350	1.14	<0.11	63	<20	2.4	0.22	3.3	<0.01	2	<0.03	74	4.1
Max	480	530	1.7	<0.11	76	<20	3	0.24	9.1	<0.01	2.5	<0.03	82	5.6
Stdev	180	164	0.5	0	18	0	0.6	0.03	5	0	0.5	0	7	2
Count	3	3	3	3	3	3	3	2	3	3	3	3	3	3
Downgradient Monitoring Points (SW2 and SW4)														
Min	12	150	1.1	<0.11	38	<20	1.9	0.19	<0.5	<0.01	0.84	<0.03	56	<2.5
Mean	36	290	1.3	<0.11	41	<20	2.2	0.2	<0.5	<0.01	1.2	<0.03	69	<2.5
Max	88	530	1.5	<0.11	45	<20	2.6	0.2	<0.5	<0.01	1.7	<0.03	81	<2.5
Stdev	28	171	0.15	0	3	0	0.2	0.01	0	0	0.39	0	11	0
Count	6	6	6	6	6	6	6	4	6	6	6	6	6	6

Note: Statistical analysis carried out with the assumption that results below the method limit of detection are equivalent to a concentration of 75% of the limit value.

Flood Risk

- 3.2.23 The Landmark Envirocheck report indicates that the proposed landfill void is located within a Flood Zone 1. Published Environment Agency guidance defines a Flood Zone 1 as land “having a less than 1 in 1,000 annual probability of river or sea flooding”.
- 3.2.24 The channel of the River Welland are designated as a Flood Zone 2 and Flood Zone 3 area. However, it is noted that these designations do not extend into the proposed Environmental Permit Boundary. Due to the lateral and vertical distance between these flood risk zones and the proposed landfill footprint, alongside the absence of historical indicators of flooding the site has been deemed as not at risk of fluvial or coastal flooding.
- 3.2.25 Surface and ground waters within the quarry are appropriately managed within the confines of the quarry and discharged to surrounding surface water course under appropriate regulatory consent.

3.3 Hydrogeology

Overview

- 3.3.1 The hydrogeology of the application site is taken from the results of groundwater monitoring undertaken by Mick George around the periphery of the quarry, the British Geological Survey (formerly the Institute of Geological Sciences) and the 1:625,000 scale hydrogeological map of England and Wales, information provided by the Environment Agency.
- 3.3.2 Groundwater designation maps of the application site identify two superficial aquifer designations and one bedrock aquifer designation cover the application site.
- 3.3.3 The superficial deposits are classified as:
- **Secondary ‘A’ Aquifer:** This designation covers the north and east of the application site; corresponding to the glaciofluvial, river terrace and alluvial deposits. This classification indicates that these deposits are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers;
 - **Secondary (Undifferentiated):** This designation covers the western portion of the application site; corresponding to the area covered by the diamicton/till deposits. This classification indicates that means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
- 3.3.4 Both the Dyrham Formation and the Charmouth Mudstone Formation are classified as Secondary (Undifferentiated) Aquifers. This classification of aquifers is assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
- 3.3.5 In light of the above designations, groundwater flow in the vicinity of Husbands Bosworth Quarry is therefore considered to be achieved through the superficial

glaciofluvial, river terrace and alluvial sand and gravel deposits. Given the recorded depths of these lithologies and the topographic setting in which Husbands Bosworth Quarry is located, it is considered that groundwater within the superficial deposits provides baseflow to surface water features, including the River Welland.

- 3.3.6 Future quarry operations will however result in the excavation of a large proportion of the sand and gravels units that make up the Secondary A aquifer designations, with reserves to the west of the landfill footprint already having been exploited. Any remaining sand and gravel reserves to the north of the quarry are overlain by a minimum of 2m of low permeability clay till, which increases in thickness northwards as the glaciofluvial sands and gravel thin out. The remaining sand and gravel reserves to the north will therefore have limited recharge and resource potential going forward. To the south of the quarry the remaining sand and gravels will continue to provide baseflow to the River Welland, although the baseflow will be reduced due to the removal of a significant part of the storage capacity of the secondary aquifer unit and its replacement with significantly lower permeability waste materials, which will also reduce the quantity of waters that infiltrate to recharge any remaining aquifers units.
- 3.3.7 Whilst thin sand and gravel lenses have been encountered within the glacial till deposit, these are laterally impersistent, with borehole logs indicating that they are typically encountered as damp rather than saturated. The glacial till therefore has no significant resource potential locally.
- 3.3.8 Similarly, whilst sands and sandstone horizons are included within the BGS descriptions for the underlying bedrock formations, none have been encountered locally, with the upper sections dominated with weathered clays and mudstones. The Dyrham and Charmouth Formations therefore have no significant resource potential locally.

Groundwater Levels

- 3.3.9 Prior to the installation of the current groundwater monitoring boreholes, no groundwater level monitoring had been undertaken at Husbands Bosworth Quarry. Therefore, to ensure that baseline groundwater levels could be identified seven groundwater boreholes were installed around the proposed landfill site to monitor the superficial deposits. These seven groundwater monitoring boreholes were arranged around the perimeter of Husbands Bosworth Quarry. The locations of these monitoring points are presented in **Drawing No. MG1001/14/07**. Groundwater level data being collected since June 2021. A statistical summary of the groundwater level data is presented in **Table ESSD8**, with the raw data and groundwater level hydrographs presented in Appendix HRA1 of the accompanying Hydrogeological Risk Assessment (*Document Ref.: MG1001/08*).

Table ESSD8: Statistical summary of monitored groundwater levels within the superficial deposits surrounding Husbands Bosworth Quarry between June 2021 and November 2021 (mAOD)

BH ID	BH1	BH2	BH3	BH4	BH5	BH6	BH7
Min	138.76	133.96	127.00	124.17	121.07	125.08	130.23
Mean	138.92	134.46	127.79	124.28	121.34	125.51	130.35
Max	139.11	136.12	129.90	124.43	121.85	126.18	130.39

- 3.3.10 Examination of the recorded groundwater indicates a variation in groundwater depths across Husbands Bosworth Quarry. Groundwater levels recorded in

monitoring boreholes situated between the eastern edge of the proposed landfill void and the site's eastern boundary (the River Welland); recorded in BH5, BH6 and BH7, are noticeably closer to surrounding ground levels than groundwater levels around the rest of Husbands Bosworth Quarry. As depicted in **Table ESSD8** average groundwater levels within BH5, BH6 and BH7 were recorded at 121.34mAOD, 125.51mAOD and 130.35mAOD respectively. Whilst a noticeable variation of range of groundwater elevations has been recorded between, comparison of these levels against surrounding ground levels indicates that the groundwater levels in BH5, BH6 and BH7 are encountered at similar depths beneath surrounding ground levels. Examination of groundwater monitoring data indicates that groundwater levels in BH5, BH6 and BH7 range from 0.67mbgl to 2.27mbgl with an average depth of 1.36mbgl.

- 3.3.11 Comparing the recorded groundwater levels in BH5, BH6 and BH7 against surrounding elevation data indicates that the groundwater levels strongly correlate to the change in topographic levels as well as the level of adjacent River Welland.
- 3.3.12 The groundwater levels recorded in the remaining boreholes show similar trends to those discussed for BH5, BH6 and BH7, with groundwater levels correlating to the surrounding topographic levels.
- 3.3.13 Based on the recorded groundwater elevations within the monitoring boreholes, groundwater is considered to flow across the site in an easterly direction.
- 3.3.14 Graphical plotting of these groundwater contours, as depicted in **Drawing No. MG1001/14/09** supports this interpretation and demonstrates that groundwater levels decrease towards the east of the quarry towards the River Welland. Based on the recorded groundwater levels and associated groundwater contours a hydraulic gradient of c.0.02 has been calculated for the site.
- 3.3.15 Finally, review of the recorded groundwater identified that groundwater levels recorded in boreholes located upgradient of the quarry void (particularly BH2 and BH3) covered a wider range of elevations compared to those monitoring boreholes located downgradient of the quarry void (BH4, BH5, BH6 and BH7). Examination of borehole investigation logs installed across the proposed inert landfill void indicate that the vertical extent of superficial sand and gravel deposits is greater along the northern boundary of the quarry void; namely where BH2 and BH3 are situated are greater the vertical extents recorded along the southern and eastern boundaries.
- 3.3.16 Consequently, it is considered that groundwater levels along the northern boundary of the site have a greater vertical distance in which to move compared to the groundwater levels along the southern boundary. It is also considered that the River Welland plays a role in the observed stability of groundwater levels downgradient of the quarry void.
- 3.3.17 As indicated in **Section 3.1**, site-specific exploratory logs and published borehole records and mapping data indicates that the superficial deposits within Husbands Bosworth Quarry are contained within a glacial/fluviol scour feature. In light of the proposals to extract all superficial sand and gravel deposits within this feature and the negligible groundwater potential of the Dyrham and Charmouth Mudstone Formations, it is considered that the mineral extraction will isolate the lateral extent of remaining sand and gravel deposits to the north of the quarry and therefore significantly limit any future groundwater resource potential associated with these deposits, which are also overlain by over 2m of low permeability clay till and will also further limit the recharge capability to the any remaining sand and gravels.

