GP PLANNING LTD
ENVIRONMENTAL CONSULTANTS

SITE CONDITION REPORT

APPLICATION FOR AN ENVIRONMENTAL PERMIT FOR INERT LANDFILL TO RESTORE A SAND AND GRAVEL QUARRY

WILLOW HALL FARM, THORNEY, PETERBOROUGH, PE6 OQN

TAG INDUSTRIES LTD

April 2015
Version 1
Draft

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Registered in England Number 6019666
Registered Office Mill House, Long Lane, East Haddon, Northamptonshire, NN6 8DU

Name of installation **Willow Hall Quarry and Landfill**

1 Location of installation

Installation address: **WILLOW HALL FARM, THORNEY, PETERBOROUGH, PE6 OQN**
National Grid reference **TF 24940 01968**

Supporting Information

- Plan showing location of installation **– GPP-TI-WHF-15-01**
- Plan showing installation boundary – **GPP-TI-WHF-15-08**

2 Condition of land at permit issue

Environmental Setting including

- Geology: **As set out in the HRA and SRA**
- Hydrology: **As described in the HRA**
- Surface waters: **As described in the HRA**

Pollution history including

- Pollution incidents that may have affected the land: **The land has historically been used for agriculture, there are no known pollution incidents**
- Historical land-uses and associated contaminants: **see above**
- Any visual/olfactory evidence of existing contamination: **there is no visual or olfactory evidence of contamination at the site.**
- Evidence of damage to pollution prevention measures; **there are no pollution prevention measures at the site.**

Evidence of historic contamination; **there is no evidence of historic contamination**. **Prior to the use of the site as a quarry, the land was fields.**

Baseline reference data: **None.**

Supporting information

- source information identifying environmental setting and pollution incidents
- Historical Ordnance Survey plans
- Site reconnaissance
- Historical investigation/assessment/remediation/verification reports
- Baseline reference data.

3. Permitted activities

Permitted activities: **Inert landfill**.
Non-permitted activities undertaken at the installation: **None**

Dangerous substances used and produced by the permitted activities; **None.**

Supporting Information

- Plan showing installation layout – **WHF_MRQD_D8 General Quarry Layout and development plan 04042012**
- List of substances used/produced - **As specified in the existing Permit**

Hydrogeological Risk Assessment report

Willow Hall Farm

Report reference: 1941/HRA
Version 2
July 2015

Report prepared for:

TAG Industries Ltd
Saxon Brickworks
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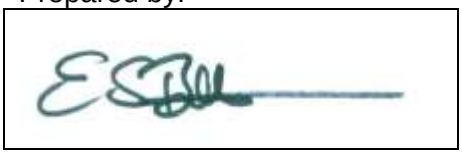
Prepared by:



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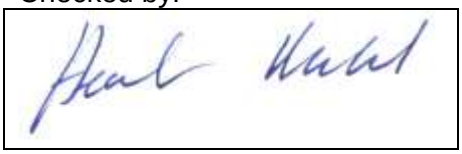

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CONTENTS

TABLES

DRAWINGS

Drawings referenced from ESID report:

APPENDICES

1 INTRODUCTION

1.1 Report context

Willow Hall Farm is located near Eye in Cambridgeshire and is an active sand and gravel quarry. Planning Permission for mineral extraction and restoration with inert waste was obtained in January 2013 and the site became operational in August 2014. The extraction site is operated by PJ Thory Ltd and the restoration will be carried out by TAG Industries Ltd.

Progressive restoration of the site will be undertaken via importation of inert waste. Under the Environmental Permitting Regulations (EPR) (2010) a permit is required for the landfilling of the site. No other landfilling has occurred at the site historically although extensive landfilling has occurred in land to the west.

Background and baseline conditions for the site are set out within the Environmental Setting and Installation Design (ESID) Report (1941/ESID, March 2015). The baseline conditions have been used to derive a conceptual model for the proposed Installation in terms of source, pathways and receptors and this has been used for the Hydrogeological Risk Assessment (HRA).

Mineral extraction and landfilling will be undertaken within the permit boundary, as indicated on drawing ***Appendix 1941/ESID/A1***. This EPR Permit Application seeks authorisation for the operation of the site as a landfill for inert wastes.

