Energy from Waste Incinerator (EFW) including Infrastructure plus that for Combined Heat and Power (CHP), Incinerator Bottom Ash (IBA) Processing Plant with Outside Storage Area, and Air Pollution Control Residue (APCR) Treatment and Disposal Facility , Visitor & Office Accommodation and Landscaping within the Sutton Courtenay Resource Recovery Park

Sutton Courtenay Resource Recovery Park, Oxfordshire.

Waste Recycling Group Limited

Chapter 11
Geology Hydrogeology and Land Contamination

RPS

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11 Geology, Hydrogeology and Land Contamination

11.1 Introduction

11.1.1 This chapter assesses the likely significant effects on geology, hydrogeology and land contamination associated with the proposed development of an Energy from Waste Incinerator (EFW) including Infrastructure for Combined Heat and Power (CHP), Incinerator Bottom Ash (IBA) Processing Plant with Outside Storage Area, and Air Pollution Control Residue (APCR) Treatment and Disposal Facility , Visitor & Office Accommodation and Landscaping ' the Scheme' within the Sutton Courtenay Resource Recovery Park, Oxfordshire. The assessment is based on a detailed baseline description of the local geology, hydrology and hydrogeology. In addition the Chapter includes a geotechnical assessment for foundations at the site as well as a review of potential contamination issues relating to both human health and controlled waters.

11.1.2 The Scheme lies within the 264 ha Sutton Courtenay Landfill complex of landfill operations, unrestored mineral voids, restored mineral voids and ancillary land.

11.1.3 The Scheme is in two parts. A 'Main Area' of restored fill to the south of Portway Road and east of Corridor Road amounting to 39 ha which is to be developed as an EfW plant and associated infrastructure. A second area of c. 16 ha is presently a water filled lagoon and is located to the west of Corridor Road within the north of the complex. The second area is to be developed as a containment landfill for the disposal of air pollution control residues (APCR) from the EfW plant. Full details of the proposed development are presented in Chapter 4.

11.2 Methodology

11.2.1 The methodology followed in this assessment is that of a qualitative risk assessment which assesses the probability of an impact occurring together with its magnitude. The risk assessment process identifies aspects of the project where mitigation measures are required and the nature of the mitigation measures appropriate to the project, in particular any mitigation measures over and above those integrated into the development design.

11.2.2 The assessment of risk is undertaken in accordance with Table 11.1.

Table 11.1: Assessment of significance

Neutral	No significant effects
Minor	Not noteworthy or material – impacts are of low magnitude and frequency and will not exceed relevant quality standards, residual effects will be negligible
Moderate	Noteworthy, material – impacts are of moderate magnitude and frequency. Relevant quality standards may be exceeded to limited extent. Possible secondary impacts, residual effects will be minimal.
Major	Impacts are likely to be of a high magnitude and frequency with quality standards being exceeded, at times considerably. There may be secondary impacts of some magnitude; residual effects will be of some significance.
Substantial	Impacts will be of a consistently high magnitude and frequency with Standards exceeded by a significant margin. Secondary impacts also likely to have a high magnitude and frequency. Significant residual effects.

Desk Study

11.2.3 A baseline data collection and review has been undertaken which included the following;

- historical maps, aerial photographs and Envirocheck data for the study area;
- geology, hydrogeology and groundwater vulnerability maps;
- available exploratory hole records;
- statutory designations such as SSSIs and SACs; and
- previous investigations pertaining to the application site.

Fieldwork

11.2.4 Intrusive ground contamination investigations have not been commissioned at this stage.

11.3 Legislation and Planning Context

11.3.1 A detailed review of the development plan documents and planning context in relation to the development proposals is provided in Chapter 3.

11.3.2 This section summarises those policies that are directly relevant to land contamination issues.

National Policy & Legislation

11.3.3 Contaminated land is addressed by the following National Policy and Legislation:

- Environmental Protection Act 1990 Part IIA. A regime for the identification and remediation of contaminated land implemented by the Local Authorities and the Environmental Agency and is subject to statutory guidance.
- Water Resources Act 1991. Section 85. Control of pollution of groundwater by land contamination through direct or indirect discharges. The Environment Agency will encourage effective remedial measures to prevent pollution.
- The Environmental Act (1995) provides clarification of the roles for assessment, enforcement and remediation of contaminated land using the regulations summarised above.
- Town and Country Planning Act 1991 Section 106. The Environment Agency will seek to ensure that Planning Permissions contain conditions designed to protect water resources through planning obligations with developers and local authorities for the identification and remediation of contaminated land.
- Planning Policy Statement 23 (PPS23) – Planning and Pollution Control sets out the relationship between controls of development under planning law and pollution control legislation. It is relevant to industrial development and the redevelopment of contaminated land.
- CLR 11 – the Model Procedures for the Management of Land Contamination, CLR 11, have been developed to provide the technical framework for applying a risk management process when dealing with land affected by contamination. The process involves identifying, making decisions on, and taking appropriate action

to deal with land contamination in a way that is consistent with government policies and legislation within the UK.

- Landfill (England and Wales) Regulations 2002.
- Landfill (England and Wales)(Amendment) Regulations 2005.
- Environmental Permitting (England and Wales) Regulations 2007.

