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SIRIUS MINERALS PLC

NYMNPA 94 - Construction Method Statement (Phase 4a)

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NYMNPA

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1 Introduction

1.1 The purpose of this document

As part of the approved 'Phase 4 Works', groundwater control was to be established within the first 120m of the Mineral Transport System shaft using diaphragm walling, as described in the Phase 4 Construction Method Statement (CMS) (40-ARI-WS-71-PA-MS-1051). Sirius Minerals has subsequently identified an opportunity to expedite this process, using a Vertical Shaft Sinking Machine (VSM). Use of the VSM offers significant construction programme benefits while not exceeding the environmental parameters that were established at Phase 4.

This document details the CMS for use of the VSM. It is recognised that this approach represents a change in construction methodology from diaphragm walling and, as such, this CMS is submitted as part of a package of documentation that forms an addendum to Phase 4, referred to as 'Phase 4a'.

It should be noted that this report does not address the health and safety implications of this technology.

1.2 Compliance with Condition NYMNPA 94

The wording of planning condition 94, and where the necessary material has been provided within the report, is set out in Table 1.

Table 1 : Details of NYMNPA Planning Condition 94

NYMNPA Condition 94	Compliance with Condition 94
Prior to the commencement of each phase of the development at Dove's Nest Farm or Lady Cross Plantation in accordance with the approved Phasing Plan, a Construction Method Statement shall be 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:	This CMS is provided for the Phase 4a Works at Woodsmith Mine only.
(i) The parking of vehicles of site operatives and visitors clear of the highway;	Section 2.1
(ii) Loading and unloading of plant and materials;	Section 2.2
(iii) Storage of plant and materials used in constructing the development;	Section 2.3
(iv) Erection and maintenance of security fencing;	Not applicable to Phase 4a.
(v) Wheel washing facilities;	Section 2.5
(vi) An outline construction method for sub-surface works including adherence to the 'rack and pillar' method of mining described in the SEI (14th	Not applicable to Phase 4a.

NYMNPA Condition 94	Compliance with Condition 94
February 2015) and the SRK Subsidence Memorandum (15th May 2013);	
(vii) Buildings and structures associated with the mine and tunnel shafts;	Not applicable to Phase 4a.
(viii) Welfare/office building and security gatehouse;	Not applicable to Phase 4a.
(ix) Screening bunds;	Section 3.7 and Drawing 40-ARI-WS-71-CI-DR-1092
(x) Hardstandings;	Not applicable to Phase 4a.
(xi) Shuttle Bus terminal;	Not applicable to Phase 4a.
(xii) Park-and-Ride layby;	Not applicable to Phase 4a.
(xiii) Emergency helipad;	Not applicable to Phase 4a.
(xiv) Lighting columns;	No permanent lighting will be installed during Phase 4a
(xv) Internal access and haul roads;	Not applicable to Phase 4a
(xvi) Domestic wastewater (foul sewage) treatment plant;	Not applicable to Phase 4a
(xvii) Non-domestic wastewater treatment plant and settlement tanks;	For Phase 4a, non-domestic wastewater, removed from the excavation, will be treated locally to the Works and discharged to the concrete lined drainage system around the MTS Shaft platform. See Section 3.5.
(xviii) Surface water attenuation ponds, settlement ponds, swales and wetland areas;	Not applicable to Phase 4a
(xix) Temporary spoil and Polyhalite storage areas;	Section 3.7 – Treatment and deposition of extractive material into the earthworks bunds
(xx) Road widening and provision of right hand turn areas;	Not applicable to Phase 4a
(xxi) Removal of any temporary structures; and	Not applicable to Phase 4a
(xxii) Formation of spoil mounds and the establishment of vegetation on them.	The formation of mounds is described in the Phase 3 CMS (40-ARI-WS-71-MS-1050) and is not reproduced for Phase 4a
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 cross refer to the CEMP in relation to any additional avoidance or mitigation measures	Section 3.8

1.3 Compliance with other relevant Planning Conditions

This CMS provides detail, in addition to that required by Condition 94, relating to the partial satisfaction of the following conditions of planning permission NYM/2017/0505/MEIA.

