STABILITY RISK ASSESSMENT
MIDDLETON QUARRY, POLLINGTON
PINFOLD LANE, DN14 0EZ

Prepared for: AA Environmental Limited

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1 INTRODUCTION

In November, ASL was instructed by AA Environmental Limited (AAe) to undertake a Stability Risk Assessment (SRA) in support of a planning application.

A draft hydrogeological risk assessment was prepared in February 2021 by McDonnell Cole ref 1763-HRA-01 at the request of AA Environmental Limited (AAe) to support a proposal to remediate an area of unauthorised waste and restore the remainder of the quarry.

It is understood that the wider site restoration will comprise inert landfilling after the installation of a Geological Separation Layer (GSL). It is understood that following restoration the site will be used for an agricultural/amenity end use.

The scope of works for this project was set out in ASL proposal reference 270-22-640.elo.4255 dated 27th October 2022 which was formerly accepted by AAe in their completed Project Award Form dated 11th November 2022.

The purpose of the Stability Risk Assessment (SRA) is to support a permit application to dispose of inert waste and to restore the site to landscaped ground. This SRA does not address the remediation process to the area of unauthorised waste in the north-east, but instead presents the methodology adopted, sources of information used, and the results of the stability analyses undertaken to restore the remainder of the quarry.

A separate methodology will be required to remove waste to natural ground from parts of the existing landfill in the north-east of the site where it is higher than the proposed GSL.

The methodology adopted for this SRA generally follows the principles outlined in the Environment Agency R&D Technical Report P-385, volumes TR1 and TR2 together with additional analytical techniques as appropriate.

This report has been prepared for the sole benefit of the Client, AAe and their representatives and agents. The report has been written based on the results of data searches and site conditions encountered at the time of the assessment. Future changes in legislation and advances in current best practises or provision of more detailed design proposals will result in this report requiring review and possible further assessment after the date of issue. The general notes section within this report should be noted in relation to the limitations of this assessment.

2 SITE DESCRIPTION

The site is located directly to the south of Heck and Pollington Lane directly to the north-west of the village of Pollington and can be located approximately by National Grid Reference SE 612 200. A site location plan is presented as Figure 1.

The site is understood to comprise a disused sandstone quarry and comprises a roughly ‘L’ shaped parcel of land with maximum dimensions of approximately 380m by 250m, with the long axis aligned approximately east to west.

The main portion of the site, located in the west, is generally rectangular in shape with dimensions of approximately 250m by 210m, with the long axis aligned approximately north to south. There is an additional area in the north-east which extends along the southern side of Heck and Pollington Land, with this area roughly rectangular in shape with dimensions of approximately 170m by 70m, with the long axis aligned approximately east to west.

It is understood that the north-eastern portion of the site was subject unauthorised landfilling during the early 2000’s and that the waste remains present on-site.

The ground level along Heck and Pollington Lane is around 14m to 15m AOD, with ground levels along the south-eastern boundary of the site indicated to be approximately 7m AOD.

Ground levels have been reduced across the main portion of the site associated with the extraction of sandstone. The HRA indicates that sandstone has been extracted to a depth of -1m AOD in the northwest of the quarry and to less than -5m AOD in the south. An area of undisturbed sandstone remains in the central southern area.

Across the north-east of the site, ground levels are indicated to be between approximately 5m and 10m AOD.

The ground surface across the site indicated to be generally undulating and generally surfaced with scrub vegetation and mature trees. Existing slopes are present along the boundaries of the main site area, which are assumed to be associated with the historical quarrying activities.

The site is bound to the north by Heck and Pollington Lane with undeveloped and agricultural land beyond together with limited commercial land uses. The site is bound to the west and south by undeveloped land and agricultural land, respectively. The land to the west also appears to have been subject to historical quarrying activities. Residential properties and areas of undeveloped land are present directly to the south-east, with Pinfold Lane present directly to the east.

Areas of industrial land uses are present in excess of approximately 50m to the east and 100m to the west and north-west.

A sewage pumping station and public water supply borehole are present approximately 20m to the north of the site.

It is understood that proposed earthworks/filling operation are to be completed to remediate the area of unauthorised landfilling in the north-east and to restore the remainder of the former quarry by inert landfilling. The proposals for the site are presented on the drawings included in Appendix I.

3 GEOLOGICAL SETTING

The British Geological Survey (BGS) Sheet No. 79 – 'Goole' (Solid Edition and Drift Edition) and the BGS Geoindex indicates the perimeter of the site to be underlain by drift geology compromising Lacustrine Beach Deposits. The Lacustrine Beach Deposits is generally described as 'comprising mainly sand with subsidiary gravel. Shingle, sand, silt and clay; may be bedded or chaotic; lacustrine beach deposits may be in the form of dunes, sheets or banks' by the BGS. The thickness of the drift deposits is not defined by the BGS in the vicinity of the site however, they are anticipated to be of relatively limited thickness.

The Lacustrine Beach Deposits are indicated to be absent across the majority of the site and it is assumed that these materials are likely to have been removed as part of the former quarrying activities.

The drift deposits and the majority of the site are indicated to be underlain by solid geology comprising the Sherwood Sandstone Group. The Sherwood Sandstone Group is described as 'sandstone, red, yellow and brown, part pebbly; conglomeritic in lower part, with some subordinate red mudstone and siltstone' by the BGS. The BGS indicates that the Sherwood Sandstone Group is up to 1500m in thickness. Information provided within the HRA indicates the Sherwood Sandstone Group to be in excess of 450m in thickness in the vicinity of the site.

The HRA indicates that the BGS holds details of borehole records for the public water supply boreholes, currently operated by Yorkshire Water, directly north of the site. The available records are for the older wells from the early 1900s and from 1952. The records indicate sandstone is recorded to depths of 600 feet (183m).

In addition to the published geology, it is anticipated that Made Ground materials of limited thickness may be present at the surface across the main site area. In the north-east of the site, it is understood that Made Ground materials associated with unauthorised landfilling are present.

4 BACKGROUND AND MODELLING

4.1 Report Context

Relevant background information describing the site and its environmental context are detailed within AAe, Non-Technical Summary Report (Document Reference 163407/NTS), and McDonnell Cole Ltd, Draft Hydrogeological Risk Assessment Report (Document Reference 1763-HRA-01, dated February 2021).

Additional information has been obtained from borehole records, the Conceptual Site Model and proposed scheme drawings provided by AAe.

4.2 Conceptual Stability Site Model

The Conceptual Site Model has been developed based on the proposed development proposals and anticipated ground conditions at the site. The Conceptual Site Model, produced by AAe, is presented in Appendix I together with drawings detailing the nature of the proposed landfill development.

The ground and groundwater conditions for the study area have been established based on findings of four boreholes and sixteen trial pits together with subsequent groundwater level monitoring.
Based on the available data the ground conditions are indicated to comprise either a fine to medium grained SAND or weathered SANDSTONE, overlying SANDSTONE bedrock materials. The encountered materials are considered to be representative of solid geology of the Sherwood Sandstone Group. The Sherwood Sandstone Group materials were proven to the base of all of the boreholes completed at the site at depths between approximately 10m bgl (-15m AOD) and 35.5m bgl (-21.6m AOD).

In addition, Topsoil of limited thickness was locally encountered at the surface in the main site area, with these materials present to a maximum depth of 0.3m bgl.

Within the area of unauthorised landfilling in the north-east of the site, Made Ground materials were encountered to depths of between approximately 1.1m bgl (11.5m AOD) and in excess of 3.5m bgl.

The available groundwater monitoring data indicates groundwater level is approximately -6.5m AOD in the south-west of the site and approximately -14.7 m AOD in the north-east. It is therefore considered that based on a formation level of 0m AOD, groundwater will not encroach into the proposed landfill, nevertheless groundwater has been included within the modelled sections consistent with the findings of the groundwater monitoring. The variation in the recorded groundwater levels is considered to be associated with groundwater abstraction borehole located approximately 20m to the north-east of the site.

Based on the results of the groundwater monitoring an unsaturated thickness of sandstone of approximately 7m exists in the south-west and 15m in the north-east.

The proposed scheme includes for the remediation of the unauthorised waste materials in the north-east of the site, with these materials removed and replaced with clean fill materials. Within the main site area, the proposed landfill will reshape the site to allow an agricultural/amenity end use.

The quarry area currently has an uneven base, together with an area of undisturbed sandstone. Earthworks will be completed across the area to provide a uniform formation layer for the engineering of a Geological Separation Layer (GSL). Any earthworks will be completed using suitable clean inert materials which are understood to be derived from the site. A formation level of 0m AOD is proposed for the formation level of the GSL.

A GSL will be used to provide a low permeability liner in accordance with the requirements of the Hydrogeological Risk Assessment. The GSL will be engineered from imported Class 2 cohesive engineering fill materials and have a minimum shear strength of 50kPa. Prior to placement of the GSL the existing ground surface is to be regulated by the placement of engineered fill in accordance with an engineering specification or CQA Strategy (engineering specification). The GSL is to be placed above the existing in-situ natural materials or engineered fill materials and will be at least 1m in thickness.

Inert landfill waste is to be placed above the GSL to a maximum thickness of approximately 12m. Following the placement of the inert landfill waste, a minimum thickness of 0.5m of restoration soils will be placed at the surface over the waste material.

4.2.1 Basal Sub-Grade Model

Given that the existing site has been subject to previous quarrying activities to a maximum depth of approximately -5 m AOD, the initial earthworks will comprise the regulation of the base of the quarry to 0m AOD using suitable site-derived engineered materials to design formation levels prior to the construction of the GSL which will have a minimum thickness of 1m.

Based on the results of the groundwater monitoring completed at the site, groundwater levels are typically in excess of approximately 7m below the formation level of the GSL.

4.2.2 Side Slopes Sub-Grade Model

The existing side slopes have typically been formed by the historical quarrying operations, which has locally left the side slopes at a comparatively steep angle. Based on the available information the existing side slopes are indicated to be formed at angles of between 18 degrees and 30 degrees. It is understood that the existing side slopes are in a stable condition.

Given the undulating nature and geometry of the site overall, the side slope subgrade will also need to be made regular by infilling with suitable site derived soils, though some cutting of existing slopes will also be required to provide a suitable formation layer for the placement of the engineered fill materials and the GSL.

The engineered fill materials are to be formed from appropriately processed and suitable engineering materials sourced from site derived natural materials which will be placed in accordance with an appropriate engineering specification.

The engineered fill materials forming the side slope subgrade have been designed with gradients of 1(v):3(h).

4.2.3 Basal Geological Separation Layer (GSL)

The landfill will have one cell. It is assumed the GSL will be constructed progressively in advance of the filling works and following the remedial works in the north-east of the site.

The GSL is to be engineered from suitable imported cohesive materials and compacted to provide a minimum thickness of 1m. In addition, engineered fill will locally be placed beneath the GSL as a regulating layer to provide a suitable surface on which to place the basal liner, with a proposed formation level for the GSL of 0m AOD. The basal liner will have an engineered hydraulic permeability of 1 x 10^{-7}m/s.

4.2.4 Side Slope GSL

The side slope GSL will comprise the same material characteristics as the basal GSL placed at a minimum thickness of 1m and constructed at a design gradient of 1(v):3(h).

The side slope GSL will locally be placed against engineered fill materials placed as part of the remedial works in the north-east and where regulating of the existing boundary slopes is required.

4.2.5 Waste Mass

The waste will comprise inert waste. It is understood that the waste materials will comprise inert subsoils and mineral-based wastes.

4.2.6 Restoration System

Following the placement of inert waste materials, restoration soils will be placed over the waste materials to prepare the site for an agricultural/amenity use.

It is understood that the restoration soils will comprise topsoil and subsoil materials. The restoration soils will have a minimum vertical thickness of approximately 0.5m.

The general and maximum slopes of the capping will be in accordance with the finished design and will generally comprise relatively shallow slopes, with a maximum slope gradient of approximately 18 degrees (1(v):3(h)) proposed in the north-west of the site.

Gas pressure is not anticipated due to the nature of the waste accepted and the waste acceptance controls operated on site.

5 STABILITY RISK ASSESSMENT

Each of the six principal components of the conceptual stability site model have been considered and the various elements of that component have been assessed with regard to stability.

The principal components considered are:

1. The basal subgrade;
2. The side slope subgrade;
3. The basal geological barrier (GSL);
4. The side slope geological barrier (GSL);
5. The inert waste material;
6. The capping system.

5.1 Risk Screening

Potential stability and integrity issues relating to each component of the proposed landfill have been reviewed to determine the requirements for further detailed geotechnical analyses. The findings of the preliminary risk screening are presented in the following sections.

5.1.1 Basal Sub-Grade Screening

The surface of the basal subgrade will generally follow the existing topography of the site and will comprise in-situ natural granular materials (sand and weathered sandstone).

Each aspect of the stability and deformability of the basal subgrade identified within the guidance is discussed below in Table 1.

Table 1 Stability Components for Basal Subgrade

Excessive Deformation	Compressible Subgrade	The basal subgrade is to comprise granular drift deposits of the Lacustrine Beach Deposits or weathered bedrock geology of the Sherwood Sandstone Group. In addition, the basal subgrade will locally comprise engineered site derived natural soils where regulating of the formation level is required in accordance with the design profile. The granular Lacustrine Beach Deposits, weathered bedrock geology of the Sherwood Sandstone Group and engineered fill materials of this origin are practically incompressible under the limited stresses imposed by the proposed waste height. Therefore, this component does not require further consideration.
	Cavities within the subgrade	No evidence of cavities has been identified based on BGS information and the site investigation data. No further assessment is required.
	Basal Heave	The water table is located within the Sherwood Sandstone and between 7 and 15 m below the Basal Subgrade and so basal heave is not considered to be a risk and so no further assessment is required.
	Stability	The surface of the basal subgrade will horizontal and formed at 0m AOD across the site area and so further assessment is not considered necessary.
Filling on Waste	The scheme does not involve any filling on Waste.	

Based on the initial screening it is considered that the basal subgrade requires no further assessment.

5.1.2 Side Slopes Sub-Grade Screening

The controlling factors that will affect the stability and the deformability of the subgrade are presented in Table 2 below.

Table 2 Stability / Integrity Components of Side Slope Subgrade

<table>
<tr><td rowspan="5">Fill Slope</td><td>Rock</td><td colspan="2">The Conceptual Site Model does not include fill slopes in rock. It is assumed that near surface Sherwood Sandstone Group materials will be in a weathered state and comprise granular materials.</td></tr>
<tr><td>Cohesive Soils</td><td colspan="2">The Conceptual Site Model does not include for filled slopes in cohesive materials. Any filled slopes will be formed with granular materials.</td></tr>
<tr><td rowspan="3">Granular Soils</td><td>Stability</td><td>The side slopes of the landfill are locally to be formed by engineered fill at a gradient of approximately 1(v):3(h). This is considered to provide an adequate factor of safety however this will be confirmed by further stability assessment.</td></tr>
<tr><td>Deformability</td><td>The side slope subgrade will locally be formed in engineered fill materials. These are considered to be practically incompressible under the limited stresses imposed by the proposed placement waste. This component does not require further consideration.</td></tr>
<tr><td>Groundwater</td><td>The water table is located within the underlying Sherwood Sandstone beneath the base of the landfill and therefore is not considered to require further assessment.</td></tr>
<tr><td rowspan="5">Cut Slopes</td><td>Rock</td><td colspan="2">It is assumed that any near surface Sherwood Sandstone Group materials will be in a weathered state and comprise granular materials.</td></tr>
<tr><td>Cohesive Soils</td><td colspan="2">The Conceptual Site Model does not include for cut slopes in cohesive materials. Any cut slopes will be formed within in-situ natural granular materials.</td></tr>
<tr><td rowspan="3">Granular Soils</td><td>Stability</td><td>The existing side slopes comprise in-situ natural granular materials and are at slopes of between 18 and 30 degrees and will be made regular by regrading/filling using site derived granular materials engineered to form the landfill profile with a maximum gradient of 1(v):3(h). Slope stability analysis is to be undertaken to determine the stability of the proposed/existing slopes.</td></tr>
<tr><td>Deformability</td><td>The side slope subgrade is formed in weathered Sandstone or granular Lacustrine Beach Deposits which is considered to be practically incompressible. This component does not require further consideration.</td></tr>
<tr><td>Groundwater</td><td>The water table is located within the underlying Sherwood Sandstone between 7m and 15m beneath the base of the landfill and therefore is not considered to require further assessment.</td></tr>
</table>

Based on the initial screening it is only the side slopes stability that will undergo further assessment.