Groundwater Quality

- 3.3.18 As previously indicated, prior to the installation of the groundwater monitoring boreholes around the periphery of Husbands Bosworth Quarry, no groundwater monitoring had been undertaken. As such groundwater quality data has been collected monthly since May 2021 to establish baseline groundwater quality conditions. A statistical summary of groundwater quality within the superficial deposits between May 2021 and November 2021 is presented in **Table ESSD9**. Full datasets and time-series charts are presented in Appendix HRA2 of the accompanying Hydrogeological Risk Assessment (*Doc Ref.: MG1001/08*).
- 3.3.19 To identify whether the existing quarrying operations have any pre-existing impacts on baseline groundwater quality, the perimeter monitoring boreholes were separated into two categories determined by their location to the site relative to the local groundwater flow regime. The first category is the upgradient monitoring boreholes and consists of BH1, BH2 and BH3. The second category is downgradient boreholes and comprise BH4, BH5, BH6 and BH7.
- 3.3.20 It is noted that during the monitoring period that whilst there was sufficient water in BH4 to enable for groundwater levels to be recorded there was insufficient to facilitate the collection of samples for hydrogeochemical analysis.
- 3.3.21 The initial statistical analysis of individual boreholes indicates that for a large number of the monitored determinands, no significant variations in recorded concentrations are observed. However, variation in recorded concentrations was noted in a small number of the recorded parameters, namely, chloride, molybdenum, nickel, selenium, and sulphate.
- 3.3.22 The recorded concentrations of chloride and sulphate fluctuate throughout the monitoring period. The consistency of these fluctuations and the absence of sudden increases in recorded concentrations suggests that the observed fluctuations are indicative of natural baseline conditions present in the groundwater surrounding the proposed inert landfill site.
- 3.3.23 In contrast, the concentrations of molybdenum, nickel and selenium show a slightly different trend. Recorded concentrations start at relatively low-levels and then suddenly display elevated concentrations between June and September 2021 before returning to pre-June 2021 concentrations.
- 3.3.24 In light of the absence of any existing landfill deposits within the proposed Husbands Bosworth Quarry Inert Landfill Site and that these elevated concentrations are recorded in all perimeter monitoring boreholes, it is considered that these concentrations are likely the result of an off-site source which has migrated into the proposed Husbands Bosworth Quarry Inert Landfill Site. It is therefore considered that the recorded elevated concentrations should also be considered as baseline concentrations as they provide a representative picture of the groundwater conditions prior to the commencement of inert landfill activities.
- 3.3.25 Furthermore the review of baseline hydrogeochemical data indicates a strong correlation between groundwater conditions upgradient and downgradient of the site.
- 3.3.26 The statistical methodology utilised in analysing the recorded background groundwater quality is that outlined in the Environment Agency Research and Development document "Techniques for the Interpretation of Landfill Monitoring Data Guidance Notes, Report No. P1-471". Accordingly, the groundwater monitoring records were screened utilising the P1-471 outlier test methodology

discussed in Section A.3 of Report No. P1-471 and the critical values ($P=1\%$) for the statistical T_{max} presented in Table A.1 of Report No. P1-471.

- 3.3.27 Prior to the application of this outlier assessment tool, histograms were generated for each dataset (where applicable) to aid in the identification of whether the examined dataset presents Normal or logNormal distribution. This confirmation of data distribution guided the subsequent statistical analysis by indicating whether the statistical analysis needed to be undertaken on the logs of the recorded datapoints. The histograms also allowed for initial visual identification of potential statistical outliers which were later confirmed during subsequent statistical analysis.

Aquifer Physical Characteristics

- 3.3.28 The superficial river terrace deposits are classified as a 'Secondary A' Aquifer whilst the diamicton deposits are classified as a 'Secondary (Undifferentiated)' aquifer by the Environment Agency. Groundwater in both of these units is perched above the Dyrham and the Charmouth Mudstone Formations which are both classed as a 'Secondary (Undifferentiated) aquifer'. A study into the geotechnical properties of the Lias Group undertaken by Hobbs et al., (2012) indicated that the field permeability of the Dyrham Formation ranges from $5 \times 10^{-6} \text{ m/s}$ to $1 \times 10^{-9} \text{ m/s}$ and the Charmouth Mudstone Formation is approximately $1 \times 10^{-7} \text{ m/s}$.
- 3.3.29 A study published in Domenico and Schwartz (1990) also examined the hydraulic conductivities of multiple lithologies (including sands and gravels). Detail geological descriptions of the superficial sand and gravel deposits were recorded in the Site Investigation Logs prepared in 2016 (presented in **Appendix ESSD2**). These logs identified the sand and gravel deposits comprising primarily of gravel and coarse to medium grained gravel. Furthermore, whilst some horizons were contained a higher percentage of coarse sand alongside some occasional references to silt, the primary component in the majority of the encountered sand and gravel. This observation is supported by the geological descriptions of the sand and gravel recorded in the 2020 Site Investigation Logs (also presented in **Appendix ESSD2**).
- 3.3.30 Consequently, it is considered that the gravel and coarse sand deposits within the superficial deposits are the primary factor in controlling groundwater flow within the superficial aquifer.
- 3.3.31 Examination of the maximum and minimum hydraulic conductivity values published in Domenico and Schwartz (1990) identifies that the range of hydraulic conductivities for gravel and coarse sand range from 3×10^{-4} to $3 \times 10^{-2} \text{ m/s}$, and 9×10^{-7} to $6 \times 10^{-3} \text{ m/s}$, respectively. As these hydraulic conductivity ranges have been adopted in hydrogeological modelling software approved by the Environment Agency (ConSim 2.5) it is considered that these hydraulic conductivity ranges provide a representative analogue for their corresponding materials.
- 3.3.32 Due to the presence of these lithologies within the glaciofluvial deposits, and the noted variation in composition, it is considered that bulk hydraulic conductivity of the Husbands Bosworth glaciofluvial deposits is a combination of the hydraulic conductivity ranges for the abovementioned materials.
- 3.3.33 A study carried out by MacDonald et al. (2009) returned median permeabilities for glaciofluvial deposits between the range of $7 \times 10^{-5} \text{ m/s}$ and $1 \times 10^{-4} \text{ m/s}$. A study further carried out by Hafren (2001) indicated that the glaciofluvial and

fluvial sand and gravels deposits within the vicinity of Colchester returned a permeability range of 5.79×10^{-5} m/s and 6.24×10^{-4} m/s.

- 3.3.34 Finally, the hydraulic conductivity of the diamicton moraines deposits is considered to be comparable to that of the local Lias Group; due to it primarily consisting of clay lithology.

Table ESSD9: Baseline groundwater quality summary (statistical outliers removed) between May 2021 and November 2021