Table 2 : Details of NYMNPA Planning Condition 45

NYMNPA Condition 45	Compliance with Condition 45
Prior to the commencement shaft sinking or chamber formation beneath ground at the Doves Nest Farm site and in accordance with the details in the document "York Potash Project: Habitats Regulations Assessment" prepared by Amec Foster Wheeler dated June 2015 with document reference 35190CGos064R, and as updated by the HRA prepared by Royal HaskoningDHV dated November 2017 with document reference 40-RHD-WS-83-WM-RP-0001 REV4, a programme for the implementation of the following shall be submitted and agreed in writing with the MPA:	This CMS is provided for the Phase 4a Works at Woodsmith Mine only. Phase 4a represents an alternative construction methodology for groundwater control within the first 120m of the MTS shaft. As per Phase 4, the Works do not require or trigger the need for mitigation measures for adverse effects on groundwater levels within the Spring Flush area of Ugglebarnby Moor and/or the function of drinking water springs up hydraulic gradient of the site.
a. A recharge trench to promote re-infiltration of surface runoff to recharge the Moor Grit aquifer up hydraulic gradient of the source area to Moorside Farm Spring.	As per Phase 4, the Phase 4a Works would not have an adverse impact on groundwater levels for which mitigation would be necessary. A programme for implementation of the mitigation will be provided prior to the relevant subsequent construction phase.
b. Provision of groundwater drainage areas beneath bunds E and F to collect spring water issues from the Scarborough and Cloughton Formations for discharge via the mine site surface water drainage system.	As per Phase 4, groundwater drainage areas under bunds E and F are not required for the Phase 4a Works.

Table 3 : Details of NYMNPA Planning Condition 81

NYMNPA Condition 81	Compliance with Condition 81
Prior to the commencement of the chamber construction work at either DNF or LCP a Wastewater Management Scheme for the construction phase shall be submitted to and approved in writing by the MPA. The scheme shall accord with the supporting document 'Integrated Water and Wastewater Management Strategy (REP-P2-WSD-003, Rev5, 30 January 2015) and shall include:	The process proposed for management of water associated with the Phase 4a Works only is described in this CMS.
• Full details of the non-domestic waste water treatment area and settlement tanks;	For Phase 4a, non-domestic wastewater, removed from the excavation, will be treated locally to the Works and discharged to the concrete lined drainage system around the MTS Shaft platform. See Section 3.5.
• A plan showing the location of the non-domestic waste water treatment area and settlement tanks;	The water treatment system will be located within the Works area of the MTS Platform, as shown in Drawing 40-ARI-WS-71-CI-DR-1090.

NYMNPA Condition 81	Compliance with Condition 81
• Detailed estimates of the amount of non-domestic waste water to be treated and estimates of the quantities predicted to be reused within the site or used for re-injection into the sandstone aquifer;	See Section 3.5 for estimate of water in relation to the Phase 4a Works.
• Details of how the non-domestic waste water treatment facility will be managed to ensure it functions effectively throughout the lifetime of the mine, including variations in flows over the construction period;	Not applicable to Phase 4a.
• Details of the ongoing maintenance of the non-domestic waste water infrastructure;	Not applicable to Phase 4a.
• Details of monitoring arrangements of the quality of the wastewater to be re-used within the site or re-injected into the sandstone aquifer and related qualitative triggers;	See Section 3.5.
• No discharges of treated domestic or non-domestic waste water to Sneaton Thorpe Beck;	See Section 3.5.
• Domestic foul sewage and wheel-wash waste water to be tankered off-site for treatment at a licensed sewage treatment facility; and	This will be the case, as per Phase 4.
• A time table for implementation of the Waste Water Management Scheme.	Not applicable to Phase 4a.
Prior to the commencement of the Welfare Building at DNF and LCP, a Foul Drainage Scheme for the operational phase shall be submitted to and approved in writing by the MPA…	Phase 4a does not include the construction or operation of the permanent Welfare Building at either DNF or LCP.