A summary of the prior investigations undertaken at the site is provided in Table 1941/HRA/T1 below.

Investigation/analysis	Date
Installation of six piezometers	March 2011
Small scale in-situ permeability tests	March 2011
Groundwater level monitoring	July to November 2011 and February and March 2015
Groundwater quality monitoring	March 2011, February and March 2015

Table 1941/HRA/T1: Details of relevant prior investigations

This report sets out the Hydrogeological Risk Assessment (HRA) that has been prepared in support of the Environmental Permit Application for the proposed inert landfill. The HRA has been prepared with due regard to the hydrogeological risk assessment guidance (Environment Agency, 2010a) and template (Environment Agency, 2010b) provided by the Environment Agency. The proposed site design and its setting are provided within the ESID, which should be read in conjunction with this report.

1.2 Conceptual hydrogeological site model

The conceptual hydrogeological model for the proposed waste operation is described in Sections 3.5 and 3.7 of the ESID report and illustrated on ***Drawing 1941/ESID/10***.

The site will receive strictly inert waste which complies with the Landfill Directive description. This will be ensured by the application of strict waste acceptance procedures and appropriately trained staff.

The stratigraphic sequence of the solid geology, taken from BGS Sheet 158, is given below.

Outcrops of the solid geology are predominantly in the west of the region, in the vicinity of Peterborough. All solid strata were deposited in a marine environment and are primarily represented by thick mudstones (Oxford Clay) over thin, often complex, sequences of limestones, mudstones and sands.

Period	Formation	Thickness (m)
Jurassic	Corallian	30
	Oxford Clay	63-73
	Kellaways Sand	1.9-4.6
	Kellaways Clay	1.4-5.8
	Cornbrash	1.2-4.3
	Blisworth Limestone	1.9-5.1
	Upper Estuarine Series	6-14
	Upper and Lower Lincolnshire Limestone	0-25

Table 1941/HRA/T2: Stratigraphic sequence

The site is located within the Oxford Clay Formation, which dips gently eastward. The outcrop extends westwards 2.5 km to Peterborough and 14 km eastwards to Rings End. This is overlain by superficial deposits comprising Alluvium, peat and Terrace deposits, which are associated with the River Nene. The latter forms the economic mineral at site.

Mineral thickness increases northwards across the site from 0.8 m to between 6 and 7 m. The thickness of Oxford Clay has been estimated from drilling at Eye Landfill, located immediately northwest of the site, at approximately 12 m thick. Drilling by CEMEX indicates the thickness of Oxford Clay west of the Cats Water Drain varies from 7 to 13 m.

Groundwater levels are located within the superficial deposit at between 1.2 to 2.4 mAOD, therefore dewatering will be undertaken to allow efficient mineral extraction.

The superficial deposits are designated a Secondary 'A' aquifer by the Environment Agency and the Oxford Clay as non-productive strata.

Due to its hydraulic properties and thickness, the Oxford Clay will provide a suitable geological barrier for the base of the void as the expected permeability is in the region of 1×10^{-10} m/s. It is proposed to create side wall barriers also using the Oxford Clay. These will be a minimum thickness of 1 m placed to achieve a minimum permeability of 1×10^{-7} m/s (more likely also in the order of 1×10^{-9} or 10^{-10} m/s).

Identified receptors and pathways are summarised in Table 1941/HIA/T3 below.

Hazard	The proposed waste at the site will be inert in nature (see Section 2.2.1 of the ESID report) therefore it is considered that the site poses minimal potential hazard to nearby surface and groundwaters. The rate of landfilling is anticipated to be in the order of 700 tonnes/ day.
Source	All waste to be deposited will adhere to Waste Acceptance Procedures which shall ensure the waste is correctly characterised and inert in accordance with Environment Agency guidance (November 2010).