Statistic	Arsenic (µg/l)	Barium (µg/l)	Cadmium (µg/l)	Chloride (mg/l)	Chromium (µg/l)	Copper (µg/l)	Fluoride (mg/l)	Lead (µg/l)	Mercury (µg/l)	Molybdenum (µg/l)	Nickel (µg/l)	Antimony (µg/l)	Phenol (µg/l)	Selenium (µg/l)	Sulphate (mg/l)	Zinc (µg/l)
BH1																
Min	<0.20	8.4	<0.11	26	0.61	<0.5	0.22	<0.5	<0.01	<0.2	<0.5	<0.5	<0.03	<0.5	40	0.57
Mean	0.28	63.1	<0.11	27	5.4	1	0.23	<0.5	<0.01	0.96	1.44	<0.5	<0.03	0.75	51	12.9
Max	0.37	88	0.23	29	7.7	1.7	0.24	<0.5	<0.01	2.9	4.9	<0.5	<0.03	<2.5	95	66
Stdev	0.07	34.3	0.06	1	2.2	0.5	0.01	0	0	1.07	1.62	0	0	0.6	20	26.0
Count	7	7	7	7	7	6	3	6	7	7	7	7	7	7	7	6
BH2																
Min	<0.20	7.9	<0.11	14	<0.5	<0.5	0.15	<0.5	<0.01	<0.2	<0.5	<0.5	<0.03	<0.5	32	0.66
Mean	0.23	46.0	0.13	21	4.1	2	0.18	<0.5	<0.01	8.85	2.0	<0.5	<0.03	0.8	48	6.9
Max	0.42	68	0.34	29	7.2	3.1	0.2	<0.5	<0.01	30	3.1	<0.5	<0.03	<2.5	65	21
Stdev	0.12	21.7	0.11	6	3.4	1.2	0.03	0	0	13.53	1.21	0	0	0.7	11	8.0
Count	6	6	6	6	5	5	3	5	6	6	5	6	6	6	6	6
BH3																
Min	0.41	35	<0.11	13	<0.5	<0.5	0.42	<0.5	<0.01	<0.2	<0.5	<0.5	<0.03	<0.5	34	<2.5
Mean	1.00	43.3	<0.11	15	4.7	2.4	0.43	0.9	<0.01	8.84	4.1	<0.5	<0.03	1.2	46	13.4
Max	1.7	50	<0.11	18	15	5.4	0.43	2	<0.01	27	8.9	<0.5	<0.03	3.9	69	40
Stdev	0.62	6.4	0	2	5.4	1.7	0.01	0.8	0	11.52	2.7	0	0	1.4	14	16.1
Count	5	6	6	6	6	6	2	6	6	6	6	6	6	6	6	6
BH4																
Min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stdev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Count	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Statistic	Arsenic (µg/l)	Barium (µg/l)	Cadmium (µg/l)	Chloride (mg/l)	Chromium (µg/l)	Copper (µg/l)	Fluoride (mg/l)	Lead (µg/l)	Mercury (µg/l)	Molybdenum (µg/l)	Nickel (µg/l)	Antimony (µg/l)	Phenol (mg/l)	Selenium (µg/l)	Sulphate (mg/l)	Zinc (µg/l)
BH5																
Min	<0.20	48	<0.11	36	<0.5	0.68	0.28	<0.5	<0.01	<0.20	<0.5	<0.5	<0.03	<0.5	63	<2.5
Mean	0.40	55.9	<0.11	45	0.7	1.47	0.31	<0.5	<0.01	3.38	2.6	<0.5	<0.03	0.59	72	3.0
Max	0.85	65	<0.11	53	2	2.9	0.32	0.82	<0.01	18	3.4	<0.5	<0.03	<2.5	77	5.4
Stdev	0.27	6.9	0	7	0.6	0.77	0.02	0.17	0	6.55	1.0	0	0	0.57	6	1.4
Count	7	7	7	7	7	7	3	7	7	7	7	7	7	7	7	7
BH6																
Min	0.86	25	<0.11	7.2	<0.5	1.2	0.25	<0.5	<0.01	0.74	1.6	<0.5	<0.03	<0.5	130	<2.5
Mean	1.79	29.0	<0.11	10.6	1.3	2.3	0.31	<0.5	<0.01	2.06	2.6	<0.5	<0.03	0.94	145	3.0
Max	3.5	33	<0.11	12	3	4.4	0.36	0.53	<0.01	3.9	4	0.6	<0.03	1.6	170	5.1
Stdev	1.19	4.1	0	2.3	1.5	1.4	0.08	0.08	0	1.32	1.0	0.1	0	0.65	19	1.9
Count	4	4	4	4	3	4	2	4	4	4	4	4	4	4	4	3
BH7																
Min	0.71	80	<0.11	46	<0.5	0.63	0.21	<0.5	<0.01	0.33	<0.5	<0.5	<0.03	<0.5	60	<2.5
Mean	1.24	90.9	<0.11	48	0.9	1.96	0.22	<0.5	<0.01	1.12	2.2	<0.5	<0.03	0.58	67	3.2
Max	2	100	<0.11	50	2.3	3.1	0.24	0.59	<0.01	3.1	2.8	<0.5	<0.03	0.87	78	6.2
Stdev	0.42	8.1	0	1	0.9	0.79	0.02	0.09	0	1.16	0.9	0	0	0.19	7	1.7
Count	7	7	7	7	7	7	3	6	6	6	6	6	6	6	6	6
Upgradient Monitoring Boreholes (BH1, BH2 and BH3)																
Min	<0.20	7.9	<0.11	13	<0.5	<0.5	0.15	<0.5	<0.01	<0.2	<0.5	<0.5	<0.03	<0.5	32	0.57
Mean	0.46	51.4	<0.11	21	4.8	1.8	0.26	0.6	<0.01	5.94	2.49	<0.5	<0.03	0.9	48	11.1
Max	1.7	88	0.34	29	15	5.4	0.43	2	<0.01	230	8.9	<0.5	<0.03	3.9	95	66
Stdev	0.46	24.9	0.07	6	3.7	1.3	0.11	0.5	0	10.17	2.23	0	0	0.9	15	17.4
Count	18	19	19	19	18	17	8	17	19	19	18	19	19	19	19	18

Statistic	Arsenic (µg/l)	Barium (µg/l)	Cadmium (µg/l)	Chloride (mg/l)	Chromium (µg/l)	Copper (µg/l)	Fluoride (mg/l)	Lead (µg/l)	Mercury (µg/l)	Molybdenum (µg/l)	Nickel (µg/l)	Antimony (µg/l)	Phenol (mg/l)	Selenium (µg/l)	Sulphate (mg/l)	Zinc (µg/l)
Downgradient Monitoring Boreholes (BH4, BH5, BH6 and BH7)																
Min	<0.20	25	<0.11	7.2	<0.5	0.63	0.21	<0.5	<0.01	<0.20	<0.5	<0.5	<0.03	<0.5	60	<2.5
Mean	0.89	63.5	<0.11	38.2	0.9	1.84	0.28	0.43	<0.01	2.21	2.4	<0.5	<0.03	0.73	87	3.1
Max	2	100	<0.11	53	3	4.4	0.36	0.82	<0.01	17	3.4	0.6	<0.03	<2.5	170	6.2
Stdev	0.55	25.6	0	15.9	0.9	0.95	0.05	0.12	0	4	0.9	0.1	0	0.55	33	1.5
Count	17	18	18	18	17	18	8	16	17	17	17	18	18	18	18	16

Note: Statistical analysis carried out with the assumption that results below the method limit of detection are equivalent to a concentration of 75% of the limit value.

Licensed Abstractions & Private Water Supplies

3.3.35 The application site is not located in a groundwater Source Protection Zone. There are 15 licensed groundwater abstractions within 2km of the of the landfill. Details of the active licensed groundwater abstractions are presented in **Table ESSD10** and **Appendix ESSD1**. The approximate locations of these groundwater abstractions are shown on **Drawing No MG1001/14/08**.

Table ESSD10:Details of licensed groundwater abstraction within 2km of the site

Location	Details
Catchpit - Husbands Bosworth Distance: On-Site NGR: 464810, 283550	Operator: Mick George Limited License No: 5/31/02/*G/0014 Abstraction: Extractive: Mineral Washing Abstraction Type: Water may be abstracted from a single point Source: Groundwater
Well 12, Husbands Bosworth Wks Distance: 101m E NGR: 465300, 283700	Operator: Severn Trent Water Ltd License No: 5/31/02/*G/0006 Abstraction: Public Water Supply: Potable Water Supply - Direct Abstraction Type: Water may be abstracted from a single point Source: Groundwater
Well At Husbands Bosworth Distance: 333m W NGR: 464200, 283600	Operator: H Middleton License No: 5/31/02/*G/0015 Abstraction: General Farming and Domestic Abstraction Type: Water may be abstracted from a single point Source: Groundwater
Well At Husbands Bosworth Distance: 428m N NGR: 464500, 284500	Operator: C J F Garner License No: 5/31/02/*G/0028 Abstraction: General Farming and Domestic Abstraction Type: Water may be abstracted from a single point Source: Groundwater
Well 11, Husbands Bosworth Wks Distance: 507m SE NGR: 465500, 283200	Operator: Severn Trent Water Ltd License No: 5/31/02/*G/0006 Abstraction: Public Water Supply: Potable Water Supply - Direct Abstraction Type: Water may be abstracted from a single point Source: Groundwater
Cote Hill Farm Distance: 1122m SW NGR: 463700, 282700	Operator: Mr E N Cook License No: 18/54/10/0108 Abstraction: General Farming and Domestic Abstraction Type: Water may be abstracted from a single point Source: Groundwater
Airfield Farm, Sulby Distance: 1308m SE NGR: 465700, 282300	Operator: Airfield Farms Ltd License No: 18/54/10/0001 Abstraction: General Farming and Domestic Abstraction Type: Water may be abstracted from a single point Source: Groundwater
Wheler Lodge Distance: 1327m S NGR: 464450, 282145	Operator: Mr B L Furber License No: 18/54/10/00731 Abstraction: Private Water Supplies (Domestic) Abstraction Type: None Source: Groundwater
Wheler Lodge, Husbands Bosworth - Well Distance: 1366m S NGR: 464500, 282100	Operator: Mr B L Furber License No: 18/54/10/0073 Abstraction: Private Water Undertaking: General Farming And Domestic Abstraction Type: Water may be abstracted from a single point Source: Groundwater
Husbands Bosworth - Well (Source No. 9) Distance: 1734m SW NGR: 463600, 282000	Operator: Severn Trent Water Limited License No: 18/54/10/0118 Abstraction: Public Water Supply: Potable Water Supply - Direct Abstraction Type: Water may be abstracted from a single point Source: Groundwater
Cote Hill Farm Distance: 1774m SW NGR: 463100, 282400	Operator: Mr E N Cook License No: 18/54/10/0109 Abstraction: General Farming and Domestic Abstraction Type: Water may be abstracted from a single point Source: Groundwater
Park House, Sulby - Well (1) Distance: 1853m SE NGR: 465700, 281700	Operator: R & J Sandercock License No: 18/54/10/0020 Abstraction: General Farming and Domestic Abstraction Type: Water may be abstracted from a single point Source: Groundwater

Location	Details
Husbands Bosworth - Well (Source No. 10) Distance: 1972m S NGR: 463900, 281600	Operator: Severn Trent Water Limited License No: 18/54/10/0118 Abstraction: Public Water Supply: Potable Water Supply - Direct Abstraction Type: Water may be abstracted from a single point Source: Groundwater
Sulby, Northants Distance: 1755m S NGR: 465900, 281900	Operator: Mr J Walton License No: 18/54/10/0065 Abstraction: General Farming and Domestic Abstraction Type: Water may be abstracted from a single point Source: Groundwater
2 Wells, Beech Fm. Theddingworth Distance: 1646m N NGR: 466500, 285600	Operator: D M S Baxter License No: 5/31/02/*G/0007 Abstraction: General Farming and Domestic Abstraction Type: Water may be abstracted from a single point Source: Groundwater

3.3.36 Freedom of Information Requests seeking confirmation of private water supplies within 2km of the landfill boundary were submitted to Harborough District Council and West Northamptonshire District Council.

