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NYMNPA
21/12/2023

Date: 21 December 2023
Our ref: 50303/04/HS/JCx/27246392v1

Dear Rob

North York Moors: Ladycross Plantation - Application to Partially Discharge Conditions 4, 18, 34, 42, 52, 57, 59, 60, 65, 68, 70, 71, 76, 80, 88, 89, 90, 91, 92, 93, 94 and 95 of Planning Permission NYM/2017/0505/MEIA

On behalf of our client, Anglo American Woodsmith Limited, we are pleased to submit this application for limited and partial approval of Planning Conditions 4, 18, 34, 42, 52, 55, 57, 59, 60, 65, 68, 70, 71, 76, 80, 88, 89, 90, 91, 92, 93, 94 and 95 of Planning Permission NYM/2017/0505/MEIA.

The Project will be delivered in a series of Phases within each discrete part of the overall consented area. This application relates solely to Phase 8 works at Ladycross Plantation.

Background

On 19 October 2015, the NYMNPA granted planning permission for the *"Winning and working of polyhalite by underground methods including the construction of a minehead at Dove's Nest Farm involving access, maintenance and ventilation shafts, the landforming of associated spoil, the construction of buildings, access roads, car parking and helicopter landing site, attenuation ponds, landscaping, restoration and aftercare and associated works. In addition, the construction of an underground tunnel between Doves Nest Farm and land at Wilton that links to the mine below ground, comprising 1 no. shaft at Doves Nest Farm, 3 no. intermediate access shaft sites, each with associated landforming of associated spoil, the construction of buildings, access roads and car parking, landscaping, restoration and aftercare, and the construction of a tunnel portal at Wilton comprising buildings, landforming of spoil and associated works"* (Council Reference NYM/2014/0676/MEIA).

NYM/2014/0676/MEIA was approved subject to 95 planning conditions and a Section 106 Agreement.

On 6 February 2017, the NYMNPA granted planning permission for the *"Variation of Condition 5 of planning permission NYM/2014/0676/MEIA to allow minor material amendments relating to that part of the development at the Woodsmith Mine site (formerly known as Doves Nest Farm and Haxby*

Plantation), including; re-design of foreshafts and shaft construction methodology, changes to building layout and shaft access arrangements, revisions to construction and operational shaft platform levels, revisions to location and layout of surface water attenuation ponds, revisions to groundwater management arrangements and amendments to internal access arrangements" (Council Reference NYM/2017/0505/MEIA).

The amended scheme (NYM/2017/0505/MEIA) was approved subject to 98 planning conditions and a deed of variation to the originally approved Section 106 Agreement.

Phase 8 Works

The Phase 8 works comprise:

- Drilling of an exploratory borehole;
- Temporary installation and use of drilling rig and ancillaries and;
- Decommissioning of borehole.

Partial Discharge

Anglo American acknowledges that limited and partial approval of Planning Conditions 4, 18, 34, 42, 52, 57, 59, 60, 65, 68, 70, 71, 76, 80, 88, 89, 90, 91, 92, 93, 94 and 95 when given, does not constitute permission to undertake works other than those described, and that such works remain subject to the approval of other conditions.

This approach has been discussed and agreed with your Planning Team and is consistent with the approach taken at the Woodsmith Mine site.

Application Submission

The application was submitted via the planning portal on 21 December 2023 (reference PP-12641005) and comprises the following documentation:

- Completed application form;
- Application drawings – Please see Appendix 1;
- Supporting Documents – Please see Appendix 1.

The requisite planning application fee of £145 has been paid online by credit card.

Conclusion

We trust that this application provides you with the necessary information to be able to partially discharge the above conditions to cover Phase 8 site works at Ladycross Plantation. However, should you require any further information, please do not hesitate to contact me.

Yours sincerely

James Cox
Associate Director
BA (Hons) MA MRTPI

Annex 1: **Supporting Documents**

Table 1 Supporting Documents

Condition No	Description	Document Name / Number	Further Details
N/A	N/A	Listed Plans	40-STS-LC-2100-PA-22-20126– Ladycross Plantation Phase 8 General Arrangement 40-STS-LC-2100-PA-22-20124– Ladycross Plantation Phase 8 Phasing Plan
4	Phasing Plan	40-STS-LC-2100-PA-22-20124– Ladycross Plantation Phase 8 Phasing Plan	N/A
18	Noise & Vibration	Phase 8 Ladycross Plantation Noise and Vibration Management Plan - 40-STS-LC-2100-EN-PL-00038	N/A
34	Construction Traffic Management Plan	Phase 6 Ladycross Plantation Construction Traffic Management Plan - 40-STS-LC-2100-LG-PL-00007	To manage the potential impacts of construction traffic associated with the Phase 6 works at Ladycross Plantation, a Construction Traffic Management Plan (CTMP; Reference 40-STC-LC-2100-LG-PL-00007) was submitted to North York Moors National Park Authority and North Yorkshire County Council (local highway authority). The Contractors have confirmed that the total numbers of employees working out of Ladycross Plantation during the proposed Phase 8 works would not lead to an exceedance of the daily target numbers of vehicle movements currently permitted by the Phase 6 CTMP. Whilst the Phase 8 works will require HGV deliveries, the Contractors have confirmed that the demand for deliveries can be accommodated within the daily targets set out in the Phase 6 CTMP. The Phase 8 works are expected to require approximately 10 abnormal indivisible load (AIL) deliveries. The routing and timing of these AIL deliveries will be subject to separate agreement

Condition No	Description	Document Name / Number	Further Details
			with the local highway authorities and police through the established Electronic Service Delivery for Abnormal Loads system (ESDAL) process. It is considered that the targets, measures and monitoring processes contained within the Phase 6 CTMP would be appropriate to manage the additional construction activities proposed as part of Phase 8.
42	Access	Refer to CEMP (Condition 93)	Access arrangements will remain as per earlier phases. Further details regarding the proposed parking, manoeuvring and turning areas that will be utilised in this phase are also set out in the Construction Method Statement and Listed Plans.
52	Protected Species Management Plan	Ladycross Plantation Phase 3 Protected Species Management Plan – Bats – 40-STS-LC-2100-EN-PL-00001 Ladycross Plantation Phase 3 Protected Species Management Plan – Breeding Birds – 40-STS-LC-2100-EN-PL-00002 Ladycross Plantation Phase 3 Protected Species Management Plan – Reptiles – 40-STS-LC-2100-EN-PL-00003 Ladycross Plantation Phase 3 Protected Species Management Plan – Badgers – 40-STS-LC-2100-EN-PL-00004 Ladycross Plantation Phase 3 Protected Species Management Plan – Water Voles – 40-STS-LC-2100-EN-PL-00005	Please also refer to the Phase 8 CEMP (Condition 93).
57	Landscape & Ecological Management Plan	Ladycross Plantation – Phase 3 Works – NYMNPA 57 Landscape & Ecological Management Plan– 40-STS-LC-2100-EN-PL-00014	The Phase 3 LEMP will remain applicable for the Phase 8 works.

Condition No	Description	Document Name / Number	Further Details
59	External Lighting	Refer to CEMP (Condition 93)	N/A
60	Surface Water Drainage	40-STS-LC-2100-PA-22-20123– Ladycross Plantation Phase 7 Drainage Layout Ladycross Plantation – Phase 3 Works – NYMNPA 60 and 80 Surface Water Drainage Scheme – 40-STS-LC-2100-PA-PL-20102	The Phase 7 drainage layout and Phase 3 Surface Water Drainage Scheme remain applicable to the Phase 8 works.
65	Temporary Fencing	Refer to Construction Method Statement (Condition 94)	Please also refer to CEMP (Condition 93).
68	Temporary Structures	Refer to Construction Method Statement (Condition 94)	Please also refer to CEMP (Condition 93).
70	Arboricultural Method Statement	Ladycross Plantation Phase 3 Arboricultural Method Statement – 40-STS-LC-2100-CN-MS-00003	Please also refer to CEMP (Condition 93).
71	Hard & Soft Landscaping	40-STS-LC-2100-PA-22-20125– Ladycross Plantation Phase 8 Hard and Soft Landscaping Plan	N/A
76	Soil Management Plan	Ladycross Plantation – Phase 3 Works – NYMNPA 76 Soil Management Plan – 40-STS-LC-2100-EN-PL-00007	The Phase 3 Soil Management Plan will remain applicable for the Phase 8 works.
80	Surface Water Drainage	40-STS-LC-2100-PA-22-20123– Ladycross Plantation Phase 7 Drainage Layout Ladycross Plantation – Phase 3 Works – NYMNPA 60 and 80 Surface Water Drainage Scheme – 40-STS-LC-2100-PA-PL-20102	See Condition 60 above
88	Hydrogeological Risk Assessment	Ladycross Plantation – Phase 8 Works – NYMNPA Condition 88 & 90 Hydrogeological Risk Assessment – 40-STS-LC-2100-EN-RA-00005	N/A
88	Ground Water & Surface Water Monitoring Scheme	Ladycross Plantation – Phase 8 Works – NYMNPA Condition 88 Construction & Operation Groundwater & Surface Water Monitoring Scheme – 40-STS-LC-2100-EN-PL-00037	Please also refer to Phase 8 HRA.

Condition No	Description	Document Name / Number	Further Details
89	Remedial Action Plan	Ladycross Plantation – Phase 8 Works – NYMNPA Condition 88 & 90 Hydrogeological Risk Assessment – 40-STS-LC-2100-EN-RA-00005	N/A
90	Groundwater Management Scheme	Ladycross Plantation – Phase 8 Works – NYMNPA Condition 88 & 90 Hydrogeological Risk Assessment – 40-STS-LC-2100-EN-RA-00005	N/A
91	Emissions	Phase 8 Ladycross Plantation Emissions to Atmosphere - 40-STS-LC-2100-EN-PL-00039	N/A
92	CVPMP	Phase 8 Ladycross Plantation Construction Vehicle & Plant Management Plan - 40-STS-LC-2100-LG-PL-00010	N/A
93	CEMP	Phase 8 Ladycross Plantation Construction Environmental Management Plan – 40-STS-LC-2100-EN-PL-00036	N/A
94	Construction Method Statement	Phase 8 Ladycross Plantation Construction Method Statement – 40-STS-LC-2100-CN-MS-00009	Listed plans.
95	Written Scheme of Investigation	Refer to CEMP (Condition 93)	40-COT-LC-8324-EN-PL-00002 – Ladycross Plantation - Written Scheme of Investigation for an Archaeological Watching Brief – Phase 2

NYMNPA

21/12/2023

Project Title / Facility Name:

Woodsmith Project

Document Title:

CONSTRUCTION METHOD STATEMENT - PHASE 8 - LADYCROSS

Document Review Status

- [x] 1. Reviewed – Accepted – Work May Proceed — By: Charlotte Bell
- [ ] 2. Reviewed – Accepted As Noted, Work May Proceed, Revise & Resubmit — On: 21 Dec 2023 11:28
- [ ] 3. Reviewed – Work May Not Proceed, Revise & Resubmit
- [ ] 4. For information only
- [ ] 5. On Hold – Pending Project Restart & Ramp Up

Rev.	Revision Date (dd mmm yyyy)	Reason For Issue	Prepared by	Verified by	Approved by
E	20-Dec-2023	Planning	PLA			
D	19-Dec-2023	Planning	PLA			
C	11-Dec-2023	Planning	PLA			
B	11-Oct-2023	Planning	PLA			

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40-STS-LC-2100-CN-MS-00009

WOODSMITH PROJECT

(788.5030)

CONSTRUCTION METHOD STATEMENT – PHASE 8 – LADYCROSS PLANTATION / 40-STS-LC-2100-CN-MS-00009

Revision	Date of issue	Prepared by	Checked by	Approved by	Changes
A (PLA)	25/09/2023	CT	Efrain Castro	C Fryer	First issue
B (PLA)	11/10/2023	CT	Efrain Castro	P Gill	Revision in accordance with rev A comments
C (PLA)	11/12/2023	J Allison	C Thomas	C Fryer	Revision post comments
D (PLA)	19/12/2023	E Castro	C Thomas	C Fryer	Revision in accordance with rev C comments
E (PLA)	20/12/2023	E Castro	C Thomas	C Fryer	Revision in accordance with rev D comments

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1. INTRODUCTION

1.1. OVERVIEW

This document has been prepared on behalf of Anglo American and details the Construction Method Statement for the Phase 8 construction activity at Ladycross Intermediate Shaft Site

Anglo American are constructing a Mineral Transport System (MTS) tunnel, as part of the wider Woodsmith Project. The tunnel will be used to transport polyhalite from the Woodsmith Mine site to the Material Handling Facility (MHF) at Wilton, Teesside. Safe and efficient construction and operation of the tunnel requires the construction of an intermediate shaft at Ladycross to provide access to the tunnel.

This document builds on the previous Construction Method Statements (CMS) for the previous phases of works.

This report only details the construction works required for the Phase 8 works at Ladycross.

The CMS provides an overview of the resource requirements, the plant and materials that are anticipated to be used during the Phase 8 construction works at Ladycross. It includes the measures to be taken to ensure that the works are carried out in accordance with the requirements of both the planning permission and of Anglo American and, above all, are carried out safely and in compliance with all statutory obligations.

In addition, while not submitted to the Planning Authority, all site works are controlled by a Risk Assessment and Method Statement (RAMS) process, which identify the resources, plant, materials and specific controls required for all scopes of work.

The Phase 8 Scope of Works is as follows:

- Drilling of an exploratory Borehole;
- Temporary Installation and use of drilling rig and ancillaries;
- Decommissioning of Borehole.

A site plan is provided separately.

Table 1 - 1 Condition NYMNPA-94: Construction Method Statement

NYMNPA 94 Compliance	Compliance
Prior to the commencement of each phase of the development at Dove's Nest Farm or Ladycross Plantation in accordance with the approved Phasing Plan, a Construction Method Statement shall be	This **Phase 8 Construction Method Statement**

NYMNPA 94 Compliance	Compliance
submitted for that phase, and approved in writing by the MPA, in consultation with the appropriate Highway Authority. Each approved Statement shall be adhered to throughout the construction period. The Statements shall provide for:	
(i) The parking of vehicles of site operatives and visitors clear of the highway;	**Section 2.3** **Phase 6 Construction Traffic Management Plan**
(ii) Loading and unloading of plant and materials;	**Section 2.5** **Phase 6 Construction Traffic Management Plan**
(iii) Storage of plant and materials used in constructing the development;	**Section 2.6**
(iv) Erection and maintenance of security fencing;	**Section 2.2**
(v) Wheel washing facilities;	**Section 2.9**
(vi) An outline construction method for sub-surface works including adherence to the 'rack and pillar' method of mining described in the SEI (14th February 2015) and the SRK Subsidence Memorandum (15th May 2013);	This type of work is not required in Phase 8
(vii) Buildings and structures associated with the mine and tunnel shafts;	**Section 3**
(viii) Welfare/office building and security gatehouse;	**Section 2.2**
(ix) Screening bunds;	**Phase 8 Noise Vibration Management Plan**
(x) Hardstandings;	**Section 3**

NYMNPA 94 Compliance	Compliance
(xi) Shuttle Bus terminal;	**Phase 6 Construction Traffic Management Plan**
(xii) Park-and-Ride layby;	This type of work is not required in Phase 8
(xiii) Emergency helipad;	This type of work is not required in Phase 8
(xiv) Lighting columns;	**Section 2.8** **Phase 8 Construction Environment Management Plan**
(xv) Internal access and haul roads;	**Section 2.7**
(xvi) Domestic wastewater (foul sewage) treatment plant;	**Section 2.10**
(xvii) Non-domestic wastewater treatment plant and settlement tanks;	**Section 2.10**
(xviii) Surface water attenuation ponds, settlement ponds, swales and wetland areas;	**Phase 3 Surface Water Management Plan** and **Phase 3 Surface Water Drainage Scheme**
(xix) Temporary spoil and Polyhalite storage areas;	This type of work is not required in Phase 8
(xx) Removal of any temporary structures; and	**Section 3.5**
(xxi) Formation of spoil mounds and the establishment of vegetation on them.	**Section 3.3** and **CEMP**
The CMS shall contain a construction timetable and order of works noting any construction dependencies, refer to any inherent mitigation measures required to address adverse impacts identified in the EIA and	**Phase 8 Construction Environment Management Plan**

NYMNPA 94 Compliance	Compliance
cross refer to the CEMP in relation to any additional avoidance or mitigation measures	

The CMS is a live document and updates to this CMS plan will be prepared for subsequent construction phases and following any design or method change. The NYMNPA has confirmed that it supports this approach.

2. DESCRIPTION OF WORKS

2.1. PHASE 8 WORKS

The Phase 8 Scope of Works is as follows:

- Drilling of an exploratory Borehole;
- Temporary Installation and use of drilling rig and ancillaries;
- Decommissioning of Borehole.

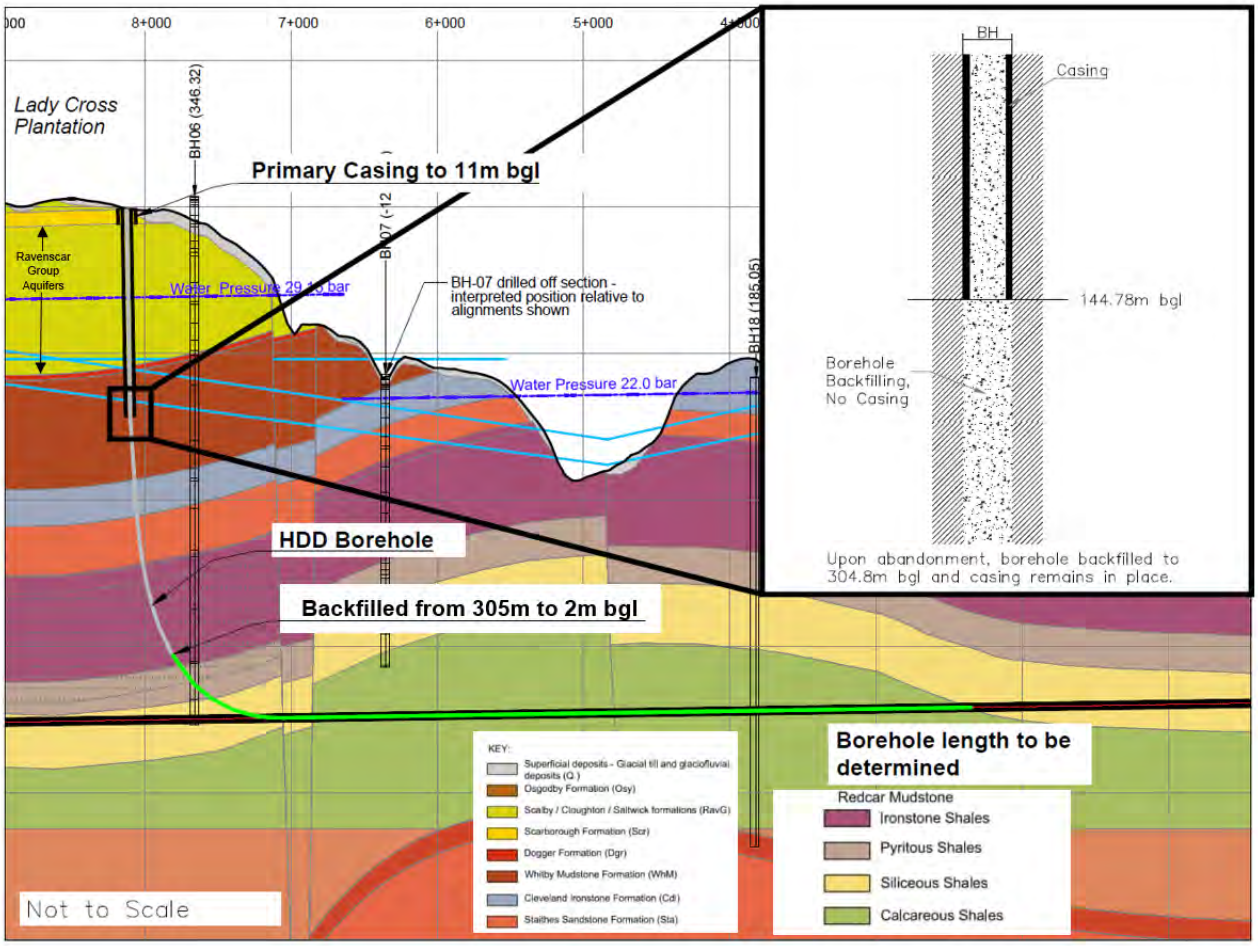
The scope of works covered by this document comprises drilling of an exploratory horizontally drilled directional (HDD) Borehole. The Eskdale Anticline through which the Tunnel Drive between Ladycross and Woodsmith Mine passes includes areas of rock containing faults. The HDD works are to assess these structures, on a precautionary basis, for ground conditions, including groundwater and the very low risk of encountering low volumes of natural gas, prior to tunnel boring activities.

The borehole will be initially 500mm in diameter and cased to circa 11mbgl, the casing will be cemented into place. Secondary drilling activities and casing, again from surface, will be at a diameter of 300mm inside of the primary casing, the secondary borehole will then be cased to approximately 145mbgl and 42m into the Whitby Mudstone Formation aquitard, sealing the upper aquifers. The HDD activities will continue as open hole boring at a diameter of 175mm to a maximum depth of 350mbgl and a distance of approximately 4km parallel to the tunnel alignment. All horizontal drilling activities will be undertaken below all abstractions and vulnerable aquifers.

Decommissioning of the borehole is to be undertaken once the TBM has passed the end of the maximum extent of the borehole; at circa 4km from the Ladycross intermediate site. The duration for monitoring of the borehole during TBM Drive 3 is predicted to take circa 12 months. Monitoring of the borehole will be undertaken until the borehole is sealed from approximately 305mbgl to 2mbgl.

A borehole schematic is shown in **Image 1**.

Image 1- HDD Borehole Schematic



2.2. LAYDOWN AREAS

The laydown area and workshops constructed during Phase 3 works will be utilised for general laydown of materials and day to day small mechanical tasks. The immediate area surrounding the Phase 8 working areas will be demarcated using pedestrian barriers and classified as a 'restricted access area' where only authorised personnel involved in the operation can gain unescorted access. See General Arrangement (40-STS-LC-2100-PA-22-20126)

2.2.1. PRE-COMMENCEMENT WORKS

Prior to the commencement of the HDD drilling works the area will be suitably prepared and segregated. The area to be used for the works will be approximately 75x30m and must be graded with imported stone, through the use of an excavator dumper and roller to provide a working surface. A High-Density Polyethylene (HDPE) liner or containment system is to be placed under those areas of highest pollutant risk (Drill rig, generator units, mud pumps etc).

Surface water from the work area will flow into the existing site drainage system or to the lagoon area.

Trenches for communication cables will be excavated to allow ducting to be placed as required to connect the directional drilling head to a computer system located in the mechanical office.

An area of hard standing will be constructed under the drilling arisings area to prevent material removed during the drilling process from entering the surface drainage system. The slab will be approximately 5x5m with skips placed on top to capture the drilling arisings. These will be removed by licenced waste carrier.

2.3. CAR PARKING

All site personnel will continue to use the car parking facilities established during the Phase 3 works and revised under Phase 7. Parking will only be permitted within designated car parking areas. No access to the site by foot is permitted. A peak of up to 50 employees are expected on site during the Phase 8 works. As stated in Section 2.5.5, mass transport such as car sharing, and mini-bus services will be utilised to ensure parking is limited to the spaces set out in the Phase 6 Construction Traffic Management Plan (CTMP).

2.4. MOBILISATION

All equipment, plant and materials will be delivered to site using the approved traffic routes as per the Phase 6 CTMP.

All HGV's and abnormal loads will drive directly to site and will not stop / wait on the public highway.

Approximately 10 Abnormal loads (AILs) are expected during the Phase 8 works to facilitate delivery of the Drilling Rig and equipment. Deliveries will be staggered throughout the duration of the Phase 8 works to reduce the number of AIL operating on the A171 and C82.

2.5. TRAFFIC AND PEOPLE

2.5.1. TRAFFIC MANAGEMENT

Condition 34 requires that a Construction Traffic Management Plan (CTMP) is to be prepared and submitted to NYMNPA prior to each phase of construction, for detailed traffic information please see the Phase 6 CTMP. Additional information for Traffic Management is also detailed in the Phase 8 Construction Environment Management Plan (CEMP).

2.5.2. PUBLIC PEDESTRIAN MANAGEMENT

Pedestrian management is to be controlled via both site security fencing and site access gate security; this is to be situated at the entrance to the main site haul road. Perimeter fencing along the site boundary was installed as part of Phase 2 works with improved site security facilities installed as part of Phase 5 works.

2.5.3. ACCESS

All construction traffic will use the existing main internal road to access the site. The access road is appropriately sized to allow for three HGVs to queue. In addition to the physical measures proposed, to prevent traffic having to wait on the highway or the potential for multiple to meet at the site access, the contractor will be required to provide a banksman and schedule deliveries and shift times.

Security will be stationed at the site access gates and all drivers will be required to have completed the appropriate driver induction before entering site. Access will only be authorised for deliveries / vehicles booked in for the day and with the appropriate access documentation. All deliveries will follow the onsite one-way traffic controls. Where required a banksman will be provided by the contractor if reversing or manoeuvring of vehicles is required.

In addition to assisting the contractor to manage the total numbers of daily HGV movements, the requirement for planning and scheduling deliveries will also assist the contractor in ensuring that deliveries can be spread throughout the working day.

The contractor will also be required to schedule shift times to try and avoid employees arriving and departing at the same time and to schedule deliveries outside of these hours.

2.5.4. LOADING AND UNLOADING

Loading and unloading of deliveries and materials on site will take place in designated areas dependent on works.

2.5.5. TRANSPORT HUB AND MASS TRANSPORT

If practical, car parks outside of the North York Moors National Park will be encouraged as a transport hub for shift workers travelling to Ladycross. Other potential locations will be explored to reduce parking at the Ladycross Site where practicable.

Car sharing and minibuses will be promoted by subcontractors to limit the numbers of people driving / parking at Ladycross to remain within the committed numbers stated in the Phase 6 CTMP.

2.6. Storage of Plant and Materials

Materials will be stored in demarcated zones dependant on material use. The laydown area established during Phase 3 will be utilised for storage of bulk materials and material deliveries will be managed to reduce overall site storage requirements. Materials will also be stored in designated areas as close to the works as possible.

All storage areas will be located on hardstanding appropriate to the plant and materials away from sensitive receptors. All COSHH and fuel will be stored in line with requirements and practices outlined in the Phase 8 CEMP.

2.7. Internal Access Routes

Haul roads and internal access routes within the Phase 8 works scope will be demarcated and separated from pedestrian areas as per previous phases. All HGV and delivery vehicles will follow the internal one-way system route. Speed limits will be enforced as per the site limits.

2.8. Lighting Columns

As part of the Phase 8 works additional temporary lighting columns / fixed lighting will be installed on new structures for emergency use and safe access / egress in the area. Where additional temporary lighting is required to provide a safe working area and access and egress, it will be installed in line with the procedures detailed in the Phase 8 CEMP, where possible aiming to limit upward light spill, and utilising warm spectrum LED's.

2.9. Wheel wash

Vehicles entering site will stay on hardstanding already installed during Phase 3 works. No plant will travel off site other than specialised plant moving transport. All HGV's and plant exiting site will use the approved wheel washing facilities described in the approved Phase 3 CMS.

2.10. Water Management

2.10.1. Surface Water Management

The Water Treatment Plant (WTP) along with finalised attenuation pond and drainage network set up as part of the Phase 3 works will be utilised to manage site surface water as indicated in the Phase 3 Surface Water Management Plan (40-STS-LC-2100-PA-PL-20102)

2.11. Process Water Management

All controls and mitigation for process water will be carried out in accordance with the controls outlined in the Phase 8 CEMP.

2.11.1. FOUL WATER MANAGEMENT

The foul sewerage from the welfare, offices and security cabin will be stored in appropriate cesspit installed during the Phase 3 works. Foul sewerage will be removed by a licensed contractor to a permitted waste facility.

2.12. HOURS OF OPERATION

All Phase 8 operations will be 24hrs 7 Days per week.

3. CONSTRUCTION METHOD STATEMENTS

3.1. WORKING PLATFORM

Working platforms for the drill rig and ancillaries are designed to withstand the loadings of all plant and equipment associated with the Phase 8 works.

3.2. POWER REQUIREMENTS

All electrical installations to required areas will be installed by STRABAG electrical team in accordance with the Phase 8 CEMP.

An emergency back-up 150 kVA generator will need to be installed onsite to facilitate emergency operations in the event of primary generator shutdown. The emergency generator would supply power to key site operations such as, mud pumps and shakers units. An additional Caterpillar C32, 1000 kvA Power Module is required for back up of the Drilling Rig activities.

3.3. EXTERNAL TEMPORARY STRUCTURES

As part of the Phase 8 scope of works various external structures and ancillaries will be installed in preparation for drilling operations. Further details are provided below alongside the Phase 8 CEMP and General Arrangement Drawing.

3.3.1. INITIAL DRILLING RIG

An initial drilling rig (Geax EK75) or similar will be set up and erected on the drilling pad to drill a hole up to approximately 11 metres below surface. Neat cement plug will be placed at the bottom of the casing and the annulus will subsequently be cemented to surface using tremie pipes**.** The height of the initial drilling is 13.65m as shown in **Image 2.**

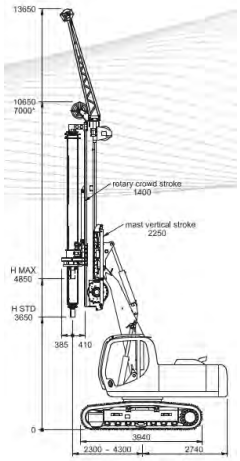


Image 2 – GEAX EK75 Auger

3.3.2. *DRILLING RIG*

The Speedstar 200 Drilling Rig will be used to carry out the directional drilling to total depth. The drilling rig mast is approximately 15.5m high as shown in **Image 3.**

Image 3 – Speedstar Drilling Rig

3.3.3. *DRILLING MUD RECYCLING SYSTEM*

The cuttings generated at the development face are displaced by direct circulation which requires a drilling fluid (mud) to be pumped at high velocity and pressure down through the drill string and flowing up the annulus of the bored hole. This process requires that the drilling fluid remain relatively clean (light) to maximise the efficiency with which cuttings are displaced and to minimise the wear and tear on the mud pumps and drilling tools. The mud recycling system is responsible for removing the solids and fines from the drilling fluid allowing it to be recirculated.

The mud recycling system will consist of:

- Centrifuge– shown in **Image 4**
- Fluid reclamation system – shown in **Image 5**

Image 4 – Centrifuge

Image 5 – Fluid Reclamation System

3.3.4. EMERGENCY SAFETY DEVICE FOR MITIGATION OF GASEOUS HYDROCARBON

A safety device (Gas separator and flare) will be installed to mitigate emissions and minimise risks for the workforce in the event of hitting gaseous hydrocarbon during drilling operations. The dimensions of the emergency device are detailed in the **Table 3-1** below.

Table 3 - 1 Dimensions – Emergency Safety Device for mitigation of gaseous hydrocarbon

Equipment	**Dimensions**
Gas Separator	6m (height) x 2.50m (width) x 2.5m (depth)
4” Single Flare Skid	8m (height) x 2.2m (width) x 2m (depth), diameter: 4 inches

The emergency safety device to be installed will ensure that waste gases will combust cleanly and efficiently by eliminating smoke and minimising noise and visible flame. An enclosure structure will be erected around the emergency safety device as an additional measure of noise attenuation. An indicative image of the device is shown in **Image 6.**

Image 6 – Emergency Safety Device for Gaseous Hydrocarbon Mitigation

3.4. DRILLING METHODOLOGIES

The Geax EK75 or similar rig will drill a 500mm casing at an angle of 8 to 10 degrees southeast to circa 11mbgl, the casing will be secured in place with cementitious grout and sealed. Works will follow the borehole design plan. The Speedstar 200 rig will be installed and centralised over the initial casing hole. The Speedstar 200 will continue drilling and casing at an angle of 8 to 10 degrees to circa 145mbgl with a secondary casing at a diameter of 300mm. The secondary casing will be grouted and sealed within the Whitby Mudstone Formation to form a barrier to the vulnerable aquifers of the Ravenscar Group. The Speedstar 200 rig will then directionally drill through a curve to achieve a horizontal position at approximately 350mbgl and at a constrained lateral offset of circa 18m from the crown of the tunnel's alignment axis, **Image 7**.

Image 7 – Drill alignment

The Speedstar 200 will drill this portion of the borehole using drilling muds. The return cuttings management separators will remove cuttings from within the mud column and the clean mud will return to the borehole. The drill will be driven using hydraulics (**Image 8**), it will run horizontally with a slight downward trend from the tunnel crown to the tunnels invert for a distance of circa 4km or until termination following the tunnels alignment at a constrained lateral offset of 18m.

Image 8 – Drill and Hydraulic Units

The borehole will then be flushed with clean water and left flooded and open until the Tunnel Boring Machine (TBM) has passed the termination of the borehole.

Gas monitoring will be conducted as the Speedstar 200 is progressing to borehole termination. In an emergency case gas will be flared. Once drilling activity has finalised the primary casing will be fitted with a gas valve to monitor any evolving gases until the TBM has past the termination of the borehole.

Once the TBM has passed termination of the borehole cement will be used to seal the borehole from 305mbgl to ground surface. The headworks for the borehole will be removed to 2m bgl and the ground will be reinstated.

3.5. UTILITIES

3.5.1. WATER SUPPLY

Raw water to facilitate drilling operations will be serviced by a 4” Yorkshire Water potable water supply. The potable water will provide services to both welfare facilities and for site process use.

Bottled water dispensers will be provided for site staff. Where required, dust suppression bowsers will also periodically be topped up via the water supply.

Temporary Baker tanks will be utilised for storage of water and drilling muds as part of the circulatory system.

4. PLANT & EQUIPMENT

All proposed plant and equipment to be used during the Phase 8 works are detailed in **Table 4-1**. Details of each main scope activity plant has been provided with proposed plant models where the information is available. The Models of plant may change closer to the time of the works based upon supply and final design requirements.

Table 4-1 Plant use for the Phase 8 works

Description	Model	Loading when operational
General Site use		
13T Excavator	Hitachi ZX135US-7	25.00%
20T Dumper	Bell B20E	25.00%
Roller Vibrator	HAMMM BW120	10.00%
Telehandler	Manitou MT1840	50.00%
Road Sweeper	DAF or similar	50.00%
45ft MEWP	Artic Boom SJ63AJ	10.00%
Flat bed	Ford transit dropside single cab	50.00%
Drill Pad Preparation		
Tracked Excavator 30T (Drill Pad regrade)	Hitachi_ZX350LC-6	50.00%
Dumper Truck 20T (Drill Pad regrade)	Bell B20E	50.00%
Roller Vibrator (Drill Pad regrade)	HAMMM BW120	20.00%
Telehandler 5T (Drill Pad set-up and drilling operations)	Manitou MT1840	50.00%
60 T Mobile Crane (Drill Pad set-up and demob)	Liebherr LTM1060	60.00%

Initial Drilling		
Initial Drilling Auger	Geax EK75	100.00%
Tracked Excavator 30T	Hitachi_ZX350LC-6	80.00%
20T Tiper Truck (Muck away)		50.00%
Drilling Rig, Casing and Horizontal Drilling		
Drilling Rig	Speedstar 200	100.00%
150 kVA Generator	SDMO	100.00%
100 kVA Generator	SDMO	100.00%
Centrifuge	MISWACO 518	100.00%
Mud Pumps	SPM 2250 Pump Module	100.00%
Fluid Reclamation Unit	Kemtron-600-X	100.00%
Gas Separator Unit		100.00%
High Baffled Flare (7.62m) - Emergency only		0.00%
1000 kvA Power Module (Drilling Rig)	Caterpillar C32	100.00%

5. HAZARDOUS MATERIALS AND SUBSTANCES

The following hazardous materials are foreseen to be used during drilling and construction activities listed within this document. This list may not be exhaustive, individual Risk Assessment and Method Statements will identify the hazardous materials and a specific COSHH Assessment will be included within the Safe System of Work (SSOW) documentation.

- Concrete / Cement
- Grout
- Diesel
- Petrol
- Oils and Greases (Plant Maintenance)
- Bentonite
- Drilling mud additives

6. RELATED DOCUMENTS AND REFERENCES

GENERAL ARRANGEMENT - PHASE 8 – LADYCROSS - 40-STS-LC-2100-PA-22-20124

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN - PHASE 8 - CONDITION 93 – LADYCROSS - 40-STS-LC-2100-EN-PL-00036

CONSTRUCTION TRAFFIC MANAGEMENT PLAN - PHASE 6 - NYMNPA CONDITION 34 (ROYAL HASKONINGDHV) – LADYCROSS - 40-STS-LC-2100-LG-PL-00007

NOISE & VIBRATION MANAGEMENT PLAN - PHASE 8 - NYMNPA CONDITION 18 (ROYAL HASKONINGDHV) - LADYCROSS - 40-STS-LC-2100-EN-PL-00038

CONSTRUCTION VEHICLE & PLANT MANAGEMENT PLAN - PHASE 8 - NYMNPA CONDITION 92 (ROYAL HASKONINGDHV) – LADYCROSS - 40-STS-LC-2100-LG-PL-00010

7. DEFINITIONS AND ABBREVIATIONS

CMS – Construction Method Statement

RAMS – Risk Assessment and Method Statement

MPA – Mineral Planning Authority

EIA – Environment Impact Assessment

NYMNPA – North York Moors National Park Authority

AIL – Abnormal Indivisible Load

CTMP – Construction Traffic Management Plan

HGV – Heavy Goods Vehicle

COSHH – Control of Substances Hazardous to Health

WTP – Water Treatment Plant

CEMP – Construction Environment Management Plan

NYMNPA

21/12/2023

Project Title / Facility Name:

Woodsmith Project

Document Title:

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN - PHASE 8 - LADYCROSS

Document Review Status

- [x] 1. Reviewed – Accepted – Work May Proceed — By: Charlotte Bell
- [ ] 2. Reviewed – Accepted As Noted, Work May Proceed, Revise & Resubmit — On: 21 Dec 2023 11:31
- [ ] 3. Reviewed – Work May Not Proceed, Revise & Resubmit
- [ ] 4. For information only
- [ ] 5. On Hold – Pending Project Restart & Ramp Up

Rev.	Revision Date (dd mmm yyyy)	Reason For Issue	Prepared by	Verified by	Approved by
E	20-Dec-2023	Planning	PLA			
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WOODSMITH PROJECT

(788.5030)

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN – PHASE 8 – LADYCROSS PLANTATION / 40-STS-LC-2100-EN-PL-00036

Revision	Date of issue	Prepared by	Checked by	Approved by	Changes
A (PLA)	25/09/2023	E Castro	C Thomas	C Eddington	First Issue
B (PLA)	11/10/2023	E Castro	C Thomas	C Eddington	Revision in accordance with rev A comments
C (PLA)	11/12/2023	E Castro	C Thomas	C Eddington	Revision post comments
D (PLA)	18/12/2023	E Castro	C Thomas	C Eddington	Revision in accordance with rev C comments
E (PLA)	20/12/2023	E Castro	C Thomas	C Eddington	Revision in accordance with rev D comments

TABLE OF CONTENTS

1. INTRODUCTION

1.1. PURPOSE OF THE DOCUMENT

In 2014 a planning application (reference NYM/2014/0676/MEIA) was submitted to the North York Moors National Park Authority (NYMNPA) for permission to develop a polyhalite mine and underground Mineral Transport System (MTS). Planning permission was subsequently granted in 2015 subject to conditions, as varied in February 2018 by NYM/2017/0505/MEIA.

Anglo American is constructing a Mineral Transport System (MTS) tunnel, as part of the wider Woodsmith Project. The tunnel will be used to transport polyhalite from the Woodsmith Mine site to the Material Handling Facility (MHF) at Wilton, Teesside. Safe and efficient construction and operation of the tunnel requires the construction of a shaft at Ladycross Intermediate Shaft Site (Ladycross) to provide access to the tunnel.

This Construction Environmental Management Plan (CEMP) has been prepared on behalf of Anglo American for the Phase 8 Works at Ladycross (as described in **Section 1.2** below).

This CEMP has been prepared to discharge condition 93. Subsequent CEMPs will be prepared for future phases of works. This CEMP covers work carried out in Phase 8.

Table 1 - 1 Condition NYMNPA-93: Construction Environment Management Plan

NYMNPA-93 Description	Compliance with Condition NYMNPA 93
Prior to the commencement of each Phase of Construction in accordance with the approved Phasing plan at either Doves Nest Farm or Lady Cross Plantation, an updated CEMP shall be based on the approved Construction Method Statement (CMS) and should be submitted and approved in writing by the MPA in consultation with the Environment Agency in respect of the area concerned.	This version of the CEMP is for Phase 8 as defined in **Section 1.2** below. Earlier versions of the CEMP were produced for preceding works.
The size, location and design of any site compounds, including how any potentially polluting materials will be stored to minimise the risk of pollution	**Section 3** and **Section 11** **Phase 8 Construction Method Statement**
An incident Response Plan to deal with any pollution that may occur during the course of construction;	**Section 12**

NYMNPA-93 Description	Compliance with Condition NYMNPA 93
A protocol to deal with contaminated ground, should this be encountered, to ensure protection of water resources;	**Section 10**
Details of how surface water run-off shall be passed through a settlement facility of settlement facilities prior to being discharged into any watercourse or soakaway;	**Section 9.1**
Plant and wheel washing including that it shall only be carried out in a designated area of hard standing at least 10 metres from any watercourse or surface water drain and that washings shall be collected in a sump, with settled solids removed regularly and water recycled and reused where possible;	**Section 3.10**
A scheme for the recycling/disposing of waste resulting from demolition and construction works;	**Section 11**
Storage of waste not covered by the Mine Waste Directive;	**Section 11**
Measures to control glare from in-site lighting;	**Section 3.6**
Measures to manage deliveries by HGV including routing and timing for deliveries and details of the penalty system for breaches of the agreed control;	**Section 4**
Temporary Traffic Management	**Section 4**
The provision of a Dust Management Plan relating to Phase 1 of the construction period (earthworks and bund formation) and Polyhalite handling and stockpiling to include dust generation modelling so as to identify	**Section 6** **Phase 8 Emissions to Atmosphere** **Construction Phase Dust Management Plan**

NYMNPA-93 Description	Compliance with Condition NYMNPA 93
sensitive receptors; likely dust generation and its disposition during the construction Phases and operation over time and under different weather conditions; the avoidance and mitigation measures required to ensure dust deposition levels at the sensitive receptors are maintained at the residual levels identified in the approved EIA, and monitoring arrangements. The Dust Management Plan must comply with the criteria set out in the 'Dust and Air Emission Mitigation Measures' best practice guidance for control of dust on construction sites from the Institute of Air Quality Management 2012. The monitoring arrangements will include dust deposition or dust flux or real-time PM_{10} continuous monitoring locations; baseline dust monitoring at least three months before construction commences; daily on-site and off-site inspections at monitoring locations with results recorded in a log to be made available to the MPA on request, and more frequent monitoring during periods of high dust generation;	
In the event that there is insufficient clay with the Lady Cross Plantation site to form 1m deep basal layer beneath the spoil storage area, a contingency plan to address the importation of clay, including the source, quantity and quality of such material, and how adverse effects on the water environmental would be avoided;	**Phase 8 Construction Environment Management Plan**
How the requirements of the approved CEMP will be disseminated to all relevant	**Section 2.2**

NYMNPA-93 Description	Compliance with Condition NYMNPA 93
staff/contractors throughout the construction period;	
The location of the site notice board;	**Section 2**
A scheme for parking, loading, unloading during construction;	**Section 4** **Phase 6 Construction Traffic Management Plan**
A scheme for security and lighting during construction;	**Section 3.1** and **3.6**
A protocol for the replenishment of tanks and containers, including that all refuelling of vehicles, generators, plant and equipment shall be supervised and shall take place within a suitable bunded, impervious hardstanding;	**Section 3.8**
Contingency proposals for if fuel cannot be delivered for the generators, e.g. due to adverse weather;	**Section 3.8**
Proposals / contingency plans for waste not managed as part of the Mine Waste Permit comprising the storage and management of temporary mining waste stored on-site for less than three years (e.g. Pyritic Mudstone); non-inert and non-hazardous materials stored for less than one year, and unexpected hazardous waste stored for less than six months, including measures to prevent the dispersal of dust, leachate and surface water run-off;	**Section 11**
Precautionary Method of Working for Site Clearance (PMWSP) which shall be submitted to and agreed in writing by the MPA prior to commencement of Preparatory Works and	**Section 7** **Attachment C** – Precautionary Method of Working

NYMNPA-93 Description	Compliance with Condition NYMNPA 93
shall be adhered to thereafter. The PMWSP shall set out proposals for tree clearance and the demolition of structures and shall include that between March and September each year surveys of areas to be cleared should occur no less than 48 hours before clearance occurs so that occupied wild bird nests can be identified and prevented from being destroyed;	
Alarms fitted to mobile plant and vehicles for the purposes of warning pedestrians of their movements;	**Section 5**

Additional conditions addressed in this CEMP are detailed in **Table 1 - 2**.

