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SIRIUS MINERALS PLC

Woodsmith Mine Phase 7 Construction Method Statement

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Woodsmith Mine Phase 7 Construction Method Statement

Contents

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1 Introduction

1.1 The purpose of this document

This document details the Construction Method Statement (CMS) for Phase 7 Site Works at Woodsmith Mine. This CMS is required to partially discharge condition 94 of the North York Moors National Park Authority (NYMNPA) planning permission NYM/2014/0676/MEIA (as subsequently varied by NYM/2017/0505/MEIA), and has been prepared in accordance with current good practice.

This CMS details the works to be undertaken during the Phase 7 Site Works at Woodsmith Mine only. Further construction method statements will be submitted to discharge condition NYMNPA 94 for subsequent phases. The CMS will remain a live document, being reviewed, and updated as required.

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 1.1.

Table 1.1 - 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 will be submitted for that phase, and approved in writing by the MPA, in consultation with the appropriate Highway Authority. Each approved Statement will be adhered to throughout the construction period. The Statements will provide for:	This CMS is provided for Phase 7 Works at Woodsmith Mine only. Other phases will have bespoke CMS documents.
(i) The parking of vehicles of site operatives and visitors clear of the highway;	Section 2.5
(ii) Loading and unloading of plant and materials;	Section 2.7
(iii) Storage of plant and materials used in constructing the development;	Section 2.8
(iv) Erection and maintenance of security fencing;	This type of work is not required in Phase 7.
(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 7.
(vii) Buildings and structures associated with the mine and tunnel shafts;	Section 3.5, Section 3.6
(viii) Welfare/office building and security gatehouse;	Section 2.4
(ix) Screening bunds;	

(x) Hardstandings;	This type of work is not required in Phase 7.
(xi) Shuttle Bus terminal;	This type of work is not required in Phase 7.
(xii) Park-and-Ride layby;	This type of work is not required in Phase 7.
(xiii) Emergency helipad;	This type of work is not required in Phase 7.
(xiv) Lighting columns;	Section 2.11
(xv) Internal access and haul roads;	Section 2.10
(xvi) Domestic wastewater (foul sewage) treatment plant;	This type of work is not required in Phase 7.
(xvii) Non-domestic wastewater treatment plant and settlement tanks;	This type of work is not required in Phase 7.
(xviii) Surface water attenuation ponds, settlement ponds, swales and wetland areas;	This type of work is not required in Phase 7.
(xix) Temporary spoil and Polyhalite storage areas;	Section 3.7
(xx) Road widening and provision of right hand turn areas;	This type of work is not required in Phase 7.
(xxi) Removal of any temporary structures; and	This type of work is not required in Phase 7.
(xxii) Formation of spoil mounds and the establishment of vegetation on them.	Section 3.7
The CMS will 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	The CMS relates to the Phase 7 Works at Woodsmith Mine only and all required mitigation has been included in a Construction Environmental Management Plan (CEMP), which is required to discharge condition 93.

Table 1.2 - 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 Transport System shaft shall be submitted to the MPA 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.	Section 3.2, Section 3.4

2 Project Overview and Description of the Works

2.1 Project overview

Sirius Minerals Plc is developing a new mine surface development south of Whitby in North Yorkshire to extract polyhalite and transfer it to a processing and port facility on Teesside (the port facility is covered by a separate consenting regime). A full and detailed description of the project can be found in the Environmental Statement.

This CMS relates to the Phase 7 Works at Woodsmith Mine only. This document builds on the CMS documents produced for Phases 1-6 and further versions of this live CMS will be produced for subsequent phases as outlined in Section 1.1.

2.2 CMS overview

The CMS provides an overview of the resource requirements and the plant and materials that are anticipated to be used during the Phase 7 Works. 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 Sirius Minerals Plc and, above all, are carried out safely and in compliance with all statutory obligations.

The works described in the method statement will be executed by three contractors:

- Carey's Civil Engineering, Principal Contractor for the excavation of the headgear chambers including the operation of the Vertical Shaft Sinking Machine (VSM) on the Service Shaft
- DMC Mining Services UK Ltd Principal Contractor for erection of their Temporary Facilities and construction of the MTS Shaft.
- Sirius Minerals acting as Principal Contractor for:
    - Construction of a dedicated building to house the dedicated surface water treatment facility
    - Associated Earthworks and Drainage

Each Principal Contractor has prepared its own Project Management Plan (PMP) in accordance with its quality management procedures. The PMP documents will be the main tools used by the contractors to manage the safety, health and environmental (SHE) aspects of the delivery of the works, including resource and materials use.

2.3 Description of the works

1. Completion of Service Shaft Headgear Chamber

These works will comprise excavation beyond 168.17m AOD (as approved under Phase 5) within the headgear chamber diaphragm wall to full depth at around 157.67m AOD and construction of the 2.5m thick concrete floor anchored down by piles. The works will also comprise the installation of a 5m sub-cellar in the base of the headgear chamber in order to facilitate the safe construction of the main mine shafts.

2. Construction of Service Shaft to 83.17m AoD

The Vertical Shaft Sinking Machine "VSM" (similar to Phase 4a) will be utilised to construct the shaft from the floor level of the headgear chamber (162.17m AOD) to 83.17m AOD, using precast concrete segmental liner. There will be a reinforced concrete guide collar at the top which will be subsequently removed in order to construct the sub-basement.

3. Excavation of Production Shaft Headgear Chamber

These works will comprise excavation within the headgear chamber diaphragm wall at the production shaft to a depth of around 158.16m AOD and construction of the 2.5m thick concrete floor anchored down by piles. The works will include the planned removal of the top sacrificial section of the deeper diaphragm walls that form the start of the main shaft. Also included within these works is the installation of a 5m sub-cellar in the base of the headgear chamber in order to facilitate the safe construction of the main mine shaft, the winder basement and the building foundations.

4. Excavation from base of Production Shaft Headgear Chamber to 83.66m AoD

These works will comprise excavation within the 120m deep diaphragm wall to a level of 83.66m AoD. This will be similar in nature to the method defined for the excavation of the Service Shaft headgear chamber within Phase 5.

5. Surface Water Run-Off Silt Treatment Facility Building

Construction of a bespoke building to house the dedicated surface water treatment facility (Siltbusters) located adjacent to the attenuation ponds.

6. Erection of temporary facilities to enable mobilisation of deep shaft sinking contractor

These works will comprise the installation of the following temporary facilities that will be required in order for the main shaft sinking contractor to begin mobilisation to site:

- Winch Houses for Service Shaft, Production Shaft and MTS Shaft
- MTS Temporary Headframe
- MTS Galloway Delivery and Installation
- Temporary Workshops and Stores
- Erection of steel headframes within the Service Shaft and Production Shaft Headgear Chambers
- Compressed Air House

7. Earthworks and Drainage

Earthworks associated with the above activities – placing of extractive material into the landscaping bunds and the installation of drainage associated with earthworks to capture and treat run off water.