Table 4 : Details of NYMNPA Planning Condition 87

NYMNPA Condition 87	Compliance with Condition 87
Prior to the commencement of each Phase of Construction in connection with either the mine shafts or MTS shaft, at Doves Nest Farm, a programme for the deep reinjection borehole to discharge water to the Sherwood Sandstone aquifer shall be submitted to and agreed in writing with the MPA. The formation pressures resulting from the reinjection at the groundwater borehole shall not exceed 450 psi above the initial formation pressure.	The reinjection borehole is not required as a result of the amended construction methodology that comprises Phase 4a. Details of the quantities of water to be disposed of, via surface water rather than via reinjection is provided in this CMS.

Table 5 : Details of NYMNPA Planning Condition 97

NYMNPA Condition 97	Compliance with Condition 97
Prior to the commencement of shaft sinking details of final expected internal diameters for the Production shaft, Service shaft and Mineral	Phase 4a relates only to the first 120m of the MTS shaft. The inner diameter of the excavation will be

NYMNPA Condition 97	Compliance with Condition 97
Transport System shaft shall be submitted to the MRA for written approval. Such details shall be accompanied by information demonstrating the expected total volume and tonnage of spoil and a breakdown of the volume and tonnage of the principle types of spoil expected to be generated during the sinking of each shaft and include updated information on the intended arrangements for the management of the spoil in accordance with the requirements of this permission.	8m, with the volume of extractive material being approximately 10,000m^3. See Section 3.

1.4 Scope of Work

The scope of Phase 4a described by this document is as per the following points:

1. Mobilisation to site;
2. Use of a VSM at the MTS Shaft, in place of the previously planned d-walling machines;
3. Construction of the guide wall and strand jacks for the operation;
4. Installation of ancillary equipment;
5. Machine setup and installation of VSM;
6. Excavation to -55m below shaft platform level (bspl);
7. Excavation to -120m bspl;
8. Deposition of limited extractive material from within the first 120m of the MTS shaft into earthworks bunds; and
9. Grouting of Annulus.

2 Construction Logistics Method Statement

2.1 Parking of cars

As for Phase 4, cars will be parked within the designated parking area shown on drawing 40-ARI-WS-71-CI-DR-1090, which has capacity for 58 cars. All visitors to the site will park within the designated car parks, and no parking will be permitted on the public highway.

2.2 Unloading and loading of materials

2.2.1 Unloading

The areas for storage have been planned to prevent excessive handling of material and to facilitate loading and unloading.

The principle materials to be delivered during Phase 4a comprise:

- Precast reinforced concrete liner segments;
- Bentonite powder and materials for production of concrete;
- Fuel; and
- Grout in bulk powder form.

Aggregates for the minor in-situ concrete elements (guide wall and temporary base) will be delivered in sheeted rigid and articulated tippers which will discharge their loads into the prepared aggregate bins within the concrete batching plant compound. Bulk cement powder will be delivered in tankers which unload via sealed pipelines directly to the cement storage silos within the concrete batching plant. This is the same procedure as is currently carried out on the site for other construction activities.

As for Phase 4, bentonite powder will be delivered in tankers which unload via sealed pipelines directly to the bentonite storage silos. For Phase 4a, the silos will be located within the VSM area dedicated bentonite batching plant.

Precast concrete segments will be delivered to site via the consented routes and will be delivered on flat-bed lorries. These will be unloaded using a dedicated crawler crane in the laydown area adjacent to the MTS shaft.

2.2.2 Loading

The only materials requiring loading will be fresh concrete, for internal site transportation from the batching plant to the working area, and wastes that require disposal off site. Concrete will be discharged directly from the concrete batching plant into conventional concrete trucks, which is the same as already approved under Phase 4.

Other materials requiring loading onto site transport will generally be handled using all terrain fork-lifts or telehandlers. Loading will only take place on level stable ground to minimise the risk of loads becoming unstable and spilling. The handling of materials on site will be controlled to protect land and water in accordance with Section 3.5 of the Construction Environmental Management Plan (CEMP) approved prior to commencement of Phase 4 (40-RHD-WS-70-EN-PL-0023).