3.3.37 Harborough District Council confirmed the absence of any private water supplies within designated search radius.

3.3.38 West Northamptonshire District Council confirmed the presence of six private water supplies within 2km of the landfill boundary. All private water supplies are located to the southeast of the landfill boundary and draw groundwater from the underlying alluvium or boulder clay. The closest private water supply is located c.1.4km from the landfill boundary with the furthest located 2km from the landfill boundary.

3.3.39 Copies of the Freedom of Information Request responses received from Harborough District Council and West Northamptonshire District Council are presented in **Appendix ESSD3**. Details of the identified private water supplies within 2km of the landfill boundary are presented in **Table ESSD11**.

Table ESSD11: Details of Private Water Supplies within 2km of the site

Location	Details
Park Farm, Sulby Hall Old Drive, Sulby, NN6 6EZ Distance: 2km SE Easting: 465929 Northing: 281699	Map No.: 1 Property Ref: PI/000047852 Class of Supply: Single Dwelling Nature of Supply: Ground - Spring Population Served: 4 Geology: Boulder Clay Radon: No protection required
Home Farm, Sulby Hall Old Drive, Sulby, NN6 6EZ Distance: 1.78km SE Easting: 465835 Northing: 281929	Map No.: 2 Property Ref: PI/000048464 Class of Supply: ≤25 people Nature of Supply: Ground - Well Population Served: 8 Geology: Alluvium Radon: No protection required
Park House, Sulby Hall Old Drive, Sulby, NN6 6EZ Distance: 1.73km SE Easting: 465437 Northing: 281844	Map No.: 3 Property Ref: PI/000047851 Class of Supply: Single Dwelling Nature of Supply: Ground – Well Population Served: 4 Geology: Boulder Clay Radon: No protection required
The Kennels, Sulby Hall Old Drive, Sulby, NN6 6EZ Distance: 1.65km SE Easting: 465943 Northing: 282143	Map No.: 4 Property Ref: PI/000047850 Class of Supply: Single Dwelling Nature of Supply: Ground - Well Population Served: 4 Geology: Alluvium Radon: No protection required

Location	Details
1 Sulby Hall Old Drive, Sulby, NN6 6EZ Distance: 1.4km SE Easting: 465956 Northing: 282330	Map No.: 5 Property Ref: PI/000048471 Class of Supply: Single Dwelling Nature of Supply: Ground - Borehole Population Served: 4 Geology: Boulder Clay Radon: No protection required
Spinney Rise, Sulby Hall Old Drive, Sulby, NN6 6EZ Distance: 1.5km SE Easting: 466090 Northing: 282365	Map No.: 6 Property Ref: PI/000047888 Class of Supply: Single Dwelling Nature of Supply: Ground - Borehole Population Served: 5 Geology: Boulder Clay Radon: No protection required

Discharge Consents

- 3.3.40 There is currently one licensed discharge to groundwater/land within 1km of the site. Summary details are provided in **Table ESSD12**. Further information is presented in **Appendix ESSD1**.

Table ESSD12: Summary of active Discharge Consents to groundwater/land within 1km of the site

Location	Details
House At Oak Lodge Farm, Husbands Bosworth, Leicester Distance: 357m SW NGR: 464200, 283300	Operator: Mr.F.J. Garner Property Type: WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Catchment Area: Not Supplied Ref: PR5LF3762 Discharge Type: Unknown Discharge Environment: Onto Land Receiving Water: Land Status: Pre National Rivers Authority Legislation where issue date < 01/09/1989

3.4 Man-Made Subsurface Pathways

- 3.4.1 Other than the monitoring boreholes associated with the quarry and abstraction boreholes/wells previously discussed, other man-made pathways in the vicinity of the site are likely to include buried utility and service conduits either beneath the local road networks or within neighbouring fields. Specific details of any such conduits have not been identified due to the associated risk with the inert waste deposits.

3.5 Receptors and Compliance Points

Controlled Waters

- 3.5.1 Potential receptors of waterborne contaminants from Husbands Bosworth Quarry landfill are:
- Groundwater Resources
 - Surface water bodies
 - Abstraction points

Groundwater

- 3.5.2 The groundwater within the superficial sand and gravels forms the primary receptor to potential pollutants that may be released as a consequence of the landfill operations. For hazardous substances, the point of compliance will be edge of the site.

3.5.3 The River Welland to the east and southeast constitute the only existing secondary groundwater receptor, although it is feasible that additional abstractions may be permitted from the superficial sand and gravel aquifer in the future. However, given the direction of groundwater flow and the resulting contribution to baseflow, the River Welland it considered to the be the principle receptor to potential non-hazardous pollutants that enter groundwater within the superficial aquifers surrounding the proposed landfill activity. The point of compliance for non-hazardous pollutants that enter groundwater is therefore the River Welland.

3.5.4 Due to the classification of both the Dyrham Formation and the Charmouth Mudstone Formation as Secondary (Undifferentiated) Aquifers, it is considered that both of these units have negligible groundwater resource potential and will prevent the vertical migration of water from within the proposed inert landfill deposits.

Surface Water

3.5.5 Surface and ground waters managed within the quarry will be discharged from the network of balancing/settlement points and lagoons into the River Welland located to the east of the proposed landfill.

3.5.6 Two springs are recorded in the vicinity of the application area and hence groundwater within the superficial aquifer is thought to contribute to baseflow of the River Welland.

Amenity (Nuisance and Health Issues)

3.5.7 There are no RAMSAR sites, Special Areas of Conservation (SACs), Special Protection Areas (SPAs) Local Nature Reserves (LNRs), National Nature Reserves (NNRs) or Sites of Special Scientific Interest (SSSIs) within 1km of the Husbands Bosworth Quarry Landfill. The nearest SSSIs are Bosworth Mill Meadow SSSI and Coombe Hill Hollow SSSI which are located approximately 2km to the southwest and 2.5km to the east of the proposed Husbands Bosworth Quarry, respectively.

3.5.8 Details of all human, natural, and cultural receptors located with 1000m of the operational extents of the landfill facility are presented in **Table ESSD1**. In summary, the nearest human receptors include users of the public rights of ways which pass through the proposed Husbands Bosworth Quarry Landfill Site and residential properties 200m to the northwest of the landfill boundary along Butt Lane.

3.5.9 The proposed inert landfill is located in the vicinity of the Husbands Bosworth Conservation Area and the Grade II* Listed Husbands Bosworth Hall. Several other listed buildings are located within the village and conservation area at Husbands Bosworth.

3.5.10 The Husbands Bosworth Conservation Area is conservation area designated by Harborough District Council to preserve the distinctive character of a neighbourhood by preventing too much change. For example, architecture, street layout, trees and views. By contrast, the role of listed building consent is to protect individual properties. The extent of the Husbands Bosworth Conservation Area and the location of the Listed Buildings are presented in **Drawing No. MG1001/14/04**.

3.5.11 As part of a recent planning application for Husbands Bosworth Quarry, a Heritage Statement identified that the effect in relation to Husbands Bosworth

Conservation Area and Grade II* listed Husbands Bosworth Hall would be negligible. It is also noted that the proposed restoration of the site, not only the proposed quarry extension but also the existing Husbands Bosworth Quarry, includes proposals to rewild the site by restoring the landscape to that shown on historic mapping. This would have a beneficial effect on the setting of the Grade II* listed hall and conservation area by reversing a series of late 20th century changes within their settings. A copy of this Heritage Statement is presented in **Appendix ESSD4**.

