1MC04 Main Works - Contract Lot S2

Stability Risk Assessment - Eastern Mound - Ruislip Northern Sustainable Placement S2

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	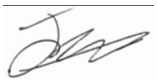					

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Contents

1 Introduction

Introduction to High Speed 2

1.1.1 Phase One of HS2 will provide dedicated high speed rail services between London, Birmingham and the West Midlands. It will extend for approximately 230km (143 miles). Just north of Lichfield, high speed trains will join the West Coast Main Line for journeys to and from Manchester, the North West and Scotland.

1.1.2 Phase One of HS2 is the first phase of a new high speed railway network proposed by the Government to connect major cities in Britain. It will bring significant benefits for inter-urban rail travellers through increased capacity and improved connectivity between London, the Midlands and the North. It will release capacity on the existing rail network between London, Birmingham and the West Midlands and so provide opportunities to improve existing commuter, regional passenger and freight services.

1.1.3 HS2 have employed Skanska Costain Strabag (SCS) as Main Works Civils Contractor for the S2 lot for Phase One of the HS2 scheme. Lot S2 extends from the western end of the proposed Old Oak Common Station and includes tunnels, shafts, a large crossover box excavation, portal structures, cuttings and embankments.

1.2 Report Context

1.2.1 This Stability Risk Assessment (SRA) report has been prepared for the Eastern Mound of the Ruislip North Sustainable Placement (from herein referred to as the 'EM RNSP') to support the Environmental Permit application in line with the requirements of the EU Landfill Directive (1193/31/EC). The site was originally identified as an area to accommodate sustainable placement for Phase 1 of the High Speed 2 project, and provisions were included within the High Speed Rail (London – West Midlands) Act 2017. Sustainable placement is the onsite placement for disposal of surplus excavated material to avoid causing environmental effects that would otherwise be associated with the offsite disposal of that material.

1.2.2 The report should be read in conjunction with the following drawings:

- 001-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711011 – Site location regional
- 002-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711012 – Site location local
- 004-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711014 – Site topography
- 005-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711015 – Proposed landfill geometry
- 006-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711016 – Location of geological Section
- 007-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711017 – Exploratory hole location plan
- 008-1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712021 – Cross Sections A and B

- 009-1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712022 – Cross Sections C and D
- 010-1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712024 – Geological cross section through the site
- 011-1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712025 – Geological cross section through Copthall
- 012-1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712026 – Conceptual site model

1.2.3 The EM RNSP is located on Newyears Green Lane in Harefield, Uxbridge. The site location is shown on Drawing 1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711011 and is located at National Grid Reference TQ 07330 88304. EM RNSP will receive inert soils excavated from the nearby Copthall Tunnel (shown on Drawing 1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711011), which is to be constructed as part of Phase 1 of the High Speed 2 rail scheme. The form of construction of the tunnel is 'cut and cover'. No tunnel boring machine will be used in its construction. The excavated material will primarily comprise London Clay.

1.2.4 The EM RNSP area will comprise two main mounds as shown on Drawing 1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711015. The maximum height of the mounds are around 22m and the slope angles vary between 1V:4H to 1V:10H as shown on Drawings 1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711015, 1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712021 and 1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712022. Site drainage will be controlled by a series of shallow swales around the perimeter of the mounds as shown on Drawing 005-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711015.

1.2.5 This report will form part of a suite of documents that together will be submitted to the Environment Agency as part of an application for a waste permit. The format of this report has been prepared in accordance with the associated Environment Agency template [1].

1.3 Conceptual Stability Site Model

1.3.1 The Conceptual Site Model (CSM) relating to the six components as outlined within the Environment Agency R&D Technical Report P1-385/TR2 are presented in the following sections.

1.3.2 As the landfill is for the disposal of inert soils only, there will be no leachate or gas generation and therefore these will not be discussed further as part of the CSM.

1.3.3 A schematic representation of the CSM is shown on Drawing 012-1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712026.

Basal Sub-Grade Model

Geological Review

1.3.4 The 1:50,000 geological map sheet [8] for the site has been reviewed and is summarised below.

1.3.5 Within the site boundary there are no superficial deposits indicated to be present. Immediately to the west of the site artificial ground is indicated to be present, specifically 'infilled ground; excavations that have been wholly filled with waste'. The area of artificial ground corresponds with the location of the historic landfill adjacent to the site.

1.3.6 The bedrock beneath the site is indicated to be Harwich and London Clay of the Thames Group. Underlying the Harwich and London Clay Formations is the Upnor and Reading Formations of the Lambeth Group which outcrops at lower levels to the east of the site.

1.3.7 On the vertical section, the Lambeth Group is indicated to be up to 28m in thickness and to lie unconformably over the Seaford and Newhaven Formations of the White Chalk Subgroup. The Seaford and Newhaven Formations are indicated to be 50m in thickness.

1.3.8 The geological map provides the following descriptions for the materials:

- Harwich and London Clay Formations (Thames Group): Clay, grey weathering to brown, stiff; thin beds of glauconitic sand and pebbles at base.
- Upnor and Reading Formations (Lambeth Group): Clay, silty with beds of sand; gravel at base, locally cemented.
- Seaford and Newhaven Formations: Chalk, soft, sporadic nodular flint beds; brown and phosphatic in upper part.

1.3.9 There are no faults indicated to be present in the vicinity of the site.

Ground investigation

1.3.10 Intrusive ground investigation has been undertaken at the site. The exploratory hole locations are shown on Drawing 007-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711017. The investigation comprised four boreholes and the exploratory hole logs are included in Appendix A. Note only one of the boreholes is within the site boundary, with the remaining three holes located between 15m and 180m away. A summary of the encountered ground conditions is presented in Table 1 below.

Table 1 - Summary of encountered ground conditions

Exploratory Hole	Topsoil / Made Ground	Clay Deposits	London Clay (Thames Group)	Harwich Formation (Thames Group)	Lambeth Group	Seaford and Newhaven Formations
ML024-RC012	0-0.5m	0.5-2m	2-17.5m	17.52-18.5m	18.5-33.5m	33.5->35m
ML025-RC048	0-0.3m	0.3-1.2m	1.2-2.2m	2.2-4.2m	4.2-20.2m	20.2->21.7m
ML025-RC049	0-0.3m	0.3-1.7m	-	1.7-3.8m	3.8-19.4m	19.4->21.5m

ML025-RC051	0-0.4m	0.4-2.1m	2.1-9.5m	9.5-11.7m	11.7-29.1	29.1->31m

1.3.11 As only one of the boreholes is located within the site boundary, the conceptual model for the basal subgrade will be based on the published geological information and all four boreholes in the area, to provide a broader understanding of the ground conditions in the vicinity of the site.

1.3.12 A cross section through the site showing the encountered ground conditions is shown on 010-1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712024 and the location of the section is shown on Drawing 006-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711016.

Topsoil and Made Ground

1.3.13 Topsoil was encountered in ML025-RC048, ML025-RC049 and ML025-RC051 to a depth of 0.3 to 0.4mbgl. This stratum was typically described as grass over soft brown slightly sandy slightly gravelly clay, with gravels subangular to rounded fine to coarse flint.

1.3.14 Made Ground was only encountered in ML024-RC012. This was described as brown and grey slightly sandy gravelly clay, with gravels angular to sub rounded fine to coarse flint and brick. From review of the site history completed as part of the ESSD [2] the site appears to be predominantly greenfield. ML024-RC012 is located on the far southern edge of the site near an access point into the site from Newyears Green Lane. It is therefore anticipated that the source of the made ground is likely to be related to works associated with this access point, or with the adjacent industrial premises.

Clay Deposits

1.3.15 Clay deposits were encountered in all holes beneath the topsoil and are referred to as 'superficial deposits' on the exploratory hole logs included in Appendix A. The thickness of the Clay Deposits encountered varied between 0.9m and 1.7m. It was typically described as soft light brown / yellow mottled grey slightly sandy slightly gravelly clay with sand being fine to coarse, and gravel as subangular and sub rounded fine to coarse flint.

1.3.16 The geological classification of this material is unclear. It considered likely to either be alluvium or weathered London Clay. Based on the grading of the material and visual appearance, it appears similar to the London Clay. However, the descriptions indicate the material contains some flint gravel which is unlikely to be present within the London Clay. As the classification is unclear, the engineering parameters will be derived based on the available information and this material will be referred to as 'Clay Deposits'

London Clay (Thames Group)

1.3.17 The Thames Group comprises the London Clay overlying the Harwich Formation.

1.3.18 The London Clay was encountered in three of the exploratory holes at depths ranging from 1.2mbgl to 2.1mbgl. The thicknesses of this strata range from 2m to 15.5m. This stratum is

typically described as stiff to very stiff fissured dark brown mottled orangish brown locally grey slightly sandy clay with occasional pockets of gypsum crystals, shell fragments and thin laminae of claystone. The fissures are noted as extremely closely to very closely spaced, planar and smooth.

1.3.19 London Clay was not encountered in ML025-RC049, although the underlying Harwich Formation was encountered. This broadly corresponds with the geological map which indicates that the Thames Group is absent in the lower parts of the site and ML025-RC049 is located near the boundary of the Thames Group in a lower area.

1.3.20 No residual shear surfaces were identified within the London Clay from the ground investigation. The site is relatively flat with the general fall of the land <5° (see Drawing 004-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711014). On this basis, residual shear surfaces are unlikely to be present within the London Clay.

Harwich Formation (Thames Group)

1.3.21 The Harwich Formation was encountered in all exploratory holes at depths ranging from 2.2mbgl to 17.5mbgl. The thicknesses of this strata range from 0.9m to 2.2m. This stratum is typically described as stiff brown or grey mottled orangish brown locally grey slightly sandy clay with occasional pockets of shell fragments. Gravels are noted in some locations as sub-surrounded and medium flint; claystones and weathered pyrite are also noted in ML025-RC049.

Reading Formation (Lambeth Group)

1.3.22 The Lambeth Group comprises the Reading Formation overlying the Upnor Formation.

1.3.23 This stratum was encountered in all exploratory holes to a maximum depth of 33.5mbgl. It is typically described as stiff to very stiff fissured dark yellowish brown slightly sandy clay with rare fragments of lignite. The sand is generally fine and medium and the fissures are extremely closely to very closely spaced, mainly planar and smooth. In some locations, it is interbedded with brown to orangish brown sand or silt that is locally slightly gravelly.

Upnor Formation (Lambeth Group)

1.3.24 This stratum was encountered in all exploratory holes to a maximum depth of 33.45mbgl. It is typically described as dark grey slightly gravelly clay. It is also noted as a sand in some locations (ML-25-RC048). The sand is glauconitic, fine to coarse and the gravel is angular to round fine to medium flint. Some fissures are noted, these are extremely closely to very closely spaced, planar, smooth.

Seaford and Newhaven Formations

1.3.25 The Seaford and Newhaven Formations were encountered in all exploratory holes to an unproven depth. It is typically described as very weak to weak high density white chalk with occasional thin beds of nodular flint. Fractures are very closely to medium spaced, planar,

smooth. In some shallower locations (ML025-RC049 and ML024-RC012) it is described as a structureless chalk composed of slightly gravelly silty sand. ML025-RC051 notes extremely weak to weak siltstone with frequent chalk and flint clasts.

Groundwater

1.3.26 A detailed review of the site hydrogeology has been undertaken as part of the Hydrogeological Risk Assessment [4]. In summary, the Seaford and Newhaven Formations are classified by the Environment Agency (EA) as a Principal aquifer, whereas the Lambeth Group and the Harwich Formation are Secondary A aquifers.

1.3.27 Groundwater level monitoring has been performed from January 2017 to May 2017 and the results are presented within the Hydrogeological Risk Assessment [4]. A summary of the monitoring data is provided in Table 2 below. All of the response zones were within the base of the Lambeth Group, just above the horizon of the chalk. In summary, the piezometric pressures were typically monitored at around 39mOD across the site.

Table 2 - Summary of groundwater monitoring information

Hole	Ground Level mOD	Response Zone mOD / mbgl	Average mOD / mbgl	Highest mOD / mbgl	Lowest mOD / mbgl
ML024-RC012	61.9	28.9 – 31.9 30 - 33	37.5 / 24.3	23.0 / 38.9	37.0 / 24.9
ML025-RC048	54.8	41.9 - 45.9 16 – 20	39.4 / 15.3	40.0 / 14.8	39.2 / 15.6
ML025-RC049	51.2	32.2 – 37.2 14 – 19	37.9 / 13.3	38.7 / 12.5	37.6 / 13.7
ML025-RC051	60.0	31 - 41 19 - 29	39.9 / 20.0	40.6 / 19.3	39.3 / 20.6

Existing topography

1.3.28 The existing site topography is shown on Drawing 004-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711014. The site is generally relatively flat with an approximate elevation of between 47mAOD and 62mAOD with gentle slopes (generally less than 5°).

Conceptual model

1.3.29 Based on the information outlined in the above sections, the proposed conceptual model for the basal subgrade is as follows and is shown on Drawing 012-1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712026:

- 0 to 1.5mbgl – Clay Deposits
- 1.5 to 15.5mbgl – London Clay (Thames Group)

- 15.5 to 17.5mbgl – Harwich Formation (Thames Group)
- 17.5mbgl to 30mbgl – Lambeth Group
- `>30mbgl - Seaford and Newhaven Formations

1.3.30 It should be noted that the Lambeth Group will be treated as a single material for the stability risk assessment and not separated between the Upnor and Reading Formations. The material is present at depth and is unlikely to have a significant impact on the results of the stability calculations. In addition, based on the review of the material descriptions and geotechnical test data (as discussed in Section 2.5), they are likely to exhibit similar engineering properties.

1.3.31 In the lower parts of the site, the London Clay is likely to be relatively thin or absent. As the London Clay generally exhibits lower undrained shear strength than the underlying Harwich Formation (see Section 2.5), accounting for a larger thickness of London Clay in the conceptual model is considered to be conservative for the stability risk assessment. In regard to drained strength parameters, the design values are proposed to be the same for both the London Clay and Harwich formation.

1.3.32 The topsoil and subsoil will be stripped from the footprint of the landfill prior to its construction.

1.3.33 In regard to the groundwater level, based on the monitoring information this indicates groundwater level is at some depth below the landfill at >10bgl. However, this is based on monitoring within installations at the base of the Lambeth Group. The underlying chalk is anticipated to be under draining the overlying superficial deposits and therefore there is potential for porewater pressures to be present within the overlying Thames Group. For design purposes, a design groundwater level of 1mbgl will be conservatively assumed.

Side Slopes Sub-Grade Model

1.3.34 The CSM for the side slopes sub-grade is as per the basal sub-grade model described above.

Basal Lining System Model

1.3.35 The use of basal and side slope liners was considered and discussed with the Environment Agency. While the waste material will comprise predominantly inert London Clay, and the underlying material comprises low permeability London Clay, an artificially enhanced geological barrier was required in order to comply with relevant landfill construction guidance. The London Clay used to construct the liner will be from the same source as the London Clay which forms the majority of the waste mass, but the liner will undergo additional testing and inspection measures as part of the CQA process to demonstrate its suitability to perform as a liner.

1.3.36 For the purpose of the stability risk assessment the barrier material will have the same geotechnical properties as that of the underlying material and the waste material. As such this

basal lining system will be assessed as part of the Waste Mass Model (Sections 1.3.38 to 1.3.47).

Side Slope Lining System Model

1.3.37 As per the above for basal lining system.

Waste Mass Model

1.3.38 The waste mass will comprise inert soils from the Copthall Tunnel which is located approximately 750m to the southwest of the site. The location of the tunnel is at National Grid Reference TQ 0649 8750 and is shown on Drawing 002-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711012.

1.3.39 Intrusive ground investigation has been undertaken at the location of the Copthall Tunnel. A long section through the tunnel has been produced showing the rail level, existing topography and ground investigation information and is shown on Drawing 011-1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712025.

1.3.40 As can be seen from the long section, the vast majority of the soils excavated from the tunnel will be within London Clay. At the base of the tunnel, the Harwich Formation is likely to be encountered.

1.3.41 Made ground and topsoil are anticipated to be present to shallow depth above the London Clay, however, these materials will not be disposed of within the landfill.

1.3.42 For the waste mass model, this will be assumed to be London Clay. Although there will be some material from the Harwich Formation within the waste mass, this will only comprise a relatively small quantity. In addition, the Harwich Formation will likely exhibit similar strength and stiffness parameters to the London Clay (see Section 2.5).

1.3.43 The maximum permanent angle of the waste mass will be 1V:4H. It is proposed to construct the landfill mounds by bringing up mounds approximately level. There will therefore not be any temporary slope angles steeper than 1V:4H.

1.3.44 As the waste mass will comprise London Clay which is a low permeability material, the majority of surface water will run off the landfill slopes and there is unlikely to be infiltration of surface water in to the waste mass. For the purpose of the stability calculations, an r_u value of 0.1 will be assumed which is considered to be conservative based on the low permeability of the waste mass.

1.3.45 As the landfill mounds are to be constructed at a relatively steep angle of up to 1V:4H, the earthworks specification will be relatively stringent in terms of the compaction requirements. The earthworks specification will be similar to that of a standard engineered earthwork (such as a highway embankment) rather than a landfill. The earthworks specification will require the waste material to be placed in thin layers and compacted with appropriate earthworks plant

to ensure the material is well compacted. This is primarily required for stability purposes, but will also limit the internal settlement and potential for surface water infiltration.

Capping System Model

1.3.46 As the waste is to comprise inert soils only there is no capping system to the landfill.

1.3.47 The landfill mounds will be landscaped which will include the placement of topsoil and subsoil on the landfill slopes. As the topsoil and subsoil is not integral to the performance of the landfill, the stability of the topsoil and subsoil has not been considered as part of the stability risk assessment.

2 Stability risk assessment

2.1 Risk Screening

Basal Sub-Grade Screening

2.1.1 The more complex geotechnical risks relating to the basal sub-grade requiring detailed analyses are as follows:

- Impact on slope stability: The basal sub-grade may impact on the stability of the landfill if the critical slips surfaces pass through the sub-grade. In particular, this is likely to be the case in the undrained conditions when larger deep-seated slips are typically critical and may pass in to the underlying basal sub-grade.
- Preferential failure plane through the Clay Deposits: The Clay Deposits have a slightly lower undrained shear strength than the overlying waste and underlying London Clay. As such this has the potential to be a preferential failure plan for the deeper undrained failure surfaces.
- Settlement of the landfill: The properties of the basal sub-grade will determine the settlement of the landfill mounds. Although the risks posed by settlement to the landfill are considered to be relatively low, it is considered necessary to have some understanding the potential settlement of the landfill to inform post construction monitoring.

2.1.2 The simple geotechnical risks relating to the basal sub-grade which do not require detailed analyses are as follows:

- Dissolution features: There is the potential for dissolution features to form and collapse within the chalk of the Seaford and Newhaven Formations. The risks posed by dissolution to the safe operation of the landfill are not considered to require complex analyses based on the following:
  - The chalk is confined and thus will remain saturated. The presence of saturated groundwater conditions minimises the risk of collapse, as dissolution features are less stable where unsaturated.
  - The top of the chalk layer is at least 19m (or greater) below the ground surface. There will be some spread of the load applied from the mound through the overlying material, reducing the load applied to the chalk.
  - As the chalk is overlain by 19m of material, should there be any of collapse of voids within the chalk, these may not propagate to the ground surface depending on the size of the void due to bulking effects.
- Strength characteristics of Lambeth Formation and Seaford and Newhaven

Formations: As these materials are present at significant depth, greater than 17.5mbgl in the conceptual model, it is not considered necessary to assess their strength characteristics in detail. This is on the basis that the critical slope slips will be driven by the landfill mound and the shallow underlying ground conditions.

- Residual shear surfaces within the London Clay: No residual shear surfaces were identified within the London Clay from the ground investigation. The site is relatively flat with the general fall of the land <5° (see Drawing 004-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711014). On this basis, residual shear surface are unlikely to be present within the London Clay.
- Soft or unsuitable ground in the mound formation: The topsoil and subsoil will be stripped from the mound formation. Prior to the placement of any material, the formation will be inspected and any soft or unsuitable ground will be excavated and replaced.
- Adjacent gas main utility: There is an existing buried gas main within the site near the western boundary (see Drawing 1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711014). Any future maintenance access to the gas main could include excavations to expose the main and such excavations could impact on the stability of the landfill. As such, the toe of the landfill slopes have been positioned a safe offset from the gas main alignment. There is a 25m wide easement around the gas main (12.5m either side) and in addition to this, an 8m wide construction corridor has been allowed for between the edge of the easement and the toe of the slopes (as illustrated on Drawing 1MC04-SCJ_SDH-LS-DSE-SS05_SL07-71201). As such, the gas main is approximately 20m from the toe of the landfill and therefore any shallow excavations to expose the main are not anticipated to have any significant impact on the stability of the landfill. This also allows for safe construction of the landfill without risk of damage to the gas main.
- Effects of perimeter drainage: The swales around the perimeter of the mounds have the potential to impact on the global stability of the adjacent mound slopes. However, the proposed swales are offset a short distance from the toe of the mound, are less than 0.5m deep and have 1:3 side slopes as shown on Drawing 008-1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712021 and 712022. As such these shallow swales don't have any impact on the stability of the adjacent mounds and do not require any further consideration.

Side Slopes Sub-Grade Screening

2.1.3 The risk screening relating to the side slopes sub-grade is as per the basal sub-grade discussed above.

Basal Lining System Screening

2.1.4 The risk screening relating to the basal lining system is as per the Waste Mass Screening discussed below.

Side Slope Lining System Screening

2.1.5 The risk screening relating to side slope lining System is as per the Waste Mass Screening discussed below.

Waste Mass Screening

2.1.6 The more complex geotechnical risks relating to the waste mass requiring detailed analyses are as follows:

- Slope stability: The stability of the landfill will primarily be driven by the geometry and properties of the waste mass. As the majority of the waste mass will be London Clay, it will be necessary to consider both drained and undrained conditions.
- Internal settlement: The properties of the waste mass will determine the internal settlement of the landfill mound. Although the risks posed by internal settlement to the landfill are considered to be relatively low, it is considered necessary to have some understanding the potential settlement of the landfill to inform post construction monitoring.

2.1.7 The simple geotechnical risks relating to the waste mass which do not require detailed analyses are as follows:

- Preferential slips surfaces: Where there are interfaces between different fill types and geotextiles, there is the potential for these to form preferential slip surfaces. As there is no capping to the landfill and the basal subgrade material comprises the same material as the waste mass, there are no preferential slip surfaces present.
- Topsoil stability: It is proposed to topsoil and landscape the landfill mound. As the topsoil is not integral part of the landfill structure, it is not considered necessary to consider the stability of the topsoil as part of this assessment.

Capping System Screening

2.1.8 As the landfill is for inert material only, no capping system is proposed.

2.2 Lifecycle Phases

2.2.1 Regarding potential lifecycle phases of the landfill, for the Stability Risk Assessment it is only considered necessary to assess the landfill in the as built condition. This is based on the following effects during and post construction:

During construction

- The waste mass will comprise inert wastes only and therefore there will be no daily cover or temporary capping.
- There are no cells or particular zoning to the landfill, it will be a single homogeneous mound.

- The slope heights will be at their greatest at the end of construction.

Post construction

- The waste mass will comprise inert wastes only and therefore there will be no leachate or gas generation.
- The formation will consolidate under the additional load which will result in an increase in the undrained shear strength.
- As the settlement of the formation and internal settlement occurs, this may result in a small reduction in the slope angles
- The landfill will be inspected and monitored (see Section 3)

Based on the above, the as built condition is considered to be most critical. No other life cycle phases will be considered as part of this assessment.

Due to the size of the mounds, during their construction there is likely to be some phasing of the earthworks to allow better quality in smaller working areas i.e. protection to soil formations, surface water control, silt management etc. As such there may be some small intermediate temporary slopes to allow this phasing but these will not exceed the finished profile of the mounds and fill will be benched into any intermediate slopes to ensure there are no potential preferential failures surfaces. As such further consideration of these small intermediate temporary slopes is not considered necessary as part of this assessment.

2.3 Data Summary

2.3.1 A summary of the data used to inform this Stability Risk Assessment is listed below.

Published data

- 1:50,000 Geological Map.

Site specific data

- Four boreholes as summarised in Section 1.3.10.
- Associated geotechnical laboratory testing including bulk unit weight, Atterberg Limits, undrained triaxial tests, particle size distribution and shear box tests. The results of the laboratory testing are presented on Figures 1 to 19.
- Groundwater monitoring data as summarised in Section 1.3.26.

Assumed data

2.3.2 The ground investigation data from the Copthall Tunnel has been used as part of this Stability Risk Assessment to supplement the site specific data. As this larger data set is available it is considered prudent to review this data to provide greater confidence in the site specific data. The Copthall Tunnel is located approximately 750m to the south and has the same geological

setting and therefore is considered to be relevant to the ground conditions at the site. In addition, as the Copthall Tunnel will be the source of the waste mass, the data will also be used to determine parameters for the waste. The data available from the Copthall Tunnel includes:

- 57no. boreholes.
- 68no. windowless sample holes.
- 37no. trial pits.
- Associated geotechnical laboratory testing including bulk unit weight, Atterberg Limits, undrained triaxial tests, particle size distribution and shear box tests. The results of the laboratory testing are presented on Figures 1 to 19.

2.4 Justification for Modelling Approach and Software

Slope stability

2.4.1 For undrained soil conditions, the stability of the slope will be assessed using Bishop's method. The slope stability analysis will be undertaken using Oasys Slope with variably inclined interslice forces of 2D circular slips. It is proposed to analyse three cross sections through the southern mound (A-C) and one through the northern mound (D) to ensure the variation in slope angles and geometry is assessed. The location of the sections are shown on Drawing 005-1MC04-SCJ_SDH-LS-DGA-SS05_SL07-711015 and the sections themselves are shown on 008-1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712021 and 009-1MC04-SCJ_SDH-LS-DSE-SS05_SL07-712022.

2.4.2 Sections A-AA, B-BB and C-CC pass through the highest point of the larger southern mound. The domed shape of the mound means that the highest part of the mound only occurs over a relatively short distance, and it is considered that analysis of the sections though the highest point is unduly conservative.

2.4.3 As can be seen in Sketch 01 included in Appendix B1, the peak of the mound is 66.8mOD. The slope of the upper 4m to 5m of the mounds is more gradual, before dropping away more steeply from around 62mOD.

2.4.4 Based on the above, for the slope profiles to be more representative and take some account for the 3D geometry of the mounds, the sections used in the analyses have been 'flattened' by 2m to model the 'averaged' height of the top of the mound.

2.4.5 To assess the potential for a preferential failure plane through the Clay Deposits, a sensitivity analysis will be undertaken for a wedge type failure. This will also be analysed in Oasys Slope using the Janbu method. The failure surface will be defined to be a wedge of similar geometry to the circular slip identified as having the lowest factor of safety, but modified to pass through the lower strength Clay Deposits.

2.4.6 For drained soil conditions the stability of the slope will be assessed using infinite slope theory. This approach is considered to be appropriate due to relatively long length of the slopes up to 22m in height. It also conservatively ignores any beneficial effects associated with circular slips, toe effects or 3D effects on the side of the slip surface. Drained conditions will be assessed for the range of slope angles present, including the steepest proposed angle of 1V:4H.

2.4.7 As an additional robustness measure, the steepest section from the mound (Section B-BB) will be analysed in Oasys Slope under drained conditions.

2.4.8 The Sustainable Placement Area mounds are more similar to standard engineered earthworks than to landfills. There are no particular additional failure mechanisms, such as interfaces within a capping system. On this basis, the slope stability of the landfill will be assessed as a whole, rather than considering elements individually.

Settlement

2.4.9 Settlement of the landfill formation will be assessed using Oasys Pdisp which is based on elastic settlement theory. To simplify the non-uniform geometry of the mounds, these will be simplified to a two-dimensional sections which are then extrapolated in to the third dimensions to form a linear type embankment. This approach is considered to be conservative as the 3D loading effects where the fill height reduces in all directions away from the top of the mounds will be ignored. The rigid boundary will be assumed to be the horizon of the Seaford and Newhaven Formations at 30mbgl in the conceptual model.

2.4.10 Section B-BB will be analysed as this section has the greatest loaded area.

2.4.11 For the internal settlement of the landfill mounds, this will be estimated based on the approach recommended outlined in Earthworks: A Guide by Trenter [5].

2.5 Justification of Geotechnical Parameters Selected for Analyses

2.5.1 In the following sections of this report, the data available from the site and also the nearby Copthall Tunnel will be set out and analysed. On the plots of the geotechnical test data (Figures 1 to 19), the site specific data is shown in red and the data from the Copthall Tunnel is shown in grey/black. In addition, as the Copthall Tunnel will be the source of the waste mass, this data will also be used to determine parameters for the waste.

Parameters Selected for Basal Sub-Grade Analyses

Clay Deposits

Classification

2.5.2 Four Atterberg Limit and Particle Size Distribution (PSD) tests were undertaken on samples of the Clay Deposits. The Atterberg limit test results are presented in Figure 1 and indicate the

plastic limit varies between 17% and 22% and liquid limits between 69% and 88%. The results of the PSD grading analysis are shown on Figure 3. These indicate the materials is a slightly sandy slightly gravelly silty clay which corresponds with the log descriptions.

2.5.3 No bulk unit testing was undertaken on the Clay Deposits. Based on the guidance in BS8002 [6], a density of 15kN/m3 to 19kN/m3 is recommended for low strength clay. On this basis, a value of 17kN/m3 is recommended for design.

Strength

2.5.4 No strength testing has been undertaken on the Clay Deposits. In regard to the undrained strength, the material is described as being of soft consistency which equates to a material of undrained shear strength of 20kPa to 40kPa in accordance with Trenter [5]. On this basis, a value of 30kPa is recommended for design. For the drained strength parameters, this can be correlated from the plasticity index in accordance with the equation stated in BS8002 [6]. Assuming a characteristic plasticity index value of 60%, this equates to a $\Phi'_{critical} = 20°$. The equation does not account for dilation effects and peak values.

Stiffness

2.5.5 For the stiffness (Young's Modulus), this can be correlated from the undrained shear strength. Based on the guidance by M.A. Stroud [7], a correlation of $E' = 200c_u$ is recommended for high plasticity clays. This equates to a value of $E' = 6000kN/m^2$.

London Clay (Thames Group)

Classification

2.5.6 Classification tests including PSD, Atterberg limit, natural moisture content and bulk unit weight have been carried out in the London Clay. The bulk unit weight of the samples is presented in Figure 4 and typically ranged between 18.6 and 20.6kN/m³. This is in agreement with Ciria C760 which suggests 18 to 19kN/m³ for firm stiff clay. A unit weight of 19.5kN/m³ is therefore suggested for design for the London Clay.

2.5.7 The Atterberg limit test results are presented in Figure 5 and suggest the plastic limit of the London Clay to lie between 17 and 34% and liquid limits between 48 and 85% with the majority of samples lying between 60 to 75%. Figure 6 shows the plasticity chart for London Clay and confirms the high to very high plasticity of the clay.

2.5.8 The results of particle size distribution tests in the London Clay are shown in Figure 7. Disregarding ML025-TP079 which contains claystones and cobbles, these show the London Clay to have a gravel content of less than 5%. The clay could be described as sandy, and over the top 15 metres with a sand content which tends to be less than 20%, most of which is fine sand. The sand content increases with depth, with the base of the London Clay containing a band of between 10 and 45% sand. The London Clay samples were very silty (20-40% silt) and 30-63% clay.

Strength

2.5.9 SPTs 'N' values show an increasing trend with depth, predominantly ranging from 9 to 38 as shown on Figure 8. A characteristic relationship of N=10+1.6z is recommended where z is measured from below the top of the London Clay stratum. The triaxial undrained shear strength test result also shows an increasing trend with depth as shown on Figure 9. The values typically vary between 45 kPa and 200kPa.

2.5.10 Stroud [7] recommends a relationship of cu = 4.5N (where N is the SPT value), however, considering the agreement of the SPT-derived and triaxial undrained shear strength values a correlation factor of 4N is more appropriate as shown in Figure 9. A characteristic approximation of the undrained shear strength with depth based on this plot would give cu = 40+6.5z.

2.5.11 Direct shear box tests have been conducted on London Clay samples to understand the effective strength behaviour of the clay. Figure 10 presents the peak strength (and residual where derived) of the direct shear box tests conducted in London Clay.

2.5.12 A characteristic approximation of the drained shear strength for London Clay based on this plot would give $\Phi'_{peak} = 25°$. An effective constant volume angle of shearing resistance for the London Clay of $\Phi'_{critical} = 20°$ is recommended in BS8002 [6] considering a conservative plasticity index of 60%.

Stiffness

2.5.13 Typical correlations between E' and c_u have been derived from back analysis of case histories within the London Clay in central London. For settlement analysis, a relationship of E' = 300cu is recommended for design.

2.5.14 The permeability of the London Clay is discussed in the Hydrogeological Risk Assessment report [4].

Harwich Formation (Thames Group)

Classification

2.5.15 Classification tests including PSD, Atterberg limit, natural moisture content and bulk unit weight tests have been carried out on the Harwich formation. The bulk unit weight of the samples is presented in Figure 11 and typically ranged between 19.3 and 22.4kN/m³. A unit weight of 20kN/m³ is suggested for design.

2.5.16 The Atterberg limit test results are presented in Figure 12 and suggest the plastic limit of the material to lie between 10% and 21% and liquid limits between 37 and 48%. However, one sample presented plastic and liquid limit of 50% and 100% respectively but the reason for this outlier is unclear. Figure 13 shows the plasticity chart for the Harwich Formation and confirms the intermediate plasticity of the clay owing to its sandy nature.

2.5.17 The results of particle size distribution tests in the Harwich Formation are shown in Figure 14. The results indicate the material is typically a slightly sandy slightly gravelly silty clay. The sand content is predominantly fine grained. The gravel content is more commonly low at less than 5%. In three samples the gravel content is slightly higher up to 25%.

Strength

2.5.18 4No SPTs were carried out within the Harwich Formation with 'N' values ranging from 20 to 38 and one encountering refusal as shown on Figure 15. According to Stroud [7] and considering the low plasticity of the material a relationship of cu = 5.5.'N' (where N is the SPT value) is recommended. This is in agreement with the results of the four triaxial undrained shear strength tests as shown in Figure 16. There is no apparent evidence of increasing strength with depth. A characteristic approximation of the undrained shear strength based on this plot would give cu=130kPa

2.5.19 Direct shear box tests have been conducted on Harwich Formation samples to understand the effective strength behaviour of the clay. Figure 17 presents the peak strength of the direct shear box tests conducted in the Harwich Formation. A characteristic approximation of the drained shear strength based on this plot would give $\Phi'_{peak} = 25°$ for the Harwich Formation.

Stiffness

2.5.20 It is conservatively considered that for the stiffness design values similar correlations as for the London Clay stratum should be used for the Harwich Formation.

2.5.21 The permeability of the Harwich Formation is discussed in the Hydrogeological Risk Assessment report [4].

Lambeth Group (Upnor and Reading Formations)

Stiffness

2.5.22 As the Upnor and Reading Formation is present at a depth of 17.5mbgl within the conceptual ground model used for design, its strength parameters are not anticipated to be relevant to the slope stability analysis. On this basis, only information relevant to the derivation of stiffness parameters will be presented to inform the settlement analysis.

2.5.23 A plot of the SPT values within the Lambeth Group is shown on Figure 18. The plot show data relative to the top of ground level. It is considered that this is more appropriate than plotting data in relation to elevation or top of Lambeth Group to better reflect the influence of the overburden pressure on strength. A characteristic approximation of the SPT profile would be 15+1.5z. According to Stroud (1989) a relationship of cu = 4.0N (where N is the SPT value) is recommended considering the upper bound plasticity of the highly variable clay. This would equate to cu = 60+6z where z is measured from the ground surface. This corresponds with the results of triaxial testing as shown on Figure 19.

2.5.24 It is recommended that for the stiffness design values the same correlations as for the London Clay stratum should be used of E' = 300cu.

2.5.25 The permeability of the Lambeth Group is discussed in the Hydrogeological Risk Assessment report [4].

Summary of geotechnical design parameters

Stratum		Bulk unit weight γ (kN/m³)	Angle of shearing resistance ϕ (°)	Cohesion c′ (kPa)	Undrained Shear Strength c_u (kPa)	Soil Stiffness Profile E'_v (MPa)
Clay Deposits		17	20 (Peak)	0	30	6,000
Thames Group	London Clay	19.5	25 (Peak) 20 (Critical State)	0	40+6.5z[1]	300 c_u
	Harwich Formation	20	25		130	
Lambeth Group		-	-	-	60+6z[2]	300 c_u

Notes
Design groundwater level has been assumed as 1m below existing ground level (see Section 1.3.33)
An r_u value of 0.1 has been assumed for design for the waste mass (see Section 1.3.44)
[1] z is the depth from top of the strata
[2] z is the depth below the ground surface

Parameters Selected for Side Slopes Sub-Grade Analyses

2.5.26 The parameters for the side slope sub-grade will be as per the basal sub-grade as outlined above.

Parameters Selected for Basal Liner Analyses

2.5.27 Assessed as part of the waste mass analysis.

Parameters Selected for Side Slopes Liner Analyses

2.5.28 Assessed as part of the waste mass analysis.

Parameters Selected for Waste Analyses

2.5.29 The waste mass will predominantly comprise London Clay sourced from the Copthall Tunnel. A small volume of the Harwich Formation may also be encountered at the base of the tunnel and therefore will also form a small volume of the slope mass. Based on the information

presented in Section 2.5 relating to the London Clay, the following parameters will be assumed:

- Bulk unit weight, γ' = 19.5kN/m3
- Peak angle of shearing resistance, ϕ = 25°
- Cohesion, c' = 0 kPa

2.5.30 In regard to the undrained shear strength, the data from the Copthall Tunnel indicates this increases with depth for the London Clay. The material at the horizon of the London Clay typically has an undrained shear strength of 40kPa. As described in Section 2.5, the design profile for increase in strength has shown to be 6.5kPa per meter. In the deepest parts of the tunnel, the depth below the horizon of the London Clay will be some 18m and therefore the undrained strength of the clay will be up to some 155kPa. The undrained shear strength of the waste material is likely to vary quite significantly. At this stage, no particular zoning of the fill proposed. To model the waste mass as a whole, a conservative design undrained shear strength value of 50kPa is proposed for design purposes. However, it is likely that in reality a reasonable proportion of the waste mass will have an undrained strength higher than this.

2.5.31 In addition, the construction specification for the landfill will have controls on the minimum strength of clay to be placed in the mound which will prevent low strength material being used in its construction.

Parameters Selected for Capping Analyses

2.5.32 As the landfill is for inert material only, no capping system is proposed.

2.6 Selection of Appropriate Factors of Safety

2.6.1 For the stability risk assessment, the analysis will be undertaken in accordance with Eurocode 7: Geotechnical design (BS EN 1997-1). The design will therefore be based on achieving an overdesign factor greater than or equal to 1.0. This approach is considered to be appropriate on the basis that:

- There is site based ground investigation data available supported by a much larger ground investigation for the High Speed 2 scheme. This gives confidence in the derived geotechnical parameters and conceptual site model.
- The Sustainable Placement Area mounds are similar to standard engineered earthworks. There are no particular additional failure mechanisms, such as interfaces within a capping system. Eurocode 7 is considered appropriate to use as the industry standard for earthworks.
- There are no exceptional risks which justify a higher factor of safety to be applied, such as highly sensitive receptors or release of hazardous waste materials.

2.6.2 The partial factors applied to geotechnical material parameters as defined in the UK National Annex (NA+A1:2014 to BS EN 1997-1:2004+A1:2013) are reproduced in Table 3 below.

Table 3 - Summary of partial factors applied to material parameters in accordance with BS EN 1997

Soil parameter	Set	
	M1	M2
Angle of shearing resistance	1.0	1.25 (Applied to tan ϕ')
Undrained shear strength	1.0	1.4
Weight density	1.0	1.0

2.6.3 As under design approach 1 combination 1, the partial factor applied to soil parameters (set M1) are all equal to 1.0, this will not be critical. Externally applied loads would be factored under combination 1, however, there are no external loads such as those associated with roads or buildings which are required to be modelled in the stability analysis. As design approach 1 combination 2 (partial factor set M2) will be critical, only the results from this combination will be presented and discussed in this report.

2.6.4 For the settlement analysis, this is a serviceability limit state check and therefore no partial factors will be applied. There are also no particular settlement limits for the landfill mounds.

Factor of Safety for Basal Sub-Grade

2.6.5 The analysis of the basal sub-grade will be undertaken in accordance with Eurocode 7 (BS EN 1997-1) as discussed above.

Factor of Safety for Side Slopes Sub-Grade

2.6.6 The analysis of the side slopes sub-grade will be undertaken in accordance with Eurocode 7 (BS EN 1997-1) as discussed above.

Factor of Safety for Basal Lining System

2.6.7 As per those of the waste mass.

Factor of Safety for Side Slope Lining System

2.6.8 As per those of the waste mass.

Factor of Safety for Waste Mass

2.6.9 The analysis of the waste mass will be undertaken in accordance with Eurocode 7 (BS EN 1997-1) as discussed above.

Factor of Safety for Capping System

2.6.10 As the landfill is for inert material only, no capping system is proposed.

2.7 Analyses

Slope stability

2.7.1 For drained conditions using infinite slope theory, the results for various slope angles present are given in Table 4 below.

Table 4 - Summary of over design factors for various slope angles assuming infinite slope theory under drained conditions

Slope Angle	Over Design Factor (DA1/C2)
1:4	1.3
1:5	1.7
1:8	2.7
1:10	3.4

2.7.2 For drained conditions, the results for the steepest sections of the mound are presented in Table 5 below:

Table 5 - Summary of over design factors from Oasys Slope under drained conditions

Section	Over Design Factor (DA1/C2)
B-BB (east)	1.3

2.7.3 For undrained conditions, the results are presented in Table 6 below.

Table 6 - Summary of over design factors for undrained conditions

Section	Over Design Factor (DA1/C2)
A-AA (south)	1.6
A-AA (north)	1.1
B-BB (west)	1.5
B-BB (east) - circular	1.0
B-BB (east) - wedge	1.0
C-CC (west)	2.9
C-CC (east)	2.3

D-DD (south)	1.2
D-DD (north)	1.3

2.7.4 As discussed in Section 2.4.2, due to the domed shape of the mounds the height of sections used in the analysis has been 'flattened' by 2m to be more representative of the 3D geometry of the mounds. The results show that all analysed sections have over design factors of 1.0 or greater.

2.7.5 The slope stability analysis completed is a 2D analysis and therefore does not take in to account any beneficial effects from the resistance provided on the sides of the slip mass. This assumption is generally more appropriate for drained conditions where shallow slips are generally critical. In this instance, for undrained conditions the critical slip is deep (approximately 14m below surface level) and therefore the side effects are likely to be of significant benefit.

2.7.6 In addition to this, all of the above is based on a characteristic undrained shear strength of the waste of 50kPa. This is considered to be conservative as the undrained shear strength of the London Clay from the Copthall Tunnel has been estimated to increase linearly with depth from 40kPa to around 155kPa. On this basis, the stability of the slope is considered to be acceptable.

2.7.7 The slope stability calculations are presented in Appendix B as detailed below:

- Appendix B1 – Drained conditions
- Appendix B2 – Undrained conditions
- Appendix B3 – Wedge analysis

Settlement analysis

2.7.8 In regard to the formation settlement, for the eastern mound, the maximum settlement at the centre of the mound has been calculated as 300mm. The amount of settlement reduces towards the toe of the slopes. The analysis also indicates some heave of the ground adjacent to the mounds of less than 50mm. In regard to the internal settlement of the fill, this has been estimated as 350mm, based on the maximum internal fill height of 17m.

2.7.9 A summary of the predicted settlement for the mound is presented in Table 8 below.

Table 7 - Summary of predicted settlement

Formation settlement	Internal settlement	Total settlement
300mm	350mm	650mm

2.7.10 The calculation data from the Oasys PDisp analysis are presented in Appendix C1. The calculations for the internal settlement analysis are presented in Appendix C2.

Basal Sub-Grade Analyses

2.7.11 The analysis of the basal sub-grade is covered by the analysis presented in Section 2.7 above.

Side Slopes Sub-Grade Analyses

2.7.12 The analysis of the side slope sub-grade is covered by the analysis presented in Section 2.7 above.

Basal Liner Analyses

2.7.13 The analysis of the basal liner is covered by the analysis presented in Section 2.7 above.

Side Slopes Liner Analyses

2.7.14 The analysis of the side slope liner is covered by the analysis presented in Section 2.7 above.

Waste Analyses

2.7.15 The analysis of the waste mass is covered by the analysis presented in Section 2.7 above.

Capping Analyses

2.7.16 As the landfill is for inert material only, no capping system is proposed.

2.8 Assessment

2.8.1 The results of the analysis have been assessed and are discussed below. As per the modelling approach for the slope stability (see Section 2.4), the assessment considers the landfill as a whole rather than elements individually. There are some limitations to the analytical approach undertaken for the slope stability analysis which are as follows:

- Circular slips: The slope analysis undertaken is based on circular shape slips. A sensitivity analysis has been undertaken on Section B-BB of a wedge type failure passing through the lower strength Clay Deposits. This indicated that the circular slip overdesign factor is the same as the wedge failure passing through the lower strength Clay Deposits. As such, this sensitivity check has shown that the failure mechanisms are very similar.
- Infinite slope theory: The infinite slope theory approach for the drained analysis is based on an infinitely long linear slope failure. This clearly is not the case, however, this approach is conservative as any end effects are ignored which would increase the over design factor, albeit only marginally.
- 2D analysis: For the slope stability assessment in undertaken in Oasys Slope, 2D sections have been analysed. This approach does not account for side effects on the slip surfaces, as such this approach is considered to be conservative.

2.8.2 There are also some uncertainties regarding some of the input data in the analysis which are as follows:

- Future groundwater level: The potential future groundwater level over the life span of the landfill is difficult to predict. Based on the monitoring undertaken to date, this indicates that groundwater level was within the Lambeth Group which is anticipated to be as a result of under-draining of the superficial deposits by the chalk. A limitation of this monitoring was that no water monitoring of potential groundwater levels within the London Clay was undertaken. Due to uncertainties regarding potential future groundwater changes and the absences of monitoring within the London Clay, a design groundwater level of 1mbgl has been conservatively assumed.
- Porewater pressures in waste mass: There is the potential for there to be porewater pressures within the waste mass. The waste mass will predominantly comprise well compacted London Clay and will therefore be highly impermeable. On this basis, the potential infiltration of surface water in to the waste mass is anticipated to be highly limited and the majority of surface water will run off the ground surface. In the analyses, to account for some infiltration of surface water and percolation towards the base and sides of the mound, an r_u value of 0.1 has been assumed. This approach is considered to be reasonable, especially for the relatively shallow slips that are the more critical in terms of stability using drained strength parameters.
- Geological origin of Clay Deposits: The geological origin of the Clay Deposits is unclear. It anticipated the material is either Alluvium or weathered London Clay. However, the geotechnical engineering parameters has been derived based on the available factual information and therefore the geological origin of this material is not anticipated to have any impact on the stability analysis.

2.8.3 In regard to the overall risk of the landfill, this is considered to be relatively low. The waste mass is inert London Clay from the nearby Copthall Tunnel and its engineering properties are well understood. The landfill will be constructed in accordance with an earthworks specification to ensure the waste is well compacted. Ground investigation data is available for both the landfill site and the Copthall Tunnel. The landfill mounds are therefore considered to be more standard engineered earthworks rather than traditional landfills

Basal Sub-Grade Assessment

2.8.4 The assessment of the basal sub-grade is covered above.

Side Slopes Sub-Grade Assessment

2.8.5 The assessment of the side slope sub-grade is covered above.

Basal Liner Assessment

2.8.6 The assessment of the basal liner is covered above.

Side Slopes Liner Assessment

2.8.7 The assessment of the side slope liner is covered above.

Waste Assessment

2.8.8 The assessment of the waste mass is covered above.

Capping Assessment

2.8.9 As the landfill is for inert material only, no capping system is proposed.

3 Monitoring

3.1 The Risk Based Monitoring Scheme

3.1.1 A risk screen exercise has been completed and is presented in Section 2.1. The results of this risk screen have been reflected in the geotechnical assessment completed but also the proposed monitoring scheme.

3.1.2 The primary risk is considered to be slope stability. This risk has been mitigated through the ground investigation and geotechnical assessment as presented in this report. In addition, the geotechnical properties of the waste material comprising London Clay sourced from the Copthall Tunnel are well understood. This risk will be further mitigated through the construction drawings, construction specification and CQA plan to ensure the assumptions made as part this Stability Risk Assessment are reflected in the construction works.

3.1.3 The residual risk associated with slope stability is considered to be low and an extensive monitoring scheme is not considered to be appropriate. The monitoring scheme proposed is outlined in the following sections.

Basal Sub-Grade Monitoring

3.1.4 As the landfill is for inert soils only there will be no leachate or gas generation. On this basis, no groundwater or gas monitoring within the basal sub-grade is proposed.

Side Slopes Sub-Grade Monitoring

3.1.5 As the landfill is for inert soils only there will be no leachate or gas generation. On this basis, no groundwater or gas monitoring within the side slopes sub-grade is proposed.

3.1.6 The visual inspections as described for Waste Mass Monitoring below shall extend a minimum of 5m from the toe of the side slopes (including along the gas main utility corridor) in order to identify any potential ground movements adjacent to the landfill.

Basal Lining System Monitoring

3.1.7 Since the basal lining system will comprise an artificially established geological barrier formed from the same material as the waste mass the monitoring requirements for the Waste Mass Monitoring as described below will apply.

Side Slope Lining System Monitoring

3.1.8 Since the side slope lining system will comprise an artificially established geological barrier formed from the same material as the waste mass the monitoring requirements for the Waste Mass Monitoring as described below will apply.

Waste Mass Monitoring

3.1.9 Visual and topographical monitoring of the mounds is proposed and will continue until the landfill license is surrendered. A summary of the monitoring proposed is presented in Table 8 below and discussed further in the following sections of this report.

Table 8 - Schedule of proposed monitoring scheme

Phase	Monitoring	Frequency	Output
During construction	Visual inspection	2 weeks	Inspection record and photographs
	Topographical survey	Yearly	Survey drawings at a scale of not less than 1:1250 and interim volume calculations
Completion of construction	Visual inspection	Single baseline survey	Inspection record and photographs
	Topographical survey	Single baseline survey	Survey drawings at a scale of not less than 1:1250 and final volume calculations
Post construction	Visual inspection	Quarterly	Inspection record and photographs, to include review against baseline and any other post construction surveys
Surrender of permit	Visual inspection	Final survey	Inspection record and photographs
	Topographical survey	Final survey	Survey drawings at a scale of not less than 1:1250

3.1.10 For topographical surveys, plan positions of ground features will be determined to within 1m and spot levels to 0.01m will be taken at a density to allow adequate representation of the true landform. Survey drawings will be produced at a scale of not less than 1:1250 and will include all ground features, roads, structures, boundaries, monitoring points and an indication of the surrounding landform.

During Construction

3.1.11 During construction of the mounds regular visual monitoring of the mounds will be undertaken. As the RSP mounds will be an active construction site, it is likely that any issues with the mounds will be identified quickly, however, to formalise the process and ensure all areas of the RSP mounds are inspected it is proposed that a visual site walkover will be undertaken by a suitably experience engineer of the whole site every two weeks. The results of each survey will be formally recorded as part of the CQA, including any problems identified and the remedial actions taken. The key aspects to be assessed by the visual inspections will include:

- Any evidence of ground movements which could include:

  - Formation of tension cracks
  - Slumping of the ground in the slopes
  - Heave of the ground around the toe of the slope
  - Any small or shallow slips
- Proper surface water control to ensure no areas of the site are becoming wet
- No overly steepened temporary slopes
- General compliance with the earthworks specification and construction drawings

3.1.12 The record of the visual inspection will include:

- Details of the walkover (e.g. date, time, weathered, attendees)
- Summary of progress and works completed to date
- Any issues identified and immediate actions. This may include additional monitoring or engagement with designers if required
- Photographs

Completion of construction

3.1.13 On completion of the RSP mounds construction, it is proposed that a visual inspection of the RSP areas will be completed. The purpose of this will be to ensure the RSP mounds have been constructed in accordance with the construction information and to form a baseline for future monitoring.

3.1.14 A final topographical survey of the restored surface will also be completed to ensure the RSP mounds have been constructed in accordance with the construction information and to form a baseline.

Post construction

3.1.15 Following completion of construction, the visual inspections will be continued on a quarterly basis until the landfill license is surrendered, or the need for further monitoring ceases as agreed with the Environment Agency.

3.1.16 Further topographical surveys are not considered necessary post construction as the visual inspections are considered sufficient. Should the visual inspections identify any potential concerns with the landfill, the need for any further topographical or other forms of monitoring will be reviewed.

Surrender of permit

3.1.17 Prior to surrender of the permit, a final visual inspection and topographical survey will be completed.

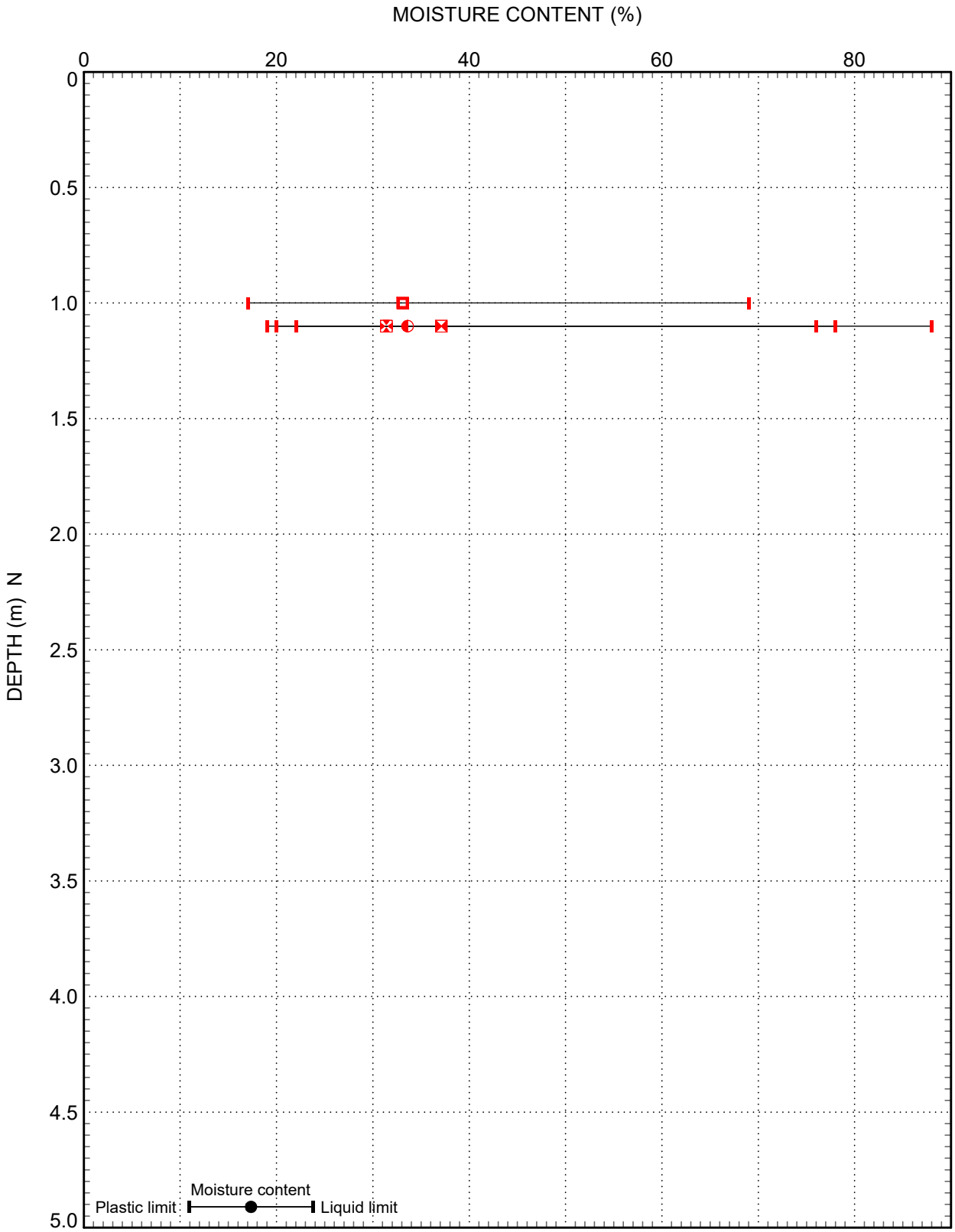
Capping System Monitoring

3.1.18 As the landfill is for inert material only, no capping system is proposed.

3.2 References

1. Environmental Agency (2010) Environmental Permitting application for a landfill permit, Stability Risk Assessment, Version 1, March
2. Arup (2020) Environmental Setting and Site Design Report (ESSD) - Eastern Mound - Ruislip Northern Sustainable Placement S2, 1MC04-SCJ_SDH-EV-REP-SS05_SL07-000005
3. British Geological Survey, Engineering Geology Viewer, Accessed August 2018 [http://mapapps.bgs.ac.uk/engineeringgeology/home.html]
4. Arup (2020) Hydrogeological Risk Assessment (HRA) - Eastern Mound - Ruislip Northern Sustainable Placement S2, Doc. Ref. 1MC04-SCJ_SDH-GT-REP-SS05_SL07-000036
5. Trenter, N.A. (2001) Earthworks: A guide.
6. BS8002:2015 Code of practice for Earth retaining structures.
7. Stroud, M.A. (1988) The standard penetration test – its application and interpretation.
8. BGS (2005) 1:50,000 Series, Sheet 255, Beaconsfield.