As for Phase 4, any non-domestic waste water and waste bentonite slurry requiring disposal off-site will be pumped from holding tanks into road going tankers for onward transport to suitably permitted waste management facilities.

2.3 Storage of Plant and Materials

Materials will be stored in accordance with the approach established for Phase 2 and implemented throughout all subsequent phases. Where required, appropriate storage of materials (e.g. COSHH store, bunded fuel and lubricant stores etc.) will be local to the Works, within the defined work area of the VSM set up on the MTS Shaft platform.

2.4 Mobilisation

All equipment will be delivered to site via the consented routes, namely the A171 from Teesside, all HGV's will drive directly into the site and are not permitted to stop/wait on the public highway.

The contractor will utilise the existing welfare arrangement established under Phase 3 and all contractor's personnel will travel to the site in accordance with the construction traffic management plan.

Where existing Herrenknecht containers and control rooms etc. are not RAL6008, on delivery, they will be painted on site as required.

2.5 Wheel Wash

The site wheel wash will be used in Phase 4a, as for Phase 4.

2.6 Plant

In addition to the ancillary equipment listed in Section 3.2, the Phase 4a works will require a crawler crane, with a maximum jib height of 40m.

2.7 Personnel

The personnel associated with this methodology on each 12-hour shift are:

- 1 No Foreman;
- 1 No VSM Operator;
- 1 No Mechanic;
- 1 No crane operator; and
- 7 No general operatives.

3 Construction Excavation Method Statement

3.1 Construction of the guide wall and strand jacks for the operation

The construction of the guide wall is reinforced concrete that will be constructed below the shaft platform surface, to maintain alignment, wall continuity and provide support for the upper soils during excavation of the shaft with the VSM. These walls act to guide the verticality of the segmental reinforced concrete wall and to aid in the positioning of the final structure. To maintain verticality of the segmental wall and cutter, all hard obstructions and rock to a depth of 3.0m bspl will be removed within the plan area of the shaft, following which the upper 3m of segmental wall will be lowered into position.

To construct the guide walls, the following method will be followed, as shown in Figure 1:

1. Initial excavation to a depth of approximately 3m using conventional site excavators;
2. Install cutting ring and precast concrete segments to above platform level;
3. Install foam spacer around outside of cutting shoe and precast concrete to just above ground level;
4. Install reinforcement as per design of guide wall; and
5. Pour fresh concrete to ground level and allow to cure.