- 3.5.12 Records held by Leicestershire and Rutland Environmental Records Centre (LRERC) identified several records of great crested newt (*Triturus cristatus*), with the closest record relates to a specifically created GCN mitigation pond in the west of the mineral processing area, which will be retained as part of the approved quarry restoration proposals
- 3.5.13 An active Great Crested Newt Natural England Mitigation Licence (EPSM2012-4441) covers the waterbody in which Great Crested Newts have been located. Details provided on Magic.gov.uk found the licence to be active until 2024.
- 3.5.14 Records of additional amphibian species include Common toad (*Bufo bufo*) are also associated with Husbands Bosworth Quarry and the surrounding area alongside records of common frog (*Rana temporaria*), smooth newt (*Lissotriton vulgaris*) and palmate newt (*Lissotriton helveticus*).
- 3.5.15 As part of a planning application submitted to Leicestershire County Council in March 2021, a Biodiversity Enhancement Plan and a Protected Species Survey Report were prepared and assessed the presence of species within Husbands Bosworth Quarry, the risks associated with the proposed mineral extraction and restoration activities, and management strategies to ensure species are not adversely affected.
- 3.5.16 The reports indicate that the identified species which utilise the Husbands Bosworth Quarry will not be negatively impacted by both the proposed mineral extraction and restoration activities. Copies of the Biodiversity Enhancement Plan and Protected Species Survey Report are presented in **Appendix ESSD5**.
- 3.5.17 Operational activities on the landfill will not result in any significant emissions to air, therefore there is no need to consider any other sites up to a radius of 10km beyond those identified above.
- 3.5.18 In addition to identification of a Code 2 protected species (Great Crested Newts), the supplied heritage and conservation screening report confirmed the presence of priority deciduous woodland habitats in the vicinity of the proposed landfill. Whilst the locations of the protected species could not be displayed, the locations of the protected habitats are shown in **Appendix ESSD6**.

4.0 POLLUTION CONTROL MEASURES

4.1 Site Engineering

Groundwater Management System

4.1.1 Groundwater encountered at Husbands Bosworth Quarry is managed by a series of collection ditches and lagoons which form the surface water management system.

Basal and Side-Sloped Engineering

Geological Barrier

4.1.2 The base of the landfill will be formed directly over the underlying mudstones of the Dyrham Formation. The full thickness of the Dyrham Formation has not been proven beneath the quarry, although a thickness of at least 10m is depicted on the BGS Sheet 170 which depicts the solid and drift geology in the vicinity of Market Harborough. Furthermore, BGS Sheet 170 indicates that the underlying Charmouth Mudstone formation is at least 152m thick. This thickness is supported by the published records of a borehole located approximately 800m of the proposed Husbands Bosworth Quarry Landfill Site. The borehole (Reference SP68SW75) is located within the Charmouth Mudstone Formation and the corresponding logs indicate the presence of silty clay (and mudstones) to a depth of 132mbgl, where the borehole was terminated.

4.1.3 As discussed in Hobbs et al., (2012), the field permeability of both the Dyrham Formation and Charmouth Mudstone Formation can vary depending on stresses offered by the depth of cover and prevalence of fissuring. As indicated in Hobbs et al., 2012 the field permeability for the Dyrham Formation ranges from 5×10^{-6} m/s to 1×10^{-9} m/s and the Charmouth Formation is approximately 1×10^{-7} m/s.

4.1.4 It is considered that this substantial thickness of clay and mudstone form a natural geological barrier that meets the requirement set out under Annex I of the Landfill Directive in order to protect to the underlying geological units.

4.1.5 The sidewall of the quarry comprises of mudstone of the Dyrham formation, glaciofluvial deposits, glacial till and topsoil deposits. Due to the recorded variation in vertical thicknesses across the Husbands Bosworth Quarry void it is considered that quarry sidewalls around the will comprise of different ratios of these lithologies.

4.1.6 The natural physical characteristics of the glaciofluvial deposits are not considered to provide the necessary attenuation requirements specified under Annex I to the Landfill Directive. It is therefore proposed to construct an Artificial Established Geological Barrier (AEGB) over the sidewalls of the proposed landfill area utilising either site-won or imported cohesive materials. This AEGB is proposed to be constructed to achieve a maximum permeability of 1×10^{-7} m/s at 1m thickness (or an equivalent specification).

4.1.7 Due to stability factors and construction techniques the thickness of the AEGB over sidewalls comprising exposed sand and gravels will be constructed to achieve a maximum permeability of 1×10^{-7} m/s at 1m thickness (or an equivalent specification). Furthermore, the sidewall will be constructed on a buttress formed against the quarry sidewalls. The buttress will be constructed using either site-won or imported cohesive materials of with a gradient of 1 in 3. AEGB details are presented in **MG1001/14/06**.

Capping

- 4.1.8 An engineered cap is not required for the Husbands Bosworth Quarry landfill facility since the only waste to be accepted is inert. The Hydrogeological Risk Assessment (*Document Reference: MG1001/08*) demonstrates that there will be no adverse environmental impacts from the deposition of inert waste in the site without an engineered cap.
- 4.1.9 During the restoration phase, the final top layer will consist of soils and restoration planting.

4.2 Restoration Profile

4.2.1 The restoration scheme is presented in **Drawing No. H37/3/21/04** with final quarry restoration levels integrating into the surrounding topographic profile. The aim of the restoration scheme for the quarry site and its environs is to create a wide range of historic landscape features and habitats which will integrate into the existing landscape and complement local and national biodiversity objectives and will include:

- Herb-rich grassland;
- Parkland with scattered broadleaved specimen trees;
- Broadleaved woodland;
- Scrub habitat;
- Hedgerows;
- Open Ditches;
- Bird, amphibian and mammal habitats; and
- Seasonal Water Feature.

4.2.2 It is proposed that the final soil profile across the site will be formed using site-won soil materials i.e. stripped topsoil's, over-burden and quarry fines/wastes. The final restoration soil profile will be formed to a maximum thickness of 1m.

4.2.3 If material balances prove that insufficient materials are available on site to restore the whole site, a Restoration Plan will be submitted for approval to enable the use of suitable imported wastes. A full list of wastes that would be used to support restoration of landfill footprint area of the quarry is presented in Appendix MP of the accompanying Management Plan (*Document Ref.: MG1001/06*).

4.3 Water Management

4.3.1 During infilling within the footprint of the landfill surface waters draining from unfilled and waste filled areas will continue to be managed within a network of settlement lagoons and subsequently used in on-site operations including mineral processing.

4.3.2 Surface water will continue to be collected within the existing ponds network pending usage in ongoing mineral processing operations, and emissions management requirements. Monitoring of discharged surface water whilst the inert landfill facility is operational will also be carried out in accordance with the monitoring schedule presented in the accompanying Hydrogeological Risk Assessment (*Document Ref. MG1001/08*).

4.4 Post Closure Controls (Aftercare)

Proposed after-use of the site

- 4.4.1 The restoration scheme for the whole of Husbands Bosworth Quarry is to create a variety of land uses including a pond, herb-rich grassland, woodland and scrubland, with a series of permissive paths across the restored site to link with existing rights of way.

Post-Closure Management of the Site

- 4.4.2 When final levels are achieved post- application of restoration soils monitoring wells will be retro drilled within waste deposits in areas where waste thicknesses exceed 4m at a minimum spacing/density of 2 wells per hectare. The wells will be used to monitor the waste deposits for the purposes of demonstrating that the waste materials are stable, both physically and chemically, to enable subsequent surrender of the permit. Monitoring for gas will be carried out quarterly for a minimum of two years after closure of the site to support subsequent surrender of the Environmental Permit. Full details are presented in the Section 8.0 of the Management Plan (*Document Ref.: MG1001/06*) submitted in support of this application. In areas where waste thicknesses are less than 4m spike tests will be performed.

Conditions when Permit Surrender is Acceptable

- 4.4.3 Permit surrender will be considered when the site has reached final levels and it has been demonstrated that the deposits are stable and do not present a risk to the environment or human health (if left undisturbed). This will be determined by appropriate monitoring and surveying of the waste deposits for a minimum period of two-years after closure. Full details of the proposed monitoring and survey requirements after closure are presented in the Section 8.0 of the Management Plan (*Document Ref.: MG1001/06*) that supports this application. If after two years, the waste is assessed as stable, and in-waste gas concentration meets the criterion as set out in the relevant guidance and the Risk Assessments, then an application for surrender of the permit will be made.

5.0 MONITORING

5.1 Weather

5.1.1 Regional climate data has been sourced from recording stations located at Church Lawford Station and Coventry Airport, which are located approximately 21km southwest and 30km southwest of Husbands Bosworth Quarry respectively.

5.1.2 Average monthly and annual rainfall depths and rainfall days are presented in **Table ESSD13**. The average annual mean rainfall for this area is 674.83mm.

