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CONCEPTUAL SITE MODEL, ENVIRONMENTAL SETTING AND SITE DESIGN REPORT

PARK GROUNDS LANDFILL

Report Reference: 2437/ESSD
Final: Version F2
October 2018

Report prepared for:

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GENERAL NOTES

Title of report: Conceptual site model, Environmental Setting and Site Design Report

Site: Park Grounds Landfill, Wootton Bassett

Report ref: 2437/ESSD

Date: October 2018

Version	Date	Issued to
Draft version D1	28th March 2018	Richard Crapper & Sophie Perrin
Draft version D2	21st June 2018	Richard Crapper & Sophie Perrin
Final Version F1	6th July 2018	Richard Crapper & Sophie Perrin
Final Version F2	October 2018	Richard Crapper & Sophie Perrin

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1 INTRODUCTION

1.1 Report context

Crapper & Sons own and operate the Park Grounds Landfill near Wootton Bassett in Wiltshire. The Environmental Permit for the site was varied in 2015 to include the addition of Cells 7 to 10 for which Planning Permission had recently been granted. Since then Planning Permission has been granted for a further extension to the west and it is now proposed to vary the permit to include this additional area and to allow increased rates of waste input to account for changing market forces.

Hafren Water has been commissioned to prepare this Conceptual Site Model, Environmental Setting and Site Design (ESSD) report. SOL Environment is the Agent submitting the permit variation on behalf of Crapper and Sons Ltd.

1.2 Site details

1.2.1 Site location

Park Grounds Landfill is centred at National Grid Reference (NGR) SU 052 839 and is located approximately 2 km northwest of Wootton Bassett, Wiltshire. The M4 motorway forms the southern boundary of the site and the B4042 Brinkworth Road passes roughly east-west to the north of the site. Access is via a metalled track off the B4042. The entrance is signed and has lockable wooden gates.

The location of the site is shown on *Drawing 2437/ESSD/D1*.

1.2.2 Site classification

The site is classified as a landfill for non-hazardous and inert wastes.

1.2.3 Site description

The landfill is bounded to the south by the M4 Motorway and a railway to the southwest. Former farm buildings, materials recovery facility and composting area owned and operated by Crapper & Sons are located north of the central landfill area. Land to the north, west and east of the site comprises arable and low quality grazing, see *Drawing 2437/ESSD/D2*.

The site comprises an active landfill, Materials Recovery Facility (MRF), recycling, composting facility and a closed landfill. The existing permit covers the closed landfill in the far east and northeast and the current landfill in the centre and west of the site (*Drawing 2437/ESSD/D4*). The closed landfill area was largely inert with only the last three, northernmost, cells (cells A-C) comprising non-hazardous waste. The closed landfill comprised a land raising operation,

infilling a low valley and raising elevations to form a small local hilltop. It was restored to a gently domed profile with a maximum elevation of 98 metres Above Ordnance Datum (mAOD).

Land to the northeast of the current landfill is used for the recycling and composting operations. A new building is being constructed to house these processes together with a new gasification plant which are all regulated by a separate permit. The site offices and meeting rooms occupy the former farmhouse.

The current landfill area comprises thirteen cells (Cells 1 to 10, 1A, 1B and an asbestos cell). These are filled with non-hazardous waste commencing in the southwest and following a roughly clockwise direction. A small asbestos cell is located towards its centre. Landfilling is currently being undertaken in Cell 9 and Cell 10 has been engineered to accept waste. A further five cells occupy the recently granted western extension area; Cells 11 to 15.

1.2.4 Landform

The site is located within landscape characteristic of the clay vales of southern and eastern England. Natural ground elevations vary from approximately 110 mAOD along the B4042, 600 m north of the landfill, to 75 mAOD in the base of the shallow valley immediately to the south and southwest of the landfill. The proposed permit boundary is shown on *Drawing 2437/ESSD/D2*.

1.2.5 Other waste management activities

Three other landfill sites are located in the vicinity of the site. These are all historical and include; Folly Farm Landfill, The Gables and Ballards Ash Farm landfills which form a complex approximately 670 m east of the site, Hookers Gate Farm landfill is 350 m southwest and Callow Hill Farm landfill, 950 m northwest of the site.

Callow Hill Farm landfill received inert waste and was operational between 1977 and 1985. Hookers Gate landfill received inert and industrial wastes and was operational between 1978 and 1992 and the sites at Folly Farm received inert waste and were operational between 1989 and 1991.

Landfills within 500 m of the site are shown on *Drawing 2437/ESSD/D2*.

1.2.6 Local environmental receptors

Agricultural land surrounds the site with four farms and scattered residential properties within 500 m of the site boundary, as shown on *Drawing 2437/ESSD/D2*. To the northwest Lowgate

Cottage is located 270 m from the site boundary. To the northeast there are several properties close to the site including; The Paddocks (370 m north-northeast), Woodlands (370 m northeast), Folly Wood Farm (480 m northeast) and Freckles Farm (460 m northeast).

No recreational areas exist in the vicinity of the site.

The nearest school is in Wootton Bassett, 1.5 km to the southeast.

1.2.7 Sites of ecological and conservation interest

Statutory sites

There are no statutory sites of conservation interest within 2 km of the site boundary.

The closest such sites are two Sites of Special Scientific Interest (SSSI): Restrop Farm and Brockhurst Wood, located 3 km northeast of the boundary of the site, and Wootton Bassett Mud Spring, located 3.5 km southeast of the site (*Drawing 2437/ESSD/D3*).

The Wootton Bassett Mud Spring SSSI is groundwater-dependent, as well as being connected to surface water flows via a small stream that feeds water off the canal, passes through the SSSI site, then flows via Hancock's Water into Brinkworth Brook.