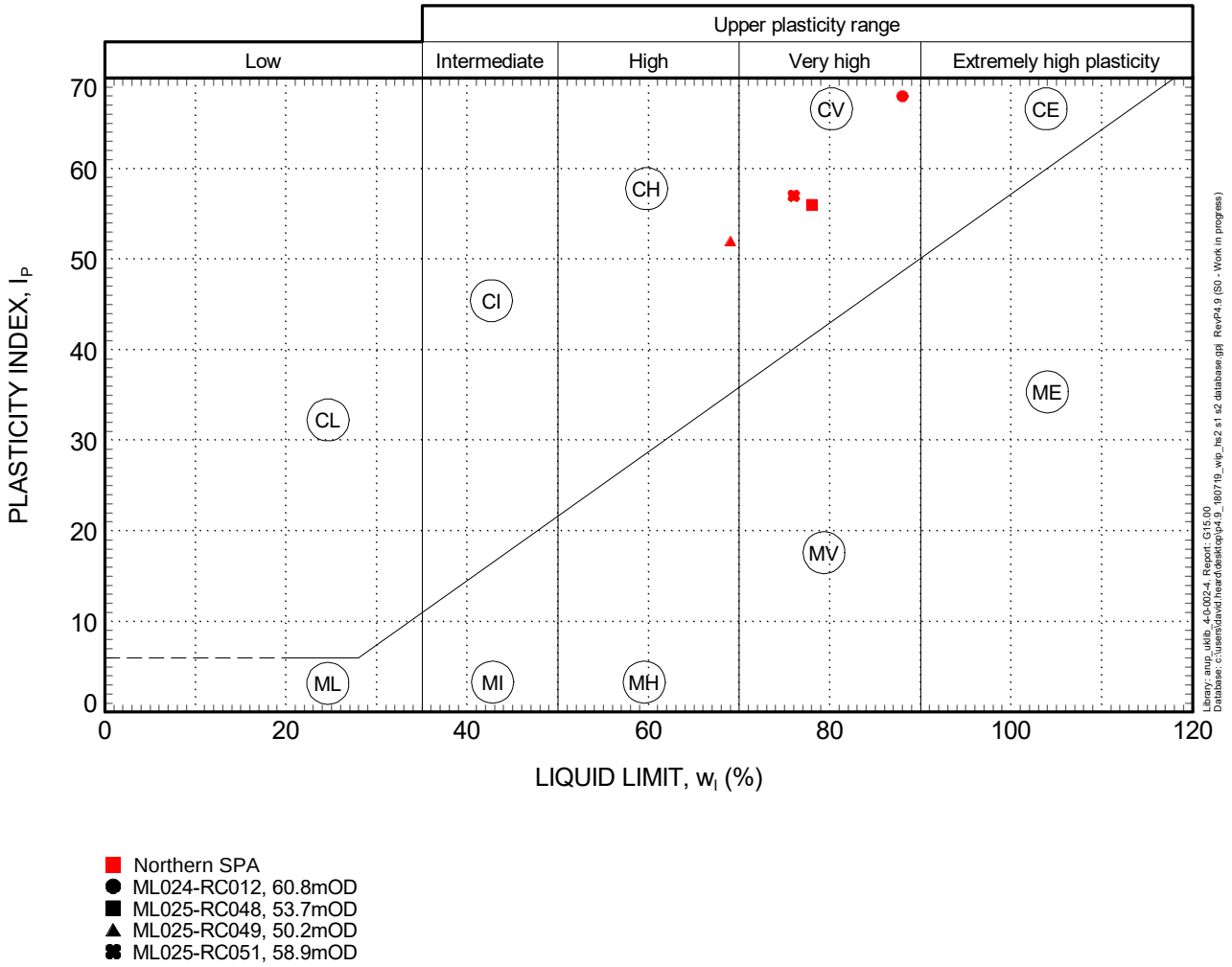
Figures



ARUP_gINT v8.30.003
Made by Edward Boss on 30-Apr-20

HS2
ATTERBERG LIMITS
SUPERFICIAL DEPOSITS - COHESIVE

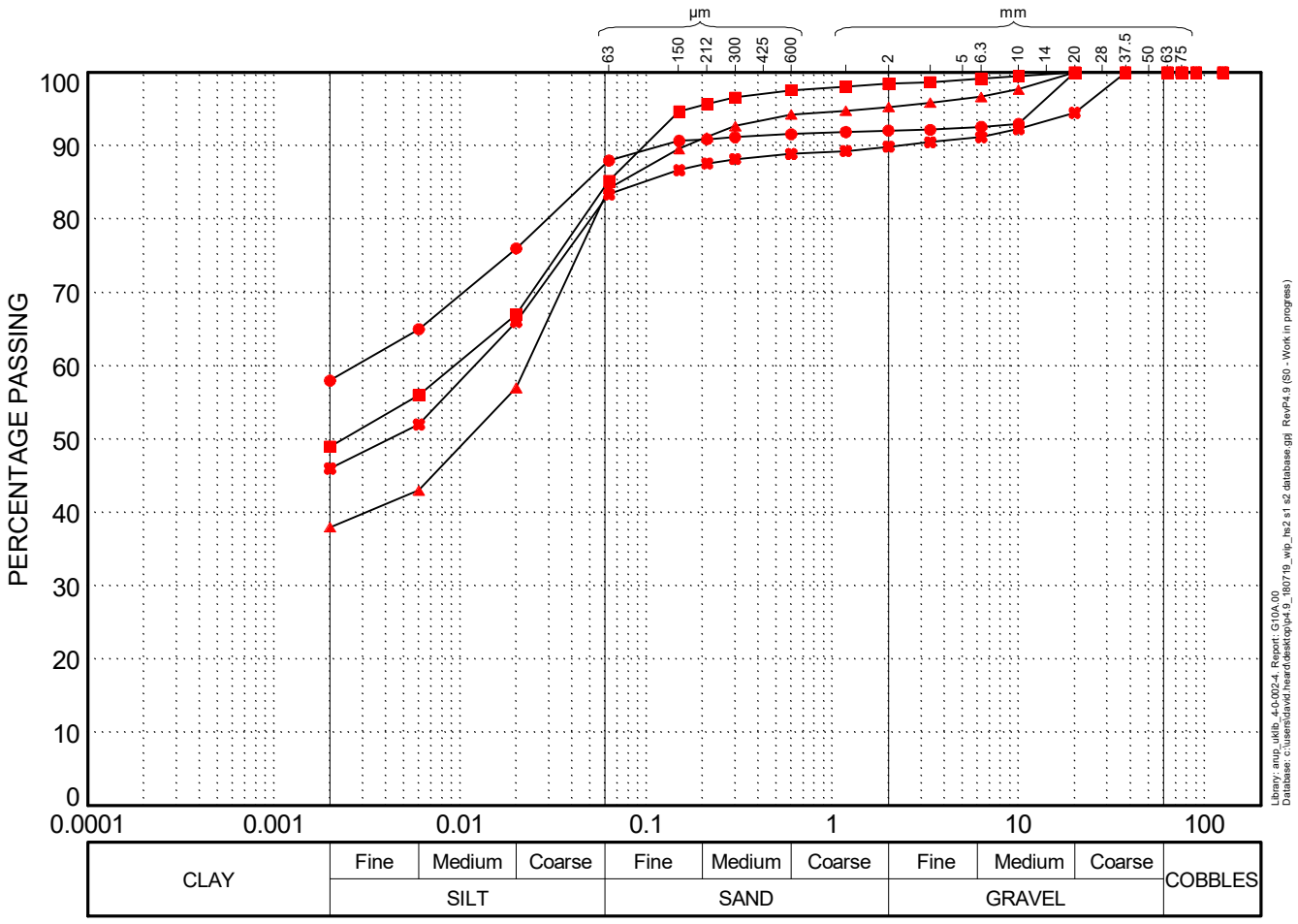
FIGURE 1



ARUP, gINT v8.30.003
Made by David Heard on 10-Sep-18

HS2
PLASTICITY CHART
CLAY DEPOSITS

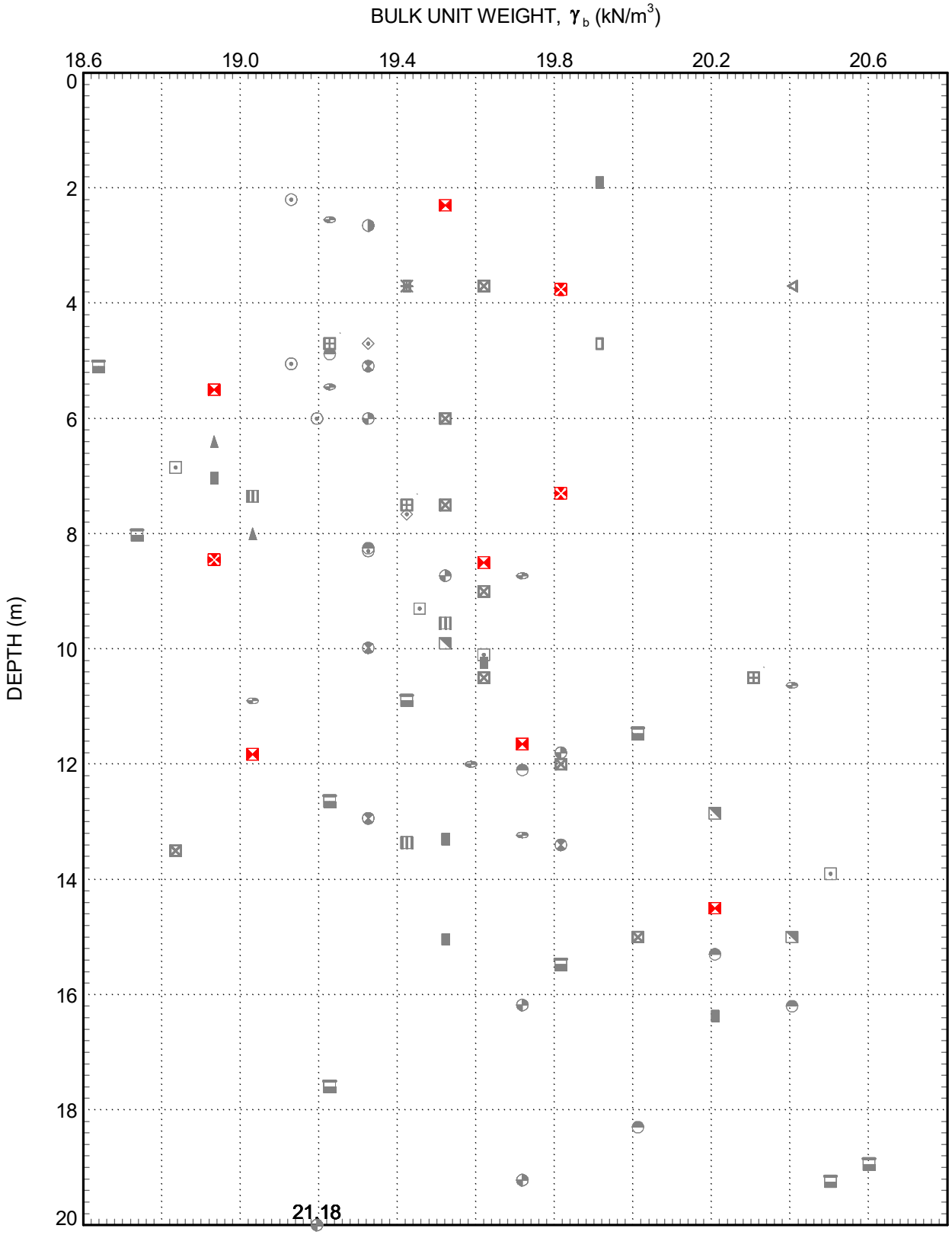
FIGURE 2



ARUP, gINT v8.30.003
Made by David Heard on 10-Sep-18

HS2
PARTICLE SIZE DISTRIBUTION
CLAY DEPOSITS

FIGURE 3



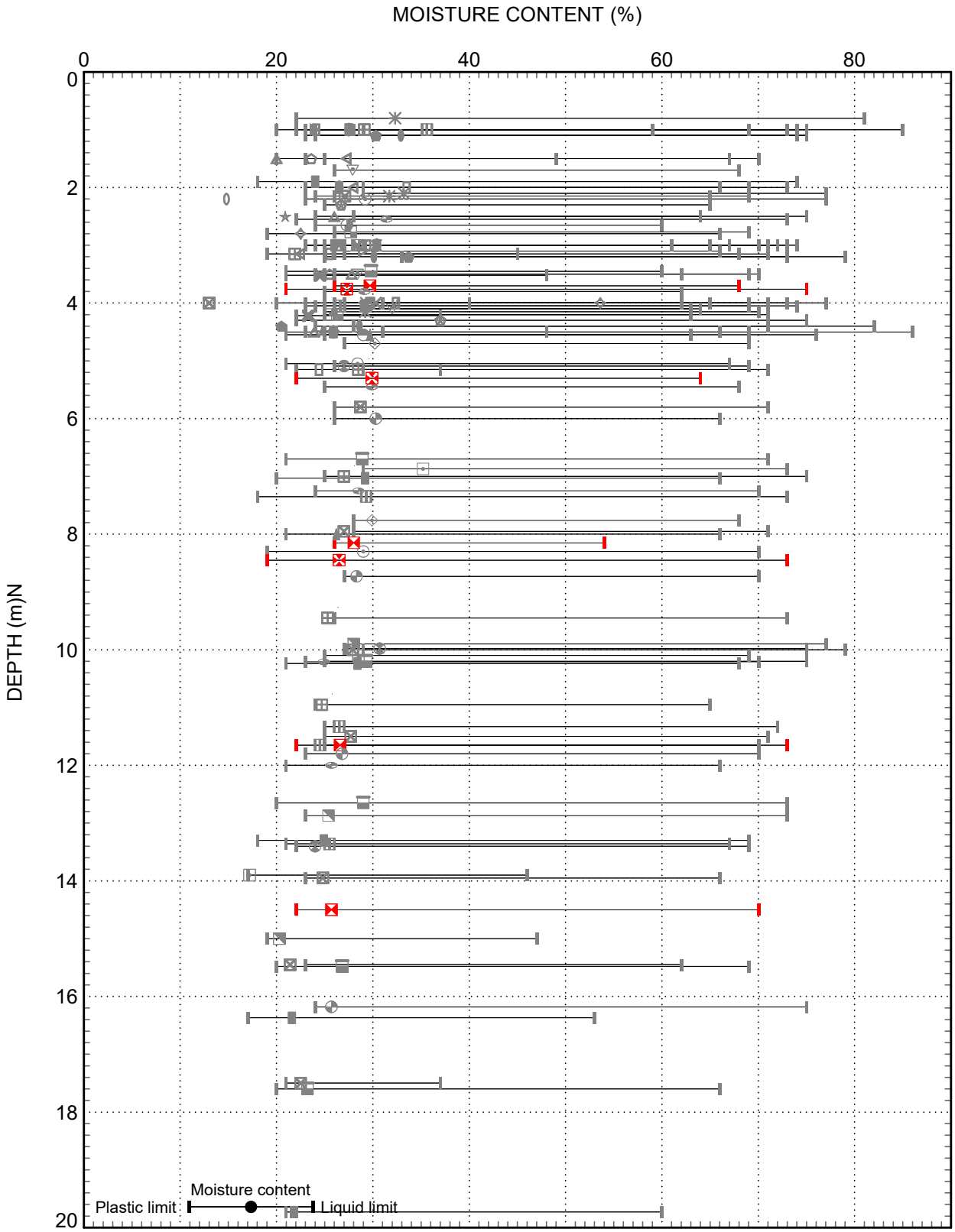
- Northern SPA
- Copthall Cutting
- ML025-CP008
- ML025-CP114
- ML025-CP115
- ML025-CP121
- ML025-CP122
- ML024-RC007
- ML024-RC012
- ML025-RC002
- ML025-RC021
- ML025-RC030
- ML025-RC031
- ML025-RC032
- ML025-RC033
- ML025-RC034
- ML025-RC036
- ML025-RC037
- ML025-RC037a
- ML025-RC051
- ML025-RC052
- ML025-RC053

Library: arup_ukllp_4-0-002-4_Report_G18_80_D
Database: c:\Users\david.heard\desktop\p4.9_180719_wip_hs2_s1_s2_database.gpj RevP4.9 (S0 - Work in progress)

ARUP, gINT v8.30.003
Made by David Heard on 10-Sep-18

HS2
BULK UNIT WEIGHT
LONDON CLAY FORMATION

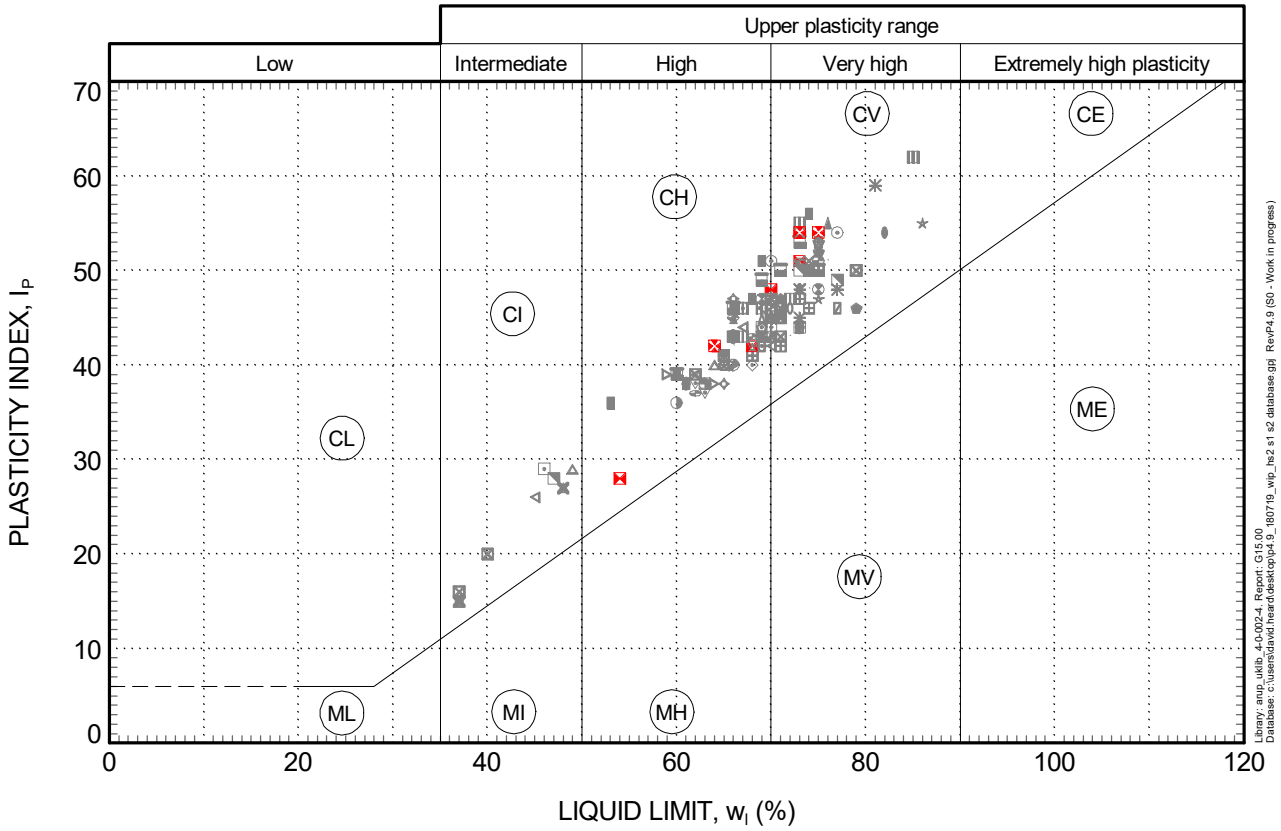
FIGURE 4



- Northern SPA
- Copthall Cutting
- ML025-CP008
- ML025-CP114
- ML025-CP115
- ML025-CP121
- ML025-CP122
- ML024-RC007
- ML024-RC012
- ML025-RC002
- ML025-RC021
- ML025-RC030
- ML025-RC031
- ML025-RC032
- ML025-RC033
- ML025-RC034
- ML025-RC036
- ML025-RC037
- ML025-RC037a
- ML025-RC051
- ML025-RC052
- ML024-WS007
- ML024-WS008
- ML024-WS029
- ML025-WS015
- ML025-WS016
- ML025-WS143
- ML025-WS144
- ML025-WS148
- ML025-WS149
- ML025-WS150
- ML024-TP114
- ML025-TP051
- ML025-TP052
- ML025-TP054
- ML025-TP055
- ML025-TP056
- ML025-TP057
- ML025-TP058
- ML025-TP060
- ML025-TP062
- ML025-TP078
- ML025-TP079
- ML025-TP082
- ML025-TP083

HS2
ATTERBERG LIMITS
LONDON CLAY FORMATION

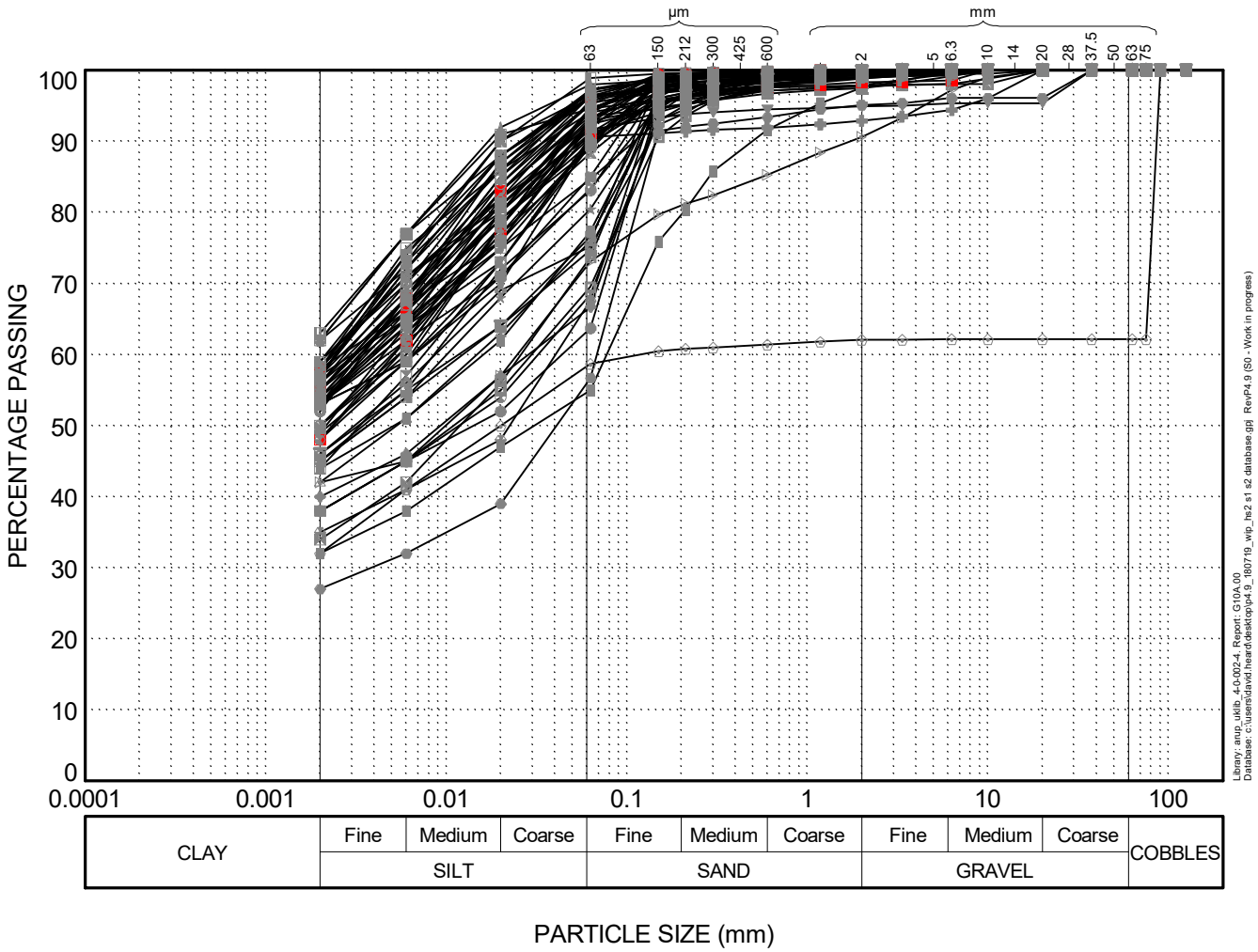
FIGURE **5**



- Northern SPA
- Copthall Cutting
- ML025-CP008
- ML025-CP114
- ML025-CP115
- ML025-CP121
- ML025-CP122
- ML024-RC007
- ML024-RC012
- ML025-RC002
- ML025-RC021
- ML025-RC030
- ML025-RC031
- ML025-RC032
- ML025-RC033
- ML025-RC034
- ML025-RC036
- ML025-RC037
- ML025-RC037a
- ML025-RC051
- ML025-RC052
- ML024-WS007
- ML024-WS008
- ML024-WS029
- ML025-WS015
- ML025-WS016
- ML025-WS143
- ML025-WS144
- ML025-WS148
- ML025-WS149
- ML025-WS150
- ML024-TP114
- ML025-TP051
- ML025-TP052
- ML025-TP054
- ML025-TP055
- ML025-TP056
- ML025-TP057
- ML025-TP058
- ML025-TP060
- ML025-TP062
- ML025-TP078
- ML025-TP079
- ML025-TP082
- ML025-TP083

HS2
PLASTICITY CHART
LONDON CLAY FORMATION

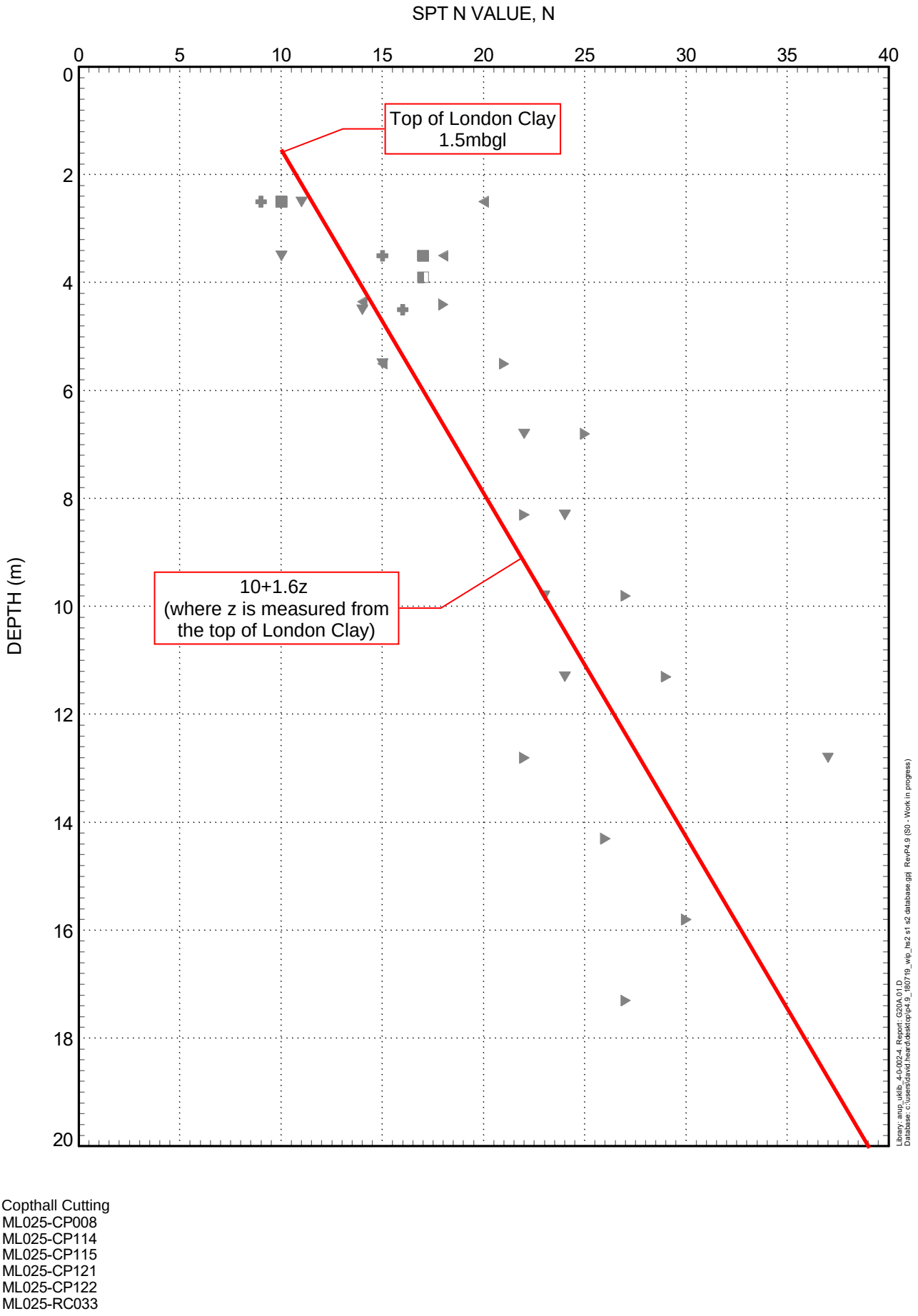
FIGURE 6



- Northern SPA
- Copthall Cutting
- ML025-CP008, 50.6mOD
- ML025-CP114, 52.3mOD
- ML025-CP115, 48.2mOD
- ML025-CP121, 52.9mOD
- ML025-CP121, 48.9mOD
- ML025-CP122, 60.1mOD
- ML025-CP122, 52.6mOD
- ML024-RC012, 50.2mOD
- ML025-RC002, 61.1mOD
- ML025-RC002, 54.6mOD
- ML025-RC002, 48.4mOD
- ML025-RC021, 54.3mOD
- ML025-RC030, 57.1mOD
- ML025-RC031, 53.1mOD
- ML025-RC032, 60.2mOD
- ML025-RC032, 49.6mOD
- ML025-RC032, 47.8mOD
- ML025-RC033, 59.4mOD
- ML025-RC033, 57.2mOD
- ML025-RC033, 52.9mOD
- ML025-RC033, 49.9mOD
- ML025-RC033, 48.0mOD
- ML025-RC034, 58.4mOD
- ML025-RC034, 52.5mOD
- ML025-RC034, 47.4mOD
- ML025-RC036, 62.3mOD
- ML025-RC036, 52.1mOD
- ML025-RC037, 52.2mOD
- ML025-RC037a, 60.4mOD
- ML025-RC051, 56.1mOD
- ML025-RC051, 51.4mOD
- ML025-RC052, 54.9mOD
- ML025-RC052, 47.9mOD
- ML024-WS007, 48.5mOD
- ML024-WS007, 46.7mOD
- ML024-WS008, 46.5mOD
- ML024-WS008, 44.7mOD
- ML024-WS029, 50.4mOD
- ML024-WS029, 48.4mOD
- ML025-WS015, 52.5mOD
- ML025-WS015, 51.5mOD
- ML025-WS016, 50.6mOD
- ML025-WS143, 54.5mOD
- ML025-WS143, 53.3mOD
- ML025-WS144, 53.1mOD
- ML025-WS144, 51.0mOD
- ML025-WS148, 63.5mOD
- ML025-WS149, 61.9mOD
- ML025-WS150, 62.4mOD
- ML024-TP114, 47.7mOD
- ML024-TP114, 46.7mOD
- ML025-TP051, 57.2mOD
- ML025-TP052, 64.6mOD
- ML025-TP052, 63.6mOD
- ML025-TP052, 62.6mOD
- ML025-TP058, 56.3mOD
- ML025-TP060, 66.0mOD
- ML025-TP060, 65.0mOD
- ML025-TP062, 52.0mOD
- ML025-TP062, 50.9mOD
- ML025-TP078, 69.1mOD
- ML025-TP078, 68.1mOD
- ML025-TP079, 64.9mOD
- ML025-TP079, 62.9mOD
- ML025-TP082, 64.7mOD
- ML025-TP082, 62.7mOD
- ML025-TP083, 63.5mOD
- ML025-TP083, 61.5mOD

HS2
PARTICLE SIZE DISTRIBUTION
LONDON CLAY FORMATION

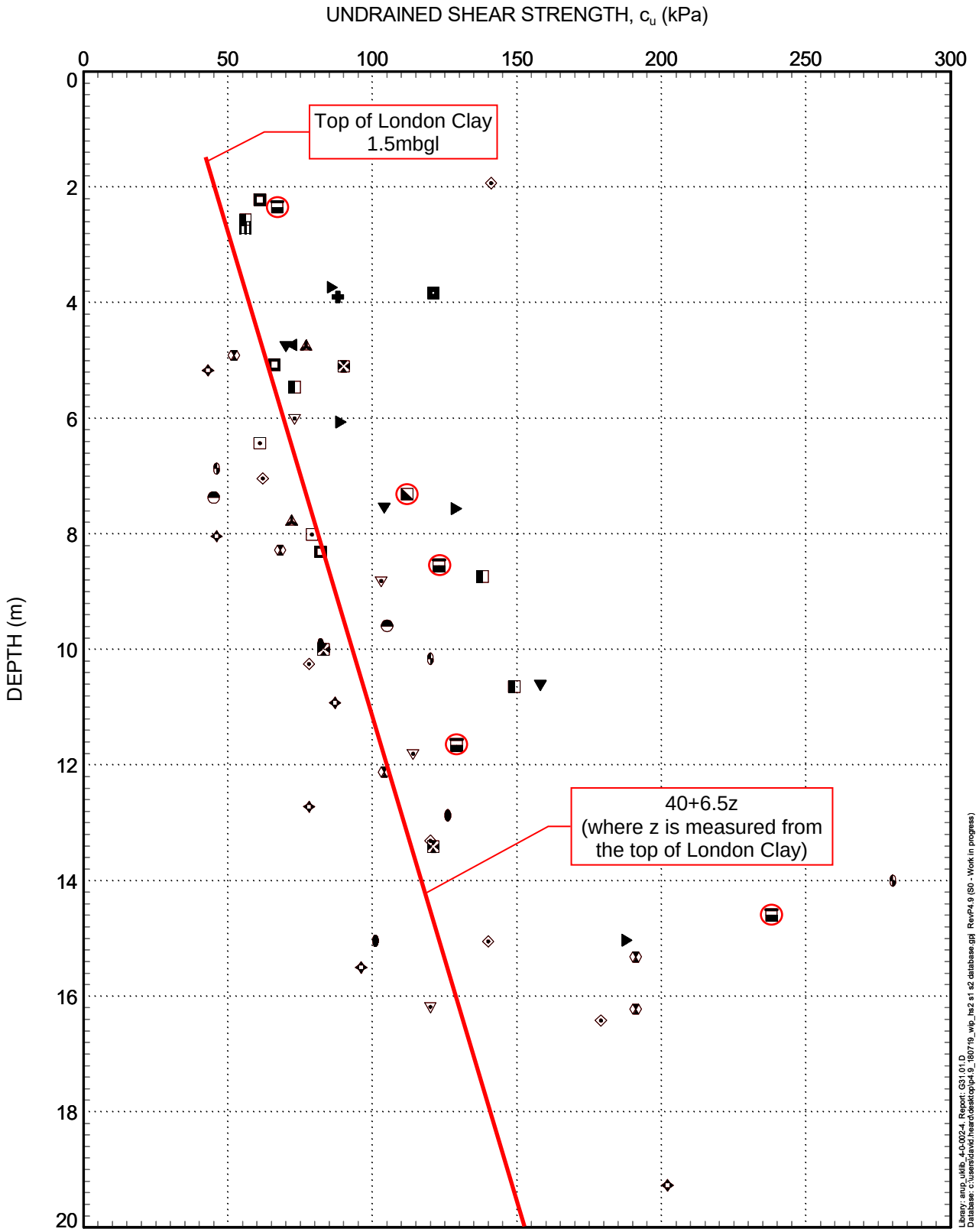
FIGURE 7



- Copthall Cutting
- ML025-CP008
- ML025-CP114
- ML025-CP115
- ML025-CP121
- ML025-CP122
- ML025-RC033

HS2
STANDARD PENETRATION TESTS
LONDON CLAY FORMATION

FIGURE 8



Northern SPA
ML025-CP008
ML025-CP114
ML025-CP115
ML025-CP121
ML025-CP122
ML024-RC007
ML024-RC012
ML025-RC002
ML025-RC021
ML025-RC030
ML025-RC031
ML025-RC032
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ML025-RC037a
ML025-RC051
ML025-RC052
ML025-RC053

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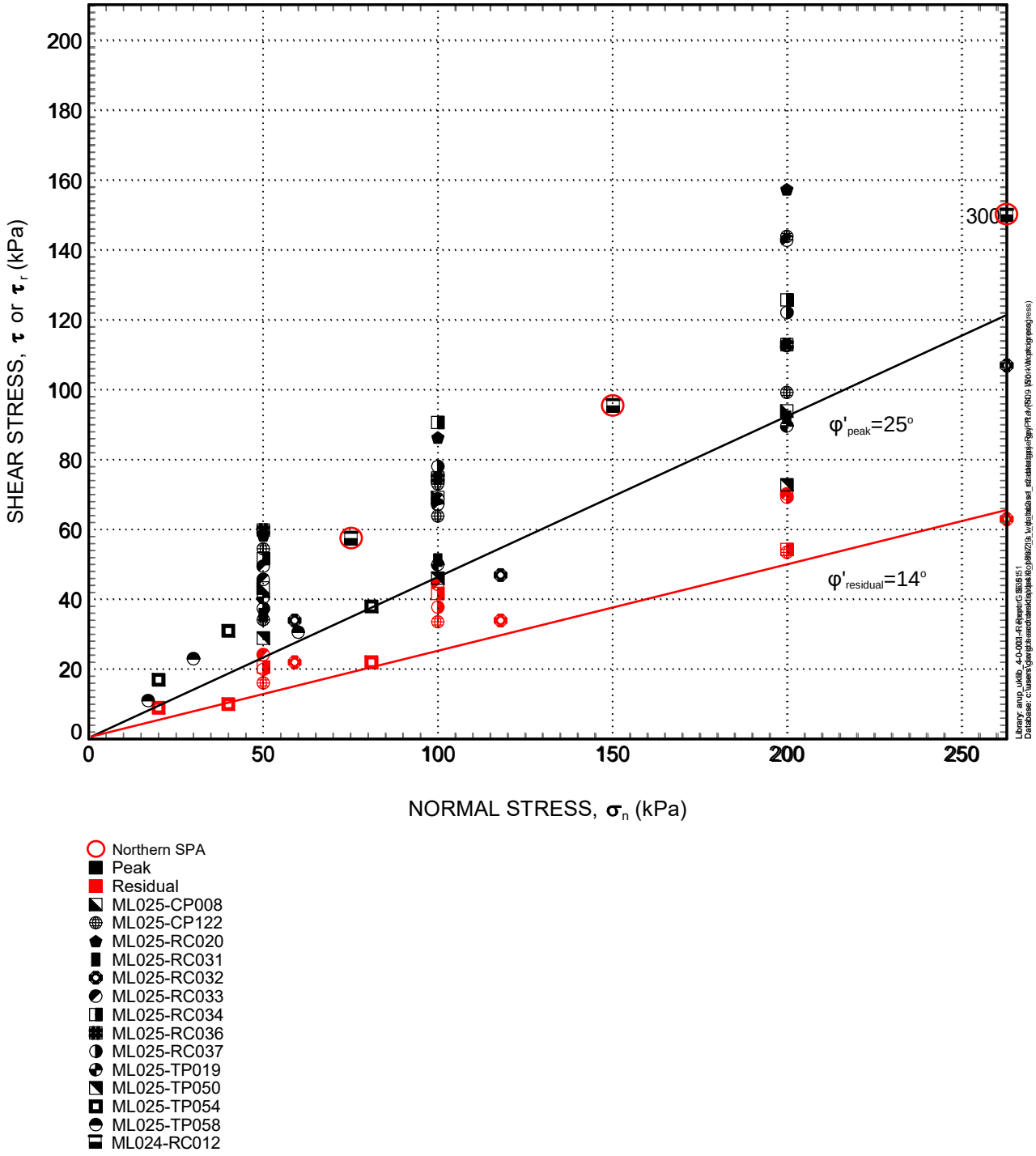
ARUP, gINT v8.30.003
Made by David Heard on 20-Sep-18

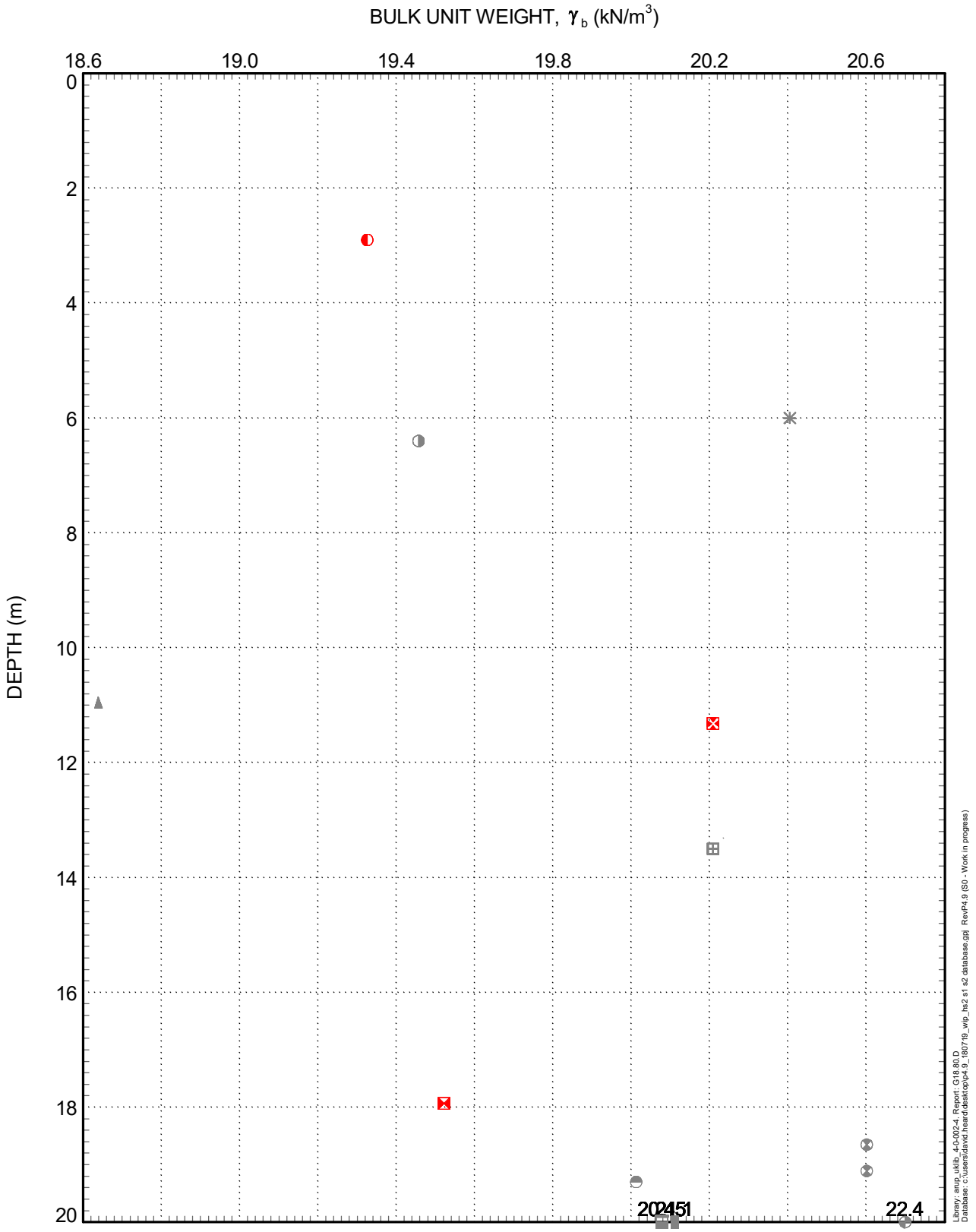
HS2
TRIAXIAL UNDRAINED SHEAR STRENGTH
LONDON CLAY FORMATION

FIGURE 9



HS2
SHEAR BOX TESTS
LONDON CLAY FORMATION

FIGURE 10

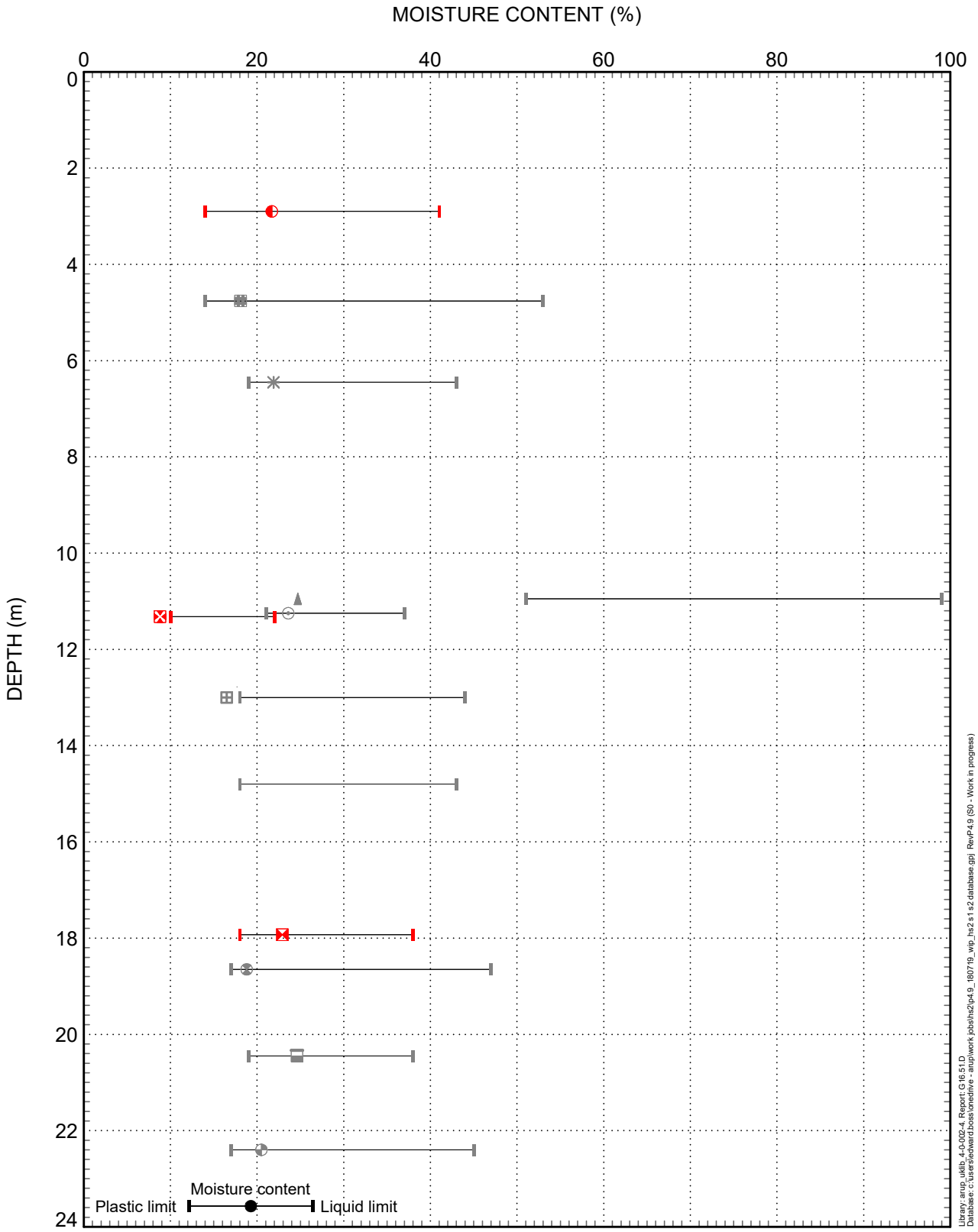


Library: arup_uklib_4-0-002-4_Report_G18_80_D
Database: c:\Users\david.heard\desktop\p4.9_180719_wip_hs2_s1_s2_database.gpj RevP4.9 (S0 - Work in progress)

ARUP, gINT v8.30.003
Made by David Heard on 10-Sep-18

HS2
BULK UNIT WEIGHT
HARWICH FORMATION

FIGURE 11

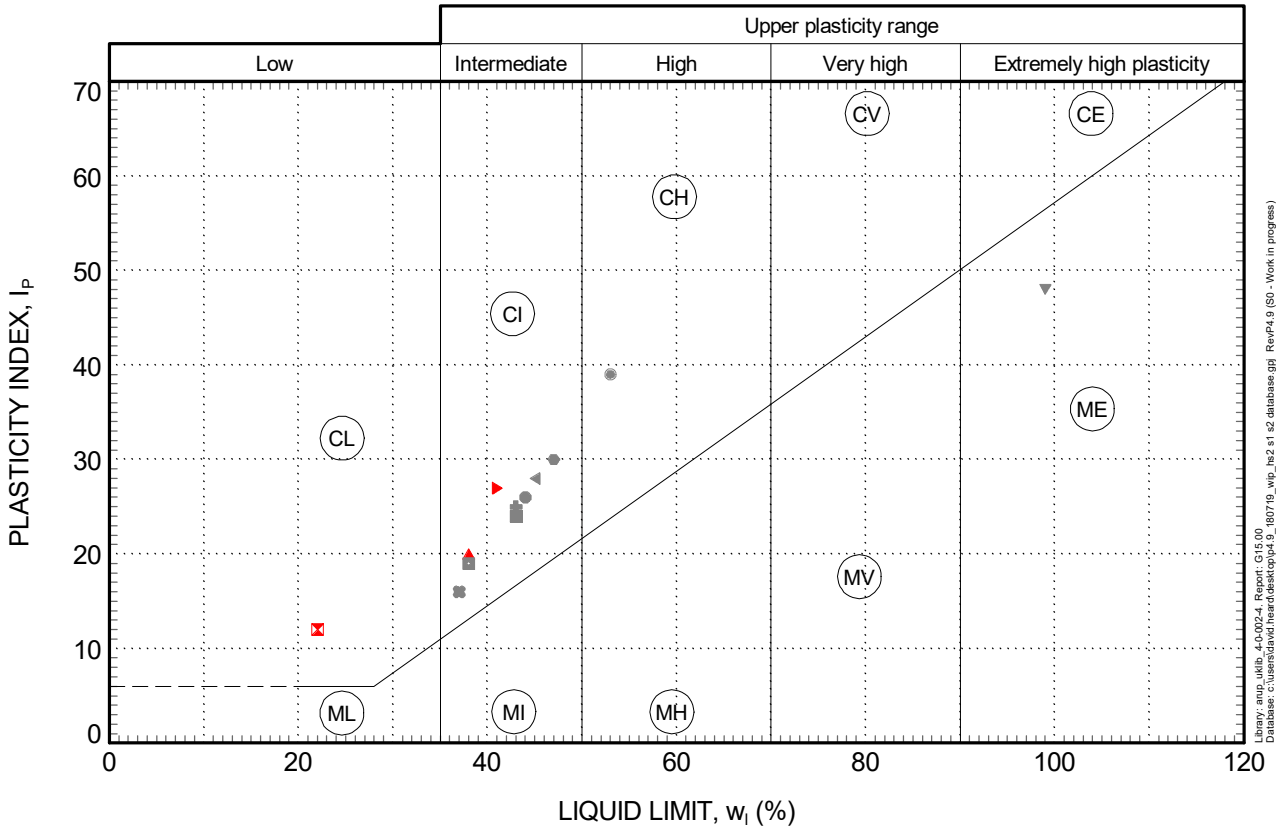


- Northern SPA
- Copthall Cutting
- ML025-CP008
- ML025-CP114
- ML024-RC012
- ML025-RC021
- ML025-RC030
- ML025-RC031
- ML025-RC033
- ML025-RC034
- ML025-RC036
- ML025-RC048
- ML025-RC051
- ML024-WS016

ARUP_gINT v8.30.003
Made by Edward Boss on 30-Apr-20

HS2
ATTERBERG LIMITS
HARWICH FORMATION

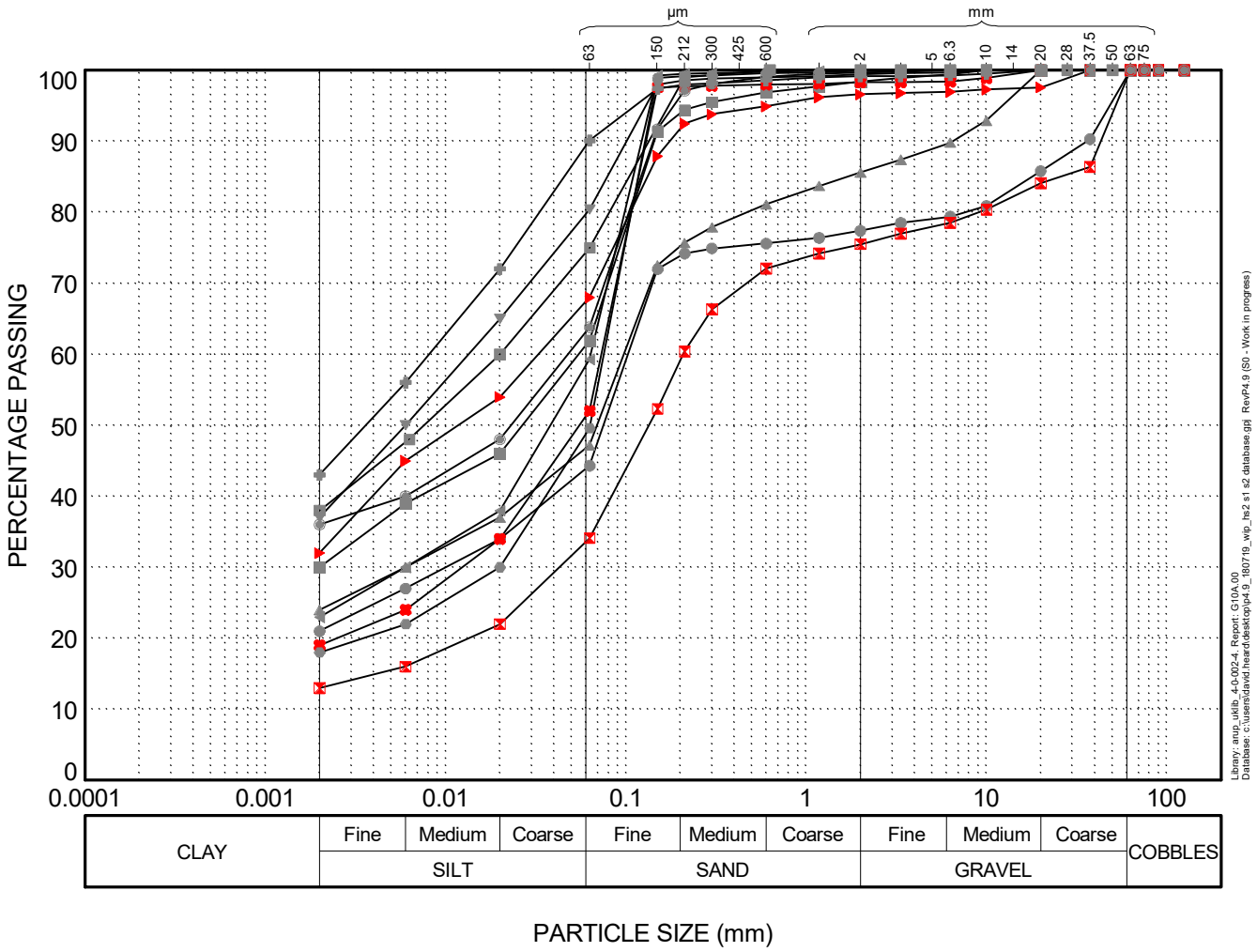
FIGURE 12



- Northern SPA
- Copthall Cutting
- ML025-CP008, 46.1mOD
- ML025-CP114, 46.6mOD
- ML024-RC012, 44.0mOD
- ML025-RC021, 48.2mOD
- ML025-RC030, 48.5mOD
- ML025-RC031, 46.7mOD
- ML025-RC033, 45.2mOD
- ML025-RC034, 44.7mOD
- ML025-RC036, 45.9mOD
- ML025-RC048, 51.9mOD
- ML025-RC051, 48.7mOD
- ML024-WS016, 40.5mOD

HS2
PLASTICITY CHART
HARWICH FORMATION

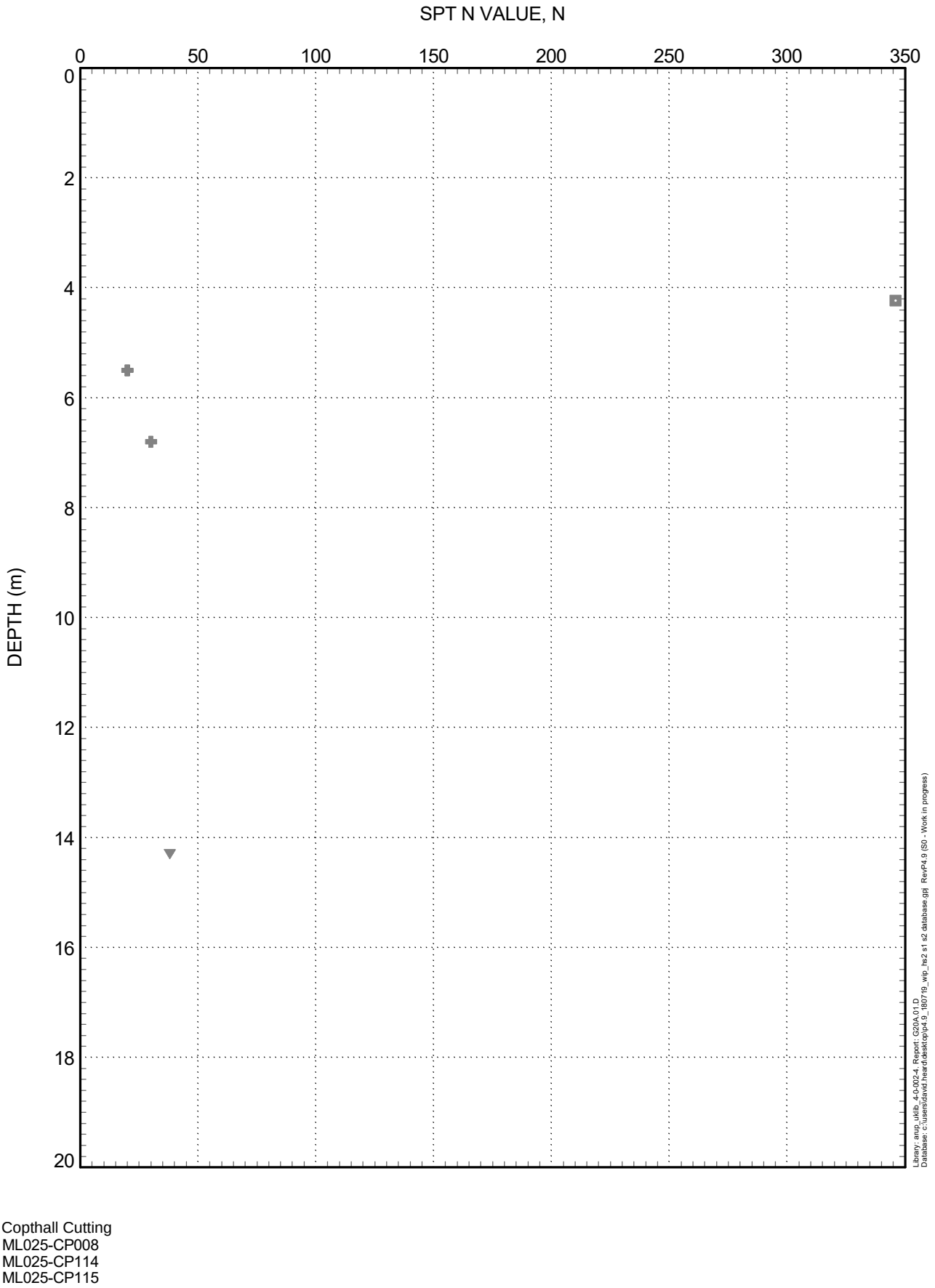
FIGURE 13



- Northern SPA
- Copthall Cutting
- ML025-CP008, 46.1mOD
- ML025-CP114, 47.6mOD
- ML025-CP115, 45.5mOD
- ML024-RC012, 44.0mOD
- ML025-RC021, 48.2mOD
- ML025-RC030, 48.5mOD
- ML025-RC031, 46.7mOD
- ML025-RC033, 45.2mOD
- ML025-RC034, 44.5mOD
- ML025-RC048, 51.9mOD
- ML025-RC051, 48.7mOD
- ML024-WS016, 40.5mOD

HS2
PARTICLE SIZE DISTRIBUTION
HARWICH FORMATION

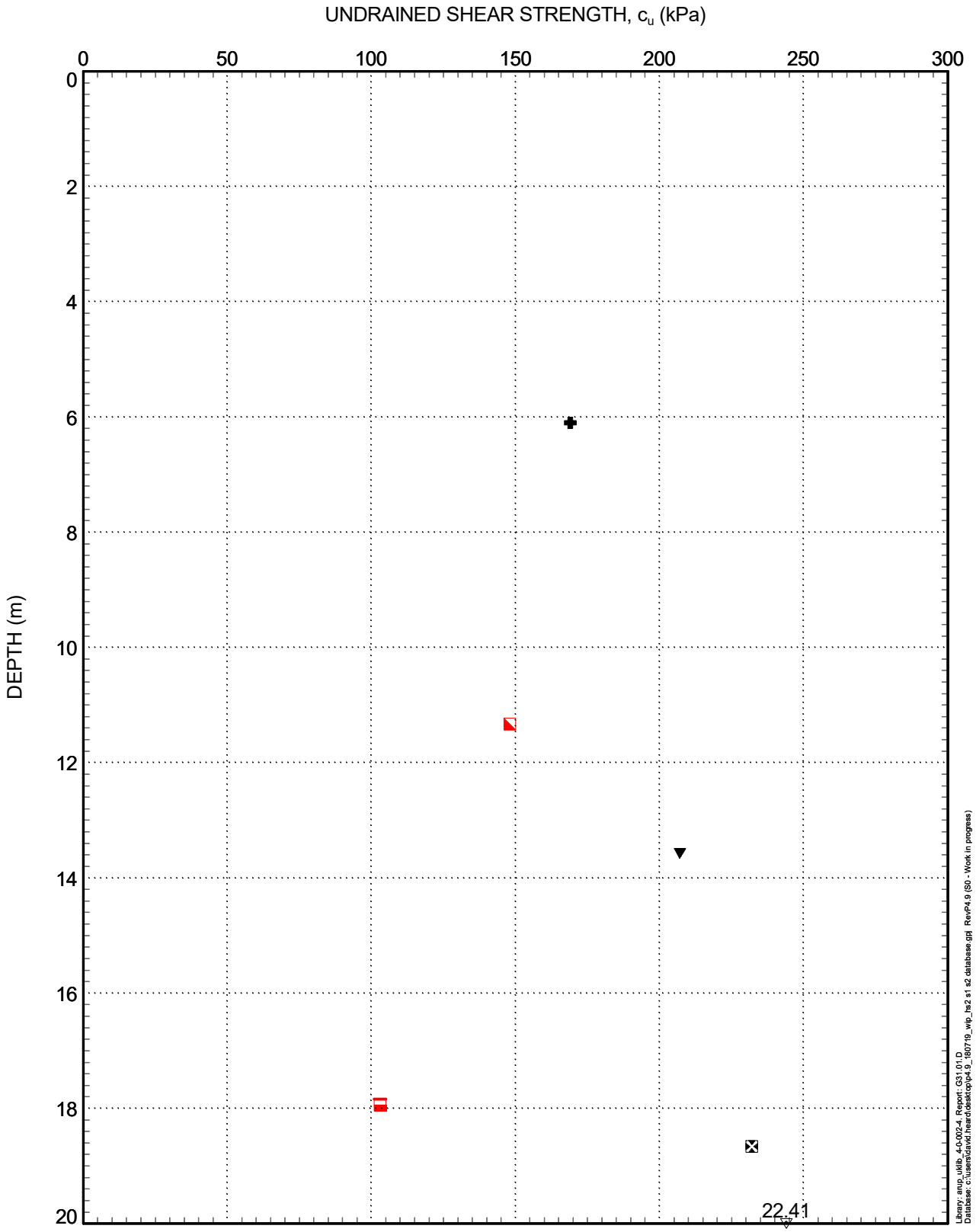
FIGURE 14



ARUP, gINT v8.30.003
Made by David Heard on 12-Sep-18

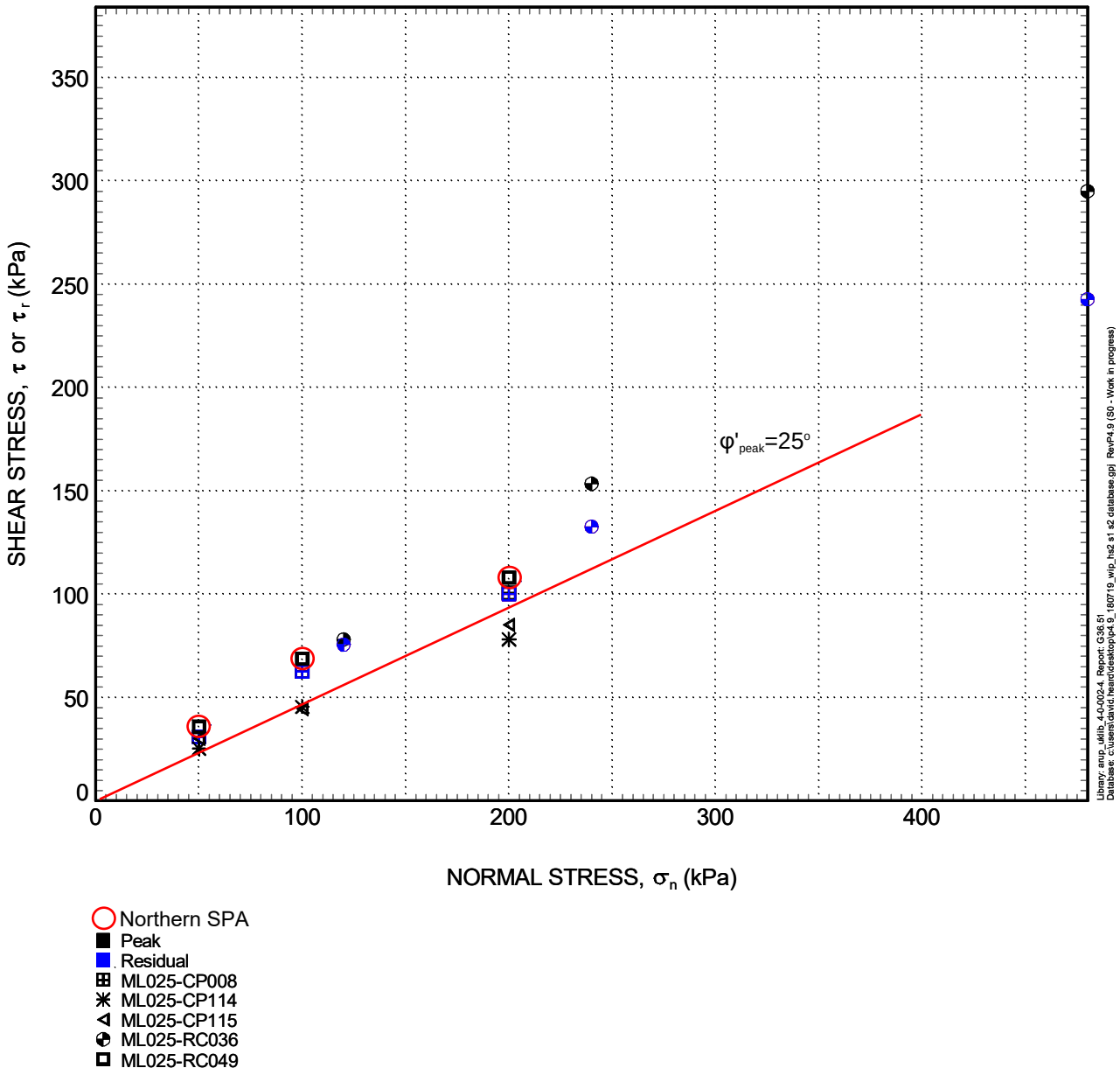
HS2
STANDARD PENETRATION TESTS
HARWICH FORMATION

FIGURE 15



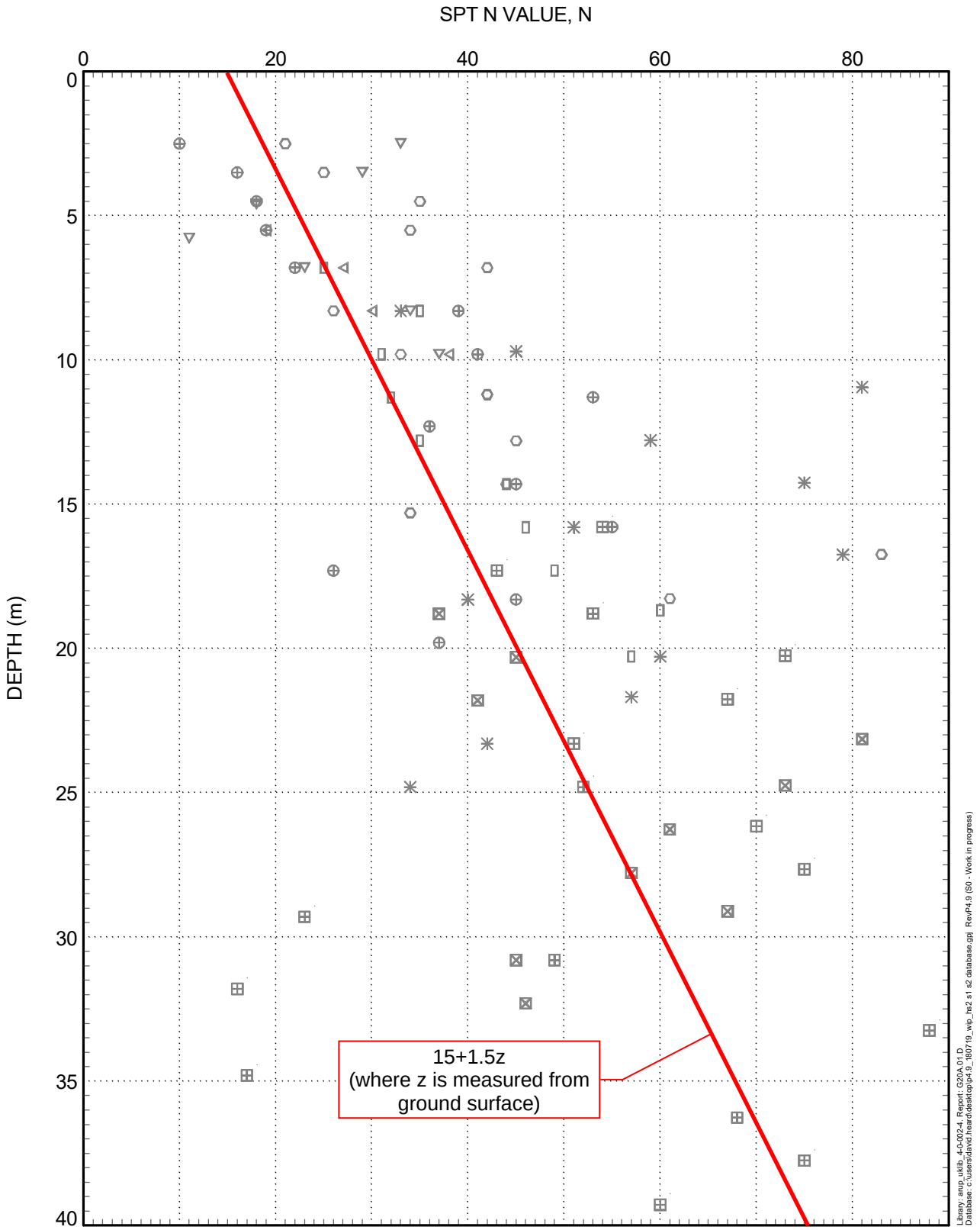
HS2
TRIAXIAL UNDRAINED SHEAR STRENGTH
HARWICH FORMATION

FIGURE 16



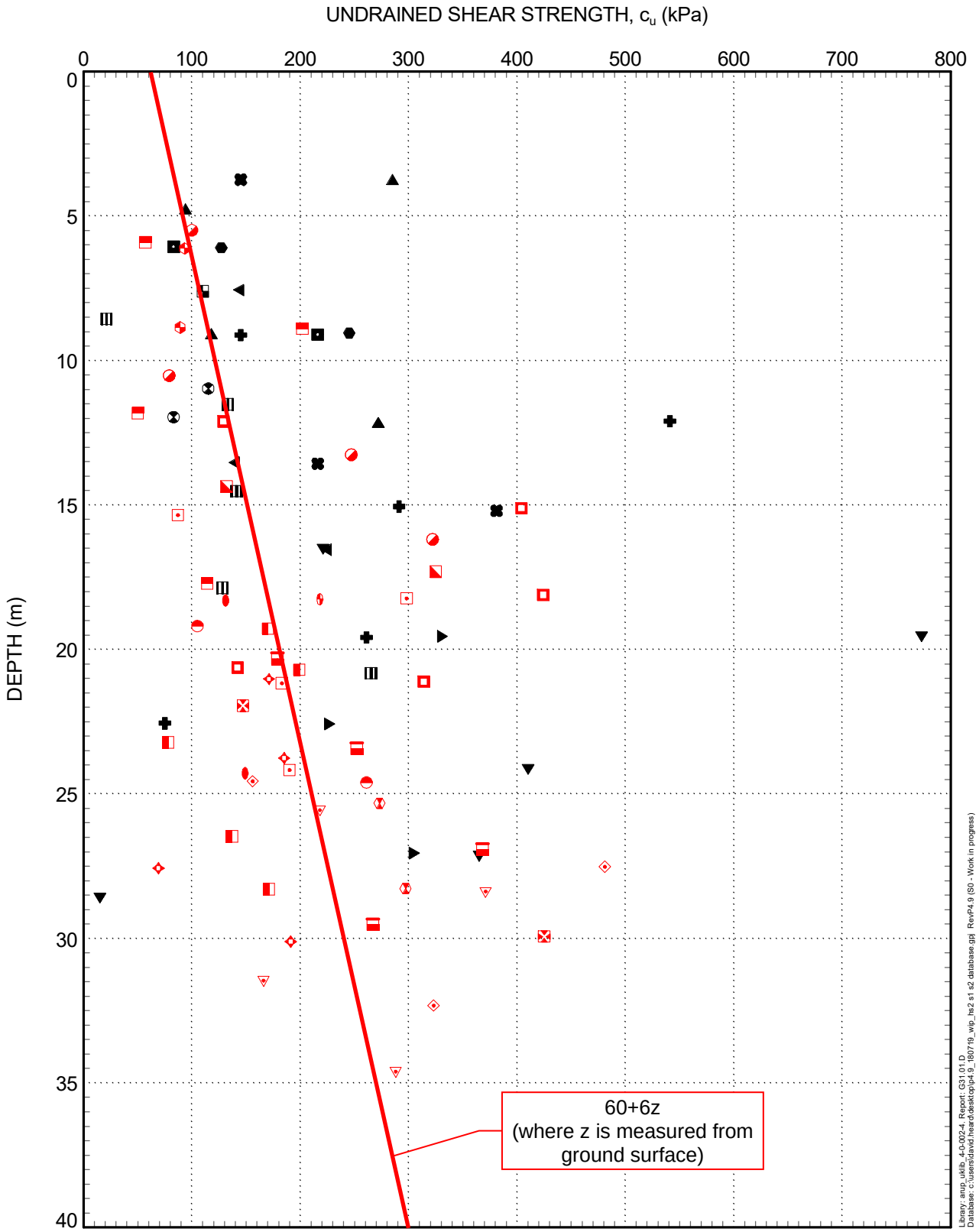
HS2
SHEAR BOX TESTS
HARWICH FORMATION

FIGURE 17



HS2
STANDARD PENETRATION TESTS
LAMBETH GROUP

FIGURE 18



- Northern SPA
- Copthall Cutting
- ML024-CP004
- ML024-CP006
- ML024-CP007
- ML025-CP008
- ML025-CP114
- ML025-CP115
- ML025-CP121
- ML025-CP122
- ML024-RC005
- ML024-RC005a
- ML024-RC007
- ML024-RC012
- ML025-RC002
- ML025-RC021
- ML025-RC023
- ML025-RC030
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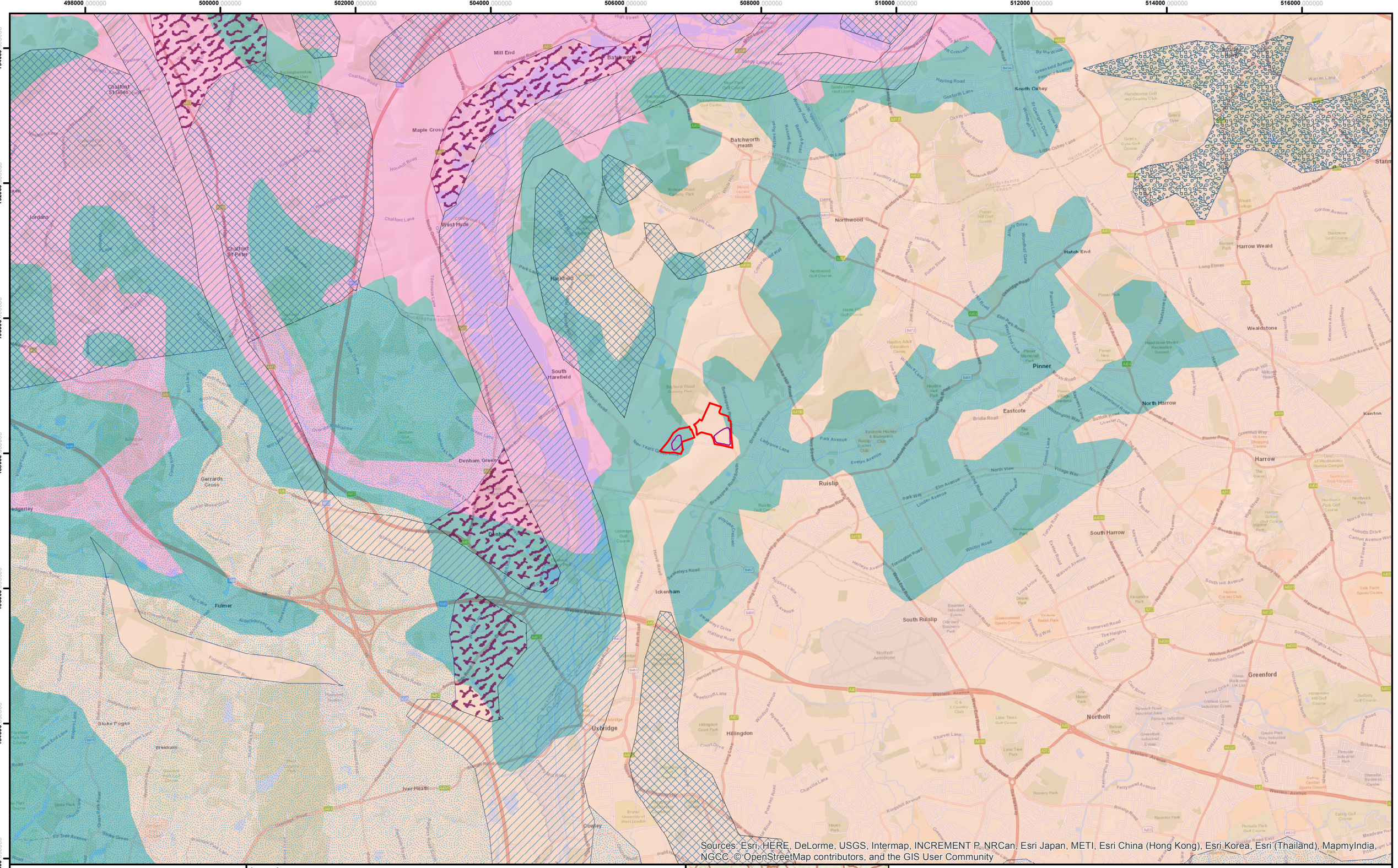
- ML025-RC032
- ML025-RC033
- ML025-RC034
- ML025-RC036
- ML025-RC037
- ML025-RC048
- ML025-RC049
- ML025-RC051
- ML025-RC052
- ML025-RC053

HS2
TRIAXIAL UNDRAINED SHEAR STRENGTH
LAMBETH GROUP

FIGURE 19



Refer to Drawing ESSD 5 for complete drawing notes and data sources

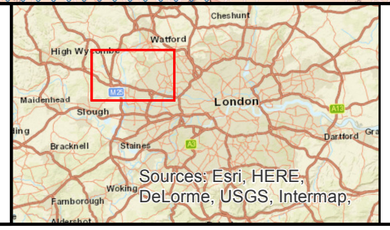
Legend

Superficial Geology

- Alluvium
- Clay with flints
- Glacial sand and gravel
- River Terrace Deposits (Undifferentiated)
- Sand and gravel of uncertain age and origin
- Mound Outline
- SPA Site Boundary

Bedrock Geology

- Lambeth Group
- London Clay Formation
- Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated)



Scale at A3: 1:50,000

0 2 Kilometres

Figure 20 - Geological Section Sketch (Refer to ESSD 5)

Date: 13/09/18

Appendix A – Exploratory hole logs

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 34.95m	**Casing Diameter** 200mm to 1.30m	**BOREHOLE No.** ML024-RC012
Equipment Comacchio MC450P			**Coordinates** 507319.36 E
Drill Fluid Polymer DS60/Pure-Bore			**(National Grid)** 188149.39 N
Crew/Vessel TS/WG	**Logged by** CJ/MCM	**Compiled by** jm	**Ground Level** 61.88 m OD
Dates Drilled Start 05/01/2017	04/01/2017	21/02/2017	**Checked by** NJB 11/12/2017
End 10/01/2017			

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type	No.	TCR %	SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min, Avg, Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
05/01			0.20		B	1						MADE GROUND: Brown and grey slightly sandy gravelly clay. Gravel is angular to subrounded fine to coarse flint and brick. [MADE GROUND - CLAY]	(0.50)		
			0.20		D	2									
													0.50	61.38	
			0.00-1.20		PIT							Soft light brown mottled grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular and subrounded mainly fine and medium flint. [SUPERFICIAL DEPOSITS - COHESIVE - CLAY]	(0.70)		
			0.70		B	3									
			0.70		D	4									
			1.10		B	5									
			1.10		D	6							1.20	60.68	
		(100)	1.20-2.00		100							Stiff brown mottled orangish brown and light grey slightly sandy slightly gravelly CLAY with subangular and subrounded claystone nodules (<60mm). Gravel is subangular and subrounded fine to coarse flint and possibly chalk. [SUPERFICIAL DEPOSITS - COHESIVE - CLAY]	(0.80)		
			1.70-2.00		C	7									
													2.00	59.88	
			2.30-2.60		C	8						Stiff fissured laminated dark brown mottled orangish brown locally grey (gleyed) CLAY with occasional pockets (<8 x 6mm) of gypsum crystals and rare shell fragments (<20mm). Occasional thin laminae of orangish brown clay with possible weathered pyrite. Thin laminae, 0-40 degs (parallel to fissures), extremely closely spaced, planar and undulating. Fissures (SET 1) are 0-40 degs, extremely closely to very closely spaced, undulating, rough to smooth, (very tight), clean with occasional orangish brown silt veneer and locally with bluish grey silt veneer (gleyed). [LONDON CLAY FORMATION A3 - CLAY] 2.50m to 3.50m; (firm to stiff) possibly DI.			
		(100)	2.00-3.50		100										
			3.70-4.00		C	9							(3.50)		
		(100)	3.50-5.00		100										

Remarks (See notes & keysheets)

1. Initially a PAS128 survey was undertaken. Prior to boring, a Cable Avoidance Tool (CAT) survey was performed to check for services. A service pit was hand-dug to 1.20m and rescanned using a CAT. Services were not located.
2. See separate sheet for installation.
3. Groundwater not encountered during drilling due to use of fluid flush.

