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ENVIRONMENTAL STATEMENT

CHAPTER 11

GROUND CONDITIONS AND THE WATER ENVIRONMENT

Viridor GRUNDON

11 Ground conditions and the water environment

Introduction

11.1 Ramboll was appointed to undertake the assessments of the potential for effects related to ground conditions and the water environment, including a flood risk assessment (FRA). The findings of the assessments are summarised in this chapter and the full reports are included as technical appendices G1 Ground conditions, G2 Water environment and G3 Flood Risk Assessment and Outline Surface Water Drainage Strategy.

11.2 The data sources and references used in the assessments are shown in Table 11.1.

British Geological Survey (BGS) Geological Survey Historical Borehole Logs
BGS (1996). England and Wales Sheet 317 & 322, Chichester and Bognor Solid and Drift Geology map, 1:50,000 series
Enzygo (2015) Geoenvironmental Report (Ref CRM.049.009.GE.R001A)
Enzygo (2018) Factual Report (Ref CRM.049.009.GE.R.002 A)
Fellows (2018). Detailed Unexploded Ordnance Risk Assessment, Ref 2078.
Golder Associates (2012) Former Tarmac Topblock Site, Ford, Arundel, West Sussex BN18 0HY Phase 1 Environmental Assessment (Ref 12514190632.500/B. O)
Historical aerial photographs viewed via Google Earth: https://www.google.co.uk/earth
Historical maps of Ford Aerodrome: http://www.abct.org.uk/airfields/airfield-finder/ford-yapton
Published literature and Ordnance Survey (OS) Maps dating from the 19th Century obtained as part of an Envirocheck report
https://magic.defra.gov.uk/MagicMap.aspx
http://environment.data.gov.uk/catchment-planning
https://flood-map-for-planning.service.gov.uk/

Table 11.1: References and data sources

Legislation and policy

Legislation

Ground conditions

11.3 Environmental risks are assessed in accordance with the Contaminated Land (England) Regulations 2006 (as amended), which consolidated previous regulations that addressed contaminated land, including Part IIA of the Environmental Protection Act (EPA) 1990 (as introduced by the Environment Act 1995). Part IIA defines contaminated land as:

> *"land which appears to the local authority in whose area it is situated to be in such a condition that, by reasons of substances in, on or under the land that significant harm is being caused, or there is a significant possibility of such harm being caused, or significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused."*

11.4 Part IIA of the EPA 1990 provides an overarching framework for the control of risks to the environment or human health from land contamination arising from historical or current application site uses. It outlines the responsibilities of local authorities to inspect and act based upon suitable risk assessment in

accordance with statutory guidance, with the exception of 'Special Sites' that are regulated by the Environment Agency (EA).

11.5 The Environmental Damage (Prevention and Remediation) (England) Regulations 2015 state that land contamination may be classed as environmental damage if it creates a significant risk of harm to human health or has serious adverse effects on the water environment or the biodiversity of protected species or habitats.

Water environment

11.6 The Water Framework Directive (2000/60/EC) was published in December 2000 and transposed into English law in December 2003 through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003, which were subsequently updated in 2015 and 2017. The intention of the directive is to provide a more holistic approach to protection of the water environment by addressing a wide range of aspects, including physio-chemical, chemical, hydromorphological and ecological.

11.7 The Groundwater Directive (2006/118/EC) established a framework to prevent the input of hazardous substances and manage the input of non-hazardous pollutants into groundwater. It was transposed into English law by the Groundwater (England and Wales) Regulations 2009, which were subsequently revoked by the Environmental Permitting (England and Wales) (Amendment) Regulations 2010 and onwards. The latter require an environmental permit or registered exemption to be obtained from the EA to discharge anything other than clean, uncontaminated water into inland freshwaters, groundwater, estuaries and coastal waters.

11.8 The Environmental Quality Standards Directive (2008/105/EC, as amended by 2013/39/EU) sets out standards for certain priority and priority hazardous substances considered to be of concern, with the aim of reducing or phasing out their presence in the water environment. The directive was transposed into English law by the Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations 2015.

National policy

Ground conditions

11.9 For sites under redevelopment through the planning system, property developers are required to ensure that developed land is suitable for its intended use. The National Planning Policy Framework (NPPF 2019) states that the planning system should contribute to and enhance the natural and local environment by protecting and enhancing geological conservation interests and soils. Furthermore, it should prevent both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution.

11.10 The NPPF stipulates that land contamination is a material consideration for planning consent and that permitted developments should ensure that:

- The site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation
- After remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990
- Adequate site investigation information, prepared by a competent person, is presented

Water environment and flood risk

The Environment Agency's Approach to Groundwater Protection, February 2018

11.11 This document details how the EA delivers government policy for groundwater. It sets out the approach to managing and protecting groundwater together with the EA's position statements that support government policy. The document provides the framework that EA staff use when making decisions regarding planning, permitting and advice for current or proposed activities that may have an impact on, or are affected by groundwater.

11.12 Government policy on flood risk and the water environment is set out in the NPPF and the National Planning Practice Guidance: Flood Risk and Coastal Change (updated 2016). The latter contains advice to planning authorities and developers about flood risk and the role played by the EA in advising on planning applications in possible flood risk areas. It recommends that a risk-based approach should be applied to assess the risk of all forms of flooding to and from development, taking climate change into account. It also contains guidelines for carrying out a flood risk assessment (FRA).

Local policy

Ground conditions

11.13 Policy ERA 5 (Air, Soil and Water) of the West Sussex Structure Plan 2001 – 2016 states that local plans will include policies to protect the quality and where appropriate, quantity of air, soil and water resources and prevent development which may be detrimental to the management and protection of such resources. The policy is yet to be replaced and therefore still in use.

11.14 Policy QE DM4 of the adopted Arun Local Plan 2011 – 2031 states that the Council will require evidence to show that unacceptable risk from contamination will be successfully addressed through remediation without undue environmental impact during and following a development. It states that the developer shall carry out investigation and risk assessment to determine if the land is already affected by contamination, whether the development will create new linkages to vulnerable resources, and what action is needed to break the link between contaminants and vulnerable resources. Where an agreed remediation scheme includes future monitoring and maintenance, arrangements need to be made to ensure that the cost of ongoing maintenance are the responsibility of the

landowner and that subsequent owners are fully aware of the requirements and responsibilities associated with the land.

Water environment and flood risk

11.15 Policy W DM 1 (Water supply and quality) of the adopted Arun Local Plan 2011 – 2031 states that to ensure good water quality in the district, all major developments must illustrate, where necessary, how they have contributed to the protection and enhancement of waterbodies identified by the South East River Basin Management Plan objectives. The development must illustrate that where it will materially increase foul and/or surface water discharges, adequate drainage capacity exists or can be provided. Where adequate capacity does not exist, there will be a requirement that facilities are adequately upgraded prior to the completion and occupation of the development.

Guidance

11.16 The EA's Land Contamination Risk Management Framework (LCRM) provides the technical framework for structured decision making about contaminated land.