Two further sites; Goldborough Farm Meadow SSSI and Ravensroost Wood SSSI are located 4.85 km southeast and 4.38 km northwest of the site respectively. Goldborough Farm Meadow comprises traditional hay meadows sited on low permeability Kimmeridge Clay deposits. Ravensroost Wood comprises wet ash-wych and elm and wet ash-maple woodland situated on low permeability Oxford Clay.

1.2.8 Non-statutory sites

The Jubilee Lake Local Nature Reserve (LNR) lies approximately 1.3 km east of the site on the fringes of Royal Wootton Bassett, see *Drawing 2437/ESSD/D3*. It was formed around the time of the First World War, when Thunder Brook was dammed. It is rich in birdlife and contains wetland habitats, ancient woodlands and grass areas.

The site is located within the Great Western Community Forest area, which extends to approximately 358 km².

Local wildlife sites (LWS) in the vicinity of the site include:

Callow Hill Farm Meadow LWS	1.2 km	WNW
Withybed Wootton Bassett LWS	Adjacent	N

Hookers Gate Farm Meadow County Wildlife Site (CWS)	0.96 km	SW
Folly Wood, Wootton Bassett LWS (Ancient Woodland)	0.35 km	NE

These are all woodlands located on low permeability/ impermeable Oxford Clay and hence will not be groundwater dependant but rely upon rainfall for water supply.

1.2.9 Summary of land use

A summary of the land use in proximity to the site is provided in *Table 2437/ESSD/T1* below.

2437/ESSD/T1: Summary of land uses

Land use	Distance from site
Residential properties:	
The Paddocks	370 m NE
Woodlands	370 m NE
Lowgate Cottage	270 m NW
Folly Wood Farm	480 m NE
Freckles Farm	460 m NE
Highgate Cottages	650 m N
Royal Wootton Basset	1.5 km SE
Nearest school	1.5 km SE
Agricultural land	Adjacent to N, E, W
Railway	Adjacent to SW
Roads: M4	Adjacent to the S
B4042	390 m N
Whitehill Lane	470 m S
Nearest landfill	
Hookers Gate Farm (historical)	350 m SW
Conservation	
Restrop Farm and Brockhurst Wood SSSI	3 km NE
Wootton Bassett Mud Spring SSSI	3.5 km SE
Goldbrorough Farm Meadow SSSI	4.85 km SE
Ravensroost Wood SSSI	4.38 km NW
Non-statutory conservation sites	
Jubilee Lake Local Nature Reserve (LNR)	1.3 km E
Great Western Community Forest	Site lies within designation
Callow Hill Farm Meadow LWS	1.2 km WNW
Withybed Wootton Bassett LWS	Adjacent N
Hookers Gate Farm Meadow LWS	0.96 km SW
Folly Wood, Wootton Bassett LWS	0.35 km NE

1.3 Compliance with Landfill Location Policy

The Environment Agency's policy on the location of landfills is detailed in 'The Environment Agency's Approach to groundwater protection' (November 2017 v 1.1), Position Statement E1. Landfill Location'. This states:

> "The Environment Agency will normally object to any proposed landfill site in groundwater SPZ 1.
> For all other proposed landfill site locations, a risk assessment must be conducted based on the nature and quality of the wastes and the natural setting and properties of the location.
> Where the risk assessment demonstrates that active long-term site management is essential to prevent long-term groundwater pollution, the Environment Agency will object to sites:
> - below the water table in any strata where the groundwater provides an important contribution to river flow, or other sensitive receptors
> - within SPZ 2 or 3
> - on or in a principal aquifer"

The site is not located within a source protection zone (SPZ) and is not in or on a principal aquifer. The site therefore complies with the Environment Agency's position statement on landfill location.

2 SOURCE TERM CHARACTERISTICS

2.1 Site development

2.1.1 Historical development

Landfilling commenced in 1986 south of the existing former farm buildings and proceeded eastwards using inert wastes. After 1988 the licence was modified to allow the northernmost part of the landfill (Cells A to C) to be filled with non-hazardous waste. Landfilling in this area ceased in 1989.

The landfilling of the current area commenced operation in 1990. Before this the land comprised low quality grazing land.

Engineering

Landfilling in the main non-hazardous area commenced in the southwest, in Cell 1 (*Drawing 2437/ESSD/D4*). Cells 1, 1A and 1B do not benefit from a constructed, engineered clay layer, however the exposed clay surface forming the cell base and sides was compacted using heavy mobile plant. Clay liners (300 mm thick) were engineered in the base and sides of Cells 2 and 3. Landfill Directive compliant clay lining has been applied from Cell 4 onwards, comprising a minimum 1 m thick (more frequently 1.5 m) re-worked clay mineral liner.

On completion of filling each cell, a 1 m thick clay cap was constructed, now normally 2 m thick.

In order to obtain material for the sidewalls, base and cap, clay is extracted from the base of each cell, resulting in the base being between 1 and 2 m below original ground levels in Cells 1 to 6. From Cell 7 onwards the depth of clay extraction for re-use on-site increased to between 6 to 7 m to allow for a cut basal elevation of approximately 81 to 82 mAOD and a formation level for each cell of approximately 82 to 83 mAOD (based on Drawings in PGW&A LLP Stability Risk Assessment, May 2011, ref PGL/SRA/3/1).

Leachate drainage

Historically, the base of each landfill cell was graded to encourage leachate to drain to a leachate collection sump located at the lowest point in the cell. In Cells 5 and 6 onwards a herringbone system of drains, comprising high density polyethylene (HDPE) pipe with a coarse gravel surround was placed to further encourage leachate drainage across the base of the landfill cell towards the leachate collection sump.

From Cell 7 onwards a leachate drainage system comprising a drainage layer of baled tyres has been installed together with a leachate collection sump constructed on a concrete pad and comprising concrete rings progressively raised with waste deposition. A geotextile is placed between the mineral liner and the baled tyres. A series of 150 mm HDPE drain pipes is laid in drain runs between the baled tyres, terminating at the leachate collection sump. A vertical 300 mm diameter HDPE drain pipe is also installed within the concrete rings of the leachate collection chamber. All the drain pipes, horizontal and vertical are completely surrounded by 10-20 mm coarse aggregate. Any gaps within the baled tyres are also filled with aggregate.

