

TECHNICAL NOTE

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Project Name: Meridian Gate - Royston

Subject Title: Slope Stability Assessment of Constructed Slopes

1. INTRODUCTION

This technical note has been prepared in relation to the slopes constructed within the residential development located north of Newmarket Road and immediately west of the A505, on the eastern outskirts of Royston (SG8 7FH). These slopes have subsequently been subjected to additional loading due to the placement of fill material following their initial construction. The constructed slopes are partly supported by retaining walls. The slope gradient is limited to 1V:2.5H. The maximum height of the additional fills is approximately 4.75 m.

The National Grid co-ordinates of the approximate centre of the Site are 537023E, 240993N.

The location plan of the exploratory boreholes relevant to the slope sections is presented in **Figure 1**. It should be read and used in accordance with the limitations and constraints identified in the report text, and at **Appendix A - Service Constraints**.

1.1 Scope of Works

The scope of this assessment is to analyse the global and local stabilities of constructed slopes and retaining walls (sheet piles) under the weight of the additional fills and maintenance loading. The worst case slope sections have been considered for these analyses, as explained below.

- Slope sections not supported by retaining structures: sections J-J (steepest section), and L-L (highest section).
- Slope sections supported by retaining structures: section P-P.

A breakdown of the scope of works for this technical note is presented below.

- Review of ground investigation data and derivation of suitable ground model and design soil parameters to be used in the stability analyses of the slope and the sheet pile wall,
- Assessment of the external stability of the constructed sheet pile walls, using the proprietary software WALLAP; and
- Assessment of the overall stability of the constructed slope sections, both with and without sheet pile support, using the proprietary software Oasys Slope; and
- Provision of recommendations for the constructed slope sections and sheet pile walls presented in **Appendix B** and **Appendix C** respectively. The list of the drawings included provided by the client and in **Appendix B** is the following:

- Drawing number 66200295-SWE-ZZ-XX-D-C-4160 (Rev. P01), dated 29th April 2025.
- Drawing number 66200295-SWE-ZZ-XX-D-C-4161 (Rev. P01), dated 29th April 2025.
- Drawing number 66200295-SWE-ZZ-XX-D-C-4162 (Rev. P01), dated 29th April 2025.
- Drawing number 66200295-SWE-ZZ-XX-D-C-4163 (Rev. P01), dated 29th April 2025.
- Drawing number 66200295-SWE-ZZ-XX-D-C-4164 (Rev. P01), dated 29th April 2025.
- Drawing number 66200295-SWE-ZZ-XX-D-C-4165 (Rev. C01), dated 29th April 2025.

The list of the drawings included provided by the client and in **Appendix C** is the following:

- Drawing number C1861-SPUK-DRG-001 (Rev. P01), dated 02 May 2025.

2. PROJECT BACKGROUND

The constructed slope is located within the ongoing residential development north of Newmarket Road and immediately west of the A505, on the eastern outskirts of Royston, SG8 7FH. The site is located at National Grid reference 537023, 240993 and currently comprises a development site, with new residential properties proposed in the north, south and west, and an area of slope on the east. The constructed slope profiles have been provided by Vistry Eastern and are presented in **Appendix B**. The constructed slope has been subject to extra fill materials on the planned slope profiles originally analysed by RSK Geosciences, report title: Development Off Newmarket Road, Royston – Revised Slope Stability Assessment, Ref. 340388 L01 (02), dated 01 March 2025.

3. GROUND CONDITIONS AND GROUND MODEL

Published British Geological Survey (BGS) data indicates that the existing slope is in New Pit Chalk Formation - Chalk, (NPCH), described as principally blocky, white firm to moderately hard chalk with numerous marls or paired marl seams.

The MLM Consulting Engineers Ltd exploratory holes in April 2017 (Ref. Phase 2 Geoenvironmental Assessment Report, dated: April 2017) revealed a thin layer of topsoil of 0.30 m thick, comprising slightly clayey gravelly silt was encountered in all exploratory holes across the site. The Chalk Underlying the topsoil in all exploratory holes, was generally described as grade Dc structureless chalk composed of very silty fine to coarse gravel in a clayey silt matrix. This overlaid an estimated Grade C3 generally weak to moderately weak closely fractured chalk with clasts of fine to coarse gravel, frequent cobbles and occasional boulders.

The related available exploratory holes near the slope, including CP02, WS08, WS09, WS10, WS11 and WS12, captured grade Dc structureless chalk recovered as silty fine to coarse gravel, overlaying grade Dm structureless chalk recovered as firm moist silty gravelly clay with silt and chalk gravel horizons. Borehole CP02 captured softer and harder horizons within grade Dm structureless chalk throughout the hole to a maximum depth of 15.00 m.

Thus, generally the exploratory hole logs comprise:

- Topsoil;
- Chalk – Clay (NPCH (C));
- Chalk - (NPCH);

On this basis, for modelling purposes, the ground model shown in **Table 1** has been derived for the slope stability analyses.

Table 1: Design ground model for sections J-J, L-L and P-P

Stratum Name	Typical Description	Top of stratum (m bgl)	Approx. thickness (m)
Topsoil (Not considered in Oasys and WALLAP models)	Dark grey brown slightly clayey gravelly SILT	Ground level	0.30
NPCH (Clay)	Firm moist off-white silty gravelly CLAY. The gravel is fine to coarse angular to subangular.	0.30	8.50
NPCH – Grade C	Grade C3 generally weak to moderately weak closely fractured chalk	8.50	-

In addition to standard penetration tests, the site investigation data contained laboratory testing on soil classification including particle size distributions PSD and Atterberg limits. Laboratory testing results are presented in the MLM engineers Ltd (Phase 2 Geoenvironmental Assessment Report, dated: April 2017).

Nine plasticity indices were recorded in the cohesive material, with an average standard deviation of 10%. This provided constant volume friction angles of 29.5°. Considering a contribution of 2.0° from over-consolidation of the material, an average peak friction angle of 31.5° can be estimated. It should be noted that the material description revealed layers of gravel and gravelly clay with the gravel being fine to coarse angular to subangular. This would also contribute to an increase in the friction angle. Considering a contribution of 1.5° from the granular components, an average peak friction angle of 33° can be estimated.

Based upon the laboratory testing from the Earthworks Materials Acceptability Assessment, a peak effective friction angle $\phi' > 33^\circ$ and effective cohesion $c' = 0 \text{ kN/m}^2$ are recommended for the recompacted Class 3 materials.

Previous visits to the site involved an assessment of the grade of the chalk exposed on the cut slopes below the weathered chalk. This chalk was described as a weak medium density white chalk. Fractures are very close to closely spaced, open and clean, approximate CIRIA Grade C4/C3.

In accordance with CIRIA C574 section 6.2 'Design of cuttings', the characteristic friction angle of Chalk grade C is assumed to be 33°.

It has been assumed that all topsoil material was stripped from the slope prior to the reprofiling.

The estimated characteristic soil parameters for the geological units encountered at the site and for the fill material (reworked chalk) are presented in **Table 2** below.

Table 2: Characteristic geotechnical parameters adopted in slope stability analyses and sheet pile design

Parameter	Stratum		
	Fill material (reworked chalk)	NPCH	NPCH – Grade C
Bulk unit weight above groundwater level - γ_k (kN/m ³)	18.0	18.0	18.0
Bulk unit weight below groundwater level - γ_k (kN/m ³)	19.0	19.0	19.0
Undrained shear strength – c_u (kN/m ²)	40 ⁽¹⁾	77+4.8z ⁽²⁾	188.0
Angle of Friction - ϕ'_{peak} (°)	33.0	33.0	33.0
Effective cohesion - $c'_{,k}$ (kN/m ²)	0.0	0.0	0.0
Undrained stiffness – E_u ((MN/m ²)	– ⁽³⁾	38.8+2.4z ⁽⁴⁾	94.1 ⁽⁴⁾
Drained stiffness – E' ((MN/m ²)	– ⁽³⁾	33.0+ 2.0z ⁽⁵⁾	80.0 ⁽⁵⁾
Undrained Poisson's ratio (ν_u)	– ⁽³⁾	0.50	0.50
Drained Poisson's ratio (ν')	– ⁽³⁾	0.25	0.25
¹ Assumed based on the soil description of the existing material and a sensitivity degree of around 2. ² Based on geotechnical in situ and laboratory testing carried out on site derived soil samples ³ not used in the retaining wall check as the fill layers were considered as a permanent surcharge. ⁴ Based on undrained modulus correlation (Jamiolkowski et al., 1979) a factor of 500 was considered for the average plasticity index value of 10% ⁵ E' was determined after Stroud (1989)			

Groundwater seepages were not encountered during the investigation and groundwater was also not present within the post fieldwork monitoring of installed wells up to 15.00 m bgl.

To account for development of pore water pressure due to surface water in the slope stability analysis, an r_u of 0.10 was considered for the soil above the groundwater level.

For the retaining wall analysis, the groundwater level was assumed to be at the toe of the sheet pile.

4. SHEET PILE WALL DESIGN

4.1 Introduction

The proposed sheet pile wall along part of the slope (Section O–O and Section P–P) has been assessed as a permanent structure, functioning as a cantilever retaining wall.

As the sheet pile wall has already been constructed, it is assumed that a third party has satisfactorily undertaken the short-term stability assessment during its installation. Based on the information provided to us, the sheet piles are currently in a stable condition, which supports the assumption of short-term stability. Please note that RSK has not been involved in the construction process, nor have we conducted any site visits to assess the current condition of the sheet pile wall.

The sheet pile analysis has been carried out using the software Geosolve WALLAP. For the geotechnical aspects of the stability analysis and design, BS EN 1997-1 + UK NA has been adopted. For the Ultimate Limit State, Design Approach 1 – Combination 2 (DA1-C2) has been applied, which represents the most onerous analysis case in most embedded retaining wall designs.

The structural adequacy of the sheet pile cross sections are outside the scope of this work and are assessed by a third party. Details of the constructed sheet pile walls provided by the client are presented in **Appendix C**.

A minimum overdraft factor (ODF) of 1.0 for the Ultimate Limit State (ULS), i.e., Design Approach 1 – Combination 2 (DA1-C2), confirms design satisfaction.

In addition, the assessment of sheet pile wall design using WALLAP provides the induced bending moments and shear forces. It is recommended that a verification of the structural adequacy of the selected sheet pile cross-sections against the induced bending moments and shear forces presented within this report, is carried out by the client/contractor.

4.2 Design Assumptions

The following assumptions have been made in the sheet pile design:

- The weight of the slope behind the sheet pile wall was modelled as a surcharge in the WALLAP models. The weights were estimated assuming a bulk unit weight of 18 kN/m³. These weights were applied at the top level of sheet pile wall.
- A variable surcharge load of 5.0 kPa was assumed to act on the slope/crest of the slope over a length of 5.00 m to account for maintenance and any other possible loads affecting the slope in the long term.

- Permanent design life of the sheet piles is 60 years. In undisturbed natural soils (chalk, silt, clay), it is reported by the client that the sheet pile cross sections would experience a total loss of steel thickness of 1.00 mm.
- The maximum allowable lateral deflection was considered to be 100.00 mm, as reported by the client.
- A structural check of the adequacy of the sheet pile cross section is not within our scope of work.
- For the constructed sheet pile walls, only long-term conditions, using drained geotechnical parameters, are considered for a global stability assessment.
- BS EN 1997-1 (Clause 9.3.2.2, P(2)) recommends accounting for unplanned excavation when designing retaining walls. The guidance suggests a depth ranging from 0.00 m where surface levels are reliably controlled, up to 10% of the wall height, capped at a maximum of 0.50 m. Greater allowances are recommended where surface level control is uncertain.

Please note that this report does not account for the allowance of unplanned excavation, as its purpose is to assess the geotechnical adequacy of existing constructed assets rather than to produce new design works.

4.3 Results

Details and results of the sheet pile design (WALLAP) are summarised in .

Based on the design outcomes, a 12.50 m long sheet pile proposed for P-P section, using a ESZ26-700 sheet pile section, is geotechnically adequate for a local stability assessment. The estimated lateral deflection at the top of the sheet pile is 64 mm, which is less than 100 mm.

WALLAP outputs are presented in **Appendix D**.

Sheet pile layout, setting out details and typical sections are provided in Sheet Piling (UK) Ltd. design drawing ref. C1861-SPUK-DRG-001 (Rev.C01).

Table 3: Sheet pile design summary

Section	Pile section	Design toe level (m AOD)	Length of pile (m) ^[1]	DA1-C2		DA1-C1		SLS
				Max. Bending Moment (kNm/m)	Max. Shear Force (kN/m)	Max. Bending Moment (kNm/m)	Max. Shear Force (kN/m)	Pile Deflection at top (mm)
P-P	ESZ26-700	67.9	12.5	394	110	339	116	64

5. SLOPE STABILITY ASSESSMENT OF SLOPES WITH AND WITHOUT SHEET PILE SUPPORT

5.1 Geometry of Constructed Slopes

16 slope sections (A to P) have been provided for analysis. 14 of these sections have been constructed without a sheet pile support, while two sections (O and P) are shown to be supported by sheet pile walls. The slope gradient varies across the profiles, comprising a combination of cut and fill slopes and at grade areas.