Methodology

Ground conditions

Levels of assessment

11.17 The principle of risk assessment underlies the determination of whether land is contaminated. The risk assessment includes the development of a conceptual site model, which describes the types and locations of contamination source(s), potential receptor(s) and potential migration / transportation pathway(s) that may link the identified source(s) to the identified receptor(s). The methodology is endorsed in relevant technical guidance. A tiered approach to risk assessment is outlined as follows:

- Tier 1 preliminary risk assessment – a qualitative assessment informed by a phase 1 study comprising a desk study and walkover
- Tier 2 generic risk assessment – a quantitative assessment of site-specific data by comparison to generic assessment criteria informed by a phase 2 study comprising intrusive investigations and laboratory testing
- Tier 3 detailed quantitative risk assessment – a quantitative risk assessment by comparison to site-specific assessment criteria

11.18 The guidance for the assessment methodology advocates that each tier of assessment should be undertaken in a stepwise approach until the level of risk posed by the site is fully understood and deemed to be acceptable. Therefore, if a tier 1 assessment concludes that the risks associated with the site are acceptable, no further assessment is required. Similarly, where unacceptable risks can be ruled out by a tier 2 assessment, then there is no need for a tier 3 assessment.

Baseline

11.19 In order to establish the existing baseline condition of the site and its surrounds, a Geoenvironmental Desk Study, Water Quality Technical Appendix and Flood Risk Assessment were undertaken. A full list of the references and data sources used in the baseline study is set out in table 11.1.

Assessment of risk

11.20 A qualitative risk assessment was undertaken using the following three stages:

- Hazard identification and assessment: development of a source-pathway-receptor conceptual site model and identification of potential pollutant linkages
- Risk estimation: a qualitative risk estimation predicting the magnitude and probability of potential consequences that may arise as a result of a hazard
- Risk evaluation: deciding whether a risk is unacceptable

11.21 The contamination assessment focused on the identification of pollutant linkages in order to evaluate whether the presence of a source of contamination could potentially lead to harmful consequences. A pollutant linkage consists of the following three elements, all of which must be present for a pollutant linkage to occur:

- A source – a substance that is capable of causing pollution or harm
- A receptor – something that could be adversely affected by the contaminant
- A pathway – a route by which the contaminant can reach the receptor

11.22 The level of risk to receptors was classified with reference to the criteria set out in figures 11.1 to 11.3. Risks that are moderate to low or above are considered to be significant for the purposes of the EIA. Full details of the assessment methodology are set out in technical appendix G1.

Water environment

Baseline

11.23 Baseline conditions were identified through a desk study and site walkover. Consultation was undertaken with the EA and relevant data and published materials relating to the local and wider water environment were reviewed.

Impact assessment

11.24 There are no standard significance criteria for assessing effects on the water environment. The significance of effects has been derived from measures of receptor sensitivity and magnitude of change, as shown on figures 11.4 and 11.5 respectively. The sensitivity and magnitude criteria were combined to determine the degree of effect using the matrix shown in figure 11.6, which was then used to determine whether the effect was significant. As discussed in chapter 5, effects that are moderate or above (including slight to moderate effects) are considered to be significant in EIA terms.

Limitations and uncertainties

11.25 Additional ground investigation and monitoring will be required to inform necessary additional works (such as a foundation works risk assessment), detailed design and further data needs in due course.

11.26 Assessments in relation to currently proposed foundation excavations have been undertaken on the basis of groundwater monitoring data available at the time of writing. These assessments do not preclude different groundwater conditions arising from climate change, future seasonal variations and groundwater responses to extreme weather events.

Consultation

11.27 The agencies, authorities, organisations and individuals which have been contacted and / or their records reviewed during the course of this study are listed in table 11.3, together with a summary of the information obtained. Full responses from consultees and information received are included in Technical Appendix G1.

Regulatory Authority	Request	Date of Consultation	Responses
Arun District Council Contaminated Land Department	Pertinent environmental information	20/01/2020	A response received from the Arun District Council Contaminated Land Department on 8 April 2020. Arun District Council advised that the site is classified under Part IIA regulations as a prioritised site which has been occupied by a potentially contaminative use. However, currently no initial investigations in the form of desktop studies and/or site inspections have been undertaken. The Contaminated Land Department stated that if the site is brought forward for re-development, a condition will be recommended for the submission of a human health-based assessment. The Contaminated Land Department is also unaware of any historic or current landfills within 250 m radius of the site nor any radon related monitoring or protective methods being utilised within buildings located within a 100 m radius of the site. In addition, the department is not aware of any water supplies located within a 2 km radius of the site.
West Sussex County Council Trading Standards	Petroleum records information	20/01/2020	During a telephone conversation on 22 January 2020, the Trading Standards Department at West Sussex County Council advised that they had no records of current petroleum storage tanks on site. However, the department had one record of a disconnected tank which was present on site, however no details for this tank were available.

Regulatory Authority	Request	Date of Consultation	Responses
Environment Agency	Pertinent environmental information	20/01/2020	In a response received from the EA on 11 February 2020 they advised that they held records relating to a fire on site in 2002 relating to drums of aluminium powder (logged as National Incident Recording System (NIRS) 123701). This resulted in 'very minimal contamination to surface water'. Additionally, the EA advised of a single odour complaint relating to the site made by a local resident in July 2017. Further investigation by the EA identified the sewage treatment plant to the south of the site as the source of the odour. The EA were unable to provide further pertinent details relating to land contamination at the site.

Table 9.3: Summary of Regulatory Consultations

Baseline

Ground conditions

Geology

11.28 The published geological mapping shows that the bedrock at the site comprises the Lewes Nodular Chalk Formation. The bedrock is overlain by River Terrace Deposits consisting generally of sand, silt and clay. Previous site investigations by Enzygo Limited found a general sequence of Made Ground over River Terrace Deposits and the Lewes Nodular Chalk Formation.

11.29 The top of the River Terrace Deposits was generally encountered at a depth of between 0.15 to 2.00 m below ground level (mbgl) with a thickness between 1.0 m and 3.8m. The top of the Lewes Nodular Chalk was generally encountered at a depth of between 2.3 to 4.5 m below ground level (mbgl) with a thickness in excess of 18.2 m. Details of the site's hydrogeology are set out in the water environment section of this chapter.

Site history

11.30 The site history was established by a review of historical Ordnance Survey maps dating back to 1876, which are provided in Technical Appendix G1. The site was undeveloped agricultural fields with the exception of the Chichester and Arundel Canal, which ran from east to west through the centre of the site. The canal was disused by 1912 and the section of the canal located within the site was infilled by 1937. The central rectangular portion was occupied by a portion of Ford Airfield in the 1940s and may have included an underground air raid bunker, historical workshop, aircraft standings and an access road. The eastern portion of the south eastern road, which was constructed in 2000, coincided with the location of a runway and access road from the 1940s until 1992.

11.31 By 1974 the site is understood to have been owned by Tarmac Limited and operated as a tarmacadam top block plant until being decommissioned in 2010. During this time the site was occupied by two disused hangars (Hangar 1 in the west of the site and Hangar 2 in the east), a building currently occupied by the existing waste transfer station (WTS) as well as autoclaves, tanks, a travelling crane and a series of hoppers and conveyors associated with the tarmacadam top block plant, as well as a gas governor located immediately adjacent to the

north eastern corner of the rectangular portion of the site. The site surface was occupied by hardstanding, with containers and waste stockpile bays located around the hangars and WTS building between 1999 and 2010. From 2012 onwards, the site is understood to have been occupied by Grundon Waste Management Limited, laid out in the approximate current configuration of the site.