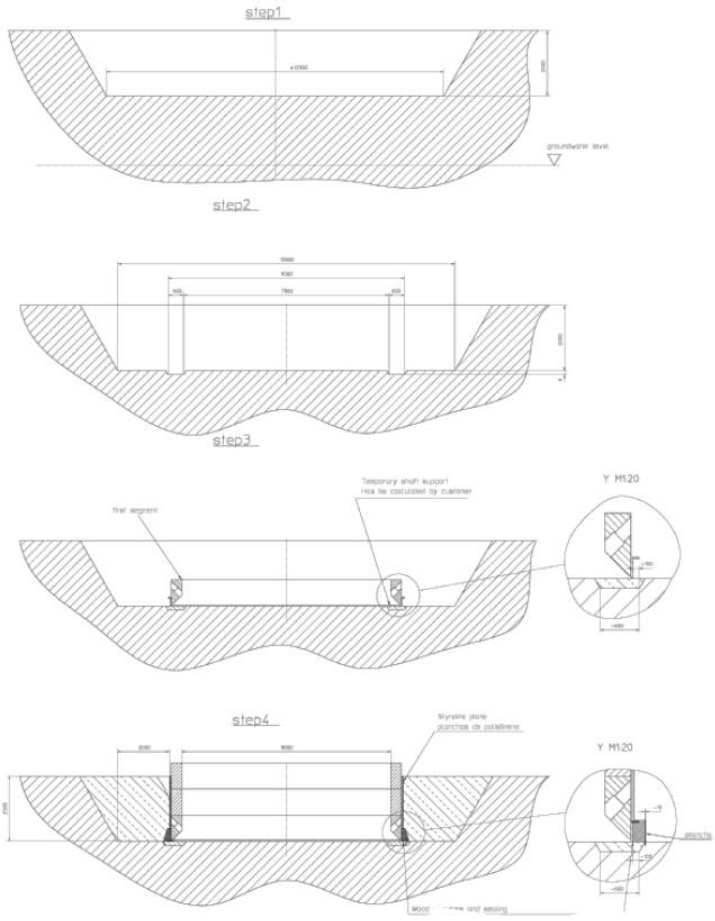

Figure 1 : Guide wall installation process

3.2 Installation of ancillary equipment

To support the excavation process, the following ancillary equipment will be installed locally to the MTS shaft location (see Figure 2 for details):

- Up to 8 No. Strand Jacks (circa 3m height) – These will be bolted to the top of the guide wall;
- 1 No. Winch Tower (circa 5m height) – This will be bolted to the guide wall;
- 3No. Pushing units (circa 4m height) – These will be bolted to the guide wall;

- 1 No. Extractive Materials Filtration (circa 6m height) – This will be located on the MTS platform adjacent to eastern bund;
- 1 No. Generator (circa 3m height) - This will be located on the MTS platform adjacent to eastern bund;
- 1 No. Control Room (circa 3m height) – This will be placed locally to the shaft; and
- 1 No. Bentonite silo (circa 5m height) – This will be located on the MTS platform adjacent to the eastern bund – Note that the image below is of two, larger silos than would be used in Phase 4a.

<table>
<tr>
<td> 
Strand Jacks</td>
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Winch Tower</td>
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Pushing unit</td>
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<td> 
Extractive materials filtration</td>
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Generator</td>
<td> 
Control Room</td>
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<td> 
Bentonite silo</td>
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Figure 2 : Ancillary Equipment

3.3 Machine setup and installation of VSM

Once the ancillary equipment is in place, the brackets that hold the VSM will be bolted to the precast rings and then the VSM will be lifted using the crawler crane and lowered into the precast rings already placed in the guide wall.

The hydraulic arms on the VSM are then extended to meet the brackets bolted to the wall and hold the VSM in position as seen in Figure 3.

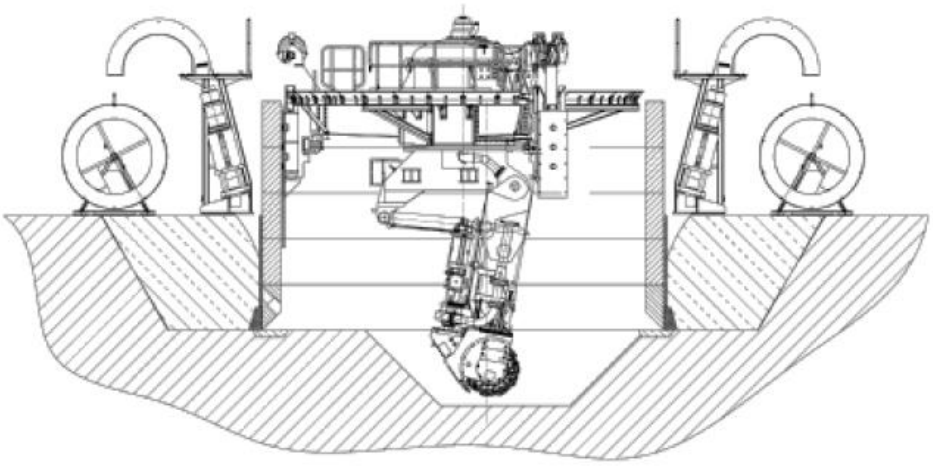

Figure 3: VSM lowered into position to commence cutting

3.4 Method of excavation to -55m bspl

The shaft will be excavated using a rotating wheel cutter bit on a radial boom that is lowered beneath the cutting shoe fixed to the base of the reinforced concrete segmental wall. This radial VSM system will cut the rock beneath the suspended wall sections to form a circular excavation. This will be undertaken with a diameter of between 10.2m to 10.4m and each time the cutter has cut the full area away, the cutter is retracted and the strand jacks used to lower the precast rings by around 1m.