5.1.3 Basal Lining System Screening

The controlling factors that influence the stability and integrity of the basal Geological Separation Layer (GSL) are included in Table 3.

Table 3 Stability / Integrity Components of Basal GSL System

<table>
<tr><td rowspan="4">Mineral Only</td><td>Stability and Integrity</td><td>The basal subgrade will comprise and engineered cohesive low permeability material placed horizontally on in-situ Sherwood Sandstone materials or engineered fill placed in accordance with an engineering specification. The overall stability of the base and side slope requires further stability assessment to ensure integrity of the GSL is maintained.</td></tr>
<tr><td>Compressible subgrade</td><td>The basal subgrade is formed on in-situ natural materials and limited thickness of engineered fill of the same materials and is considered to have low compressibility and so does not require further consideration.</td></tr>
<tr><td>Cavities</td><td>Not applicable.</td></tr>
<tr><td>Basal Heave</td><td>The water table is located within the underlying Sherwood Sandstone between 7m and 15 m beneath the base of the landfill and therefore is not considered to require further assessment.</td></tr>
<tr><td>Geosynthetic/Mineral</td><td colspan="2">The scheme does not include a geosynthetic liner system.</td></tr>
</table>

Based on the initial screening it is considered that the basal GSL does not require further assessment except in conjunction with the stability of the side slope GSL, subgrade and waste mass. This is considered in sections 5.1.5 and 5.1.6.

5.1.4 Side Slope Lining System Screening

The controlling factors that influence the stability and integrity of the side slope GSL barrier system are given below in Table 4.

Table 4 Stability / Integrity Components of Side Slope GSL Barrier System

<table>
<tr><td rowspan="4">Unconfined</td><td rowspan="2">Mineral only</td><td>Stability</td><td>The side slope GSL will comprise an engineered low permeability material placed to an engineered specification.
The overall stability of the side slope is subject to stability assessment to ensure the integrity of the GSL is maintained.</td></tr>
<tr><td>Integrity</td><td>The integrity of the side slope GSL will not be compromised in the unconfined condition providing the stability assessment returns a suitable factor of safety; considered to be 1.3 or higher. This aspect therefore does not require further consideration.</td></tr>
<tr><td rowspan="2">Geosynthetic/ Mineral</td><td>Stability</td><td rowspan="2">The scheme does not include a geosynthetic liner system.</td></tr>
<tr><td>Integrity</td></tr>
<tr><td rowspan="4">Confined</td><td rowspan="2">Mineral only</td><td>Stability</td><td>If the stability in the unconfined condition is satisfactory, the stability of the side slope GSL will be satisfactory in the confined condition, due to the buttressing effect of the emplaced waste.</td></tr>
<tr><td>Integrity</td><td>If the integrity in the unconfined condition Factor of Safety is satisfactory; considered to be 1.3 or higher, then the integrity of the side slope GSL in the confined condition will be greater due to the buttressing effect of the emplaced waste.</td></tr>
<tr><td rowspan="2">Geosynthetic/ Mineral</td><td>Stability</td><td rowspan="2">The scheme does not include a geosynthetic liner system.</td></tr>
<tr><td>Integrity</td></tr>
</table>

Based on the preliminary screening it is considered that the side slope GSL requires further assessment. Refer to Table 8 for the results of this assessment.

5.1.5 Waste Mass Screening

The controlling factors that influence the stability of the waste mass are presented below in Table 5.

Table 5 Stability / Integrity Components of Waste Mass

Failure wholly in waste	Stability	The waste will be placed in layers and compacted with a slope of 1(h):3(v). Based on the likely nature of the waste (inert materials) this is likely to provide an adequate Factor of Safety, however this is to be confirmed by stability analysis. Based on the nature of the waste materials, leachate is not anticipated to be present within the waste mass.
Failure involving Geological barrier and waste	Mineral Only	The development of progressive infilling will result in the generation of a single temporary waste slope in the short term. The proposed method of working is likely to generate a stable temporary waste slope. However, there is a risk temporary waste slopes could impact the stability of the side or basal GSL.

Based on the preliminary screening it is considered that the waste mass requires slope stability assessment.

Due to the nature of the waste to be deposited, a significant volume of leachate will not be generated and therefore a specific leachate collection system will not be installed. The presence of leachate is not considered within the analysis.

Due to the nature of the waste to be deposited, a significant volume of landfill gas will not be generated. Therefore, a gas extraction system is not required and will not be installed.

5.1.6 Capping System Screening

The controlling factors that influence the stresses in the capping system are provided below in Table 6.

Table 6 Stability Components of Capping System

Soil/Mineral	Stability	Pre-settlement slope inclination	Stability assessment is considered necessary to ensure long term stability of the waste mass and restoration soils. The restoration soils are to be typically placed at shallow slope angles, however in the north-west of the site a maximum gradient of approximately 18 degrees is locally expected.
	Integrity	Compressible waste	The inert waste is considered to have limited compressibility and no external factors will be present to cause anything other than deformations normally associated with inert waste settlement. Further assessment is not considered to be required.
		Slope deformation	No external factors will be present to cause anything other than deformations normally associated with waste settlement. This aspect is therefore not considered to require further assessment.
		Construction	The potential effects of construction plant activity during the placement of restoration soils do not require further assessment.
		Cavities in waste	It is proposed that the final waste surface will be graded and inspected prior to placement of the restoration soils. This practice will eliminate the potential for near-surface cavities to be present. As such, this issue does not require further assessment.
Geosynthetic/ mineral	The scheme does not include a Geosynthetic Capping system.		

Based on the initial screening it is considered that the stability of the restoration profile slope in the mid-west boundary area of the site requires further assessment.

5.2 Lifecycle Phase(s)

This aspect of the assessment identifies any critical phases during the development of the landfill.

The inert waste will be filled in lifts as part of a single phase of infilling and so to ensure stability throughout the life of the landfill, the side slope subgrade, side slope GSL barrier and temporary waste slope (short term) stability have all been considered.

5.3 Data Summary

The following data is required as input for the analyses undertaken for this Stability Risk Assessment:

- Material unit weight
- Drained and undrained shear strength of soils and waste

It should be noted that there is no laboratory test data relating to the shear strength of the materials available on the site or those proposed for import to site. Only the GSL will comprise cohesive soils; all the natural soils onsite are granular. An assumed undrained shear strength of 50 kPa has been provided by AAe for the GSL. As indicated, the remaining and available onsite materials are all granular and do not possess undrained characteristics.

For the purposes of modelling slope stability, the limited available site investigation information has been used to determine so-called moderately conservative soil parameters based on material descriptions, previous experience, and engineering judgment.

The assumed drained shear strength parameters however take account of possible finer grained sands within the in-situ natural weathered Sandstone and Lacustrine Beach Deposits but acknowledge that if they are proven by site investigation and testing to be exclusively granular then such low values chosen are lower than 'worst credible' parameters rather than moderately conservative.

5.4 Justification for Modelling Approach and Software

To undertake the detailed SRA, the various components of the landfill development have been considered not only individually but also in terms of the and overall model.

The assessment and analytical methods should adequately represent all the considered scenarios, including the different modelled phases of the lifecycle, for both confined and unconfined conditions (where appropriate).

The methodology and the software should also produce the required output results for the assessment, e.g. determination of limit equilibrium factor of safety within geological barrier components.

The analytical methods used in this SRA include:

- Limit equilibrium stability analyses for the derivation of factors of safety for the unconfined subgrade, side slope GSL, temporary waste slopes and final restoration profile.

The limit equilibrium analyses have been undertaken using the Slide (from Rocscience), utilising the Bishop simplified, Janbu and Spencer methods of analysis.

The 8 No. section locations are presented on Drawing No. 270-22-610-01 in Appendix II and the output plots from the slope stability assessment including the waste and restoration profiles are presented on Drawings 270-22-610-02 to 10 inclusive with the FoS also shown.

5.5 Justification of Geotechnical Parameters Selected for Analyses

The following sections present a justification for the various parameters used in the stability analyses based on the following criteria:

- Site specific information;
- An assessment of the suitability of non-site specific data;
- Methods for the derivation of the parameters adopted.

A summary of the geotechnical parameters used in the design and analysis of the development are presented in tabular form for each component of the landfill in Table 7 below.

Due to the limited data acquired, the parameters chosen for the SRA have been moderately conservative.

The adopted parameters are based on the available data for the site together with previous experience and engineering judgment.

Table 7 Geotechnical Design Parameters

Material	Unit Weight ɣ (kN/m^3)	Effective cohesion c' (kPa)	Angle of Shearing Resistance Ø' (°)	Description
Restoration Soils	19	0	25	Imported low permeability capping material
Inert Waste	19	0	25	Inert Waste Fill
Geological Separation layer (GSL)	20	0	25	Imported low permeability clay
Engineered Fill*	20	0	25	Granular - engineered placed and compacted materials
In-situ natural materials (Lacustrine Beach Deposits and weathered Sherwood Sandstone)*	20	1	40	In-situ weathered Sandstone, Sandstone bedrock or sand and gravel lacustrine beach deposits or engineered fill of the same in accordance with an engineering specification

Note - * The parameters chosen for the natural deposits and Engineered Fill reflect the possibility that limited cohesive/silt lenses may exist though the material will still exhibit granular characteristics (not undrained properties) and it is therefore acknowledged that the parameters chosen are highly conservative because 'granular' soils will naturally have significantly higher Ø' values than have been chosen.

The underlying Sherwood Sandstone Group has been found to comprise weathered/uncemented materials and sandstone bedrock materials.

The Sherwood Sandstone Group materials are anticipated to extend to significant depth beneath the site.

5.5.1 Parameters Selected for Basal Sub-Grade Analyses

The parameters for the basal sub-grade are provided within Table 7. The basal subgrade will comprise existing in-situ granular materials of weathered sandstone, sandstone bedrock or Lacustrine Beach Deposits (sand and gravel). These same materials will be utilised as engineered fill materials, where required, placed in accordance with an engineering specification.

In the absence of any site-specific data for these materials, the parameters have been assumed based of the material descriptions within the available site investigation data and engineering judgment.

5.5.2 Parameters Selected for Side Slopes Sub-Grade Analyses

The side slope subgrade will comprise existing in-situ granular materials of weathered sandstone, sandstone bedrock or Lacustrine Beach Deposits and these same materials will be utilised as engineered fill materials, where required, placed in accordance with an engineering specification.

The engineered fill materials are to be placed at a maximum gradient of approximately 1(v):3(h).

In the absence of any site-specific data for these materials, parameters have been assumed based of the material descriptions within the available site investigation data and engineering judgment.

5.5.3 Parameters Selected for Basal GSL Analyses

The parameters required for the Basal GSL comprise typical effective angle of shearing resistance and effective cohesion, as shown in Table 7.

The adopted parameters assume that the GSL will be formed using suitable imported cohesive material and that the materials will be placed in accordance with an engineering specification.

Engineered fill materials placed as part of a regulating layer beneath the proposed GSL will comprise compacted onsite derived natural granular materials placed in accordance with an engineering specification.

5.5.4 Parameters Selected for Side Slope GSL Analyses

The parameters required for the Side Slope GSL analysis are the typical angle of shearing resistance and the effective cohesion of the materials forming the GSL.

The adopted parameters assume that the GSL will be formed using suitable imported cohesive material and that the materials will be placed in accordance with an engineering specification.

It is assumed that the GSL and regulating engineered fill materials will comprise suitable materials placed in accordance with an engineering specification.

5.5.5 Parameters Selected for Waste Analyses

Moderately conservative values of effective shear strength and effective cohesion parameters for inert waste have been assumed also to allow for variations in the waste accepted at the site. The assumed parameters are presented in Table 7 based on the expected nature of the waste.

5.5.6 Parameters Selected for Capping Analyses

As described in Section 4.2.6, restoration soils are to be placed above the waste mass following completion of filling activities.

Typical restoration soil parameters are presented in Table 7 and are based on the expected nature of these soils (Subsoils and Topsoil).

5.5.7 Selection of Appropriate Factors of Safety (FoS)

The factor of safety comprises the ratio of the load or action which would cause failure against the actual load or actions likely to be applied during service and is the numerical expression of the degree of confidence that exists, for a given set of conditions, against a particular failure mechanism taking place.

The factor of safety should be appropriate to the parameters selected and the quality of the site-specific data. In this instance there is very limited site-specific data and therefore conservative parameters have been assumed where relevant together with an appropriate factor of safety.

The factor of safety adopted for each component of the model is related to the consequences of a failure.

Therefore, prior to determining appropriate factors of safety for the various components of the model, it is necessary to identify key ‘receptors’ and evaluate the consequences in the event of a failure (relating to both stability and integrity).

Consideration of the following receptors is required.

- Groundwater;
- Other environmental receptors;
- Property - relating to site infrastructure, third party property;
- Human beings (i.e. direct risk).

The factors of safety have been determined based on using a Traditional Approach to the stability assessment and uses material properties and loads in an unmodified state and then apply a factor of safety to the analysis to allow for uncertainty and consequence of failure.

5.5.8 Factor of Safety (FoS) for Basal Sub-Grade

Based on experience of similar slopes it is considered that a FoS of 1.3 is considered appropriate for the overall stability of the existing basal sub-grade.

It is understood that there has been no evidence of instability within the existing natural slopes at the site.

5.5.9 Factor of Safety for Side Slopes Sub-Grade

The side slope subgrade is to be formed either by in-situ or re-engineered granular materials of weathered sandstone, sandstone bedrock or granular Lacustrine Beach Deposits and constructed at a maximum gradient of approximately 1(v):3(h).

An acceptable FoS is usually considered to be 1.3 for permanent slopes of this nature.

Based on the consequences of any failure, limited activity is proposed at the base of slope, though should such activity take place in the temporary (non-permanent) nature of them, a factor of safety of greater than 1.0 is considered acceptable.

Any failures would be remediated as part of the placement of the GSL. The waste would act as a restoring force and so increase the FoS in the permanent condition.

5.5.10 Factor of Safety for Basal GSL System

In this case it is considered appropriate to adopt a FoS of 1.3 for the basal GSL.

5.5.11 Factor of Safety for Side Slope GSL

A factor of safety of 1.3 is considered appropriate when using conservative peak shear strength parameters as long term stability.