Table 1 – 2 Additional relevant conditions

Condition	Topic	Compliance with Condition
NYMNPA-18	Noise and Vibration Management	**Section 5** **Phase 8 Noise and Vibration Management Plan**
NYMNPA-34	Construction Traffic Management	**Section 4** **Phase 6 Construction Traffic Management Plan**
NYMNPA-42	Access Arrangements	**Section 3** **Previous Phase 2 Construction Environment Management Plan and Phase 8 Construction Method Statement**
NYMNPA-52	Protected Species	**Section 7.1** **Phase 3 Protected Species Management Plans**
NYMNPA-57	Landscape and Ecological Management	**Section 7.3** **Phase 3 Landscape and Ecological Management Plan**

Condition	Topic	Compliance with Condition
NYMNPA-59	External Lighting	**Section 3.6**
NYMNPA-65	Temporary boundary treatments	**Section 3**
NYMNPA-68	Temporary Structures	**Section 3** **Phase 8 Construction Method Statement**
NYMNPA-70	Vegetation retained & clearance	**Section 7.2** **Construction Phase Arboricultural Method Statement**
NYMNPA-76	Soil Management Plan	**Section 10** **Phase 3 Soil Management Plan**
NYMNPA-88	Hydrogeological Risk Assessment	**Section 9** **Phase 8 Hydrogeological Risk Assessment**
NYMNPA-90	Groundwater Management	**Section 9**
NYMNPA-92	Plant and Vehicle Management	**Section 4** **Phase 8 Construction Vehicle and Plant Management Plan**
NYMNPA-95	Written scheme of Archaeological Investigation	**Section 8** **Phase 2 Written Scheme of Investigation for an Archaeological Watching Brief**

This document details only the additional activities required for Phase 8 at Ladycross associated with the Anglo American Woodsmith Project. Updates to this plan will be prepared for subsequent phases and following any design or method changes. The NYMNPA, as well as the Environment Agency and Natural England agreed that they support this approach in meetings held in April 2016.

1.2. SCOPE OF WORKS

The Phase 8 Scope of Works is as follows:

- Drilling of an exploratory Borehole;
- Temporary Installation and use of drilling rig and ancillaries;
- Decommissioning of Borehole.

The scope of works covered by this document comprises drilling of an exploratory horizontally drilled directional (HDD) Borehole. The Eskdale Anticline through which the Tunnel Drive between Ladycross and Woodsmith Mine passes includes areas of rock containing faults. The HDD works are to assess these structures, on a precautionary basis, for ground conditions, including groundwater and the very low risk of encountering low volumes of natural gas, prior to tunnel boring activities.

The borehole will be initially 500mm in diameter and cased to circa 11mbgl, the casing will be cemented into place. Secondary drilling activities and casing, again from surface, will be at a diameter of 300mm inside of the primary casing, the secondary borehole will then be cased to approximately 145mbgl and 42m into the Whitby Mudstone Formation aquitard, sealing the upper aquifers. The HDD activities will continue as open hole boring at a diameter of 175mm to a maximum depth of 350mbgl and a distance of approximately 4km parallel to the tunnel alignment. All horizontal drilling activities will be undertaken below all abstractions and vulnerable aquifers.

Decommissioning of the borehole is to be undertaken once the TBM has passed the end of the maximum extent of the borehole; at circa 4km from the Ladycross intermediate site. The duration for monitoring of the borehole during TBM Drive 3 is predicted to take circa 12 months. Monitoring of the borehole will be undertaken until the borehole is sealed from approximately 305mbgl to 2mbgl.

A site layout is shown in **Image 1** below.

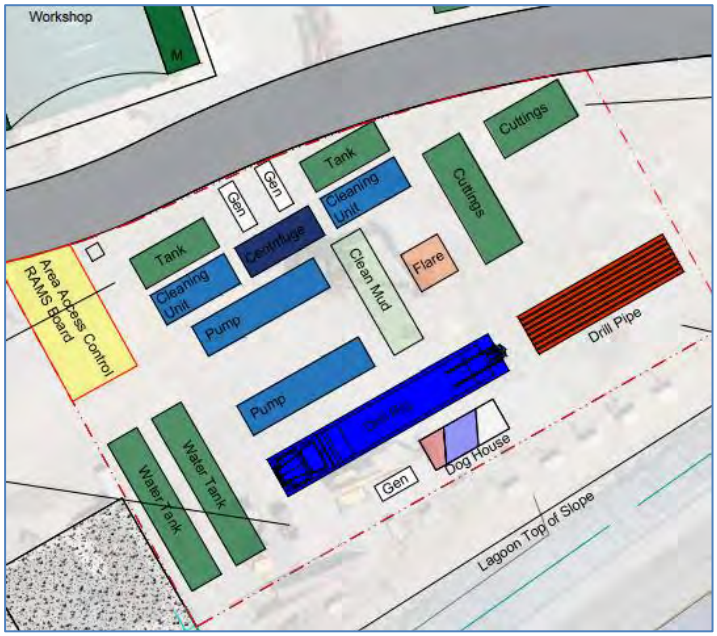

Image 1 –Site layout

1.3. SCOPE OF THIS DOCUMENT

This CEMP details how the Phase 8 works will be planned, monitored and managed in an environmentally responsible manner. The document outlines the management framework for the environmental requirements, commitments, and performance targets associated with the planning and implementation of Phase 8 of the project.

The CEMP refers to several management plans, which have been prepared to discharge a number of planning conditions. Collectively these plans incorporate all mitigation measures relevant to Phase 8.

The Phase 8 CEMP should also be read together with the documentation listed below. Information in these documents is summarised in this CEMP where appropriate:

- Phase 8 Construction Vehicle & Plant Management Plan (40-STS-LC-2100-LG-PL-00010)
- Phase 6 Construction Traffic Management Plan (40-STS-LC-2100-LG-PL-00007)
- Phase 8 Noise & Vibration Management Plan (40-STS-LC-2100-EN-PL-00038)
- Phase 3 Landscape and Ecological Management Plan (40-STS-LC-2100-EN-PL-00014)
- Phase 8 Emissions to Atmosphere (40-STS-LC-2100-EN-PL-00039)
- Phase 3 Surface Water Management Plan (40-STS-LC-2100-PA-PL-20102)
- Phase 8 Construction Method Statement (40-STS-LC-2100-CN-MS-00009)

- Phase 2 Archaeological Watching Brief Written Scheme of Investigation (40-COT-LC-8324-EN-PL-00002)
- Phase 3 Soil Management Plan (40-STS-LC-2100-EN-PL-00007)
- Phase 8 Hydrogeological Risk Assessment (40-STS-LC-2100-EN-RA-00005)
- Phase 7 Surface Water Drainage Scheme (40-STS-LC-2100-PA-22-20123)
- Construction Phase Dust Management Plan (40-STS-LC-2100-EN-PL-00015)
- Construction Phase Arboricultural Method Statement (40-STS-LC-21-CN-MS-00003)
- Phase 8 Construction and Operation Groundwater and Surface Water Monitoring Scheme (40-STS-LC-2100-EN-PL-00037)
- Phase 8 Phasing Plan (40-STS-LC-2100-PA-22-20124)
- Phase 8 Hard & Soft Landscaping (40-STS-LC-2100-PA-22-20125)
- Phase 8 General Arrangement (40-STS-LC-2100-PA-22-20126)

This CEMP will remain a live document, being reviewed and updated in consultation with the appointed contractor(s) or sub-contractor(s) as required. Each of these updated CEMPs will be submitted to NYMNPA for approval prior to the start of each phase of works.

2. ENVIRONMENTAL MANAGEMENT FRAMEWORK

2.1. STRUCTURE OF RESPONSIBILITIES

This CEMP addresses those environmental matters within the responsibility of Anglo American and the Contractors engaged on its behalf to deliver the Phase 8 construction works. While overall responsibility for compliance with environmental requirements will remain with Anglo American, the Contractors working on site are accountable for undertaking the works in line with the requirements of this CEMP as well as all legal and other requirements imposed via permits and licenses.

2.2. TRAINING, AWARENESS AND COMPETENCE

2.2.1. *INTERNAL COMMUNICATION*

All staff and sub-contractors working on site will be required to attend a site induction prior to commencing work. This will cover the key environmental aspects relating to the project and the roles and responsibilities of individuals.

Toolbox talks will be undertaken by the Environmental Manager or other nominated personnel throughout the project. The aim will be to communicate information to all staff and serve to educate, prompt and remind them of their responsibility to protect the environment during works.

Monthly progress meetings will be used to disseminate the results of monitoring and audit reports. At these meetings, a review of the environmental performance throughout the site to date will be undertaken, and any improvements required during the Phase 6 works will be identified. Details of where sustainable approaches to works activities have been implemented or developed as the work proceeds will also be discussed and recorded. Their suitability for implementation at other areas of the site will be considered and applied where appropriate. Decisions about amendments required to the processes and procedures will also be agreed.

2.2.2. *EXTERNAL COMMUNICATIONS*

Anglo American will lead communication with members of the public, including adjacent landowners, local residents and businesses in line with the Community Stakeholder and Engagement Framework (CSEF) see **Attachment A**.

The CSEF includes provision for a quarterly Liaison Group Forum meeting, which are open to members of the public to attend.

2.3. MONITORING OF COMPLIANCE

All Phase 8 construction works will be supervised by the Contractor's managerial staff with the support of members of their teams on a daily basis. The Contractor's managerial staff will receive a briefing from the Contractor's Environmental Manager to ensure that they are aware of the environmental requirements. The briefing will also ensure that they are able to assess whether the environmental requirements are being implemented properly.

Procedures relating to environmental management and monitoring of environmental performance identified within the CEMP will be subject to inspections by the Contractor at least once every week, with oversight and audit by the Anglo American Environmental Team. Records of inspections, audits and overall environmental performance will be submitted to Anglo American.

2.4. COMPLAINTS PROCEDURE

The implementation of the systems and procedures to protect the environment will effectively reduce or remove the risk of an environmental incident and/or exceedance of established thresholds. However, complaints may still be received and in this event the Complaints Procedure will be implemented, as detailed in **Attachment B**.

3. DESCRIPTION OF SITE

The following section seeks to address the requirements of planning conditions 65 and 68, providing details for the site's temporary boundary treatments, temporary compounds and structures that will be used as part of Phase 8 works. Most of the site set-up will have been completed as part of the previous phases of works. Only small changes will be made to the existing site set-up as detailed in the below sections.

3.1. FENCING AND SECURITY OF THE SITE

Perimeter fencing will be installed around the phase 8 works area as a demarcation zone. Site access and controls established in previous phases will be utilised for site access and security during the Phase 8 works. Further controls for site access are detailed in the Phase 8 CMS.

3.2. SITE LAYOUT AND COMPOUNDS

The site layout and compounds are detailed in the Phase 8 Ladycross Plantation General Arrangement Plan and the Phase 8 Construction Method Statement (CMS).

The working platform built during Phase 3 works was designed and constructed to withstand of the loadings of part of the plant and equipment associated with the Phase 8 works. The laydown area adjacent to the cuttings pit/muck bin area will be regraded with stone to accommodate the drilling equipment associated to Phase 8 works. More details about the pre-commencement works are shown in the Phase 8 CMS.

3.3. AREAS OF HARDSTANDING

3.3.1. *CONCRETE/SLABS*

To facilitate the install of temporary units for the Phase 8 works, additional concrete slabs will be required dependent on load capacities. Existing concrete pads / slabs will be utilised where practicable, the below provides details of maximum concrete slabs required during the Phase 8 works:

- A concrete pad will be constructed next to the muck bin to place the drilling mud recycling equipment. Total surface area 25m^2, length 5m and width 5m.

The above dimensions are indicative sizes and are subject to change based upon final design requirements.

3.3.2. *STONE / AGGREGATE HARDSTANDING*

Additional stone hardstanding will be placed on the existing laydown area which will be redefined as the drilling pad to withstand the loadings of the plant and equipment associated with the Phase 8 works. The total approximate surface area to be regraded will be 2250m^2, length 75m, width 30m.

3.4. EXTERNAL TEMPORARY STRUCTURES

As part of the Phase 8 scope of works various external structures and ancillaries will be installed in preparation for drilling operations. Further details are set out below.

3.4.1. *INITIAL DRILLING RIG*

An initial drilling rig (Geax EK75) or similar will be set up and erected on the drilling pad to drill a hole up to approximately 11 metres below surface. Neat cement plug will be placed at the bottom of the casing and the annulus will subsequently be cemented to surface using tremie pipes. The height of the initial drilling is 13.65m as shown in Image 2.

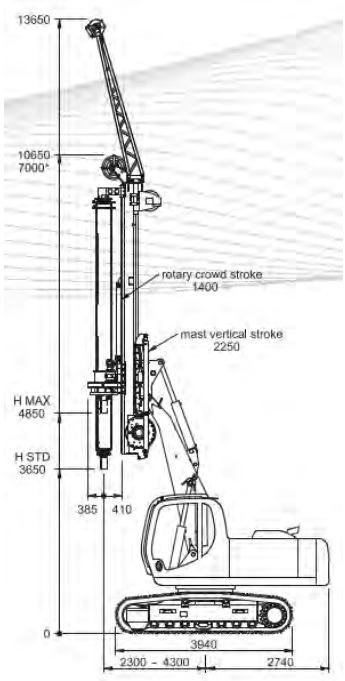

Image 2 – GEAX EK75 Auger

3.4.2. *DRILLING RIG*

The Speedstar Drilling Rig will be used to carry out the directional drilling to total depth. The drilling rig mast is approximately 15.5m high as shown in **Image 3.**

Image 3 – Speedstar Drilling Rig

3.4.3. *DRILLING MUD RECYCLING SYSTEM*

The cuttings generated at the development face are displaced by direct circulation which requires a drilling fluid (mud) to be pumped at high velocity and pressure down through the drill string and flowing up the annulus of the bored hole. This process requires that the drilling fluid remain relatively clean (light) to maximise the efficiency with which cuttings are displaced and to minimise the wear and tear on the mud pumps and drilling tools. The mud recycling system is responsible for removing the solids and fines from the drilling fluid allowing it to be recirculated.

The mud recycling system will consist of:

- Centrifuge– shown in Image 4
- Fluid reclamation system – shown in Image 5

Image 4 – Centrifuge

Image 5 – Fluid Reclamation System

3.4.4. *EMERGENCY SAFETY DEVICE FOR MITIGATION OF GASEOUS HYDROCARBON*

A safety device (Gas separator and flare) will be installed to mitigate emissions and minimise risks for the workforce in the event of hitting gaseous hydrocarbon during drilling operations. The dimensions of the emergency device are detailed in the **Table 3-1** below.

Table 3 - 3 Dimensions – Emergency Safety Device for mitigation of gaseous hydrocarbon

Equipment	Dimensions
Gas Separator	6m (height) x 2.50m (width) x 2.5m (depth)
4” Single Flare Skid	8m (height) x 2.2m (width) x 2m (depth), diameter: 4 inches

The emergency safety device to be installed will ensure that waste gases will combust cleanly and efficiently by eliminating smoke and minimising noise and visible flame. An enclosure structure will be erected around the emergency safety device as an additional measure of noise attenuation. An indicative image of the device is shown in **Image 6.**

Image 6 – Emergency Safety Device for Gaseous Hydrocarbon Mitigation

3.5. UTILITIES

3.5.1. *WATER SUPPLY*

Raw water to facilitate drilling operations will be serviced by a 4" Yorkshire Water potable water supply. The potable water will provide services to both welfare facilities and for site process use.

Bottled water dispensers will be provided for site staff. Where required, dust suppression bowsers will also periodically be topped up via the water supply. Temporary tanks may be utilised for storage of water for site specific operations.

3.5.2. *ELECTRICAL SUPPLY*

A three-phased 415V electrical supply was installed during Phase 4 to power site operations. Where practical the main supply will power the Phase 8 activities.

Additional generators will be installed in Phase 8 to provide power where it is not practical to use the existing mains supply. Details of the additional generators are described in the Phase 8 CMS and Phase 8 Emissions to Atmosphere.

Where standalone generators are required, these will be super silent and installed in a manner to reduce noise impacts on local receptors. Further details for generators are supplied in the Phase 8 Emissions to Atmosphere. Practices to reduce noise impacts will include but not be limited to:

- Procurement of super silent generators with reduced noise impact,

- Positioning of generators during installation, and
- Noise attenuation fencing/panels installed around generators, where required.

3.6. WELFARE FACILITIES

New welfare facilities will be installed in the north-western part of site, as part of Phase 7 works. It is expected that the new welfare will be installed prior to commencement of Phase 8 works.

3.7. LIGHTING

The Phase 8 works will be illuminated, when necessary, through temporary, task-specific directional lighting. The drilling operations area will be fitted with discreet lighting for safe access and egress. Shutters on welfare buildings will be shut after nightfall to reduce light spill. Phase 8 works will be 24/7 works.

On-site exterior lighting will apply the following principles which will ensure that impacts on wildlife are minimised in accordance with 'Artificial Lighting and Wildlife' guidance[1]:

- Task lighting will be used where appropriate,
- Lighting will be directed downwards (0 to 20 degrees where possible), with all beam angles below 70°,
- Lighting will be kept as low as is safe and practicable for the works taking place and kept at a maximum height of 4m,
- Lights will be switched off when not in use or will be motion sensor controlled,
- Where safe and practicable, British Standards and guidance from the Institute of Lighting Professionals in the document 'Bats and Artificial Lighting in the UK' (September 2018) (https://www.theilp.org.uk/documents/guidance-note-8-bats-and-artificial-lighting/) will be followed where relevant, and
- All lighting will be directed to avoid light spill on to the perimeter woodland.

Where additional temporary lighting is required to provide a safe working area and access and egress, it will be installed in line with the above procedures, where possible aiming to limit upward light spill, and utilising warm spectrum LED's.

3.8. MATERIAL STORAGE

The type of material stored on site will determine the storage methodology adopted. Fuel and chemical storage areas will be located as far from all open drains and watercourses as

practicable, with at least 10m from these locations. In addition, the storage areas will not be located near any open excavation of natural ground. Additional storage requirements will be implemented based upon the associated manufacturers Material Safety Data Sheet (MSDS).

The areas in which hazardous substances are stored will be clearly demarcated and within appropriate containerised units with integrated secondary containment.

All fuel will be stored within the onsite fuel tank installed during Phase 3 works. Specific areas on site will be designated for materials storage.

All non-polluting materials will be stored in designated areas, with surface water run-off draining to adjacent filter drains, surface swales and surface water drainage as detailed in **Section 10**. Penstocks and hydraulic brakes have been installed within the surface water drainage network, which will be closed in the event of a spill or detection of other contaminants. Details of site drainage and penstock locations are detailed in the Phase 3 Surface Water Management Plan and Phase 7 Surface Water Drainage Scheme.

Table 3 - 1 Material storage for Phase 8 works.

Material	How it will be stored
Concrete (Wagon / truck loads)	Bulk concrete will be delivered and used straight from the concrete wagon.
Diesel / Petrol (Bulk storage)	Bulk storage of diesel/petrol will be stored in a designated refuelling area installed as part of Phase 3 works. A towable bowser with secondary containment will be utilised for refuelling of large plant. The bowser will be stored in an appropriate demarcated location.
Oils and greases (Plant maintenance and site operations)	Oils and greases will be stored in appropriate containers in segregated areas of site (COSHH container and workshops). COSHH assessment and MSDS will be assessed for further storage requirements.
Bentonite (small bags 25kg)	Small bags of bentonite will be stored on pallets with appropriate weatherproofing in a designated area away from high trafficked zones.

Material	How it will be stored
Chemicals/Drilling additives	Chemicals and drilling additives will be stored within appropriate container within the on-site COSHH containers and following MSDS guidance.

3.9. Fuel Oil Storage and Refuelling on Site

3.9.1. *Storage*

Fuel will be stored within/on the refuelling area provided as part of Phase 3 works, it will be stored in accordance with The Control of Pollution (Oil Storage) (England) Regulations 2001, as follows:

Secondary containment will be provided for all surface oil and diesel tanks:

- For a single tank, the secondary containment will be at least 110% of the maximum storage capacity; and
- For two or more tanks in one secondary containment system, the secondary containment will be at least 110% of the biggest tank's maximum storage capacity or 25% of the total maximum storage capacity of all the tanks, whichever is the greater.

Storage must be more than 10m away from any watercourse or the surface drainage system. Static fuel tanks (such as those linked to generators) will be sited on sealed, level ground adjacent to the generators. All fuel bowsers will have tanks with integrated secondary containment that holds a minimum of 110% of the volume of the inner tank.

Spill kits will be stored adjacent to the storage areas and relevant staff will be trained in the use of such equipment in the event that spillages occur.

3.9.2. *Refuelling*

All replenishment of tanks and containers and all re-fuelling of vehicles, plant and equipment shall take place within bunded, impervious hardstanding where practical. The refuelling area built during Phase 3 works will be utilised to refuel all site mobile plant. A double bunded tank will be used for the storage of diesel and a further bunded IBC unit will be used to contain AdBlue. Toolbox talks regarding refuelling processes will be briefed to all relevant personnel.

For larger or stationary plant such as the drilling rig, pumps and generators, refuelling will be carried out in-situ on site. The following control measures will be implemented during refuelling processes:

- Supervision of all fuel deliveries;

- Checks carried out on delivery of fuels to ensure correct fuel is delivered;
- Ensure all valves on a bunded tank or secondary containment is closed when not in use;
- Any static fuel bowsers are fitted with automatic cut-off or trigger nozzles; and
- Never leave vehicle or plant unattended during refuelling.

Heavy plant undergoing in-situ refuelling will be located on the drill pad area.

3.10. SITE HOUSEKEEPING

The implementation of a good site housekeeping policy is key to reducing the likelihood of accidents and environmental pollution incidents. Good housekeeping measures that will be implemented on site include:

- Keeping the site tidy;
- Segregating waste and removing it from site regularly;
- Maintaining all site facilities, including welfare facilities;
- Maintaining site roads, ensuring internal roads and those surrounding the site are kept clean;
- Ensuring plant and vehicles on site are well maintained;
- Ensuring all materials are stored appropriately;
- Undertaking regular inspections of all areas of the site to ensure housekeeping requirements are being fully implemented; and
- Ensuring that detailed records of these inspections, their findings and any mitigation required are kept.

The Site Supervisor will monitor the cleanliness of the road daily to ensure that it is free of dirt and debris. Road sweepers will be deployed to clean the roads as necessary, under instruction of the Site Supervisor/Manager.

3.11. WHEEL WASHING FACILITIES

The wheel washing facilities constructed as part of Phase 3 works will be utilised for wheel cleaning of all HGVs and plant exiting site onto the public highways. Traffic will be routed one way to ensure all vehicles required use the wheel washing facilities.

Regular maintenance of the wheel washing facility will be carried out in accordance with the manufacturers servicing specification. The washings shall be collected in a sump, with settled solids removed regularly and water recycled and reused where possible.

4. TRAFFIC

4.1. CONSTRUCTION TRAFFIC MANAGEMENT PLAN

The Phase 6 Construction Traffic Management Plan (CTMP) (40-STS-LC-2100-LG-PL-00007) outlines control measures implemented for the Phase 8 works. This contains a range of general measures for the management of transport including:

- High occupancy travel for employees, including car-sharing, minibus pick up and utilising a parking area outside of the NYMNPA as a transport hub, and
- All vehicles travelling to site using the designated routes only.

The CTMP also contains a Highway Communication Plan, which outlines how communication with the public, the planning and local authorities, and any other stakeholders will be undertaken.

The CTMP also specifies prohibited routes for construction vehicles. To support this, Prohibitive and Directional Signage will be shared with all delivery drivers. This signage was installed prior to the commencement of Phase 2 of the project as part of the Phase 1 Highway works and will be maintained throughout the activity period for Phase 8.

4.2. PARKING, LOADING AND UNLOADING

4.2.1. *PARKING AND LOADING*

4.2.1.1 PARKING

Parking will only be permitted within designated car parking areas and drivers will be required to display permits while parking on site. No access to the site by foot is permitted. A peak of up to 50 employees will be on site during Phase 8.

4.2.1.2 LOADING AND UNLOADING

Loading and unloading of deliveries and materials on site will take place in designated areas dependent on works.

Approximately 10 Abnormal Indivisible Loads (AIL) are expected during the Phase 8 works. Deliveries will be staggered throughout the duration of the Phase 8 works to reduce the number of AIL operating on the A171 and Egton Road between Lockwood Beck Site and Ladycross.

4.2.2. *Access*

All construction traffic will use the existing main access road to access site. The access road is appropriately sized to allow for three HGVs to queue. In addition to the physical measures proposed, to prevent traffic having to wait on the highway or the potential for multiple to meet at the site access, the contractor will be required to provide a banksman and schedule deliveries and shift times.

Security will be stationed at the site access gates and all drivers will be required to have completed the appropriate driver induction before entering site. Access will only be authorised for deliveries / vehicles booked in for the day and with the appropriate access documentation. All deliveries will follow the onsite one-way traffic controls. Where required a banksman will be provided by the contractor if reversing or manoeuvring of vehicles is required.

In addition to assisting the contractor to manage the total numbers of daily HGV movements, the requirement for planning and scheduling deliveries will also assist the contractor in ensuring that deliveries can be spread throughout the working day.

The contractor will also be required to schedule shift times to try and avoid employees arriving and departing at the same time and to schedule deliveries outside of these hours.

5. NOISE AND VIBRATION

5.1. NOISE AND VIBRATION MANAGEMENT PLAN

The imposed noise limits for the Ladycross Plantation are 55dB $LAeq^{-1}hr$ during the day and 42dB $LAeq^{-1}hr$ in the evening (07:00-19:00 and 19:00-07:00 respectively). The Phase 8 works will comply with these limits. Noise monitoring will be carried out for the full duration of the Phase 8 works. A Phase 8 Noise and Vibration Management Plan (NVMP) (40-STS-LC-2100-EN-PL-00038) has been produced and provides further details regarding the mitigation, monitoring and controls to be implemented during the Phase 8 works.

6. AIR QUALITY AND DUST MANAGEMENT PLAN

During the Phase 8 works dust suppression measures will include:

- Damping down of road surfaces, road sweeping and potentially vehicle wheel washing will be utilised across the works area, as appropriate,
- Site fencing, barriers and other areas of dust accumulation will be kept clean using water spraying where there is the risk of dust accumulation. Any run-off will be filtered via the site surface water drainage system,
- Materials that have the potential to create dust problems will be removed unless they are to be re-used on site. Where possible these will be covered or contained in a fenced area,
- Seeding of all topsoil and subsoil bunds,
- Burning of waste materials will be prohibited,
- Pollutant emissions from potential flaring of gaseous hydrocarbon to be mitigated by ensuring complete and efficient combustion, and
- Plant and vehicles used on site will be well maintained to minimise pollutant emissions.

6.1. DUST MANAGEMENT PLAN

Measures and controls to minimise dust emissions from Phase 8 are provided in the Construction Phase Dust Management Plan (DMP) submitted as part of Phase 3 to partially discharge condition 93. Daily inspections and monitoring will be undertaken by the contractors, in accordance with this procedure. Some of the dust management mitigation identified in the DMP is detailed in **Table 6-1** below. The Phase 8 Emissions to Atmosphere and Phase 8 CTMP provides further detail regarding the air quality and dust mitigation to be adopted during the Phase 8 works.

Table 6 - 1 Dust Mitigation

Source / Activity	Mitigation Measures
Construction Traffic	• Implement speed limit on internal roads • Dust suppression used on roads when dust emissions noted • Provide wheel washes to reduce dust on public highways • Sheeting of vehicles carrying dust generating materials

Source / Activity	Mitigation Measures
	• Regular maintenance of vehicles and plant
Compound Areas	• Ensure areas used for welfare facilities and vehicle management (loading and unloading) are constructed of hardstanding • Sweeping / dampening down areas of hardstanding when required
Storage Areas	• Grass seeding temporary earth bunds until re-use • Profiling stockpiles of dust generating materials • Covering dust generating materials, if practical • Dampening down facilities for stockpiles
Drilling operations	• Dust suppression in areas of noted emissions • Background dust monitoring to assess impacts • Covering dust generating materials, if practical • Regular maintenance of vehicles and plant • Sweeping / dampening down areas of hardstanding when required

7. NATURE CONSERVATION

7.1. PROTECTED SPECIES AND PRECAUTIONARY METHOD OF WORKING FOR SITE CLEARANCE

Protected Species Management Plans (PSMPs) were produced for reptiles, birds, bats, badgers and water voles to partially discharge condition NYMNPA-52 for Phase 3. These remain applicable for the Phase 8 works, and the accompanying Precautionary Methods of Working will be applied. The measures detailed in these PSMPs will be implemented in Phase 8.

7.2. VEGETATION CLEARANCE

An assessment by competent persons and consultation with the Project Ecologist will determine if any works impact on the peripheral tree line. Appropriate measures will be followed as outlined in the Arboricultural Method Statement (AMS) prior to any works commencing.

In the event trees require removal, pre-commencement checks for protected species will be carried out 48 hours prior to felling works. Further checks will be undertaken at three-day intervals while works are ongoing to ensure nesting birds have not returned.

7.3. LANDSCAPING AND ECOLOGICAL MANAGEMENT

A Landscape and Ecological Management Plan (LEMP) was produced during Phase 3 works to partially discharge condition NYMNPA-70. Drilling operations that will be undertaken within the Phase 8 works requires no variation to the Phase 3 LEMP.

8. ARCHAEOLOGY

According to the Phase 8 scope of works the potential for interaction with archaeology is negligible. The principles set out in the Phase 2 Written Scheme of Investigation (WSI) will be applied to archaeology encountered during the Phase 8 works.

9. HYDROGEOLOGY, WATER QUALITY AND DRAINAGE

9.1. SURFACE WATER MANAGEMENT

As part of the Phase 8 works the full site surface water drainage network installed during the Phase 3 works will be adopted for surface water management on site. The scope of works for Phase 8 has been reviewed and it was concluded that no review is required to the existing Phase 3 Surface Water Management Plan (SWMP) which provides further detail regarding the control measures and mitigation which will adopted during the Phase 8 works. Surface water will be managed in accordance with the Phase 7 Surface Water Drainage Scheme.

While surface water runoff is captured by the oil interceptor installed as part of Phase 3 works, additional mitigation controls may be implemented around the drill pad to segregate potential polluted surface water runoff if necessary.

9.2. GROUNDWATER MANAGEMENT

The following section seeks to address the requirements of planning conditions 88 and 90, providing details for managing shallow groundwater during the Phase 8 works.

Groundwater will be (HRA) and Phase 8 Construction and Operation Groundwater and Surface Water Monitoring Scheme. Gaseous hydrocarbon monitoring will be undertaken during Phase 8 works to determine chemical impact on the groundwater quality in Ravenscar Group aquifers and potential gaseous hydrocarbon migration through the exploratory borehole. Location of monitoring points is provided in the Phase 8 (HRA). The frequency of the monitoring is stated in the Phase 8 Construction and Operation Groundwater and Surface Water Monitoring Scheme.

Any short term ingress water from either shallow groundwater or surface water sources will be managed by pumping. Water will be pumped into the site drainage network and managed in accordance with the Water Abstraction and Impounding (Exemptions) Regulations 2017 and the Phase 7 Surface Water Drainage Scheme.

Remedial actions will remain in accordance with the Phase 4 Remedial Action Plan (RAP).

To mitigate any pollution migration from drilling operations and fuel refuelling a membrane HDPE liner or similar will be installed underneath the designated drill pad area. To protect the integrity of the liner two layers of sand will be placed at the bottom and at the top to avoid stone penetration and subsequent damage. For further details refer to the Phase 8 Construction Method Statement (CMS) and Phase 8 General Arrangement Drawing.

9.3. SILT AND POLLUTANT MANAGEMENT

Silt and pollutant management remain as per the Phase 3 SWMP.

10. SOILS AND CONTAMINATED LAND

As part of the Phase 8 works, there is no requirement to excavate topsoil or subsoil on site.

11. MATERIALS AND WASTE

A range of materials and waste materials will be stored on site, and these will be stored in a designated area on site. The areas used for storage of material have been planned to avoid excessive handling of material and to facilitate loading and unloading. Details of the measures taken to reduce potential pollution are detailed in **Sections 11.1 – 11.4**.

11.1. Waste Minimisation

Waste management practices will ensure that the waste will be managed in accordance with the Environmental Protection Act 1990 Part II: (Duty of Care); The Waste (England & Wales) Regulations 2011: and the Environmental Permitting (England & Wales) Regulations 2016 Waste Duty of Care requirements are met.

The national hierarchy for waste will be used as reference for management of all wastes produced on site:

Reduce: we will seek to minimise waste through design

Re-use: Wherever possible we will utilise waste exemptions to enable waste to be re-used both on and off-site.

Recycle: We will recycle material wherever technically, environmentally and economically practicable.

Recover: We will look to recover energy and material from waste (digestion, incineration, gasification etc.)

Dispose: We will look to avoid the disposal of waste to landfill and only use disposal as a last resort. Wastes will be minimised through adoption of the following procedures:

- Appropriate procurement of materials (volumes, and options to use recycled materials);
- Use of 'Just in Time' delivery of raw materials to ensure that raw materials (aggregate etc.) are not wasted or lost to the environment;
- Operation of a take-back scheme for excess materials when possible; and
- Adoption of energy management practices minimising use of plant and fuels.

11.2. Materials and Waste Storage

Details of generic materials and waste stored on site are provided in the Phase 3 CEMP and are applicable for Phase 8.

Additional storage measures for materials used in Phase 8 not covered by previous CEMPs are detailed in **Section 3.8**.

11.3. Liquid Waste Material

11.3.1. *Drilling Muds*

Sludges will be produced during the drilling operations. The sludges will be pumped to a sludge tank for holding. A licensed waste contractor will carry out collection and disposal of sludges where required.

11.3.2. *Oily Wastes from drilling*

In the event of hitting gaseous hydrocarbon a mixture of low-boiling hydrocarbon liquids obtained by condensation of the vapours of these hydrocarbon constituents might be generated. A licensed waste contractor will carry out collection and disposal of oily waste where required.

11.3.3. *Water Treatment Plant Sludges*

Waste sludges will be produced during the operation of the onsite Water Treatment Plant (WTP). The sludges will be pumped to a sludge tank for holding. A licensed waste contractor will carry out collection and disposal of sludges where required.

11.3.4. *Oil Interceptor (Oils and Water)*

The oil interceptor will undergo regular maintenance and servicing based upon the specification outlined in the supplier guidelines and manuals. The silt removed from the silt trap will be collected and disposed by a licensed waste contractor. The oil will be collected and disposed by a licensed waste contractor.

11.3.5. *Cesspit Foul Sludges*

The cesspits installed as part of previous phases will undergo regular maintenance and servicing based upon the specification outlined in the supplier guidelines and manuals.

The foul sludge will be emptied from the tanks on a routine basis based upon site footfall and supplier recommendations. The tanks are fitted with high level alarms as an additional layer of safety.

12. INCIDENT AND EMERGENCY PLANNING

Potential environmental issues and emergencies are considered as part of the project planning, and the appropriate prevention and control measures put into place. These measures are communicated to all people working on the project including subcontractors through the site induction and toolbox talks.

The emergency contacts list and drainage plan/ site plan (including the location of spill kits) will be posted on notice boards. Spill kits will be located within the stores in the site compound, at strategic points around the site and within all working vehicles. Vehicles will carry enough spill kit to clean up the amount of diesel/ oils they are carrying.

All employees will be instructed to bring any environmental incidents they identify to the immediate attention of Site Management, after first taking what steps to contain/ remediate the incident (without putting the health and safety of themselves or others at risk).

Environmental Emergency Preparedness Plans (EEPP) have been prepared specifying the actions to be undertaken in the event of an environmental emergency or a breach of the measures set out in the EIA. The EEPP will be displayed on all site notice boards. In accordance with the EEPP, the Contractor's Environmental Manager will be notified of environmental incidents.

13. RELATED DOCUMENTS AND REFERENCES

Phase 8 Construction Method Statement (40-STS-LC-2100-CN-MS-00009)

Phase 8 Construction Vehicle & Plant Management Plan (40-STS-LC-2100-LG-PL-00010)

Phase 6 Construction Traffic Management Plan (40-STS-LC-2100-LG-PL-00007)

Phase 8 Noise & Vibration Management Plan (40-STS-LC-2100-EN-PL-00038)

Phase 8 Emissions to Atmosphere (40-STS-LC-2100-EN-PL-00039)

Phase 8 Hydrogeological Risk Assessment (40-STS-LC-2100-EN-RA-00005)

Phase 8 Construction and Operation Groundwater and Surface Water Monitoring Scheme (40-STS-LC-2100-EN-PL-00037)

Phase 8 Phasing Plan (40-STS-LC-2100-PA-22-20124)

Phase 8 Hard & Soft Landscaping (40-STS-LC-2100-PA-22-20125)

Phase 8 General Arrangement (40-STS-LC-2100-PA-22-20126)

Phase 7 Surface Water Drainage Scheme (40-STS-LC-2100-PA-22-20123)

Phase 3 Landscape and Ecological Management Plan (40-STS-LC-2100-EN-PL-00014)

Phase 3 Surface Water Management Plan (40-STS-LC-2100-PA-PL-20102)

Phase 2 Archaeological Watching Brief Written Scheme of Investigation (40-COT-LC-8324-EN-PL-00002)

Phase 3 Soil Management Plan (40-STS-LC-2100-EN-PL-00007)

Construction Phase Dust Management Plan (40-STS-LC-2100-EN-PL-00015)

Construction Phase Arboricultural Method Statement (40-STS-LC-21-CN-MS-00003)

14. DEFINITIONS AND ABBREVIATIONS

NYMNPA – North York Moors National Planning Authority

MTS – Mineral Transport System

CEMP – Construction Environmental Management Plan

HGV – Heavy Goods Vehicle

EIA – Environmental Impacts Assessment

PMWSP – Precautionary Method of Working Standard Procedures

CSEF – Community Stakeholder Engagement Framework

ANPR – Automatic Number Plate Recognition

AMS – Arboricultural Method Statement

MSDS – Material Safety Data Sheet

COSHH – Control of Substances Hazardous to Health

IBC – Intermediate Bulk Container

PSMP – Protected Species Management Plan

RPZ – Root Protection Zone

WSI – Written Scheme of Investigation

WTP – Water Treatment Plant

EEPP – Environmental Emergency Preparedness Plan

AIL – Abnormal Indivisible Loads

15. ATTACHMENTS

ATTACHMENT A – Community Stakeholder Engagement Framework

ATTACHMENT B – Complaints Procedure

ATTACHMENT C – Precautionary Method of Working

ATTACHMENT A - COMMUNITY STAKEHOLDER ENGAGEMENT FRAMEWORK

Community and Stakeholder Engagement Framework

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Community and Stakeholder Engagement Framework

Contents

Community and Stakeholder Engagement Framework

1 Purpose and Scope

1.1 Background

The Company takes its responsibility to the local area very seriously and is committed to taking an active and positive role in the local community. This means minimising the potential adverse impacts on people living and working in the area, making a meaningful contribution to the social and economic well-being of the area, keeping the community informed as the project develops and responding quickly to questions and concerns.

There is widespread interest in the Company's Woodsmith Project (the Project) at local, regional and national levels. This is demonstrated by the ongoing media and stakeholder enquiries, as well as the levels of participation during the planning consultations and at Company events.

Anglo American (the Company) successfully engaged the community and other key stakeholders during the planning period and has continued to do so beyond, gaining widespread support for the Project. This has helped to provide the Company with a social license to operate. Maintaining this throughout the construction period is important to the successful delivery of the Project and is a key objective of the Company's board and management team.

1.2 Purpose

This Community and Stakeholder Engagement Framework (CSEF or the Framework) aims to set out a clear communications approach during the construction period which, when implemented correctly, can help to maintain the Project's social license to operate.

1.3 Scope

The Framework sets out an approach to community and stakeholder communications during the construction period. It outlines the overall strategy, identifies the main stakeholder groups and details the engagement objectives and activities. Stakeholders have been identified as those groups in the local area who have the potential to be impacted by construction, and as such does not include wider corporate stakeholders such as investors or customers.

The Framework sets out the roles and responsibilities of the Company and the principle construction contractors for implementing and managing its delivery.

1.4 Standards and compliance

The Framework is in compliance with planning obligations relating to community and stakeholder engagement including: producing a communications plan; the establishment of the Liaison Group Forum and Traffic Management Liaison Group; notification to neighbours of construction activities, particularly in relation to noise; dealing with complaints and initiatives to promote local benefits.

It is not within the scope of this plan to include engagement with the planning authorities and other statutory bodies in relation to the compliance with planning obligations and further environmental requirements, other than those specifically regarding community engagement.

1.5 Document review

The Company is committed to regularly reviewing its approach. This is the fifth time this document has been updated since the off-site highways improvement works were undertaken on the main transport route and construction started at Woodsmith, Ladycross Plantation, Lockwood Beck and Wilton. The principles of the Framework therefore remain unchanged, with the addition of the good practice learnt over the last five years.

The Framework will be reviewed on annual basis by the General Manager External Affairs and Corporate Relations Director, in consultation with the land, environment and planning team, and updated as necessary. It will be distributed to the list shown in section 1.6. Lessons learnt will be adopted into the working practices of the social performance team under the direction of the Corporate Relations Director.

1.6 Distribution list

- North York Moors National Park Authority
- North Yorkshire County Council
- Principle contractors

2 Engagement Strategy

2.1 Rationale

The strategy is based on the principle that the local community and key stakeholders should be kept informed of developments and in advance of them occurring. The failure to communicate often leads to a communications vacuum and this in turn leads to misinformation and rumours which is unhelpful for all stakeholders.

Similarly, providing channels for feedback to the Company in the first instance, including direct contact with the community relations team, allows local people or spokespeople to be engaged in matters that might affect them. Since construction started on the off-site highways works over five years ago, the vast majority of questions or concerns about the Project have come directly to the Company. This demonstrates the importance of developing and maintaining relationships ‘on the ground’.

Keeping people informed is not just about notification of physical activities during the construction period, but is also about allowing a channel for feedback that might raise an issue or local knowledge that the Company or its contractor teams were not aware of. It also enables a channel to promote the benefits of the Project as well as engaging in other positive public relations activities.

Any materials that are prepared for public consumption to explain parts of the construction work are designed and drafted in a manner that promotes the understanding of works or issues in as clear and straightforward manner as possible.

2.2 Approach

1. **Conduct pre-briefings for key events or activities**
   Providing clear information before each phase of works commences at the Project sites detailing what construction will involve, when it will take place and the measures to limit impacts. Since

construction started this has included newsletters, mailouts, direct face-to-face meetings, drop-in events, public meetings, press releases and notices in the local media.

2. **Have effective ongoing management of local communications**
   Providing ongoing updates about construction progress and establish mechanisms that enable concerns to be raised and acted upon. This includes participation in the various liaison groups and clear processes to manage incoming queries or complaints. These have worked well since construction started. The Company also operates a 24-hour community helpline.

3. **Community benefit initiatives**
   Undertaking and promoting regular initiatives that deliver community benefits such as education schemes and employment and business opportunity information sessions. These have been ongoing since construction started and have been well received by the community.

Further details on the methodology for pre-briefings, ongoing management and community benefits initiatives are available in sections 4.2 – 4.4.

3 Stakeholder Identification

Stakeholder groups have been identified and engaged as the Project has developed and can be broadly categorised as follows:

1. **Site neighbours**
   Residential neighbours and/or landowners, businesses and organisations close to the individual construction sites. This also includes those directly affected in other areas such as those living close to key transport corridors or junctions. Approximately 70 households have been identified as 'site neighbours' to the Woodsmith, Ladycross Plantation and Lockwood sites and regular contact has been maintained since construction commenced. In addition, links with the neighbourhood of Dormanstown have been established since construction commenced at the Wilton site.

2. **Community representatives**
   This group includes elected representatives of the community including parish and town councils, local authority officers and councillors, and local MPs.

3. **Interest groups**
   Business networks, environmental bodies, other local clubs and groups.

4. **Education Institutions**
   This includes local schools, colleges, universities and other training providers.

5. **Media**
   A wide range of online, print and broadcast outlets and journalists are considered key stakeholders.

6. **General public**
   The wider public as accessed through media channels, the website, social media or site signage etc.

A register has been developed for each Project site for of these broad groups, which is reviewed and updated. Stakeholder engagement takes into account the needs of vulnerable and disadvantaged groups, making sure that information about the Project is accessible and people are able to contact the

Company and receive a prompt response. This is ensured by utilising a broad range of engagement channels, as set out in section 4, and holding public events in accessible venues.

4 Engagement Methodology

This section sets out how community and stakeholder communications will be handled.

4.1 Identify stakeholders

The broad stakeholder groups have been identified, together with specific stakeholders relevant to each of the construction sites that are most likely to be impacted by the works. This includes landowners and local residents in close proximity to the sites.

4.2 Pre-briefings for key events

Before each phase of construction starts, or before a specific construction activity that has the potential to impact stakeholders, it is important to provide information to the local community. For the purpose of this Framework these stages are defined as “construction events” (these are listed in Appendix 1). Each construction event triggers the requirement for pre-briefing activities. The level of pre-briefing activity will vary, taking into account the extent of the local impact anticipated.

The pre-briefing information will include details about what construction will involve and how people can contact the Company if they have questions or concerns. Reassurance will be given that measures will be taken to limit adverse impacts to an acceptable level and that planning conditions and other requirements are in place to ensure that this happens. As a minimum, the pre-briefing activities will include:

- Letters – Letters and or emails should be sent to those that are likely to be immediately affected. This might include neighbouring residents or households and businesses on access routes. As a courtesy, the same information will be sent to the local Parish Council, borough and county councillors covering those areas.

- Visits and phone calls – In addition to letters, affected households and businesses will be visited, or at the very least receive a telephone call.

For construction activities that are more significant, in terms of their potential for stakeholders to be affected, the Company will use the following pre-briefing methods. The precise details and extent of pre-briefing will be a matter of judgement and as a result of discussions between the contractor and the Company and, where appropriate, the planning authorities. Activities may include:

- Newsletter / Leaflet – A short summary newsletter or leaflet about the works will be made distributed, including local noticeboards and community facilities.