Table ESSD13: Average rainfall and days of rainfall (>1mm) at Church Lawford (1981-2010)

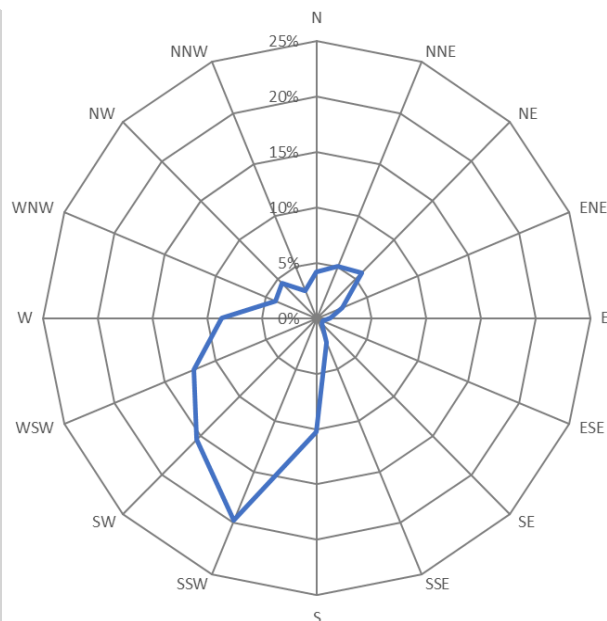
Month	Rainfall (mm)	Days of rainfall >= 1 mm (days)
Jan	56.39	11.52
Feb	39.99	9.47
Mar	44.73	11.16
Apr	49.73	10.1
May	57.51	9.49
Jun	55.63	9.19
Jul	59.95	8.42
Aug	61.96	9.13
Sep	65.25	9.52
Oct	66.78	10.56
Nov	60.18	11.1
Dec	56.73	11.63
Annual	674.83	121.29

Source: <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/qcr1cerx2>

5.1.3 The predominant wind direction is presented in **Figure ESSD1** which depicts prevailing winds from the southwestern quadrant, in particular the south-southwest, southwest, west and south. Wind from the north-eastern quarter occurring relatively less frequently, with winds from the south-eastern and north-western, occurring very infrequently.

Figure ESSD1: Wind direction data and wind rose for Coventry Airport meteorological recording station between 2000-2010 (inclusive (Source: RenSMART)

Direction	Percentage
N	4.15%
NNE	5.04%
NE	5.79%
ENE	2.54%
E	1.27%
ESE	0.60%
SE	0.68%
SSE	2.35%
S	10.28%
SSW	19.77%
SW	15.50%
WSW	12.16%
W	8.66%
WNW	4.08%
NW	4.47%
NNW	2.66%



5.2 Gas Monitoring Infrastructure

5.2.1 There are currently 7 boreholes monitoring around the periphery of the landfill and quarry: BH1, BH2, BH3, BH4, BH5, BH6, and BH7. The locations of these boreholes are presented in **Drawing No. MG1001/14/07**.

5.3 Gas Monitoring

5.3.1 Initial baseline ground gas monitoring has been carried out around the periphery of Husbands Bosworth Quarry between May 2021 to November 2021 recording methane, carbon dioxide and oxygen concentrations and relative pressures within each peripheral borehole. Full datasets and time-series charts for each determinand are provided in **Appendix ESSD7**. In addition to this, **Table ESSD14** has been prepared and displays the statistically analysed background concentrations for each determinand across both individual monitoring boreholes and within the wider superficial deposits.

5.3.2 Background gas monitoring demonstrates that methane is regularly detected around the periphery of the site, with detections of 0.1% recorded in each borehole throughout the monitoring period. A maximum methane concentration of 0.3% was recorded in BH5 which is located in the north-eastern corner of Husbands Bosworth Quarry; in between the proposed landfill void and the River Welland.

5.3.3 Carbon dioxide was continuously detected in all the monitoring boreholes around the edge of Husbands Bosworth Quarry. The highest concentrations of 0.7%v/v were recorded in BH1, BH2 and BH4 which are located along the south-western, northern, and north-eastern corner of Husbands Bosworth Quarry respectively. Whilst some variation in mean carbon dioxide concentrations is observed between the monitoring boreholes these mean concentrations fall within a narrow range (between 0.2%v/v and 0.4%v/v). The consistent mean concentrations around the periphery of Husbands Bosworth Quarry suggest that the concentrations recorded are representative of stable baseline ground gas conditions.

5.3.4 Similarly, the relative pressures recorded in the peripheral monitoring boreholes showed strong correlation across the site. Recorded relative pressures fell within a narrow range of -0.18mBar to 0.26mBar.

5.3.5 As previously indicated complete datasets and time-series plots for each of the monitoring parameters within the superficial deposits are presented in **Appendix ESSD7**.

Table ESSD14: Baseline gas concentration quality summary (statistical outliers removed) between May 2021 and November 2021

Statistic	Methane (%v/v)	Carbon Dioxide (%v/v)	Oxygen (%v/v)	Relative Pressure (mBar)
BH1				
Min	0	0.1	20.3	-0.18
Mean	0.1	0.4	20.6	0.03
Max	0.2	0.7	21	0.18
Stdev	0.1	0.3	0.3	0.13
Count	7	7	7	7
BH2				
Min	0	0.1	19.9	0.02
Mean	0.1	0.4	20.4	0.08
Max	0.1	0.7	20.9	0.11
Stdev	0.0	0.2	0.4	0.04
Count	7	7	7	7
BH3				
Min	0	0.1	20.2	-0.04
Mean	0.1	0.3	20.8	0.04
Max	0.2	0.4	21.4	0.11
Stdev	0.1	0.1	0.4	0.06
Count	7	7	7	7
BH4				
Min	0	0.1	19.8	-0.04
Mean	0.1	0.3	20.5	0.03
Max	0.1	0.7	20.9	0.09
Stdev	0.1	0.2	0.4	0.04
Count	7	7	7	7
BH5				
Min	0	0.1	19.8	-0.05
Mean	0.1	0.3	20.4	0.02
Max	0.3	0.6	21	0.11
Stdev	0.1	0.2	0.5	0.06
Count	7	7	7	7

Statistic	Methane (%v/v)	Carbon Dioxide (%v/v)	Oxygen (%v/v)	Relative Pressure (mBar)
BH6				
Min	0	0.1	20.5	-0.07
Mean	0.1	0.3	20.7	0.06
Max	0.2	0.5	21.4	0.19
Stdev	0.1	0.2	0.3	0.11
Count	7	7	7	7
BH7				
Min	0	0	20.4	-0.05
Mean	0.1	0.2	20.7	0.12
Max	0.2	0.5	21.1	0.26
Stdev	0.1	0.2	0.3	0.12
Count	7	7	7	7
Superficial Deposits				
Min	0	0	19.8	-0.18
Mean	0.1	0.3	21	0.05
Max	0.3	0.7	21.4	0.26
Stdev	0.1	0.2	0.4	0.09
Count	49	49	49	49

- 5.3.6 As with the groundwater quality data presented in **Table ESSD9**, statistical analysis of the background peripheral gas concentrations was completed utilising the statistical assessment/outlier screening methodology presented in Environment Agency Research and Development document “Techniques for the Interpretation of Landfill Monitoring Data Guidance Notes, Report No. P1-471”.
- 5.3.7 It is important to note that only inert wastes will be deposited at the site, therefore the potential for deposited wastes to produce landfill gas will be negligible. However, whilst the potential for the deposited wastes to produce landfill gas, it is considered prudent undertake perimeter gas monitoring during the active period of infilling of the site to demonstrate the absence of any impact from the proposed inert landfill site.
- 5.3.8 Perimeter gas compliance limits and action levels for the perimeter monitoring boreholes have been derived in accordance with the ICoP guidance document.
- 5.3.9 The derivation of these limits has been accomplished using the recorded perimeter ground gas datasets recorded in each individual borehole and account for the geographical position of each borehole in relation to surrounding sensitive human receptors.
- 5.3.10 It is important to note that each borehole presented in **Table ESSD14** will be assigned both a methane action level and compliance limit.
- 5.3.11 Due to the lateral distance between the perimeter monitoring boreholes and the identified sensitive human receptors, based on the guidance presented in the ICoP it is proposed that only carbon dioxide action levels are derived rather than compliance limits.
- 5.3.12 Following the analysis of the selected monitoring borehole datasets which included the visual examination of time-series charts and statistical outlier assessment, it was considered that the recorded datasets represent a stable sub-surface environment. Accordingly, it is considered that the corresponding methane and carbon dioxide action level and compliance limit derivation criteria presented in the ICoP can be applied.
- 5.3.13 Due to the stability of the analysed datasets; as demonstrated in the time-series plots presented in **Appendix ESSD7** and the datasets presented in **Table ESSD14**, the action levels for carbon dioxide in the perimeter boreholes are set at 1.0% above the T_{max} carbon dioxide concentration. The proposal of carbon dioxide action levels 1.0% above corresponding T_{max} concentrations was informed by the ICoP guidance which states that where T_{max} concentrations are below 5% action levels should be set 1% higher than measured T_{max} concentrations.
- 5.3.14 Due to the stability of the analysed datasets; as demonstrated in the time-series plots presented in **Appendix ESSD7** and the datasets presented in **Table ESSD14**, the action levels for methane in the perimeter boreholes are set at 0.5% above the background (T_{max}) methane concentration in accordance with the ICoP guidance.
- 5.3.15 In addition to methane action levels, compliance limits for methane will also be applied to the assessed monitoring boreholes. In accordance with the ICoP guidance, the methane compliance limits will be set at 1.0% above the T_{max} methane concentration.