Source cont	It is therefore considered highly unlikely that rainfall incident to the waste will incorporate within it measurable concentrations of pollutants as it percolates through the waste. No Hazardous substances are expected to be present and Non-hazardous pollutants, if present within the leachate, will be of low concentration such that pollution of nearby groundwater and surface water will not occur.
Potential primary pathway	Migration through the sides of the landfill towards the groundwater within the superficial deposits may occur. To provide a suitable attenuation layer, an artificial geological barrier will be placed on the sidewalls of the landfill. The presence of Oxford Clay beneath site limits any potential pathway to deeper aquifers.
Potential secondary pathway	The Cats Water Drain is in hydraulic continuity with the groundwater within the superficial deposit. Therefore potential exists for any pollutants in groundwater to reach surface water by groundwater flow.
Potential primary receptor	The site is located within a Secondary 'A' Aquifer, therefore for: Hazardous substances – groundwater in the superficial deposits adjacent to the site is the primary receptor. Non-hazardous pollutants – groundwater within the superficial deposits surrounding the site boundary forms the receptor.
Potential secondary receptor	Surface water in the Cats Water Drain, located adjacent to the western boundary of the site, forms the secondary receptor.
Compliance point	For Hazardous substances – groundwater immediately adjacent to the Installation. For Non-hazardous pollutants – surface water at the western boundary of the landfill.

Table 1941/HRA/T3: Summary of conceptual hydrogeological model

2 HYDROGEOLOGICAL RISK ASSESSMENT

2.1 Nature of the Hydrogeological Risk Assessment

Environment Agency guidance proposes a tiered approach to risk assessment such that the degree of effort and complexity reflects the potential risk posed by a particular site or situation, the sensitivity of the site setting and the degree of uncertainty and likelihood of the risk being realised. To meet the requirements a robust conceptual model for the site has been set out and basic risk screening undertaken. The conceptual model is set out in the ESID report and the risk screening is summarised in Section 2.2 below. The risk screening exercise is used to determine whether a landfill development represents, or potentially represents, a risk to groundwater or surface water resources.

In accordance with the Environment Agency H1 technical annex (2010a), guidance suggests that no further risk assessment is required for inert landfill sites. However, due to the setting of the site within a Secondary 'A' Aquifer, the potential risk due to accidental acceptance of contaminated material (rogue load) is also provided below (Section 2.6).

2.2 Risk screening

2.2.1 Compliance with Groundwater (England and Wales) Regulations (2009)

Based upon the waste types to be accepted at the site it is considered that the quantity and concentration of Hazardous substances or Non-hazardous pollutants within any leachate (defined here as water coming into contact with the waste) are "likely to be very small indeed and likely to be similarly stringent to Drinking Water Standards"[1], hence the site falls outside the scope of the Groundwater (England and Wales) Regulations (2009).

2.2.2 Collection of leachate

As the waste to be accepted at the site will be inert, in accordance with Environment Agency guidance, it is considered that there is no requirement to collect and manage leachate. Therefore there is no requirement for leachate drainage layers or an artificial sealing liner, however a geological barrier will be provided.

2.2.3 Geological barrier

The geological barrier is required to provide sufficient attenuation between the landfill source and any potential groundwater receptor in order to ensure compliance with the Groundwater Directive. As the site will accept only inert waste the geological barrier need only be nominal to ensure compliance.

The site is partially sub-watertable, situated within Terrace sand and gravel deposits. Hence Oxford Clay will provide a 'natural' geological barrier for the base only.

An artificial geological barrier comprising re-worked Oxford Clay will therefore be constructed on the sides of the landfill. The barrier will be constructed to achieve a permeability equivalent to a barrier with a minimum thickness of 1 m and maximum permeability of 1×10^{-7} m/s, however this will more likely be 1×10^{-9} or 10^{-10} m/s.

2.2.4 Landfill location

The proposed landfill is located within the superficial deposits, a Secondary 'A' Aquifer with Oxford Clay underlying this and forming the base of the extraction void. The superficial deposits are in hydraulic continuity with local watercourses, the closest being the Cats Water Drain

1 Quote from paragraph 12 of the statutory "Guidance on the Groundwater Regulations, 1998", DETR, 2001.

located immediately to the west of the site boundary. The proposed site does not fall within a Source Protection Zone (SPZ). The closest total catchment is 10 km west-northwest.

Three groundwater abstractions are located within a 3 km radius of the Application Area. They are listed below in Table 1941/HRA/T4.