- Exhibitions / Open days – In the case of certain key events, such as the main shaft sinking, it will be appropriate to inform local residents and the wider general public through open days prior to works starting. This includes further information on exhibition boards and will be attended by key personnel from the Company and contractors, who are be able to respond to queries and provide reassurance on potential concerns. Ten of these sessions have taken place since construction started.

- Press release – If appropriate (often where a wider audience is potentially affected or interested in the works planned) then a press release will be prepared detailing the key facts. Any press release needs to be signed off by the Company in a timeframe that makes sure newspaper deadlines are met. Where possible, coverage should always appear in the week prior to the proposed activities beginning. The local media has been particularly useful in instances where the community beyond the immediate site neighbours could be affected, such as public highways disruption.

- Website updates – Details of key events are uploaded to the Company website. Some works may also require more detailed information and documents to be uploaded.

- Social media updates – The Company will control its social media accounts. As above, the contractor will be expected to provide the relevant details to the Company in a timely fashion so the relevant information can be released through its social media channels.

- Stakeholder briefings – In some circumstances specific stakeholders will be individually briefed to inform them of key events. This may include elected representatives, local authority officers or interest groups. The Company will take the lead on such matters and will involve contractors where appropriate.

4.3 Ongoing management

Local residents and stakeholders will continue to be engaged throughout construction (i.e. general updates in addition to those covered under 'key events' in appendix 1). This will enable the Company to provide regular updates of the Project's progress, and that it is being delivered in accordance with planning consents and any other Company commitments. Alternatively, if the Project is not progressing as expected it is important that stakeholders are provided with an explanation and reassurance that corrective measures will be implemented.

In addition, on-going engagement will include a range of communication channels that enable stakeholders to raise issues and ask questions and for the Company to respond to these.

4.3.1 Liaison Group Forum

The Liaison Group Forum (LGF) was established prior to the commencement of construction and has met quarterly. It is chaired by the Company and its membership includes representatives from the National Park Authority, parish and town councils and wider community stakeholder representation as appropriate. The meetings take place in community venues, such as village halls, close to the Woodsmith site and are open to the general public to attend and to ask questions.

The purpose of the group is to facilitate liaison between local stakeholders about construction, providing updates about progress, and to enable issues and concerns to be raised and resolved.

4.3.2 Industrial Business Group

The Industrial Business Group (IBG) was established to facilitate liaison between the businesses based at Wilton International and residents from the neighbourhoods in close proximity of the site.

Meetings are held bi-monthly and attended by the major businesses on the site, local councillors and residents. The Company joined the group once construction started on the Wilton site.

4.3.3 Traffic Management Liaison Group

The purpose of this group is to facilitate liaison between local authorities and other interested stakeholders in regard to construction traffic. The group, which meets quarterly, oversees the management and monitoring of the Construction Traffic Management Plan (CTMP) and is chaired by the Company. The meetings take place after the LGF meetings, on the same day and venue, with traffic issues raised by the LGF addressed by the group.

There is representation from the National Park Authority, highways authorities, local authorities, the police and other stakeholders as invited.

4.3.4 24-hour community helpline

To ensure that there are accessible points of contact for the local community and wider stakeholders a 24-hour community helpline has been established, which is delivered by a specialist contractor. In addition there is a community email address, which is managed by the Company.

4.3.5 Regular briefings and updates

Key individuals and organisations are regularly briefed and updated. Similarly to pre-briefings for key events, updates are communicated through the following channels:

- Public meetings and presentations – Parish council and town council meetings are regularly attended, together with presentations to local interest groups.

- Site visits and meetings – visits to the Project sites for key stakeholders have been an effective way to communicate site activity and progress. In addition, drone footage of the project sites is regularly used to show progress and is used in Project presentations and on the Company's website.

- Press releases – the print and broadcast media are utilised extensively to communicate with the wider community and at a regional and national level.

- Newsletters, website and social media – regular updates produced throughout construction via the website, leaflets, newsletters, social media and publications relating to specific issues, such as careers. Videos, including footage of the sites and interviews with key Project personnel have also been an effective tool.

4.4 Community benefit initiatives

The Company has made a number of commitments to benefit the local area during construction such as providing employment and supply chain opportunities, training schemes, school outreach programmes and funding community projects. It important that these are implemented and widely promoted so that the community and stakeholders are aware that the Company's commitments are being delivered. The activities and initiatives, some of which are planning obligations in the S106 agreements, are outlined below:

- Funding to Scarborough Borough Council and Redcar and Cleveland Council to identify and prepare local people for employment opportunities.

- Funding to raise awareness of science, technology, engineering and maths (STEM) related careers in schools in North Yorkshire and Redcar and Cleveland.

- Targets specified in the S106 agreement - take on 50 apprentices, recruit 15 local students on the Company's Undergraduate Programme and train 300 adults.
- Quarterly employment opportunity sessions to promote job opportunities to local people and meet the buyer events for local businesses.
- Education outreach initiatives, careers events and presentations.
- Funding community projects through the Woodsmith Foundation.

4.5 Dealing with complaints

The Company aims to respond promptly to complaints and concerns, ensuring that issues are investigated and resolved as quickly as possible. The Company's approach is detailed in its Complaints Procedure – see Appendix C.

5 Roles and Responsibilities

This section provides a framework that identifies responsibilities for the delivery and management of community and stakeholder engagement, focusing on roles of the Company and the principle construction contractors. The Company will be responsible for all community and stakeholder engagement during construction, supported by each construction contractor as required.

5.1 Anglo American

The Company will be responsible for:

- Identifying key stakeholders likely to be impacted by the works.
- Undertaking pre-briefing activities before construction starts such as:
    - Open Days / exhibitions as appropriate.
    - Producing information outlining what is involved, impacts and mitigation, contact information, etc.
    - Direct correspondence with neighbours and landowners about construction events
- Liaison with the planning authorities and community representatives, including chairing the Liaison Group Forum and Traffic Management Liaison Group.
- Media relations.
- Manage the complaints procedure.
- Producing project newsletters, social media and updating the website.
- Direct engagement and briefings with key stakeholders including local residents, community representatives and interest groups.

5.1.1 Social performance team

The Company's social performance team is responsible for implementing the Framework in liaison with others in the Company as appropriate.

The Company's Corporate Relations Director has overall responsibility for all company communications and external relations. The Corporate Relations Director chairs the Liaison Group Forum.

The General Manager External Affairs, reporting to the Corporate Relations Director, manages the implementation of the approach detailed in the Framework. The Local Liaison Officer, Social Programmes Manager and Education Programme Manager report to the GM External Affairs, and are further supported by the EA to the Corporate Relations Director.

The social performance team work closely with other departments in the Company in the implementation of the Framework, particularly the land, environment and planning team as well as the project development team. They assist in providing relevant information, investigating and resolving complaints, and attending Company events and public meetings as required. The Company's Logistics Manager chairs the Traffic Management Liaison Group.

5.2 Construction Contractors

Having developed and maintained positive relationships with key local stakeholders since the Project was launched in 2011, Anglo American takes the lead role in all community and stakeholder engagement. Each of the construction contractors will be required to support the Company's stakeholder engagement approach as follows:

- Provide expected durations of phases or work, their potential impact on the local community and mitigation measures where required.
- Provide details of any expected public transport diversions, delays, planned road closures, impacts on highways, interrupted access for residents/ businesses, or other expected community disruption.
- Participate in employment opportunity sessions, meet the buyer events, and education outreach events as required.
- Cooperate with Anglo American in media events and provide information to the Company for publications, the website, newsletters, etc.
- Adherence to Anglo American's communications protocols and guidelines.
- Attend the liaison groups, parish/town council meetings and assisting Anglo American as required.
- Ensure that all sub-contractors comply with stakeholder and community relations requirements.

Appendix A – Construction Events

The following provides a list of construction events which trigger the requirement for pre-briefing activities, as outlined in section 4.2. The list is not exhaustive and there may be other events or activities not listed here that could be classified as construction events as a result of discussions between the Company and its contractors.

The construction events for the purposes of this Framework are:

- Any significant geotechnical investigation or drilling works
- Main Woodsmith Mine shaft sink
- Main Lockwood Beck shaft sinking
- Main Ladycross Plantation shaft sinking
- MHF construction
- Harbour construction
- Other construction activities with the potential to affect stakeholders including site neighbours or road users in regard to noise, light, disruption to the public highway, etc. Examples include an abnormal load arriving to site or a short period of piling.

Appendix B – Engagement Activities Summary

The table below provides an 'at a glance' overview of the main community and stakeholder engagement activities, together with the respective roles of Anglo American and contractors.

	Pre-briefing activities	Ongoing management	Community benefit initiatives
Anglo American	• Establish Liaison Group Forum and Traffic Management Liaison Group • Project update newsletter • Media, website update, social media • Briefings with site neighbours, landowners, community representatives and other key stakeholders as identified • Produce leaflet detailing upcoming construction activities • Send letters to stakeholders likely to be immediately affected • Hold public open days / exhibitions	• Chair Liaison Group Forum and Traffic Management Liaison Group • Attend the Industrial Business Group • Manage 24-hour community helpline and cropnutrients.info@angloamerican.com • Attend parish and town council meetings quarterly • Regular updates to site neighbours, landowners, community representatives and interest groups • Site visits • Media, website update, social media • Manage complaints procedure	• Training targets and promotion of initiatives funded by the S106 • Promote activities of the Sirius Minerals Foundation • Organise meet the buyer events • Organise regular employment opportunity sessions • Deliver education outreach programmes
Construction Contractor	• Provide information to Anglo American to be used in leaflets, letters, web content, etc., as required • Attend public open days/exhibitions and meetings with stakeholders as required	• Attend liaison groups, parish council and other meetings as required • Provide information to support on-going community and stakeholder relations • Participate in media events as required • Adherence to complaints procedure, media protocol and crisis response procedure	• Involvement in community benefit initiatives as required

Community engagement is tracked across these three elements. Activities and complaints are reported in the Company's annual Responsible Business Report. Minutes of the Liaison Group Forum, which includes community engagement as a standing agenda item, are published on the Company's website.

By being proactive in building and maintaining relationships in the community, the Company is always receiving feedback about its performance. This helps to inform the Company on what it could be doing better, enables it to respond quickly to concerns and pre-empt them in the future and is an important part of annual review of the Framework.

Appendix C – Complaints Procedure

This procedure outlines the Company's standards in handling complaints and the process of managing complaints from receipt through to resolution. The procedure has been updated to take into account the lessons learnt during the first two years of construction.

1 Standards for Handling Complaints

- All complaints will be treated seriously, fairly and with courtesy;
- Complaints will be responded to quickly – we will acknowledge a receipt of a complaint straight away wherever possible;
- We will investigate and aim to resolve complaints within a maximum of three days, making sure that initial feedback is provided within one day; and
- We publish information about complaints, with the identity of the complainant kept confidential, to the Liaison Group Forum and in the Company's annual Responsible Business Report.

2 Stages of the Complaints Procedure

2.1 Receipt of complaint

The vast majority of complaints are received directly by the Anglo American community relations team through a variety of channels, e.g. directly to a team member, via the general cropnutrients.info@angloamerican.com email, social media, parish council meetings or the 24-hour community helpline. Relationships with the regulatory authorities are well established and complaints received by them are forwarded to the Company's community relations team to investigate.

The team aim to acknowledge a complaint straight away and ascertain the relevant details as soon as possible.

Occasionally a complaint is made directly to a Project site. In this instance the community relations team will be informed and further communication with the complainant managed by them.

2.2 Investigation

In all cases the community relations team will notify the Anglo American site manager, the environment team and the logistics team (where complaints are related to traffic). The site manager will lead the investigation, delegating where appropriate and liaise with the relevant contractor. All relevant personnel will be kept updated.

If remedial action is required this will be implemented as quickly as possible in consultation with the environment and planning team, community relations team and others as appropriate.

2.3 Feedback

The community relations team will feedback to the complainant within a maximum of three days, with initial feedback given within one day. Further details will be sought from the complainant if required.

The complainant will be given the details of any remedial action taken and have the opportunity to discuss the outcome of the investigation with the community relations team, who will involve others as appropriate. If further relevant information comes to light, the complaint will be investigated again.

2.4 Log and Review

Complaints are logged and reported to the next Liaison Group Forum (LGF) meeting. The minutes of LGF meetings are published on the Company's website.

Complaints are reviewed to establish whether action can be taken to reduce the likelihood of similar complaints in the future, and whether the way in which the complaint was dealt with could be improved.

ATTACHMENT B – COMPLAINTS PROCEDURE

Complaints Procedure

Document Number: 40-SMP-GE-0000-PU-PR-00001

Document Verification				
Revision	**Date**	**Prepared by**	**Approved by**	**Reason for Issue**
0	22/03/2019	M. Parsons	G. Edmunds	Issued for Use
1	17/12/2020	M. Parsons	G. Edmunds	Issued for Use

Complaints Procedure

Contents

Complaints Procedure

This procedure outlines the Company's standards in handling complaints and the process of managing complaints from receipt through to resolution. The procedure has been updated to take into account the lessons learnt during the first three and half years of construction.

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In all cases the community relations team will notify the Woodsmith site manager, the environment team and the logistics team (where complaints are related to traffic). The site manager will lead the investigation, delegating where appropriate and liaise with the relevant contractor. All relevant personnel will be kept updated.

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ATTACHMENT C – PRECAUTIONARY METHOD OF WORKING

Precautionary Method of Working (PMoW) for Site Clearance (Ecology)

The Precautionary Method of Working (PMoW) for site clearance predominantly relates to the protection of reptiles and nesting birds which may be present within the development site although requirements for otters and badgers have also been included for completeness.

General overview

The construction site manager will ensure that anyone undertaking construction works on the site (including sub-contractors) is made aware of the potential for the site to support nesting birds, common reptile species and other protected species, where to expect them, their protected status and the procedure (see below) to follow in the unlikely event that nesting birds or common reptiles are discovered during works. Where applicable this advice will be given through site inductions, ecological tool box talks or similar.

Should any nesting birds, reptiles or other species be discovered during construction, which are likely to be effected by the development, works will cease immediately. The construction site manager will then seek the advice of a suitably qualified and experienced ecologist and works will only proceed in accordance with the advice they provide.

Reptiles

Within the development's construction zone the following methods of working will be adopted:

- All clearance works will be undertaken when reptiles are likely to be fully active i.e. during the period March/April to September/October inclusive, but this is weather and temperature dependent;
- Where clearance works cannot be undertaken within this period, additional surveys and/or mitigation measures may be required to confirm the absence of reptiles prior to clearance works, and a suitably qualified ecologist (the project ecologist) should be on site during the works to inspect areas immediately prior to clearance;
- Clearance of dry stone walls, logs, brash, stones, rocks, or piles of similar debris will be undertaken carefully and by hand and supervised by a suitably qualified ecologist;
- Clearance of tall vegetation (any vegetation over 150mm) should be undertaken using a hand held strimmer or brush cutter with all cuttings raked and removed the same day. Cutting will only be undertaken in a phased way which may either include:
    - Cutting vegetation to a height of no less than 30mm, clearing no more than one third of the site in anyone day or;
    - Cutting vegetation over three consecutive days to a height of no less than150mm at the first cut, 75mm at the second cut and 30mm at the third cut;
- Following removal of tall vegetation using the methods outlined in above remaining vegetation will be maintained at a height of 30mm through regular mowing or strimming to discourage common reptiles from returning;

- Ground clearance of any remaining low vegetation (if required) and any ground works will only be undertaken following the works as above;
- Any trenches left overnight will be covered or provided with ramps to prevent reptiles from becoming trapped and enable escape; and
- Any building materials such a bricks, stone etc. will be stored on pallets to discourage reptiles from using them as shelter. Any demolition materials will be stored in skips or small containers rather than in piles on the ground.

Nesting Birds

Within the development's construction zone the following methods of working will be adopted:

- Vegetation clearance that is required will be undertaken outside of the breeding bird season (i.e. the works will be undertaken between September and February);
- Any demolition work that is required will be undertaken outside of the breeding bird season (i.e. between the works will be undertaken September and February);
- Where clearance works or demolition works cannot be undertaken out with this period, additional surveys maybe required to verify absence of breeding birds prior to clearance works and an ecologist should be on site during the works to inspect areas immediately prior to clearance, or at least no less than 24 – 48 hours before the works commence. The area of inspection should extend for at least 500m from the area of works;
- Where felling outside the breeding season is not possible a sensitive felling methodology will be implemented, involving the identification of specific areas to be felled, followed by surveys for occupied nests (or nests being built) being carried out by a suitably qualified ecologist (the project ecologist) undertaken a maximum of 24 - 48 hours prior to the commencement of works) and extending over an area of at least 500m from the area of works;
- If active birds' nests are found within the following distances from site, the area should be roped off and no works should be undertaken in the these exclusion areas until the birds have fledged and the nests are empty:
    - Common crossbill - 150m;
    - Nightjar - 500m;
    - Goshawk - 150m; and
    - All other species - 10m.
- Alternatively, liaison with Natural England may be undertaken to agree the approach to working within the exclusion zones of the nest sites specified above.

Other Protected Species

Within the development's construction zone the following methods of working will be adopted:

- Dust minimisation methodologies will be implemented and adhered to at all times;
- Construction lighting will be directed away from areas of retained habitat wherever possible;
- Pollution prevention controls will be implemented and adhered to at all times; and
- All excavations will be covered every night to reduce the risk of otters, badgers or any other species falling into the excavations and becoming stranded or if this is not possible then a means of enabling their escape will be provided.

Project Title / Facility Name:

Woodsmith Project

Document Title:

CONSTRUCTION & OPERATION GROUNDWATER & SURFACE WATER MONITORING SCHEME - PHASE 8 - CONDITION 88 - LADYCROSS

NYMNPA

21/12/2023

Document Review Status

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WOODSMITH PROJECT

(788.5030)

CONSTRUCTION AND OPERATION GROUNDWATER AND SURFACE WATER MONITORING SCHEME – PHASE 8 – CONDITION 88 / 40-STS-LC-2100-EN-PL-00037

Revision	Date of issue	Prepared by	Checked by	Approved by	Changes
A (PLA)	25/09/2023	John Allison	Carl Thomas	Charles Eddington	First Issue
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D (PLA)	18/12/2023	Efrain Castro	Carl Thomas	Charles Eddington	Revision in accordance with rev C comments
E (PLA)	20/12/2023	Efrain Castro	Carl Thomas	Charles Eddington	Revision in accordance with rev D comments

TABLE OF CONTENTS

1. INTRODUCTION

1.1. General Background

In 2014 a planning application (reference NYM/2014/0676/MEIA) was submitted to the North York Moors National Park Authority (NYMNPA) for permission to develop a Polyhalite mine and underground Mineral Transport System (MTS). Planning permission was subsequently granted in 2015 subject to conditions, as varied in February 2018 by NYM/2017/0505/MEIA.

This document details the hydrological, hydrogeological and ecological monitoring to be undertaken from commencement of the Phase 8 works at the Ladycross Plantation Site, as defined in **Section 1.2** below.

1.2. Phase 8 Scope of Works

The Phase 8 Scope of Works is as follows:

- Drilling of an exploratory Borehole;
- Temporary Installation and use of drilling rig and ancillaries;
- Decommissioning of Borehole.

The scope of works covered by this document comprises drilling of an exploratory horizontally drilled directional (HDD) Borehole. The Eskdale Anticline through which the Tunnel Drive between Ladycross and Woodsmith Mine passes includes areas of rock containing faults. The HDD works are to assess these structures, on a precautionary basis, for ground conditions, including groundwater and the very low risk of encountering low volumes of natural gas, prior to tunnel boring activities.

The borehole will be initially 500mm in diameter and cased to circa 11mbgl, the casing will be cemented into place. Secondary drilling activities and casing, again from surface, will be at a diameter of 300mm inside of the primary casing, the secondary borehole will then be cased to approximately 145mbgl and 42m into the Whitby Mudstone Formation aquitard, sealing the upper aquifers. The HDD activities will continue as open hole boring at a diameter of 175mm to a maximum depth of 350mbgl and a distance of approximately 4km parallel to the tunnel alignment. All horizontal drilling activities will be undertaken below all abstractions and vulnerable aquifers.

Decommissioning of the borehole is to be undertaken once the TBM has passed the end of the maximum extent of the borehole; at circa 4km from the Ladycross intermediate site. The duration for monitoring of the borehole during TBM Drive 3 is predicted to take circa 12 months. Monitoring of the borehole will be undertaken until the borehole is sealed from approximately 305mbgl to 2mbgl.

1.3. COMPLIANCE WITH CONDITIONS

This document is required to partially discharge condition NYMNPA-88 as stated in the planning permission Ref. no NYM/2017/0505/MEIA. **Table 1-1** details where the relevant information has been provided within this report.

Table 1-1 – Summary of planning condition 88 and where the relevant details are provided in the report.

NYMNPA Condition 88 Description	Compliance with Condition NYMNPA 88
The scheme shall include:	
Groundwater quality and level triggers	**Section 3.4.4**
Surface water quality triggers, including those necessary to protect the health of the River Esk Pearl Mussel beds	**Section 3.7.5**
Details of the number, type and location of monitoring points	**Section 3.3.2**, **Section 3.4.2, Section 3.5.2, Section 3.6.2, Section 3.7.2 and Section 3.8.2**
A protocol for the removal and replacement of any existing monitoring points	**Section 3.4.2**
Details of the frequency with which monitoring points will be monitored during construction and operation	**Section 3.3.3**, **Section 3.4.3, Section 3.5.3, Section 3.6.3, Section 3.7.3 and Section 3.8.3**
A list of the ground and surface water determinants to be tested for	**Section 3.5.4** and **Section 3.7.4**
Monitoring of groundwater levels and spring flows	**Section 3.4** and **Section 3.6**
Monitoring of groundwater quality against ground water triggers	**Section 3.5.5**
A scheme of periodic review and refinement of the monitoring regime to take account of any approved changes to site layout/design, construction methods and monitoring data	**Section 4**
A protocol for notifying the MPA of any breach of the trigger levels, including the timing of any such notification	**Section 4**
Details of the method and frequency with which monitoring results will be shared with the MPA and the Environment Agency	**Section 4**

This document should be read together with the following documents:

- Phase 4 Remedial Action Plan (40-STS-LC-2100-EN-PL-00017)
- Phase 8 Revised Hydrogeological Risk Assessment (40-STS-LC-2100-EN-RA-00005)
- Phase 3 Surface Water Management Plan (40-STS-LC-2100-PA-PL-20102)
- Phase 7 Surface Water Drainage Scheme (40-STS-LC-2100-PA-22-20123)

2. SITE DETAILS

The site details remain the same as previous phases. For information with regards to site geology, receptors and historic information refer to previous Groundwater and Surface Water Monitoring Schemes (GWSWMSs) along with the historic Hydrogeological Baseline Report (FWS, September 2014).

3. MONITORING

3.1. GENERAL

In the following sections, the requirements for undertaking ground and surface water monitoring are presented in terms of the monitoring locations, frequency of monitoring, determinants to be analysed for, trigger values and reporting procedures. This document amends the previous monitoring scheme presented for the Phase 7 GWSWMS (40-STS-LC-2100-EN-PL-00033), to incorporate revised monitoring practices.

The monitoring requirements have been determined specifically to enable monitoring of Phase 8 activities. The following sections present details of the scope, data requirements, frequency and trigger values (where appropriate) to be adopted for monitoring the following elements:

- Meteorology,
- Groundwater,
- Springs,
- Surface Water,
- Gaseous Hydrocarbons

Ground and surface water trigger levels, comprising ‘Control’ and ‘Compliance’ values, have been set to enable evaluation of whether the works have an adverse impact on water resources, In accordance with Environment Agency guidance:

- The Control Trigger values are an early warning system designed to draw attention to the development of adverse trends in the monitoring data that may suggest the mitigation measures incorporated into the Phase 8 Works are not working as anticipated. These values have been derived from the baseline data, and where the baseline data is less than the detection limit, the Control Trigger value has been set at the detection limit.
- The Compliance Trigger values are defined as the levels at which significant adverse environmental effects have occurred, i.e. if compliance value for a specific receptor has been breached there is pollution occurring. These values have been derived from current Statutory Instruments, where available. Where the detection limit is greater than the Statutory Instrument value, the Compliance Trigger value have been set at the detection limit.

3.2. Changes to External Offsite Monitoring (Tracer Units)

Due to the small diameter and low volumes of grout associated with this phase of works, there is still no requirement to monitor groundwater levels associated with leaching of grout into the aquifers associated with shaft sinking activities. Monitoring was undertaken throughout grouting activities (27 May 2023) and for a sustained period after completion of grouting activities. It has been shown that no leaching of grout was experienced in the aquifers as a result of grouting activities, due to the two external grout rings (that were installed as an environmental curtain). Monitoring of BH01 (and associated vibrating wire piezometers) will continue to be undertaken in order to monitor groundwater levels associated with the immediate proximities of the shaft installation and surrounding proximities of the exploratory borehole.

Details of changes to the GWSWMS are shown in **Table 3-1.**

Table 3-1 Changes made to the monitoring requirements for Phase 8 works,

Section	Changes
3.3 Meteorology	No changes, monitoring remains the same as detailed in the Phase 4 GWSWMS.
3.4 Groundwater Levels	Frequency of groundwater level monitoring at particular onsite boreholes will revert back to a weekly basis until the Tunnel Boring Machine passes the end of the drill string. All other groundwater levels monitoring will remain consistent with the Phase 7 GWSWMS.
3.5 Groundwater Quality	No changes. Monitoring remains the same as detailed in the Phase 7 GWSWMS.
3.6 Spring Water Quality and Levels	No changes. Monitoring remains the same as detailed in the Phase 7 GWSWMS.
3.7 Surface Water Quality	No changes. Monitoring remains the same as detailed in the Phase 7 GWSWMS.

3.3. METEOROLOGY

3.3.1. OBJECTIVES

To provide rainfall and evapotranspiration information to confirm water balance inputs and outputs.

3.3.2. SCOPE OF MONITORING

Meteorological monitoring will be undertaken of the following parameters from the automated permanent weather station located at Ladycross Plantation.

3.3.3. METEOROLOGICAL DATA

Meteorological monitoring will consist of:

- Rainfall (mm),
- Evapotranspiration (mm),
- Temperature (°C),
- Wind Speed (km/hr) and Direction, and
- Barometric Pressure (m/bar).

3.3.4. MONITORING FREQUENCY

The monitoring frequency will be set for 15-minute intervals for all parameters and will be continually uploaded to the web portal via a data logger.

3.3.5. ASSESSMENT AND COMPLIANCE LEVELS

Not required, information obtained will confirm water balances and influences on shallow groundwater activity.

3.4. GROUNDWATER LEVEL MONITORING

3.4.1. OBJECTIVES

1. Demonstrate that construction activities, in the vicinity of the working platform, and bored shaft cause no adverse long-term impacts on water levels within the Superficial Deposits, Scalby Formations, Scarborough Formations, Cloughton / Saltwick Formations.
2. Provide continual data to aid with tunnelling works. Off-site boreholes are monitored to demonstrate that the TBM causes no adverse long-term impacts on groundwater levels along the whole length of the tunnel drive.

3.4.2. MONITORING LOCATIONS

From the design layout of the Phase 8 works, monitoring of construction stage boreholes with response zones within the Superficial Deposits, Scalby, Scarborough, Cloughton / Saltwick aquifers will be undertaken as summarised below, for which the monitoring well positions are shown in **Attachment A**

- Groundwater levels will be monitored within the superficial deposits (non-aquifer) using the series of monitoring wells detailed in **Table 3-2**. The wells are orientated to monitor water levels both up and down hydraulic gradient of the working site area. To compare soil moisture conditions in comparison with baseline conditions.
- Groundwater levels will be monitored within the Scalby Formation, the Long Nab and Moor Grit (Secondary A Aquifer) using the series of monitoring wells detailed in **Table 3-2**. The wells are orientated to monitor water levels both up and down hydraulic gradient of the working site area.
- Groundwater levels will be monitored within the Scarborough Formation (Secondary A Aquifer) using the series of monitoring wells detailed in **Table 3-2**. The wells are orientated to monitor water levels both up and down hydraulic gradient of the working site area.
- Groundwater levels will be monitored within the Cloughton / Saltwick Formation Secondary A Aquifer) using the series of monitoring wells detailed in **Table 3-2**. The wells are orientated to monitor water levels both up and down hydraulic gradient of the working site area.

During the Phase 1 access works, BH401 was decommissioned due to the location of the access road.

During the Phase 3 construction works, BH413A, BH413B and BH413C were commissioned to allow for the construction of the working platform. Boreholes 34_BH04, 34_BH06 and 34_BH07 were installed as replacement monitoring boreholes.

As part of the Phase 7 construction works, 34_BH03 and 34_BH06 are to be decommissioned to allow for the extension of the welfare, office and parking facilities. No replacement boreholes are required for the purposes of groundwater quality and groundwater level monitoring.

Table 3-2 Groundwater Monitoring Boreholes ID, location, and geological description

Monitoring Well ID	NGR Coordinates	Geology and description
BH402 BH403 BH405 BH406 BH407 BH408	481737, 507534 481807, 507620 481218, 507701 481452, 507744 481590, 507886 481423, 507919	Monitor potential changes in the groundwater levels within the superficial deposits.
BH401A BH402A BH405A BH406A BH407A BH408A	481571, 507474 481738, 507552 481221, 507693 481442, 507743 481583, 507881 481414, 507916	Monitor potential changes in the groundwater levels within the Scalby Formation (Long Nab and/or Moor Grit Member).
BH401B BH402B 34_BH07[1]	481572, 507470 481736, 507547 481673, 507627	Monitor potential changes in the groundwater levels within the Scarborough Formation.
BH401C BH402C 34_BH04[1]	481576, 507473 481730, 507540 481635, 507638	Monitor potential changes in the groundwater levels within the Cloughton Formation.

Note[1] Additional monitoring boreholes installed during the 2022 GI works and will replace the BH413 series. 34_BH04 installed into the Cloughton / Saltwick Formation.

3.4.3. MONITORING FREQUENCY

A relatively small excavation of the exploratory borehole constitutes the Phase 8 works. Therefore, a reduced risk on the groundwater environment has been evaluated based upon the associated activities within the Phase 8 scope.

A continuation of the groundwater level monitoring approach will be carried out using a dip meter from all boreholes listed in **Table 3-2**.

Monthly monitoring of groundwater levels will be conducted during Phase 8. Monitoring will continue to be monthly during this period if no continual impacts are observed as a result of shaft sinking operations. However, weekly monitoring of the following boreholes will be undertaken during the drilling works of the exploratory borehole, as shown in **Table 3-2a.** This will be as a measure of best practice done to ensure the Phase 8 works do not have an adverse impact on groundwater levels, though this is not anticipated to be the case.

Monitoring Well ID	NGR Coordinates	Geology and description
BH401A BH402A	481571, 507474 481738, 507552	Monitor potential changes in the groundwater levels within the Scalby Formation (Long Nab and/or Moor Grit Member).
BH401B BH402B 34_BH07[1]	481572, 507470 481736, 507547 481673, 507627	Monitor potential changes in the groundwater levels within the Scarborough Formation.
BH401C BH402C 34_BH04[1]	481576, 507473 481730, 507540 481635, 507638	Monitor potential changes in the groundwater levels within the Cloughton Formation.

Note[1] Additional monitoring boreholes installed during the 2022 GI works and will replace the BH413 series. 34_BH04 installed into the Cloughton / Saltwick Formation.

Periodic reviews will be carried out during the Phase 8 works and will determine any changes required to frequency and type of monitoring. Any details of changes to the monitoring scheme will be communicated to the Mineral Planning Authority (MPA).

3.4.4. GROUNDWATER LEVEL CONTROL AND COMPLIANCE TRIGGER VALUES

The GWL (Groundwater Levels) Control Trigger Values determined for the Superficial Deposits, Scalby, Scarborough and Cloughton / Saltwick formation in the area of the Site have been derived using the following methodology:

$$\text{Control Trigger Values} = \text{mean baseline value} - 2 \times \text{standard deviation of baseline data}^{1}$$

Note[1] The monitoring undertaken during the Ground Investigation works showed potential for suppressed groundwater levels within the Scarborough and Cloughton Formations during drilling activities. Following on from the completion of the pre-grout works, recovery towards baseline levels is observed. No long-term impacts on groundwater levels have been noted.

The GWL Compliance Trigger Values determined for the Superficial Deposits, Scalby, Scarborough and Cloughton formation in the area of the Site have been derived using the following methodology:

$$\text{Compliance Trigger Values} = \text{mean baseline value} - 3 \times \text{standard deviation of baseline data}^{1}$$

Note[1] The monitoring undertaken during the Ground Investigation works showed potential for suppressed groundwater levels within the Scarborough and Cloughton Formations during drilling activities. Following on from the completion of the pre-grout works, recovery towards baseline levels is observed. No long-term impacts on groundwater levels have been noted.

The above methodology was adopted for the monitoring wells where a comprehensive baseline was available. It was noted from the baseline during the summer months and periods of dry weather large fluctuations in GWL were observed in the superficial deposits and Scalby Formations. Further baseline data has been collected and captures further fluctuations with seasonal trends.

The Phase 8 and preceding HRA's identified that the works will have a negligible impact on strata used for abstractions below the Cloughton Formation, the Saltwick was identified as low sensitivity with no active abstractions within this geology. The Ground Investigation works along with baseline monitoring has advised on appropriate exceedance values for the newly installed boreholes.

Table 3-3 VWP installations in 34_BH01

VWP ID	Depth of install (mbgl)	Geology
34_BH01_1	12	Scarborough Formation
34_BH01_2	37	Cloughton Formation
34_BH01_3	53	Cloughton Formation
34_BH01_4	76	Cloughton / Saltwick Formation
34_BH01_5	111.5	Saltwick Formation
34_BH01_6	118.5	Saltwick Formation

3.4.4.1 Superficial Deposits

Table 3-4 - Control and compliance trigger levels for monitoring wells in the Superficial Deposits based on baseline data from 2020-2022.

MONTH	CONTROL (mAOD)						COMPLIANCE (mAOD)					
	BH402	BH403	BH405	BH406	BH407	BH408	BH402	BH403	BH405	BH406	BH407	BH408
Jan	195.98	201.47	205.01	204.80	207.98	209.25	195.51	200.74	204.75	203.68	207.01	208.44
Feb	195.13	201.56	205.01	206.64	207.70	209.13	194.34	200.88	204.75	206.27	206.87	208.13
Mar	194.36	202.79	205.01	206.95	208.98	209.36	193.60	202.72	204.75	206.73	208.86	208.88
Apr	193.55	202.14	204.75	206.44	208.42	209.44	192.44	201.98	204.69	206.13	208.09	208.62
May	193.73	202.01	204.82	207.00	208.60	210.37	192.82	201.55	204.51	206.86	208.50	210.17
Jun	193.95	201.87	204.62	205.95	208.14	210.16	193.57	201.52	204.40	205.52	207.75	209.90
Jul	193.48	201.93	204.33	205.63	208.13	209.76	192.67	201.66	203.98	205.23	207.85	209.28
Aug	193.63	202.02	204.17	204.74	207.94	209.66	192.94	201.89	204.01	204.13	207.68	209.15
Sep	193.63	201.64	204.01	205.67	208.04	209.32	192.93	201.35	203.93	205.50	207.79	208.72
Oct	194.45	201.82	205.37	205.03	207.91	209.26	193.73	201.42	205.27	204.37	207.63	208.62
Nov	195.78	201.82	205.37	205.93	208.09	209.08	195.43	201.42	205.27	205.42	207.64	207.76
Dec	196.39	202.72	205.01	207.25	208.59	209.09	196.19	202.65	204.75	207.16	207.96	208.04

3.4.4.2 Scalby Formation

Table 3-5 - Control and compliance trigger levels for monitoring wells in the Scalby Formation based on baseline data from 2020-2022

MONTH	CONTROL (mAOD)						COMPLIANCE (mAOD)					
	BH401A	BH402A	BH405A	BH406A	BH407A	BH408A	BH401A	BH402A	BH405A	BH406A	BH407A	BH408A
Jan	187.74	194.18	204.70	205.58	207.58	196.42	185.59	193.35	204.62	205.31	206.93	192.70
Feb	188.10	194.15	204.41	205.39	207.05	196.45	186.06	193.23	204.21	205.05	206.04	192.73
Mar	189.26	194.27	204.58	205.70	207.43	196.59	187.65	193.18	204.46	205.52	206.61	192.67
Apr	189.99	195.15	204.09	205.62	208.20	197.03	188.66	194.62	203.81	205.49	207.84	193.81
May	191.33	194.97	204.12	205.57	208.74	195.46	191.23	194.32	203.71	205.39	208.40	192.37
Jun	188.04	193.30	203.96	204.82	207.07	195.27	186.07	192.13	203.66	204.38	206.40	192.07
Jul	187.76	193.20	203.49	204.30	206.95	196.93	186.03	192.51	203.14	203.83	206.49	193.55
Aug	188.81	194.01	203.32	204.39	206.79	196.87	187.25	193.84	202.99	203.99	206.44	193.41
Sep	189.25	192.83	203.19	204.20	206.90	196.17	187.87	192.31	202.95	203.87	206.65	192.86
Oct	188.72	192.60	202.69	203.86	206.86	199.09	187.07	191.60	202.10	203.34	206.60	196.16
Nov	188.49	193.60	203.14	203.95	206.58	202.03	186.89	192.83	202.61	203.28	206.04	199.90
Dec	188.55	195.18	204.81	205.65	207.74	196.14	186.93	194.87	204.76	205.45	207.26	192.28

3.4.4.3 Scarborough Formation

Table 3-6 - Control and compliance trigger levels for monitoring wells in the Scarborough Formation based on baseline data from 2020-2022

MONTH	CONTROL (mAOD)			COMPLIANCE (mAOD)		
	BH401B	BH402B	34_BH07	BH401B	BH402B	34_BH07
Jan	184.33	183.54	183.542	184.10	183.49	183.49
Feb	185.02	183.21	177.23	184.94	182.88	176.77
Mar	185.02	183.87	183.872	184.91	183.74	183.74
Apr	185.11	183.96	183.962	185.05	183.89	183.89
May	184.56[1]	183.90	183.902	184.38[1]	183.80	183.8
Jun	184.56	183.85	183.852	184.38	183.81	183.81
Jul	185.05	183.71	183.712	185.01	183.62	183.62
Aug	184.64	183.43	183.432	184.53	183.30	183.3
Sep	184.54	183.31	183.312	184.47	183.23	183.23
Oct	184.35	183.08	183.082	184.24	182.91	182.91
Nov	184.05	183.08	183.082	183.82	182.91	182.91
Dec	184.05	183.79	183.792	183.82	182.91	182.91

[1] *Limited or no baseline data available, values based upon neighbouring months.*

3.4.4.4 Cloughton / Saltwick Formation

Table 3-7 - Control and compliance trigger levels for monitoring wells in the Cloughton Formation based on baseline data from 2020-2022

MONTH	CONTROL (mAOD)			COMPLIANCE (mAOD)		
	BH401C	BH402C	34_BH04	BH401C	BH402C	34_BH04
Jan	183.47	183.05	143.84	183.39	182.79	142.81
Feb	183.70	183.70	143.91	183.62	183.62	142.44
Mar	183.67	183.71	147.29	183.50	183.60	147.21
Apr	183.81	183.79	147.29	183.74	183.72	147.14
May	183.36	181.88	147.29	183.16	180.90	147.07
Jun	183.36	183.69	147.29[1]	183.16	183.65	147.07[1]
Jul	183.42	183.54	148.93	183.22	183.44	148.73
Aug	183.13	182.66	148.98	182.93	182.06	148.85
Sep	183.02	182.87	148.17	182.80	182.67	147.99
Oct	183.04	181.66	147.91	182.92	180.55	147.75
Nov	183.04	181.66	147.36	182.92	180.55	147.13
Dec	184.30	183.09	147.36[1]	184.27	183.02	147.13[1]

[1] *Limited or no baseline data available, values based upon neighbouring months.*

3.5. GROUNDWATER QUALITY MONITORING

3.5.1. OBJECTIVES

From the results of the Hydrogeological Risk Assessment, the objectives of the groundwater quality monitoring are:

- Determine whether the previously completed phases of works and proposed Phase 8 works have an adverse chemical impact on the groundwater quality in the superficial deposits, Scalby, Scarborough, Cloughton / Saltwick aquifers.
- Determine if adverse chemical impact on groundwater quality of shallow aquifers is due to onsite pollution of surface water run-off from the Phase 8 works.

3.5.2. MONITORING LOCATIONS

Groundwater quality sampling will be undertaken at locations up hydraulic gradient and down hydraulic of the potentially polluting activities associated with the Phase 8 works.

As such, groundwater quality will be monitored in the superficial deposits, Scalby, Scarborough, Cloughton / Saltwick aquifers using a series of monitoring wells both up and down gradient of the development areas detailed in **Table 3-2**.

3.5.3. MONITORING FREQUENCY

All construction activities will be managed in accordance with the Phase 8 Construction Environmental Management Plan (CEMP). Monthly monitoring will continue throughout the Phase 6 lagoon restoration works and for three months post the completion of these works. Monitoring frequency will change to quarterly after this period if no long-term exceedances are observed from the monthly monitoring schedule.

Monitoring of groundwater quality will continue for a minimum period of six months following completion of the Phase 6 works and until it has been demonstrated that no significant variance from the Control Trigger Values or exceedance above the Compliance Limits detailed below has been detected.

In the event significant exceedances are identified during Phase 8 works, additional rounds of monitoring at an increased frequency will be undertaken to help define extent, where appropriate.

3.5.4. GROUNDWATER QUALITY DATA

The baseline suite of analysis will include both onsite water analysis and laboratory testing, as detailed below. The suite of determinants will be carried out in accordance with the suite identified during baseline and is a continuation of previous phases of work.

Presented below are details of the onsite monitoring and of the sampling and laboratory testing that will be undertaken to obtain the groundwater quality data for the Phase 8 works. All chemical analysis will be undertaken by a MCERTS accredited laboratory.

3.5.4.1 Onsite Water Analysis

On site monitoring, using appropriately calibrated field equipment, will be undertaken for the following determinants:

- pH,
- Temperature,
- Electrical Conductivity, and
- Total Dissolved Solids.

3.5.4.2 Sampling

Prior to sampling of the up and down gradient boreholes, each well will be developed by pumping and either purged to three well volumes or the establishment of stable pH and conductivity readings (typically three consecutive field measurements of +/- 0.1 pH units and +/-250 µS/cm) to ensure the groundwaters sampled are representative of the surrounding groundwater quality.

Unfiltered samples will be collected in two 1-litre coloured glass jars, and one 100 ml vial and as required by the laboratory, to complete the specified testing suites.

3.5.4.3 Laboratory Analysis

The laboratory chemical analysis will be undertaken for the following suite of determinants:

- pH,
- Conductivity,
- Metals (including Aluminium, Boron, Cadmium, Calcium, Chromium III, Chromium VI, Copper, Iron (total and dissolved), Lead, Magnesium, Manganese, Nickel, Potassium, Sodium and Zinc)
- Chloride,

- Sulphate,
- BTEX (Benzene, Toluene, Ethylbenzene and Xylene),
- Speciated Polycyclic Aromatic Hydrocarbons, and
- Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG) (Aliphatic/Aromatic split).

3.5.5. GROUNDWATER QUALITY CONTROL AND COMPLIANCE TRIGGER VALUES

Groundwater Quality (GWQ) Control Trigger Values have been set for all monitoring well locations (as detailed in **Table 3-2**, above) for the determinants to be analysed by consideration of the baseline groundwater quality level range and typical variation. The Control Trigger value has been set at a value equivalent to the mean baseline value plus 2 x the Standard Deviation for that dataset. The GWQ Compliance Trigger Value has been set at the equivalent Drinking Water Standard (DWS), Environmental Quality Standard (EQS) or the baseline value determined where the current baseline value exceeds the EQS value.

Where the analytical detection limit (MRV) has been adopted as the Compliance Trigger Value, then no Control Trigger Value is included, as presented below.