Regional Policy

The Draft South east Plan – A Clear vision for the South East (March 2006)

11.3.4 The key policy relevant to geology, hydrogeology and contaminated land is:

- Policy W15: Hazardous Waste.

Local Policy

The Oxfordshire Structure Plan, 2005

11.3.5 The key policy relevant to geology, hydrogeology and contaminated land is:

- Policy EN7: Geology.

The Oxfordshire minerals and waste Local Plan, 1996 to 2006

11.3.6 The key policies relevant to geology, hydrogeology and contaminated land are:

- Policy SD1: Sand and Gravel Land banks;
- Policy SD5: Clay extraction;
- Policy SD10: Mineral Safeguarding;
- Policy W3: Recycling Proposals;
- Policy W7: Landfill;
- Policy PE4: Groundwater;

The Vale of White Horse Local Plan

11.3.7 The key policies relevant to geology, hydrogeology and land contamination are:

- Policy DC9: The Impact of Development on neighbouring Uses;
- Policy DC12: Water Quality and Resources.

Relevant Guidance

11.3.8 As a matter of best practice, this assessment has been undertaken based on the relevant guidance on geology, hydrogeology and land contamination assessment. This includes:

- CLAN 02/05 Soil Guideline Values and the Determination of Land as Contaminated Land under Part IIA, Defra/LEQ (2005).
- BS5930: 1999 Code of Practice for site investigations.
- BS10175: 2001 Investigation of potentially contaminated sites. Code of practice.
- Environmental Impact Assessment, A Guide to Procedures, DETR (2000).

11.3.9 As detailed in Chapter 1, a formal scoping exercise has been undertaken to inform the scope of the Environmental Assessment. The formal Scoping response is included at Appendix 1.2. The exercise highlighted the following issues relevant to geology, hydrogeology and contaminated land impacts:

- Impacts on local watercourses springs and groundwater flow.
- Land contamination and risk of mobilising contamination from former uses of the site
- Potential effects of piling

These issues are addressed in this Chapter.

Cumulative Impacts

11.3.10 A review of proposed or possible future third party projects that may have a cumulative impact with the development proposals has been undertaken and used to inform this Environmental Statement. Projects identified are summarised in Chapter 1.

11.3.11 In relation to geology, hydrogeology and land contamination impacts, no developments have been identified as having the potential to impact cumulatively with the proposal.

11.4 Baseline Conditions

Main Site History

11.4.1 Between c.1883 and 1932 the site and immediate surroundings generally comprised agricultural fields with a single residence on the northern boundary of the application site subsequently modified in layout and labelled as Radcot Farm. The villages of Sutton Courtenay and Appleford are approximately 1.5km to the northwest and 600m northeast respectively.

11.4.2 By 1960 an Ordnance Depot was located approximately 500m south of the application site. By 1975 this area is occupied by Didcot Power station. The 1975 Ordnance Survey (OS) map shows much of the application site together with areas to the north and limited area to the south, as sand and gravel pits. A refuse tip is shown towards the centre of the application site on its northern boundary. By 1999 the site and areas to the north, west and south form the Sutton Courtenay landfill complex. The 2007 OS map and aerial photograph show an attenuation pond occupying the eastern section of the application site.

11.4.3 Information provided within the Landmark Envirocheck Report and on the Environment Agency database indicates that there are a number of historical landfill entries within the application site boundary and in the locality as detailed in Table 11.2.

APCR Disposal Facility Site History

11.4.4 Between the 1883 1: 10,560 scale map (showing data originating around the 1840s) and 1960 1:10,000 scale map the site is shown as unenclosed agricultural land. A footpath between Sutton Courtenay and Appleford crosses the site from west to east. On the 1913-1914 map there is a second track in the south of the site extending west from Appleford.

11.4.5 On the northern boundary of the site is an area of marshland 170m long and 20m wide orientated east-west. On the later mapping and certainly by 1972 this former marshland is

shown as non- coniferous woodland and scrub. On the 1972 mapping the majority of the site has been enclosed and a drain runs alongside the footpath through the site.

11.4.6 The southern boundary of site and the land to the south is occupied by unenclosed agricultural land from 1883 through 1960 until, on the 1972 map the area to the immediate south is shown as flooded sand and gravel workings with a much larger area of workings to the east and a smaller area to the immediate south west. The southern half of the site itself is occupied by minerals processing plant.

11.4.7 Between 1999 and 2008 map editions most of the minerals processing plant has been removed (apart from an area in the southwest corner of site and the majority of the site is shown as a gravel pit. On the 2008 sheet an area to the immediate east of the site is shown as mineral workings occupied by ponds.

11.4.8 There is no indication on any of the historical mapping sheets that the area immediately north of the landfill was worked for minerals and then restored. This conflicts with the published BGS geological mapping, which shows the area to have been worked for minerals.

11.4.9 Information provided within the Landmark Envirocheck Report and on the Environment Agency database indicates that there are a number of historical landfill entries in the locality as detailed in Table 11.2.