The materials largely present in the existing and proposed profiles are granular and only cohesive materials are proposed for the side slope GSL and are expected to exhibit 'fully-softened'/'residual shear strength' of the side slope GSL of say 30kPa from 50kPa. In consideration of these undrained shear strengths in the temporary condition a FoS of 1.0 or greater is considered acceptable, in accordance with the advice given in the Guidance. FoS in such limited undrained conditions of the GSL are higher in all instances as a consequence and so no individual slope stability assessment is considered necessary.

5.5.12 Factor of Safety for Waste Mass

In this case it is considered appropriate to adopt a FoS of 1.3.

5.5.13 Factor of Safety for Capping System

Assessment of the restoration soils and waste mass has been assessed by the Midwest boundary and because the soil parameters have the same engineering parameters a minimum FoS of 1.3 is considered appropriate for peak shear strength conditions, applied for the pre-settlement slopes.

5.6 Analyses

Details of the various SRA analyses undertaken for the site are presented in the following sections with a summary of the results included as Appendix II.

The analyses have been completed at 8 No. locations and at regular intervals around the cell; with drained parameters. A further assessment has been undertaken by the mid-west boundary to assess the FoS of the waste both partly restored and fully restored.

5.6.1 Basal Sub-Grade Analyses, Side Slope Sub-Grade Analyses and GSL Model

The stability analysis program Slide by Rocscience has been used to analyse the sections as indicated.

The assessment has been completed assuming the material parameters detailed in Table 7. The chosen parameters are for the most-part have the same effective angle of internal friction, effective shear strength and density; the major differences between sections assessed being the existing slope geometry and the where localised re-profiling is necessary to meet the design GSL slope gradient.

The calculated factor of safety for the existing side slope subgrade where steeper existing slopes are present has locally returned factors of safety of close to unity. It is considered that any localised failures will not pose a risk to the overall stability, as such slopes are to be regraded as part of the proposed design. Any localised evidence of instability will be addressed as part pf the works.

An assessment of the overall stability of the existing onsite slope (Side Slope sub-grade) has been undertaken assuming and overall slope gradient of 1(v):3(h) to reflect the design.

The analysis undertaken for the design slope gradient of 1(v):3(h) indicates a calculated FoS of between 1.3 and 2.1 for the drained parameters. The overall calculated FoS of 1.3 or greater for the drained condition has been met and so the slope design is considered acceptable.

The FoS against slope failure for the limited undrained condition of the GSL does not reduce the overall FoS because all but the GSL are assumed to be granular.

The output plots are presented in Appendix II with a summary of the recorded FoS presented in Table 8.

Localised ground level reduction and the trimming of slopes are to be expected to ensure slopes are 1(v):3(h).

5.6.2 Waste Analyses

In considering the stability of the waste mass, the stability and integrity of the GSL system has been naturally part of the appraisal, because they are intrinsically linked and have similar strength parameters.

Analyses have been undertaken for a single-phase deposition of waste and assumes therefore that waste materials are also placed at slope gradients of no steeper than 1(v):3(h), the FoS is greater than 1.3; refer to Table 8.

Should steeper temporary slopes for the waste be proposed during construction then further slope stability analysis and an agreed construction sequence will need to be followed in response to the outcome of that analysis to ensure the work is executed and a safe outcome is achieved.

Based on the results of the current assessment the required FoS exceeds the target 1.3 in each case.

5.6.3 Capping Analyses

Due to the nature of the waste contained in the inert landfill, the surface will be restored with 0.5m thickness layer of restoration soils (Topsoil and Subsoil). Slope stability assessment undertaken in the steepest part of the restoration profile indicates a FoS of 2.2 for both parts completed and fully restored profiles.

5.7 Assessment

5.7.1 Basal Sub-Grade Assessment

It was not considered necessary to undertake assessment of the basal subgrade as the formation level will be generally horizontal and will be formed in in-situ weathered sandstone, sandstone bedrock or granular Lacustrine Beach deposits or granular site derived engineered fill of the same in accordance with an engineering specification. It is expected therefore to be largely incompressible and have a high allowable bearing capacity with a suitable FoS.

5.7.2 Side Slopes Sub-Grade Assessment

The assessment undertaken assumes unconfined side slopes formed at a maximum gradient of at 1(v):3(h), comprising existing natural granular materials or engineered fill.

The analysis undertaken has considered the stability of typical representative side slope geometry of 1(v):3(h).

Based on the findings of the analyses, it is considered that the side slope subgrade has a suitable FoS, providing existing slopes are cut back or regraded to 1(v):3(h).

5.7.3 Basal GSL Assessment

The assessment of the basal GSL indicates that there is a suitable FoS in allowable bearing capacity. A generic appraisal of the total settlement to be expected of the GSL in response to the applied load from the Waste indicates that less than 50 mm would occur.

5.7.4 Side Slopes GSL Assessment

The assessment of the side slope GSL indicate that the unconfined side slope FoS is 1.3 or higher for the proposed slopes of 1(v):3(h).

The FoS will increase as the cell is filled by the waste as it loads the slope.

5.7.5 Waste Assessment

This SRA covers side slope GSL stability together with waste mass stability (focused on the mid-west boundary, where the steepest gradients are proposed. Given that the geotechnical parameters taken for the waste are very similar to the other materials, a slope stability analysis on the mid-west boundary of the waste partly filled in the temporary condition of the waste set at a gradient of 1(v):3(h) returns a FoS of greater than 1.3.

It is recommended however that site tipping rules should be used in order to maintain safe working practices.

5.7.6 Capping Assessment

Stability analysis of the worst-case restoration profile has been carried out on the mid-west boundary area. Providing existing slopes are cut back or regraded so that neither the GSL nor the restoration capping exceeds slopes at 1(v):3(h), then the FoS is 1.3 or greater.

5.7.7 Summary

The analysis findings indicate the factors of safety exceeds the minimum required providing the gradient of the side slope GSL does not exceed 1(v):3(h). A summary of the analysis results is detailed in Table 8 below.

Table 8 Summary of Overall FoS for Analysed Sections

Section	FoS for Existing Topographical profile at Section	FoS of Proposed Profile and GSL	Comments
Section 1	1.1	1.3	Low FoS for the existing side slope considered to be acceptable in the short term. Side slopes to be regarded as part of the works. FoS is considered to be acceptable.
Section 2	1.0	2.1	Low FoS for the existing side slope considered to be acceptable in the short term. Side slopes to be regarded as part of the works. FoS is considered to be acceptable.
Section 3	1.3	1.6	Acceptable.
Section 4	2.2	1.3	Acceptable.
Section 5	1.3	1.3	Acceptable.
Section 6	1.8	1.3	Acceptable.
Section 7	1.5	1.8	Acceptable.
Section 8	2.6	1.4	Acceptable.
	FoS Part Filled Waste / Restored	**FoS Fully Filled Waste / Restored**	
Mid-west Boundary	2.2	2.2	Temporary Waste Slope at 1v:3h and restored profile have acceptable FoS

5.8 Monitoring

5.8.1 The Risk Based Monitoring Scheme

Based on the results of the SRA, a simple risk-based monitoring scheme is considered appropriate for the future development of the landfill. The monitoring is limited to ensuring compliance with the tipping rules and as a precaution ongoing monitoring of groundwater levels.

5.8.2 Basal Sub-Grade Monitoring

No instrumentation is required during construction or post final landscape restoration.

During construction it is recommended that visual inspection is undertaken to determine any areas of weakened or softened materials or areas of anomalous ground conditions. Any such materials should be removed and replaced with appropriately engineered fill materials.

5.8.3 Side Slopes Sub-Grade Monitoring

Monitoring during construction will comprise visual inspection to determine any failed or weakened zones that may require removal and replacement with appropriately engineered fill materials.

No instrumentation required during construction or post final landscape restoration.

5.8.4 Basal GSL Monitoring

Monitoring during construction will comprise Construction Quality Assurance to ensure compliance with the construction specification.

No additional instrumentation is required during construction or post final landscape restoration.

5.8.5 Side Slope GSL Monitoring

Monitoring during construction will comprise Construction Quality Assurance to ensure compliance with the construction specification.

No additional instrumentation required during construction or post final landscape restoration.

5.8.6 Waste Mass Monitoring

During infilling, tip faces and surrounding areas should be inspected daily for signs of failure.

No other specific monitoring is required for the waste other than to record waste elevations across the site.

5.8.7 Capping System Monitoring

Monitoring during construction will comprise Construction Quality Assurance to ensure compliance with the construction specification.

No additional instrumentation is required during construction or post final landscape restoration.

REFERENCES

BGS Sheet No. 79 – 'Goole' (Solid Edition and Drift Edition). 1:50 000 scale.

Geology of Britain viewer

AA Environmental Limited, Non-Technical Summary Report (Document Reference 163407/NTS)

McDonnell Cole Ltd, Draft Hydrogeological Risk Assessment Report (Document Reference 1763-HRA-01, dated February 2021)

Stability of Landfill; Lining Systems: Report No. 1 Literature Review - R&D Technical Report P1-385, volume TR1 - Environment Agency

Stability of Landfill; Lining Systems: Report No. 2 Guidance - R&D Technical Report P1-385, volume TR2 - Environment Agency

GENERAL NOTES

The interpretation made in this report is based on the information obtained during the course of the desk study and ground investigation. It should be appreciated that any desk study information is not necessarily exhaustive and that further information relevant to the site and its proposed usage may be available. There may be conditions present on the site that have not been revealed by the ground investigation which as a result have not been addressed within this report.

The accuracy of any map extracts cannot be guaranteed and it should be recognised that different conditions on site may have existed between and subsequent to the various map surveys.

The qualitative assessment of risk presented in this report presents an assessment of potential pollutant linkages between sources, pathways and receptors. A level of risk is attributed to these linkages. However a low or insignificant risk does not imply that elevated concentrations of various determinants are not present on the site when compared to background or 'greenfield' conditions.

The level of risk attributed is based on a number of factors and the interpretation of this risk may be applied in a different manner for a different end use or environmental setting. The presence of contaminants may be assessed in alternative ways by institutional bodies regardless of whether an apparent risk is present based on the identified pollutant linkages in this assessment.

This report may express an opinion on possible configurations of strata underlying the site between or beyond the exploratory holes or on the possible presence of features based on either visual, verbal or published evidence, this is for guidance only and no liability can be accepted for its accuracy.

Comments made on ground conditions are based on the observations made at the time of the investigation works. It should be noted that groundwater levels may vary due to seasonal fluctuation or other factors. Observations made with respect to below ground gas concentrations may also vary due to seasonal factors and atmospheric conditions.

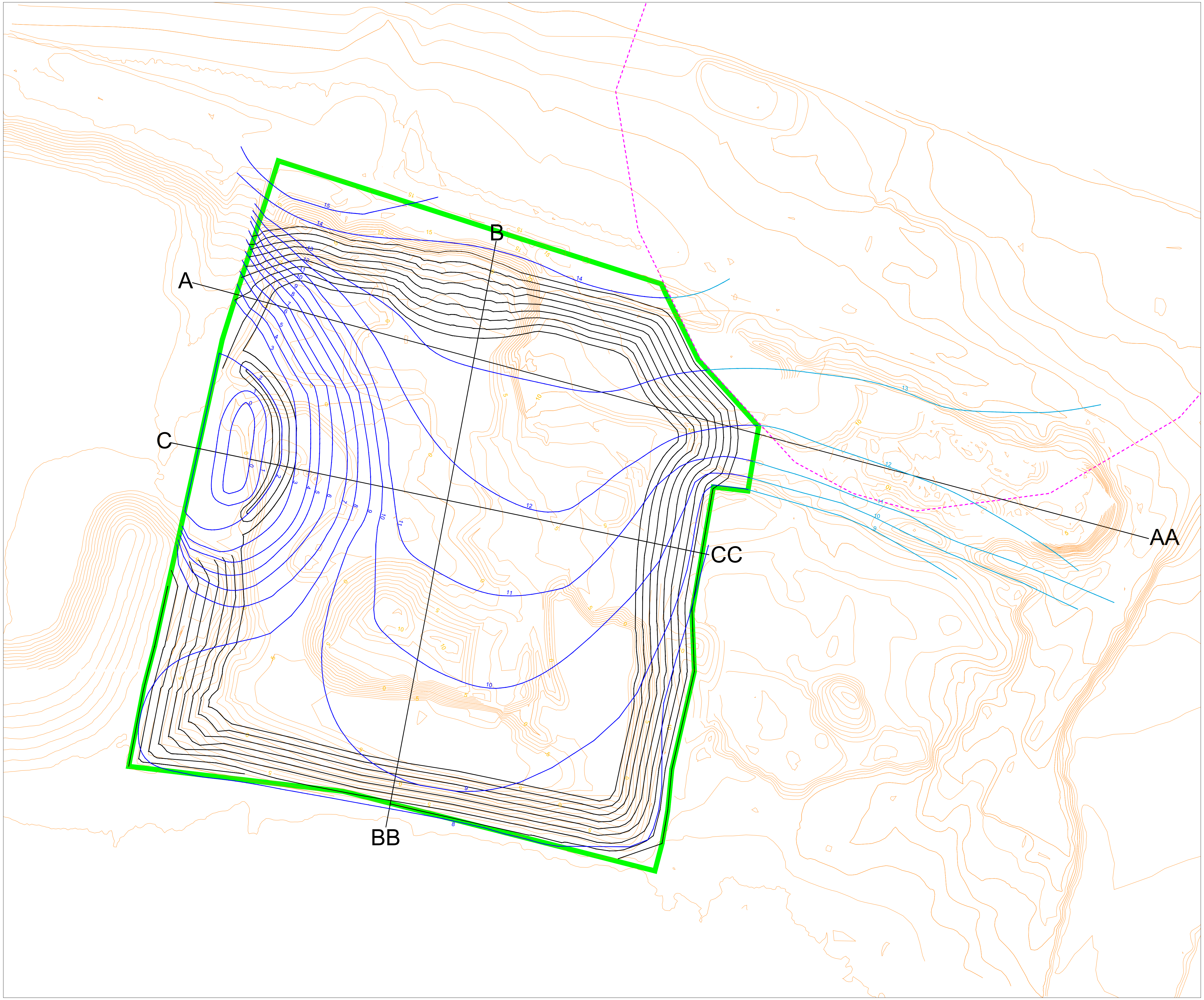
This report has been prepared in relation to the proposed development as detailed herein. Should the nature of the development change following the submission of this report a re-assessment of the conditions recorded on the site may be necessary.

This report may not be used in the assessment of the conditions at any site other than the site described herein

This report has been prepared for the sole use of the client and the client's agents and advisors in relation to the proposed development as detailed herein. The issue of this report to third parties not involved in the proposed development as described herein is not permitted without the prior permission being received in writing by ASL. Reproduction of this report to include all figures, drawings and appendices is prohibited without the prior written consent of ASL.