Each time the precast rings are lowered, an additional layer of precast rings will be added onto the top of the system at surface level. Where possible, the rings will be lowered onto the top of the stack at the end of the day shift to minimise the level of mobile plant activity during the night shift. The shaft wall will be assembled from reinforced concrete segmental panels. Each panel incorporates rubber side gaskets that form a complete seal to groundwater ingress once assembled

Figure 4: Lifting precast rings into position

The annulus of the precast rings is filled with bentonite to ensure the stability of the excavation, to lubricate the rings and aid lowering by preventing blockages. This bentonite is pumped into the annulus just behind the cutting ring via a tremie pipe down the inside of the excavation.

During the cutting process to a depth of 55m bspl, the head of water within the excavation will be maintained at ambient groundwater level, i.e. approximately equivalent to the groundwater table in the relevant aquifer. Should significant fracture zones be encountered causing loss from the cutting zone, potable water will be utilised to maintain a minimum 10m head of water above the cutting shoe.

This process will be repeated to a depth of 55m. The cutter system will be submerged below groundwater throughout the cutting process and can work with a maximum head of 85m above the cutting boom assembly. The cutter wheels mix the arisings with the formation water and transport it to the surface by a suction pump located on the radial boom at the cutting head.

Following installation of the 9m internal diameter rings to 55m bspl, the annulus between the surface and the rock wall will be grouted to seal off hydraulic continuity between the upper groundwater tables in the Moor Grit, Scarborough and Cloughton aquifers from the toe of the excavation. This grouting will be installed by a tremmie pipe system from the base of cutting shoe to ensure a seal. A mass concrete floor plug will then be constructed across the base of this upper VSM wall section using underwater concrete.

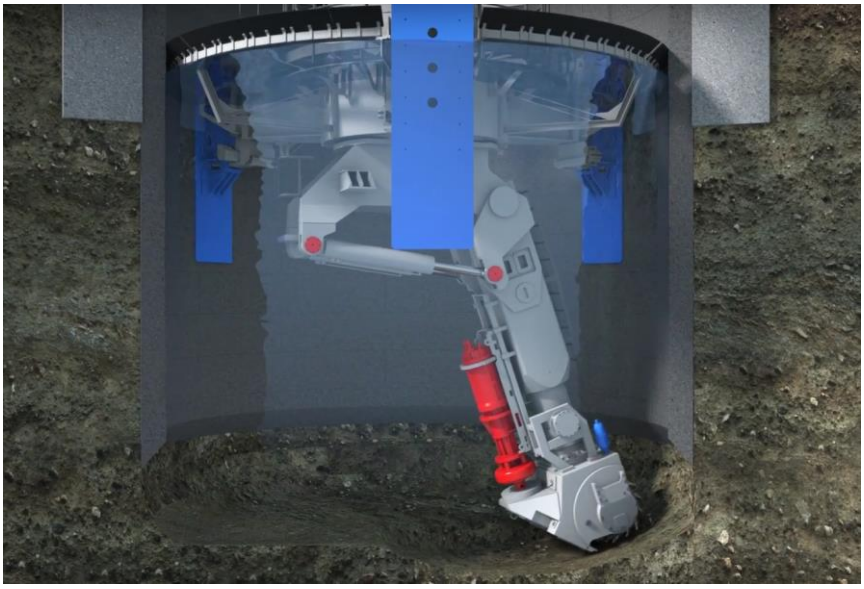

Figure 5: VSM cutting under ring prior to lowering

3.5 Excavation to -120m bspl

Once the top 55m of excavation is fully in position with the annulus grouted to seal off the upper aquifers and the base plugged with mass concrete, the VSM will be assembled into an 8m (inner diameter) set of precast rings at surface level, strand jacks will lower down the unit into the base of the 9m inner diameter excavation whilst adding precast segment to the top as per the first section. This process can be seen in Figure 6.