Table 11.2: Landfill sites within the application site

Licence Holder / Name	**Specified Waste**	**Licence Status**	**Date**
Historical Landfill Sites			
ARC Ltd Radcot Farm	Inert, industrial, commercial and household waste and liquid sludge	NA	1976
Name	**Specified Waste**	**Licence Status**	
Local Authority Recorded Landfill Sites			
Radcot Farm	Not supplied	Unknown	Unknown
Registered Landfill Sites			
ARC Southern Ltd	Pulverised Fuel Ash	Not active	1982

11.4.10 Information obtained from the reports submitted in support of the 2003 PPC permit application for Sutton Courtenay landfill (CL Associates Refs 1, 2, 3 and 4) Indicate that there are several restored landfill areas in the vicinity of the application site:

- '90 Acres': Located approximately 200m north of the main site. Household and inert wastes and pulverised fuel ash were deposited between 1977 and 1982 to a maximum depth of 6m. The clay base of the gravel pit and PFA side wall bunds were not engineered to any identified specification.

- '6 Acres': Located immediately adjacent to the southern boundary of the main site. Approximately 200,000 m^3 of household waste and PFA were deposited to a

maximum depth of 18m between 1986 and 1987. The clay base and clay sidewalls were not engineered to any identified specification.

- '12 Acres': Located immediately adjacent to the western boundary of the main site. It was constructed as a non-engineered cell resting on in situ low permeability clays and was filled with domestic waste to a maximum depth of approximately 8 – 9 m in 1981/1982. The landfill was capped in 1994.

Regional Geology

11.4.11 The British Geological Survey (BGS) mapping of the area indicates that drift deposits of Head and Alluvium overlie Quaternary Terrace sand and gravels in places. The sands and gravels are underlain by Gault Clay that dips to the south at 1º to 2º and appears to rest unconformably on the Lower Greensand Formation, except where it oversteps on to the Kimmeridge Clay. The regional stratigraphy is summarised in Table 11.3.

Table 11.3: Regional Stratigraphic Sequence

Age	Unit	Typical thickness (m)	Description
Quaternary	Head	0-?	Gravelly Loams
Quaternary	Alluvium	0 -2	Humic clays and silts with rare thin beds of peat and iron cemented gravels at the base. (Drift)
Quaternary	First Terrace Deposits (Northmoor Member)	3 – 5	River gravels containing a mixture of Jurassic limestone, ironstones and flints with minor proportions of erratic pebbles and sand matrix. (Drift)
Upper Cretaceous	Upper Greensand	0-18	Sandy silts with siltstone bands
Upper Cretaceous	Gault Clay	12 –25	This formation is grey silty clay with a basal bed containing nodules locally. The silty mudstones weather to a dark bluish grey clay developing to grey and buff marls on the upward passage.
Lower Cretaceous	Lower Greensand	Variable 0 – 10	Greenish brown coarse grained ferruginous quartzose sands that weather reddish brown and contain small quartzite pebbles. Mixed sands gravels and clays.
Jurassic	Kimmeridge Clay	30+	Dark bluish brown silty mudstones with cementstones containing septarian nodules of earthy limestone.

Local Geology

11.4.12 Any Head and Alluvium present over the site is likely to have been removed from areas of sand / gravel extraction together with the terrace gravels.

11.4.13 The Upper Greensand is seen some 1500m to the south of the site but is not present in the immediate vicinity.

11.4.14 The base of the Gault Clay and hence its maximum thickness is not proved in the available borehole records for the Sutton Courtenay complex but its recorded thickness is in excess of 13 m in eight boreholes. In addition the BGS 1: 10,560 geology sheet SU59 SW records Gault in excess of 27m thick (base at 18.2 mAOD) for a borehole to the north between the site and the River Thames (NGR SU 5155 9455)

11.4.15 The Gault in the vicinity of site may be underlain by Lower Greensand as recorded on Geology Sheet SU59SW in a borehole 900m to the east of the proposed site (top of Greensand at 32.9 mAOD) and also 2000m to the south (top of Greensand at 11.4 mAOD). However, as reviewed above the available borehole records show there is a considerable thickness of low permeability Gault Clay confining any Greensand beneath the Sutton Courtenay complex.

11.4.16 At depth, the site may be underlain by Kimmeridge Clay and then by the Upper and Lower Corallian Limestone below around 13 mAOD, as seen in a borehole 140m NE at SU 950 526 on Geology Sheet SU59 SW.

11.4.17 Three boreholes (BH105, BH106 and BH107) were advanced by CL Associates within the main application site during 2003. The encountered ground conditions are summarised in Table 11.4.

Table 11.4: Site borehole information

Borehole	Depth (m)	Geology
BH105	GL – 3.7 3.7 – 5.5	Made Ground comprising very soft to soft grey slightly sandy silt with rare gravel. Probably pulverised fuel ash (PFA). Made Ground comprising very soft grey slightly sandy slightly gravely clay with plastic bags and wood fragments.
BH106	GL – 1.7 1.7 – 7.7	Made Ground comprising soft to firm grey slightly sandy clay. PFA? Made Ground comprising very soft to soft grey clay.
BH107	GL – 1.7 1.7 – 2.0	Made Ground comprising grey slightly sandy silt. Probably PFA. Stiff grey clay with rare shell fragments. Gault Clay.

Hydrogeology

11.4.18 The site is not situated in a designated groundwater Source Protection Zone

11.4.19 The Environment Agency Groundwater Vulnerability Sheet 38 (Upper Thames and Berkshire Downs) indicates that prior to mineral extraction the site was underlain by the minor aquifer of Quaternary deposits (sands and gravels). Table 11.5 details the aquifer characteristics of the underlying and adjacent strata.