Slope stability assessments have been undertaken for the two worst-case slope profiles (i.e., the highest and steepest slopes) for the area without a sheet pile support, and for the worst-case slope section supported by a sheet pile wall.

The locations of the sections are presented in the drawing Soil Redistribution Cut&Fill GA-Option 7 (no. 66200295-SWE-ZZ-XX-D-C-4160, DATED: 29th April 2025), provided by Vistry Eastern, and presented within **Appendix B**.

5.2 Global Stability

The Oasys Slope (v21.0) software application, developed by Arup, has been employed by RSK to perform this slope stability assessment. Circular slip surfaces have been assumed using Bishop's Method of Slices. In this method, a large number of theoretical computer-generated slip circles are drawn, relative to a predetermined grid of centres. By default, the programme draws the slip circle with a minimum Overdesign Factor (ODF).

Ultimate limit state (ULS) overdesign factor using BS EN 1997-1 partial factors (Design Approach 1, Combinations 1 and 2) approach was adopted for the slope stability assessments. Two critical sections without a sheet pile support (Section J-J and Section L-L) and a section with a sheet pile support (Section P-P) were analysed.

Partial factors from UK NA to BS EN 1997-1 (DA1-C1 and DA1-C2) are presented in **Table 4**.

Table 4: GEO/STR Partial Factors

Stratum	DA1C1: A1 + M1 + R1	DA1C2: A2 + M2 + R1
Combination	A1	A2
Unfavourable Permanent Action (γ_G)	1.35	1.00
Favourable Permanent Action (γ_G, fav)	1.00	1.00
Unfavourable Variable Action (γ_Q)	1.50	1.30
Favourable Variable Action (γ_Q, fav)	0.00	0.00
	M1	M2
Friction angle	1.00	1.25
Effective cohesion	1.00	1.25
Undrained cohesion	1.00	1.40
Unit weight of soil	1.00	1.00

5.3 Loading

As explained earlier in this report, the focus of this technical note is on assessing impacts of the additional fill material on the stability of the previous analysed slope. For this purpose, in addition to the self-weights from soil and placed fill, a maintenance load of 5.0 kPa (UDL) was applied to the slope crest, acting along 5.00 m long strip of the slope.

5.4 Results of Global Slope Stability Analyses

Details and results of the slope stability analyses using ultimate limit state are summarised in **Table 5**. Oasys Slope stability outputs are given in **Appendix E**. Note that a minimum overdiseign factor of 1.0 is required to demonstrate slope stability.

Table 5: Slope stability assessment results

Condition		Overdesign Factors (ODF) – ULS*	
		DA1-C1	DA1-C2
Sections without a sheet pile support			
Section J-J	Global Stability	1.367	1.054
	Local Stability	1.367	1.054
Section L-L	Global Stability	1.635	1.264
	Local Stability	1.575	1.215
Sections with a sheet pile support			
Section P-P	Global Stability	1.738	1.519
*Ultimate limit state			

5.5 Assumptions

The following assumptions apply to the slop stability assessments carried out as part of this report.

- Ground investigation carried out and included in the MLM engineers Ltd report (Phase 2 Geoenvironmental Assessment Report, dated: April 2017) is representative to the site conditions.
- A maintenance load of 5.0 kPa applied to two worst-case locations to model local and global stabilities of the slope.
- The slope sections provided by the client represent the worst-case design cases. These drawings are presented in Soil Redistribution Cut&Fill GA-Option 7 (no. 66200295-SWE-ZZ-XX-D-C-4160, DATED: 29th April 2025), **Appendix B**.
- It is assumed that the constructed slopes and sheet pile walls are stable in their current condition as reported by the client.

- For the slope stability analyses, a pore pressure ratio of $r_u = 0.10$ was considered for the soil above the groundwater level.

6. RESULTS SUMMARY

The results of the global slope stability assessment indicate that the minimum overdraft factor for slopes without a sheet pile support is $1.054 > 1.0$ under the weight of the additional fill and a maintenance load of 5.0 kPa.

Global stability assessments of the sheet pile supported slopes recorded a minimum overdraft factor $1.781 > 1.0$ under the weight of the additional fill and a maintenance load of 5.0 kPa.

Regarding the sheet pile design, the constructed section produced a maximum deflection of 64 mm in the serviceability limit state. This deflection is within the allowable range of 100 mm provided by the client. In addition, the induced bending moment and shear force are provided for both ULS and SLS analyses. Note that an assessment of the structural capacity of the sheet pile cross section against bending moment and shear force is outside the scope of this report, and is highly recommended to be undertaken by others (e.g. communicating outcomes of this report to the structural designer or the supplier for a review).

6.1 Conclusions and Recommendations

Results of the slope stability and sheet pile design assessments concluded that:

- The constructed slopes with and without sheet piles are considered to be stable against long-term impacts of the placement of additional fill material on the slope crest, with satisfactory overdraft factors in accordance with Eurocode 7 Design Approach 1, Combination 2 (DA1 C2).
- The slopes are already constructed, have withstood the short-term effects of construction loading and are currently stable as reported by the client. This confirms its short-term stability, therefore an undrained slope stability assessment is considered unnecessary, particularly as a drained condition would represent the more critical, worst-case design scenario.
- A drained slope stability assessment was undertaken with applying a variable load of 5.0 kPa at the crest of the slope to account for maintenance or any other possible loads.
- Assessment results provided a minimum overdraft factor of 1.054 for the drained analysis of the slope stability, showing a satisfactory stability of the slope in long term conditions.
- The results of the sheet pile design showed that the constructed sheet pile was satisfactory geotechnically, experiencing a lateral deflection within the allowable value of 100 mm. Note that it is highly recommended to check the structural adequacy of the sheet pile cross section for the induced bending moment and shear force presented within this report.
- These outcomes are subject to the assumptions presented in Sections 4.2 and 5.5 for the slope stability assessment and sheet pile design, respectively.
- It is recommended that the relevant authority is issued with a copy of this report to confirm the conclusions drawn.

7. REFERENCES

1. BS EN 1997-2:2007 Incorporating corrigendum June 2010. Eurocode 7: Geotechnical Design – Part 2: Ground investigation and testing.
2. NA to BS EN 1991-2:2003 Incorporating corrigendum No. 1. UK National Annex to Eurocode 1: Actions on structures – Part 2: Traffic loads on bridges.
3. Look, B. G., Handbook of Geotechnical Investigation and Design Tables, Taylor & Francis Group, London, UK, 2007
4. Stroud, M.A., 1989, The standard penetration test-its application and interpretation, Proc. ICE Conf. on Penetration Testing in the UK, Birmingham, Thomas Telford, London.
5. National Highways (2020) CD 350: Design of Highway Structures. Design Manual for Roads and Bridges. Coventry: National Highways. Available at: <https://www.standardsforhighways.co.uk/dmrb/search/> (Accessed: 1 August 2025).

FIGURES



Appendix A – SERVICE CONSTRAINTS

APPENDIX A

SERVICE CONSTRAINTS

1. Service Constraints

1.1. This Report (the "Report") and any study, inspection, investigation, sampling, testing and or interpretation carried out in connection with the Report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) trading as Leap Environmental or RSK Geosciences, for the Client named in the first paragraph of the Report (the "Client") in accordance with the terms of an RSK Fee Proposal including RSK Environment Standard Terms and Conditions (the "Appointment") between RSK and the Client, unless otherwise stated in the first paragraph of the Report. The Services were performed by RSK with the reasonable skill and care ordinarily exercised by a geo-environmental consultant at the time the Services were performed. Nothing in this Report shall be construed as imposing any fitness for purpose obligation. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the Client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the Client.

1.2 Other than that, expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services. RSK shall not be liable in respect of any action or proceedings arising out of or in connection with this Report whether in contract, in tort, for breach of statutory duty or otherwise after the expiry of six (6) years from either (i) the date of the Report or (ii) such earlier date as prescribed by law, unless varied in the terms of the Appointment.

1.3 Unless otherwise agreed in writing, the Services were performed by RSK exclusively for the purposes of the Client. RSK is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent, or condone any party, other than the Client relying upon the Services. Should this Report or any part of this Report, or details of the Services or any part of the Services, be made known to any such party, and such party relies thereon, that party does so wholly at its own and sole risk, and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent geo-environmental consultant and/or lawyer.

1.4 The Client shall not, without the prior written consent of RSK, assign, transfer, charge, mortgage, subcontract, or deal in any other manner with all or any of the benefits provided in this Report. Unless specified in the Appointment, RSK shall not be obliged to assign the benefit of the Report whether by collateral warranty, third party rights pursuant to the Contracts (Rights of Third Parties) Act 1999, letter of reliance or otherwise. If RSK agrees to any assignment of the benefit of this Report, in whatever form, benefits to third parties through collateral warranties, third party rights or letters of reliance shall not be provided unless a fee for each right, warranty or letter is agreed. The form of wording used in the warranty or letter shall be provided by RSK for agreement by the Client. Any reasonable changes to the form of wording will be implemented by mutual agreement, however the terms in the warranty or letter cannot offer the third party any greater benefit than the Appointment offered to the Client.

1.5 It is the understanding of RSK that this Report is to be used for the purpose described in the introduction to the Report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the Report is used, or the proposed use of the site change, this Report may no longer be valid and any further use of or reliance upon the Report in those circumstances by the Client without the review and advice of RSK shall be at the Client's sole and own risk. RSK shall not be liable for any use of this Report for any purpose other than that for which it was provided.

1.6 The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the Report inaccurate or unreliable. The information and conclusions contained in this Report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the Report in the future shall be at the Client's own and sole risk.

1.7 The observations and conclusions described in this Report are based solely upon the Services which were provided pursuant to the agreement between the Client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out, or required by the Appointment between the Client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this Report, RSK did not seek to evaluate the presence on or off site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas, fuel storage, persistent bio-accumulative or toxic chemicals (including PFAS and related compounds) or other radioactive or hazardous materials, unless specifically identified in the Services.

1.8 The Services are based upon RSK's observations of existing physical conditions at the Site gained from a visual inspection of the site together with RSK's interpretation of desk based publicly available information, including documentation, obtained from third parties and from the Client on the history and usage of the site, unless specifically identified in the Services and the limitations below:

- a. The Services were based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely.
- b. The Services were limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the visual inspection.
- c. The Services did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the Client or third parties, including laboratories and information services, during the performance of the Services.
- d. The Client has identified in writing to RSK, the information, reports, findings, surveys and preliminary works RSK may not rely upon when providing the Services.

RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK, and including the doing of any independent investigation of the information provided to RSK, save as otherwise provided in the terms of the Appointment between the Client and RSK.

1.9 Any site drawing(s) provided in this Report is (are) not meant to be an accurate base plan for scale measurement but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for accurate setting out and should be considered indicative only.

1.10 Should RSK be requested to review the Report after the date of issue of this Report, RSK shall be entitled to additional payment at the existing rates, or such other terms as agreed between RSK and the Client.

2. Service Constraints where the Report provides an intrusive assessment of ground conditions:

2.1 The intrusive environmental ground investigation aspects of the Services are a limited sampling of soil from the site, at pre-determined locations based on the known historic / operational configuration of the site. The conclusions given in this Report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent

of the limited area depends on the properties of the materials adjacent and local conditions, together with the position of any current structures and underground utilities and facilities, and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters (as stipulated in the scope agreed between the Client and RSK, based on an understanding of the available operational and historical information) and it should not be inferred that other chemical species (not tested) are not present.

2.2 The comments given in this Report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. The extent of the exploratory holes, laboratory testing and monitoring undertaken may have been restricted due to a number of factors including accessibility, the presence of buried or overhead services, current development, site usage, timescales or the Client's specification. The exploratory holes only assess a small proportion of the site area with respect to the site as a whole, and as such may only provide an indicative assessment of ground conditions on site. There may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows, may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised. The presence of hotspots of undisclosed contamination or exceptional and unforeseen ground conditions cannot be discounted.

2.3 Where the Services include Investigation of an exploratory nature or relating to physical ground works, any costings and prices provided in the Report are estimated and provided for guidance purposes only. The actual cost and time quantities shall be remeasured and shall be dependent upon the ground or other conditions, constraints present, and number and depth of the investigation locations, which shall influence the number of samples and tests required, and the quantities of soil being classified.

2.4 Asbestos is often observed to be present in soils in discrete areas. Whilst asbestos-containing materials may have been locally encountered during the fieldworks or supporting laboratory analysis, the history of brownfield and demolition sites indicates that asbestos fibres may be present more widely in soils and aggregates, which could be encountered during more extensive ground works. However, this Report does not constitute an asbestos survey. On this basis, the presence of asbestos on site cannot be discounted and a full asbestos survey should be undertaken.

2.5 Unless stated otherwise, only preliminary geotechnical recommendations are presented in this Report and these should be verified in a Geotechnical Design Report, once proposed construction and structural design proposals are confirmed. Eurocode 7 gives guidance on the type of sampling, sample quality, number and spacing of intrusive investigations, and number of laboratory tests required. It is intended that the Geotechnical Information section of this Report will fulfil the general requirements of the Ground Investigation Report as set out in section 6 of Eurocode7, although this is subject to the restrictions imposed on the investigation, as listed above. For geotechnical design, Eurocode 7 requires the Geotechnical Design Report to address both the geotechnical and structural aspects of the geotechnical design for both the limit and serviceability states. The Geotechnical Appraisal section of this Report will not meet the requirements of a Geotechnical Design Report (GDR) and should therefore be used for preliminary guidance only.