8. Contingency Grouting of the MTS Shaft

As permitted under the Phase 4a works, the VSM operation is planned to take the MTS shaft to a depth of 120m. However, it is possible that the liner could become wedged or experience other difficulties that results in the shaft failing to reach the target depth. The Phase 7 Works therefore include the potential use of grouting as a contingency against this scenario.

2.4 Contractor's offices/compounds

All contractors will continue to use the facilities already established in earlier phases, namely the main site welfare facility established in Phase 3 and extended in Phase 6. Some smaller self-contained facilities may need to be established closer to certain work areas as the site develops in order to provide facilities at a suitable distance of work areas.

2.5 Parking of cars

Sirius Minerals has agreed with North Yorkshire County Council (NYCC) Highways that up to 187 additional parking spaces will be constructed at the existing NYCC Park and Ride facility at Cross Butts, Whitby; for the use of construction and, subsequently, operational employee parking.

Permission was granted in 2014 for 180 spaces at Cross Butts (Ref: NYM/2014/0864/FL). A Section 73 variation to this permission has subsequently been permitted by North York Moors National Park Authority to provide a further seven spaces (and other minor amendments).

There will be no parking on site with the exception of limited designated spaces for exceptional permitted use.

2.6 Mobilisation

All equipment, plant and materials will be delivered to site using the approved traffic routes as per the Phase 7 Construction Traffic Management Plan (Ref: 40-RHD-WS-70-CI-PL-0011).

All HGVs and abnormal loads will drive directly to site and will not stop / wait on the public highway. All storage units will be painted RAL6008 (brown/green) prior to arrival on site.

2.7 Unloading and loading of materials

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

The majority of materials requiring loading will be fresh concrete (for internal site transportation from the batching plant to the work area); the excavated soil and stone from the shaft construction 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 Phases 3, 4 and 5.

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 the appropriate section of the Construction Environmental Management Plan (CEMP) submitted for Phase 7 (40-RHD-WS-70-EN-PL-0029).

2.8 Storage of plant and materials

Materials will be stored in accordance with the approach established for Phase 2 and implemented throughout all subsequent phases.

Plant and materials will be stored in designated areas as close to the works as possible. All storage areas will be on hardstanding appropriate to the plant and materials and away from sensitive receptors. COSHH and fuel storage will be as per Pollution Prevention Best Practice measures and Construction Environmental Management Plan (CEMP) submitted for Phase 7 (40-RHD-WS-70-EN-PL-0029).

2.9 Wheel wash

Vehicles entering site will stay on hardstanding already installed in previous phases. No plant will travel off site other than by specialised plant moving transport.

Vehicles exiting the site and on-site plant will use the wheel wash as described in the approved documents for Phase 3.

2.10 Internal access routes

Haul roads and internal access routes within the Phase 7 working area will be demarcated and separated from pedestrians as per previous phases. Speed limits will be enforced as per the site wide limits.

2.11 Lighting columns

No permanent lighting columns will be installed in this Phase of Works. Only temporary task lighting will be used, as described in the CEMP (Ref: 40-RHD-WS-70-EN-PL-0029).

3 Construction Method Statements

3.1 Completion of Service Shaft Headgear Chamber

The service shaft headgear chamber will be excavated to a depth of 157.67m AoD by using two number 22 tonne excavators, one number 35 tonne excavator, and a 160-tonne crawler crane and gantry system. The excavation area will be within the circular diaphragm walls installed previously under the permitted Phase 4 activities. Material will be removed from the excavation using skips lifted to the surface where it will be transferred to a tipper truck (moxi) and stockpiled for re-use on site.

During excavation, to maintain a dry working area, any water (either from rainfall or from water trapped within the diaphragm wall) accumulating will be pumped from a sump to a settlement facility. Should groundwater be encountered, it will be pumped to a settlement tank at surface level for particulates to settle and, in the unlikely event it is necessary, pH balanced, before being passed through an oil/water interceptor and discharged to the surface water drainage system, under the same methodology as used in Phase 5. Water will be pumped from the excavation at a rate not exceeding 50m^3 per day, for a duration of less than six months in total. A water meter will be installed to monitor rate of pumping.

On completion of the excavation and the installation of the main shaft to 83.17m AoD via the VSM Method (see Section 3.2), the sub cellar will be constructed by excavating locally to a level of 154.67m AoD in the area of the sub cellar allowing for a safe angle of repose on the excavation. The already constructed deeper shaft will be protected against falls from height throughout the process.

Once localised excavation is completed, the sub collar foundation and walls will then be created by installing reinforcement. Shutters will be installed and lifted into position by the mobile crane. The concrete will be poured from either a concrete pump or concrete skip lifted by the mobile crane. The shutters will be removed by the crane. Site won, non-waste material will be used as backfill to the winder building foundations after being temporarily stockpiled in the Bund C area.

During these activities, significant water ingress is not expected as the diaphragm walls will seal off the groundwater, however if small amounts from the remaining ground are encountered, then localised sump pumping will be utilised to keep the excavation dry.

Once the excavation reaches a depth of 157.67m AoD, a piling rig similar to Figure 6 will be lowered into the headgear chamber in order to install the piles. The piles will consist of 600mm diameter cast in situ reinforced concrete piles expected to penetrate through the Eller Beck Formation into the Saltwick Formation below, the maximum length of these piles will be 37m, there will be no more than 140 piles in each foreshaft, see Figure 1 for details. No support fluid will be needed for this as the piles will be a mixture of open bore and steel casing.