Table 11.5: Aquifers beneath or adjacent to the site area

Formation	Aquifer Characteristics	EA Classification
First Terrace Deposits (Northmoor Member) (adjacent to the application site)	First terrace deposits are river gravels characterised by intergranular groundwater flow. Where there is significant silt/clay there is some potential for attenuation of pollution. Support locally important abstractions.	Minor Aquifer
Second Terrace Deposits (Not present beneath application site)	Second terrace deposits are river gravels characterised by intergranular groundwater flow. Where there is significant silt/clay there is some potential for attenuation of pollution. Support locally important abstractions.	Minor Aquifer
Gault Clay	Negligible permeability.	Non Aquifer

Lower Greensand	Flow within the Lower Greensand is intergranular and the potential for pollution attenuation is high. It supports locally important abstractions.	Minor Aquifer
Kimmeridge Clay	Negligible permeability.	Non Aquifer
Corallian Limestone	High fissure/fracture permeability that may be highly productive and can support large abstractions.	Major Aquifer

11.4.20 The application site is located on the Gault Clay. This is considered by the Environment Agency to be a non-aquifer.

11.4.21 The hydrogeology of the region can be divided into shallow groundwater of the Terrace deposits (Drift) and deep groundwater of the solid geology aquifers. The Terrace deposits support a number of licensed abstractions. However, of greater significance as a groundwater resource are the deeper Lower Greensand and the Corallian Limestone aquifers.

11.4.22 Two groundwater abstractions recorded within 1km of the application site relate to dust suppression, mineral washing and process water for quarry activities.

11.4.23 The sand and gravel aquifer is unconfined. According to the 2003 PPC permit application the groundwater table is 1 – 3 mbgl (metres below ground level) in this area.

11.4.24 The Lower Greensand has been encountered at depth in some but not all deep boreholes drilled at site. The Lower Greensand is a locally important aquifer at outcrop, but evidence suggests that, where the Lower Greensand is confined at depth below the Gault Clay, supplies are likely to be limited and of poor quality. Hydraulic continuity within the lower Greensand is not assumed as its nature and distribution within the Gault is not uniform within the region.

11.4.25 The Corallian Limestone is a regional aquifer of some importance and underlies the site at depth. It is overlain by up to 34 metres of low permeability Kimmeridge Clay and is known to be artesian at Sutton Courtenay. Due to the thickness of the Kimmeridge Clay between the site and the deep Corallian aquifer it is considered unlikely that there is hydraulic continuity between the shallow and deep aquifer units.

11.4.26 In the vicinity of the site the groundwater flow direction appears to be northeast towards the River Thames.

11.4.27 Groundwater quality within the sands and gravels has been monitored on site since 1995 within boreholes located up-gradient of the landfill site and in 2 boreholes down-gradient of the main application site. The following summary (Table 11.6) indicates conditions at the site as reported in the 2003 PPC permit application documents for Sutton Courtenay landfill (Ref. 1, 2, 3 and 4).

Table 11.6: Water quality data for the sands and gravels

Determinand	Unit	Minimum	Mean	Maximum
Ammoniacal Nitrogen	mg/l	0.04	2.12	15.1
Chloride	mg/l	11	75.22	337
Nickel	mg/l	0.007	0.021	0.126
Zinc	mg/l	0.005	0.64	0.212
pH		6.4	7.5	8.3

11.4.28 The results show that ammoniacal nitrogen is the only measured determinand present in concentrations above the relevant Drinking Water Standard (DWS). As the concentrations are elevated both up and down gradient of the application site, it is inferred that these levels of contamination are not caused by the landfill but are present as background concentrations in the groundwater, most likely from an agricultural source.

11.4.29 The DWS for chloride is 250 mg/l which has not been exceeded in any borehole on any monitoring occasions since 1995 except one occasion in March 1998 where the chloride concentrations in GW7 (borehole located on the southern boundary of Phase 4) peaked at 337 mg/l. The average chloride concentration for GW7 is elevated at 177 mg/l.

11.4.30 There are no groundwater monitoring boreholes located within suitable proximity of the APCR Disposal Facility area.

Hydrology

11.4.31 The application site is located within the low-lying Thames Valley on the south bank of the River Thames. The scarp formed by the Upper Greensand defines the valley edge to the south. The River Thames passes by the site to the north and there are three smaller watercourses in the vicinity off site, namely Mill Brook to the west, Moor Ditch to the east which both flow north-eastwards to the River Thames, and Hobbyhorse Ditch which flows northwards to the River Thames.

11.4.32 The Sutton Courtenay complex is located in relatively flat land with a network of man-made and natural watercourses and water bodies of varying sizes, some of which bound the application site. These ultimately flow to the River Thames located approximately 1.5km north. Drainage is to the north and northeast, with the scarp to the south defining the catchment boundary for the application site.

11.4.33 The Environment Agency flood risk maps confirm that the main application site does not lie within the indicative flood plain. However, the southeast edge of the APCR Disposal Facility lies within Zone 2.