3. Service Constraints where the Report relates to Surface Water Management:

3.1 The Surface Water Management Inspection (SWMI) Report, documents provided, observations, actions, and recommendations, with respect to the management of potential pollution issues to surface waters, made during the site Inspection visit, are those present at the time of the visit, and may not represent those recorded by others on the same day.

3.2 The comments given in this Report and the opinions expressed are based on the weather, ground and ground water conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the inspection and therefore could not be taken into account. In addition, groundwater levels and flows, may vary from those Reported due to seasonal, or other, effects and the limitations stated in the data should be recognised.

3.3 RSK places a degree of dependence upon oral information provided by site representatives, which is not readily verifiable through visual inspection, or supported by any available written documentation. RSK shall not be held responsible for conditions or consequences arising from relevant facts that were not fully disclosed by facility or site representatives at the time this Report was prepared.

3.4 This Report is a live document, to be continually reviewed and updated as the development progresses or other changes occur on site. RSK can only maintain the currency of this Report through the Client requesting support with supplementary site visits or attendance at meetings ahead of key stages of the development in relation to surface water management. Our risk rating assesses a number of risk factors in line with the source-pathway- receptor model and is therefore subject to constant change.

3.5 Standard design drawings are indicative. Material types, dimensions and construction details will need to be adjusted by the Client to suit the specific conditions / flows on Site.

3.6 The full responsibility for implementing the site-specific protection and maintenance measures to protect the surface water system as stated in this Report, remains with the Client and their site management team. Additional control measures may be required to achieve the objectives set out in the Surface Water Management Plan to be implemented and financed by the Client.

4. Service Constraints where the Report relates to Waste Management:

4.1 In accordance with the definition provided in the Waste Framework Directive (WFD), materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded, by the holder'. Naturally occurring soils are not considered waste if re-used on the site of origin for the purposes of development. Soils such as made ground that are not of clean and natural origin (irrespective of whether they are contaminated or not) and other materials such as recycled aggregate, do not necessarily become waste until the criteria above are met. Excavation arisings from the development may therefore be classified as waste if surplus to requirements and/or unsuitable for re-use.

4.2 It is the duty of the waste producer, to ensure that all waste is accurately classified prior to waste disposal. Technical Guidance WM3 (EA, 2018) sets out in its Appendix D requirements for waste sampling. It is a legal requirement to correctly assess and classify waste. The level of sampling should be proportionate to the volume of waste and its heterogeneity. Unless otherwise stated, the waste assessment presented in this Report should be considered as preliminary and further testing and assessment of the waste under the provisions of a Waste Sampling Plan may be required to obtain the necessary level of data required for basic characterisation of the waste in support of disposal.

4.3 Unless stated otherwise in the Report, information relating to historical operations at the site was not reviewed as part of the assessment by RSK. In addition, unless otherwise stated in the Services, RSK was not present during the collection of the samples nor had any input on the chemical testing suite. Therefore, the waste assessment and classification detailed in this Report are based solely on any information that were provided to RSK (e.g., laboratory chemical data, exploratory hole records) and were completed without prejudice for our Client.

4.4 RSK assumes that any ground investigation data, chemical testing results etc., that were provided by the Client to inform the waste assessment and supporting review were carried out in accordance with current best practice and relevant guidance/ standards, where applicable. Thus, the

comments given in this Report and the opinions expressed are based solely on the information provided by the Client. However, it is noted that there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account as part of the RSK assessment.

5. Service Constraints for Construction Environmental Management Plan Reports:

5.1 This Report should be considered in the light of any changes in legislation, statutory requirement or industry practices that may have occurred subsequent to the date of issue.

5.2 The measures and comments outlined in this Report and any opinions expressed are based on the plans provided at the time and discussions with relevant parties. However, there may be conditions pertaining to the site that have not been disclosed by investigations and therefore could not be taken into account.

5.3 This CEMP is a live document and is subject to change throughout the project, as and when necessary, to ensure management of environmental aspects remains relevant, and to ensure continued compliance with legislation and commitments as they may change. RSK understands that this CEMP will be reviewed by the Client every six months and updated as and when necessary.

5.4 It is the full responsibility of the Principal Contractor/ Client to ensure that their works do not contravene legal requirements, and adherence to this CEMP alone cannot be a full defence regarding legal action against the Principal Contractor.

6. Service Constraints where the Report relates to Ground Gas Membrane Verification:

6.1 This Report is limited to the verification of the gas resistant membrane/vapour membrane/radon barrier after installation and no inspections were undertaken of the substrate (i.e. prepared ground). The Report therefore does not constitute as a full verification of ground gas protection system.

6.2 The comments given in this Report and the opinions expressed, are based on the condition of the ground gas membrane as encountered at the time of inspection by suitably qualified personnel. RSK cannot accept liability for any subsequent change to the status of the gas membrane by follow-on trades or other construction activity.

6.3 Where not designed by RSK, the verification of protection measures is carried out with reference to the gas protection design provided by the Client. RSK assume the scope of gas protection measures as determined by third parties to be correct and to have achieved any required approval from authorities.

6.4 The Ground Gas Design Report/Remediation Strategy and Verification Plan contains details of the procedures to be adopted for inspection and validation of the works. However, it should be noted that responsibility for the correct implementation of the strategy lies with the appointed contractor. RSK cannot be held responsible for any remedial works that are carried out without the agreed procedures involving either direct supervision by RSK, or inspection and validation of the works by a representative from RSK.

7. Service Constraints for Environmental Due Diligence (EDD) Reports:

7.1 The comments given in this Report and the opinions expressed are based on the information obtained and reviewed as part of the desk-based assessment. However, there may be conditions pertaining to the Site that have not been disclosed by the assessment and therefore could not be taken into account. Furthermore, no intrusive investigations, monitoring or sampling have been undertaken to confirm the environmental status of the site, therefore any comments relating to ground conditions and subsurface contamination are based solely on a review of desk-based information.

7.2 This Report describes the results of the EDD exercise. The scope of this EDD Report, where appropriate, covers legal or regulatory compliance with respect to UK or international regulations associated with environmental matters.

7.3 As with any EDD exercise, there is a certain degree of dependence upon information provided by the target company. The EDD does not include a site walkover / visit or liaison with site representatives unless identified in the Services. Therefore, the assessment is based on the available desk study information. Also, there is a certain degree of dependence upon oral information provided by site representatives, which is not readily verifiable through visual inspection, or supported by any available written documentation. RSK shall not be held responsible for conditions or consequences arising from relevant facts that were not fully disclosed by facility or site representatives at the time this EDD exercise was performed.

7.4 This Report, including all supporting data and notes (collectively referred to hereinafter as "information"), was prepared or collected by RSK for the benefit of its Client.

7.5 The comments given in this Report and the opinions expressed are based on the information obtained and reviewed as part of the desk-based assessment and the site inspection visit. However, there may be conditions pertaining to the Site that have not been disclosed by the assessment and therefore could not be taken into account. Furthermore, no intrusive investigations, monitoring or sampling have been undertaken to confirm the environmental status of the Site therefore any comments relating to ground conditions and subsurface contamination are based solely on a review of desk-based information and observations collected during the site inspection visit.

8. Service Constraints for Ground source heat energy Reports:

8.1 It is understood that this is a desktop survey only and that there are no requirements for a site walkover, service utility survey, or provision of service plans. These services can be provided upon request if required.

8.2 At a later stage, it is possible that a thermal response test (TRT) will need to be completed, for which a test borehole will have to be drilled, and these would be costed at the time. RSK can provide all aspects of subsequent site work for a GSHP system if required.

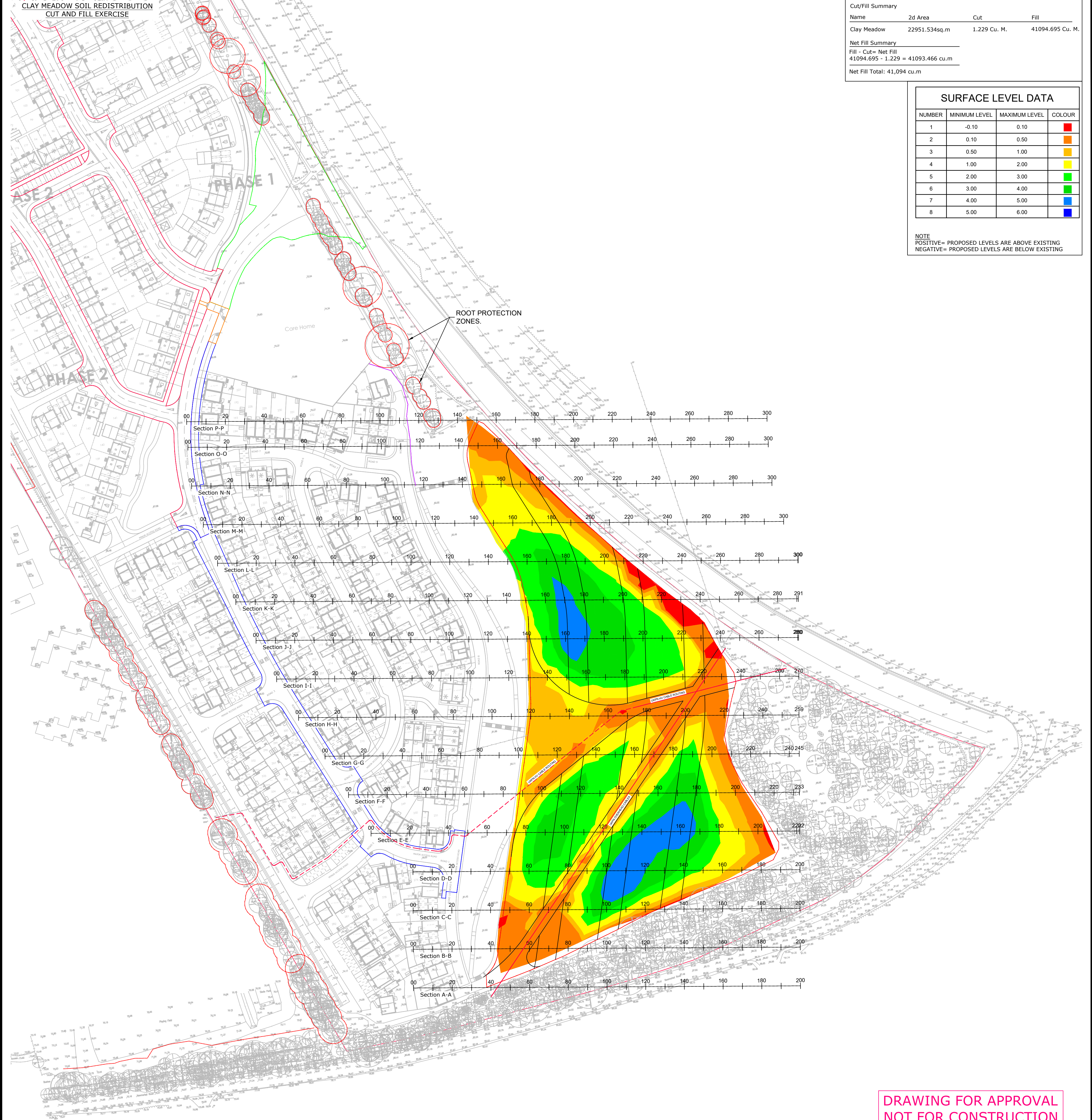
9. Service Constraints for Water Abstraction Borehole Reports:

9.1 The Report aims principally to only identify and assess the suitability of the site for a water abstraction borehole. This Report should be considered in the light of any changes in legislation, statutory requirements, and industry practices, that have occurred subsequent to the date of the Report.

9.2 Unless stated in the Report, the opinions expressed in this Report including all comments and recommendations provided are on the basis of the information obtained from a desk-based assessment.