Finally a geogrid is tied to the completed upper surface of the baled tyres to act as a confinement layer, without impeding flow through the drainage system.

The leachate drainage system is subject to third party CQA.

2.1.2 Leachate management

Leachate management in the closed non-hazardous cells A to C has now ceased and levels are stable and leachate extraction is not undertaken.

A number of the cells in the main body of the non-hazardous landfill are currently non-compliant with leachate level Compliance Limits. Leachate is extracted from a leachate collection chamber in three of these cells at any time using suction pumps. The extracted leachate is pumped to one of three leachate re-circulation pods and to a reed bed. Pumping continues until leachate levels fall below the pump intake. Records of pumped volumes are not available, however records are maintained of when pumping occurs.

<u>Leachate re-circulation pods</u>

Leachate re-circulation pods are located in Cells 3, 4 and 6. The locations of the pods is shown on *Drawing 2437/ESSD/D6*. The pods comprise a rectangular pit, approximately 20 m x 5 m x 5 m in size, filled with coarse aggregate or similar drainage medium and constructed below the landfill cap. A radial series of drainage pipes were laid within the pods to ensure injected leachate reaches the points distal to the injection point.

Leachate is injected to the pod via individual headworks serving each pod.

Reed bed

The reed bed is located south of the site offices and adjacent to Cell 7. The reed bed was designed by ARM Ltd in April 2012[1] specifically to treat the leachate generated at Park Grounds Landfill. Treated effluent from the reed bed is taken by tanker and sprayed over the composting area in the north of the site to damp down the composting windrows.

Leachate monitoring

Retro-drilled leachate wells are constructed in each completed cell. These comprise 450 mm drilled diameter with 225 mm HDPE perforated well casing surrounded by 20 mm clean washed gravel. From Cell 8 onwards these leachate monitoring wells will be installed over a concrete pad constructed on the base of the landfill to prevent damage to the landfill liner. Concrete pads are identified by GPS having been located at the time of cell construction.

The locations of the leachate monitoring wells are shown on *Drawing 2437/ESSD/D6*.

2.1.3 Waste types

Along with the development of engineering practices at the site, waste inputs have also evolved. With the commencement of recycling and composting operations north of the landfill, the majority of green waste, rubble, virgin plasterboard and other recyclable material has been removed from the waste stream to the landfill. Very few residues arise from the MRF and composting operations. Since the commencement of landfilling in Cell 7, some domestic waste has been accepted at the site, mixed with other non-recyclable wastes.

Based on weekly waste analyses for the period 22nd November 2017 to 22nd December 2017 (5 sets of samples) the average waste inputs are as follows:

- Wood, carpet, textiles, geotextiles (soft and foam), hygiene products 28.7%
- <10 mm fines 22.9%
- Cardboard and paper 16.1%
- Stones, bricks, rubble, glass, plasterboard 10%
- Bags, film, wrap 8.9%
- Soil, grass 5.3%
- Electrical and electrical equipment cables 2%
- Food waste, pet litter 1%
- Nuts, bolts, pipes, cans 0.6%

1 Design specification – Brinkworth Landfill reed bed – CR3310, 04 April 2012

- Straps, cans, containers 0.5%
- Paint cans, batteries, chemicals, medicines 0%

Over 60% of the incoming waste currently comprises textiles, fines and cardboard/paper.

2.1.4 Waste volumes

After the original permit was issued in 2005, landfilling rates decreased from 53,000 tonnes per annum (tpa) to approximately 10,000 to 15,000 tpa in 2010-11. This was in part due to the lack of void space in the Permitted Area at the time, necessitating a reduction in the rate of waste brought into the site.

The current Permit (EPR/SP3336SN/V005 issued in 2015) allows for landfilling of 17,000 tonnes of non-hazardous waste per year and 6,000 tonnes of inert waste.

Waste input rates have risen in recent years as shown in *Table 2437/ESSD/T2*. The average combined inert and non-hazardous waste input has increased year on year since 2012 and the annual waste inputs now exceed that allowed by the current permit.

2437/ESSD/T2: Waste input rates						
Year	Period	No of months	Non-Hazardous (tonnes)	Inert (tonnes)	Total (tonnes)	Ave per month (tonnes)
2012	Oct-Dec	3	4,745.88	647.00	5,392.88	1,797.63
2013	Jan-Dec	12	34,319.60	3,387.38	37,706.98	3,142.25
2014	Jan-Dec	12	46,559.78	26,598.95	73,158.73	6,096.56
2015	Jan-Dec	12	59,256.80	31,001.66	90,258.46	7,521.54
2016	Jan-Dec	12	63,505.80	29,456.92	92,962.72	7,746.89
2017	Jan-Mar	3	15,482.42	14,004.40	29,486.82	9,828.94

The non-compliance with respect to the waste inputs is intended to be addressed as part of this Permit Variation Application.

2.1.5 Leachate levels

Leachate levels are monitored quarterly in all completed cells. The results of the monitoring are provided in *Appendix 2437/ESSD/A1* together with temporal graphs. It can be seen from the graphs that leachate levels have been largely stable since 2012 with more recent slight decreases recoded in Cells 5 and 7B were recorded.