Scale 1:25

TUGRO 13/12/2017

Project WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED

Contract No. G160015U

Figure No. ML024-RC012 (1 of 9)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 34.95m	**Casing Diameter** 200mm to 1.30m	**BOREHOLE No.** ML024-RC012
Equipment Comacchio MC450P			**Coordinates** 507319.36 E
Drill Fluid Polymer DS60/Pure-Bore			**(National Grid)** 188149.39 N
Crew/Vessel TS/WG	**Logged by** CJ/MCM	**Compiled by** jm	**Ground Level** 61.88 m OD
Dates Drilled Start 05/01/2017			
End 10/01/2017	04/01/2017	21/02/2017	**Checked by** NJB 11/12/2017

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From To	Type	No. TCR %	SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
										Stiff mottled CLAY as previous sheet.			
			5.50-5.80	C	10						5.50	56.38	
		(100)	5.00-6.50		100					Very stiff fissured dark brown mottled orangish brown locally grey (gleyed) slightly sandy CLAY with occasional pockets (<6 x 3mm) of gypsum crystals and rare shell fragments (<20mm). Occasional thin laminae of claystone. Fissures (SET 1) are 0-20 degs, extremely closely to very closely spaced, planar locally undulating, smooth occasionally rough, (very tight), occasionally polished locally with slickensides, mainly with orangish brown staining or silt veneer. Fissures (SET 2) are 70-90 degs, spacing not determined locally very closely spaced, planar, smooth, (very tight), polished locally with slickensides, with orangish brown staining. [LONDON CLAY FORMATION A3 - CLAY] 6.40m to 8.15m; (firm to stiff) possibly DI. Driller notes dropped core.			
		(100)	6.50-8.00		80					7.70m to 8.00m; assumed zone of core loss.	(4.40)		
			8.15-8.35	C	11								
			8.50-8.80	C	12								
		(100)	8.00-9.30		100					9.00m to 9.03m; orangish brown claystone. Stiff fissured becoming indistinctly fissured dark brownish grey CLAY, becoming silty with occasional partings of silt. Fissures (SET 1) are 0-30 degs, extremely closely to very closely spaced occasionally closely spaced, planar, smooth, (very tight), locally polished with slickensides, clean. Fissures (SET 2) are 70-90 degs, spacing not determined, planar, smooth, (very tight), frequently polished. Fissures (SET 3) are 30-60 degs, mainly localised and very closely to closely spaced, planar, smooth, (very tight), frequently polished occasionally with slickensides. [LONDON CLAY FORMATION A2 - CLAY]	9.90	51.98	

Remarks
(See notes & keysheets)

Scale 1:25

13/12/2017

Project
WEST RUISLIP
HIGH SPEED TWO (HS2) LIMITED

Contract No. G160015U

Figure No. ML024-RC012 (2 of 9)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 34.95m	**Casing Diameter** 200mm to 1.30m	**BOREHOLE No.ML024-RC012**
Equipment Comacchio MC450P			**Coordinates** 507319.36 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188149.39 N
Crew/Vessel TS/WG	**Logged by** CJ/MCM	**Compiled by** jm	**Checked by** NJB	**Ground Level** 61.88 m OD
Dates Drilled Start 05/01/2017	04/01/2017	21/02/2017	11/12/2017
End 10/01/2017			

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery: Depth (m) From–To	Type	No.	TCR %	SCR %	RQD %	SPT Blows /N / Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
		(100)	9.30-10.80			83					9.90m to 10.30m; fissures frequently polished with slickensides. Below 10.30m; indistinctly fissured.	(0.65)		
05/01	1.30										Assumed zone of core loss. Driller notes liner failed. [- NO CORE RECOVERY]	10.55	51.33	
06/01	1.30											(0.80)		
		(100)	10.80-12.30			63					Very stiff indistinctly fissured laminated dark grey locally slightly sandy CLAY with partings of silt or fine sand and occasionally with greenish black possibly carbonaceous elongate pockets (<40 x 5mm). Sand is mainly fine and medium. Thin laminae of clay, 0-20 degs, extremely closely spaced, planar with partings of silt and fine sand. Fissures (SET 1) are 0-20 degs, spacing not determined, planar, smooth, (very tight), clean or with occasional polishing and locally with slickensides. Fissures (SET 2) are 70-90 degs, probably very closely to closely spaced, planar, smooth, (very tight), clean or with occasional polishing and locally with slickensides. [LONDON CLAY FORMATION A2 - CLAY]	11.35	50.53	
			11.65-11.83	C	13									
			11.83-12.06	C	14									
06/01	1.30													
09/01	1.30	GL												
		(100)	12.30-13.80			100								
												(6.17)		
		(100)	14.50-14.80	C	15									
			13.80-15.30			100								
			14.80-15.06	C	16									

Remarks
(See notes & keysheets)

Scale 1:25

TUGRO 13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U **Figure No.** ML024-RC012 (3 of 9)

Drilling Method	Rotary Cored	Borehole Diameter	Casing Diameter	**BOREHOLE No.ML024-RC012**	
Equipment	Comacchio MC450P	146mm to 34.95m	200mm to 1.30m	Coordinates	507319.36 E
Drill Fluid	Polymer DS60/Pure-Bore			(National Grid)	188149.39 N
Crew/Vessel	TS/WG	Logged by	Compiled by	Checked by	Ground Level 61.88 m OD
Dates Drilled	Start 05/01/2017	CJ/MCM	jm	NJB	
	End 10/01/2017	04/01/2017	21/02/2017	11/12/2017	

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
										Very stiff dark grey CLAY as previous sheet.			
		(100)	15.30	16.80	100				NA				
			17.25	17.52	C	17				At 17.25m; thin lamina of shell fragments (<60mm).	17.52	44.36	
		(100)	16.80	18.30	100					Stiff dark grey slightly sandy CLAY with occasional shell fragments (<60mm). Sand is mainly fine. [HARWICH FORMATION - CLAY]			
			17.93	18.13	C	18				17.88m to 17.93m; thin bed of dark grey siltstone. At 17.93m; slightly gravelly.	(0.93)		
		(100)	18.30	19.05	100					Very stiff friable fissured greenish grey to bluish grey mottled yellowish green and whitish grey silty CLAY with occasional subrounded white calcrete nodules (<40 x 20mm). All fissures frequently polished with slickensides, with greenish grey and yellowish green mottling and silt veneer. Fissures (SET 1) are 0-30 degs, extremely closely to very closely spaced, planar and undulating, smooth, (very tight). Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely to very closely spaced, planar and undulating, smooth, (very tight). Fissures (SET 3) are 30-60 degs, very closely to closely spaced, planar, smooth, (very tight). [LOWER MOTTLED CLAY - CLAY] 18.45m to 18.60m; with greenish grey infilled burrows. 18.50m to 18.90m; with lenses of grey sandy clay (<90 x 90mm). 18.90m to 19.45m; with frequent calcrete nodules. At 19.30m; with purplish red mottling.	18.45	43.43	
		(100)	19.05	19.80	100						(1.00)		
										Very stiff locally friable fissured yellowish green mottled purplish red, grey and white locally slightly sandy CLAY with occasional subrounded and rounded white calcrete nodules (<65 x	19.45	42.43	

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method	Rotary Cored	Borehole Diameter	Casing Diameter	**BOREHOLE No.ML024-RC012**	
Equipment	Comacchio MC450P	146mm to 34.95m	200mm to 1.30m	Coordinates	507319.36 E
Drill Fluid	Polymer DS60/Pure-Bore			(National Grid)	188149.39 N
Crew/Vessel	TS/WG	Logged by	Compiled by	Checked by	Ground Level 61.88 m OD
Dates Drilled	Start 05/01/2017	CJ/MCM	jm	NJB	
	End 10/01/2017	04/01/2017	21/02/2017	11/12/2017	

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
			20.30	20.60	C	19				40mm) and occasional worm burrows (<4mm). All fissures with occasional polishing with slickensides, with yellowish green and purplish red mottling and silt veneer. Fissures (SET 1) are 0-30 degs, extremely closely to very closely spaced, planar and undulating, smooth, (very tight). Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely to very closely spaced, planar and undulating, smooth, (very tight). Fissures (SET 3) are 30-60 degs, very closely to closely spaced, planar, smooth, (very tight). [LOWER MOTTLED CLAY - CLAY] 19.80m to 19.90m; (firm to stiff), DI.	(1.85)		
		(100)	19.80	21.30	100								
			20.95	21.25	C	20							
09/01	1.30	GL									21.30	40.58	
10/01	1.30	0.10								Very stiff indistinctly fissured greenish brown mottled greenish grey silty CLAY with frequent pockets (<30 x 20mm) of greenish grey clayey silt and sandy silt and locally with worm burrows. Fissures (SET 1) are 0-20 degs, spacing not determined, planar, smooth, (very tight), rarely polished with slickensides, with greenish brown and greenish grey mottling and silt veneer. Fissures (SET 2) are 70-90 degs, spacing not determined, undulating, rough, (very tight), rarely polished, with greenish grey silt veneer. [LOWER MOTTLED CLAY - CLAY] Top (21.30m) to 21.45m; locally distinctly fissured, locally mottled purplish red and yellow. 22.45m to base (22.80m); very thin laminae with partings of silt, 0 degs, extremely closely spaced, planar, occasionally discontinuous and locally in pockets.			
		(100)	21.30	22.80	100						(1.50)		
											22.80	39.08	
			23.42	23.75	C	21				Very stiff fissured locally indistinctly fissured brown to dark reddish brown mottled bluish grey, yellowish green and locally purplish red slightly sandy CLAY. Sand is fine to coarse. Occasional subrounded and rounded white calcrete nodules (<25 x 20mm), locally with worm burrows (<5mm). Fissures (SET 1) are 0-30 degs, extremely closely to very closely occasionally closely spaced, planar locally undulating, smooth, (very tight), frequently polished with slickensides, with bluish grey and yellowish green mottling and silt veneer, locally with calcrete veneer. Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely spaced rarely very closely spaced, undulating, rough and smooth, (very tight), rarely polished, frequently with greenish grey silt veneer. Fissures (SET 3) are 30-60 degs, very closely to closely spaced, planar, smooth, (very tight), frequently polished with slickensides, with bluish grey and yellowish green mottling and silt veneer. [LOWER MOTTLED CLAY - CLAY] 23.05m to 23.20m; very stiff indistinctly fissured yellowish brown to brown mottled greenish grey silty clay with frequent pockets (<30 x 40mm) of greenish grey clayey silt. 24.30m to 24.75m; prominent fissures (SET 2).			
		(100)	22.80	24.30	100						(2.20)		
			23.90	24.21	C	22							
			24.30		EW	1					25.00	36.88	
										Very stiff indistinctly fissured reddish			

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 34.95m	**Casing Diameter** 200mm to 1.30m	**BOREHOLE No.** ML024-RC012
Equipment Comacchio MC450P			**Coordinates** 507319.36 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188149.39 N
Crew/Vessel TS/WG	**Logged by** CJ/MCM	**Compiled by** jm	**Checked by** NJB	**Ground Level** 61.88 m OD
Dates Drilled Start 05/01/2017	04/01/2017	21/02/2017	11/12/2017
End 10/01/2017			

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery: Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
		(100)	24.30	25.80	100					brown mottled greenish grey CLAY. Fissures (SET 1) are 0-20 degs, very closely to closely spaced, planar, smooth, (very tight), clean, occasionally polished with slickensides. [LOWER MOTTLED CLAY - CLAY]	25.00 (0.50)	36.88	
											25.50	36.38	
										Very stiff indistinctly fissured laminated yellowish brown to brown mottled greenish grey slightly sandy CLAY. Thin laminae of clay and silt, 0 degs, extremely closely spaced, planar. Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely spaced, undulating, rough, (very tight), with greenish grey silt veneer. [LOWER MOTTLED CLAY - CLAY] 25.80m to 26.30m; locally with beds of sandy clay, very thin beds of silty sand and occasional pockets (<40 x 20mm) of silty sand. Sand is fine and medium.	(1.70)		
			26.50	26.67	C	23							
		(100)	25.80	27.30	100								
			26.90	27.20	C	24							
											27.20	34.68	
										Very stiff indistinctly fissured laminated reddish brown mottled greenish grey CLAY. Thin laminae of clay and silt, 0 degs, extremely closely spaced, planar. Fissures (SET 1) are 0-20 degs, spacing not determined, planar, smooth, (very tight), polished or with silt veneer. [LOWER MOTTLED CLAY - CLAY]	(1.30)		
		(100)	27.30	28.80	100								
										Very stiff indistinctly fissured laminated yellowish brown mottled greenish grey silty CLAY. Thin laminae of clay and silt, 0 degs, extremely closely spaced, planar. Fissures (SET 2) are 70-90 degs, spacing not determined, undulating, rough, (very tight), with greenish grey silt veneer. [LOWER MOTTLED CLAY - CLAY] 28.63m to 28.85m; with very closely spaced very thin beds of reddish brown clay.	28.50 (0.65)	33.38	
										Stiff fissured thinly laminated to very thinly bedded reddish brown mottled greenish grey locally slightly sandy CLAY. Sand is fine. Thin laminae and very thin beds of clay and silt, 0 degs, extremely closely spaced, planar. Fissures (SET 1) are 0-30 degs, extremely closely to very closely spaced, planar locally undulating, smooth, (very tight), locally polished occasionally with slickensides, occasionally with silt veneer. Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely to very closely spaced, undulating locally planar, rough to smooth, (very tight), with greenish grey	29.15 (1.15)	32.73	
			29.50	29.80	C	25							
		(100)	28.80	30.30	100								
			30.00	30.30	C	26							

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method	Rotary Cored	Borehole Diameter	Casing Diameter	**BOREHOLE No.ML024-RC012**	
Equipment	Comacchio MC450P	146mm to 34.95m	200mm to 1.30m	Coordinates	507319.36 E
Drill Fluid	Polymer DS60/Pure-Bore			(National Grid)	188149.39 N
Crew/Vessel	TS/WG	Logged by	Compiled by	Checked by	Ground Level 61.88 m OD
Dates Drilled	Start 05/01/2017	CJ/MCM	jm	NJB	
	End 10/01/2017	04/01/2017	21/02/2017	11/12/2017	

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type	No.	TCR %	SCR %	RQD %	SPT Blows /N	Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
													silt veneer. [LOWER MOTTLED CLAY - CLAY]			
													Very stiff indistinctly fissured laminated yellowish brown to brown mottled greenish grey CLAY. Thin laminae of clay and silt, 0-20 degs, extremely closely spaced, planar. Fissures (SET 1) are 0-20 degs, spacing not determined, planar, smooth to rough, (very tight), occasionally with polishing and silt veneer. Fissures (SET 2) are 70-90 degs, spacing not determined, planar and undulating, smooth to rough, (very tight), locally polished and with partial greenish grey silt veneer. [LOWER MOTTLED CLAY - CLAY]	30.30 (0.45) 30.75 (0.55)	31.58 31.13 	
		(100)	31.00 30.30-31.80 31.00 31.00 31.00		EW 100 EW EW EW	1 2 3 4							Very stiff indistinctly fissured dark brownish grey to brown mottled bluish grey silty CLAY. Fissures (SET 1) are 0-20 degs, very closely to closely spaced, planar, smooth, (very tight), clean, locally polished with slickensides. Fissures (SET 2) are 70-90 degs, spacing not determined, planar, smooth, (very tight), occasionally with polishing and with silt veneer. [LOWER MOTTLED CLAY - CLAY] To 31.00m; slightly sandy, cemented. 31.00m to 31.30m; prominent fissure (SET 2), 90 degs.	31.30 (1.15)	30.58 	
		(100)	31.80-33.30		63								Stiff locally very stiff fissured laminated greenish brown mottled bluish grey CLAY. Possibly glauconitic. Occasional very thin beds and pockets of silty fine sand. Locally with subrounded and rounded calcrete nodules and worm burrows (<4mm). All fissures with bluish grey mottling and silt veneer. Fissures (SET 1) are 0-30 degs, extremely closely to very closely spaced, planar, smooth, (very tight), frequently polished with slickensides. Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely to very closely spaced, planar to undulating, smooth to rough, (very tight), occasionally polished. Fissures (SET 3) are 30-60 degs, probably closely spaced, planar, smooth, (very tight), frequently polished with slickensides. [UPNOR FORMATION - CLAY] 31.30m to 31.50m; silty. 31.70m to 31.95m; thinly interbedded silty fine sand and sandy clay, with pockets (<60 x 30mm) of silty fine sand.	32.45 (0.30) 32.75 (0.55) 33.30 (0.15) 33.45	29.43 29.13 28.58 28.43	
		(100)	33.30-33.80		100	70	0			20, 95, 230			Dark brown silty sandy locally clayey angular and subangular fine to coarse GRAVEL and COBBLE of black flint with cortex and occasional red flint. Sand is fine. [UPNOR FORMATION - COBBLES]			
										NI						
		(100)	33.80-34.95		96	38	10			30, 95, 160			Assumed zone of core loss. [- NO CORE RECOVERY] Approximate boundary	(1.50)		
										NI			Greenish grey very silty gravelly SAND, possibly glauconitic locally clayey. Gravel is angular and subangular fine to coarse rinded flint and chalk. Sand is fine. [UPNOR FORMATION - SAND]			
10/01	1.30	0.80								>250						
										NI			Weak medium density locally high to very high density light brownish white CHALK. Fractures (SET 1) are 5-20 degs, very closely to medium spaced, planar to	34.95	26.93	

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 34.95m	**Casing Diameter** 200mm to 1.30m	**BOREHOLE No.ML024-RC012**
Equipment Comacchio MC450P			**Coordinates** 507319.36 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188149.39 N
Crew/Vessel TS/WG	**Logged by** CJ/MCM	**Compiled by** jm	**Checked by** NJB
Dates Drilled Start 05/01/2017	04/01/2017	21/02/2017	11/12/2017
End 10/01/2017			**Ground Level** 61.88 m OD

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery: Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N / Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
										undulating, smooth to rough, (partly open to wide), with grey and brown or occasionally greenish grey silty fine sand infill, occasional brown staining, rarely clean. Fractures (SET 2) are 70-90 degs, spacing not determined locally extremely closely to very closely spaced, planar occasionally undulating, smooth to rough, (very tight to wide), with either brown fine sand or greenish grey silty fine sand infill, occasionally clean. Fractures (SET 3) are 40-60 degs, probably very closely to closely spaced, planar occasionally undulating, smooth to rough, (very tight to wide), mainly with either brown sand or greenish grey silty sand infill, rarely clean. [CIRIA Grade: C4/C5] [SEAFORD CHALK - CHALK] 33.92m to 34.07m; Non Intact chalk with light greenish grey sandy matrix 34.25m to 34.35m; breccia zone comprising of angular chalk fragments within greenish grey silty fine sandstone matrix. 34.35m to 34.60m; Non Intact chalk. Below 34.45m; with pockets and infill of light greenish grey sandy matrix. 34.85m to 34.95m; Non Intact chalk. End of Borehole			

Remarks
(See notes & keysheets)

Scale 1:25

13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U **Figure No.** ML024-RC012 (8 of 9)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 34.95m	**Casing Diameter**	**BOREHOLE No** ML024-RC012
Equipment Comacchio MC450P Polymer DS60/Pure-Bore			**Coordinates** 507319.36 E **(National Grid)** 188149.39 N **Ground Level** 61.88 m OD
Crew/Vessel TS/WG	**Logged by** CJ/MCM	**Compiled by** jm	**Checked by** NJB
Dates Drilled Start 05/01/2017 End 10/01/2017	04/01/2017	21/02/2017	11/12/2017

Installation Details	Installation Depth (m)	Level m OD	Water Strikes	Strata Depth (m)	Strata Details
Instrumentation: 50mm slotted section (SL) from 30.00 to 33.00m					
Concrete	0.50	61.38		0.50	MADE GROUND
Bentonite					CLAY
				10.55	
				11.35	No Recovery
					CLAY
				18.45	
				19.45	Silty CLAY
					CLAY
				21.30	
				22.80	Silty CLAY
					CLAY
				28.50	
				29.15	Silty CLAY
	30.00	31.88			CLAY
Gravel backfill				30.75	
SL=30.00-33.00m				31.30	Silty CLAY
				32.45	CLAY
	33.00	28.88		32.75	Silty sandy cobbly GRAVEL
Bentonite				33.30	No Recovery
				33.45	Silty gravelly SAND
	34.95	26.93		34.95	CHALK Base of Hole

Remarks
(See notes & keysheets)

▽ Water Strike
▼ Water Rise

Not to Scale

DEFRA cover.
Pipe diameter 50mm to 33.00m, installed on 11/01/2017.

UGRO 13/12/2017

Project
WEST RUISLIP
HIGH SPEED TWO (HS2) LIMITED

Contract No. G160015U

Figure No. ML024-RC012 (9 of 9)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 21.70m	**Casing Diameter** 175mm to 2.20m	**BOREHOLE No.ML025-RC048**
Equipment Hanjin DB 10			**Coordinates** 506935.59 E
Drill Fluid Polymer DS60/Pure-Bore			**(National Grid)** 188350.64 N
Crew/Vessel CJ/ZI	**Logged by** CJ/AU	**Compiled by** jm	**Ground Level** 54.76 m OD
Dates Drilled Start 11/01/2017	11/01/2017	02/03/2017	**Checked by** ASC/WFL 21/06/2017
End 12/01/2017			

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type	No.	TCR %	SCR %	RQD %	SPT Blows /N	Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
11/01			0.10		B	1							TOPSOIL: Grass over (very soft) brown slightly sandy slightly gravelly clay. Gravel is subangular and subrounded fine and medium flint.	(0.30)		
			0.10		D	2							[TOPSOIL - CLAY]	0.30	54.46	
			0.00-1.20		PIT								Soft fissured light brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine and medium flint. Fissures (SET 1) are 0 degs, extremely closely to very closely spaced, undulating, smooth.			
			0.60		B	3								(0.90)		
			0.60		D	4							[SUPERFICIAL DEPOSITS - COHESIVE - CLAY]			
			1.10		B	5								1.20	53.56	
			1.10		D	6							Firm to stiff locally fissured brown mottled orangish brown and bluish grey (gleyed) slightly sandy CLAY, locally sandy. Locally with black organic staining (<1 x 1mm), frequent roots and rootlets (<2mm). Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely spaced, planar and undulating, rough occasionally smooth, (very tight). Fissures (SET 3) are 40-60 degs, extremely closely spaced, planar, smooth, (very tight), polished.			
			1.60-1.82		C	7							[LONDON CLAY FORMATION A2 - CLAY]			
		(100)	1.20-2.20		95								1.40m to 1.82m; fissured.	(1.00)		
													1.82m to 1.92m; thickly laminated brown mottled orangish brown sand. Sand is fine.			
													1.92m to 2.15m; sandy with black organic staining possibly lignite.	2.20	52.56	
													Soft to firm brown mottled bluish grey and grey slightly sandy slightly gravelly CLAY with frequent roots and rootlets (<1mm). Gravel is subrounded and rounded fine and medium white flint and orangish brown weathered pyrite.	(0.50)		
			2.20-3.70		93								[HARWICH FORMATION - CLAY]	2.70	52.06	
		(100)	2.90-3.10		C	8							Greyish brown mottled orangish brown slightly gravelly clayey SAND, locally slightly sandy clay. Rare reddish brown claystone (<40mm) and abundant shell fragments (<40 x 25mm). Sand is fine to coarse. Gravel is well rounded fine and medium brown flint.			
													[HARWICH FORMATION - SAND]	(1.50)		
													At 2.90m; slightly gravelly slightly sandy clay.			
														4.20	50.56	
			3.70-5.20		83								Firm to stiff fissured grey mottled orangish brown and locally brown silty CLAY with occasional calcrete nodules (<40 x 20mm), occasional black organic staining possibly lignite (<2 x 2mm), rare black leaf imprints (<20 x 10mm). Locally with pockets (<100 x 90mm) of sand. Fissures (SET 1) are 0-20 degs, extremely closely spaced, planar and undulating, rough, (very tight). Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely spaced, planar, smooth occasionally rough, (very tight). Fissures (SET 3) are			
		(100)	4.48-4.78		C	9								(1.20)		

Remarks (See notes & keysheets)

1. Initially a PAS128 survey was undertaken. Prior to boring, a Cable Avoidance Tool (CAT) survey was performed to check for services. A service pit was hand-dug to 1.20m and rescanned using a CAT. Services were not located.
2. See separate sheet for installation.
3. Groundwater not encountered during drilling due to use of fluid flush.

Scale 1:25

TUGRO 13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U
		Figure No. ML025-RC048 (1 of 6)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 21.70m	**Casing Diameter** 175mm to 2.20m	**BOREHOLE No.ML025-RC048**
Equipment Hanjin DB 10			**Coordinates** 506935.59 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188350.64 N
Crew/Vessel CJ/ZI	**Logged by** CJ/AU	**Compiled by** jm	**Checked by** ASC/WFL
Dates Drilled Start 11/01/2017	11/01/2017	02/03/2017	21/06/2017
End 12/01/2017			**Ground Level** 54.76 m OD

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
										40-60 degs, extremely closely spaced, planar, smooth, (very tight), polished with slickensides, with grey silt veneer. [LOWER MOTTLED CLAY - CLAY] Top (4.20m) to 4.48m; grey mottled brown with pockets (<100 x 90mm) of sand, possibly burrows. 4.95m to 5.20m; assumed zone of core loss.	5.40	49.36	
		(100)	5.20	6.70	100					Stiff to very stiff fissured mottled orangish brown, bluish grey, and reddish grey slightly sandy CLAY, locally clayey silt. Occasional calcrete nodules (<40 x 25mm). Sand is mainly fine. Fissures (SET 1) are 0-20 degs, extremely closely spaced, planar, rough and smooth, (very tight). Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely spaced, planar and undulating, rough and smooth, (very tight), polished with slickensides, with silt veneer. Fissures (SET 3) are 40-60 degs, extremely closely to very closely spaced, planar and undulating, smooth, (very tight), polished with slickensides, with silt veneer. [LOWER MOTTLED CLAY - CLAY]			
			5.90	6.20	C	10							
										7.20m to 7.90m; with occasional calcrete nodules.			
		(100)	6.70	8.20	100						(4.45)		
			7.40	7.70	C	11							
										7.90m to 8.15m; bluish grey mottled orangish brown with abundant calcrete nodules.			
			8.85	9.15	C	12							
		(100)	8.20	9.70	100								
										9.30m to 9.70m; bluish grey mottled orangish brown clayey silt.			
										Stiff to very stiff fissured reddish brown mottled bluish grey silty CLAY. Fissures (SET 1) are 0-20 degs, extremely	9.85	44.91	

Remarks
(See notes & keysheets)

Scale 1:25

TUGRO 13/12/2017

Project
WEST RUISLIP
HIGH SPEED TWO (HS2) LIMITED

Contract No. G160015U

Figure No. ML025-RC048 (2 of 6)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 21.70m	**Casing Diameter** 175mm to 2.20m	**BOREHOLE No.ML025-RC048**
Equipment Hanjin DB 10			**Coordinates** 506935.59 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188350.64 N
Crew/Vessel CJ/ZI	**Logged by** CJ/AU	**Compiled by** jm	**Checked by** ASC/WFL
Dates Drilled Start 11/01/2017	11/01/2017	02/03/2017	21/06/2017
End 12/01/2017			**Ground Level** 54.76 m OD

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
									NA	closely to very closely spaced, planar, smooth and rough, (very tight), polished. Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely spaced, planar and undulating, rough, (very tight). Fissures (SET 3) are 40-60 degs, extremely closely to very closely spaced, planar and undulating, smooth, (very tight), polished with slickensides. [LOWER MOTTLED CLAY - CLAY]			
		(100)	9.70-11.20 10.50-10.80	100 C	13						(1.35)		
										10.80m to 10.95m; laminated bluish grey mottled brown clayey silt. Thin laminae of white and bluish grey silt, 0-10 degs, extremely closely spaced, planar, rough.			
											11.20	43.56	
										Stiff fissured bluish grey and orangish brown locally mottled black slightly sandy CLAY with rare roots and rootlets (<1mm) on fissure surfaces and rare ferricrete nodules. Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely to very closely spaced, planar, smooth and rough, (very tight). Fissures (SET 3) are 40-60 degs, extremely closely to very closely spaced, planar, smooth, (very tight), polished with slickensides, with grey silt veneer. [LOWER MOTTLED CLAY - CLAY]	(0.85)		
			11.80-12.10	C	14								
		(100)	11.20-12.70	100							12.05	42.71	
										Very stiff fissured reddish brown mottled bluish grey CLAY. Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely spaced, planar, rough, (very tight). Fissures (SET 3) are 40-60 degs, extremely closely to very closely spaced, planar, smooth, (very tight), polished with slickensides. [LOWER MOTTLED CLAY - CLAY]	(0.65)		
											12.70	42.06	
										Stiff fissured brown to bluish grey silty CLAY. Fissures (SET 1) are 0-20 degs, extremely closely spaced, planar, smooth, (very tight). Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely spaced, planar, smooth, (very tight). [LOWER MOTTLED CLAY - CLAY] At base; abundant black organic staining at contact with sand.	(0.30)		
											13.00	41.76	
		(100)	12.70-14.20	100						Brown to orangish brown, bluish grey and grey SAND, locally slightly gravelly. Abundant black possibly glauconite. Sand is fine to coarse. [ANY SAND UNIT (E.G. CHANNEL SANDS) - SAND]	(1.40)		
										(Firm) fissured laminated brownish red mottled bluish grey and black CLAY. Fissures (SET 1) are 0-20 degs, extremely closely spacing, planar, smooth, (very tight). Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely spaced, planar, smooth, (very tight). Thin laminae of clay, parallel to SET 1 fissures. [LOWER MOTTLED CLAY - CLAY]	14.40	40.36	
											(0.32)		
											14.72	40.04	
		(100)	14.20-15.70	93						Brown to orangish brown, bluish grey and grey SAND, locally slightly gravelly. Abundant black possibly glauconite. Sand			

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 21.70m	**Casing Diameter** 175mm to 2.20m	**BOREHOLE No.ML025-RC048**
Equipment Hanjin DB 10			**Coordinates** 506935.59 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188350.64 N
Crew/Vessel CJ/ZI	**Logged by** CJ/AU	**Compiled by** jm	**Checked by** ASC/WFL
Dates Drilled Start 11/01/2017	11/01/2017	02/03/2017	21/06/2017
End 12/01/2017			**Ground Level** 54.76 m OD

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type	No. TCR %	SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
											is fine to coarse. [ANY SAND UNIT (E.G. CHANNEL SANDS) - SAND]			
			15.27		EW	1								
11/01	2.20	GL												
12/01	2.20	4.70										(2.78)		
		(100)	15.70	17.20	93						Below 16.73m; orangish brown and grey.			
			17.00		EW	1								
			17.00		EW	5								
												17.50	37.26	
			17.70	18.00	C	15					Stiff fissured brown and grey mottled black slightly sandy CLAY. Sand is fine and medium. Fissures (SET 3) are 40-60 degs, extremely closely to very closely spaced, planar, smooth, (very tight). [LOWER MOTTLED CLAY - CLAY]	(0.70)		
		(100)	17.20	18.70	100									
			18.00		EW	2					Brown to orangish brown, bluish grey and grey SAND, locally slightly gravelly to gravelly. Abundant black possibly glauconite. Sand is fine to coarse. [UPNOR FORMATION - SAND]	18.20	36.56	
			18.00		EW	3						(0.15)		
			18.00		EW	4						18.35	36.41	
											Stiff fissured grey and brown mottled black sandy CLAY. Fissures (SET 1) are 0-20 degs, extremely closely spaced, planar, smooth, (very tight), polished. [UPNOR FORMATION - CLAY]	(0.20)		
												18.55	36.21	
												(0.15)		
												18.70	36.06	
											Very stiff fissured dark brown mottled bluish grey and brown slightly gravelly to gravelly CLAY with pockets (<100 x 80 x 30mm) of fine to coarse sand. Gravel is subangular to well rounded fine and medium reddish pink flint. Fissures (SET 1) are 0-20 degs, extremely closely spaced, planar and undulating, rough, (very tight). [UPNOR FORMATION]	(0.60)		
												19.30	35.46	
		(100)	18.70	20.20	100									
											Brown to orangish brown, bluish grey and grey SAND, locally slightly gravelly to gravelly. Abundant black possibly glauconite. Sand is fine to coarse. [UPNOR FORMATION - SAND]	(0.40)		
												19.70	35.06	
												(0.25)		
											Stiff dark greyish brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to rounded fine and medium flint.	19.95	34.81	

Remarks
(See notes & keysheets)

Scale 1:25

TUGRO 13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U
		Figure No. ML025-RC048 (4 of 6)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 21.70m	**Casing Diameter** 175mm to 2.20m	**BOREHOLE No.ML025-RC048**
Equipment Hanjin DB 10			**Coordinates** 506935.59 E
Drill Fluid Polymer DS60/Pure-Bore			**(National Grid)** 188350.64 N
Crew/Vessel CJ/ZI	**Logged by** CJ/AU	**Compiled by** jm	**Ground Level** 54.76 m OD
Dates Drilled Start 11/01/2017	11/01/2017	02/03/2017	**Checked by** ASC/WFL 21/06/2017
End 12/01/2017			

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
										[UPNOR FORMATION - CLAY]	(0.25)		
										Stiff bluish grey mottled brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to rounded fine and medium flint.	20.20	34.56	
			20.30	20.60	C	16							
		(100)	20.20	20.72	100	0	0		NA	[UPNOR FORMATION - CLAY]	(0.50)		
										Stiff greenish brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to well rounded fine to coarse flint. [UPNOR FORMATION - CLAY]	20.70	34.06	
									10, 70, 230	Structureless CHALK composed of light grey slightly gravelly silty SAND. Gravel is very weak medium density rounded fine to coarse. [CIRIA Grade: Dm]. [SEAFORD CHALK - CHALK]	(0.60)		
		(100)	20.72	21.70	100	47	31			Very weak and weak medium to high density off white CHALK with light grey wispy marl. Occasional flint nodular. Fractures (SET 1) are 5-20 degs, very closely to closely spaced, planar, smooth, (partly open to moderately wide), with brown sand and silt infill (<10mm), occasional brown staining. Fractures (SET 2) are 80 degs, locally extremely closely spaced, planar, smooth, (very tight to moderately wide), with brown and grey staining and locally sand infill (<4mm). Fractures (SET 3) are 60 degs, spacing not determined, planar and undulating, smooth to rough, (very tight to moderately wide) with brown staining or sand infill (<5mm). [CIRIA Grade: C4]. [SEAFORD CHALK - CHALK] 21.00m to 21.20m; Non Intact chalk (probably DI due to flint). At 21.10m; flint nodular, black.	21.30	33.46	
									90, -, 310		(0.40)		
12/01	2.20	GL								Very weak medium to high density cream CHALK. Fractures (SET 1) are 0 degs, spacing not determined, planar, smooth, (open), with grey silt infill (<1mm). Fractures (SET 2) are 80 degs, possibly extremely closely spaced, planar, smooth, (very tight), with brown and grey staining. [CIRIA Grade: possibly B3]. [SEAFORD CHALK - CHALK]	21.70	33.06	
										End of Borehole			

Remarks
(See notes & keysheets)

Scale 1:25

13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U
		Figure No. ML025-RC048 (5 of 6)

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 Polymer DS60/Pure-Bore **Crew/Vessel** CJ/ZI **Dates Drilled** Start 11/01/2017 End 12/01/2017	**Borehole Diameter** 146mm to 21.70m **Casing Diameter** **Logged by** CJ/AU 11/01/2017 **Compiled by** jm 02/03/2017 **Checked by** ASC/WFL 21/06/2017	**BOREHOLE No** ML025-RC048 **Coordinates** 506935.59 E **(National Grid)** 188350.64 N **Ground Level** 54.76 m OD

Installation Details	Installation Depth (m)	Level m OD	Water Strikes	Strata Depth (m)	Strata Details
Instrumentation: 50mm slotted section (SL) from 16.00 to 20.00m				0.30	TOPSOIL
Concrete	0.50	54.26			CLAY
Bentonite				2.70	
				4.20	Clayey SAND
				5.40	Silty CLAY
				9.85	CLAY
				11.20	Silty CLAY
				12.70	CLAY
				13.00	Silty CLAY
				14.40	SAND
				14.72	CLAY
	16.00	38.76		17.50	SAND
Gravel backfill				18.20	CLAY
SL=16.00-20.00m				18.35	SAND
				18.55	Sandy CLAY
				18.70	Gravelly CLAY
				19.30	SAND
	20.00	34.76		20.20	Sandy CLAY
Bentonite					CHALK
	21.70	33.06		21.70	Base of Hole

Remarks
(See notes & keysheets)

▽ Water Strike
▼ Water Rise

Not to Scale

Flush lockable stopcock box cover.
Pipe diameter 50mm to 20.00m, installed on 16/01/2017.

13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U **Figure No.** ML025-RC048 (6 of 6)

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 **Crew/Vessel** CJ/ZI **Dates Drilled** Start 11/01/2017 End 12/01/2017	**Borehole Diameter** 146mm to 21.70m **Casing Diameter** 175mm to 2.20m **Logged by** CJ/AU 11/01/2017 **Compiled by** jm 02/03/2017 **Checked by** ASC/WFL 21/06/2017	**BOREHOLE No** ML025-RC048 **Coordinates** 506935.59 E **(National Grid)** 188350.64 N **Ground Level** 54.76 m OD

Discon. Ref	Depth (m)	Type	Dip ° (Deg)	Aperture (mm)	Infill	Roughness: Inter-mediate	Roughness: Small	Description	Legend m OD

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 **Crew/Vessel** CJ/ZI **Dates Drilled** Start 11/01/2017 End 12/01/2017	**Borehole Diameter** 146mm to 21.70m **Casing Diameter** 175mm to 2.20m **Logged by** CJ/AU 11/01/2017 **Compiled by** jm 02/03/2017 **Checked by** ASC/WFL 21/06/2017	**BOREHOLE No** ML025-RC048 **Coordinates** 506935.59 E **(National Grid)** 188350.64 N **Ground Level** 54.76 m OD	

Discon. Ref	Depth (m)	Type	Dip ° (Deg)	Aperture (mm)	Infill	Roughness: Inter-mediate	Roughness: Small	Description	Legend m OD

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 **Crew/Vessel** CJ/ZI **Dates Drilled** Start 11/01/2017 End 12/01/2017	**Borehole Diameter** 146mm to 21.70m **Casing Diameter** 175mm to 2.20m **Logged by** CJ/AU 11/01/2017 **Compiled by** jm 02/03/2017 **Checked by** ASC/WFL 21/06/2017	**BOREHOLE No** ML025-RC048 **Coordinates** 506935.59 E **(National Grid)** 188350.64 N **Ground Level** 54.76 m OD	

Discon. Ref	Depth (m)	Type	Dip ° (Deg)	Aperture (mm)	Infill	Roughness: Inter-mediate	Roughness: Small	Description	Legend m OD

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 **Crew/Vessel** CJ/ZI **Dates Drilled** Start 11/01/2017 End 12/01/2017	**Borehole Diameter** 146mm to 21.70m **Casing Diameter** 175mm to 2.20m **Logged by** CJ/AU 11/01/2017 **Compiled by** jm 02/03/2017 **Checked by** ASC/WFL 21/06/2017	**BOREHOLE No** ML025-RC048 **Coordinates** 506935.59 E **(National Grid)** 188350.64 N **Ground Level** 54.76 m OD	

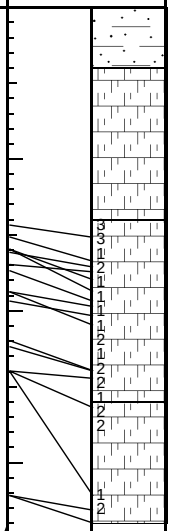
Discon. Ref	Depth (m)	Type	Dip ° (Deg)	Aperture (mm)	Infill	Roughness: Inter-mediate	Roughness: Small	Description	Legend m OD

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 **Crew/Vessel** CJ/ZI **Dates Drilled** Start 11/01/2017 End 12/01/2017	**Borehole Diameter** 146mm to 21.70m **Casing Diameter** 175mm to 2.20m **Logged by** CJ/AU 11/01/2017 **Compiled by** jm 02/03/2017 **Checked by** ASC/WFL 21/06/2017	**BOREHOLE No** ML025-RC048 **Coordinates** 506935.59 E **(National Grid)** 188350.64 N **Ground Level** 54.76 m OD	

Discon. Ref	Depth (m)	Type	Dip ° (Deg)	Aperture (mm)	Infill	Roughness: Inter-mediate	Roughness: Small	Description	Legend
	20.20							20.20 m - Top of rock.	
3	20.72-20.76	J	45	MW	<5mm	Pl	Sm	With sand infill.	
3	20.76-20.84	J	60	VT		Pl	Ro	Planar to undulating. With brown staining.	
1	20.80	B	20	MW	<5mm	Pl	Sm	With sand infill.	
2	20.80-20.94	J	80	VT		Pl	Sm	With brown staining.	
1	20.81	B	10	MW	6mm	Pl	Sm	Planar to undulating. With sand infill.	
1	20.85	B	5	O	<1mm	Pl	Sm	With sand infill.	
1	20.87	B	20	MW	<6mm	Pl	Sm	With sand infill.	
1	20.94	B	10	O	<2mm	Pl	Sm	With brown and grey silt infill.	
2	20.94-21.05	J	80	VT		Pl	Sm	With brown staining.	
1	20.97	B	10	MW	<10mm	Pl	Sm	With brown sand infill.	
2	21.10-21.20	J	80	MW	<5mm	Pl	Sm	With brownish grey sand infill.	
2	21.12-21.20	J	80	VT		Pl	Sm	With brown staining.	
1	21.20	B	5	MW	<6mm	Pl	Sm	With soft grey silt infill.	
2	21.20-21.32	J	80	MW	<4mm	Pl	Sm	With brown sand infill.	
2	21.20-21.61	J	80	VT		Pl	Sm	With brown and grey staining.	
1	21.61	B	10	O	<1mm	Pl	Sm	With grey silt infill.	
2	21.61-21.70	J	80	VT		Pl	Sm	With brown and grey staining.	
								End of Borehole	



Remarks
(See notes & keysheets)

Scale 1:25

13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U **Figure No.** ML025-RC048 (5 of 5)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 21.50m	**Casing Diameter** 175mm to 2.70m	**BOREHOLE No.ML025-RC049**
Equipment Hanjin DB 10			**Coordinates** 506885.88 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188198.58 N
Crew/Vessel CJ/ZI	**Logged by** CJ/MCM	**Compiled by** jw	**Checked by** ASC/WFL
Dates Drilled Start 17/01/2017	18/01/2017	09/02/2017	21/06/2017
End 18/01/2017			**Ground Level** 51.23 m OD

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
17/01			0.20		B	1				TOPSOIL: Very soft brown slightly sandy slightly gravelly clay. Sand is fine to coarse, gravel is subangular to rounded fine to coarse flint.	(0.30)		
			0.20		D	2				[TOPSOIL - LONDON CLAY C]	0.30	50.93	
			0.00-1.20		PIT					Soft light brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine and medium flint. [- LONDON CLAY C]			
			0.60		B	3							
			0.60		D	4					(0.90)		
			1.00		B	5							
			1.00		D	6							
											1.20	50.03	
										Soft to firm laminated orangish brown mottled with grey slightly gravelly CLAY. Gravel is angular to subrounded fine and medium flint. Thin laminae, orangish brown and light grey, 0-10 degs. [- LONDON CLAY C]	(0.45)		
											1.65	49.58	
			1.80-2.10		C	7				Stiff to very stiff fissured dark brown mottled bluish grey silty CLAY. Occasional subrounded to rounded nodules (<50 x 35mm) and frequent fine sand partings. Frequent shell fragments. Locally with black organic staining and decomposed roots (<4mm). Fissures (SET 1) are 0-20 degs, spacing not determined, planar, rough, (very tight), with bluish grey staining (gleying). Fissures (SET 2) are 70-90 degs, spacing not determined, undulating, rough, (very tight), with bluish grey staining (gleying) or silt veneer. [- LONDON CLAY C] Below 2.10m; becoming indistinctly laminated. At 2.56m; pocket (<60 x 50mm) of orangish brown clayey silt.			
		(100)	1.20-2.70		100						(1.05)		
			2.26-2.56		C	8							
											2.70	48.53	
		(100)	2.70-3.50		100					Stiff brown locally grey clayey SILT with pockets (<45 x 3mm) of grey clayey silt and occasional shell fragments. To 2.85m; firm to stiff orangish brown slightly gravelly clay. Gravel is subangular to rounded, fine to coarse of flint. Below 3.35m; sandy silt partings, 0-20 degs, extremely closely spaced, planar and undulating.	(1.05)		
											3.75	47.48	
		(100)	3.50-5.00		100					Stiff to very stiff fissured yellowish brown mottled greenish grey slightly sandy CLAY with occasional calcrete nodules (<4 x 2mm) and frequent black organic staining. Locally with lenses (<70 x 20mm) of clayey silt. Fissures (SET 2) are 70-90 degs, extremely closely spaced, undulating, smooth to rough, (very tight), locally polished, mottled yellowish brown or greenish grey or with silt veneer. Fissures (SET 3) are 30-60 degs, extremely closely to closely spaced, planar, smooth, (very tight), occasionally polished with slickensides, mottled yellowish brown or greenish grey or with silt veneer. [- LONDON CLAY C]	(1.05)		
			4.50-4.76		C	9							
											4.80	46.43	
										Very stiff friable fissured yellowish brown to orangish brown mottled purplish red and greenish grey silty CLAY. Locally			

Remarks (See notes & keysheets)

1. Initially a PAS128 survey was undertaken. Prior to boring, a Cable Avoidance Tool (CAT) survey was performed to check for services. A service pit was hand-dug to 1.20m and rescanned using a CAT. Services were not located.
2. Groundwater not encountered during drilling due to use of fluid flush.
3. See separate sheet for installation.

Scale 1:25

TUGRO 14/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U
		Figure No. ML025-RC049 (1 of 6)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 21.50m	**Casing Diameter** 175mm to 2.70m	**BOREHOLE No.ML025-RC049**
Equipment Hanjin DB 10			**Coordinates** 506885.88 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188198.58 N
Crew/Vessel CJ/ZI	**Logged by** CJ/MCM	**Compiled by** jw	**Checked by** ASC/WFL
Dates Drilled Start 17/01/2017	18/01/2017	09/02/2017	21/06/2017
End 18/01/2017			**Ground Level** 51.23 m OD

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
										with occasional burrows. Sand is fine to coarse. Fissures (SET 1) are 0-30 degs, extremely closely to very closely spaced, planar to undulating, smooth, (very tight), occasionally polished with slickensides, mottled greenish grey or yellowish brown or silt veneer. Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely to very closely spaced, undulating, smooth, (very tight), occasionally polished with slickensides, mottled greenish grey, yellowish brown or purplish red or silt veneer locally with calcrete veneer. Fissures (SET 3) are 30-60 degs, very closely to closely spaced, planar, smooth, (very tight), polished occasionally with slickensides, mottled yellowish brown greenish grey or purplish red or silt veneer. [- LONDON CLAY C] 5.00m to 5.10m; soft to firm (possibly DI). 5.95m to 6.05m; with frequent subrounded and rounded calcrete nodules (<40mm x 30mm). 6.35m to 6.50m; assumed zone of core loss.	(2.65)		
			5.40-5.70	C	10								
		(100)	5.00-6.50	90									
		(100)	6.50-8.00	100						7.30m to 7.40m; with frequent subrounded and rounded calcrete nodules (<40mm x 30mm).	7.45	43.78	
			7.50-7.80	C	11					Interbedded stiff to very stiff indistinctly fissured locally fissured brown mottled greenish grey slightly sandy CLAY with greenish grey silty sand with frequent pockets (<70 x 30mm) of greenish grey sandy silt. Sand is mainly fine. Fissures (SET 2) are 70-90 degs, spacing not determined, undulating, rough, (very tight), with greenish grey silt veneer. [- LONDON CLAY C] 8.00m to 8.20m; fissured (set 2). 8.20m to 8.75m; indistinctly laminated greenish grey fine and medium sand.	(1.65)		
		(100)	8.00-9.50	100						8.75m to 9.10m; fissured (set 2).			
			9.00-9.30	C	12						9.10	42.13	
									NA	Very stiff fissured dark brown mottled bluish grey yellowish brown and purplish red CLAY with burrows. Fissures (SET 1) are 0-30 degs, extremely closely to very closely spaced, planar, smooth, (very tight), with bluish grey silt veneer. Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely spaced, planar to undulating, (very tight), occasionally polished, mainly with bluish grey silt veneer. Fissures (SET 3) are 30-60 degs, spacing not determined, planar, smooth, (very tight), polished with slickensides. [- LONDON CLAY C]	(0.70)		
											9.80	41.43	

Remarks
(See notes & keysheets)

Scale 1:25

14/12/2017

Project
WEST RUISLIP
HIGH SPEED TWO (HS2) LIMITED

Contract No. G160015U

Figure No. ML025-RC049 (2 of 6)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 21.50m	**Casing Diameter** 175mm to 2.70m	**BOREHOLE No.ML025-RC049**
Equipment Hanjin DB 10			**Coordinates** 506885.88 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188198.58 N
Crew/Vessel CJ/ZI	**Logged by** CJ/MCM	**Compiled by** jw	**Checked by** ASC/WFL
Dates Drilled Start 17/01/2017			**Ground Level** 51.23 m OD
End 18/01/2017	18/01/2017	09/02/2017	21/06/2017

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
										9.50m to 9.70m; firm to stiff (possibly DI).			
		(100)	9.50	11.00	100					Very stiff fissured dark brown to yellowish brown mottled greenish grey yellowish green silty CLAY with occasional calcrete nodules (<40 x 25mm) and burrows. Fissures (SET 1) are 0-30 degs, extremely closely to very closely spaced, planar locally undulating, smooth, (very tight), locally polished with slickensides, mottled greenish grey or silt veneer. Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely spaced, planar to undulating, smooth, (very tight), occasional polishing, rare slickensides, with greenish grey or yellowish green silt veneer locally with calcrete veneer. [- LONDON CLAY C] Below 10.50m; clay.	(1.20)		
			10.50	10.80	C	13							
											11.00	40.23	
		(100)	11.00	12.50	100					Thinly interlaminated to medium interbedded indistinctly fissured locally fissured very stiff brown mottled yellowish brown and greenish grey slightly sandy CLAY, reddish brown to light brown slightly silty to silty SAND and reddish brown clayey SILT. Sand is fine and medium. Thin laminae of silty clay and clayey silt, 0 degs, extremely closely spaced, planar, with rare calcrete nodules. Fissures (SET 2) are 80-90 degs, spacing not determined, planar, smooth, (very tight), with yellowish brown staining. 11.00m to 11.95m; fissured (set 2). 11.95m to 12.40m; silty to very silty sand.			
17/01	2.70	GL											
18/01	2.70	2.15								12.65m to 12.70m; weakly cemented silty clay. 12.70m to 13.10m; silty to very silty sand.			
										13.10m to 13.25m; clayey silt pockets.			
		(100)	12.50	14.00	100						(4.50)		
			13.25	13.55	C	14							
			13.40		EW	1							
										13.65m to 14.00m; clay with indistinct partings of silt, 0 degs, extremely closely spaced, planar.			
										14.00m to 14.15m; clayey silt.			
										14.15m to 14.30m; silty sand with pockets (<20 x 6mm) of clay. 14.30m to 14.70m; slightly silty sand.			
		(100)	14.00	15.50	90					14.70m to 15.05m; thinly laminated clayey silt, 0 degs.			

Remarks
(See notes & keysheets)

Scale 1:25

TUGRO 14/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U
		Figure No. ML025-RC049 (3 of 6)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 21.50m	**Casing Diameter** 175mm to 2.70m	**BOREHOLE No.ML025-RC049**
Equipment Hanjin DB 10			**Coordinates** 506885.88 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188198.58 N
Crew/Vessel CJ/ZI	**Logged by** CJ/MCM	**Compiled by** jw	**Checked by** ASC/WFL
Dates Drilled Start 17/01/2017			**Ground Level** 51.23 m OD
End 18/01/2017	18/01/2017	09/02/2017	21/06/2017

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
										15.05m to base; clay with partings of silt, 0 degs, extremely closely spaced, planar. 15.35m to 15.50m; assumed zone of core loss. Approximate boundary			
											15.50	35.73	
			15.60	15.90	C	15				Very stiff fissured reddish brown mottled greenish grey locally purplish red slightly sandy CLAY locally silty. Occasional calcrete nodules (<12 x 6mm). Fissures (SET 1) are 0-30 degs, very closely to closely spaced, planar, smooth, (very tight), with bluish grey	(0.95)		
			16.00		EW	1							
			16.00		EW	3							
			16.15	16.45	C	16							
		(100)	15.50	17.00	90					silt veneer. Sand is fine. Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely to very closely spaced, undulating, smooth to rough, (very tight) with bluish green silt veneer and occasional yellowish brown staining. [- LONDON CLAY C]			
											16.45	34.78	
										Very stiff fissured dark brown mottled bluish grey and orangish brown slightly sandy CLAY. Fissures (SET 1) are 0-30 degs, very closely to closely spaced, planar, smooth, (very tight), occasionally polished with slickensides and locally greenish grey silt veneer.	(0.55)		
			16.70		EW	2							
											17.00	34.23	
			17.00		EW	5				Fissures (SET 2) are 70-90 degs, spacing not determined, planar to undulating, rough to smooth, (very tight), with orangish brown staining or greenish grey silt veneer. [- LONDON CLAY C] 16.85m to 17.00m; assumed zone of core loss. Approximate boundary			
											(0.90)		
										Thinly interbedded to medium interbedded very stiff fissured greenish brown mottled greenish grey or bluish grey CLAY and very stiff indistinctly fissured greenish brown mottled greenish grey sandy CLAY possibly glauconitic.			
		(100)	17.00	18.50	100								
			18.00		EW	4				Occasional pockets (<60 x 30mm) of sand. Occasional subrounded and rounded calcrete nodules (<15 x 10mm). Occasional rootlets (<1mm). Fissures (SET 1) are 0-30 degs, very closely spaced, planar, smooth, (very tight), occasionally polished with slickensides, mottled bluish grey or greenish grey or silt veneer. Fissures (SET 2) are 70-90 degs, spacing not determined possibly extremely closely to very closely spaced, undulating, rough, (very tight), with calcrete veneer yellowish brown staining or greenish grey veneer. [- LONDON CLAY C] 17.30m to 17.75m; indistinctly fissured sandy clay with sand pockets. 17.80m to 17.90m; occasional angular fragments (<20mm) of lignite.	17.90	33.33	
											(0.80)		
											18.70	32.53	
											(0.65)		
		(100)	18.50	20.00	100	20	17			Dark brown slightly gravelly clayey SAND. Gravel is subangular and subrounded fine to coarse gravel of red flint.	19.35	31.88	
									NI	Below 18.50m; becoming stiff sandy clay.	(0.10)		
									>50		19.45	31.78	
									NI	Very stiff fissured greenish mottled greenish grey and yellowish brown mottled orange slightly gravelly sandy CLAY possibly glauconitic. Below 19.00m gravel is angular and subangular coarse black flint. Fissures (SET 2) are indistinct 70-90 degs, spacing not determined, undulating, rough, (very tight), clean. [- LONDON CLAY C]			
			19.80	20.00	C	17							

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 21.50m	**Casing Diameter** 175mm to 2.70m	**BOREHOLE No.** ML025-RC049
Equipment Hanjin DB 10			**Coordinates** 506885.88 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188198.58 N
Crew/Vessel CJ/ZI	**Logged by** CJ/MCM	**Compiled by** jw	**Checked by** ASC/WFL
Dates Drilled Start 17/01/2017	18/01/2017	09/02/2017	21/06/2017
End 18/01/2017			**Ground Level** 51.23 m OD

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type	No. TCR %	SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
											Very weak low density white CHALK with occasional orange staining. Non Intact. [CIRIA Grade: not determined].			
			20.45-20.75		C	18				40	Very weak locally high density becoming low density white CHALK locally stained orangish brown. Occasional thin beds of nodular flint. Fractures (SET 1) are 0-10 degs, possibly very closely to medium spaced, planar, smooth, (very tight to partly open), with orangish brown staining and locally comminuted chalk veneer. Fractures (SET 2) are 70-90 degs, spacing not determined, planar occasionally undulating, smooth, (very tight), clean, locally with orangish brown staining. [CIRIA Grade: possibly B3].	(2.05)		
		(100)	20.00-21.50		100	70		67						
18/01	2.70	4.90								NI	19.50m to 19.68m; Non Intact chalk. 20.25m to 20.30m; flint nodular (<50 x 25mm) with greyish white cortex (<2mm). At 20.40m; flint nodular (<30 x 20mm) with greyish brown cortex (<5mm). At 20.50m; flint nodular (<30 x 20mm) with greyish white cortex (<2mm). 21.15m to 21.50m; Non Intact chalk with orangish brown staining. 21.20m to 21.50m; closely spaced very thin beds of thinly laminated orangish brown and white chalk, horizontal, planar.	21.50	29.73	
											End of Borehole			

Remarks
(See notes & keysheets)

Scale 1:25

14/12/2017

Project
WEST RUISLIP
HIGH SPEED TWO (HS2) LIMITED

Contract No. G160015U

Figure No. ML025-RC049 (5 of 6)

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 Polymer DS60/Pure-Bore **Crew/Vessel** CJ/ZI **Dates Drilled** Start 17/01/2017 End 18/01/2017	**Borehole Diameter** 146mm to 21.50m **Casing Diameter** **Logged by** CJ/MCM 18/01/2017 **Compiled by** jw 09/02/2017 **Checked by** ASC/WFL 21/06/2017	**BOREHOLE No** ML025-RC049 **Coordinates** 506885.88 E (National Grid) 188198.58 N **Ground Level** 51.23 m OD	

Installation Details	Installation Depth (m)	Level m OD	Water Strikes	Strata Depth (m)	Strata Details
Instrumentation: 50mm slotted section (SL) from 14.00 to 19.00m				0.30	TOPSOIL
Concrete	0.50	50.73			
Bentonite				1.65	CLAY
				2.70	Silty CLAY
				3.75	Clayey SILT
				4.80	CLAY
				7.45	Silty CLAY
				9.80	CLAY
				11.00	Silty CLAY
	14.00	37.23		15.50	Sandy CLAY
Flush cover Gravel backfill SL=14.00-19.00m				17.00	CLAY
				17.90	Sandy CLAY
				18.70	Clayey SAND
	19.00	32.23		19.35	Sandy CLAY
Bentonite				21.50	CHALK
	21.50	29.73		21.50	Base of Hole

Remarks
(See notes & keysheets)

▽ Water Strike
▼ Water Rise

Not to Scale

DEFRA cover.
Pipe diameter 50mm to 19.00m, installed on 19/01/2017.