Licence N^{o}	Location	Licensed volume (m^3/yr)	Use	Distance and direction from Application boundary
5/32/11/*G/0011	Willow Hall Farm	25,000	SI (Apr-Sep)	0.1 km E
5/32/11/*G/0091	Flagg Fen Farm	50,000	SI	2.3 km SW
AN/032/0011/001	Catchpit, Pode Hole Quarry	1,314,750	MW	1.3 km NE
		7,000	GPW	
		1,000	DS	
KEY: SI = spray irrigation, MW = mineral washing, GPW = general process & washing, DS = dust suppression				

Table 1941/HRA/T4: Details of licensed groundwater abstractions

The closest abstraction to the site is at Willow Hall Farm. However, this was not in use at the time of the site visit (14th February 2011) and is understood to have been disused for some years. The borehole has now been concreted over and is no longer connected to a power supply.

The abstraction at Pode Hole Quarry, northeast of the site, is from the superficial sand and gravel aquifer.

The Flagg Fen Farm abstraction is located west of Cats Water Drain and derives water from the Northampton Sand aquifer, which is located at depth below the Oxford Clay and other strata. Due to its depth and the presence of intervening Oxford Clay this abstraction is not considered to be at risk from the proposed development.

Peterborough City Council has confirmed that there are no unlicensed abstractions within a 3 km radius of the site.

Although the site setting could be deemed highly sensitive as a result of it being sub-watertable within a Secondary 'A' Aquifer, the nature of the waste stream is such that the location complies with the Environment Agency position statement[2] on landfill location.

2.3 Proposed assessment scenarios

2.3.1 Lifecycle phases

Environment Agency guidance states that a Hydrogeological Risk Assessment must be carried out for the whole lifecycle of the landfill, ie from the start of the operational phase until the point at which the landfill is no longer capable of posing an unacceptable environmental risk.

As the site receives inert waste a quantitative Hydrogeological Risk Assessment of the intended operational and post-closure phases of the landfill is not deemed necessary under the current guidance.

2 Landfill Directive Regulatory Guidance Note 3 (v4, December 2002). Groundwater Protection: Locational aspects of landfills in Planning Consultation responses and permitting decisions.

2.3.2 Failure scenarios and accidents

Failure scenarios

There are no engineering management structures at the site to prevent the ingress of groundwater or the egress of leachate. This is due to the inert nature of the proposed waste stream. Failure of such systems is, therefore, not possible hence failure scenarios will not be considered.

Accidents

Accidents are considered to be unintentional incidents that could reasonably occur, which are unforeseeable at their time of occurrence. An assessment of the potential impacts of accidents, together with the likelihood of their occurrence and magnitude of the consequences (in relation to compliance with the Groundwater (England and Wales) Regulations (2009)) are presented below.

Accidents at the site could include the acceptance of contaminated material. Due to the proposed Waste Acceptance Procedures and absence of any historical waste on-site it is considered highly unlikely that 'rogue loads' will be or have been accidentally accepted at the site. However, an assessment of the potential impacts due to 'rogue loads' is considered in Section 2.6 of this report.

2.4 Review of technical precautions

Due to the inert nature of the waste it is considered that the proposed essential and technical precautions detailed below are appropriate and sufficient to prevent any unacceptable discharge from the site:

- Strict control of waste types sourced and accepted
- Strict adherence to compliance criteria and testing
- Removal of standing water in areas to be landfilled prior to commencement of waste disposal
- Provision of a geological barrier in compliance with the Landfill Directive
- Progressive restoration to a mounded profile to encourage surface water run-off and minimise water ingress
- Provision of ditches or berms, where required, to minimise surface water ingress to the landfill area
- Monitoring of down-gradient water quality

It is considered that leachate monitoring and management is not required due to the inert nature of the waste.

Details of the Waste Acceptance Procedures and criteria are contained in the Site Management Plan.

2.5 Emissions to groundwater

One of the main purposes of the HRA is to establish whether the predicted discharge from the landfill complies with the requirements of the Groundwater (England and Wales) Regulations (2009).

2.5.1 Hazardous substances

The HRA must demonstrate that the proposed technical precautions will prevent Hazardous substances from entering groundwater. Consequently it must consider whether there is likely to be a discernible discharge of Hazardous substances to groundwater. The compliance point is therefore the watertable prior to any dilution occurring.

Given the strictly inert nature of the waste and the presence of a geological barrier, and the other technical precautions in place, it is concluded that during normal operation and through to long-term post-closure there will be no discernible discharge of Hazardous substances into the groundwater.