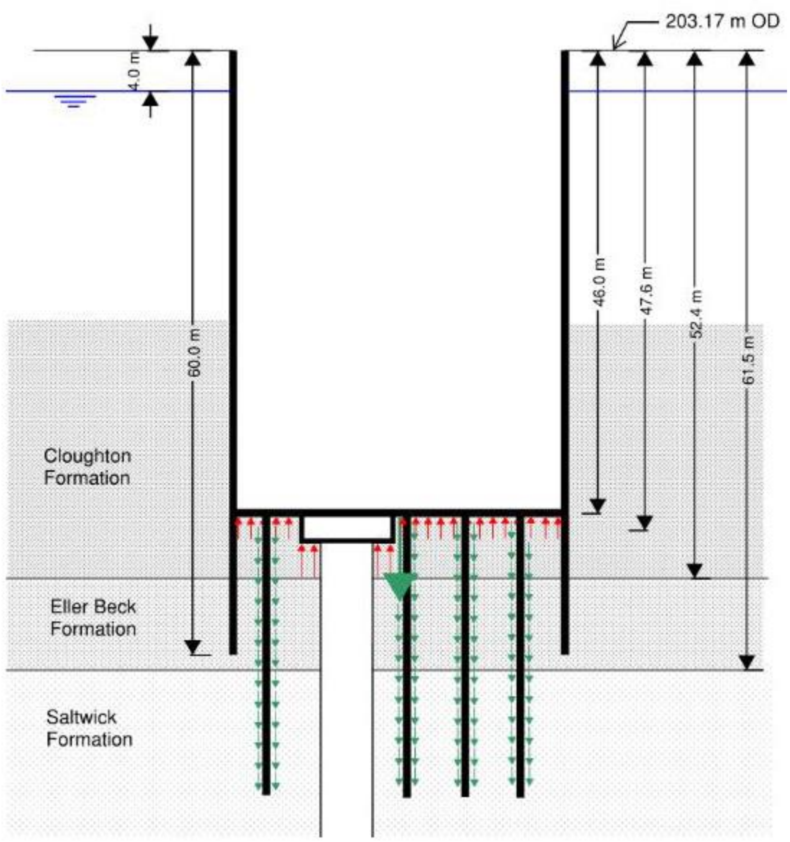

Figure 1 - Section through piles in base of foreshaft

On completion of the sub collar, the piles will be cropped by mechanical breaking methods to a cut off level and more reinforcement will be placed for the construction of the reinforced concrete floor. Concrete will then be placed via up to 3 no mobile concrete pumps in order to ensure the operation is completed in a minimum timescale.

There is a low risk that during excavation, water pressures in the Saltwick formation will cause issues with the stability of the base of the chamber, water pressures in the Saltwick formation are currently being monitored via Piezometers installed through reservation tubes in the diaphragm wall to determine if this is the case. The current water pressured being monitored do not present a concern however it is noted that rainfall in recent months has been very low. If this water pressure were to present a concern it may be required to install pressure relief wells, should this be the case the requirement for an abstraction permit will be discussed with the Environment Agency as applicable.

3.2 Construction of Service Shaft to 83.17m AoD via VSM Method

The main shaft will be constructed to 83.17m AoD via the use of a Vertical Shaft Sinking Machine. The method used will be similar to that approved in the in Phase 4a Construction Method Statement (40-SMP-WS-7100-PA-MS-00001) with the exception of the following variations:

1. The internal diameter of the shaft will be 7.25m and the wall thickness will be circa 450mm, the annulus will be 100mm hence the outer diameter (OD) of the excavation will be 8.25m.

2. Due to the VSM being utilised from the base of the headgear chamber, it will be paramount to optimise safety by having as much activity carried out from surface level as possible, therefore the minimum amount of equipment possible will be positioned in the base of the foreshaft, this will comprise the Strand Jacks, Energy Tower, Recovery Winches and minor ancillary equipment.

3. Once the excavation of the headgear chamber reaches a level of around 164.17m AoD, the guide collar will be locally excavated and cast, this is expected to be approximately 2m deep, hence local excavation to around 162.17m AOD will be required.

4. The VSM will be installed in the liner similar to that outlined in Phase 4a (See Figure 2), however the liner will be constructed from precast concrete segments as opposed to the cast in situ liner utilised in Phase 4a. The fundamental reason for this change is to optimise safety as less work is required to be carried out in the base of the headgear chamber.

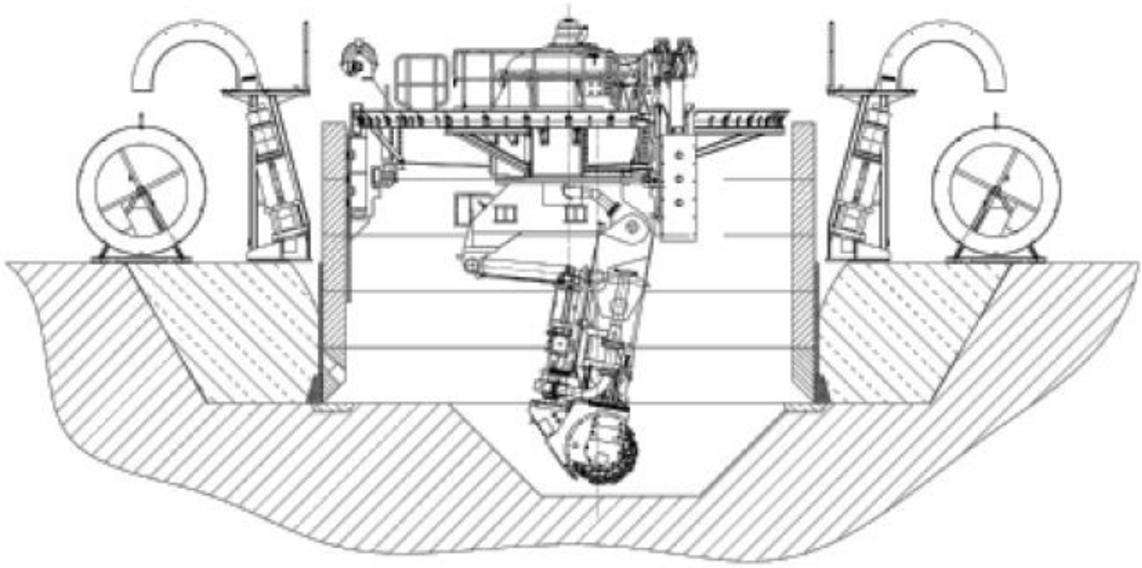

Figure 2 - VSM lowered into position to commence cutting

5. On completion of the shaft to a depth of 83.17m AoD, the guide collar will be removed to achieve the excavation depth of 157.67m AoD as outlined in Section 3.1. The top rings will also be removed in order to facilitate the construction of the sub cellar described in Section 3.1.

6. On completion of the shaft, the annulus of the liner will be grouted, with the 'SeaJack' lubricant displaced and removed to temporary storage for ultimate removal from site.

7. Once fully grouted, the remaining water in the shaft will be pumped to a settlement tank at surface level for particulates to settle and, pH balanced, before being passed through an oil/water interceptor and discharged to the surface water drainage system, under the same methodology as used in Phase 4a.

3.3 Excavation of Production Shaft Headgear Chamber and Winder Foundation

The Production Shaft Headgear Chamber will be excavated to a depth of 158.16m AoD and construction of the 2.5m thick concrete floor anchored down by piles.

The methodology of this excavation will be largely similar to that outlined in Section 3.1 and the methodology for the Service Shaft headgear chamber within Phase 5 with the exception that there will also be demolition of the sacrificial portion of the inner diaphragm wall being required. This demolition will be a mixture of removal by hydraulic breaker and by cutting into sections and removing via the service crane. The concrete will be crushed on site for re-use as access roads and laydowns with the reinforcement removed and disposed off site.