Leachate levels are below 1 m above the base of the landfill in Cells A, C, 1, 1A, 1B and 3, ie these cells are compliant with the permit requirements. Within the remaining cells, the greatest depth of leachate is 2 m in Cell 2 and 1.6 m in Cells 5 and 7. Leachate heads are all between 1 and 1.5 m in the remaining cells. It should be noted that where leachate heads are highest in Cells 2 and 5, no external cell walls exist, ie they are completely contained by other landfill cells hence surface outbreak or lateral migration of leachate is unlikely. Cell 7 does have an external sidewall liner, however, this cell was constructed 7 m into the Oxford Clay and so, allowing for 1 m of re-engineered basal liner, the leachate level remains approximately 4.5 m below original and peripheral ground levels. Therefore egress through the cap or junction of the cap and sidewall is highly unlikely.

The stability of the leachate levels within individual cells indicates that the current method of leachate management, coupled with the provided landfill engineering is ensuring leachate levels do not rise.

2.1.6 Leachate quality

Leachate quality is required to be monitored quarterly in operational cells and annually once cells are completed.

Leachate quality monitoring is currently undertaken in Cells A to C and 1 to 8. All of these cells are complete and capped hence leachate quality is recorded annually.

The permit requires annual analyses as follows:

> pH, EC, total alkalinity, ammoniacal nitrogen, chloride, COD, BOD, cadmium, chromium, copper, lead, nickel, iron, arsenic, magnesium, potassium, total sulphates, calcium, sodium, zinc and manganese

Chromium, copper and lead are currently not included in the analyses suite. However, TOC, TON, phenols, barium, boron, cyanide, fluoride and mercury are determined.

The Permit also requires analyses of hazardous substances every four years. It is understood that a hazardous screen was undertaken in 2012 as part of a study by Enitial[2]. They concluded that, although four species of hazardous substances was identified (dimethyl phthalate, toluene, naphthalene and Extractable Petroleum Hydrocarbons (EPH) within the C10 to C40 range) they can all be readily explained by prevalence in the local environment or cross-contamination. The Enitial report was submitted to the Environment Agency in

2 Leachate management and monitoring plan, Park Grounds Landfill Site. PPC Permit ref: EPR SP33365N, Revision 1, November 2012

response to Improvement Condition 1 (Table S3.1) of the current permit. Further hazardous substance analysis is now overdue.

The results of the leachate analyses are provided in *Appendix 2437/ESSD/A1* together with temporal graphs of indicator parameters.

pH has reduced since 2006 from between 7.8 and 8.5 to between 6.4 and 7.2 in 2013. Since this time pH has returned to more neutral conditions and is now between 7.1 and 7.9.

Conductivity and chloride concentrations have risen since approximately 2013 in Cells 1, 1B, 2, and 7, with the highest concentration of chloride being 1690 mg/l in Cell 7 in 2017. However, conductivity and chloride concentrations tend to be more stable in Cells 2, 3, 4, 5 and 6. Within this more stable trend, concentrations in Cell 5 rose in 2017 before returning to pre-existing levels in 2017 and those in Cell 6 have risen in 2017. Concentrations in Cells A to C tend to be significantly lower than in the main body of the waste.

Ammoniacal nitrogen concentrations were below 100 mg/l until 2012 when they started to rise in all cells. Concentrations in Cells 6 and 7 peaked in 2013/2014 at 780 and 900 mg/l before declining to below 200 mg/l. The concentration in Cell 7 has now increased to 1010 mg/l in 2018. Concentrations at other cells fluctuate but remain below 700 mg/l and concentrations in Cells 3 and 4 appear to have stabilised. Ammoniacal nitrogen concentrations remain 'weak' compared with landfills excepting predominantly municipal wastes where values of 1600 to 2000 mg/l could be expected.

Biochemical Oxygen Demand (BOD) was also low until 2013 when concentrations rose, generally peaking below 200 mg/l in 2014/2015. The exception to this is Cell 7 which exhibited a BOD of 955 mg/l when monitoring in this cell commenced in January 2013 however this has since declined to 8.9 mg/l in November 2016. Concentrations of BOD in Cell 1 have increased from 27.4 to 324 mg/l between 2015 and 2016. Chemical Oxygen Demand (COD) follows a similar trend of low concentrations (up to 350 mg/l) until 2012, after which significant increases are observed. Concentrations generally remain below 2000 mg/l. the reason for this marked increase is not known.

Sulphate concentrations have fluctuated between around 100 to 1000 mg/l until 2014, after which they have generally declined. During November 2016 the highest concentration recorded across the site was 184 mg/l.

Changes observed in the leachate quality could be due to regular mixing of the leachate as a result of the leachate management program. However, erroneous data are present in the

leachate quality data set and lower reporting limits vary significantly (and reporting units) hampering interpretation and assessment. In particular the lower limits of detection require review and the analytical suite should be revised to ensure it includes chromium, copper and lead analyses.

2.2 Adjacent pollution sources

Three main potential sources of pollution exist adjacent to the application site:

- The MRF and composting area to the northeast
- The M4 Motorway to the southeast
- The railway line to the southwest

a) MRF and composting area

The MRF (materials recovery facility) and Composting site are located adjacent to the north boundary of the site.

Wastes that come into the site are green, wood waste and industrial commercial waste. The green waste is composted and the wood waste is shredded for use in the on-site gasification plant and other biomass plants and panel board plants around the country

The industrial commercial waste is sorted and hardcore, wood, cardboard and metals are removed for recycling and the residuals go to the landfill.

Odour management (OMP) and fire prevention (FPP) plans are in place. The run-off from the composting and the wood storage area is collected in a sealed drainage system which drains to a lagoon. The collected run-off is then reused in the composting process. The surface water drainage system is connected to 2 large underground storage tanks which can be used for firefighting, the excess is then collected in a lagoon which has a shut off valve should there be any pollution incidents.

b) M4 Motorway

The M4 Motorway is located adjacent to the southern boundary of the site. Run-off from the motorway enters the local drainage system in the area surrounding the site. Any contaminants; salt, oils or fuel etc present on the road have potential to reach local watercourses.

c) Railway

it is understood that run-off from the railway to the southwest of the site drains southwards, away from the site and directly to Thunder Brook. Any contaminants or spills on the railway will therefore drain directly to the brook.

