Horse Hill Developments LTD

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Details to include revision number, a description of the revision indicating paragraphs and pages that have been revised, together with the date and approved signature.

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0	Draft	19/10/16	
1	For Review	21/10/16	
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6	Revised for Permit Variation for Drilling and Production	26/07/19	TH
7	Revised for Permit Variation to include EWT on HH-3 to HH-6	18/10/19	TH
8	Revised for Permit Variation Schedule 5 Notice	01/10/20	TH
9	Revised to Remove Outdated Figures in Section 6	26/01/21	TH

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1. INTRODUCTION

Horse Hill Developments LTD (HHDL) is a Limited Company that was formed to manage the exploration and production activities at the Horse Hill Well Site. HHDL is a consortium of natural resource companies and owns a 65% interest and operatorship of Petroleum Exploration and Development Licence (PEDL) 137 within which the Horse Hill Well Site is located.

HHDL is the holder of a number of Environmental Permits issued by the Environment Agency in accordance with the Environmental Permitting (England and Wales) Regulations 2016. The current permitted activities at the Horse Hill Well Site allow the undertaking of the following activities:

EPR/BB3300XG - A mining waste operation for the management of extractive waste from prospecting mineral resources, not involving a mining waste facility.

A mining waste operation for the management of non-hazardous extractive liquid waste and gas, from prospecting for mineral resources not including a waste facility resulting from well testing operation. No more than 10 tonnes of natural gas may be flared each day.

EPR/BB3691NN - The discharge of clean surface water off-site during periods of non-operational activity. Discharges to surface water may not take place during drilling, flow testing or well testing.

EPR/SP3339YS - The loading, unloading, handling or storage of, or physical, chemical or thermal treatment of crude oil with a capacity of no more than 500 tonnes.

EPR/AB3498DZ - SR 2014 No4 Permit for the Accumulation and Disposal of radioactive waste from the NORM Industrial Activity of the production of oil and gas.

As the development continues to progress, additional permitted activities have been identified as being necessary. As a result, HHDL have prepared an application to vary the environmental permits with the purpose of gaining permission to undertake the following activities:

- Construct up to four (4) new additional boreholes (HH-3/HH-4/HH-5/HH-6) in addition to the current two (2) boreholes (HH-1/HH-2) already constructed at the Horse Hill Well Site **(EPR/BB3300XG)**;
- Harness at least one (1) of the six (6) boreholes as a reinjection well for the purpose of providing production support **(EPR/BB3691NN)**;
- Undertake well treatments such as an acid wash and solvent treatments **(EPR/BB3300XG)**;
- Undertake a 90 day well test for each of the additional wells (HH-3/HH-4/HH-5/HH-6) before later being added to the portfolio of production wells at the site or being abandoned **(EPR/BB3300XG)**;
- Undertake an injectivity test within HH-2 (HH-2z) and any other wells as dictated by HHDL **(EPR/BB3691NN)**;
- Incinerate natural gas at a rate not exceeding 10 tonnes per day during production operations, until such a time that it can be demonstrated that the incineration of natural gas is no longer considered Best Available Technique through a cost benefit analysis **(EPR/BB3300XG)**;

HHDL will continue to undertake the following activities at the site in accordance with the current permissions presented within the permit:

- Store and handle crude oil up to a capacity of 500 tonnes within the existing infrastructure and within the current permitted boundary. Permit **EPR/SP3339YS** will not be the subject of a permit variation.

2. SCOPE

This Waste Management Plan is applicable to the 2019 environmental permit application. It is applicable to HHDL, its contractors and subcontractors and can be used in support of applications to the Environment Agency under the Environmental Permitting (England and Wales) Regulations 2016 (EPR2016), where there is a requirement to provide a Waste Management Plan.

Environmental Permits, which are subject to the Mining Waste Directive, cover the management of extracted waste and not the extraction process. This Waste Management Plan has been drafted such that it aligns with the management of extracted waste and not the extraction process.

3. DEFINITIONS

“	Inch
API	American Petroleum Institute
bbl	Barrel
BS	British Standard
$CaCl_2$	Calcium Chloride (Salt)
$CaCO_3$	Calcium Carbonate (Rock)
CO_2	Carbon Dioxide (Gas)
EPR2016	Environmental Permitting (England and Wales) Regulation 2016
EWC	European Waste Catalogue
EWT	Extended Well Test
ft	Feet
H_2O	Water
HCl	Hydrochloric Acid
HDPE	High Density Polyethylene
HHDL	Horse Hill Developments LTD
m	Metres
m^3	Metres cubed
MD	Measured Depth
mm	Millimetre
NORM	Naturally Occurring Radioactive Material
PEDL	Petroleum Exploration and Development License
RP	Recommended Practices
RPS	Radiation Protection Supervisor
RWA	Radioactive Waste Advisor
SCC	Surrey County Council
TVDSS	True Vertical Depth Sub-Sea
WFD	Waste Framework Directive

4. ENVIRONMENTAL LEGISLATION AND APPLICABILITY

The Horse Hill Well Site is the subject of a number of activities which, under current environmental legislation, requires an environmental permit. The Environment Agency regulate all permitted activities under the Environmental Permitting (England and Wales) Regulations 2016, as amended (EPR2016). Under EPR2016, Operators are required to submit environmental permit applications to the Environment Agency to seek approval to undertake such activities.

Onshore oil and gas developments have been the subject of the environmental permitting regulations since 1st October 2013, and as such a number of environmental permits have already been obtained. This Waste Management Plan aims to update the Environment Agency on the proposed drilling and production activities to be conducted at the Horse Hill Well Site and the associated permits which will be varied.

4.1 Industrial Emissions Activity

The Industrial Emissions Directive 2010/75/EU lays down rules on integrated prevention of pollution arising from industrial activities, whilst also laying down rules designed to prevent or, where that is not practicable, to reduce emissions into the air, water and land and to prevent the generation of waste, in order to achieve a high level of protection of the environment taken as a whole.

Schedule 1, Part 2 of EPR2016 details a number of activities that are classified as an Industrial Emissions Activity including 'Energy Activities' (Chapter 1) and 'Waste Management' (Chapter 5). Energy Activities include the storage of crude oil, whilst Waste Management includes the incineration of waste, a description of each has been provided below.

Schedule 25A and Schedule 25B details a number of activities that fall within the regulatory regime of medium combustion plants and specified generators.

4.1.1 Oil Storage

Schedule 1, Part 2, of EPR2016 transposes the requirements of the Industrial Emissions Directive, which requires an environmental permit to authorise an installation for gasification, liquefaction and refining activities, as detailed within Section 1.2, Part A(1) including the loading, unloading, handling or storage of, or the physical, chemical or thermal treatment of crude oil.

The operations will continue to involve the handling and storage and unloading of oil or condensate and as such the existing permit **EPR/SP3339YS** is still considered suitable and relevant.

4.1.2 Incineration of Natural Gas

Schedule 1, Part 2 of the EPR2016 transposes the requirements of the Industrial Emissions Directive, which requires an environmental permit to authorise an installation operation for Incineration and co-incineration of waste, as detailed within *Section 5.1, Part A(1):*

(a) The incineration of hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 10 tonnes per day;

The operations will not involve the incineration of natural gas exceeding 10 tonnes per day and therefore under EPR2016 a permit is not required. HHDL are currently in possession of an environment permit **(EPR/BB3300XG)** which allows for the incineration of natural gas no greater than 10 tonnes per day. During the extended well test phase on each of the additional wells the flare will be used as a waste incineration device. In addition, gas is expected to be incinerated as a safety measure to ensure that excess gas is safety disposed of in an emergency scenario at any time during the proposed production operations.

4.1.3 Medium Combustion Plants and Specified Generator

Operators of medium combustion plant and specified generators that are in scope will require an environmental permit under schedule 25A and 25B of EPR2016. A permit to operate both is determined by the capacity, emissions and operating hours of the plant.

Medium Combustion Plant (MCP) applies to combustion plants with a rated thermal input (th) equal to or greater than 1MW (Megawatt) and less than 50MW regardless of the fuel type.

Specified Generators (SG) are combustion plants which are used to generate electricity and are on a site aggregated to less than 50MWth (Megawatt Thermal). Specified generators are also divided into Tranche A and B depending on the electricity supply contract they may have.

A single diesel generator shall be in place at the site to provide electricity which is considered by HHDL as meeting the definition of 'mobile' in so far as it has been designed to move or be moved whether on roads or other land. The generator in use currently at the site has been designed so as to be easily transported via a flatbed trailer, and has dedicated lifting points. As a result of ongoing operations, the generator may need to be re-located around the site as dictated by operations.

HHDL acknowledge that the installation of fixed MCP and SG, such as those used for gas management, would be the subject of a separate permit application, would require a MCP permit as defined under Schedule 25a and 25b of EPR2016, as amended.

4.2 Mining Waste Activity

Schedule 20 of EPR2016 defines a mining waste operation as being the management of extractive waste, whether or not it involves a waste facility. Under EPR2016, an environmental permit is required to authorise a mining waste operation.

The proposed operations involve the management of non-hazardous extractive waste, not including a waste facility. Environmental Permit **EPR/BB3300XG** has been issued by the Environment Agency which covers the mining waste activities being undertaken at the Horse Hill Well Site.

HHDL are applying to vary the existing permit to include waste streams associated with the drilling of four new boreholes, additional well testing and production.

4.3 Water Discharge Activity

Schedule 21 of EPR2016 relates to water discharge activities, including the discharge or entry to inland freshwaters, coastal waters or relevant territorial waters of any trade effluent. Environmental permit EPR/BB3691NN will be varied to allow for the discharge of surface water during production activities from the well pad. During extended well testing and production operations the potential for hazardous substances at the site will be significantly lower than that of drilling and workover operations. Drilling operations and any well workovers during the lifetime of the development will require the surface water to be collected via a licenced haulier to an Environment Agency permitted waste facility with the interceptor isolated and closed off to prevent the discharge of water.

A Surface Water Management Plan (HHDL-EPR-HH-SWMP-013) shall provide details of the monitoring and testing regime to enable either the discharge of surface water from the site or to utilise it for production support via reinjection. The Surface Water Management Plan has been provided as part of an application to the Environment Agency.

4.4 Groundwater Activity

Under Schedule 22 of EPR2016, an activity that could involve the discharge of pollutants into groundwater must be notified to the Environment Agency, together with the nature of these pollutants. The Environment Agency will then determine whether the groundwater activity needs to be permitted.

During production operations produced water is expected to be produced alongside oil. The produced water produced, together with rain water collected within contain bunds will flowed down the reinjection well and injected into the Portland Sandstone (a producing formation) for the purpose of providing production support and facilitating the production of hydrocarbons. Reinjection is considered a groundwater activity and as such a groundwater activity permit is being sought under Schedule 22 of EPR2016.