The winder foundation on the northern side of the shaft will be excavated and concreted in exactly the same manner as the service shaft winder foundation in Phase 5, as will the foundation for the main building to a depth of around 201.66m AoD.

3.4 Excavation from base of Production Shaft Headgear Chamber to 83.66m AoD

Upon completion of the activities outlined in Section 3.3, the excavation will continue to a depth of 83.66m. The ID of the diaphragm walls is circa 8.25m therefore smaller plant will be utilised.

The excavation will proceed using an 8t excavator and material will be removed from the excavation using skips lifted to the surface where it will be transferred to a tipper truck (moxi) and engineered into the landscaping bunds on site.

During these activities, significant water ingress is not expected as the diaphragm walls seal off the groundwater, however if small amounts from the remaining ground are encountered, then localised sump pumping will be utilised to keep the excavation dry. Water will be pumped from the excavation at a rate not exceeding 50m3 per day, for a duration of less than six months in total. A water meter will be installed to monitor rate of pumping.

3.5 Surface Water Run-Off Silt Treatment Facility Building

In order to better control the quality of the site surface water runoff it is proposed to construct a small building adjacent to the attenuation ponds to house the equipment. The building will be clad to suit the surroundings as shown in Figure 3 and Figure 4.

3.5.1 Building Foundations

The foundation of the facility will require some 0.5m-1m of excavation to create a level platform for a 0.3-0.75m thick concrete slab. A 1.5m deep wedge pit will be required to allow the removal of the separated solids.

Once localised excavation is completed, the foundation will then be created by installing reinforcement. Shutters will be installed and lifted into position by a 50t mobile crane. The concrete will be poured from either a concrete pump or concrete skip lifted by the mobile crane. The shutters will be removed by the crane. The foundation concrete will be supplied by the onsite batching plant.

The area will be inspected by an Archaeologist and Ecologist prior to stripping topsoil and the material will be managed in accordance with the Phase 4 Soil Management Plan (40-FWS-WS-70-CI-PL-0003).

3.5.2 Building Superstructure

The building superstructure will be a steel portal frame sized to suit the equipment, the ridge height will be no more than 10.5m above surface and the building will be clad in timber materials to suit the wooded backdrop of the National Park (see 3 and 4).

Figure 3 - Siltbuster Building Northern Elevation

In order to construct the building superstructure, the materials will be delivered to site and driven directly down to the facility location where they will be offloaded into position using a 100t mobile crane.

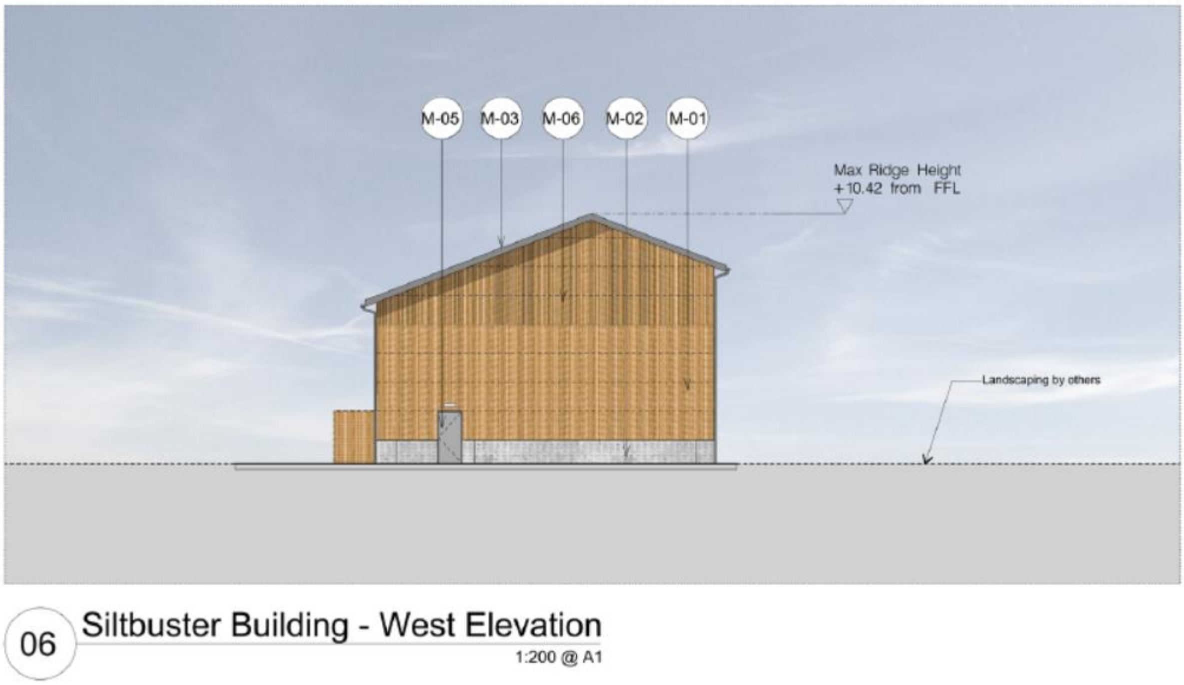

Figure 4 Siltbuster Eastern Elevation

3.6 Erection of temporary facilities to enable mobilisation of deep shaft sinking contractor

This section will describe the construction of the temporary facilities required in order for the main shaft sinking contractor to begin mobilisation to site:

- Winch Houses for Service Shaft, Production Shaft and MTS Shaft
- MTS Temporary Headframe
- MTS Galloway Delivery and Installation
- Temporary Workshops and Stores
- Erection of steel headframes within the Service Shaft and Production Shaft Headgear Chambers
- Compressed Air House
- Ventilation Buildings

3.6.1 Foundations

There will be two fundamental forms that the foundations will take depending on the detailed design and specific geology of the location:

1. Willow foundations will be used where the design permits as a preferred option, this will require excavation of up to 2.5m and reinforced concrete foundations cast using concrete from the on-site batching plant. The excavation will be carried by traditional excavators of around 25t and the extractive material will be placed into the landscape bunds on site. A typical profile of the foundation is shown in Figure 5.