2.3 Proposed development

The proposed Permit Variation relates to the western extension area recently granted Planning Permission (Cells 11 to 15) and increasing permitted waste input rates. The waste types, landfill engineering, leachate management, etc, will continue as per current practices as described in Section 2.1. The agreed final contours and after care scheme will also be revised to include the western extension area.

It is proposed to increase the waste input rates as below:

Non-hazardous	60,000 tonnes
Inert	20,000 tonnes

Landfilling is currently on-going in Cell 9 with Cell 10 engineered ready to receive waste.

The proposed layout/phasing of the site is provided on *Drawing 2437/ESSD/D4*.

The agreed post-settlement contours are shown on *Drawing 2437/ESSD/D5*. It is expected that little settlement will occur across the landfill due to the waste types accepted.

A summary of the engineering for the site is shown on *Drawing 2437/ESSD/D6*.

The locations and justification for existing site gas and proposed monitoring points are provided in the Gas Risk Assessment[3] undertaken by Enitial Ltd.

2.3.1 Waste stream

The waste stream for the proposed new cells will not alter from that currently permitted and as described in Section 2.1.1.

2.3.2 Phasing

Cells 9 and 10 will be completed up to the final agreed pre-settlement elevations in accordance with the 2017 Planning Permission prior to development of Cells 11 to 15 to avoid the need for surcharging older waste and stripping of the cap. The CQA report for Cell 10 is provided in *Appendix 2437/ESSD/A2*.

3 Landfill Gas Risk Assessment Review and Gas Management Plan. Park Grounds Waste Disposal Site. Enitial Ltd.

Cells 11 to 15 will be constructed and infilled in an anti-clockwise direction commencing in the north. The new cells will not overlap older waste. Instead, in order to create a smooth restoration profile the overlap areas, as indicated on *Drawing 2437/ESSD/D4*, will be filled with inert soils.

3 PATHWAY AND RECEPTOR CLASSIFICATION

3.1 Climate

Rainfall data has been obtained from the Environment Agency for the Wootton Bassett Sewage Treatment Works raingauge, (Station ID 411276) located approximately 3.5 km to the southeast of the site boundary (NGR SU 07292 81284). Long-term average (LTA) rainfall has been calculated using years where a complete data set has been provided (1992 to 2015, excluding 1993 and 1994). The results are shown in *Table 2437/ESSD/T3*. Over this period, the average annual rainfall was 745 mm.

2437/ESSD/T3: Long-term average rainfall at Wootton Bassett STW raingauge (1992-2015)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	65.5	54.0	44.5	55.7	58.0	48.8	57.3	65.4	52.0	77.7	85.3	78.8

Historical rainfall data and evapotranspiration data have also been obtained from MAFF Technical Bulletin 34 for this area (Area 30) and are shown in *Table 2437/ESSD/T4*.

2437/ESSD/T4: Historical rainfall data from MAFF Area 30												
(mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	69	53	51	52	65	57	66	78	67	65	78	74
PT	3	11	32	55	80	93	93	75	46	20	5	1
ER	66	42	19	0	0	0	0	3	21	45	73	73
PT – Potential Transpiration						ER – Effective Rainfall						

The indicated annual LTA effective rainfall is, therefore, 342 mm.

Wind speed and direction are recorded by the MET office at Lyneham approximately 5 km southwest of the site. Based on the wind rose produced using MET office data and provided on www.willyweather.co.uk the following predominant wind direction is derived from the last 5 years records;

13.57%	WSW
13.6%	SSW
11.6%	SW
10.85%	SSE
10.63%	S

Average (1981-2010) wind speeds are reported on the MET office website as:

Annual average	8.6	Knots
Max monthly average	9.9	Knots in January
Min monthly average	7.4	Knots in August

3.2 Geology

3.2.1 Bedrock

The site is underlain by dark blue-grey, over-consolidated Jurassic Oxford Clay, which dips gently to the east. The log of a borehole near Purton (Purton House), 5.5 km northeast of the site, indicates a thickness of the Oxford Clay in excess of 88 m. The Oxford Clay contains 'clay stone' horizons in places. Of the nineteen closest boreholes to the site (available on the BGS Geology Viewer website), claystones were only identified in two. However, they have been identified in places at the site (noted in construction quality assurance (CQA) report for Cell 9 as random and up to 75 mm thick. Based on the nearby borehole data, it is assumed that these claystones are not laterally continuous in the vicinity of the site. The logs of BGS boreholes are provided on *Appendix 2437/ESSD/A3*.

The overlying Corallian strata (now the Stamford Formation), a detrital limestone, outcrop at Wootton Bassett, 5 km east of the site. It is therefore considered likely that almost the full thickness of Oxford Clay is present beneath the site. Only the feather edge of the Corallian is present in a north-south exposure, the remainder being capped by the overlying Kimmeridge Clay further to the east.

The Kellaways Beds underlie the Oxford Clay and are in turn underlain by the Cornbrash which is the uppermost formation of the Great Oolite Series. The Kellaways Beds comprise grey mudstone, which is commonly silty or sandy with siltstone or sandstone beds, particularly in the upper horizons. It is in the order of 10 to 20 m thick. The Cornbrash comprises a bluish-grey or yellow-brown, fine to medium-grained bioclastic limestone. It is up to 10 m thick in the region (based on the BGS generalised section on 1:50,000 Sheet 252, Swindon).

The regional geology is provided on *Drawing 2437/ESSD/D8*, taken from the BGS on-line Geology Viewer.

3.2.2 Superficial

Shallow alluvial deposits occur in the vicinity of Thunder Brook south of the railway and 140 m south of the proposed permit boundary.

3.3 Hydrology

The water features discussed below are show on *Drawing 2437/ESSD/D2*.