2.5.2 Non-hazardous Pollutants

The HRA must demonstrate that technical precautions will limit the introduction of Non-hazardous pollutants into groundwater so as to avoid pollution. Consequently it must consider whether predicted concentrations of Non-hazardous pollutants are likely to exceed relevant standards and other environmental quality criteria, or cause an unacceptable deterioration in groundwater quality following dilution.

Given the inert nature of the waste, the presence of a geological barrier, and the other technical precautions in place, it is concluded that during normal operation and through to long-term post-closure concentrations of Non-hazardous pollutants would be sufficiently low as to avoid pollution of the groundwater.

2.6 Rogue load assessment

The waste acceptance criteria applied at the site make the deposition of rogue loads unlikely and the potential risk to groundwater minimal.

2.6.1 Environmentally Acceptable Levels

Environmentally Acceptable Levels (EALs)[3] are used to determine the sensitivity of the groundwater near a landfill and are a measure against which the results of models can be compared. EALs have been determined on the basis of available water quality standards for the parameters below and the recorded background groundwater concentrations.

Hazardous substances

The Groundwater (England and Wales) Regulations (2009) requires there to be no discernible discharge of Hazardous substances to groundwater. Therefore, the appropriate EAL would be the concentration at which they become 'discernible'. Cadmium was chosen as a representative Hazardous metal and benzene was chosen to represent a Hazardous hydrocarbon. Background concentrations and relevant quality standards are presented in Table 1941/HRA/T5 together with the derived EAL.

Substance	UK Drinking Water Standard	Fresh Water EQS[1]	Maximum background concentration[2]	Minimum reporting value	Resultant EAL
Cadmium	5 µg/l	5 µg/l	<0.1 µg/l	1 µg/l[3]	1 µg/l
Benzene	1 µg/l	30 µg/l	<7 µg/l	7 µg/l	1 µg/l

1 EQS = Environmental Quality Standard
2 Based on 95%ile
3 Lower detection limit for groundwater at site

Table 1941/HRA/T5: Derivation of EALs for Hazardous substances

Non-hazardous pollutants

The Groundwater Directive requires there to be no groundwater pollution caused as a result of discharges of Non-hazardous pollutants. The appropriate EAL is therefore deemed to be the most stringent relevant quality standard, except where background concentrations exceed those

3 Termed Environmental Assessment Levels in the Environment Agency HRA Guidance (H1-Technical Annex to Annex(j))

standards. The relevant standards, together with background monitoring data, are provided in Table 1941/HRA/T6. Ammoniacal nitrogen has been chosen as it frequently occurs where biodegradable matter has been incorporated within the waste mass, and chloride as a conservative, non-reactive parameter.

Substance	UK Drinking Water Standard	Fresh Water EQS[1]	Maximum background concentration	Resultant EAL
Nitrate	50 mg/l	-		
Ammoniacal nitrogen	0.39 mg/l	0.015 mg/l	0.47[2]	0.47
Chloride	250 mg/l	250 mg/l	58.2[3]	59

1 EQS = Environmental Quality Standard
2 March BH/03 2015
3 Maximum chloride concentration P11/05 (March 2011)

Table 1941/HRA/T6: Provisional quality standards and background levels for Non-hazardous pollutants

Chloride concentrations in Cats Water Drain are higher than the background groundwater concentrations at the site and this is probably due to influence from the adjacent landfill to the west. Evidence indicates that as chloride concentrations at Willow Hall increase towards Cats Water Drain may also be impacted (refer to ESID, Section 3.5.4). It is likely that more water will be drawn from Cats Water Drain during dewatering, therefore higher chloride may be experienced resulting in higher concentrations than current site background. Whilst chloride has been used in the rogue load modelling as a conservative determinand for the above reason Control Levels and Compliance limits have not been set.

2.6.2 Justification for modelling approach and software

The 'rogue load' assessment has been undertaken using ESI's Risk Assessment Model (RAM) in order to determine the maximum concentration of the above determinands that could be accepted at the site, assuming conservative hydraulic properties, before a breach of the UK Drinking Water Standards (DWS) occurs. The RAM model was used as this can be used to represent sub-watertable conditions.