APPENDIX I

DRAWINGS



Key:

(green line)	Site Boundary
(magenta dashed line)	Source Protection Zone 1
(orange line)	Existing Contours (m AOD)
(black line)	Geological Separation Layer Contours (m AOD)
(blue line)	Restoration Contours (m AOD)
(cyan line)	Restoration Contours (Non-Waste Activity - not relevant to the landfilling operations)
A———AA	Section Line

Rev.	Details	Drawn / Chkd.	Date

Project

Middleton Quarry, Pollington

Title

Cross-Section Overview Plan

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Scale	Date	Drawn	Chkd.	Drg. No.	Rev.
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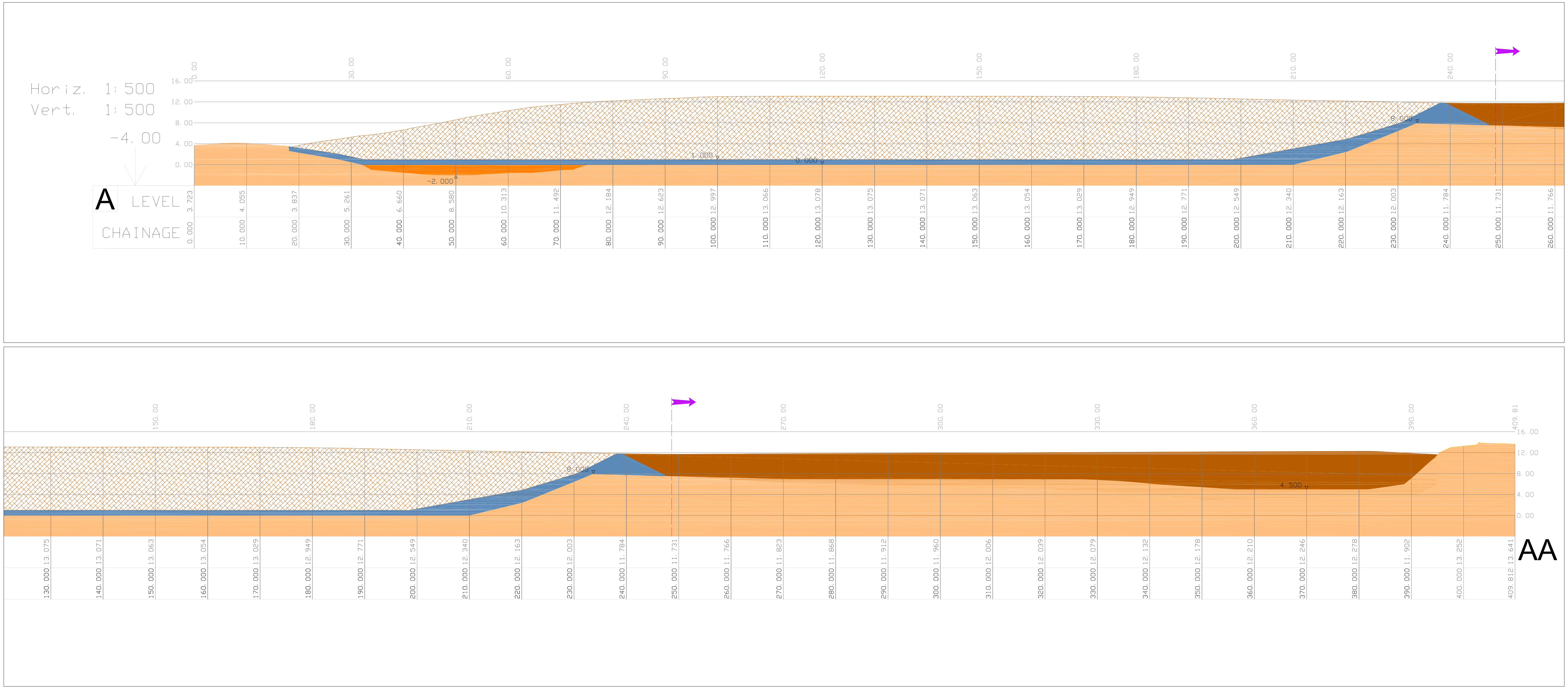

Key:

- Source Protection Zone 1
- Sandstone
- Clean Natural Arising Fill Material
- Geological Separation Layer
- Inert Waste
- Clean Natural Arising Fill Material - non-waste activity and not relevant to the landfilling operations

Rev.	Details	Drawn / Chkd.	Date

Project

Middleton Quarry, Pollington

Title

Cross-Section Plan
A-AA

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Scale	Date		Drg. No.	Rev.
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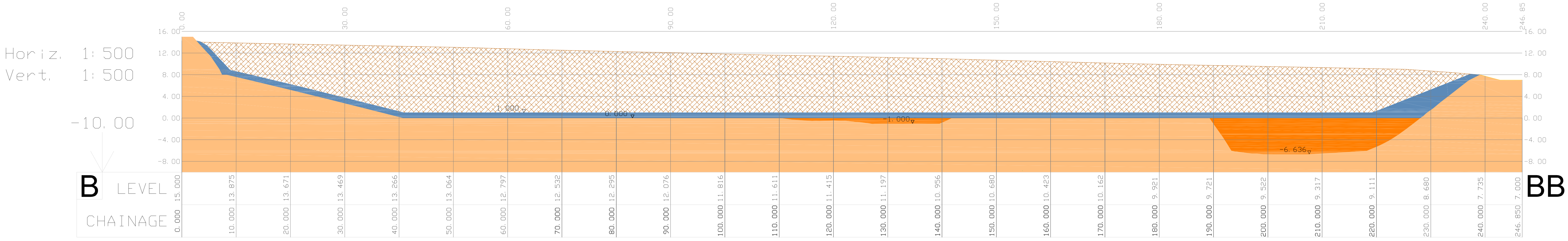

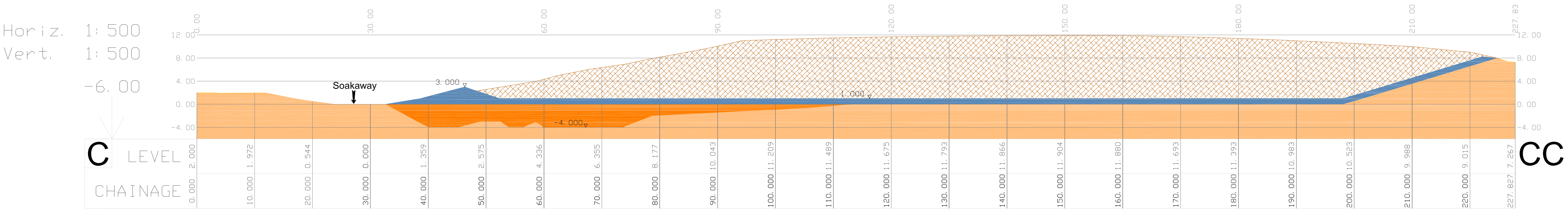

Key:

- Sandstone
- Clean Fill Material
- Geological Separation Layer
- Inert Waste

Rev.	Details	Drawn / Chkd.	Date

Project
Middleton Quarry, Pollington

Title
Cross-Section Plan
B-BB & C-CC

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Scale	Date		Drg. No.	Rev.
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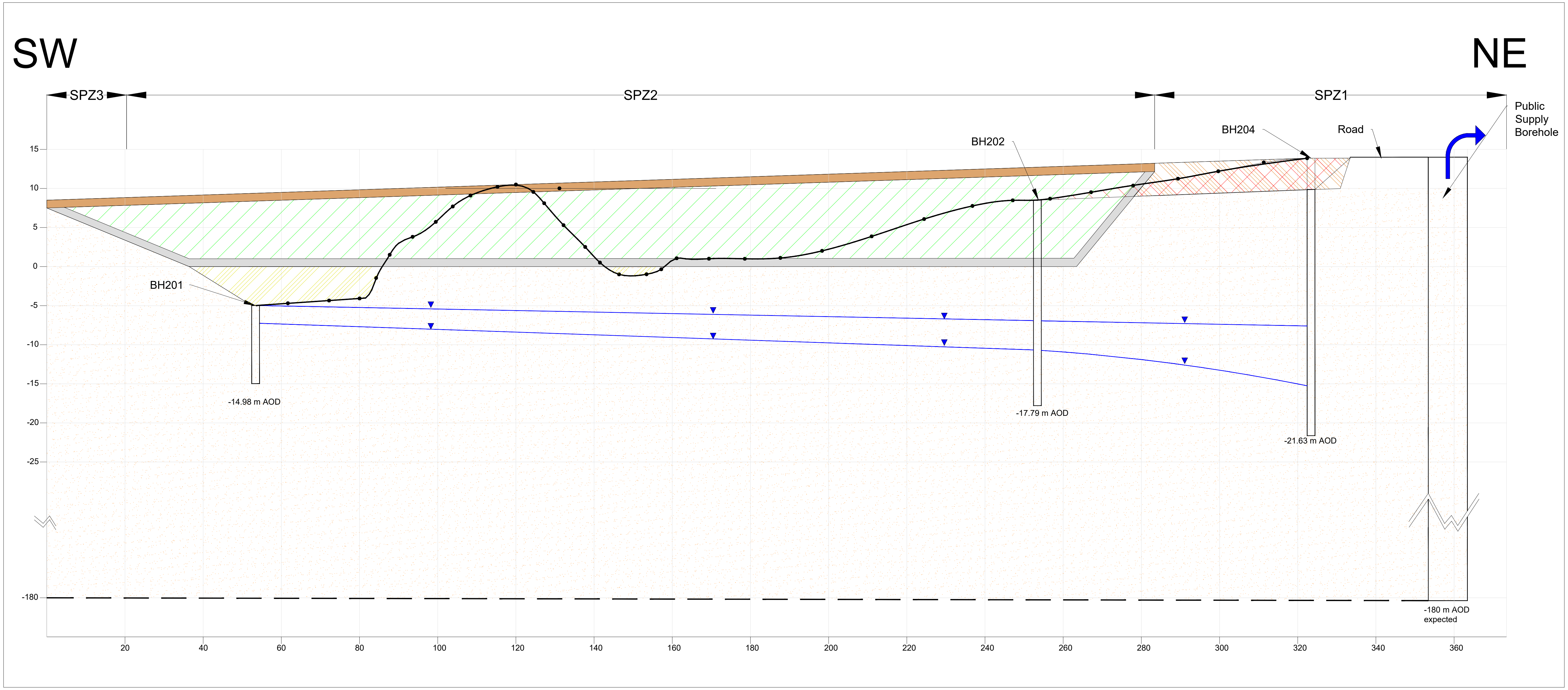

Key

- Sandstone
- Existing ground level
- Engineered barrier
- Surface fill (hardstanding and soft landscaping)
- Clean natural arising infill
- Inert landfilled waste
- Groundwater level
- Public supply abstraction borehole
- Fly-tipped waste to be removed - non-waste activity and not relevant to the landfilling operations.
- Clean natural arising infill - non-waste activity and not relevant to the landfilling operations.

Notes:
1. The conceptual model has a 2:1 vertical exaggeration and 1:1 horizontal exaggeration.

Rev.	Details	Drawn / Chkd.	Date

Project
163407
Pollington Lane Quarry

Title
Conceptual Site Model
South West to North East

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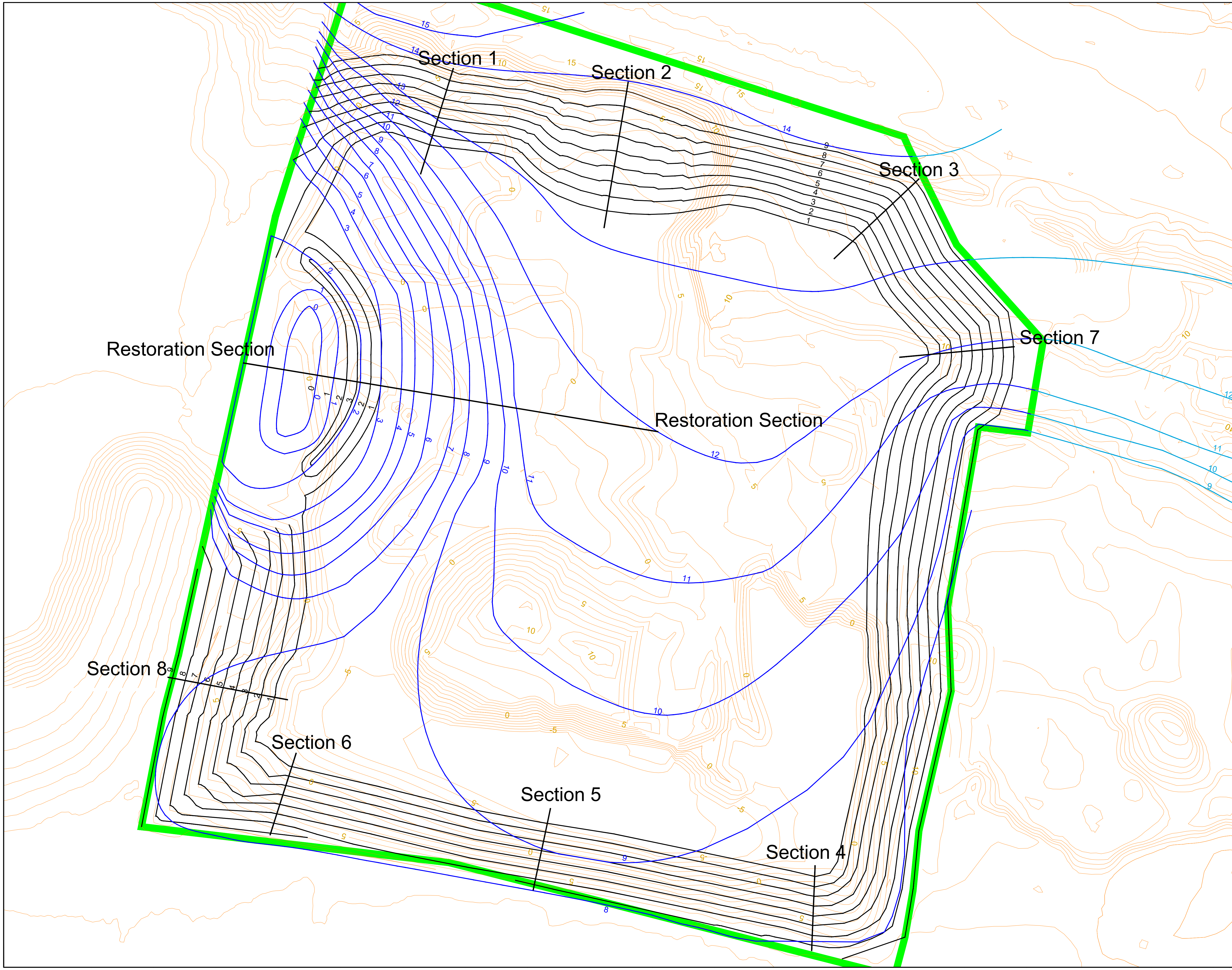
Scale	Date	Drawn	Chkd.	Drg. No.	Rev.
NTS	Jul'24	JM	ML	163407/CSM/001	