11.32 Two groundwater abstraction licences relating to abstraction boreholes located to the south east of Hangar 2 were associated with the historical owner Tarmac Limited and are unlikely to still be operational, however, it is uncertain if the abstraction boreholes were decommissioned and these may form a preferential pathway to groundwater if decommissioning was not undertaken.

11.33 Two above-ground storage tanks (ASTs) were observed during a site walkover undertaken by Ramboll staff in December 2019, containing oil, gas oil or heating oil. One of these tanks was understood to have been relocated from its historical location near the centre of the rectangular portion of the site. Two additional locations exist where ASTs were historically located before being removed from site. Manhole covers and open, vegetation-covered holes adjacent to Hangar 2 indicate the potential presence of underground storage tanks (USTs) at this location. Historical desk-based information indicates the possible presence of interceptors, slurry pits or an underground storage tank adjacent to Hanger 2.

11.34 An AdBlue (exhaust fluid) tank was observed in the centre of the site adjacent to one of the remaining oil tanks, and an oil tube was observed to the south of Hangar 1.

11.35 Several areas of fly tipping were recorded during the site walkover. The waste included old tyres, bikes, pipe work, metal cables, plastic, brick blocks and wooden planks. Although no asbestos containing materials (ACMs) were noted during the site walkover within the fly tipped waste, it should be noted that an asbestos survey was not undertaken by Ramboll, therefore there is the potential for ACM to be present on site. It is noted that asbestos surveys for the buildings onsite undertaken in 2004 highlight the presence of asbestos within the building fabric.

11.36 Three electricity substations are present on site, one located at the western side of Hangar 1 and two located to the north and south of Hangar 2. The age of these substations is unknown; however, it is likely to coincide with the construction of the hangars (pre-1974). The substations were overgrown with vegetation, therefore unlikely to be in use.

11.37 To the north of the main access road (approximately 50 m north from the site boundary) was the former RAF refuelling area used by Tarmac Limited (the previous owner) for storage.

11.38 A former RAF pumping station was located immediately adjacent to the north of this area (approximately 80 m north from the site boundary), which was noted to comprise a brick bunker constructed partly below ground level and surrounded by concrete hardstanding to the south and scrub and woodland to the north. The bunker is filled with fly-tipped waste and was not accessible during the site walkover.

11.39 EA licensing information indicates that a bank to the east of the site boundary was constructed between November 1985 and September 1986 from deposited waste including inert waste. The sewage treatment works located 20 m to the south of the rectangular portion of the site was first documented on the 1999 map.

11.40 Information received from the EA included reference to a fire on site in 2002 relating to drums of aluminium powder, which was recorded as resulting in 'very minimal contamination to surface water'.

Past intrusive investigations

11.41 Information regarding ground contamination is available from a ground investigation undertaken within the rectangular portion of the site (although the ground investigation did not encompass the northern portion or south-eastern road). Made Ground was generally recorded up to 2 m in thickness, however, in the location of the former autoclaves this increased to 3 m thickness. Made Ground constituents included large (<300 mm) concrete blocks, cable, rebar, concrete matrix with brick fragments, metal pipe, pieces of plastic and wood fragments.

11.42 The Enzygo ground investigation report documents testing that included the screening of soil samples for determinands including metals, pH, sulphate, cyanide, phenols, speciated polycyclic aromatic hydrocarbons (PAH), banded total petroleum hydrocarbons (TPH), organic carbon, volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), polychlorinated biphenyls (PCBs) and asbestos. No contaminants were found to exceed the human health generic assessment criteria (GACs) for a commercial land use in soil samples and asbestos was not detected in the samples tested. Organic contaminants were recorded at elevated concentrations in soil samples (but not in excess of the GACs).

11.43 Although the soil results did not exceed the GACs for commercial use for pathways such as direct contact and ingestion, organic compounds do exist at a level that indicates the potential for migration into water supplies. Additionally, elevated sulphate concentrations recorded by Enzygo were noted to have the potential to impact buried concrete structures.

11.44 The Enzygo ground investigation report documents the screening of groundwater samples obtained from the Lewes Chalk Formation for approximately the same suite of chemicals as the soil samples, the results of which were screened against GACs derived from the freshwater Environmental Quality Standards (EQS), UK Drinking Water Values (DWV) and World Health Organisation (WHO) values for drinking waters (the latter being utilised where no other suitable options were available).

11.45 Groundwater samples were found to exceed the relevant GACs for PAHs including anthracene, fluoranthene and benzo(a)pyrene and TPH (C8 to C10) in the south-eastern quarter of the site, in particular at the location of a former fuel AST to the southeast of the existing WTS building. Exceedances were also recorded at the eastern boundary, south eastern corner and south-western corner of the site; however, these concentrations were significantly lower than at

the location of the former fuel AST. Enzygo theorised the elevated concentrations to be the result of a historical leakage of the AST.

11.46 The historical AST had been removed by the time of the ground investigation, and thus Enzygo considered the impact of organic contaminants in groundwater to be a residual risk and one that was not significant as the concentrations of contaminants in groundwater decreased significantly towards the site boundaries.

11.47 Enzygo carried out seven rounds of ground gas monitoring following their intrusive ground investigation (four on a weekly basis in July and August 2015 and three in January and February 2018). From that data Enzygo classified the site as what is known as Characteristic Situation 1 (CS1) which is indicative of conditions representing a very low risk associated with ground gases, where no protection measures are required. It is noted that ground gas monitoring was not undertaken during a period of falling atmospheric pressure and as such the results of ground gas monitoring may not be representative of the worst-case scenario for ground gas generation at the site.

Summary of potential sources of contamination

11.48 Based on the findings of the desk study, potential sources of contamination are summarised in table 11.2. A detailed table is provided in Technical Appendix G1.

Source	Contaminants of concern
On-site	
Made Ground associated with historical site uses (Chichester Canal infill, Ford Airfield, Tarmac Top block manufacture)	Heavy metals, asbestos, total petroleum hydrocarbons (TPH), phenols, polycyclic aromatic hydrocarbons (PAH), ground gas, sulphate, sulphide, glycols
Former and existing above-ground storage tanks	TPH, PAH, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs)
Aerated block plant containing soluble oil, mould oil storage vessels and oil store, PFA silo and anhydrite silo	TPH, PAH, VOCs, SVOCs, pulverised fuel ash (PFA), sulphate
Electricity substations	PCBs
Infilled slurry pit, HCL store and delivery point	Heavy metals, asbestos, TPH, PAH, ground gas, low pH conditions
Former autoclave pit and infill	Heavy metals, asbestos, TPH, PAH, ground gas
Possible UST or interceptor	TPH, PAH, VOCs, SVOCs
Historical landfill	Heavy metals, asbestos, TPH, PAH, ground gas, low pH conditions
Waste storage and fly tipped waste	Heavy metals, asbestos, TPH, PAH, VOCs, acids, ground gas
Asbestos in building fabric	Asbestos
Offsite	
Former RAF refuelling area	TPH, PAH, VOCs, SVOCs, glycols
Pallet storage area and possible former RAF bunker	Heavy metals, asbestos, TPH, PAH, ground gas
Agricultural works	Herbicides and pesticides
Sewage works	Heavy metals, faecal coliforms, pathogens

Table 11.2: Potential sources of contamination

Sensitive ground conditions receptors

11.49 Based upon the above information, the following sensitive receptors have been identified, with regard to the guidance in figure 11.1:

- River Arun
- Ditches in the vicinity of the site
- Groundwater in River Terrace Deposits (Secondary A Aquifer)
- Groundwater in the Lewes Nodular Chalk Formation (Principal Aquifer)
- Existing and Future site staff
- Construction/maintenance workers
- Buildings and structures
- Adjacent site users

Water environment

Surface water

11.50 The River Arun lies approximately 900 m to the east of the rectangular portion of the site. The River Arun is designated under the Water Framework Directive (WFD) as a transitional heavily modified water body. It was classified as being of good status with respect to its chemical quality in 2016, but its ecological classification was of moderate potential and so did not comply with the requirements of the WFD (which requires all classifications to be at least 'Good'). This was as a result of the presence of physical modifications to the waterbody. The pressures that the Agency identifies as contributing to the river's moderate status arise from use of flood protection in the river course.