2.6.3 Model parameterisation

The parameters used in the RAM 'rogue load' assessment are described together with justification for their use within the RAM model and on Table 1941/HRA/T7. A printout of the RAM model is provided as ***Appendix 1941/HRA/A1*** along with a CD version. Parameter values were determined from information directly measured on-site or, in the absence of site data, other recognized sources. The results of the assessment are discussed below.

Parameter	Value/distribution	Justification
SOURCE TERM		
Waste volume (m^3)	200	Assuming rogue load of dimensions 2 m x 10 m x 10 m
GENERAL CONTAMINANT INFORMATION		
Free water diffusion coefficient: Chloride Ammoniacal nitrogen Cadmium Benzene	 2.03×10^{-9} 1.96×10^{-9} 7.17×10^{-9} 7×10^{-10}	Environment Agency, 2004, contaminant fluxes from hydraulic containment landfills – a review (SC0310/SR)

Parameter	Value/distribution	Justification
HYDROGEOLOGICAL UNITS		
Thickness (m): Artificial geological barrier Saturated sand and gravel	 0.5 m 2.4 m	 As per design Approximate thickness based on borehole logs and observed groundwater levels
Hydraulic conductivity (m/s): Artificial geological barrier Sand and gravel	 1 x 10^{-10} m/s 47 m/d	 Assumed likely achievable value From field tests
Hydraulic gradient: Artificial clay barrier Saturated sand and gravel	 1 1.56 x 10^{-3}	 Assumed vertical Average gradient based on monitoring results (Drawing 1941/ESID/09)
Porosity: Artificial geological barrier Sand and gravel	 0.46 0.27	
Tortuosity	5	Assumed generic value for all hydrogeological layers
Horizontal travel distance in sand and gravel (m)	300	Approximate distance from centre of site to the closest part of western boundary, ie the compliance point
ATTENUATION PARAMETERS		
Dispersivity	Unit thickness/10	Standard assumption
Mixing depth in saturated sand and gravel	2.4 m	Assumed (average saturated thickness)
Bulk density (kg/m^3): Artificial clay barrier Sand and gravel	 1900 2400	Estimate
Fraction of organic carbon Artificial geological barrier Sand and gravel	 0.0053 0.04	
<u>Ammoniacal Nitrogen</u> Partition coefficient (k_d) (L/kg) Artificial geological barrier Sand and gravel	 0.1 0.4	 Environment Agency, 2003, Review of ammonium attenuation in soils and groundwater. Average of range given.
Half life (days) Artificial geological barrier Sand and gravel	 No decay No decay	Environment Agency, 2003, Review of ammonium attenuation in soils and groundwater.
<u>Cadmium</u> Partition coefficient (k_d) (L/kg) Artificial geological barrier Sand and gravel	 120 120	 Environment Agency, 2000, CEC and k_d determination in landfill performance evaluation, conservative values used
<u>Chloride</u> Partition coefficient (k_d) (L/kg) Half life (days)	 0 No decay	
<u>Benzene</u> Partition coefficient (k_d) (L/kg) Half life (days)	 0 365	 Environment Agency, 2003 Sensitivity analysis for the remedial targets workshop V2.29, mean value

Parameter	Value/distribution	Justification
WATER BALANCE		
Precipitation (mm/yr) Effective Precipitation (mm/yr)	544 142	Thorney North House 5.5 km ENE Area 19, MAFF Technical Bulletin 34

Table 1941/HRA/T7: Model input parameters

2.6.4 Results of rogue load risk assessment

As discussed above although the site will receive only inert waste (as defined in the Landfill Regulations, 2002) it is appropriate to assess the potential impact of a 'rogue load' of non-inert material being deposited on-site. It has been assumed that the rogue load is equivalent to a 2 m thick, 10 m by 10 m area within the waste mass. This approach has been used previously by Hafren Water for other inert sites.

The results of the rogue load assessment are provided in Table 1941/HRA/T8 below.