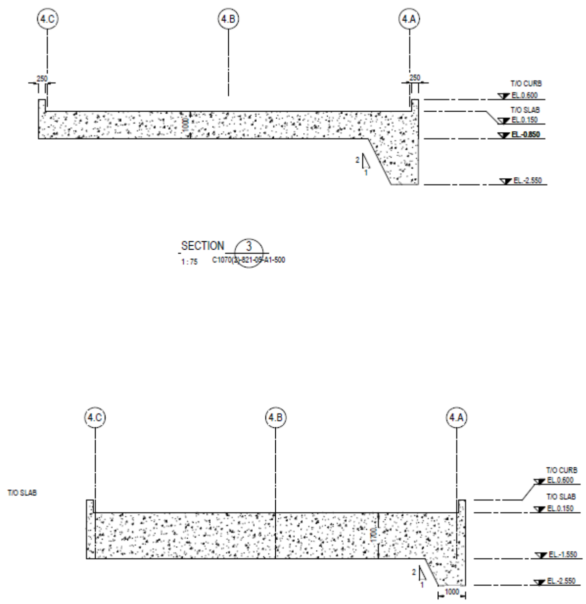

Figure 5 - Typical willow foundation detail

2. Piled foundations will be used where the detailed design determines that a willow foundation is not capable of carrying the loads required. Piles will be around 600mm in diameter and extend to depths of no more than 20m. In order to install the piles, a temporary steel casing will be used in the softer materials and the bore will be self-supporting in the harder materials, so no support mediums will be required. Once the pile is augured to depth, the reinforcement cage will be installed and the concrete will be placed via a tremmie pipe to base of the pile. In order to facilitate this operation there will be one piling rig (see Figure 6) and one attendant excavator of around 20t.

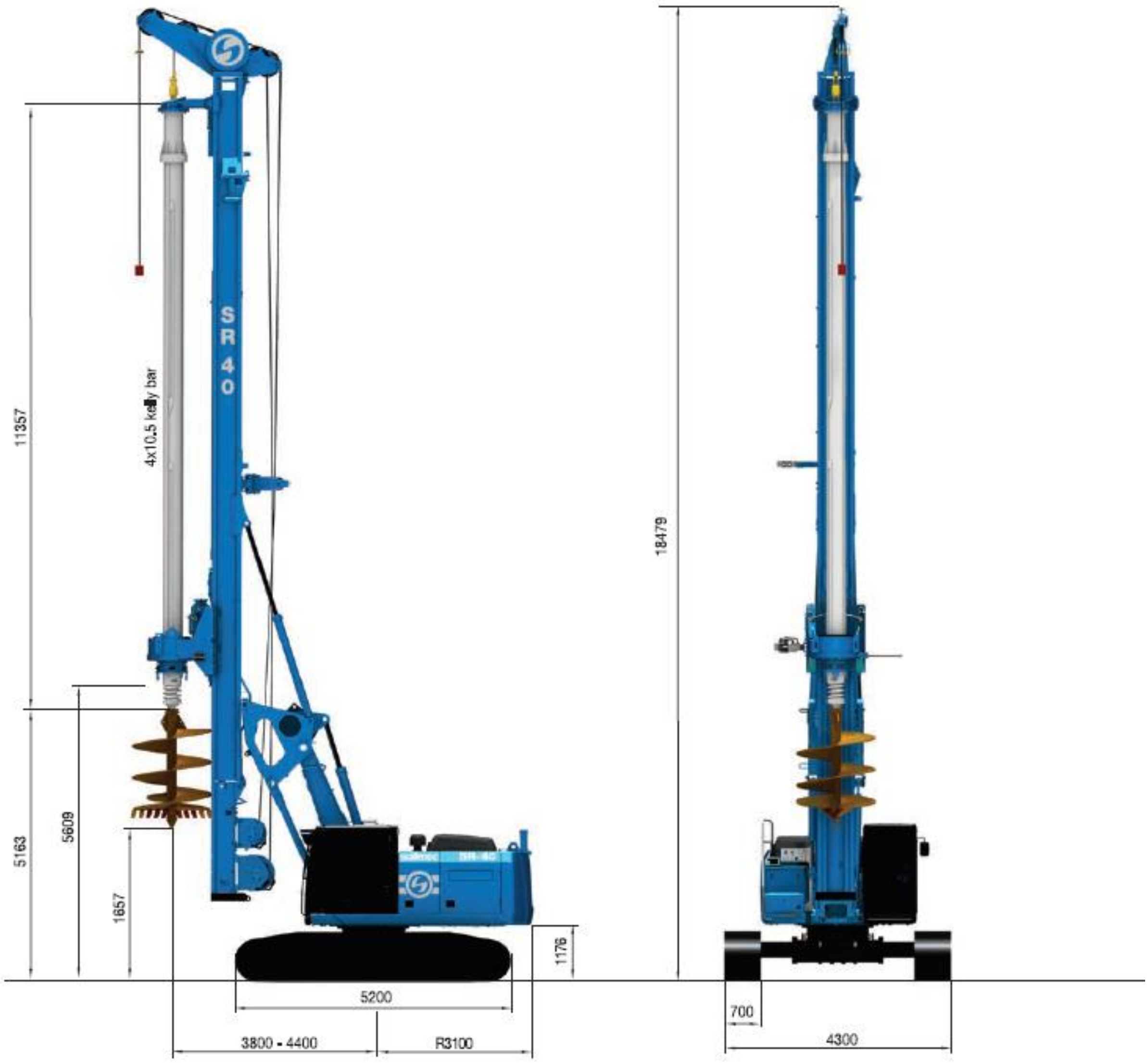

Figure 6 - Typical size of piling rig (Soilmec SR-40)

3.6.2 Headframe Superstructure

The headframe will be a standard steel sinking style headframe which will be erected over the foundations constructed during the collar construction phase. It will house the sheaves for the sinking winches and mucking winches. It will also house two sets of collar doors, an upper section that will sit flush with the concrete floor and a lower section that will sit in the sub collar. Having two sets of doors allows surface work at the collar to be completed and still have a set of doors covering the workers below. A good example of this is when loading and unloading ground support, loading in concrete etc. The sub collar will house the plumb bob winches which will be controlled by the deckman and will serve as an access point for the services that will be installed in the shaft.

Once the headframe is constructed, it will be fitted with the proper electrical stops, lighting, safeties, heating, and communications required to accommodate the sinking operations.

The collar house will be located in such a manner that it faces the shaft doors. This will provide easy access for equipment and materials during the sinking operations. A 10-20 Tonne overhead crane will also be installed in order to move materials and equipment around during operations. Attached to the head frame will be the surface dumps which will dump to ground on a concrete pad just outside the head frame, on the opposite side from the collar house access doors. A loader and dump truck will then take the material to its designated storage location.

The headframe steel crew will transfer over to the winch building and begin construction there. The outer shell of the building will be completed and stop momentarily when the roof is ready to go on. This is required in order to install the winch and winch components, which will be lifted into the winch building before the roof is installed via a mobile crane. This will give the crane operators enough space and area to safely land the winch and winches onto their respective foundations.

The services building will be incorporated within the winch building. This configuration will reduce the overall site footprint and allow the services to remain in close proximity to the winch and shaft limits. Final layout and sizing to be determined based on final demand calculations.