3.5.5.1 Superficial Deposits

Table 3-8 Control and compliance trigger quality levels for monitoring wells in the Superficial Deposits based on baseline data from 2020-2022

Determinants	LOD	Units	Control	Compliance	Source
Aliphatic C10-C12	1	μgl^{-1}	-	300	DWS
Aliphatic C12-C16	1	μgl^{-1}	-	300	DWS
Aliphatic C16-C21	1	μgl^{-1}	-	1	LOD
Aliphatic C21-C35	1	μgl^{-1}	-	1	LOD
Aliphatic C5-C35	10	μgl^{-1}	-	300	Combined DWS
Aliphatic C5-C6	0.1	μgl^{-1}	-	15000	DWS
Aliphatic C6-C8	0.1	μgl^{-1}	-	15000	DWS
Aliphatic C8-C10	0.1	μgl^{-1}	-	300	DWS
Aluminium, Dissolved	10	μgl^{-1}	1550	2100	Max Baseline
Anthracene	0.01	μgl^{-1}	0.34	0.47	LOD / EQS
Aromatic C10-C12	1	μgl^{-1}	-	90	DWS
Aromatic C12-C16	1	μgl^{-1}	-	90	DWS
Aromatic C16-C21	1	μgl^{-1}	-	90	DWS
Aromatic C21-C35	1	μgl^{-1}	-	90	DWS
Aromatic C5-C35	10	μgl^{-1}	-	300	Combined WHO
Aromatic C5-C7	0.1	μgl^{-1}	-	10	DWS
Aromatic C7-C8	0.1	μgl^{-1}	-	700	DWS
Aromatic C8-C10	0.1	μgl^{-1}	-	300	DWS
Benzene	1	μgl^{-1}	-	10	EQS
Benzo(a)pyrene	0.01	μgl^{-1}	0.11	0.15	EQS
Benzo(b)fluoranthene	0.01	μgl^{-1}	1	2	Max Baseline
Boron, Dissolved	12	μgl^{-1}	105	150	Max Baseline
Cadmium, Dissolved	0.03	μgl^{-1}	1.3	1.8	Max Baseline
Calcium, Dissolved	0.09	mgl^{-1}	365	485	Max Baseline
Chloride	0.1	mgl^{-1}	-	250	DWS
Chromium III, Dissolved	1	μgl^{-1}	5.7	7.9	Max Baseline

Determinants	LOD	Units	Control	Compliance	Source
Chromium VI, Dissolved	7	µgl^{-1}	-	7	LOD
Conductivity	1	µS/cm	570	625	Max Baseline
Copper, Dissolved	0.4	µgl^{-1}	12	15	Max Baseline
Ethylbenzene	1	µgl^{-1}	-	300	WHO
Fluoranthene	0.01	µgl^{-1}	1.1	1.6	Max Baseline
Iron, Dissolved	5.5	µgl^{-1}	2965	3910	Max Baseline
Iron, Total	5.5	µgl^{-1}	268000	346000	Max Baseline
Lead, Dissolved	0.09	µgl^{-1}	8.5	11.5	Max Baseline
Magnesium, Dissolved	0.02	µgl^{-1}	13	15	Max Baseline
Manganese, Dissolved	0.22	µgl^{-1}	3850	5200	Max Baseline
Nickel, Dissolved	0.5	µgl^{-1}	16	21	Max Baseline
PAH Total	0.2	µgl^{-1}	13	18	Max Baseline
pH			-	6 to 9	EQS
Potassium, Dissolved	0.08	mgl^{-1}	16.5	18.5	Max Baseline
Sodium, Dissolved	0.07	mgl^{-1}	25	34	Max Baseline
Sulphate as SO4	0.1	mgl^{-1}	40	250	Max Baseline / DWS
Toluene	1	µgl^{-1}	-	74	EQS
TPH Ali/Aro Total	10	µgl^{-1}	128	173	Max Baseline
Xylene	1	µgl^{-1}	-	30	DWS
Zinc, Dissolved	1.3	µgl^{-1}	133	181	Max Baseline

3.5.5.2 Scalby Formation

Table 3-9 - Control and compliance trigger quality levels for monitoring wells in the Scalby Formation based on baseline data from 2020-2022

Determinants	LOD	Units	Control	Compliance	Source
Aliphatic C10-C12	1	µgl^{-1}	-	300	DWS
Aliphatic C12-C16	1	µgl^{-1}	-	300	DWS
Aliphatic C16-C21	1	µgl^{-1}	45	62	Max Baseline
Aliphatic C21-C35	1	µgl^{-1}	71	99	Max Baseline
Aliphatic C5-C35	10	µgl^{-1}	147	300	Max Baseline / Combined DWS
Aliphatic C5-C6	0.1	µgl^{-1}	-	15000	DWS
Aliphatic C6-C8	0.1	µgl^{-1}	-	15000	DWS
Aliphatic C8-C10	0.1	µgl^{-1}	-	300	DWS
Aluminium, Dissolved	10	µgl^{-1}	1230	1650	Max Baseline
Anthracene	0.01	µgl^{-1}	-	0.11	EQS
Aromatic C10-C12	1	µgl^{-1}	-	90	DWS
Aromatic C12-C16	1	µgl^{-1}	-	90	DWS
Aromatic C16-C21	1	µgl^{-1}	-	90	DWS
Aromatic C21-C35	1	µgl^{-1}	-	90	DWS
Aromatic C5-C35	10	µgl^{-1}	-	300	Combined DWS
Aromatic C5-C7	0.1	µgl^{-1}	-	10	DWS
Aromatic C7-C8	0.1	µgl^{-1}	-	700	DWS
Aromatic C8-C10	0.1	µgl^{-1}	-	300	DWS
Benzene	1	µgl^{-1}	-	10	EQS
Benzo(a)pyrene	0.01	µgl^{-1}	0.11	0.15	Max Baseline
Benzo(b)fluoranthene	0.01	µgl^{-1}	0.08	0.11	Max Baseline
Boron, Dissolved	12	µgl^{-1}	75	90	Max Baseline
Cadmium, Dissolved	0.03	µgl^{-1}	1.5	1.8	Max Baseline
Calcium, Dissolved	0.09	mgl^{-1}	365	485	Max Baseline
Chloride	0.1	mgl^{-1}	60	250	Max Baseline
Chromium III, Dissolved	1	µgl^{-1}	3.5	5	Max Baseline
Chromium VI, Dissolved	7	µgl^{-1}	-	7	LOD
Conductivity	1	µS/cm	670	830	Max Baseline

Determinants	LOD	Units	Control	Compliance	Source
Copper, Dissolved	0.4	µgl^{-1}	32	45	Max Baseline
Ethylbenzene	1	µgl^{-1}	-	300	DWS
Fluoranthene	0.01	µgl^{-1}	-	0.11	Max Baseline
Iron, Dissolved	5.5	µgl^{-1}	9400	12100	Max Baseline
Iron, Total	5.5	µgl^{-1}	865400	1100000	Max Baseline
Lead, Dissolved	0.09	µgl^{-1}	2.8	3.7	Max Baseline
Magnesium, Dissolved	0.02	µgl^{-1}	50	75	Max Baseline
Manganese, Dissolved	0.22	µgl^{-1}	3700	4800	Max Baseline
Nickel, Dissolved	0.5	µgl^{-1}	150	210	Max Baseline
PAH Total	0.2	µgl^{-1}	1.6	2.5	Max Baseline
pH			-	6 to 9	EQS
Potassium, Dissolved	0.08	mgl^{-1}	30	45	Max Baseline
Sodium, Dissolved	0.07	mgl^{-1}	75	90	Max Baseline
Sulphate as SO4	0.1	mgl^{-1}	120	250	Max Baseline / DWS
Toluene	1	µgl^{-1}	-	74	EQS
TPH Ali/Aro Total	10	µgl^{-1}	175	250	Max Baseline
Xylene	1	µgl^{-1}	-	30	DWS
Zinc, Dissolved	1.3	µgl^{-1}	210	280	Max Baseline

3.5.5.3 Scarborough Formation

Table 3-10 - Control and compliance trigger quality levels for monitoring wells in the Scarborough Formation based on baseline data from 2020-2022

Determinants	LOD	Units	Control	Compliance	Source
Aliphatic C10-C12	1	µgl^{-1}	-	300	DWS
Aliphatic C12-C16	1	µgl^{-1}	-	300	DWS
Aliphatic C16-C21	1	µgl^{-1}	-	300	DWS
Aliphatic C21-C35	1	µgl^{-1}	-	1	LOD
Aliphatic C5-C35	10	µgl^{-1}	32	300	Max Baseline / Combined DWS
Aliphatic C5-C6	0.1	µgl^{-1}	-	15000	DWS
Aliphatic C6-C8	0.1	µgl^{-1}	-	15000	DWS
Aliphatic C8-C10	0.1	µgl^{-1}	-	300	DWS
Aluminium, Dissolved	10	µgl^{-1}	330	440	Max Baseline
Anthracene	0.01	µgl^{-1}	-	0.1	EQS
Aromatic C10-C12	1	µgl^{-1}	-	90	DWS
Aromatic C12-C16	1	µgl^{-1}	-	90	DWS
Aromatic C16-C21	1	µgl^{-1}	-	90	DWS
Aromatic C21-C35	1	µgl^{-1}	-	90	DWS
Aromatic C5-C35	10	µgl^{-1}	-	300	Combined DWS
Aromatic C5-C7	0.1	µgl^{-1}	-	10	DWS
Aromatic C7-C8	0.1	µgl^{-1}	-	700	DWS
Aromatic C8-C10	0.1	µgl^{-1}	-	300	DWS
Benzene	1	µgl^{-1}	-	10	EQS
Benzo(a)pyrene	0.01	µgl^{-1}	-	0.01	EQS
Benzo(b)fluoranthene	0.01	µgl^{-1}	-	0.01	EQS
Boron, Dissolved	12	µgl^{-1}	25	32	Max Baseline
Cadmium, Dissolved	0.03	µgl^{-1}	0.28	0.36	Max Baseline
Calcium, Dissolved	0.09	mgl^{-1}	110	130	Max Baseline
Chloride	0.1	mgl^{-1}	90	250	Max Baseline
Chromium III, Dissolved	1	µgl^{-1}	1.4	1.9	Max Baseline
Chromium VI, Dissolved	7	µgl^{-1}	-	7	LOD
Conductivity	1	µS/cm	690	850	Max Baseline

Determinants	LOD	Units	Control	Compliance	Source
Copper, Dissolved	0.4	µgl⁻¹	6.7	9.3	Max Baseline
Ethylbenzene	1	µgl⁻¹	-	300	DWS
Fluoranthene	0.01	µgl⁻¹	-	0.01	LOD
Iron, Dissolved	5.5	µgl⁻¹	5650	7400	Max Baseline
Iron, Total	5.5	µgl⁻¹	1500000	2000000	Max Baseline
Lead, Dissolved	0.09	µgl⁻¹	0.4	1.3	Max Baseline / EQS
Magnesium, Dissolved	0.02	µgl⁻¹	12	15	Max Baseline
Manganese, Dissolved	0.22	µgl⁻¹	510	600	Max Baseline
Nickel, Dissolved	0.5	µgl⁻¹	17	20	Max Baseline
PAH Total	0.2	µgl⁻¹	-	0.2	LOD
pH			-	6 to 9	EQS
Potassium, Dissolved	0.08	mgl⁻¹	2.3	2.8	Max Baseline
Sodium, Dissolved	0.07	mgl⁻¹	19	22	Max Baseline
Sulphate as SO4	0.1	mgl⁻¹	15	250	Max Baseline / DWS
Toluene	1	µgl⁻¹	-	74	EQS
TPH Ali/Aro Total	10	µgl⁻¹	24	33	Max Baseline
Xylene	1	µgl⁻¹	-	30	DWS
Zinc, Dissolved	1.3	µgl⁻¹	20	25	Max Baseline

3.5.5.4 Cloughton / Saltwick Formation

Table 3-11 - Control and compliance trigger quality levels for monitoring wells in the Cloughton Formation based on baseline data from 2020-2022

Determinants	LOD	Units	Control	Compliance	Source
Aliphatic C10-C12	1	µgl⁻¹	-	300	DWS
Aliphatic C12-C16	1	µgl⁻¹	-	300	DWS
Aliphatic C16-C21	1	µgl⁻¹	18	25	Max Baseline
Aliphatic C21-C35	1	µgl⁻¹	5	7.5	Max Baseline
Aliphatic C5-C35	10	µgl⁻¹	75	300	Max Baseline / Combined DWS
Aliphatic C5-C6	0.1	µgl⁻¹	-	15000	DWS
Aliphatic C6-C8	0.1	µgl⁻¹	-	15000	DWS
Aliphatic C8-C10	0.1	µgl⁻¹	-	300	DWS
Aluminium, Dissolved	10	µgl⁻¹	610	820	Max Baseline
Anthracene	0.01	µgl⁻¹	-	0.1	EQS
Aromatic C10-C12	1	µgl⁻¹	-	90	DWS
Aromatic C12-C16	1	µgl⁻¹	-	90	DWS
Aromatic C16-C21	1	µgl⁻¹	-	90	DWS
Aromatic C21-C35	1	µgl⁻¹	-	90	DWS
Aromatic C5-C35	10	µgl⁻¹	-	300	Combined DWS
Aromatic C5-C7	0.1	µgl⁻¹	-	10	DWS
Aromatic C7-C8	0.1	µgl⁻¹	-	700	DWS
Aromatic C8-C10	0.1	µgl⁻¹	-	300	DWS
Benzene	1	µgl⁻¹	-	10	EQS
Benzo(a)pyrene	0.01	µgl⁻¹	-	0.01	EQS
Benzo(b)fluoranthene	0.01	µgl⁻¹	-	0.01	EQS
Boron, Dissolved	12	µgl⁻¹	53	75	Max Baseline
Cadmium, Dissolved	0.03	µgl⁻¹	1.5	2	Max Baseline
Calcium, Dissolved	0.09	mgl⁻¹	300	400	Max Baseline
Chloride	0.1	mgl⁻¹	50	250	Max Baseline
Chromium III, Dissolved	1	µgl⁻¹	2.5	3.5	Max Baseline

Determinants	LOD	Units	Control	Compliance	Source
Chromium VI, Dissolved	7	$\mu g l^{-1}$	-	7	LOD
Conductivity	1	µS/cm	550	750	Max Baseline
Copper, Dissolved	0.4	$\mu g l^{-1}$	1.2	1.6	Max Baseline
Ethylbenzene	1	$\mu g l^{-1}$	-	300	DWS
Fluoranthene	0.01	$\mu g l^{-1}$	-	0.04	Max Baseline
Iron, Dissolved	5.5	$\mu g l^{-1}$	2900	3900	Max Baseline
Iron, Total	5.5	$\mu g l^{-1}$	150000	200000	Max Baseline
Lead, Dissolved	0.09	$\mu g l^{-1}$	3.2	4.4	Max Baseline / EQS
Magnesium, Dissolved	0.02	$\mu g l^{-1}$	15	20	Max Baseline
Manganese, Dissolved	0.22	$\mu g l^{-1}$	860	1150	Max Baseline
Nickel, Dissolved	0.5	$\mu g l^{-1}$	10	15	Max Baseline
PAH Total	0.2	$\mu g l^{-1}$	10	14	Max Baseline
pH			-	6 to 9	EQS
Potassium, Dissolved	0.08	$mg l^{-1}$	125	200	Max Baseline
Sodium, Dissolved	0.07	$mg l^{-1}$	110	150	Max Baseline
Sulphate as SO4	0.1	$mg l^{-1}$	12	250	Max Baseline / DWS
Toluene	1	$\mu g l^{-1}$	-	74	EQS
TPH Ali/Aro Total	10	$\mu g l^{-1}$	55	75	Max Baseline
Xylene	1	$\mu g l^{-1}$	-	30	DWS
Zinc, Dissolved	1.3	$\mu g l^{-1}$	95	120	Max Baseline

3.6. SURFACE WATER

3.6.1. OBJECTIVES

The purpose of the surface water monitoring strategy is to detect chemical and physical impacts on surface waters within Cat Scar Beck and Cold Keld Beck caused by the ongoing construction works, so that appropriate remedial measures can be adopted should potentially detrimental impacts arise.

From the results of the Revised Hydrogeological Risk Assessment and the Surface Water Drainage Scheme, potential impacts on Cat Scar Beck that could arise from the then completed and ongoing construction works, and therefore require evaluation by the surface water monitoring strategy include:

- Chemical pollution in the form of hydrocarbon (fuel, hydraulic oil, lubricant oil) spillage or leakage from construction plant and silt/particulate suspended solids entering surface water drainage via runoff and discharging into controlled waters.
- Chemical pollution in the form of cementitious materials from construction works entering the surface water drainage via runoff or pre-grouting works and discharging into controlled water.
- Physical impacts of the groundwater and surface water discharges to the surface water outfall system on Cat Scar Beck by causing siltation, scour or erosion of the stream bed.
- The outfall locations at Cold Keld Beck (LCSW3) will be monitored. However, as the outfalls do not lie within the catchment area of the Ladycross Site works, the impact of works is negligible, control and compliance trigger values will not be set for these monitoring locations.

3.6.2. MONITORING LOCATIONS

To meet the above objectives, the surface water monitoring locations have been designed to provide:

1. Further baseline data for Cat Scar Beck,
2. Early monitoring of surface water drainage within the onsite construction activities, and
3. Monitoring of surface water outfalls at downstream compliance points prior to discharge to Cat Scar Beck.

From the design layout of the Phase 8 Works, monitoring of the construction stage discharges up and down stream of the surface water drainage outfall points will be undertaken as summarised in **Table 3-13** and **Attachment A**.

Table 3-13 – Surface Water Monitoring Locations

ID	X	Y	Description
LCSW1	481868	507673	Upstream monitoring location of unnamed tributary A running along South-East boundary of site
LCSW2	481633	507421	Downstream monitoring location Highway drainage, outfall for site surface water
LCSW3	481344	507542	Discharge to Cold Keld Beck from drain culvert
LCSW4	481641	507460	Downstream monitoring location of unnamed tributary A running along South-East boundary of site.
LCSW5	481600	507440	Monitoring location upstream of LCSW2, outfall for site surface drainage

3.6.3. MONITORING FREQUENCY

Surface water quality samples will be undertaken on a monthly basis for laboratory analysis at monitoring location LCSW3. The other monitoring locations will continue to be sampled on a bi-weekly frequency or at frequencies detailed in site related discharge permits. Field measurements will be undertaken on a weekly basis for the parameters outlined in **Section 3.5.4.1**. Where no flow is observed at the monitoring location, this will be stated as part of the reporting procedure.

Monitoring of surface water quality shall continue for a minimum period of three months following completion of the Phase 6 Works and until it has been demonstrated that no significant variance from the Control Trigger Values has occurred and no exceedance above the Compliance Trigger Values detailed below has been detected.

3.6.4. SURFACE WATER DATA

To meet with the surface water monitoring objectives, the minimum baseline suite of analysis will include onsite analysis, sampling and laboratory testing.

The suite of determinants to be analysed to evaluate construction related pollution will include the specific Contaminants of Concern (CoC) associated with the Phase 8 Works.

3.6.4.1 Sampling

During the sampling visits, surface water sampling of the downstream monitoring points will be collected first, to minimise disturbed sediment impacting on the results. These samples are to be

taken from sections of fast flowing water, where possible. In the event no flow is observed this will be stated.

Unfiltered samples will be collected in two litre coloured glass jars, and one 100 ml vial, or as required by the laboratory to complete the specified testing suites.

3.6.4.2 Onsite Monitoring

Visual inspection will be undertaken of the construction works surface water drainage systems to observe for evidence of high suspended solids, discolouration or hydrocarbon pollution.

On site monitoring using calibrated equipment will be undertaken for the following determinants: -

- Temperature,
- pH,
- Electrical Conductivity,
- Total Dissolved Solids, and
- Turbidity.

3.6.4.3 Laboratory Analysis

All chemical analysis will be undertaken by an MCERTS accredited laboratory. From the expected potentially polluting activities associated with Phase 8 Works the CoC that are to be analysed will include:

- pH,
- Conductivity,
- Suspended Solids,
- Free ammonia (NH3),
- Chloride,
- Sodium,
- Sulphate,
- Aluminium,
- BTEX (Benzene, Toluene, Ethylbenzene and Xylene),
- Speciated Polycyclic Aromatic Hydrocarbons, and

- Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG) (Aliphatic/Aromatic split).

Flow rates will not be quantified; however, consideration will be made of climatic conditions, particularly after high runoff storm events.

3.6.5. SURFACE WATER QUALITY CONTROL AND COMPLIANCE TRIGGER VALUES

Surface Water Quality (SWQ) Control Trigger Values have been set for all of the determinants to be analysed for by consideration of the baseline surface water quality testing undertaken to date from Cat Scar Beck. The SWQ Control Trigger Value have been derived using the following methodology:

$$\text{Control Trigger Values} = \text{mean baseline value} + 2 \times \text{standard deviation of baseline data}^{1}$$

Note[1] The monitoring undertaken thus far during pre-commencements and early site establishment and construction works has demonstrated that 2 standard deviations is most appropriate considering the natural variation observed in the monitoring baseline data.

The Compliance Value has been set at the appropriate Environmental Quality Standard (EQS), DWS or the baseline value where this exceeds the EQS value using the below methodology:

$$\text{Compliance Trigger Values} = \text{mean baseline value} + 3 \times \text{standard deviation of baseline data}^{1}$$

Note[1] The monitoring undertaken thus far pre-commencements and early site establishment and construction works has demonstrated that 3 standard deviations is most appropriate considering the natural variation observed in the monitoring baseline data.

Where the analytical detection limit (MRV), EQS or DWS has been adopted as the Compliance Trigger Value, then no Control Trigger Value is included, as presented below in **Table 3-12**.

Table 3-14 – Surface Water Monitoring Control and Compliance Trigger Levels

Determinants	LOD	Units	Control	Compliance	Source
Aliphatic C10-C12	1	$\mu g l^{-1}$	-	300	Max Baseline / WHO DWQ
Aliphatic C12-C16	1	$\mu g l^{-1}$	-	300	Max Baseline / WHO DWQ
Aliphatic C16-C21	1	$\mu g l^{-1}$	-	300	Max Baseline
Aliphatic C21-C35	1	$\mu g l^{-1}$	250	350	Max Baseline
Aliphatic C5-C35	1	$\mu g l^{-1}$	250	350	Max Baseline
Aliphatic C5-C6	0.1	$\mu g l^{-1}$	-	15000	WHO DWQ
Aliphatic C6-C8	0.1	$\mu g l^{-1}$	-	15000	WHO DWQ
Aliphatic C8-C10	0.1	$\mu g l^{-1}$	-	300	WHO DWQ
Alkalinity as CaCO3 (Automated)	10	$mg l^{-1}$	150	300	Max Baseline

Determinants	LOD	Units	Control	Compliance	Source
Aluminium, Dissolved	10	µgl⁻¹	2780	3500	Max Baseline
Ammoniacal Nitrogen as N	0.015	mgl⁻¹	2.1	2.9	Max Baseline
Anthracene	0.01	µgl⁻¹	-	0.1	EQS
Aromatic C10-C12	1	µgl⁻¹	-	90	WHO DWQ
Aromatic C12-C16	1	µgl⁻¹	-	90	WHO DWQ
Aromatic C16-C21	1	µgl⁻¹	20	90	Max Baseline / WHO DWQ
Aromatic C21-C35	1	µgl⁻¹	10	90	Max Baseline / WHO DWQ
Aromatic C5-C35	10	µgl⁻¹	25	300	Max Baseline / WHO DWQ
Aromatic C5-C7	0.1	µgl⁻¹	-	10	WHO DWQ
Aromatic C7-C8	0.1	µgl⁻¹	-	700	WHO DWQ
Aromatic C8-C10	0.1	µgl⁻¹	-	300	WHO DWQ
Benzene	1	µgl⁻¹	-	10	EQS
Benzo(a)pyrene	0.01	µgl⁻¹	-	0.05	Max Baseline
Benzo(b)fluoranthene	0.01	µgl⁻¹	-	0.05	Max Baseline
Boron, Dissolved	12	µgl⁻¹	75	100	Max Baseline
Cadmium, Dissolved	0.03	µgl⁻¹	0.33	3	Max Baseline / WHO DWQ
Calcium, Dissolved	0.09	mgl⁻¹	80	90	Max Baseline
Chloride	0.1	mgl⁻¹	60	250	Max Baseline / EQS
Chromium III, Dissolved	1	µgl⁻¹	5	50	Max Baseline / DWD
Chromium VI, Dissolved	7	µgl⁻¹	-	7	LOD
Conductivity	1	µS/cm	650	800	Max Baseline
Copper, Dissolved	0.4	µgl⁻¹	4.65	5.6	Max Baseline
Ethylbenzene	1	µgl⁻¹	-	300	WHO
Fluoranthene	0.01	µgl⁻¹	0.06	0.08	LOD
Iron, Dissolved	5.5	µgl⁻¹	1900	2400	Max Baseline
Iron, Total	5.5	µgl⁻¹	7500	10000	Max Baseline
Lead, Dissolved	0.09	µgl⁻¹	10.6	14.9	Max Baseline
Magnesium, Dissolved	0.02	µgl⁻¹	14.5	18	Max Baseline
Manganese, Dissolved	0.22	µgl⁻¹	120	150	Max Baseline
Nickel, Dissolved	0.05	µgl⁻¹	13.7	15.4	Max Baseline
Nitrate as NO3	5	mgl⁻¹	15	50	Max Baseline / WHO DWQ
PAH Total	0.2	µgl⁻¹	0.6	0.9	Max Baseline
pH			-	6 to 9	EQS
Potassium, Dissolved	0.08	mgl⁻¹	55	80	Max Baseline
Sodium, Dissolved	0.07	mgl⁻¹	110	150	Max Baseline
Sulphate as SO4	0.1	mgl⁻¹	225	300	Max Baseline / DWS
Suspended Solids	5	mgl⁻¹	90	120	Max Baseline
Toluene	1	µgl⁻¹	-	74	EQS
TPH Ali/Aro Total	10	µgl⁻¹	153	220	Max Baseline
Xylene	1	µgl⁻¹	-	30	DWS
Zinc, Dissolved	1.3	µgl⁻¹	120	180	Max Baseline

3.7. GASEOUS HYDROCARBON MONITORING

3.7.1. OBJECTIVES

From the results of the Hydrogeological Risk Assessment, the objectives of the gaseous hydrocarbon monitoring are:

- Determine whether the proposed Phase 8 works have an adverse chemical impact on the groundwater quality in Ravenscar Group aquifers.
- Determine the chemical composition, flow, volume and pressure of any gaseous hydrocarbons(following BS 8576:2013 guidance) that may potentially migrate through the exploratory borehole, as stated in the Phase 8 Hydrogeological Risk Assessment (HRA).

3.7.2. MONITORING LOCATIONS

The location of the gaseous hydrocarbon sampling will be undertaken at the exploratory borehole via a gas valve, as detailed in the Phase 8 Construction Environmental Management Plan (CEMP).

3.7.3. MONITORING FREQUENCY

All construction activities will be managed in accordance with the Phase 8 Construction Environmental Management Plan (CEMP). Initial monitoring will comprise daily checks for 1 week post drilling activity to develop a/any baseline. Monitoring will be undertaken on an as required basis once a base line has been assessed and where practicably and safely appropriate, following BS 8576:2013 guidance.

3.7.4. GASEOUS HYDROCARBON QUALITY DATA

The baseline suite of analysis will include both onsite analysis and laboratory testing, as detailed below. The suite of determinants will be carried out in accordance under BS 8576:2013 guidance.

3.7.4.1 Onsite Analysis

On site monitoring, using appropriately calibrated field equipment, will be undertaken for the following determinants:

- Flow rate
- Pressure
- Temperature

3.7.4.2 Sampling

Samples will be collected regularly as required and where practicably and safely appropriate. Samples will be collected using 2no. 1.4L canister as required by the ISO17025 accredited laboratory to provide a representative and sufficient sample size for hydrocarbon speciated analysis.

3.7.4.3 Laboratory Analysis

Laboratory chemical analysis will be undertaken for the following suite of determinants:

- Bulk Gas
- Determination of C1 - C7 Hydrocarbons
- Odorant Gas Analysis
- TPH in Gas samples
- Volatile Organic Compounds (VOC's)

4. REPORTING REQUIREMENTS

All exceedances of Control and Compliance Trigger Values and remedial actions that are implemented will be reported to Anglo American. A quarterly water report will detail the exceedance that occurred, the construction activities and antecedent meteorological conditions, the results of the site inspection, the established cause of the exceedance in Trigger Values and the remedial action specified together with the timescale for it to be implemented.

Where exceedances to Trigger Values are identified, associated with the site works a record of the data and site observations will be issued on receipt of results of the event. Where visual evidence of a significant change in stream flows, cloudy discharge or elevated turbidity or pH readings are identified associated with the works, the inspection report and remedial action specified will be issued to those identified in **Section 3.1** within 48 hours of that exceedance.

On completion of the remedial action, a record of the measures implemented, and their effectiveness will be reported to the relevant parties. The Anglo-American Construction Manager or Environment and Permitting Manager will provide a copy of the report.

Remedial actions will remain in accordance with the Phase 4 Remedial Action Plan (RAP).

5. REFERENCES

DEFRA. (2014). *Water Framework Directive implementation in England and Wales: new and updated standards to protect the water environment.* GOV.UK.

Environment Agency. (2012). *Good practice for decommissioning redundant boreholes and wells.* Environment Agency.

FWS. (September 2014). *Hydrogeological Baseline Report of the Lady Cross Plantation, North Yorkshire.* FWS Consultants LTD.

WHO. (2017). *Guidelines for drinking-water quality: fourth edition incorporating the first addendum* (Fourth Edition ed.). World Health Organization.

BSI. (2013). *Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs).* BSI Standards.

6. DEFINITIONS AND ABBREVIATIONS

DWS – Drinking Water Standards

EQS – Environmental Quality Standards

HRA – Hydrogeological Risk Assessment

GWSWMS – Groundwater and Surface Water Monitoring Scheme

CoC – Contaminants of Concern

LOD – Limit of Detection

GWL – Groundwater Level

CEMP – Construction Environment Management Plan

GWQ – Groundwater Quality

SWQ – Surface Water Quality

VOC – Volatile Organic Compounds

TPH – Total Petroleum Hydrocarbon

7. ATTACHMENTS

ATTACHMENT A – MONITORING LOCATIONS

ATTACHMENT B – SPRING MONITORING LOCATIONS

ATTACHMENT C – SPRING AND ABSTRACTION LOCATIONS

ATTACHMENT A – MONITORING LOCATIONS


Legend
Site Boundary
SW monitoring Location
GW monitoring boreholes 2022
BH408
BH408A
BH407
BH407A
BH406A
BH406
BH405
BH405A
34_BH06
34_BH04
34_BH07
LCSW1
BH403
LCSW3
BH402A
BH402C
BH402B
BH402
BH401A
BH401C
BH401B
LCSW4
LCSW5
LCSW2

ATTACHMENT B – SPRING MONITORING LOCATIONS


th York Moors National Park
North York Moors National Park
Location 6_BH401C_onsite borehole
Location 1_Newstead farm
Location 5_Church Cliff
Egton Cemetery
Egton Lane
High Street
North York Moors
North York Moors
North York Moors
Location 3_Grosmont Farm
Location 2_Priory Farm
Location 4_Egton Bridge
River Esk
Barnard's Road
Old Park Lane
Eskdaleside
Front Street
River
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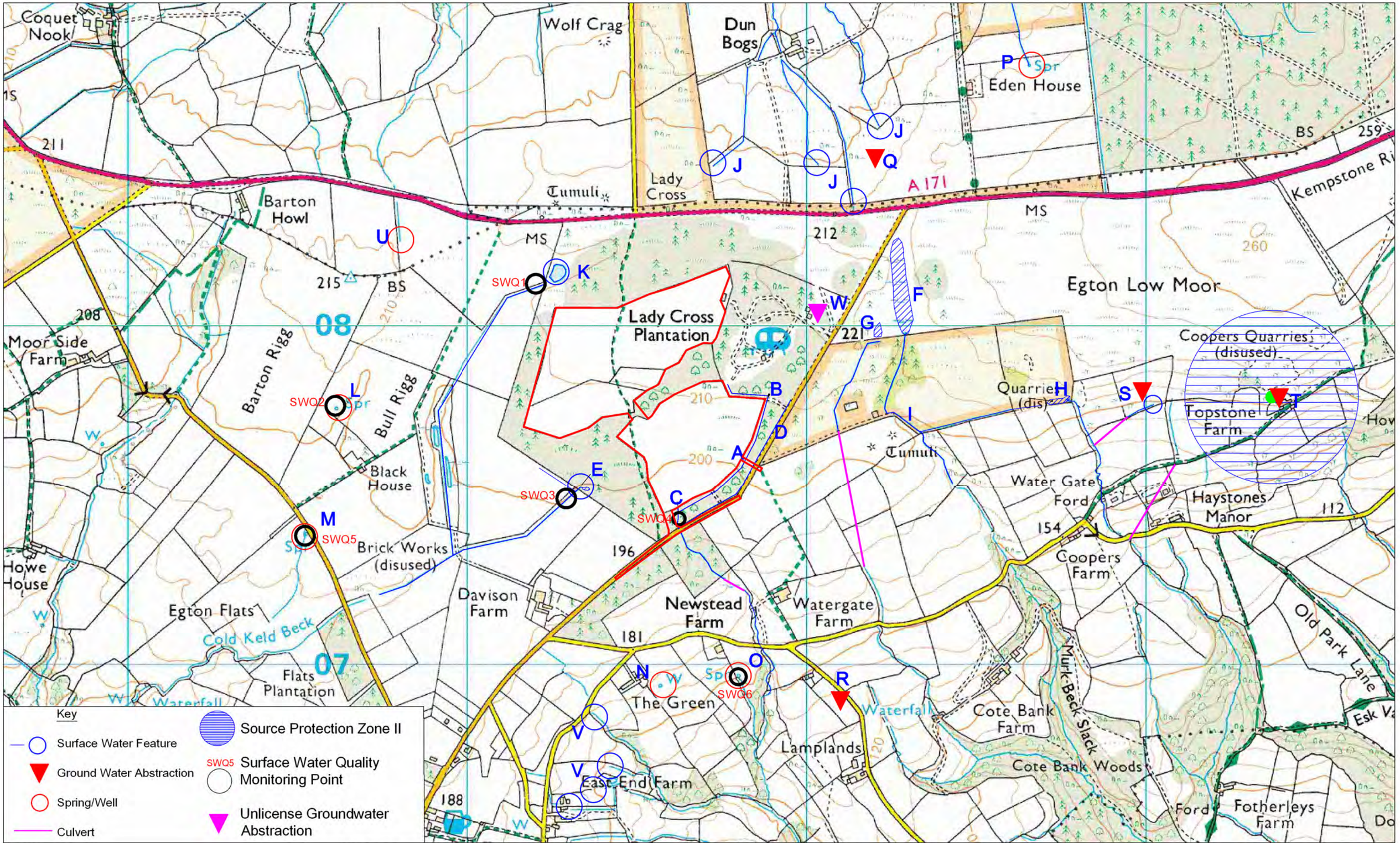
ATTACHMENT C – SPRING AND ABSTRACTION LOCATIONS



Key

- Surface Water Feature
- Ground Water Abstraction
- Spring/Well
- Culvert
- Source Protection Zone II
- SWQ5 Surface Water Quality Monitoring Point
- Unlicense Groundwater Abstraction

DRAWING NUMBER 1433AmtsOD27Rev1	JOB TITLE YORK POTASH - MINERAL TRANSPORT SYSTEM	CLIENT York Potash Ltd	
DRAWING TITLE HYDROLOGICAL AND HYDROGEOLOGICAL FEATURES - LADY CROSS PLANTATION		SCALE 1:10,000 @A3	DRAWN BY KW
		DATE July 2014	

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Project Title / Facility Name:

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NOISE & VIBRATION MANAGEMENT PLAN - PHASE 8 - NYMNPA CONDITION 18 (ROYAL HASKONINGDHV) - LADYCROSS

NYMNPA

21/12/2023

Document Review Status

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- [ ] 2. Reviewed – Accepted As Noted, Work May Proceed, Revise & Resubmit — On: 21 Dec 2023 11:48
- [ ] 3. Reviewed – Work May Not Proceed, Revise & Resubmit
- [ ] 4. For information only
- [ ] 5. On Hold – Pending Project Restart & Ramp Up

Rev.	Revision Date (dd mmm yyyy)	Reason For Issue	Prepared by	Verified by	Approved by
D	20-Dec-2023	Planning	PLA			
C	14-Dec-2023	Planning	PLA			
B	25-Oct-2023	Planning	PLA			
A	06-Oct-2023	Planning	PLA			

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WOODSMITH PROJECT

(788.5030)

NOISE AND VIBRATION MANAGEMENT PLAN - PHASE 8 - NYMNPA CONDITION 18 - LADYCROSS PLANTATION

/

40-STS-LC-2100-EN-PL-00038

(Royal HaskoningDHV)

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A (PLA)	06/10/2023	Ben Cartwright (RHDHV)	Tim Britton (RHDHV)	John Drabble (RHDHV)	First Issue
B (PLA)	25/10/2023	Ben Cartwright (RHDHV)	Tim Britton (RHDHV)	John Drabble (RHDHV)	Revision in accordance with rev A comments
C (PLA)	14/12/2023	Ben Cartwright (RHDHV)	Tim Britton (RHDHV)	John Drabble (RHDHV)	Revision in accordance with rev B comments
D (PLA)	20/12/2023	Ben Cartwright (RHDHV)	Tim Britton (RHDHV)	John Drabble (RHDHV)	Revision in accordance with rev C comments

REPORT

Phase 8 - Ladycross Plantation Noise and Vibration Management Plan

Ladycross Phase 8 - NVMP

Client: STRABAG AG

Reference: 40-STS-LC-2100-EN-PL-00038 Rev D

Status: 01/Final

Date: 12 December 2023

Royal HaskoningDHV

Enhancing Society Together

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Checked by: TB

Date: 12.12.2023

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Project related

Royal HaskoningDHV

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Table of Tables

Appendices

1 INTRODUCTION

1.1 Purpose of this Report

1.1.1 In 2014 a planning application (reference NYM/2014/0676/MEIA) was submitted to North York Moors National Park Authority (NYMNPA) for permission to develop a polyhalite mine and underground Mineral Transport System (MTS). Planning permission was subsequently granted in 2015 subject to conditions, as varied in February 2018 by NYM/2017/0505/MEIA.

1.1.2 This document has been prepared on behalf of STRABAG AG, who are the contractor delivering part of the works on behalf of Anglo American Ltd (Anglo American); and details the requirements with respect to noise and vibration management for the Phase 8 Works (see Paragraph 1.1.4 below) at the Ladycross Plantation site.

1.1.3 This document is required to partially satisfy the requirements of Condition 18 of the NYMNPA planning permission. The details of this planning condition, and how the relevant requirements have been addressed, are set out in Table 1-1.

Table 1-1: Condition NYMNPA 18 Noise and Vibration Management Plan

NYMNPA 18	Compliance with Condition NYMNPA-18
Prior to the commencement of each Phase of Construction at Dove's Nest Farm or Lady Cross Plantation, a Noise and Vibration Management Plan (NVMP) for the control, mitigation and monitoring of noise and vibration for both construction and operational phases at the two sites shall be submitted to and approved in writing by the MPA in consultation with the SBC EHO. The scheme shall set out the following:	This document addresses Phase 8 Works at Ladycross Plantation. Works at Woodsmith Mine are addressed in a site specific NVMP and are therefore not addressed in this Plan.
Noise-sensitive receptors for which predictions shall be made and at which the noise and vibration limits shall apply and which shall include recreational receptors.	Section 3.1
Predicted noise levels at the noise-sensitive receptors from noise and vibration generated at the DNF and LCP sites for the key construction phases during the forthcoming year including any periods in which the higher daytime limit of 70 dB L_{Aeq} shall apply (permitted 56 days for temporary works to create noise-reducing bunds and/or barriers as per Conditions 20 and 22).	Section 3, and Appendix A
The best practicable means which will be used to control noise and vibration levels on site including such measures proposed in the Environmental Statement (September 2014 as updated by the Supplementary Environmental Statement dated February 2015) and the Supplementary Environmental Statement dated July 2017 (updated by further information dated October and November 2017) as relevant. Such measures shall include, but are not limited to: the use of the quietest available plant, equipment and techniques; the regular maintenance and inspection of such plant and equipment; the use of cladding, attenuators and barriers to reduce noise levels from noisy plant and operations; the specification of appropriate reversing alarms to minimise annoyance; and, measures to reduce vibration and air overpressure during blasting.	Section 5

NYMNPA 18	Compliance with Condition NYMNPA-18
Details of the noise and vibration monitoring system to be installed around the DNF and LCP sites to continuously log noise levels during construction and operation. The system shall include at least six noise monitors installed around the boundary of the Dove's Nest site and at least four monitors at key residential receptors near the Dove's Nest site and at least four noise monitors around the Lady Cross Plantation Site and at least three monitors at key residential receptors near the Lady Cross Plantation site.	Section 4
The precise number and location of noise monitors shall be set out in the NVMP. The developer shall use reasonable endeavours to obtain access to the residential receptor properties for the installation of noise monitors and only if access cannot be obtained the number or location of noise monitors may be reduced. The MPA and the SBC EHO and/or their advisers shall be granted access to inspect the noise and vibration data whenever required, records of the data should be kept for a reasonable period and these records should be accessible by the public.	Section 3, Section 4 and Figure B.1
Details of the procedure to be followed in the event that the noise predictions detailed in the NVMP or the noise limits detailed in conditions 20 to 23 are exceeded. Such procedures shall require the investigation of the reasons for the breach of the limits and the cessation of the activity causing the breach until such a time as additional mitigation can be provided.	Section 5
Details of how the residents will be informed and consulted about the site operations and progress, particularly in regard to blasting and especially noisy operations including details of complaints logging and management procedures and a 24-hour telephone incident hotline. Details of the procedure for investigating complaints and informing complainants of the results of such investigations and of any actions resulting from them.	Section 5
The NVMP shall be adhered to at all times unless agreed previously in writing by the MPA.	
The NVMP shall be updated and agreed whenever appropriate to reflect changes in the programme during construction and operation and at intervals not less than 6 months after the initial start on site and thereafter annually.	Section 1

1.1.4 This NVMP relates to the Phase 8 Works at Ladycross Plantation only. These works comprise the following:

- Drilling of an exploratory borehole;
- Temporary installation and use of drilling rig and ancillaries;
- Decommissioning of Borehole.

1.1.5 Decommissioning of borehole is to be completed once the tunnel boring machine (TBM) has passed, as detailed in the Phase 8 CEMP (Document reference: 40-STS-LC-2100-EN-PL-00036). It is estimated this will occur one year after completion of drilling and therefore has not been considered in the Phase 8 NVMP.

1.1.6 As set out in the Phase 8 Construction Environmental Management Plan (CEMP; reference 40-STS-LC-2100-EN-PL-00036), Phase 8 Works will be undertaken continuously i.e. 24 hours a day.

1.1.7 Contractors responsible for implementing the Phase 8 Works have advised that some works associated with Phases 6 and 7 (as detailed in previous reports) will continue throughout the Phase 8 period; these are detailed in Appendix A.

Planning Conditions

1.1.8 In addition to Condition NYMNPA 18, two further conditions NYMNPA 22 and NYMNPA 23 establish noise limits relating to the Ladycross Plantation site (see **Section 2.2**). Planning condition detail is provided in Table 1-2 and Table 1-3.

Table 1-2: Condition NYMNPA 22 Noise and Vibration Management Plan

NYMNPA 22	Compliance with Condition NYMNPA-22
Day-time (07.00 hrs to 19.00 hrs) noise levels $L_{Aeq,1hr}$ from mine construction at the Lady Cross Plantation site, excluding blasting operations, shall not exceed 55 dB $L_{Aeq,1hr}$ and for short-term, construction activities solely relating to the demolition of existing buildings and erection of new structures excluding earth mound and bunds shall not exceed 65dB $L_{Aeq,1hr.}$ An upper limit of 70 dB $L_{Aeq,1hr}$ for the purposes of temporary noisy operations to provide noise-reducing earth bunds and / or barriers may be permitted for up to 56 days in any calendar year provided such temporary operations are specified and agreed in the NVMP described in Condition 18. Each calendar day when the higher temporary noise level is exceeded shall be counted as one day. Noise levels shall be measured in accordance with BS 4142:2014 and shall apply at the curtilage boundary of residential properties and at the following recreational receptors: on the open access land to the north and east of the site at OS Grid Reference locations 810684 and 819077.	Section 3, and Appendix A

Table 1-3: Condition NYMNPA 23 Noise and Vibration Management Plan

NYMNPA 23	Compliance with Condition NYMNPA-23
Evening (19.00 hrs to 22.00 hrs) and night-time (22.00 to 07.00 hrs) noise levels $L_{Aeq,1hr}$ from mine construction at the Lady Cross Plantation site, excluding blasting operations, shall not exceed 42 dB $L_{Aeq,1hr}$. Noise levels shall be measured in accordance with BS 4142:2014 and the limits apply at the curtilage boundary of residential properties.	Section 3, and Appendix A

1.1.9 Condition NYMNPA 26 relates to vibration arising from construction activities other than blasting, details are provided in Table 1-4.

Table 1-4: Condition NYMNPA 26 Noise and Vibration Management Plan

NYMNPA 26	Compliance with Condition NYMNPA-26
Vibration from construction work on site and during operation (but excluding blasting) shall not exceed 0.3mm/s (PPV) at any residential property at any time.	Section 3.3

1.1.10 In this document, the term *"construction"* includes all physical and related engineering and construction activities associated with the Phase 8 Works, as described above. Updates to this plan will be prepared and submitted to the NYMNPA for approval in advance of subsequent construction phases and following any material design or method change.

2 GUIDANCE

2.1 Legislation and British Standards

2.1.1 Wherever practicable, construction will be carried out in accordance with:

- Planning Practice Guidance for Minerals (PPGM), 2014[1]
- BS 5228:2009+A1:2014 *Code of Practice for noise and vibration control on construction and open sites*[2].

2.2 Construction Limits

2.2.1 The PPGM includes noise limits which align with the established noise limits detailed in NYMNPA Condition 22 and NYMNPA Condition 23.

2.2.2 The established noise limits detailed in NYMNPA Condition 22 and NYMNPA Condition 23 (as measured at the identified receptors) remain as:

- 55 dB $L_{Aeq,1hr}$ for daytime (07:00 – 19:00);
- 65 dB $L_{Aeq,1hr}$ for the demolition of buildings and erection of new structures;
- Up to 70 dB $L_{Aeq,1hr}$ for temporary noisy operations to provide noise-reducing earth bunds and / or barriers; and
- 42 dB $L_{Aeq,1hr}$ for evening and night-time (19:00 – 07:00).

2.2.3 Established vibration limits for construction works (other than blasting) shall not exceed 0.3 mm/s. Vibration limits for blasting activities are outlined in Conditions 27 and 28, however blasting works are not anticipated at the Ladycross Plantation Site and are therefore not considered in the NVMP.