11.51 A number of small ponds are located in the vicinity of the site. These include:

- A pond approximately 400 m^2 in area connecting to ditches draining to the River Arun approximately 720 m to the north east of the site;
- A second pond approximately 640 m^2 in area approximately 900 m to the south east of the site, approximately 50 m from the bank of the River Arun;
- Two large artificial ponds approximately 2880 m^2 and 12,650 m^2 in area located approximately 1 km to the north of the site.
- An artificial pond approximately 3,465 m^2 in area located 320 m to the south of the site in Rudford Industrial Estate. The purpose of this pond is unclear; however, it could be related to industrial uses at the industrial estate or be used to store surface water runoff.

11.52 None of the ponds are designated under the WFD. Due to the distance of the ponds from the site and the lack of continuous surface drainage routes from the site to the ponds, they are not considered to be sensitive receptors for the purposes of this assessment.

11.53 There are several ditches within the vicinity of the site. The closest of these ditches is located approximately 350 m from the rectangular portion of the site, in a south easterly direction. The ditches are generally anticipated to flow towards the River Arun in the east and a number of outlets are noted along the

western bank of the River Arun, coinciding with the locations of the ditches. No ditches were observed around the site during the site walkover and it is not clear whether any flow is present in the ditches in the area. The ditch 350 m from the site was observed to contain no water.

Hydrogeology

11.54 EA mapping shows that the River Terrace Deposits underlying the site are classified as a Secondary A Aquifer, which are permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers. The Lewes Nodular Chalk Formation is classified as a Principal Aquifer, which are layers that provide a high level of water storage and may support water supply and / or river base flows on a strategic scale.

11.55 The EA monitors groundwater quality under the WFD. It considers both quantitative quality (the degree to which a body of groundwater is currently affected by direct or indirect abstractions) and chemical quality. The groundwater in the area is currently classified as being of good chemical quality, however, it is classified as being of poor quantitative quality, and thus is not in compliance with the WFD requirements. The latter classification is related to potential effects on associated surface water bodies associated with water quantity and thus is not of relevance to the proposed development.

11.56 The site is not located within a groundwater Source Protection Zone (SPZ), Nitrate Vulnerable Zone (NVZ) or a Drinking Water Protection Area (DrWPA) although the River Arun located approximately 900 m to the east is classified as a surface water DrWPA. There are two groundwater abstractions located on the site, as discussed within Technical Appendix G1. Four further groundwater abstractions are located within 1 km of the site; however, these are located up- or cross-gradient from the site, located at significant distance or used for low sensitivity purposes and as such are considered not to be significant with respect to this assessment.

11.57 Groundwater monitoring visits were undertaken by Enzygo in 2015 and Grundon Waste Management Ltd carried out groundwater level monitoring visits between 2018 and November 2020. Ramboll also carried out a groundwater monitoring visit on 18 February 2020 immediately following Storm Dennis (15 February 2020), in order to observe the impacts of winter rain infiltration on groundwater level at the site.

11.58 Groundwater elevations were monitored at the site during the period 2015 to 2020; since 2018 this has been at approximately monthly intervals. The highest recorded groundwater elevation event during this monitoring period occurred on 11 March 2020, when the elevation of the groundwater table was recorded to be approximately 3.5 mAOD (3.0 mbgl) in the area of the site which is proposed to be subject to lowering of ground levels; to the west groundwater levels were recorded at up to 4.5 mAOD (2.0 mbgl), and to the east at up to 3.0 mAOD (3.5 mbgl). Groundwater was broadly within the Chalk and granular River Terrace Deposits.

11.59 Allowing for groundwater level to rise higher than that recorded on 11 March 2020, a worst-case expected groundwater elevation of 4 mAOD (2.5 mbgl) in the area of the site proposed for ground level lowering was determined.

11.60 From review of the BGS hydrogeology map[1], the groundwater level in the Chalk would be expected to be in the region of 0 mAOD to 5 mAOD (1.5 mbgl to 6.5 mbgl) at the site, with groundwater flow towards the southeast at a shallow hydraulic gradient of approximately 0.0014, towards the River Arun and the coast. The BGS data concurs with the groundwater monitoring data obtained from boreholes at the site.

Flood risk

11.61 The pre-development and greenfield (in brackets) runoff rates were calculated for the site as follows:

- 1-in-1 year storm: 559 (22.5) l/s
- 1-in-30 year storm: 1,371 (60) l/s
- 1-in-100 year storm: 1,772 (84) l/s

11.62 The site is entirely located in Flood Zone 1, at low risk of fluvial flooding.

11.63 The EA surface water flood mapping indicates low risk of flooding from surface water in the external yard area surrounding Hangar 1, Hangar 2 and the WTS, with the predicted depth from EA data as up to 0.30 m. Furthermore, the area adjacent to the west of the site office and weighbridge is shown to be at medium to low risk of surface water flooding. Associated depth of flooding is predicted to be between 0.15 m and 0.30 m. The north west part of the site is also shown to be at low risk of surface water flooding, with the predicted depth as up to 0.30 m.

11.64 Surface water flooding is created primarily due to natural ground depressions in certain parts of the site covered with concrete. It is understood that surface water ponding is mainly caused due to blockages in the existing surface water drainage system, which do not allow surface water to freely drain off the site.

11.65 The overall risk of flooding from surface water within the site boundary is therefore considered to be low.

11.66 According to Arun District Council Strategic Flood Risk Assessment (2016), there are no incidents of sewer flooding within the site boundary or in the vicinity of the site.

11.67 Arun District Council Strategic Flood Risk Assessment (2016) indicates that the area in general is highly susceptible to groundwater flooding. In addition, it is mentioned that '*significant groundwater flood events have been recorded across the Arun District. This risk is supported by the Areas Susceptible to Groundwater Flooding mapping and suggests that susceptibility to groundwater flooding is generally high through the district'*.

[1] BGS (1984) Hydrogeological Map of the Area Between Cambridge and Maidenhead

11.68 Given the depth to groundwater described above (worst case of 4 mAOD (2.5 mbgl) the overall risk of flooding from groundwater within and in the vicinity of the site is therefore considered to be high based on a precautionary approach.

11.69 The UK Government indicative mapping database shows that there is no risk of flooding from reservoirs within the site boundary and thus, the associated risk is considered to be low.