Appendix B – Existing Slope Sections

CLAY MEADOW SOIL REDISTRIBUTION
CUT AND FILL EXERCISE



Cut/Fill Summary			
Name	2d Area	Cut	Fill
Clay Meadow	22951.534sq.m	1.229 Cu. M.	41094.695 Cu. M.
Net Fill Summary			
Fill - Cut= Net Fill			
41094.695 - 1.229 = 41093.466 cu.m			
Net Fill Total: 41,094 cu.m			

SURFACE LEVEL DATA			
NUMBER	MINIMUM LEVEL	MAXIMUM LEVEL	COLOUR
1	-0.10	0.10	Red
2	0.10	0.50	Orange
3	0.50	1.00	Yellow
4	1.00	2.00	Light Green
5	2.00	3.00	Green
6	3.00	4.00	Dark Green
7	4.00	5.00	Blue
8	5.00	6.00	Dark Blue

NOTE
POSITIVE= PROPOSED LEVELS ARE ABOVE EXISTING
NEGATIVE= PROPOSED LEVELS ARE BELOW EXISTING

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Client
VISTRY HOMES

Project Title
**NEWMARKET ROAD, ROYSTON
PHASE 3**

Drawing Title
**SOIL REDISTRIBUTION CUT &
FILL GA - OPTION 7**

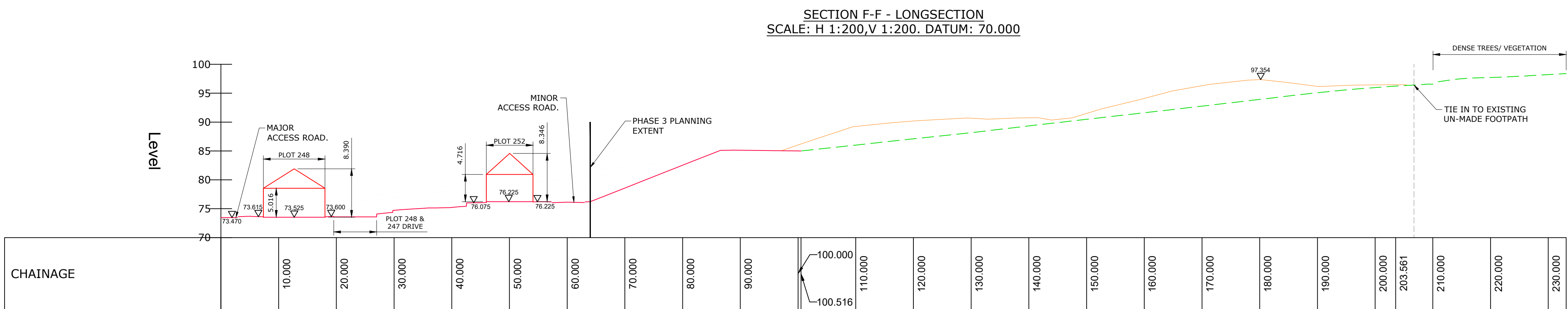
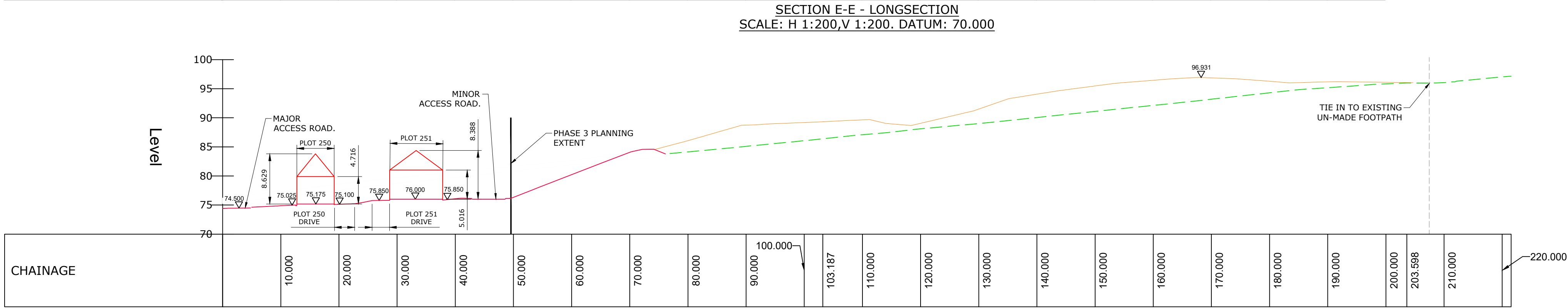
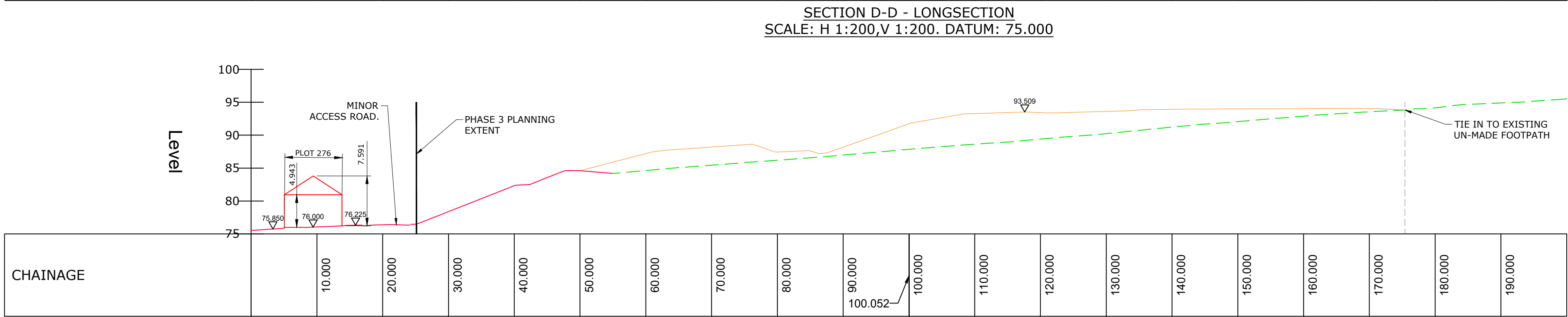
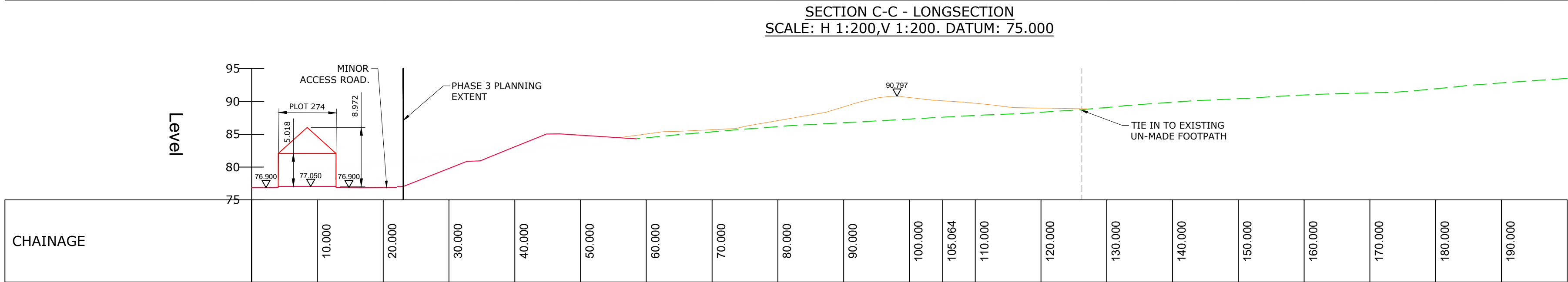
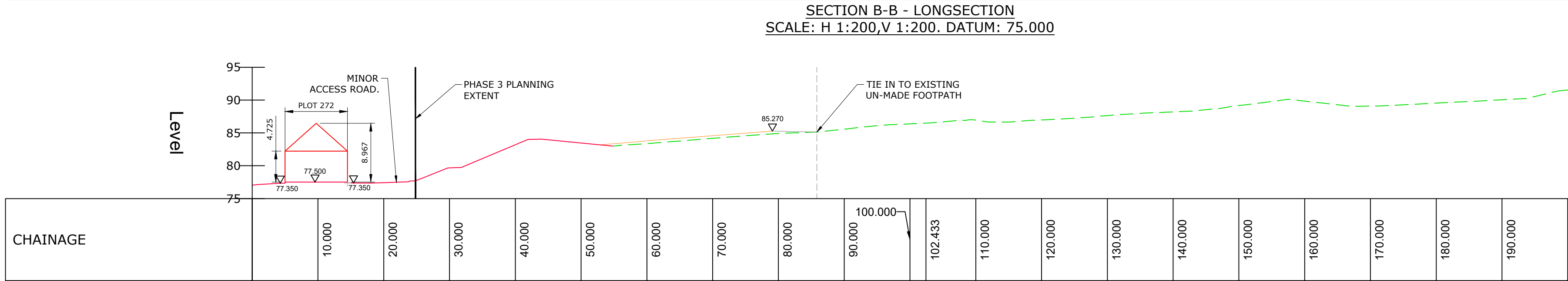
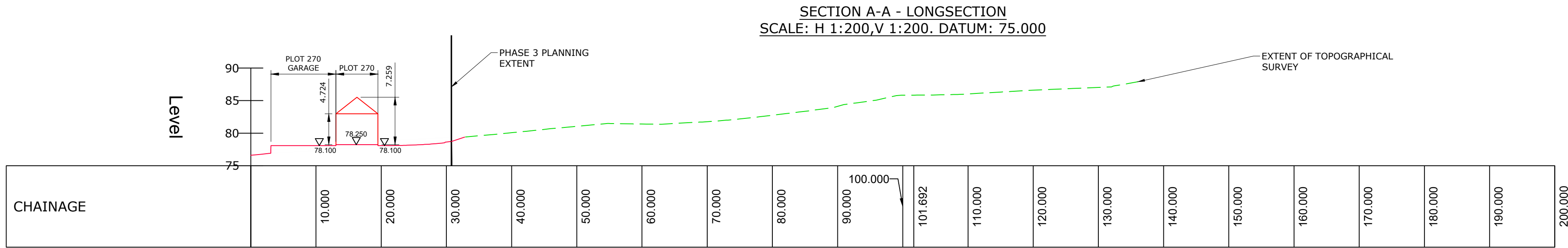
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Designed	Drawn	Checked	Approved	
TM	GJ	RS	TM	
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A1	1:1000	66200295	P01	

Drawing Number
66200295-SWE-ZZ-XX-D-C-4160



KEY	
—	CURRENT FINISHED GROUND PROFILE - APPROVED UNDER NMA Ref: 21/00996/NMA
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---	AS-BUILT RE-GRADING/ STEPPED EMBANKMENT PROFILE