14/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U **Figure No.** ML025-RC049 (6 of 6)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 31.00m	**Casing Diameter** 175mm to 2.60m	**BOREHOLE No.ML025-RC051**
Equipment Hanjin DB 10			**Coordinates** 507179.59 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188653.51 N
Crew/Vessel CJ/ZI	**Logged by** CJ/GDF	**Compiled by** jm	**Checked by** NJB	**Ground Level** 59.98 m OD
Dates Drilled Start 04/01/2017 End 06/01/2017	04/01/2017	10/01/2017	11/12/2017	

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type	No. TCR %	SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
04/01			0.10		B	1					TOPSOIL: Grass over (soft) brown slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint. [TOPSOIL - CLAY]	(0.40)		
			0.10		D	2						0.40	59.58	
			0.00-1.20		PIT						Soft light brown mottled grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse, gravel is subangular and subrounded fine to coarse flint. Sand is fine and medium. [SUPERFICIAL DEPOSITS - COHESIVE - CLAY]	(0.80)		
			0.60		B	3								
			0.60		D	4								
			1.10		B	5						1.20	58.78	
			1.10		D	6								
		(100)	1.20-2.00		31						Soft light yellowish brown locally mottled light grey slightly gravelly CLAY locally gravelly. Gravel is subrounded and rounded fine and medium dark grey, white and yellowish brown flint. [SUPERFICIAL DEPOSITS - COHESIVE - CLAY]	(0.25)		
												1.45	58.53	
											Assumed zone of core loss. [- NO CORE RECOVERY]	(0.55)		
												2.00	57.98	
		(100)	2.00-2.75		100						Soft light yellowish brown locally mottled light grey slightly gravelly CLAY locally gravelly. Gravel is subrounded and rounded fine and medium dark grey, white and yellowish brown flint. [SUPERFICIAL DEPOSITS - COHESIVE - CLAY]	(0.10)		
			2.35-2.65		C	7						2.10	57.88	
		(100)	2.75-3.50		60						Firm locally indistinctly fissured brown mottled yellowish brown and locally grey bluish grey (gleyed) slightly sandy CLAY with occasional subangular and subrounded claystones and rare clay lithorelicts. Sand is mainly fine. Locally rare burrows (<10 x 4mm). Occasional pockets (<5 x 5mm) of black lignite. Rare to occasional rootlets (<10 x 3mm). [LONDON CLAY FORMATION A2 - CLAY] 3.20m to 3.50m; assumed zone of core loss.	(1.90)		
		(100)	3.50-4.00		100									
			3.76-4.00		C	8						4.00	55.98	
		(100)	4.00-5.00		100						Stiff locally firm indistinctly laminated/bedded dark brown mottled bluish grey (gleyed) and dark yellowish brown slightly sandy silty CLAY. Rare to occasional dark grey to black and yellowish brown fragments (<85 x 10mm) of possible lignite and rare roots (<2mm). Thick laminae of slightly sandy silt, 0-5 degs, extremely closely to closely spaced, yellowish brown. [LONDON CLAY FORMATION A2 - CLAY] 4.70m to 5.00m soft to firm (possibly DI).			

Remarks (See notes & keysheets)
1. Initially a PAS128 survey was undertaken. Prior to boring, a Cable Avoidance Tool (CAT) survey was performed to check for services. A service pit was hand-dug to 1.20m and rescanned using a CAT. Services were not located.
2. See separate sheet for installation.
3. Groundwater not encountered during drilling due to use of fluid flush.

Scale 1:25

13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U
		Figure No. ML025-RC051 (1 of 8)

Drilling Method	Rotary Cored	Borehole Diameter	Casing Diameter	**BOREHOLE No.ML025-RC051**	
Equipment	Hanjin DB 10	146mm to 31.00m	175mm to 2.60m	Coordinates	507179.59 E
Drill Fluid	Polymer DS60/Pure-Bore			(National Grid)	188653.51 N
Crew/Vessel	CJ/ZI	Logged by	Compiled by	Checked by	Ground Level 59.98 m OD
Dates Drilled	Start 04/01/2017	CJ/GDF	jm	NJB	
	End 06/01/2017	04/01/2017	10/01/2017	11/12/2017	

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
		(50)	5.00-5.50		100					Stiff locally firm silty CLAY as previous sheet.	(2.50)		
			5.30-5.50		C	9							
		(50)	5.50-6.50		100								
											6.50	53.48	
		(50)	6.50-8.00		100					Stiff fissured locally indistinctly laminated/bedded dark brown mottled dark yellowish brown silty CLAY with occasional to frequent locally abundant crystals (<4mm) of gypsum and occasional black specks. Partings to thin laminae of yellowish brown silt, 0-10 degs, very closely to medium spaced. Fissures (SET 2) are 80-90 degs, spacing not determined possibly locally closely spaced, planar, rough, (very tight to tight), with yellowish brown veneer. Fissures (SET 3) are 20-30 degs and 40-45 degs, very closely to closely spaced, planar, rough, (very tight to tight), polished, locally with yellowish brown veneer. [LONDON CLAY FORMATION A2 - CLAY]	(1.05)		
			7.30-7.50		C	10							
											7.55	52.43	
			8.45-8.75		C	11				Stiff locally very stiff locally indistinctly fissured indistinctly laminated/bedded black brownish grey and dark grey slightly sandy CLAY with occasional to frequent pockets (<50 x 40mm) and lenses (<70 x 25mm) of grey and light grey sandy silt and silt. Sand is mainly fine. Rare pyrite nodules (<10 x 10mm) and occasional fragments (<10 x 5mm) of lignite. Occasional white shell fragments (<25mm). Thin laminae of light grey silt and brown sandy silt, 0-10 degs, possibly extremely closely to very closely spaced. Fissure sets not determined, randomly orientated, spacing not determined, planar, smooth. [LONDON CLAY FORMATION A2 - CLAY]	(1.95)		
		(50)	8.00-9.50		100					8.00m to 8.20m; soft (possibly DI). At 8.45m; slightly sandy. 9.20m to 9.50m; slightly sandy.			
											9.50	50.48	
										Stiff to very stiff dark grey silty CLAY locally gravelly. Rare nodules (<20 x 10mm) of lignite or pyrite. Occasional to frequent shell fragments (<20 x 5mm) and foraminifera. Gravel is black, rounded to subangular medium to coarse locally (<3 x 3mm). [HARWICH FORMATION - CLAY]			

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 31.00m	**Casing Diameter** 175mm to 2.60m	**BOREHOLE No.ML025-RC051**
Equipment Hanjin DB 10			**Coordinates** 507179.59 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188653.51 N
Crew/Vessel CJ/ZI	**Logged by** CJ/GDF	**Compiled by** jm	**Checked by** NJB	**Ground Level** 59.98 m OD
Dates Drilled Start 04/01/2017 End 06/01/2017	04/01/2017	10/01/2017	11/12/2017	

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type	No.	TCR %	SCR %	RQD %	SPT Blows /N	Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
		(100)	9.50-11.00		100								A 9.80m; rounded medium and coarse gravel of black flint.			
			10.25-10.55		C	12							At 10.25m; pyrite nodule.	(1.50)		
													10.80m to 11.00m; slightly sandy silty clay.			
04/01	2.60	GL												11.00	48.98	
05/01	2.60	1.70											Stiff locally friable dark grey sandy CLAY, locally gravelly. Sand is fine to coarse. Rare to occasional fragments (<10 x 5mm) of lignite. Frequent shell fragments (<30 x 20 x 2mm). Gravel is black rounded fine and medium of possible flint. [HARWICH FORMATION - CLAY]	(0.70)		
			11.32-11.56		C	13										
		(100)	11.00-12.50		93								Stiff to very stiff indistinctly fissured locally fissured light bluish grey mottled dark yellowish brown and white silty CLAY with frequent calcrete nodules (<30 x 20mm). Locally with calcareous enriched beds (<300mm). Fissure sets not determined, randomly orientated, spacing not determined, planar, smooth and rough. [LOWER MOTTLED CLAY - CLAY]	11.70	48.28	
														(1.55)		
		(100)	12.50-14.00		100									13.25	46.73	
			13.25-13.55		C	14							Very stiff fissured bluish grey mottled dark yellowish brown dark purplish red and locally white slightly sandy CLAY with rare to occasional calcrete nodules (<50 x 50mm) and locally with ferricrete. Sand is mainly fine. Fissures (SET 2) are 60-90 degs, spacing not determined, planar to undulating, smooth and striated, (very tight), polished, clean locally stained dark purplish red. Fissures (SET 3) are 20-30 degs and 40-50 degs, very closely to widely spaced, planar and undulating, smooth, (very tight), polished with occasional slickensides, clean locally stained dark purplish red. [LOWER MOTTLED CLAY - CLAY]			
			14.30-14.60		C	15						NA				
		(100)	14.00-15.50		100											

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 31.00m	**Casing Diameter** 175mm to 2.60m	**BOREHOLE No.ML025-RC051**
Equipment Hanjin DB 10			**Coordinates** 507179.59 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188653.51 N
Crew/Vessel CJ/ZI	**Logged by** CJ/GDF	**Compiled by** jm	**Ground Level** 59.98 m OD
Dates Drilled Start 04/01/2017	04/01/2017	10/01/2017	**Checked by** NJB 11/12/2017
End 06/01/2017			

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
										Very stiff CLAY as previous sheet.	(3.75)		
		(100)	15.50	17.00	100								
			16.80	17.00	C	16					17.00	42.98	
			17.30	17.60	C	17				Very stiff indistinctly fissured dark brown mottled bluish grey and dark yellowish brown slightly sandy CLAY locally with rare fragments (<40 x 10mm) of lignite. Sand is fine and medium. Fissure sets not determined, randomly orientated, spacing not determined, planar and undulating, rough and smooth. [LOWER MOTTLED CLAY - CLAY]			
		(100)	17.00	18.50	100						(2.25)		
		(100)	18.50	20.00	93						19.25	40.73	
										Locally laminated/bedded dark brown dark purplish red dark greyish green mottled dark yellowish brown silty SAND. Sand is fine and medium slightly glauconitic to glauconitic. Thin to thick laminae of dark yellowish brown and dark purplish red silty fine and medium sand, 0-5 degs, closely to medium spaced. [ANY SAND UNIT (E.G. CHANNEL SANDS) - SAND]			

Remarks
(See notes & keysheets)

Scale 1:25

TUGRO 13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U
		Figure No. ML025-RC051 (4 of 8)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 31.00m	**Casing Diameter** 175mm to 2.60m	**BOREHOLE No.ML025-RC051**
Equipment Hanjin DB 10			**Coordinates** 507179.59 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188653.51 N
Crew/Vessel CJ/ZI	**Logged by** CJ/GDF	**Compiled by** jm	**Checked by** NJB
Dates Drilled Start 04/01/2017	04/01/2017	10/01/2017	11/12/2017
End 06/01/2017			**Ground Level** 59.98 m OD

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery: Depth (m) From	To	Type	TCR %	No.	SCR %	RQD %	SPT Blows /N	Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
			19.96		EW		1						Mottled silty SAND as previous sheet.			
		(100)	20.00-20.75		80								20.60m to 20.75m; assumed zone of core loss.			
			21.00		EW		1									
		(100)	20.75-21.50		87								21.40m to 21.50m; assumed zone of core loss.			
		(100)	21.50-22.25		93									(5.10)		
			22.00		EW		3									
		(100)	22.25-23.00		67								22.75m to 23.00m; assumed zone of core loss.			
													23.00m to 23.18m; yellowish brown silty fine sand.			
		(100)	23.00-23.75		80								23.60m to 23.75m; assumed zone of core loss.			
		(100)	23.75-24.50		80											
													Assumed zone of core loss. [- NO CORE RECOVERY]	24.35	35.63	
		(100)	24.50-25.25		0									(0.95)		

Remarks
(See notes & keysheets)

Scale 1:25

TUGRO 13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U
		Figure No. ML025-RC051 (5 of 8)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 31.00m	**Casing Diameter** 175mm to 2.60m	**BOREHOLE No.ML025-RC051**
Equipment Hanjin DB 10			**Coordinates** 507179.59 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188653.51 N
Crew/Vessel CJ/ZI	**Logged by** CJ/GDF	**Compiled by** jm	**Checked by** NJB	**Ground Level** 59.98 m OD
Dates Drilled Start 04/01/2017	04/01/2017	10/01/2017	11/12/2017	
End 06/01/2017				

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
									Assumed zone of core loss as previous sheet.			
									Approximate boundary			
										25.30	34.68	
		(100)	25.25-26.00	91					Dark greenish grey mottled dark brownish yellow SAND. Sand is glauconitic, fine and medium. [UPNOR FORMATION - SAND]	(0.70)		
05/01	2.60	GL								26.00	33.98	
06/01	2.60	3.90							Dark greenish grey silty SAND. Sand is glauconitic, coarse rarely medium. [UPNOR FORMATION - SAND]	(0.25)		
										26.25	33.73	
		(100)	26.00-26.75	33					Assumed zone of core loss. [- NO CORE RECOVERY]			
										(1.20)		
		(100)	26.75-27.25	0								
										27.45	32.53	
		(100)	27.25-27.75	60					Dark greenish grey silty SAND. Sand is glauconitic, coarse rarely medium. [UPNOR FORMATION - SAND]	(0.30)		
			27.50	EW	2					27.75	32.23	
		(100)	27.75-28.25	70					Dark greyish green rarely mottled dark yellowish brown slightly silty SAND locally clayey locally gravelly. Gravel is subangular to rounded fine to coarse mainly flint. Sand is fine rarely medium. [UPNOR FORMATION - SAND] 28.10m to 28.54m; assumed zone of core loss.			
										(1.30)		
		(100)	28.25-28.75	42								
		(100)	28.75-29.00	52					28.75m to 28.88m; frequent subangular to rounded fine to coarse flint gravel. 28.88m to 29.00m; assumed zone of core loss.			
										29.05	30.93	
			29.15-29.35	C	18				(Very stiff) extremely weak to weak cemented grey mottled dark greyish green and light brown SILTSTONE with frequent chalk and flint clasts. Chalk clasts are subangular and subrounded (<20mm). [SEAFORD CHALK - SILTSTONE]			
		(100)	29.00-29.50	100				450		(0.45)		
										29.50	30.48	
		(100)	29.50-30.00	100	100	64		500	Weak locally very weak medium to high density white locally stained yellowish brown and dark greyish green fractured locally brecciated CHALK with occasional flint. Single fracture (SET 1) is 0-10 degs, spacing not determined, planar and undulating, rough, (very tight), clean, incipient. Fractures (SET 2) are 85-90 degs, possibly extremely closely to			

Remarks
(See notes & keysheets)

Scale 1:25

TUGRO 13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U
		Figure No. ML025-RC051 (6 of 8)

Drilling Method Rotary Cored	**Borehole Diameter** 146mm to 31.00m	**Casing Diameter** 175mm to 2.60m	**BOREHOLE No.ML025-RC051**
Equipment Hanjin DB 10			**Coordinates** 507179.59 E
Drill Fluid Polymer DS60/Pure-Bore			(National Grid) 188653.51 N
Crew/Vessel CJ/ZI	**Logged by** CJ/GDF	**Compiled by** jm	**Checked by** NJB
Dates Drilled Start 04/01/2017	04/01/2017	10/01/2017	11/12/2017
End 06/01/2017			**Ground Level** 59.98 m OD

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)	Fracture Spacing mm (Min,Avg,Max) or Result	Description of Strata	Depth (Thick-ness) (m)	Level m OD	Legend
		(100)	30.00	30.50	40	40	40		NR	closely spaced, planar and undulating, with yellowish brown locally green and dark grey to black staining. Single fracture (SET 3) is 40-45 degs, spacing not determined, planar and undulating, rough (tight), slight to moderate brown and green staining. (Grade A3) [SEAFORD CHALK - CHALK]	(1.50)		
		(100)	30.50	31.00	100	70	70		700	29.50m to 29.57m; flint nodular (<100 x 70mm). 29.57m to 29.67m; brecciated zone. Intact with natural incipient fractures and frequent yellowish brown staining. 29.67m to 29.77m; flint nodular (<100 x 90 x 70mm).			
06/01	2.60	GL								29.95m to 30.00m; brecciated zone. Intact with natural incipient fractures and with occasional to frequent yellowish brown staining. 30.00m to 30.30m; assumed zone of core loss. 30.30m to 30.40m; Non Intact chalk (DI). 30.50m to 30.60m; brecciated zone. Intact with abundant yellow staining. 30.60m to 30.75m; Non Intact chalk (DI). 30.90m to 30.95m; Non Intact chalk (DI).	31.00	28.98	
										End of Borehole			

Remarks
(See notes & keysheets)

Scale 1:25

13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U
		Figure No. ML025-RC051 (7 of 8)

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 Polymer DS60/Pure-Bore **Crew/Vessel** CJ/ZI **Dates Drilled** Start 04/01/2017 End 06/01/2017	**Borehole Diameter** 146mm to 31.00m **Casing Diameter** **Logged by** CJ/GDF 04/01/2017 **Compiled by** jm 10/01/2017 **Checked by** NJB 11/12/2017	**BOREHOLE No** ML025-RC051 **Coordinates** 507179.59 E **(National Grid)** 188653.51 N **Ground Level** 59.98 m OD

Installation Details	Installation Depth (m)	Level m OD	Water Strikes	Strata Depth (m)	Strata Details
Instrumentation: 50mm slotted section (SL) from 19.00 to 29.00m				0.40	TOPSOIL
Concrete	0.50	59.48			
Bentonite				1.45	CLAY
				2.00	No Recovery
				4.00	CLAY
				7.55	Silty CLAY
				9.50	CLAY
				11.00	Silty CLAY
				11.70	Sandy CLAY
				13.25	Silty CLAY
				19.25	CLAY
	19.00	40.98			
Gravel backfill SL=19.00-29.00m				24.35	Silty SAND
				25.30	No Recovery
				26.00	SAND
				26.25	Silty SAND
				27.45	No Recovery
				27.75	Silty SAND
				29.05	SAND
	29.00	30.98		29.50	SILTSTONE
Bentonite				31.00	CHALK Base of Hole
	31.00	28.98			

Remarks
(See notes & keysheets)

▽ Water Strike
▼ Water Rise

Not to Scale

Flush lockable stopcock box cover.
Pipe diameter 50mm to 29.00m, installed on 09/01/2017.

UGRO 13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U **Figure No.** ML025-RC051 (8 of 8)

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 **Crew/Vessel** CJ/ZI **Dates Drilled** Start 04/01/2017 End 06/01/2017	**Borehole Diameter** 146mm to 31.00m **Casing Diameter** 175mm to 2.60m **Logged by** CJ/GDF 04/01/2017 **Compiled by** jm 10/01/2017 **Checked by** NJB 11/12/2017	**BOREHOLE No** ML025-RC051 **Coordinates** 507179.59 E **(National Grid)** 188653.51 N **Ground Level** 59.98 m OD	

Discon. Ref	Depth (m)	Type	Dip ° (Deg)	Aperture (mm)	Infill	Roughness: Inter-mediate	Roughness: Small	Description	Legend m OD

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 **Crew/Vessel** CJ/ZI **Dates Drilled** Start 04/01/2017 End 06/01/2017	**Borehole Diameter** 146mm to 31.00m **Casing Diameter** 175mm to 2.60m **Logged by** CJ/GDF 04/01/2017 **Compiled by** jm 10/01/2017 **Checked by** NJB 11/12/2017	**BOREHOLE No** ML025-RC051 **Coordinates** 507179.59 E **(National Grid)** 188653.51 N **Ground Level** 59.98 m OD	

Discon. Ref	Depth (m)	Type	Dip ° (Deg)	Aperture (mm)	Infill	Roughness: Inter-mediate	Roughness: Small	Description	Legend m OD

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 **Crew/Vessel** CJ/ZI **Dates Drilled** Start 04/01/2017 End 06/01/2017	**Borehole Diameter** 146mm to 31.00m **Casing Diameter** 175mm to 2.60m **Logged by** CJ/GDF 04/01/2017 **Compiled by** jm 10/01/2017 **Checked by** NJB 11/12/2017	**BOREHOLE No** ML025-RC051 **Coordinates** 507179.59 E **(National Grid)** 188653.51 N **Ground Level** 59.98 m OD	

Discon. Ref	Depth (m)	Type	Dip ° (Deg)	Aperture (mm)	Infill	Roughness: Inter-mediate	Roughness: Small	Description	Legend m OD

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 **Crew/Vessel** CJ/ZI **Dates Drilled** Start 04/01/2017 End 06/01/2017	**Borehole Diameter** 146mm to 31.00m **Casing Diameter** 175mm to 2.60m **Logged by** CJ/GDF 04/01/2017 **Compiled by** jm 10/01/2017 **Checked by** NJB 11/12/2017	**BOREHOLE No** ML025-RC051 **Coordinates** 507179.59 E **(National Grid)** 188653.51 N **Ground Level** 59.98 m OD	

Discon. Ref	Depth (m)	Type	Dip ° (Deg)	Aperture (mm)	Infill	Roughness: Inter-mediate	Roughness: Small	Description	Legend m OD

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 **Crew/Vessel** CJ/ZI **Dates Drilled** Start 04/01/2017 End 06/01/2017	**Borehole Diameter** 146mm to 31.00m **Casing Diameter** 175mm to 2.60m **Logged by** CJ/GDF 04/01/2017 **Compiled by** jm 10/01/2017 **Checked by** NJB 11/12/2017	**BOREHOLE No** ML025-RC051 **Coordinates** 507179.59 E **(National Grid)** 188653.51 N **Ground Level** 59.98 m OD

Discon. Ref	Depth (m)	Type	Dip ° (Deg)	Aperture (mm)	Infill	Roughness: Inter-mediate	Roughness: Small	Description	Legend m OD

Remarks
(See notes & keysheets)

Scale 1:25

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 **Crew/Vessel** CJ/ZI **Dates Drilled** Start 04/01/2017 End 06/01/2017	**Borehole Diameter** 146mm to 31.00m **Casing Diameter** 175mm to 2.60m **Logged by** CJ/GDF 04/01/2017 **Compiled by** jm 10/01/2017 **Checked by** NJB 11/12/2017	**BOREHOLE No** ML025-RC051 **Coordinates** 507179.59 E **(National Grid)** 188653.51 N **Ground Level** 59.98 m OD	

Discon. Ref	Depth (m)	Type	Dip ° (Deg)	Aperture (mm)	Infill	Roughness: Inter-mediate	Roughness: Small	Description	Legend (m OD)
	29.05							29.05 m - Top of rock.	
	29.57-29.63	J	90	VT		Pl	Ro	Planar to undulating. Incipient. With orangish brown staining.	
3	29.83-29.85	J	43	T		Pl	Ro	Planar to undulating. Clean, locally with yellowish brown and green staining.	
2	29.86-30.90	J	90	VT		Pl	Ro	2 No. extremely closely spaced sub-parallel fractures. Planar to Undulating. Clean.	

Remarks
(See notes & keysheets)

Scale 1:25

13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U **Figure No.** ML025-RC051 (6 of 7)

Drilling Method Rotary Cored **Equipment** Hanjin DB 10 **Crew/Vessel** CJ/ZI **Dates Drilled** Start 04/01/2017 End 06/01/2017	**Borehole Diameter** 146mm to 31.00m **Casing Diameter** 175mm to 2.60m **Logged by** CJ/GDF 04/01/2017 **Compiled by** jm 10/01/2017 **Checked by** NJB 11/12/2017	**BOREHOLE No** ML025-RC051 **Coordinates** 507179.59 E **(National Grid)** 188653.51 N **Ground Level** 59.98 m OD	

Discon. Ref	Depth (m)	Type	Dip ° (Deg)	Aperture (mm)	Infill	Roughness: Inter-mediate	Roughness: Small	Description	Legend (m OD)
	29.93 30.00-30.30	B	5	VT		Pl	Ro	Planar to undulating. Incipient. Clean. Assumed zone of core loss.	
2	30.50-30.60	J	90	VT		Pl	Ro	2 No. extremely closely spaced sub-parallel fractures. Planar to undulating. With yellowish brown staining and dark grey to black specks.	
2	30.75-30.90	J	90	VT		Pl	Ro	2 No. intersecting fractures. Planar to undulating. Fracture 1 is clean. Fracture 2 is with yellowish brown and black staining.	
								End of Borehole	

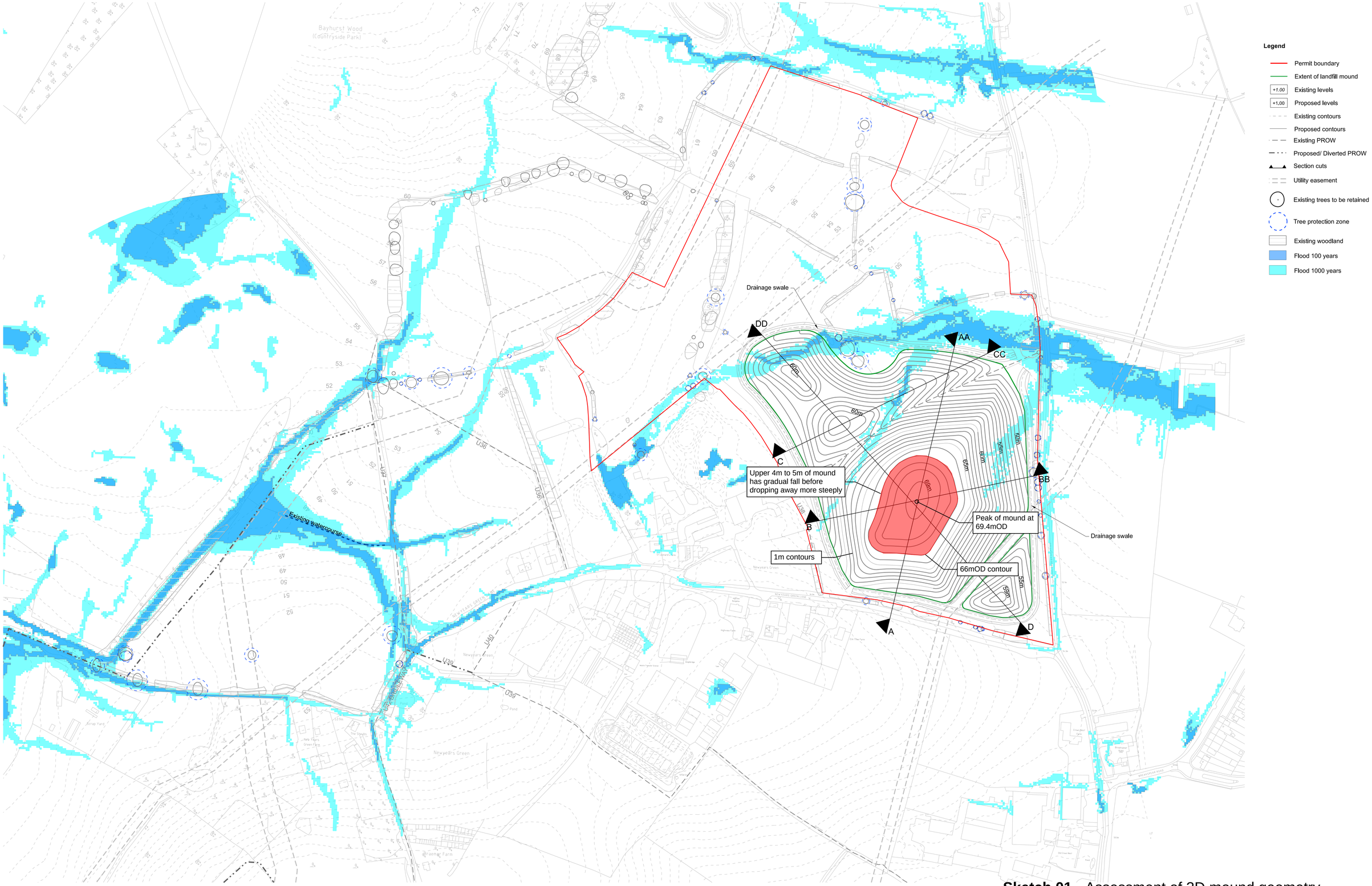
Remarks
(See notes & keysheets)

Scale 1:25

13/12/2017	**Project** WEST RUISLIP HIGH SPEED TWO (HS2) LIMITED	**Contract No.** G160015U **Figure No.** ML025-RC051 (7 of 7)

Appendix B – Slope stability calculations

Appendix B1 – Drained conditions



Sketch - Not to Scale

Sketch 01 - Assessment of 3D mound geometry for slope stability analysis

Rev 1

2020-04-30

ARUP

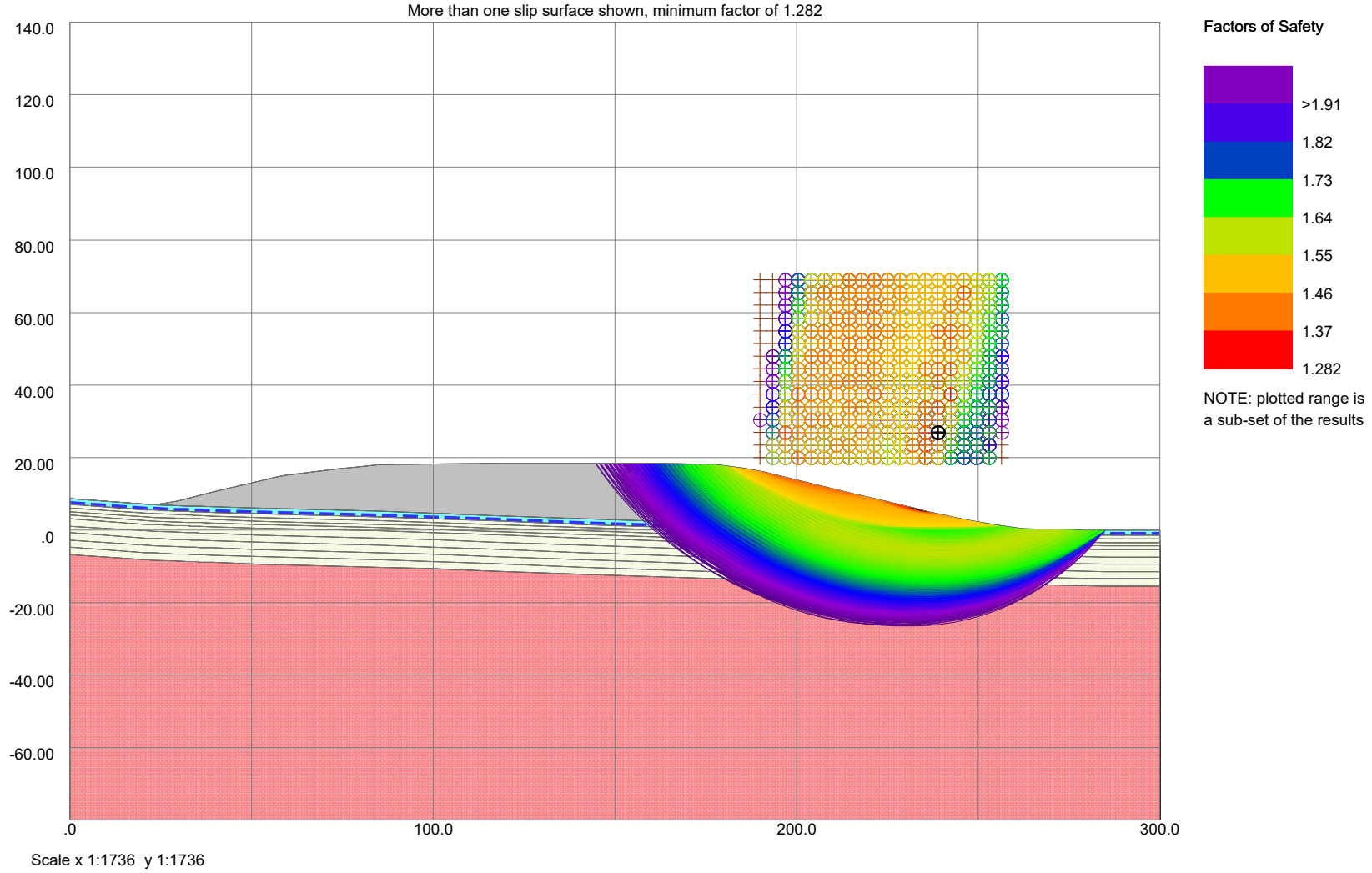
Arup

Northern SPA
Eastern Mound - drained
Section B-BB (west)

Job No.	Sheet No.	Rev.
256906		

Drg. Ref.

Made by	Date	Checked
EB		



General Parameters

Direction of slip: DOWNHILL
Minimum slip weight [kN/m] : 0.00000
Type of analysis : STATIC

Analysis Options

Partial Factor Analysis
Minimum number of slices: 25
Method: Bishop (Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: NOT ACTIVE

Method Partial Factors

Current selection: BS EN 1997-1:2011 DA1-2
Factor on FAVOURABLE PERMANENT LOAD: 1.00000
Factor on UNFAVOURABLE PERMANENT LOAD: 1.00000
Factor on FAVOURABLE VARIABLE LOAD: 0.00000
Factor on UNFAVOURABLE VARIABLE LOAD: 1.30000
Factor on SOIL UNIT WEIGHT: 1.00000
Factor on DRAINED SOIL COHESION: 1.25000
Factor on UNDRAINED SOIL COHESION: 1.40000
Factor on SOIL FRICTION ANGLE: 1.25000
Factor on reinforcement pullout: 1.50000
Economic ramification of failure: 1.00000
Sliding along reinforcement: 1.50000

Material properties

No	Description	Unit Weight Above GWL [kN/m3]	Unit Weight Below GWL [kN/m3]	Shear Strength Parameters Condition	Phi or Phi0 [°]	c or c0' [kN/m²]
1	Waste	19.500	19.500	Drained - linear strength	25.000	0.0
2	Clay Deposits	17.000	17.000	Drained - linear strength	25.000	0.0
3	London Clay 1	19.500	19.500	Drained - linear strength	25.000	0.0
4	London Clay 2	19.500	19.500	Drained - linear strength	25.000	0.0
5	London Clay 3	19.500	19.500	Drained - linear strength	25.000	0.0
6	London Clay 4	19.500	19.500	Drained - linear strength	25.000	0.0
7	London Clay 5	19.500	19.500	Drained - linear strength	25.000	0.0
8	London Clay 6	19.500	19.500	Drained - linear strength	25.000	0.0
9	London Clay 7	19.500	19.500	Drained - linear strength	25.000	0.0
10	London Clay 8	19.500	19.500	Drained - linear strength	25.000	0.0
11	London Clay 9	19.500	19.500	Drained - linear strength	25.000	0.0
12	Harwich	20.000	20.000	Drained - linear strength	25.000	0.0

Coordinates of top of soil strata

The units of the following coordinates are in m

Stratum	X --> 0.0	20.898	23.379	28.828	29.581	32.369	33.335
1	8.6893	7.2080	7.0791	.	8.1157	.	.
2	8.6893	7.2080	7.0791	6.8704	.	6.7401	6.7034
3	7.1893	5.7080	5.5791	5.3704	.	5.2401	5.2034
4	6.1893	4.7080	4.5791	4.3704	.	4.2401	4.2034
5	5.1893	3.7080	3.5791	3.3704	.	3.2401	3.2034
6	4.1893	2.7080	2.5791	2.3704	.	2.2401	2.2034
7	3.1893	1.7080	1.5791	1.3704	.	1.2401	1.2034
8	1.1893	-0.29200	-0.42090	-0.62960	.	-0.75990	-0.79660
9	-0.81070	-2.2920	-2.4209	-2.6296	.	-2.7599	-2.7966
10	-2.8107	-4.2920	-4.4209	-4.6296	.	-4.7599	-4.7966
11	-4.8107	-6.2920	-6.4209	-6.6296	.	-6.7599	-6.7966
12	-6.8107	-8.2920	-8.4209	-8.6296	.	-8.7599	-8.7966
GW Profile 1	7.6893	6.2080	6.0791	5.8704	.	5.7401	5.7034

Stratum	X -->						
	34.766	**35.786**	**39.364**	**40.591**	**47.080**	**51.434**	**52.355**
1	.	.	.	10.836	12.443	.	13.709
2	6.6573	6.6276	6.4857	.	.	6.1039	.
3	5.1573	5.1276	4.9857	.	.	4.6039	.
4	4.1573	4.1276	3.9857	.	.	3.6039	.
5	3.1573	3.1276	2.9857	.	.	2.6039	.
6	2.1573	2.1276	1.9857	.	.	1.6039	.
7	1.1573	1.1276	0.98570	.	.	0.60390	.
8	-0.84270	-0.87240	-1.0143	.	.	-1.3961	.
9	-2.8427	-2.8724	-3.0143	.	.	-3.3961	.
10	-4.8427	-4.8724	-5.0143	.	.	-5.3961	.
11	-6.8427	-6.8724	-7.0143	.	.	-7.3961	.
12	-8.8427	-8.8724	-9.0143	.	.	-9.3961	.
GW Profile 1	5.6573	5.6276	5.4857	.	.	5.1039	.

Stratum	X -->						
	56.933	**59.521**	**66.317**	**73.606**	**78.893**	**85.003**	**85.461**
1	14.621	15.116	16.116	16.989	17.505	.	18.116
2	.	.	.	.	.	5.2282	.
3	.	.	.	.	.	3.7282	.
4	.	.	.	.	.	2.7282	.
5	.	.	.	.	.	1.7282	.
6	.	.	.	.	.	0.72820	.
7	.	.	.	.	.	-0.27180	.
8	.	.	.	.	.	-2.2718	.
9	.	.	.	.	.	-4.2718	.
10	.	.	.	.	.	-6.2718	.
11	.	.	.	.	.	-8.2718	.
12	.	.	.	.	.	-10.272	.
GW Profile 1	.	.	.	.	.	4.2282	.

Stratum	X -->						
	99.536	**115.65**	**118.48**	**121.49**	**127.57**	**132.45**	**141.16**
1	.	.	18.516	18.516	18.516	18.516	.
2	4.7505	4.1518	.	.	.	.	3.2210
3	3.2505	2.6518	.	.	.	.	1.7210
4	2.2505	1.6518	.	.	.	.	0.72100
5	1.2505	0.65180	.	.	.	.	-0.27900
6	0.25050	-0.34820	.	.	.	.	-1.2790
7	-0.74950	-1.3482	.	.	.	.	-2.2790
8	-2.7495	-3.3482	.	.	.	.	-4.2790
9	-4.7495	-5.3482	.	.	.	.	-6.2790
10	-6.7495	-7.3482	.	.	.	.	-8.2790
11	-8.7495	-9.3482	.	.	.	.	-10.279
12	-10.750	-11.348	.	.	.	.	-12.279
GW Profile 1	3.7505	3.1518	.	.	.	.	2.2210

Stratum	X -->						
	144.70	**144.70**	**153.81**	**162.49**	**172.17**	**177.64**	**185.66**
1	18.516	18.516	18.516	18.516	.	18.116	17.116
2	.	.	.	.	2.1856	.	.
3	.	.	.	.	0.68560	.	.
4	.	.	.	.	-0.31440	.	.
5	.	.	.	.	-1.3144	.	.
6	.	.	.	.	-2.3144	.	.
7	.	.	.	.	-3.3144	.	.
8	.	.	.	.	-5.3144	.	.
9	.	.	.	.	-7.3144	.	.
10	.	.	.	.	-9.3144	.	.
11	.	.	.	.	-11.314	.	.
12	.	.	.	.	-13.314	.	.
GW Profile 1	.	.	.	.	1.1856	.	.

Stratum	X -->						
	191.41	**194.77**	**200.18**	**216.26**	**218.03**	**222.93**	**225.17**
1	16.116	15.267	.	9.9809	.	8.3921	7.9546
2	.	.	1.3365	.	0.89880	.	.
3	.	.	-0.16350	.	-0.60120	.	.
4	.	.	-1.1635	.	-1.6012	.	.
5	.	.	-2.1635	.	-2.6012	.	.
6	.	.	-3.1635	.	-3.6012	.	.
7	.	.	-4.1635	.	-4.6012	.	.
8	.	.	-6.1635	.	-6.6012	.	.
9	.	.	-8.1635	.	-8.6012	.	.
10	.	.	-10.163	.	-10.601	.	.
11	.	.	-12.163	.	-12.601	.	.
12	.	.	-14.163	.	-14.601	.	.
GW Profile 1	.	.	0.33650	.	-0.10120	.	.

Stratum	X --> 230.21	232.54	236.31	246.23	248.97	251.04	252.69
1	6.6974	6.1157	5.1157	3.1157	2.5294	2.1157	.
2	.	.	.	.	.	.	0.57650
3	.	.	.	.	.	.	-0.92350
4	.	.	.	.	.	.	-1.9235
5	.	.	.	.	.	.	-2.9235
6	.	.	.	.	.	.	-3.9235
7	.	.	.	.	.	.	-4.9235
8	.	.	.	.	.	.	-6.9235
9	.	.	.	.	.	.	-8.9235
10	.	.	.	.	.	.	-10.924
11	.	.	.	.	.	.	-12.924
12	.	.	.	.	.	.	-14.924
GW Profile 1	.	.	.	.	.	.	-0.42350

Stratum	X --> 255.13	262.54	285.08
1	1.4450	0.45890	0.0
2	.	0.45890	0.0
3	.	-1.0411	-1.5000
4	.	-2.0411	-2.5000
5	.	-3.0411	-3.5000
6	.	-4.0411	-4.5000
7	.	-5.0411	-5.5000
8	.	-7.0411	-7.5000
9	.	-9.0411	-9.5000
10	.	-11.041	-11.500
11	.	-13.041	-13.500
12	.	-15.041	-15.500
GW Profile 1	.	-0.54110	-1.0000

Piezometers

Stratum-linked data

No.	Material	Water table	Piezo Set/ Ru value
1	Waste		- 0.10000
2	Clay Deposits	GW Profile 1	-
3	London Clay 1	GW Profile 1	-
4	London Clay 2	GW Profile 1	-
5	London Clay 3	GW Profile 1	-
6	London Clay 4	GW Profile 1	-
7	London Clay 5	GW Profile 1	-
8	London Clay 6	GW Profile 1	-
9	London Clay 7	GW Profile 1	-
10	London Clay 8	GW Profile 1	-
11	London Clay 9	GW Profile 1	-
12	Harwich	GW Profile 1	-

Slip Surface Specification

Circle centre specification: GRID
Bottom left of grid: x = 190.00000 m y = 20.00000 m
Inclination of grid: 0.00000 deg
(positive anticlockwise direction about bottom left of grid)
Centres on grid: 20 in x direction at 3.50000m spacing
15 in y direction at 3.50000m spacing
Initial radius of circle 5.00000 m
Incremented by 1.00000 m until all possible circles considered

WORST CASE

Centre at (239.00m,27.000m) Radius 22.000m
Iterations: 5 Horiz acceleration [%g]: 0.0
Net vertical force [kN/m]: 302.36E-6 *Slip weight [kN/m] 10.395*
Net horiz force [kN/m]: 0.0011615 Disturbing moment [kN/m]: 57.623
Restoring moment [kNm/m]: 73.846
Reinf.Rest.Moment [kNm/m]: 0.0
Over-Design Factor: 1.2815

The system of interslice and base forces are in equilibrium
when the strengths available at the bases are divided by the computed
over-design factor. The interslice forces shown in the following table
are in equilibrium with the factored strengths of the soil at the bases of slices.

Slip surface coordinates Point	x [m]	y [m]	Pore Pressure L [kN/m²]	R [kN/m²]	Interslice forces [kN/m] T	E	E(u)
1	231.04	6.4886	-	0.0	0.0	0.0	0.0

Slip surface coordinates Pore Pressure Interslice forces [kN/m]

Point	x [m]	z [m]	L	R	T	E	Y(z)
2	231.21	6.4256	0.042926	0.042926	73.613E-6	0.0039770	472.47E-6
3	231.37	6.3640	0.083042	0.083042	0.0023477	0.014684	0.0017682
4	231.54	6.3036	0.12035	0.12035	0.0062488	0.030669	0.0037138
5	231.71	6.2446	0.15483	0.15483	0.011263	0.050561	0.0061471
6	231.87	6.1869	0.18651	0.18651	0.016939	0.073080	0.0089192
7	232.04	6.1306	0.21536	0.21536	0.022881	0.097038	0.011893
8	232.21	6.0756	0.24140	0.24140	0.028747	0.12133	0.014942
9	232.37	6.0219	0.26461	0.26461	0.034248	0.14496	0.017953
10	232.54	5.9695	0.28500	0.28500	0.039150	0.16703	0.020827
11	232.73	5.9134	0.29843	0.29843	0.043837	0.18838	0.022836
12	232.91	5.8590	0.30842	0.30842	0.047313	0.20566	0.024391
13	233.10	5.8062	0.31497	0.31497	0.049504	0.21831	0.025437
14	233.29	5.7550	0.31807	0.31807	0.050389	0.22594	0.025940
15	233.47	5.7055	0.31772	0.31772	0.049995	0.22830	0.025883
16	233.66	5.6576	0.31392	0.31392	0.048397	0.22534	0.025269
17	233.85	5.6114	0.30669	0.30669	0.045709	0.21718	0.024117
18	234.04	5.5668	0.29600	0.29600	0.042078	0.20411	0.022466
19	234.23	5.5240	0.28187	0.28187	0.037683	0.18662	0.020373
20	234.42	5.4827	0.26430	0.26430	0.032725	0.16536	0.017912
21	234.61	5.4432	0.24329	0.24329	0.027423	0.14119	0.015177
22	234.80	5.4053	0.21884	0.21884	0.022011	0.11515	0.012279
23	234.99	5.3691	0.19094	0.19094	0.016725	0.088442	0.0093487
24	235.18	5.3346	0.15962	0.15962	0.011808	0.062500	0.0065330
25	235.37	5.3017	0.12486	0.12486	0.0074924	0.038913	0.0039973
26	235.56	5.2706	0.086666	0.086666	0.0040024	0.019477	0.0019259
27	235.75	5.2411	0.045044	0.045044	0.0015445	0.0061697	520.24E-6
28	235.94	5.2133	0.0	-	302.36E-6	0.0011615	0.0

Slice No.	Strength Parameters c' [kN/m²]	Tan phi	Average Pore Pressure [kN/m²]	Slice Weight [kN/m]	Forces on base [kN/m] Normal	Shear (capacity)	Shear (mobilised)
1	*0.0*	*0.37305*	0.021463	*0.035268*	0.034287	0.011381	0.0088812
2	*0.0*	*0.37305*	0.062984	*0.10381*	0.098854	0.032742	0.025549
3	*0.0*	*0.37305*	0.10170	*0.16812*	0.15974	0.052915	0.041290
4	*0.0*	*0.37305*	0.13759	*0.22811*	0.21685	0.071861	0.056074
5	*0.0*	*0.37305*	0.17067	*0.28373*	0.27007	0.089546	0.069874
6	*0.0*	*0.37305*	0.20094	*0.33499*	0.31940	0.10596	0.082681
7	*0.0*	*0.37305*	0.22838	*0.38176*	0.36465	0.12104	0.094447
8	*0.0*	*0.37305*	0.25300	*0.42400*	0.40576	0.13476	0.10515
9	*0.0*	*0.37305*	0.27480	*0.46171*	0.44270	0.14711	0.11479
10	*0.0*	*0.37305*	0.29171	*0.54131*	0.51984	0.17283	0.13486
11	*0.0*	*0.37305*	0.30343	*0.56448*	0.54327	0.18072	0.14102
12	*0.0*	*0.37305*	0.31169	*0.58138*	0.56073	0.18664	0.14563
13	*0.0*	*0.37305*	0.31652	*0.59183*	0.57199	0.19049	0.14864
14	*0.0*	*0.37305*	0.31789	*0.59580*	0.57702	0.19226	0.15003
15	*0.0*	*0.37305*	0.31582	*0.59327*	0.57572	0.19193	0.14977
16	*0.0*	*0.37305*	0.31030	*0.58419*	0.56801	0.18945	0.14783
17	*0.0*	*0.37305*	0.30134	*0.56852*	0.55383	0.18481	0.14421
18	*0.0*	*0.37305*	0.28894	*0.54621*	0.53309	0.17797	0.13888
19	*0.0*	*0.37305*	0.27309	*0.51729*	0.50579	0.16893	0.13182
20	*0.0*	*0.37305*	0.25380	*0.48168*	0.47180	0.15765	0.12302
21	*0.0*	*0.37305*	0.23106	*0.43927*	0.43102	0.14408	0.11243
22	*0.0*	*0.37305*	0.20489	*0.39021*	0.38355	0.12826	0.10009
23	*0.0*	*0.37305*	0.17528	*0.33435*	0.32923	0.11014	0.085945
24	*0.0*	*0.37305*	0.14224	*0.27176*	0.26809	0.089722	0.070012
25	*0.0*	*0.37305*	0.10576	*0.20235*	0.20005	0.066978	0.052264
26	*0.0*	*0.37305*	0.065855	*0.12618*	0.12512	0.041914	0.032706
27	*0.0*	*0.37305*	0.022522	*0.043208*	0.043274	0.014515	0.011326

Slice No.	Surface Load [kN/m_hor/m] Vert	Horiz	Point Load [kN/m] Vert	Horiz	Water Pressure on ground surface [kN/m_hor/m] Vert	Horiz
1	*0.0*	*0.0*	0.0	0.0	0.0	0.0
2	*0.0*	*0.0*	0.0	0.0	0.0	0.0
3	*0.0*	*0.0*	0.0	0.0	0.0	0.0
4	*0.0*	*0.0*	0.0	0.0	0.0	0.0
5	*0.0*	*0.0*	0.0	0.0	0.0	0.0
6	*0.0*	*0.0*	0.0	0.0	0.0	0.0
7	*0.0*	*0.0*	0.0	0.0	0.0	0.0
8	*0.0*	*0.0*	0.0	0.0	0.0	0.0
9	*0.0*	*0.0*	0.0	0.0	0.0	0.0
10	*0.0*	*0.0*	0.0	0.0	0.0	0.0
11	*0.0*	*0.0*	0.0	0.0	0.0	0.0
12	*0.0*	*0.0*	0.0	0.0	0.0	0.0
13	*0.0*	*0.0*	0.0	0.0	0.0	0.0
14	*0.0*	*0.0*	0.0	0.0	0.0	0.0

Slice No	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]	
15	*0.0*	*0.0*	0.0	0.0	0.0	0.0
16	*0.0*	*0.0*	0.0	0.0	0.0	0.0
17	*0.0*	*0.0*	0.0	0.0	0.0	0.0
18	*0.0*	*0.0*	0.0	0.0	0.0	0.0
19	*0.0*	*0.0*	0.0	0.0	0.0	0.0
20	*0.0*	*0.0*	0.0	0.0	0.0	0.0
21	*0.0*	*0.0*	0.0	0.0	0.0	0.0
22	*0.0*	*0.0*	0.0	0.0	0.0	0.0
23	*0.0*	*0.0*	0.0	0.0	0.0	0.0
24	*0.0*	*0.0*	0.0	0.0	0.0	0.0
25	*0.0*	*0.0*	0.0	0.0	0.0	0.0
26	*0.0*	*0.0*	0.0	0.0	0.0	0.0
27	*0.0*	*0.0*	0.0	0.0	0.0	0.0

Appendix B2 – Undrained conditions

ARUP

Arup

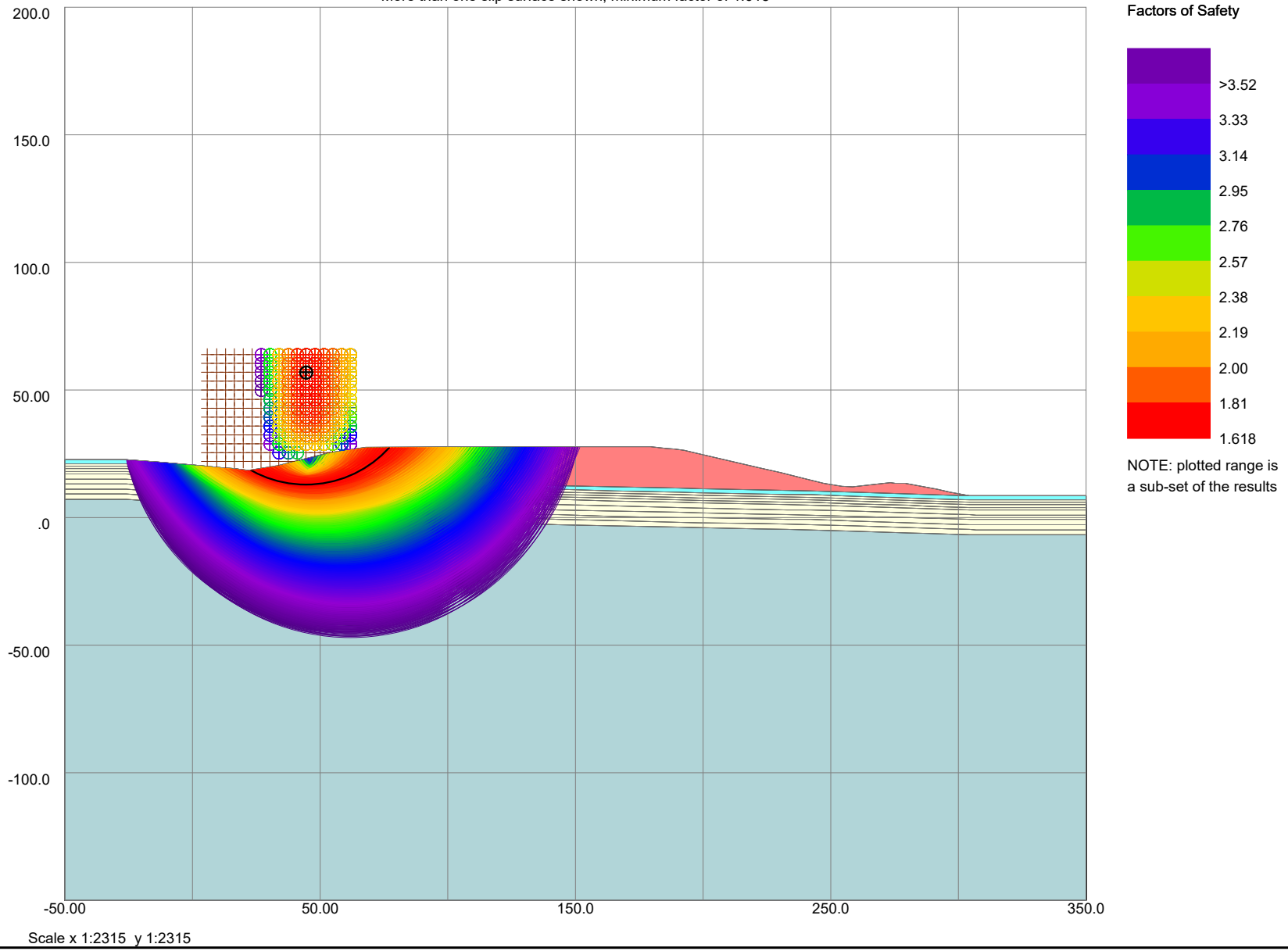
Job No.	Sheet No.	Rev.
256906		

Drg. Ref.

Made by EB | Date | Checked

Northern SPA
Eastern Mound - Undrained
Section A-AA (south)

More than one slip surface shown, minimum factor of 1.618



Scale x 1:2315 y 1:2315

General Parameters

Direction of slip: DOWNHILL
Minimum slip weight [kN/m] : 0.00000
Type of analysis : STATIC

Analysis Options

Partial Factor Analysis
Minimum number of slices: 25
Method: Bishop (Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: NOT ACTIVE

Method Partial Factors

Current selection: BS EN 1997-1:2011 DA1-2
Factor on FAVOURABLE PERMANENT LOAD: 1.00000
Factor on UNFAVOURABLE PERMANENT LOAD: 1.00000
Factor on FAVOURABLE VARIABLE LOAD: 0.00000
Factor on UNFAVOURABLE VARIABLE LOAD: 1.30000
Factor on SOIL UNIT WEIGHT: 1.00000
Factor on DRAINED SOIL COHESION: 1.25000
Factor on UNDRAINED SOIL COHESION: 1.40000
Factor on SOIL FRICTION ANGLE: 1.25000
Factor on reinforcement pullout: 1.50000
Economic ramification of failure: 1.00000
Sliding along reinforcement: 1.50000

Material properties

No	Description	Unit Weight Above GWL [kN/m3]	Unit Weight Below GWL [kN/m3]	Shear Strength Parameters Condition	Phi or Phi0 [°]	c or c0' [kN/m²]
1	Waste	19.500	19.500	Undrained	N.A.	50.000
2	Clay Deposits	17.000	17.000	Undrained	N.A.	30.000
3	London Clay 1	19.500	19.500	Undrained	N.A.	43.250
4	London Clay 2	19.500	19.500	Undrained	N.A.	49.750
5	London Clay 3	19.500	19.500	Undrained	N.A.	56.250
6	London Clay 4	19.500	19.500	Undrained	N.A.	62.750
7	London Clay 5	19.500	19.500	Undrained	N.A.	72.500
8	London Clay 6	19.500	19.500	Undrained	N.A.	85.500
9	London Clay 7	19.500	19.500	Undrained	N.A.	98.500
10	London Clay 8	19.500	19.500	Undrained	N.A.	111.50
11	London Clay 9	19.500	19.500	Undrained	N.A.	124.50
12	Harwich	20.000	20.000	Undrained	N.A.	130.00

Coordinates of top of soil strata

The units of the following coordinates are in m

Stratum X -->	-25.990	-13.434	2.9935	12.353	16.539	19.617	22.041
1	22.764	21.893	20.594	19.594	19.220	18.936	18.712
2	22.764	21.893	20.594	19.594	19.220	18.936	18.712
3	21.264	20.393	19.094	18.094	17.720	17.436	17.212
4	20.264	19.393	18.094	17.094	16.720	16.436	16.212
5	19.264	18.393	17.094	16.094	15.720	15.436	15.212
6	18.264	17.393	16.094	15.094	14.720	14.436	14.212
7	17.264	16.393	15.094	14.094	13.720	13.436	13.212
8	15.264	14.393	13.094	12.094	11.720	11.436	11.212
9	13.264	12.393	11.094	10.094	9.7202	9.4358	9.2119
10	11.264	10.393	9.0940	8.0940	7.7202	7.4358	7.2119
11	9.2635	8.3926	7.0940	6.0940	5.7202	5.4358	5.2119
12	7.2635	6.3926	5.0940	4.0940	3.7202	3.4358	3.2119
Stratum X -->							

	32.403	**33.593**	**41.700**	**53.852**	**59.260**	**60.113**	**68.027**
1	.	20.594	22.594	25.594	.	26.616	27.594
2	17.896	.	.	.	16.165	.	.
3	16.396	.	.	.	14.665	.	.
4	15.396	.	.	.	13.665	.	.
5	14.396	.	.	.	12.665	.	.
6	13.396	.	.	.	11.665	.	.
7	12.396	.	.	.	10.665	.	.
8	10.396	.	.	.	8.6648	.	.
9	8.3957	.	.	.	6.6648	.	.
10	6.3957	.	.	.	4.6648	.	.
11	4.3957	.	.	.	2.6648	.	.
12	2.3957	.	.	.	0.66480	.	.
Stratum X -->							
	70.780	**81.062**	**101.60**	**108.91**	**119.63**	**120.09**	**122.32**
1	.	.	.	27.994	27.994	27.994	.
2	15.549	15.129	14.128	.	.	.	13.324
3	14.049	13.629	12.628	.	.	.	11.824
4	13.049	12.629	11.628	.	.	.	10.824
5	12.049	11.629	10.628	.	.	.	9.8240
6	11.049	10.629	9.6284	.	.	.	8.8240
7	10.049	9.6291	8.6284	.	.	.	7.8240
8	8.0494	7.6291	6.6284	.	.	.	5.8240
9	6.0494	5.6291	4.6284	.	.	.	3.8240
10	4.0494	3.6291	2.6284	.	.	.	1.8240
11	2.0494	1.6291	0.62840	.	.	.	-0.17600
12	0.049400	-0.37090	-1.3716	.	.	.	-2.1760
Stratum X -->							
	131.13	**135.71**	**136.60**	**143.05**	**144.38**	**154.68**	**163.59**
1	.	27.994	.	.	27.994	27.994	27.994
2	13.041	.	12.865	12.678	.	.	.
3	11.541	.	11.365	11.178	.	.	.
4	10.541	.	10.365	10.178	.	.	.
5	9.5410	.	9.3652	9.1783	.	.	.
6	8.5410	.	8.3652	8.1783	.	.	.
7	7.5410	.	7.3652	7.1783	.	.	.
8	5.5410	.	5.3652	5.1783	.	.	.
9	3.5410	.	3.3652	3.1783	.	.	.
10	1.5410	.	1.3652	1.1783	.	.	.
11	-0.45900	.	-0.63480	-0.82170	.	.	.
12	-2.4590	.	-2.6348	-2.8217	.	.	.
Stratum X -->							
	164.91	**172.19**	**179.60**	**185.60**	**188.89**	**190.60**	**192.70**
1	.	27.994	27.862	27.295	26.996	.	26.594
2	12.140	.	.	.	.	11.601	.
3	10.640	.	.	.	.	10.101	.
4	9.6403	.	.	.	.	9.1006	.
5	8.6403	.	.	.	.	8.1006	.
6	7.6403	.	.	.	.	7.1006	.
7	6.6403	.	.	.	.	6.1006	.
8	4.6403	.	.	.	.	4.1006	.
9	2.6403	.	.	.	.	2.1006	.
10	0.64030	.	.	.	.	0.10060	.
11	-1.3597	.	.	.	.	-1.8994	.
12	-3.3597	.	.	.	.	-3.8994	.
Stratum X -->							
	196.62	**198.55**	**220.60**	**222.25**	**230.64**	**233.03**	**239.02**
1	25.691	.	.	19.594	17.594	.	15.594
2	.	11.362	10.967	.	.	10.724	.
3	.	9.8624	9.4675	.	.	9.2241	.
4	.	8.8624	8.4675	.	.	8.2241	.
5	.	7.8624	7.4675	.	.	7.2241	.
6	.	6.8624	6.4675	.	.	6.2241	.
7	.	5.8624	5.4675	.	.	5.2241	.
8	.	3.8624	3.4675	.	.	3.2241	.
9	.	1.8624	1.4675	.	.	1.2241	.
10	.	-0.13760	-0.53250	.	.	-0.77590	.
11	.	-2.1376	-2.5325	.	.	-2.7759	.
12	.	-4.1376	-4.5325	.	.	-4.7759	.
Stratum X -->							
	242.25	**247.40**	**254.47**	**258.65**	**259.38**	**266.63**	**273.14**
1	.	13.594	12.312	12.122	.	12.992	13.704
2	10.576	.	.	.	10.050	.	.
3	9.0759	.	.	.	8.5501	.	.
4	8.0759	.	.	.	7.5501	.	.

Stratum X -->							
	242.25	247.40	254.47	258.65	259.38	266.63	273.14
5	7.0759	.	.	.	6.5501	.	.
6	6.0759	.	.	.	5.5501	.	.
7	5.0759	.	.	.	4.5501	.	.
8	3.0759	.	.	.	2.5501	.	.
9	1.0759	.	.	.	0.55010	.	.
10	-0.92410	.	.	.	-1.4499	.	.
11	-2.9241	.	.	.	-3.4499	.	.
12	-4.9241	.	.	.	-5.4499	.	.

Stratum X -->							
	273.80	275.41	279.18	280.74	288.42	291.81	296.17
1	13.708	13.594	13.594	.	.	11.137	.
2	.	.	.	9.3616	9.1283	.	8.8925
3	.	.	.	7.8616	7.6283	.	7.3925
4	.	.	.	6.8616	6.6283	.	6.3925
5	.	.	.	5.8616	5.6283	.	5.3925
6	.	.	.	4.8616	4.6283	.	4.3925
7	.	.	.	3.8616	3.6283	.	3.3925
8	.	.	.	1.8616	1.6283	.	1.3925
9	.	.	.	-0.13840	-0.37170	.	-0.60750
10	.	.	.	-2.1384	-2.3717	.	-2.6075
11	.	.	.	-4.1384	-4.3717	.	-4.6075
12	.	.	.	-6.1384	-6.3717	.	-6.6075

Stratum X -->				
	296.86	304.43	307.09	309.09
1	10.154	8.6578	8.5940	8.5940
2	.	8.6578	8.5940	8.5940
3	.	7.1578	7.0940	7.0940
4	.	6.1578	6.0940	6.0940
5	.	5.1578	5.0940	5.0940
6	.	4.1578	4.0940	4.0940
7	.	3.1578	3.0940	3.0940
8	.	1.1578	1.0940	1.0940
9	.	-0.84220	-0.90600	-0.90600
10	.	-2.8422	-2.9060	-2.9060
11	.	-4.8422	-4.9060	-4.9060
12	.	-6.8422	-6.9060	-6.9060

Stratum-linked data

No.	Material	Water table	Piezo Set/ Ru value
1	Waste		- -
2	Clay Deposits		- -
3	London Clay 1		- -
4	London Clay 2		- -
5	London Clay 3		- -
6	London Clay 4		- -
7	London Clay 5		- -
8	London Clay 6		- -
9	London Clay 7		- -
10	London Clay 8		- -
11	London Clay 9		- -
12	Harwich		- -

Slip Surface Specification

Circle centre specification: GRID
Bottom left of grid: x = 6.00000 m y = 22.00000 m
Inclination of grid: 0.00000 deg
(positive anticlockwise direction about bottom left of grid)
Centres on grid: 17 in x direction at 3.50000m spacing
13 in y direction at 3.50000m spacing
Grid extended to find minimum FoS
Initial radius of circle 5.00000 m
Incremented by 1.00000 m until all possible circles considered

WORST CASE

Centre at (44.500m,57.000m) Radius 44.000m
Iterations: 5 Horiz acceleration [%g]: 0.0
Net vertical force [kN/m]: 16.569 *Slip weight [kN/m] 8019.0*
Net horiz force [kN/m]: 76.366 Disturbing moment [kN/m]: 56133.
Restoring moment [kNm/m]: 90824.
Reinf.Rest.Moment [kNm/m]: 0.0
Over-Design Factor: 1.6180

The system of interslice and base forces are in equilibrium
when the strengths available at the bases are divided by the computed
over-design factor. The interslice forces shown in the following table
are in equilibrium with the factored strengths of the soil at the bases of slices.