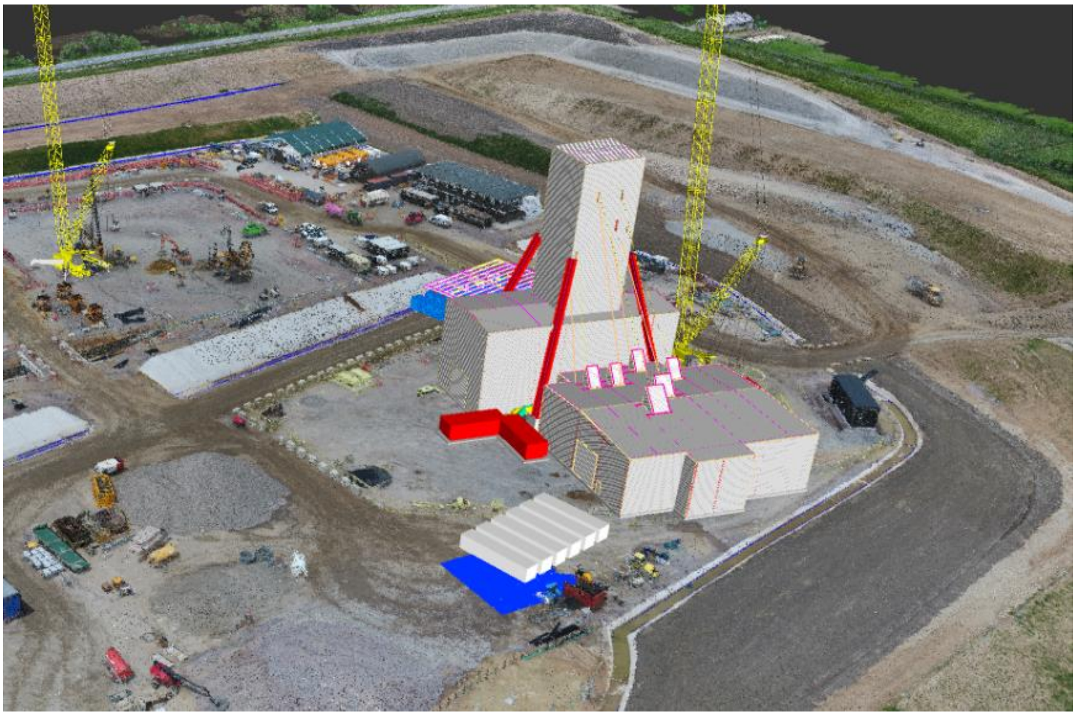

Figure 7 - Impression of Site Layout (Note Cladding will be RAL 6008)

The headframe and associated building will be clad in materials coloured RAL 6008 to match the other temporary facilities and, in doing so, seek ti minimise any potential visual impacts. The headframes will not be more than 45m above platform level.

3.6.3 Galloway installation - MTS Shaft

Some parts of the Galloway will be pre-assembled in the fabrication shops for delivery to site by conventional flatbed lorries and container lorries for the smaller items. When at site the Galloway will be built on surface in sections from the bottom up and then winched into the MTS shaft for assembly of the complete Galloway in the shaft bottom. The Galloway ropes for suspending the Galloway in the shaft will then be installed and, when suspended, will be balanced and tested.

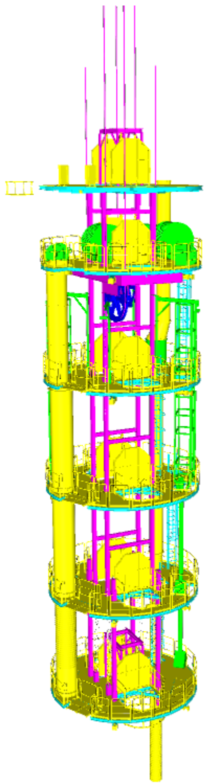

Figure 8 - Design of Galloway

3.6.4 Temporary Winch houses

The temporary winch houses are required to house the temporary winches that are solely for the purposes of shaft sinking. The buildings will be clad in simple RAL 6008 cladding and a plan and section of the buildings is shown in Figure 9 and the location is shown on drawing 40-ARI-WS-7100-CI-18-01005.

There will be a need for a variety of other temporary, small structures to facilitate construction such as compressed air houses, ventilation houses and workshops; all of these structures will be constructed in accordance with best site practice (ie. use of RAL 6008 cladding and keeping building sizes to a minimum).