11.4.34 There are no licensed surface water or groundwater abstractions within 1km of the application site.

11.4.35 The Environment Agency has indicated that there is one discharge consent within the application site and a further three within 250m shown in Table 11.7 below.

Table 11.7: Discharge consents

Operator	Nature of Discharge	Receiving Water	Distance and Direction from Site	Comment
Waste Recycling Group Ltd	Trade discharge – mineral workings	Tributary of Moor Ditch	0m	Revoked and replaced by IPC authorisation
Thames Water Utilities Ltd	Sewage discharge	Moor Ditch	42m, E	Temporary consent
Hanson Quarry Products Europe Ltd	Trade discharge – mineral workings	Tributary of River Thames	104m, NW	Authorisation revoked
Waste Recycling Group Ltd	Mine / groundwater	Tributary of River Thames	186m, W	Revoked and replaced by IPC authorisation

11.4.36 Water quality details of the surface watercourses in the vicinity of the application site are listed in Table 11.8 as obtained from the Environment Agency website.

Table 11.8: Surface water quality

River name	River stretch name	Report year	River quality target	Compliance with target	Biological Grade	Chemistry Grade
Moor Ditch	Didcot Sewage Treatment Works to Thames	2006	5	Compliant	C	B
Moor Ditch	Didcot Sewage Treatment Works to Thames	2005	5	Compliant	-	B
Moor Ditch	Didcot Sewage Treatment Works to Thames	2004	5	Compliant	-	B
Ginge Brook	Lydebank Brook to Odhay Hill Ditches	2006	2	Compliant	B	B
Ginge Brook	Lydebank Brook to Odhay Hill Ditches	2005	2	Compliant	-	B
Ginge Brook	Lydebank Brook to Odhay Hill Ditches	2004	2	Compliant	-	A
Moor Ditch	Milton Hill to Didcot Sewage Treatment Works	2006	3	Compliant	D	B
Moor Ditch	Milton Hill to Didcot Sewage Treatment Works	2005	3	Compliant	-	B
Moor Ditch	Milton Hill to Didcot Sewage Treatment Works	2004	3	Compliant	-	B
River Thames	Ock to Sutton Bridge Culham	2006	2	Compliant	B	A
River Thames	Ock to Sutton Bridge Culham	2005	2	Compliant	-	B
River Thames	Ock to Sutton Bridge Culham	2004	2	Compliant	-	B
Ginge Brook	Odhay Hill Ditches to Thames	2006	3	Compliant	-	B
Ginge Brook	Odhay Hill Ditches to Thames	2005	3	Compliant	-	B
Ginge Brook	Odhay Hill Ditches to Thames	2004	3	Compliant	-	B

11.4.37 Surface water quality in the watercourses around the application site is considered to be very good to fair. Those locations close to sewage treatment facilities are of a poorer quality than the other monitoring locations.

Current usage of the site and landfill complex

11.4.38 The Sutton Courtenay landfill site is an operational quarry owned by WRG and leased to Hanson for the extraction of sand and gravel. The resulting void is being restored by WRG through landfilling of household, general and industrial wastes. An application for a PPC permit for the Sutton Courtenay landfill site was submitted to the EA in September 2003 and a permit was issued by the EA on 22nd September 2004. The site is operated on a phased basis and comprises of 3 phases (Phases 2A, 2B and 4). The site currently accepts non hazardous waste.

11.4.39 The main application site is currently restored with PFA which gently rises to an elevation of around 59m AOD, beyond which lies a large mineral void known as "Phase 4" which is proposed to be infilled with 3,900,120 tonnes of non hazardous waste. This will involve the extraction and relocation of the waste contained within the historical 6 acre site defined above. The artificial sealing liner for Phase 4 is to be engineered over the Gault Clay complying with the requirements of the Landfill Regulations 2002. The Phase 4 landfill cells will be engineered to include basal and sidewall clay lining, capping and leachate drainage and collection system.

11.4.40 A restoration pond is located to the east of the main application site. A gas utilisation plant compound is located in the northwestern corner of the site. The compound comprises two buildings, the first housing six gas engines and associated flares and the second housing three, with planning consent for a further three engines as gas production increases. To the east of this area is a storage tank for leachate from the landfill. Leachate is currently tankered from the site but proposals are being considered for the construction of a treatment facility with the ability to discharge to sewer.

11.4.41 It is understood that the main application site has undergone an engineered over tip of waste onto the existing landfilled PFA to raise the level for the current restoration profile. It is understood that a 1 m thick clay liner was placed over the existing PFA prior to the engineered over tip of waste.

11.4.42 To the west of Corridor Road lies a recently laid concrete pad for the windrowing of green waste, an aggregate processing plant and two unrestored mineral voids. To the west of these areas lie mineral working backfilled with PFA, fully restored and returned to agricultural or recreational use. South of these areas lies the active landfill operational areas known as Phase 2.

11.4.43 Dewatering at the Sutton Courtenay complex has been in operation since sand and gravel extraction began, to prevent flooding of the extraction area and aid the development of the landfill. The volume of groundwater removed is limited by consented discharge to surface water. Sand and gravel is extracted down to the level of the Gault Clay. The Gault Clay is then extracted down to a minimum level of 35 m AOD, agreed with the planning authority. The clay is either used as an engineering material for the development of the landfill or exported.