APPENDIX II

SLOPE STABILITY ASSESSMENT SECTIONS AND OUTPUT PLOTS



General notes

Base Drawings Ref AAe Inert Landfill Jan23

Legend to symbols

Revision	Description

Title

Middleton Quarry, Pollington, Pinfold Lane, DN14 0EZ

Project

Stability Risk Assessment
Site Plan and Section Locations

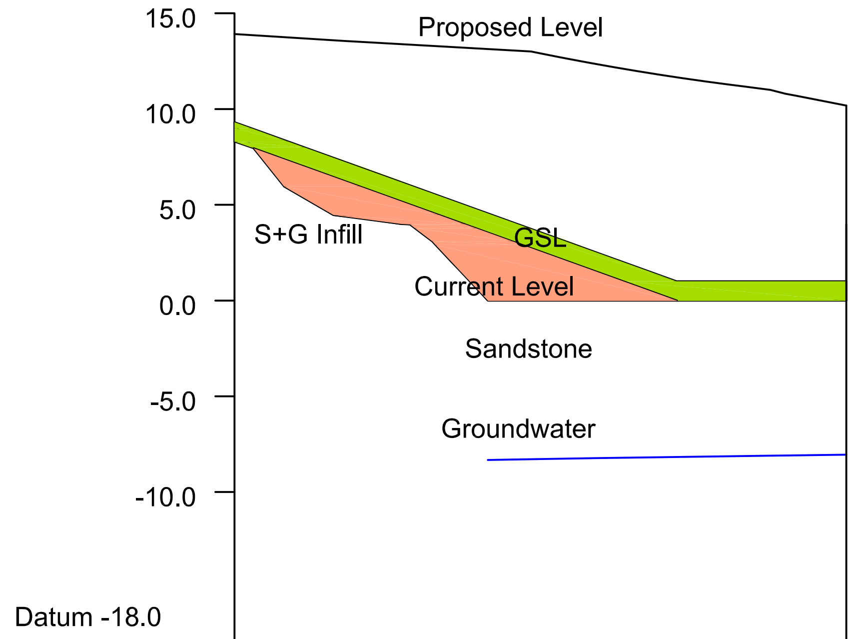
Client

AA Environmental Limited

asl

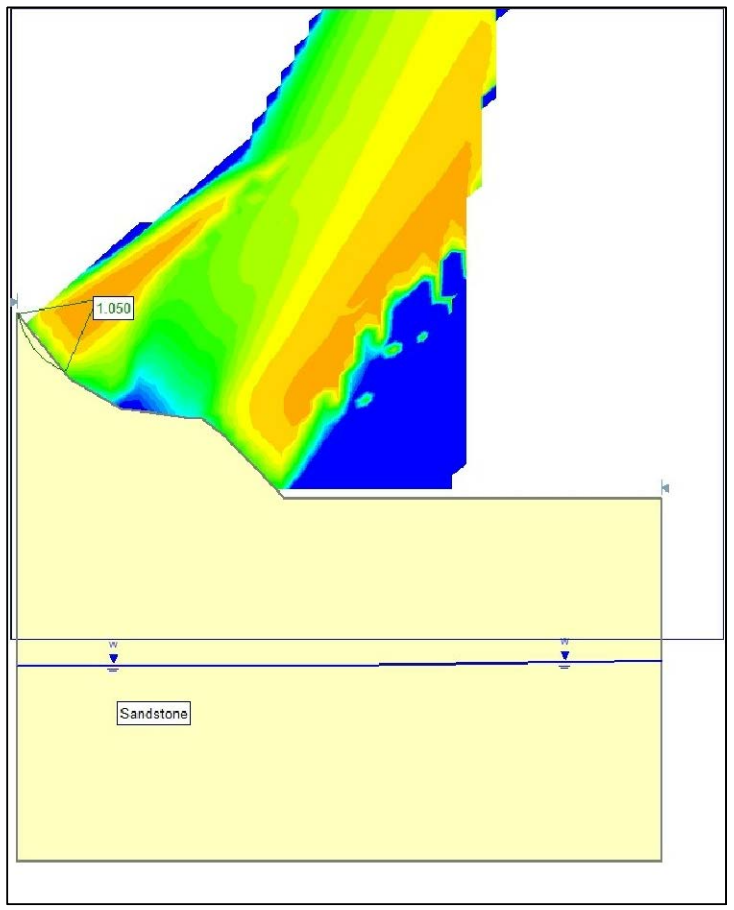
Date	Drawing No.	Scale
20/01/23	270-22-610-01	As Shown

Drawn By	Checked by	Sheet Size
PDS	CT	A3

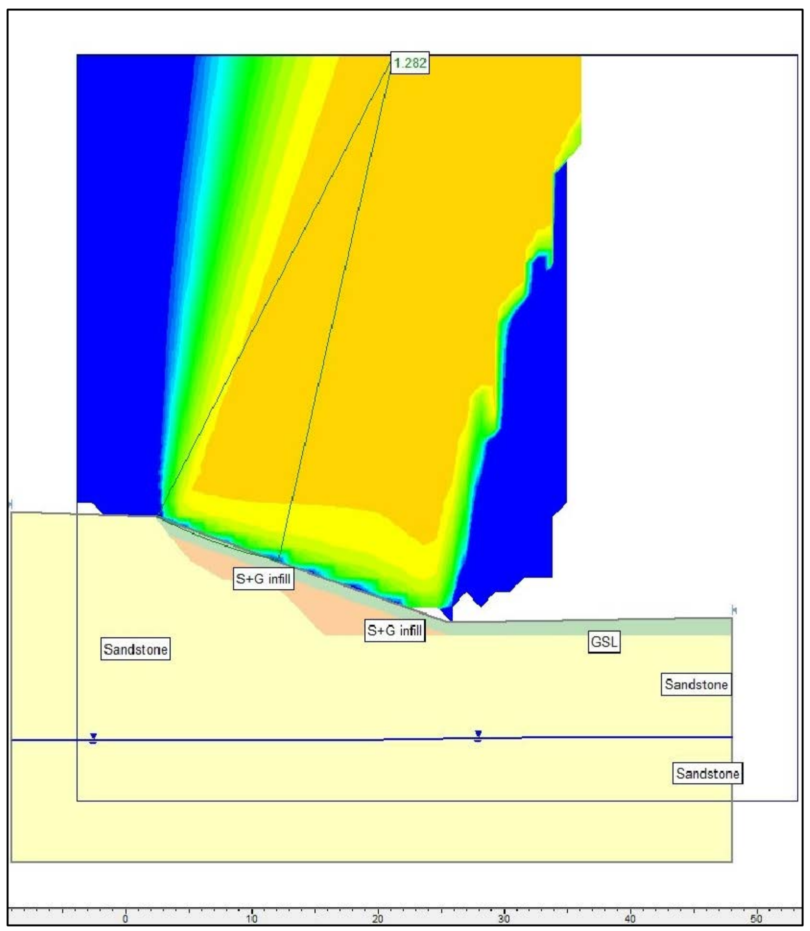


TOPO	9.208, 4.564, 4.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000
PROPOSED LEVELS	13.913, 13.598, 13.311, 13.028, 12.155, 11.395, 10.184
GWT	-8.324, -8.293, -8.212, -8.140, -8.050
GSL TOP ELVN	9.000, 7.522, 5.729, 3.925, 2.082, 1.000, 1.000, 1.000
GSL chainage	0.000, 5.000, 8.715, 13.248, 15.000, 20.000, 21.752, 25.000, 31.964
Regular offsets	0.000, 5.000, 10.000, 15.000, 20.000, 25.000, 30.000

Section 1 - Existing Side Slope FoS (1.1)



Section 1 - Proposed GSL Profile FoS (1.3)



General notes	Base Drawings Ref AAe Inert Landfill Nov22
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Revision	Description
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Project	Slope Stability Factors of Safety Section 1 Current and Proposed
Client	AA Environmental Limited

asl

Date	Drawing No.	Scale
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Drawn By	Checked by	Sheet Size
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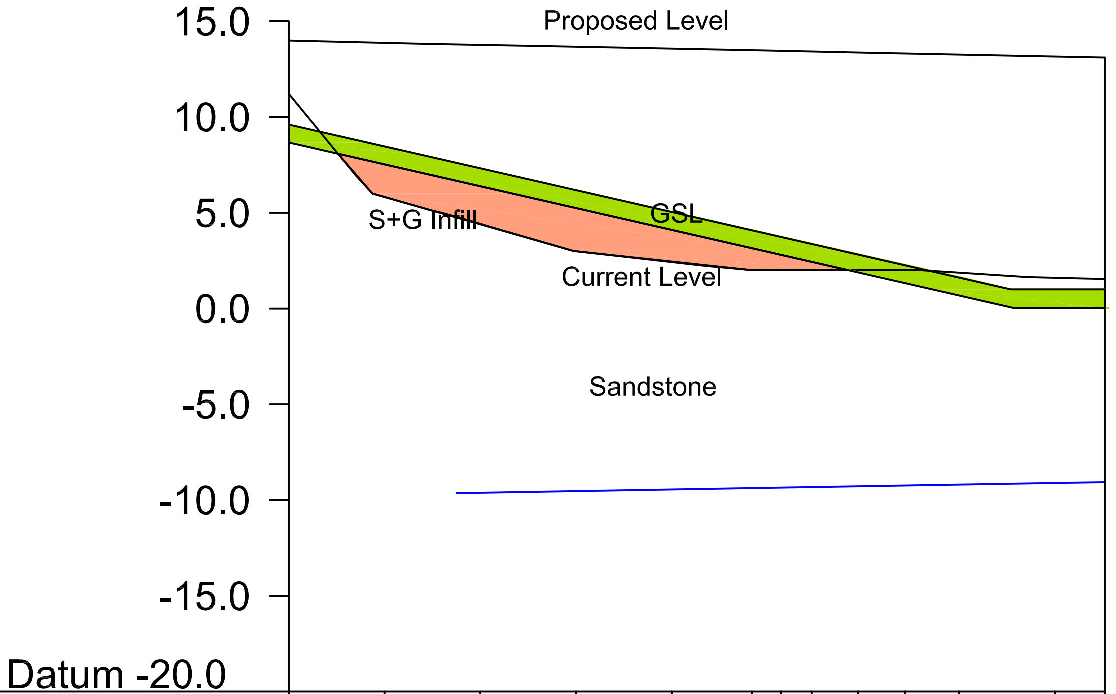

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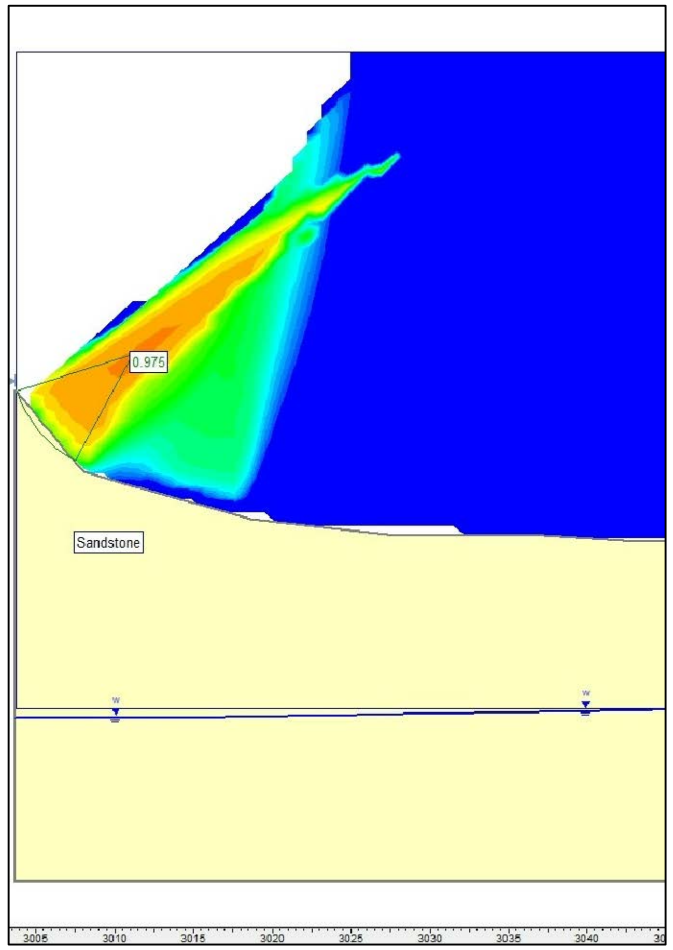
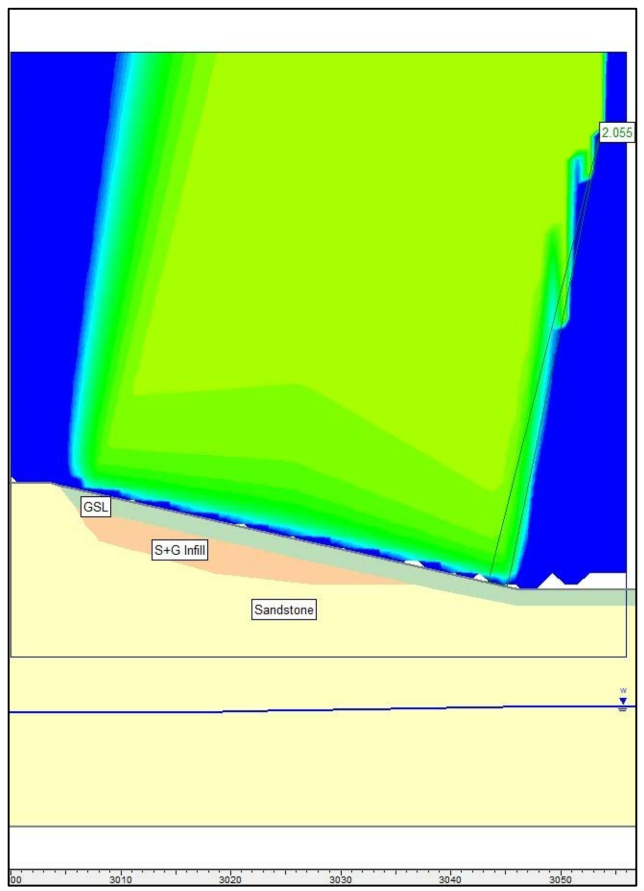
PROPOSED LEVELS	13.991, 13.870, 13.765, 13.668, 13.567, 13.464, 13.359, 13.258, 13.158, 13.105
GWT	-9.638, -9.532, -9.447, -9.362, -9.278, -9.195, -9.112, -9.069
GSL TOP ELVN	9.000, 8.461, 7.320, 6.181, 5.044, 3.906, 2.772, 1.644, 1.000, 1.000, 1.000
GSL chainage	0.000, 5.000, 10.000, 15.000, 20.000, 24.190, 25.698, 27.297, 29.726, 32.183, 35.000, 40.000, 42.606
Regular offsets	0.000, 5.000, 10.000, 15.000, 20.000, 25.000, 30.000, 35.000, 40.000

Section 2 - Existing Side Slope FoS (1.0)



Section 2 - Proposed GSL Profile FoS (2.1)