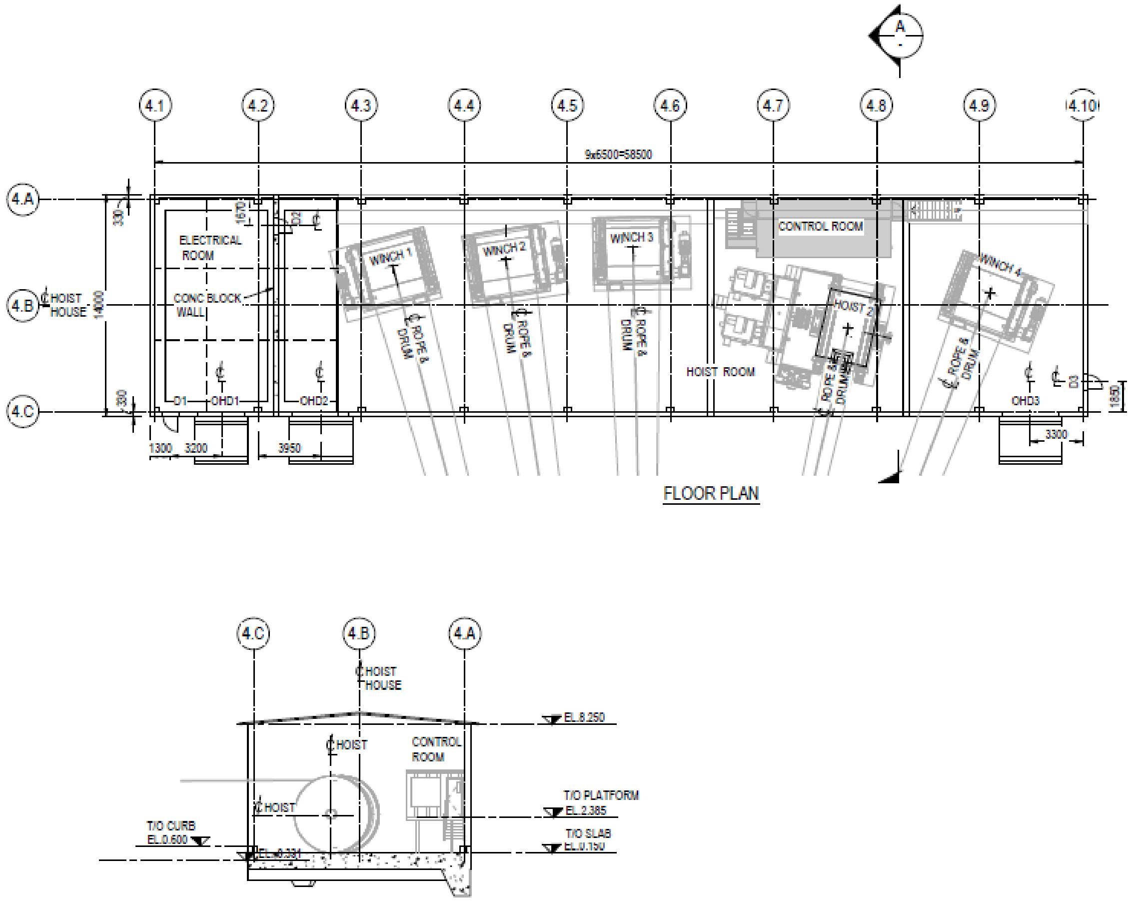

Figure 9 -3 Plan and Section of Winch House

3.7 Earthworks and Drainage

3.7.1 Earthworks

This Phase of works will generate extractive material that will require storing on site, a summary of the material expected to be generated and the destination in this phase is included below:

Source	Estimated Volume (m^3)	Temporary / Permanent Storage	Destination
Service Shaft Foreshaft	43,750	Temporary	Bund C Area
Production Shaft Foreshaft	37,400	Temporary	Bund C Area
Service Shaft Main Shaft	4,000	Temporary	North West Corner (As per D Walling)
Production Shaft Main Shaft	5,100	Temporary	Bund C Area

Inert material generated during the excavations will be temporarily stockpiled in the ‘Bund C’ area to the south west of the site. Any lower material classified as landscape fill material with a low pollution potential extracted during this phase will be temporarily stockpiled on site in a bunded area for placement in future phases.

3.7.2 Preparation of Initial Extractive Material Placement Area

The works include the preparation of an initial area for the placement of extractive material in future phases as shown in Figure 10. No landscape fill material with a low pollution potential will be permanently placed during this phase. The works during this phase include constructing a toe consisting of inert material to the base of the eventual bund as shown on drawing 40-ARI-WS-7100-CI-18-01011. This will enable landscape fill material with a low pollution potential to be permanent placed against this inert toe in later phases.

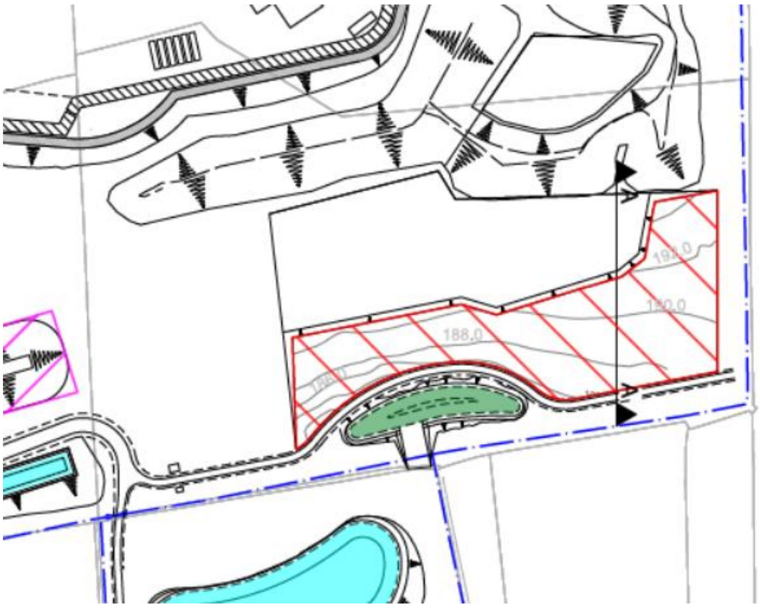

Figure 40 - Area of bunding formed in Phase 7

All material will be handled in accordance with the Soil Management Plan approved as part of Phase 4 (40-FWS-WS-70-CI-PL-0003.)

3.7.3 Drainage

In order to capture and treat any run off from the bunds formed in this phase, a basal drainage layer will be installed and piped to the surface water swale that is located to the base of the eventual bund as shown on drawing 40-ARI-WS-7100-CI-18-01007 (Extract in Figure 11).

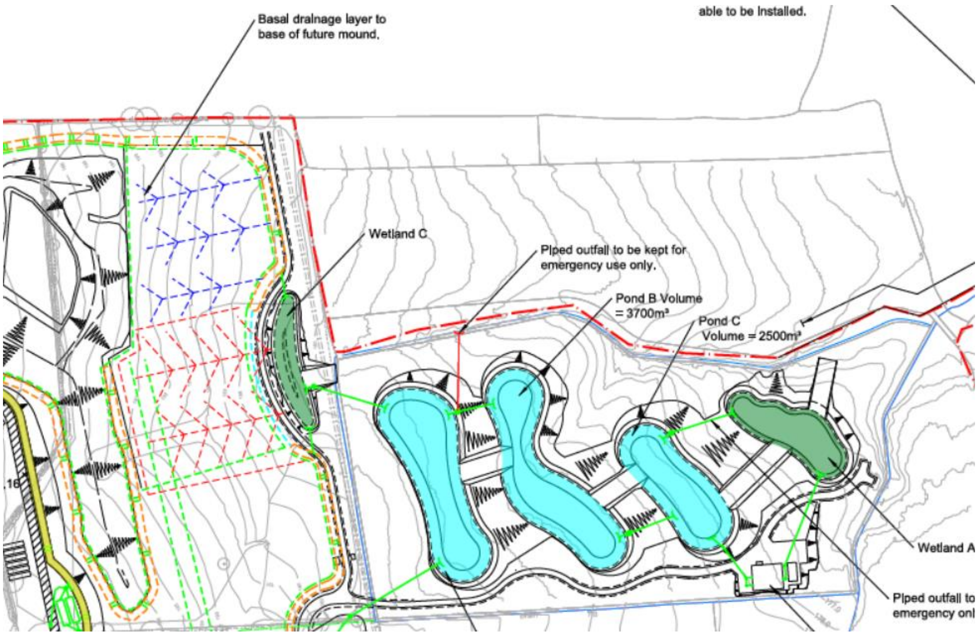

Figure 11 - New drainage for bunding in Phase 7

3.8 Contingency Grouting of MTS Shaft

As outlined in the submission for Phase 4a (40-SMP-WS-7100-PA-MS-00001), the VSM operation is planned to take the MTS shaft to a depth of 120m however it is possible that the liner could become wedged or experience other difficulties that results in the shaft failing to reach the target depth, as a result it may be required to cease the VSM operation and grout from that level through the water bearing strata.

Once the shaft has reached its final depth (wherever this may be due to the contingency nature of this scope), the fractures in the ground will be grouted to seal against water ingress whilst the drill and blast methodology is used to proceed through the rock (to be discharged separately).