11.4.44 The Sutton Courtenay landfill produces landfill gas which is extracted and utilised by the on site gas extraction/utilisation system.

Sensitive Land Uses

11.4.45 There is one Site of Special Scientific Interest namely Little Wittenham located approximately 4.6km east of the site. The SSSI comprises a mix of wet woodland, ponds, small springs (flushes), scrub and undisturbed grassland.

Limitations

11.4.46 Intrusive investigations have not been undertaken over the areas affected by the proposed development for the purposes of establishing site soil contaminant concentrations or installing gas monitoring wells. Therefore there is the possibility of unidentified contamination being encountered. Mitigation measures are identified for such circumstances.

11.5 Incorporated Enhancement and Mitigation

Water use re-use and disposal

11.5.1 Clean water from the roofs of buildings and hardstandings will be directed to attenuation storage in soakaways, eventually percolating to groundwater.

11.5.2 Mains (public) water will be supplied for boiler supply and top up, amenities, cleaning, and distribution in the fire-fighting network. Raw water will be treated (demineralised) prior to being used in the boiler. The steam system comprising the boiler, turbine, condensers and associated pipe work will be a closed system which will require topping up only for relatively small losses. It is estimated that water usage for the EfW facility will amount to approximately 20,000 m^3 per year. There will not, therefore, be a significant continuous demand for water.

11.5.3 Foul water from welfare facilities (e.g., toilets, mess rooms) will be discharged to the public sewer.

11.5.4 Clean water from the roofs of buildings and hardstandings will be directed to attenuation storage in soakaways, eventually percolating to the groundwater.

11.5.5 Waste water from boiler blow-down and the demineralisation process will be utilised to quench bottom ash. There will be no water discharge from the ash quench because water will either be absorbed by the ash or evaporated. Water from infrequent extended periods of boiler blow down will be directed to the foul sewer via a settlement tank.

11.5.6 Any drainage or spillage from the waste bunker, lime silo and fly-ash silo will be separately contained in bunded areas for treatment and re-use or disposal to sewer in accordance with the discharge consent.

11.5.7 Any effluent discharge to sewer will meet the discharge consent limits set by the local water authority and any other appropriate requirements of the Environment Agency. Sampling, as appropriate, will be undertaken in accordance with the conditions of the consent.

11.6 Identification and Evaluation of Key Impacts

Construction Phase

11.6.1 All construction works have some potential effects relevant to this assessment:

- Exposure of construction and site workers to existing contamination present within soils;
- Mobilisation of any existing contaminants and leachate into groundwater or surface water;
- Creation of new areas of contamination through spillage and leaks;
- Creation of dust and silt from ground disturbance;

- Generation of potentially contaminated spoil;
- Instability during earthworks

Existing Contamination

11.6.2 Much of the main application site is known to have been restored with PFA. No soil chemical results have been obtained for this material. However, PFA has the potential to create leachate which is likely to contain soluble substances as well as heavy metals including arsenic, boron, cadmium, chromium, molybdenum, nickel, lead, selenium, vanadium and zinc. Part of the site was also subject to historical landfilling (indicated to comprise inert, industrial, commercial, household waste and liquid sludge) and more recently an engineered over tip of non-hazardous waste for restoration purposes. During construction, workers at the site could be exposed to contaminants contained within the waste material through ingestion, dermal contact or inhalation of volatiles or dust particles. This impact is considered **neutral** with the use of appropriate engineering controls, PPE and good hygiene.

11.6.3 The proposed APCR Disposal Facility is presently a worked out gravel quarry with no evidence of waste deposition. The impact of an introduction of APCR into an engineered containment landfill is considered **neutral** with the use of appropriate landfill design, engineering controls and operational and managed phase management.

Dust and Silt

11.6.4 Dust and silt can result from ground disturbance during construction. This can lead to the potential exposure of site workers to dust particles. In some cases, generation of dust and silt may also lead to deposition on nearby surface waters. This impact is assessed as **minor** with incorporation of good construction site management practices, such as damping down, covering of stockpiles and use of wheel washes to ensure that the potential effects associated with airborne dust are minimised.

11.6.5 Dust is not considered a significant pathway for the transmission of contaminants to deep groundwater given the considerable thickness of low permeability clay below both the main and APCR Disposal Facility areas. However, there is the potential for migration of fugitive dust (fine particulate solid materials) into the shallow aquifer via rainfall infiltration and down washing. Appropriate engineering controls will be utilised.

11.6.6 Silt may potentially migrate into the shallow aquifer as reviewed above. However, the impact is considered to be **minor** with the use of appropriate engineering controls.

Effects on Shallow Groundwater

11.6.7 Construction activities can result in the mobilisation of contaminants within the soil and the provision of a pathway for contaminants to migrate to underlying deep groundwater and adjacent shallow groundwater.

11.6.8 Ground conditions encountered in the main area of landfilling activities indicate the removal of the permeable Terrace sand and gravel deposits and restoration by landfill. The fill at the site has been restored with a low permeability 1 m thick clay cap. This low permeability material will reduce infiltration to the site and impede the mobilisation of contaminants to the in situ shallow aquifer.