The act of discharging substances to groundwater is termed a "Groundwater Activity" and is controlled by EPR2016. There are exemptions within the regulations that are related to de minimis amounts of discharge, relative to the quality of the receiving groundwater, which result in a trivial impact.

Schedule 22, Paragraph 3 of EPR2016 states:

"(3) The regulator may determine that a discharge, or an activity that might lead to a discharge, is not a groundwater activity if the input of the pollutant –

(b) is or would be of a quantity and concentration so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater,"

The drilling of production wells will be undertaken using both Water Based Mud (WBM) and Low Toxicity Oil Based Mud (LTOBM). LTOBM will be used at depths below 400m bgl, the depth at which groundwater is considered to lose its resource value. Any water encountered in the Jurassic strata below this depth will be poor quality and is likely to contain hydrocarbons. Any mud losses during drilling will be very low and considered de minimis; and will not present a deterioration in the quality of the receiving groundwater. It is therefore considered that the drilling of additional wells will not constitute a groundwater activity.

A Surface Water Management Plan and Site Drainage Plan shall provide details of the monitoring and testing regime to enable either the discharge of surface water from the site or to utilise it for production support via reinjection. The Surface Water Management Plan and Site Drainage Plan (has been provided as part of an application to the Environment Agency.

4.5 Radioactive Substances Activity

Schedule 23 of EPR2016 provides for the control of Naturally Occurring Radioactive Material (NORM). Schedule 23 defines the production of oil and gas as a NORM industrial activity and therefore any accumulation of radioactive waste, which exceeds concentration threshold set out in Table 1 of Schedule 23, and its subsequent disposal, requires an environmental permit to authorise a radioactive substances activity.

A SR2014 No4 Permit (EPR/AB3498DZ) is currently in place.

5. CRITERIA FOR DETERMINING THE CLASSIFICATION OF WASTE FACILITIES

In addition to the management of extractive waste, well sites may require environmental permits that also cover the deposit or accumulation of extractive waste in a waste facility. The definition of a waste facility is based on the well site having a designated area for the accumulation or deposit of waste subject to certain timescales, depending on the nature and source of the waste.

Article 3 (15) of the Mining Waste Directive defines a waste facility as *any area designated for the accumulation or deposit of extractive waste whether in a solid or liquid state or in solution or suspension, for the following time periods:*

- *No time-period for Category A waste facilities and waste characterised as hazardous in the waste management plan;*
- *A period of more than six months for facilities for hazardous waste generated unexpectedly;*
- *A period of more than one year for facilities for non-hazardous non-inert waste; and*
- *A period of more than three years for facilities for unpolluted soil, non-hazardous prospecting waste, waste, resulting from extraction, treatment and storage of peat and inert waste.*

The well site will not involve the accumulation or deposit extractive waste exceeding the timescales specified above. All extractive wastes stored at the well site will:

a) be limited to non-hazardous substances; and
b) be of a short duration, significantly less than 1 year.

A full list of extractive waste streams has been provided within this Waste Management Plan.

5.1.1 Criteria for Determining a Category A Waste Facility

Where the proposed activities include a waste facility, the Operator is required to include an assessment as to whether the proposed facility will be classified as Category A or not.

Where a mining waste facility is to be considered, a review of the mining waste facility against criteria specified within Annex III of the Mining Waste Directive must be undertaken to determine whether or not the mining waste facility should be classified as a Category A Mining Waste Facility. The criteria for determining a Category A Mining Waste Facility is as follows:

a) A failure or incorrect operation e.g. the collapse of a heap or the busting of a dam, could give rise to a major accident, on the basis of a risk assessment taking into account factors such as the present or future size, the location and the environmental impact of the water facility;
b) It contains waste classified as hazardous under Directive 91/689/EEC above a certain threshold: or
c) It contains substances or preparations classified as dangerous under Directives 67/548/EEC or 1999/45/EC above a certain threshold.

Section 5 above provides justification detailing why the operations are not considered a waste facility. The criteria for determining a Category A Waste Facility does not apply to this Waste Management Plan.

6. WASTE GENERATING ACTIVITIES

A waste is defined in Article 3(1) of the Mining Waste Directive by reference to Article 3(1) of the Waste Framework Directive 2008/98/EC. The definition is; 'waste' shall mean any substance or object in the categories set out in Annex I which the holder discards or intends or is required to discard. The wastes are defined in Article 3 of the Directive as inert, non-hazardous or hazardous and are as follows:

Hazardous Waste: The Waste Framework Directive (2008/98/EC) (WFD) sets out what waste is and how it should be managed. The WFD defines some wastes to be hazardous waste. A hazardous waste is defined as a waste that has one or more of the fifteen specified hazardous properties listed in Annex III to the WFD. The application of this is determined by the List of Wastes Decision (2000/532/EC).

Non-hazardous Waste: A waste which is neither classed as inert or hazardous.

Inert Waste: Inert Waste is waste which does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant and in particular not endanger the quality of surface water and/or groundwater.

A summary of the waste generating activities associated with operations at the well site is outlined below, with a more detailed description of each activity provided within each subsection.

- Drilling of Four (4) Additional Wells;
- Undertaking of Production Operations;
- Undertaking of Reinjection Operations; and
- Workovers and Well Treatment Operations (if necessary); and
- The Plugging and Abandoning of the Productions Wells and Reinjection Well.

This Waste Management Plan, sets out the classification of waste streams associated with well site and associated site activities. Waste management arrangements for each waste stream are detailed within Section 7.3 of this Waste Management Plan.

6.1 Drilling of Four (4) Additional Boreholes (HH3/HH4/HH5/HH6)

HHDL are proposing to construct a number of boreholes from the existing well site. It is anticipated that the majority of the boreholes will become production wells with the potential for some to become additional re-injection wells for the purpose of providing production support. To date the HH-1 and HH-2 wells have been constructed at the wellsite which were used to investigate the commercial viability of potential hydrocarbon reservoirs. Extended Well Testing undertaken within the HH-1 well has indicated that presence of hydrocarbons at a volume considered commercially viable. It is for this reason that additional production wells are being considered. HH-2 is being considered as a reinjection well for the purpose of providing production support.

The anticipated extractive waste streams associated with the drilling of borehole are expected to include:

- Water based drilling mud;
- Oil based drilling mud;
- Water based drill cuttings;
- Oil Based Drill cuttings; and
- Brines and Circulation fluid;

For clarity, each well shall be managed so as to ensure its design, construction and lifetime integrity is in line with HHDL Well Planning Design & Operating Standards, which conform to the Offshore Installations and Wells (Design and Construction, etc) Regulations 1996 (DCR) and are each subject to independent well examination. This is the overarching technical and operational set of standards that will be applied specifically to individual wells and their

characteristics. Each well, prior to construction shall be designed and subject of Independent Well Examination in accordance with the Offshore Installations and Wells (Design and Construction, etc) Regulations 1996. As yet the additional wells have yet to be designed in full and so cannot be confirmed at this time. Operators are required under DCR to ensure that each well remains integral and has been design and constructed so as to prevent the unintentional release of fluids throughout its life, even after suspension and abandonment. The description provided below in each subsection is not absolute, but a good indication.

6.1.1 HH-1 Well Description and Proposed HH-1z Sidetrack

The drilling of the original Horse Hill 1 (HH-1) well was drilled in 2014 to a depth of 2,717m (8,915ft) MD / 2,421m (7,942ft) TVDSS into the Triassic. The HH-1 well discovered oil within both the Portland Sandstones and the Kimmeridge Limestones. The well was re-entered in 2016 and a series of short tests confirmed the oil potential of the Portland Sandstone and the Kimmeridge Limestones at KL#4 and KL#3 levels. In 2018 the well was re-entered again for an Extended Well Test which was successful in flowing significant amounts of oil from all three target levels. A cement abandonment plug is currently placed within the 9 $^{5}/_{8}$" (244.475mm) casing.

HHDL currently have the necessary environmental permits in place to undertake the HH-1z sidetrack. However, this has yet to be drilled. The permission to drill the HH-1z well shall be retained within this application.

6.1.2 Reinjection Well HH-2

The HH-2 well was subsequently drilled 4th quarter of 2019 and was drilled to a depth of 708m (2,322ft) MD / 627m (2,056ft) TVDSS and terminated in the Portland Mudstone. From the HH-2 well a sidetrack well known as HH-2z was drilled, kicking off from a depth of 397m (1,301ft) MD / 324m (1,062ft) TVDSS and entered the Portland Mudstone 720m (2,362ft) MD / 620m (2,035ft) TVDSS and reached a total depth of 1,245m (4,086ft) MD / 589m (1,934ft) TVDSS. The HH-2 well (HH-2 and HH-2z) is currently suspended pending reinjection.

6.1.3 HH-3 Borehole

The proposed HH-3 well will commence with the drilling of an initial hole section to accommodate a 13 $^{3}/_{8}$" (339.725mm) surface conductor which will be installed with a conductor setting rig to circa 18m (60ft) and section TD within the impervious Weald Clay formation.

In order to drill the remaining sections of the well an oilfield drilling rig will be mobilised to the well site. Once mobilised, a 12 ¼" (311.15mm) hole section will be drilled using water based mud to a depth of circa 549m (1,800ft) MD with water based mud and 9 ⅝" (244.475mm) casing run and cemented to isolate the shallower section of the well. This will be drilled through the Weald Clay and the Lower Cretaceous Hastings Beds. The exact casing point will be located within the shale section of the Portland sequence.

An 8 ½" (215.9mm) hole section will be drilled to the Top Kimmeridgian formation, circa 756m (2,480ft) MD / 681m (2,233ft) TVDSS, to accurately locate the Upper Portland Sandstone. A core may be cut in the Upper Portland Sandstone with electrical logs also being run. This hole section will be drilled with either water based or oil based mud.

The well(s) will then be plugged back to allow a side-track to be carried out. The drilling of the sidetrack well (HH-3z) will commence with the milling through of the 9 $^{5}/_{8}$" (244.475mm) casing at a depth of circa 396m - 427m (1,300ft - 1,400ft). Once milled, an 8 ½" (215.9mm) hole will be drilled to land horizontally within the Upper Portland Sands circa 747m (2,450ft) MD 549m (1,800ft) TVDSS. A 7" (177.8mm) liner will be run and cemented. A near-horizontal 6" (152.4mm) hole will be drilled to circa 1,661m (5,450ft) MD / 564m (1,850ft) TVDSS staying within the Upper Portland.