3.3.1 Watercourses

The site lies within the catchment of The River Avon, which flows westwards towards Malmesbury and then takes a southward course to Chippenham and beyond. At its closest point it is 7 km west of the site. Thunder Brook, a tributary of Brinkworth Brook, is the closest named watercourse to the site. Thunder Brook flows westwards approximately 170 m southwest of the site to its confluence with Brinkworth Brook west of Dovey's Bridge, just under 1 km to the west-southwest. Brinkworth Brook then flows westwards to its confluence with the River Avon 7.3 km west of the site.

The drainage around Park Grounds landfill comprises three ephemeral streams that carry water only after, and during, storm events. The streams have previously been numbered 1 to 3 and the same numbering system will be used here.

Stream 1 rises north of the M4 motorway embankment (NGR SU 055 840,) as shown on *Drawing 2437/ESSD/D2*. It receives run-off from the motorway and flows northwestwards, through a culvert around the closed area of landfill and under the access road before continuing westwards to Lowgate Cottage. It then proceeds southwards under the railway via a large culvert to its confluence with Thunder Brook at Dovey's Bridge (NGR SU 4064 8361).

Stream 2 used to rise at a pond (NGR SU 0496 8399), which is now largely dry, approximately 90 m west of Park Grounds Offices. It now collects local surface water run-off from south and west of the site offices and has been diverted into the newly constructed ecological and flow balancing pond west of the waste recycling facility (see *Drawing 2437/ESSD/D2*). An overflow from this waterbody flows northeastwards to join Stream 1 (NGR SU 0467 8433) approximately 55 m northeast of Lowgate Cottage.

Stream 3 receives run-off from the completed landfill cells 8 and 9 and the Withy Bed Woodland area. It rises from the southeastern corner of the woodland and flows southwestwards, under the railway to Thunder Brook at NGR SU 0439 8368, approximately 215 m west of the site. The culvert under the railway is of brick and stone construction and is approximately 1.2 m square.

3.3.2 Waterbodies

A number of man-made waterbodies exist at the site associated with the development. The largest is a pond constructed east of Withy Bed Woodland as an ecological and surface water run-off flow balancing structure. This was created in 2013 and was subsequently deepened in 2017. It now provides water for firefighting, if necessary. Two smaller

'waterbodies' comprising surface water run-off and composting area run-off lagoons, are located to the north and northeast of the existing recycling and composting complex (W1 and W2).

A natural pond exists to the east of the current site offices (W4). Two small waterbodies lie on Stream 1 to the east and west of Lowgate Cottage (W5 and W6). A further pond (W7) is shown on the Ordnance Survey (OS) map immediately south of the site and adjacent to the M4 motorway, this 'pond' appears to be generally dry, however it will receive run-off from the competed landfill to the north and east.

3.3.3 Springs

No springs are shown on the OS 1: 25,000-scale map within a 2 km radius of the site.

3.3.4 Surface water abstractions

Licensed abstractions

One licensed surface water abstraction exists within 2 km of the site boundary: Harvey-Lloyd Fisheries Limited abstract water from Tockenham Water (NGR SU 0410 8265) for use in aquiculture. The maximum permitted annual quantity abstracted is 100,000 m^3, and the maximum daily total is 1,000 m^3. This abstraction is approximately 1.2 km southwest of the site and beyond Brinkworth and Thunder Brooks as shown on *Drawing 2437/ESSD/D2*.

Unlicensed abstractions

In September 2016, Wiltshire Council was consulted regarding the presence of unlicensed, private abstractions. They confirmed that they are not aware of any such abstractions within 2 km of the site.

3.3.5 Discharges from site

Clean surface water run-off is discharged passively from the site to the streams (1-3) described above. No active discharge occurs.

3.3.6 Surface water quality

Surface water quality is monitored at three locations on a quarterly basis. Sample points are located as described below and shown on *Drawing 2437/ESSD/D10*. Analyses required by the existing permit are also detailed below.

SW1, on Stream 1 east of the closed inert landfill
SW2, on Stream 1 north of Cell A in the north of the closed landfill

SW3, on Stream 2 west of the main recycling complex, now moved to discharge from ecological/flow balancing pond

Monthly analyses: Ammoniacal nitrogen, chloride, suspended solids, visual oil and grease, pH and electrical conductivity.

Surface water samples are currently analysed for numerous parameters in addition to those listed above and monitoring since November 2016 has been undertaken approximately monthly.

The results of surface water quality monitoring are provided in *Appendix 2437/ESSD/A4* together with graphs of temporal trends in concentration.

Since 2012 pH concentrations at the three sample points have followed similar trends. Values are generally around 7.3 to 7.8. However, low values were recorded in October and December 2013 at SW1 and SW3 and in December 2016 at all monitoring points. High values were recorded in January 2016, peaking at 8.8 (in SW1 and SW2) before declining once more to neutral values of between 7 and 7.5.

Conductivity varies more widely across the site, between 500 and 2500 μS/cm. Trends are not prevalent, with the exception of a possible rising trend at SW1, upstream of the site. Trends in chloride concentration largely mimic those of conductivity. Concentrations remain below 200 mg/l.

Ammoniacal nitrogen has historically been below 0.5 mg/l. Since the end of 2015, concentrations have varied more, including those at SW1 up-gradient of the site.

A slight rising trend in total organic carbon (TOC) occurred at SW3, north of the centre of the site since 2013. In 2013 the sampling point was moved, subsequent to creation of the ecological/flow balancing lagoon. After this time SW3 now samples the outlet of the lagoon. Sulphate concentrations in SW3 also increased at this time and may be due to the influence of newly exposed Oxford Clay on the standing water in the lagoon.

No over-arching increasing or decreasing trends in surface water quality are observed. However, concentrations in Stream 3 are often slightly higher than those observed in Stream 1 at SW1 and SW2.