11.6.9 Leachate levels will be maintained below the base of the shallow groundwater during the management control period. There is the potential for the raising of leachate levels in the landfilled wastes through any construction loading. However, leachate levels at the site will continue to be controlled by the Environmental Permit by way of leachate abstraction wells. This impact is considered minor with the implementation of controls as required by the Environmental Permit.

11.6.10 Any dewatering required during the construction of the engineered containment for the APCR Disposal Facility will result in localised lowering of the shallow groundwater table. However, groundwater levels will be restored on completion of the landfill.

Effects on Surface Water

11.6.11 Construction activities can result in the mobilisation of contaminants within the ground and in stockpiles and provide a pathway for contaminants to migrate to surface water ditches surrounding the site. This impact is assessed as minor given the incorporation of good construction site management practices such as creating buffer zones alongside surface water ditches.

Effects on Deep Aquifers

11.6.12 The deep Corallian aquifer is separated from the fill by low permeability Gault and Kimmeridge Clays. The confined pressure exerted therefore would prevent downward migration of contaminants by advection. The impact to deeper groundwater is considered neutral.

11.6.13 The driving of piles and/or deep excavation can create pathways through otherwise impermeable barriers allowing run off from contaminated soils to reach groundwater. The significant thickness of Gault and Kimmeridge Clay minimises any hydrogeological risk to any Lower Greensand unit or the Corallian Limestone aquifer. Therefore, the impact is considered minor with appropriate engineering controls.

Creation of New Contamination

11.6.14 During construction works there is some potential for accidental spillage of contaminating materials. The main source is considered to be from construction plant and materials stored on site. The magnitude of the effect on the land / shallow groundwater due to accidental spillage of contaminating materials is dependant upon the nature, frequency and size of the spillage. However, with appropriate management, this impact is assessed as minor.

11.6.15 The development of the APCR Disposal facility will create a new source of potential contamination. However, the APCR will be disposed to an engineered containment system of a high standard sufficient to obtain an Environmental Permit, and consequently will not pose a risk to the environment.

Spoil Generation and Management

11.6.16 Spoil will be generated through excavation of the bunker and any potential areas of cut on site. In the event that construction activities are undertaken in areas of contamination, a management strategy will be in place to ensure that the risks associated within its mobilisation are minimised. Any material generated that is identified as contaminated would, if deemed unsuitable for re-use, require disposal to an appropriately licensed landfill facility. In addition there is potential for the generation of leachate from any residual emplaced wastes through loading. The impact is assessed as neutral given suitable arrangements for stockpiling of material.

Instability

11.6.17 Additional Gault Clay may be extracted during the construction of the bunker and during construction of the APCR Disposal Facility, leading to a reduced thickness of the confining unit above more permeable deep aquifer units. However, sufficient standoff will be made to minimise the risk of basal heave.

11.6.18 Dewatering of the lagoon in the main area of site could potentially result in excess pore water pressures to develop in underlying granular layers.

11.6.19 It is considered that there is negligible potential for cavities to exist beneath the site. The Gault Clay and the underlying Kimmeridge Clay would not be anticipated to contain natural cavities. The Kimmeridge Clay is underlain by a layer of Corallian Limestone which potentially contains cavities. The Corallian Limestone is predicted to be greater than 40 m depth beneath the base of the landfill and due to the depth to the Corallian Limestone it is considered there is a low risk from subsidence or collapse.

11.6.20 Excavations made in the Gault Clay are likely to be stable during temporary works with suitable normal practise engineering solutions.

11.6.21 The impact is assessed as neutral with regard to potential instability during construction.

Operational Phase

Existing Contamination

11.6.22 The identified sources of contamination on site are primarily associated with past landfilling of the site. This may give rise to elevated contaminant concentrations whereby end users of the site may be exposed through incidental soil ingestion, dermal contact and inhalation of volatiles or dust particles. In addition landfill gas may be generated from the waste materials on site which has the potential to accumulate within the proposed buildings. It is understood that a clay capping layer has been placed over the PFA which will provide a barrier between end users of the site and potential contaminants below and impede the flow of landfill gas. However, it is unclear as to how far this capping layer extends across the whole of the application site. The impact from existing contamination is assessed as **neutral** given the recommended incorporation of gas protection measures within the development buildings (Table 11.9).

11.6.23 The impact associated with lateral migration of landfill gas from current landfilling operations is assessed as **neutral,** as an active landfill gas extraction system is installed within Sutton Courtenay landfill which comprises landfill gas extraction wells and associated pipe work with all landfill gas extracted from the waste cells and pumped to the landfill gas utilisation plant.

New Contamination

11.6.24 The proposed Energy from Waste Facility would have the potential to generate contaminated run-off from hardstandings areas, mobilisation of contaminants from stockpiled materials and escape of leachate from imported waste material which would have the potential to impact upon surface waters. The measures that would be taken to manage this pollution hazard would be specified in the Environmental Permit for these facilities. Consequently the impact from these activities is assessed as **neutral**.