A Formation Integrity Test (FIT) will be carried out on the on the casing shoe immediately following the drilling out of the shoe, at the start of the next hole section. For clarity, the purpose of the FIT is to test the integrity of the casing shoe, its ability to withstand anticipated wellbore pressures during the drilling of the next hole section.

6.1.4 HH-4, HH-5 and HH-6 Boreholes

The drilling of each well will commence with the drilling of an initial hole section to accommodate a 20" (508mm) surface conductor which will be installed with a conductor setting rig to circa 18m (60ft) and section TD within the impervious Weald Clay formation.

In order to drill the remaining sections of the well an oilfield drilling rig will be mobilised to the well site. Once mobilised, a 17 $^{1}/_{2}$" (444.5mm) hole section will be drilled using water based mud to a depth of circa 1,549m (1,800ft) MD and a 13 $^{3}/_{8}$ casing run and cemented in place. A 12 ¼" hole section will then commence with the a 9⅝" (244.475mm) casing run and cemented to isolate the shallower section of the well. This will be drilled through the Weald Clay and the Lower Cretaceous Hastings Beds. The exact casing point will be located within the shale section of the Portland sequence.

An 8 ½" (215.9mm) hole section will be drilled to penetrate the complete section of the KL#3 Kimmeridgian circa 975m (3,200ft) MD 884m (2,900ft) TVDSS to accurately locate the KL#3 Limestone. A core may be cut in the KL#3 and KL#4 Limestones and electric logs will also be run. This section will be drilled with either water based or oil based mud.

The well(s) will then be plugged back to allow a side-track to be carried out. The drilling of the sidetrack wells (HH-4z, HH-5z and HH-6z respectively) will commence with the milling through of the 13 $^{3}/_{8}$" (339.725mm) casing at a depth of circa 396m - 427m (1,300ft - 1,400ft). Once milled, a 12 ¼ (311.15mm) hole will be drilled to land within the Kimmeridgian shales circa 914m (3,000ft) MD / 823m (2,700ft) TVDSS in order to isolate the Portland/Purbeck section the 9 $^{5}/_{8}$" (244.475mm) casing will be run and cemented.

An 8 ½" (215.9mm) hole section will be drilled to land horizontally in the KL#3 Limestones at circa 945m (3,100ft) MD / 838m (2,750ft) TVDSS. A 7" liner will be run and cemented. A near-horizontal 6" (152.4mm) hole will be drilled, staying within the KL#3 Limestone. A 4 ½" (114.3mm) slotted liner will be run across the open hole for production.

A Formation Integrity Test (FIT) will be carried out on the on the casing shoe immediately following the drilling out of the shoe, at the start of the next hole section. For clarity, the purpose of the FIT is to test the integrity of the casing shoe, its ability to withstand anticipated wellbore pressures during the drilling of the next hole section.

6.1.5 Reinjection Well

In the event a decision is made to develop a reinjection well in lieu of one of the additional boreholes (HH3-HH6) then a proposed reinjection well will be constructed. It will commence with the drilling of an initial hole section to accommodate a 13 $^{3}/_{8}$" (339.725mm) surface conductor which will be installed with a conductor setting rig to ~18m (60ft). This will be located in the impervious Weald Clay Section. A 12 ¼" (311.15mm) hole will be drilled to a depth of circa 549m (1,800ft) MD with water based mud and a 9 ⅝" (244.475mm) casing run and cemented to isolate the shallower section of the well. This will be drilled through the Weald Clay and the Lower Cretaceous Hastings Beds. The exact casing point will be located within the shale section of the Portland sequence.

An 8 ½" (215.9mm) hole will be drilled to the Top Kimmeridgian circa 756m (2,480ft) MD / 681m (2,233ft) TVDSS to accurately locate the Upper Portland Sandstone. A core may be cut in the Upper Portland Sandstone with electrical logs also being run. This hole section will be drilled with either water based or oil based mud.

6.2 Extended Well Testing

Following the drilling of each of the additional wells, but prior to production operations there may be a requirement to undertake an extended well test (EWT) for the purpose of ensuring that the well is sufficiently cleaned up for long term production. It may be necessary to undertake an EWT on each well i.e. HH-3, HH-4, HH-5 and HH-6. For clarity the HH-1 and HH-2 wells are currently permitted for an EWT activity.

The purpose of the EWT is to ensure that the characteristics (Inc. flowrate) of the associated gas is understood giving HHDL the confidence to utilise the associated gas effectively by means of specified generators for electricity generation at the site, when production operations commence.

During the EWT associated natural gas will be separated from the oil and formation water by means of a 3 phase separator and will be diverted to an enclosed ground flare for incineration. For clarity the activity will not include the incineration of natural gas in excess of 10 tonnes per day.

A Gas Management Plan has been provided to illustrate the assessment undertaken when establishing the 'Best Available Technique' with regards to waste gas management.

6.3 Production Operations

Once the well(s) have been drilled and tested, production tubing and downhole pumping equipment (if required) has been installed, production will be conducted through surface-based equipment, which provides for:

- Shutting in the well at any time with a remotely operable safety valves;
- Control of the production via a "choke manifold";
- Flow of produced reservoir fluids through high-pressure pipework;
- Separation of the produced fluid's 3 phases of oil, gas and water into individually controllable and metered flow streams; and
- Storage of produced oil and produced water in segregated, vented tanks;

Produced fluids (oil and production water) will either free flow to the surface naturally or with the aid of surface pumps, artificially lifting fluids to surface. For clarity, a permit subject to the Mining Waste Directive covers the management of extracted waste and not the extraction process, therefore, the method by which oil, natural gas and associated fluids come to surface is not a material consideration of this waste management plan and associated environmental permits.

At surface, produced fluids and associated natural gas will be diverted by pipework to a crude oil heater, preheating the fluid to aid in the three phase separation process, which will separate out oil, water (if present) and associated natural gas. Oil, which for clarity is not a waste, will be diverted via pipework to dedicated storage tanks onsite for subsequent offsite removal by a licenced haulier to a permitted refinery for sale.

Water, if present, will be diverted via pipework to dedicated storage tanks onsite for subsequent reinjection into the formation for the purpose of production support. In the event production water cannot be re-injected it will be stored pending offsite removal by a licenced haulier to either Environment Agency permitted water treatment facility where it is processed, treated and discharged in accordance with the permitted controls of the water treatment facility.

Water produced during hydrocarbon production has the potential to contain low levels of Naturally Occurring Radioactive Material (NORM). HHDL will appoint a competent Radiation Protection Supervisor (RPS) and/or Radioactive Waste Advisor (RWA) to ensure that NORM is managed correctly.

The anticipated extractive waste streams associated with the production operations are expected to include:

- Production Water;
- Natural Gas;
- Suspension / Circulation Fluid (Brine)

6.4 Groundwater Re-injection

EPR2016 transposes the requirement of the Water Framework Directive (Directive 2000/60/EC) including the conditions required for the injection of water specifically:

'injection of water containing substances resulting from the operations for exploration and extraction of hydrocarbons or mining activities, and injection of water for technical reasons, into geological formations from which hydrocarbons or other substances have been extracted or into geological formations which for natural reasons are permanently unsuitable for other purposes. Such injections shall not contain substances other than those resulting from the above operations'.

The term produced water refers to those waters which result from the exploration and extraction of hydrocarbons that are produced from a well alongside oil and gas.

The proposed activities include the reinjection of produced water into a geological formation from which hydrocarbons will be produced for the purpose of providing production support. A groundwater activity permit is being applied for, to facilitate the proposed reinjection activity.

Reinjection is a recognised strategy within the oil and gas industry to derive value from produced waters. The process of which can be considered, where implemented properly, to be an environmentally attractive management technique while aiding optimisation of the production of oil mainly through maintenance of reservoir pressure.

In a conventional oil and gas reservoir, the pore pressure under which the oil is stored is initially sufficient for hydrocarbons to flow through the rock to the production well. This phase of the reservoir lifecycle is known as primary production. Over time, pore pressure in the reservoir will tend to reduce as it is depleted of the hydrocarbons it previously contained. Depletion has numerous consequences for the reservoir, one of which is reduced reservoir productivity.

To maintain or increase the well's productivity as it becomes depleted, reinjection wells are drilled in the vicinity of the production well to begin the secondary recovery process. The process usually begins with water flooding where water (or potentially a gas under pressure such as carbon dioxide) is used to maintain reservoir pressure and drive the hydrocarbons towards the production well.

In some instances, the volume of reinjection waters required to maintain the necessary pressures is greater than the volume of recovered liquid (that is, the removal of oil leaves a net loss in volume). Where there is a net loss, additional water is required to maintain the required pressures. This net loss will be made up of surface water run-off (where collected appropriately).

Conventional reinjection schemes generally reinject produced water at low pressures over long durations (for example, years to decades). The desired pressures used are typically determined through detailed analysis and modelling based on a range of field data. In essence, conventional operations are trying to optimise injectivity and to this end pressures are used to ensure maintenance of existing pressures and to limit the potential for the creation of new or propagation of existing fractures.

The produced water will be reinjected together with water collected from process areas at the well site for production support. Reinjection pressures will be controlled and monitored to ensure that they do not exceed the fracture gradient of the reinjection formations.

HHDL will ensure that the reinjection volumes are no more than the produced volumes. For example, the water injection profile (fluid in) will match the oil + produced water profile (fluid out).

6.5 Workover and Well Treatments

A number of well treatments are being considered for use at the well site, such treatments, including the chemical additives have already been the subject of review and approval by the Environment Agency via the permitting regime, (see permit EPR/VP3305PT).

All treatment options will be applied to the formation via the existing perforations or open hole within the well bore. The treatment formulation for an oil well includes a corrosion inhibitor to protect steel tubulars and a surfactant to aid in penetration and flow-back. Such treatments are applied to the formation at low pressures and pump rates determined by an injectivity test, resulting in the treatment being displaced into the near well bore formation to remove induced damage and increase the near well bore permeability. For clarity, the chemicals are expected to displaced 10s of centimetres away from the wellbore only and shall be recovered to surface. This includes the reinjection well for acid wash treatments only. Water shall be circulated to recover the spent acid to surface prior to recommencement of reinjection operations.

An injectivity test is an engineering test, which will apply increased pressure to the oil bearing reservoir formation until it reaches a point at which injectivity starts to occur. This, in turn, will determine the maximum pressure that can be applied for a near-wellbore treatment. The applied pressure is controlled by the injection rate (I.e. the pump rate) which is typically very low, in the order of 2 barrels (318 litres) per minute. The fluid used for the injectivity test will be either water or KCl brine.