General notes

Base Drawings Ref AAe Inert Landfill Nov22

Legend to symbols

Revision	Description

Title

Middleton Quarry, Pollington, Pinfold Lane, DN14 0EZ

Project

Slope Stability Factors of Safety Section 2 Current and Proposed

Client

AA Environmental Limited

asl

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Drawn By	**Checked by**	**Sheet Size**
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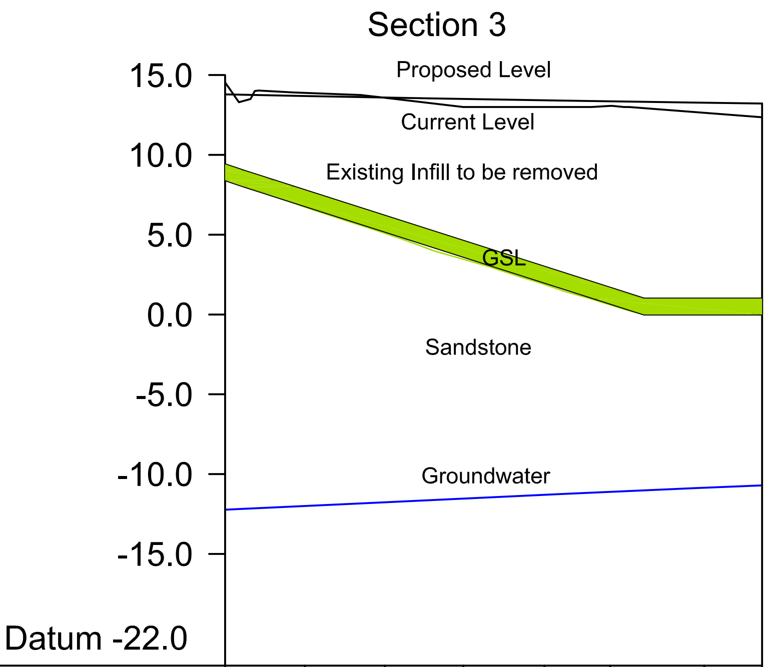
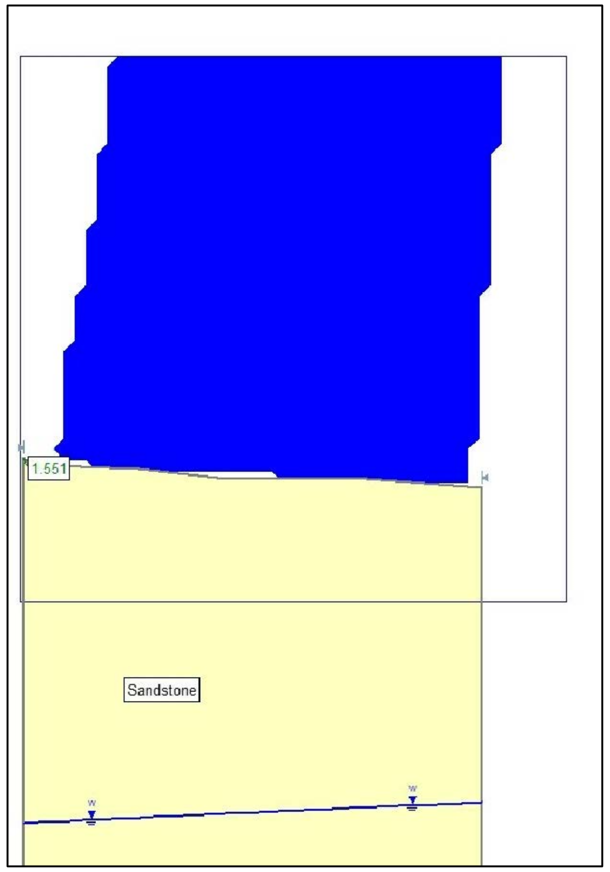
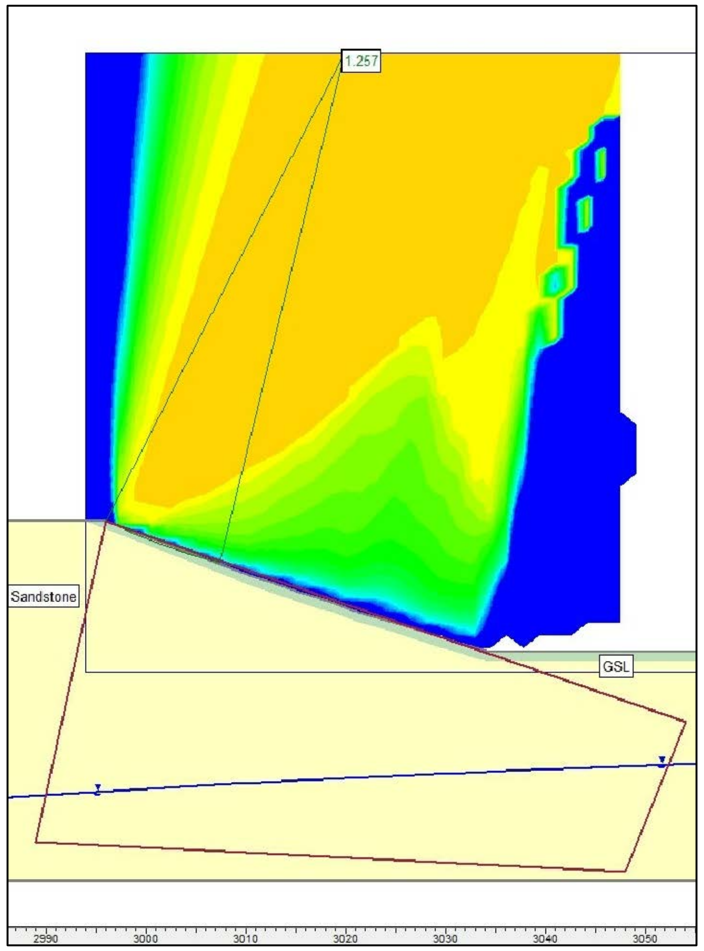


TOPO	14.538	13.883	13.576	13.000	13.000	13.072	12.638	12.357	
PROPOSED LEVELS	13.790	13.688	13.593	13.505	13.415	13.343	13.273	13.221	
GWT	-12.231	-12.000	-11.765	-11.530	-11.299	-11.073	-10.855	-10.704	
GSL TOP ELVN	9.000	7.742	6.099	4.438	2.883	1.000	1.000	1.000	1.000
GSL chainage	0.000	5.000	10.000	14.925	19.991	24.114	30.000	33.626	
Regular offsets	0.000	5.000	10.000	15.000	20.000	25.000	30.000		

Section 3 - Existing Side Slope FoS (1.3)



Section 3 - Proposed GSL Profile FoS (1.6)



General notes

Base Drawings Ref AAe Inert Landfill Nov22

Legend to symbols

Revision	Description

Title

Middleton Quarry, Pollington, Pinfold Lane, DN14 0EZ

Project

Slope Stability Factors of Safety Section 3 Current and Proposed

Client

AA Environmental Limited

asl

Date	Drawing No.	Scale
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Drawn By	Checked by	Sheet Size
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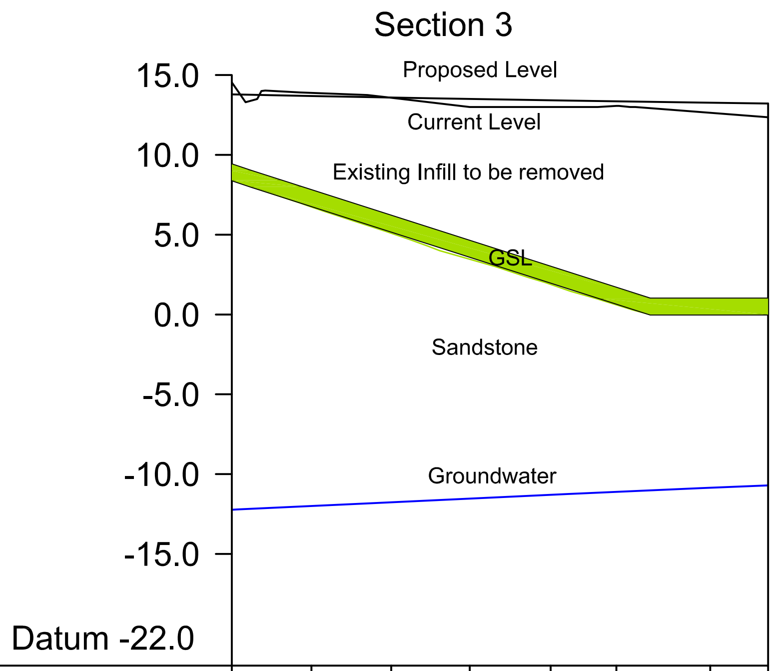
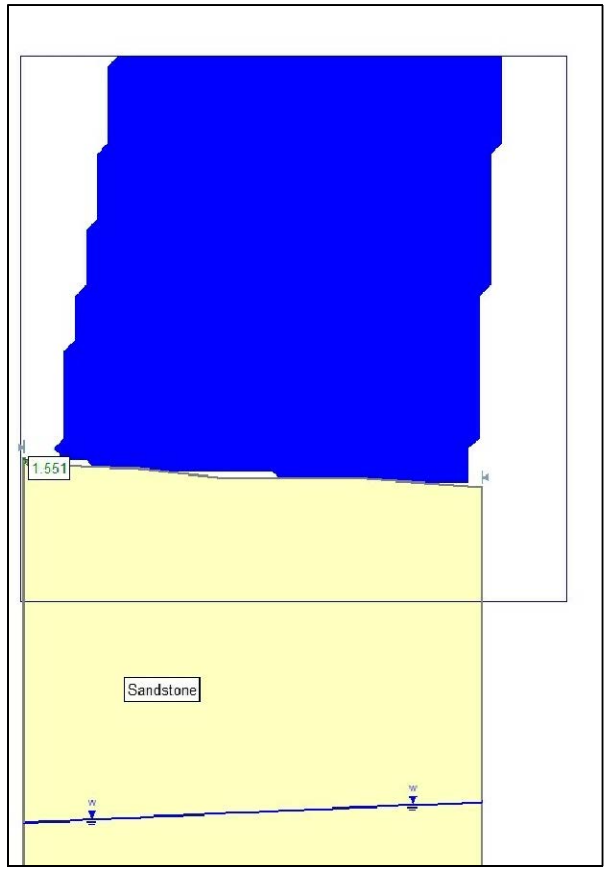
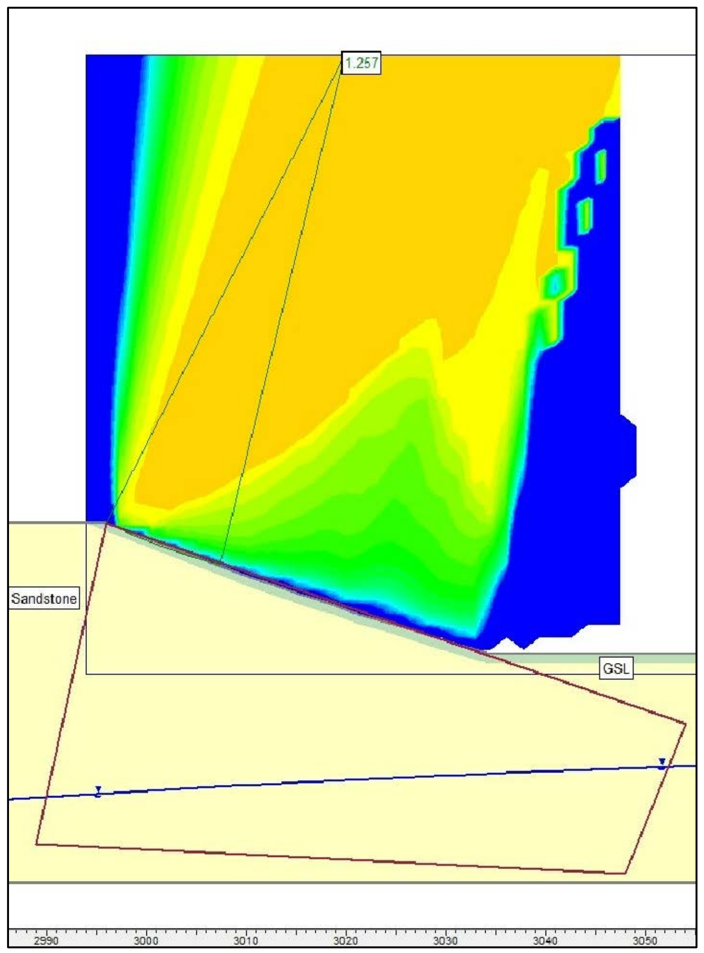


TOPO	14.538	13.883	13.576	13.000	13.000	13.072	12.638	12.357	
PROPOSED LEVELS	13.790	13.688	13.593	13.505	13.415	13.343	13.273	13.221	
GWT	-12.231	-12.000	-11.765	-11.530	-11.299	-11.073	-10.855	-10.704	
GSL TOP ELVN	9.000	7.742	6.099	4.438	2.883	1.000	1.000	1.000	1.000
GSL chainage	0.000	5.000	10.000	14.925	19.991	24.114	30.000	33.626	
Regular offsets	0.000	5.000	10.000	15.000	20.000	25.000	30.000		

Section 3 - Existing Side Slope FoS (1.3)



Section 3 - Proposed GSL Profile FoS (1.6)



General notes

Base Drawings Ref AAe Inert Landfill Nov22

Legend to symbols

Revision	Description

Title

Middleton Quarry, Pollington, Pinfold Lane, DN14 0EZ

Project

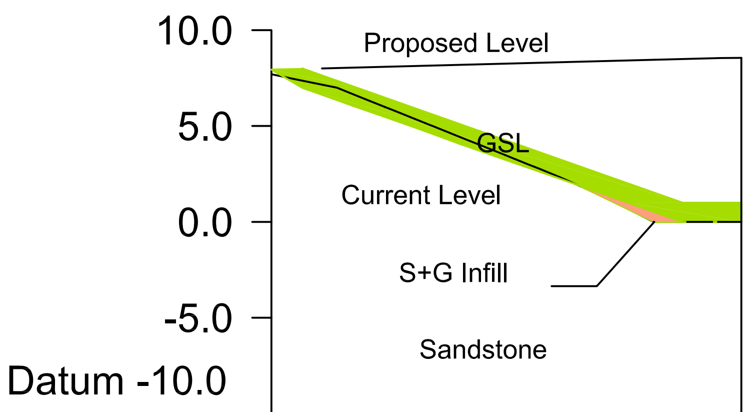
Slope Stability Factors of Safety Section 3 Current and Proposed

Client

AA Environmental Limited

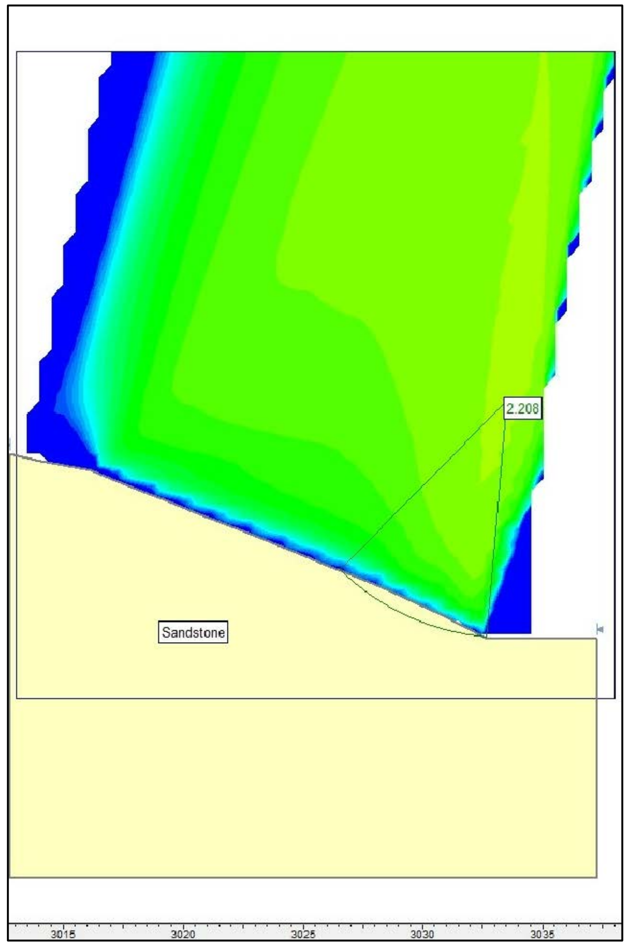
Date	Drawing No.	Scale
20/1/23	270-22-610-04	As Shown
Drawn By	**Checked by**	**Sheet Size**
PDS	CT	A3