Slip surface coordinates		Pore Pressure		Interslice forces [kN/m]		
Point	x [m]	y [m]	L [kN/m²]	R [kN/m²]	T	E	E(u)
1	22.647	18.811	-	0.0	0.0	0.0	0.0
2	22.947	18.641	0.0	0.0	1.3834	9.8960	0.0
3	24.689	17.712	0.0	0.0	13.432	59.965	0.0
4	26.472	16.863	0.0	0.0	19.767	122.66	0.0
5	27.994	16.213	0.0	0.0	18.283	192.21	0.0
6	29.540	15.621	0.0	0.0	15.459	267.67	0.0
7	30.964	15.134	0.0	0.0	11.167	343.68	0.0
8	32.403	14.696	0.0	0.0	7.2935	421.27	0.0
9	33.593	14.373	0.0	0.0	4.7154	484.90	0.0
10	33.882	14.300	0.0	0.0	4.1871	500.21	0.0
11	35.814	13.866	0.0	0.0	0.37593	605.92	0.0
12	37.764	13.519	0.0	0.0	-1.4093	706.31	0.0
13	39.727	13.260	0.0	0.0	-1.3886	797.76	0.0
14	41.700	13.089	0.0	0.0	-0.24996	877.08	0.0
15	43.664	13.008	0.0	0.0	0.91738	941.17	0.0
16	45.629	13.014	0.0	0.0	1.3638	988.67	0.0
17	47.592	13.109	0.0	0.0	6.9053	1017.9	0.0
18	49.549	13.291	0.0	0.0	15.749	1027.4	0.0
19	51.709	13.595	0.0	0.0	26.262	1008.1	0.0
20	53.852	14.005	0.0	0.0	35.582	964.34	0.0
21	53.880	14.012	0.0	0.0	35.686	963.59	0.0
22	55.444	14.383	0.0	0.0	39.342	912.19	0.0
23	56.993	14.811	0.0	0.0	40.355	850.32	0.0
24	58.132	15.165	0.0	0.0	36.947	791.66	0.0
25	59.260	15.550	0.0	0.0	31.333	728.33	0.0
26	60.113	15.863	0.0	0.0	25.489	677.35	0.0
27	60.693	16.088	0.0	0.0	20.703	641.29	0.0
28	62.590	16.891	0.0	0.0	7.9458	534.59	0.0
29	64.448	17.782	0.0	0.0	-9.4915	424.91	0.0
30	66.261	18.758	0.0	0.0	-30.274	316.47	0.0
31	68.027	19.818	0.0	0.0	-52.474	213.35	0.0
32	69.721	20.946	0.0	0.0	-72.426	121.86	0.0
33	71.361	22.150	0.0	0.0	-86.391	45.261	0.0
34	72.943	23.429	0.0	0.0	-91.057	-14.048	0.0
35	74.464	24.780	0.0	0.0	-83.070	-54.461	0.0
36	75.922	26.199	0.0	0.0	-59.210	-75.207	0.0
37	77.312	27.685	0.0	-	-16.569	-76.366	0.0

Slice No.	Strength Parameters		Average Pore Pressure	Slice Weight	Forces on base [kN/m]		
	c' [kN/m²]	Tan phi	[kN/m²]	[kN/m]	Normal	Shear (capacity)	Shear (mobilised)
1	*35.714*	*0.0*	0.0	*0.64019*	6.9690	12.314	7.6102
2	*21.429*	*0.0*	0.0	*26.317*	59.226	42.314	26.152
3	*21.429*	*0.0*	0.0	*64.459*	92.597	42.314	26.152
4	*30.893*	*0.0*	0.0	*83.947*	104.50	51.138	31.605
5	*30.893*	*0.0*	0.0	*111.48*	129.72	51.138	31.605
6	*35.536*	*0.0*	0.0	*124.33*	139.24	53.456	33.038
7	*35.536*	*0.0*	0.0	*145.24*	158.80	53.456	33.038
8	*35.536*	*0.0*	0.0	*133.92*	144.13	43.819	27.082
9	*35.536*	*0.0*	0.0	*34.414*	36.764	10.602	6.5526
10	*40.179*	*0.0*	0.0	*249.73*	264.10	79.570	49.177
11	*40.179*	*0.0*	0.0	*285.07*	297.29	79.570	49.177
12	*40.179*	*0.0*	0.0	*317.15*	327.01	79.570	49.177
13	*40.179*	*0.0*	0.0	*345.65*	352.73	79.569	49.177
14	*40.179*	*0.0*	0.0	*367.42*	371.11	78.962	48.802
15	*40.179*	*0.0*	0.0	*387.74*	388.03	78.962	48.802
16	*40.179*	*0.0*	0.0	*403.93*	407.56	78.962	48.802
17	*40.179*	*0.0*	0.0	*415.86*	421.91	78.962	48.802
18	*35.536*	*0.0*	0.0	*470.24*	478.60	77.519	47.909
19	*35.536*	*0.0*	0.0	*473.64*	482.38	77.519	47.910
20	*35.536*	*0.0*	0.0	*6.3695*	6.4824	1.0425	0.64428
21	*30.893*	*0.0*	0.0	*345.69*	351.60	49.651	30.686
22	*30.893*	*0.0*	0.0	*338.06*	343.10	49.651	30.686
23	*21.429*	*0.0*	0.0	*245.27*	248.20	25.551	15.791
24	*21.429*	*0.0*	0.0	*240.30*	242.38	25.550	15.791
25	*21.429*	*0.0*	0.0	*179.34*	180.28	19.471	12.034
26	*21.429*	*0.0*	0.0	*120.61*	120.92	13.336	8.2419
27	*35.714*	*0.0*	0.0	*381.57*	380.84	73.564	45.465
28	*35.714*	*0.0*	0.0	*351.33*	348.06	73.564	45.465
29	*35.714*	*0.0*	0.0	*318.07*	312.67	73.564	45.465
30	*35.714*	*0.0*	0.0	*282.25*	275.49	73.564	45.465
31	*35.714*	*0.0*	0.0	*238.45*	232.01	72.662	44.908

Slice No.	Strength Parameters		Average Pore	Slice Weight	Forces on base [kN/m]		
32	35.714	0.0	0.0	194.10	189.91	72.661	44.907
33	35.714	0.0	0.0	149.48	149.25	72.662	44.908
34	35.714	0.0	0.0	105.18	110.76	72.661	44.907
35	35.714	0.0	0.0	61.799	75.099	72.662	44.908
36	35.714	0.0	0.0	19.950	42.849	72.662	44.908

Slice No.	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]	
	Vert	Horiz	Vert	Horiz	Vert	Horiz
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0

ARUP

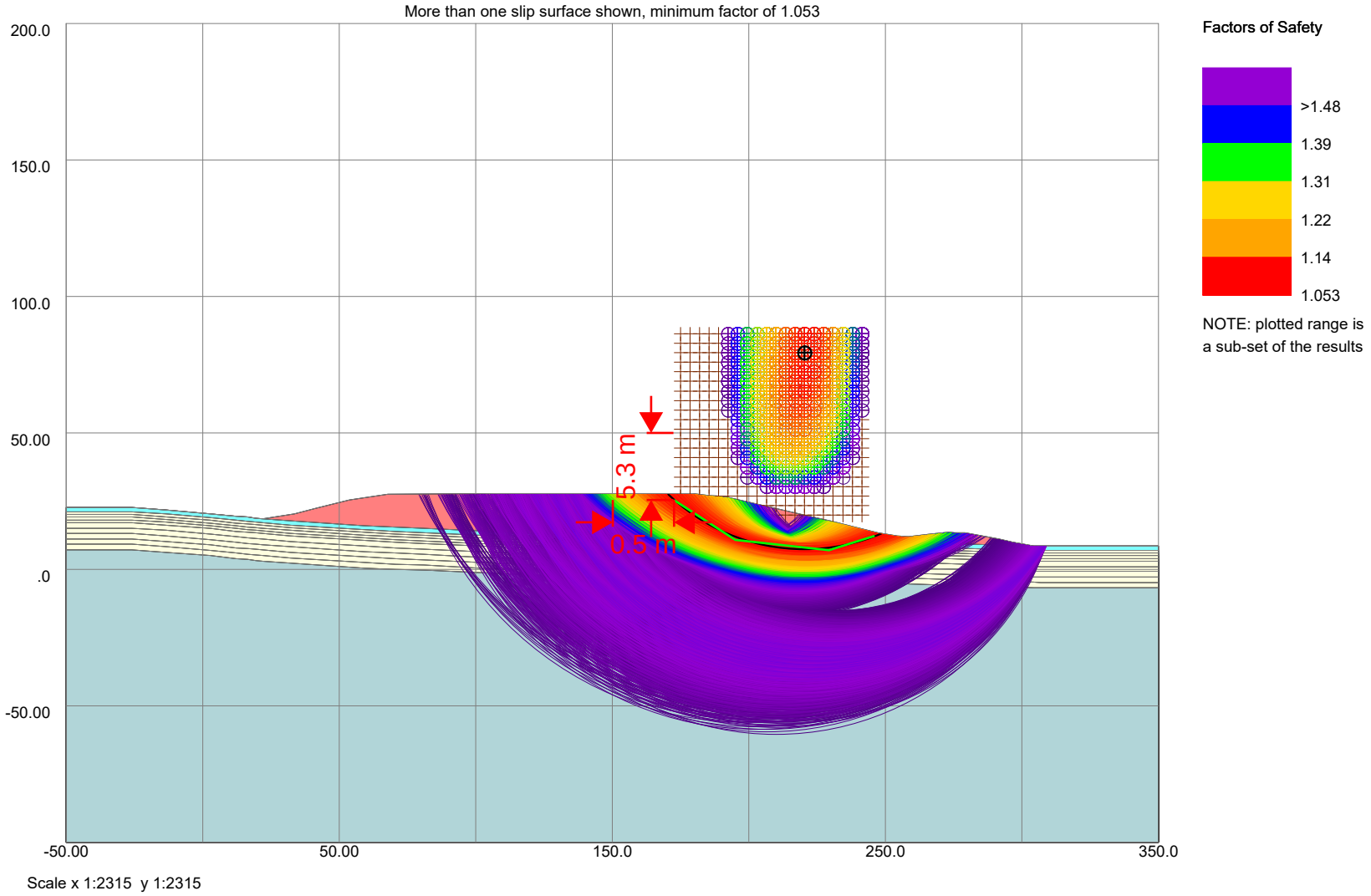
Arup

Northern SPA
Eastern Mound - Undrained
Section A-AA (north)

Job No.	Sheet No.	Rev.
256906		

Drg. Ref.

Made by	Date	Checked
EB		



General Parameters

Direction of slip: DOWNHILL
Minimum slip weight [kN/m] : 0.00000
Type of analysis : STATIC

Analysis Options

Partial Factor Analysis
Minimum number of slices: 25
Method: Bishop (Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: NOT ACTIVE

Method Partial Factors

Current selection: BS EN 1997-1:2011 DA1-2
Factor on FAVOURABLE PERMANENT LOAD: 1.00000
Factor on UNFAVOURABLE PERMANENT LOAD: 1.00000
Factor on FAVOURABLE VARIABLE LOAD: 0.00000
Factor on UNFAVOURABLE VARIABLE LOAD: 1.30000
Factor on SOIL UNIT WEIGHT: 1.00000
Factor on DRAINED SOIL COHESION: 1.25000
Factor on UNDRAINED SOIL COHESION: 1.40000
Factor on SOIL FRICTION ANGLE: 1.25000
Factor on reinforcement pullout: 1.50000
Economic ramification of failure: 1.00000
Sliding along reinforcement: 1.50000

Material properties

No	Description	Unit Weight Above GWL [kN/m3]	Unit Weight Below GWL [kN/m3]	Shear Strength Parameters Condition	Phi or Phi0 [°]	c or c0' [kN/m²]
1	Waste	19.500	19.500	Undrained	N.A.	50.000
2	Clay Deposits	17.000	17.000	Undrained	N.A.	30.000
3	London Clay 1	19.500	19.500	Undrained	N.A.	43.250
4	London Clay 2	19.500	19.500	Undrained	N.A.	49.750
5	London Clay 3	19.500	19.500	Undrained	N.A.	56.250
6	London Clay 4	19.500	19.500	Undrained	N.A.	62.750
7	London Clay 5	19.500	19.500	Undrained	N.A.	72.500
8	London Clay 6	19.500	19.500	Undrained	N.A.	85.500
9	London Clay 7	19.500	19.500	Undrained	N.A.	98.500
10	London Clay 8	19.500	19.500	Undrained	N.A.	111.50
11	London Clay 9	19.500	19.500	Undrained	N.A.	124.50
12	Harwich	20.000	20.000	Undrained	N.A.	130.00

Coordinates of top of soil strata

The units of the following coordinates are in m

Stratum X -->	-25.990	-13.434	2.9935	12.353	16.539	19.617	22.041
1	22.764	21.893	20.594	19.594	19.220	18.936	18.712
2	22.764	21.893	20.594	19.594	19.220	18.936	18.712
3	21.264	20.393	19.094	18.094	17.720	17.436	17.212
4	20.264	19.393	18.094	17.094	16.720	16.436	16.212
5	19.264	18.393	17.094	16.094	15.720	15.436	15.212
6	18.264	17.393	16.094	15.094	14.720	14.436	14.212
7	17.264	16.393	15.094	14.094	13.720	13.436	13.212
8	15.264	14.393	13.094	12.094	11.720	11.436	11.212
9	13.264	12.393	11.094	10.094	9.7202	9.4358	9.2119
10	11.264	10.393	9.0940	8.0940	7.7202	7.4358	7.2119
11	9.2635	8.3926	7.0940	6.0940	5.7202	5.4358	5.2119
12	7.2635	6.3926	5.0940	4.0940	3.7202	3.4358	3.2119
Stratum X -->							

	32.403	**33.593**	**41.700**	**53.852**	**59.260**	**60.113**	**68.027**
1	.	20.594	22.594	25.594	.	26.616	27.594
2	17.896	.	.	.	16.165	.	.
3	16.396	.	.	.	14.665	.	.
4	15.396	.	.	.	13.665	.	.
5	14.396	.	.	.	12.665	.	.
6	13.396	.	.	.	11.665	.	.
7	12.396	.	.	.	10.665	.	.
8	10.396	.	.	.	8.6648	.	.
9	8.3957	.	.	.	6.6648	.	.
10	6.3957	.	.	.	4.6648	.	.
11	4.3957	.	.	.	2.6648	.	.
12	2.3957	.	.	.	0.66480	.	.
Stratum X -->							
	70.780	**81.062**	**101.60**	**108.91**	**119.63**	**120.09**	**122.32**
1	.	.	.	27.994	27.994	27.994	.
2	15.549	15.129	14.128	.	.	.	13.324
3	14.049	13.629	12.628	.	.	.	11.824
4	13.049	12.629	11.628	.	.	.	10.824
5	12.049	11.629	10.628	.	.	.	9.8240
6	11.049	10.629	9.6284	.	.	.	8.8240
7	10.049	9.6291	8.6284	.	.	.	7.8240
8	8.0494	7.6291	6.6284	.	.	.	5.8240
9	6.0494	5.6291	4.6284	.	.	.	3.8240
10	4.0494	3.6291	2.6284	.	.	.	1.8240
11	2.0494	1.6291	0.62840	.	.	.	-0.17600
12	0.049400	-0.37090	-1.3716	.	.	.	-2.1760
Stratum X -->							
	131.13	**135.71**	**136.60**	**143.05**	**144.38**	**154.68**	**163.59**
1	.	27.994	.	.	27.994	27.994	27.994
2	13.041	.	12.865	12.678	.	.	.
3	11.541	.	11.365	11.178	.	.	.
4	10.541	.	10.365	10.178	.	.	.
5	9.5410	.	9.3652	9.1783	.	.	.
6	8.5410	.	8.3652	8.1783	.	.	.
7	7.5410	.	7.3652	7.1783	.	.	.
8	5.5410	.	5.3652	5.1783	.	.	.
9	3.5410	.	3.3652	3.1783	.	.	.
10	1.5410	.	1.3652	1.1783	.	.	.
11	-0.45900	.	-0.63480	-0.82170	.	.	.
12	-2.4590	.	-2.6348	-2.8217	.	.	.
Stratum X -->							
	164.91	**172.19**	**179.60**	**185.60**	**188.89**	**190.60**	**192.70**
1	.	27.994	27.862	27.295	26.996	.	26.594
2	12.140	.	.	.	.	11.601	.
3	10.640	.	.	.	.	10.101	.
4	9.6403	.	.	.	.	9.1006	.
5	8.6403	.	.	.	.	8.1006	.
6	7.6403	.	.	.	.	7.1006	.
7	6.6403	.	.	.	.	6.1006	.
8	4.6403	.	.	.	.	4.1006	.
9	2.6403	.	.	.	.	2.1006	.
10	0.64030	.	.	.	.	0.10060	.
11	-1.3597	.	.	.	.	-1.8994	.
12	-3.3597	.	.	.	.	-3.8994	.
Stratum X -->							
	196.62	**198.55**	**220.60**	**222.25**	**230.64**	**233.03**	**239.02**
1	25.691	.	.	19.594	17.594	.	15.594
2	.	11.362	10.967	.	.	10.724	.
3	.	9.8624	9.4675	.	.	9.2241	.
4	.	8.8624	8.4675	.	.	8.2241	.
5	.	7.8624	7.4675	.	.	7.2241	.
6	.	6.8624	6.4675	.	.	6.2241	.
7	.	5.8624	5.4675	.	.	5.2241	.
8	.	3.8624	3.4675	.	.	3.2241	.
9	.	1.8624	1.4675	.	.	1.2241	.
10	.	-0.13760	-0.53250	.	.	-0.77590	.
11	.	-2.1376	-2.5325	.	.	-2.7759	.
12	.	-4.1376	-4.5325	.	.	-4.7759	.
Stratum X -->							
	242.25	**247.40**	**254.47**	**258.65**	**259.38**	**266.63**	**273.14**
1	.	13.594	12.312	12.122	.	12.992	13.704
2	10.576	.	.	.	10.050	.	.
3	9.0759	.	.	.	8.5501	.	.
4	8.0759	.	.	.	7.5501	.	.

Stratum X -->							
	243.25	247.40	254.47	258.65	259.38	266.63	273.14
5	7.0759	.	.	.	6.5501	.	.
6	6.0759	.	.	.	5.5501	.	.
7	5.0759	.	.	.	4.5501	.	.
8	3.0759	.	.	.	2.5501	.	.
9	1.0759	.	.	.	0.55010	.	.
10	-0.92410	.	.	.	-1.4499	.	.
11	-2.9241	.	.	.	-3.4499	.	.
12	-4.9241	.	.	.	-5.4499	.	.

Stratum X -->	273.80	275.41	279.18	280.74	288.42	291.81	296.17
1	13.708	13.594	13.594	.	.	11.137	.
2	.	.	.	9.3616	9.1283	.	8.8925
3	.	.	.	7.8616	7.6283	.	7.3925
4	.	.	.	6.8616	6.6283	.	6.3925
5	.	.	.	5.8616	5.6283	.	5.3925
6	.	.	.	4.8616	4.6283	.	4.3925
7	.	.	.	3.8616	3.6283	.	3.3925
8	.	.	.	1.8616	1.6283	.	1.3925
9	.	.	.	-0.13840	-0.37170	.	-0.60750
10	.	.	.	-2.1384	-2.3717	.	-2.6075
11	.	.	.	-4.1384	-4.3717	.	-4.6075
12	.	.	.	-6.1384	-6.3717	.	-6.6075

Stratum X -->	296.86	304.43	307.09	309.09
1	10.154	8.6578	8.5940	8.5940
2	.	8.6578	8.5940	8.5940
3	.	7.1578	7.0940	7.0940
4	.	6.1578	6.0940	6.0940
5	.	5.1578	5.0940	5.0940
6	.	4.1578	4.0940	4.0940
7	.	3.1578	3.0940	3.0940
8	.	1.1578	1.0940	1.0940
9	.	-0.84220	-0.90600	-0.90600
10	.	-2.8422	-2.9060	-2.9060
11	.	-4.8422	-4.9060	-4.9060
12	.	-6.8422	-6.9060	-6.9060

Stratum-linked data

No.	Material	Water table	Piezo Set/ Ru value
1	Waste		- -
2	Clay Deposits		- -
3	London Clay 1		- -
4	London Clay 2		- -
5	London Clay 3		- -
6	London Clay 4		- -
7	London Clay 5		- -
8	London Clay 6		- -
9	London Clay 7		- -
10	London Clay 8		- -
11	London Clay 9		- -
12	Harwich		- -

Slip Surface Specification

Circle centre specification: GRID
Bottom left of grid: x = 175.00000 m y = 20.00000 m
Inclination of grid: 0.00000 deg
(positive anticlockwise direction about bottom left of grid)
Centres on grid: 20 in x direction at 3.50000m spacing
20 in y direction at 3.50000m spacing
Initial radius of circle 5.00000 m
Incremented by 1.00000 m until all possible circles considered

WORST CASE

Centre at (220.50m,79.500m) Radius 72.000m
Iterations: 5 Horiz acceleration [%g]: 0.0
Net vertical force [kN/m]: 29.443 *Slip weight [kN/m] 14938.*
Net horiz force [kN/m]: 145.78 Disturbing moment [kN/m]: 192630.
Restoring moment [kNm/m]: 202890.
Reinf.Rest.Moment [kNm/m]: 0.0
Over-Design Factor: 1.0533

The system of interslice and base forces are in equilibrium
when the strengths available at the bases are divided by the computed
over-design factor. The interslice forces shown in the following table
are in equilibrium with the factored strengths of the soil at the bases of slices.

Slip surface coordinates		Pore Pressure		Interslice forces [kN/m]		
Point	x [m]	y [m]	L [kN/m²]	R [kN/m²]	T	E	E(u)
1	170.19	27.994	-	0.0	0.0	0.0	0.0
2	172.19	26.115	0.0	0.0	-79.185	-18.785	0.0
3	173.97	24.556	0.0	0.0	-122.14	-7.5022	0.0
4	175.80	23.057	0.0	0.0	-144.99	28.529	0.0
5	177.68	21.618	0.0	0.0	-150.84	88.350	0.0
6	179.60	20.242	0.0	0.0	-142.86	170.46	0.0
7	181.56	18.939	0.0	0.0	-125.19	270.81	0.0
8	183.56	17.700	0.0	0.0	-101.50	386.12	0.0
9	185.60	16.527	0.0	0.0	-74.312	513.60	0.0
10	187.23	15.647	0.0	0.0	-51.855	620.96	0.0
11	188.89	14.810	0.0	0.0	-29.609	732.46	0.0
12	190.78	13.920	0.0	0.0	-6.0150	860.55	0.0
13	192.70	13.085	0.0	0.0	15.000	988.89	0.0
14	194.65	12.302	0.0	0.0	32.105	1114.1	0.0
15	196.62	11.576	0.0	0.0	44.233	1231.6	0.0
16	197.11	11.406	0.0	0.0	46.467	1259.2	0.0
17	198.55	10.926	0.0	0.0	57.671	1355.6	0.0
18	200.51	10.331	0.0	0.0	67.910	1474.7	0.0
19	202.48	9.7921	0.0	0.0	73.127	1580.7	0.0
20	204.92	9.2053	0.0	0.0	68.399	1669.8	0.0
21	207.39	8.7042	0.0	0.0	59.354	1735.8	0.0
22	210.01	8.2685	0.0	0.0	44.929	1767.5	0.0
23	212.64	7.9299	0.0	0.0	29.970	1770.8	0.0
24	215.29	7.6887	0.0	0.0	16.685	1745.8	0.0
25	217.94	7.5454	0.0	0.0	7.2861	1693.2	0.0
26	220.60	7.5001	0.0	0.0	3.8708	1614.7	0.0
27	222.25	7.5214	0.0	0.0	3.5775	1553.9	0.0
28	225.06	7.6443	0.0	0.0	2.7330	1431.6	0.0
29	227.85	7.8763	0.0	0.0	2.9169	1288.5	0.0
30	230.64	8.2171	0.0	0.0	5.3208	1129.1	0.0
31	230.96	8.2646	0.0	0.0	5.7906	1109.4	0.0
32	233.03	8.5991	0.0	0.0	8.2147	991.14	0.0
33	235.95	9.1772	0.0	0.0	13.880	817.74	0.0
34	237.49	9.5329	0.0	0.0	14.542	739.01	0.0
35	239.02	9.9222	0.0	0.0	15.283	661.02	0.0
36	241.37	10.590	0.0	0.0	15.943	544.28	0.0
37	243.40	11.238	0.0	0.0	23.713	421.84	0.0
38	245.41	11.947	0.0	0.0	29.341	309.64	0.0
39	247.40	12.714	0.0	0.0	31.287	210.42	0.0
40	248.87	13.327	0.0	-	29.443	145.78	0.0

Slice No.	Strength Parameters		Average Pore Pressure	Slice Weight	Forces on base [kN/m]		
	c' [kN/m²]	Tan phi	[kN/m²]	[kN/m]	Normal	Shear (capacity)	Shear (mobilised)
1	*35.714*	*0.0*	0.0	*36.602*	70.219	97.954	93.000
2	*35.714*	*0.0*	0.0	*91.741*	107.73	84.517	80.243
3	*35.714*	*0.0*	0.0	*147.78*	153.82	84.516	80.242
4	*35.714*	*0.0*	0.0	*204.30*	202.26	84.517	80.243
5	*35.714*	*0.0*	0.0	*260.89*	252.58	84.516	80.242
6	*35.714*	*0.0*	0.0	*312.03*	299.75	83.962	79.715
7	*35.714*	*0.0*	0.0	*360.89*	346.52	83.961	79.715
8	*35.714*	*0.0*	0.0	*408.32*	393.14	83.961	79.715
9	*35.714*	*0.0*	0.0	*355.20*	343.34	66.336	62.982
10	*35.714*	*0.0*	0.0	*382.92*	371.69	66.336	62.982
11	*35.714*	*0.0*	0.0	*462.05*	450.68	74.641	70.867
12	*35.714*	*0.0*	0.0	*492.88*	483.31	74.641	70.866
13	*35.714*	*0.0*	0.0	*520.04*	512.88	75.051	71.255
14	*35.714*	*0.0*	0.0	*537.58*	533.23	75.050	71.255
15	*35.714*	*0.0*	0.0	*135.26*	134.61	18.545	17.607
16	*21.429*	*0.0*	0.0	*400.24*	399.32	32.613	30.963
17	*21.429*	*0.0*	0.0	*544.08*	545.02	43.773	41.559
18	*21.429*	*0.0*	0.0	*549.80*	552.91	43.773	41.559
19	*30.893*	*0.0*	0.0	*682.62*	688.81	77.685	73.757
20	*30.893*	*0.0*	0.0	*686.00*	693.98	77.685	73.757
21	*35.536*	*0.0*	0.0	*722.79*	732.16	94.432	89.656
22	*35.536*	*0.0*	0.0	*714.49*	723.73	94.431	89.656
23	*35.536*	*0.0*	0.0	*699.94*	707.87	94.432	89.656
24	*35.536*	*0.0*	0.0	*679.15*	684.62	94.432	89.656
25	*35.536*	*0.0*	0.0	*652.21*	654.16	94.432	89.656
26	*35.536*	*0.0*	0.0	*389.62*	390.74	58.745	55.775
27	*35.536*	*0.0*	0.0	*627.59*	633.58	99.681	94.640
28	*35.536*	*0.0*	0.0	*579.96*	590.35	99.681	94.640
29	*35.536*	*0.0*	0.0	*525.96*	540.10	99.681	94.640

Slice No.	Strength Parameters		Average Pore	Slice Weight	Forces on base [kN/m]		
30	*35.536*	*0.0*	0.0	*58.478*	60.378	11.804	11.207
31	*30.893*	*0.0*	0.0	*348.54*	361.59	64.706	61.433
32	*30.893*	*0.0*	0.0	*432.00*	453.66	91.878	87.232
33	*21.429*	*0.0*	0.0	*198.56*	211.62	33.832	32.121
34	*21.429*	*0.0*	0.0	*176.99*	191.20	33.832	32.121
35	*21.429*	*0.0*	0.0	*229.55*	254.07	52.322	49.676
36	*35.714*	*0.0*	0.0	*153.61*	178.05	76.170	72.318
37	*35.714*	*0.0*	0.0	*106.56*	134.50	76.169	72.317
38	*35.714*	*0.0*	0.0	*58.249*	90.411	76.169	72.317
39	*35.714*	*0.0*	0.0	*12.647*	39.906	57.007	54.124

Slice No.	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]	
	Vert	Horiz	Vert	Horiz	Vert	Horiz
1	*0.0*	*0.0*	0.0	0.0	0.0	0.0
2	*0.0*	*0.0*	0.0	0.0	0.0	0.0
3	*0.0*	*0.0*	0.0	0.0	0.0	0.0
4	*0.0*	*0.0*	0.0	0.0	0.0	0.0
5	*0.0*	*0.0*	0.0	0.0	0.0	0.0
6	*0.0*	*0.0*	0.0	0.0	0.0	0.0
7	*0.0*	*0.0*	0.0	0.0	0.0	0.0
8	*0.0*	*0.0*	0.0	0.0	0.0	0.0
9	*0.0*	*0.0*	0.0	0.0	0.0	0.0
10	*0.0*	*0.0*	0.0	0.0	0.0	0.0
11	*0.0*	*0.0*	0.0	0.0	0.0	0.0
12	*0.0*	*0.0*	0.0	0.0	0.0	0.0
13	*0.0*	*0.0*	0.0	0.0	0.0	0.0
14	*0.0*	*0.0*	0.0	0.0	0.0	0.0
15	*0.0*	*0.0*	0.0	0.0	0.0	0.0
16	*0.0*	*0.0*	0.0	0.0	0.0	0.0
17	*0.0*	*0.0*	0.0	0.0	0.0	0.0
18	*0.0*	*0.0*	0.0	0.0	0.0	0.0
19	*0.0*	*0.0*	0.0	0.0	0.0	0.0
20	*0.0*	*0.0*	0.0	0.0	0.0	0.0
21	*0.0*	*0.0*	0.0	0.0	0.0	0.0
22	*0.0*	*0.0*	0.0	0.0	0.0	0.0
23	*0.0*	*0.0*	0.0	0.0	0.0	0.0
24	*0.0*	*0.0*	0.0	0.0	0.0	0.0
25	*0.0*	*0.0*	0.0	0.0	0.0	0.0
26	*0.0*	*0.0*	0.0	0.0	0.0	0.0
27	*0.0*	*0.0*	0.0	0.0	0.0	0.0
28	*0.0*	*0.0*	0.0	0.0	0.0	0.0
29	*0.0*	*0.0*	0.0	0.0	0.0	0.0
30	*0.0*	*0.0*	0.0	0.0	0.0	0.0
31	*0.0*	*0.0*	0.0	0.0	0.0	0.0
32	*0.0*	*0.0*	0.0	0.0	0.0	0.0
33	*0.0*	*0.0*	0.0	0.0	0.0	0.0
34	*0.0*	*0.0*	0.0	0.0	0.0	0.0
35	*0.0*	*0.0*	0.0	0.0	0.0	0.0
36	*0.0*	*0.0*	0.0	0.0	0.0	0.0
37	*0.0*	*0.0*	0.0	0.0	0.0	0.0
38	*0.0*	*0.0*	0.0	0.0	0.0	0.0
39	*0.0*	*0.0*	0.0	0.0	0.0	0.0

ARUP

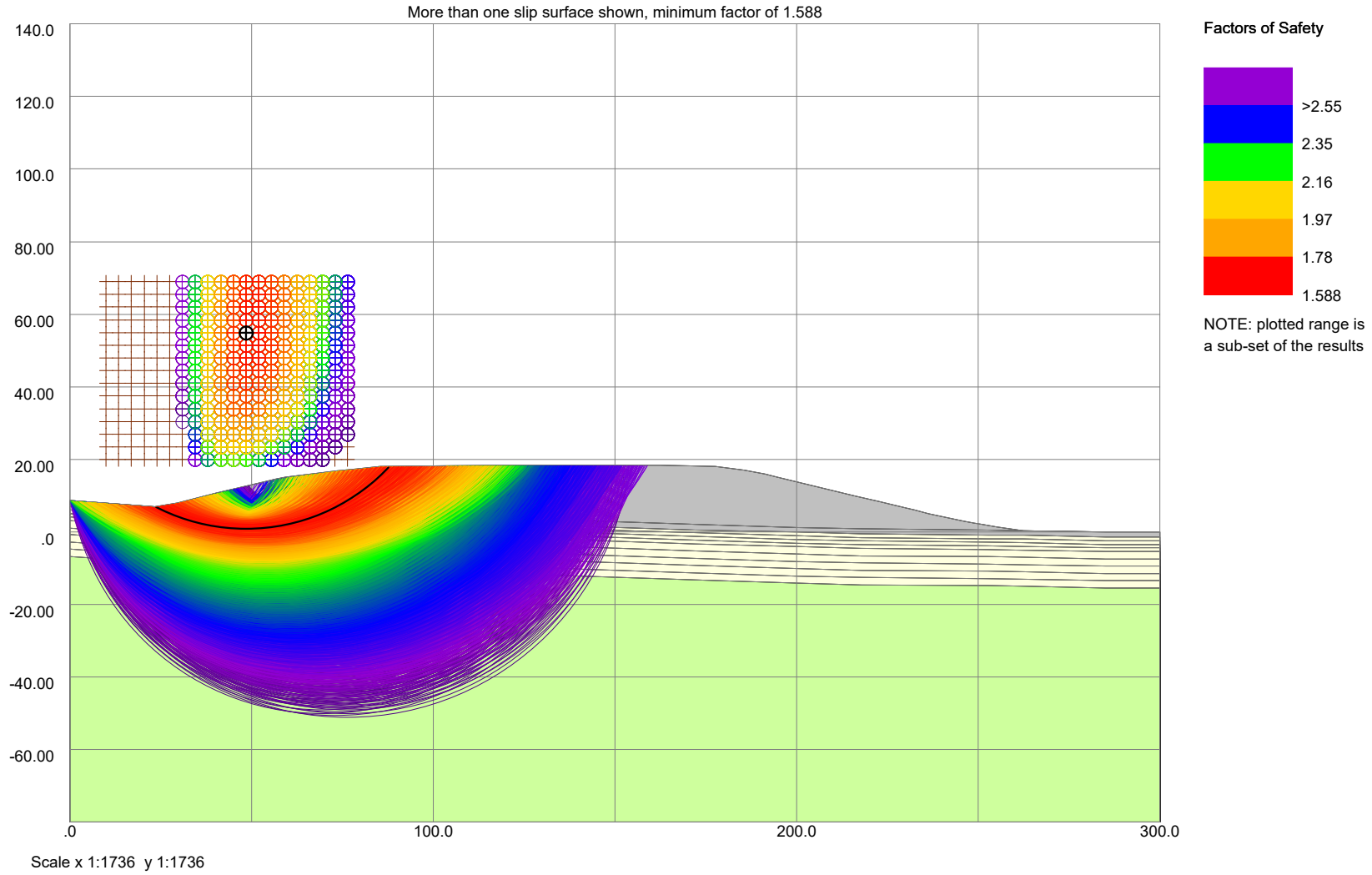
Arup

Northern SPA
Eastern Mound - Undrained
Section B-BB

Job No.	Sheet No.	Rev.
256906		

Drg. Ref.

Made by	Date	Checked
EB		



General Parameters

Direction of slip: DOWNHILL
Minimum slip weight [kN/m] : 0.00000
Type of analysis : STATIC

Analysis Options

Partial Factor Analysis
Minimum number of slices: 25
Method: Bishop (Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: NOT ACTIVE

Method Partial Factors

Current selection: BS EN 1997-1:2011 DA1-2
Factor on FAVOURABLE PERMANENT LOAD: 1.00000
Factor on UNFAVOURABLE PERMANENT LOAD: 1.00000
Factor on FAVOURABLE VARIABLE LOAD: 0.00000
Factor on UNFAVOURABLE VARIABLE LOAD: 1.30000
Factor on SOIL UNIT WEIGHT: 1.00000
Factor on DRAINED SOIL COHESION: 1.25000
Factor on UNDRAINED SOIL COHESION: 1.40000
Factor on SOIL FRICTION ANGLE: 1.25000
Factor on reinforcement pullout: 1.50000
Economic ramification of failure: 1.00000
Sliding along reinforcement: 1.50000

Material properties

No	Description	Unit Weight Above GWL [kN/m3]	Unit Weight Below GWL [kN/m3]	Shear Strength Parameters Condition	Phi or Phi0 [°]	c or c0' [kN/m²]
1	Waste	19.500	19.500	Undrained	N.A.	50.000
2	Clay Deposits	17.000	17.000	Undrained	N.A.	30.000
3	London Clay 1	19.500	19.500	Undrained	N.A.	43.250
4	London Clay 2	19.500	19.500	Undrained	N.A.	49.750
5	London Clay 3	19.500	19.500	Undrained	N.A.	56.250
6	London Clay 4	19.500	19.500	Undrained	N.A.	62.750
7	London Clay 5	19.500	19.500	Undrained	N.A.	72.500
8	London Clay 6	19.500	19.500	Undrained	N.A.	85.500
9	London Clay 7	19.500	19.500	Undrained	N.A.	98.500
10	London Clay 8	19.500	19.500	Undrained	N.A.	111.50
11	London Clay 9	19.500	19.500	Undrained	N.A.	124.50
12	Harwich	20.000	20.000	Undrained	N.A.	130.00

Coordinates of top of soil strata

The units of the following coordinates are in m

Stratum X -->	0.0	20.898	23.379	28.828	29.581	32.369	33.335
1	8.6893	7.2080	7.0791	.	8.1157	.	.
2	8.6893	7.2080	7.0791	6.8704	.	6.7401	6.7034
3	7.1893	5.7080	5.5791	5.3704	.	5.2401	5.2034
4	6.1893	4.7080	4.5791	4.3704	.	4.2401	4.2034
5	5.1893	3.7080	3.5791	3.3704	.	3.2401	3.2034
6	4.1893	2.7080	2.5791	2.3704	.	2.2401	2.2034
7	3.1893	1.7080	1.5791	1.3704	.	1.2401	1.2034
8	1.1893	-0.29200	-0.42090	-0.62960	.	-0.75990	-0.79660
9	-0.81070	-2.2920	-2.4209	-2.6296	.	-2.7599	-2.7966
10	-2.8107	-4.2920	-4.4209	-4.6296	.	-4.7599	-4.7966
11	-4.8107	-6.2920	-6.4209	-6.6296	.	-6.7599	-6.7966
12	-6.8107	-8.2920	-8.4209	-8.6296	.	-8.7599	-8.7966
Stratum X -->							

	34.766	35.786	39.364	40.591	47.080	51.434	52.355
1	.	.	.	10.836	12.443	.	13.709
2	6.6573	6.6276	6.4857	.	.	6.1039	.
3	5.1573	5.1276	4.9857	.	.	4.6039	.
4	4.1573	4.1276	3.9857	.	.	3.6039	.
5	3.1573	3.1276	2.9857	.	.	2.6039	.
6	2.1573	2.1276	1.9857	.	.	1.6039	.
7	1.1573	1.1276	0.98570	.	.	0.60390	.
8	-0.84270	-0.87240	-1.0143	.	.	-1.3961	.
9	-2.8427	-2.8724	-3.0143	.	.	-3.3961	.
10	-4.8427	-4.8724	-5.0143	.	.	-5.3961	.
11	-6.8427	-6.8724	-7.0143	.	.	-7.3961	.
12	-8.8427	-8.8724	-9.0143	.	.	-9.3961	.

Stratum X -->

	56.933	59.521	66.317	73.606	78.893	85.003	85.461
1	14.621	15.116	16.116	16.989	17.505	.	18.116
2	.	.	.	.	.	5.2282	.
3	.	.	.	.	.	3.7282	.
4	.	.	.	.	.	2.7282	.
5	.	.	.	.	.	1.7282	.
6	.	.	.	.	.	0.72820	.
7	.	.	.	.	.	-0.27180	.
8	.	.	.	.	.	-2.2718	.
9	.	.	.	.	.	-4.2718	.
10	.	.	.	.	.	-6.2718	.
11	.	.	.	.	.	-8.2718	.
12	.	.	.	.	.	-10.272	.

Stratum X -->

	99.536	115.65	118.48	121.49	127.57	132.45	141.16
1	.	.	18.516	18.516	18.516	18.516	.
2	4.7505	4.1518	.	.	.	.	3.2210
3	3.2505	2.6518	.	.	.	.	1.7210
4	2.2505	1.6518	.	.	.	.	0.72100
5	1.2505	0.65180	.	.	.	.	-0.27900
6	0.25050	-0.34820	.	.	.	.	-1.2790
7	-0.74950	-1.3482	.	.	.	.	-2.2790
8	-2.7495	-3.3482	.	.	.	.	-4.2790
9	-4.7495	-5.3482	.	.	.	.	-6.2790
10	-6.7495	-7.3482	.	.	.	.	-8.2790
11	-8.7495	-9.3482	.	.	.	.	-10.279
12	-10.750	-11.348	.	.	.	.	-12.279

Stratum X -->

	144.70	144.70	153.81	162.49	172.17	177.64	185.66
1	18.516	18.516	18.516	18.516	.	18.116	17.116
2	.	.	.	.	2.1856	.	.
3	.	.	.	.	0.68560	.	.
4	.	.	.	.	-0.31440	.	.
5	.	.	.	.	-1.3144	.	.
6	.	.	.	.	-2.3144	.	.
7	.	.	.	.	-3.3144	.	.
8	.	.	.	.	-5.3144	.	.
9	.	.	.	.	-7.3144	.	.
10	.	.	.	.	-9.3144	.	.
11	.	.	.	.	-11.314	.	.
12	.	.	.	.	-13.314	.	.

Stratum X -->

	191.41	194.77	200.18	216.26	218.03	222.93	225.17
1	16.116	15.267	.	9.9809	.	8.3921	7.9546
2	.	.	1.3365	.	0.89880	.	.
3	.	.	-0.16350	.	-0.60120	.	.
4	.	.	-1.1635	.	-1.6012	.	.
5	.	.	-2.1635	.	-2.6012	.	.
6	.	.	-3.1635	.	-3.6012	.	.
7	.	.	-4.1635	.	-4.6012	.	.
8	.	.	-6.1635	.	-6.6012	.	.
9	.	.	-8.1635	.	-8.6012	.	.
10	.	.	-10.163	.	-10.601	.	.
11	.	.	-12.163	.	-12.601	.	.
12	.	.	-14.163	.	-14.601	.	.

Stratum X -->

	230.21	232.54	236.31	246.23	248.97	251.04	252.69
1	6.6974	6.1157	5.1157	3.1157	2.5294	2.1157	.
2	.	.	.	.	.	.	0.57650
3	.	.	.	.	.	.	-0.92350
4	.	.	.	.	.	.	-1.9235

Stratum X -->							
	220.21	232.54	236.21	246.23	248.07	251.04	252.60
5	.	.	.	.	.	.	-2.9235
6	.	.	.	.	.	.	-3.9235
7	.	.	.	.	.	.	-4.9235
8	.	.	.	.	.	.	-6.9235
9	.	.	.	.	.	.	-8.9235
10	.	.	.	.	.	.	-10.924
11	.	.	.	.	.	.	-12.924
12	.	.	.	.	.	.	-14.924

Stratum X -->	255.13	262.54	285.08
1	1.4450	0.45890	0.0
2	.	0.45890	0.0
3	.	-1.0411	-1.5000
4	.	-2.0411	-2.5000
5	.	-3.0411	-3.5000
6	.	-4.0411	-4.5000
7	.	-5.0411	-5.5000
8	.	-7.0411	-7.5000
9	.	-9.0411	-9.5000
10	.	-11.041	-11.500
11	.	-13.041	-13.500
12	.	-15.041	-15.500

Stratum-linked data

No.	Material	Water table	Piezo Set/ Ru value
1	Waste		- -
2	Waste		- -
3	London Clay 1		- -
4	London Clay 2		- -
5	London Clay 3		- -
6	London Clay 4		- -
7	London Clay 5		- -
8	London Clay 6		- -
9	London Clay 7		- -
10	London Clay 8		- -
11	London Clay 9		- -
12	Harwich		- -

Slip Surface Specification

Circle centre specification: GRID
Bottom left of grid: x = 10.00000 m y = 20.00000 m
Inclination of grid: 0.00000 deg
(positive anticlockwise direction about bottom left of grid)
Centres on grid: 20 in x direction at 3.50000m spacing
15 in y direction at 3.50000m spacing
Initial radius of circle 5.00000 m
Incremented by 1.00000 m until all possible circles considered

WORST CASE

Centre at (48.500m,55.000m) Radius 54.000m
Iterations: 5 Horiz acceleration [%g]: 0.0
Net vertical force [kN/m]: 22.027 *Slip weight [kN/m] 10824.*
Net horiz force [kN/m]: 105.28 Disturbing moment [kN/m]: 91265.
Restoring moment [kNm/m]: 144910.
Reinf.Rest.Moment [kNm/m]: 0.0
Over-Design Factor: 1.5878

The system of interslice and base forces are in equilibrium
when the strengths available at the bases are divided by the computed
over-design factor. The interslice forces shown in the following table
are in equilibrium with the factored strengths of the soil at the bases of slices.

Slip surface coordinates		Pore Pressure		Interslice forces [kN/m]		
Point x [m]	y [m]	L [kN/m²]	R [kN/m²]	T	E	E(u)
1 23.553	7.1082	-	0.0	0.0	0.0	0.0
2 23.627	7.0696	0.0	0.0	0.52045	2.4100	0.0
3 25.330	6.2236	0.0	0.0	8.9130	64.503	0.0
4 27.061	5.4381	0.0	0.0	12.045	139.22	0.0
5 28.828	4.7106	0.0	0.0	13.821	219.42	0.0
6 29.581	4.4225	0.0	0.0	13.816	255.79	0.0
7 29.820	4.3339	0.0	0.0	13.742	267.56	0.0
8 31.089	3.8838	0.0	0.0	11.474	335.79	0.0
9 32.369	3.4655	0.0	0.0	8.7035	407.15	0.0
10 33.217	3.2079	0.0	0.0	6.8028	455.29	0.0
11 33.335	3.1732	0.0	0.0	6.4394	462.38	0.0
12 34.766	2.7758	0.0	0.0	2.2635	548.62	0.0

Slip surface coordinates		Pore Pressure		Interslice forces [kN/m]		
13	35.786	2.5180	0.0	0.0	-0.33479	609.99	0.0
14	37.943	2.0421	0.0	0.0	-4.4137	737.18	0.0
15	39.364	1.7784	0.0	0.0	-6.7090	821.69	0.0
16	40.591	1.5823	0.0	0.0	-7.8676	891.46	0.0
17	42.746	1.3074	0.0	0.0	-8.2820	1005.0	0.0
18	44.910	1.1195	0.0	0.0	-7.2941	1104.8	0.0
19	47.080	1.0187	0.0	0.0	-5.9688	1188.1	0.0
20	49.258	1.0053	0.0	0.0	-5.6757	1252.6	0.0
21	51.434	1.0798	0.0	0.0	-0.61613	1296.3	0.0
22	52.355	1.1378	0.0	0.0	2.9014	1308.0	0.0
23	54.063	1.2873	0.0	0.0	10.997	1319.0	0.0
24	55.765	1.4909	0.0	0.0	20.288	1315.6	0.0
25	56.933	1.6625	0.0	0.0	26.370	1301.7	0.0
26	58.230	1.8838	0.0	0.0	32.846	1278.4	0.0
27	59.521	2.1366	0.0	0.0	38.621	1247.2	0.0
28	60.567	2.3656	0.0	0.0	42.571	1216.2	0.0
29	62.297	2.7923	0.0	0.0	46.017	1149.8	0.0
30	64.012	3.2758	0.0	0.0	46.399	1072.2	0.0
31	66.317	4.0242	0.0	0.0	39.086	944.71	0.0
32	66.820	4.2025	0.0	0.0	36.499	914.78	0.0
33	68.589	4.8759	0.0	0.0	26.668	809.89	0.0
34	70.334	5.6109	0.0	0.0	13.005	700.64	0.0
35	71.983	6.3734	0.0	0.0	-3.2370	594.03	0.0
36	73.606	7.1909	0.0	0.0	-21.823	487.99	0.0
37	75.408	8.1816	0.0	0.0	-44.326	371.74	0.0
38	77.171	9.2402	0.0	0.0	-66.531	262.74	0.0
39	78.893	10.365	0.0	0.0	-86.348	163.83	0.0
40	80.611	11.585	0.0	0.0	-101.69	75.654	0.0
41	82.280	12.870	0.0	0.0	-109.27	3.0586	0.0
42	83.897	14.220	0.0	0.0	-106.28	-52.212	0.0
43	85.461	15.631	0.0	0.0	-89.902	-88.978	0.0
44	86.736	16.868	0.0	0.0	-63.079	-104.53	0.0
45	87.969	18.146	0.0	-	-22.027	-105.28	0.0

Slice No.	Strength Parameters		Average Pore Pressure	Slice Weight	Forces on base [kN/m]		
	c' [kN/m²]	Tan phi	[kN/m²]	[kN/m]	Normal	Shear (capacity)	Shear (mobilised)
1	*35.714*	*0.0*	0.0	*0.036885*	1.6953	2.9869	1.8811
2	*35.714*	*0.0*	0.0	*20.465*	55.449	67.911	42.769
3	*35.714*	*0.0*	0.0	*58.048*	88.461	67.910	42.769
4	*30.893*	*0.0*	0.0	*95.374*	122.15	59.034	37.179
5	*30.893*	*0.0*	0.0	*51.177*	61.503	24.900	15.682
6	*30.893*	*0.0*	0.0	*17.531*	20.681	7.8647	4.9531
7	*35.536*	*0.0*	0.0	*104.52*	120.30	47.858	30.140
8	*35.536*	*0.0*	0.0	*124.11*	138.56	47.858	30.140
9	*35.536*	*0.0*	0.0	*92.092*	100.96	31.477	19.824
10	*40.179*	*0.0*	0.0	*13.436*	14.629	4.9423	3.1126
11	*40.179*	*0.0*	0.0	*174.27*	187.99	59.668	37.578
12	*40.179*	*0.0*	0.0	*136.83*	145.85	42.290	26.634
13	*40.179*	*0.0*	0.0	*321.07*	338.20	88.727	55.879
14	*44.821*	*0.0*	0.0	*234.15*	244.08	64.799	40.810
15	*44.821*	*0.0*	0.0	*215.44*	223.13	55.694	35.075
16	*44.821*	*0.0*	0.0	*405.84*	417.27	97.368	61.321
17	*44.821*	*0.0*	0.0	*439.92*	448.41	97.368	61.321
18	*44.821*	*0.0*	0.0	*469.92*	474.87	97.368	61.321
19	*44.821*	*0.0*	0.0	*496.47*	497.19	97.601	61.468
20	*44.821*	*0.0*	0.0	*517.08*	520.30	97.601	61.468
21	*44.821*	*0.0*	0.0	*224.44*	226.73	41.385	26.064
22	*44.821*	*0.0*	0.0	*421.76*	427.18	76.825	48.384
23	*44.821*	*0.0*	0.0	*425.79*	432.28	76.825	48.384
24	*40.179*	*0.0*	0.0	*294.38*	299.21	47.420	29.865
25	*40.179*	*0.0*	0.0	*328.12*	333.63	52.870	33.297
26	*40.179*	*0.0*	0.0	*326.91*	332.34	52.870	33.297
27	*40.179*	*0.0*	0.0	*264.07*	268.30	43.038	27.105
28	*35.536*	*0.0*	0.0	*432.29*	438.73	63.302	39.867
29	*35.536*	*0.0*	0.0	*421.79*	427.13	63.302	39.867
30	*30.893*	*0.0*	0.0	*552.92*	557.88	74.896	47.169
31	*30.893*	*0.0*	0.0	*117.87*	118.55	16.469	10.372
32	*35.714*	*0.0*	0.0	*405.13*	406.37	67.611	42.580
33	*35.714*	*0.0*	0.0	*382.69*	382.07	67.611	42.581
34	*35.714*	*0.0*	0.0	*344.21*	341.99	64.891	40.867
35	*35.714*	*0.0*	0.0	*319.87*	316.29	64.890	40.867
36	*35.714*	*0.0*	0.0	*330.03*	324.90	73.451	46.259
37	*35.714*	*0.0*	0.0	*293.63*	288.18	73.452	46.259
38	*35.714*	*0.0*	0.0	*255.77*	250.95	73.451	46.259
39	*35.714*	*0.0*	0.0	*221.42*	218.35	75.237	47.383

Slice No.	Strength Parameters		Average Pore	Slice Weight	Forces on base [kN/m]		
40	*35.714*	*0.0*	0.0	*179.48*	179.70	75.237	47.383
41	*35.714*	*0.0*	0.0	*137.22*	142.24	75.237	47.383
42	*35.714*	*0.0*	0.0	*95.058*	106.49	75.237	47.383
43	*35.714*	*0.0*	0.0	*46.572*	62.751	63.430	39.947
44	*35.714*	*0.0*	0.0	*15.188*	38.816	63.430	39.947

Slice No.	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]	
	Vert	Horiz	Vert	Horiz	Vert	Horiz
1	*0.0*	*0.0*	0.0	0.0	0.0	0.0
2	*0.0*	*0.0*	0.0	0.0	0.0	0.0
3	*0.0*	*0.0*	0.0	0.0	0.0	0.0
4	*0.0*	*0.0*	0.0	0.0	0.0	0.0
5	*0.0*	*0.0*	0.0	0.0	0.0	0.0
6	*0.0*	*0.0*	0.0	0.0	0.0	0.0
7	*0.0*	*0.0*	0.0	0.0	0.0	0.0
8	*0.0*	*0.0*	0.0	0.0	0.0	0.0
9	*0.0*	*0.0*	0.0	0.0	0.0	0.0
10	*0.0*	*0.0*	0.0	0.0	0.0	0.0
11	*0.0*	*0.0*	0.0	0.0	0.0	0.0
12	*0.0*	*0.0*	0.0	0.0	0.0	0.0
13	*0.0*	*0.0*	0.0	0.0	0.0	0.0
14	*0.0*	*0.0*	0.0	0.0	0.0	0.0
15	*0.0*	*0.0*	0.0	0.0	0.0	0.0
16	*0.0*	*0.0*	0.0	0.0	0.0	0.0
17	*0.0*	*0.0*	0.0	0.0	0.0	0.0
18	*0.0*	*0.0*	0.0	0.0	0.0	0.0
19	*0.0*	*0.0*	0.0	0.0	0.0	0.0
20	*0.0*	*0.0*	0.0	0.0	0.0	0.0
21	*0.0*	*0.0*	0.0	0.0	0.0	0.0
22	*0.0*	*0.0*	0.0	0.0	0.0	0.0
23	*0.0*	*0.0*	0.0	0.0	0.0	0.0
24	*0.0*	*0.0*	0.0	0.0	0.0	0.0
25	*0.0*	*0.0*	0.0	0.0	0.0	0.0
26	*0.0*	*0.0*	0.0	0.0	0.0	0.0
27	*0.0*	*0.0*	0.0	0.0	0.0	0.0
28	*0.0*	*0.0*	0.0	0.0	0.0	0.0
29	*0.0*	*0.0*	0.0	0.0	0.0	0.0
30	*0.0*	*0.0*	0.0	0.0	0.0	0.0
31	*0.0*	*0.0*	0.0	0.0	0.0	0.0
32	*0.0*	*0.0*	0.0	0.0	0.0	0.0
33	*0.0*	*0.0*	0.0	0.0	0.0	0.0
34	*0.0*	*0.0*	0.0	0.0	0.0	0.0
35	*0.0*	*0.0*	0.0	0.0	0.0	0.0
36	*0.0*	*0.0*	0.0	0.0	0.0	0.0
37	*0.0*	*0.0*	0.0	0.0	0.0	0.0
38	*0.0*	*0.0*	0.0	0.0	0.0	0.0
39	*0.0*	*0.0*	0.0	0.0	0.0	0.0
40	*0.0*	*0.0*	0.0	0.0	0.0	0.0
41	*0.0*	*0.0*	0.0	0.0	0.0	0.0
42	*0.0*	*0.0*	0.0	0.0	0.0	0.0
43	*0.0*	*0.0*	0.0	0.0	0.0	0.0
44	*0.0*	*0.0*	0.0	0.0	0.0	0.0

ARUP

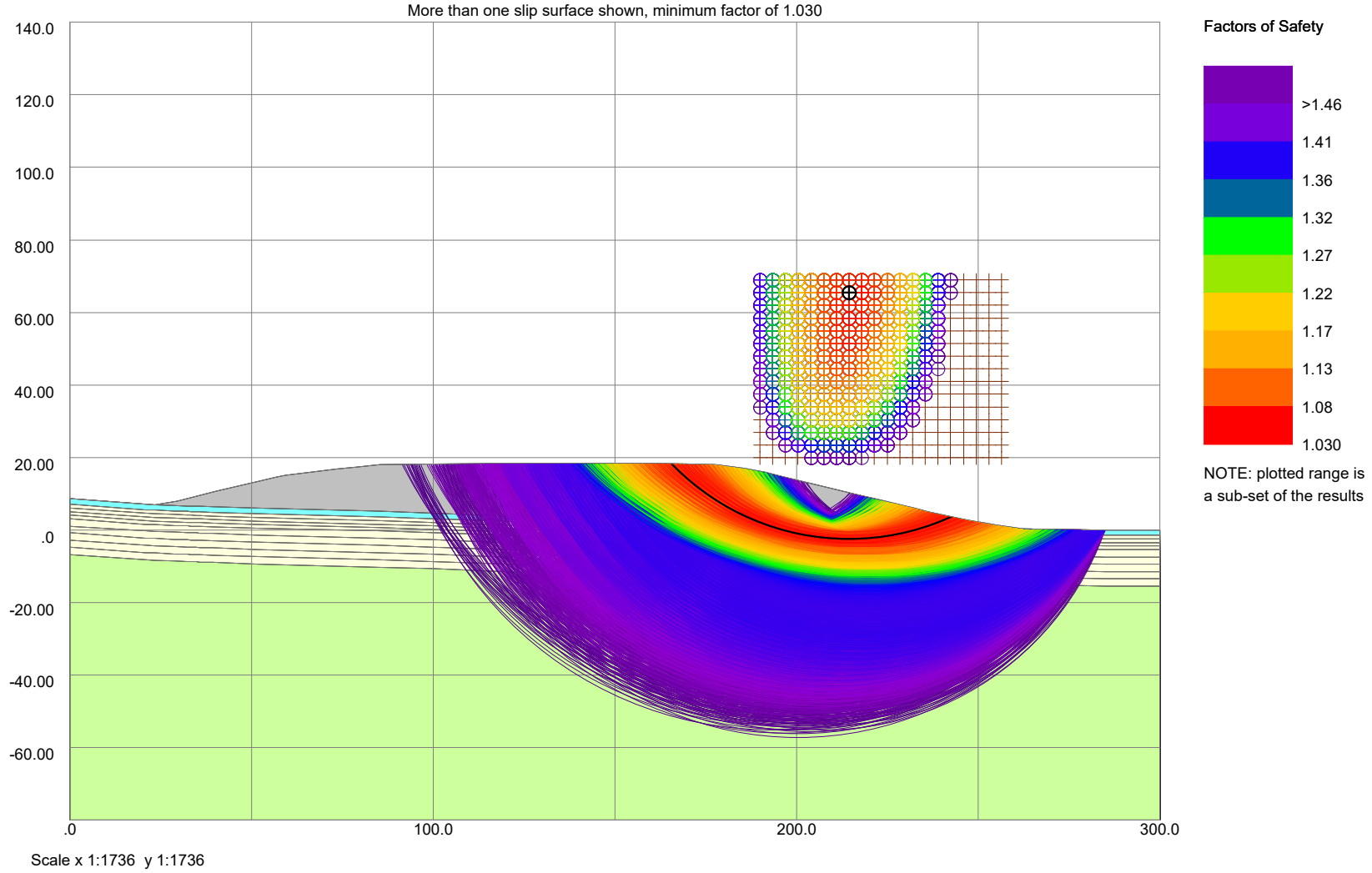
Arup

Northern SPA
Eastern Mound - Undrained
Section B-BB (west)

Job No.	Sheet No.	Rev.
256906		

Drg. Ref.

Made by	Date	Checked
EB		



General Parameters

Direction of slip: DOWNHILL
Minimum slip weight [kN/m] : 0.00000
Type of analysis : STATIC

Analysis Options

Partial Factor Analysis
Minimum number of slices: 25
Method: Bishop (Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: NOT ACTIVE

Method Partial Factors

Current selection: BS EN 1997-1:2011 DA1-2
Factor on FAVOURABLE PERMANENT LOAD: 1.00000
Factor on UNFAVOURABLE PERMANENT LOAD: 1.00000
Factor on FAVOURABLE VARIABLE LOAD: 0.00000
Factor on UNFAVOURABLE VARIABLE LOAD: 1.30000
Factor on SOIL UNIT WEIGHT: 1.00000
Factor on DRAINED SOIL COHESION: 1.25000
Factor on UNDRAINED SOIL COHESION: 1.40000
Factor on SOIL FRICTION ANGLE: 1.25000
Factor on reinforcement pullout: 1.50000
Economic ramification of failure: 1.00000
Sliding along reinforcement: 1.50000

Material properties

No	Description	Unit Weight Above GWL [kN/m3]	Unit Weight Below GWL [kN/m3]	Shear Strength Parameters Condition	Phi or Phi0 [°]	c or c0' [kN/m²]
1	Waste	19.500	19.500	Undrained	N.A.	50.000
2	Clay Deposits	17.000	17.000	Undrained	N.A.	30.000
3	London Clay 1	19.500	19.500	Undrained	N.A.	43.250
4	London Clay 2	19.500	19.500	Undrained	N.A.	49.750
5	London Clay 3	19.500	19.500	Undrained	N.A.	56.250
6	London Clay 4	19.500	19.500	Undrained	N.A.	62.750
7	London Clay 5	19.500	19.500	Undrained	N.A.	72.500
8	London Clay 6	19.500	19.500	Undrained	N.A.	85.500
9	London Clay 7	19.500	19.500	Undrained	N.A.	98.500
10	London Clay 8	19.500	19.500	Undrained	N.A.	111.50
11	London Clay 9	19.500	19.500	Undrained	N.A.	124.50
12	Harwich	20.000	20.000	Undrained	N.A.	130.00

Coordinates of top of soil strata

The units of the following coordinates are in m

Stratum X -->	0.0	20.898	23.379	28.828	29.581	32.369	33.335
1	8.6893	7.2080	7.0791	.	8.1157	.	.
2	8.6893	7.2080	7.0791	6.8704	.	6.7401	6.7034
3	7.1893	5.7080	5.5791	5.3704	.	5.2401	5.2034
4	6.1893	4.7080	4.5791	4.3704	.	4.2401	4.2034
5	5.1893	3.7080	3.5791	3.3704	.	3.2401	3.2034
6	4.1893	2.7080	2.5791	2.3704	.	2.2401	2.2034
7	3.1893	1.7080	1.5791	1.3704	.	1.2401	1.2034
8	1.1893	-0.29200	-0.42090	-0.62960	.	-0.75990	-0.79660
9	-0.81070	-2.2920	-2.4209	-2.6296	.	-2.7599	-2.7966
10	-2.8107	-4.2920	-4.4209	-4.6296	.	-4.7599	-4.7966
11	-4.8107	-6.2920	-6.4209	-6.6296	.	-6.7599	-6.7966
12	-6.8107	-8.2920	-8.4209	-8.6296	.	-8.7599	-8.7966
Stratum X -->							

	34.766	35.786	39.364	40.591	47.080	51.434	52.355
1	.	.	.	10.836	12.443	.	13.709
2	6.6573	6.6276	6.4857	.	.	6.1039	.
3	5.1573	5.1276	4.9857	.	.	4.6039	.
4	4.1573	4.1276	3.9857	.	.	3.6039	.
5	3.1573	3.1276	2.9857	.	.	2.6039	.
6	2.1573	2.1276	1.9857	.	.	1.6039	.
7	1.1573	1.1276	0.98570	.	.	0.60390	.
8	-0.84270	-0.87240	-1.0143	.	.	-1.3961	.
9	-2.8427	-2.8724	-3.0143	.	.	-3.3961	.
10	-4.8427	-4.8724	-5.0143	.	.	-5.3961	.
11	-6.8427	-6.8724	-7.0143	.	.	-7.3961	.
12	-8.8427	-8.8724	-9.0143	.	.	-9.3961	.

Stratum X -->

	56.933	59.521	66.317	73.606	78.893	85.003	85.461
1	14.621	15.116	16.116	16.989	17.505	.	18.116
2	.	.	.	.	.	5.2282	.
3	.	.	.	.	.	3.7282	.
4	.	.	.	.	.	2.7282	.
5	.	.	.	.	.	1.7282	.
6	.	.	.	.	.	0.72820	.
7	.	.	.	.	.	-0.27180	.
8	.	.	.	.	.	-2.2718	.
9	.	.	.	.	.	-4.2718	.
10	.	.	.	.	.	-6.2718	.
11	.	.	.	.	.	-8.2718	.
12	.	.	.	.	.	-10.272	.

Stratum X -->

	99.536	115.65	118.48	121.49	127.57	132.45	141.16
1	.	.	18.516	18.516	18.516	18.516	.
2	4.7505	4.1518	.	.	.	.	3.2210
3	3.2505	2.6518	.	.	.	.	1.7210
4	2.2505	1.6518	.	.	.	.	0.72100
5	1.2505	0.65180	.	.	.	.	-0.27900
6	0.25050	-0.34820	.	.	.	.	-1.2790
7	-0.74950	-1.3482	.	.	.	.	-2.2790
8	-2.7495	-3.3482	.	.	.	.	-4.2790
9	-4.7495	-5.3482	.	.	.	.	-6.2790
10	-6.7495	-7.3482	.	.	.	.	-8.2790
11	-8.7495	-9.3482	.	.	.	.	-10.279
12	-10.750	-11.348	.	.	.	.	-12.279

Stratum X -->

	144.70	144.70	153.81	162.49	172.17	177.64	185.66
1	18.516	18.516	18.516	18.516	.	18.116	17.116
2	.	.	.	.	2.1856	.	.
3	.	.	.	.	0.68560	.	.
4	.	.	.	.	-0.31440	.	.
5	.	.	.	.	-1.3144	.	.
6	.	.	.	.	-2.3144	.	.
7	.	.	.	.	-3.3144	.	.
8	.	.	.	.	-5.3144	.	.
9	.	.	.	.	-7.3144	.	.
10	.	.	.	.	-9.3144	.	.
11	.	.	.	.	-11.314	.	.
12	.	.	.	.	-13.314	.	.

Stratum X -->

	191.41	194.77	200.18	216.26	218.03	222.93	225.17
1	16.116	15.267	.	9.9809	.	8.3921	7.9546
2	.	.	1.3365	.	0.89880	.	.
3	.	.	-0.16350	.	-0.60120	.	.
4	.	.	-1.1635	.	-1.6012	.	.
5	.	.	-2.1635	.	-2.6012	.	.
6	.	.	-3.1635	.	-3.6012	.	.
7	.	.	-4.1635	.	-4.6012	.	.
8	.	.	-6.1635	.	-6.6012	.	.
9	.	.	-8.1635	.	-8.6012	.	.
10	.	.	-10.163	.	-10.601	.	.
11	.	.	-12.163	.	-12.601	.	.
12	.	.	-14.163	.	-14.601	.	.

Stratum X -->

	230.21	232.54	236.31	246.23	248.97	251.04	252.69
1	6.6974	6.1157	5.1157	3.1157	2.5294	2.1157	.
2	.	.	.	.	.	.	0.57650
3	.	.	.	.	.	.	-0.92350
4	.	.	.	.	.	.	-1.9235

Stratum X -->							
	220.21	232.54	236.21	246.23	248.07	251.04	252.60
5	.	.	.	.	.	.	-2.9235
6	.	.	.	.	.	.	-3.9235
7	.	.	.	.	.	.	-4.9235
8	.	.	.	.	.	.	-6.9235
9	.	.	.	.	.	.	-8.9235
10	.	.	.	.	.	.	-10.924
11	.	.	.	.	.	.	-12.924
12	.	.	.	.	.	.	-14.924

Stratum X -->	255.13	262.54	285.08
1	1.4450	0.45890	0.0
2	.	0.45890	0.0
3	.	-1.0411	-1.5000
4	.	-2.0411	-2.5000
5	.	-3.0411	-3.5000
6	.	-4.0411	-4.5000
7	.	-5.0411	-5.5000
8	.	-7.0411	-7.5000
9	.	-9.0411	-9.5000
10	.	-11.041	-11.500
11	.	-13.041	-13.500
12	.	-15.041	-15.500

Stratum-linked data

No.	Material	Water table	Piezo Set/ Ru value
1	Waste		- -
2	Clay Deposits		- -
3	London Clay 1		- -
4	London Clay 2		- -
5	London Clay 3		- -
6	London Clay 4		- -
7	London Clay 5		- -
8	London Clay 6		- -
9	London Clay 7		- -
10	London Clay 8		- -
11	London Clay 9		- -
12	Harwich		- -

Slip Surface Specification

Circle centre specification: GRID
Bottom left of grid: x = 190.00000 m y = 20.00000 m
Inclination of grid: 0.00000 deg
(positive anticlockwise direction about bottom left of grid)
Centres on grid: 20 in x direction at 3.50000m spacing
15 in y direction at 3.50000m spacing
Initial radius of circle 5.00000 m
Incremented by 1.00000 m until all possible circles considered

WORST CASE

Centre at (214.50m,65.500m) Radius 68.000m
Iterations: 5 Horiz acceleration [%g]: 0.0
Net vertical force [kN/m]: 33.357 *Slip weight [kN/m] 15127.*
Net horiz force [kN/m]: 158.16 Disturbing moment [kN/m]: 185400.
Restoring moment [kNm/m]: 191050.
Reinf.Rest.Moment [kNm/m]: 0.0
Over-Design Factor: 1.0305

The system of interslice and base forces are in equilibrium
when the strengths available at the bases are divided by the computed
over-design factor. The interslice forces shown in the following table
are in equilibrium with the factored strengths of the soil at the bases of slices.