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Client

VISTRY HOMES

Project Title

NEWMARKET ROAD, ROYSTON

Drawing Title

SOIL REDISTRIBUTION CUT &
FILL SECTIONS - OPTION 7
SHEET 1

Purpose Of Issue

PRELIMINARY

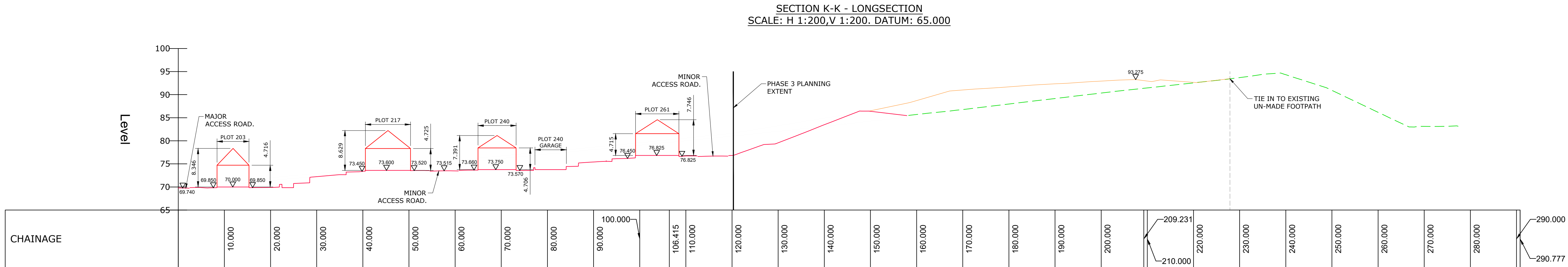
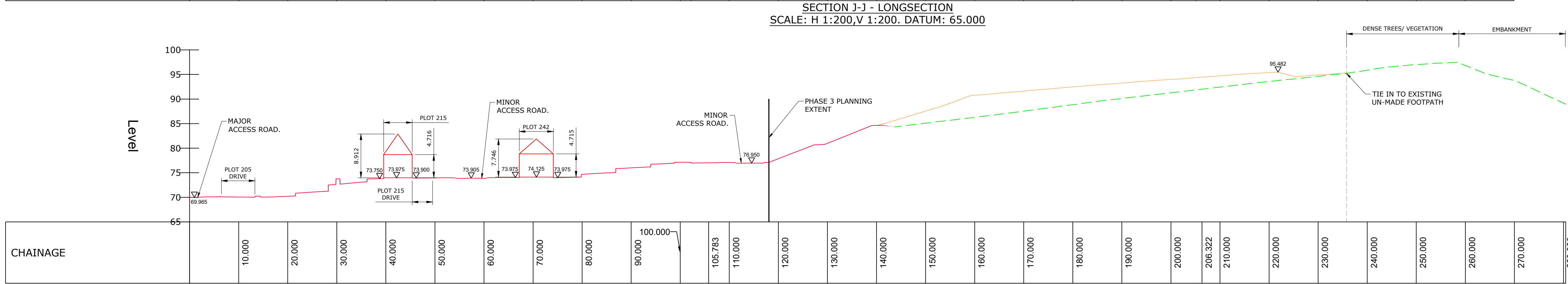
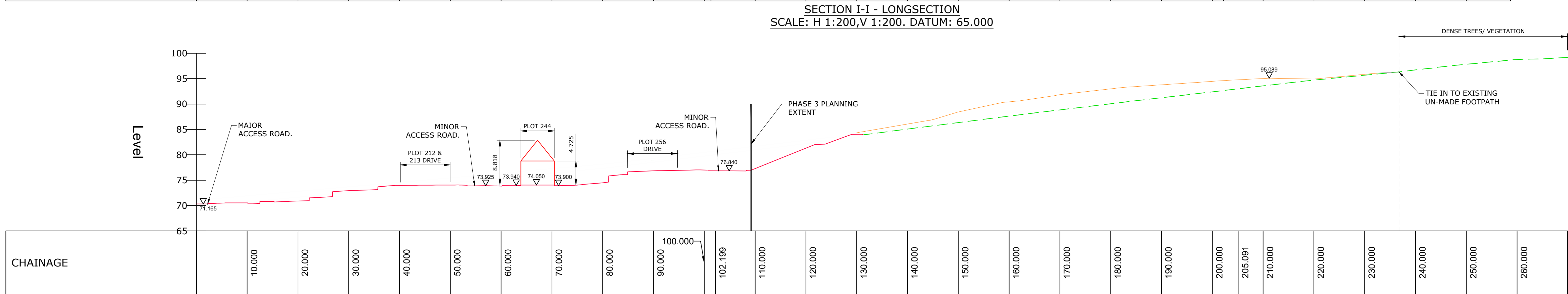
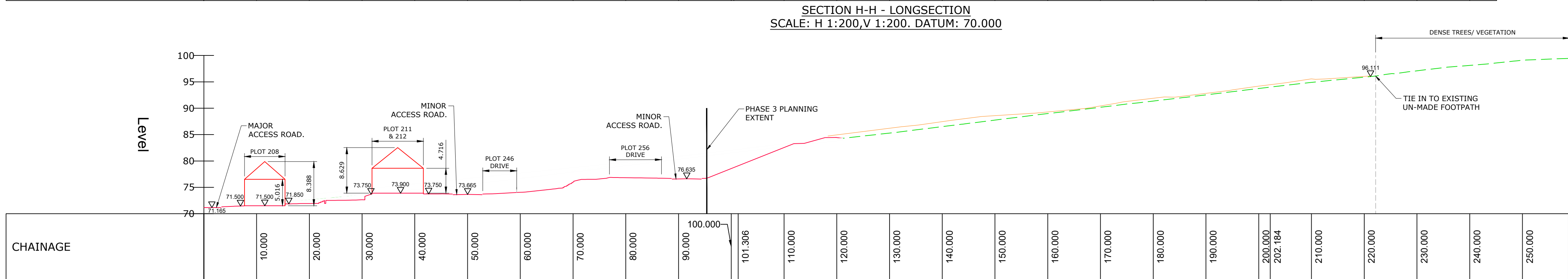
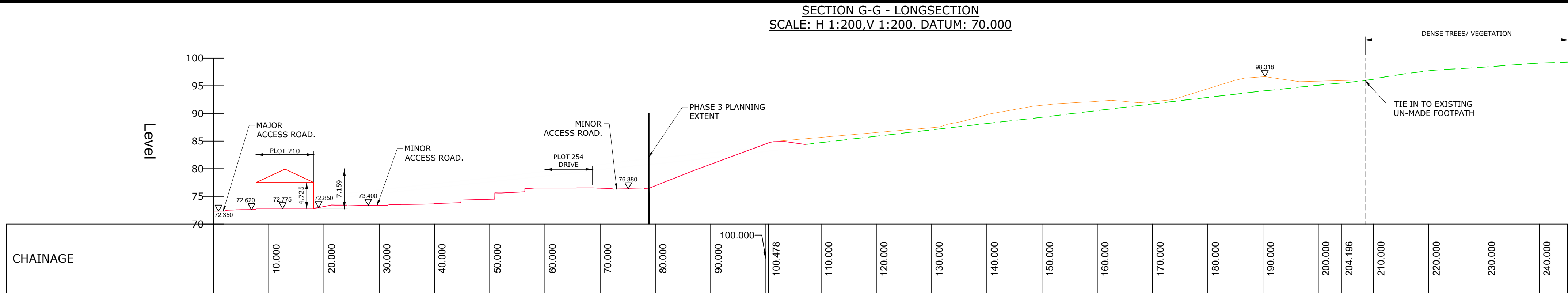
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Client

VISTRY HOMES

Project Title

NEWMARKET ROAD, ROYSTON

Drawing Title

SOIL REDISTRIBUTION CUT & FILL SECTIONS - OPTION 7
SHEET 2

Purpose Of Issue

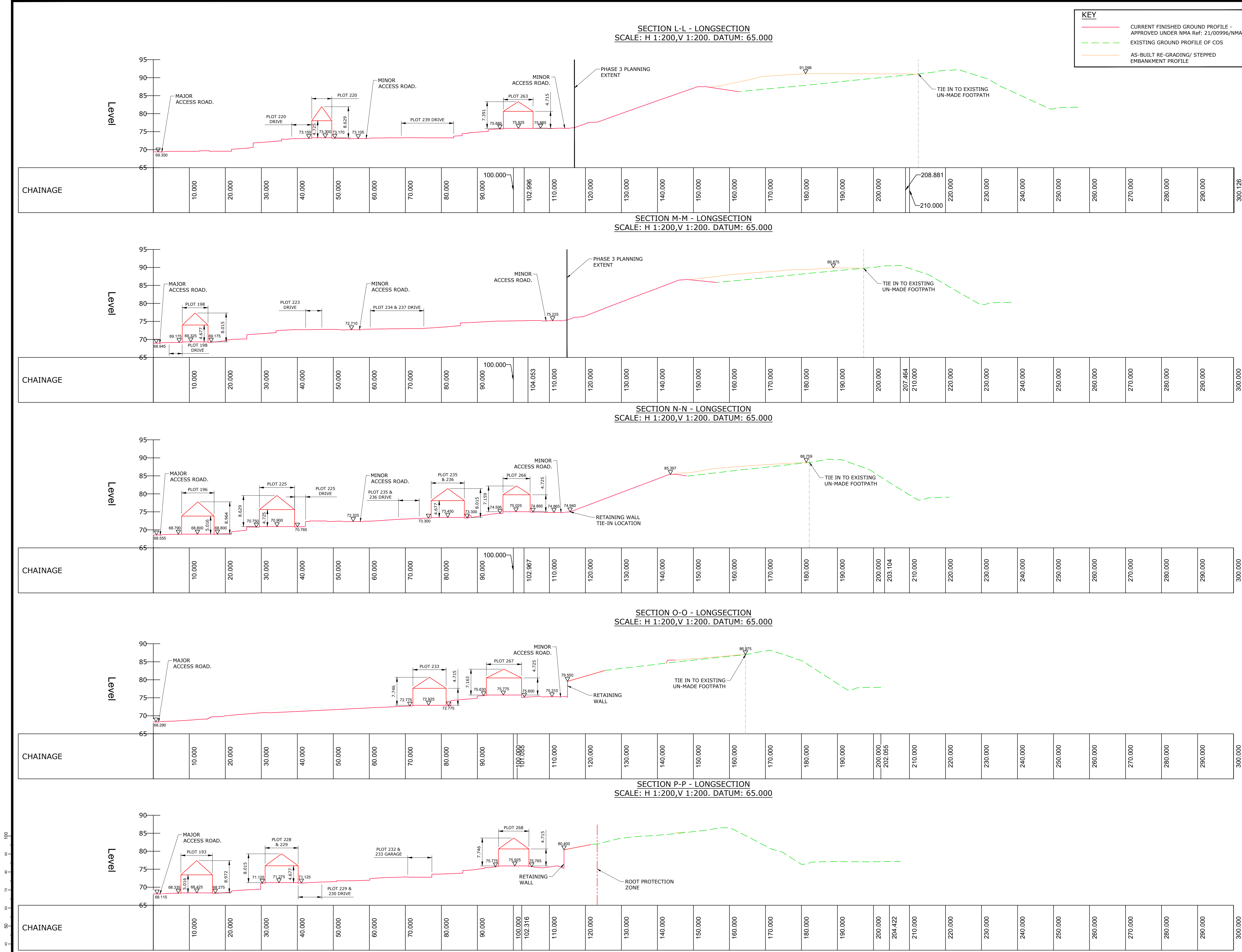
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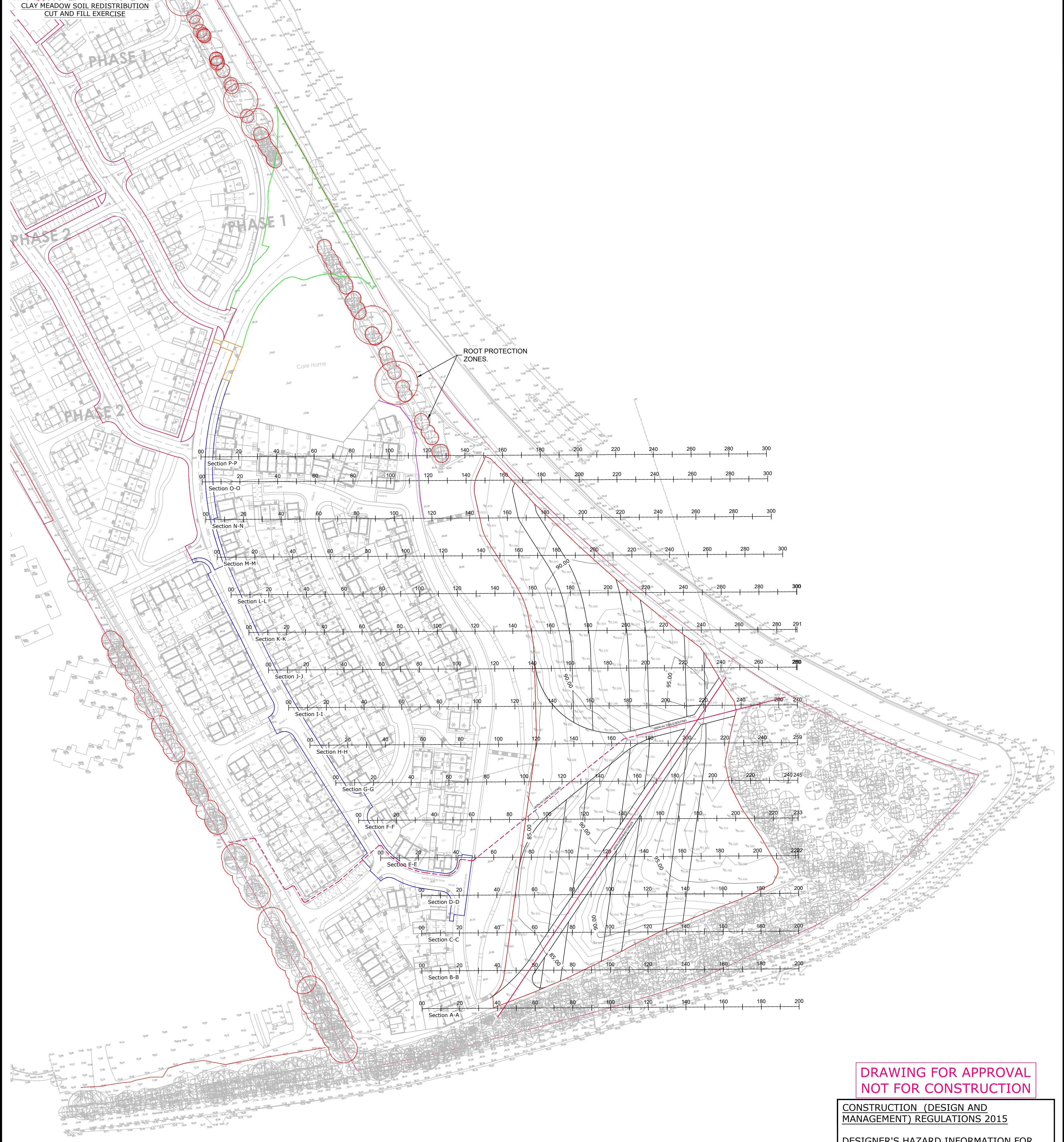
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KEY

- 1.0m MINOR CONTOUR
- 5.0m MAJOR CONTOUR
- CLAY MEADOW FILL SLOPE EXTENTS
- AS-BUILT RE-GRADING/ STEPPED EMBANKMENT PROFILE LEVELS
- PROPOSED RETAINING WALL
- ROOT PROTECTION ZONE

Rev	Date	Amendment Details	Dr'n	Chk'	App'
P01	29.04.2025	FIRST ISSUE	GJ	RS	TM

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Project Title
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PHASE 3