11.6.25 The present landfill site would continue to be subject to engineering and management controls to minimise the generation of leachate and to extract and treat leachate such that pollution does not occur. Under its Environmental Permit the site must comply with the Landfill Regulations 2002 and the Groundwater Regulations 1998. As surface water at site may be a pathway to shallow groundwater, the migration of contaminants from the landfill to surrounding surface water receptors is not allowed to pollute such watercourses. To demonstrate compliance with the Landfill and Groundwater Regulations a detailed Hydrogeological Risk Assessment was undertaken as part of the permit application and the grant of the permit shows that the EA is satisfied that the site is fully compliant with its permit conditions. This impact is assessed as **neutral.**

11.6.26 The proposed APCR Disposal Facility will require an Environmental Permit and will be subject to engineering and management controls to minimise the generation of leachate, and to extract and treat leachate such that pollution does not occur. Under the Environmental Permitting regime, the site must comply with the Landfill Regulations 2002 and the Groundwater Regulations 1998. In that surface water at site may be a pathway to shallow groundwater this means that the migration of contaminants from the landfill to

surrounding surface water receptors would not be allowed to pollute such watercourses. In order to demonstrate compliance with the Landfill and Groundwater Regulations a detailed Hydrogeological Risk Assessment will be undertaken as part of an Environmental Permit application. Once the permit is granted the site will fully comply with the Landfill and Groundwater Regulations. This impact is assessed as **neutral**.

Groundwater Resources

11.6.27 The proposed main site development will not involve any further alteration to the perched shallow aquifer and therefore the impact is assessed as **neutral.**

11.6.28 Localised dewatering of the shallow aquifer north of the APCR Disposal Facility is likely to occur during construction works. However, the groundwater levels will be restored once landfilling is complete. Therefore, the impact is assessed as **neutral.**

Geotechnical Considerations

11.6.29 There is potential for differential settlement should buildings be founded on waste materials, although limited settlement of the PFA is expected. The foundations of the buildings on site will be appropriately designed within specified tolerances. Foundation solutions will be identified following structure specific investigation and assessment. .Therefore the impact is assessed as **neutral**

11.7 Mitigation

11.7.1 During construction, the risk to construction workers exposed to contaminants through ingestion, dermal contact or inhalation of volatiles or dust particles would be controlled through appropriate hygiene practices, use of Personal Protective Equipment (PPE) such as face masks of the appropriate grade, staff training and occupational monitoring.

11.7.2 The potential for significant quantities of hazardous material to be generated during the construction phase would be managed through appropriate identification and segregation of any hotspots at source and pre treatment where appropriate.

11.7.3 The following measures would be adopted to reduce the risk and effect of accidental spills and leaks during construction:

- Regular servicing and inspection of vehicles used on site;
- The restriction of refuelling of vehicles to bunded areas underlain by hardstanding, or other low permeability materials; and
- Storage of potentially contaminating materials such as fuels in bunded areas with a minimum volume of 110% of the volume stored.

11.7.4 The following monitoring and consents would be adopted throughout the construction phase:

- A surface gas emissions monitoring programme;
- A water quality monitoring programme;
- A visual water quality monitoring programme;
- A visual dust monitoring programme;
- Licences, permits and approvals required for disposal of grey waters, waste disposal etc.

- Measures for the protection of watercourses in accordance with CIRIA document 'Control of Water Pollution from Construction Sites' and the Environment Agency PP5 Works in, Near or Liable to Affect Watercourses';

- Contingency measures in response to pollution incidents.

11.7.5 During operation the effect of accidental spillage of materials during the operation and maintenance of the facility would be reduced through appropriate storage and handling of materials in designated areas. In addition appropriate infrastructure and drainage systems would be implemented within the scheme design.

11.7.6 All waste received at the facility would be unloaded directly within the buildings and would not be stored outside thereby reducing the opportunity for the generation or release of leachate. However leachate may be present in waste delivered to site. The floors of the buildings would be constructed of reinforced concrete and would be positively drained. All drainage from within the buildings would be directed to a holding tank and disposed of via sewer. The drainage system would isolate liquids released by waste delivered to the site and would therefore provide adequate protection against pollution of the water environment.

11.7.7 No additional mitigation measures above those required above that would be adopted as standard practice during construction and operation phases and required as part of the Sutton Courtenay Environmental Permit have been identified.

Table 11.9: Summary of recommended additional mitigation measures

Phase	**Recommended Mitigation**
Operation	Gas protection measures to be incorporated within the building design. The level of protection will be determined through a gas risk assessment.

Follow Up

11.7.8 A Surface Water Management Plan, Groundwater Management System and Gas Management Plan are currently in operation within the Sutton Courtenay landfill complex required as part of the Environmental Permit. These would be modified to incorporate the proposed scheme. On completion this will require prior agreement with the Environment Agency prior to works commencing on site.

11.8 Residual Impact

11.8.1 No residual impacts relating to the geology, hydrogeology and land contamination of the site are expected with regard to the proposed scheme.

11.9 References

1. CL Associates, Sutton Courtenay Landfill Site Stability Risk Assessment, September 2003.
2. CL Associates, Sutton Courtenay Landfill Site Landfill Gas Risk Assessment, September 2003.
3. CL Associates, Sutton Courtenay Landfill Site Hydrogeological Risk Assessment, September 2003.
4. CL Associates, Environmental Setting and Installation Design Sutton Courtenay Landfill, September 2003.
5. SLR, Planning Application & Environmental Statement for Proposed Changes to the Approved Restoration Scheme Sutton Courtenay Landfill Site, Draft Ver. 01 October 2007 SLR Ref: 403-0197-00205/007