Sensitive water and flood risk environment receptors

11.70 Based upon the above information, the following sensitive receptors have been identified, with regard to the guidance in figure 11.2. The locations of these receptors is shown in Figure 11.7:

- River Arun – medium sensitivity
- Ditches in the vicinity of the site – low sensitivity
- Groundwater in River Terrace Deposits (Secondary A Aquifer) – low sensitivity
- Groundwater in the Lewes Nodular Chalk Formation (Principal Aquifer) – high sensitivity

Future baseline

11.71 Should the site not be developed and instead remain as the current use, there would not be any significant change in ground conditions at the site compared to the current situation. The existing water environment could be subject to change as a result of climate change or future seasonal variations.

Effects of the proposed development

Ground conditions

11.72 In order for potential contaminants to pose a risk to receptors, there has to be a viable pathway for them to reach the receptors. Construction workers have the potential to come into direct contact with soil and groundwater during site works and construction activities, including during the construction of the connecting cablework to the National Grid, and also to be subject to accidental soil ingestion and inhalation of dust and asbestos fibres.

11.73 The latter could also affect adjacent site users if dusts are blown from the site. Future site users could come into direct contact with soils in soft landscaped areas and could also be impacted through inhalation or the ingestion of dust and asbestos fibres from these areas. These pathways will be eliminated where buildings, hardstanding and other engineering surfaces remove the pathway.

11.74 Organic contaminants could permeate buried plastic water supply pipes and enter the water system. This may affect the health of future site users. Volatiles from organic compounds could be generated from contaminants in the ground. These have the potential to build up in buildings and confined spaces, potentially affecting both construction workers and future site users. Carbon dioxide and methane generated from underlying geology and / or contaminants in the

ground could also build up in buildings and confined spaces and pose a risk to the buildings and to health.

11.75 There is the potential for rainfall infiltration, leaching and contaminant migration in open areas of the site and areas of potential soakaways to affect the water environment. Deep foundations will be required to support the facilities and building levels require excavation to at least 5 m below ground. There is the potential for contamination within Made Ground to be mobilised via newly created pathways into the river terrace deposits, or potentially deeper strata, depending on the depth of the piles.

11.60 As the highest recorded groundwater table was recorded to be approximately 4 mAOD (2.5 mbgl) and given the deepest excavation is proposed to be excavated down to approximately 1.5 mAOD (5.0 mbgl), dewatering will be required. Due to the potential groundwater dewatering there will be the potential for contaminants to migrate towards the excavation.

11.76 Given the excavation requirements, dewatering will need to be undertaken, should groundwater be encountered. Dewatering has the potential to mobilise contamination into controlled waters, such as nearby waterbodies which are in hydrological continuity with the groundwater.

11.77 Some contaminants can pose a risk to subsurface construction materials, leading to damage to buried structures and services.

11.78 There is the potential for harm to plants as a result of the direct uptake of contamination. This is considered to be unlikely because of the limited soft landscaping proposed.

11.79 A conceptual site model has been developed for the proposed development and is presented in full in table 11.3 below. Of the source-pathway-receptor linkages identified, those with a risk classification of moderate/low or above are considered to be potentially significant and are highlighted in bold.

Hazard	Pathway	Potential Receptor	Potential Consequence	Probability of Risk	Level of Risk
On-site sources – historical and existing Made Ground, former and existing gas oil storage tanks, aerated block plant and storage vessels, electricity substations, slurry pit and HCL, former autoclave pit, historical landfill, former	Dermal contact/ ingestion of soils/dust/ inhalation of dusts	Future site staff	Mild	Unlikely	Very low
		Construction/ maintenance workers	Mild	Low likelihood	Low
		Adjacent residential site users	Medium	Unlikely	Low
	Inhalation of asbestos fibres	Future site staff	Medium	Unlikely	Low
		Construction/maintenance workers	**Medium**	**Low likelihood**	**Moderate/low**
		Adjacent residential site users	Medium	Unlikely	Low
	Accumulation and inhalation of gas/vapours in confined spaces	**Future site staff**	**Medium**	**Low likelihood**	**Moderate/low**
		Construction/ maintenance workers	**Medium**	**Low likelihood**	**Moderate/low**
		Buildings and structures (internal spaces)	**Medium**	**Low likelihood**	**Moderate/low**

Hazard	Pathway	Potential Receptor	Potential Consequence	Probability of Risk	Level of Risk
RAF refuelling area, possible former RAF bunker, waste storage, asbestos in buildings Heavy metals, asbestos, TPH, phenols, PAH, sulphate, sulphide, glycols, VOCs, SVOCs, PCBs, low pH conditions, ground gas.		Adjacent residential site users	Medium	Unlikely	Low
	Permeation of contaminants into drinking water pipes	Future site staff via water supply pipes	Medium	Likely	Moderate
	Leaching and vertical migration of contaminants in groundwater	Secondary A aquifer (River Terrace Deposits	Medium	Low likelihood	Moderate/low
		Principal aquifer (Lewes Nodular Chalk Formation)	Medium	Low likelihood	Moderate/low
		Surface water course (ditch and River Arun)	Medium	Unlikely	Low
	Migration of contaminants through dewatering of excavations: during the dewatering of excavations the drawdown of the water table may mobilise contaminants towards the dewatering area.	**Secondary A aquifer (River Terrace Deposits**	**Medium**	**Likely**	**Moderate**
		Principal aquifer (Lewes Nodular Chalk Formation)	**Medium**	**Likely**	**Moderate**
		Surface water course (ditch and River Arun)	Medium	Unlikely	Low
	Impact on surface water body (ditch and River Arun) -increased flow from proposed groundwater abstraction	**Surface water course (ditch)**	**Medium**	**Low likelihood**	**Moderate/low**
		Surface water course (River Arun)	Medium	Unlikely	Low
	Contaminant migration via surface runoff	Surface water course (ditch and River Arun)	Medium	Unlikely	Low
	Migration of contaminants via preferential pathways (i.e. piled foundation, piles constructed around the area to be dewatered and the wells drilled to pump water from and drinking water supply pipes).	Secondary A aquifer (River Terrace Deposits)	Medium	Likely	Moderate
		Principal aquifer (Lewes Nodular Chalk Formation)	Medium	Likely	Moderate
	Damage to building materials or services through direct contact with contaminated soil/groundwater	Buildings and structures (construction materials)	Mild	Low likelihood	Low
Off-site sources – agricultural land, sewage works, including former RAF refuelling area and possible	Leaching and vertical migration of contaminants onto site in soils and groundwater	Secondary A aquifer (River Terrace Deposits	Medium	Unlikely	Low
		Principal aquifer (Lewes Nodular Chalk Formation)	Medium	Unlikely	Low
	Accumulation and inhalation of gas and vapours	Future site staff	Medium	Unlikely	Low
		Construction/maintenance workers	Medium	Unlikely	Low

Hazard	Pathway	Potential Receptor	Potential Consequence	Probability of Risk	Level of Risk
former RAF bunker Heavy metals, faecal coliforms, pathogens		Buildings and structures (internal spaces)	Medium	Unlikely	Low
Notes Assessment completed assuming site in current condition. Should site levels be significantly altered during development, a reassessment would be required Assessment completed assuming no remediation/mitigation in place Should the development proposals alter significantly a review of this risk assessment may be required, in particular if new areas of soft landscaping are required Given the use of appropriate personal protective equipment (PPE) and on-site health and safety precautions, risk to site development workers would be reduced to low					