Determinand	Standard	Maximum permitted leachate concentration in rogue load assuming compliance at the appropriate boundary for Hazardous substances and Non-hazardous pollutants
Hazardous: Cadmium Benzene	 EAL EAL	 40 mg/l 90 mg/l
Non-hazardous: Ammoniacal Nitrogen Chloride	 EAL Not set	 1800 mg/l Not set

Table 1941/HRA/T8: Results of rogue load assessment

The results (***Appendix 1941/HRA/A1***) indicate that significant concentrations of cadmium, benzene and ammoniacal nitrogen could be accidentally accepted at the site without breach of the appropriate EAL (assuming a contaminated load of 2 m x 10 m x 10 m) either in the groundwater beneath the site or at the site boundary.

2.6.5 Surface water management

The proposed waste facility is not located in an area that is liable to flood.

Surface water management bunds and ditches will be constructed as necessary to direct surface water run-off away from the active landfill area during its operational phase.

Post-operation, the restoration profile is such that surface water run-off will run-off to the west and that which does not infiltrate will collect in one of two waterbodies in the west of the site. A high level outfall from the southern waterbody to the Cats Water Drain will be constructed to allow overflow.

2.7 Hydrogeological completion criteria

Hydrogeological completion criteria refer to the conditions that must be met before an Environmental Permit can be surrendered, ie Permit Completion attained. Completion relating to hydrogeological risk will have been achieved when there is no longer any unacceptable risk of pollution from the landfill, ie the site complies with the Groundwater (England and Wales) Regulations (2009) without any active leachate management. It is suggested that assessment of completion should be with reference to the recommended EALs.

As the site is inert and unacceptable discharge is unlikely, it is considered that hydrogeological completion criteria will not be the controlling factor in the ultimate surrender of the Environmental Permit. In fact guidance issued by the Environment Agency[4] states that for inert waste landfills permitted under the Landfill Directive "you should be able, through waste records, to demonstrate that the waste accepted was genuinely inert", and this could form the basis for Permit Surrender.

4 Environment Agency, September 2010, The surrender of permits for the permanent deposits of waste

3 REQUISITE SURVEILLANCE

3.1 Risk-based monitoring scheme

Under the Groundwater (England and Wales) Regulations (2009), there is a requirement for 'requisite surveillance' in the form of leachate, groundwater and surface water monitoring.

Environmental monitoring is a crucial element of the risk assessment process as it:

- Allows for validation of the risk assessment
- Can confirm whether risk management options are meeting their aims
- Provides a warning mechanism if adverse impacts are found

Control levels and compliance limits form the basis for assessing groundwater monitoring data at landfill sites.

Control levels are specific assessment criteria relating to groundwater, or other relevant parameters, that are used to determine whether a landfill is performing as designed. They act primarily as an early warning system to enable appropriate investigative or control measures to be implemented.

Compliance limits are specific compliance concentrations (or regulatory standards) and are specified in an Environmental Permit. If the defined compliance limits are exceeded significant adverse environmental effects and/or breaches of regulatory standards will have occurred. Such effects are deemed consistent with groundwater having been polluted.

3.1.1 Leachate monitoring

There is no requirement for collection and management of leachate, hence leachate monitoring is not proposed.

3.1.2 Surface water monitoring

It is proposed that surface water monitoring is undertaken at the following locations:

Sample point reference	Location	Description
SW1	Quarry discharge	At the discharge from the settlement lagoons
SW2	Cats Water Drain	Up-stream of the site
SW3	Cats Water Drain	Down-gradient of groundwater flow and downstream of site

Table 1941/HRA/T9: Surface water monitoring points

The locations of the surface water monitoring points are shown on ***Drawing 1941/HRA/01***. It is proposed that surface water is monitored initially on a quarterly basis and that the frequency is reviewed after collection of 12 months data.

Measurements

All surface water samples should be analysed for the following analytical suites:

Frequency	Analytical suite
Quarterly	pH, conductivity, ammoniacal nitrogen, chloride, sulphate, Biochemical Oxygen Demand, Chemical Oxygen Demand, Total Organic Carbon, Total Organic Nitrogen
Annually	As quarterly suite plus alkalinity, sodium, magnesium, potassium, lead, copper, zinc, chromium, iron, manganese, cadmium, nickel, polyaromatic hydrocarbons, total petroleum hydrocarbons, BTEX

Table 1941/HRA/T10: Surface water analytical suites

3.1.3 Groundwater monitoring

It is proposed that groundwater quality and level is monitored on a quarterly basis in boreholes BH11/01, BH11/05 and BH11/06 down-gradient and BHP11/02 up-gradient of the site. The locations of the groundwater monitoring boreholes are shown on ***Drawing 1941/HRA/01***.