2.3 Construction Method

2.3.1 Contractors responsible for implementing these Phase 8 Works have provided details of the construction plan, number and type of plant items to be used and location/duration of construction activities within the site. Further detail is provided in the Phase 8 Construction Environmental Management Plan (CEMP) (reference 40-STS-LC-2100-EN-PL-00036).

2.3.2 **Appendix A** details the plant items included within the noise model, their sound power level and location on site. Predictions of noise levels based upon these details are assessed within this NVMP.

[1] *Planning Practice Guidance for Minerals (PPGM), 2014 Department for Levelling Up, Housing and Communities (/government/organisation/department-for-levelling-up-housing-and-communities) and Ministry of Housing, Communities & Local Government (/government/organisations/ministry-of-housing-communities-and-local-government. (URL:https://www.gov.uk/guidance/minerals, accessed 03 February 2022)*
[2] *British Standards Institute (2014). BS 5228:2009+A1:2014 Code of Practice for noise and vibration control on construction and open sites*

3 PREDICTED CONSTRUCTION NOISE AND VIBRATION LEVELS

3.1 Baseline Receptor Locations

3.1.1 The Environmental Statement (ES) which accompanied the planning application included (Part 2, Chapter 8, Noise and Vibration) an assessment of construction noise at the following nearby residential locations:

- Ladycross Caravan Park Owner's Property, approximately 320m from the nearest site boundary;
- Davidson Farm, approximately 425m from the nearest site boundary; and
- Watergate Farm, approximately 365m from the nearest site boundary.

3.1.2 For the purposes of this NVMP the receptors detailed above are the residential receptors at which the noise limits in Conditions 22 and 23 apply, and for which predictions of construction noise were undertaken.

3.1.3 The following recreational receptors, detailed within Condition 22, were included within the construction noise calculations:

- Open access land to the north of the site (OS Grid Reference 816084), OSGB36 co-ordinates (m) X:481600, Y:508400; approximately 310m from the nearest site boundary; and
- Open access land to the east of the site (OS Grid Reference 819077), OSGB36 co-ordinates (m) X:481900, Y:507700, approximately 60m from the nearest site boundary.

3.2 Predicted Noise Levels

3.2.1 3-D noise modelling was undertaken using computational noise modelling software SoundPLAN (9.0) to predict construction noise levels associated with the Phase 8 Works. **Table A.1** and **Table A.2** in **Appendix A** show the predicted construction noise levels for the Phase 8 Works (including ongoing Phase 6 and 7 works).

3.2.2 Predicted noise levels from the Phase 8 Works do not exceed the agreed construction noise limits at any of the identified noise-sensitive receptors during the day or night-time when the activity timing and physical mitigation measures described in **Section 5.3** are adopted.

3.3 Vibration

3.3.1 Ground-borne vibration assessments can be drawn from the empirical methods detailed in BS 5228-2:2009+A1:2014; in the Transport and Road Research Laboratory Research Report (TRRL) 246: Traffic induced vibrations in buildings 2; and within the Transport Research Laboratory (TRL) Report 429 (2000): Ground-borne vibration caused by mechanical construction works.

3.3.2 A series of calculations, in accordance with the empirical methods referred to above, were carried out based on typical construction activities, applying reasonable worst-case assumptions, in order to determine set-back distances at which critical vibration levels may occur. These were presented in the ES and are reproduced in **Appendix A**, **Table A.4**.

3.3.3 During Phase 8, no significant sources of vibration are to be present. Additionally, the minimum distance between the plant and any of the surrounding residential receptors is over 350m. At this distance, ground-borne vibration levels will be significantly lower than 0.3mm/s at all nearby sensitive receptors, i.e. significantly below levels which are considered to be *"just about perceptible in residential environments"*[3].

[3] British Standards Institution (2014). BS5228:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration'

4 NOISE AND VIBRATION MONITORING PROGRAMME

4.1 Vibration Monitoring

4.1.1 As detailed within Section 3.3 of this NVMP, construction activities during Phase 8 will not give rise to significant levels of vibration at nearby residential receptors.

4.1.2 The construction methodology for the Ladycross Plantation site is similar to works that are being undertaken at Lockwood Beck. There have been no complaints or incidents from vibration at the Lockwood Beck site for the Phase 6 & 7 works only. No works similar to the Phase 8 works have been undertaken at Lockwood Beck, but these are not anticipated to cause vibration issues.

4.1.3 Given the experience and knowledge gained from the Lockwood Beck site and the distance between the Ladycross Phase 8 Works and the residential receptors, vibration impacts are not anticipated. Vibration monitoring is therefore not proposed.

4.2 Noise Monitoring

4.2.1 Condition NYMNPA 18 specifies that continuous noise monitoring is undertaken during construction and operation at three key residential receptor locations near the Ladycross Plantation Site. Residential receptor locations are outlined in **Section 3.1.1**.

4.2.2 Monitoring is currently being undertaken both on and off site at the following monitoring locations:

- LC-NM1 – Ladycross Caravan Park Owner's Property;
- LC-NM2 – Centre of the site;
- LC-NM3 – Davidson Farm; and
- LC-NM4 – Barn Cottages (a temporary relocation from the North-east boundary of the site).

4.2.3 Noise monitoring locations are presented in **Appendix B, Figure B1**. The redline boundary shown on **Figure B1** is the land ownership boundary.

4.2.4 Although Watergate Farm is closer to the site boundary than Davidson Farm, similar construction noise is anticipated at these receptors due to the distance to the works and the intervening ground between the works and the receptors. This is confirmed by the noise predictions presented in **Appendix A**.

4.2.5 The noise measurements are conducted in accordance with the guidance contained in BS 7445 parts 1[4] and 2[5].

[4] *British Standard Institution (2003) BS 7445-1:2013 Description and measurement of environmental noise – Guide to quantities and procedures*
[5] *British Standard Institution (1991) BS 7445-2:1991 Description and measurement of environmental noise – Guide to acquisition of data pertinent to land use*

4.2.6 The sound level meters are fully calibrated, traceable to United Kingdom Accreditation Service (UKAS) standards and satisfy the requirements of BS EN 61672-1:2013[6] for a 'Class 1' Sound Level Meter (SLM).

4.2.7 The SLMs record L_{Aeq}, L_{Amax}, L_{A90}, and L_{A10} data with a 'fast' time constant and A-weighting. **Appendix C** presents descriptions of these terms.

4.2.8 The noise measurements are being conducted in accordance with BS 7445 with the SLM microphone mounted on a tripod or secured mounting pole at 1.5m above ground level and 3.5m away from any reflecting surface other than the ground. The instruments will be calibrated at monthly intervals during the monitoring period, and before and after any battery change using a portable field calibrator. Any deviations in the calibration level will be noted and reported within the summary reports.

4.2.9 The SLMs operate using a system of real time alerting which allows remote monitoring of noise levels and indication of noise levels approaching and/or breaching the limits. Alerts are managed by the Contractors who, following an investigation as to the cause of any alert (assisted by live audio observations provided by the monitoring equipment located at the boundary), will report the alert to Scarborough Borough Council (SBC) and the NYMNPA as necessary.

4.2.10 The SLMs are inspected during each field calibration and maintenance visit and any faults will be identified and rectified during the visits. Should faults require off-site repair a replacement SLM will be installed during the repair period.

4.2.11 Monitoring of weather conditions including wind speed and direction, rainfall, temperature and humidity is being carried out simultaneously at the Ladycross Plantation Site.

4.2.12 Reports are provided monthly to SBC and NYMNPA, detailing the type and system of sound level meters used and a summary of the measured noise data at each location with corresponding weather data and survey notes.

[6] *British Standard Institution (2013) BS EN 61672-1:2013 Electroacoustics. Sound level meters - Specifications*

5 MITIGATION AND PROCEDURES

5.1 Purpose of the Section

5.1.1 This section outlines measures to be taken by the Contractors to limit, and manage the impact of, noise. This section also outlines the Best Practicable Means and specific mitigation actions to be adopted.

5.2 Best Practicable Means

5.2.1 The Control of Pollution Act 1974 and BS 5228 define a set of Best Practice working methods and mitigation measures, referred to as Best Practicable Means (BPM). The following measures will be adopted:

- Weekly construction meetings will take place to discuss the minimisation of noise emanating from the site, the potential for noise reduction for any upcoming activities and to identify any potential concurrent activities which may lead to noise levels requiring the upper limit of 70 dB $L_{Aeq,1hr}$. Occasions requiring these upper limits will be reported to the NYMNPA and SBC prior to the activities occurring and will be included within the regular communication to residents detailed within **Section 5.4**;
- Locating temporary plant so that it is screened from receptors by on-site structures, such as site cabins;
- Where practicable, not undertaking noisy activities concurrently close to residential receptors;
- Using modern, quiet equipment and ensuring such equipment is properly maintained (see **Section 5.2.8** below) and operated by trained staff (see **Section 5.2.10** below);
- Applying enclosures to particularly noisy equipment where possible;
- Ensuring that mobile plant is well maintained such that loose body fittings or exhausts do not rattle or vibrate;
- Ensuring plant machinery is turned off when not in use;
- Undertaking daily, pre-start inspections of plant and machinery;
- Providing local residents with 24-hour contact details for a site representative in the event that disturbance due to noise from the construction works is perceived (see **Section 5.4.1**); and
- Informing local residents about the construction works, including the timing and duration of any particularly noisy elements (see **Section 5.4.3**).

Management Structure and Responsibilities

5.2.2 Anglo American are accountable for compliance with environmental and approvals requirements. Contractors on site are responsible for undertaking construction activities in accordance with the requirements of this NVMP.

5.2.3 The CEMP provides details of the lines of responsibility for environmental management during the Phase 8 Works.

5.2.4 The Environmental Manager/Project Manager (or deputy) for each Contractor will be on site during working hours and will be responsible for robust implementation of noise management and mitigation measures.

5.2.5 The Operations Director/Project Manager (or deputy) for each Contractor is responsible for implementation of the appropriate Environmental Policy and the CEMP through:

- Compliance with contractual requirements regarding environmental matters;

- Adherence to the NVMP and associated control measures;
- Designated responsibility for environmental control during the works;
- Regular meetings with project team members to review environmental matters;
- Regular reporting to the employer on environmental matters;
- Ensuring adequate resources are made available;
- Managing and advising on environmental matters affecting the Project with the assistance of the Employer's Environment Manager, the Contractor's Environmental Manager and Environmental Inspector;
- Reporting to the Employer's Environment Manager on implementation of the NVMP;
- Carrying out regular internal audits and procedure review on environmental matters;
- Reviewing and mitigating all environmental impacts identified in submitted method statements;
- Recording and maintaining all environmental matters/incidents in accordance with reporting procedures; and
- Ensuring all team members work in accordance with the NVMP.

5.2.6 The Operations Director/Environmental Manager/Project Manager for the contractors and their appointed subcontractors engaged for the Phase 8 Works will, with the Employer's Environment Manager acting as coordinator, liaise to ensure regular review of environmental matters and appropriate assignment of responsibilities for Contractors' specific site activities.

Maintenance

5.2.7 Maintenance of plant will be carried out routinely and in accordance with the manufacturers' guidance.

5.2.8 A daily safety inspection of all plant and equipment will be undertaken to ensure that, as a minimum:

- all plant is in a good state of repair and fully functional;
- any plant found to be requiring interim maintenance has been identified and taken out of use;
- acoustic enclosures fitted to plant are in a good state of repair;
- doors and covers remain closed during operation (self-closing doors/covers are recommended); and
- any repairs are undertaken by a fully qualified maintenance engineer.

Training

5.2.9 The site induction programme and site rules will include good working practice instructions for site staff, managers, visitors and contractors to help minimise noise whilst working on the site.

5.2.10 The good working practice guidelines/instructions will include, but not be limited to, the following points:

- avoid unnecessary revving of engines;
- plant used intermittently will be shut-down between operational periods, where possible;
- avoid reversing wherever possible;
- contractors to be advised that reversing alarms on mobile equipment must be specified as low/white noise where safety requirements allow;
- report any defective equipment/plant as soon as possible so that corrective maintenance can be undertaken; and
- handle material in a manner that minimises noise.

5.3 Specific Mitigation

Bunds and barriers

5.3.1 Temporary storage bunds north of the Works, constructed during Phase 3, were included in the noise model, providing screening between the proposed construction works and the residential receptors. The Phase 7 works included creation of top soil and sub soil screening stockpiles and modifications to the Phase 3 bunds; however, the Contractor responsible for the works has confirmed that the Phase 3 bunds will be retained during the Phase 8 works. Hence, the Phase 8 modelling included the completed bunds as per the end of Phase 6.

5.3.2 The use of emergency equipment has not been included in the results shown in **Table A.1** or **Table A.2**. The use of emergency equipment is considered unlikely. Further modelling has been undertaken which indicates that the noise from emergency flaring, in combination with that from other Phase 8 activities at night, could result in exceedances of the evening and night-time noise limits by up to 2dB, at Davidson Farm or Watergate Farm. Exceedances are only anticipated when the wind is from the source to the receiver (i.e. from the north) and the prevailing wind direction at the site is from the southwest. Combined with the fact that the flare will only be used in an emergency, an exceedance of the noise level limit is therefore considered extremely unlikely.

5.3.3 Given the length of time that the temporary flare will be in place, the night-time activities that will be being undertaken at the time of the flaring (if required) are not currently known, and neither is the wind direction. Hence, it is not possible to identify specific mitigation measures to be applied in the scenario that flaring results in an exceedance.

5.3.4 Noise monitoring will continue to be used to identify any exceedances of the consented limits. Should flaring of gas be required, and noise monitoring stations surrounding the site indicate an exceedance at any receptor, it may be necessary to cease some or all non-essential noise emitting processes for the duration of the flaring outside of normal daytime hours. The modelling indicates that noise from the flare, without the contribution from other site activities, would not cause an exceedance of the evening and night-time limit.

5.3.5 Short-term exceedances of the noise level limit, if they do occur, as a result of temporary flaring, are not considered sufficient to be a breach of the site's planning obligations. This is because a temporary emergency event such as flaring does not necessarily fall within the scope of "mine construction" as referred to by the relevant planning condition (Condition NYMNPA 23) and best practicable means are being implemented to minimise noise from the site, including flaring, in accordance with Condition NYMNPA 18.

5.4 Communications

5.4.1 If monitoring indicates that the noise limits are being exceeded as a result of the works, or a complaint is received from a local resident, an investigation will be instigated in accordance with the Complaints Procedure provided in Appendix B to the Phase 3 CEMP.

5.4.2 Good relations with local residents in nearby noise-sensitive receptors will be maintained.

5.4.3 A Community and Stakeholder Engagement Plan is provided in Appendix A to the Phase 8 CEMP which details actions to be taken by Anglo American and the Contractors.

Appendix A Predicted Construction Noise Levels

The predicted noise levels detailed within the tables below are considered to represent the most conservative, worst-case, scenario without any emergency equipment operational. The modelled results for Phase 8 daytime construction works are detailed in **Table A.1**.

Table A.1 Calculated noise levels during Phase 8 – Daytime

Receptor location	Daytime (07:00–19:00)	
	Limit $L_{Aeq,1hr}$ dB	Maximum predicted $L_{Aeq,1hr}$ dB
Ladycross Caravan Park Owners Property	55	43
Davison Farm	55	44
Watergate Farm	55	43
Recreational Receptor OS Grid 816084	55	35
Recreational Receptor OS Grid 819077	55	50

The modelled results for Phase 8 evening and night-time construction works are detailed in **Table A.2**.

Table A.2 Calculated noise levels during Phase 8 – evening and night-time

Receptor location	Night time (19:00–07:00)	
	Limit $L_{Aeq,1hr}$ dB	Maximum predicted $L_{Aeq,1hr}$ dB
Ladycross Caravan Park Owners Property	42	40
Davison Farm	42	41
Watergate Farm	42	41
Recreational Receptor OS Grid 816084	N/A	33
Recreational Receptor OS Grid 819077	N/A	47

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Modelling Assumptions

The works at the site are considered to comprise mineral extraction and the conditioned noise limits are in accordance with the Planning Practice Guidance for Minerals (PPGM). The PPGM does not specify the method to be used to predict noise propagation; therefore, in line with acoustics industry best practice, noise propagation from the site was calculated using the ISO 9613-2 methodology.

The contractor responsible for the works provided a schedule of construction activities. This has been used to identify the following weeks of the schedule which potentially result in the worst-case impacts:

- Week 1:
  - Installation of drilling rig and ancillaries
  - Operation of drilling rig and ancillaries
  - Drilling of exploratory Borehole
  - General site activities
- Week 2:
  - Operation of drilling rig and ancillaries
  - Drilling of exploratory Borehole
  - General site activities
  - Installation & use of Alimak and associated infrastructure
  - Decommissioning of old welfare and installation of new welfare
- Week 6:
  - Operation of drilling rig and ancillaries
  - Drilling of exploratory Borehole
  - General site activities
  - Installation and use of temporary shaft head house and associated services
  - Decommissioning of old welfare and installation of new welfare
- Week 8:
  - Operation of drilling rig and ancillaries
  - Drilling of exploratory Borehole
  - General site activities
  - Installation and use of temporary shaft head house and associated services
  - Hardstanding Areas
- Week 13:
  - Removal / storage of Borehole material

Separate modelling was undertaken for each potentially worst-case week, including the simultaneous operation of all the identified activities due to the ongoing works. The maximum of the predicted noise levels from each modelled scenario at each receptor are provided in Tables A.1 and A.2.

Overall, the model setup and assumptions made on the number of plant and their location within the site were conservative, and therefore the predicted impacts are considered to be worst-case.

Acoustic modelling input data

Data sources used for this modelling are shown in **Table A.3**.

Table A.3 Data sources

Data	Source file	Origin
Nearby building locations	OS Buildings.geo	Ordnance Survey Vectormap
Site topography	CAD drawing entitled '221013 - LDX TIN_2.dwg'	Anglo American
Wider area topography	NZ80NW _DTM_2m.tif	Defra LiDAR survey data (available at Defra Survey Data Download)
Site layout	Rig Layout 2 - Zoomed	STRABAG

Acoustic model settings

Acoustic modelling was undertaken using the following model settings:

- Maximum search radius of 5000m.
- Maximum number of reflections: 3
- Noise predictions carried out at each floor level of sensitive receptors, ground floor level is 1.5m above ground, each storey is 2.5m high.
- Side diffraction enabled.
- Ground absorption was set as:
  Areas within site red line boundary and roads/haul routes within site set to G=0;
  Ground outside of site red line boundary set to G=1 (representing soft ground).

Plant details

The following Phase 8 equipment, associated sound power levels and conservative assumptions regarding plant 'on-times' were used within the SoundPLAN noise model:

General Site Use Equipment
1 x 13T Excavator, 10% 24 hours per day, 99dB L_{wA}
Delivery Vehicles, 5 per hour, 10 mph daytime only, 111dB L_{wA}
1 x Telehandler, 25% on-time 24 hours per day, 105dB L_{wA}
1 x Road Sweeper, 25% on time 24 hours per day, 104dB L_{wA}
45 ft MEWP, 10% on-time 24 hours per day, 95dB L_{wA}

General Site Activities Equipment
1 x 250kVa Generator (Welfare) (emergency situation only), 100% on-time 24 hours per day, 95dB L_{wA}
1 x 60kVa Generator (Siltbuster) (emergency situation only), 100% on-time 24 hours per day, 96dB L_{wA}
6 x Supersilent Pumps, 25% on-time 24 hours per day, 87dB L_{wA}
1 x Static Fuel Bowser, 50% on-time 24 hours per day, 101dB L_{wA}
1 x Towable Fuel Bowser, 25% on-time 24 hours per day, 101dB L_{wA}
4 x Lighting Towers, 50% on-time 24 hours per day, 85dB L_{wA}
1 x Towable Jet wash, 25% on-time Daytime only, 91dB L_{wA}
1 x 6m Ecowash Wheelwash, 25% on-time Daytime only, 91dB L_{wA}
1 x Siltbuster, 25% on-time 24 hours per day, 93dB L_{wA}
1 x 4kVa Mobile Generator (Water Management), 25% on-time 24 hours per day, 93 dB L_{wA}
1 x 13T Excavator, 10% daytime only, 99dB L_{wA}

Decommissioning of old welfare and installation of new welfare
1 x 30T excavator, 100% on-time daytime only, 103dB *L*wA
1 x 20T Dumper, 60% on-time daytime only, 102dB *L*wA
1 x Telehandler 5T, 50% on-time daytime only, 105dB *L*wA
1 x Vibratory Roller, 25% on-time daytime only, 103dB *L*wA
1 x Concrete Pump, 75% on-time daytime only, 109dB *L*wA
2 x Vibratory poker, 25% on-time daytime only, 106 *L*wA
1 x 500kVa Emergency Generator 10% on-time 24 hours per day, 95dB *L*wA
1 x 130T mobile Crane, 50% on-time Daytime only, 105dB *L*wA
1x Compressor, 100% on-time daytime only, 107dB *L*wA

Installation & use of Alimak and associated infrastructure
1 x 130T mobile Crane, 50% on-time Daytime only, 105dB *L*wA
1 x 250T Mobile Crane, 50% on-time Daytime only, 107dB *L*wA
1 x Alimak, 15% on-time 24 hours per day, 94dB *L*wA

Installation and use of temporary shaft head house and associated services
1 x 130T mobile Crane, 50% on-time Daytime only, 105dB *L*wA
1 x 250T Mobile Crane, 50% on-time Daytime only, 107dB *L*wA
1 x MEWP, 75% on-time Daytime only, 95dB *L*wA
1 x Alimak, 15% on-time 24 hours per day, 94dB *L*wA

Hardstanding Areas
1 x Dozer, 75% on-time daytime only, 105dB *L*wA
1 x Vibratory Roller, 50% on-time daytime only, 103dB *L*wA
1 x Asphalt Paver, 50% on-time daytime only, 112dB *L*wA
1 x 20T excavator, 10% on-time daytime only, 101dB *L*wA
1 x Asphalt Roller, 50% on-time daytime only, 108dB *L*wA
1 x Skid Steer, 50% on-time daytime only, 112 *L*wA

Drilling of an exploratory Borehole
1 x Auger or drilling rig (top drive), 75% on-time 24 hours, 105dB L_{wA}
1 x Auger or drilling rig (main body), 75% on-time 24 hours, 100dB L_{wA}
1 x M50E electrical compressor unit, 100% on time 24 hours, 98dB L_{wA}
1 x 30T Tracked excavator, 50% on time 24 hours, 103 dB L_{wA}
2 to 6 x 20T Tipper Trucks, Included in ‘delivery vehicles’

Temporary Installation and use of drilling rig and ancillaries
1 x 30T Tracked excavator, 50% on time daytime only, 103 dB L_{wA}
1 x 20T 20T Dumper, 60% on-time daytime only, 102 dB L_{wA}
1 x Vibratory Roller, 25% on-time daytime only, 103 dB L_{wA}
1 x Telehandler 5T, 50% on-time daytime only, 105 dB L_{wA}
1 x 60T Mobile Crane, 10% on time 24 hours, 105 dB L_{wA}
2 x 150 kVa Generator, 100% on time 24 hours, 98 dB L_{wA}
1 x 100kVa Generator, 100% on time 24 hours, 95 dB L_{wA}
1 x Centrifuge, 75% on time 24 hours, 104 dB L_{wA}
2 x Mud Pumps, 75% on time 24 hours, 98 dB L_{wA}
2 x Fluid Reclamation Units, 75% on time 24 hours, 98 dB L_{wA}
1 x Gas Separator Unit, 75% on time 24 hours, 98 dB L_{wA}

1 x 1000 kVa Power Module (Drilling Rig), 75% on time 24 hours, 105 dB L_{wA}

Emergency flaring modelling
1 x High Baffled Flare (7.62m) – Emergency Only, 100% on time 24 hours, 108 dB L_{wA}

Noise propagation was calculated using the ISO 9613-2:1996 methodology.

Table A.4 Predicted Distances at which Specific Vibration Levels Occur

Activity	Set-back distance at which vibration level (PPV) occurs			
	0.3 mm/s	1.0 mm/s	10 mm/s	15 mm/s
Vibratory compaction (start-up)	*116m**	65m	9m	6m
Vibratory compaction (steady state)	102m	44m	8m	6m
Vibratory piling (start-up)	*154m**	56m	8m	6m
Vibratory piling (steady state)	75m	32m	6m	5m
Tunnelling	*137**	54m	*9m**	*7m**
HGV movements on uneven haul route (assuming Alluvium surface)	277m	60m	3m	2m

Note These predicted distances are outside the limitations of the calculations and are therefore provided for information only.*

Appendix B Figures

Appendix C Acoustic Terminology

Term	Definition
Noise sensitive receptors	People, property or designated sites for nature conservation that may be at risk from exposure to noise and vibration that could potentially arise as a result of the proposed development/project
Noise and Vibration study area	The area assessed for noise and vibration impacts during this assessment
Baseline scenario	Scenarios with the proposed development/project not in operation
Decibel (dB)	A unit of noise level derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure level the reference quantity is 20 µPa, the threshold of normal hearing is 0dB, and 140dB is the threshold of pain. A change of 1dB is only perceptible under controlled conditions. Under normal conditions a change in noise level of 3dB(A) is the smallest perceptible change.
dB(A)	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
$L_{Aeq,T}$	The equivalent continuous sound level – the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T). $L_{Aeq,T}$ is used to describe many types of noise and can be measured directly with an integrating sound level meter.
$L_{A10,T}$	The A weighted noise level exceeded for 10% of the specified measurement period (T). L_{A10} is the index generally adopted to assess traffic noise
$L_{A90,T}$	The A weighted noise level exceeded for 90% of the specified measurement period (T). In BS 4142:2014 it is used to define the 'background' noise level.
L_{Amax}	The maximum A-weighted sound pressure level recorded during a measurement.
PPV	Instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position.
'A' weighting	A frequency weighting to compensate for the varying sensitivity of the human ear to sound at different frequencies.
Fast time constant	Sound level meters have two conventional time weightings, F = Fast and S = Slow with time constants of 125ms and 1000ms respectively. Fast time constant relates to the response time of the meter which allows rapid variations in noise level to be registered.

NYMNPA

21/12/2023

Project Title / Facility Name:

Woodsmith Project

Document Title:

EMISSIONS TO ATMOSPHERE - PHASE 8 - NYMNPA CONDITION 91 (ROYAL HASKONINGDHV) - LADYCROSS

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WOODSMITH PROJECT

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EMISSIONS TO ATMOSPHERE - PHASE 8 - NYMNPA CONDITION 91 - LADYCROSS PLANTATION

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REPORT

NYMNPA-91 Emissions to Atmosphere

Ladycross Plantation Phase 8

Client: STRABAG AG

Reference: 40-STS-LC-2100-EN-PL-00039 REV D

Status: 01/Final

Date: 11 December 2023

Royal HaskoningDHV

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1 Introduction

1.1.1 In 2014 a planning application (reference NYM/2014/0676/MEIA) was submitted to North York Moors National Park Authority (NYMNPA) for permission to develop a polyhalite mine and underground Mineral Transport System (MTS). Planning consent was subsequently granted in 2015, subject to conditions, as varied in February 2018 by NYM/2017/0505/MEIA.

1.1.2 This document has been prepared on behalf of STRABAG AG, the contractor delivering the Phase 8 Works on behalf of Anglo American, and details the requirements with respect to emissions to atmosphere for the Phase 8 Works of the development at Ladycross Plantation (see paragraph 1.1.6 below). This document is required to partially discharge Condition 91 of the NYMNPA planning permission NYM/2017/0505/MEIA and has been prepared in accordance with current good practice. The planning condition states that:

"The final specification and configuration of generators to be employed at Doves Nest Farm and Ladycross Plantation, such to be fitted with Selective Catalytic Reduction (SCR), or other such emissions control measures as are necessary, will be submitted to the MPA for approval prior to commencement of their use. Results of air dispersion modelling will be submitted at the same time to verify that the identified configuration will lead to nutrient nitrogen and acid deposition at levels no greater than those that were demonstrated in the York Potash Environmental Statement (September 2014 as updated by the Supplementary Environmental Statement dated February 2015) as not leading to a significant effect on the integrity of the North York Moors SAC, SPA and SSSI."

1.1.3 The specific requirements of Condition NYMNPA-91 are detailed in **Table 1.1**.

Table 1.1 Condition NYMNPA-91 Emissions to Atmosphere

Condition NYMNPA-91	Compliance with Condition NYMNPA-91
The specification and configuration of generators and Selective Catalytic Reduction (SCR) / emission control measures.	Section 2
Confirmation that Phase 8 nutrient nitrogen and acid deposition rates are below those presented in the York Potash Environmental Statement (ES) and Supplementary Environmental Information Report (SEI).	Section 3

1.1.4 This assessment considers only the Phase 8 Works at Ladycross Plantation. Updates to this assessment will be prepared for subsequent construction phases and following any design review or method change. The approach adopted in this document was agreed with Natural England and NYMNPA for previous Phases at Woodsmith Mine.

1.1.5 The scope of Phase 8 described by this document is as follows:

- Drilling of an exploratory borehole;
- Temporary installation and use of drilling rig and ancillaries; and
- Decommissioning of borehole.

2 Assessment

2.1.1 This assessment considers the impact of nutrient nitrogen and acid deposition from emissions arising from the Phase 8 Works. During Phase 8, an electrical grid supply will be in use on the site, which will be supplemented with additional diesel generation to ensure there is sufficient power for the proposed activities. As a proportion of the power requirement will be provided by electrical means, it was not considered that detailed dispersion modelling was necessary to undertake the assessment for this Phase of works. This document therefore presents a comparison of the power demand required during Phase 8, hours of working and duration, with the power demand and working hours presented within the York Potash Environmental Statement (ES) and Supplementary Environmental Information report (SEI) (Royal HaskoningDHV, 2014 and 2015), upon which the consented nutrient nitrogen and acid deposition values were based. The expected impact upon designated ecological sites was then evaluated.

2.1.2 A comparison of the atmospheric emission sources operating during Phase 8 with those considered in the York Potash ES and SEI (Royal HaskoningDHV, 2014 and 2015) is shown in **Table 2.1**.

Table 2.1 Comparison of Emission Sources between Phase 8 and the York Potash ES and SEI

Parameter	Phase 8	ES and SEI
Number of generators and capacity	2 x 150 kVA generators 1 x 100 kVA generator 1 x 1,000 kVA generator 1 x 60 kVA generator 1 x 4 kVA generator **1,464 kVA total**	7 x 1,290 kVA generators with SCR at 88% efficiency **9,030 kVA total**
Stack height	Approx. 2.5 m	30 m
Other emission sources	Road traffic Plant emissions	Road traffic Plant emissions Blasting emissions
Working hours	Some activities 7am to 7pm Other activities 24 hours a day	24 hours a day
Duration	14 weeks	26 weeks

2.1.3 As shown in **Table 2.1**, there is significantly less power generation capacity required during the Phase 8 Works in comparison to the level of generation assessed in the York Potash ES and SEI (16%). In the ES and SEI, the generator emissions were assumed to be abated using Selective Catalytic Reduction (SCR) technology; given the lower power demand during Phase 8 in comparison to the ES and SEI assessment scenario, SCR or other emissions abatement technology is not considered to be required to mitigate impacts at designated ecological sites. In addition, the assessment presented in the ES and SEI included emissions from blasting which would not occur during Phase 8. The 1,000 kVA power module (drilling rig), 100 kVA generator and two 150 kVA generators would be used during the temporary installation and use of drilling rig and ancillaries activities and would be operated at 100% load for up to 24 hours per day as a worst-case scenario. The 60 kVA generator will be operated at 10% load for up to 24 hours per day as a worst-case scenario as back-up power to the siltbuster. In addition, a 4 kVA mobile generator will be used to power water management and will therefore be used only intermittently when this activity is required at a low load (10%). As such, emissions from the onsite generators will be relatively low. Two additional generators, a 250 kVA emergency back-up (welfare) generator and 1,000 kVA back-up power module (drilling rig) will be on site in Phase 8 for emergency use. Whilst these generators will be routinely tested and maintained, as they will be used only in exceptional circumstances, emissions from these sources were not included in this assessment.

2.1.4 Whilst higher stack heights typically reduce off site effects by allowing greater dilution and dispersion of emissions before reaching receptors at ground level, they also carry pollutants across greater distances from the source. The lower stack heights utilised during Phase 8 will prevent emissions from dispersing further from the site towards designated habitats. As shown in **Figure 1**, the Ladycross Plantation site is situated at a distance from the North York Moors SAC and SSSI boundaries (3.5 km at its closest point). Whilst the total duration of diesel power usage at Ladycross Plantation has exceeded the six-month duration assessed in the ES and SEI, it is considered highly unlikely that emissions from the relatively small onsite generators would give rise to effects on designated sites given that emissions would be well dispersed and diluted across a 3.5 km distance. As such, emissions from plant and generators operating as part of the Phase 8 works would not lead to nutrient nitrogen and acid deposition of a greater magnitude than that presented in the ES and SEI at designated ecological sites.

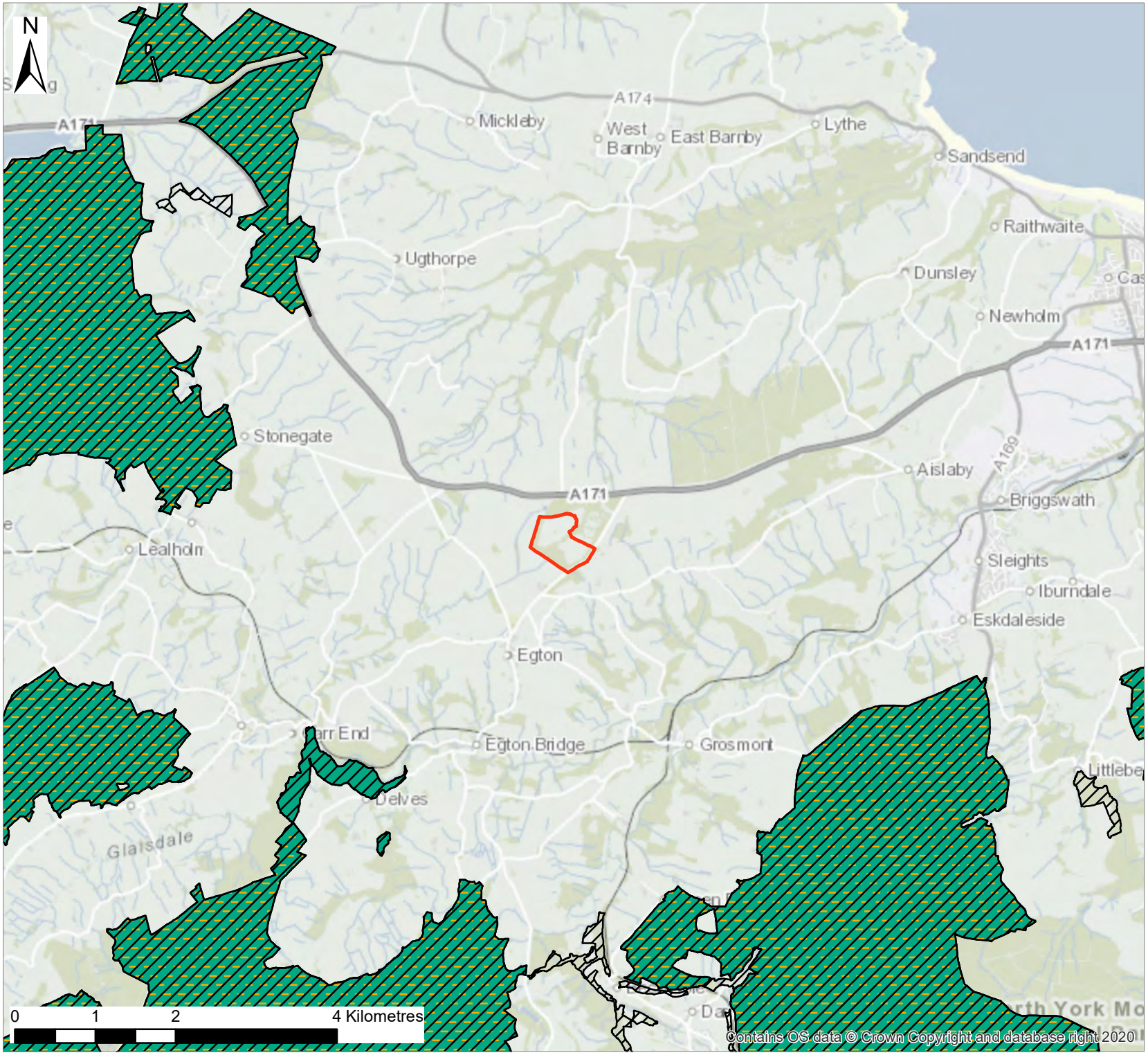
2.1.5 As part of the Phase 8 works, a safety device (gas separator and 4'' single flare skid) will be installed to mitigate emissions and minimise risk to the workforce in the unlikely event of hitting gaseous hydrocarbons during drilling operations. The emergency safety device to be installed will ensure that waste gases will combust cleanly and efficiently by eliminating smoke and minimised noise and visible flame. Further details of the gas separator and 4'' single flare skid are provided in the Phase 8 CEMP (Document reference: 40-STS-LC-2100-EN-PL-00036). It is currently not known how long the flare would have to operate in an emergency case. If gas is encountered, the operational duration of the emergency flare would depend on location, pressure and volume of gaseous hydrocarbons, which are not known at this stage. Geology indicates that given rock porosity any reservoir would be small and of low pressure due to compensation from the Sherwood sandstone aquifer, and is likely to be at or around hydrostatic head 20-30 bar. As the emergency flare is relatively small in scale (a 4" diameter stack) and will be used only in exceptional circumstances, emissions from this source were not included in this assessment.

2.1.6 If required, additional assessments will be carried out for future Phases of construction as the power demand at Ladycross Plantation increases.

3 Conclusions/Condition Discharge

3.1.1 This emissions to atmosphere assessment shows that emissions from the Phase 8 Works will result in no greater nutrient nitrogen and acid deposition at ecological receptors than those values presented in the ES and SEI. Additional mitigation controls are therefore not required for Phase 8.

3.1.2 The assessment thereby demonstrates that the requirements of Condition NYMNPA-91 are met.



Key:

- Lady Cross Plantation
- Special Protection Area
- Sites of Special Scientific Interest
- Special Area of Conservation

Title
Location of Lady Cross Plantation in relation to Designated Ecological Sites

Project
PB1110 Woodsmith Project

Client
STRABAG AG

Date	*Scale*
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Figure 1

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HYDROGEOLOGICAL RISK ASSESSMENT - PHASE 8 - NYMNPA CONDITION 88 & 90 - LADYCROSS

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1. INTRODUCTION

1.1. General Background

STRABAG has been commissioned by Anglo American to construct the Mineral Transport System (MTS) tunnel, a part of its wider Woodsmith Project. The tunnel will be used to transport polyhalite from the Woodsmith Mine site to the Material Handling Facility (MHF) at Wilton, Teesside.

In 2014 a planning application (reference NYM/2014/0676/MEIA) was submitted to the North York Moors National Park Authority (NYMNPA) for permission to develop a polyhalite mine and underground Mineral Transport System (MTS). Planning permission was subsequently granted in 2015 subject to conditions, as varied in February 2018 by NYM/2017/0505/MEIA. This permits the construction of intermediate shafts, including at Ladycross Plantation.

Phase 2 of the works at the Ladycross Plantation site comprised the mobilisation of STRABAG to site, topsoil and subsoil stripping, drainage works, and construction of roads. Phase 3 incorporated additional surface works intended to establish the basis for pre-grouting, including additional soil stripping and drainage works, development and installation of welfare and operational facilities, cuttings lagoon development as amended in Phase 3A and installation of a working pad for pre-grouting and shaft sinking works. Phase 4 works comprised the installation of additional utilities at the site and the implementation of the two-stage pre-grouting works. Phase 5 works included the reaming of the intermediate shaft, casing of the shaft and dewatering of the lagoon. The Phase 6 works comprised installation of grout plant and Alimak and associated services. The Phase 7 works included surface changes to facilitate tunnelling team.

Phase 8 of the works comprise horizontal directional drilling (HDD) of an exploratory Borehole. The information derived will aid in the understanding of geological formations, particularly the Redcar Mudstone in advance of the TBM drive from Ladycross plantation towards Woodsmith mine. Decommissioning of the borehole is anticipated to be undertaken once the TBM has passed the end of the maximum extent of the borehole.

1.2. Phase 8 Scope of Works

The Phase 8 Scope of Works is as follows:

- Drilling of an exploratory Borehole;
- Temporary Installation and use of drilling rig and ancillaries;
- Decommissioning of Borehole.

1.3. Purpose of Document

This Revised Hydrogeological Risk Assessment is required to partially discharge an element of condition NYMNPA-88 as stated in the planning permission ref. no NYM/2017/0505/MEIA. Table 1-1 details where the relevant information has been provided within this report.

1.4. SCOPE OF DOCUMENT

The scope of works covered by this document comprises drilling of an exploratory horizontally drilled directional (HDD) Borehole. The Eskdale Anticline through which the Tunnel Drive between Ladycross and Woodsmith Mine passes includes areas of rock containing faults. The HDD works are to assess these structures, on a precautionary basis, for ground conditions, including groundwater and the very low risk of encountering low volumes of natural gas, prior to tunnel boring activities.

The borehole will be initially 500mm in diameter and cased to circa 11mbgl, the casing will be cemented into place. Secondary drilling activities and casing, again from surface, will be at a diameter of 300mm inside of the primary casing, the secondary borehole will then be cased to approximately 145mbgl and 42m into the Whitby Mudstone Formation aquitard, sealing the upper aquifers. The HDD activities will continue as open hole boring at a diameter of 175mm to a maximum depth of 350mbgl and a distance of approximately 4km parallel to the tunnel alignment. All horizontal drilling activities will be undertaken below all abstractions and vulnerable aquifers.

Decommissioning of the borehole is to be undertaken once the TBM has passed the end of the maximum extent of the borehole; at circa 4km from the Ladycross intermediate site. The duration for monitoring of the borehole during TBM Drive 3 is predicted to take circa 12 months. Monitoring of the borehole will be undertaken until the borehole is sealed from approximately 305mbgl to 2mbgl.

A SCHEMATIC IS PROVIDED IN ATTACHMENT A.

This document does not include an assessment of the risks relating to surface works (e.g. establishment of surface structures, civils works and infrastructure) as the risks from activities of these types have been assessed in submissions supporting previous phases.

1.5. STRUCTURE OF DOCUMENT

The structure of this document is as follows:

Section 1 – Introduction - this section,

Section 2 – Geology – provides a summary description of the ground conditions pertinent to the risk assessment,

Section 3 – Hydrology - provides a summary description of the surface water environment pertinent to the risk assessment,

Section 4 – Hydrogeology – provides a summary of the current hydrogeological understanding of the site,

Section 5 – Construction Methodology – describes a summary of the proposed Phase 8 works,

Section 6 – Risk Statement – a statement of water related risks from the Phase 8 works,

Section 7 – Groundwater Management Scheme – describes proposed control measures to be used during the Phase 8 works to mitigate the identified risks, and

Section 8 – Groundwater and Surface Water Monitoring Scheme, Remedial Action Plan – describes any monitoring required to confirm the efficacy of the control measures during the Phase 5 activities.

1.6. COMPLIANCE WITH CONDITIONS

This document is required to partially discharge condition NYMNPA-88, NYMNPA-89 and NYMNPA-90. These parts of the planning conditions state that:

Table 1-1 NYNMPA Discharge Condition No 88 – Revised Hydrogeological Risk Assessment

NYMNPA Description	Compliance with Condition NYMNPA 88
Prior to Commencement of Development for the MTS at Lady Cross Plantation and informed by the most up-to-date monitoring, a Revised Hydro-geological Risk Assessment shall be submitted to and approved in writing by the MPA in consultation with the Environment Agency.	Whole text.
Following approval of the Revised Hydro-geological Risk Assessment, but prior to the Commencement of Development, a Construction and Operation Phase Ground and Surface Water Monitoring Scheme shall be submitted to and approved in writing by the MPA. The scheme shall include: • Groundwater quality and level triggers • Surface water quality triggers, including those necessary to protect the health of the River Esk Pearl Mussel beds • Details of the number, type and location of monitoring points • A protocol for the removal and replacement of any existing monitoring points • Details of the frequency with which monitoring points will be monitored during construction and operation • A list of the ground and surface water determinants to be tested for	**Section 7 & 8** **Phase 8 Construction and Operation Ground & Surface Water Monitoring Scheme**

NYMNPA Description	Compliance with Condition NYMNPA 88
• Monitoring of groundwater levels and spring flows • Monitoring of groundwater quality against ground water triggers • A scheme of periodic review and refinement of the monitoring regime to take account of any approved changes to site layout/design, construction methods and monitoring data • A protocol for notifying the MPA of any breach of the trigger levels, including the timing of any such notification • Details of the method and frequency with which monitoring results will be shared with the MPA and the Environment Agency The approved scheme shall thereafter be implemented in full, with monitoring continuing in accordance with the approved scheme until such time that it is agreed in writing with the MPA that monitoring may cease.	