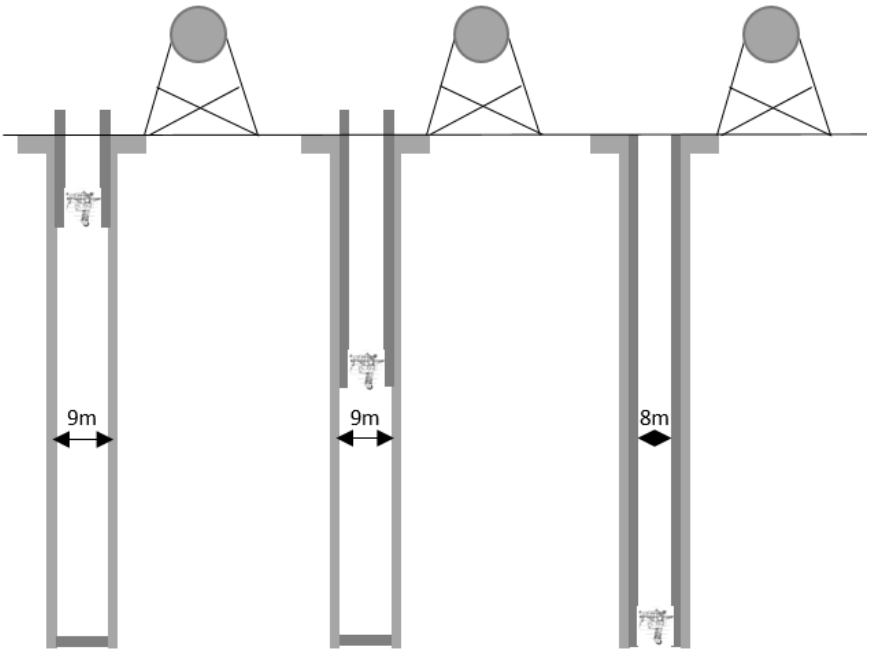

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Figure 6 : VSM being lowered to depth in 8m shaft

Once at the base of the 9m inner diameter excavation, the VSM will cut through the concrete plug at the base and proceed to construct the 8m diameter segmental wall to a depth of 120m bspl. It should be noted that during this second stage, groundwater that has accumulated in excavation to 55m bspl will remain in the excavation until the water level head above the rotating cutter head approaches 85m. If the head of water above the cutting head exceeds 85m, pumping will commence to maintain water head levels at or below the 85m bspl Water removed from the excavation during this stage would be managed to volumes below abstraction licensing requirements and would be stored for re-use.

Once the segmental lining system has been progressed to 120m bspl, the lower excavation section will be grouted, followed by proof drilling and grouting, as for the upper section. Following completion of grouting, the construction waters retained in lower shaft section from 55m bspl to 120m bspl and estimated to be in the order of 2,000m^3 to 3,000m^3, will be pumped for onsite treatment prior to discharge to the Shaft Platform surface water drainage system. The pre-treatment of these construction waters will be through the de-sander and de-silter unit, prior to passing through an oil separator and a secondary desilter unit where pH will also be balanced where necessary. From the secondary de-silter, the water would be discharged via the existing site drainage and attenuation system. Remaining within the existing constraints of not exceeding site Q-bar flow, all water would be removed from the excavation, treated and discharged over a period of up to two days. Additional water quality monitoring has been incorporated into the Ground and Surface Water Monitoring Plan (40-FWS-WS-70-WM-PL-0012) to record the quality of this discharge and enable action to be taken to mitigate adverse impacts on surface water quality in accordance with a specific Remedial Action Plan (40-FWS-WS-70-WM-PL-0013).

The process from -55m bspl to -120m bspl is illustrated in Figure 7.