The typical treatments comprise of:

- A pre-flush (spearhead) of 8m^3 surfactant solution;
- A main treatment of approximately either:
    1. Acid wash of 200-300 bbl (32 – 48m^3) PROTEKT 15 PLUS formulation of 15% hydrochloric acid together with corrosion inhibitor (to protect the steel tubulars from acid corrosion) and surfactants (to aid the acid in entering the formation pores and then returning the spent acid from the well) (7.2m^3 neat);

2. Acid wash of 200-300 bbl (32 – 48m^3) PROTEKT 7 PLUS formulation of 7.5% hydrochloric acid together with corrosion inhibitor (to protect the steel tubulars from acid corrosion) and surfactants (to aid the acid in entering the formation pores and then returning the spent acid from the well) (3.6m3 neat);
3. Acid wash of 200-300 bbl (32 – 48m^3) PROTEKT 14 PLUS formulation of 15% acetic acid together with corrosion inhibitor (to protect the steel tubulars from acid corrosion) and surfactants (to aid the acid in entering the formation pores and then returning the spent acid from the well) (7.2m3 neat);
4. Acid wash of 200-300 bbl (32 – 48m^3) made up of 4.5% w/v CS-SAF-2, 7.5% v/v ORCA B and 1.5% w/v Butanol in 7% w/v KCl solution together with corrosion inhibitor (to protect the steel tubulars from corrosion). (2.16m^3, 3.6m^3 0.24m^3 and 39.6m^3);
5. Xylene Solvent treatment of 160-200 bbl (25.6 - 32m^3) of 100% Xylene. (32m^3);

- A displacement fluid of 20m^3 light potassium chloride or alternatively ammonium chloride brine containing typically 10% ethylene glycol monobutyle ether (EGMBE).

6.5.1.1 Hydrochloric Acid

The proposed dilution of hydrochloric acid (HCl) is to be no greater than 15%, each acid wash is expected to use no more than 15m^3 of 15% dilute hydrochloric acid.

The chemical formula for the use of hydrochloric acid is presented as follows.

Calcium Carbonate (Rock)	+	Hydrochloric Acid	>	Calcium Chloride (Salt)	+	Water	+	Carbon Dioxide (Gas)
$CaCO_3$	+	2HCl	>	$CaCl_2$	+	H_2O	+	CO_2

Once the HCl acid has reacted with the formation it will form a waste stream known as ‘spent acid’ which, following the completion of the acid wash, will be circulated back to surface.

6.5.1.2 Acetic Acid

The proposed dilution of acetic acid is to be no greater than 15%, each acid wash is expected to use no more than 15m^3 of 15% dilute acetic acid.

The chemical formula for the use of hydrochloric acid is presented as follows.

Calcium Carbonate (Rock)	+	Acetic Acid	>	Calcium Acetate (Salt)	+	Water	+	Carbon Dioxide (Gas)
$CaCO_3$	+	CH3COOH	>	$Ca(CH_3COO)_2$	+	H_2O	+	CO_2

Once the acetic acid has reacted with the formation it will form a waste stream known as ‘spent acid’ which, following the completion of the acid wash, will be circulated back to surface.

6.5.1.3 ORCA B and CS-SAF-2

ORCA B and CS-SAF-2 will be used together within a KCl fluid. The acid precursor ORCA B acts as a solvent initially solubilising (microemulsify) hydrocarbons in the near wellbore filter cake. As the ORCA B reaches formation temperature It hydrolyses (break down (a compound) by chemical reaction with water) to generate formic acid and an alcohol bi-product (diethylene glycol). The formic acid reacts with calcium carbonate (present in the filter cake and formation) to generate an aqueous solution of calcium formate and carbon dioxide.

The CS-SAF-2 surfactant is present in the formulation to water-wet the calcium carbonate particles present in the filter cake and allow them to be dissolved by the formic acid generated from hydrolysis of the ORCA B acid precursor. The intention is also to act as a micro-emulsifying surfactant and micro-emulsify the hydrocarbon present in the OBM filter cake. It will be left to soak for a period of 96 hours and the waste stream produced as a result of Calcium Formate (salt), diethylene glycol (66 Litres) and Carbon Dioxide.

The treatment is applied down the drill pipe or production tubing in the well. Once the formation damage-removing treatment has been applied, the well is returned to production via the testing facility.

6.5.2 Xylene

The Xylene acts as solvents to remove any wax/asphaltic materials that may build up on the open hole reservoir formation or well tubulars. It is a common oilfield treatment for this purpose. It is known as an excellent breaker of oil-mud emulsions post drilling. They are used as a solvent and emulsion breaker in workover operations to clean up reservoirs. No waste would be generated, as the returned xylene becomes part of the oil for export from site. It will be left to soak for a period of 24 hours.

It is anticipated that each product will be retrieved from the well and be flowed to surface leaving. UKOG does not anticipate any treatment fluid to remain within the wellbore. Any recovered fluids would be managed onsite in the same way as HCl. Waste fluids will be placed in to a designated waste tank within a bund on the well pad which is lined and contained and will be removed offsite by an approved Environment Agency (EA) waste contractor to an EA approved waste treatment facility.

Other than the above damage removal treatment, well operations may be conducted from time to time during the testing phase in order to:

- Repair or replace the downhole pump;
- Install or remove a downhole shut-in tool with pressure gauges, for acquisition of reservoir pressure data;
- Acquire bottomhole samples of produced fluids;
- Conduct wax removal treatments, which may involve “hot oiling” (see below).

6.5.3 Hot Oil Treatment

Earlier testing confirmed the presence of dissolved waxes in the crude oil that can precipitate in the production tubing and wellbore area, restricting both the flow of hydrocarbons to the well, and the passage of mechanical tools in the tubing. Hot oil washing is a process of removing the build-up of wax precipitates within the production tubing and casing (if affected).

Heated oil, previously produced from the formation, is pumped from the oil storage tanks, via a heater and mobile hot oil pump, and circulated down the well. The hot oil is pumped down the tubing to immediately above the perforations and circulated back to surface, dissolving or dislodging wax precipitates. The returning oil is diverted from the well at surface back to the oil storage tanks, where it is commingled with the produced oil. No extractive waste is generated, as the returned waxy oil becomes part of the oil for export from site. The volume of hot oil required to undertake a single treatment is variable, however it is not expected to exceed 15m^3, per treatment. The frequency of the treatment is impossible to predict, as this is determined by reservoir characteristics.

It is now proposed to conduct hot oil treatments across all of the production wells.

7. MANAGEMENT OF EXTRACTIVE WASTE

The following sections describe the various extractive wastes arising from well site operations, including their classification and anticipated quantities. This section also describes the objectives of HHDL insofar as appropriately managing wastes and how these objectives are achieved through waste minimisation, methods of treatment and disposal.

7.1 Article 5(2) of the 2006/21/EC Mining Waste Directive

Article 5(2) of the 2006/21/EC Mining Waste Directive sets out the objectives of the Waste Management Plan:

(a) to prevent or reduce waste production and its harmfulness, in particular by considering:

- *(i) waste management in the design phase and in the choice of the method used for mineral extraction and treatment;*
- *(ii) the changes that the extractive waste may undergo in relation to an increase in surface area and exposure to conditions above ground;*
- *(iii) placing extractive waste back into the excavation void after extraction of the mineral, as far as is technically and economically feasible and environmentally sound in accordance with existing environmental standards at Community level and with the requirements of this Directive where relevant;*
- *(iv) putting topsoil back in place after the closure of the waste facility or, if this is not practically feasible, reusing topsoil elsewhere;*
- *(v) using less dangerous substances for the treatment of mineral resources;*

In accordance with Article 5(2)(a)(i) of the Mining Waste Directive, the management of waste was identified during the design phase of the proposed operations. The choice of method proposed for production water management will involve the re-use of produced water via a re-injection well to enhance production (production support).

With reference to Article 5(2)(a)(ii) of the Mining Waste Directive, extractive waste generated during the operations does not undergo any changes in relation to surface area or exposure to conditions above ground. It is the intention that all extractive waste generated during operations will be temporarily stored onsite for subsequent offsite treatment and/or disposal at an Environment Agency permitted waste treatment facility or, where produced water is encountered, reinjected into the formation to aid in production support.

The operations will not generate extraction voids. Article 5(2)(a)(iii) of the Mining Waste Directive is, therefore, not applicable to the well site.

The well site is subject to a closure plan upon cessation of operations. The closure plan will set out the details for well site restoration, including the replacement of topsoil currently stored onsite. The reuse of topsoil after closure accords with Article 5(2)(a)(iv) of the Mining Waste Directive.

The treatment of mineral resources shall be limited to those described within the environmental permit application.

(b) to encourage the recovery of extractive waste by means of recycling, reusing or reclaiming such waste, where this is environmentally sound in accordance with existing environmental standards at Community level and with the requirements of this Directive where relevant;

Where reasonably practicable the recovery of extractive waste by means of recycling, reusing or reclaiming will be considered as described within Section 7.3 of this Waste Management Plan.

(c) to ensure short and long-term safe disposal of the extractive waste, in particular by considering, during the design phase, management during the operation and after-closure of a waste facility and by choosing a design which:

- *(i) requires minimal and, if possible, ultimately no monitoring, control and management of the closed waste facility;*
- *(ii) prevents or at least minimises any long-term negative effects, for example attributable to migration of airborne or aquatic pollutants from the waste facility; and*

(iii) ensures the long-term geotechnical stability of any dams or heaps rising above the pre-existing ground surface.

The well site is anticipated to be permitted as a site for the management of non-inert, non-hazardous extractive waste that does not include a waste facility. Following the abandonment and subsequent restoration of the well site no waste, extractive or other shall remain.

7.2 Waste Prevention and Minimisation

The activities will be conducted so as to prevent waste production wherever possible, and to reduce the quantities generated in all other cases applying the Waste Hierarchy Principles. However, the nature of the operations giving rise to the extractive waste that are the subject of this plan means that it is practically impossible to decouple waste creation from the originating process. It is also subject to a degree of variation, and whilst every effort will be made to conserve natural resources and therefore generate as little waste as possible, the precise characteristics encountered in the target reservoir will mean this is subject to change.

Article 4 of the Waste Framework Directive provides a Waste Hierarchy and is described below in order of priority for waste prevention.

Figure 7.1 Hierarchy of Waste Management

7.2.1 Waste Prevention

Every effort will be made to eliminate the waste produced at source. Control measures will include:

- Calculating quantities of required products;
- Avoiding packaged material where practicable;
- Ordering correct quantities;
- Avoiding damage by handling and storing correctly; and
- Using fewer materials in designs and manufacturing.

7.2.2 Preparing for Re-Use

Only dispose of waste which cannot economically or practically be re-used or recycled. Materials such as low toxicity oil based drilling fluids can be readily re-used. Checking, cleaning, repairing and refurbishing of items and spare parts for subsequent re-use.