Table 1-2 NYNMPA Discharge Condition No 89 –Remedial Action Plan

NYMNPA Description	Compliance with Condition NYMNPA 89
Prior to the commencement of development at Ladycross Plantation, a Remedial Action Plan, setting out the remedial actions to be taken in the event that any monitoring triggers of the approved Construction and Operation Phase Ground and Surface Water Monitoring Schemes are exceeded, shall be submitted to and approved in writing by the MPA in consultation with the Environment Agency. Should any monitoring result exceed those triggers set out in the approved Construction and Operation Phase Ground and Surface Water Monitoring Scheme, the MPA, the Environment Agency and Natural England shall be informed as soon as practicable, and the approved Remedial Action Plan shall	**Section 7 & 8** **Phase 4 Remedial Action Plan**

thereafter be implemented as soon as practicable. Following remedial action, monitoring in accordance with the Construction and Operation Phase Ground and Surface Water Monitoring Scheme will be undertaken in accordance with a timescale to be submitted to and approved by the MPA in consultation with the Environment Agency, the results of which shall be reported to the MPA within four weeks of the monitoring date.	

Table 1-2 NYNMPA Discharge Condition No 90 – Groundwater Management Scheme

NYMNPA Description	Compliance with Condition NYMNPA 90
Following the approval of the Revised Hydro-Geological Risk Assessment for the MTS, but prior to the Commencement of the Development of the MTS at Lady Cross Plantation, a Groundwater Management Scheme (covering construction, operation, and post-operation phases), shall be submitted to and approved in writing by the MPA. The Scheme shall include technical drawings detailing the conceptualised hydrogeology with the final detail designs of the proposed mitigation measures outlined in the York Potash Environmental Statement (September 2014 as updated by the Supplementary Environmental Statement dated February 2015). Development shall thereafter proceed only in strict accordance with the approved Scheme and a timetable to be included within it.	**Section 7 & 8**

2. GEOLOGY

2.1. REGIONAL GEOLOGY

A geological section of the shaft at Ladycross Plantation site is shown in **Attachment B**.

2.2. LOCAL GEOLOGY

The local geological model is reproduced from the Hydrogeological Baseline Report, FWS, Sept 2014 (ref 1433AmtsOR27Rev2),

2.2.1. GEOLOGICAL SEQUENCE

A detailed geological sequence established from on-site and near site boreholes is presented in **Table 2-1**, below. Locally, the strata dip gently (~2°) to the southwest.

Table 2-1 – Ladycross Plantation geological sequence

Formation Name		Approximate thickness (m)	Geological description
Topsoil		-	Now removed over large parts of the site and stockpiled for reinstatement.
Superficial deposits		2.4 to 4	Glacial till to depths of 2.9 m in the northern part of the site. Fluvioglacial interbedded sands, gravels, and clays to depths of 2.4 m to > 4 m in the southern part.
Scalby Formation (Long Nab Member and Moor Grit Member)	**Ravenscar Group**	9 to 15	Comprises two members: The upper Long Nab Member with yellow-grey sandstones and grey mudstones, siltstones with some heavily fractured zones. Up to ~12 m thick with up to 3 m of the upper surface weathered in places. The Long Nab Member is absent in the south-eastern half of the site. The lower Moor Grit Member which is mainly grey fine-grained sandstones, in places interbedded with siltstones and mudstones. Between ~5 m and ~ 7 m thick.
Scarborough Formation		12 to 16	Sandstone with thin beds of mudstones and siltstones that are often interlaminated and interbedded.
Cloughton Formation		38	Strong thinly laminated to medium bedded light to dark grey fine to medium sandstone with occasional interlaminations of mudstone, siltstones and thin coal laminae.

Formation Name	Approximate thickness (m)	Geological description
Saltwick Formation	51	The upper sandstone unit is a thinly bedded orange brown and medium grained with rare to occasional siltstone and coal/micaceous laminae and discontinuous coals. This is underlain by a sandy siltstone and a thickly bedded orange-brown sandstone basal unit with siltstone and carbonaceous mudstone laminae.
Dogger Formation	3	Thinly to thickly laminated grey to brownish grey argillaceous sandstone with laminae of mudstone and mica.
Whitby Mudstone Formation	60	Strong thinly interlaminated to thinly interbedded dark grey mudstone with pyritic inclusions and highly calcareous fossiliferous material.
Cleveland Ironstone Formation	27	A succession of grey mudstones, siltstones and sandstones with rare to occasional ironstone nodules and thin beds of ironstone. The upper sequence is calcareous with occasional fossils.
Staithes Sandstone Formation	28	Thinly to thickly laminated light to dark grey argillaceous silty fine sandstone. It contains occasional thin beds of shell fossils, ironstone nodules and green pyritic inclusions.
Redcar Mudstone Formation	Full depth not proven on site but expected to be > 190	The Redcar Mudstone Formation comprises grey silty mudstones and clayey siltstones with subordinate thin beds of limestone and sandstone. Bands of ironstone nodules and fossil shells as well as pyrite are present in places. The formation is divided into four main members, from youngest to oldest: • Ironstone Shale Member. Can be further subdivided into an upper ironstone shale and lower banded ironstone shale. Grey silty mudstone or clayey siltstone with occasional sandstone and siltstone laminations or beds and numerous ironstone bands and nodular horizons, as well as fossil shell (bivalve and belemnite) beds and occasional pyrite nodules. • Pyritious Shale Member. Similar to the ironstone shales above and also contains some ironstone

Formation Name	Approximate thickness (m)	Geological description
		bands / nodular horizons, but with a higher pyrite content. • Siliceous Shale Member. Grey silty mudstones and clayey siltstones with interbeds and laminations of calcareous or sandy siltstone and fine-grained sandstone. With rare pyrite and fossil shells. • Calcareous Shale Member. Grey silty mudstones and clayey siltstones with thin beds of shelly clayey limestone. Becoming sandy in places. This is unlikely to be encountered in the shaft.

2.2.2. STRUCTURAL GEOLOGY

No faults are recorded in site investigation boreholes, and seismic reflection or reported by the BGS within 800 m of the site. However, ground investigation at the site has identified a high permeability zone at approximately 113mbgl beneath the site. This feature may be partly related to a previously undefined fault zone extending beneath the intermediate shaft site.

Faults are recorded in the direction of drilling towards Woodsmith Mine and across the Esk Anticline, the HDD works are to assess these structures prior to tunnel boring activities. Although the geology is well-defined, ground conditions are relatively unknown within the section of tunnel alignment. Available evidence indicates that there is low potential for gas accumulations to be encountered around fault zones.

3. HYDROLOGY

The Ladycross Plantation site is situated at an average elevation of approximately 200mAOD close to an east-west trending surface water drainage divide. Land to the south of the divide, including the Ladycross Plantation site, is located within the River Esk catchment, with surface water runoff from the area draining to the river via multiple ordinary watercourses that flow in a south to south-easterly direction. Land to the north of the divide is located within the East Row Beck catchment with surface water draining in a northerly direction via several ordinary watercourses. The HDD route is located entirely within the River Esk catchment. The location of the Ladycross Plantation site and the HDD route in relation to local hydrology is shown in **Attachment C**.

At Newbiggin Hall Farm, which is located downstream of tributaries draining land in the vicinity of Ladycross Plantation, the River Esk catchment extends to approximately 290km^2 with a catchment standard annual average rainfall of 886mm.

The catchment area consists predominantly of upland moorland with several dispersed towns and villages. As bedrock geology and topographic variation is reasonably consistent across the area, catchment-wide hydrological characteristics can be considered representative of hydrological characteristics in the area around Ladycross. The catchment has a standard percentage runoff (SPRhost) of 49.15 and a baseflow index (BFihost19) of 0.321. The relatively high SPR and low BFi value indicate that a high proportion of incident rainfall contributes to surface runoff to rivers with lower contribution from groundwater baseflow. A baseflow index of around 0.3 is typical of catchments with steeper topography and low permeability bedrock.

Long term hydrometric monitoring of the River Esk at Sleights (Station 25050) demonstrates average annual runoff equivalent to 487mm rainfall which is approximately 57% of incident rainfall. Applying long term average data, and hence neglecting changes in soil or groundwater storage, an indication of annual average catchment recharge can be derived as the baseflow component of average flow in the River Esk. On this basis, annual average recharge is estimated to be approximately 150mm/yr which is approximately 18% of incident rainfall. It is noted that this estimate infers an annual average evapotranspirative loss of only 210mm which is lower than expected for an upland catchment but may reflect the impact of steep topography and high percentage runoff.

3.1. SURFACE WATERCOURSES

The location of the Ladycross Plantation site and the HDD route in relation to local hydrology is shown in **Attachment C**. The HDD route will pass beneath the River Esk in the vicinity of Low Newbiggin South. At this location the River Esk flows south west to north east across superficial alluvial deposits consisting of clay, silt and sand, underlain by low permeability Redcar Mudstone Formation.

Several ordinary watercourses, that form tributaries of the River Esk, drain steeply sloping land to the west, south and south east of the Ladycross Plantation site. Watercourses with a catchment area of greater than 0.5km^2 are listed in Table 2-1.

Watercourse Name	Catchment Area (km^2)	Relationship to Ladycross Plantation
Cold Keld Beck	4.23	West of the site
Starfoot Woods Stream	0.56	South west of the site
Cat Scar Beck	1.78	Includes the site and land to the south
Murk Beck	1.83	South east of the site
Dorsley Bank Woods Stream	0.94	South east of the site

Table 2-1: Local surface watercourses

A brief description of each tributary sub-catchment is provided below.

Cold Keld Beck: A small pond is located 500 m north of the site. The pond drains to an open field drainage channel that flows to the south around 500 m west of the site before combining with other local field drains to become Cold Keld Beck which flows away from the site in a south westerly direction to join the River Esk approximately 4km to the west. The headwaters of the beck also receive inflow from springs north of Egton Flats. The sub-catchment is almost entirely rural with increasing topographic gradient to the west.

Starfoot Woods Stream: Two ordinary watercourses drain from the Starfoot Woods area, west of Egton Bridge, with direct discharge to the River Esk. The sub-catchment consists of steeply sloping agricultural land and woodland.

Cat Scar Beck: The beck forms from the confluence of multiple headwaters. A stream exits from the Lady Cross Caravan Park, via a culvert then flows through the wooded area along the southern site boundary. This is joined by field drainage from the site as it flowed through the wooded area towards a culvert under Egton Road. On the southern side of Egton Road, the culvert discharges to an ordinary watercourse that flows southeast through Newstead Farm and combines with watercourses originating east of Egton to form Cat Scar Beck. The sub-catchment is predominantly rural, becoming increasingly steep and wooded downstream.

Murk Beck: A wet shallow valley with abundant aquatic vegetation is located 450 m northeast of the site. This is in the lowest area of Egton Low Moor and collects surface water draining from the moorland. The water collects and drains south in an ordinary watercourse that flows via Murk Beck Slack towards Grosmont Farm and the River Esk approximately 2km downstream. The sub-catchment is relatively steeply sloping and increasing wooded downstream.

Dursley Bank Wood Stream: An area of wet/saturated ground is located 400 m to the northeast. Water from this area feeds an ordinary watercourse that drains south, 200 m east of the site, which collects in a pond/boggy area, by the entrance track to Coopers Farm, before entering a culvert that discharges to an open watercourse east of Watergate Farm. Water collects in an ordinary watercourse approximately 800 m east of the works area by Coopers Farm North that flows south in an open channel to join the River Esk at Dorsley Bank Wood approximately 1.5km downstream.

Several surface watercourses originate from or incorporate flow from springs on the north bank of the Esk Valley. The location of springs identified in previous hydrogeological studies of the area are shown on **Attachment D**.

3.1.1. OTHER SURFACE WATER FEATURES

The only other mapped surface water features in the vicinity of Ladycross Plantation are a number of small ponds, likely to be associated with historic extraction of sand & gravel deposits or the development of small surface water ponds for agricultural supply. As shown on **Attachment C**, these features are located to the west of the site within the Cold Keld Beck sub-catchment and at East End Farm within the Cat Scar Beck sub-catchment.

3.2. SURFACE WATER DRAINAGE AT LADYCROSS PLANTATION SITE

Surface water runoff from the Ladycross Plantation site is managed by drainage to a site-wide surface water drainage system with final off-site discharge to the upstream end of Cat Scar Beck. During Phase 1 and 2 of the site development, surface water drainage works were undertaken at the site as follows:

- A swale was installed alongside the site road. It discharges to the culvert beneath Egton Road, and into the southerly flowing ordinary watercourse. The drainage from the road junction built in Phase 1, including drainage from a significant length of Egton Road, also enters this watercourse;
- Site perimeter drainage ditches have been installed around the entire perimeter of the site to intercept notionally clean surface water runoff from surrounding land and shallow field drainage. The interceptor drainage system is intended to minimise overland flow across the site and hence minimise risk of silt entrainment in surface water runoff. The site interceptor drainage system discharges to the existing culvert beneath Egton Road;
- Field drainage pipes that previously entered the site from higher ground to the north east and north west have been intercepted by the peripheral site drainage system to reduce shallow soil water flow onto the site with associated reduction in risk of site waterlogging;
- The pipe which collected field drains before discharging into the stream in the wooded area to the south of the site has been isolated in order to prevent silt laden runoff from discharging directly into the stream; and

- A temporary site surface water drainage system has been installed within the works area to control surface water falling directly onto the area and any groundwater arising during the preparatory soil stripping activities. A temporary attenuation pond was constructed to provide additional storage of site surface water. The system comprises a network of temporary ditches and sumps that drain to the temporary attenuation pond. Accumulated site surface water is passed through a silt removal system prior to off-site discharge of clean water via a shallow swale with outfall to the culvert beneath Egton Road.

During Phase 3 the provisional surface water drainage works installed during Phases 1 and 2 were expanded and upgraded in accordance with the Phase 3 Surface Water Management Plan (40-STS-LC-2100-PA-PL-20102). The Phase 3 surface water drainage scheme is designed to manage surface water from all areas of the site including areas of hardstanding within the site, the internal site access road and temporary earthworks storage bunds.

The site drainage system has two functions as follows:

- To provide stormwater attenuation capacity to restrict off-site discharge to the pre-development QBar greenfield rate; and

- To manage surface water quality within the site to mitigate risk to the receiving watercourse and downstream sections of Cat Scar Beck.

As detailed in the Phase 3 Surface Water Management Plan, stormwater attenuation capacity is provided through installation of an attenuation lagoon, swale systems and flow control structures in the peripheral interceptor drains. On-site silt management systems, including swales, filter drains, silt fences and a surface water treatment facility are designed to prevent off-site discharge of silt to the receiving watercourse. An oil separator will be installed at the downstream end of drainage components serving operational areas of the site.

4. HYDROGEOLOGY

4.1. REGIONAL HYDROGEOLOGY

Regionally, the formations of the Ravenscar Group have potential as aquifers although flow is restricted by numerous interbedded, thin mudstone aquitards (BGS, 2000). Of particular note, the thick sequence of the Whitby Mudstone Formation is a regionally significant aquiclude. Beneath the Whitby Mudstone Formation, the Staithes Sandstone Formation and Cleveland Ironstone Formation are generally found to be in close hydraulic continuity, although hydraulic conductivity is expected to be low. Whilst where the Redcar Mudstone Formation subcrops at the MTS portal site in Wilton, flow is dominated by bedding parallel fractures, it is anticipated that at the proposed tunnel depths at Ladycross Plantation, any bedding parallel fractures will be geomechanically tight and the conductivity will be low.

In some locations close to the MTS route, abandoned ironstone mine workings in the Cleveland Ironstone Formation have a significant influence on the groundwater regime in the hydraulically connected Cleveland Ironstone Formation and Staithes Sandstone Formation. Flooded mine workings that overflow to the surface water system via former water levels, drifts or natural outlets tend to regulate water levels within the workings. With high storage capacity within the workings, mine water levels tend to exhibit low variation.

The presence of thick mudstone formations above and below the Cleveland Ironstone and Staithes Sandstone Formations tends to isolate the overlying Ravenscar Group Formation and underlying Redcar Mudstone Formation from the effects of mine drainage.

4.1.1. HYDROLOGICAL INFLUENCES

Hydrological review included at Section 3 of this document has indicated a potential catchment-wide recharge rate of approximately 18% of incident rainfall. As aquifer hydraulic conductivity is generally expected to reduce with increasing depth, particularly where dominated by fracture flow, groundwater present within the Ravenscar Group Formation aquifers tends to drain laterally with final discharge to the surface water system. The deeply incised River Esk valley, which extends throughout the study area, creates multiple open faces in the Ravenscar Group Formation with potential for emergence of groundwater at multiple horizons. Groundwater baseflow to tributary watercourses, therefore, has a dominant influence on local groundwater flow directions and rates particularly, in shallower aquifers.

The Esk Valley sides are characterised by the presence of multiple springs emerging at the base of more permeable sandstone units or at discrete fracture outlets from Ravenscar Group aquifers. Spring discharges that form the headwaters of multiple tributary watercourses establish hydraulic connectivity between the groundwater system and the River Esk.

4.1.2. STRUCTURAL AND STRATIGRAPHIC INFLUENCES

Bedrock strata in the vicinity of the Ladycross Plantation site and surrounding area exhibit shallow stratigraphic dip of approximately 2° to the south. Deeper formations are gently folded and the area is locally faulted. Sandstone, siltstone and mudstone units tend to have a well-developed fracture based secondary porosity that influences the potential for storage and transmission of groundwater. The presence of multiple low permeability mudstones within the sequence restricts the potential for vertical hydraulic continuity and promotes lateral drainage of groundwater within hydraulically connected formations.

The hydrogeological significance of faulting in the area is likely to be variable with some fault zones resulting in local increase in vertical and lateral hydraulic conductivity, and others acting to reduce the potential for lateral groundwater flow due to cross-fault stratigraphic variation or fault disturbance/infill features. There is considered to be low potential for gas accumulations to be encountered around fault structures across the Esk Anticline. HDD activities and subsequent analysis are to be used to further assess ground conditions and geological structure between Ladycross and Woodsmith.

At a regional scale, stratigraphic displacement due to faulting and the presence of multiple lower permeability mudstone horizons are likely to impart greatest physical influence on the groundwater regime. Enhanced hydraulic conductivity zones at specific horizons may have more local significance where linked to groundwater discharges locations but, due to poor vertical hydraulic connectivity, are unlikely to influence regional groundwater flow patterns.

4.2. LOCAL HYDROGEOLOGY

Characterisation of the local hydrogeological flow regime at the Ladycross Plantation site and the HDD route has been undertaken on the basis of site-specific investigation, testing and monitoring information derived from existing monitoring boreholes and the on-going ground investigation programme. The investigation programme has provided information to define local geological conditions, site-specific groundwater levels, aquifer hydraulic properties and provisional evaluation of local groundwater - surface water linkages.

4.2.1. WATER BEARING STRATA

The geological formations at Ladycross Plantation constitute a series of water bearing aquifer units separated by lower permeability mudstone formations. For the purpose of this assessment, aquifers and aquicludes are defined as indicated in **Table 4-1**.

Formation Name	Description	Thickness (m)	Basal Depth (mAOD)
Superficial deposits	Aquifer	2 – 4	199
Scalby Formation	Aquifer	9 – 15	187
Scarborough Formation	Aquifer	12 – 16	172
Cloughton Formation	Aquifer	54	134
Saltwick Formation	Aquifer	32	102
Dogger Formation	Aquifer	3	99
Whitby Mudstone	Aquiclude	60	21
Cleveland Ironstone Formation	Aquifer	27	-6
Staithes Sandstone Formation	Aquifer	28	-39
Redcar Mudstone Formation	Aquiclude	>190	<-154

Table 4-1 Aquifers and aquicludes

The Whitby Mudstone Formation, with an average thickness of approximately 60m, acts to isolate groundwater systems in overlying formations from the underlying Cleveland Ironstone and Staithes Sandstone Formations. In general, the presence of multiple thin mudstone horizons within sandstone and siltstone units in formations above the Whitby Mudstone Formation results in low vertical hydraulic continuity between these formations and promote the development of high lateral continuity within individual formations. However, groundwater monitoring data for the Site indicates that some formations in the upper 100m retain high enough vertical hydraulic conductivity to produce comparable groundwater heads at various depth.

As the HDD route extends in a south easterly direction from the Ladycross Plantation site, water bearing strata above the Whitby Mudstone Formation outcrop on the northern side of the Esk Valley and do not extend beneath the River Esk. As the HDD route extends through the shallow Esk Anticline, beneath the Esk Valley, overlying geological formations above the Redcar Mudstone Formation would consist of the Whitby Mudstone Formation and the underlying Cleveland Ironstone Formation and Staithes Sandstone Formation.

4.2.2. GROUNDWATER LEVELS AND AQUIFER CONNECTIVITY

Groundwater levels in the superficial deposits and the Ravenscar Group Formation at Ladycross Plantation are monitored at 31 monitoring boreholes within the site boundary. The monitoring installations were designed to monitor groundwater conditions in hydraulically connected strata as

indicated in **Table 4-2**. Boreholes BH409, BH410 and BH411 form part of the site-wide groundwater monitoring network but are not included in the groundwater compliance monitoring programme. The borehole BH413 series was operational until April 2022 but then decommissioned to facilitate construction of the working platform and replaced within the compliance monitoring programme with more recently constructed boreholes as listed in **Table 4-3**.

Superficial Deposits	Scalby Formation	Scarborough Formation	Cloughton/Saltwick Formations
	BH401A	BH401B	BH401C
BH402	BH402A	BH402B	BH402C
BH403			
BH404	BH404A	BH404B	BH404C
BH405	BH405A		
BH406	BH406A		
BH407	BH407A		
BH408	BH408A		
BH409	BH409A		
BH410	BH10A		
BH411	BH411A		
BH413	BH413A	BH413B	BH413C

Table 4-2 Groundwater Monitoring Installations

Observed groundwater levels for the period November 2021 to August 2023 are presented graphically in **Figure 4-1**. In general, monitoring results demonstrate lower groundwater elevations with increasing depth. Although such conditions may reflect a vertical hydraulic gradient and the potential for vertical drainage, it is considered more likely that, due to highly anisotropic hydraulic conductivity and the presence of multiple perching horizons, that groundwater level variation in successive formations is outfall controlled with deeper formations draining to lower level discharge points.

As indicated on **Figure 4-1**, Observed groundwater levels in the Scarborough Formation are generally consistent with groundwater levels in the underlying Cloughton Formation suggesting a degree of hydraulic continuity between these units. Groundwater levels in the underlying Saltwick Formation are significantly lower, indicating hydraulic separation from overlying aquifers.

Groundwater levels in the overlying Scalby Formation, consisting of the Long Nab Member and Moor Grit Member, are approximately 10m higher than groundwater levels in the Scarborough Formation, indicating a degree of hydraulic separation with perching at the base of the Scalby

Formation. Reference to detailed geological logs for the area does not indicate the presence of a persistent perching horizon, although the top of the Scarborough Formation is marked by a weathered mudstone in some locations.

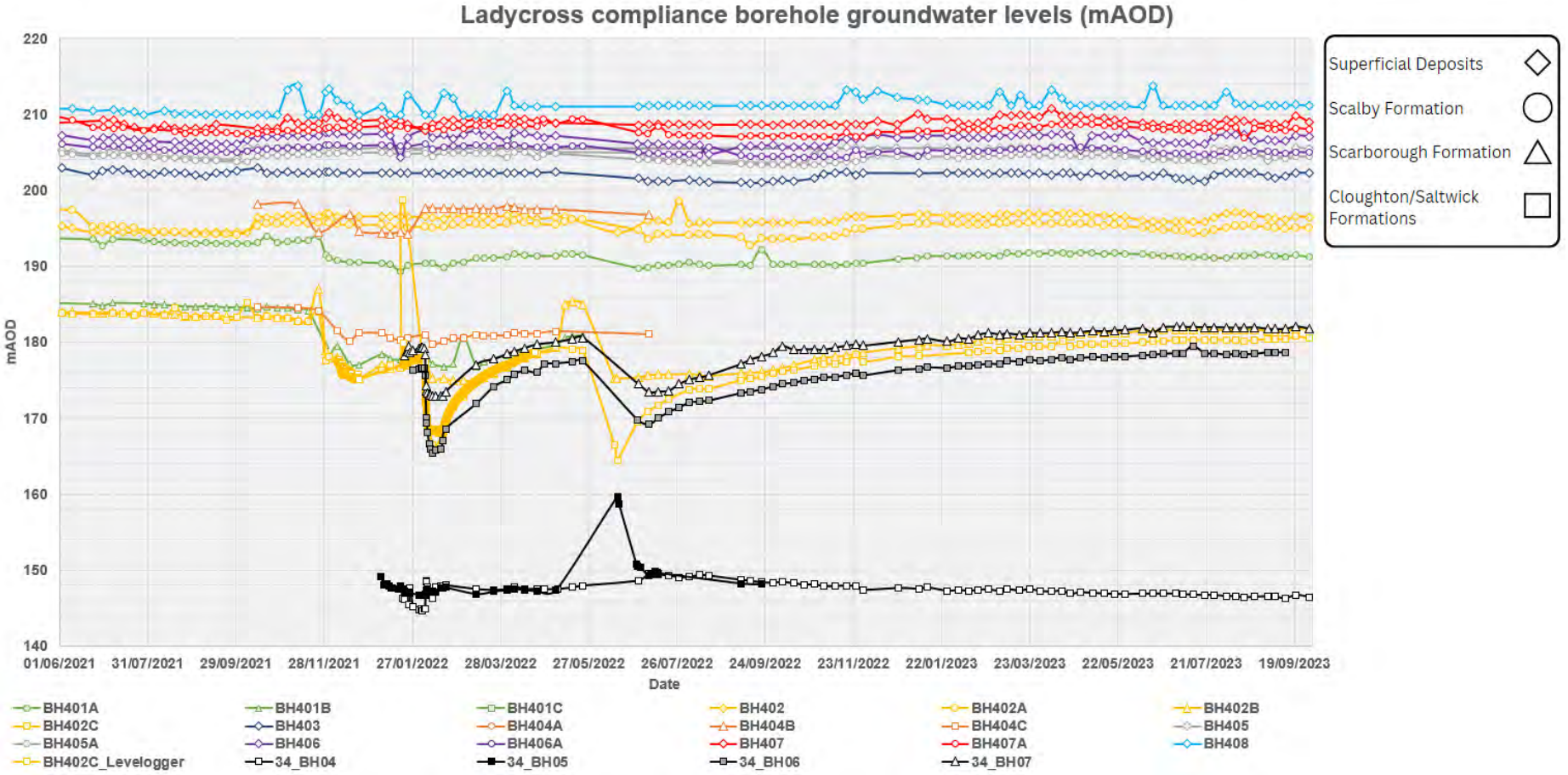
Scalby Formation groundwater levels are typically approximately 10m below groundwater levels observed in the superficial deposits suggesting a perched groundwater system in the superficial deposits.

In addition to the 2014 monitoring installations listed in **Table 4-2**, more recent ground investigation works have included the installation of an additional 6 new investigation boreholes that have provided an opportunity for additional monitoring of groundwater levels at the Site. The 6 new boreholes have been drilled within the site boundary to depths of between 36.40mbgl to 396.40mbgl, extending into geological strata of the Ravenscar Group Formations, Whitby Mudstone Formation and underlying formations. Boreholes 34_BH03 and BH06 are to be decommissioned as part of Phase 7 works. One borehole (Borehole 34_BH01) has been equipped with multiple level VWP's to monitoring groundwater heads at multiple elevations within the borehole. Borehole response zones for these boreholes are detailed in **Table 4-3**.

Borehole	Basal Depth (mbgl)	Response Zone (mbgl)	Contributing Formations
34_BH01	396.40	See Table 4.4	See Table 4.4
34_BH04	71.30	54.0 – 68.0	Cloughton Formation Saltwick Formation
34_BH05	100.00	70.0 – 80.0	Saltwick Formation
34_BH07	36.40	17.5 – 30.5	Cloughton Formation

Table 4-3 Borehole response zones

Figure 4-1 Observed Groundwater Levels (mAOD)



Six Vibrating Wire Piezometers (VWP's) have been installed in Borehole 34_BH01 which was constructed to a depth of 396.40mbgl and located in close proximity to the shaft centre. VWP depths and target formation are summarised in **Table 4-4**.

VWP ID	Depth of install (mbgl)	Geology
34_BH01_1	12	Scalby Formation
34_BH01_2	37	Cloughton Formation
34_BH01_3	53	Cloughton Formation
34_BH01_4	76	Saltwick Formation
34_BH01_5	111.5	Saltwick Formation
34_BH01_6	118.5	Saltwick Formation

Table 4-4 VWP installations in 34_BH01

Groundwater level data for borehole 34_BH01 for the period February 2022 to August 2023 (where data was available) are presented as **Figure 4-2**.

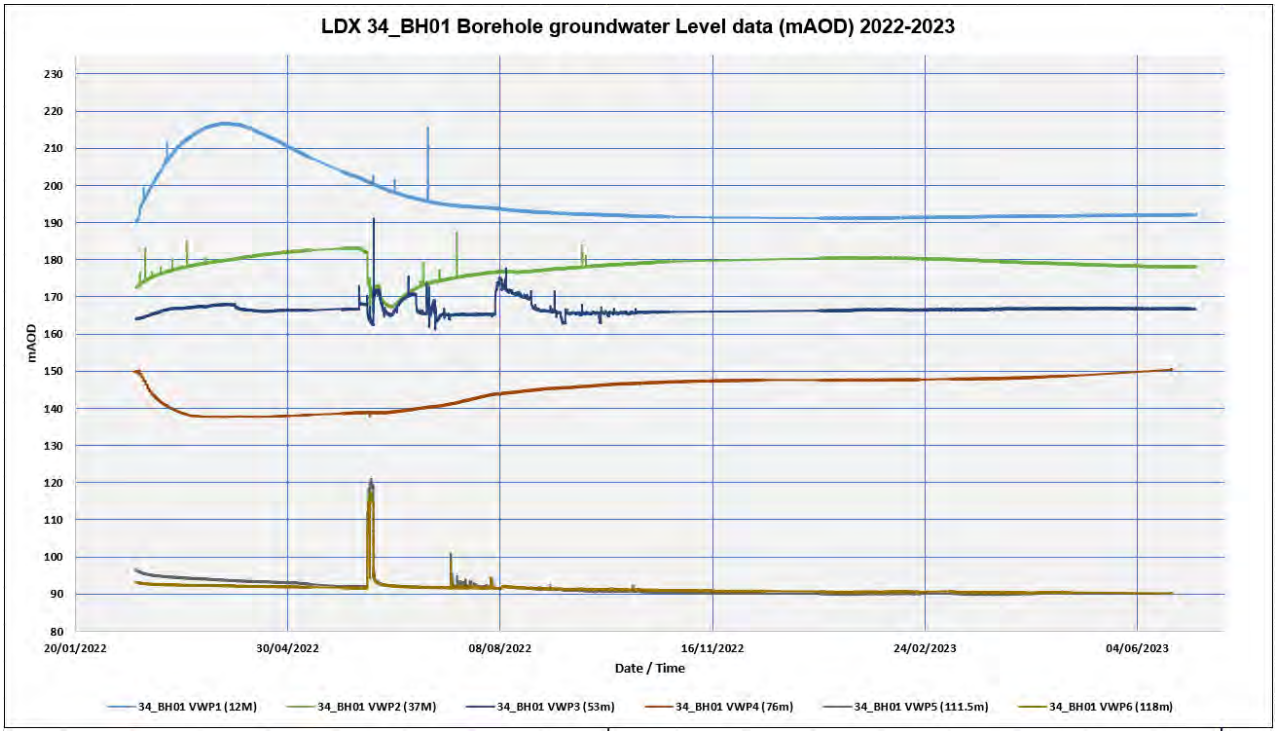


Figure 4-2 Fugro Borehole 34_BH01 Groundwater Levels

During the drilling of borehole 34_BH01 and 34_BH03, a high hydraulic conductivity zone was encountered at a depth of approximately 117mbgl which corresponds to the lower section of the Saltwick Formation. Observed groundwater level at borehole 34_BH03, as shown in **Figure 4-2**, is approximately 91mAOD within the lower Saltwick Formation.

During the monitoring period November 2021 to February 2022 as shown on **Figure 4-1**, groundwater levels in the superficial deposits have varied within a range of approximately 2m with a hydraulic gradient to the south, consistent with local topographic variation. Groundwater levels in the underlying Scalby Formation have shown lower variation.

Groundwater levels in the underlying Scarborough and Cloughton Formations in the southern part of the site have averaged 184mAOD during the monitoring period with variation generally within a 5m range. Groundwater levels in the Scarborough and Cloughton Formations indicate a hydraulic gradient to the south and southwest.

On 24th November 2021 during the recent current ground investigation, groundwater levels in some boreholes fell by several metres. On this date, borehole 34_BH01 extended through the high hydraulic conductivity zone at the lower Saltwick Formation resulting in sudden loss of head in the borehole. The response in surrounding monitoring boreholes suggest that loss of head in borehole 34_BH01 resulted in lateral drainage from strata within the Ravenscar Group Formations into borehole 34_BH01 for drainage at depth. It is noted that, following the grouting of borehole 34_BH01 in February 2022, water levels in surrounding boreholes began to recover to previous levels.

As the Whitby Mudstone Formation, with an average thickness of approximately 60m, acts to isolate the Ravenscar Group Formation aquifers from underlying strata, monitoring of groundwater levels in the Cleveland Ironstone Formation, Staithes Sandstone Formation and Redcar Mudstone Formation has been less intensive. Groundwater level data for these formations is available for borehole BH06 which extends to the Redcar Mudstone Formation. Average groundwater elevation in the Cleveland Ironstone Formation and underlying Staithes Sandstone Formation is approximately 50mAOD. Historic mine workings in the Cleveland Ironstone Formation extend from the River Esk valley to within approximately 1km of the Ladycross Plantation site. Groundwater levels in the Cleveland Ironstone Formation in the area are likely to be controlled by mine drainage outfalls to the River Esk at an elevation of 45mAOD – 50mAOD.

The underlying Redcar Mudstone Formation consists primarily of low permeability mudstone units with groundwater storage capacity restricted to fracture systems. Available monitoring data indicates that groundwater head in the Redcar Mudstone Formation is comparable to that in the overlying Cleveland Ironstone/Staithes Sandstone Formations at approximately 45mAOD, reflecting outfall control.

Historic mine records indicate that part of the HDD route would pass through an area of the Redcar Mudstone Formation that extends beneath former mine workings in the Cleveland Ironstone Formation. Although the presence of historic mine workings is known to influence groundwater levels and flow in the Cleveland Ironstone Formation the workings are hydraulically isolated from underlying strata due to the low vertical permeability of the Redcar Mudstone Formation.

4.2.3. GROUNDWATER FLOW

The above analysis provides evidence to demonstrate the presence of three separate active aquifer systems beneath the Ladycross Plantation site, as follows.

Aquifer group 1 – Superficial deposits

Aquifer group 2 – Scalby Formation

Aquifer group 3 – Scarborough/Cloughton Formations

Aquifer group 4 – Saltwick Formation

Although defined as separate aquifer groups, it is apparent from the above analysis that there is a degree of vertical connectivity between some bedrock strata, and with the superficial deposits, where groundwater discharge occurs via the superficial deposits.

The direction and rate of groundwater flow through the site and surrounding area is influenced by topography, geological structure and the location and elevation of groundwater discharge points. In general, groundwater in all formations is expected to flow in a southerly direction towards the River Esk Valley, subject to local variation.

Indicative groundwater contour plans have been prepared for the superficial deposits, Scalby Formation and the Scarborough/Cloughton Formation. There is currently not enough data to define groundwater flow directions in the high permeability zone in the lower Saltwick Formation.

Monitoring data within the Ladycross Plantation site provides a reasonable basis for evaluation of groundwater levels in the superficial deposits beneath the site. Review of local hydrological data indicates that groundwater in the superficial deposits is likely to be the source of spring flows in the vicinity of Bull Rigg to the west of the site and emergence of groundwater to the east of the site. Ground elevation at these locations, plus superficial geological boundaries, have been used to support development of groundwater contours for the superficial deposits in the area.

Superficial deposits groundwater contour mapping indicates groundwater flow to the south at an average hydraulic gradient of approximately 0.030 with potential for baseflow discharge to Cat Scar Beck and Murk Beck in the south plus spring flow contribution to Cold Keld Beck in the west.

Surfaces watercourses in the vicinity of Egton are too high to receive inflow from the superficial deposits beneath the site and surface watercourse east of Murk Beck Slack are underlain by low permeability Till.

Observed groundwater levels in the Scalby Formation within the site are comparable to superficial deposit groundwater levels with groundwater flowing in a southerly direction.

With the exception of potential for direct discharge to the headwaters of Cat Scar Beck, there are no other obvious outlets for groundwater within the Scalby Formation. It is considered likely that groundwater draining from the Scalby Formation discharges at the same locations as identified for superficial deposits groundwater.

With regard to the Scarborough/Cloughton Formation, reference has been made to known groundwater discharges from the system. Groundwater linkage to Cold Keld Beck has been established by tracer testing and hydrogeological analysis indicates that the spring at Newstead Farm may be sourced from this formation. The spring drains to Cat Scar Beck. Groundwater level mapping indicates that the Scarborough/Cloughton Formation flows in a south and south westerly direction with an average hydraulic gradient of approximately 0.042, reflecting a lower bulk hydraulic conductivity than the superficial deposits. With the exception of spring discharge at Newstead Farm, all other outlets from the Scarborough/Cloughton Formation are likely to occur as baseflow to Cat Scar Beck, Murk Beck and Cold Keld Beck. The formation may also discharge to the headwaters of watercourses further east at Haystones Manor but these watercourses are not directly down-gradient of Ladycross Plantation.

Tracer testing has demonstrated direct hydraulic connection between the high permeability zone in the lower Saltwick Formation and surface water at Cold Keld Beck and Murk Beck. Discharge at Cold Keld Beck occurs via the overlying Scarborough/Cloughton/Saltwick Formation whilst discharge to Murk beck could occur directly from the Saltwick Formation.

4.2.4. HYDRAULIC PARAMETERS

An assessment of formation hydraulic conductivities and potential groundwater flow rates is required to support evaluation of potential hydrological and hydrogeological risk associated with Phase 8 HDD activities. Formation hydraulic conductivity values have been derived from the following sources:

- Historic pumping test data
- Literature sources
- Borehole discontinuity logs
- Packer test results
- Tracer test analysis

Packer test results provide the most accurate site-specific hydraulic conductivity data. Groundwater contour mapping and tracer test results provide a basis to estimate groundwater flow rates.

Summary details related to average permeability values and rest water levels have been updated on the basis of data derived from the recent ground investigation.

Permeability values have been established in two of the recent boreholes (BH03 and BH05) by packer testing at defined intervals in each borehole. The results are summarised in **Table 4-5**.

Through a combination of the analysis of borehole core logs and downhole geophysical surveying it has been demonstrated that the majority of competent bedrock formations beneath the site contain multiple discontinuities consisting of bedding planes, faults and fractures. Groundwater storage and transmission is therefore likely to be dominated by flow through discontinuity systems. As indicated in **Table 4-5**, downhole permeability testing in on-site boreholes resulted in hydraulic conductivity values in the range 2.8 x 10^{-5} m/s to 1.4 x 10^{-8} m/s with a tendency to lower hydraulic conductivity with depth, consistent with increasing discontinuity closure with depth. Pumping tests undertaken in the Cloughton Formation at the Doves Nest South Shaft, 8km from the Ladycross site, resulted in the determination of higher hydraulic conductivity values within the range 2 x 10^{-4} m/s to 8 x 10^{-4} m/s.

Stratigraphic Unit		Base level of unit (m AOD)	Inferred groundwater surface (m AOD)	Mean permeability** ($m \cdot s^{-1}$)	Water quality
Scalby Formation	**Long Nab Member**	192.88	195	1.2 x 10^{-5} to 5.6 x 10^{-6} With discreet zones of higher permeability	Good
	Moor Grit Member	185.86			
Scarborough Formation		172.17	174	2.8 x 10^{-5} to 6.8 x 10^{-6}	
Cloughton Formation		134.16	174	6.10 x 10^{-6} to 7.20 x 10^{-8} With discreet zones of higher permeability	
Saltwick Formation		82.86	173	5.21 x 10^{-6} With discreet zones of higher permeability	
Dogger Formation		76.68	146	5.5 x 10^{-8} With discreet zones of higher permeability	
Whitby Mudstone Formation		2.07	88	-	-

Stratigraphic Unit		Base level of unit (m AOD)	Inferred groundwater surface (m AOD)	Mean permeability** ($m \cdot s^{-1}$)	Water quality
Cleveland Ironstone Formation		-26.64	-	1.00×10^{-8}	Probably poor
Staithes Sandstone Formation		-53.91	-	1.00×10^{-7}	Probably poor
Redcar Mudstone Formation	**Banded Ironstone and Pyritious Shale**	-154.87	-	1.43×10^{-8}	If present probably poor
	Siliceous Shale	< -195	165	1.40×10^{-8}	

Table 4-5 Summary of Hydrogeological Conditions

4.3. CONCEPTUAL HYDROGEOLOGICAL MODEL

A Conceptual Hydrogeological Model for the Ladycross Plantation site was presented in the Phase 4 HRA report 40-STS-LC-2100-EN-RA-00002. Detailed review of local hydrogeological linkages supports a review of the pathways and receptor components of the model. Where necessary, the model has been expanded to retain relevance along the entire HDD route.

4.3.1. PATHWAYS AND RECEPTORS

The ground investigation and hydrogeological monitoring programme has demonstrated that groundwater is present in both superficial deposits and bedrock formations beneath the site and that groundwater flow to the south and southwest is likely to be dominated by flow through secondary porosity fracture flow systems. Groundwater in the superficial deposits, and hence the Scalby Formation, is likely to be in hydraulic continuity with the surface water drainage system in the vicinity of the Ladycross Plantation site.

Monitoring evidence indicates that deeper groundwater in the underlying strata may be draining to the surface water system via fracture flow systems in the Cloughton and Saltwick Formations.

Any groundwater present in the Redcar Mudstone Formation is hydraulically isolated from aquifer units above the Whitby Mudstone Formation. Beneath the Esk Valley, the River Esk is the primary discharge point for groundwater draining from the Cleveland Ironstone Formation, Staithes Sandstone Formation or the Redcar Mudstone Formation. Due to inherently low vertical hydraulic conductivity, groundwater flow pathways from the Redcar Mudstone Formation to the Esk Valley could only develop along permeable fault or fracture zones. At the proposed depth of the HDD, discontinuities in the Redcar Mudstone Formation are expected to have low permeability.

Detailed hydrogeological analysis has established potential groundwater flowpaths for four separate aquifer groups. Pathways are summarised **Table 4-6**.

Aquifer Group	Groundwater Receptors	Groundwater Pathways
Aquifer group 1 – Superficial deposits	Cold Keld Beck Cat Scar Beck Murk Beck	Source of spring flow at headwaters of Cold Keld Beck and source of baseflow to Cat Scar Beck and Murk Beck
Aquifer group 2 – Scalby Formation	Cold Keld Beck Cat Scar Beck Murk Beck	Direct drainage to headwaters of Cat Scar Beck. Indirect drainage via superficial deposits to provide baseflow to Cold Keld Beck and Murk Beck
Aquifer group 3 – Scarborough/Cloughton Formations	Cold Keld Beck Cat Scar Beck Murk Beck	Source of spring flow at Newstead Farm and source of baseflow to Cold Keld Beck, Cat Scar Beck and Murk Beck
Aquifer group 4 – Saltwick Formations	Cold Keld Beck Murk Beck	Baseflow to Cold Keld Beck via Cloughton/Saltwick Formation and potential direct discharge to headwaters of Murk Beck

Table 4-6 Groundwater Pathways from Aquifer Groups

The analysis included in this document reconfirms groundwater pathways identified in the Phase 4 HRA and the low potential for additional pathways if permeable discontinuity systems are present in the Recar Mudstone Formation.

In addition to the surface water systems detailed in **Table 4-6**, the Phase 4 HRA identified four groundwater abstractions that take water from springs sourced from the Cloughton or Saltwick Formations and a single borehole that may be abstracting groundwater from the same formations. The following comments are relevant.

Springs at Duns Bog Farm: Aquifer group 3 – Scarborough/Cloughton Formations the most likely source.

Springs at Newbiggen Hall: Aquifer group 3 – Scarborough/Cloughton Formations the most likely source.

Springs at Lamplands Farm: Springs located at boundary of superficial sand & gravel with Till deposits. Source may be superficial deposits.

Springs at Toplands Farm: Aquifer group 3 – Scarborough/Cloughton Formations the most likely source.

Borehole at Ladycross Plantation Caravan Park: Borehole may receive inflow from multiple formations from Scalby to Saltwick Formations.

Groundwater contour mapping for the Scarborough/Cloughton Formations indicates that, of the five identified groundwater abstractions, only the springs at Lamplands Farm are located down-gradient of the Ladycross Plantation site.

The HDD horizontal section through the Redcar Mudstone Formation would not represent a risk to groundwater abstractions or surface springs.

Groundwater quality monitoring in superficial deposits and bedrock formations above the Whitby Mudstone Formation has been undertaken on a monthly basis since January 2021.

In general, the quality of groundwater is relatively good but there is consistent evidence of high background concentrations of iron and manganese together with slightly elevated concentrations of other heavy metals. Groundwater quality is consistent with presence of groundwater flow through iron-rich sedimentary formations which form the bedrock beneath the site.

A conceptual interpretation of local hydrogeological conditions at the site is shown on a drawing prepared by Geo-Design and included for reference at **Attachment F**. The drawing shows probable local groundwater flowpaths and measured groundwater heads in respective aquifer units.

Current understanding of local hydrogeological conditions, based on site-specific investigation, testing and monitoring, provides a robust basis for evaluation of potential hydrological and hydrogeological risk and the development of effective risk management strategies.

5. CONSTRUCTION METHODOLOGY

5.1. HORIZONTAL DIRECTIONAL DRILLING (HDD)

5.2. PHASE 8 SCOPE OF WORKS

The Phase 8 Scope of Works is as follows:

- Drilling of an exploratory Borehole;
- Temporary Installation and use of drilling rig and ancillaries;
- Decommissioning of Borehole.