Table 11.3: Conceptual Site Model

11.80 In summary, the potential effects during construction related to ground conditions include:

- Inhalation of asbestos fibres by construction/ maintenance workers - Moderate/low risk
- Accumulation and inhalation of gas/vapours in confined spaces, affecting future site staff, construction/ maintenance workers and buildings and structures - Moderate/low risk
- Permeation of contaminants into drinking water pipes – Moderate risk
- Leaching and vertical migration of contaminants in groundwater (River Terrace Deposits and Lewes Nodular Chalk Formation) - Moderate risk
- Migration of contaminants via preferential pathways (i.e. piled foundation, piles constructed around the area to be dewatered and the wells drilled to pump water from and drinking water supply pipes) – Moderate risk

11.81 The potential effects post-construction with respect to ground conditions include:

- Accumulation and inhalation of gas/vapours in confined spaces in constructed buildings - Moderate/low risk
- Permeation of contaminants into drinking water pipes – Moderate risk

Water environment

Effects during construction

11.82 The mobilisation of contaminants from sub-surface strata and surface soils into groundwater could occur through the process of dewatering (if groundwater is struck) and excavation activities. Given the proposed excavations, the potential for the excavations to interact with groundwater is anticipated to be high. Therefore, dewatering of the excavations will likely be required during the construction phase.

11.83 In addition, there is the potential for contaminants present in groundwater to migrate towards the excavation during dewatering. In the absence of mitigation this is predicted to lead to a negligible (River Arun) to small (River Terrace

Deposits and Lewes Nodular Chalk) change in quality, resulting in negligible to slight adverse effects within the River Terrace Deposits that will not be significant. However, the effects within the Lewes Nodular Chalk will be moderate, therefore significant if no mitigation is in place.

11.84 It should also be noted that there is the potential for mobilised contaminants to enter the excavation area during dewatering and which are in turn pumped out, which may be beneficial if the contaminants are removed from site. However, the contaminated abstracted water would require disposal offsite and mitigation needs to be in place should the water be pumped into the nearby ditch/ River Arun.

11.85 There is the potential for rainfall infiltration, leaching and contaminant migration in areas of open excavation, stripped ground etc. which may migrate into the water environment. In the absence of mitigation this is predicted to lead to negligible (River Arun), small (River Terrace Deposits) and small (Lewes Nodular Chalk) changes in quality, resulting in negligible to slight effects adverse effects that will not be significant for the River Terrace Deposits and River Arun and a moderate effect for the Lewes Nodular Chalk.

11.86 Creation of pathways via piling (including piles constructed around the area to be dewatered and the wells drilled to pump water from) or other construction activities. Deep foundations are anticipated to be required to support the proposed development and building levels will require excavation. There is the potential for contamination within Made Ground to be mobilised via newly created preferential pathways into the River Terrace Deposits and Lewes Nodular Chalk. The magnitude of change for both aquifers is predicted to be small resulting in a slight adverse effect that will not be significant within the River Terrace Deposits, however a moderate effect within the Lewes Nodular Chalk, which will therefore be significant if no mitigation is place.

11.87 There is a risk that accidental spillages and leaks of fuels, oils and chemicals could affect groundwater quality during construction. In the absence of mitigation this is predicted to lead to small changes in the quality of both aquifers resulting in slight adverse effects within the River Terrace Deposits, that will not be significant. However, a moderate effect could occur within the Lewes Nodular Chalk, which will therefore be significant if no mitigation is place. Similarly, no significant adverse effects are predicted for the ditches in the vicinity of the site or the River Arun based on predicted negligible changes in quality.

11.88 The changes to local groundwater resources through dewatering activities could affect the underlying aquifers. However, the radius of influence would be small and within the site boundary. In the absence of mitigation this is predicted to lead to a negligible (River Terrace Deposits and Lewes Nodular Chalk) change, resulting in negligible effects with the River Terrace Deposits that will not be significant. The effects within the Lewes Nodular Chalk will be negligible/slight and not significant.

11.89 There are a number of ditches in the vicinity of the site which drain into the River Arun, however the nearest of these ditches is approximately 350 m from the site and was not observed to contain water. Surface contaminants mobilised at the site are unlikely to travel the distance over the surface required to impact the nearest ditch (negligible magnitude of change) and therefore no significant

adverse effects on surface water features anticipated. In addition, standard practices will be put in place to manage fine material run-off into the drainage system during the construction phase.

11.90 Should abstracted groundwater be pumped into the surface waters (such as the ditch and River Arun) the effects upon the surface water could be significant without mitigation in place.

11.91 The entire site is located within Flood Zone 1, at low risk of fluvial flooding and at low risk of surface water flooding and therefore, no significant adverse effects are predicted.

11.92 The overall risk of groundwater flooding within and in the vicinity of the site is considered to be high. The areas where groundwater interaction will occur will be limited to the:

- The proposed bunker hall (proposed depth of the excavation to 2.5 mAOD (4.0 mbgl))
- Surface water pumping station (proposed depth of the excavation to 1.5m AOD (5.0 mbgl))
- Reduced level dig (proposed depth of the excavation to 4.0 mAOD (2.5 mbgl))
- Installation of piles

11.93 Based on existing groundwater level data the shallowest depth of groundwater has been recorded at 4 mAOD (2.5 mbgl), therefore the potential for the design elements to interact with groundwater is anticipated to be likely, given the proposed depths of the excavations. Therefore, slight adverse effect will be predicted which will not be significant.

Effects post-construction

11.94 Considering the high potential groundwater levels and contamination at the site in conjunction with its location within a high vulnerability zone on Principal aquifer, infiltration is not considered to be a viable drainage option for the site.

11.95 The proposed sustainable drainage system (SuDS) measures at the site therefore include lined, below ground cellular storage tanks (with an impermeable membrane to avoid potential groundwater ingress) ensuring adequate volumetric and discharge management of surface water runoff. Additionally, the quality of the surface water discharged off site will be managed by the implementation of light-liquid separators within the proposed new surface water drainage network.

11.96 A detailed maintenance regime will be put in place for the drainage system by the site management team, including regular inspections, removal of sediment and debris and repair as necessary. Regular inspections will also be in place for any waste temporarily stored at the WSTF in relation to the drainage network. With the proposed surface water drainage system in place, no significant adverse effects are predicted on surface water quality post-construction.

11.97 Direct infiltration of runoff into the ground has the potential to affect water quality through the introduction of pollutants such as spilled fuels, oils or chemicals. However, as discussed above, infiltration is not considered a viable option for this site and surface contaminants mobilised at the site are unlikely to travel the distance over the surface required to impact the nearest ditch (approximately 350 m away).

11.98 However, the surface water contaminants may enter the water environment through the surface water drainage system. To reduce this potential impact the detailed design will incorporate light-liquid separators to aid in containing oil, diesel, petrol etc that may be deposited on the surface of the hard-landscaped areas that may be mobilised during rainfall events. Negligible changes are predicted for both aquifers and the River Arun resulting in no significant adverse effects.

11.99 Although the proposed construction will create a barrier to groundwater flow, groundwater will flow around the secant piled structure, with no overall loss in water quantity. Notwithstanding this, a barrier to groundwater flow will be created, which may result in groundwater mounding on the up hydraulic gradient side of the buried structure. However, groundwater mounding is unlikely to pose a significant issue given that minimal construction below the water table is proposed.