7.2.3 Recycle

Waste is to be segregated onsite to allow for recycling offsite. Additionally, materials that are recycled shall be procured for use onsite where practicable and where specification permits. Turning wastes into a substance or product including composting subject to quality protocols.

7.2.4 Other Recovery

Other recovery includes anaerobic digestion, incineration with energy recovery, gasification and pyrolysis which produce energy (fuels, heat and power) and materials from waste, some backfilling. These activities will not be undertaken at the site and do not form part of this application.

7.2.5 Disposal

Waste that cannot be reused or recycled practicably shall be disposed of responsibly and in compliance with HHDL duty of care obligations. All waste shall be removed from site by a licenced waste carrier to a licenced waste facility.

7.3 Waste Classification and Management Arrangements

An assessment of the potential extractive wastes arising during the operations has been undertaken. The potential waste, together with its classification anticipated quantities, prevention, minimisation, treatment and disposal is provided in this section.

- Table 7.1 - Water Based Drill Cuttings;
- Table 7.2 - Oil Based Drill Cuttings; and
- Table 7.3 - Water Based Drilling Mud;
- Table 7.4 - Oil Based Drilling Mud;
- Table 7.5 - Well Suspension / Circulation Fluid;
- Table 7.6 - Production Water;
- Table 7.7 - Natural Gas;
- Table 7.8 - Spent (Neutralised) Acid

Water Based Rock Cuttings		
Waste Classification, Quantity and Storage	**Classification**	Non Hazardous
	EWC Code	01 05 08
	Estimated Quantity	550m^3 - Estimate Only
	Onsite Storage	Open Top Cutting Tank
	Odour Potential	No Odour Anticipated
Operation / Activity	Drilling fluids are used in a closed loop system, within which the rock cuttings are circulated to surface and removed by vibrating screens (shakers) into an open top tank, which is also a fluid separator tank. Finer particles of rock cuttings are then extracted from the drilling fluid by a centrifuge and the drilling fluid is circulated back down the well.	
Waste Prevention and Minimisation	The ability to prevent or minimise rock cuttings as a waste stream is limited given that the formation needs to be removed to allow the casing to be installed. The selection of the drilling bit will be such that it minimises the hole size required to install each string of casing which, in turn, keeps the recover to a minimum. The rock cuttings tank is a fluid separator tank (perforated false floor), which allows drilling fluid coating the rock cuttings to percolate down through the false floor where it is collected and pumped back into the closed loop fluid system.	
Waste Treatment and Disposal	Rock cuttings will be transferred from the rock cuttings tank to a sealed road bulker by a hydraulic grab arm fitted to the rock cuttings tank and transported offsite via licenced haulier to a permitted facility where it may be blended into compost after compost has been sanitised or used for the production of building materials.	
Waste Remaining in Formation	None. Extractive process only.	
Monitoring	An inspection of the tank shall be carried out prior to being used and will be subject to regular visual inspections and annual thickness checks.	

Table 7.1: Water Based Rock Cuttings

Oil Based Rock Cuttings		
Waste Classification, Quantity and Storage	**Classification**	Hazardous
	EWC Code	01 05 05*
	Estimated Quantity	500m^3 - Estimate Only
	Onsite Storage	Open Top Cutting Tank
	Odour Potential	No Odour Anticipated
Operation / Activity	Drilling fluids are used in a closed loop system, within which the rock cuttings are circulated to surface and removed by vibrating screens (shakers) into an open top tank, which is also a fluid separator tank. Finer particles of rock cuttings are then extracted from the drilling fluid by a centrifuge and the drilling fluid is circulated back down the well.	
Waste Prevention and Minimisation	The ability to prevent or minimise rock cuttings is limited given that the formation needs to be removed to allow the casing to be installed. The selection of the drilling bit will be such that it minimises the hole size required to install each string of casing which, in turn, keeps the recover to a minimum. The rock cuttings tank is a fluid separator tank (perforated false floor), which allows drilling fluid coating the rock cuttings to percolate down through the false floor where it is collected and pumped back into the closed loop fluid system.	
Waste Treatment and Disposal	Rock cuttings will be transferred from the rock cuttings tank to a sealed road bulker by a hydraulic grab arm fitted to the rock cuttings tank and transported offsite via licenced haulier to a permitted facility where it is physically treated and blended into compost after compost has been sanitised. The physical treatment process consists of oil recovery prior to blending with compost. The physical treatment process is identified within the waste facility's Environmental Permit as: 'R3: Oil Recovery from Waste.'	
Waste Remaining in Formation	None. Extractive process only.	
Monitoring	An inspection of the tank shall be carried out prior to being used and will be subject to regular visual inspections and annual thickness checks.	

Table 7.2 Oil Based Rock Cuttings

Water Based Drilling Fluid		
Waste Classification, Quantity and Storage	**Classification**	Non Hazardous
	EWC Code	01 05 08
	Estimated Quantity	1,800m^3 Estimate Only
	Onsite Storage	Open Top Tank System on Rig
	Odour Potential	No Odour Anticipated
Operation / Activity	Drilling fluids are used to aid in the drilling process by lubricating the drill bit, circulating to surface the rock cuttings from the drilling process and for well control by maintaining a prescribed hydrostatic pressure within the well to prevent the uncontrolled release of natural gas or formation pressure. Drilling fluids are used in a closed loop system, within which the rock cuttings are circulated to surface and removed by vibrating screens (shakers). Finer particles of rock cuttings are extracted from the drilling fluid by a centrifuge and the drilling fluid is circulated back down the well.	
Waste Prevention and Minimisation	Drilling fluid waste is minimised by continually reusing the fluid in a closed loop system and sustained by way filtering out rock cuttings and finer particles of rock. The rock cuttings tank is a fluid separator tank (perforated false floor), which allows drilling fluid coating the rock cuttings to percolate down through the false floor where it is collected and pumped back into the closed loop fluid system. Whenever the drilling fluid weight exceeds the prescribed fluid weight, due to finer particles of rock cuttings in the fluid, the drilling fluid needs to be diluted. Dilution may require the removal of a prescribed volume of active drilling fluid and diluting the remaining volume with new drilling fluid. Periodically, the drilling fluid system will be completely changed, which will depend on the formation being drilled. The drilling fluid supplier may request that the drilling fluid is returned to them for reclamation for further use with or without treatment at another well site independent from HHDL.	
Waste Treatment and Disposal	Drilling fluids are used in a closed loop system and become a waste when no longer required for use in the operation. In such an event the drilling fluid will be transferred from the active fluid system on the drilling rig to a vacuum tanker for removal offsite via licenced haulier to a permitted composting facility where it is blended into compost after compost has been sanitised.	
Waste Remaining in Formation	None. Any drilling fluids remaining within the formation exist as a filter cake on borehole wall and forms part of the well construction. It is not considered a waste.	
Monitoring	An inspection of the fluid system shall be carried out prior to being used and will be subject to regular visual inspections and annual thickness checks.	

Table 7.3 Water Based Drilling Fluid

Oil Based Drilling Fluid		
Waste Classification, Quantity and Storage	**Classification**	Hazardous
	EWC Code	01 05 05*
	Estimated Quantity	1,800m^3 Estimate Only
	Onsite Storage	Open Top Tank System on Rig
	Odour Potential	No Odour Anticipated
Operation / Activity	Drilling fluids are used to aid in the drilling process by lubricating the drill bit, circulating to surface the rock cuttings from the drilling process and for well control by maintaining a prescribed hydrostatic pressure within the well to prevent the uncontrolled release of natural gas or formation pressure. Drilling fluids are used in a closed loop system, within which the rock cuttings are circulated to surface and removed by vibrating screens (shakers). Finer particles of rock cuttings are extracted from the drilling fluid by a centrifuge and the drilling fluid is circulated back down the well.	
Waste Prevention and Minimisation	Drilling fluid waste is minimised by continually reusing the fluid in a closed loop system and sustained by way filtering out rock cuttings and finer particles of rock. The rock cuttings tank is a fluid separator tank (perforated false floor), which allows drilling fluid coating the rock cuttings to percolate down through the false floor where it is collected and pumped back into the closed loop fluid system. Whenever the drilling fluid weight exceeds the prescribed fluid weight, due to finer particles of rock cuttings in the fluid, the drilling fluid needs to be diluted. Dilution may require the removal of a prescribed volume of active drilling fluid and diluting the remaining volume with new drilling fluid. Periodically, the drilling fluid system will be completely changed, which will depend on the formation being drilled. Where possible Oil-based Drilling Fluid will be returned to the supplier for further use, thereby eliminating the waste stream.	
Waste Treatment and Disposal	Drilling fluids are used in a closed loop system and become a waste when no longer required for use in the operation. In such an event the drilling fluid will be transferred from the active fluid system on the drilling rig to a vacuum tanker for removal offsite via licenced haulier to a permitted composting facility where it is blended into compost after compost has been sanitised.	
Waste Remaining in Formation	None. Any drilling fluids remaining within the formation exist as a filter cake on borehole wall and forms part of the well construction. It is not considered a waste.	
Monitoring	An inspection of the fluid system shall be carried out prior to being used and will be subject to regular visual inspections and annual thickness checks.	

Table 7.4 Oil Based Drilling Fluid

Well Suspension Brine / Circulation Fluid		
Waste Classification, Quantity and Storage	**Classification**	Non Hazardous
	EWC Code	01 05 08
	Estimated Quantity	50m^3 Per workover / Well Suspension
	Onsite Storage	Storage Tanks
	Odour Potential	No Odour Anticipated
Operation / Activity	The wells may be subject to a period of suspension using suspension brine plugs. Following suspension any further operations will require the suspension brine to be circulated out of the well to an onsite storage tank via temporary surface pipework. The fluid may also be used in workovers as circulation fluid.	
Waste Prevention and Minimisation	The suspension brine will be stored onsite for subsequent reuse as a suspension brine for the well at a later date when the well will need to be suspended again.	
Waste Treatment and Disposal	Once the suspension fluid has fully served its purpose at the well site, the suspension brine will be removed from site via a licenced haulier to an Environment Agency permitted waste water treatment works facility where it is processed, treated and discharged in accordance with the permitted controls of the water treatment facility.	
Waste Remaining in Formation	None. Suspension brine is circulated out prior to well intervention and/or flow testing.	
Monitoring	An inspection of the fluid tanks that contain the suspension fluid shall be carried out prior to being used and will be subject to visual weekly inspections and annual thickness checks.	