Section 4

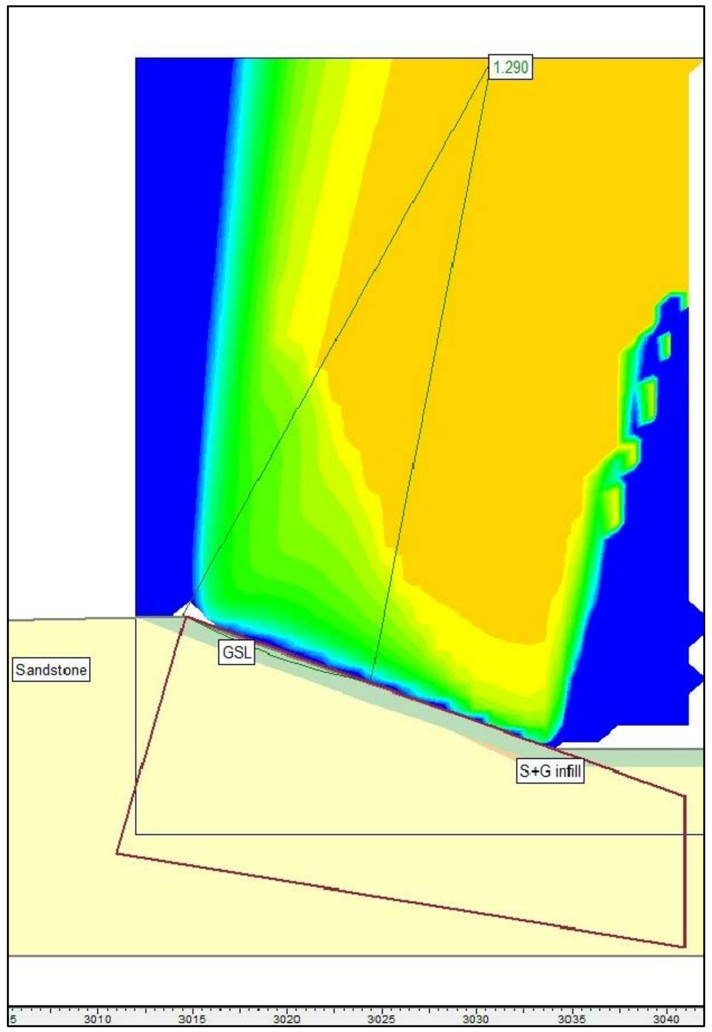


TOPO	7.702 6.365 4.367 2.352 0.000 0.000 0.000
PROPOSED LEVELS	8.000 8.062 8.192 8.322 8.453 8.558
GWT	
GSL TOP ELVN	8.000 6.787 4.998 3.264 1.000 1.000
GSL chainage	0.000 5.000 10.000 15.000 19.956 21.707 24.535
Regular offsets	0.000 5.000 10.000 15.000 20.000

Section 4 - Existing Side Slope FoS (2.2)



Section 4 - Proposed GSL Profile FoS (1.3)



General notes

Base Drawings Ref AAe Inert Landfill Nov22

Legend to symbols

Revision	Description

Title

Middleton Quarry, Pollington, Pinfold Lane, DN14 0EZ

Project

Slope Stability Factors of Safety Section 4 Current and Proposed

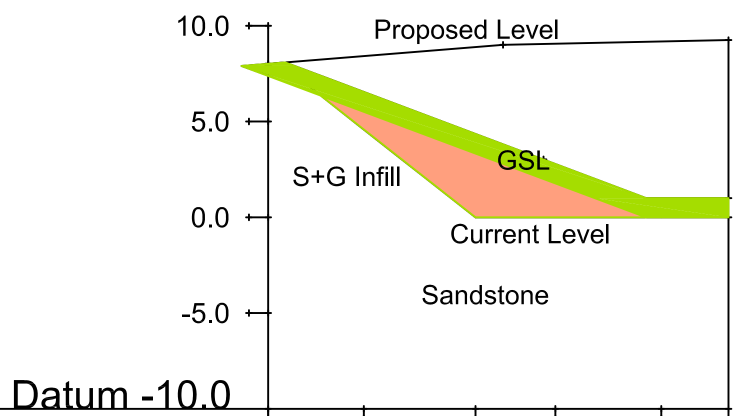
Client

AA Environmental Limited

asl

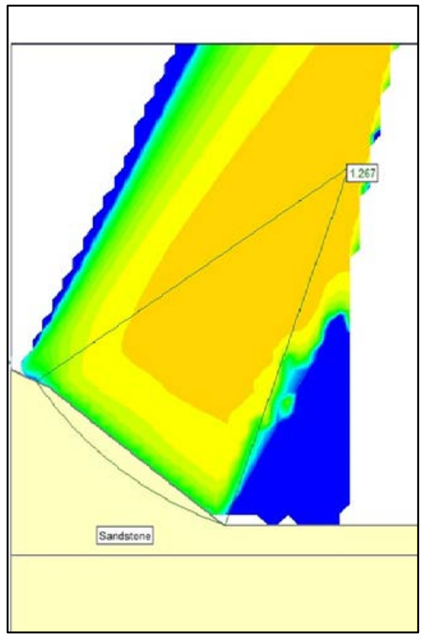
Date	Drawing No.	Scale
14/12/22	270-22-610-05	As Shown
Drawn By	**Checked by**	**Sheet Size**
PDS	CT	A3

Section 5

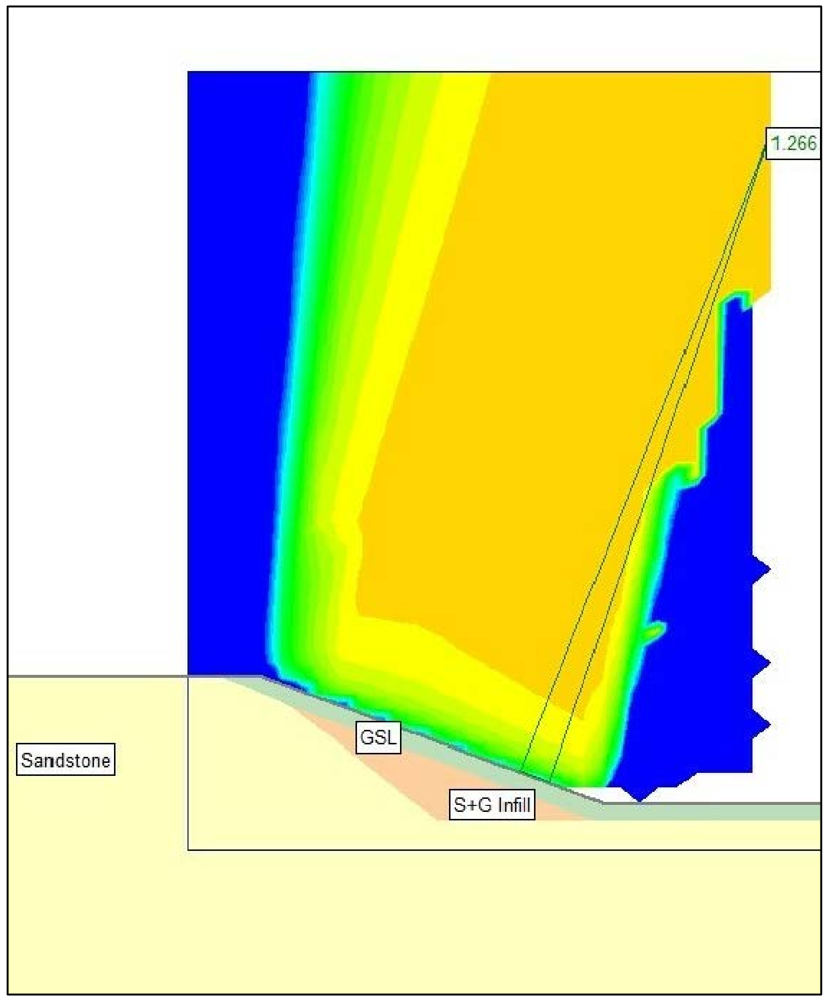


TOPO	7.923	4.586	0.000	0.000	0.000	0.000
PROPOSED LEVELS	8.013	8.414	8.817	9.058	9.164	9.250
GWT						
GSL TOP ELVN	7.781	6.557	4.672	2.785	1.000	1.000
GSL chainage	0.000	5.000	10.832	15.000	20.532	24.041
Regular offsets	0.000	5.000	10.000	15.000	20.000	

Section 5 - Existing Side Slope FoS (1.3)



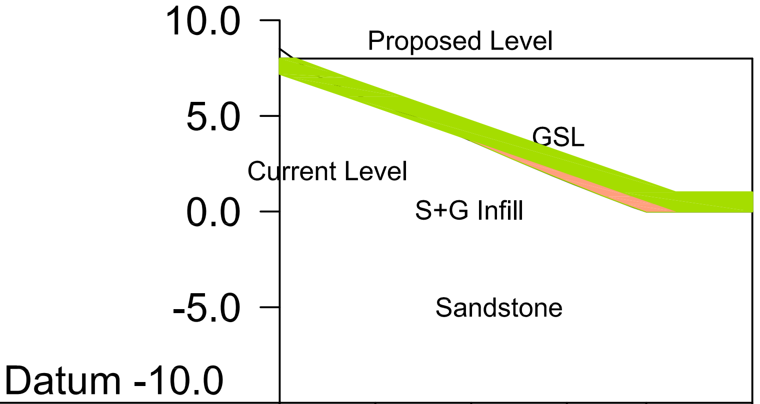
Section 5 - Proposed GSL Profile FoS (1.3)



General notes	Base Drawings Ref AAe Inert Landfill Nov22
Legend to symbols	
Revision	
Description	
Title	Middleton Quarry, Pollington, Pinfold Lane, DN14 0EZ
Project	Slope Stability Factors of Safety Section 5 Current and Proposed
Client	AA Environmental Limited
Date	20/1/23
Drawing No.	270-22-610-06
Scale	As Shown
Drawn By	PDS
Checked by	CT
Sheet Size	A3

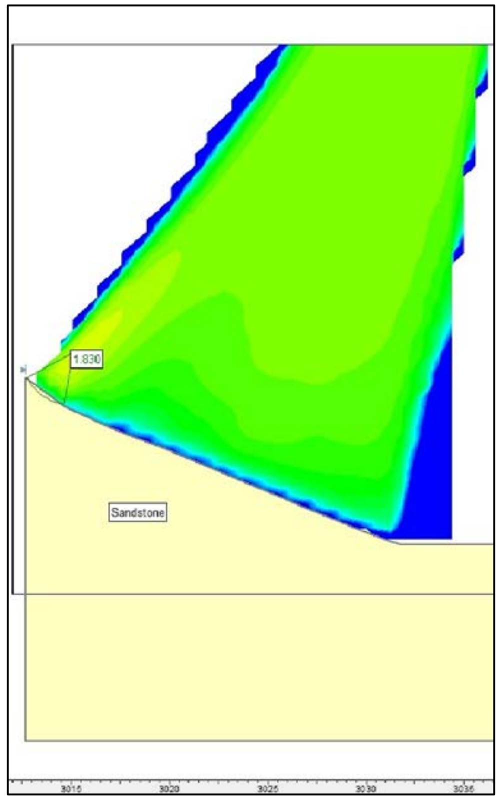
asl

Section 6

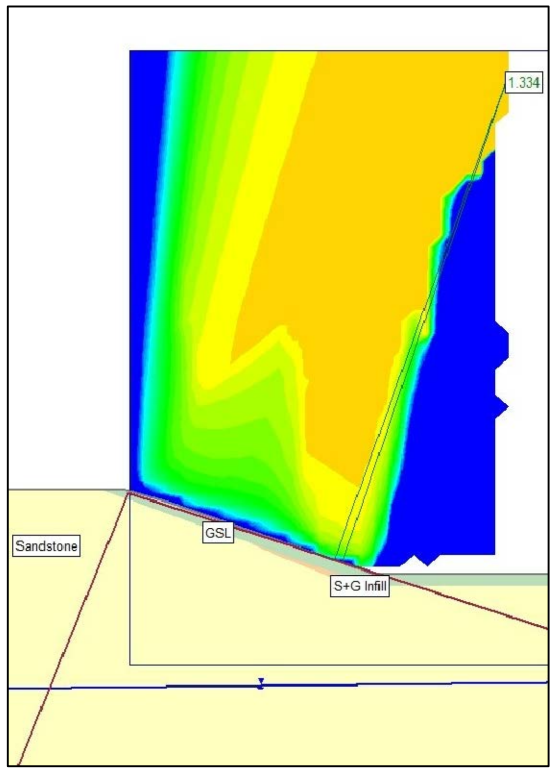


TOPO	8.506	5.712	3.707	1.593	0.000	0.000
PROPOSED LEVELS	8.000	8.000	8.000	8.000	8.000	8.000
GWT						
GSL TOP ELVN	7.000	4.735	2.972	1.000	1.000	
GSL chainage	0.000	5.000	10.000	15.000	19.144	24.683
Regular offsets	0.000	5.000	10.000	15.000	20.000	

Section 6 - Existing Side Slope FoS (1.8)



Section 6 - Proposed GSL Profile FoS (1.3)



General notes

Base Drawings Ref AAe Inert Landfill Nov22

Legend to symbols

Revision	Description

Title

Middleton Quarry, Pollington, Pinfold Lane, DN14 0EZ

Project

Slope Stability Factors of Safety Section 6 Current and Proposed

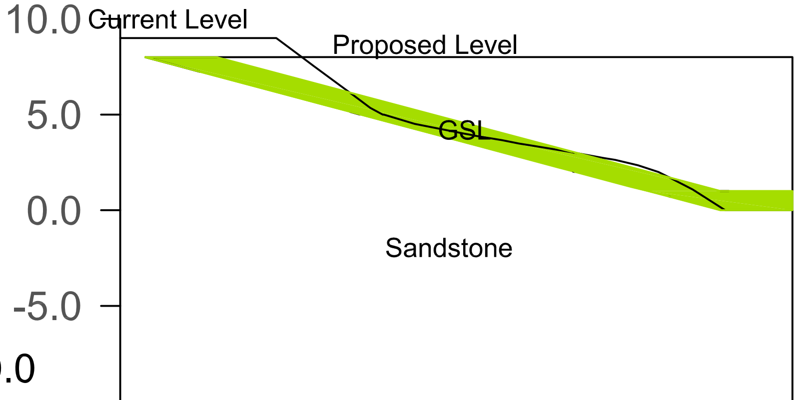
Client

AA Environmental Limited

asl

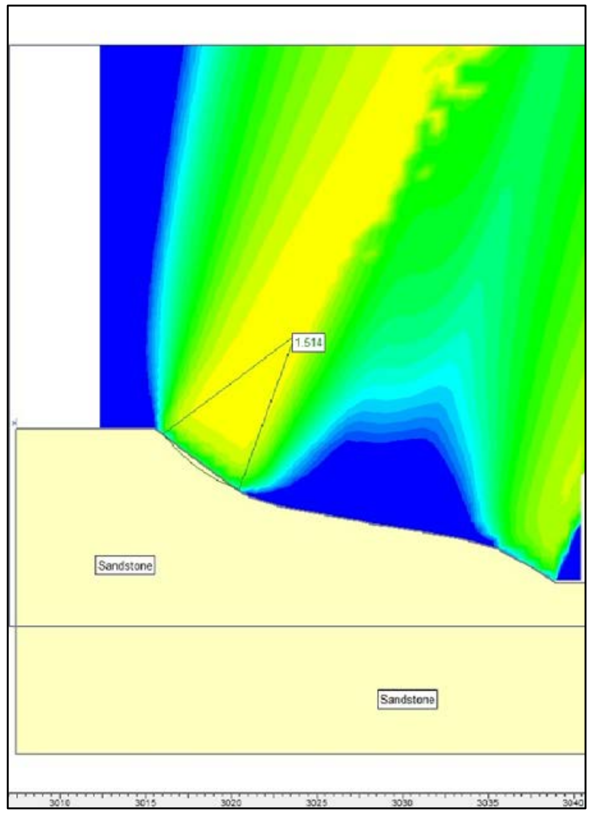
Date	Drawing No.	Scale
20/1/23	270-22-610-07	As Shown
Drawn By	Checked by	Sheet Size
PDS	CT	A3