Slip surface coordinates		Pore Pressure		Interslice forces [kN/m]		
Point	x [m]	y [m]	L [kN/m²]	R [kN/m²]	T	E	E(u)
1	165.42	18.438	-	0.0	0.0	0.0	0.0
2	167.29	16.564	0.0	0.0	-80.814	-15.520	0.0
3	169.23	14.763	0.0	0.0	-131.00	0.69905	0.0
4	171.23	13.039	0.0	0.0	-154.82	48.487	0.0
5	173.31	11.395	0.0	0.0	-156.84	126.68	0.0
6	175.45	9.8328	0.0	0.0	-141.75	233.16	0.0
7	177.64	8.3550	0.0	0.0	-114.22	364.88	0.0
8	180.25	6.7567	0.0	0.0	-74.564	540.33	0.0
9	182.92	5.2771	0.0	0.0	-33.523	731.47	0.0
10	185.66	3.9190	0.0	0.0	4.2896	930.48	0.0
11	188.42	2.7019	0.0	0.0	34.383	1125.0	0.0
12	191.22	1.6080	0.0	0.0	54.800	1308.7	0.0

Slip surface coordinates		Pore Pressure		Interslice forces [kN/m]		
13	191.41	1.5405	0.0	0.0	56.723	1322.8	0.0
14	193.08	0.96122	0.0	0.0	71.182	1443.8	0.0
15	194.77	0.42567	0.0	0.0	80.966	1555.4	0.0
16	196.41	-0.049100	0.0	0.0	86.336	1653.1	0.0
17	198.29	-0.53940	0.0	0.0	83.688	1734.5	0.0
18	200.18	-0.97574	0.0	0.0	77.724	1801.4	0.0
19	201.21	-1.1887	0.0	0.0	73.414	1831.2	0.0
20	203.87	-1.6645	0.0	0.0	57.602	1874.7	0.0
21	206.55	-2.0340	0.0	0.0	40.773	1886.2	0.0
22	209.25	-2.2967	0.0	0.0	25.612	1865.7	0.0
23	211.95	-2.4520	0.0	0.0	14.824	1814.0	0.0
24	213.72	-2.4955	0.0	0.0	11.212	1756.0	0.0
25	216.26	-2.4773	0.0	0.0	10.863	1664.1	0.0
26	218.03	-2.4084	0.0	0.0	10.050	1586.7	0.0
27	220.49	-2.2361	0.0	0.0	9.1721	1463.2	0.0
28	222.93	-1.9749	0.0	0.0	9.6161	1323.8	0.0
29	225.11	-1.6671	0.0	0.0	11.807	1188.7	0.0
30	225.17	-1.6572	0.0	0.0	11.855	1185.0	0.0
31	227.59	-1.2283	0.0	0.0	14.790	1036.3	0.0
32	229.99	-0.71243	0.0	0.0	19.660	883.32	0.0
33	230.21	-0.66100	0.0	0.0	19.711	871.30	0.0
34	232.54	-0.063148	0.0	0.0	20.503	742.58	0.0
35	235.24	0.73878	0.0	0.0	20.860	597.75	0.0
36	236.31	1.0931	0.0	0.0	25.168	527.83	0.0
37	238.58	1.9046	0.0	0.0	32.655	388.36	0.0
38	240.81	2.7956	0.0	0.0	36.237	263.85	0.0
39	243.01	3.7650	0.0	-	33.357	158.16	0.0

Slice No.	Strength Parameters		Average Pore Pressure	Slice Weight	Forces on base [kN/m]		
	c' [kN/m²]	Tan phi	[kN/m²]	[kN/m]	Normal	Shear (capacity)	Shear (mobilised)
1	*35.714*	*0.0*	0.0	*33.264*	68.166	94.544	91.748
2	*35.714*	*0.0*	0.0	*102.17*	121.39	94.543	91.747
3	*35.714*	*0.0*	0.0	*172.78*	179.06	94.544	91.749
4	*35.714*	*0.0*	0.0	*244.37*	240.46	94.543	91.747
5	*35.714*	*0.0*	0.0	*316.22*	304.80	94.544	91.749
6	*35.714*	*0.0*	0.0	*387.62*	371.22	94.543	91.748
7	*35.714*	*0.0*	0.0	*528.12*	506.95	109.14	105.92
8	*35.714*	*0.0*	0.0	*605.21*	585.13	109.14	105.92
9	*35.714*	*0.0*	0.0	*677.38*	660.44	109.14	105.92
10	*35.714*	*0.0*	0.0	*729.11*	717.19	107.61	104.43
11	*35.714*	*0.0*	0.0	*779.43*	773.16	107.61	104.43
12	*21.429*	*0.0*	0.0	*52.857*	52.641	4.2455	4.1199
13	*21.429*	*0.0*	0.0	*476.50*	475.84	37.925	36.804
14	*21.429*	*0.0*	0.0	*482.88*	484.32	37.925	36.803
15	*21.429*	*0.0*	0.0	*470.39*	473.53	36.578	35.497
16	*30.893*	*0.0*	0.0	*540.40*	545.68	60.046	58.270
17	*30.893*	*0.0*	0.0	*544.16*	550.83	60.045	58.270
18	*30.893*	*0.0*	0.0	*294.43*	298.43	32.409	31.451
19	*35.536*	*0.0*	0.0	*757.58*	768.67	96.130	93.287
20	*35.536*	*0.0*	0.0	*750.11*	761.10	96.129	93.287
21	*35.536*	*0.0*	0.0	*735.53*	744.99	96.129	93.287
22	*35.536*	*0.0*	0.0	*713.87*	720.39	96.129	93.287
23	*40.179*	*0.0*	0.0	*453.17*	455.20	71.274	69.167
24	*35.536*	*0.0*	0.0	*622.46*	623.51	90.122	87.457
25	*35.536*	*0.0*	0.0	*415.53*	419.27	63.042	61.178
26	*35.536*	*0.0*	0.0	*546.04*	554.81	87.525	84.937
27	*35.536*	*0.0*	0.0	*506.07*	518.45	87.525	84.937
28	*35.536*	*0.0*	0.0	*416.24*	429.94	78.108	75.798
29	*30.893*	*0.0*	0.0	*11.468*	11.896	1.9506	1.8929
30	*30.893*	*0.0*	0.0	*419.56*	437.64	75.823	73.581
31	*30.893*	*0.0*	0.0	*366.35*	387.28	75.823	73.581
32	*21.429*	*0.0*	0.0	*30.735*	32.794	4.8045	4.6624
33	*21.429*	*0.0*	0.0	*301.36*	325.08	51.619	50.092
34	*21.429*	*0.0*	0.0	*282.09*	313.95	60.256	58.474
35	*35.714*	*0.0*	0.0	*91.090*	105.44	40.450	39.254
36	*35.714*	*0.0*	0.0	*149.57*	183.39	85.881	83.342
37	*35.714*	*0.0*	0.0	*90.761*	129.88	85.881	83.342
38	*35.714*	*0.0*	0.0	*30.321*	75.946	85.881	83.342

Slice No.	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]	
	Vert	Horiz	Vert	Horiz	Vert	Horiz
1	*0.0*	*0.0*	0.0	0.0	0.0	0.0
2	*0.0*	*0.0*	0.0	0.0	0.0	0.0
3	*0.0*	*0.0*	0.0	0.0	0.0	0.0

Slice No.	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]	
4	*0.0*	*0.0*	0.0	0.0	0.0	0.0
5	*0.0*	*0.0*	0.0	0.0	0.0	0.0
6	*0.0*	*0.0*	0.0	0.0	0.0	0.0
7	*0.0*	*0.0*	0.0	0.0	0.0	0.0
8	*0.0*	*0.0*	0.0	0.0	0.0	0.0
9	*0.0*	*0.0*	0.0	0.0	0.0	0.0
10	*0.0*	*0.0*	0.0	0.0	0.0	0.0
11	*0.0*	*0.0*	0.0	0.0	0.0	0.0
12	*0.0*	*0.0*	0.0	0.0	0.0	0.0
13	*0.0*	*0.0*	0.0	0.0	0.0	0.0
14	*0.0*	*0.0*	0.0	0.0	0.0	0.0
15	*0.0*	*0.0*	0.0	0.0	0.0	0.0
16	*0.0*	*0.0*	0.0	0.0	0.0	0.0
17	*0.0*	*0.0*	0.0	0.0	0.0	0.0
18	*0.0*	*0.0*	0.0	0.0	0.0	0.0
19	*0.0*	*0.0*	0.0	0.0	0.0	0.0
20	*0.0*	*0.0*	0.0	0.0	0.0	0.0
21	*0.0*	*0.0*	0.0	0.0	0.0	0.0
22	*0.0*	*0.0*	0.0	0.0	0.0	0.0
23	*0.0*	*0.0*	0.0	0.0	0.0	0.0
24	*0.0*	*0.0*	0.0	0.0	0.0	0.0
25	*0.0*	*0.0*	0.0	0.0	0.0	0.0
26	*0.0*	*0.0*	0.0	0.0	0.0	0.0
27	*0.0*	*0.0*	0.0	0.0	0.0	0.0
28	*0.0*	*0.0*	0.0	0.0	0.0	0.0
29	*0.0*	*0.0*	0.0	0.0	0.0	0.0
30	*0.0*	*0.0*	0.0	0.0	0.0	0.0
31	*0.0*	*0.0*	0.0	0.0	0.0	0.0
32	*0.0*	*0.0*	0.0	0.0	0.0	0.0
33	*0.0*	*0.0*	0.0	0.0	0.0	0.0
34	*0.0*	*0.0*	0.0	0.0	0.0	0.0
35	*0.0*	*0.0*	0.0	0.0	0.0	0.0
36	*0.0*	*0.0*	0.0	0.0	0.0	0.0
37	*0.0*	*0.0*	0.0	0.0	0.0	0.0
38	*0.0*	*0.0*	0.0	0.0	0.0	0.0

ARUP

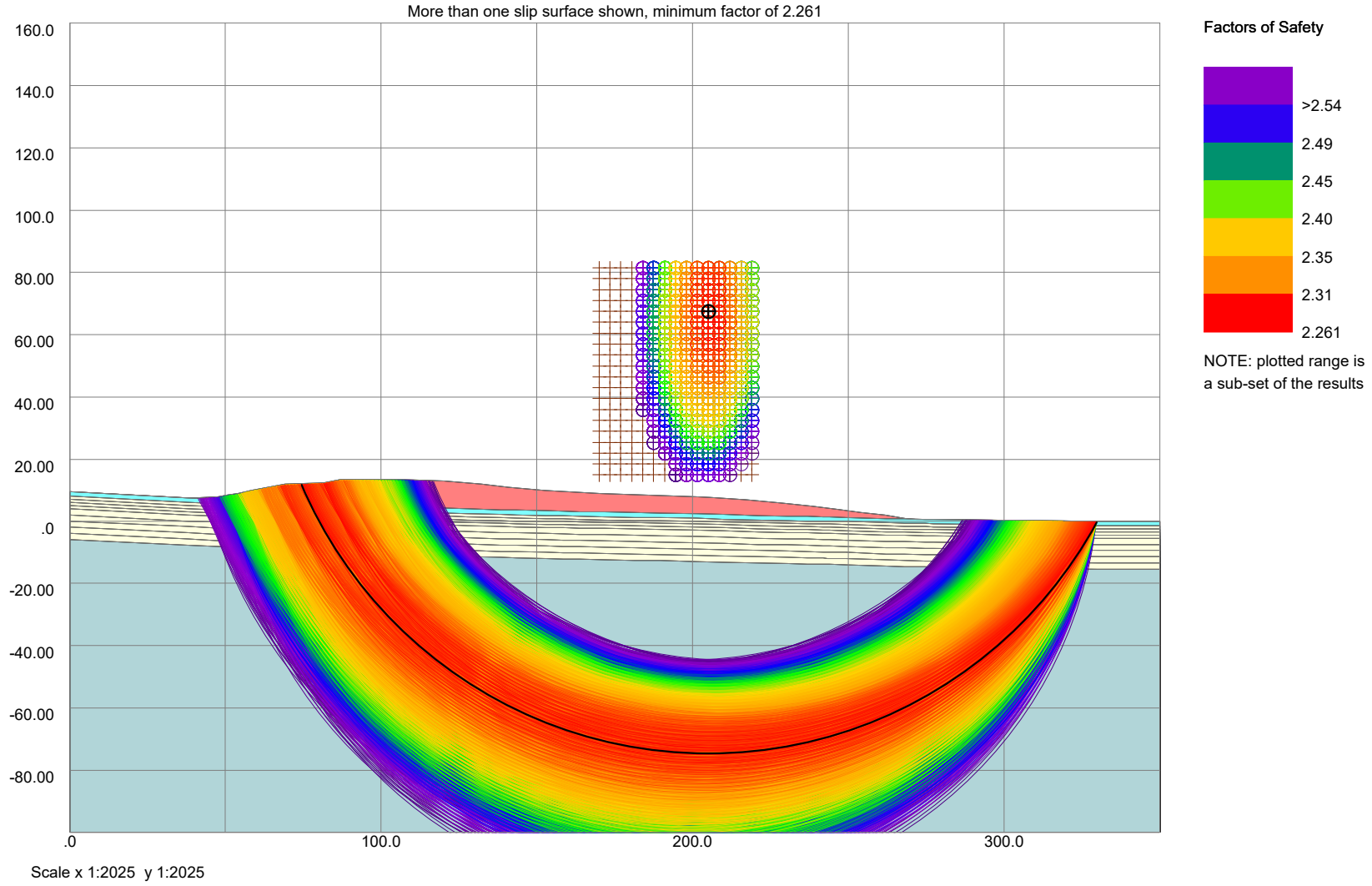
Arup

Northern SPA
Eastern Mound - Undrained (East)
Section C-CC

Job No.	Sheet No.	Rev.
256906		

Drg. Ref.

Made by	Date	Checked
EB		



General Parameters

Direction of slip: DOWNHILL
Minimum slip weight [kN/m] : 0.00000
Type of analysis : STATIC

Analysis Options

Partial Factor Analysis
Minimum number of slices: 25
Method: Bishop (Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: NOT ACTIVE

Method Partial Factors

Current selection: BS EN 1997-1:2011 DA1-2
Factor on FAVOURABLE PERMANENT LOAD: 1.00000
Factor on UNFAVOURABLE PERMANENT LOAD: 1.00000
Factor on FAVOURABLE VARIABLE LOAD: 0.00000
Factor on UNFAVOURABLE VARIABLE LOAD: 1.30000
Factor on SOIL UNIT WEIGHT: 1.00000
Factor on DRAINED SOIL COHESION: 1.25000
Factor on UNDRAINED SOIL COHESION: 1.40000
Factor on SOIL FRICTION ANGLE: 1.25000
Factor on reinforcement pullout: 1.50000
Economic ramification of failure: 1.00000
Sliding along reinforcement: 1.50000

Material properties

No	Description	Unit Weight Above GWL [kN/m3]	Unit Weight Below GWL [kN/m3]	Shear Strength Parameters Condition	Phi or Phi0 [°]	c or c0' [kN/m²]
1	Waste	19.500	19.500	Undrained	N.A.	50.000
2	Clay Deposits	17.000	17.000	Undrained	N.A.	30.000
3	London Clay 1	19.500	19.500	Undrained	N.A.	43.250
4	London Clay 2	19.500	19.500	Undrained	N.A.	49.750
5	London Clay 3	19.500	19.500	Undrained	N.A.	56.250
6	London Clay 4	19.500	19.500	Undrained	N.A.	62.750
7	London Clay 5	19.500	19.500	Undrained	N.A.	72.500
8	London Clay 6	19.500	19.500	Undrained	N.A.	85.500
9	London Clay 7	19.500	19.500	Undrained	N.A.	98.500
10	London Clay 8	19.500	19.500	Undrained	N.A.	111.50
11	London Clay 9	19.500	19.500	Undrained	N.A.	124.50
12	Harwich	20.000	20.000	Undrained	N.A.	130.00

Coordinates of top of soil strata

The units of the following coordinates are in m

Stratum X -->	0.0	37.887	39.880	47.753	48.087	50.946	52.674
1	9.6040	7.6791	7.6000	8.0369	.	8.5415	.
2	9.6040	7.6791	.	.	7.2131	.	7.0000
3	8.1040	6.1791	.	.	5.7131	.	5.5000
4	7.1040	5.1791	.	.	4.7131	.	4.5000
5	6.1040	4.1791	.	.	3.7131	.	3.5000
6	5.1040	3.1791	.	.	2.7131	.	2.5000
7	4.1040	2.1791	.	.	1.7131	.	1.5000
8	2.1040	0.17910	.	.	-0.28690	.	-0.50000
9	0.10400	-1.8209	.	.	-2.2869	.	-2.5000
10	-1.8960	-3.8209	.	.	-4.2869	.	-4.5000
11	-3.8960	-5.8209	.	.	-6.2869	.	-6.5000
12	-5.8960	-7.8209	.	.	-8.2869	.	-8.5000
Stratum X -->							

	53.908	56.525	58.187	63.253	68.895	69.256	73.969
1	9.0382	9.7094	10.038	.	.	12.037	.
2	.	.	.	6.4898	6.2419	.	6.0203
3	.	.	.	4.9898	4.7419	.	4.5203
4	.	.	.	3.9898	3.7419	.	3.5203
5	.	.	.	2.9898	2.7419	.	2.5203
6	.	.	.	1.9898	1.7419	.	1.5203
7	.	.	.	0.98980	0.74190	.	0.52030
8	.	.	.	-1.0102	-1.2581	.	-1.4797
9	.	.	.	-3.0102	-3.2581	.	-3.4797
10	.	.	.	-5.0102	-5.2581	.	-5.4797
11	.	.	.	-7.0102	-7.2581	.	-7.4797
12	.	.	.	-9.0102	-9.2581	.	-9.4797

Stratum X -->

	78.810	81.563	82.267	86.824	89.785	95.064	95.328
1	.	12.436	.	13.436	.	13.436	.
2	5.8370	.	5.7080	.	5.4187	.	5.2048
3	4.3370	.	4.2080	.	3.9187	.	3.7048
4	3.3370	.	3.2080	.	2.9187	.	2.7048
5	2.3370	.	2.2080	.	1.9187	.	1.7048
6	1.3370	.	1.2080	.	0.91870	.	0.70480
7	0.33700	.	0.20800	.	-0.081300	.	-0.29520
8	-1.6630	.	-1.7920	.	-2.0813	.	-2.2952
9	-3.6630	.	-3.7920	.	-4.0813	.	-4.2952
10	-5.6630	.	-5.7920	.	-6.0813	.	-6.2952
11	-7.6630	.	-7.7920	.	-8.0813	.	-8.2952
12	-9.6630	.	-9.7920	.	-10.081	.	-10.295

Stratum X -->

	102.13	102.26	107.56	114.16	120.11	127.69	132.14
1	13.436	.	13.436	.	13.038	.	12.032
2	.	4.9444	.	4.5316	.	4.0601	.
3	.	3.4444	.	3.0316	.	2.5601	.
4	.	2.4444	.	2.0316	.	1.5601	.
5	.	1.4444	.	1.0316	.	0.56010	.
6	.	0.44440	.	0.031600	.	-0.43990	.
7	.	-0.55560	.	-0.96840	.	-1.4399	.
8	.	-2.5556	.	-2.9684	.	-3.4399	.
9	.	-4.5556	.	-4.9684	.	-5.4399	.
10	.	-6.5556	.	-6.9684	.	-7.4399	.
11	.	-8.5556	.	-8.9684	.	-9.4399	.
12	.	-10.556	.	-10.968	.	-11.440	.

Stratum X -->

	138.49	140.91	143.43	152.59	152.99	158.50	163.69
1	.	11.039	.	10.037	.	.	.
2	3.7749	.	3.6682	.	3.4738	3.3339	3.2289
3	2.2749	.	2.1682	.	1.9738	1.8339	1.7289
4	1.2749	.	1.1682	.	0.97380	0.83390	0.72890
5	0.27490	.	0.16820	.	-0.026200	-0.16610	-0.27110
6	-0.72510	.	-0.83180	.	-1.0262	-1.1661	-1.2711
7	-1.7251	.	-1.8318	.	-2.0262	-2.1661	-2.2711
8	-3.7251	.	-3.8318	.	-4.0262	-4.1661	-4.2711
9	-5.7251	.	-5.8318	.	-6.0262	-6.1661	-6.2711
10	-7.7251	.	-7.8318	.	-8.0262	-8.1661	-8.2711
11	-9.7251	.	-9.8318	.	-10.026	-10.166	-10.271
12	-11.725	.	-11.832	.	-12.026	-12.166	-12.271

Stratum X -->

	170.37	171.66	181.35	189.75	201.03	201.38	205.61
1	9.0342	.	.	.	8.0000	.	7.8090
2	.	3.0843	2.9011	2.7546	.	2.5170	.
3	.	1.5843	1.4011	1.2546	.	1.0170	.
4	.	0.58430	0.40110	0.25460	.	0.017000	.
5	.	-0.41570	-0.59890	-0.74540	.	-0.98300	.
6	.	-1.4157	-1.5989	-1.7454	.	-1.9830	.
7	.	-2.4157	-2.5989	-2.7454	.	-2.9830	.
8	.	-4.4157	-4.5989	-4.7454	.	-4.9830	.
9	.	-6.4157	-6.5989	-6.7454	.	-6.9830	.
10	.	-8.4157	-8.5989	-8.7454	.	-8.9830	.
11	.	-10.416	-10.599	-10.745	.	-10.983	.
12	.	-12.416	-12.599	-12.745	.	-12.983	.

Stratum X -->

	210.16	217.45	221.16	228.51	230.35	236.79	238.53
1	.	7.0357	.	6.0363	.	.	5.0366
2	2.2925	.	2.0000	.	1.8143	1.6882	.
3	0.79250	.	0.50000	.	0.31430	0.18820	.
4	-0.20750	.	-0.50000	.	-0.68570	-0.81180	.

Stratum X -->							
	210.16	217.45	221.16	228.51	230.35	236.70	238.53
5	-1.2075	.	-1.5000	.	-1.6857	-1.8118	.
6	-2.2075	.	-2.5000	.	-2.6857	-2.8118	.
7	-3.2075	.	-3.5000	.	-3.6857	-3.8118	.
8	-5.2075	.	-5.5000	.	-5.6857	-5.8118	.
9	-7.2075	.	-7.5000	.	-7.6857	-7.8118	.
10	-9.2075	.	-9.5000	.	-9.6857	-9.8118	.
11	-11.208	.	-11.500	.	-11.686	-11.812	.
12	-13.208	.	-13.500	.	-13.686	-13.812	.

Stratum X -->							
	241.91	243.25	243.98	246.44	249.30	253.99	261.82
1	.	.	.	4.0371	.	3.0370	2.0376
2	1.5678	1.5422	1.5283	.	1.3846	.	.
3	0.067800	0.042200	0.028300	.	-0.11540	.	.
4	-0.93220	-0.95780	-0.97170	.	-1.1154	.	.
5	-1.9322	-1.9578	-1.9717	.	-2.1154	.	.
6	-2.9322	-2.9578	-2.9717	.	-3.1154	.	.
7	-3.9322	-3.9578	-3.9717	.	-4.1154	.	.
8	-5.9322	-5.9578	-5.9717	.	-6.1154	.	.
9	-7.9322	-7.9578	-7.9717	.	-8.1154	.	.
10	-9.9322	-9.9578	-9.9717	.	-10.115	.	.
11	-11.932	-11.958	-11.972	.	-12.115	.	.
12	-13.932	-13.958	-13.972	.	-14.115	.	.

Stratum X -->							
	262.26	268.02	268.80	272.18	274.68	277.27	329.94
1	.	.	1.0000	0.80000	0.71990	0.66680	0.0
2	0.96400	0.85690	.	.	0.71990	0.66680	0.0
3	-0.53600	-0.64310	.	.	-0.78010	-0.83320	-1.5000
4	-1.5360	-1.6431	.	.	-1.7801	-1.8332	-2.5000
5	-2.5360	-2.6431	.	.	-2.7801	-2.8332	-3.5000
6	-3.5360	-3.6431	.	.	-3.7801	-3.8332	-4.5000
7	-4.5360	-4.6431	.	.	-4.7801	-4.8332	-5.5000
8	-6.5360	-6.6431	.	.	-6.7801	-6.8332	-7.5000
9	-8.5360	-8.6431	.	.	-8.7801	-8.8332	-9.5000
10	-10.536	-10.643	.	.	-10.780	-10.833	-11.500
11	-12.536	-12.643	.	.	-12.780	-12.833	-13.500
12	-14.536	-14.643	.	.	-14.780	-14.833	-15.500

Stratum-linked data

No.	Material	Water table	Piezo Set/ Ru value
1	Waste		- -
2	Clay Deposits		- -
3	London Clay 1		- -
4	London Clay 2		- -
5	London Clay 3		- -
6	London Clay 4		- -
7	London Clay 5		- -
8	London Clay 6		- -
9	London Clay 7		- -
10	London Clay 8		- -
11	London Clay 9		- -
12	Harwich		- -

Slip Surface Specification

Circle centre specification: GRID
Bottom left of grid: x = 170.00000 m y = 15.00000 m
Inclination of grid: 0.00000 deg
(positive anticlockwise direction about bottom left of grid)
Centres on grid: 15 in x direction at 3.50000m spacing
20 in y direction at 3.50000m spacing
Grid extended to find minimum FoS
Initial radius of circle 5.00000 m
Incremented by 1.00000 m until all possible circles considered

WORST CASE

Centre at (205.00m,67.500m) Radius 142.00m
Iterations: 5 Horiz acceleration [%g]: 0.0
Net vertical force [kN/m]: 3521.2 *Slip weight [kN/m] 296330.*
Net horiz force [kN/m]: 436.53 Disturbing moment [kN/m]: 1.7546E+6
Restoring moment [kNm/m]: 3.9678E+6
Reinf.Rest.Moment [kNm/m]: 0.0
Over-Design Factor: 2.2615

The system of interslice and base forces are in equilibrium
when the strengths available at the bases are divided by the computed
over-design factor. The interslice forces shown in the following table
are in equilibrium with the factored strengths of the soil at the bases of slices.

Slip surface coordinates		Pore Pressure		Interslice forces [kN/m]		
Point	x [m]	y [m]	L [kN/m²]	R [kN/m²]	T	E	E(u)
1	74.211	12.198	-	0.0	0.0	0.0	0.0
2	77.055	5.9034	0.0	0.0	-270.33	725.34	0.0
3	77.802	4.3751	0.0	0.0	-295.35	950.41	0.0
4	78.313	3.3558	0.0	0.0	-309.80	1108.8	0.0
5	78.810	2.3850	0.0	0.0	-320.06	1266.8	0.0
6	78.835	2.3361	0.0	0.0	-320.43	1275.0	0.0
7	79.367	1.3162	0.0	0.0	-327.17	1449.3	0.0
8	79.910	0.29595	0.0	0.0	-329.96	1632.1	0.0
9	81.028	-1.7458	0.0	0.0	-323.37	2024.0	0.0
10	81.563	-2.6955	0.0	0.0	-315.73	2218.2	0.0
11	82.192	-3.7892	0.0	0.0	-299.73	2453.6	0.0
12	82.267	-3.9180	0.0	0.0	-297.84	2481.8	0.0
13	83.403	-5.8357	0.0	0.0	-256.18	2924.7	0.0
14	84.662	-7.8842	0.0	0.0	-191.92	3440.3	0.0
15	85.971	-9.9345	0.0	0.0	-106.63	4003.2	0.0
16	86.824	-11.231	0.0	0.0	-39.546	4386.1	0.0
17	89.785	-15.504	0.0	0.0	256.73	5808.2	0.0
18	95.064	-22.379	0.0	0.0	953.34	8661.5	0.0
19	95.328	-22.700	0.0	0.0	991.98	8813.5	0.0
20	98.658	-26.603	0.0	0.0	1500.3	10805.	0.0
21	102.13	-30.382	0.0	0.0	2052.8	13002.	0.0
22	102.26	-30.527	0.0	0.0	2075.0	13091.	0.0
23	107.56	-35.797	0.0	0.0	2918.9	16648.	0.0
24	114.16	-41.642	0.0	0.0	3889.1	21296.	0.0
25	120.11	-46.334	0.0	0.0	4629.7	25602.	0.0
26	127.69	-51.612	0.0	0.0	5328.5	31083.	0.0
27	132.14	-54.382	0.0	0.0	5598.6	34231.	0.0
28	138.49	-57.959	0.0	0.0	5802.3	38571.	0.0
29	140.91	-59.217	0.0	0.0	5825.9	40168.	0.0
30	143.43	-60.459	0.0	0.0	5820.7	41781.	0.0
31	152.59	-64.475	0.0	0.0	5568.3	47239.	0.0
32	152.99	-64.631	0.0	0.0	5550.4	47458.	0.0
33	158.50	-66.670	0.0	0.0	5249.3	50360.	0.0
34	163.69	-68.357	0.0	0.0	4894.2	52816.	0.0
35	170.37	-70.212	0.0	0.0	4368.6	55553.	0.0
36	171.66	-70.532	0.0	0.0	4261.9	56025.	0.0
37	181.35	-72.516	0.0	0.0	3460.7	58936.	0.0
38	189.75	-73.679	0.0	0.0	2855.6	60550.	0.0
39	195.39	-74.174	0.0	0.0	2553.9	61150.	0.0
40	201.03	-74.445	0.0	0.0	2370.1	61368.	0.0
41	201.38	-74.454	0.0	0.0	2363.5	61369.	0.0
42	205.61	-74.499	0.0	0.0	2330.2	61269.	0.0
43	210.16	-74.406	0.0	0.0	2271.2	60930.	0.0
44	217.45	-73.953	0.0	0.0	2014.5	59883.	0.0
45	221.16	-73.577	0.0	0.0	1826.3	59108.	0.0
46	228.51	-72.541	0.0	0.0	1378.3	57106.	0.0
47	230.35	-72.220	0.0	0.0	1257.3	56508.	0.0
48	236.79	-70.896	0.0	0.0	824.63	54120.	0.0
49	238.53	-70.484	0.0	0.0	709.64	53398.	0.0
50	241.91	-69.620	0.0	0.0	494.05	51913.	0.0
51	243.25	-69.250	0.0	0.0	411.43	51288.	0.0
52	243.98	-69.046	0.0	0.0	368.27	50947.	0.0
53	246.44	-68.319	0.0	0.0	226.55	49743.	0.0
54	249.30	-67.413	0.0	0.0	75.653	48279.	0.0
55	253.99	-65.783	0.0	0.0	-134.06	45730.	0.0
56	261.82	-62.637	0.0	0.0	-355.15	41107.	0.0
57	262.26	-62.444	0.0	0.0	-361.94	40835.	0.0
58	268.02	-59.747	0.0	0.0	-393.68	37186.	0.0
59	268.80	-59.360	0.0	0.0	-389.44	36683.	0.0
60	272.18	-57.604	0.0	0.0	-345.17	34465.	0.0
61	274.68	-56.229	0.0	0.0	-283.90	32794.	0.0
62	277.27	-54.733	0.0	0.0	-193.96	31041.	0.0
63	285.52	-49.464	0.0	0.0	271.01	25367.	0.0
64	293.38	-43.640	0.0	0.0	949.59	19954.	0.0
65	300.83	-37.288	0.0	0.0	1749.9	14988.	0.0
66	307.82	-30.438	0.0	0.0	2558.9	10614.	0.0
67	314.32	-23.123	0.0	0.0	3256.6	6925.0	0.0
68	320.30	-15.378	0.0	0.0	3730.1	3962.8	0.0
69	321.70	-13.396	0.0	0.0	3798.8	3341.6	0.0
70	323.05	-11.413	0.0	0.0	3839.3	2775.1	0.0
71	324.36	-9.4293	0.0	0.0	3851.4	2260.3	0.0
72	325.61	-7.4452	0.0	0.0	3835.0	1794.4	0.0
73	326.82	-5.4605	0.0	0.0	3790.2	1374.6	0.0
74	327.41	-4.4680	0.0	0.0	3757.2	1181.1	0.0

Slip surface coordinates Pore Pressure Interslice forces [kN/m]

75	327.99	-3.4753	0.0	0.0	3717.2	998.15	0.0
76	328.56	-2.4825	0.0	0.0	3670.2	825.36	0.0
77	329.11	-1.4896	0.0	0.0	3616.2	662.43	0.0
78	329.93	110.51E-6	0.0	-	3521.2	436.53	0.0

Slice Strength Parameters Average Slice Forces on base [kN/m]

No.	c' [kN/m²]	Tan phi	Pore Pressure [kN/m²]	Slice Weight [kN/m]	Normal	Shear (capacity)	Shear (mobilised)
1	35.714	0.0	0.0	177.08	873.41	246.68	109.08
2	21.429	0.0	0.0	102.95	266.26	36.453	16.119
3	30.893	0.0	0.0	82.353	190.41	35.226	15.577
4	35.536	0.0	0.0	89.752	191.62	38.741	17.131
5	35.536	0.0	0.0	4.8304	9.9461	1.9590	0.86626
6	40.179	0.0	0.0	107.24	213.13	46.215	20.436
7	44.821	0.0	0.0	120.41	225.29	51.799	22.905
8	51.786	0.0	0.0	282.10	488.85	120.56	53.311
9	61.071	0.0	0.0	150.89	245.70	66.578	29.440
10	61.071	0.0	0.0	190.50	298.36	77.036	34.065
11	70.357	0.0	0.0	23.688	36.280	10.484	4.6361
12	70.357	0.0	0.0	384.65	569.43	156.82	69.346
13	79.643	0.0	0.0	480.60	672.62	191.50	84.681
14	88.929	0.0	0.0	558.17	745.19	216.33	95.659
15	92.857	0.0	0.0	395.40	511.04	144.10	63.722
16	92.857	0.0	0.0	1541.5	1916.4	482.74	213.46
17	92.857	0.0	0.0	3336.2	3941.4	804.87	355.91
18	92.857	0.0	0.0	185.40	214.26	38.573	17.057
19	92.857	0.0	0.0	2484.3	2843.4	476.37	210.65
20	92.857	0.0	0.0	2854.1	3223.2	476.37	210.65
21	92.857	0.0	0.0	119.05	133.75	18.590	8.2204
22	92.857	0.0	0.0	4856.0	5427.1	694.04	306.90
23	92.857	0.0	0.0	6761.0	7509.6	818.27	361.84
24	92.857	0.0	0.0	6706.5	7432.8	703.83	311.23
25	92.857	0.0	0.0	9234.5	10238.	857.78	379.30
26	92.857	0.0	0.0	5729.3	6355.3	486.41	215.09
27	92.857	0.0	0.0	8515.8	9449.9	676.61	299.19
28	92.857	0.0	0.0	3350.0	3716.2	253.83	112.24
29	92.857	0.0	0.0	3525.2	3908.5	260.67	115.27
30	92.857	0.0	0.0	13218.	14626.	928.78	410.70
31	92.857	0.0	0.0	583.19	643.32	39.431	17.436
32	92.857	0.0	0.0	8239.4	9068.4	545.49	241.21
33	92.857	0.0	0.0	7920.9	8673.7	506.58	224.01
34	92.857	0.0	0.0	10395.	11304.	643.96	284.75
35	92.857	0.0	0.0	2040.2	2206.2	124.02	54.841
36	92.857	0.0	0.0	15419.	16529.	917.70	405.80
37	92.857	0.0	0.0	13605.	14330.	788.22	348.54
38	92.857	0.0	0.0	9178.3	9510.3	524.90	232.11
39	92.857	0.0	0.0	9225.0	9416.2	524.90	232.11
40	92.857	0.0	0.0	570.32	577.09	32.410	14.332
41	92.857	0.0	0.0	6905.9	6939.0	392.65	173.63
42	92.857	0.0	0.0	7410.3	7477.6	422.73	186.93
43	92.857	0.0	0.0	11768.	12081.	677.92	299.77
44	92.857	0.0	0.0	5941.9	6189.0	346.88	153.39
45	92.857	0.0	0.0	11562.	12205.	688.49	304.45
46	92.857	0.0	0.0	2857.4	3046.9	173.44	76.695
47	92.857	0.0	0.0	9847.1	10591.	610.74	270.07
48	92.857	0.0	0.0	2622.8	2843.2	166.50	73.625
49	92.857	0.0	0.0	5007.5	5454.4	323.35	142.98
50	92.857	0.0	0.0	1977.1	2162.7	129.84	57.414
51	92.857	0.0	0.0	1050.6	1151.3	69.533	30.747
52	92.857	0.0	0.0	3561.2	3913.8	238.67	105.54
53	92.857	0.0	0.0	4064.1	4486.9	278.46	123.14
54	92.857	0.0	0.0	6499.0	7220.9	460.87	203.79
55	92.857	0.0	0.0	10360.	11630.	783.77	346.58
56	92.857	0.0	0.0	562.71	635.78	44.615	19.729
57	92.857	0.0	0.0	7154.9	8127.8	591.03	261.35
58	92.857	0.0	0.0	930.73	1063.3	80.451	35.575
59	92.857	0.0	0.0	3972.7	4553.7	353.51	156.32
60	92.857	0.0	0.0	2856.4	3288.8	265.06	117.21
61	92.857	0.0	0.0	2882.4	3331.5	277.90	122.89
62	92.857	0.0	0.0	8600.6	10032.	908.79	401.86
63	92.857	0.0	0.0	7313.2	8676.0	908.79	401.86
64	92.857	0.0	0.0	6001.8	7300.7	908.78	401.86
65	92.857	0.0	0.0	4699.3	5955.4	908.79	401.86
66	92.857	0.0	0.0	3438.8	4685.2	908.79	401.86
67	92.857	0.0	0.0	2253.7	3529.1	908.78	401.86
68	88.929	0.0	0.0	390.39	715.07	215.78	95.415

Slice No.	Strength Parameters		Average Pore	Slice Weight	Forces on base [kN/m]		
69	79.643	0.0	0.0	323.96	648.92	191.04	84.478
70	70.357	0.0	0.0	261.71	587.44	166.94	73.818
71	61.071	0.0	0.0	203.43	530.39	143.40	63.411
72	51.786	0.0	0.0	148.93	477.48	120.39	53.238
73	44.821	0.0	0.0	55.218	220.19	51.730	22.875
74	40.179	0.0	0.0	42.933	208.40	46.157	20.410
75	35.536	0.0	0.0	31.078	197.08	40.640	17.971
76	30.893	0.0	0.0	19.640	186.19	35.174	15.554
77	21.429	0.0	0.0	10.409	260.52	36.401	16.096

Slice No.	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]	
	Vert	Horiz	Vert	Horiz	Vert	Horiz
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0	0.0	0.0

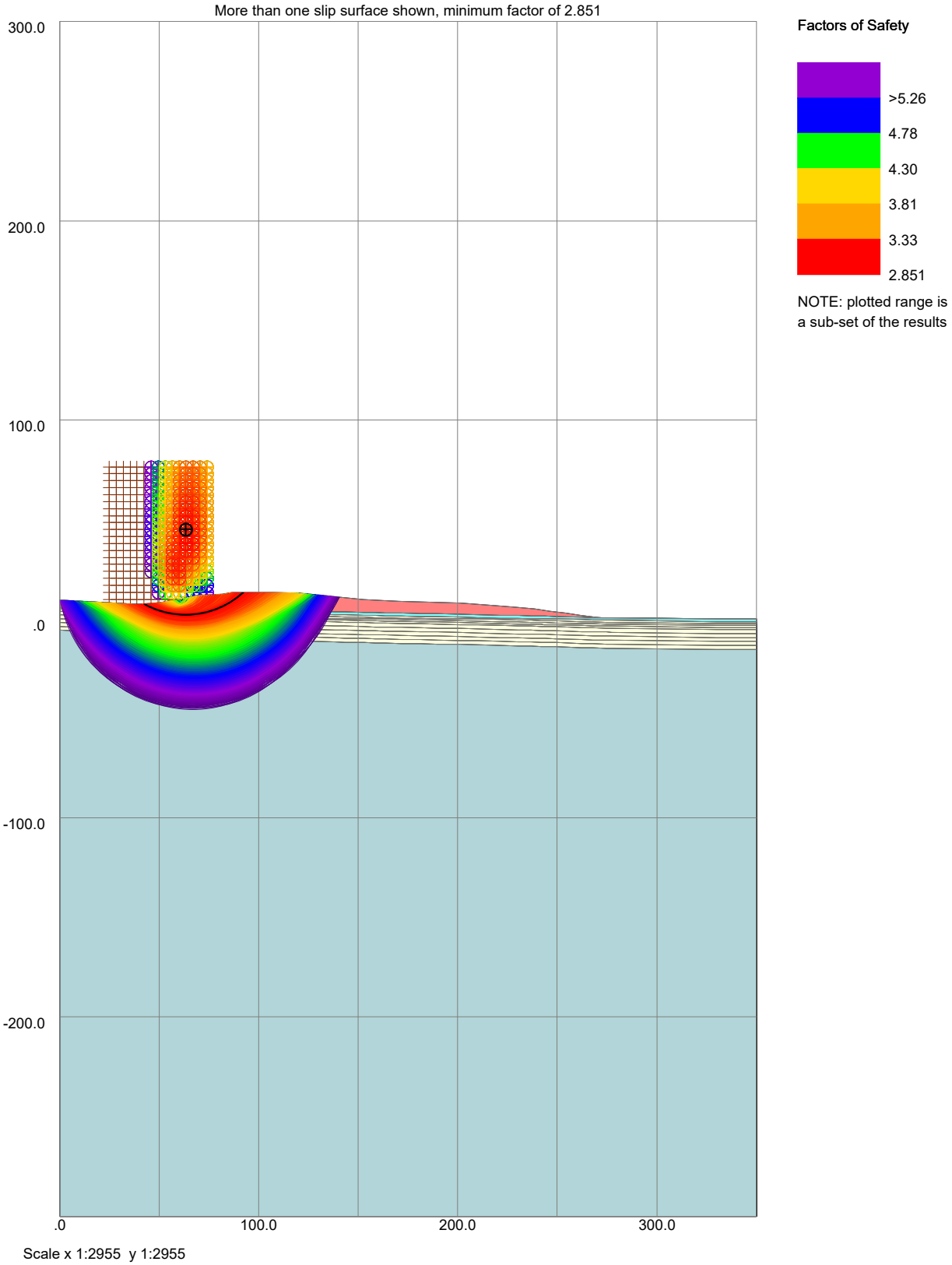
Slice No	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]	
66	*0.0*	*0.0*	0.0	0.0	0.0	0.0
67	*0.0*	*0.0*	0.0	0.0	0.0	0.0
68	*0.0*	*0.0*	0.0	0.0	0.0	0.0
69	*0.0*	*0.0*	0.0	0.0	0.0	0.0
70	*0.0*	*0.0*	0.0	0.0	0.0	0.0
71	*0.0*	*0.0*	0.0	0.0	0.0	0.0
72	*0.0*	*0.0*	0.0	0.0	0.0	0.0
73	*0.0*	*0.0*	0.0	0.0	0.0	0.0
74	*0.0*	*0.0*	0.0	0.0	0.0	0.0
75	*0.0*	*0.0*	0.0	0.0	0.0	0.0
76	*0.0*	*0.0*	0.0	0.0	0.0	0.0
77	*0.0*	*0.0*	0.0	0.0	0.0	0.0

ARUP

Arup

Northern SPA
Eastern Mound - Undrained
Section C-CC (west)

Job No.	Sheet No.	Rev.
256906		
Drg. Ref.		
Made by EB	Date	Checked



General Parameters

Direction of slip: DOWNHILL
Minimum slip weight [kN/m] : 0.00000
Type of analysis : STATIC

Analysis Options

Partial Factor Analysis
Minimum number of slices: 25
Method: Bishop (Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: NOT ACTIVE

Method Partial Factors

Current selection: BS EN 1997-1:2011 DA1-2
Factor on FAVOURABLE PERMANENT LOAD: 1.00000
Factor on UNFAVOURABLE PERMANENT LOAD: 1.00000
Factor on FAVOURABLE VARIABLE LOAD: 0.00000
Factor on UNFAVOURABLE VARIABLE LOAD: 1.30000
Factor on SOIL UNIT WEIGHT: 1.00000
Factor on DRAINED SOIL COHESION: 1.25000
Factor on UNDRAINED SOIL COHESION: 1.40000
Factor on SOIL FRICTION ANGLE: 1.25000
Factor on reinforcement pullout: 1.50000
Economic ramification of failure: 1.00000
Sliding along reinforcement: 1.50000

Material properties

No	Description	Unit Weight Above GWL [kN/m3]	Unit Weight Below GWL [kN/m3]	Shear Strength Parameters Condition	Phi or Phi0 [°]	c or c0' [kN/m²]
1	Waste	19.500	19.500	Undrained	N.A.	50.000
2	Clay Deposits	17.000	17.000	Undrained	N.A.	30.000
3	London Clay 1	19.500	19.500	Undrained	N.A.	43.250
4	London Clay 2	19.500	19.500	Undrained	N.A.	49.750
5	London Clay 3	19.500	19.500	Undrained	N.A.	56.250
6	London Clay 4	19.500	19.500	Undrained	N.A.	62.750
7	London Clay 5	19.500	19.500	Undrained	N.A.	72.500
8	London Clay 6	19.500	19.500	Undrained	N.A.	85.500
9	London Clay 7	19.500	19.500	Undrained	N.A.	98.500
10	London Clay 8	19.500	19.500	Undrained	N.A.	111.50
11	London Clay 9	19.500	19.500	Undrained	N.A.	124.50
12	Harwich	20.000	20.000	Undrained	N.A.	130.00

Coordinates of top of soil strata

The units of the following coordinates are in m

Stratum X -->	0.0	37.887	39.880	47.753	48.087	50.946	52.674
1	9.6040	7.6791	7.6000	8.0369	.	8.5415	.
2	9.6040	7.6791	.	.	7.2131	.	7.0000
3	8.1040	6.1791	.	.	5.7131	.	5.5000
4	7.1040	5.1791	.	.	4.7131	.	4.5000
5	6.1040	4.1791	.	.	3.7131	.	3.5000
6	5.1040	3.1791	.	.	2.7131	.	2.5000
7	4.1040	2.1791	.	.	1.7131	.	1.5000
8	2.1040	0.17910	.	.	-0.28690	.	-0.50000
9	0.10400	-1.8209	.	.	-2.2869	.	-2.5000
10	-1.8960	-3.8209	.	.	-4.2869	.	-4.5000
11	-3.8960	-5.8209	.	.	-6.2869	.	-6.5000
12	-5.8960	-7.8209	.	.	-8.2869	.	-8.5000
Stratum X -->							

	53.908	56.525	58.187	63.253	68.895	69.256	73.969
1	9.0382	9.7094	10.038	.	.	12.037	.
2	.	.	.	6.4898	6.2419	.	6.0203
3	.	.	.	4.9898	4.7419	.	4.5203
4	.	.	.	3.9898	3.7419	.	3.5203
5	.	.	.	2.9898	2.7419	.	2.5203
6	.	.	.	1.9898	1.7419	.	1.5203
7	.	.	.	0.98980	0.74190	.	0.52030
8	.	.	.	-1.0102	-1.2581	.	-1.4797
9	.	.	.	-3.0102	-3.2581	.	-3.4797
10	.	.	.	-5.0102	-5.2581	.	-5.4797
11	.	.	.	-7.0102	-7.2581	.	-7.4797
12	.	.	.	-9.0102	-9.2581	.	-9.4797

Stratum X -->

	78.810	81.563	82.267	86.824	89.785	95.064	95.328
1	.	12.436	.	13.436	.	13.436	.
2	5.8370	.	5.7080	.	5.4187	.	5.2048
3	4.3370	.	4.2080	.	3.9187	.	3.7048
4	3.3370	.	3.2080	.	2.9187	.	2.7048
5	2.3370	.	2.2080	.	1.9187	.	1.7048
6	1.3370	.	1.2080	.	0.91870	.	0.70480
7	0.33700	.	0.20800	.	-0.081300	.	-0.29520
8	-1.6630	.	-1.7920	.	-2.0813	.	-2.2952
9	-3.6630	.	-3.7920	.	-4.0813	.	-4.2952
10	-5.6630	.	-5.7920	.	-6.0813	.	-6.2952
11	-7.6630	.	-7.7920	.	-8.0813	.	-8.2952
12	-9.6630	.	-9.7920	.	-10.081	.	-10.295

Stratum X -->

	102.13	102.26	107.56	114.16	120.11	127.69	132.14
1	13.436	.	13.436	.	13.038	.	12.032
2	.	4.9444	.	4.5316	.	4.0601	.
3	.	3.4444	.	3.0316	.	2.5601	.
4	.	2.4444	.	2.0316	.	1.5601	.
5	.	1.4444	.	1.0316	.	0.56010	.
6	.	0.44440	.	0.031600	.	-0.43990	.
7	.	-0.55560	.	-0.96840	.	-1.4399	.
8	.	-2.5556	.	-2.9684	.	-3.4399	.
9	.	-4.5556	.	-4.9684	.	-5.4399	.
10	.	-6.5556	.	-6.9684	.	-7.4399	.
11	.	-8.5556	.	-8.9684	.	-9.4399	.
12	.	-10.556	.	-10.968	.	-11.440	.

Stratum X -->

	138.49	140.91	143.43	152.59	152.99	158.50	163.69
1	.	11.039	.	10.037	.	.	.
2	3.7749	.	3.6682	.	3.4738	3.3339	3.2289
3	2.2749	.	2.1682	.	1.9738	1.8339	1.7289
4	1.2749	.	1.1682	.	0.97380	0.83390	0.72890
5	0.27490	.	0.16820	.	-0.026200	-0.16610	-0.27110
6	-0.72510	.	-0.83180	.	-1.0262	-1.1661	-1.2711
7	-1.7251	.	-1.8318	.	-2.0262	-2.1661	-2.2711
8	-3.7251	.	-3.8318	.	-4.0262	-4.1661	-4.2711
9	-5.7251	.	-5.8318	.	-6.0262	-6.1661	-6.2711
10	-7.7251	.	-7.8318	.	-8.0262	-8.1661	-8.2711
11	-9.7251	.	-9.8318	.	-10.026	-10.166	-10.271
12	-11.725	.	-11.832	.	-12.026	-12.166	-12.271

Stratum X -->

	170.37	171.66	181.35	189.75	201.03	201.38	205.61
1	9.0342	.	.	.	8.0000	.	7.8090
2	.	3.0843	2.9011	2.7546	.	2.5170	.
3	.	1.5843	1.4011	1.2546	.	1.0170	.
4	.	0.58430	0.40110	0.25460	.	0.017000	.
5	.	-0.41570	-0.59890	-0.74540	.	-0.98300	.
6	.	-1.4157	-1.5989	-1.7454	.	-1.9830	.
7	.	-2.4157	-2.5989	-2.7454	.	-2.9830	.
8	.	-4.4157	-4.5989	-4.7454	.	-4.9830	.
9	.	-6.4157	-6.5989	-6.7454	.	-6.9830	.
10	.	-8.4157	-8.5989	-8.7454	.	-8.9830	.
11	.	-10.416	-10.599	-10.745	.	-10.983	.
12	.	-12.416	-12.599	-12.745	.	-12.983	.

Stratum X -->

	210.16	217.45	221.16	228.51	230.35	236.79	238.53
1	.	7.0357	.	6.0363	.	.	5.0366
2	2.2925	.	2.0000	.	1.8143	1.6882	.
3	0.79250	.	0.50000	.	0.31430	0.18820	.
4	-0.20750	.	-0.50000	.	-0.68570	-0.81180	.

Stratum X -->							
	210.16	217.45	221.16	228.51	230.35	236.70	238.53
5	-1.2075	.	-1.5000	.	-1.6857	-1.8118	.
6	-2.2075	.	-2.5000	.	-2.6857	-2.8118	.
7	-3.2075	.	-3.5000	.	-3.6857	-3.8118	.
8	-5.2075	.	-5.5000	.	-5.6857	-5.8118	.
9	-7.2075	.	-7.5000	.	-7.6857	-7.8118	.
10	-9.2075	.	-9.5000	.	-9.6857	-9.8118	.
11	-11.208	.	-11.500	.	-11.686	-11.812	.
12	-13.208	.	-13.500	.	-13.686	-13.812	.

Stratum X -->							
	241.91	243.25	243.98	246.44	249.30	253.99	261.82
1	.	.	.	4.0371	.	3.0370	2.0376
2	1.5678	1.5422	1.5283	.	1.3846	.	.
3	0.067800	0.042200	0.028300	.	-0.11540	.	.
4	-0.93220	-0.95780	-0.97170	.	-1.1154	.	.
5	-1.9322	-1.9578	-1.9717	.	-2.1154	.	.
6	-2.9322	-2.9578	-2.9717	.	-3.1154	.	.
7	-3.9322	-3.9578	-3.9717	.	-4.1154	.	.
8	-5.9322	-5.9578	-5.9717	.	-6.1154	.	.
9	-7.9322	-7.9578	-7.9717	.	-8.1154	.	.
10	-9.9322	-9.9578	-9.9717	.	-10.115	.	.
11	-11.932	-11.958	-11.972	.	-12.115	.	.
12	-13.932	-13.958	-13.972	.	-14.115	.	.

Stratum X -->							
	262.26	268.02	268.80	272.18	274.68	277.27	329.94
1	.	.	1.0000	0.80000	0.71990	0.66680	0.0
2	0.96400	0.85690	.	.	0.71990	0.66680	0.0
3	-0.53600	-0.64310	.	.	-0.78010	-0.83320	-1.5000
4	-1.5360	-1.6431	.	.	-1.7801	-1.8332	-2.5000
5	-2.5360	-2.6431	.	.	-2.7801	-2.8332	-3.5000
6	-3.5360	-3.6431	.	.	-3.7801	-3.8332	-4.5000
7	-4.5360	-4.6431	.	.	-4.7801	-4.8332	-5.5000
8	-6.5360	-6.6431	.	.	-6.7801	-6.8332	-7.5000
9	-8.5360	-8.6431	.	.	-8.7801	-8.8332	-9.5000
10	-10.536	-10.643	.	.	-10.780	-10.833	-11.500
11	-12.536	-12.643	.	.	-12.780	-12.833	-13.500
12	-14.536	-14.643	.	.	-14.780	-14.833	-15.500

Stratum-linked data

No.	Material	Water table	Piezo Set/ Ru value
1	Waste		- -
2	Clay Deposits		- -
3	London Clay 1		- -
4	London Clay 2		- -
5	London Clay 3		- -
6	London Clay 4		- -
7	London Clay 5		- -
8	London Clay 6		- -
9	London Clay 7		- -
10	London Clay 8		- -
11	London Clay 9		- -
12	Harwich		- -

Slip Surface Specification

Circle centre specification: GRID
Bottom left of grid: x = 25.00000 m y = 10.00000 m
Inclination of grid: 0.00000 deg
(positive anticlockwise direction about bottom left of grid)
Centres on grid: 15 in x direction at 3.50000m spacing
20 in y direction at 3.50000m spacing
Grid extended to find minimum FoS
Initial radius of circle 5.00000 m
Incremented by 1.00000 m until all possible circles considered

WORST CASE

Centre at (63.500m,45.000m) Radius 43.000m
Iterations: 5 Horiz acceleration [%g]: 0.0
Net vertical force [kN/m]: 6.0727 *Slip weight [kN/m] 5954.4*
Net horiz force [kN/m]: 35.814 Disturbing moment [kN/m]: 28828.
Restoring moment [kNm/m]: 82177.
Reinf.Rest.Moment [kNm/m]: 0.0
Over-Design Factor: 2.8506

The system of interslice and base forces are in equilibrium
when the strengths available at the bases are divided by the computed
over-design factor. The interslice forces shown in the following table
are in equilibrium with the factored strengths of the soil at the bases of slices.

Slip surface coordinates		Pore Pressure		Interslice forces [kN/m]		
Point	x [m]	y [m]	L [kN/m²]	R [kN/m²]	T	E	E(u)
1	42.069	7.7214	-	0.0	0.0	0.0	0.0
2	42.516	7.4676	0.0	0.0	2.1985	9.3482	0.0
3	44.133	6.6081	0.0	0.0	10.946	41.370	0.0
4	45.786	5.8182	0.0	0.0	15.569	82.286	0.0
5	46.764	5.3905	0.0	0.0	15.485	112.88	0.0
6	47.753	4.9871	0.0	0.0	14.741	145.75	0.0
7	48.087	4.8573	0.0	0.0	14.376	157.24	0.0
8	48.522	4.6929	0.0	0.0	13.812	172.54	0.0
9	49.728	4.2651	0.0	0.0	11.201	218.41	0.0
10	50.946	3.8734	0.0	0.0	8.4563	266.24	0.0
11	52.153	3.5242	0.0	0.0	5.9509	314.18	0.0
12	52.674	3.3852	0.0	0.0	4.7677	335.66	0.0
13	53.908	3.0834	0.0	0.0	2.4076	385.94	0.0
14	55.213	2.8062	0.0	0.0	0.61436	437.59	0.0
15	56.525	2.5694	0.0	0.0	-0.45284	487.24	0.0
16	58.187	2.3295	0.0	0.0	-0.74457	544.95	0.0
17	59.885	2.1522	0.0	0.0	-0.10814	596.03	0.0
18	61.429	2.0499	0.0	0.0	0.64538	636.79	0.0
19	62.975	2.0032	0.0	0.0	1.2550	668.93	0.0
20	63.253	2.0007	0.0	0.0	1.3005	673.27	0.0
21	65.138	2.0312	0.0	0.0	2.6308	694.53	0.0
22	67.020	2.1443	0.0	0.0	6.6518	700.65	0.0
23	68.895	2.3397	0.0	0.0	11.947	691.11	0.0
24	69.256	2.3870	0.0	0.0	12.984	687.45	0.0
25	70.958	2.6518	0.0	0.0	17.648	663.01	0.0
26	72.470	2.9459	0.0	0.0	20.497	629.67	0.0
27	73.969	3.2940	0.0	0.0	22.008	588.93	0.0
28	74.727	3.4916	0.0	0.0	22.155	565.78	0.0
29	76.178	3.9116	0.0	0.0	20.492	514.97	0.0
30	77.614	4.3823	0.0	0.0	17.053	460.39	0.0
31	78.810	4.8177	0.0	0.0	11.345	408.41	0.0
32	79.946	5.2691	0.0	0.0	4.6223	357.39	0.0
33	81.068	5.7527	0.0	0.0	-3.1347	306.07	0.0
34	81.563	5.9780	0.0	0.0	-5.7009	285.89	0.0
35	83.361	6.8618	0.0	0.0	-16.220	212.41	0.0
36	85.116	7.8284	0.0	0.0	-27.757	141.88	0.0
37	86.824	8.8756	0.0	0.0	-38.512	77.403	0.0
38	88.366	9.9192	0.0	0.0	-44.497	27.431	0.0
39	89.862	11.029	0.0	0.0	-42.770	-8.8861	0.0
40	91.308	12.202	0.0	0.0	-30.794	-30.220	0.0
41	92.701	13.436	0.0	-	-6.0727	-35.814	0.0

Slice No.	Strength Parameters		Average Pore Pressure	Slice Weight	Forces on base [kN/m]		
	c' [kN/m²]	Tan phi	[kN/m²]	[kN/m]	Normal	Shear (capacity)	Shear (mobilised)
1	*35.714*	*0.0*	0.0	*1.2164*	7.8139	18.380	6.4477
2	*21.429*	*0.0*	0.0	*22.169*	43.132	39.246	13.768
3	*21.429*	*0.0*	0.0	*49.049*	66.829	39.247	13.768
4	*30.893*	*0.0*	0.0	*41.176*	50.328	32.988	11.572
5	*30.893*	*0.0*	0.0	*50.675*	59.048	32.988	11.572
6	*30.893*	*0.0*	0.0	*19.206*	21.855	11.071	3.8836
7	*30.893*	*0.0*	0.0	*26.785*	30.099	14.370	5.0410
8	*35.536*	*0.0*	0.0	*84.233*	92.700	45.465	15.949
9	*35.536*	*0.0*	0.0	*99.365*	107.03	45.465	15.949
10	*35.536*	*0.0*	0.0	*111.83*	118.71	44.649	15.663
11	*40.179*	*0.0*	0.0	*52.210*	54.986	21.659	7.5982
12	*40.179*	*0.0*	0.0	*132.59*	138.77	51.061	17.913
13	*40.179*	*0.0*	0.0	*154.37*	160.28	53.585	18.798
14	*40.179*	*0.0*	0.0	*170.48*	175.79	53.585	18.798
15	*40.179*	*0.0*	0.0	*234.35*	240.17	67.461	23.666
16	*40.179*	*0.0*	0.0	*256.92*	261.67	68.605	24.067
17	*44.821*	*0.0*	0.0	*246.50*	249.52	69.326	24.320
18	*44.821*	*0.0*	0.0	*257.58*	259.10	69.326	24.320
19	*40.179*	*0.0*	0.0	*47.356*	47.441	11.173	3.9195
20	*40.179*	*0.0*	0.0	*327.68*	328.62	75.746	26.572
21	*40.179*	*0.0*	0.0	*336.98*	339.99	75.746	26.572
22	*40.179*	*0.0*	0.0	*342.54*	346.89	75.746	26.572
23	*40.179*	*0.0*	0.0	*66.569*	67.495	14.640	5.1358
24	*40.179*	*0.0*	0.0	*310.51*	315.11	69.228	24.286
25	*35.536*	*0.0*	0.0	*268.92*	273.04	54.710	19.193
26	*35.536*	*0.0*	0.0	*258.91*	262.78	54.710	19.193
27	*35.536*	*0.0*	0.0	*127.35*	129.16	27.833	9.7642

Slice No.	Strength Parameters		Average Pore	Slice Weight	Forces on base [kN/m]		
28	30.893	0.0	0.0	236.11	239.20	46.668	16.372
29	30.893	0.0	0.0	222.41	224.92	46.668	16.372
30	21.429	0.0	0.0	176.40	178.04	27.267	9.5655
31	21.429	0.0	0.0	160.02	161.16	26.197	9.1901
32	21.429	0.0	0.0	150.14	150.92	26.197	9.1902
33	35.714	0.0	0.0	63.341	63.604	19.422	6.8135
34	35.714	0.0	0.0	216.94	217.39	71.554	25.102
35	35.714	0.0	0.0	191.63	191.47	71.554	25.102
36	35.714	0.0	0.0	163.93	163.96	71.554	25.102
37	35.714	0.0	0.0	121.44	123.30	66.498	23.328
38	35.714	0.0	0.0	86.380	92.053	66.498	23.328
39	35.714	0.0	0.0	51.347	62.254	66.498	23.328
40	35.714	0.0	0.0	16.777	34.395	66.498	23.328

Slice No.	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]	
	Vert	Horiz	Vert	Horiz	Vert	Horiz
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0

ARUP

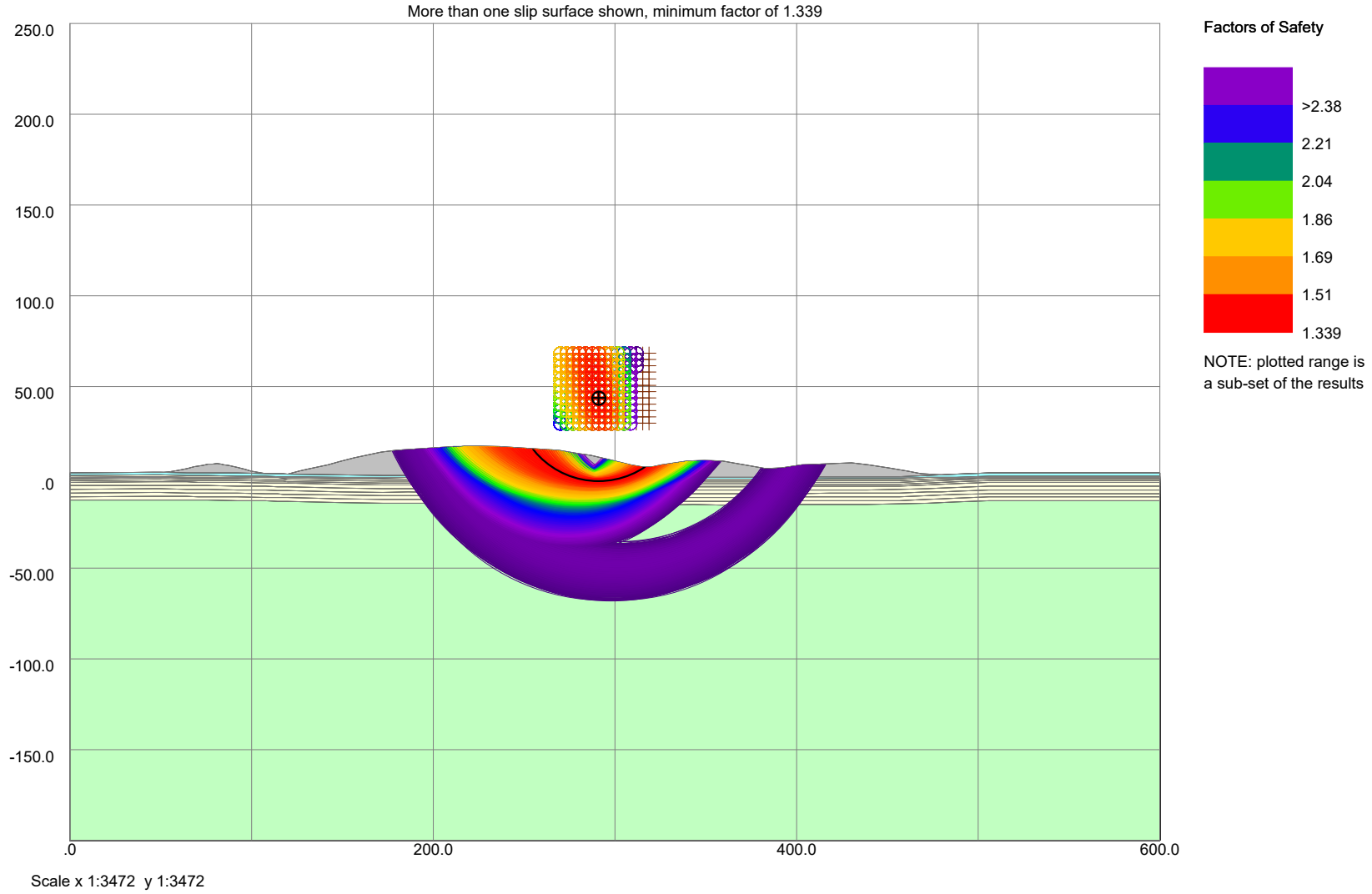
Arup

Job No.	Sheet No.	Rev.
256906		

Drg. Ref.