Table 7.5 Well Suspension Brine / Circulation Fluid

Produced Water		
Waste Classification, Quantity and Storage	**Classification**	Non-Hazardous
	EWC Code	01 01 02
	Estimated Quantity	Unknown
	Onsite Storage	Storage Tanks
	Odour Potential	No Odour Anticipated
Operation / Activity	During production operations there is a possibility of produced water (formation water) being produced together with hydrocarbons. Produced water is separated from the hydrocarbons at surface using fluid separation equipment and transferred via temporary pipework to storage tanks.	
Waste Prevention and Minimisation	Produced Water will be separated from oil and gas and stored onsite pending re-injection into the formation for the purpose of production support. In the event produced water cannot be re-injected it will be the subject of offsite treatment and disposal.	
Waste Treatment and Disposal	Produced water if not re-injected, will be transported via a licenced haulier to either an Environment Agency permitted waste water treatment works facility where it is processed, treated and discharged in accordance with the permitted controls of the water treatment facility, or to a bespoke RSR permitted waste treatment facility for treatment and disposal in accordance with the Best Available Technique (BAT).	
Waste Remaining in Formation	None. Produced water naturally occurs within certain hydrocarbon bearing formations and is only considered as a waste when produced from the wellbore.	
Monitoring	A Radioactive Waste Advisor will be appointed for the well testing operations in accordance with the general management arrangements as detailed within SR2014 No 4 Permit. A contamination monitoring programme will be devised and include the wellhead temporary separator equipment and storage tanks. Consignment of produced water will be screened externally for contamination prior to leaving site. An inspection of the fluid tanks that contain the produced water shall be carried out prior to being used and will be subject to visual inspections and annual thickness checks.	

Table 7.6 Produced Water

Natural Gas		
Waste Classification, Quantity and Storage	**Classification**	Hazardous
	EWC Code	16 05 04*
	Estimated Quantity	<10 Tonnes Per Day
	Onsite Storage	None – Incineration by Flare
	Odour Potential	No Odour Anticipated
Operation / Activity	During operations associated natural gas is expected to be produced alongside oil and produced water.	
Waste Prevention and Minimisation	During the EWT of each well, natural gas will be diverted via pipework to an enclosed ground flare for incineration to enable HHDL to understand the characteristics of the associated gas. The natural gas will be utilised onsite during the production phase to provide electricity to the well site with excess electricity generated being exported to the national grid. The infrastructure required to suitably store natural gas onsite in a liquid state for subsequent offsite transfer to a liquid natural gas receiving facility it is not feasible for emergency scenarios.	
Waste Treatment and Disposal	Associated natural gas which is sent to the enclosed flare unit for incineration is to be considered a waste. This includes both the EWT phase and in the event of an emergency scenario. Associated natural gas will be used as a fuel to generate electricity during the production phase of the proposed development.	
Waste Remaining in Formation	None. Natural gas naturally occurs within certain hydrocarbon bearing formations and is only considered as a waste when produced from the well and flared.	
Monitoring	Flaring operations will be managed through onsite supervision and safety and performance systems to ensure its effectiveness and efficiency.	

Table 7.7 Natural Gas

Spent Acid		
Waste Classification, Quantity and Storage	**Classification**	Non Hazardous
	EWC Code	01 05 08
	Estimated Quantity	25m^3 Per Workover / Clean Up
	Onsite Storage	Closed Storage Tank
	Odour Potential	No Odour Anticipated
Operation / Activity	Acid is used to remove production-resisting completion-induced formation damage. As the acid reacts with minerals within the formation the chemical reaction produces a near neutral solution. This operation may be repeated a number of times within each well across the lifetime of the development as part of planned maintenance.	
Waste Prevention and Minimisation	The acid will be used in stages to ensure its use is minimised. The reaction of the acid with minerals produces a near neutral solution. This reaction, and in turn the waste generated, is unavoidable. Careful planning will be taken prior to any acid being undertaking to ensure to minimal amounts of acid is used, which in turn reduces the amount of waste generated by the operation.	
Waste Treatment and Disposal	The spent acid will be lifted out of the wellbore into a closed tank and stored onsite for subsequent removal via a licenced haulier to an Environment Agency permitted waste water treatment works facility where it is processed, treated and discharged in accordance with the permitted controls of the water treatment facility.	
Waste Remaining in Formation	None. The reaction of the acid with the minerals produces chlorides, which are classified as non-hazardous. The chloride solution will be lifted out of the formation and collected at surface.	
Monitoring	Competent supervisors will oversee the operation ensuring the correct volumes of acid are used. The storage tanks will be inspected prior to use to ensure they are suitable for holding both acid and spent acid.	

Table 7.8 Spent Acid

7.3.1 Non-Extractive Waste

During the operations there will be a number of non-extractive waste streams generated, including:

- Surface run-off water;
- Foul water and sewage;
- Waste engine, gear and lubricating oils;
- Waste hydraulic oils;
- Oil rags and absorbents;
- Waste oil filters;
- Waste Packaging
- Paper and cardboard;
- Canteen waste;
- Cement;
- Wood;
- Mixed Municipal Waste;
- Metal.

7.3.2 Waste Supervision and Carriers

HHDL is ultimately accountable for waste management at the site. During operations, the management of waste generated at the well site will be delegated to the Well site Supervisor, appointed by HHDL to exercise overall control of the well site operations, in accordance with the Borehole Sites and Operations Regulations 1995 and the Waste (England and Wales) Regulations 2011.

The management of waste onsite will include:

- Management of waste in accordance with the waste hierarchy, as set out in the Waste (England and Wales) Regulations 2011;
- Monitoring of all waste storage units such as skips and storage tanks;
- Liaison with third party waste advisors with respect to sampling and analysis of waste;
- Compiling all waste transfer notes; and
- Managing the collection and offsite disposal of all waste streams.

HHDL will appoint competent waste dealers or brokers and carriers, responsible for the transportation of all waste streams to the relevant Environment Agency permitted waste treatment facility. Waste dealers or brokers and carriers will hold relevant certificates issued by the Environment Agency, which shall be inspected prior to being appointed.

8. ENVIRONMENTAL AND HUMAN IMPACT

The well site has been designed and constructed with consideration for both environmental and human impacts. All permitted activities will take place within the contained area of the well site to mitigate against adverse impact to the environment

The well site has been designed to ensure complete containment of any spillages in the unlikely event they occur onsite. An enclosed perimeter containment ditch has been excavated and installed around the perimeter of the well site, with all storage tanks being installed within contained bunded areas. Following the excavation of the perimeter containment ditch, the well site was overlaid with an impermeable membrane to provide well site integrity and ensure that any surface run off liquids, either rain water or spillages, flow to the perimeter containment ditch

Details of the current construction and installation of the impermeable membrane are detailed within the Site Condition Report (HHDL-EPR-HHP-SCR-006) provided in support of the environmental permit application to vary the existing permit.

During operations, all hazardous substances will be stored within the well site, ensuring that in the unlikely event of a spillage, hazardous substances will be contained within the well site, preventing the migration or percolation of hazardous substances offsite. No hazardous substances shall be stored outside of the active area of the well site.

An Environmental Risk Assessment has been undertaken The Environmental Risk Assessment has been undertaken in accordance with Environment Agency guidance. The qualitative risk assessment has considered odour, noise, fugitive emissions, dust, air emissions, releases to water environment, waste, global warming potential, and potential for accidents and incidents as these relate directly to the activities. The Environmental Risk Assessment has also identified the potential hazards associated with the extractive wastes, including the risk they pose and the control measures that HHDL will adopt in order to mitigate all risks identified.

The assessment concluded that with the implementation of appropriate risk management measures, potential hazards from the activities are likely to be insignificant due to the control measures proposed by HHDL. Any environment or human impact is expected to be negligible.

Measures to minimise the environmental and human impact of the exploratory operations have been incorporated as part of the initial site selection process, site design and construction. The measures to mitigate long term environmental impact are:

- Site located suitable distance from residential properties;
- Site design to include impermeable membrane and containment ditches;
- Wellbore lifecycle designed to protect groundwater;
- Hierarchy of waste management;
- Operating procedures and inductions;
- Waste handling, storage and disposal regime;
- Continuous training and development;
- Environmental monitoring; and
- Restoration and aftercare.

Should the proposed operations be confirmed to be a COMAH establishment by the Competent Authority HHDL will undertake a further risk assessment (independent to the permit application process) in accordance with the Chemical and Downstream Oil Industries Forum guidance which provides a screening mechanism by which environmental receptors can be reviewed. The purpose of the risk assessment is to that demonstrates the environmental risk for the whole COMAH establishment has been reduced to a tolerable level, the risk assessment will be viewed by the Competent Authority prior to the commencement of COMAH activities. The COMAH activity relating to the proposed operations relates to the storage of large volumes of crude oil.

9. SURFACE WATER MANAGEMENT

The Horse Hill Well Site currently holds an environmental permit (EPR/BB3691NN) for the discharge of surface water from the well site. The permit relates to the discharge of site drainage (rainfall related runoff) from the site when the rig and all associated drilling related equipment have left the site. i.e. during periods of inactivity. The site drainage passes through a Class 1 SPEL Oil bypass separator before being discharged to a tributary of Spencer's Gill via a submerged pipe.

The Class 1 SPEL Oil bypass separator has been designed manufactured and will continue to be maintained according to European Standards BS EN 858-1-2.

The permit will be varied to allow for the discharge of surface water during production activities from the well pad. Once full time production is undertaken the potential for hazardous substances at the site will be significantly lower than that of drilling and workover operations. Produced oil will be contained within pipework and will not come into contact with the site surface. In the event of a leak or spillage, the contaminated area will be remediated and hazardous waste (contaminated site surface) will be disposed of accordingly via a licenced haulier to a licenced waste facility. Surface water will continue to be monitored routinely, with monitoring also taking place following a leak or spillage. Drilling operations and any well workovers during the lifetime of the development will require the surface water to be collected via a licenced haulier to an Environment Agency permitted waste facility with the interceptor isolated and closed off to prevent the discharge of water. Surface water may be used for reinjection in parallel with drilling operations, but this shall be the subject of treatment in accordance with the approved Surface Water Management Plan.

The existing well site is constructed with a 300mm granular sub-base material over a geo-grid forming a granular working platform; this overlies a 1mm thick HDPE liner. The liner itself is underlain and overlain by protective layers of geotextile material composed of non-woven fleece. This system prevents infiltration of contaminants or contaminated water into the underlying soil and rock. This working surface and liner will be retained.

HHDL are applying to vary to discharge surface run-off water during normal operations and during any periods of inactivity. All hazardous substances will be stored in secondary containment bunds to capture any spillages, ensuring that spills remain isolated from the surface water on the site.