Drawing Title
SOIL REDISTRIBUTION CUT &
FILL CONTOUR GA - OPTION 7

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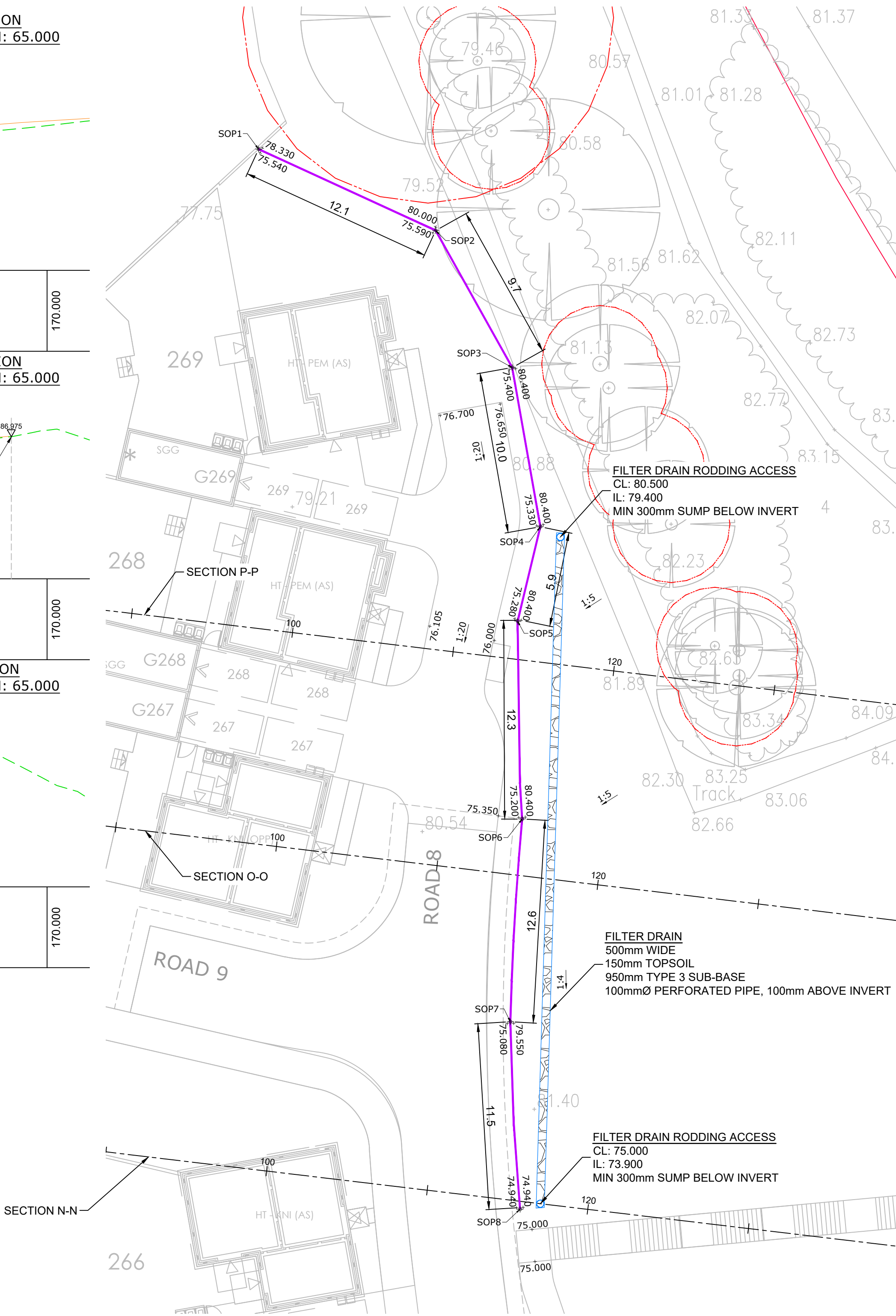
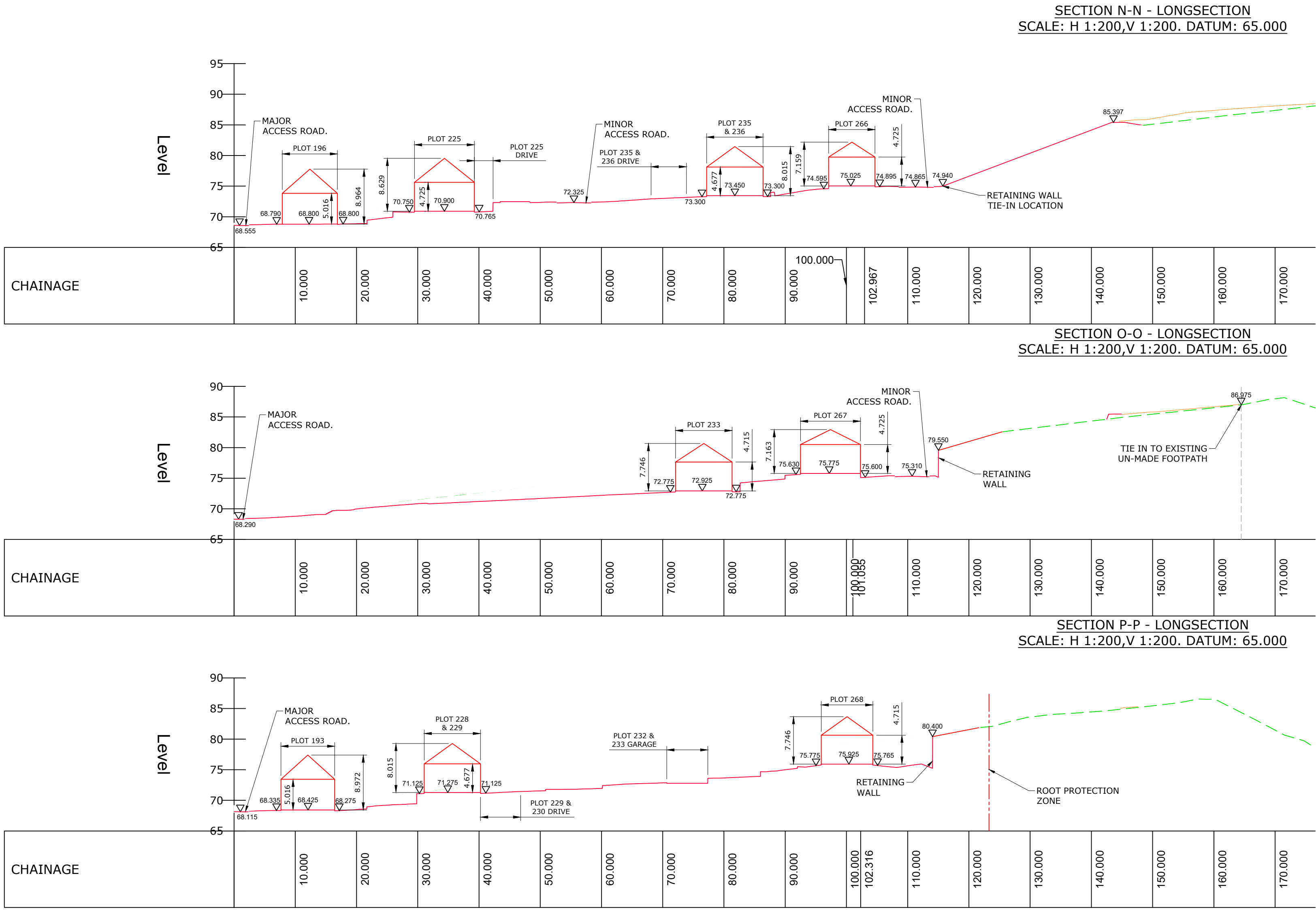


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66200295-SWE-ZZ-XX-D-C-4164



PLAN
SCALE 1:10

SETTING OUT TABLE		
POINT REF.	EASTING	NORTHING
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SOP3	536982.423	241172.166
SOP4	536984.160	241162.318
SOP5	536982.756	241156.484
SOP6	536983.037	241144.249
SOP7	536982.310	241131.711
SOP8	536982.906	241120.117

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- ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
- FOR SECTION LOCATIONS REFER TO 66200295-SWE-ZZ-XX-D-C-4160.
- DETAILED SPECIFICATION OF SHEET PILE WALL TO BE PRODUCED AND PROVIDED BY SPECIALIST THIRD PARTY DESIGNER.

KEY

- CURRENT FINISHED GROUND PROFILE - APPROVED UNDER NMA Ref: 21/00996/NMA
- EXISTING GROUND PROFILE OF COS
- AS-BUILT RE-GRADING/ STEPPED EMBANKMENT PROFILE
- PROPOSED RETAINING WALL
- ROOT PROTECTION ZONE
- STEPS SETTING OUT POINT

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CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2015

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- IF YOU DO NOT FULLY UNDERSTAND THE RISKS INVOLVED DURING THE CONSTRUCTION OF THE ITEMS INDICATED ON THIS DRAWING ASK YOUR MANAGER, HEALTH & SAFETY ADVISOR OR A MEMBER OF THE DESIGN TEAM BEFORE PROCEEDING.
 - STRIKING CHARTED AND UNCHARTED BURIED AND OVERHEAD SERVICES.
 - DEEP DRAINAGE EXCAVATIONS. RISK OF FALLS, COLLAPSE OF TRENCH OR BATTER, CONFINED SPACES.
 - CONNECTIONS TO EXISTING LIVE SEWERS/DRAINS. RISK OF DANGEROUS GASES/CONDITIONS/DISEASE.
 - CONFLICT BETWEEN CONSTRUCTION WORKERS, VISITORS AND GENERAL PUBLIC WITH MOVING PLANT AND VEHICLES.
 - WORKS ADJACENT TO AND WITHIN PUBLIC ADOPTED HIGHWAY. CONFLICT BETWEEN CONSTRUCTION WORKERS/ACTIVITIES AND MOVING VEHICLES.
- THE ABOVE NOTES REFER SPECIFICALLY TO THE INFORMATION SHOWN ON THIS DRAWING. REFER TO THE HEALTH AND SAFETY PLAN FOR FURTHER INFORMATION.

P01	29.04.2025	FIRST ISSUE	GJ	RS	TM
Rev	Date	Amendment Details	Dr'n	Chk'	App'