- 5.3.16 Due to the observed stability and strong correlation between carbon dioxide and methane concentrations recorded in the perimeter monitoring boreholes and the inert nature of the proposed waste deposits, it is considered that blanket action levels and compliance limits (where required) are suitable.
- 5.3.17 The proposed carbon dioxide action levels and methane action levels and compliance limits for the assessed monitoring boreholes are presented in **Table ESSD15** alongside the maximum T_{max} concentration recorded in the superficial deposits.

Table ESSD15: Proposed action levels and compliance limits for carbon dioxide and methane in boreholes BH1 – BH7

Borehole ID	Carbon Dioxide (%v/v)		Methane (%v/v)		
	T_{max} Concentration	Action Level	T_{max} Concentration	Action Level	Compliance Limit
BH1	0.7	1.7	0.3	0.8	1.3
BH2					
BH3					
BH4					
BH5					
BH6					
BH7					

- 5.3.18 Once final levels are achieved in each phase a series of in-waste monitoring boreholes will be installed within the wastes mass at a density of 2 per hectare where waste deposits exceed depths of 4m. These will be monitored quarterly for a period of 2 years post-closure to support the subsequent surrender of the permit. The proposed positions of these boreholes are present in **Drawing No. MG1001/14/07**.

6.0 SITE CONDITION REPORT

6.1 Scope and Objectives

- 6.1.1 The Site Condition Report assess the baseline environment of the operational areas of Husbands Bosworth Quarry Landfill site that will not receive permanent deposits of waste.
- 6.1.2 The Site Condition Report has been compiled in accordance with Environment Agency's Templates: Conceptual Site Model, Environmental Setting and Site Design Report, Version 1, 14/10/2016, and H5 Guidance. Information has been gathered from a number of sources including existing site investigation reports, desk study analysis and observations made by Sirius.
- 6.1.3 The purpose of this initial Site Condition Report is to provide a factual statement of the condition of the site at the time of issue of the Environmental Permit. The Site Condition Report must describe the nature and distribution of potentially polluting substances in the ground and groundwater at the site prior to the commencement of operations under the Environmental Permit, and those handled during the course of the permitted operations. The potentially polluting substances of interest are those which are to be handled at the site under the Permit, and include raw materials, waste materials and by-products that are generated by the process.
- 6.1.4 The proposed development comprises the restoration of Husbands Bosworth Quarry through landfilling with inert wastes. However, this section of the ESSD focuses on the condition of the areas of the site which will not be subject to the permanent deposit of wastes, which for this site will be restricted to land around the periphery of the landfill void between the edge of the landfill void and the Environmental Permit Boundary. The waste that will be disposed at the site will be inert in nature and as such should present little chance of pollution or contamination. Notwithstanding this, the proposed development is described in **Section 2.0** which allows derivation of the types of contaminants to be considered.

6.2 Condition of the Land at Permit Issue

Sources of Information

- 6.2.1 The base information this report has been determined from a review of available published information, including:
- Landmark Envirocheck Report
 - BGS 1:50,000 scale geology maps
 - Environment Agency web-based data

Development History

- 6.2.2 A full description of the development history of the quarry and surrounding areas is provided in **Section 2.0**. In summary, the development history of the access road, reception area and most of the current quarry void consisted of open agricultural land at the time of the earliest map record dated 1885. Since then these areas have supported the wider quarry operations, including infrastructure such as overhead conveyors, access roads, weighbridges, storage facilities and landfilling activities. To the southwest of the quarry landholding are the site offices and the main mineral processing facility. Mineral extraction will be undertaken in the north-eastern area of the site.

- 6.2.3 Beyond the boundary of Husbands Bosworth Quarry the development history has been limited to mainly agricultural and residential activities, with the exception of mineral extraction; and subsequent infilling activities, and recreational activities associated with the quarry and airfield, respectively, both located to the south of Husbands Bosworth Quarry.

Geology

- 6.2.4 A detailed description of the regional and local geology and hydrogeology is present in **Section 3.1**. In summary, the areas not subject to permanent deposits of waste are immediately underlain by a combination of superficial glaciofluvial and river terrace deposits; comprising sands and gravels, and diamicton deposits. Bedrock geology in these areas is comprised of the mudstones of the Dyrham and the Charmouth Mudstone Formations; both part of the Lias Group.

Hydrogeology

- 6.2.5 The detailed description of the regional and local hydrogeology is presented in **Section 3.3**. To summarise, superficial glaciofluvial and river terrace deposits are classified as a 'Secondary A' Aquifer whilst the diamicton deposits are classified as a 'Secondary (Undifferentiated)', with the Dyrham and the Charmouth Mudstone Formations both classed as 'Secondary (Undifferentiated) aquifers'.

- 6.2.6 There is currently a total of seven licensed abstraction points within 2km the landfill, details of which are presented in **Appendix ESSD1** and summarised in **Table ESSD10**. Mick George Limited hold an abstraction license to abstract water groundwater collected within a seepage catchpit, a copy of this Abstraction License (Serial No. 5/31/02/*G/0014) is presented in **Appendix ESSD8**.

Hydrology

- 6.2.7 A comprehensive description of the hydrological setting of Husbands Bosworth Quarry is presented in **Section 3.2**.
- 6.2.8 The application site is located in the headwaters of the River Welland catchment area. The River Welland rises approximately 2.6km southeast of the quarry from where it flows west then north before flowing east passing approximately 50m to the southeast of the landfill footprint. Two unnamed tributaries flow into the River Welland are located within the vicinity of the proposed site.
- 6.2.9 The first tributary is located along the southern boundary of the Husbands Bosworth Quarry Mineral Processing Area and flows eastwards into the River Welland c.110m to the south of the landfill footprint.
- 6.2.10 The second tributary is located to the north of the Husbands Bosworth Quarry and flows in a north-easterly direction into the River Welland c.310m to the northeast of the landfill footprint.
- 6.2.11 The Site is located within a Flood Zone 1; defined as land "having a less than 1 in 1,000 annual probability of river or sea flooding".
- 6.2.12 The channel of the River Welland are designated as a Flood Zone 2 and Flood Zone 3 area. However, it is noted that these designations do not extend into the proposed Environmental Permit Boundary. Due to the lateral distance between these flood risk zones and the proposed landfill void, alongside the absence of

historical (including geological) indicators of flooding the site has been deemed as not at risk of fluvial or coastal flooding.

- 6.2.13 Surface and ground waters within the quarry are appropriately managed within the confines of the quarry and discharged to surrounding surface water course under appropriate regulatory consent.
- 6.2.14 There is a total of 12 active surface water discharge consents within 1km of the proposed landfill, details of which are presented in **Table ESSD5** and one active groundwater discharge consent within 1km of the landfill, summary details of which are summarised in **Table ESSD12**.
- 6.2.15 There are currently three licensed abstractions within 2km of the site as detailed in **Table ESSD6** and **Table ESSD10**.

Natural Hazards

- 6.2.16 The Landmark Information Group Service produced in January 2022 was used to identify the potential natural hazards at the site. A summary of the ratings associated with each potential hazard on site and to distance of 250m from the site boundary is provided in **Table ESSD15**.

Table ESSD16: Natural Hazard Rating Summary within 250m of the site

Hazard Type	Hazard Rating
Instability due to Coal Mining	No Hazard
Collapsible Ground Stability	No Hazard to Very Low
Compressible Ground Stability	No Hazard to Moderate
Ground Dissolution Stability	No Hazard
Landslide Ground Stability	Very Low to Low
Running Sand Ground Stability	No Hazard to Low
Shrinking or Swelling Clay Ground Stability	No Hazard to Low
Radon Potential	The Property is in a Lower to Intermediate probability Radon Area (<1% to 3% of homes are estimated to be at or above the Action Level)

Mineral Sites and Hazardous Facilities

- 6.2.17 A total of nine BGS recorded mineral sites are located within 1km of the site. Five of these records fall within the application site boundary with three records located at least 600m from the application site boundary.
- 6.2.18 There are no registered facilities handling hazardous substances located within 1km of the site.

Environmental Regulatory Authorisations

- 6.2.19 There are no active Local Authority Pollution Prevention and Controls authorisations within 1km of landfill.
- 6.2.20 There are also three records within 1km of the site relating to historical landfill sites, four relating to licensed active waste management facilities, and one relating to Local Authority Recorded Landfill Sites. Details are presented **Appendix ESSD1** and summarised in **Table ESSD16**.