Measurements

The following analytical suites are proposed for groundwater samples.

Frequency	Analytical suite
Quarterly	pH, conductivity, ammoniacal nitrogen, chloride, Sulphate, Biochemical Oxygen Demand, Chemical Oxygen Demand, Total Organic Carbon, Total Organic Nitrogen
Annually	As quarterly suite and alkalinity, sodium, magnesium, potassium, lead, copper, zinc, chromium, iron, manganese, cadmium, nickel, polyaromatic hydrocarbons, total petroleum hydrocarbons, BTEX

Table 1941/HRA/T11: Groundwater monitoring schedule

3.1.4 Compliance limits and control levels

The following are deemed preliminary surface water and groundwater control levels and compliance limits. It is proposed that these are reviewed after monitoring data have been collected for a further 12 months.

Compliance point	Parameter	Derived control level	Derived compliance limit
Groundwater down-gradient monitoring boreholes BH11/05 and BH11/06	Groundwater Quality:		
	Cadmium (Hazardous)	None set	1 µg/l[1]
	Benzene (Hazardous)	None set	1 µg/l[1]
	Ammoniacal Nitrogen (Non-hazardous)	<0.5 mg/l[2]	1 mg/l

1 Based on EAL
2 Based on maximum background concentrations

Table 1941/HRA/T12: Surface water and groundwater control levels and compliance limits

Compliance limits and control levels for non- hazardous pollutants will be deemed to have been breached if the three point rolling average, relative to a particular compliance limit or control level, demonstrates a rising trend. Monitoring data will be compared against these levels each time they are collected.

If such a breach is observed, as described above, the actions listed on Table 1941/HRA/T13 will be taken.

Contingency action	Following breach in	
	Control level	Compliance limit
Advise site management	√	√
Advise manager of landfill operating company	√	√
Advise Environment Agency	√	√
Confirm by repeat sampling and analysis	√	√
Review existing monitoring information	√	√
Review site management and operation and implement actions to prevent future failure	√	
Determine degree of risk presented by breach	√	√
Review HRA control levels and compliance limits	√	√
Agree any corrective/remedial action with Environment Agency		√

Table 1941/HRA/T13: Contingency actions following breach in control levels or compliance limits

4 CONCLUSIONS

4.1 Compliance with the Landfill Regulations, 2002

It is considered that the artificial geological barrier constructed on the sides to provide a maximum permeability of 1 m at 1 x 10^{-7} m/s, or equivalent, is such that the Landfill Regulation requirement for a geological barrier will be met. There is no requirement for an artificial sealing liner or leachate management system due to the inert nature of the waste. **It is therefore considered that the landfill is compliant with the requirements of the Landfill Regulations 2002**.

4.2 Compliance with the Groundwater (England and Wales) Regulations (2009)

The risk assessment has demonstrated that under normal operational and post-operational phases of landfilling Hazardous substances will not be present in groundwater beneath the site in concentrations discernible above background and Non-hazardous pollutants will not be present in concentrations such that pollution of nearby groundwater is caused. **It is considered therefore that the site will be compliant with respect to the Groundwater (England and Wales) Regulations (2009).**

5 REFERENCES

Environment Agency, April 2010 (a). H1 – Technical Annex to Annex (j): Hydrogeological Risk Assessments for landfills and the derivation of Groundwater Control and Compliance levels.

Environment Agency, March 2010 (b). Environmental Permitting (England and Wales) Regulations Information in support of an application for a landfill permit – Hydrogeological Risk Assessment Report.

Environment Agency, November 2010. Waste acceptance at landfills: Guidance on waste acceptance procedures and criteria.

Environment Agency. Environmental Permitting Regulations: Inert Waste Guidance. Standards and measures for the deposit of Inert waste on land.

Hafren Water, November 2011. Conceptual Model, Environmental Setting and Installation Design report. Willow Hall Farm. Report reference: WHF/ESID/v1.

DRAWINGS

APPENDIX 1941/HRA/A1

Spreadsheet printout from rogue load assessment