A detailed Construction Method Statement has been provided to accompany the submissions for the proposed Phase 8 works (40-STS-LC-2100-CN-MS-00009).

A Speedstar 200 truck mounted drilling rig will be established at coordinates x 481626.121, y 507590.267 as indicated in **Image 1** below at an offset of 18.3m from the tunnel annular alignment.

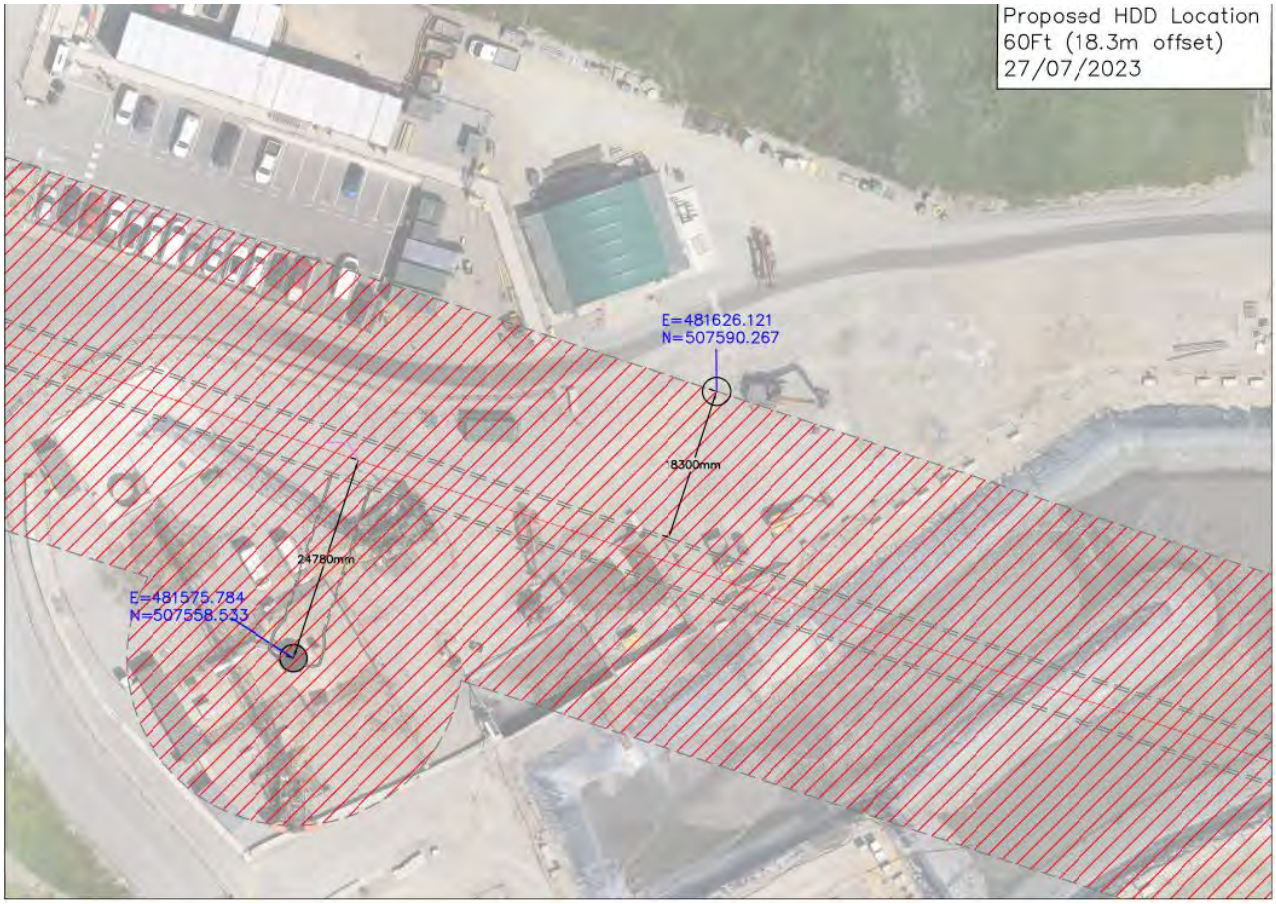


Image 1 - HDD rig location

- **Stage 1** - A primary casing of 500mm in diameter will be installed to ca. 11mbgl prior to main drilling activities. The secondary drilling activities will comprise a 300mm diameter borehole drilled to ca. 145mbgl. A steel casing will be installed from surface into the major aquiclude. Drilling will be undertaken using freshwater muds. The casing will be cemented into place. The casing will provide an effective seal to arrest hydraulic connectivity of the overlying aquifers. The casing will also prevent any interaction between drill cuttings, fluids and groundwater during later stages of hole completion. The casing will isolate the vulnerable aquifers of the Ravenscar Group and the Dogger Formations.
- **Stage 2** - Open hole boring at 175mm diameter will then commence from below the Whitby Formation to terminate within the Redcar Mudstone at the crown level of the tunnel alignment. The boring will continue following the alignment at a minimum standoff distance of circa 18m, horizontally for circa 4km to termination at the invert level of the tunnel alignment. The Borehole will be fitted with a blowout prevention unit, enabling closure and containment of the boring as required. A flare stack will be available for use in emergency.
- **Stage 3** –The drill rig will be demobilised from the borehole position. The borehole will remain open and will be monitored for a period of approximately 12 months, while the Tunnel Boring Machine advances, until it has passed the end position of the borehole. During this period the borehole will be protected from surface ingress via a top hat and gas valve. Once the requirement for the borehole has finished, the borehole will then be sealed and decommissioned using a grouting truck and tremie methodology. The internal annulus of the borehole will be infilled with suitable cement grout from 305mbgl within the Redcar Mudstone to surface. Grouting will continue to 2mbgl, the drill casing will be cut and the site restored to ground level.

The presence of a cemented casing into the primary local aquiclude (Whitby Mudstone Formation) is a significant factor in assessment of hydrogeological risk associated with Phase 8 works.

6. RISK STATEMENT

The consideration of the risks from Phase 8 activities is based on source-pathway-receptor linkages. The following sections describe the sources, pathways and receptors which have been considered here. An assessment of the risks relating to surface works (e.g. civils and infrastructure works) has not been undertaken as the risks from activities of these types have been assessed in submissions supporting previous phases, and appropriate mitigation agreed.

6.1. SOURCES

The sources of potential impact which have been considered are detailed in **Table 6-1**.

Table 6-1 - Sources

Source	Discussion	Potential Magnitude
Physical effects		
Changes to groundwater levels/pore pressure	Increase in superficial groundwater level in response drilling activity and casing emplacement	**Minor**
	Groundwater level reduction/increase due to vertical connection of aquifers during drilling and casing emplacement	**Minor**
	Groundwater level increase due to flow obstruction resulting from casing installation	**Negligible**
	Groundwater level increase due to drilling fluid elevation in HDD activities	**Minor**
Changes to groundwater flow paths	Increased vertical hydraulic connection between successive aquifer formations during drilling and casing emplacement	**Minor**
	Changes to groundwater flowpaths due to obstruction created by installation of casing.	**Negligible**
Gas migration/evolution	Migration of methane via vertical hydraulic connection between successive aquifer formations from HDD activities	**Minor**

Source	Discussion	Potential Magnitude
Quality effects		
Drilling fluid	Drilling fluid will be environmentally friendly. During mud recirculation drilling fluids will also contain cuttings and fines and may contain additional amendments such as bentonite. There is potential for localised migration of drilling fluid into borehole walls via discontinuities through HDD activities.	**Minor**
Grout	Cementitious grout will be used to grout the casing There is potential for localised migration of grout to enter upper formation aquifer groundwater during the grouting process. Grout migration potential is likely to be significantly restricted due to low volumes.	**Minor**
Reactivated sediment	Sediment held within subsurface conduits has the potential to be mobilised due to hydraulic head variation in the borehole.	**Negligible**
Gas migration/evolution	Migration of methane via vertical hydraulic connection from faults and between successive aquifer formations from HDD activities	**Minor**

6.2. RECEPTORS

The receptors which have been considered are detailed in **Table 6-2**. The water quality in the Staithes Sandstone Formation, Cleveland Ironstone Formation and Redcar Mudstone Formation is likely to be poor and of limited resource value. Strata beneath the Whitby Mudstone Formation have not been considered as receptors in this assessment. The location of defined receptors in the vicinity of the Ladycross Plantation site is shown on Drawing 1433AmtsOD27Rev1 which is included at **Attachment D**.

The groundwater within the Ravenscar Group is of generally good quality and has water resource value. Strata within the group are defined as Secondary A aquifers with low-medium groundwater vulnerability at surface.

There are a number of abstractions in the proximity of the site which take water from boreholes in the aquifer units within the Ravenscar Group, or from springs fed from the same aquifers. These are provided in **Table 6-2**.

Table 6-2 Receptors

Receptor	Discussion	Sensitivity
1) Duns Bog Farm	Used for general farming and domestic purposes, from springs issuing from the Cloughton Formation upgradient of the site.	**Moderate**
2) Newbiggin Hall	Used for general farming and domestic purposes, from springs issuing from the Cloughton Formation or Saltwick Formation upgradient of the site.	**Moderate**
3) Lamplands Farm	Used for general farming and domestic purposes, from springs issuing from the superficials downgradient of the site. It is possible that the source is actually the underlying Cloughton Formation.	**Moderate**
4) Topstone Farm	A private water undertaking and general farming and domestic purposes, from springs issuing from the Cloughton Formation upgradient of the site. Source Protection Zone (SPZ) II	**High**
5) Ladycross Plantation Caravan Park	Used for general domestic purposes from a borehole which abstracts from the Cloughton Formation up- or cross-gradient of the site	**Moderate**
6) Church Cliff	Confluence of springs providing base flows to Cat Scar Beck. No known abstractions, medium base flow rates observed from multiple springs.	**Moderate-High**
7) Newstead Farm	Spring head providing base flow to Cat Scar Beck and water for cattle.	**Moderate**
8) Priory Farm	Confluence of springs providing base flows to Cat Scar Beck. Situated close to Haggs Farm mine drift. High base flow rates observed from multiple springs. Close to the Esk and likely influence from ironstone mines.	**Moderate**
9) Egton Bridge	Confluence of springs providing base flows to unnamed tributary of the River Esk. High base flow rates observed from multiple springs. No abstractions and close to the Esk.	**Moderate-High**

Receptor	Discussion	Sensitivity
10) Grosmont Farm	Confluence of springs providing base flows to Murk Beck Slack. High base flow rates observed from multiple springs. No abstractions and close to the Esk.	**Moderate-High**
All watercourses	The River Esk and surface watercourses in the area that can be defined as those that combine to form Cold Keld Beck, Cat Scar Beck and the un-named system that flows through Grosmont Farm. All are tributaries of the River Esk. All watercourses which flow in the proximity of the site have been considered together. They collectively have: 1) high ecological value (the River Esk and its tributaries support populations of salmonids and protected populations of Freshwater Pearl Mussels) 2) value as a water resource, and 3) high visual amenity value due to the location within the North York Moors National Park.	**Moderate-High**

6.3. PATHWAYS/MECHANISMS

The pathways/mechanisms which have been considered are detailed in **Table 6-3**.

Table 6-3 Pathways

Mechanism			
Key	**Source**	**Receptor**	**Pathway**
1	Changes to groundwater levels/pore pressure during HDD activities	Ravenscar Group aquifers	Groundwater in superficial aquifers draining through the borehole
2	Changes to groundwater levels/pore pressure due to aquifer interconnection during borehole construction	Ravenscar Group aquifers	Borehole could act as temporary conduit for connection between discrete aquifers
3	Changes to groundwater levels/pore pressure due to flow obstruction by casing	Ravenscar Group aquifers	Interception and/or obstruction of groundwater flow due to physical presence of casing

Mechanism			
Key	**Source**	**Receptor**	**Pathway**
4	Changes to groundwater levels/pore pressure due to drilling fluid column head during borehole construction	Ravenscar Group aquifers	Local groundwater level change due to hydraulic head within borehole
5	Changes to groundwater levels/pore pressure during borehole construction	Surface watercourses, springs & issues	Hydraulic continuity between groundwater in superficial deposits and surface watercourses
6	Changes to groundwater levels/pore pressure due to aquifer interconnection during borehole construction	Surface watercourses, springs & issues	Hydraulic continuity between groundwater in superficial deposits and surface watercourses
7	Changes to groundwater levels/pore pressure due to flow obstruction by casing	Surface watercourses, springs & issues	Hydraulic continuity between groundwater in superficial deposits and surface watercourses
8	Changes to groundwater levels/pore pressure due to drilling fluid column head during borehole construction	Surface watercourses, springs & issues	Hydraulic continuity between groundwater in superficial deposits and surface watercourses
9	Changes to groundwater flow paths due to aquifer interconnection during borehole construction	Ravenscar Group aquifers	Temporary interconnection of discrete aquifers in the Ravenscar Group during borehole construction resulting in localised alteration of groundwater flow paths in the vicinity of the borehole
10	Changes to groundwater flow paths due to casing obstruction	Ravenscar Group aquifers	Groundwater flowpath obstruction resulting from presence of sealed borehole
11	Changes to groundwater flow paths due to aquifer interconnection during borehole construction	Surface watercourses, springs & issues	Hydraulic continuity between groundwater in superficial deposits and surface watercourses
12	Changes to groundwater flow paths due to casing obstruction	Surface watercourses, springs & issues	Hydraulic continuity between groundwater in superficial deposits and surface watercourses
13	Drilling fluid	Ravenscar Group aquifers	Direct discharge of drilling fluid into the aquifer during borehole construction.
14	Drilling fluid	CIL/SS Aquifers	Direct discharge of drilling fluid into the aquifer during borehole construction.

Mechanism			
Key	**Source**	**Receptor**	**Pathway**
15	Drilling fluid	Surface watercourses	Indirect discharge of drilling fluid into surface watercourses as a consequence of migration through strata of the Ravenscar Group aquifers.
16	Drilling fluid	Surface watercourses	Loss of containment in the drilling mud separation and shaker units leading to overtopping and overland flow into the site interceptor drainage system or the boundary watercourse.
17	Grout	Ravenscar Group aquifers	Migration of grout into Ravenscar Group aquifers via high permeability flow horizons during casing annular grouting works.
18	Grout	Surface watercourses	Indirect discharge of grout into surface watercourses as a consequence of migration through strata of the Ravenscar Group aquifers.
19	Reactivated sediment	Surface watercourses	Changes to groundwater level or pore pressure mobilise sediment in the subsurface leading to discharge of sediment laden groundwater into local watercourses.
20	Gas migration/evolution	Ravenscar Group aquifers	Migration of gas from fault zones located across the Esk Anticline and within the Redcar Mudstone through strata of the Ravenscar Group aquifers
21	Mine water intersection/mobilisation	River Esk	Drilling fluid/mine water migration through the Cleveland Ironstone Formation leading to variation in discharge at the River Esk

6.4 Risk Assessment

Assessment of hydrological and hydrogeological risk has been undertaken by consideration of receptor sensitivity, the potential magnitude of any impacts and the potential significance of any consequent effect. The risk assessment methodology is summarised at **Attachment F**. The conclusion of the risk assessment process is summarised in the Risk Statement which is included as **Table 6-4**.

Table 6-4 Risk Statement

Key	Mechanism	Discussion	Impact Significance
1	Changes to groundwater levels/pore pressure during drilling and casing activities impacting groundwater resources in Ravenscar group aquifers	An upper casing is to be installed to ca 11mbgl prior to main drilling activities. The main internal casing will be installed through the unconsolidated superficial deposits and the Ravenscar group aquifers and into the Whitby Mudstone as part of drilling activities. There is anticipated to be a lowering of the upper aquifers temporarily until the casing is installed. Monitoring of aquifers will be undertaken using monitoring boreholes across site. The relatively high hydraulic conductivity of the superficial deposits will allow continued groundwater flow around the borehole with negligible change in groundwater elevation upstream or downstream of the site.	**Low**
2	Changes to groundwater levels/pore pressure due to aquifer interconnection during borehole construction impacting groundwater resources in Ravenscar group aquifers.	The casing hole will be extended through multiple aquifer units creating hydraulic connection via the borehole. Groundwater level monitoring during ground investigation and grouting programmes has demonstrated that groundwater levels in the upper (Ravenscar Group) aquifers in the near vicinity of the borehole may fall temporarily by a few metres due to drainage into the borehole during drilling, however once the casing is installed this will close the pathway.	**Low**

Key	Mechanism	Discussion	Impact Significance
3	Changes to groundwater levels/pore pressure due to flow obstruction by casing impacting groundwater resources in Ravenscar group aquifers	The radius of the borehole/casing within the upper aquifers is approximately 300mm. Within this area lateral hydraulic conductivity will be only marginally reduced by the borehole/casing installation and development. Groundwater in the Ravenscar Group aquifers flows in a south south-westerly direction. Hydrogeological testing and analysis have demonstrated that lateral hydraulic conductivity is relatively high and aquifers extend over a significant area around the shaft site. Available evidence indicates that groundwater will continue to flow around the borehole/casing with no significant change in upstream or downstream groundwater level.	**Very Low**
4	Changes to groundwater levels/pore pressure due to drilling fluid column head during borehole construction impacting groundwater resources in Ravenscar group aquifers	Maintenance of an excess hydraulic head in the borehole construction could result in loss of drilling fluid to the formation. However, formation hydraulic conductivity around the borehole is expected to be minimal due to size. Groundwater levels outside of the casing are therefore unlikely to be affected by hydraulic pressure associated with drilling fluid.	**Low**
5	Changes to groundwater levels/pore pressure due to aquifer interconnection during borehole construction impacting surface water resources	As temporary inter-aquifer connection would have no significant impact on groundwater levels outside of the casing there would be no significant effect on surface water receptors.	**Very Low**

Key	Mechanism	Discussion	Impact Significance
6	Changes to groundwater levels/pore pressure due to flow obstruction by casing impacting surface water resources	As groundwater would continue to flow without significant variation in level or flow rate around the casing there would be no adverse impact on surface water receptors.	**Very Low**
7	Changes to groundwater levels/pore pressure due to drilling fluid column head during borehole construction impacting surface water resources	As any groundwater level variation would be restricted to the area within the casing there would be no effect on surface water resources.	**Very Low**
8	Changes to groundwater flow paths due to aquifer interconnection during borehole construction impacting groundwater resources in Ravenscar group aquifers	During borehole construction groundwater may temporarily flow from upper aquifers into the borehole. However, any effects would be localised whilst the casing is driven downwards with no adverse impact on external groundwater flow in Ravenscar Group aquifers.	**Low**
9	Changes to groundwater flow paths due to aquifer interconnection during borehole construction impacting groundwater resources in Staithes, Cleveland and Redcar Mudstone aquifers	During borehole construction groundwater may temporarily flow from the Staithes into the Cleveland and Redcar Mudstone aquifers due to open hole boring for a period of around 12 months whilst the TBM passes hole termination. These aquifers will be uncased until decommissioning of the borehole. Once the borehole drilling has completed it will be flushed and filled with fresh water. Aquifers of the Staithes Cleveland and Redcar Mudstone will reach hydraulic equilibrium. Any effects would be minimal, and the linkage is to be sealed on final decommissioning.	**Low**

Key	Mechanism	Discussion	Impact Significance
10	Changes to groundwater flow paths due to aquifer interconnection during borehole construction impacting surface water resources	With no observable impact on the groundwater regime in the Ravenscar Group aquifers there would be no effect on groundwater flow to surface water systems.	**Very Low**
11	Changes to groundwater flow paths due to casing obstruction impacting groundwater resources in Ravenscar group aquifers	As groundwater levels and aquifer hydraulic conductivities outside the casing curtain would be unaffected by development there would be no definable effect on groundwater flow in the Ravenscar Group aquifers.	**Very Low**
12	Changes to groundwater flow paths due to casing obstruction impacting surface water resources	As there would be no effect on groundwater flow there would be no change in flow rates to surface water systems including abstraction points and springs.	**Very Low**
13	Direct discharge of drilling fluid into the aquifer during borehole construction impacting groundwater in Ravenscar group aquifers.	The presence of an elevated hydraulic head in the borehole construction could allow migration of drilling fluid into Ravenscar Group aquifers. However, given casing progresses vertically conductivity is expected to be limited and a low risk to groundwater resources. Additional controls would include the possibility of reversed circulation of air or water and the use of bentonite to mitigate losses to formation.	**Low**

Key	Mechanism	Discussion	Impact Significance
14	Direct discharge of drilling fluid into the aquifer during borehole construction impacting groundwater in CIL/SS aquifers.	The presence of an elevated hydraulic head in the borehole during construction could allow migration of drilling fluid into the CIL/SS aquifers directly or via discontinuities. However, low aquifer hydraulic conductivity and expected low hydraulic conductivity of any discontinuities encountered at HDD depth would limit any losses. Measures to mitigate loss of circulation could be implemented prior to any significant loss to CIL/SS aquifers	**Low**
15	Direct discharge of drilling fluid into the aquifer during borehole construction impacting surface water resources.	As migration of drilling fluid into aquifers would be highly localised there would be low risk of drilling fluid migration to surface water systems.	**Low**
16	Loss of containment in the drilling mud separation and shaker units leading to overtopping and overland flow into the site interceptor drainage system or the boundary watercourse.	Site pollution prevention controls are in place to mitigate against any such flows. All water within the site periphery is fitted with control mechanisms that would, where required allow contaminants to be contained within the site attenuation pond via onsite drainage.	**Very Low**
17	Migration of grout into Ravenscar group aquifers	Following casing the annular space around the borehole would be grouted. Given the low volume of grout the potential for migration of grout outside a localised area is considered to be low.	**Low**
18.	Transport of grout into surface watercourses via migration in groundwater .	As the potential for grout migration in groundwater is considered to be low there is low risk of grout migration to surface water systems.	**Low**

Key	Mechanism	Discussion	Impact Significance
19.	Changes to groundwater level or pore pressure mobilise sediment in the subsurface leading to discharge of sediment laden groundwater into surface watercourses	During borehole construction, it is intended that unconsolidated drift and soils will be cased to maintain borehole stability. The potential for change to groundwater levels or pressures within such superficial deposits would therefore be negligible.	**Very Low**
20	Migration/evolution of gas from borehole to Ravenscar Group aquifers	There is a low potential for gas migration from the borehole. The borehole casing will be grouted into the Whitby Mudstone Formation, the primary low permeability aquiclude. Once the casing has been grouted in place the borehole will be pressure tested to confirm the seal.	**Very low**
21	Drilling fluid migration into flooded historic mine workings, and eventual release to surface water	If mine workings located within the dogger formation are intersected, any lost drilling fluid could discharge to mine water present in the workings. However, the extremely high storage capacity within the workings and the distance of any potential intersection from the River Esk would act to mitigate any risk of contaminant migration to the river.	**Very Low**

7. GROUNDWATER MANAGEMENT SCHEME

To demonstrate the effectiveness of the groundwater management measures adopted during the Phase 8 works, the Phase 8 Groundwater and Surface Water Monitoring Scheme (see Section 8, below) and the Phase 4 Remedial Action Plan (40-STS-LC-2100-EN-PL-00017) will be implemented.

7.1. BOREHOLE DRILLING

7.1.1. BOREHOLE AND CASING

Groundwater inflow into the borehole and around the casing is expected to be low due to the size of the casing, primary 500mm to ca. 11mbgl and 300mm radii to circa 145mbgl, and reduction in hydraulic conductivity due to casing methodology. As rest groundwater levels in all aquifers are expected to be below design borehole drilling fluid elevation there is no expectation that borehole dewatering will be required during the drilling programme.

Drill cuttings from the borehole will be discharged via a circulatory system to skips and tanks located on surface.

It is anticipated that there may be low level groundwater inflow to the borehole during the casing process but no requirement for any additional groundwater control measures.

Once the borehole drilling has completed it will be flushed and filled with fresh water. Aquifers of the Staithes, Cleveland and Redcar Mudstone will then reach hydraulic equilibrium. During decommissioning, the borehole will be sealed using cement grout between a depth of 305mbgl and surface; leaving the horizontal section of the borehole unsealed. This unsealed section of borehole is situated within the Redcar Mudstone Formation with very low permeability of 1.40 x 10-8 ms^{-1} and provides a negligible risk to either the tunnel or any vulnerable aquifer.

Any dewatering as part of borehole construction would be achieved by pumping out accumulated water via the onsite package treatment plant and discharged under the Environmental Permit EPRXB3696EZ.

7.2. WATER DISCHARGE

7.2.1. WATER DISCHARGE

All water discharged from the Ladycross Plantation site will discharge to the existing drainage culvert beneath Egton Road. Surface water discharged from the site will comprise:

- clean surface water and field drainage water collected by the site interceptor drainage system;
- treated site surface water that is subject to primary settlement in the attenuation pond, followed by active silt removal and flow via an oil interceptor; and

- water will be discharged under an Environment Agency Permit EPRXB3696EZ or disposed off site at a suitably licenced facility.

7.3. CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

The Phase 8 works will be operated in accordance with the Ladycross Plantation Phase 8 Construction Environmental Management Plan (CEMP) (40-STS-LC-2100-EN-PL-00036).

8. GROUNDWATER AND SURFACE WATER MONITORING SCHEME

Phase 8 works will be operated in accordance with the Ladycross Plantation Phase 8 Groundwater and Surface Water Monitoring Scheme (40-STS-LC-2100-EN-PL-00037). The scheme comprises the following:

- Details of the monitoring locations
- The frequency of monitoring
- Determinants to be analysed for
- Control and Compliance Trigger Values
- Reporting procedures

Following review of Phase 8 activities in relation to the Phase 4 Remedial Action Plan (RAP) it has been agreed that the Phase 4 RAP will provide effective monitoring of Phase 8 activities and therefore no changes to the schemes are required. Additional monitoring will be conducted for gas migration on the borehole until decommissioning. Details are contained within Ladycross Plantation Phase 8 Groundwater and Surface Water Monitoring Scheme (40-STS-LC-2100-EN-PL-00037).

9. RELATED DOCUMENTS AND REFERENCES

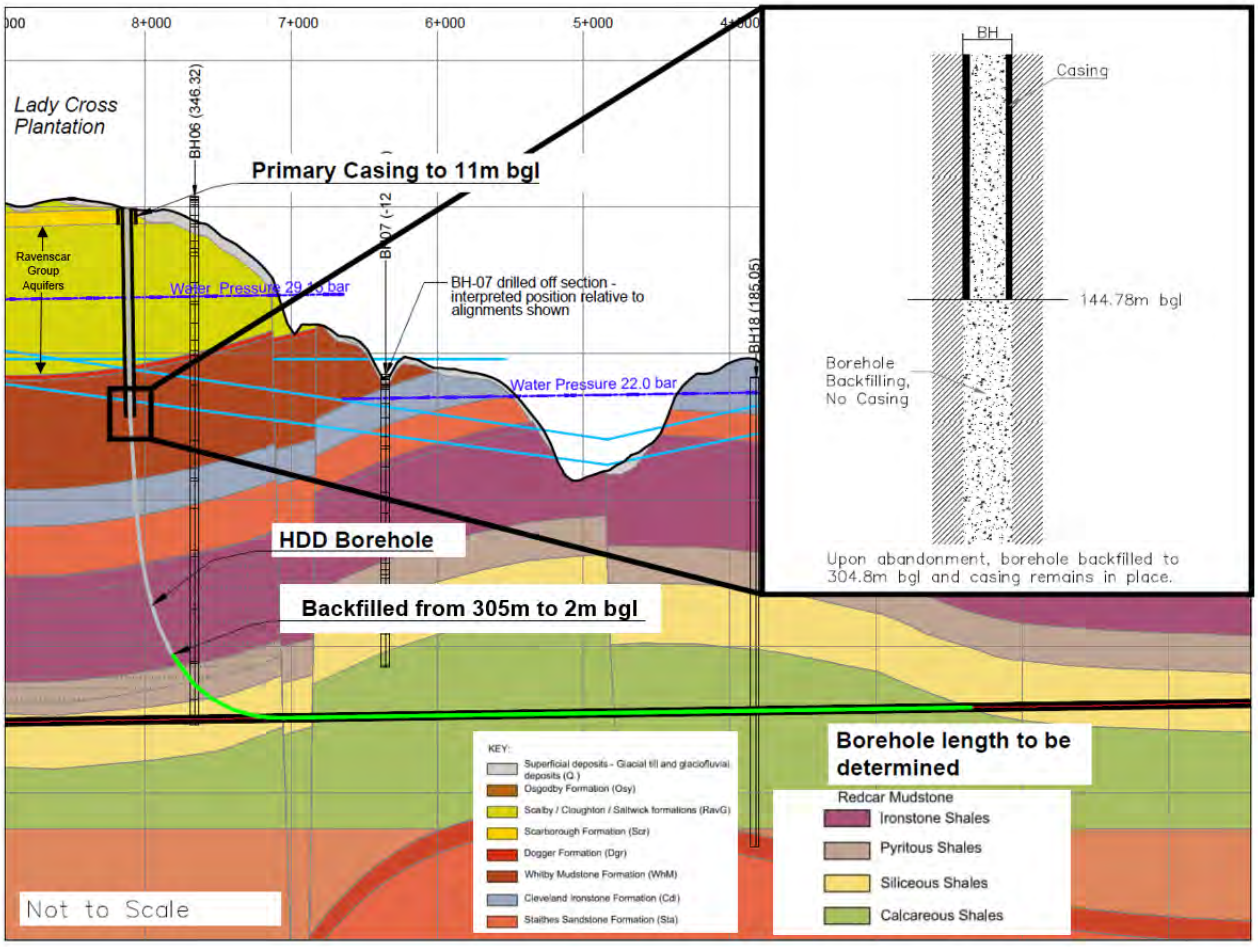
BGS, 2000	Jones, H K, Morris, B L, Cheney, C S, Brewerton, L J, Merrin, P D, Lewis, M A, MacDonald, A M, Coleby, L M, Talbot, J C, McKenzie, A, Bird, M J, Cunningham, J, and Robinson, V K. 2000. The physical properties of minor aquifers in England and Wales. British Geological Survey Technical Report, WD/00/4. 234pp. Environment Agency R&D Publication 68.
40-STS-LC-2100-CN-MS-00009	CONSTRUCTION METHOD STATEMENT - PHASE 8 -NYMNPA CONDITION 94 - LADYCROSS
40-STS-LC-2100-EN-PL-00036	CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN - PHASE 8 - NYMNPA CONDITION 93 - LADYCROSS
40-STS-LC-2100-EN-PL-00017	REMEDIAL ACTION PLAN - PHASE 4 – NYMNPA CONDITION 89 - LADYCROSS
40-STS-LC-2100-EN-PL-00037	CONSTRUCTION & OPERATION GROUNDWATER & SURFACE WATER MONITORING SCHEME - PHASE 8 - NYMNPA CONDITION 88 - LADYCROSS

10. DEFINITIONS AND ABBREVIATIONS

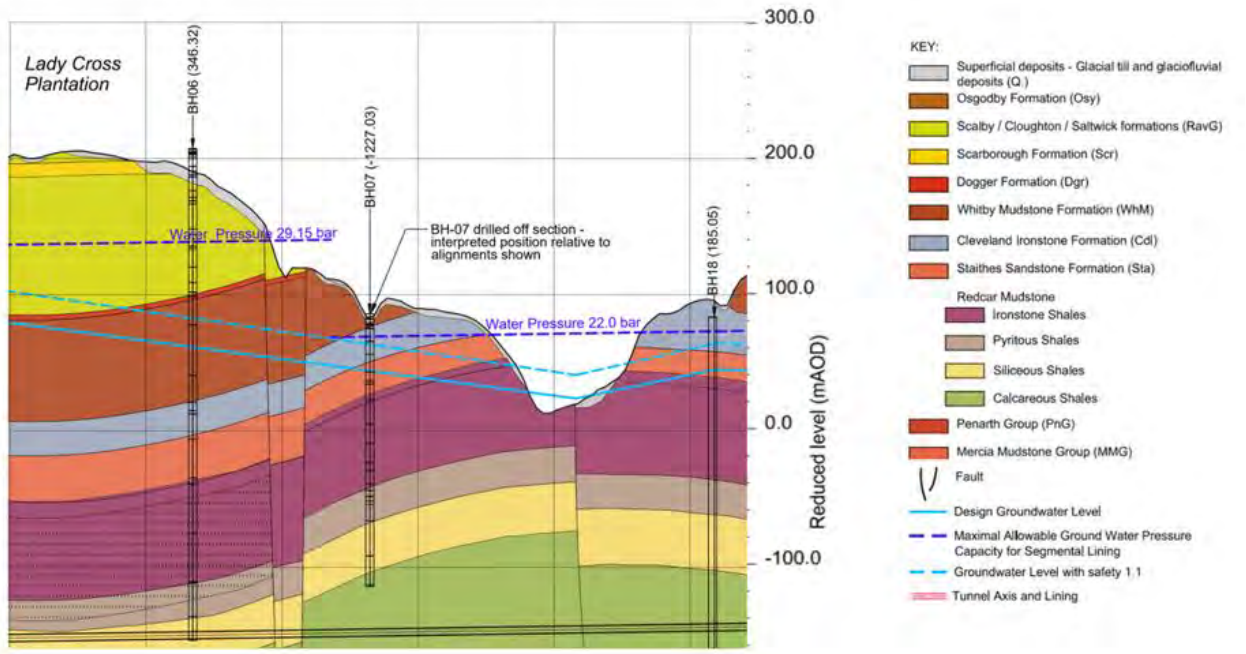
BGS	British Geological Survey
BH	Borehole
HRA	Hydrogeological Risk Assessment
mAOD	Metres Above Ordnance Datum
m bgl	Metres below ground level
MHF	Material Handling Facility
MTS	Mineral Transport System
NYMNPA	North York Moors National Park Authority
RCBC	Redcar and Cleveland Borough Council
TBM	Tunnel Boring Machine