11.100 With regard to flooding, the site lies outside the 1-in-100 year floodplain and the proposed development will not give rise to a reduction in floodplain storage. Therefore, negligible changes and no significant adverse effects are predicted. The proposed attenuation system will require 2,400 m3 of below ground attenuation storage volume designed to contain the 1-in-30-year critical storm event, including 40% allowance for climate change without causing any flooding to the site. Discharge rate from the site will also be restricted to the 1-in-30 year greenfield runoff rate.

11.101 Although West Sussex County Council has advised that exceedance flows beyond the 1-in-30 year critical storm event can be discharged uncontrolled to the drainage system, it is considered appropriate to manage surface water volumes in excess of the 1-in-30 year event (including 40% climate change allowance) on site by allowing shallow surface water ponding (~ 150 mm average depth) on managed external hardstanding areas, thereby not increasing flood risk downstream as a result of the proposed development.

11.102 In addition, these areas will be at marginally lower elevations and would also allow for the ponding of groundwater should levels rise in a groundwater flood event, prior to that water being conveyed as a managed overland flow path within the site boundary and subsequently following the existing flow path towards the local watercourse as part of the isolated surface water drainage network. In addition, it should be noted that controlled ponding of 150 mm at the lower level in extreme events (and in case of pump failure) and 300 mm storage around the contractor's layby (where the pump is situated) for low-return period events is proposed for the site.

11.103 Overall, no significant effects on flood risk are predicted as a result of the proposed development and the built development will not be at risk from flooding.

Grid connection

11.104 Although not part of this application, in order for the ERF to export power to the local electricity grid, a connection will be made from the proposed development site to the existing substation near Crockerhill, to the north of the A27. The construction of the grid connection will involve the excavation of a trench. The effects of the construction will be mitigated through the implementation of a construction environment management plan (CEMP). It is anticipated that standard personal protective equipment will be sufficient to provide protection to ground workers, although asbestos may need a specific protocol and equipment, should it be found along the route. No effects are considered to arise during operation as the cables will be underground.

Mitigation and monitoring

11.105 The construction of the proposed development will be carried out in line with a construction environmental management plan (CEMP) which will include best practice measures to manage potential effects associated with ground conditions and the water environment. An outline CEMP is provided in technical appendix L. The measures will include the preparation of a pollutants, water and sediment management protocol to inform construction works, which will set out measures such as the following:

- Minimise storage of hazardous chemicals on site and, where storage is necessary, use anti-pollution measures such as bunded trays or leak-proof containers
- Use designated refuelling sites, located away from open water
- Any cleaning materials or chemicals used during the construction phase are not to be hazardous to the water environment
- No storage of potentially contaminating materials in areas liable to water inundation
- Use of electrical power, rather than diesel, where possible
- Design of construction methods to minimise disturbance to, and mobilisation of, sediment
- Controlled washing down of plant while on site
- Implementation of piling design with tight quality assurance / quality controls
- Oil spill kits to be kept on site, and site staff trained in their use
- Minimisation of dewatering requirements by programming excavation works to be as short as possible. The need for an environmental permit to undertake dewatering will be established and the necessary applications made as required
- Development of a waste soils management strategy
- Development of a materials management strategy
- Development of an asbestos management and health and safety plan (if necessary)

11.106 Based on current knowledge of the site's level of contamination, it is anticipated that standard personal protective equipment will be sufficient to provide

protection to ground workers, although asbestos may need a specific protocol and equipment, should it be found on site.

11.107 Construction works will be carried out in accordance with the Environment Agency's (2007) *Pollution Prevention Guideline 5: Works and Maintenance on or Near Water.* While this document is no longer officially supported by the EA, it is still considered to be representative of good practice within the UK.

11.108 With the above mitigation measures in place, there will be no significant effects on ground conditions, groundwater and surface water quality during construction of the development.

11.109 Prior to groundwater dewatering, the following steps will be taken (where necessary):

- Liaison with the Environment Agency at pre-application stage for abstraction licensing and discharge consent
- Site-specific hydrogeological site investigation
- Hydrogeological calculations based on the site investigation to better delineate expected abstraction rates
- Determination of suitable route to discharge abstracted water, should the abstracted water drain into surface water, the impacts on these surface waters should be assessed,
- Application for groundwater abstraction licence
- Application for discharge consent from the Environment Agency, for which a surface water flood risk assessment and assessment of water quality impacts are likely to be required
- If necessary, design remediation to treat groundwater and reduce contamination to an acceptable concentration prior to discharge
- Design of discharge system
- Provision of strategy for monitoring of water quality, groundwater level and surface water flow pre, during and post abstraction

11.110 In addition to the CEMP, further work and monitoring will be undertaken in order to ensure that no residual risks associated with ground conditions remain once the proposed development is constructed, where necessary:

- An intrusive ground investigation (including a contaminated land interpretative report) will be undertaken to determine the presence and composition of any on-site contamination and the potential for off-site sources to have affected the site. Any significant contamination identified through appropriate risk assessment will be remediated where needed to mitigate the impacts on identified receptors. Design and completion of intrusive investigation and assessment will be in accordance with appropriate Eurocodes, British Standards and current UK guidance
- A separate UXO desk study / risk assessment will be undertaken for the site by a UXO specialist, in advance of intrusive works being undertaken at the site
- A remediation strategy report will be undertaken depending upon the results of the intrusive ground investigation,

- Completion of a foundation works risk assessment, in accordance with EA standards, prior to construction to inform the potential risks associated with foundation types under consideration or to identify mitigation measures that may be needed
- Where site won materials are sought for reuse it is recommended that a Materials Management Plan (MMP) is prepared in accordance with the provisions of the CL:AIRE document *The Definition of Waste: Development Code of Practice Version 2* March 2011
- A programme of long-term groundwater monitoring to be undertaken in line with any foundation works programme, including the proposed excavations. The long-term water monitoring should also include surface water monitoring of the nearest ditch and the River Arun, due to site discharge into these features
- Standard design measures for below ground structures constructed in groundwater such as piles, for example, by the provision of granular conveyance routes and drainage blankets where necessary to maintain groundwater flow rates to be approximately equivalent to that pre-development (although unlikely to be required)
- Compliance with environmental permits where needed to undertake the dewatering works
- Following groundworks and construction at the site, a verification report will be prepared to document the successful completion of the development and will include a detailed audit trail to ensure that the implementation of any required remedial measures was in accordance with the remediation strategy

Residual effects

11.111 With the above measures in place, no significant residual risks are predicted in association with ground conditions, the water environment or flood risk.

Cumulative effects

11.112 As no significant ground conditions or water environment effects are predicted as a result of the proposed development, there is no potential for significant cumulative effects with other consented developments in the area.

Fall-back position

11.113 The ES chapters for ground conditions, water environment and flood risk for the 2015 consented gasification scheme were undertaken in 2013. This assessment is considered to still be valid today given likely limited changes to the baseline environment.

11.114 Several construction phase impacts were identified, however, with the incorporation of comprehensive mitigation measures no significant residual adverse effects were considered to arise. The majority of effects were considered to be negligible / not significant and a few minor beneficial effects were recorded. With regard to the latter, it is important to note that design of the gasification scheme is different for the current application (for example no bunker excavations were proposed).