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SWECO

Client

VISTRY HOMES

Project Title

NEWMARKET ROAD, ROYSTON

Drawing Title

**SOIL REDISTRIBUTION CUT &
FILL RETAINING WALL SECTIONS
AND SETTING OUT POINTS -
OPTION 7**

Purpose Of Issue

PRELIMINARY

Status

Status Description

Designed

Drawn

Checked

Approved

Sheet Size

Scale

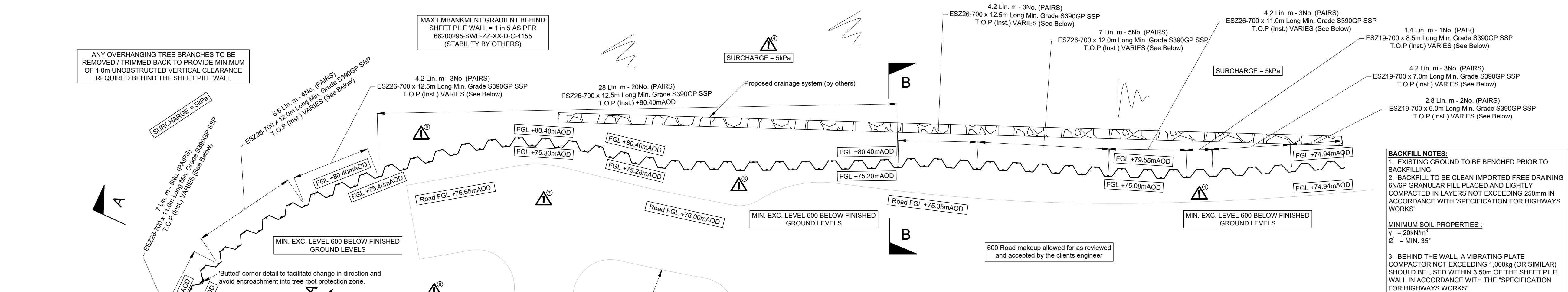
SWECO Ref

Revision

Drawing Number

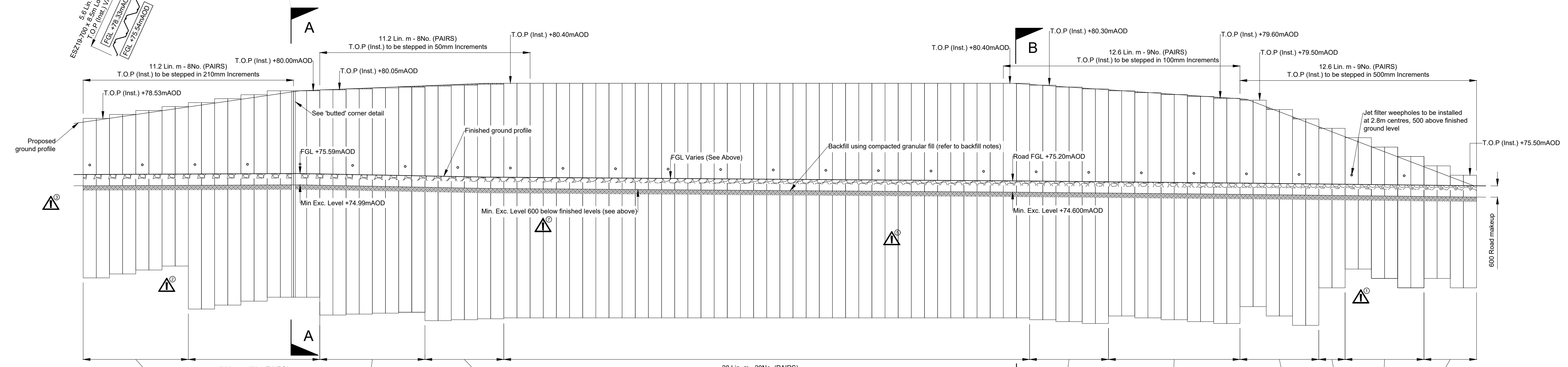
66200295-SWE-ZZ-XX-D-C-4165

Appendix C – STRUCTURAL DESIGN OF SHEET PILE WALL DRAWING

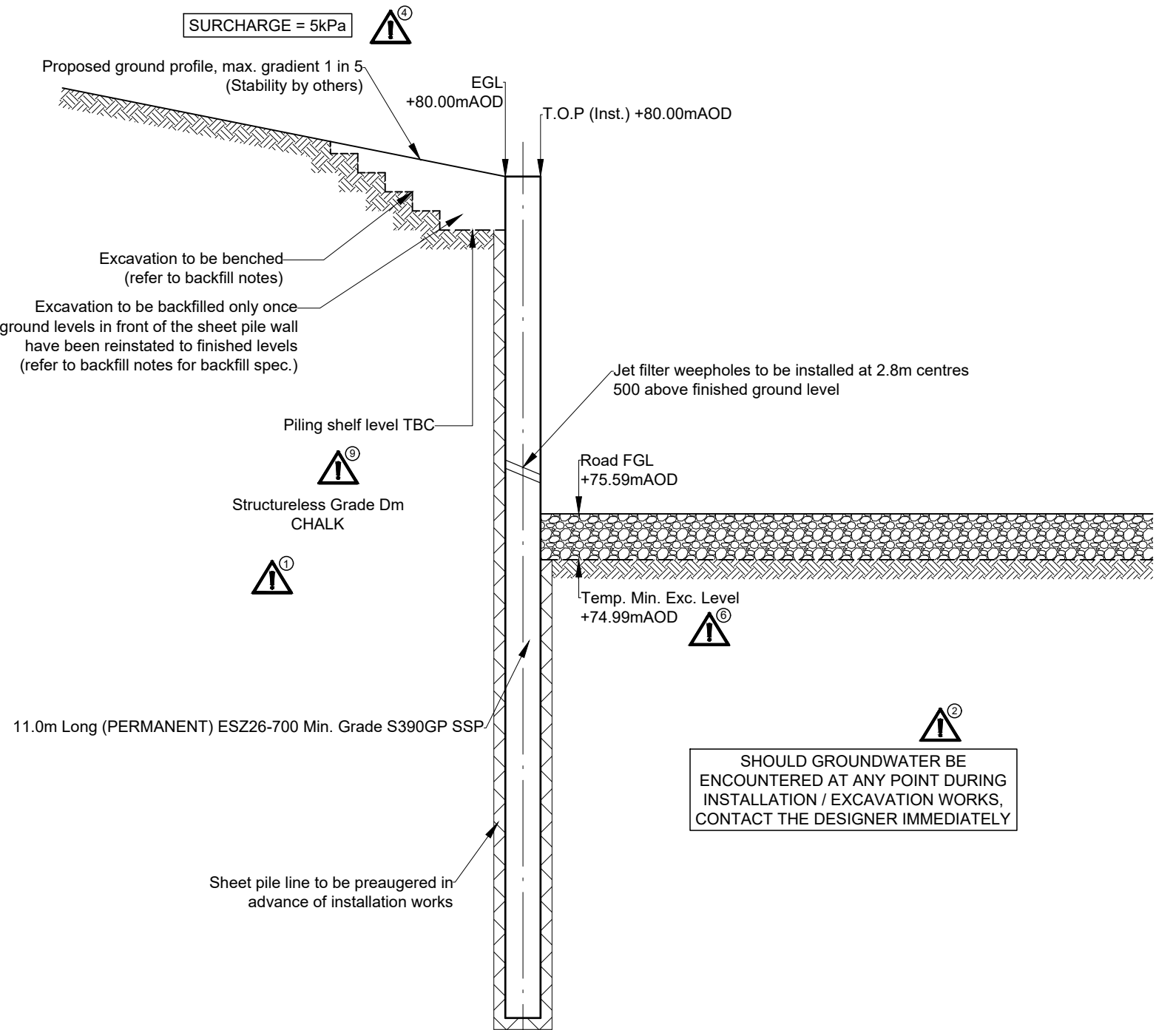


PLAN ON PROPOSED PERMANENT SHEET PILES
Scale 1:125

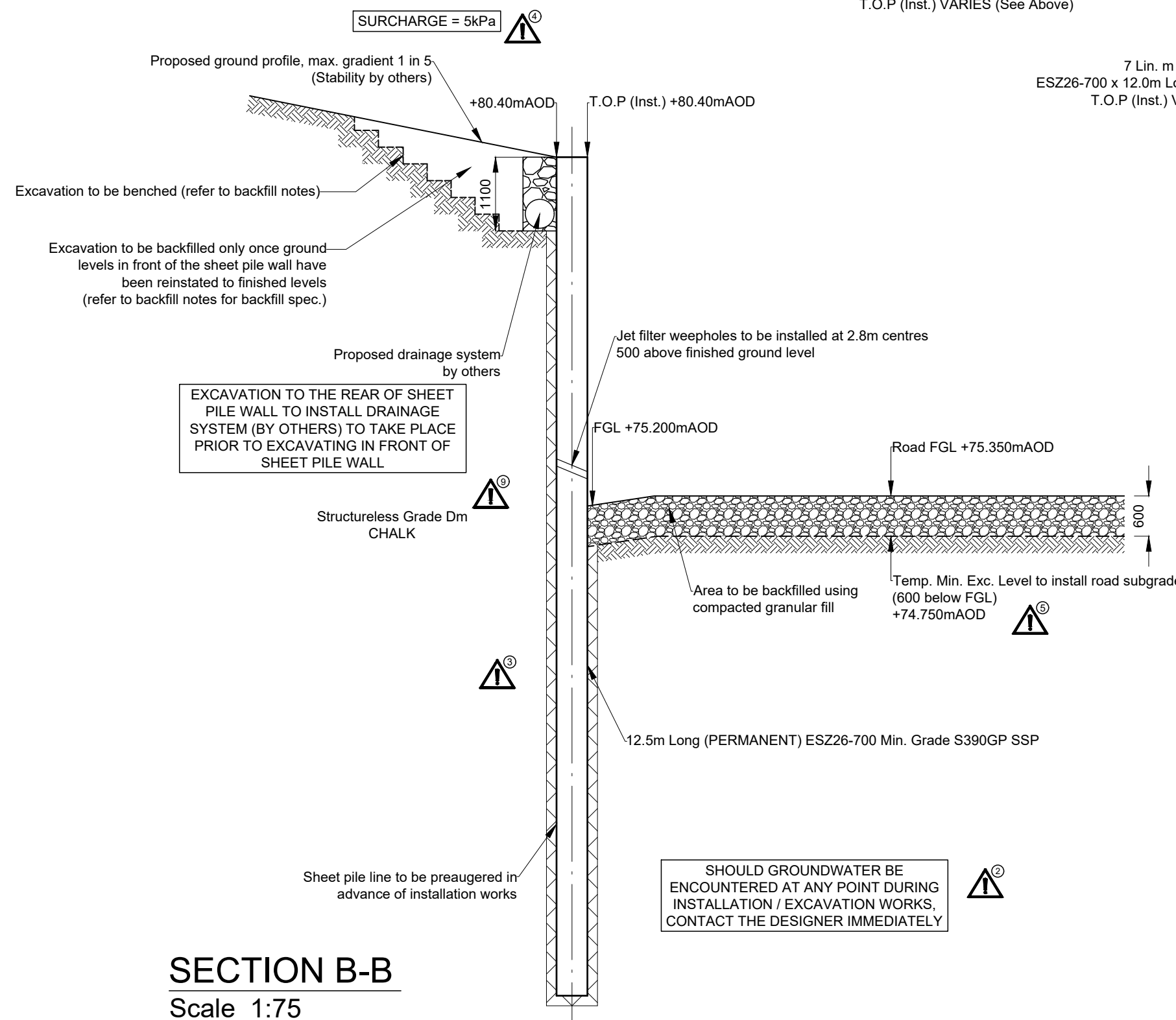
CONSTRUCTION ISSUE



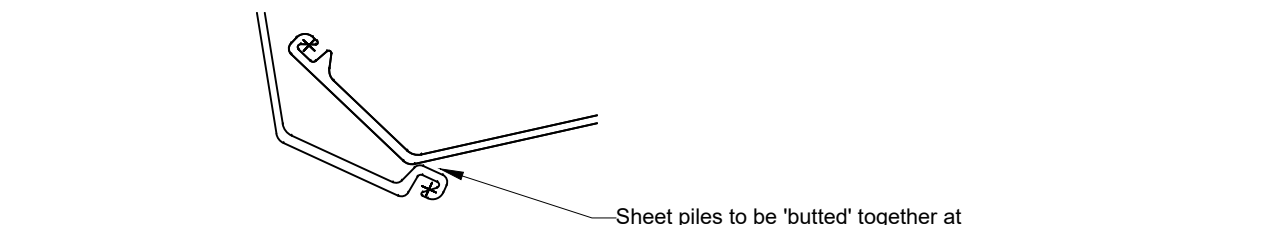
UNFOLDED ELEVATION ON SHEET PILES
Scale 1:125



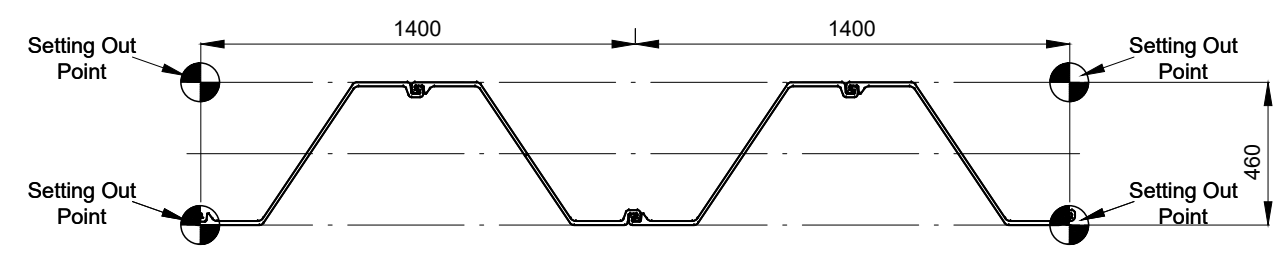
SECTION A-A
Scale 1:75



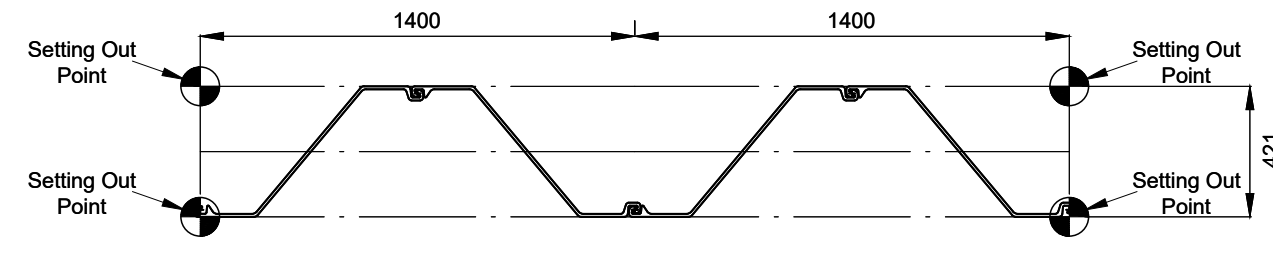
SECTION B-B
Scale 1:75



TYPICAL 'BUTTED' CORNER DETAIL
Scale 1:10



ESZ26-700 - SETTING OUT DETAIL
Scale 1:25



ESZ19-700 SETTING OUT DETAIL
Scale 1:25

- GENERAL NOTES**
- See also SPUK Method Statement
 - See also SPUK Design Report
 - Setting out by others
 - Pile numbers, wall plan lengths and pile orientations indicated are indicative only and are subject to rolling and installation tolerances below:
 - 75mm plan position from given line at commencement level
 - 50mm verticality of specified pile head level
 - Maximum 1:75 rake in verticality
 - Backfill to be clean imported 6N/6P placed and compacted in layers not exceeding 250mm in accordance with "Specification for Highways Works".

- CONSTRUCTION SEQUENCE**
- Install min. 10.0m wide working platform min. 500mm below top of sheet pile install levels detailed on the SPUK GA drawing(s). Piling platform to be designed by others to accommodate tracked plant bearing pressures provided to the client. (by others)
 - Set out sheet pile centreline for preaugering of the pile line (by others)
 - Preauger the sheet pile line (SPUK)
 - Level auger arisings (by others)
 - Set out front and back face of sheet pile wall (by others).
 - Install permanent sheet pile retaining wall. Approx plan dimension = 74.2 Linear metres. T.O.P. (Inst.) level varies. Sheet piles to be installed using vibratory methods (SPUK).
 - Prior to excavating in front of sheet pile wall, excavate behind the sheet pile wall to install drainage system. Excavation depth (to the rear of the wall) = 1100 below existing levels (by others)
 - Excavate to formation level (minimum excavation level = 600 below finished ground levels) and construct road subgrade + surface (by others)
 - Backfill to finished levels using compacted granular fill in front of sheet pile wall. Refer to backfill notes on SPUK GA drawing. (by others)
 - Following completion of works in front of the sheet pile retaining wall, backfill excavation behind the sheet pile retaining wall, constructing the max 1 in 5 embankment detailed on the clients engineers drawings. Refer to backfill notes (by others)

Note: Works in front of the sheet pile wall to be completed and fully backfilled to finished levels prior to backfilling behind the sheet pile wall.