9.1 Surface Water Management Operating Technique

HHDL submitted a surface water management operating technique (HSE-HH1-PF-09) in support of a previous permit application in August 2016 for the discharge of surface water at the existing Horse Hill Well Site. This section provides an outline of the monitoring techniques to be implemented at the well site which for clarity are the same as those already approved and enforced by the Environment Agency. The existing well site surface drainage system and sampling and analysis procedures will continue to operate as normal.

The current site provides containment through containment ditches where water will percolate through the site surface and flows along to the lined containment ditched where it is retained. The Oil bypass separator which again is designed, manufactured and will continue to be maintained according to European Standards BS EN 858-1-2. All hazardous substances will be stored in secondary containment bunds to capture any spillages, ensuring that spills remain isolated from the surface water on the site.

9.1.1 Sampling and Analysis

Prior to the first discharge of surface water from the site monthly, water samples will be collected to ensure that the collected surface water has not picked up any contaminants such as hydrocarbons, the results will indicate whether or not hydrocarbons have been introduced to the site surface as a result of a spill. Previous operations have indicated that the surface water sampled from the containment ditch have had a Total Petroleum Hydrocarbon (TPH) (C10-C40) level of <35 µg/l. Based on previous levels of TPH the presence of the separator is immaterial due to achieving results of 5mg/l.

Table 9.1 below provides summary of the parameters to be monitored for together with the monitoring standard. This again is consistent with the operating procedures previously approved by the Environment Agency.

Parameter	Monitoring Frequency	Monitoring Standard or Method	EQS (or equivalent)
pH	a) Once prior to the first discharge. b) Monthly thereafter.	BS ISO 10523	pH between 6 - 9
Ammoniacal Nitrogen (N)		BS EN ISO 11732	0.5 mg/l
ATU-BOD as O_2		BS EN 1899-1	1 mg/l
COD as O_2		BS 6068-2.34	10 mg/l
Total Arsenic as As		BS EN ISO 11969	50 µg/l
Total Cadmium as Cd		BS EN ISO 5961	0.9 µg/l
Chlorine		SCA blue book 51 ISBN 0117516260	250 mg/l
Chromium VI		BS 6068-2.47 ISO 11083	3.4 µg/l
Total Copper as Cu		BS 6068-2.29 ISO 8288	10 µg/l
Total Iron as Fe		BS EN ISO 15586	1000 µg/l
Total Lead as Pb		BS 6068-2.29 ISO 8288	7.2 µg/l
Manganese		Must ensure LOD is less than EQS.	300 µg/l
Total Mercury as Hg		BS EN1483	0.07 µg/l
Total Nickel as Ni		BS 6068-2.29 ISO 8288	20 µg/l
Total Zinc as Zn		BS 6068-2.29 ISO 8288	75 µg/l
Benzene		Must ensure LOD is less than EQS.	50 µg/l
Toluene		Must ensure LOD is less than EQS.	380 µg/l (95 percentile)
Xylene		Must ensure LOD is less than EQS.	30 µg/l

Table 9.1: Monitoring Parameters

Once the sample has been analysed, the results will be compared against the EQS (Environmental Quality Standard) or equivalent. Should the EQS be met the water will be considered 'clean' and not contaminated and is available to discharge in accordance with the conditions of the environmental permit. Should however the results of the analysis indicate that the EQS have not been met by even a single parameter i.e. a pH of 9.1. then the water will be considered contaminated and will be collected via a vacuum tanker to a licenced waste facility. Only once the results of the analysis concluded that they meet the EQS can the collected water be considered suitable for discharge. HHDL will forward the sampling and analysis report, along with the previous report(s) to the Environment Agency for review and request written approval to discharge water. Only then will the discharge of surface water recommence.

It is assumed this discharge will occur around 1-2 weeks after the initial water samples were taken. In the interim period, when the valves are closed, if torrential rain threatens to overflow the perimeter ditches, HHDL will tanker the water within the ditches off site for disposal at a permitted disposal facility.

The Environment Agency will be provided the sampling and analysis results as required by the environmental permit once varied. The current proposal is to monitor the surface water on a monthly basis, however this frequency may increase should the analysis show consistent levels above the EQS, advice would be sought from the Environment Agency should this be the case.

Once written approval has been received from the Environment Agency following a reporting of 'contaminated surface water', HHDL will open the valves to the Class 1 Bypass Separator in order to commence discharging the water from the well site. The maximum daily volume of effluent to be discharged from the site will be 362.88m^3 based on a maximum flow rate of approximately 4.2 litre/second as per the Qbar Greenfield Runoff Rate calculated in Microdrainage.

On commencement of the discharge, a water sample will be taken from the effluent sampling point at field dyke sample location point (TQ 25306 43549) and sent to the laboratory for analysis. The parameters and LOD of the techniques that will be used to analyse the sample will be the same as those listed above. The analysis report will be sent to the Environment Agency for their records. A visual inspection will also be made of the field dyke to confirm that the discharge is not having an adverse visible effect. The output will be inspected on a regular basis to ensure that the quality of the water has not deteriorated in any way. This will be carried out every time a sample is taken, or more often if there has been a long rainy period.

Once the valve is open, a monthly testing regime will be carried out at the effluent sampling point (field dyke sample location point), depending on the water flow.

Should there not be any flow from the site at the effluent sample point, a response will be made to the Environment Agency advising that there was no discharge and a sample could not be taken. Results will be sent in on a quarterly basis unless samples show the returns to be outside of the given parameters.

If any of the concentrations are greater than the EQS, then the discharge would be considered to be contaminated. In this event the input and output valves to the separator would be shut as soon as reasonably practicable and any fluid within the perimeter ditches would be tankered off site for disposal.

HHDL to notify the Environment Agency of any breach of EQS as soon as reasonably practicable and no later than 7 days after HHDL receives the analysis report. HHDL to also notify the Environment Agency of the period that the valve was left open after the sample was taken. Once an EQS has been breached and the valves are closed.

Upon receipt of an analysis report from the laboratory, showing that the results indicate that the water is uncontaminated, HHDL will forward the report, along with ALL other previous sampling reports to the Environment Agency for inspection and request that written approval is provided to allow the discharge from the well site to commence.

10. CONTROL AND MONITORING OF WASTE AND EMISSIONS

A brief description of the waste controls and monitoring processes is provided below.

10.1 Releases to Groundwater

The potential for a release to groundwater exists both at surface and within the subsurface and have been assessed and included within the Environmental Risk Assessment, provided in support of the environmental permit application to vary the existing permit.

10.1.1 Surface Release

The existing well site is constructed with a 300mm granular sub-base material over a geo-grid forming a granular working platform; this overlies a 1mm thick HDPE liner. The liner itself is underlain and overlain by protective layers of geotextile material composed of non-woven fleece. This system prevents infiltration of contaminants or contaminated water into the underlying soil and rock. This working surface and liner will be retained.

The permit will be varied to allow for the discharge of surface water during production activities from the well pad. Once full time production is undertaken the potential for hazardous substances at the site will be significantly lower than that of drilling and workover operations.

Monitoring of the surface water will be undertaken in accordance with HHDL Operating Technique (HSE-HH1-PD-09).

10.1.1.1 Liner Integrity

A liner inspection regime will be designed consistent with EA guidance documents *LFE8: Geophysical testing of geomembranes used in landfill*. In spite of the guidance being primarily designed for landfill engineering it can inform the use of geo-membranes in other industries including onshore oil & gas exploration. Adopting the methodology will ensure the integrity of the lining system is maintained during operations consistent with *CIRIA 736: Containment Systems for the Prevention of Pollution*.

The primary objectives of the scheme would be:

- Detect potential leaks in the HDPE membrane;
- Investigate the potential for dissolution features in the bedrock and recommend remediation measures if necessary; and
- Investigate the integrity of the engineered upper surfaces (including the membrane layer) and recommend appropriate remediation measures if necessary.

It is likely that leaks within the HDPE membrane would be detected by way of an Electrical Leak Location Survey (see Figure 10.1). This involves establishing an electrical potential between two transmitting/receiving electrodes across an insulating membrane and the underlying sub-strata. A leak in a membrane creates a characteristic flip in the polarity of measured readings across an isolated area indicative of a potential leak derived from any unintended opening, perforation, slit, tear puncture, crack, hole, cut, or similar breach which may allow the passage of liquid.

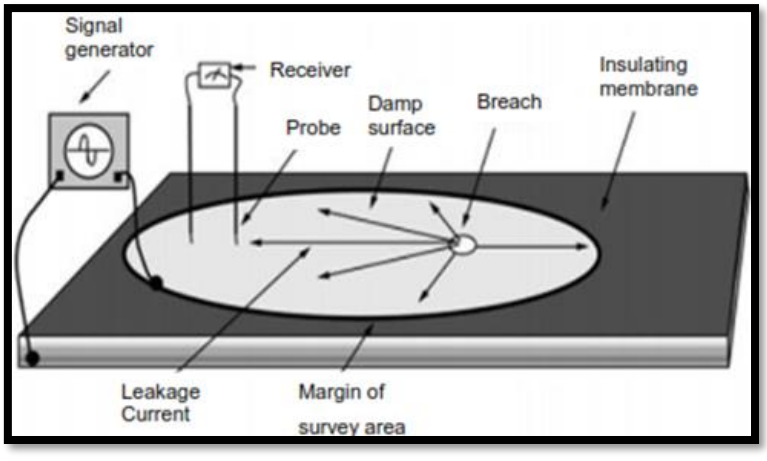

Figure 10.1: Indicative Electrical Leak Location Survey Arrangement

It is likely that potential dissolution of the bedrock would be detected by way of a Ground Penetrating Radar Survey generating detailed cross-sectional images that identify shallow features of interest, subsurface voiding or dipping geological boundaries. This survey involves the transmission of a pulsed electro-magnetic (radio) wave and the recording of any returning reflections. The transmitted waves are focused into the ground and can penetrate soils, rock and concrete. Waves reflected from geological or hydrological boundaries can be observed as 'point' sources indicative of voids or anomalies.

It is likely that the integrity of the engineered upper surfaces would be monitored by way of an Electromagnetic Ground Conductivity Survey generating contour plans of the variation in ground conductivity across the site. Conductive materials e.g. clay, water and some contaminants can be distinguished from areas of sediment, dry zones or bedrock.

These non-invasive methods have been used on other well sites to establish the integrity of HDPE membranes, identify void spaces in the underlying bedrock and anomalies in the engineered upper surfaces of constructed well pads.

HHDL are proposing to conduct such non-intrusive integrity testing every three (3) years or following the demobilisation of drilling and workover rigs, whichever is sooner. Records of tests shall be held by HHDL and shall act on repairing any deficiencies in liner integrity.