11. ATTACHMENTS

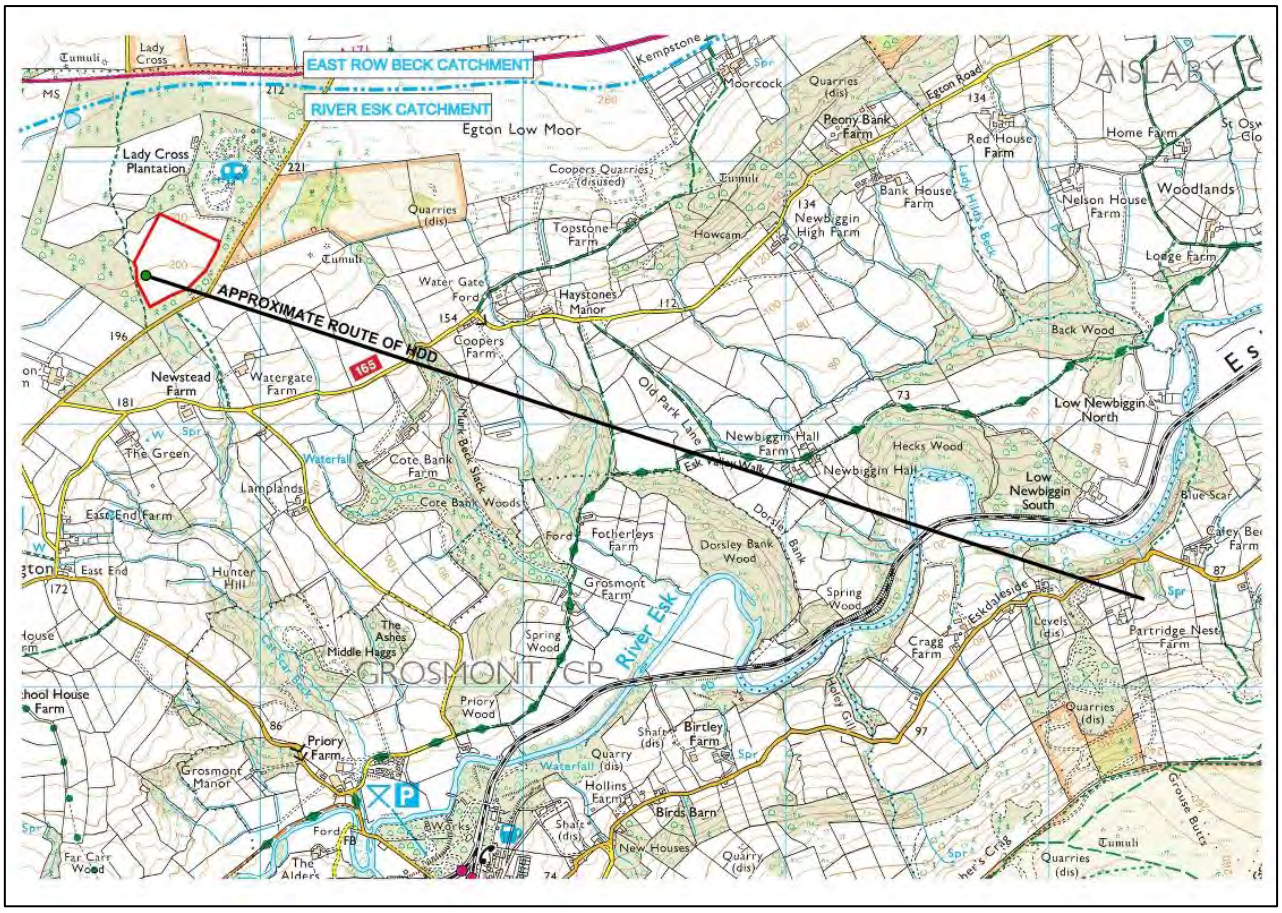
11.1. ATTACHMENT A – BOREHOLE SCHEMATIC



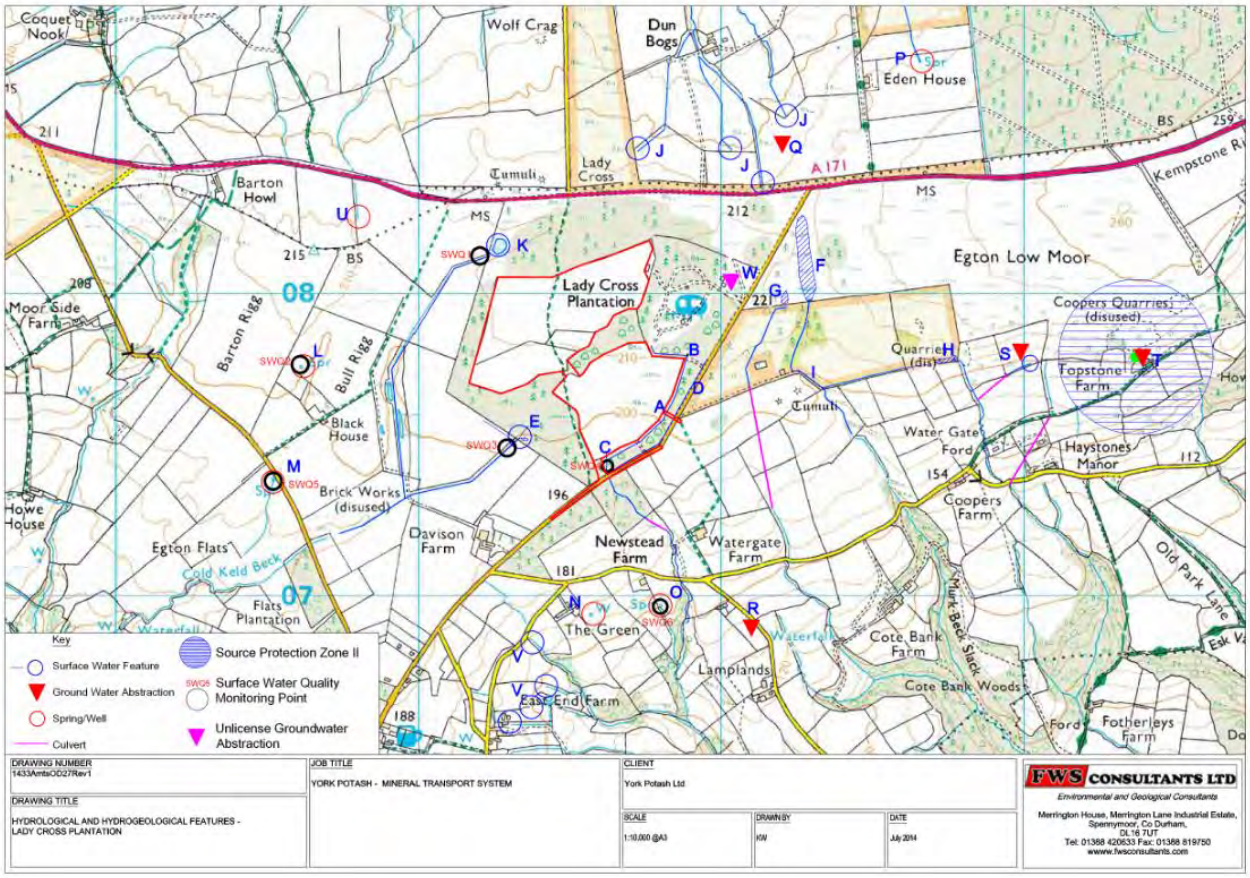
11.2. ATTACHMENT B – GEOLOGICAL SECTION



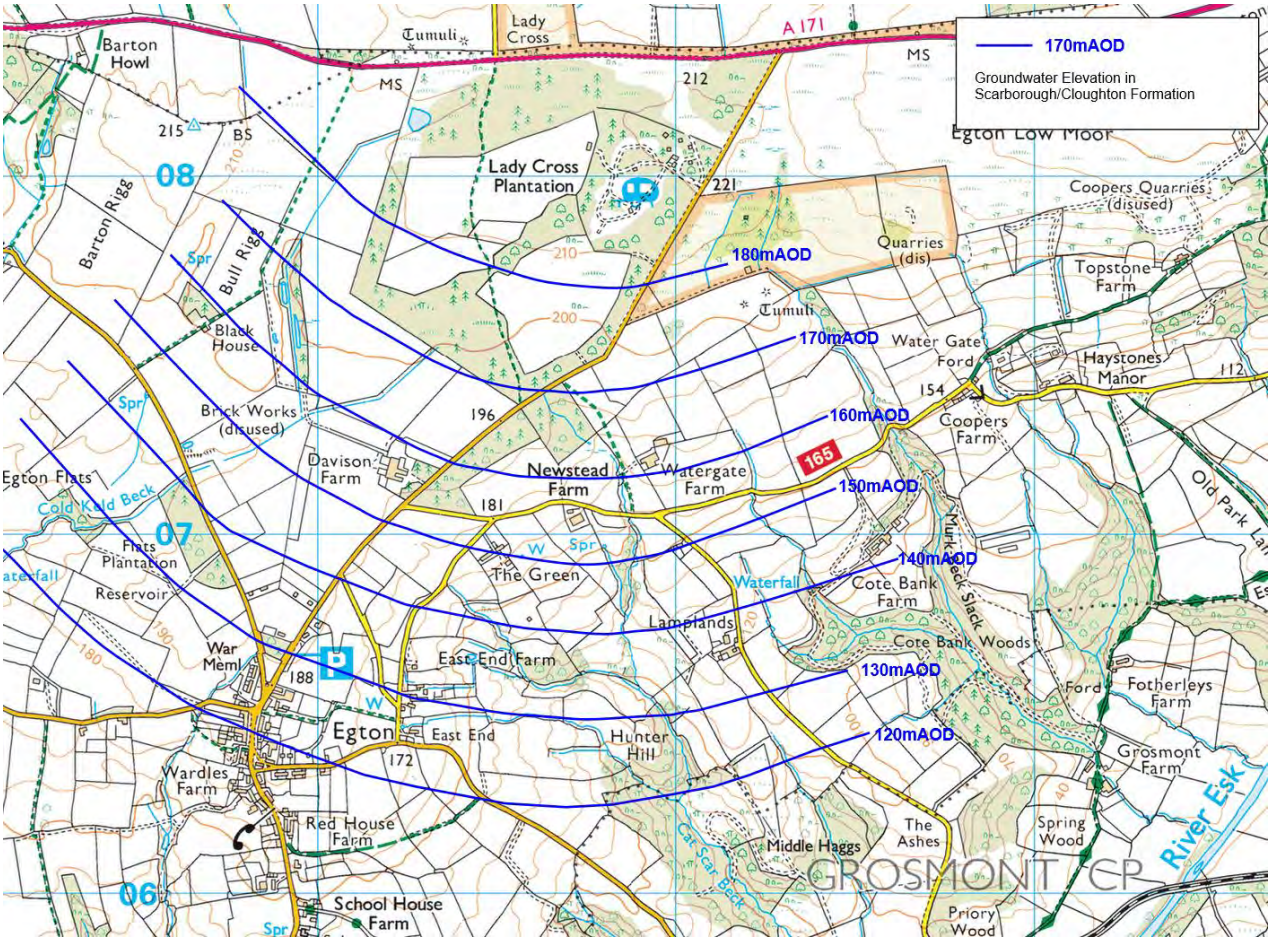
11.3. ATTACHMENT C – LOCAL HYDROLOGY

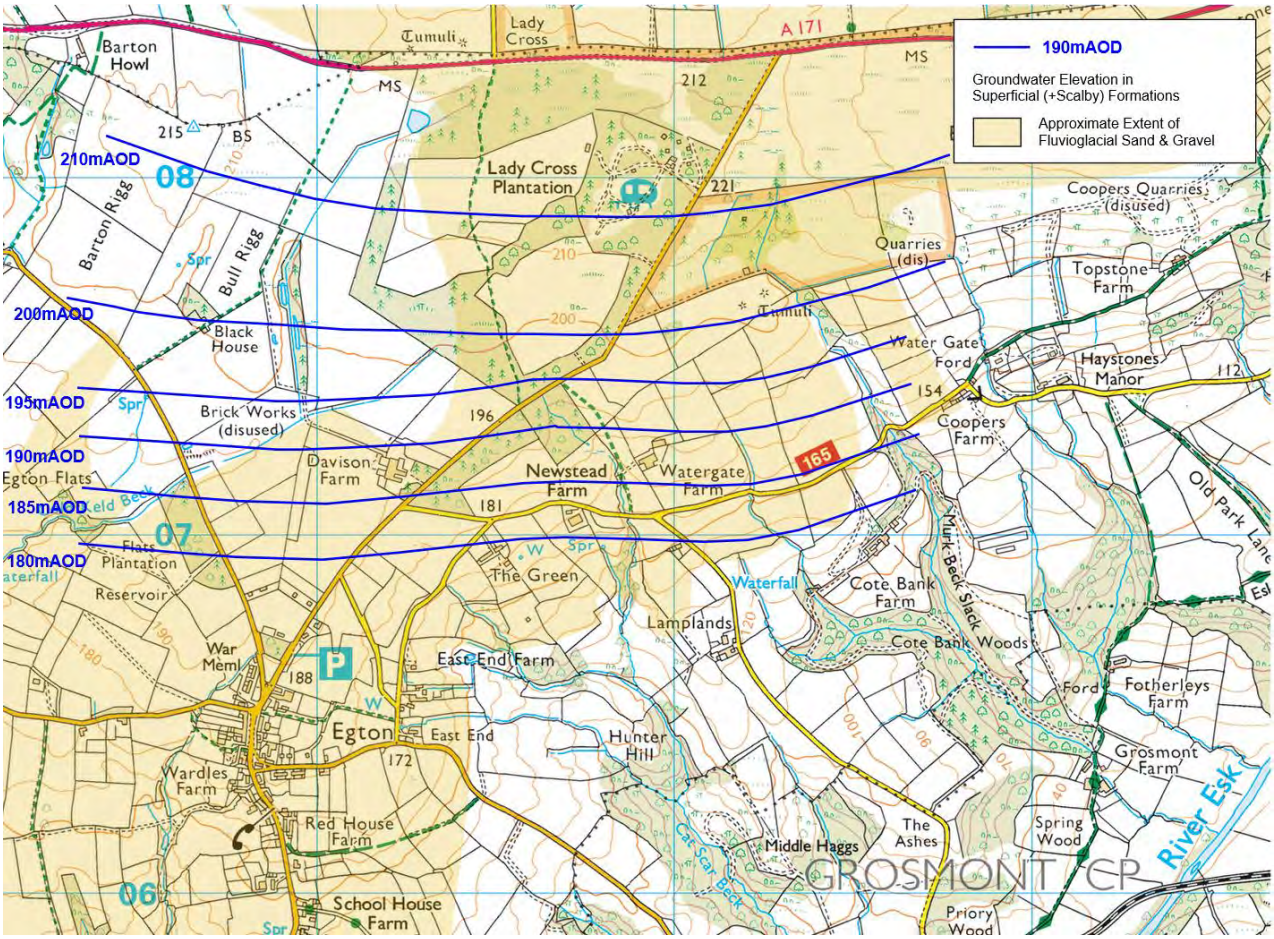


11.4. ATTACHMENT D – POTENTIAL RECEPTORS

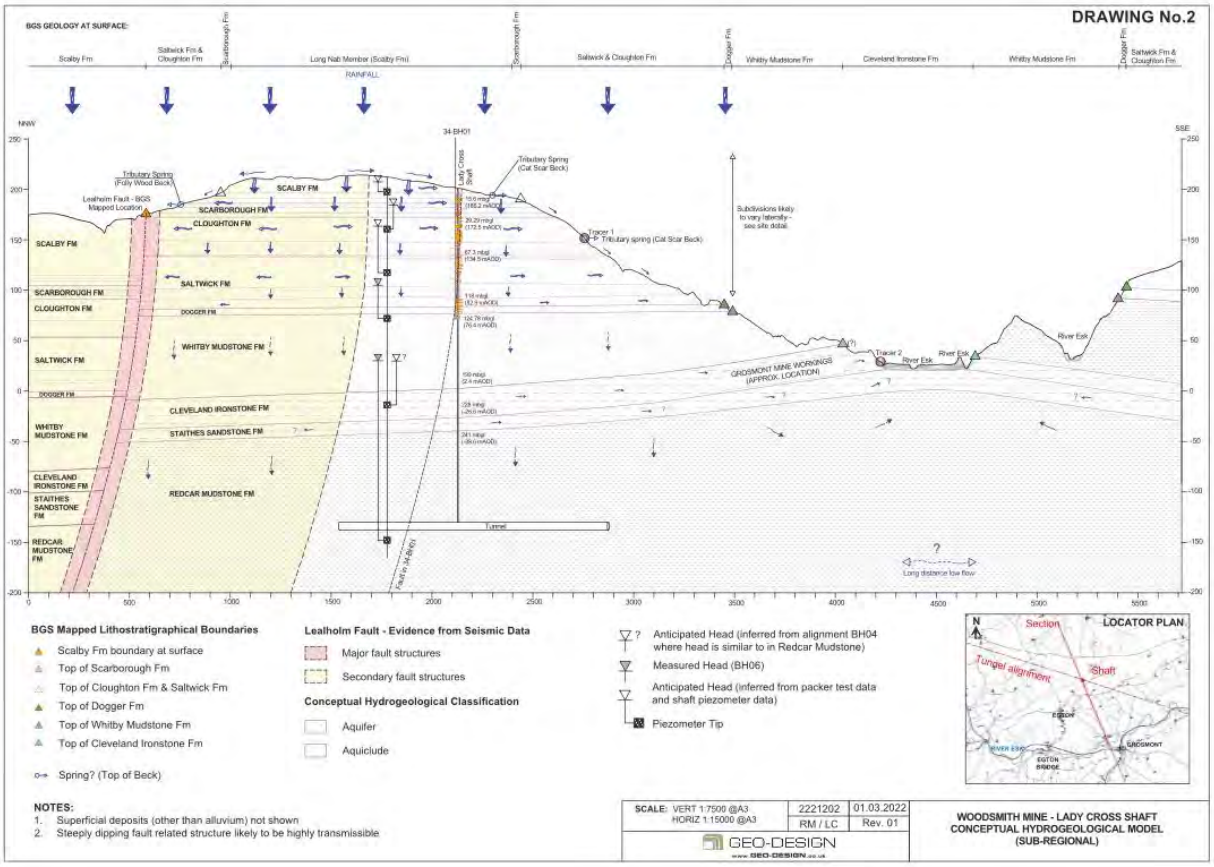


11.5. ATTACHMENT E – GROUNDWATER CONTOUR PLANS




190mAOD
Groundwater Elevation in Superficial (+Scalby) Formations
Approximate Extent of Fluvioglacial Sand & Gravel
210mAOD
200mAOD
195mAOD
190mAOD
185mAOD
180mAOD
Barton Howl
Tumuli
Lady Cross
A171
MS
212
215
BS
Barton Rigg
Bull Rigg
Lady Cross Plantation
221
Coopers Quarries (disused)
Quarries (dis)
Topstone Farm
Black House
Water Gate Ford
Haystones Manor
112
154
Brick Works (disused)
196
Coopers Farm
Davison Farm
Newstead Farm
Watergate Farm
165
Egton Flats
181
Old Park Lane
Flats Plantation
Reservoir
The Green
Waterfall
Cote Bank Farm
Lamplands
Cote Bank Woods
Turk Beck Slack
War Meml
188
East End Farm
Ford
Fotherleys Farm
Egton
East End
172
Hunter Hill
Grosmont Farm
Wardles Farm
Red House Farm
Middle Haggs
The Ashes
Spring Wood
River Esk
Cat Scar Beck
GROSMONT CP
School House Farm
Priory Wood
07
08
06

11.6. ATTACHMENT F – CONCEPTUAL HYDROGEOLOGICAL MODEL



11.7. ATTACHMENT G – RISK ASSESSMENT METHODOLOGY

Assessment of potential development impacts on local hydrology and hydrogeology has been undertaken through a combination of desk-based analysis, site survey work, qualitative and quantitative impact assessment, and consideration of potential impact mitigation requirements. The criteria for determining the significance of effects is based upon the following method:

(i) Assessment of potential receptor sensitivity
(ii) Assessment of potential effect magnitude.
(iii) Determination of potential effect significance

Effect magnitude is considered in relation to the potential impact on the receptor with magnitude defined in a range from negligible to major. The receptor sensitivity is defined as low, medium, or high depending on the specific receptor character on its ability to tolerate change. Effect significance is defined in relation to both effect magnitude and receptor significance. If the significance of the potential impact is Medium or High, then mitigation measures may need to be considered. In considering effect significance account is taken of effect duration; reversibility and compatibility with relevant environmental policies and standards.

Table E1: Methodology for determining sensitivity

Sensitivity	Examples of receptor
High	The receptor/resource has little ability to absorb change without fundamentally altering its present character, or is of international or national importance
Moderate	The receptor/resource has moderate capacity to absorb change without significantly altering its present character, or is of high importance
Low	The receptor/resource is tolerant of change without detriment to its character, is of low or local importance

Table E2: Methodology for determining impact magnitude

Magnitude of impact	Criteria for assessing impact
Major	Total loss or major/substantial alteration to key elements/features of the baseline (pre-development) conditions such that the post development character/composition/attributes will be fundamentally changed
Moderate	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of the baseline will be materially changed
Minor	A minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible/detectable but not material. The underlying character/composition/attributes of the baseline condition will be similar to the pre-development circumstances/situation
Negligible	Very little change from baseline conditions. Change barely distinguishable, approximating to a 'no change' situation

Table E3: Impact significance matrix

	Sensitivity		
Magnitude	**High**	**Moderate**	**Low**
Major	High	High-Medium	Medium-Low
Moderate	High-Medium	Medium-Low	Low
Minor	Medium-Low	Low	Low-Very Low
Negligible	Very Low	Very Low	Very Low

NYMNPA

21/12/2023

Project Title / Facility Name:

Woodsmith Project

Document Title:

CONSTRUCTION VEHICLE & PLANT MANAGEMENT PLAN - PHASE 8 - NYMNPA CONDITION 92 (ROYAL HASKONINGDHV) - LADYCROSS

Document Review Status		
☑	1. Reviewed – Accepted – Work May Proceed	By: Charlotte Bell
☐	2. Reviewed – Accepted As Noted, Work May Proceed, Revise & Resubmit	On: 21 Dec 2023 11:50
☐	3. Reviewed – Work May Not Proceed, Revise & Resubmit	
☐	4. For information only	
☐	5. On Hold – Pending Project Restart & Ramp Up	

Rev.	Revision Date (dd mmm yyyy)	Reason For Issue	Prepared by	Verified by	Approved by
D	20-Dec-2023	Planning	PLA			
C	13-Dec-2023	Planning	PLA			
B	25-Oct-2023	Planning	PLA			
A	06-Oct-2023	Planning	PLA			

Document ID:

40-STS-LC-2100-LG-PL-00010

WOODSMITH PROJECT

(788.5030)

CONSTRUCTION VEHICLE & PLANT MANAGEMENT PLAN - PHASE 8 - NYMNPA CONDITION 92 - LADYCROSS PLANTATION

/

40-STS-LC-2100-LG-PL-00010

(Royal HaskoningDHV)

Revision	Date of issue	Prepared by	Checked by	Approved by	Changes
A (PLA)	06/10/2023	Isabel O'Mahoney (RHDHV)	Iain Johnson (RHDHV)	John Drabble (RHDHV)	First Draft
B (PLA)	25/10/2023	Isabel O'Mahoney (RHDHV)	Iain Johnson (RHDHV)	John Drabble (RHDHV)	Revision in accordance with rev A comments
C (PLA)	13/12/2023	Isabel O'Mahoney (RHDHV)	Iain Johnson (RHDHV)	John Drabble (RHDHV)	Revision in accordance with rev B comments
D (PLA)	20/12/2023	Isabel O'Mahoney (RHDHV)	Iain Johnson (RHDHV)	John Drabble (RHDHV)	Revision in accordance with rev C comments

REPORT

NYMNPA-92 Construction Vehicle and Plant Management Plan

Ladycross Plantation Phase 8

Client: STRABAG AG

Reference: 40-STS-LC-2100-LG-PL-00010 Rev D

Status: 01/Final

Date: 11 December 2023

Royal HaskoningDHV

Enhancing Society Together

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Document title: NYMNPA-92 Construction Vehicle and Plant Management Plan

Document short title: Ladycross Plantation Phase 8 CVPMP
Reference: 40-STS-LC-2100-LG-PL-00010 Rev D
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Date: 11 December 2023
Project name: Woodsmith Project
Project number: PB1110
Author(s): CG, IOM

Drafted by: IOM

Checked by: JD/IJ

Date: 27/09/2023

Approved by: JD/IJ

Date: 12/12/2023

Classification
Project related

Royal HaskoningDHV

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Appendices

1 Introduction

1.1.1 In 2014 a planning application (reference NYM/2014/0676/MEIA) was submitted to North York Moors National Park Authority (NYMNPA) for permission to develop a polyhalite mine and underground Mineral Transport System (MTS). Planning permission was subsequently granted in 2015, subject to conditions, as varied in February 2018 by NYM/2017/0505/MEIA.

1.1.2 This document has been prepared on behalf of STRABAG AG, the contractor delivering the Phase 8 Works on behalf of Anglo American, and details the requirements with respect to construction vehicles and plant for Phase 8 of the development at Ladycross Plantation (see paragraph 1.1.5 below). This document is required to partially discharge Condition 92 of the NYMNPA planning permission NYM/2017/0505/MEIA and has been prepared in accordance with current good practice. The planning condition states that:

"Prior to the commencement of each Phase of Construction at either Dove's Nest Farm or Ladycross Plantation, a Construction Vehicle and Plant Management Plan (CVPM) shall be submitted to and approved in writing by the MPA. The CVPM shall include details of monitoring locations and baseline particulate emissions; predicted traffic movements into/out of the sites including levels at the A171/Mayfield junction; predicted particulate emissions from plant and HGVs during the construction period; proposed particulate control levels; proposed avoidance or mitigation measures to comply with control levels, and arrangements for monitoring over the construction period. Development shall only occur in strict accordance with the measures set out in the CVMP [sic]*, unless otherwise agreed in writing with the MPA."*

1.1.3 The specific requirements of the planning condition are detailed in **Table 1-1**.

Table 1-1 Condition NYMNPA-92 Construction Vehicle and Plant Management Plan

Condition NYMNPA-92	Compliance with Condition NYMNPA-92
Details of monitoring locations and baseline particulate emissions	Section 2
Predicted traffic movements into/out of the sites including levels at the A171/Mayfield junction	Section 3
Predicted particulate emissions from plant and Heavy Goods Vehicles (HGVs) during the construction period	Section 4
Proposed avoidance or mitigation measures to comply with control levels	Section 5
Proposed particulate control levels	Section 5
Arrangements for monitoring over the construction period	Section 2

1.1.4 This management plan details only the Phase 8 Works at Ladycross Plantation. Updates to this plan will be prepared for subsequent construction phases (as required) and following any design review or method change. The NYMNPA has confirmed that it supports this approach.

1.1.5 The activities required for the Phase 8 Works comprise the following:

- Drilling of an exploratory borehole;
- Temporary installation and use of drilling rig and ancillaries; and

- Decommissioning of borehole.

1.1.6 Meetings to discuss the scope and content of this document were held with the Environmental Health Officer (EHO) of Scarborough Borough Council (SBC) and NYMNPA on 17 March 2016 and 27 April 2016 respectively for earlier Phases of Works at Woodsmith Mine. The scope was re-confirmed with the EHO in a meeting on 1 December 2016. This document follows the agreed approach and is in line with the CVPMPs previously submitted for Woodsmith Mine.

2 Baseline Conditions

2.1 Definitions of Dust and Fine Particulate Matter

2.1.1 Definitions of dust and fine particulate matter are provided in **Appendix A1**.

2.2 Site-Specific Dust Deposition Survey

2.2.1 Baseline dust deposition monitoring was not undertaken at Ladycross Plantation as part of the Environmental Statement (ES) which supported the planning application. As such, there are no historical baseline datasets at the site.

2.2.2 Dust deposition monitoring is now undertaken at four locations around the site, as shown in **Figure 1**, which will continue throughout the construction works.

2.2.3 Wind roses of hourly sequential meteorological data from the Fylingdales recording station were provided in the ES[1]. The predominant wind direction is from the south-west, and locations downwind of particulate sources are likely to experience the greatest deposition.

2.2.4 Regulatory authorities conventionally consider a threshold of 200 mg/m^2/day[2,3] to be the dust deposition rate above which complaints are likely[4]. It is expected that, given the nature of the area and that the ground has a covering of vegetation, baseline dust deposition rates would be below 200 mg/m^2/day. This would be expected in a rural and relatively undeveloped location.

2.3 Background Particulate Matter Concentrations

2.3.1 Background PM_{10} and $PM_{2.5}$ concentrations were sourced from pollutant maps provided by Defra[5] for a 1 km x 1 km resolution of the UK. The relevant 2023 background pollutant concentrations at Ladycross Plantation were obtained for the grid squares covering the area, and are detailed in **Appendix A2**.

2.3.2 Background PM_{10} and $PM_{2.5}$ concentrations at Ladycross Plantation are well below the annual mean Air Quality Objectives (in England) of 40 µg.m^{-3} and 20 µg.m^{-3} respectively. The main contributor to PM_{10} concentrations within the above grid squares is secondary PM_{10} (aerosols formed in atmospheric condensation reactions), sea salt and calcium and iron rich dusts, reflecting the proximity of Ladycross Plantation to the coast.

[1] Royal HaskoningDHV (2014) York Potash Project Mine, MTS and MHF Environmental Statement: Part 2 Chapter 9 Air Quality
[2] Environment Agency (2013) Technical Guidance Note (Monitoring) M17 Monitoring Particulate Matter in Ambient Air around Waste Facilities
[3] Institute of Air Quality Management (2016) Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites
[4] Vallack & Shillito (1998) Suggested guidelines for deposited ambient dust, Atmospheric Environment **16** (32), 2737-2744
[5] Defra (2020) 2018-based background maps https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

2.4 Additional Monitoring

2.4.1 Construction activities will be subject to a range of dust and vehicle management measures, as set out in the Construction Environmental Management Plan (CEMP), submitted to partially discharge planning condition NYMNPA-93. The measures detailed in the CEMP include regular visual site inspections to monitor compliance with dust control procedures set out within the document. The results of the inspections will be recorded within the site log book, and included in monthly reporting. Details around dust management are included within the Phase 5 CEMP, and within the Phase 3 Dust Management Plan which remains applicable for this Phase.

2.4.2 The programme of site inspections will assist with interpretation of the results of the ongoing dust deposition monitoring which will be undertaken throughout the construction works, and which will provide retrospective information about dust levels generated during construction to inform site management practices.

3 Predicted Traffic Movements Associated with Phase 8 Works

3.1 Construction Phase Road Traffic Movements

3.1.1 The anticipated traffic movements associated with Phase 8 align with the targets for vehicle movements presented in the Construction Traffic Management Plan (CTMP), submitted to partially discharge planning condition NYMNPA-34, and are based on the peak number of movements permitted at Ladycross Plantation. The Phase 8 Works will be undertaken over a 14 week period, totalling approximately 98 working days. It is expected that due to their scale, the Phase 8 Works would not generate the peak number of permitted vehicle movements; the assessment is therefore conservative.

3.1.2 The number of traffic movements generated during the Phase 8 Works is detailed in **Table 3-1**.

Table 3-1 Traffic Movements Generated During Phase 8 at Ladycross Plantation

Vehicle Type	Number of Vehicles During Phase 8 (Two-Way)*	Maximum Number of Vehicles per Day (Two-Way)
HGV	4,788	56
Light Goods Vehicles (LGVs)**	11,760	120

*HGVs are restricted on Sundays and therefore the total number of HGVs during Phase 8 does not equate to the duration multiplied by the number of HGVs per day
**Includes cars, minibuses and vans

3.1.3 As the primary source of construction materials within the area will be from Teesside, no HGVs would travel through the A171/Mayfield junction. It is expected that, based upon forecast employee distribution, there would be a negligible increase in traffic movements through the A171/Mayfield junction.

3.2 On-Site Plant

3.2.1 The number and types of plant that would be operating for the duration of Phase 8 at Ladycross Plantation are provided in **Table 3-2**. Two generators, a 250 kVA emergency back-up (welfare) generator and a 1,000 kVA back-up power module (drilling rig), will be on site in Phase 8 for emergency use. Whilst these generators will be routinely tested and maintained, as they will be used only in exceptional circumstances, emissions from these sources were not included in this assessment. In the table below, the generators for powering the siltbuster and wheelwash are noted as being in use for the full duration of Phase 8; however, these generators would be used periodically and only when required, and therefore the assessment is considered to be conservative.

Table 3-2 Plant Required During Phase 8

Task	Plant Type	Duration of Phase 8 That Plant Will Be Used*
General site use	13T Excavator	32.1%
	Telehandler	32.1%

Task	Plant Type	Duration of Phase 8 That Plant Will Be Used*
	Road Sweeper	32.1%
	45ft Mobile Elevated Working Platform (MEWP)	10.7%
Drilling of exploratory borehole	Auger unit / ZX160	1.9%
	Drilling Rig	64.3%
	Tracked Excavator 30T (Muck away)	64.3%
	20T Tipper Truck (Muck away)	37.5%
Temporary installation and use of drilling rig and ancillaries	Tracked Excavator 30T (Drill Pad regrade)	2.7%
	Dumper Truck 20T (Drill Pad regrade)	2.7%
	Roller Vibrator (Drill Pad regrade)	2.7%
	Telehandler 5T (Drill Pad set-up and drilling operations)	56.3%
	60T mobile crane (Drill Pad set-up and demob)	24.1%
	2x 150 kVA Generators	86%
	100 kVA Generator	86%
	Centrifuge	64.3%
	Mud Pumps	64.3%
	2x Fluid Reclamation Units	64.3%
	1,000 kVA Power Module (Drilling Rig)	86%
Decommissioning of borehole (1 year after completion of drilling)	Grout plant	N/A**
	Pump	N/A**
	Cement wagons	N/A**
General equipment	60 kVA generator (Back-up-Siltbuster) (Rain Dependant)	100%
	4 kVA Mobile generator (water management)	100%
	4" Supersilent Pump x6 (Rain dependent)	64.3%
	Lighting Towers x4	32.1%
	Towable Jet Wash	32.1%
	Towable Water Bowser 1900L	32.1%
	Wheelwash	32.1%
	Electric compressor	100%

*This takes into account the utilisation of each piece of plant throughout the 14 week construction period and the expected on-time of the plant.
**Decommissioning of borehole is to be completed once the tunnel boring machine (TBM) has passed, as detailed in the Phase 8 CEMP (Document reference: 40-STS-LC-2100-EN-PL-00036). It is estimated this will occur one year after completion of drilling and therefore has not been considered in the Phase 8 CVPMP.

3.2.2 As part of the Phase 8 works, a safety device (gas separator and 4'' single flare skid) will be installed to mitigate emissions and minimise risk to the workforce in the unlikely event of hitting gaseous hydrocarbons during drilling operations. The emergency safety device to be installed will ensure that waste gases will combust cleanly and efficiently by eliminating smoke and minimised noise and visible flame. Further details of the gas separator and 4'' single flare skid are provided in the Phase 8 CEMP (Document reference: 40-STS-LC-2100-EN-PL-00036). It is currently not known how long the flare would have to operate in an emergency case. If gas is encountered, the operational duration of the emergency flare would depend on location, pressure and volume of gaseous hydrocarbons, which are not known at this stage. Geology indicates that given rock porosity any reservoir would be small and of low pressure due to compensation from the Sherwood sandstone aquifer, and is likely to be at or around hydrostatic head 20-30 bar. As the emergency flare is relatively small in scale (a 4" diameter stack) and will be used only in exceptional circumstances, emissions were not included in this assessment.

4 Predicted Particulate Emissions from Plant and HGVs during Phase 8

4.1 Methodology

4.1.1 Particulate matter will be generated by the combustion of fuel and brake and tyre wear associated with the following activities during Phase 8:

- Transportation of workforce to site;
- HGV deliveries and movements; and
- The operation of on-site plant (referred to as Non-Road Mobile Machinery (NRMM)) and generators.

4.1.2 Data on the above activities are provided where the required information is known. Where data were not available, information used in the assessments undertaken for the Environmental Statement are used, which included the average trip length and speeds. This is considered to be a reasonable worst-case scenario.

4.1.3 The quantification of emissions from road traffic was undertaken using the Defra Emission Factor Toolkit (version 11.0). The Emission Factor Toolkit is regularly updated to reflect the latest vehicle technologies and fleet compositions, and is the primary method of deriving emissions from road transport in the UK. The standard UK fleet composition for 2023, built into the Emission Factor Toolkit, was utilised.

4.1.4 The Emission Factor Toolkit does not provide specific emission factors for NRMM. As such, emissions of NRMM were calculated using the methodology detailed in European Environment Agency (EEA) Guidance[6]. This document details specific emission factors for NRMM, based on the power rating of the plant and the various emission stages, which correspond to the emission standards set out in relevant EU Directives.

[6] EMEP/EEA (2019) *Emission Inventory Guidebook – Non-Road Mobile Sources and Machinery*

4.1.5 The guidance provides three tiers of emission factors; the appropriate tier for use is dependent on the level of information available on the types of plant. As specific information on the make and model of plant used at Ladycross Plantation were provided by STRABAG, Tier 3 emission factors were used.

4.1.6 Emissions associated with generators were derived using the Tier 1 approach in EEA Guidance[7]. Fuel consumption was derived using the electrical power of the plant, the electrical efficiency, the anticipated load and hours of use per day as provided by STRABAG. Emission factors were obtained from the EEA Guidance.

4.2 Assumptions

4.2.1 The following assumptions were made in the assessment of particulate emissions from NRMM and vehicle movements:

- NRMM was assumed to be in operation for 75% of the working day, with more specialist items of plant (the MEWP) assumed to be in operation for 25% of the working day;
- Phase 8 will commence in 2023 – emission factors for 2023 were therefore used;
- Some activities will be undertaken during a 12-hour working day, with others undertaken 24/7. This has been reflected within the calculations;
- All generators were assumed to operate at 40% efficiency;
- The duration of Phase 8 will be 14 weeks, with all Sundays worked. Drilling will be completed after 12 weeks and an additional 2 weeks are required for disposal of drilling muds (only during the day); and
- HGV deliveries are restricted to 10% of weekday volumes on Sundays (as per the CTMP). It was therefore assumed that, on Sundays, HGV deliveries would be 10% of weekday trips.

4.2.2 Data were provided by STRABAG on the expected loading for all items of plant during their use, and this information was applied in the assessment.

4.2.3 Average HGV speeds were obtained from GIS smartphone data on the road links that comprise the haul route, and average speeds of cars were obtained from route mapping and estimated distance over time.

4.3 Emissions from Construction Phase Road Traffic Movements

4.3.1 The quantification of particulate emissions generated by construction-phase traffic movements was undertaken using the following input data:

- Number of daily HGV and car movements;
- Average trip lengths (km);
- Average speed vehicles will be travelling; and
- Emission factors for each vehicle type.

4.3.2 Input and output data from the Emission Factor Toolkit are detailed in **Appendix A3**.

[7] EMEP/EEA (2019) *Emission Inventory Guidebook – Small Combustion*

4.4 Emissions from the Operation of On-Site NRMM and Generators

4.4.1 The input data used to calculate particulate (PM_{10}) emissions from NRMM and generators are detailed in **Appendix A4** and **Appendix A5**. The calculated particulate emissions from NRMM and generators are detailed in **Table 4-1**.

Table 4-1 Total PM_{10} Emissions from NRMM during Phase 8

Task	Plant Type	Total PM_{10} Emission (tonnes)
General site use	13T Excavator	0.0003
	Telehandler	0.0083
	Road Sweeper	0.0024
	45ft MEWP	0.0005
Drilling of an exploratory borehole	Auger unit / ZX160	0.0001
	Drilling Rig	0.0099
	Tracked Excavator 30T (Muck away)	0.0374
	20T Tipper Truck (Muck away)	0.0419
Temporary Installation and use of drilling rig and ancillaries	Tracked Excavator 30T (Drill Pad regrade)	0.0010
	Dumper Truck 20T (Drill Pad regrade)	0.0007
	Roller Vibrator (Drill Pad regrade)	0.0002
	Telehandler 5T (Drill Pad set-up and drilling operations)	0.0145
	60T mobile crane (Drill Pad set-up and demob)	0.0020
	2x 150 kVA Generators	0.0914
	100 kVA Generator	0.0305
	Centrifuge	0.0332
	Mud Pumps	0.1682
	Fluid Reclamation Unit	0.0086
	1,000 kVA Power Module	0.3048
General equipment	60 kVA generator (Back-up-Siltbuster) (Rain Dependant)	0.0021
	4 kVA generator (water management)	0.0001
	4" Supersilent Pump x6	0.0036
	Lighting Towers	0.0143
	Towable Jet Wash	0.0003
	Towable Water Bowser 1900L	0.0020
	Wheelwash	0.0024

4.5 Total Particulate Emissions Generated During Phase 8

4.5.1 The total particulate predicted to be generated during Phase 8 as a result of emissions from construction-phase traffic, NRMM and generators is detailed in **Table 4-2**.

Table 4-2 Total PM Emissions from Construction Traffic, NRMM and Generators

Source	Total PM Emission (tonnes)
Construction Traffic	0.044
NRMM and Generators	0.781
TOTAL	**0.825**

4.5.2 The total PM_{10} emission within the SBC area was derived from National Atmospheric Emission Inventory (NAEI) mapping[8], as detailed in **Figure 2**.

4.5.3 The total annual PM_{10} emission within the whole SBC area of jurisdiction was 245.34 tonnes in 2021. Particulate emissions generated during Phase 8 will therefore contribute 0.34% of the total emissions within this local authority area.

[8] National Atmospheric Emission Inventory (2021) Emission Maps for the UK http://naei.defra.gov.uk/data/map-uk-das?pollutant_id=24&emiss_maps_submit=naei-20160526090831

5 Mitigation Measures

5.1 Construction Dust and NRMM Mitigation Measures

5.1.1 Details of mitigation measures to minimise construction phase dust emissions are included in the CEMP.

5.1.2 All NRMM and plant will be well maintained. If any emissions of dark smoke occur then the relevant machinery will stop immediately and any problem rectified. In addition, the following controls will apply to NRMM:

- All NRMM should use fuel equivalent to ultralow sulphur diesel (fuel meeting the specification within EN590:2004);
- All NRMM will comply with the appropriate NRMM emission standards;
- All NRMM will be fitted with Diesel Particulate Filters (DPF) conforming to defined and demonstrated filtration efficiency (load/duty cycle permitting);
- The ongoing conformity of plant retrofitted with DPF, to a defined performance standard, will be ensured through a programme of onsite checks; and,
- Fuel conservation measures will be implemented, including instructions to:
  - throttle down or switch off idle construction equipment;
  - switch off the engines of trucks while they are waiting to access the site and while they are being loaded or unloaded; and,
  - ensure equipment is properly maintained to ensure efficient fuel consumption.

5.1.3 The vehicle fleet accessing Ladycross Plantation will be fitted with DPFs, which will control particle emissions[9].

[9] DPFs are commonly fitted to cars and commercial vehicles to reduce particulate emissions and ensure compliance with the latest Euro standards. It is an offence under the Road Vehicles (Construction and Use) Regulations (1986) to use a vehicle that has had the DPF removed.

Figures

Key:

Location of Dust Monitor

Title
Ladycross Plantation Dust Monitoring Locations

Project
PB1110 Woodsmith Project

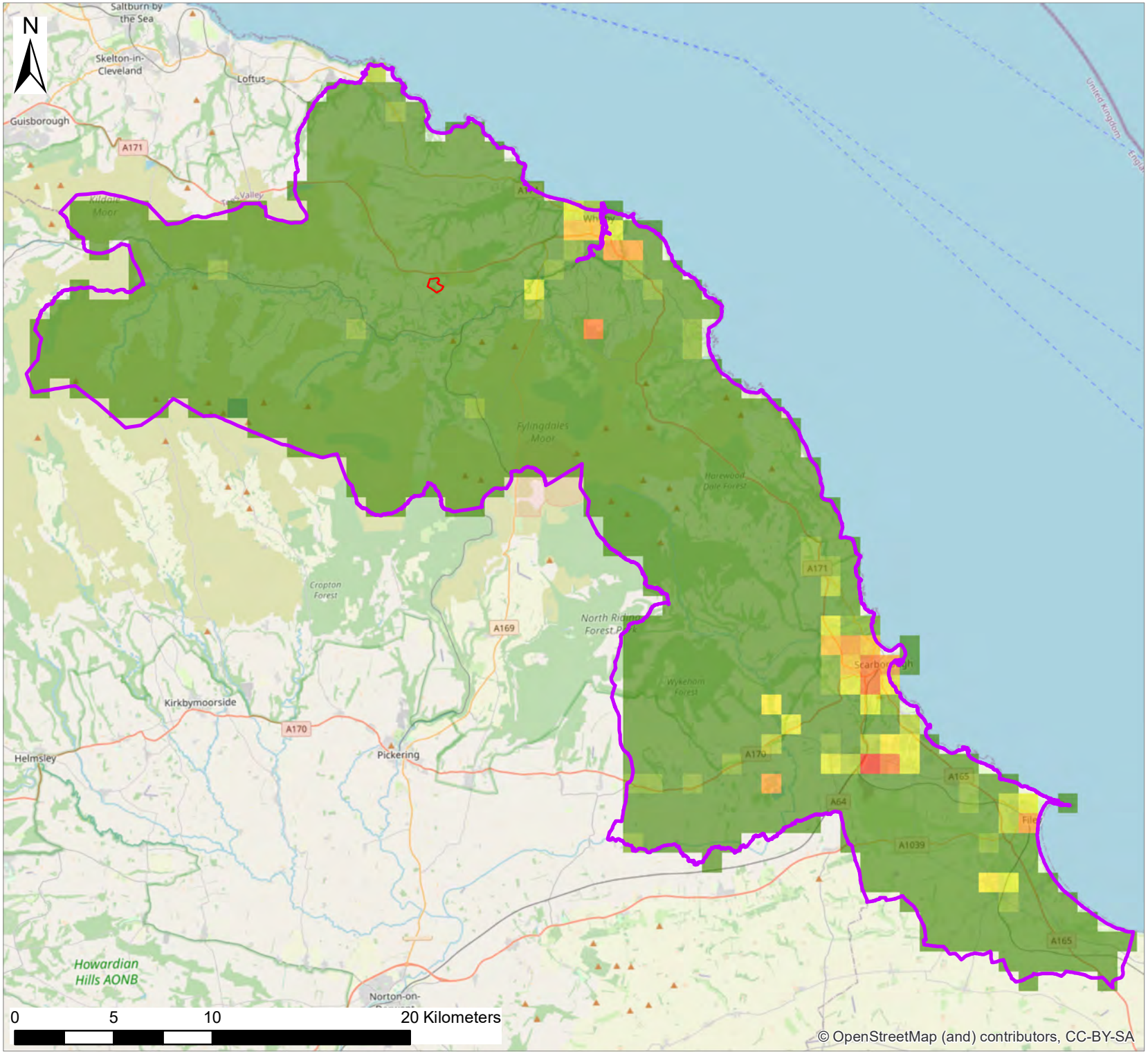
Client
STRABAG AG

Date	*Scale*
12/07/2022	1:3300

Figure
Figure 1

Checked by	*Number*
JD	1

Royal HaskoningDHV
Enhancing Society Together



Key:

- Ladycross Plantation
- Scarborough Borough Council Area

Tonnes PM_{10}/km^2 (2021)

- <0.01
- 0.01 - 0.58
- 0.59 - 1.35
- 1.36 - 1.93
- 1.94 - 2.9
- 2.91 - 3.67
- 3.68 - 4.25
- 4.26 - 6.19
- 6.2 - 18.56
- 18.57 - 49.31

Title
2021 NAEI PM_{10} Emissions Mapping

Project
PB1110 Woodsmith Project

Client
STRABAG AG

Date	*Scale*
12/07/2023	1:265000

Figure
Figure 2

Checked by	*Number*
JD	1

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Appendix A

A1 Definitions of Dust and Fine Particulate Matter

Atmospheric particles are generally categorised by size fraction and by their source, and are usually measured by mass concentration (although particle number and 'black carbon' techniques are available). The generic term of 'dust' and the two size fractions most commonly used to consider human health environmental effects are defined below.

'Dust' is considered to be the mass of solid particles that are suspended in air or have settled out onto a surface after having been suspended in air. In IAQM Guidance[10] and within this document, the term 'dust' has been used to include the particles that give rise to soiling, and to potential human health and ecological effects. BS 6069:1993 provides a definition of dust as particles up to 75 µm in diameter.

The smaller size fractions considered in the UK Local Air Quality Management regime are defined in Regulations[11] as follows:

- "PM_{10}" means particulate matter which passes through a size-selective inlet as defined in the reference method for the sampling and measurement of PM_{10}, EN 12341, with a 50% efficiency cut-off at 10 µm aerodynamic diameter; and,
- "$PM_{2.5}$" means particulate matter which passes through a size-selective inlet as defined in the reference method for the sampling and measurement of $PM_{2.5}$, EN 14907, with a 50% efficiency cut-off at 2.5 µm aerodynamic diameter.

The term 'aerodynamic diameter' is a reference to the terminal velocity in air of a spherical particle of unit density, therefore this is a way of standardising the range of irregular airborne particle loading for measurement and standard-setting.

Particulate matter is generally described by source as being either 'primary' or 'secondary'. Primary particles such as carbon particles from fuel combustion, sea salt and mineral particles derived from construction activities are released directly into the air, whereas secondary particles are formed in the atmosphere by chemical reactions that lead to the formation of low volatility compounds that condense into particles.

The main sources of primary particulate are road transport (combustion emissions, brake and tyre wear and re-entrainment of dust from road surfaces); stationary combustion (such as domestic coal burning); and industrial processes (production of metals, cement, lime, coke and chemicals, bulk handling of dusty materials, construction, mining and quarrying).

Secondary particles are less easy to ascribe to their original sources. They are comprised mainly of ammonium sulphate and nitrate, originating from the oxidation of sulphur and nitrogen oxides in the atmosphere to acids, which are then neutralised by atmospheric ammonia derived mainly from agricultural sources. The chemical processes involved in their formation are relatively slow and their persistence in the atmosphere is prolonged. Thus, secondary particles are distributed more evenly

[10] Institute of Air Quality Management (2023). Guidance on the assessment of dust from demolition and construction.
[11] The Air Quality Standards Regulations 2010 (SI 2010 No.1001)

throughout the air with fewer differences between urban and rural areas. They can also travel large distances, resulting in the transport of particles across national boundaries (AQEG, 2005)[12].

[12] Air Quality Expert Group (AQEG), (2005). Particulate Matter in the United Kingdom. Defra, London

A2 Background Particulate Matter Concentrations

Table A2 2023 Background Particulate Matter Concentrations

Grid Square	PM_{10} Background Concentration ($\mu g.m^{-3}$)	$PM_{2.5}$ Background Concentration ($\mu g.m^{-3}$)
481500,507500	9.56	5.87
481500,508500	9.31	5.84

A3 Inputs and Outputs of the Emission Factor Toolkit

Table A3 Input Data into the Emission Factor Toolkit

Vehicle Type	Number of Vehicles During Phase 8	Number of Vehicles per Day (Averaged over Phase 8)	Speed (kph)	Trip Length (km)
HGV	4,788	49	69	46
Cars	11,760	120	62	45.5

Table A4 Output from the Emission Factor Toolkit

Vehicle Type	Emissions of PM_{10} over Phase 8 (kg)
HGV	27.3
Cars	16.8
Total	**44.2**

A4 Calculation of Emissions from NRMM

The European Monitoring and Evaluation Programme (EMEP)/European Environment Agency (EEA) Emission Inventory Guidebook 2019[13] provides the following equation to calculate emissions from NRMM:

$$E = N \times HRS \times P \times (1+DFA) \times LFA \times EF_{(base)}$$

Where:

E = mass of emissions generated
N = source population
HRS = hours of use over the period
P = engine size (kW)
DFA = deterioration factor adjustment
LFA = load factor adjustment
$EF_{(base)}$ = base emission factor (g/kWh).

The average kilowatt (kW) power ratings for the proposed NRMM are provided in **Table A5**.

Table A5 Power Ratings of Required Plant During Phase 8 at Ladycross Plantation

Task	Plant Type	Power in kW
General site use	13T Excavator	74
	Telehandler	74.5
	Road Sweeper	172
	45ft Mobile Elevated Working Platform (MEWP)	36
Drilling of an exploratory Borehole	Auger unit / ZX160	101.3
	Drilling Rig	444
	Tracked Excavator 30T (Muck away)	210
	20T Tipper Truck (Muck away)	128.4
Temporary Installation and use of drilling rig and ancillaries	Tracked Excavator 30T (Drill Pad regrade)	210
	Dumper Truck 20T (Drill Pad regrade)	152
	Roller Vibrator (Drill Pad regrade)	24.3
	Telehandler 5T (Drill Pad set-up and drilling operations)	74.5
	60T mobile crane (Drill Pad set-up and demob)	270
	Centrifuge	37.3
	Mud Pumps	1,678
	Fluid Reclamation Unit	4.8
General equipment	4" Supersilent Pump x6	16
	Lighting Towers	4
	Towable Jet Wash	0.59
	Towable Water Bowser 1900L	18

[13] EMEP/EEA (2019) *Emission Inventory Guidebook – Non-Road Mobile Sources and Machinery*

Task	Plant Type	Power in kW
	Wheelwash	22

The input data used to calculate emissions from NRMM are detailed in **Table A6**.

Table A6 Input Data Used to Calculate Particulate Emissions from NRMM

Plant	kW	Hours of Use During Phase 8*	Deterioration Factor	Load Factor	Emission Factor Stage	Emission Factor (g/kWh)
13T Excavator	74	756	0.473	25%	Stage 5	0.015
Telehandler	74.5	756	0.473	50%	Stage 3A	0.2
Road Sweeper	172	756	0.473	50%	Stage 4	0.025
45ft MEWP	36	252	0.473	10%	Stage 3A	0.4
Auger unit / ZX160	101.3	45	0.473	100%	Stage 5	0.015
Drilling Rig	444	1,512	0.473	10%	Stage 3A	0.1
Tracked Excavator 30T	210	1,512	0.473	80%	Stage 3A	0.1
20T Tipper Truck	128.4	1,386	0.473	80%	Stage 3A	0.2
Tracked Excavator 30T	210	63	0.473	50%	Stage 3A	0.1
Dumper Truck 20T	152	63	0.473	50%	Stage 3A	0.1
Roller Vibrator	24.3	63	0.473	20%	Stage 3A	0.4
Telehandler 5T	74.5	1,323	0.473	50%	Stage 3A	0.2
60T mobile crane	270	567	0.473	60%	Stage 5	0.015
Centrifuge	37.3	1,512	0.473	100%	Stage 1	0.4
Mud Pumps	1,678	1,512	0.473	100%	Stage 5	0.045
Fluid Reclamation Unit	4.8	3,024	0.473	100%	Stage 5	0.4
4" Supersilent Pump x6	16	1,512	0.473	25%	Stage 3A	0.4
Lighting Towers	4	3,024	0.473	50%	Stage 3A	1.6
Towable Jet Wash	0.59	756	0.473	25%	Stage 3A	1.6
Towable Water Bowser 1900L	18	756	0.473	25%	Stage 3A	0.4
Wheelwash	22	756	0.473	25%	Stage 3A	0.4
*Taking in to account on-time						

A5 Calculation of Emissions from Generators

The EMEP/EEA Emission Inventory Guidebook 2019[14] provides the following equation to calculate emissions from small combustion sources such as generators:

$$E_{pollutant} = AR_{fuelconsumption} \times EF_{pollutant}$$

Where:

$E_{pollutant}$ = the emission of the specified pollutant ($g.h^{-1}$)
$AR_{fuelconsumption}$ = the activity rate for fuel consumption ($GJ.h^{-1}$)
$EF_{pollutant}$ = the emission factor for the pollutant (g/GJ)

The fuel consumption (AR) of each generator was derived using the power rating of the generators, the load, the electrical efficiency and the utilisation percentage. The EF was taken from EMEP/EEA Guidance. The inputs are detailed in **Table A7**.

Table A7 Input Data Used to Calculate Particulate Emissions from Generators

Activity	Generator	Power (kVA)	Power (kW*)	Power Load (%)	Percentage of Phase 8 Used (%)	Efficiency (%)	AR Fuel Consumption ($GJ.h^{-1}$)	EF (Emission Factor) PM_{10} (g/GJ)**
Temporary Installation and use of drilling rig and ancillaries	2x 150 kVA generators	150	120	100	86	40%	1.08	21
	100 kVA generator	100	80	100	86	40%	0.72	21
	1,000 kVA Power Module	1,000	800	100	86	40%	7.20	21
General Site Activities	60 kVA generator (back-up Siltbuster)	60	48	10	100	40%	0.04	21
	4 kVA mobile generator (water management)	4	3.2	10	100	40%	0.003	21

*Based on kVA to kW conversion of 0.8
**The Emission Factor for liquid fuel was used

[14] EMEP/EEA (2019) *Emission Inventory Guidebook – Small Combustion*