Ground conditions – classification of consequence

Classification	Definition
Severe	Highly elevated concentrations likely to result in 'significant harm' to human health as defined by the Environmental Protection Act 1990, Part 2A, if exposure occurs. Equivalent to Environment Agency Category 1 pollution incident including persistent and / or extensive effects on water quality; leading to closure of a potable abstraction point; major impact on amenity value or major damage to agriculture or commerce. Major damage to aquatic or other ecosystems, which is likely to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long term maintenance of the population. Catastrophic damage to crops, buildings or property.
Medium	Elevated concentrations that could result in 'significant harm' to human health as defined by the Environmental Protection Act 1990, Part 2A, if exposure occurs. Equivalent to Environment Agency Category 2 pollution incident including significant effect on water quality; notification required to abstractors; reduction in amenity value or significant damage to agriculture or commerce. Significant damage to aquatic or other ecosystems, which may result in a substantial adverse change in its functioning or harm to a species of special interest that may endanger the long term maintenance of the population. Significant damage to crops, buildings or property.
Mild	Exposure to human health unlikely to lead to 'significant harm'. Equivalent to Environment Agency Category 3 pollution incident including minimal or short lived effect on water quality; marginal effect on amenity value, agriculture or commerce. Minor or short lived damage to aquatic or other ecosystems, which is unlikely to result in a substantial adverse change in its functioning or harm to a species of special interest that would endanger the long term maintenance of the population. Minor damage to crops, buildings or property.
Minor	No measurable effect on humans. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects of damage to buildings, structures and services.

From: Environment Agency, NHBC and Chartered Institute of Environmental Health, 2008, Guidance for the Safe Development of Housing on Land Affected by Contamination.

Ground conditions – classification of probability*

Category	Definition
High likelihood	There is a pollutant linkage and an event would appear very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollutant linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low likelihood	There is a pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a long period such an event would take place, and is less likely in the shorter term.
Unlikely	There is a pollutant linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

From: Environment Agency, NHBC and Chartered Institute of Environmental Health, 2008, Guidance for the Safe Development of Housing on Land Affected by Contamination.

*only applies if there is a possibility of a pollutant linkage being present

Figure 11.2 Ground conditions: classification of probability

Ground conditions – the classification of risk

Probability	Consequence: Severe	Consequence: Medium	Consequence: Mild	Consequence: Minor
High likelihood	Very high risk	High risk	Moderate risk	Low risk
Likely	High risk	Moderate risk	Moderate / low risk	Low risk
Low likelihood	Moderate risk	Moderate / low risk	Low risk	Very low risk
Unlikely	Moderate / low risk	Low risk	Very low risk	Very low risk

Description of the classified risks

Very high risk
There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without remediation action OR there is evidence that severe harm to a designated receptor is already occurring. Realisation of that risk is likely to present a substantial liability to the site owner or occupier. Investigation is required as a matter of urgency and remediation works are likely to follow in the short term.

High risk
Harm is likely to arise to a designated receptor from an identified hazard at the site without remediation action. Realisation of the risk is likely to present a substantial liability to the site owner or occupier. Investigation is required as a matter of urgency to clarify the risk. Remediation works may be necessary in the short term and are likely over the longer term.

Moderate risk
It is possible that harm could arise to a designated receptor from an identified hazard. However, it is relatively unlikely that any such harm would be severe and, if any harm were to occur, it is more likely that the harm would be relatively mild. Further investigative work is normally required to clarify the risk and to determine the potential liability to the site owner / occupier. Some remediation works may be required in the longer term.

Low risk
It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely, at worst, that this harm if realised would normally be mild. It is unlikely that the site owner / occupier would face substantial liabilities from such a risk. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited.

Very low risk
It is a low possibility that harm could arise to a designated receptor, but it is likely, at worst, that this harm if realised would normally be mild or minor.

No potential risk
There is no potential risk if no pollution linkage has been established.

From: Environment Agency, NHBC and Chartered Institute of Environmental Health, 2008, Guidance for the Safe Development of Housing on Land Affected by Contamination.

Figure 11.3 Ground conditions: classification of risk

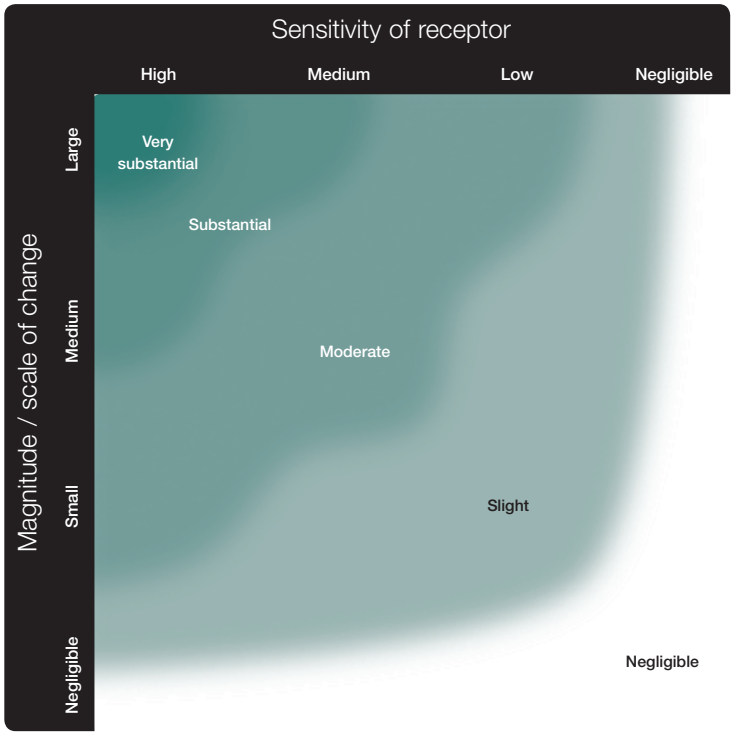
Sensitivity of receptor – Water

Figure 11.4 Receptor sensitivity (water environment)

Magnitude of change – Water

Figure 11.5 Impact magnitude (water environment)

Determination of significance matrix – Water



Degrees of effect

Very substantial:
Wholesale change to watercourse, water chemistry, erosion and sedimentation characteristics within areas protected for their environmental importance or significance as water supply sources.

Substantial:
Wholesale or fundamental changes to water bodies, which are not water supply sources, but of good quality. Wholesale and/or moderate changes to associated erosion/sedimentation patterns and water chemistry. Also, moderate changes to watercourse, water chemistry, erosion and sedimentation characteristics within areas protected for their environmental importance or significant as water supply sources.

Moderate:
Wholesale and/or fundamental changes to water bodies of average quality, and features of local interest. Also minor changes to important water bodies such as those in areas protected for their environmental significance, water bodies of good quality, and both water supply and non-water supply sources.

Slight:
Small changes to water bodies of local interest or of average water quality.

Not significant:
No change to water bodies of poor quality and artificial watercourses.

Professional judgement can be used to vary the category of significance where specific circumstances dictate, for example due to the vulnerability or condition of the receptor.

The reason for and nature of any variation will be made clear in the assessment.

Figure 11.6 Degree of effect matrix (water environment)

Figure 11.7
Water features