10.1.2 Subsurface Release

Subsurface releases are mitigated by adopting the best practice approach to well site construction and wellbore construction. Dilute (15%) Hydrochloric Acid will be introduced to the formation at levels considered de-minimis and will not constitute a ground water activity. All fluids introduced to the formation(s) by HHDL shall be recovered and will not remain within the formation (subsurface).

10.2 Release to Air

An Air Quality Impact Assessment has been undertaken. The Air Quality Impact Assessment has assessed that the impact to human health receptors has been assessed as negligible and the impact on air quality over the 21 years as being insignificant.

The Air Quality Impact Assessment is included within the Site Condition Report, provided in support of the environmental permit application.

10.3 Odour

Extractive wastes generated are not ordinarily malodorous, nor are any of the associated processes that will be performed. Measures will be taken to minimise all fugitive emissions which may cause odours.

The potential of odour releases has been assessed and included within an Odour Management Plan provided in support of the environmental permit application to vary the existing permit.

10.4 Waste Management

The quantity of each waste will be recorded as it is removed from site. All records of waste movements (extractive and non-extractive wastes) will be retained by the operator and made available for inspection by the Environment Agency on request.

10.5 Natural Gas or Oil

In the event of any unexpected release of natural gas or oil releases, the Environment Agency will be notified in accordance with the environmental permit requirements. Details to be recorded will include the volume of unexpected release, together with the mitigation measures taken to manage and reduce the likelihood of any reoccurrence. The records will be made available to the Environment Agency on request, presumably as a follow up following the initial notification. A Leak Detection and Repair Plan (HHDL-EPR-HHP-LDAR-010) has been provided as part of the permit application

10.6 Contractor Performance

HHDL is ultimately responsible for any waste generated onsite during the operations and will not delegate its responsibilities or accountabilities as Operator to a contractor.

Contractors, who are involved in the generating of waste and subsequent reuse, recycle or disposal will first have been selected in accordance with the HHDL management system.

10.7 Security

Security of the well site is provided in the form of a security fence and lockable access gates. The positioning of, both permanent and temporary equipment, will be within the confines of the security fence.

During operations it may be necessary to have manned security. Manned security will control access and egress to the well site and will play a key role in the control of personnel in the event of an emergency situation, in accordance with the Site Safety Document, a requirement of the Borehole Sites and Operations Regulations 1995.

10.8 Complaints

In the event that a complaint is received from stakeholders, including neighbours, the complaint shall be recorded and investigated in accordance with HHDL management processes.

Complaints relating to the environment will be reported to the Environment Agency within the required timescales, as determined by the severity and environmental impact of the incident initiating the complaint and/or permit conditions. In some cases, permit conditions will require notification the Environment Agency within 24 hours or without delay for a potentially polluting incident.

Following notification, measures to prevent reoccurrence will be agreed with the Environment Agency, together with a programme for implementation. Implementation of the actions will be monitored and the Environment Agency informed.

11. ENVIRONMENTAL INCIDENT MANAGEMENT

The potential for an environmental incident to occur during operations is minimal. The source of such incident is contained within the wellbore and contained within the well site.

11.1 Containment Within the Wellbore

During operations, wellbore control equipment and/or pressure control equipment will be deployed on the wellbore in accordance with the relevant American Petroleum Institute (API) Recommended Practices (RP) and/or applicable British Standard (BS). Wellbore control equipment and/or pressure control equipment is subject to a schedule of certification and testing, together with a requirement for those operating wellbore control equipment to be certified competent.

11.2 Well Site Containment

Incorporated into the design of the well site is a HDPE impermeable membrane. The impermeable membrane prevents surface fluids (mainly rainwater) from penetrating the underlying subsoils. Surface fluids migrate along the surface of the impermeable membrane to a perimeter ditch, where it is contained.

In addition, general spill containment and clean up equipment is provided onsite. In the very unlikely event of an environmental incident occurring beyond the capabilities of the equipment or personnel onsite then a specialist contractor will be called to assist HHDL in dealing with the incident.

11.3 Fire Response

Whilst a fire is associated more so with the health and safety of the personnel onsite, a fire does have the potential to lead to an environmental incident. It is imperative, therefore, that any potential for a fire and subsequent emergency response is identified and included in the operational planning. The Site Safety Document, which is a requirement under Regulation 7 of the Boreholes Sites and Operations Regulations 1995, specifies the arrangements for identification and mitigation in the event of a fire, including consultation with the local Fire & Rescue Service.

In addition, it is expected the site will be classified as an upper tier COMAH site and as such will be the subject of a Major Accident and Prevention Policy and the preparation of a Safety Report under The Control of Major Accident Hazards Regulations 2015.

Containment of any firefighting fluid is provided by the impermeable membrane incorporated in to the design of the well site. In the event that such requirements were to be necessary, continued monitoring of the containment ditch shall be implemented to ensure it does not exceed its containment capacity.

11.4 Incident Reporting and Investigation

All incidents, no matter how minor, are reported in accordance with HHDL management systems. The procedures therein provide for the investigation of all incidents to ensure lessons are captured and actions implemented to avoid reoccurrence.

In addition, the procedure provides for the notification to the relevant Regulatory Authority in the event of an incident which extends beyond the containment of the well site.

Environmental incidents will be reported to the Environment Agency within the required timescales, as determined by the severity and environmental impact of the incident and/or permit conditions. In some cases, permit conditions will require notification to the Environment Agency within 24 hours or without delay for a potentially polluting incident.

Following notification, measures to prevent reoccurrence will be agreed with the Environment Agency, together with a programme for implementation. Implementation of the actions will be monitored and the Environment Agency informed.

12. ALTERATIONS TO THE PLAN

Any required changes or deviations from this waste management plan are to be referred to the HHDL management team or, during operations, to the Well site Supervisor in the first instance. No changes to or deviations from this waste management plan are to be implemented until the required changes or deviations have been reviewed and approved by HHDL and the relevant approvals obtained in writing from the Environment Agency for any changes to the plans and operating techniques approved under the environmental permits to be issued.

Within the environmental permits there will be a requirement for the operator, HHDL, to review the waste management plan every five (5) years and amend where necessary. The review date shall take place five (5) years from the date of permit issue. Reviews and amendments will also be required in the event of a substantial change(s) to the operations taking place onsite.

In some cases, changes to operations will require the environmental permit to be varied in order to accommodate such changes. In this instance an application will be made to the Environment Agency to vary the existing permit or apply for a new permit.

13. PROPOSED PLAN FOR CLOSURE

Following the cessation of operations a decision may be made to close the site resulting in subsequent wellbore abandonment and well site restoration.

13.1 Well Abandonment

If a decision is made to restore the well site, the boreholes will be abandoned in accordance with Oil & Gas UK Guidelines for the abandonment of wells, which requires all distinct permeable zones penetrated by the wellbore to be isolated from each other and from surface by a minimum of one permanent barrier. If any permeable zone penetrated by the wellbore is hydrocarbon-bearing or over-pressured and water-bearing then the requirement is for two permanent barriers from surface, the second barrier being a back-up to the first.

In addition to the Oil & Gas UK Guidelines for the abandonment of wells, the borehole abandonment(s) will be undertaken in accordance with the following regulations:

- The Borehole Sites and Operations Regulations 1995, and
- Offshore Installations and Wells (Design & Construction, etc.) Regulations 1996

Prior to any abandonment a full wellbore abandonment programme will be submitted to the HSE and the appointed Independent Well Examiner for review and examination. The wellbore abandonment programme does not form part of the Well Testing programme.

Wastes arising from the wellbore abandonment phase are detailed within Section 7.3 of this Waste Management Plan.

13.2 Well Site Restoration

All extractive waste brought to surface will be stored temporarily on site as detailed within Section 7.3 of this Waste Management Plan. No extractive waste brought to surface or non-extractive waste generated at surface shall remain onsite following completion of the operations.

The purpose of the site restoration is to ensure that the well site is returned to its former use, in a condition that is as close as reasonably practically possible to its original condition, prior to well site construction. The restoration will typically involve the following activities as detailed within each subsection below.

The well site will be restored following the abandonment of the boreholes and removal of surface equipment. Full details of the proposed well site restoration will be included within the Site Condition Report, which will be submitted as part of an application to surrender the environmental permit.

No extractive wastes will be produced during the well site restoration phase.

13.2.1 Pre-Restoration Site Clearance

All surface equipment will be purged clean and dismantled for offsite reuse. The well site containment systems and associated management of surface water will continue to be implemented until all equipment has been removed from the site and the wellbore has been decommissioned.

A wellbore that has been designed, independently examined and reviewed by the HSE to ensure integrity, which in turn is constructed and subsequently decommissioned in accordance with applicable regulation, guidance and industry best practice, represents no risk of contamination.

The boundary fencing will be dismantled and removed prior to site restoration works. Temporary Heras fencing, if necessary, will be used to maintain security of the site once the boundary fencing has been removed. On completion of the site restoration works, all boundary fencing and temporary Heras fencing will be removed.

13.2.2 Surface Water Containment System

All surface water containment systems will be emptied using vacuum tankers for subsequent offsite treatment and/or disposal at an Environment Agency permitted waste water treatment works.

Once the containment systems are empty of surface water and surface aggregate will be carefully removed exposing the impermeable membrane. The impermeable membrane will then be removed and the geotextile and subsoil below

the impermeable membrane carefully inspected for signs of contamination. In the unlikely event that localised contamination is identified, the contaminated area will be excavated for subsequent offsite treatment and/or disposal at an Environment Agency permitted waste facility.

The impermeable membrane will be removed for subsequent offsite recycling and/or disposal at an Environment Agency permitted waste facility.

The drilling cellar will be dismantled and the concrete removed from site for subsequent offsite recycling and/or disposal at an Environment Agency permitted waste facility.

The open voids as a result of removal of the surface water containment system and drilling cellar, will be infilled with sub-soil stored on the site during site construction.

13.2.3 Timing

Landscape proposals shall be implemented during the first planting season following the cessation of operations at the well site.

13.2.4 Soil Management

The cultivation of sub-soil and the replacement/cultivation of top-soil is weather dependent. Timescales are estimated assuming both the sub-soil and top-soil are in a suitably dry non-plastic state such that damage to its structure shall be avoided.

The subsoil and topsoil should be in a non-compacted state, such that the growth of roots is unimpeded and drainage water can percolate down through the profile relatively freely to the naturally permeable strata.

The topsoil mound will be redistributed over the previously surfaced area of the site to a minimum depth of 300mm and reseeded using a grassland mix.

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APPENDIX 1 - CHEMICAL INVENTORY

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APPENDIX 2 - SAFETY DATA SHEETS

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