3.3.7 Flood risk

The site lies within Flood Zone 1 as shown on the Environment Agency's flood map, which is designated as having a less than 1 in 1,000-annual probability of fluvial flooding. Surface water flood risk on the site is 'high' (greater than 3.3% chance of flooding) to 'very low' (less than 0.1% chance of flooding) (shown on *Drawing 2437/ESSD/D2*). Areas of risk of surface water flooding on the site are located along ditches and depressions; high to medium risk along the east boundary of Withy Bed and continuing south, high to medium risk to the north of the railway and M4 motorway along the field boundaries, also some ponding on the track leading north from the M4 motorway as it turns east.

3.3.8 Ecological importance of watercourses

The watercourses adjacent to the site are not identified as statutory or non-statutory sites of ecological or natural heritage interest.

3.4 Hydrogeology

3.4.1 Aquifer status and regional context

The Oxford Clay is an aquiclude and is designated by the Environment Agency as 'Unproductive'. The closest aquifer to the site is the Stamford Formation (Corallian) at Wootton Bassett, which is designated a Secondary 'A' Aquifer. This aquifer is at a higher elevation than the site and hence could not be impacted upon by the landfill.

The Cornbrash, which underlies the Oxford Clay at depths greater than 120 m, also possesses aquifer properties suitable for groundwater abstraction. However, due to its depth and distance to the nearest outcrop (approximately 10 km at Malmesbury) it is considered likely that the groundwater would have high salinity and would not be suitable for potable use. The limited thickness, up to 10 m, would also limit the aquifer potential of the Cornbrash.

Fractures can be seen within the Oxford Clay in exposed faces within local brick pits. However, where it is unweathered these are likely to be tight or closed and are not water-bearing. Clay stone bands identified within the Oxford Clay at the site and in nearby boreholes associated with the M4 Motorway construction are thin, less than 0.75 m thick, and appear to be discontinuous. Where identified during excavation works for cell construction at site, they have not been water-bearing.

Shallow alluvial deposits associated with Thunder Brook are designated a Secondary 'A' Aquifer by the Environment Agency. These deposits are separated from the site by the railway.

3.4.2 Aquifer characteristics

Permeability

Tests have been carried out on the Oxford Clay at the site which indicates a natural permeability less than 1 x 10^{-9} m/s and a re-worked permeability in the order of 1 x 10^{-11} m/s. Published data indicates a range of 1 x 10^{-9} to 1 x 10^{-12} m/s, with the higher end of the range representing horizontal permeability and the lower end vertical. The Oxford Clay therefore acts as a natural geological barrier.

3.4.3 Aquifer vulnerability

Maps provided by the Environment Agency on the MAGIC website indicate that the site is underlain by 'unproductive' strata and hence groundwater vulnerability is negligible.

3.4.4 Groundwater abstractions

Licensed abstractions

No licensed groundwater abstractions exist within 2 km of the site, the closest is The Wiltshire Hotel and Golf Club, Licence N° 17/53/007/S/018, from a borehole located approximately 2.2 km south of the site and is likely to utilise water from the Stamford Formation limestones overlying the Oxford Clay.

Unlicensed abstractions

In September 2016, Wiltshire Council was consulted on the presence of unlicensed, private abstractions. They confirmed that they are not aware of any such abstractions within 2 km of the site.

3.4.5 Groundwater quality and levels

As a distinct groundwater body does not exist within the Oxford Clay and no other aquifers or water-bearing strata occur within the immediate vicinity of the site, groundwater monitoring is not required. There are, therefore, no groundwater monitoring boreholes or monitoring data.

3.5 Man-made pathways

No known man-made pathways, buried pipes and other services, exist in the vicinity of the site.

3.6 Off-site landfill gas monitoring

There is currently no off-site gas monitoring at Park Grounds Landfill. This is discussed further in the Landfill Gas Risk Assessment (LFGRA) presented elsewhere in the Application.

3.7 Receptors and compliance points

Groundwater

The absence of a plausible and discernible watertable within the Oxford Clay underlying the site is such that a groundwater receptor does not exist in the immediate vicinity of the site.

Groundwater in the shallow alluvium aquifer associated with Thunder Brook is separated from the site by the railway. Hence whilst this may be deemed a receptor there is no plausible groundwater pathway from the existing site.

Secondary groundwater receptors are similarly absent due to the lack of a groundwater pathway.

Surface water

Potential surface water receptors include the unnamed tributaries of Thunder Brook located to the north and west of the site. However, the distance between these and the landfill area and the absence of a groundwater pathway render it unlikely that impact on these watercourses will occur due to continued operation of the landfill.

If leachate levels were to rise above original ground levels outbreaks through the cap could potentially occur and result in contamination of Stream 3 via overland flow. It is considered that the likelihood of occurrence of this is low, however Stream 3 could be deemed a potential receptor in this instance.

Compliance points

It is not appropriate to set compliance points for groundwater and surface waters at the site as currently likely receptors do not exist. The existing Permit does not include compliance limits for either surface water or groundwater quality.

4 POLLUTION CONTROL MEASURES

4.1 Site engineering

4.1.1 Basal and side slope engineering

The Oxford Clay forms an extensive natural geological barrier beneath Park Grounds Landfill, and is estimated to be a minimum of 80 m thick beneath the existing landfill. The clay was relied upon to provide leachate containment in Cells A to B, 1, 1A and 1B, although the surface of the clay was tracked over to enhance the protection it afforded. Subsequent cells all benefitted from an artificial sealing liner, constructed from re-worked Oxford Clay. In Cells 2 and 3 this liner was 300 mm thick and in all subsequent cells it is a minimum of 1 m thick. Side slopes of reworked Oxford Clay are also a minimum of 1 m thick.