Table ESSD17: Summary of waste facilities within 1km of the site boundary

Location	Details
Historical Landfill Sites	
Leicester Road, Lutterworth, Leicestershire Distance: 0m SW NGR: 464682, 283547	Licence Holder: Redland Aggregates Name: Husbands Bosworth Provider Reference: EAHL01541 First Input Date: 28 th February 1985 Last Input Date: 15 th October 1993 Specified Waste type: Deposited Waste included Inert Waste
Welford Road, Lutterworth, Husbands Bosworth, Leicestershire Distance: 0m SW NGR: 464682, 283547	Licence Holder: Redland Aggregates Name: Husbands Bosworth Quarry Provider Reference: EAHL035836 First Input Date: Not Supplied Last Input Date: Not Supplied Specified Waste type: Not Supplied
Husbands Bosworth, Leicestershire Distance: 762m NW NGR: 464760, 285053	Licence Holder: British Waterways Name: Grand Union Canal Provider Reference: EAHL01542 First Input Date: 30 th November 1991 Last Input Date: Not Supplied Specified Waste type: Deposited Waste included Inert and Industrial Waste
Licensed Waste Management Facilities	
Husbands Bosworth Quarry, Welford Road, Husbands Bosworth, Market Harborough, Leicestershire, LE17 6JH Distance: 289m S NGR: 464533, 283176	Name: Husbands Bosworth Landfill Site Licence Number: 73281 Licence Holder: Tarmac Aggregates Limited Authority: Environment Agency - Midlands Region, East Area Site Category: Inert LF Licence Status: Modified Issued: 30 th March 2007
PO Box 7388, High Street, Syston, Leicestershire, LE7 1WA Distance: 342m W NGR: 464177, 283553	Licence Number: 73339 Licence Holder: Redland Aggregates Authority: Environment Agency - Anglian Region, Northern Area Site Category: Landfills Taking Non-biodegradable Wastes (Not Construction) Licence Status: Issued Issued: 30 th March 2007
Pebble Hall, Theddingworth, Lutterworth, Leicestershire, LE17 6NJ Distance: 790m NE NGR: 466239, 284670	Licence Number: 73293 Operator Name: Welland Waste Management Limited Authority: Environment Agency - Anglian Region, Northern Area Site Category: Composting Licence Status: Modified Issued: 26 th April 2007
Pebble Hall, Theddingworth, Lutterworth, Leicestershire, LE17 6NJ Distance: 808m NE NGR: 466300, 284600	Licence Number: 73196 Operator Name: Roger Clarke, Jeffrey J Clarke, Elizabeth Clarke, Jonathan Clarke Authority: Environment Agency - Anglian Region, Northern Area Site Category: Composting Licence Status: Issued Issued: 8 th September 2004
Local Authority Recorded Landfill Site	
Location Not Supplied Distance: 764m NW NGR: 464763, 285056	Reference: 261 Authority: Leicestershire County Council Last Reported Status: Unknown Types Of Waste: Not Supplied Date Of Closure: Not Supplied

Contemporary Trades

6.2.21

There are currently three active contemporary trade directory entries within 1km of the site as detailed in **Table ESSD17**, all other contemporary trade directory entries are either inactive or obsolete.

Table ESSD18: Summary of active contemporary trade directory entries within 1km of the site.

Location	Details
Welford Road, Husbands Bosworth, Lutterworth, Leicestershire, LE17 6JH Distance: 414m W NGR: 464136, 283675	Name: Tarmac Classification: Quarries Status: Active Positional Accuracy: Manually positioned within the geographical locality

Location	Details
Pebble Hall Farm, Theddingworth, Lutterworth, LE17 6NJ Distance: 720m NE NGR: 466180, 284631	Name: Bioganix Welland Ltd Classification: Recycling Services Status: Active Positional Accuracy: Automatically positioned to the address
Airfield Park, Sibbertoft Road, Husbands Bosworth, Lutterworth, Leicestershire, LE17 6JA Distance: 647m S NGR: 464529, 282821	Name: N B J Classification: Joinery Manufacturers Status: Active Positional Accuracy: Automatically positioned to the address

History of Incidents

6.2.22 The Landmark Envirocheck report was examined to identify all records relating to pollution incidents to controlled waters and substantiated pollution incidents which fall within 1km of the site boundary. The search identified six pollution incidents to controlled waters and two substantiated pollution incidents within 1km of the site. Details of these incidents are contained within **Table ESSD18**.

Table ESSD19: Pollution Incidents within 500m of the site

Location	Details
Pollution Incidents to Controlled Waters	
Kettering District, HUSBANDS BOSWORTH Distance: 58m E NGR: 465100, 283500	Property Type: Aggregate (Sand/Gravel) Authority: Environment Agency, Anglian Region Pollutant: Miscellaneous - Inert Suspended Solids Incident Date: 6 th January 1999 Incident Reference: 3624 Receiving Water: Freshwater Stream/River Cause of Incident: High Flow Incident Severity: Category 3 – minor incident
Kettering District Distance: 308m N NGR: 464500, 284300	Property Type: No Given Authority: Environment Agency, Anglian Region Pollutant: Unknown Incident Date: 20 th November 1992 Incident Reference: 1498 Receiving Water: Freshwater Stream/River Cause of Incident: Unknown Incident Severity: Category 3 – minor incident
Kettering District, HUSBANDS BOSWORTH Distance: 442m N NGR: 464400, 284400	Property Type: Domestic/Residential Authority: Environment Agency, Anglian Region Pollutant: Oils - Kerosene Fuel Oil Incident Date: 18 th January 1999 Incident Reference: 3615 Receiving Water: Freshwater Stream/River Cause of Incident: Accidental Spillage/Leakage Incident Severity: Category 3 – minor incident
Field Adjacent A 4304 Road Distance: 797m NW NGR: 463800, 284000	Property Type: Other Farming Authority: Environment Agency, Midlands Region Pollutant: Organic Wastes: Cattle slurry Incident Date: 19 th December 1997 Incident Reference: 2503211 Receiving Water: Watercourse Cause of Incident: Land Runoff Incident Severity: Category 3 – minor incident
Kettering District Distance: 835m NW NGR: 464000, 284500	Property Type: Not Given Authority: Environment Agency, Anglian Region Pollutant: Unknown Incident Date: 3 rd July 1992 Incident Reference: 1384 Receiving Water: Freshwater Stream/River Cause of Incident: Unknown Incident Severity: Category 2 - Significant Incident
Kettering District Distance: 817m NW NGR: 464400, 284900	Property Type: Water Company Sewage: Sewage Treatment Works Authority: Environment Agency, Anglian Region Pollutant: Storm Sewage Incident Date: 1 st October 1994 Incident Reference: 2175 Receiving Water: Freshwater Stream/River Cause of Incident: High Flow Incident Severity: Category 3 – minor incident

Location	Details
Substantiated Pollution Incidents	
Unknown Distance: 418m W NGR: 464133, 283676	Authority: Environment Agency - Midlands Region, East Area Incident Date: 21st February 2020 Incident Reference: 1784344 Water Impact: Category 3 - Minor Incident Air Impact: Category 4 - No Impact Land Impact: Category 2 - Significant Incident Positional Accuracy: Located by supplier to within 10m Pollutant: Agricultural Materials And Wastes: Slurry And Dilute Slurry Pollutant: Specific Waste Materials: Commercial Waste
Unknown Distance: 852m W NGR: 464200, 284800	Authority: Environment Agency - Midlands Region, Lower Trent Area Incident Date: 1 st October 2001 Incident Reference: 35890 Water Impact: Category 2 - Significant Incident Air Impact: Category 4 - No Impact Land Impact: Category 4 - No Impact Positional Accuracy: Located by supplier to within 100m Pollutant: Storm Sewage

6.3 Permitted Activities

6.3.1 The area under the consideration of this SCR will not be subject to any specified waste management activities and will serve as buffer between the main landfill area and the Environmental Permit Boundary.

Potential Contaminants

6.3.2 Potential polluting substances that may present a risk to the condition of the land within buffer land are limited to oil and fuel leaks from vehicles and spillages of wastes materials during restoration activities.

6.4 Conclusions

6.4.1 The development history of the quarry areas has largely been associated with the extraction and processing of sand and gravel, together with some waste related activities. Beyond the site boundary there is one active landfill and an area of historic landfill which has been restored to grassland.

6.4.2 Future use of the buffer land within the permitted boundary of the inert landfill facility presents a limited risk from the future contamination of the land from leaks and spills of low-risk wastes, oils and fuels. Appropriate measures will be implemented to adequately manage any such spills and leaks, and appropriate investigations to be undertaken to determine if the condition of the land has been significantly affected by any such incidents. Ongoing monitoring of groundwater around the periphery of the site will also be carried out during the life of the landfill operations to identify any potential future increasing trends in pollutant concentrations.

REFERENCES

Domenico, P. A., and F. W. Schwartz (1990). *Physical and Chemical Hydrogeology*, 824 pp., John Wiley, New York.

Hafren Water (2001). *An environmental assessment of the surface and groundwater regime in the vicinity of Colchester Quarry, Essex*.

Hobbs, P.R.N., Entwisle, D. C., Northmore, K. J., Sumbler, L. D., Kemp, S., Self, S., Barron, M. & Meakin, J. L. (2012). *Engineering Geology of British Rocks and Soils - Lias Group*. British Geological Survey Internal Report, OR/12/032. 323pp

MacDonald, A., Maurice, L., Booth, D., Auton, C., Reeves, H. (2009). *Measuring in situ permeability of Quaternary deposits: examples from Forres, Morayshire*. [Lecture] In: *Engineering Geology of the Quaternary Deposits*, Reading, UK, 31 March 2009. British Geological Survey. (Unpublished)