3.8.1 Grouting Layout

The grout layout comprises a series of primary, secondary and possibly tertiary holes, depending on the lugeon testing results during grouting. The preliminary layout of grout holes is outlined in Figure .

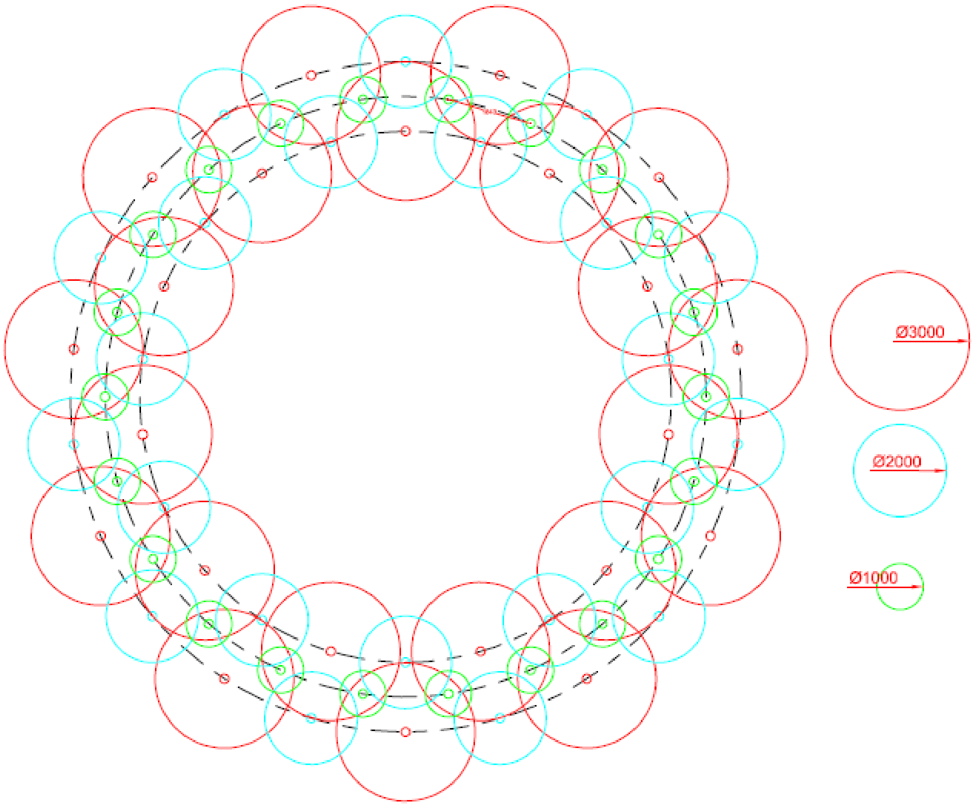

Figure 12 - Preliminary Design of Grout Hole Layout

3.8.2 Grout Drilling Process

The grout holes are 100mm to 150mm diameter and extend to a depth of 80.66m AoD. The grout holes may (subject to detailed design) be drilled in an inclined manner in order to intercept more of the vertical fractures.

Due to the level of fractured ground, the drilling and grouting will initially (primary) descend in 5m stages to mitigate water/grout loss and bore collapse.

If necessary, these stage lengths can be shortened (i.e. drilling may cease if persistent water loss / no returns and grouting will be performed before further drilling).

3.8.3 Grouting Materials

The grout used is expected to be a cement based grout (either standard or microfine cement or a mixture to achieve target permeability), with typical 1:1 (Cement : Water) ratio, expected additives to be used are:

- Superplasticiser
- Anti Washout

The grout hole layout is a triangular grid which should allow the grout to extend an approximate radius from the borehole as shown in Figure 12. Only potable water should be used for the grouting operation and not recirculated water.

The grout injection pressure will be selected by the hydrofracture test, in accordance with BS5930:1999+A2:2010, section 25.5.1. The maximum grout stage length is 3m length. Before the stage grouting begins, a 5 minute pre-treatment permeability test will be carried out using an in-situ-packer for each stage, in accordance with BS5930:1999+A2:2010, section 25.5.1 using a target pressure of 10 bar. Grout will be injected at a pressure of up to 0.5 bar per meter depth.

Following grouting, a 10 minute post-treatment permeability testing using an in-situ packer will be required for each stage using a target pressure of 10 bar. The process should be repeated if further treatment is needed, in decided areas. On completion of treatment, the holes will be backfilled with the same grout mix as used for the curtain grouting. The tremie pipe should be taken to the base of the hole to ensure it is fully grouted.

The following parameters will be adopted for the fissure grouting process:

- Cement – Eg (Microcem 650, with 1% Rheobuild2000PF superplasticiser)
- Water/Binder Ratio – 1.0
- Treatment technique – stage grouting via a top-hole packer / down hole packer. 3m grout stages.
- Pre-treatment permeability testing – All stages to be simple water tested
- Post-treatment permeability testing – 7nr boreholes
- Target permeability – 1 x 10-7 m/s
- Grout pressure – 0.5 Bar / depth (maximum 20 Bar)
- Grout flow rate – Variable, subject to grout pressure.
- Termination criteria – Grout pressure, grout surfacing or flow (see Grouting control section)

Should any voids greater than 300mm be encountered, our grouting method would be modified and more viscose grouts used to “bulk infill” the voids.

When grouting commences from the upper level, there will be an overlap of grouting holes to ensure full coverage of grout.

3.8.4 Grouting Control

In order to ensure that the grout used does not disperse outside of the desired area, the Grouting Intensity Number (GIN) method will be implemented. The GIN method for cement grouting rock masses is derived from the ground investigation and is designed to introduce additional stop criteria to ensure that the spread of the grout is limited to tens of metres. This approach has been successfully implemented on several environmentally sensitive sites across the UK. The main features unique to the method are:

1) a single, stable grout mix for the entire grouting process with superplasticizer to increase penetrability;

2) a steady low-to-medium rate of grout pumping;

3) the monitoring of pressure, flow rate, volume injected, and penetrability versus time in real-time by PC graphics; and

4) the termination of grouting when the grouting path on the displaced pressure versus total volume (per metre of grouted interval) diagram intersects one of the curves of limiting volume, limiting pressure, or limiting grouting intensity.

3.8.5 Drilling Water

Water used in drilling will be passed through settlement tanks, siltbusters and a sand filter and re-used as far as practicable, however when water quality deteriorates beyond that required by the grouting contractor the “used” water will be bled-off and tankered off-site for disposal off site, and the tanks will be refilled with fresh water.

3.8.6 Verification

Verification tests will be carried out to prove the specified permeability. These will be Lugeon tests carried out in accordance with BS 5930:1999, Section 25.5 with a target pressure of 10 bar.