Section 7

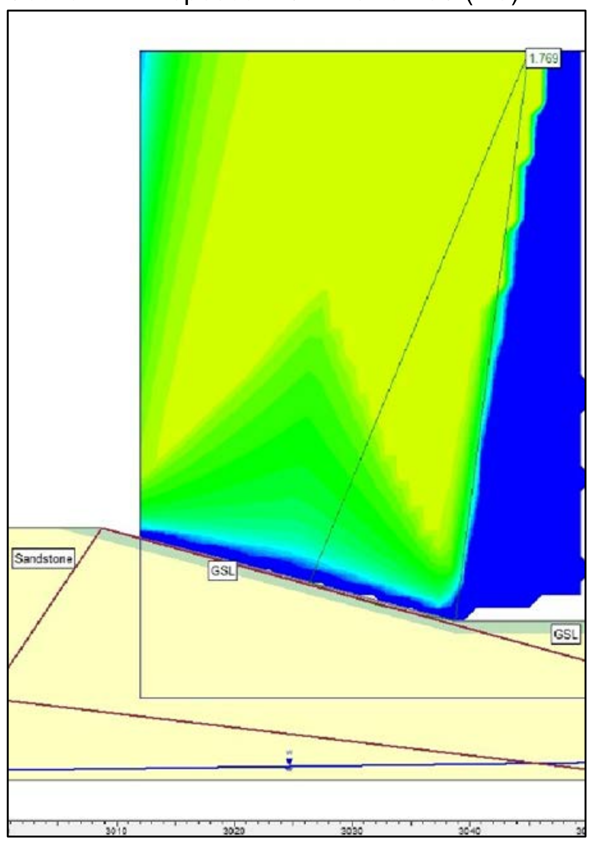


Datum -10.0	
TOPO	9.000 9.000 7.620 5.000 3.650 2.779 1.025 0.000 0.000
PROPOSED LEVELS	8.000 8.000 8.000 8.000 8.000 8.000
GWT	
GSL TOP ELVN	9.000 8.013 6.675 5.337 3.999 2.662 1.000 1.000
GSL chainage	0.000 5.000 10.000 13.719 20.000 25.000 30.000 31.611 35.128
Regular offsets	0.000 5.000 10.000 15.000 20.000 25.000 30.000 35.000

Section 7 - Existing Side Slope FoS (1.5)



Section 7 - Proposed GSL Profile FoS (1.8)



General notes

Base Drawings Ref AAe Inert Landfill Nov22

Legend to symbols

Revision	Description

Title

Middleton Quarry, Pollington, Pinfold Lane, DN14 0EZ

Project

Slope Stability Factors of Safety Section 7 Current and Proposed

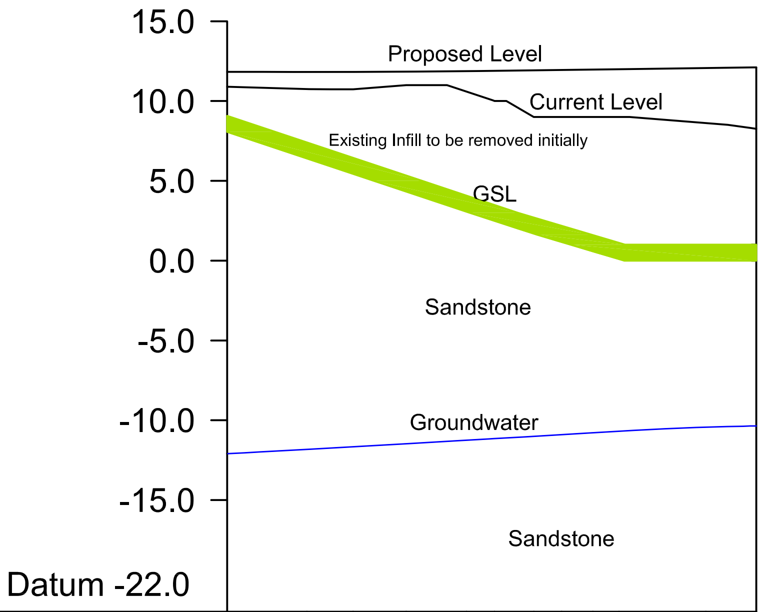
Client

AA Environmental Limited

asl

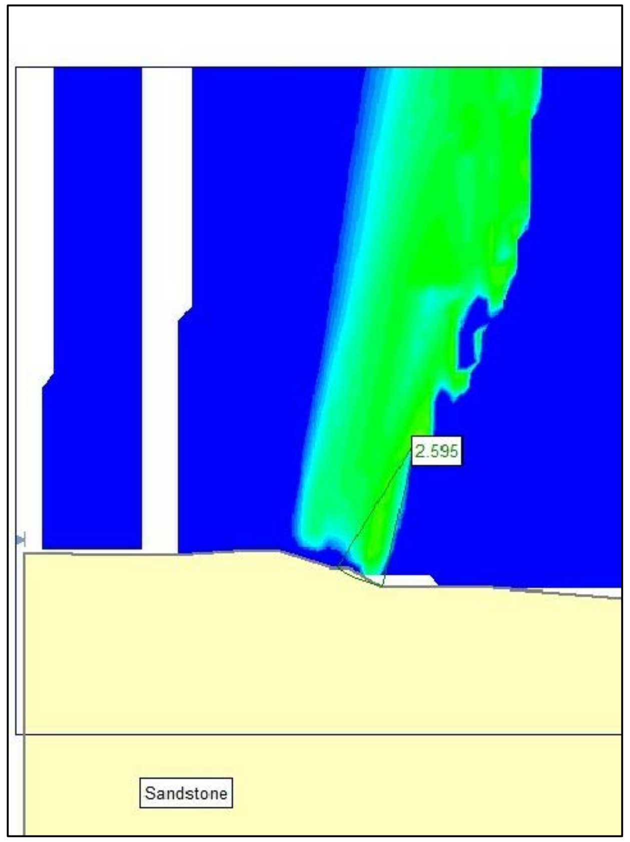
Date	Drawing No.	Scale
20/1/23	270-22-610-08	As Shown
Drawn By	Checked by	Sheet Size
PDS	CT	A3

Section 8

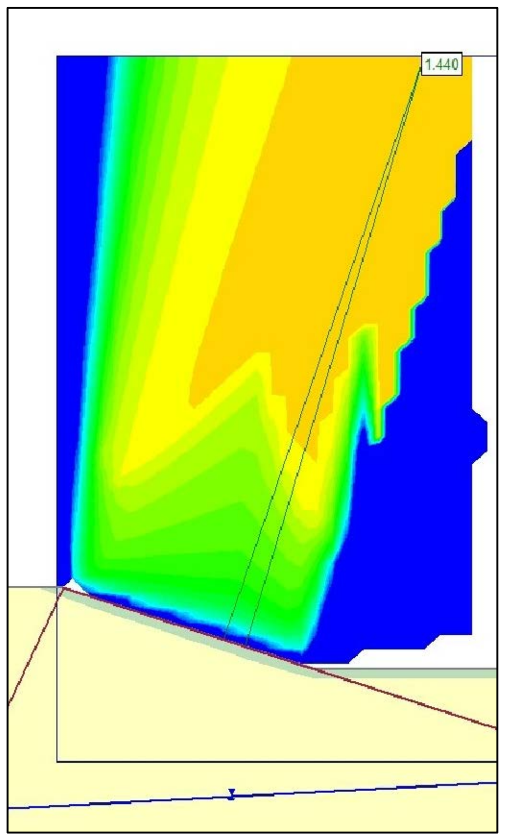


TOPO	10.898, 10.751, 10.732, 11.000, 10.594, 10.000, 9.000, 9.000, 9.000, 9.000, 8.618, 8.262
PROPOSED LEVELS	11.829, 11.831, 11.836, 11.871, 11.928, 12.010, 12.067, 12.111
GWT	-12.096, -11.824, -11.541, -11.250, -10.955, -10.664, -10.434, -10.353
GSL TOP ELVN	9.000, 7.402, 5.736, 4.071, 2.457, 1.000, 1.000, 1.000, 1.000
GSL chainage	0.000, 5.000, 7.888, 11.226, 15.000, 16.757, 19.220, 20.966, 22.922, 24.551, 30.000, 33.156
Regular offsets	0.000, 5.000, 10.000, 15.000, 20.000, 25.000, 30.000

Section 8 - Existing Side Slope FoS (2.6)



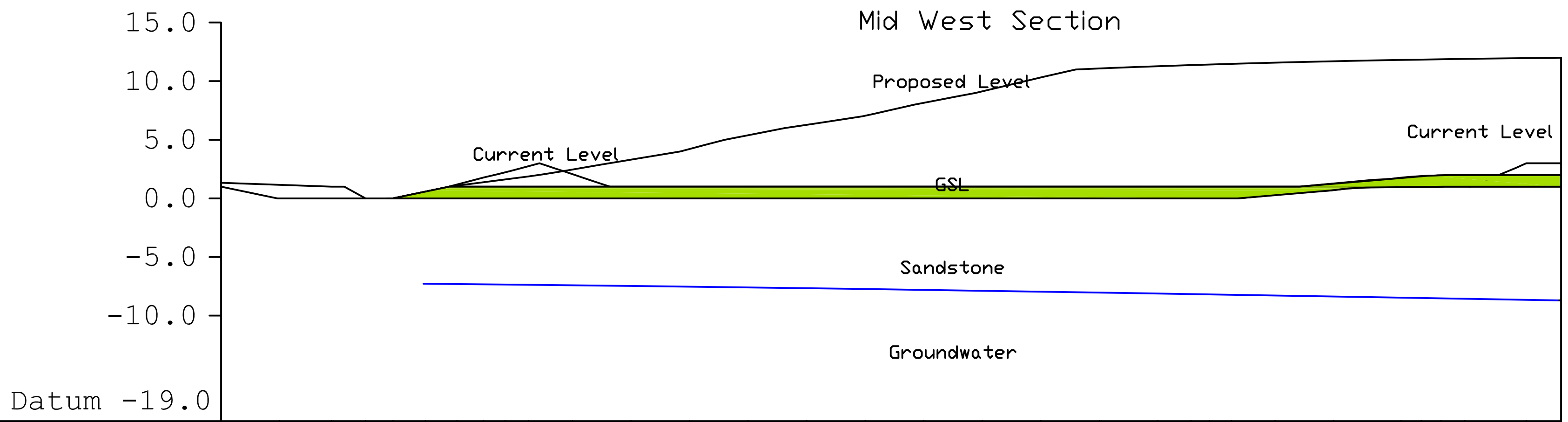
Section 8 - Proposed GSL Profile FoS (1.4)



General notes	Base Drawings Ref AAe Inert Landfill Nov22
Legend to symbols	
Revision	Description
Title	Middleton Quarry, Pollington, Pinfold Lane, DN14 0EZ
Project	Slope Stability Factors of Safety Section 8 Current and Proposed
Client	AA Environmental Limited

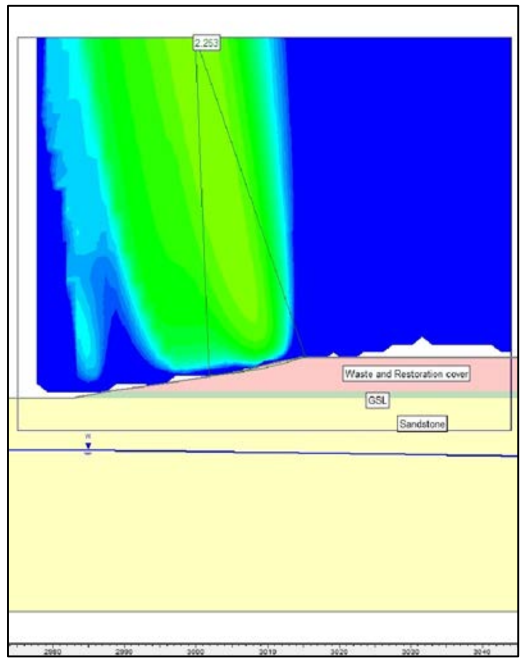
asl

Date	Drawing No.	Scale
20/1/23	270-22-610-09	As Shown
Drawn By	**Checked by**	**Sheet Size**
PDS	CT	A3

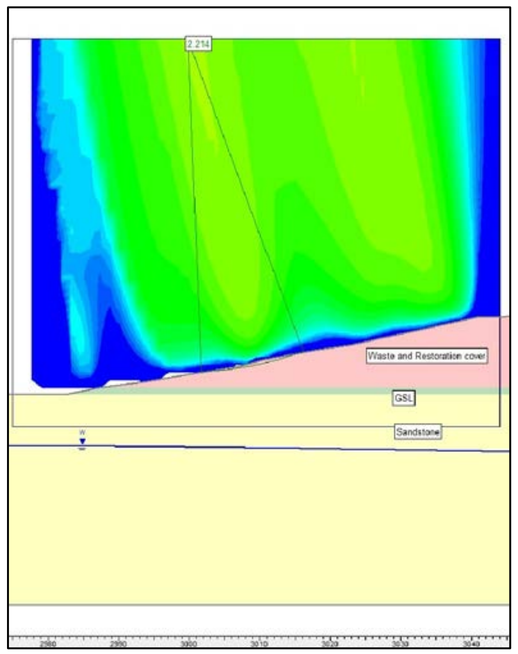


TOPO	1.327 1.153 1.000 0.251 0.664 0.986 0.980 0.971 1.000 3.000 3.000
PROPOSED LEVELS	1.000 0.000 0.000 0.000 0.073 1.069 1.713 2.468 3.302 4.210 5.392 6.280 7.052 8.157 9.134 10.324 11.086 11.267 11.443 11.580 11.696 11.807 11.882 11.956 12.000
GWT	-7.277 -7.304 -7.370 -7.411 -7.470 -7.529 -7.596 -7.664 -7.734 -7.807 -7.882 -7.959 -8.038 -8.119 -8.201 -8.285 -8.369 -8.454 -8.540 -8.626 -8.703
GSL TOP ELVN	1.000 2.419 3.000 2.065 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000
GSL chainage	0.000 5.000 9.421 12.331 14.672 17.448 20.147 22.376 24.252 26.250 30.000 35.000 40.000 45.000 50.000 55.000 60.000 65.000 70.000 75.000 80.000 82.822 84.404 86.282 90.000 95.000 100.765 102.482 104.163 106.208 111.459 114.427
Regular offsets	0.000 5.000 10.000 15.000 20.000 25.000 30.000 35.000 40.000 45.000 50.000 55.000 60.000 65.000 70.000 75.000 80.000 85.000 90.000 95.000 100.000 105.000 110.000

Midwest - Part Waste Restoration 1v:3h FoS (2.2)



Midwest - Full Restoration FoS (2.2)



General notes

Base Drawings Ref AAe Inert Landfill Nov22

Legend to symbols

Revision	Description

Title

Middleton Quarry, Pollington, Pinfold Lane, DN14 0EZ

Project

Slope Stability Factors of Safety MidWest Restorn (Part and Full)

Client

AA Environmental Limited

asl

Date	Drawing No.	Scale
26/1/23	270-22-610-10	As Shown
Drawn By	**Checked by**	**Sheet Size**
PDS	CT	A3