Made by EB | Date | Checked

Northern SPA
Eastern Mound - Undrained
Section D-DD (north)



General Parameters

Direction of slip: DOWNHILL
Minimum slip weight [kN/m] : 0.00000
Type of analysis : STATIC

Analysis Options

Partial Factor Analysis
Minimum number of slices: 25
Method: Bishop (Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: NOT ACTIVE

Method Partial Factors

Current selection: BS EN 1997-1:2011 DA1-2
Factor on FAVOURABLE PERMANENT LOAD: 1.00000
Factor on UNFAVOURABLE PERMANENT LOAD: 1.00000
Factor on FAVOURABLE VARIABLE LOAD: 0.00000
Factor on UNFAVOURABLE VARIABLE LOAD: 1.30000
Factor on SOIL UNIT WEIGHT: 1.00000
Factor on DRAINED SOIL COHESION: 1.25000
Factor on UNDRAINED SOIL COHESION: 1.40000
Factor on SOIL FRICTION ANGLE: 1.25000
Factor on reinforcement pullout: 1.50000
Economic ramification of failure: 1.00000
Sliding along reinforcement: 1.50000

Material properties

No	Description	Unit Weight Above GWL [kN/m3]	Unit Weight Below GWL [kN/m3]	Shear Strength Parameters Condition	Phi or Phi0 [°]	c or c0' [kN/m²]
1	Waste	19.500	19.500	Undrained	N.A.	50.000
2	Clay Deposits	17.000	17.000	Undrained	N.A.	30.000
3	London Clay 1	19.500	19.500	Undrained	N.A.	43.250
4	London Clay 2	19.500	19.500	Undrained	N.A.	49.750
5	London Clay 3	19.500	19.500	Undrained	N.A.	56.250
6	London Clay 4	19.500	19.500	Undrained	N.A.	62.750
7	London Clay 5	19.500	19.500	Undrained	N.A.	72.500
8	London Clay 6	19.500	19.500	Undrained	N.A.	85.500
9	London Clay 7	19.500	19.500	Undrained	N.A.	98.500
10	London Clay 8	19.500	19.500	Undrained	N.A.	111.50
11	London Clay 9	19.500	19.500	Undrained	N.A.	124.50
12	Harwich	20.000	20.000	Undrained	N.A.	130.00

Coordinates of top of soil strata

The units of the following coordinates are in m

Stratum X -->	0.0	45.962	49.759	51.953	54.883	59.695	64.560
1	2.6980	2.9579	2.9332	2.9400	3.1990	4.0976	.
2	2.6880	2.9479	2.9232	.	.	.	2.7612
3	1.1880	1.4479	1.4232	.	.	.	1.2612
4	0.18800	0.44790	0.42320	.	.	.	0.26120
5	-0.81200	-0.55210	-0.57680	.	.	.	-0.73880
6	-1.8120	-1.5521	-1.5768	.	.	.	-1.7388
7	-2.8120	-2.5521	-2.5768	.	.	.	-2.7388
8	-4.8120	-4.5521	-4.5768	.	.	.	-4.7388
9	-6.8120	-6.5521	-6.5768	.	.	.	-6.7388
10	-8.8120	-8.5521	-8.5768	.	.	.	-8.7388
11	-10.812	-10.552	-10.577	.	.	.	-10.739
12	-12.812	-12.552	-12.577	.	.	.	-12.739
Stratum X -->							

	64.754	**68.531**	**70.667**	**73.559**	**75.785**	**76.349**	**78.727**
1	5.1990	6.0478	.	6.9178	.	7.3059	7.5024
2	.	.	2.7127	.	2.7056	.	.
3	.	.	1.2127	.	1.2056	.	.
4	.	.	0.21270	.	0.20560	.	.
5	.	.	-0.78730	.	-0.79440	.	.
6	.	.	-1.7873	.	-1.7944	.	.
7	.	.	-2.7873	.	-2.7944	.	.
8	.	.	-4.7873	.	-4.7944	.	.
9	.	.	-6.7873	.	-6.7944	.	.
10	.	.	-8.7873	.	-8.7944	.	.
11	.	.	-10.787	.	-10.794	.	.
12	.	.	-12.787	.	-12.794	.	.
Stratum X -->							
	81.104	**83.565**	**85.009**	**87.400**	**92.023**	**92.106**	**96.293**
1	7.6990	7.4535	7.1990	6.7117	5.6844	.	4.6335
2	.	.	.	.	.	2.5277	.
3	.	.	.	.	.	1.0277	.
4	.	.	.	.	.	0.027700	.
5	.	.	.	.	.	-0.97230	.
6	.	.	.	.	.	-1.9723	.
7	.	.	.	.	.	-2.9723	.
8	.	.	.	.	.	-4.9723	.
9	.	.	.	.	.	-6.9723	.
10	.	.	.	.	.	-8.9723	.
11	.	.	.	.	.	-10.972	.
12	.	.	.	.	.	-12.972	.
Stratum X -->							
	99.985	**107.70**	**114.57**	**117.64**	**119.79**	**126.31**	**130.80**
1	3.8142	2.3500	.	.	2.0700	3.5739	4.6001
2	.	2.3239	2.1890	2.1188	2.0562	.	.
3	.	0.82390	0.68900	0.61880	0.55620	.	.
4	.	-0.17610	-0.31100	-0.38120	-0.44380	.	.
5	.	-1.1761	-1.3110	-1.3812	-1.4438	.	.
6	.	-2.1761	-2.3110	-2.3812	-2.4438	.	.
7	.	-3.1761	-3.3110	-3.3812	-3.4438	.	.
8	.	-5.1761	-5.3110	-5.3812	-5.4438	.	.
9	.	-7.1761	-7.3110	-7.3812	-7.4438	.	.
10	.	-9.1761	-9.3110	-9.3812	-9.4438	.	.
11	.	-11.176	-11.311	-11.381	-11.444	.	.
12	.	-13.176	-13.311	-13.381	-13.444	.	.
Stratum X -->							
	135.67	**142.07**	**148.43**	**148.77**	**156.55**	**171.43**	**172.29**
1	5.7893	7.2601	8.7875	.	10.788	14.199	.
2	.	.	.	1.5117	.	.	1.1346
3	.	.	.	0.011700	.	.	-0.36540
4	.	.	.	-0.98830	.	.	-1.3654
5	.	.	.	-1.9883	.	.	-2.3654
6	.	.	.	-2.9883	.	.	-3.3654
7	.	.	.	-3.9883	.	.	-4.3654
8	.	.	.	-5.9883	.	.	-6.3654
9	.	.	.	-7.9883	.	.	-8.3654
10	.	.	.	-9.9883	.	.	-10.365
11	.	.	.	-11.988	.	.	-12.365
12	.	.	.	-13.988	.	.	-14.365
Stratum X -->							
	179.78	**186.36**	**201.87**	**211.22**	**215.38**	**217.28**	**217.71**
1	15.199	.	.	17.199	17.355	.	17.482
2	.	1.2139	1.0963	.	.	0.87990	.
3	.	-0.28610	-0.40370	.	.	-0.62010	.
4	.	-1.2861	-1.4037	.	.	-1.6201	.
5	.	-2.2861	-2.4037	.	.	-2.6201	.
6	.	-3.2861	-3.4037	.	.	-3.6201	.
7	.	-4.2861	-4.4037	.	.	-4.6201	.
8	.	-6.2861	-6.4037	.	.	-6.6201	.
9	.	-8.2861	-8.4037	.	.	-8.6201	.
10	.	-10.286	-10.404	.	.	-10.620	.
11	.	-12.286	-12.404	.	.	-12.620	.
12	.	-14.286	-14.404	.	.	-14.620	.
Stratum X -->							
	221.59	**224.46**	**234.21**	**236.68**	**243.63**	**255.53**	**269.24**
1	17.599	.	.	17.199	.	.	15.199
2	.	0.88650	0.90540	.	0.95470	1.0016	.
3	.	-0.61350	-0.59460	.	-0.54530	-0.49840	.
4	.	-1.6135	-1.5946	.	-1.5453	-1.4984	.

Stratum X -->							
	301.50	304.46	304.91	306.68	312.62	315.53	319.24
5	.	-2.6135	-2.5946	.	-2.5453	-2.4984	.
6	.	-3.6135	-3.5946	.	-3.5453	-3.4984	.
7	.	-4.6135	-4.5946	.	-4.5453	-4.4984	.
8	.	-6.6135	-6.5946	.	-6.5453	-6.4984	.
9	.	-8.6135	-8.5946	.	-8.5453	-8.4984	.
10	.	-10.613	-10.595	.	-10.545	-10.498	.
11	.	-12.613	-12.595	.	-12.545	-12.498	.
12	.	-14.613	-14.595	.	-14.545	-14.498	.
Stratum X -->							
	272.62	**279.71**	**287.12**	**289.49**	**289.81**	**297.32**	**304.59**
1	.	13.513	12.199	.	11.660	10.048	.
2	0.78170	.	.	0.42960	.	.	0.17560
3	-0.71830	.	.	-1.0704	.	.	-1.3244
4	-1.7183	.	.	-2.0704	.	.	-2.3244
5	-2.7183	.	.	-3.0704	.	.	-3.3244
6	-3.7183	.	.	-4.0704	.	.	-4.3244
7	-4.7183	.	.	-5.0704	.	.	-5.3244
8	-6.7183	.	.	-7.0704	.	.	-7.3244
9	-8.7183	.	.	-9.0704	.	.	-9.3244
10	-10.718	.	.	-11.070	.	.	-11.324
11	-12.718	.	.	-13.070	.	.	-13.324
12	-14.718	.	.	-15.070	.	.	-15.324
Stratum X -->							
	308.73	**314.89**	**320.53**	**320.82**	**325.73**	**327.94**	**340.24**
1	7.1990	6.1990	.	6.1990	6.9555	.	9.1990
2	.	.	0.0	.	.	0.12360	.
3	.	.	-1.5000	.	.	-1.3764	.
4	.	.	-2.5000	.	.	-2.3764	.
5	.	.	-3.5000	.	.	-3.3764	.
6	.	.	-4.5000	.	.	-4.3764	.
7	.	.	-5.5000	.	.	-5.3764	.
8	.	.	-7.5000	.	.	-7.3764	.
9	.	.	-9.5000	.	.	-9.3764	.
10	.	.	-11.500	.	.	-11.376	.
11	.	.	-13.500	.	.	-13.376	.
12	.	.	-15.500	.	.	-15.376	.
Stratum X -->							
	343.34	**349.56**	**359.11**	**359.43**	**370.45**	**383.28**	**387.29**
1	.	9.6990	9.1990	.	.	5.1990	.
2	0.23810	.	.	0.22100	0.23660	.	0.34010
3	-1.2619	.	.	-1.2790	-1.2634	.	-1.1599
4	-2.2619	.	.	-2.2790	-2.2634	.	-2.1599
5	-3.2619	.	.	-3.2790	-3.2634	.	-3.1599
6	-4.2619	.	.	-4.2790	-4.2634	.	-4.1599
7	-5.2619	.	.	-5.2790	-5.2634	.	-5.1599
8	-7.2619	.	.	-7.2790	-7.2634	.	-7.1599
9	-9.2619	.	.	-9.2790	-9.2634	.	-9.1599
10	-11.262	.	.	-11.279	-11.263	.	-11.160
11	-13.262	.	.	-13.279	-13.263	.	-13.160
12	-15.262	.	.	-15.279	-15.263	.	-15.160
Stratum X -->							
	391.88	**399.19**	**402.91**	**418.64**	**421.17**	**430.50**	**439.15**
1	5.2314	.	7.1990	.	7.8857	8.1869	.
2	.	0.45500	.	0.51920	.	.	0.48210
3	.	-1.0450	.	-0.98080	.	.	-1.0179
4	.	-2.0450	.	-1.9808	.	.	-2.0179
5	.	-3.0450	.	-2.9808	.	.	-3.0179
6	.	-4.0450	.	-3.9808	.	.	-4.0179
7	.	-5.0450	.	-4.9808	.	.	-5.0179
8	.	-7.0450	.	-6.9808	.	.	-7.0179
9	.	-9.0450	.	-8.9808	.	.	-9.0179
10	.	-11.045	.	-10.981	.	.	-11.018
11	.	-13.045	.	-12.981	.	.	-13.018
12	.	-15.045	.	-14.981	.	.	-15.018
Stratum X -->							
	439.67	**450.69**	**456.64**	**461.31**	**468.46**	**472.06**	**479.86**
1	7.1990	5.5400	.	3.5883	2.1990	.	1.5100
2	.	.	0.61420	.	.	1.1890	1.4858
3	.	.	-0.88580	.	.	-0.31100	-0.014200
4	.	.	-1.8858	.	.	-1.3110	-1.0142
5	.	.	-2.8858	.	.	-2.3110	-2.0142
6	.	.	-3.8858	.	.	-3.3110	-3.0142
7	.	.	-4.8858	.	.	-4.3110	-4.0142
8	.	.	-6.8858	.	.	-6.3110	-6.0142
9	.	.	-8.8858	.	.	-8.3110	-8.0142

Stratum X -->							
	439.67	450.69	456.64	461.31	468.46	473.06	479.86
10	.	.	-10.886	.	.	-10.311	-10.014
11	.	.	-12.886	.	.	-12.311	-12.014
12	.	.	-14.886	.	.	-14.311	-14.014

Stratum X -->	487.82	505.89
1	1.8044	2.4739
2	1.7944	2.4639
3	0.29440	0.96390
4	-0.70560	-0.036100
5	-1.7056	-1.0361
6	-2.7056	-2.0361
7	-3.7056	-3.0361
8	-5.7056	-5.0361
9	-7.7056	-7.0361
10	-9.7056	-9.0361
11	-11.706	-11.036
12	-13.706	-13.036

Stratum-linked data

No.	Material	Water table	Piezo Set/ Ru value
1	Waste		- -
2	Clay Deposits		- -
3	London Clay 1		- -
4	London Clay 2		- -
5	London Clay 3		- -
6	London Clay 4		- -
7	London Clay 5		- -
8	London Clay 6		- -
9	London Clay 7		- -
10	London Clay 8		- -
11	London Clay 9		- -
12	Harwich		- -

Slip Surface Specification

Circle centre specification: GRID
Bottom left of grid: x = 270.00000 m y = 30.00000 m
Inclination of grid: 0.00000 deg
(positive anticlockwise direction about bottom left of grid)
Centres on grid: 15 in x direction at 3.50000m spacing
12 in y direction at 3.50000m spacing
Grid extended to find minimum FoS
Initial radius of circle 5.00000 m
Incremented by 1.00000 m until all possible circles considered

WORST CASE

Centre at (291.00m,44.000m) Radius 46.000m
Iterations: 5 Horiz acceleration [%g]: 0.0
Net vertical force [kN/m]: 32.420 *Slip weight [kN/m] 11637.*
Net horiz force [kN/m]: 123.09 Disturbing moment [kN/m]: 77326.
Restoring moment [kNm/m]: 103570.
Reinf.Rest.Moment [kNm/m]: 0.0
Over-Design Factor: 1.3393

The system of interslice and base forces are in equilibrium
when the strengths available at the bases are divided by the computed
over-design factor. The interslice forces shown in the following table
are in equilibrium with the factored strengths of the soil at the bases of slices.

Slip surface coordinates		Pore Pressure		Interslice forces [kN/m]		
Point	x [m]	y [m]	L [kN/m²]	R [kN/m²]	T	E	E(u)
1	254.42	16.110	-	0.0	0.0	0.0	0.0
2	255.96	14.199	0.0	0.0	-63.333	8.1713	0.0
3	257.60	12.373	0.0	0.0	-98.104	44.336	0.0
4	259.33	10.637	0.0	0.0	-108.51	109.61	0.0
5	261.15	8.9966	0.0	0.0	-99.598	203.49	0.0
6	263.06	7.4553	0.0	0.0	-76.887	323.82	0.0
7	265.05	6.0179	0.0	0.0	-45.956	466.85	0.0
8	267.11	4.6885	0.0	0.0	-12.073	627.43	0.0
9	269.24	3.4710	0.0	0.0	20.136	799.22	0.0
10	271.25	2.4549	0.0	0.0	44.241	958.98	0.0
11	273.31	1.5384	0.0	0.0	60.574	1113.2	0.0
12	275.41	0.72359	0.0	0.0	68.492	1256.2	0.0
13	277.54	0.011986	0.0	0.0	75.655	1404.8	0.0
14	279.71	-0.59409	0.0	0.0	74.421	1531.5	0.0
15	280.97	-0.89250	0.0	0.0	70.733	1592.5	0.0
16	283.00	-1.2997	0.0	0.0	58.624	1657.4	0.0

Slip surface coordinates Pore Pressure Interslice forces [kN/m]

17	285.06	-1.6146	0.0	0.0	45.153		1697.0	0.0
18	287.12	-1.8364	0.0	0.0	32.731		1710.3	0.0
19	289.49	-1.9751	0.0	0.0	23.022		1693.1	0.0
20	289.81	-1.9846	0.0	0.0	22.278		1688.2	0.0
21	292.32	-1.9810	0.0	0.0	22.115		1629.3	0.0
22	294.83	-1.8404	0.0	0.0	17.775		1536.6	0.0
23	297.32	-1.5633	0.0	0.0	12.686		1413.9	0.0
24	299.35	-1.2363	0.0	0.0	9.8887		1295.4	0.0
25	301.11	-0.87529	0.0	0.0	6.7121		1193.5	0.0
26	302.86	-0.44566	0.0	0.0	5.1474		1084.4	0.0
27	304.59	0.051945	0.0	0.0	5.2283		971.09	0.0
28	304.97	0.17141	0.0	0.0	5.4464		945.68	0.0
29	306.86	0.82132	0.0	0.0	14.104		798.30	0.0
30	308.73	1.5532	0.0	0.0	23.684		655.53	0.0
31	310.83	2.4948	0.0	0.0	34.204		501.00	0.0
32	312.89	3.5407	0.0	0.0	41.838		360.99	0.0
33	314.89	4.6882	0.0	0.0	42.967		240.48	0.0
34	316.06	5.4261	0.0	0.0	39.404		178.14	0.0
35	317.21	6.1990	0.0	-	32.420		123.09	0.0

Slice Strength Parameters Average Slice Forces on base [kN/m]

No.	c' [kN/m²]	Tan phi	Pore Pressure [kN/m²]	Weight [kN/m]	Normal	Shear (capacity)	Shear (mobilised)
1	*35.714*	*0.0*	0.0	*27.248*	61.944	87.615	65.416
2	*35.714*	*0.0*	0.0	*85.583*	106.11	87.613	65.415
3	*35.714*	*0.0*	0.0	*147.24*	156.46	87.615	65.416
4	*35.714*	*0.0*	0.0	*211.04*	212.00	87.613	65.415
5	*35.714*	*0.0*	0.0	*275.82*	271.53	87.614	65.415
6	*35.714*	*0.0*	0.0	*340.40*	333.70	87.614	65.416
7	*35.714*	*0.0*	0.0	*403.65*	396.98	87.614	65.415
8	*35.714*	*0.0*	0.0	*464.50*	459.83	87.615	65.416
9	*35.714*	*0.0*	0.0	*473.05*	472.14	80.408	60.035
10	*35.714*	*0.0*	0.0	*509.81*	513.00	80.408	60.035
11	*35.714*	*0.0*	0.0	*542.06*	549.23	80.408	60.035
12	*21.429*	*0.0*	0.0	*567.91*	578.62	48.278	36.046
13	*21.429*	*0.0*	0.0	*586.36*	599.70	48.279	36.046
14	*21.429*	*0.0*	0.0	*341.23*	349.51	27.592	20.601
15	*30.893*	*0.0*	0.0	*556.73*	570.31	64.182	47.920
16	*30.893*	*0.0*	0.0	*561.11*	573.79	64.182	47.920
17	*30.893*	*0.0*	0.0	*560.53*	570.99	64.182	47.921
18	*30.893*	*0.0*	0.0	*630.42*	637.95	73.156	54.621
19	*30.893*	*0.0*	0.0	*85.276*	85.832	10.026	7.4858
20	*30.893*	*0.0*	0.0	*645.29*	645.55	77.555	57.905
21	*30.893*	*0.0*	0.0	*614.43*	623.47	77.554	57.904
22	*30.893*	*0.0*	0.0	*575.36*	591.39	77.554	57.905
23	*30.893*	*0.0*	0.0	*434.17*	451.38	63.325	47.281
24	*21.429*	*0.0*	0.0	*350.92*	368.55	38.550	28.783
25	*21.429*	*0.0*	0.0	*321.30*	340.98	38.551	28.783
26	*21.429*	*0.0*	0.0	*289.83*	311.41	38.550	28.783
27	*21.429*	*0.0*	0.0	*59.862*	64.900	8.5471	6.3816
28	*35.714*	*0.0*	0.0	*273.77*	300.64	71.576	53.441
29	*35.714*	*0.0*	0.0	*227.20*	257.00	71.577	53.442
30	*35.714*	*0.0*	0.0	*205.37*	243.81	82.345	61.481
31	*35.714*	*0.0*	0.0	*147.16*	190.91	82.344	61.481
32	*35.714*	*0.0*	0.0	*87.621*	138.22	82.345	61.482
33	*35.714*	*0.0*	0.0	*26.142*	60.327	49.524	36.976
34	*35.714*	*0.0*	0.0	*8.6762*	45.730	49.525	36.977

Slice Surface Load [kN/m_hor/m] Point Load [kN/m] Water Pressure on ground surface [kN/m_hor/m]

No.	Vert	Horiz	Vert	Horiz	Vert	Horiz
1	*0.0*	*0.0*	0.0	0.0	0.0	0.0
2	*0.0*	*0.0*	0.0	0.0	0.0	0.0
3	*0.0*	*0.0*	0.0	0.0	0.0	0.0
4	*0.0*	*0.0*	0.0	0.0	0.0	0.0
5	*0.0*	*0.0*	0.0	0.0	0.0	0.0
6	*0.0*	*0.0*	0.0	0.0	0.0	0.0
7	*0.0*	*0.0*	0.0	0.0	0.0	0.0
8	*0.0*	*0.0*	0.0	0.0	0.0	0.0
9	*0.0*	*0.0*	0.0	0.0	0.0	0.0
10	*0.0*	*0.0*	0.0	0.0	0.0	0.0
11	*0.0*	*0.0*	0.0	0.0	0.0	0.0
12	*0.0*	*0.0*	0.0	0.0	0.0	0.0
13	*0.0*	*0.0*	0.0	0.0	0.0	0.0
14	*0.0*	*0.0*	0.0	0.0	0.0	0.0
15	*0.0*	*0.0*	0.0	0.0	0.0	0.0

Slice No	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]	
16	*0.0*	*0.0*	0.0	0.0	0.0	0.0
17	*0.0*	*0.0*	0.0	0.0	0.0	0.0
18	*0.0*	*0.0*	0.0	0.0	0.0	0.0
19	*0.0*	*0.0*	0.0	0.0	0.0	0.0
20	*0.0*	*0.0*	0.0	0.0	0.0	0.0
21	*0.0*	*0.0*	0.0	0.0	0.0	0.0
22	*0.0*	*0.0*	0.0	0.0	0.0	0.0
23	*0.0*	*0.0*	0.0	0.0	0.0	0.0
24	*0.0*	*0.0*	0.0	0.0	0.0	0.0
25	*0.0*	*0.0*	0.0	0.0	0.0	0.0
26	*0.0*	*0.0*	0.0	0.0	0.0	0.0
27	*0.0*	*0.0*	0.0	0.0	0.0	0.0
28	*0.0*	*0.0*	0.0	0.0	0.0	0.0
29	*0.0*	*0.0*	0.0	0.0	0.0	0.0
30	*0.0*	*0.0*	0.0	0.0	0.0	0.0
31	*0.0*	*0.0*	0.0	0.0	0.0	0.0
32	*0.0*	*0.0*	0.0	0.0	0.0	0.0
33	*0.0*	*0.0*	0.0	0.0	0.0	0.0
34	*0.0*	*0.0*	0.0	0.0	0.0	0.0

ARUP

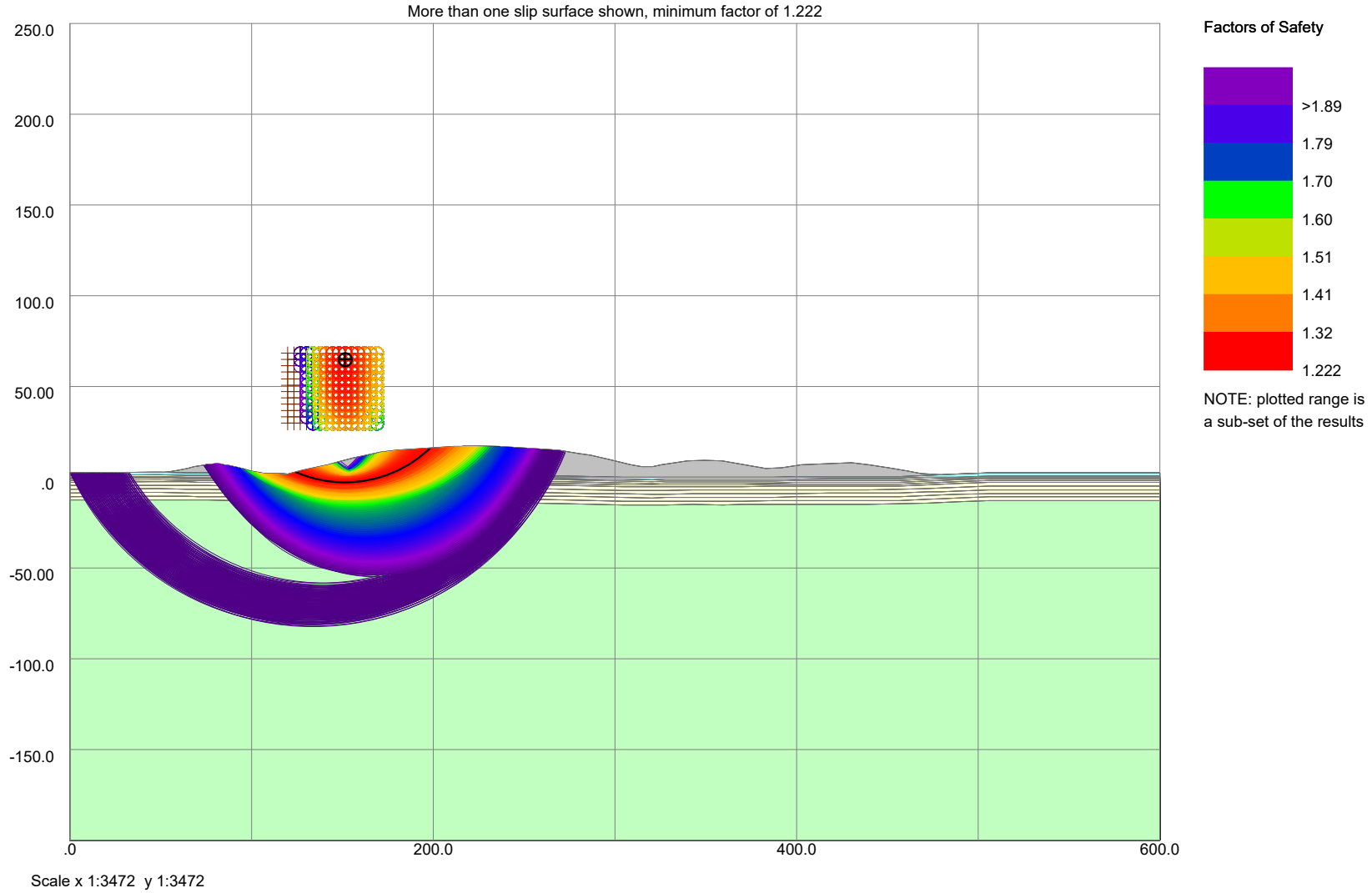
Arup

Job No.	Sheet No.	Rev.
256906		

Drg. Ref.

Made by EB | Date | Checked

Northern SPA
Eastern Mound - Undrained
Section D-DD (south)



General Parameters

Direction of slip: DOWNHILL
Minimum slip weight [kN/m] : 0.00000
Type of analysis : STATIC

Analysis Options

Partial Factor Analysis
Minimum number of slices: 25
Method: Bishop (Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: NOT ACTIVE

Method Partial Factors

Current selection: BS EN 1997-1:2011 DA1-2
Factor on FAVOURABLE PERMANENT LOAD: 1.00000
Factor on UNFAVOURABLE PERMANENT LOAD: 1.00000
Factor on FAVOURABLE VARIABLE LOAD: 0.00000
Factor on UNFAVOURABLE VARIABLE LOAD: 1.30000
Factor on SOIL UNIT WEIGHT: 1.00000
Factor on DRAINED SOIL COHESION: 1.25000
Factor on UNDRAINED SOIL COHESION: 1.40000
Factor on SOIL FRICTION ANGLE: 1.25000
Factor on reinforcement pullout: 1.50000
Economic ramification of failure: 1.00000
Sliding along reinforcement: 1.50000

Material properties

No	Description	Unit Weight Above GWL [kN/m3]	Unit Weight Below GWL [kN/m3]	Shear Strength Parameters Condition	Phi or Phi0 [°]	c or c0' [kN/m²]
1	Waste	19.500	19.500	Undrained	N.A.	50.000
2	Clay Deposits	17.000	17.000	Undrained	N.A.	30.000
3	London Clay 1	19.500	19.500	Undrained	N.A.	43.250
4	London Clay 2	19.500	19.500	Undrained	N.A.	49.750
5	London Clay 3	19.500	19.500	Undrained	N.A.	56.250
6	London Clay 4	19.500	19.500	Undrained	N.A.	62.750
7	London Clay 5	19.500	19.500	Undrained	N.A.	72.500
8	London Clay 6	19.500	19.500	Undrained	N.A.	85.500
9	London Clay 7	19.500	19.500	Undrained	N.A.	98.500
10	London Clay 8	19.500	19.500	Undrained	N.A.	111.50
11	London Clay 9	19.500	19.500	Undrained	N.A.	124.50
12	Harwich	20.000	20.000	Undrained	N.A.	130.00

Coordinates of top of soil strata

The units of the following coordinates are in m

Stratum X -->	0.0	45.962	49.759	51.953	54.883	59.695	64.560
1	2.6980	2.9579	2.9332	2.9400	3.1990	4.0976	.
2	2.6880	2.9479	2.9232	.	.	.	2.7612
3	1.1880	1.4479	1.4232	.	.	.	1.2612
4	0.18800	0.44790	0.42320	.	.	.	0.26120
5	-0.81200	-0.55210	-0.57680	.	.	.	-0.73880
6	-1.8120	-1.5521	-1.5768	.	.	.	-1.7388
7	-2.8120	-2.5521	-2.5768	.	.	.	-2.7388
8	-4.8120	-4.5521	-4.5768	.	.	.	-4.7388
9	-6.8120	-6.5521	-6.5768	.	.	.	-6.7388
10	-8.8120	-8.5521	-8.5768	.	.	.	-8.7388
11	-10.812	-10.552	-10.577	.	.	.	-10.739
12	-12.812	-12.552	-12.577	.	.	.	-12.739
Stratum X -->							

	64.754	**68.531**	**70.667**	**73.559**	**75.785**	**76.349**	**78.727**
1	5.1990	6.0478	.	6.9178	.	7.3059	7.5024
2	.	.	2.7127	.	2.7056	.	.
3	.	.	1.2127	.	1.2056	.	.
4	.	.	0.21270	.	0.20560	.	.
5	.	.	-0.78730	.	-0.79440	.	.
6	.	.	-1.7873	.	-1.7944	.	.
7	.	.	-2.7873	.	-2.7944	.	.
8	.	.	-4.7873	.	-4.7944	.	.
9	.	.	-6.7873	.	-6.7944	.	.
10	.	.	-8.7873	.	-8.7944	.	.
11	.	.	-10.787	.	-10.794	.	.
12	.	.	-12.787	.	-12.794	.	.
Stratum X -->							
	81.104	**83.565**	**85.009**	**87.400**	**92.023**	**92.106**	**96.293**
1	7.6990	7.4535	7.1990	6.7117	5.6844	.	4.6335
2	.	.	.	.	.	2.5277	.
3	.	.	.	.	.	1.0277	.
4	.	.	.	.	.	0.027700	.
5	.	.	.	.	.	-0.97230	.
6	.	.	.	.	.	-1.9723	.
7	.	.	.	.	.	-2.9723	.
8	.	.	.	.	.	-4.9723	.
9	.	.	.	.	.	-6.9723	.
10	.	.	.	.	.	-8.9723	.
11	.	.	.	.	.	-10.972	.
12	.	.	.	.	.	-12.972	.
Stratum X -->							
	99.985	**107.70**	**114.57**	**117.64**	**119.79**	**126.31**	**130.80**
1	3.8142	2.3500	.	.	2.0700	3.5739	4.6001
2	.	2.3239	2.1890	2.1188	2.0562	.	.
3	.	0.82390	0.68900	0.61880	0.55620	.	.
4	.	-0.17610	-0.31100	-0.38120	-0.44380	.	.
5	.	-1.1761	-1.3110	-1.3812	-1.4438	.	.
6	.	-2.1761	-2.3110	-2.3812	-2.4438	.	.
7	.	-3.1761	-3.3110	-3.3812	-3.4438	.	.
8	.	-5.1761	-5.3110	-5.3812	-5.4438	.	.
9	.	-7.1761	-7.3110	-7.3812	-7.4438	.	.
10	.	-9.1761	-9.3110	-9.3812	-9.4438	.	.
11	.	-11.176	-11.311	-11.381	-11.444	.	.
12	.	-13.176	-13.311	-13.381	-13.444	.	.
Stratum X -->							
	135.67	**142.07**	**148.43**	**148.77**	**156.55**	**171.43**	**172.29**
1	5.7893	7.2601	8.7875	.	10.788	14.199	.
2	.	.	.	1.5117	.	.	1.1346
3	.	.	.	0.011700	.	.	-0.36540
4	.	.	.	-0.98830	.	.	-1.3654
5	.	.	.	-1.9883	.	.	-2.3654
6	.	.	.	-2.9883	.	.	-3.3654
7	.	.	.	-3.9883	.	.	-4.3654
8	.	.	.	-5.9883	.	.	-6.3654
9	.	.	.	-7.9883	.	.	-8.3654
10	.	.	.	-9.9883	.	.	-10.365
11	.	.	.	-11.988	.	.	-12.365
12	.	.	.	-13.988	.	.	-14.365
Stratum X -->							
	179.78	**186.36**	**201.87**	**211.22**	**215.38**	**217.28**	**217.71**
1	15.199	.	.	17.199	17.355	.	17.482
2	.	1.2139	1.0963	.	.	0.87990	.
3	.	-0.28610	-0.40370	.	.	-0.62010	.
4	.	-1.2861	-1.4037	.	.	-1.6201	.
5	.	-2.2861	-2.4037	.	.	-2.6201	.
6	.	-3.2861	-3.4037	.	.	-3.6201	.
7	.	-4.2861	-4.4037	.	.	-4.6201	.
8	.	-6.2861	-6.4037	.	.	-6.6201	.
9	.	-8.2861	-8.4037	.	.	-8.6201	.
10	.	-10.286	-10.404	.	.	-10.620	.
11	.	-12.286	-12.404	.	.	-12.620	.
12	.	-14.286	-14.404	.	.	-14.620	.
Stratum X -->							
	221.59	**224.46**	**234.21**	**236.68**	**243.63**	**255.53**	**269.24**
1	17.599	.	.	17.199	.	.	15.199
2	.	0.88650	0.90540	.	0.95470	1.0016	.
3	.	-0.61350	-0.59460	.	-0.54530	-0.49840	.
4	.	-1.6135	-1.5946	.	-1.5453	-1.4984	.

Stratum X -->							
	301.50	304.46	304.91	306.68	312.62	315.53	320.24
5	.	-2.6135	-2.5946	.	-2.5453	-2.4984	.
6	.	-3.6135	-3.5946	.	-3.5453	-3.4984	.
7	.	-4.6135	-4.5946	.	-4.5453	-4.4984	.
8	.	-6.6135	-6.5946	.	-6.5453	-6.4984	.
9	.	-8.6135	-8.5946	.	-8.5453	-8.4984	.
10	.	-10.613	-10.595	.	-10.545	-10.498	.
11	.	-12.613	-12.595	.	-12.545	-12.498	.
12	.	-14.613	-14.595	.	-14.545	-14.498	.
Stratum X -->							
	272.62	**279.71**	**287.12**	**289.49**	**289.81**	**297.32**	**304.59**
1	.	13.513	12.199	.	11.660	10.048	.
2	0.78170	.	.	0.42960	.	.	0.17560
3	-0.71830	.	.	-1.0704	.	.	-1.3244
4	-1.7183	.	.	-2.0704	.	.	-2.3244
5	-2.7183	.	.	-3.0704	.	.	-3.3244
6	-3.7183	.	.	-4.0704	.	.	-4.3244
7	-4.7183	.	.	-5.0704	.	.	-5.3244
8	-6.7183	.	.	-7.0704	.	.	-7.3244
9	-8.7183	.	.	-9.0704	.	.	-9.3244
10	-10.718	.	.	-11.070	.	.	-11.324
11	-12.718	.	.	-13.070	.	.	-13.324
12	-14.718	.	.	-15.070	.	.	-15.324
Stratum X -->							
	308.73	**314.89**	**320.53**	**320.82**	**325.73**	**327.94**	**340.24**
1	7.1990	6.1990	.	6.1990	6.9555	.	9.1990
2	.	.	0.0	.	.	0.12360	.
3	.	.	-1.5000	.	.	-1.3764	.
4	.	.	-2.5000	.	.	-2.3764	.
5	.	.	-3.5000	.	.	-3.3764	.
6	.	.	-4.5000	.	.	-4.3764	.
7	.	.	-5.5000	.	.	-5.3764	.
8	.	.	-7.5000	.	.	-7.3764	.
9	.	.	-9.5000	.	.	-9.3764	.
10	.	.	-11.500	.	.	-11.376	.
11	.	.	-13.500	.	.	-13.376	.
12	.	.	-15.500	.	.	-15.376	.
Stratum X -->							
	343.34	**349.56**	**359.11**	**359.43**	**370.45**	**383.28**	**387.29**
1	.	9.6990	9.1990	.	.	5.1990	.
2	0.23810	.	.	0.22100	0.23660	.	0.34010
3	-1.2619	.	.	-1.2790	-1.2634	.	-1.1599
4	-2.2619	.	.	-2.2790	-2.2634	.	-2.1599
5	-3.2619	.	.	-3.2790	-3.2634	.	-3.1599
6	-4.2619	.	.	-4.2790	-4.2634	.	-4.1599
7	-5.2619	.	.	-5.2790	-5.2634	.	-5.1599
8	-7.2619	.	.	-7.2790	-7.2634	.	-7.1599
9	-9.2619	.	.	-9.2790	-9.2634	.	-9.1599
10	-11.262	.	.	-11.279	-11.263	.	-11.160
11	-13.262	.	.	-13.279	-13.263	.	-13.160
12	-15.262	.	.	-15.279	-15.263	.	-15.160
Stratum X -->							
	391.88	**399.19**	**402.91**	**418.64**	**421.17**	**430.50**	**439.15**
1	5.2314	.	7.1990	.	7.8857	8.1869	.
2	.	0.45500	.	0.51920	.	.	0.48210
3	.	-1.0450	.	-0.98080	.	.	-1.0179
4	.	-2.0450	.	-1.9808	.	.	-2.0179
5	.	-3.0450	.	-2.9808	.	.	-3.0179
6	.	-4.0450	.	-3.9808	.	.	-4.0179
7	.	-5.0450	.	-4.9808	.	.	-5.0179
8	.	-7.0450	.	-6.9808	.	.	-7.0179
9	.	-9.0450	.	-8.9808	.	.	-9.0179
10	.	-11.045	.	-10.981	.	.	-11.018
11	.	-13.045	.	-12.981	.	.	-13.018
12	.	-15.045	.	-14.981	.	.	-15.018
Stratum X -->							
	439.67	**450.69**	**456.64**	**461.31**	**468.46**	**472.06**	**479.86**
1	7.1990	5.5400	.	3.5883	2.1990	.	1.5100
2	.	.	0.61420	.	.	1.1890	1.4858
3	.	.	-0.88580	.	.	-0.31100	-0.014200
4	.	.	-1.8858	.	.	-1.3110	-1.0142
5	.	.	-2.8858	.	.	-2.3110	-2.0142
6	.	.	-3.8858	.	.	-3.3110	-3.0142
7	.	.	-4.8858	.	.	-4.3110	-4.0142
8	.	.	-6.8858	.	.	-6.3110	-6.0142
9	.	.	-8.8858	.	.	-8.3110	-8.0142

Stratum X -->

	439.67	450.69	456.64	461.31	468.46	473.06	479.86
10	.	.	-10.886	.	.	-10.311	-10.014
11	.	.	-12.886	.	.	-12.311	-12.014
12	.	.	-14.886	.	.	-14.311	-14.014

Stratum X -->

	487.82	**505.89**
1	1.8044	2.4739
2	1.7944	2.4639
3	0.29440	0.96390
4	-0.70560	-0.036100
5	-1.7056	-1.0361
6	-2.7056	-2.0361
7	-3.7056	-3.0361
8	-5.7056	-5.0361
9	-7.7056	-7.0361
10	-9.7056	-9.0361
11	-11.706	-11.036
12	-13.706	-13.036

Stratum-linked data

No.	Material	Water table	Piezo Set/ Ru value
1	Waste		- -
2	Clay Deposits		- -
3	London Clay 1		- -
4	London Clay 2		- -
5	London Clay 3		- -
6	London Clay 4		- -
7	London Clay 5		- -
8	London Clay 6		- -
9	London Clay 7		- -
10	London Clay 8		- -
11	London Clay 9		- -
12	Harwich		- -

Slip Surface Specification

Circle centre specification: GRID
Bottom left of grid: x = 120.00000 m y = 30.00000 m
Inclination of grid: 0.00000 deg
(positive anticlockwise direction about bottom left of grid)
Centres on grid: 15 in x direction at 3.50000m spacing
12 in y direction at 3.50000m spacing
Grid extended to find minimum FoS
Initial radius of circle 5.00000 m
Incremented by 1.00000 m until all possible circles considered

WORST CASE

Centre at (151.50m,65.000m) Radius 68.000m
Iterations: 5 Horiz acceleration [%g]: 0.0
Net vertical force [kN/m]: 25.645 *Slip weight [kN/m] 13909.*
Net horiz force [kN/m]: 129.69 Disturbing moment [kN/m]: 157970.
Restoring moment [kNm/m]: 193020.
Reinf.Rest.Moment [kNm/m]: 0.0
Over-Design Factor: 1.2218

The system of interslice and base forces are in equilibrium
when the strengths available at the bases are divided by the computed
over-design factor. The interslice forces shown in the following table
are in equilibrium with the factored strengths of the soil at the bases of slices.

Slip surface coordinates		Pore Pressure		Interslice forces [kN/m]		
Point	x [m]	y [m]	L [kN/m²]	R [kN/m²]	T	E	E(u)
1	123.66	2.9618	-	0.0	0.0	0.0	0.0
2	126.06	1.9384	0.0	0.0	4.1055	100.46	0.0
3	126.31	1.8373	0.0	0.0	5.2318	109.30	0.0
4	128.34	1.0644	0.0	0.0	11.588	187.11	0.0
5	130.40	0.35687	0.0	0.0	14.439	275.52	0.0
6	130.80	0.22804	0.0	0.0	13.711	296.64	0.0
7	132.40	-0.26112	0.0	0.0	10.273	383.84	0.0
8	134.00	-0.71088	0.0	0.0	6.4132	474.70	0.0
9	135.67	-1.1314	0.0	0.0	0.92015	576.58	0.0
10	137.22	-1.4843	0.0	0.0	-3.6103	671.83	0.0
11	138.79	-1.8007	0.0	0.0	-7.3507	766.34	0.0
12	140.42	-2.0918	0.0	0.0	-11.387	869.16	0.0
13	142.07	-2.3428	0.0	0.0	-14.239	968.59	0.0
14	144.18	-2.6051	0.0	0.0	-16.264	1089.0	0.0
15	146.30	-2.8011	0.0	0.0	-16.794	1199.6	0.0
16	148.43	-2.9306	0.0	0.0	-16.379	1298.1	0.0

Slip surface coordinates Pore Pressure Interslice forces [kN/m]

17	148.77	-2.9452	0.0	0.0	-16.277		1312.7	0.0
18	151.37	-2.9999	0.0	0.0	-15.632		1410.8	0.0
19	153.96	-2.9555	0.0	0.0	-12.347		1485.1	0.0
20	156.55	-2.8122	0.0	0.0	-3.1885		1533.3	0.0
21	159.23	-2.5586	0.0	0.0	10.210		1553.9	0.0
22	161.91	-2.1989	0.0	0.0	25.035		1543.9	0.0
23	164.32	-1.7807	0.0	0.0	36.000		1499.4	0.0
24	166.71	-1.2760	0.0	0.0	43.964		1430.9	0.0
25	168.54	-0.83028	0.0	0.0	45.337		1356.1	0.0
26	170.35	-0.33431	0.0	0.0	43.237		1269.3	0.0
27	171.43	-0.014328	0.0	0.0	37.597		1203.6	0.0
28	172.29	0.25662	0.0	0.0	31.875		1148.1	0.0
29	174.89	1.1492	0.0	0.0	8.4297		968.66	0.0
30	177.35	2.1059	0.0	0.0	-11.270		814.15	0.0
31	179.78	3.1574	0.0	0.0	-36.866		654.71	0.0
32	182.43	4.4391	0.0	0.0	-69.697		479.13	0.0
33	185.02	5.8342	0.0	0.0	-103.06		314.22	0.0
34	187.55	7.3402	0.0	0.0	-132.54		166.86	0.0
35	190.01	8.9543	0.0	0.0	-152.95		43.160	0.0
36	192.40	10.673	0.0	0.0	-158.55		-51.700	0.0
37	194.71	12.494	0.0	0.0	-143.28		-113.71	0.0
38	196.94	14.414	0.0	0.0	-100.95		-140.15	0.0
39	199.09	16.428	0.0	-	-25.645		-129.69	0.0

Slice No.	Strength Parameters c' [kN/m²]	Tan phi	Average Pore Pressure [kN/m²]	Slice Weight [kN/m]	Forces on base [kN/m] Normal	Shear (capacity)	Shear (mobilised)
1	*35.714*	*0.0*	0.0	*36.954*	79.756	93.272	76.338
2	*21.429*	*0.0*	0.0	*8.1118*	12.125	5.8180	4.7617
3	*21.429*	*0.0*	0.0	*90.971*	120.65	46.584	38.127
4	*21.429*	*0.0*	0.0	*136.83*	162.73	46.584	38.127
5	*30.893*	*0.0*	0.0	*31.650*	36.264	12.947	10.597
6	*30.893*	*0.0*	0.0	*143.94*	161.19	51.625	42.252
7	*30.893*	*0.0*	0.0	*172.00*	187.61	51.625	42.253
8	*35.536*	*0.0*	0.0	*204.88*	219.43	60.982	49.910
9	*35.536*	*0.0*	0.0	*214.69*	227.01	56.640	46.356
10	*35.536*	*0.0*	0.0	*236.88*	248.14	56.640	46.356
11	*40.179*	*0.0*	0.0	*269.89*	280.56	66.860	54.721
12	*40.179*	*0.0*	0.0	*291.78*	301.33	66.859	54.721
13	*40.179*	*0.0*	0.0	*403.75*	414.24	85.578	70.041
14	*40.179*	*0.0*	0.0	*435.62*	443.98	85.577	70.040
15	*40.179*	*0.0*	0.0	*464.56*	470.47	85.578	70.041
16	*40.179*	*0.0*	0.0	*77.332*	78.028	13.778	11.276
17	*40.179*	*0.0*	0.0	*605.57*	608.30	104.25	85.322
18	*40.179*	*0.0*	0.0	*638.19*	640.09	104.25	85.322
19	*40.179*	*0.0*	0.0	*664.83*	670.21	104.25	85.322
20	*40.179*	*0.0*	0.0	*711.26*	719.37	108.33	88.662
21	*40.179*	*0.0*	0.0	*724.06*	733.41	108.33	88.662
22	*35.536*	*0.0*	0.0	*662.76*	671.19	86.998	71.203
23	*35.536*	*0.0*	0.0	*662.39*	669.78	86.999	71.204
24	*30.893*	*0.0*	0.0	*505.05*	509.44	58.050	47.511
25	*30.893*	*0.0*	0.0	*499.56*	502.45	58.050	47.511
26	*21.429*	*0.0*	0.0	*295.27*	296.13	24.045	19.679
27	*21.429*	*0.0*	0.0	*235.69*	235.88	19.391	15.871
28	*21.429*	*0.0*	0.0	*694.01*	691.95	58.867	48.179
29	*35.714*	*0.0*	0.0	*630.62*	624.82	94.344	77.215
30	*35.714*	*0.0*	0.0	*587.01*	577.84	94.344	77.216
31	*35.714*	*0.0*	0.0	*593.48*	580.37	105.13	86.042
32	*35.714*	*0.0*	0.0	*521.28*	506.92	105.13	86.042
33	*35.714*	*0.0*	0.0	*445.14*	431.59	105.13	86.042
34	*35.714*	*0.0*	0.0	*365.98*	355.79	105.13	86.042
35	*35.714*	*0.0*	0.0	*284.79*	280.93	105.13	86.042
36	*35.714*	*0.0*	0.0	*202.58*	208.36	105.13	86.043
37	*35.714*	*0.0*	0.0	*120.39*	139.37	105.13	86.042
38	*35.714*	*0.0*	0.0	*39.297*	75.129	105.13	86.042

Slice No.	Surface Load [kN/m_hor/m] Vert	Horiz	Point Load [kN/m] Vert	Horiz	Water Pressure on ground surface [kN/m_hor/m] Vert	Horiz
1	*0.0*	*0.0*	0.0	0.0	0.0	0.0
2	*0.0*	*0.0*	0.0	0.0	0.0	0.0
3	*0.0*	*0.0*	0.0	0.0	0.0	0.0
4	*0.0*	*0.0*	0.0	0.0	0.0	0.0
5	*0.0*	*0.0*	0.0	0.0	0.0	0.0
6	*0.0*	*0.0*	0.0	0.0	0.0	0.0
7	*0.0*	*0.0*	0.0	0.0	0.0	0.0

Slice No	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]	
8	*0.0*	*0.0*	0.0	0.0	0.0	0.0
9	*0.0*	*0.0*	0.0	0.0	0.0	0.0
10	*0.0*	*0.0*	0.0	0.0	0.0	0.0
11	*0.0*	*0.0*	0.0	0.0	0.0	0.0
12	*0.0*	*0.0*	0.0	0.0	0.0	0.0
13	*0.0*	*0.0*	0.0	0.0	0.0	0.0
14	*0.0*	*0.0*	0.0	0.0	0.0	0.0
15	*0.0*	*0.0*	0.0	0.0	0.0	0.0
16	*0.0*	*0.0*	0.0	0.0	0.0	0.0
17	*0.0*	*0.0*	0.0	0.0	0.0	0.0
18	*0.0*	*0.0*	0.0	0.0	0.0	0.0
19	*0.0*	*0.0*	0.0	0.0	0.0	0.0
20	*0.0*	*0.0*	0.0	0.0	0.0	0.0
21	*0.0*	*0.0*	0.0	0.0	0.0	0.0
22	*0.0*	*0.0*	0.0	0.0	0.0	0.0
23	*0.0*	*0.0*	0.0	0.0	0.0	0.0
24	*0.0*	*0.0*	0.0	0.0	0.0	0.0
25	*0.0*	*0.0*	0.0	0.0	0.0	0.0
26	*0.0*	*0.0*	0.0	0.0	0.0	0.0
27	*0.0*	*0.0*	0.0	0.0	0.0	0.0
28	*0.0*	*0.0*	0.0	0.0	0.0	0.0
29	*0.0*	*0.0*	0.0	0.0	0.0	0.0
30	*0.0*	*0.0*	0.0	0.0	0.0	0.0
31	*0.0*	*0.0*	0.0	0.0	0.0	0.0
32	*0.0*	*0.0*	0.0	0.0	0.0	0.0
33	*0.0*	*0.0*	0.0	0.0	0.0	0.0
34	*0.0*	*0.0*	0.0	0.0	0.0	0.0
35	*0.0*	*0.0*	0.0	0.0	0.0	0.0
36	*0.0*	*0.0*	0.0	0.0	0.0	0.0
37	*0.0*	*0.0*	0.0	0.0	0.0	0.0
38	*0.0*	*0.0*	0.0	0.0	0.0	0.0

Appendix B3 – Wedge analysis

ARUP

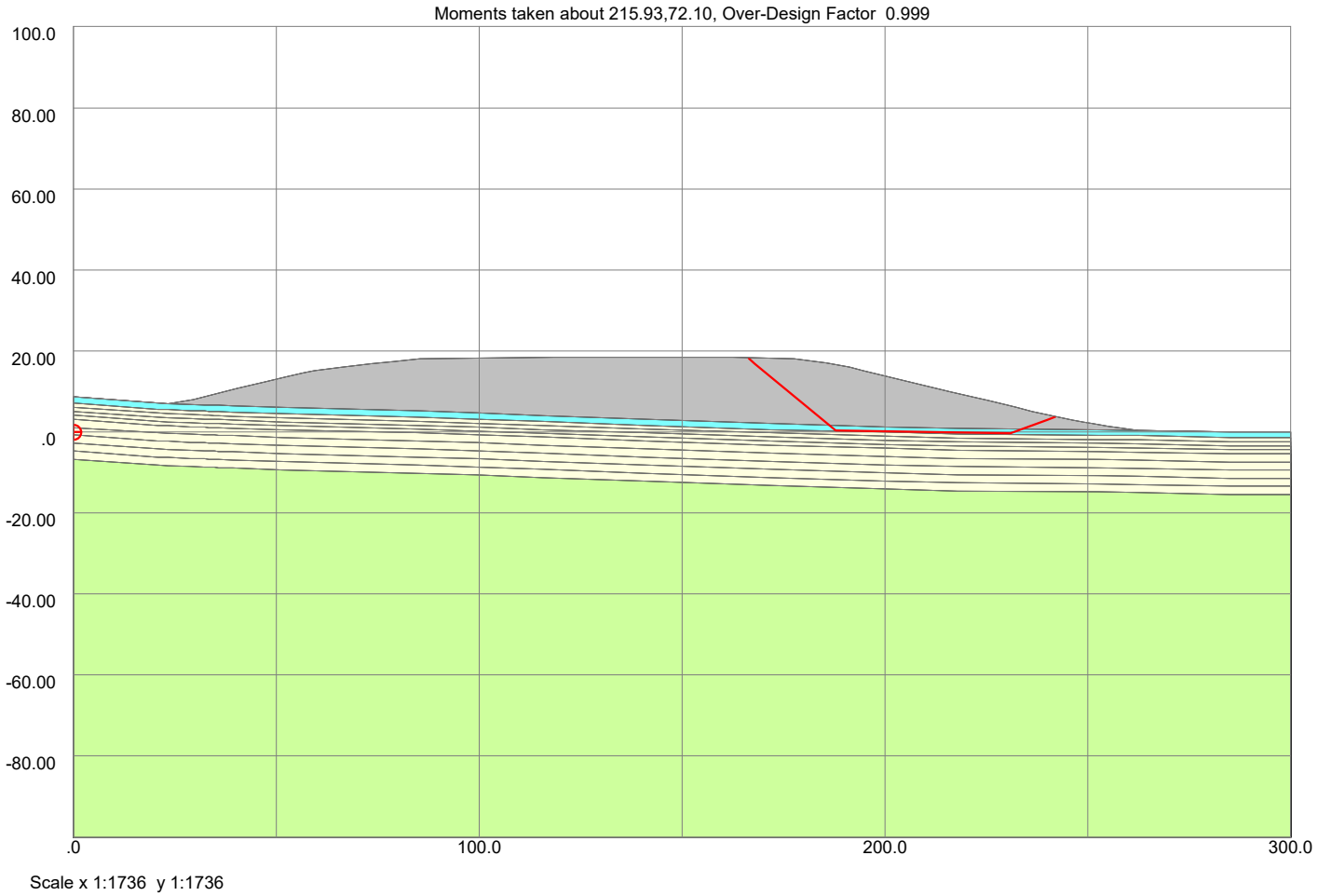
Arup

Northern SPA
Eastern Mound - Wedge
Section B-BB (west)

Job No.	Sheet No.	Rev.
256906		

Drg. Ref.

Made by	Date	Checked
EB		



General Parameters

Direction of slip: DOWNHILL
Minimum slip weight [kN/m] : 0.00000
Type of analysis : STATIC

Analysis Options

Partial Factor Analysis
Minimum number of slices: 25
Method: Janbu (Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: NOT ACTIVE

Method Partial Factors

Current selection: BS EN 1997-1:2011 DA1-2
Factor on FAVOURABLE PERMANENT LOAD: 1.00000
Factor on UNFAVOURABLE PERMANENT LOAD: 1.00000
Factor on FAVOURABLE VARIABLE LOAD: 0.00000
Factor on UNFAVOURABLE VARIABLE LOAD: 1.30000
Factor on SOIL UNIT WEIGHT: 1.00000
Factor on DRAINED SOIL COHESION: 1.25000
Factor on UNDRAINED SOIL COHESION: 1.40000
Factor on SOIL FRICTION ANGLE: 1.25000
Factor on reinforcement pullout: 1.50000
Economic ramification of failure: 1.00000
Sliding along reinforcement: 1.50000

Material properties

No	Description	Unit Weight Above GWL [kN/m3]	Unit Weight Below GWL [kN/m3]	Shear Strength Parameters Condition	Phi or Phi0 [°]	c or c0' [kN/m²]
1	Waste	19.500	19.500	Undrained	N.A.	50.000
2	Clay Deposits	17.000	17.000	Undrained	N.A.	30.000
3	London Clay 1	19.500	19.500	Undrained	N.A.	43.250
4	London Clay 2	19.500	19.500	Undrained	N.A.	49.750
5	London Clay 3	19.500	19.500	Undrained	N.A.	56.250
6	London Clay 4	19.500	19.500	Undrained	N.A.	62.750
7	London Clay 5	19.500	19.500	Undrained	N.A.	72.500
8	London Clay 6	19.500	19.500	Undrained	N.A.	85.500
9	London Clay 7	19.500	19.500	Undrained	N.A.	98.500
10	London Clay 8	19.500	19.500	Undrained	N.A.	111.50
11	London Clay 9	19.500	19.500	Undrained	N.A.	124.50
12	Harwich	20.000	20.000	Undrained	N.A.	130.00

Coordinates of top of soil strata

The units of the following coordinates are in m

Stratum X -->	0.0	20.898	23.379	28.828	29.581	32.369	33.335
1	8.6893	7.2080	7.0791	.	8.1157	.	.
2	8.6893	7.2080	7.0791	6.8704	.	6.7401	6.7034
3	7.1893	5.7080	5.5791	5.3704	.	5.2401	5.2034
4	6.1893	4.7080	4.5791	4.3704	.	4.2401	4.2034
5	5.1893	3.7080	3.5791	3.3704	.	3.2401	3.2034
6	4.1893	2.7080	2.5791	2.3704	.	2.2401	2.2034
7	3.1893	1.7080	1.5791	1.3704	.	1.2401	1.2034
8	1.1893	-0.29200	-0.42090	-0.62960	.	-0.75990	-0.79660
9	-0.81070	-2.2920	-2.4209	-2.6296	.	-2.7599	-2.7966
10	-2.8107	-4.2920	-4.4209	-4.6296	.	-4.7599	-4.7966
11	-4.8107	-6.2920	-6.4209	-6.6296	.	-6.7599	-6.7966
12	-6.8107	-8.2920	-8.4209	-8.6296	.	-8.7599	-8.7966
Slip 1	.	.	.	.	.	.	.

Stratum X -->							
	34.766	**35.786**	**39.364**	**40.591**	**47.080**	**51.434**	**52.355**
1	.	.	.	10.836	12.443	.	13.709
2	6.6573	6.6276	6.4857	.	.	6.1039	.
3	5.1573	5.1276	4.9857	.	.	4.6039	.
4	4.1573	4.1276	3.9857	.	.	3.6039	.
5	3.1573	3.1276	2.9857	.	.	2.6039	.
6	2.1573	2.1276	1.9857	.	.	1.6039	.
7	1.1573	1.1276	0.98570	.	.	0.60390	.
8	-0.84270	-0.87240	-1.0143	.	.	-1.3961	.
9	-2.8427	-2.8724	-3.0143	.	.	-3.3961	.
10	-4.8427	-4.8724	-5.0143	.	.	-5.3961	.
11	-6.8427	-6.8724	-7.0143	.	.	-7.3961	.
12	-8.8427	-8.8724	-9.0143	.	.	-9.3961	.
Slip 1	.	.	.	.	.	.	.
Stratum X -->							
	56.933	**59.521**	**66.317**	**73.606**	**78.893**	**85.003**	**85.461**
1	14.621	15.116	16.116	16.989	17.505	.	18.116
2	.	.	.	.	.	5.2282	.
3	.	.	.	.	.	3.7282	.
4	.	.	.	.	.	2.7282	.
5	.	.	.	.	.	1.7282	.
6	.	.	.	.	.	0.72820	.
7	.	.	.	.	.	-0.27180	.
8	.	.	.	.	.	-2.2718	.
9	.	.	.	.	.	-4.2718	.
10	.	.	.	.	.	-6.2718	.
11	.	.	.	.	.	-8.2718	.
12	.	.	.	.	.	-10.272	.
Slip 1	.	.	.	.	.	.	.
Stratum X -->							
	99.536	**115.65**	**118.48**	**121.49**	**127.57**	**132.45**	**141.16**
1	.	.	18.516	18.516	18.516	18.516	.
2	4.7505	4.1518	.	.	.	.	3.2210
3	3.2505	2.6518	.	.	.	.	1.7210
4	2.2505	1.6518	.	.	.	.	0.72100
5	1.2505	0.65180	.	.	.	.	-0.27900
6	0.25050	-0.34820	.	.	.	.	-1.2790
7	-0.74950	-1.3482	.	.	.	.	-2.2790
8	-2.7495	-3.3482	.	.	.	.	-4.2790
9	-4.7495	-5.3482	.	.	.	.	-6.2790
10	-6.7495	-7.3482	.	.	.	.	-8.2790
11	-8.7495	-9.3482	.	.	.	.	-10.279
12	-10.750	-11.348	.	.	.	.	-12.279
Slip 1	.	.	.	.	.	.	.
Stratum X -->							
	144.70	**144.70**	**153.81**	**162.49**	**166.28**	**168.00**	**172.17**
1	18.516	18.516	18.516	18.516	.	.	.
2	.	.	.	.	.	.	2.1856
3	.	.	.	.	.	.	0.68560
4	.	.	.	.	.	.	-0.31440
5	.	.	.	.	.	.	-1.3144
6	.	.	.	.	.	.	-2.3144
7	.	.	.	.	.	.	-3.3144
8	.	.	.	.	.	.	-5.3144
9	.	.	.	.	.	.	-7.3144
10	.	.	.	.	.	.	-9.3144
11	.	.	.	.	.	.	-11.314
12	.	.	.	.	.	.	-13.314
Slip 1	.	.	.	.	.	17.000	.
Stratum X -->							
	177.64	**185.66**	**188.00**	**191.41**	**194.77**	**200.18**	**216.26**
1	18.116	17.116	.	16.116	15.267	.	9.9809
2	.	.	.	.	.	1.3365	.
3	.	.	.	.	.	-0.16350	.
4	.	.	.	.	.	-1.1635	.
5	.	.	.	.	.	-2.1635	.
6	.	.	.	.	.	-3.1635	.
7	.	.	.	.	.	-4.1635	.
8	.	.	.	.	.	-6.1635	.
9	.	.	.	.	.	-8.1635	.
10	.	.	.	.	.	-10.163	.
11	.	.	.	.	.	-12.163	.
12	.	.	.	.	.	-14.163	.
Slip 1	.	.	0.50000	.	.	.	.

Stratum X -->	218.03	222.93	225.17	230.21	231.00	232.54	236.31
1	.	8.3921	7.9546	6.6974	.	6.1157	5.1157
2	0.89880	.	.	.	.	.	.
3	-0.60120	.	.	.	.	.	.
4	-1.6012	.	.	.	.	.	.
5	-2.6012	.	.	.	.	.	.
6	-3.6012	.	.	.	.	.	.
7	-4.6012	.	.	.	.	.	.
8	-6.6012	.	.	.	.	.	.
9	-8.6012	.	.	.	.	.	.
10	-10.601	.	.	.	.	.	.
11	-12.601	.	.	.	.	.	.
12	-14.601	.	.	.	.	.	.
Slip 1	.	.	.	.	-0.50000	.	.

Stratum X -->	240.00	242.32	246.23	248.97	251.04	252.69	255.13
1	.	.	3.1157	2.5294	2.1157	.	1.4450
2	.	.	.	.	.	0.57650	.
3	.	.	.	.	.	-0.92350	.
4	.	.	.	.	.	-1.9235	.
5	.	.	.	.	.	-2.9235	.
6	.	.	.	.	.	-3.9235	.
7	.	.	.	.	.	-4.9235	.
8	.	.	.	.	.	-6.9235	.
9	.	.	.	.	.	-8.9235	.
10	.	.	.	.	.	-10.924	.
11	.	.	.	.	.	-12.924	.
12	.	.	.	.	.	-14.924	.
Slip 1	3.0000	.	.	.	.	.	.

Stratum X -->	262.54	285.08
1	0.45890	0.0
2	0.45890	0.0
3	-1.0411	-1.5000
4	-2.0411	-2.5000
5	-3.0411	-3.5000
6	-4.0411	-4.5000
7	-5.0411	-5.5000
8	-7.0411	-7.5000
9	-9.0411	-9.5000
10	-11.041	-11.500
11	-13.041	-13.500
12	-15.041	-15.500
Slip 1	.	.

Stratum-linked data

No.	Material	Water table	Piezo Set/ Ru value
1	Waste		- -
2	Clay Deposits		- -
3	London Clay 1		- -
4	London Clay 2		- -
5	London Clay 3		- -
6	London Clay 4		- -
7	London Clay 5		- -
8	London Clay 6		- -
9	London Clay 7		- -
10	London Clay 8		- -
11	London Clay 9		- -
12	Harwich		- -

WORST CASE

Slip 1
Iterations: 69
Net vertical force [kN/m]: 0.20109
Net horiz force [kN/m]: 1.1395
Horiz acceleration [%g]: 0.0
Slip weight [kN/m] 13974.
Disturbing moment [kN/m]: 166270.
Restoring moment [kNm/m]: 166060.
Reinf.Rest.Moment [kNm/m]: 0.0
Over-Design Factor: 0.99873

The system of interslice and base forces are in equilibrium
when the strengths available at the bases are divided by the computed
over-design factor. The interslice forces shown in the following table
are in equilibrium with the factored strengths of the soil at the bases of slices.