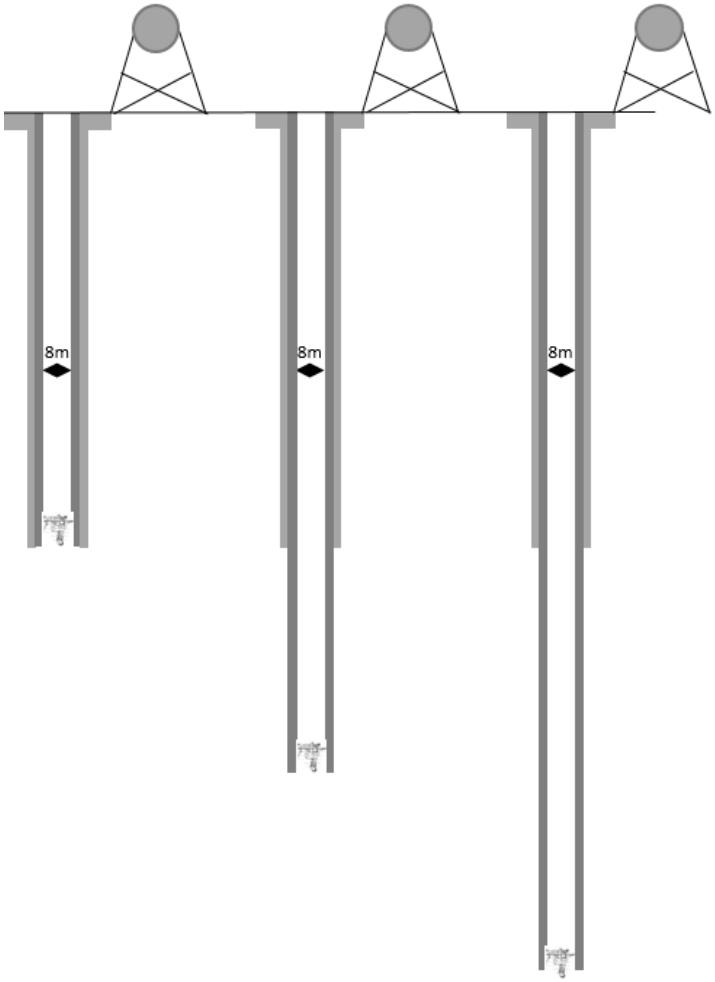

Figure 7 : VSM sinking from -55m to -120m

3.6 Grouting of Annulus

At both the intermediate -55m bspl stage and the -120m bspl stage, the annulus of the precast concrete rings will need to be grouted to seal the void and prevent any water connectivity between the different aquifers. The grout will be introduced at the base of the void via a pipe connecting to a fill hole in the lowest ring; this will allow the grout to be introduced steadily and consistently, which will displace the bentonite at the top of the void. This bentonite will be pumped off the top and removed from site.

3.7 Treatment and deposition of extractive material into the earthworks bunds

The VSM wall construction will result in the generation of approximately 10,000m^3 of extractive material. The extractive material will primarily comprise of stone from the Moor Grit, Scarborough, Cloughton, Ellerbeck and Saltwick formations and a smaller quantity of material as the extraction process is completed in Whitby Mudstone at around -120m bspl. The extractive material generated will be pumped within the water suspension from the rotating cutting heads to a cutter dedicated de-sanding unit at the surface. The material generated from this process will comprise silt to gravel sized fragments of the host rock, which will be discharged onto a concrete apron draining to a blind sump. Extractive material generated from sandstone units will comprise a free draining sand to gravel

sized material. Extractive material from the siltstone and mudstone units will comprise a rock flour / paste to gravel sized material. Following the de-sanding process, the VSM arisings will undergo further moisture content reduction, as necessary to achieve suitable geotechnical properties (i.e. lime stabilisation). Excess water drained from the rock will be recycled into the VSM excavation, where appropriate, or will be passed through an oil interceptor and a silt buster for pH buffering prior to discharge to the site's surface water drainage system.

Figure 8 : Desilting equipment separating arisings

Compliance testing will be undertaken to confirm the acceptable moisture content ranges, appropriate to cohesive and granular materials generated by the VSM process, to enable placement as a geotechnically acceptable Class 4 landscape fill. Where high moisture content is recorded, lime addition may be necessary to achieve a geotechnically acceptable material.

3.8 Construction timetable and sequence of work

The Phase 4a Works described in this CMS are scheduled to occur between June and end of December 2018. The sequence of work is as set out in the scope provided in Section 1.3 of this document.