Construction quality assurance (CQA) work has identified that permeabilities lower than 1×10^{-9} m/s are readily achieved using the local Oxford Clay. The proven range in Cell 7 was and 2.3 to 0.57×10^{-10} m/s, Cell 9 was 1 to 0.37×10^{-10} m/s and in Cell 10 was 2.7 to 8.7×10^{-10} m/s. The CQA report for the construction of Cell 9 also indicates that in Cell 7 the basal liner thickness was 1.2 m. Cells 9 and 10 had an average thickness of 1.5 m.

External sidewalls are constructed in 20 m lengths where the clay cut face is trimmed before re-laying excavated clay to provide completed internal 1:4 slopes. This finished slope angle results in a 7 to 8 m width at the base of the engineered side slope with a crest width of 1 m.

Internal sidewalls, against already filled areas are similarly trimmed and excavated clay re-laid adjacent to the in-situ cut face. Construction of Cell 10 is now complete and the CQA report is provided in *Appendix 2437/ESSD/A2*.

4.1.2 Leachate drainage

The base of each of the non-hazardous cells is graded to provide a fall to the leachate collection sump. In Cells 5, 6 and the asbestos cell, the leachate drainage is supplemented with a herringbone drainage system comprising high density polyethylene (HDPE) pipe with a coarse gravel surround.

From Cell 7 onwards a drainage layer of baled tyres has been placed in the base of each cell, together with herringbone HDPE pipes as above. The tyre bales are placed on top of a geotextile layer to distribute the weight of the baled tyre and prevent damage of the mineral clay liner. HDPE 180 mm diameter slotted drainage pipe is placed between the baled tyres to direct leachate to the leachate sump at the lowest point on the base of the

cell. The pipework is then surrounded with aggregate and this is also used to infill any gaps between the baled tyres.

The drainage layer is completed with a geogrid to separate the waste from the drainage layer.

4.1.3 Cap

Cell caps are constructed using Oxford Clay engineered to provide a minimum 1 m thick layer with a maximum permeability of 1 x 10^{-9} m/s (more usually 10^{-10} m/s). Cells 8 onwards benefit from a 2 m thick mineral cap. A drainage layer for surface water is not provided as the slope of the cap is designed to encourage run-off.

Currently Cell 9 is not capped as waste placement is on-going and further waste will be placed in the cell to bring elevations up to the newly agreed restoration profile.

4.2 Restoration

The land surrounding the site falls to a low of 80 mAOD in the northwest and 83 mAOD in the southwest. The restored site will form an elongate domed structure with a roughly east-west axis. The centre of the site will have a maximum elevation of 99 mAOD. The contours reduce towards the site boundary where they tie in with pre-existing ground elevations.

The waste types to be used in the landfill are unchanged from those allowed by the existing Permit. The proposed rates of infilling are to increase as below:

2437/ESSD/T5: Proposed rates of infilling		
	Existing permitted (tonnes/annum)	Proposed (tonnes/per annum)
Inert	6,000	20,000
Non-hazardous	17,000	60,000

Soils will be replaced as closely to the original profile as possible. A depth of 250 mm of topsoil and 750 mm of subsoil will be achieved with stripped soils from storage, with any shortfall made up by importing local soils. The land will be put down to grass, either rye or ryegrass/clover mix.

The site will be returned to agriculture following completion of landfilling.

4.3 Surface water management

Run-off from the site is largely radial from the centre.

From the eastern, inert part of the site, run-off drains to Stream 1 as discussed above.

From the central, inert part of the site, run-off drains either northwards to the pond adjacent to the site offices or southwards to a perimeter ditch on the southern boundary of the site.

Run-off from the main body of the non-hazardous landfill is described in the Flood Risk Assessment[4] accompanying the 2017 Planning Application. This area drains to a perimeter drain that will direct run-off to a balancing pond to be located west of the landfill, which will limit discharge to the local natural surface water system to pre-existing greenfield run-off rates. The location of the proposed ponds and perimeter drains are shown on *Drawing 2437/ESSD/D6*.

The ditches to the south of the site, adjacent to the railway, are in place. The northern ditch and balancing pond to the west are still to be constructed.

4.4 Post-closure controls (aftercare)

4.4.1 Procedures for closure

The low permeability engineered capping layer, will be protected through the placement of subsoil and topsoils. Once soils have been placed they will be seeded with a grass mix and returned to agriculture.

Site information will be maintained in accordance with the requirements of the Environmental Permit. This will include maintenance of a site office and existing fencing and gates. Landfill gas and leachate monitoring wells will continue to be sampled and will be regularly inspected for defects. Any repairs needed will be carried out within two weeks of being identified to maintain their integrity. Leachate and landfill gas will continue to be managed to ensure compliance with the Environmental Permit until such time as the landfill no longer poses a threat to the environment. The infrastructure to enable this will be regularly inspected and maintained as necessary to prevent defects/blockages.

Drainage ditches and surface water attenuation lagoons will be regularly inspected and repairs/desilting will be undertaken as necessary.

In addition, the site will be surveyed annually to permit assessment of settlement rates.

Annual reports of the monitoring results and topographical survey will be prepared and submitted to the Environment Agency in the January of each year.

4 Abington Consulting Engineers. Flood Risk Assessment for Proposed Non-Hazardous Waste Landfill Site at Park Grounds Farm, Wootton Bassett, Wiltshire. March 2017 Revision

Permit surrender will be acceptable when it can be demonstrated that the site no longer presents a hazard to the environment and there are no longer "any unacceptable releases" from the site. This condition will occur when active management of leachate and landfill gas is no longer required and conditions in the waste body have stabilised.

Due to the site setting and general absence of groundwater surrounding the site, it is likely that permit surrender will be governed by the cessation of landfill gas production within the waste body.

DRAWINGS

APPENDIX 2437/ESSD/A1

Leachate monitoring data

APPENDIX 2437/ESSD/A2

CQA report for Cell 10

APPENDIX 2437/ESSD/A3

BGS borehole logs

APPENDIX 2437/ESSD/A4

Surface water quality monitoring data