Slip surface coordinates Pore Pressure Interslice forces [kN/m]

Point	x [m]	y [m]	L [kN/m²]	R [kN/m²]	T	E	E(u)	
1	166.28	18.416	-	0.0	0.0	0.0	0.0	
2	168.00	17.000	0.0	0.0	-86.350	-12.967	0.0	
3	170.08	15.282	0.0	0.0	-166.22	1.5298	0.0	
4	172.17	13.564	0.0	0.0	-218.73	49.183	0.0	
5	173.99	12.057	0.0	0.0	-242.26	118.24	0.0	
6	175.82	10.551	0.0	0.0	-244.77	212.78	0.0	
7	177.64	9.0446	0.0	0.0	-226.26	332.81	0.0	
8	179.65	7.3912	0.0	0.0	-183.29	492.00	0.0	
9	181.65	5.7378	0.0	0.0	-118.11	678.12	0.0	
10	183.66	4.0845	0.0	0.0	-30.721	891.15	0.0	
11	185.66	2.4311	0.0	0.0	78.879	1131.1	0.0	
12	186.48	1.7517	0.0	0.0	130.22	1237.4	0.0	
13	188.00	0.50000	0.0	0.0	250.92	1464.7	0.0	
14	189.70	0.46036	0.0	0.0	247.40	1440.5	0.0	
15	191.41	0.42071	0.0	0.0	243.88	1416.1	0.0	
16	193.09	0.38165	0.0	0.0	240.40	1391.9	0.0	
17	194.77	0.34259	0.0	0.0	236.92	1367.3	0.0	
18	197.48	0.27963	0.0	0.0	231.29	1327.1	0.0	
19	200.18	0.21667	0.0	0.0	225.64	1286.1	0.0	
20	202.86	0.15438	0.0	0.0	220.04	1244.9	0.0	
21	205.54	0.092081	0.0	0.0	214.42	1202.9	0.0	
22	208.22	0.029785	0.0	0.0	208.78	1160.2	0.0	
23	210.90	-0.032512	0.0	0.0	203.12	1116.8	0.0	
24	213.58	-0.094808	0.0	0.0	197.45	1072.6	0.0	
25	216.26	-0.15710	0.0	0.0	191.76	1027.8	0.0	
26	218.03	-0.19833	0.0	0.0	187.99	997.69	0.0	
27	220.48	-0.25538	0.0	0.0	182.76	955.56	0.0	
28	222.93	-0.31243	0.0	0.0	177.51	912.83	0.0	
29	225.17	-0.36449	0.0	0.0	172.71	873.37	0.0	
30	227.69	-0.42303	0.0	0.0	167.30	828.45	0.0	
31	230.21	-0.48157	0.0	0.0	161.88	782.88	0.0	
32	231.00	-0.50000	0.0	0.0	160.16	768.39	0.0	
33	232.54	0.099236	0.0	0.0	144.04	649.46	0.0	
34	234.21	0.74832	0.0	0.0	122.49	531.15	0.0	
35	236.31	1.5657	0.0	0.0	100.63	368.59	0.0	
36	238.16	2.2828	0.0	0.0	75.636	240.92	0.0	
37	240.00	3.0000	0.0	0.0	45.495	126.48	0.0	
38	242.32	3.9034	0.0	-	0.20109	1.1395	0.0	

Slice No.	Strength Parameters c' [kN/m²]	Tan phi	Average Pore Pressure [kN/m²]	Slice Weight [kN/m]	Forces on base [kN/m] Normal	Shear (capacity)	Shear (mobilised)
1	*35.714*	*0.0*	0.0	*22.923*	76.031	79.440	79.541
2	*35.714*	*0.0*	0.0	*89.418*	139.80	96.424	96.546
3	*35.714*	*0.0*	0.0	*156.96*	191.90	96.424	96.546
4	*35.714*	*0.0*	0.0	*193.18*	211.11	84.538	84.646
5	*35.714*	*0.0*	0.0	*245.10*	251.16	84.538	84.646
6	*35.714*	*0.0*	0.0	*297.02*	291.20	84.538	84.646
7	*35.714*	*0.0*	0.0	*381.92*	362.76	92.789	92.907
8	*35.714*	*0.0*	0.0	*436.76*	405.06	92.789	92.906
9	*35.714*	*0.0*	0.0	*491.61*	447.37	92.789	92.907
10	*35.714*	*0.0*	0.0	*546.45*	489.67	92.789	92.907
11	*35.714*	*0.0*	0.0	*240.11*	213.22	38.128	38.176
12	*21.429*	*0.0*	0.0	*462.64*	408.46	42.147	42.201
13	*21.429*	*0.0*	0.0	*529.40*	532.22	36.538	36.584
14	*21.429*	*0.0*	0.0	*520.92*	523.73	36.538	36.584
15	*21.429*	*0.0*	0.0	*502.80*	505.57	36.001	36.047
16	*21.429*	*0.0*	0.0	*490.23*	493.01	36.001	36.047
17	*21.429*	*0.0*	0.0	*764.20*	768.68	58.028	58.102
18	*21.429*	*0.0*	0.0	*732.49*	736.99	58.028	58.102
19	*21.429*	*0.0*	0.0	*693.52*	697.97	57.417	57.490
20	*21.429*	*0.0*	0.0	*662.37*	666.84	57.417	57.490
21	*21.429*	*0.0*	0.0	*631.22*	635.69	57.417	57.490
22	*21.429*	*0.0*	0.0	*600.07*	604.56	57.417	57.490
23	*21.429*	*0.0*	0.0	*568.92*	573.41	57.417	57.490
24	*21.429*	*0.0*	0.0	*537.78*	542.28	57.417	57.490
25	*21.429*	*0.0*	0.0	*339.00*	341.99	37.997	38.045
26	*21.429*	*0.0*	0.0	*447.32*	451.45	52.580	52.646
27	*21.429*	*0.0*	0.0	*421.93*	426.06	52.580	52.646
28	*21.429*	*0.0*	0.0	*364.97*	368.75	47.985	48.046
29	*21.429*	*0.0*	0.0	*386.71*	390.97	53.955	54.023
30	*21.429*	*0.0*	0.0	*358.51*	362.78	53.955	54.023
31	*21.429*	*0.0*	0.0	*107.05*	108.40	16.989	17.010
32	*21.429*	*0.0*	0.0	*191.81*	236.91	35.428	35.473

Slice No.	Strength Parameters		Average Pore	Slice Weight	Forces on base [kN/m]		
33	*21.429*	*0.0*	0.0	*176.67*	227.64	38.376	38.424
34	*35.714*	*0.0*	0.0	*173.67*	241.17	80.541	80.643
35	*35.714*	*0.0*	0.0	*108.08*	170.31	70.666	70.755
36	*35.714*	*0.0*	0.0	*68.915*	133.82	70.666	70.755
37	*35.714*	*0.0*	0.0	*31.075*	116.63	89.022	89.135

Slice No.	Surface Load [kN/m_hor/m]		Point Load [kN/m]		Water Pressure on ground surface [kN/m_hor/m]	
	Vert	Horiz	Vert	Horiz	Vert	Horiz
1	*0.0*	*0.0*	0.0	0.0	0.0	0.0
2	*0.0*	*0.0*	0.0	0.0	0.0	0.0
3	*0.0*	*0.0*	0.0	0.0	0.0	0.0
4	*0.0*	*0.0*	0.0	0.0	0.0	0.0
5	*0.0*	*0.0*	0.0	0.0	0.0	0.0
6	*0.0*	*0.0*	0.0	0.0	0.0	0.0
7	*0.0*	*0.0*	0.0	0.0	0.0	0.0
8	*0.0*	*0.0*	0.0	0.0	0.0	0.0
9	*0.0*	*0.0*	0.0	0.0	0.0	0.0
10	*0.0*	*0.0*	0.0	0.0	0.0	0.0
11	*0.0*	*0.0*	0.0	0.0	0.0	0.0
12	*0.0*	*0.0*	0.0	0.0	0.0	0.0
13	*0.0*	*0.0*	0.0	0.0	0.0	0.0
14	*0.0*	*0.0*	0.0	0.0	0.0	0.0
15	*0.0*	*0.0*	0.0	0.0	0.0	0.0
16	*0.0*	*0.0*	0.0	0.0	0.0	0.0
17	*0.0*	*0.0*	0.0	0.0	0.0	0.0
18	*0.0*	*0.0*	0.0	0.0	0.0	0.0
19	*0.0*	*0.0*	0.0	0.0	0.0	0.0
20	*0.0*	*0.0*	0.0	0.0	0.0	0.0
21	*0.0*	*0.0*	0.0	0.0	0.0	0.0
22	*0.0*	*0.0*	0.0	0.0	0.0	0.0
23	*0.0*	*0.0*	0.0	0.0	0.0	0.0
24	*0.0*	*0.0*	0.0	0.0	0.0	0.0
25	*0.0*	*0.0*	0.0	0.0	0.0	0.0
26	*0.0*	*0.0*	0.0	0.0	0.0	0.0
27	*0.0*	*0.0*	0.0	0.0	0.0	0.0
28	*0.0*	*0.0*	0.0	0.0	0.0	0.0
29	*0.0*	*0.0*	0.0	0.0	0.0	0.0
30	*0.0*	*0.0*	0.0	0.0	0.0	0.0
31	*0.0*	*0.0*	0.0	0.0	0.0	0.0
32	*0.0*	*0.0*	0.0	0.0	0.0	0.0
33	*0.0*	*0.0*	0.0	0.0	0.0	0.0
34	*0.0*	*0.0*	0.0	0.0	0.0	0.0
35	*0.0*	*0.0*	0.0	0.0	0.0	0.0
36	*0.0*	*0.0*	0.0	0.0	0.0	0.0
37	*0.0*	*0.0*	0.0	0.0	0.0	0.0

Appendix C – Settlement calculations

Appendix C1 – Formation settlement

Appendix C2 – Internal settlement

Project Title	High Speed 2
Job No.	256906
Heading	SPA internal settlement calculations
Date	21/04/2020
Revision	Rev 1
By	EB
Checked	JKL

Density of soil	19.5	kN/m^3
Height of fill	17	m
Constrained modulus	8	
Internal settlement	352.2188	mm

Notes

Methodology for calculation is as per Section 4.4.2 of Trenter (2001) Earthworks: A Guide.
The equation and other relevant information is reproduced below

$$\rho = 0.50\frac{\gamma H^2}{D*}\ (m)$$

Where H is the embankment height, γ the material unit weight and D* is the constant equivalent constrained modulus.

Table 4.1 Typical values of constant equivalent constrained modulus D^* for various fill types and embankment heights (Charles, 1993)

Fill type	D^*		
	$H = 10$ m	$H = 30$ m	$H = 100$ m
Sandy gravel ($D_r = 80\%$)	50	90	170
Sandy gravel ($D_r = 50\%$)	30	50	90
Sandstone rockfill ($D_r = 80\%$)	15	25	45
Sandstone rockfill ($D_r = 50\%$)	6	10	20
Clay (plasticity index, 15%; liquidity index, 0.1)	6	10	18

ARUP

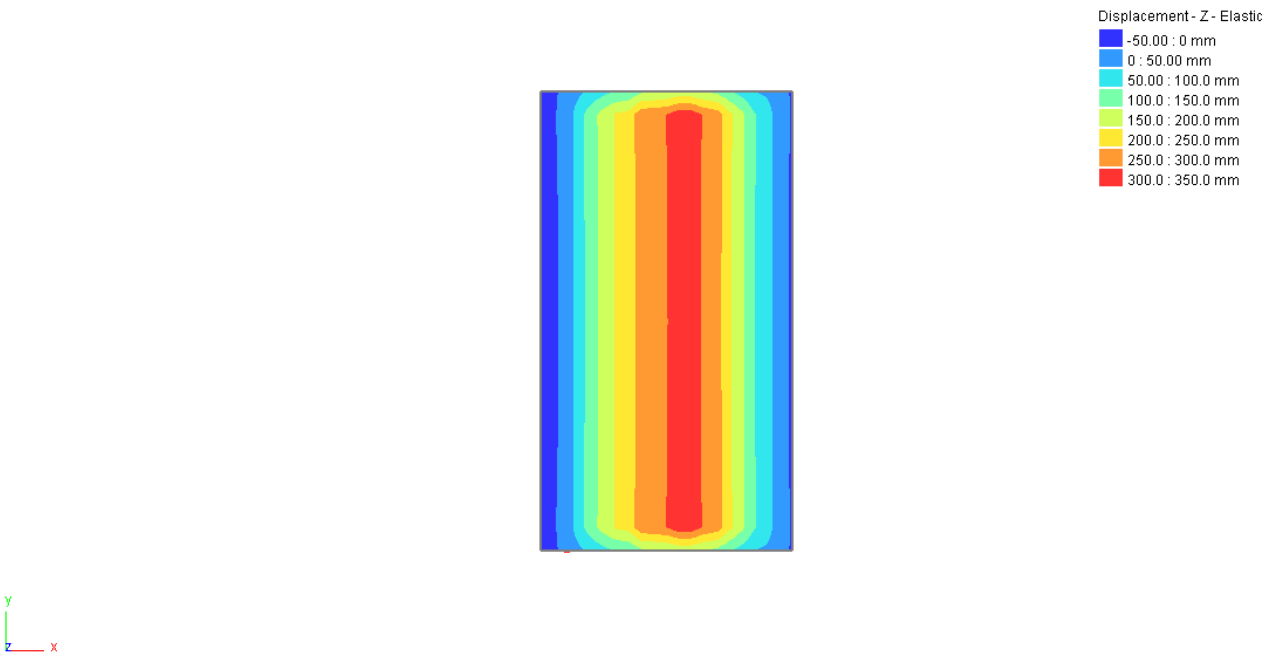
Arup

Northern SPA
Eastern Mound
Section F-FF

Job No.	Sheet No.	Rev.
256906		

Drg. Ref.

Made by	Date	Checked
DH		



Results : Immediate : Load Centres : Rectangular

Ref.	Name	x	y	z	δz	Stress: Calc. Level	Stress: Vertical	Stress: Sum Princ.	Vert. Strain
		[m]	[m]	[mOD]	[mm]	[mOD]	[kN/m²]	[kN/m²]	[μ]
1	Layer 1	104.00000	255.00000	0.00000	290.47673	-0.12500	341.25	818.47	0.040968
2	Layer 2	102.80000	255.00000	0.00000	289.88229	-0.12500	341.25	818.39	0.040970
3	Layer 3	102.80000	255.00000	0.00000	289.88229	-0.12500	341.25	818.39	0.040970
4	Layer 4	102.80000	255.00000	0.00000	289.88229	-0.12500	341.25	818.39	0.040970
5	Layer 5	104.70000	255.00000	0.00000	290.88329	-0.12500	341.25	818.53	0.040966
6	Layer 6	107.00000	255.00000	0.00000	292.67118	-0.12500	341.25	818.84	0.040955
7	Layer 7	154.00000	255.00000	0.00000	288.33849	-0.12500	341.25	817.97	0.040984
8	Layer 8	172.00000	255.00000	0.00000	244.54696	-0.12500	292.50	700.92	0.035136

Results : Consolidation : Load Centres : Rectangular

None

Results : Total : Load Centres : Rectangular

None

Results : Immediate : Displacement Data : Grids

Ref.	Name	x	y	z	δz	Stress: Calc. Level	Stress: Vertical	Stress: Sum Princ.	Vert. Strain
		[m]	[m]	[mOD]	[mm]	[mOD]	[kN/m²]	[kN/m²]	[μ]
1	Grid 1	-30.00000	0.00000	0.00000	-2.45499	-0.12500	735.53E-9	0.23019	-7.6728E-6
1	Grid 1	-30.00000	25.50000	0.00000	-2.93342	-0.12500	1.1946E-6	0.30433	-10.144E-6
1	Grid 1	-30.00000	51.00000	0.00000	-3.40445	-0.12500	1.3631E-6	0.35325	-11.775E-6
1	Grid 1	-30.00000	76.50000	0.00000	-3.77068	-0.12500	1.4209E-6	0.38348	-12.782E-6
1	Grid 1	-30.00000	102.00000	0.00000	-4.03171	-0.12500	1.4445E-6	0.40281	-13.427E-6
1	Grid 1	-30.00000	127.50000	0.00000	-4.21428	-0.12500	1.4557E-6	0.41560	-13.853E-6
1	Grid 1	-30.00000	153.00000	0.00000	-4.34100	-0.12500	1.4614E-6	0.42420	-14.140E-6
1	Grid 1	-30.00000	178.50000	0.00000	-4.42730	-0.12500	1.4646E-6	0.42994	-14.331E-6
1	Grid 1	-30.00000	204.00000	0.00000	-4.48310	-0.12500	1.4663E-6	0.43361	-14.453E-6
1	Grid 1	-30.00000	229.50000	0.00000	-4.51443	-0.12500	1.4672E-6	0.43565	-14.521E-6
1	Grid 1	-30.00000	255.00000	0.00000	-4.52453	-0.12500	1.4674E-6	0.43631	-14.543E-6
1	Grid 1	-30.00000	280.50000	0.00000	-4.51443	-0.12500	1.4672E-6	0.43565	-14.521E-6
1	Grid 1	-30.00000	306.00000	0.00000	-4.48310	-0.12500	1.4663E-6	0.43361	-14.453E-6
1	Grid 1	-30.00000	331.50000	0.00000	-4.42730	-0.12500	1.4646E-6	0.42994	-14.331E-6
1	Grid 1	-30.00000	357.00000	0.00000	-4.34100	-0.12500	1.4614E-6	0.42420	-14.140E-6
1	Grid 1	-30.00000	382.50000	0.00000	-4.21428	-0.12500	1.4557E-6	0.41560	-13.853E-6
1	Grid 1	-30.00000	408.00000	0.00000	-4.03171	-0.12500	1.4445E-6	0.40281	-13.427E-6
1	Grid 1	-30.00000	433.50000	0.00000	-3.77068	-0.12500	1.4209E-6	0.38348	-12.782E-6
1	Grid 1	-30.00000	459.00000	0.00000	-3.40445	-0.12500	1.3631E-6	0.35325	-11.775E-6
1	Grid 1	-30.00000	484.50000	0.00000	-2.93342	-0.12500	1.1946E-6	0.30433	-10.144E-6
1	Grid 1	-30.00000	510.00000	0.00000	-2.45499	-0.12500	735.53E-9	0.23019	-7.6728E-6
1	Grid 1	-16.00000	0.00000	0.00000	-2.35518	-0.12500	3.6152E-6	0.37608	-12.535E-6
1	Grid 1	-16.00000	25.50000	0.00000	-2.41102	-0.12500	6.6458E-6	0.54537	-18.178E-6
1	Grid 1	-16.00000	51.00000	0.00000	-2.96986	-0.12500	7.0666E-6	0.62343	-20.780E-6
1	Grid 1	-16.00000	76.50000	0.00000	-3.42852	-0.12500	7.1640E-6	0.66425	-22.140E-6
1	Grid 1	-16.00000	102.00000	0.00000	-3.74453	-0.12500	7.1978E-6	0.68835	-22.943E-6
1	Grid 1	-16.00000	127.50000	0.00000	-3.95867	-0.12500	7.2123E-6	0.70356	-23.451E-6
1	Grid 1	-16.00000	153.00000	0.00000	-4.10385	-0.12500	7.2195E-6	0.71349	-23.782E-6
1	Grid 1	-16.00000	178.50000	0.00000	-4.20107	-0.12500	7.2232E-6	0.71999	-23.998E-6
1	Grid 1	-16.00000	204.00000	0.00000	-4.26321	-0.12500	7.2252E-6	0.72409	-24.135E-6
1	Grid 1	-16.00000	229.50000	0.00000	-4.29784	-0.12500	7.2262E-6	0.72635	-24.210E-6
1	Grid 1	-16.00000	255.00000	0.00000	-4.30897	-0.12500	7.2265E-6	0.72708	-24.235E-6
1	Grid 1	-16.00000	280.50000	0.00000	-4.29784	-0.12500	7.2262E-6	0.72635	-24.210E-6
1	Grid 1	-16.00000	306.00000	0.00000	-4.26321	-0.12500	7.2252E-6	0.72409	-24.135E-6
1	Grid 1	-16.00000	331.50000	0.00000	-4.20107	-0.12500	7.2232E-6	0.71999	-23.998E-6
1	Grid 1	-16.00000	357.00000	0.00000	-4.10385	-0.12500	7.2195E-6	0.71349	-23.782E-6
1	Grid 1	-16.00000	382.50000	0.00000	-3.95867	-0.12500	7.2123E-6	0.70356	-23.451E-6
1	Grid 1	-16.00000	408.00000	0.00000	-3.74453	-0.12500	7.1978E-6	0.68835	-22.943E-6
1	Grid 1	-16.00000	433.50000	0.00000	-3.42852	-0.12500	7.1640E-6	0.66425	-22.140E-6
1	Grid 1	-16.00000	459.00000	0.00000	-2.96986	-0.12500	7.0666E-6	0.62343	-20.780E-6
1	Grid 1	-16.00000	484.50000	0.00000	-2.41102	-0.12500	6.6458E-6	0.54537	-18.178E-6
1	Grid 1	-16.00000	510.00000	0.00000	-2.35518	-0.12500	3.6152E-6	0.37608	-12.535E-6
1	Grid 1	-2.00000	0.00000	0.00000	2.95682	-0.12500	0.0012680	1.6126	-53.499E-6
1	Grid 1	-2.00000	25.50000	0.00000	8.47847	-0.12500	0.0025346	2.9431	-97.595E-6
1	Grid 1	-2.00000	51.00000	0.00000	7.91511	-0.12500	0.0025357	3.0704	-101.84E-6
1	Grid 1	-2.00000	76.50000	0.00000	7.34986	-0.12500	0.0025358	3.1250	-103.66E-6
1	Grid 1	-2.00000	102.00000	0.00000	6.97143	-0.12500	0.0025359	3.1547	-104.65E-6
1	Grid 1	-2.00000	127.50000	0.00000	6.72264	-0.12500	0.0025359	3.1726	-105.25E-6
1	Grid 1	-2.00000	153.00000	0.00000	6.55778	-0.12500	0.0025359	3.1840	-105.62E-6
1	Grid 1	-2.00000	178.50000	0.00000	6.44916	-0.12500	0.0025359	3.1913	-105.87E-6
1	Grid 1	-2.00000	204.00000	0.00000	6.38052	-0.12500	0.0025359	3.1958	-106.02E-6
1	Grid 1	-2.00000	229.50000	0.00000	6.34252	-0.12500	0.0025359	3.1983	-106.10E-6
1	Grid 1	-2.00000	255.00000	0.00000	6.33036	-0.12500	0.0025359	3.1991	-106.13E-6
1	Grid 1	-2.00000	280.50000	0.00000	6.34252	-0.12500	0.0025359	3.1983	-106.10E-6
1	Grid 1	-2.00000	306.00000	0.00000	6.38052	-0.12500	0.0025359	3.1958	-106.02E-6
1	Grid 1	-2.00000	331.50000	0.00000	6.44916	-0.12500	0.0025359	3.1913	-105.87E-6
1	Grid 1	-2.00000	357.00000	0.00000	6.55778	-0.12500	0.0025359	3.1840	-105.62E-6
1	Grid 1	-2.00000	382.50000	0.00000	6.72264	-0.12500	0.0025359	3.1726	-105.25E-6
1	Grid 1	-2.00000	408.00000	0.00000	6.97143	-0.12500	0.0025359	3.1547	-104.65E-6
1	Grid 1	-2.00000	433.50000	0.00000	7.34986	-0.12500	0.0025358	3.1250	-103.66E-6
1	Grid 1	-2.00000	459.00000	0.00000	7.91511	-0.12500	0.0025357	3.0704	-101.84E-6
1	Grid 1	-2.00000	484.50000	0.00000	8.47847	-0.12500	0.0025346	2.9431	-97.595E-6
1	Grid 1	-2.00000	510.00000	0.00000	2.95682	-0.12500	0.0012680	1.6126	-53.499E-6
1	Grid 1	12.00000	0.00000	0.00000	37.37443	-0.12500	48.750	116.78	0.0058573
1	Grid 1	12.00000	25.50000	0.00000	77.49216	-0.12500	97.500	233.18	0.011727
1	Grid 1	12.00000	51.00000	0.00000	77.03020	-0.12500	97.500	233.37	0.011721
1	Grid 1	12.00000	76.50000	0.00000	76.34738	-0.12500	97.500	233.44	0.011718
1	Grid 1	12.00000	102.00000	0.00000	75.90079	-0.12500	97.500	233.48	0.011717
1	Grid 1	12.00000	127.50000	0.00000	75.61521	-0.12500	97.500	233.50	0.011717
1	Grid 1	12.00000	153.00000	0.00000	75.42994	-0.12500	97.500	233.51	0.011716
1	Grid 1	12.00000	178.50000	0.00000	75.30973	-0.12500	97.500	233.52	0.011716
1	Grid 1	12.00000	204.00000	0.00000	75.23456	-0.12500	97.500	233.53	0.011716
1	Grid 1	12.00000	229.50000	0.00000	75.19322	-0.12500	97.500	233.53	0.011716
1	Grid 1	12.00000	255.00000	0.00000	75.18002	-0.12500	97.500	233.53	0.011716
1	Grid 1	12.00000	280.50000	0.00000	75.19322	-0.12500	97.500	233.53	0.011716
1	Grid 1	12.00000	306.00000	0.00000	75.23456	-0.12500	97.500	233.53	0.011716
1	Grid 1	12.00000	331.50000	0.00000	75.30973	-0.12500	97.500	233.52	0.011716
1	Grid 1	12.00000	357.00000	0.00000	75.42994	-0.12500	97.500	233.51	0.011716
1	Grid 1	12.00000	382.50000	0.00000	75.61521	-0.12500	97.500	233.50	0.011717
1	Grid 1	12.00000	408.00000	0.00000	75.90079	-0.12500	97.500	233.48	0.011717
1	Grid 1	12.00000	433.50000	0.00000	76.34738	-0.12500	97.500	233.44	0.011718
1	Grid 1	12.00000	459.00000	0.00000	77.03020	-0.12500	97.500	233.37	0.011721
1	Grid 1	12.00000	484.50000	0.00000	77.49216	-0.12500	97.500	233.18	0.011727
1	Grid 1	12.00000	510.00000	0.00000	37.37443	-0.12500	48.750	116.78	0.0058573
1	Grid 1	26.00000	0.00000	0.00000	62.02602	-0.12500	73.125	175.85	0.0087634
1	Grid 1	26.00000	25.50000	0.00000	126.96064	-0.12500	146.25	351.21	0.017543
1	Grid 1	26.00000	51.00000	0.00000	126.62283	-0.12500	146.25	351.48	0.017534
1	Grid 1	26.00000	76.50000	0.00000	125.81531	-0.12500	146.25	351.57	0.017531
1	Grid 1	26.00000	102.00000	0.00000	125.29747	-0.12500	146.25	351.62	0.017530
1	Grid 1	26.00000	127.50000	0.00000	124.97425	-0.12500	146.25	351.64	0.017529
1	Grid 1	26.00000	153.00000	0.00000	124.76851	-0.12500	146.25	351.65	0.017528
1	Grid 1	26.00000	178.50000	0.00000	124.63685	-0.12500	146.25	351.66	0.017528
1	Grid 1	26.00000	204.00000	0.00000	124.55530	-0.12500	146.25	351.67	0.017528
1	Grid 1	26.00000	229.50000	0.00000	124.51074	-0.12500	146.25	351.67	0.017528
1	Grid 1	26.00000	255.00000	0.00000	124.49655	-0.12500	146.25	351.67	0.017528
1	Grid 1	26.00000	280.50000	0.00000	124.51074	-0.12500	146.25	351.67	0.017528
1	Grid 1	26.00000	306.00000	0.00000	124.55530	-0.12500	146.25	351.67	0.017528
1	Grid 1	26.00000	331.50000	0.00000	124.63685	-0.12500	146.25	351.66	0.017528
1	Grid 1	26.00000	357.00000	0.00000	124.76851	-0.12500	146.25	351.65	0.017528
1	Grid 1	26.00000	382.50000	0.00000	124.97425	-0.12500	146.25	351.64	0.017529
1	Grid 1	26.00000	408.00000	0.00000	125.29747	-0.12500	146.25	351.62	0.017530
1	Grid 1	26.00000	433.50000	0.00000	125.81531	-0.12500	146.25	351.57	0.017531
1	Grid 1	26.00000	459.00000	0.00000	126.62283	-0.12500	146.25	351.48	0.017534
1	Grid 1	26.00000	484.50000	0.00000	126.96064	-0.12500	146.25	351.21	0.017543

Ref.	Name	x	y	z	δz	Stress: Calc. Level	Stress: Vertical	Stress: Sum Princ.	Vert. Strain
		[m]	[m]	[mOD]	[mm]	[mOD]	[kN/m²]	[kN/m²]	[μ]
1	Grid 1	26.00000	510.00000	0.00000	62.02602	-0.12500	73.125	175.85	0.0087634
1	Grid 1	40.00000	0.00000	0.00000	84.30175	-0.12500	97.501	234.65	0.011679
1	Grid 1	40.00000	25.50000	0.00000	171.72218	-0.12500	195.00	468.69	0.023377
1	Grid 1	40.00000	51.00000	0.00000	171.46150	-0.12500	195.00	469.04	0.023366
1	Grid 1	40.00000	76.50000	0.00000	170.52735	-0.12500	195.00	469.15	0.023362
1	Grid 1	40.00000	102.00000	0.00000	169.93851	-0.12500	195.00	469.20	0.023360
1	Grid 1	40.00000	127.50000	0.00000	169.57836	-0.12500	195.00	469.23	0.023360
1	Grid 1	40.00000	153.00000	0.00000	169.35283	-0.12500	195.00	469.24	0.023359
1	Grid 1	40.00000	178.50000	0.00000	169.21026	-0.12500	195.00	469.25	0.023359
1	Grid 1	40.00000	204.00000	0.00000	169.12271	-0.12500	195.00	469.26	0.023358
1	Grid 1	40.00000	229.50000	0.00000	169.07512	-0.12500	195.00	469.26	0.023358
1	Grid 1	40.00000	255.00000	0.00000	169.06001	-0.12500	195.00	469.26	0.023358
1	Grid 1	40.00000	280.50000	0.00000	169.07512	-0.12500	195.00	469.26	0.023358
1	Grid 1	40.00000	306.00000	0.00000	169.12271	-0.12500	195.00	469.26	0.023358
1	Grid 1	40.00000	331.50000	0.00000	169.21026	-0.12500	195.00	469.25	0.023359
1	Grid 1	40.00000	357.00000	0.00000	169.35283	-0.12500	195.00	469.24	0.023359
1	Grid 1	40.00000	382.50000	0.00000	169.57836	-0.12500	195.00	469.23	0.023360
1	Grid 1	40.00000	408.00000	0.00000	169.93851	-0.12500	195.00	469.20	0.023360
1	Grid 1	40.00000	433.50000	0.00000	170.52735	-0.12500	195.00	469.15	0.023362
1	Grid 1	40.00000	459.00000	0.00000	171.46150	-0.12500	195.00	469.04	0.023366
1	Grid 1	40.00000	484.50000	0.00000	171.72218	-0.12500	195.00	468.69	0.023377
1	Grid 1	40.00000	510.00000	0.00000	84.30175	-0.12500	97.501	234.65	0.011679
1	Grid 1	54.00000	0.00000	0.00000	101.30283	-0.12500	121.87	292.19	0.014635
1	Grid 1	54.00000	25.50000	0.00000	205.97551	-0.12500	243.75	583.69	0.029294
1	Grid 1	54.00000	51.00000	0.00000	205.73452	-0.12500	243.75	584.11	0.029280
1	Grid 1	54.00000	76.50000	0.00000	204.67878	-0.12500	243.75	584.23	0.029276
1	Grid 1	54.00000	102.00000	0.00000	204.02282	-0.12500	243.75	584.29	0.029274
1	Grid 1	54.00000	127.50000	0.00000	203.62815	-0.12500	243.75	584.32	0.029273
1	Grid 1	54.00000	153.00000	0.00000	203.38435	-0.12500	243.75	584.33	0.029272
1	Grid 1	54.00000	178.50000	0.00000	203.23182	-0.12500	243.75	584.34	0.029272
1	Grid 1	54.00000	204.00000	0.00000	203.13883	-0.12500	243.75	584.35	0.029272
1	Grid 1	54.00000	229.50000	0.00000	203.08852	-0.12500	243.75	584.35	0.029272
1	Grid 1	54.00000	255.00000	0.00000	203.07258	-0.12500	243.75	584.36	0.029271
1	Grid 1	54.00000	280.50000	0.00000	203.08852	-0.12500	243.75	584.35	0.029272
1	Grid 1	54.00000	306.00000	0.00000	203.13883	-0.12500	243.75	584.35	0.029272
1	Grid 1	54.00000	331.50000	0.00000	203.23182	-0.12500	243.75	584.34	0.029272
1	Grid 1	54.00000	357.00000	0.00000	203.38435	-0.12500	243.75	584.33	0.029272
1	Grid 1	54.00000	382.50000	0.00000	203.62815	-0.12500	243.75	584.32	0.029273
1	Grid 1	54.00000	408.00000	0.00000	204.02282	-0.12500	243.75	584.29	0.029274
1	Grid 1	54.00000	433.50000	0.00000	204.67878	-0.12500	243.75	584.23	0.029276
1	Grid 1	54.00000	459.00000	0.00000	205.73452	-0.12500	243.75	584.11	0.029280
1	Grid 1	54.00000	484.50000	0.00000	205.97551	-0.12500	243.75	583.69	0.029294
1	Grid 1	54.00000	510.00000	0.00000	101.30283	-0.12500	121.87	292.19	0.014635
1	Grid 1	68.00000	0.00000	0.00000	107.09861	-0.12500	121.88	293.23	0.014601
1	Grid 1	68.00000	25.50000	0.00000	217.77950	-0.12500	243.75	585.67	0.029228
1	Grid 1	68.00000	51.00000	0.00000	217.56576	-0.12500	243.75	586.15	0.029212
1	Grid 1	68.00000	76.50000	0.00000	216.40125	-0.12500	243.75	586.29	0.029207
1	Grid 1	68.00000	102.00000	0.00000	215.68562	-0.12500	243.75	586.35	0.029205
1	Grid 1	68.00000	127.50000	0.00000	215.26056	-0.12500	243.75	586.38	0.029204
1	Grid 1	68.00000	153.00000	0.00000	215.00083	-0.12500	243.75	586.40	0.029203
1	Grid 1	68.00000	178.50000	0.00000	214.83969	-0.12500	243.75	586.41	0.029203
1	Grid 1	68.00000	204.00000	0.00000	214.74205	-0.12500	243.75	586.42	0.029203
1	Grid 1	68.00000	229.50000	0.00000	214.68942	-0.12500	243.75	586.42	0.029203
1	Grid 1	68.00000	255.00000	0.00000	214.67278	-0.12500	243.75	586.42	0.029203
1	Grid 1	68.00000	280.50000	0.00000	214.68942	-0.12500	243.75	586.42	0.029203
1	Grid 1	68.00000	306.00000	0.00000	214.74205	-0.12500	243.75	586.42	0.029203
1	Grid 1	68.00000	331.50000	0.00000	214.83969	-0.12500	243.75	586.41	0.029203
1	Grid 1	68.00000	357.00000	0.00000	215.00083	-0.12500	243.75	586.40	0.029203
1	Grid 1	68.00000	382.50000	0.00000	215.26056	-0.12500	243.75	586.38	0.029204
1	Grid 1	68.00000	408.00000	0.00000	215.68562	-0.12500	243.75	586.35	0.029205
1	Grid 1	68.00000	433.50000	0.00000	216.40125	-0.12500	243.75	586.29	0.029207
1	Grid 1	68.00000	459.00000	0.00000	217.56576	-0.12500	243.75	586.15	0.029212
1	Grid 1	68.00000	484.50000	0.00000	217.77950	-0.12500	243.75	585.67	0.029228
1	Grid 1	68.00000	510.00000	0.00000	107.09861	-0.12500	121.88	293.23	0.014601
1	Grid 1	82.00000	0.00000	0.00000	140.85284	-0.12500	170.62	408.65	0.020503
1	Grid 1	82.00000	25.50000	0.00000	285.41855	-0.12500	341.25	816.44	0.041035
1	Grid 1	82.00000	51.00000	0.00000	285.26956	-0.12500	341.25	816.97	0.041018
1	Grid 1	82.00000	76.50000	0.00000	284.01574	-0.12500	341.25	817.12	0.041013
1	Grid 1	82.00000	102.00000	0.00000	283.25121	-0.12500	341.25	817.19	0.041010
1	Grid 1	82.00000	127.50000	0.00000	282.80145	-0.12500	341.25	817.22	0.041009
1	Grid 1	82.00000	153.00000	0.00000	282.52890	-0.12500	341.25	817.24	0.041009
1	Grid 1	82.00000	178.50000	0.00000	282.36090	-0.12500	341.25	817.25	0.041008
1	Grid 1	82.00000	204.00000	0.00000	282.25956	-0.12500	341.25	817.26	0.041008
1	Grid 1	82.00000	229.50000	0.00000	282.20509	-0.12500	341.25	817.26	0.041008
1	Grid 1	82.00000	255.00000	0.00000	282.18790	-0.12500	341.25	817.27	0.041008
1	Grid 1	82.00000	280.50000	0.00000	282.20509	-0.12500	341.25	817.26	0.041008
1	Grid 1	82.00000	306.00000	0.00000	282.25956	-0.12500	341.25	817.26	0.041008
1	Grid 1	82.00000	331.50000	0.00000	282.36090	-0.12500	341.25	817.25	0.041008
1	Grid 1	82.00000	357.00000	0.00000	282.52890	-0.12500	341.25	817.24	0.041009
1	Grid 1	82.00000	382.50000	0.00000	282.80145	-0.12500	341.25	817.22	0.041009
1	Grid 1	82.00000	408.00000	0.00000	283.25121	-0.12500	341.25	817.19	0.041010
1	Grid 1	82.00000	433.50000	0.00000	284.01574	-0.12500	341.25	817.12	0.041013
1	Grid 1	82.00000	459.00000	0.00000	285.26956	-0.12500	341.25	816.97	0.041018
1	Grid 1	82.00000	484.50000	0.00000	285.41855	-0.12500	341.25	816.44	0.041035
1	Grid 1	82.00000	510.00000	0.00000	140.85284	-0.12500	170.62	408.65	0.020503
1	Grid 1	96.00000	0.00000	0.00000	143.66659	-0.12500	170.63	409.06	0.020490
1	Grid 1	96.00000	25.50000	0.00000	291.14802	-0.12500	341.25	817.21	0.041010
1	Grid 1	96.00000	51.00000	0.00000	291.03743	-0.12500	341.25	817.78	0.040991
1	Grid 1	96.00000	76.50000	0.00000	289.71884	-0.12500	341.25	817.95	0.040985
1	Grid 1	96.00000	102.00000	0.00000	288.91902	-0.12500	341.25	818.02	0.040983
1	Grid 1	96.00000	127.50000	0.00000	288.45163	-0.12500	341.25	818.05	0.040982
1	Grid 1	96.00000	153.00000	0.00000	288.17002	-0.12500	341.25	818.07	0.040981
1	Grid 1	96.00000	178.50000	0.00000	287.99719	-0.12500	341.25	818.08	0.040981
1	Grid 1	96.00000	204.00000	0.00000	287.89327	-0.12500	341.25	818.09	0.040980
1	Grid 1	96.00000	229.50000	0.00000	287.83753	-0.12500	341.25	818.09	0.040980
1	Grid 1	96.00000	255.00000	0.00000	287.81995	-0.12500	341.25	818.10	0.040980
1	Grid 1	96.00000	280.50000	0.00000	287.83753	-0.12500	341.25	818.09	0.040980
1	Grid 1	96.00000	306.00000	0.00000	287.89327	-0.12500	341.25	818.09	0.040980
1	Grid 1	96.00000	331.50000	0.00000	287.99719	-0.12500	341.25	818.08	0.040981
1	Grid 1	96.00000	357.00000	0.00000	288.17002	-0.12500	341.25	818.07	0.040981
1	Grid 1	96.00000	382.50000	0.00000	288.45163	-0.12500	341.25	818.05	0.040982
1	Grid 1	96.00000	408.00000	0.00000	288.91902	-0.12500	341.25	818.02	0.040983
1	Grid 1	96.00000	433.50000	0.00000	289.71884	-0.12500	341.25	817.95	0.040985
1	Grid 1	96.00000	459.00000	0.00000	291.03743	-0.12500	341.25	817.78	0.040991
1	Grid 1	96.00000	484.50000	0.00000	291.14802	-0.12500	341.25	817.21	0.041010
1	Grid 1	96.00000	510.00000	0.00000	143.66659	-0.12500	170.63	409.06	0.020490
1	Grid 1	110.00000	0.00000	0.00000	148.33002	-0.12500	170.63	410.13	0.020454
1	Grid 1	110.00000	25.50000	0.00000	300.50193	-0.12500	341.25	819.32	0.040940
1	Grid 1	110.00000	51.00000	0.00000	300.44079	-0.12500	341.25	819.91	0.040920
1	Grid 1	110.00000	76.50000	0.00000	299.08652	-0.12500	341.25	820.08	0.040914
1	Grid 1	110.00000	102.00000	0.00000	298.26731	-0.12500	341.25	820.16	0.040912
1	Grid 1	110.00000	127.50000	0.00000	297.79041	-0.12500	341.25	820.19	0.040911
1	Grid 1	110.00000	153.00000	0.00000	297.50397	-0.12500	341.25	820.21	0.040910
1	Grid 1	110.00000	178.50000	0.00000	297.32860	-0.12500	341.25	820.22	0.040910
1	Grid 1	110.00000	204.00000	0.00000	297.22333	-0.12500	341.25	820.23	0.040909
1	Grid 1	110.00000	229.50000	0.00000	297.16692	-0.12500	341.25	820.24	0.040909
1	Grid 1	110.00000	255.00000	0.00000	297.14914	-0.12500	341.25	820.24	0.040909
1	Grid 1	110.00000	280.50000	0.00000	297.16692	-0.12500	341.25	820.24	0.040909
1	Grid 1	110.00000	306.00000	0.00000	297.22333	-0.12500	341.25	820.23	0.040909
1	Grid 1	110.00000	331.50000	0.00000	297.32860	-0.12500	341.25	820.22	0.040910
1	Grid 1	110.00000	357.00000	0.00000	297.50397	-0.12500	341.25	820.21	0.040910
1	Grid 1	110.00000	382.50000	0.00000	297.79041	-0.12500	341.25	820.19	0.040911
1	Grid 1	110.00000	408.00000	0.00000	298.26731	-0.12500	341.25	820.16	0.040912
1	Grid 1	110.00000	433.50000	0.00000	299.08652	-0.12500	341.25	820.08	0.040914
1	Grid 1	110.00000	459.00000	0.00000	300.44079	-0.12500	341.25	819.91	0.040920
1	Grid 1	110.00000	484.50000	0.00000	300.50193	-0.12500	341.25	819.32	0.040940
1	Grid 1	110.00000	510.00000	0.00000	148.33002	-0.12500	170.63	410.13	0.020454
1	Grid 1	124.00000	0.00000	0.00000	163.67905	-0.12500	195.00	467.24	0.023425
1	Grid 1	124.00000	25.50000	0.00000	331.14310	-0.12500	390.00	933.51	0.046883
1	Grid 1	124.00000	51.00000	0.00000	331.14582	-0.12500	390.00	934.12	0.046863
1	Grid 1	124.00000	76.50000	0.00000	329.78795	-0.12500	390.00	934.29	0.046857
1	Grid 1	124.00000	102.00000	0.00000	328.96671	-0.12500	390.00	934.36	0.046855
1	Grid 1	124.00000	127.50000	0.00000	328.48905	-0.12500	390.00	934.40	0.046853
1	Grid 1	124.00000	153.00000	0.00000	328.20231	-0.12500	390.00	934.42	0.046853
1	Grid 1	124.00000	178.50000	0.00000	328.02680	-0.12500	390.00	934.43	0.046852
1	Grid 1	124.00000	204.00000	0.00000	327.92147	-0.12500	390.00	934.44	0.046852
1	Grid 1	124.00000	229.50000	0.00000	327.86505	-0.12500	390.00	934.44	0.046852
1	Grid 1	124.00000	255.00000	0.00000	327.84726	-0.12500	390.00	934.44	0.046852
1	Grid 1	124.00000	280.50000	0.00000	327.86505	-0.12500	390.00	934.44	0.046852
1	Grid 1	124.00000	306.00000	0.00000	327.92147	-0.12500	390.00	934.44	0.046852
1	Grid 1	124.00000	331.50000	0.00000	328.02680	-0.12500	390.00	934.43	0.046852

Ref.	Name	x [m]	y [m]	z [mOD]	δz [mm]	Stress: Calc. Level [mOD]	Stress: Vertical [kN/m²]	Stress: Sum Princ. [kN/m²]	Vert. Strain [μ]
1	Grid 1	124.00000	357.00000	0.00000	328.20231	-0.12500	390.00	934.42	0.046853
1	Grid 1	124.00000	382.50000	0.00000	328.48905	-0.12500	390.00	934.40	0.046853
1	Grid 1	124.00000	408.00000	0.00000	328.96671	-0.12500	390.00	934.36	0.046855
1	Grid 1	124.00000	433.50000	0.00000	329.78795	-0.12500	390.00	934.29	0.046857
1	Grid 1	124.00000	459.00000	0.00000	331.14582	-0.12500	390.00	934.12	0.046863
1	Grid 1	124.00000	484.50000	0.00000	331.14310	-0.12500	390.00	933.51	0.046883
1	Grid 1	124.00000	510.00000	0.00000	163.67905	-0.12500	195.00	467.24	0.023425
1	Grid 1	138.00000	0.00000	0.00000	162.09421	-0.12500	195.00	466.96	0.023435
1	Grid 1	138.00000	25.50000	0.00000	327.89858	-0.12500	390.00	932.97	0.046901
1	Grid 1	138.00000	51.00000	0.00000	327.91236	-0.12500	390.00	933.57	0.046881
1	Grid 1	138.00000	76.50000	0.00000	326.58348	-0.12500	390.00	933.74	0.046875
1	Grid 1	138.00000	102.00000	0.00000	325.77808	-0.12500	390.00	933.81	0.046873
1	Grid 1	138.00000	127.50000	0.00000	325.30855	-0.12500	390.00	933.84	0.046872
1	Grid 1	138.00000	153.00000	0.00000	325.02608	-0.12500	390.00	933.86	0.046871
1	Grid 1	138.00000	178.50000	0.00000	324.85287	-0.12500	390.00	933.88	0.046871
1	Grid 1	138.00000	204.00000	0.00000	324.74878	-0.12500	390.00	933.88	0.046871
1	Grid 1	138.00000	229.50000	0.00000	324.69297	-0.12500	390.00	933.89	0.046870
1	Grid 1	138.00000	255.00000	0.00000	324.67537	-0.12500	390.00	933.89	0.046870
1	Grid 1	138.00000	280.50000	0.00000	324.69297	-0.12500	390.00	933.89	0.046870
1	Grid 1	138.00000	306.00000	0.00000	324.74878	-0.12500	390.00	933.88	0.046871
1	Grid 1	138.00000	331.50000	0.00000	324.85287	-0.12500	390.00	933.88	0.046871
1	Grid 1	138.00000	357.00000	0.00000	325.02608	-0.12500	390.00	933.86	0.046871
1	Grid 1	138.00000	382.50000	0.00000	325.30855	-0.12500	390.00	933.84	0.046872
1	Grid 1	138.00000	408.00000	0.00000	325.77808	-0.12500	390.00	933.81	0.046873
1	Grid 1	138.00000	433.50000	0.00000	326.58348	-0.12500	390.00	933.74	0.046875
1	Grid 1	138.00000	459.00000	0.00000	327.91236	-0.12500	390.00	933.57	0.046881
1	Grid 1	138.00000	484.50000	0.00000	327.89858	-0.12500	390.00	932.97	0.046901
1	Grid 1	138.00000	510.00000	0.00000	162.09421	-0.12500	195.00	466.96	0.023435
1	Grid 1	152.00000	0.00000	0.00000	144.51283	-0.12500	170.63	409.08	0.020489
1	Grid 1	152.00000	25.50000	0.00000	292.64234	-0.12500	341.25	817.27	0.041008
1	Grid 1	152.00000	51.00000	0.00000	292.61791	-0.12500	341.25	817.83	0.040989
1	Grid 1	152.00000	76.50000	0.00000	291.34928	-0.12500	341.25	817.99	0.040984
1	Grid 1	152.00000	102.00000	0.00000	290.57687	-0.12500	341.25	818.06	0.040981
1	Grid 1	152.00000	127.50000	0.00000	290.12400	-0.12500	341.25	818.09	0.040980
1	Grid 1	152.00000	153.00000	0.00000	289.85017	-0.12500	341.25	818.11	0.040980
1	Grid 1	152.00000	178.50000	0.00000	289.68159	-0.12500	341.25	818.12	0.040979
1	Grid 1	152.00000	204.00000	0.00000	289.57999	-0.12500	341.25	818.13	0.040979
1	Grid 1	152.00000	229.50000	0.00000	289.52540	-0.12500	341.25	818.13	0.040979
1	Grid 1	152.00000	255.00000	0.00000	289.50817	-0.12500	341.25	818.13	0.040979
1	Grid 1	152.00000	280.50000	0.00000	289.52540	-0.12500	341.25	818.13	0.040979
1	Grid 1	152.00000	306.00000	0.00000	289.57999	-0.12500	341.25	818.13	0.040979
1	Grid 1	152.00000	331.50000	0.00000	289.68159	-0.12500	341.25	818.12	0.040979
1	Grid 1	152.00000	357.00000	0.00000	289.85017	-0.12500	341.25	818.11	0.040980
1	Grid 1	152.00000	382.50000	0.00000	290.12400	-0.12500	341.25	818.09	0.040980
1	Grid 1	152.00000	408.00000	0.00000	290.57687	-0.12500	341.25	818.06	0.040981
1	Grid 1	152.00000	433.50000	0.00000	291.34928	-0.12500	341.25	817.99	0.040984
1	Grid 1	152.00000	459.00000	0.00000	292.61791	-0.12500	341.25	817.83	0.040989
1	Grid 1	152.00000	484.50000	0.00000	292.64234	-0.12500	341.25	817.27	0.041008
1	Grid 1	152.00000	510.00000	0.00000	144.51283	-0.12500	170.63	409.08	0.020489
1	Grid 1	166.00000	0.00000	0.00000	136.78347	-0.12500	170.62	406.96	0.020559
1	Grid 1	166.00000	25.50000	0.00000	277.06038	-0.12500	341.24	813.10	0.041144
1	Grid 1	166.00000	51.00000	0.00000	276.96692	-0.12500	341.24	813.60	0.041128
1	Grid 1	166.00000	76.50000	0.00000	275.78623	-0.12500	341.24	813.75	0.041123
1	Grid 1	166.00000	102.00000	0.00000	275.06207	-0.12500	341.24	813.81	0.041121
1	Grid 1	166.00000	127.50000	0.00000	274.63345	-0.12500	341.24	813.84	0.041120
1	Grid 1	166.00000	153.00000	0.00000	274.37220	-0.12500	341.24	813.86	0.041119
1	Grid 1	166.00000	178.50000	0.00000	274.21036	-0.12500	341.24	813.87	0.041119
1	Grid 1	166.00000	204.00000	0.00000	274.11238	-0.12500	341.24	813.88	0.041118
1	Grid 1	166.00000	229.50000	0.00000	274.05959	-0.12500	341.24	813.88	0.041118
1	Grid 1	166.00000	255.00000	0.00000	274.04290	-0.12500	341.24	813.88	0.041118
1	Grid 1	166.00000	280.50000	0.00000	274.05959	-0.12500	341.24	813.88	0.041118
1	Grid 1	166.00000	306.00000	0.00000	274.11238	-0.12500	341.24	813.88	0.041118
1	Grid 1	166.00000	331.50000	0.00000	274.21036	-0.12500	341.24	813.87	0.041119
1	Grid 1	166.00000	357.00000	0.00000	274.37220	-0.12500	341.24	813.86	0.041119
1	Grid 1	166.00000	382.50000	0.00000	274.63345	-0.12500	341.24	813.84	0.041120
1	Grid 1	166.00000	408.00000	0.00000	275.06207	-0.12500	341.24	813.81	0.041121
1	Grid 1	166.00000	433.50000	0.00000	275.78623	-0.12500	341.24	813.75	0.041123
1	Grid 1	166.00000	459.00000	0.00000	276.96692	-0.12500	341.24	813.60	0.041128
1	Grid 1	166.00000	484.50000	0.00000	277.06038	-0.12500	341.24	813.10	0.041144
1	Grid 1	166.00000	510.00000	0.00000	136.78347	-0.12500	170.62	406.96	0.020559
1	Grid 1	180.00000	0.00000	0.00000	103.77652	-0.12500	121.88	292.61	0.014621
1	Grid 1	180.00000	25.50000	0.00000	210.92304	-0.12500	243.75	584.51	0.029266
1	Grid 1	180.00000	51.00000	0.00000	210.71191	-0.12500	243.75	584.94	0.029252
1	Grid 1	180.00000	76.50000	0.00000	209.64087	-0.12500	243.75	585.07	0.029248
1	Grid 1	180.00000	102.00000	0.00000	208.97714	-0.12500	243.75	585.13	0.029246
1	Grid 1	180.00000	127.50000	0.00000	208.57901	-0.12500	243.75	585.16	0.029245
1	Grid 1	180.00000	153.00000	0.00000	208.33361	-0.12500	243.75	585.18	0.029244
1	Grid 1	180.00000	178.50000	0.00000	208.18031	-0.12500	243.75	585.19	0.029244
1	Grid 1	180.00000	204.00000	0.00000	208.08694	-0.12500	243.75	585.19	0.029244
1	Grid 1	180.00000	229.50000	0.00000	208.03645	-0.12500	243.75	585.20	0.029244
1	Grid 1	180.00000	255.00000	0.00000	208.02046	-0.12500	243.75	585.20	0.029244
1	Grid 1	180.00000	280.50000	0.00000	208.03645	-0.12500	243.75	585.20	0.029244
1	Grid 1	180.00000	306.00000	0.00000	208.08694	-0.12500	243.75	585.19	0.029244
1	Grid 1	180.00000	331.50000	0.00000	208.18031	-0.12500	243.75	585.19	0.029244
1	Grid 1	180.00000	357.00000	0.00000	208.33361	-0.12500	243.75	585.18	0.029244
1	Grid 1	180.00000	382.50000	0.00000	208.57901	-0.12500	243.75	585.16	0.029245
1	Grid 1	180.00000	408.00000	0.00000	208.97714	-0.12500	243.75	585.13	0.029246
1	Grid 1	180.00000	433.50000	0.00000	209.64087	-0.12500	243.75	585.07	0.029248
1	Grid 1	180.00000	459.00000	0.00000	210.71191	-0.12500	243.75	584.94	0.029252
1	Grid 1	180.00000	484.50000	0.00000	210.92304	-0.12500	243.75	584.51	0.029266
1	Grid 1	180.00000	510.00000	0.00000	103.77652	-0.12500	121.88	292.61	0.014621
1	Grid 1	194.00000	0.00000	0.00000	78.94391	-0.12500	97.500	233.51	0.011716
1	Grid 1	194.00000	25.50000	0.00000	161.11416	-0.12500	195.00	466.42	0.023453
1	Grid 1	194.00000	51.00000	0.00000	160.77127	-0.12500	195.00	466.77	0.023441
1	Grid 1	194.00000	76.50000	0.00000	159.82434	-0.12500	195.00	466.87	0.023437
1	Grid 1	194.00000	102.00000	0.00000	159.22937	-0.12500	195.00	466.92	0.023436
1	Grid 1	194.00000	127.50000	0.00000	158.86618	-0.12500	195.00	466.95	0.023435
1	Grid 1	194.00000	153.00000	0.00000	158.63913	-0.12500	195.00	466.97	0.023434
1	Grid 1	194.00000	178.50000	0.00000	158.49579	-0.12500	195.00	466.98	0.023434
1	Grid 1	194.00000	204.00000	0.00000	158.40784	-0.12500	195.00	466.98	0.023434
1	Grid 1	194.00000	229.50000	0.00000	158.36006	-0.12500	195.00	466.99	0.023434
1	Grid 1	194.00000	255.00000	0.00000	158.34489	-0.12500	195.00	466.99	0.023434
1	Grid 1	194.00000	280.50000	0.00000	158.36006	-0.12500	195.00	466.99	0.023434
1	Grid 1	194.00000	306.00000	0.00000	158.40784	-0.12500	195.00	466.98	0.023434
1	Grid 1	194.00000	331.50000	0.00000	158.49579	-0.12500	195.00	466.98	0.023434
1	Grid 1	194.00000	357.00000	0.00000	158.63913	-0.12500	195.00	466.97	0.023434
1	Grid 1	194.00000	382.50000	0.00000	158.86618	-0.12500	195.00	466.95	0.023435
1	Grid 1	194.00000	408.00000	0.00000	159.22937	-0.12500	195.00	466.92	0.023436
1	Grid 1	194.00000	433.50000	0.00000	159.82434	-0.12500	195.00	466.87	0.023437
1	Grid 1	194.00000	459.00000	0.00000	160.77127	-0.12500	195.00	466.77	0.023441
1	Grid 1	194.00000	484.50000	0.00000	161.11416	-0.12500	195.00	466.42	0.023453
1	Grid 1	194.00000	510.00000	0.00000	78.94391	-0.12500	97.500	233.51	0.011716
1	Grid 1	208.00000	0.00000	0.00000	50.16602	-0.12500	60.938	146.43	0.0073064
1	Grid 1	208.00000	25.50000	0.00000	103.36453	-0.12500	121.88	292.38	0.014629
1	Grid 1	208.00000	51.00000	0.00000	102.92163	-0.12500	121.88	292.65	0.014620
1	Grid 1	208.00000	76.50000	0.00000	102.10538	-0.12500	121.88	292.74	0.014617
1	Grid 1	208.00000	102.00000	0.00000	101.58325	-0.12500	121.88	292.78	0.014616
1	Grid 1	208.00000	127.50000	0.00000	101.25760	-0.12500	121.88	292.81	0.014615
1	Grid 1	208.00000	153.00000	0.00000	101.05051	-0.12500	121.88	292.82	0.014614
1	Grid 1	208.00000	178.50000	0.00000	100.91812	-0.12500	121.88	292.83	0.014614
1	Grid 1	208.00000	204.00000	0.00000	100.83618	-0.12500	121.88	292.83	0.014614
1	Grid 1	208.00000	229.50000	0.00000	100.79143	-0.12500	121.88	292.84	0.014614
1	Grid 1	208.00000	255.00000	0.00000	100.77718	-0.12500	121.88	292.84	0.014614
1	Grid 1	208.00000	280.50000	0.00000	100.79143	-0.12500	121.88	292.84	0.014614
1	Grid 1	208.00000	306.00000	0.00000	100.83618	-0.12500	121.88	292.83	0.014614
1	Grid 1	208.00000	331.50000	0.00000	100.91812	-0.12500	121.88	292.83	0.014614
1	Grid 1	208.00000	357.00000	0.00000	101.05051	-0.12500	121.88	292.82	0.014614
1	Grid 1	208.00000	382.50000	0.00000	101.25760	-0.12500	121.88	292.81	0.014615
1	Grid 1	208.00000	408.00000	0.00000	101.58325	-0.12500	121.88	292.78	0.014616
1	Grid 1	208.00000	433.50000	0.00000	102.10538	-0.12500	121.88	292.74	0.014617
1	Grid 1	208.00000	459.00000	0.00000	102.92163	-0.12500	121.88	292.65	0.014620
1	Grid 1	208.00000	484.50000	0.00000	103.36453	-0.12500	121.88	292.38	0.014629
1	Grid 1	208.00000	510.00000	0.00000	50.16602	-0.12500	60.938	146.43	0.0073064
1	Grid 1	222.00000	0.00000	0.00000	37.42971	-0.12500	48.750	116.89	0.0058536
1	Grid 1	222.00000	25.50000	0.00000	77.65340	-0.12500	97.500	233.41	0.011720
1	Grid 1	222.00000	51.00000	0.00000	77.15267	-0.12500	97.500	233.60	0.011713
1	Grid 1	222.00000	76.50000	0.00000	76.46558	-0.12500	97.500	233.67	0.011711
1	Grid 1	222.00000	102.00000	0.00000	76.01626	-0.12500	97.500	233.71	0.011710
1	Grid 1	222.00000	127.50000	0.00000	75.72884	-0.12500	97.500	233.73	0.011709
1	Grid 1	222.00000	153.00000	0.00000	75.54244	-0.12500	97.500	233.74	0.011709
1	Grid 1	222.00000	178.50000	0.00000	75.42157	-0.12500	97.500	233.75	0.011708

Ref.	Name	x [m]	y [m]	z [mOD]	δz [mm]	Stress: Calc. Level [mOD]	Stress: Vertical [kN/m²]	Stress: Sum Princ. [kN/m²]	Vert. Strain [μ]
1	Grid 1	222.00000	204.00000	0.00000	75.34603	-0.12500	97.500	233.75	0.011708
1	Grid 1	222.00000	229.50000	0.00000	75.30450	-0.12500	97.500	233.76	0.011708
1	Grid 1	222.00000	255.00000	0.00000	75.29125	-0.12500	97.500	233.76	0.011708
1	Grid 1	222.00000	280.50000	0.00000	75.30450	-0.12500	97.500	233.76	0.011708
1	Grid 1	222.00000	306.00000	0.00000	75.34603	-0.12500	97.500	233.75	0.011708
1	Grid 1	222.00000	331.50000	0.00000	75.42157	-0.12500	97.500	233.75	0.011708
1	Grid 1	222.00000	357.00000	0.00000	75.54244	-0.12500	97.500	233.74	0.011709
1	Grid 1	222.00000	382.50000	0.00000	75.72884	-0.12500	97.500	233.73	0.011709
1	Grid 1	222.00000	408.00000	0.00000	76.01626	-0.12500	97.500	233.71	0.011710
1	Grid 1	222.00000	433.50000	0.00000	76.46558	-0.12500	97.500	233.67	0.011711
1	Grid 1	222.00000	459.00000	0.00000	77.15267	-0.12500	97.500	233.60	0.011713
1	Grid 1	222.00000	484.50000	0.00000	77.65340	-0.12500	97.500	233.41	0.011720
1	Grid 1	222.00000	510.00000	0.00000	37.42971	-0.12500	48.750	116.89	0.0058536
1	Grid 1	236.00000	0.00000	0.00000	3.87468	-0.12500	531.86E-6	1.5401	-51.231E-6
1	Grid 1	236.00000	25.50000	0.00000	10.31167	-0.12500	0.0010624	2.7989	-93.086E-6
1	Grid 1	236.00000	51.00000	0.00000	9.75787	-0.12500	0.0010635	2.9254	-97.301E-6
1	Grid 1	236.00000	76.50000	0.00000	9.19134	-0.12500	0.0010636	2.9797	-99.112E-6
1	Grid 1	236.00000	102.00000	0.00000	8.81126	-0.12500	0.0010637	3.0095	-100.10E-6
1	Grid 1	236.00000	127.50000	0.00000	8.56112	-0.12500	0.0010637	3.0275	-100.70E-6
1	Grid 1	236.00000	153.00000	0.00000	8.39534	-0.12500	0.0010637	3.0389	-101.09E-6
1	Grid 1	236.00000	178.50000	0.00000	8.28615	-0.12500	0.0010637	3.0463	-101.33E-6
1	Grid 1	236.00000	204.00000	0.00000	8.21717	-0.12500	0.0010637	3.0508	-101.48E-6
1	Grid 1	236.00000	229.50000	0.00000	8.17900	-0.12500	0.0010637	3.0534	-101.57E-6
1	Grid 1	236.00000	255.00000	0.00000	8.16678	-0.12500	0.0010637	3.0542	-101.59E-6
1	Grid 1	236.00000	280.50000	0.00000	8.17900	-0.12500	0.0010637	3.0534	-101.57E-6
1	Grid 1	236.00000	306.00000	0.00000	8.21717	-0.12500	0.0010637	3.0508	-101.48E-6
1	Grid 1	236.00000	331.50000	0.00000	8.28615	-0.12500	0.0010637	3.0463	-101.33E-6
1	Grid 1	236.00000	357.00000	0.00000	8.39534	-0.12500	0.0010637	3.0389	-101.09E-6
1	Grid 1	236.00000	382.50000	0.00000	8.56112	-0.12500	0.0010637	3.0275	-100.70E-6
1	Grid 1	236.00000	408.00000	0.00000	8.81126	-0.12500	0.0010637	3.0095	-100.10E-6
1	Grid 1	236.00000	433.50000	0.00000	9.19134	-0.12500	0.0010636	2.9797	-99.112E-6
1	Grid 1	236.00000	459.00000	0.00000	9.75787	-0.12500	0.0010635	2.9254	-97.301E-6
1	Grid 1	236.00000	484.50000	0.00000	10.31167	-0.12500	0.0010624	2.7989	-93.086E-6
1	Grid 1	236.00000	510.00000	0.00000	3.87468	-0.12500	531.86E-6	1.5401	-51.231E-6
1	Grid 1	250.00000	0.00000	0.00000	-2.22525	-0.12500	4.0751E-6	0.38577	-12.858E-6
1	Grid 1	250.00000	25.50000	0.00000	-2.15600	-0.12500	7.5494E-6	0.56438	-18.811E-6
1	Grid 1	250.00000	51.00000	0.00000	-2.70534	-0.12500	7.9873E-6	0.64266	-21.421E-6
1	Grid 1	250.00000	76.50000	0.00000	-3.16420	-0.12500	8.0838E-6	0.68336	-22.777E-6
1	Grid 1	250.00000	102.00000	0.00000	-3.48123	-0.12500	8.1174E-6	0.70750	-23.582E-6
1	Grid 1	250.00000	127.50000	0.00000	-3.69637	-0.12500	8.1320E-6	0.72277	-24.091E-6
1	Grid 1	250.00000	153.00000	0.00000	-3.84228	-0.12500	8.1391E-6	0.73275	-24.423E-6
1	Grid 1	250.00000	178.50000	0.00000	-3.93999	-0.12500	8.1429E-6	0.73928	-24.641E-6
1	Grid 1	250.00000	204.00000	0.00000	-4.00242	-0.12500	8.1449E-6	0.74340	-24.778E-6
1	Grid 1	250.00000	229.50000	0.00000	-4.03722	-0.12500	8.1459E-6	0.74568	-24.854E-6
1	Grid 1	250.00000	255.00000	0.00000	-4.04840	-0.12500	8.1462E-6	0.74641	-24.879E-6
1	Grid 1	250.00000	280.50000	0.00000	-4.03722	-0.12500	8.1459E-6	0.74568	-24.854E-6
1	Grid 1	250.00000	306.00000	0.00000	-4.00242	-0.12500	8.1449E-6	0.74340	-24.778E-6
1	Grid 1	250.00000	331.50000	0.00000	-3.93999	-0.12500	8.1429E-6	0.73928	-24.641E-6
1	Grid 1	250.00000	357.00000	0.00000	-3.84228	-0.12500	8.1391E-6	0.73275	-24.423E-6
1	Grid 1	250.00000	382.50000	0.00000	-3.69637	-0.12500	8.1320E-6	0.72277	-24.091E-6
1	Grid 1	250.00000	408.00000	0.00000	-3.48123	-0.12500	8.1174E-6	0.70750	-23.582E-6
1	Grid 1	250.00000	433.50000	0.00000	-3.16420	-0.12500	8.0838E-6	0.68336	-22.777E-6
1	Grid 1	250.00000	459.00000	0.00000	-2.70534	-0.12500	7.9873E-6	0.64266	-21.421E-6
1	Grid 1	250.00000	484.50000	0.00000	-2.15600	-0.12500	7.5494E-6	0.56438	-18.811E-6
1	Grid 1	250.00000	510.00000	0.00000	-2.22525	-0.12500	4.0751E-6	0.38577	-12.858E-6

Results : Consolidation : Displacement Data : Grids

None

Results : Total : Displacement Data : Grids

None