CDM (2015) – RESIDUAL RISKS		
REF	RISK	
Note		
01	Unexpected Ground Conditions	
02	Unexpected / Higher than assumed groundwater table.	
03	Obstructions / Existing Services encountered on the sheet pile line.	
04	Excessive Surcharge Loadings.	
05	Excessive 'softening' of formation.	
06	Accuracy of Clients Site Survey Information / Client over excavates.	
07	Limited Design Responsibility – Temporary works Duration (<6Month)	
08	Piling Adjacent 3rd Party Properties	
09	Dissolution Features	

C01	02/05/2025	ISSUED FOR CONSTRUCTION	CP
P1	16/04/2025	FIRST ISSUE-FOR REVIEW	CP

Client :
VISTRY HOMES

Project :
MERIDIAN GATE, ROYSTON

Drawing Title :
PERMANENT SHEET PILE RETAINING WALL INSTALLATION GA DRAWING

MAY 2025	Scale @ A1: SHOWN	Drawn by: CP	Checked: SD
ORIGINAL SIZE A1	Drawing No. C1861-SPUK-DRG-001	Revision: C01	

Unit C, Clayton Green Business Park, Library Road, Clayton-Le-Woods, Chorley, Lancashire, PR6 7EN
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Appendix D –

WALLAP OUTPUT OF SHEET PILE DESIGN ASSESSMENT

RSK ENVIRONMENT LTD	Sheet No.
Program: WALLAP Version 6.09 Revision A59.B77.R60	Job No. 373447
Licensed from GEOSOLVE	Made by : MS
Data filename/Run ID: Section_P-P_SLS	
Newmarket Road, Royston	Date: 4-09-2025
Sheet Pile design analysis (Section P-P)	Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Left side	Soil types	Right side
1	80.40	1 W Chalk (up 75)		1 W Chalk (up 75)
2	55.00	3 Chalk GC		3 Chalk GC

SOIL PROPERTIES

-- Soil type --	Bulk density	Young's Modulus	At rest coeff.	Consol state.	Active limit	Passive limit	Cohesion
No. Description	kN/m3	Eh, kN/m2	Ko	NC/OC	Ka	Kp	kN/m2
(Datum elev.)		(dEh/dy)	(dKo/dy)	(Nu)	(Kac)	(Kpc)	(dc/dy)
1 W Chalk (..	18.00a	33000	0.455	OC	0.266	4.787	0.0d
(80.40)	19.00b	(2043)		(0.200)	(1.131)	(5.831)	
2 Not defined							
3 Chalk GC	18.00a	80000	0.455	OC	0.266	4.787	0.0d
	19.00b			(0.200)	(1.131)	(5.831)	

Note: (a) and (b) are Bulk Densities above and below the water table

Additional soil parameters associated with Ka and Kp

--- parameters for Ka ---			--- parameters for Kp ---		
Soil	Wall	Back-	Soil	Wall	Back-
friction	adhesion	fill	friction	adhesion	fill
No. Description	angle	coeff.	angle	coeff.	angle
1 W Chalk (up 75)	33.00	0.350	0.00	33.00	0.350
2 Not defined					
3 Chalk GC	33.00	0.350	0.00	33.00	0.350

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	67.90	67.90

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 67.90
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 2.0000E+08 kN/m2
Moment of inertia of wall I = 5.9800E-04 m4/m run
(Arcelor AZ26-700N*) E.I = 119600 kN.m2/m run
Yield Moment of wall = Not defined

SURCHARGE LOADS

Surcharge no.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge (kN/m2)	Surcharge	Part	Short Q
Elev.				Near edge	Far edge	fact.	reduc. fact.
1	80.40	-0.00(R)	20.00	7.56	0.00	26.48	-- -- 1.00U --
2	80.40	-7.56(R)	20.00	1.70	26.48	=	-- -- 1.00U --
3	80.40	-9.97(R)	20.00	5.68	26.48	52.73	-- -- 1.00U --
4	80.40	-15.64(R)	20.00	27.87	52.73	107.02	-- -- 1.00U --
5	80.40	-0.01(R)	5.00	5.00	=		-- -- 1.00V --

Note: L = Left side, R = Right side
A ramp surcharge is defined by two values:
N = at edge near to wall, F = at edge far from wall
Limit State Categories: U = Permanent Unfavourable
F = Permanent Favourable
V = Variable (unfavourable)

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 80.40
2	Apply surcharge no.2 at elevation 80.40
3	Apply surcharge no.3 at elevation 80.40
4	Apply surcharge no.4 at elevation 80.40
5	Excavate to elevation 75.20 on LEFT side
6	Apply surcharge no.5 at elevation 80.40
7	Change EI of wall to 107440 kN.m2/m run
	Allow wall to relax with new modulus value

LIMIT STATE PARAMETERS

Limit State: Serviceability Limit State
All loads and soil strengths are unfactored

FACTORS OF SAFETY and ANALYSIS OPTIONS

Limit State options: Serviceability Limit State
All loads and soil strengths are unfactored
Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.00

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 7.000 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 1000.00 m

Width of excavation/fill on Left side of wall = 50.00 m
Width of excavation/fill on Right side of wall = 50.00 m

Distance to rigid boundary on Left side = 50.00 m
Distance to rigid boundary on Right side = 50.00 m

OUTPUT OPTIONS

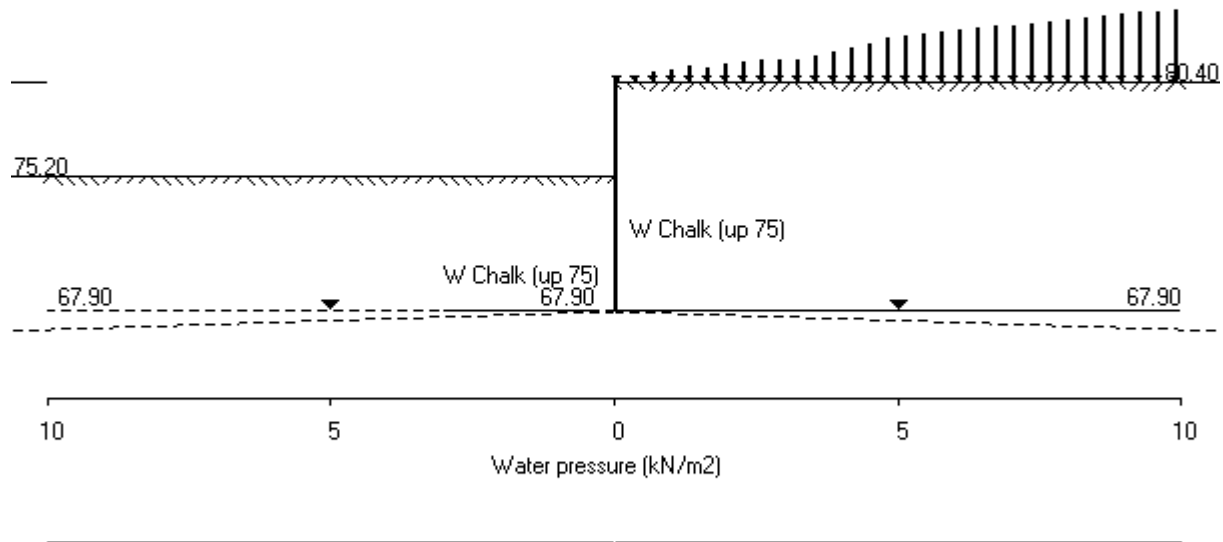
Stage no.	Stage description	Displacement	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 80.40	Yes	Yes	Yes
2	Apply surcharge no.2 at elev. 80.40	Yes	Yes	Yes
3	Apply surcharge no.3 at elev. 80.40	Yes	Yes	Yes
4	Apply surcharge no.4 at elev. 80.40	Yes	Yes	Yes
5	Excav. to elev. 75.20 on LEFT side	Yes	Yes	Yes
6	Apply surcharge no.5 at elev. 80.40	Yes	Yes	Yes
7	Change EI of wall to 107440kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

RSK ENVIRONMENT LTD
Program: WALLAP Version 6.09 Revision A59.B77.R60
Licensed from GEOSOLVE
Data filename/Run ID: Section_P-P_SLS
Newmarket Road, Royston
Sheet Pile design analysis (Section P-P)

| Sheet No.
| Job No. 373447
| Made by : MS
| Date: 4-09-2025
Checked :

Units: kN,m

Stage No.7 Change EI of wall to 107440kN.m²/m run



Units: kN,m

Stage No. 5 Excavate to elevation 75.20 on LEFT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	Ground level		Prop Elev.	FoS for toe elev. = 67.90		Toe elev. for FoS = 1.000		Direction of failure
	Act.	Pass.		Factor of Safety	Moment of equilib. at elev.	Toe elev.	Wall Penetr -ation	
5	80.40	75.20	Cant.	1.585	68.71	71.47	3.73	R to L

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Subgrade reaction model - Boussinesq Influence coefficients

Soil deformations are elastic until the active or passive limit is reached

Open Tension Crack analysis - No

Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Left side 50.00m from wall

Right side 50.00m from wall

Limit State: Serviceability Limit State

Calculated Bending Moments and Prop Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m ²	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m	EI of wall kN.m ² /m
1	80.40	0.00	-0.052	-7.76E-03	0.0	-0.0		119600
2	79.80	-3.22	-0.048	-7.76E-03	-1.0	-0.2		119600
3	79.20	-6.44	-0.043	-7.75E-03	-3.9	-1.6		119600
4	78.60	-9.65	-0.038	-7.73E-03	-8.7	-5.3		119600
5	78.00	-12.84	-0.034	-7.69E-03	-15.4	-12.4		119600
6	77.40	-16.01	-0.029	-7.60E-03	-24.1	-24.2		119600
7	76.80	-19.16	-0.025	-7.43E-03	-34.6	-41.8		119600
8	76.20	-22.28	-0.020	-7.16E-03	-47.1	-66.2		119600
9	75.70	-24.86	-0.017	-6.83E-03	-58.9	-92.6		119600
10	75.20	-27.42	-0.013	-6.37E-03	-71.9	-125.3		119600
11	74.80	5.00	-0.011	-5.91E-03	-76.4	-155.4		119600
12	74.40	37.44	-0.009	-5.34E-03	-67.9	-184.7		119600
13	73.80	86.12	-0.006	-4.33E-03	-30.9	-215.8		119600
14	73.20	84.83	-0.004	-3.23E-03	20.4	-224.0		119600
15	72.60	47.31	-0.002	-2.17E-03	60.1	-196.4		119600
16	72.00	6.99	-0.001	-1.30E-03	76.4	-153.3		119600
17	71.40	-16.29	-0.000	-6.51E-04	73.6	-106.2		119600
18	70.80	-27.69	-0.000	-2.22E-04	60.4	-65.0		119600
19	70.20	-30.46	-0.000	2.54E-05	42.9	-33.8		119600
20	69.60	-27.36	-0.000	1.44E-04	25.6	-13.5		119600
21	69.00	-20.40	-0.000	1.85E-04	11.3	-3.1		119600
22	68.45	-10.36	-0.000	1.92E-04	2.8	0.0		119600
23	67.90	0.19	-0.000	1.92E-04	-0.0	-0.0		---

(continued)

Stage No.5 Excavate to elevation 75.20 on LEFT side

LEFT side								
Node no.	Y coord	Water press. kN/m2	Effective stresses				Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
			Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	80.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	79.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	79.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	78.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	78.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	77.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	76.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	76.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	75.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	75.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	22973
11	74.80	0.00	7.20	1.91	34.46	34.46	34.46p	23403
12	74.40	0.00	14.40	3.82	68.93	68.93	68.93p	23834
13	73.80	0.00	25.20	6.69	120.63	120.63	120.63p	24479
14	73.20	0.00	36.00	9.56	172.33	122.34	122.34	25125
15	72.60	0.00	46.81	12.43	224.04	87.80	87.80	25770
16	72.00	0.00	57.61	15.30	275.76	66.59	66.59	26416
17	71.40	0.00	68.42	18.17	327.49	56.50	56.50	27061
18	70.80	0.00	79.23	21.04	379.24	54.71	54.71	26631
19	70.20	0.00	90.04	23.91	430.99	58.27	58.27	27251
20	69.60	0.00	100.85	26.78	482.76	64.76	64.76	27872
21	69.00	0.00	111.67	29.65	534.55	73.17	73.17	45580
22	68.45	0.00	121.60	32.29	582.04	82.71	82.71	46490
23	67.90	0.00	131.52	34.92	629.55	92.51	92.51	47399

RIGHT side								
Node no.	Y coord	Water press. kN/m2	Effective stresses				Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
			Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	80.40	0.00	0.00	0.00	0.00	0.00	0.00	9510
2	79.80	0.00	12.14	3.22	58.09	3.22	3.22a	9863
3	79.20	0.00	24.25	6.44	116.09	6.44	6.44a	10216
4	78.60	0.00	36.33	9.65	173.89	9.65	9.65a	10569
5	78.00	0.00	48.35	12.84	231.42	12.84	12.84a	10923
6	77.40	0.00	60.29	16.01	288.58	16.01	16.01a	11276
7	76.80	0.00	72.14	19.16	345.31	19.16	19.16a	11629
8	76.20	0.00	83.90	22.28	401.59	22.28	22.28a	11982
9	75.70	0.00	93.62	24.86	448.13	24.86	24.86a	12277
10	75.20	0.00	103.27	27.42	494.34	27.42	27.42a	12571
11	74.80	0.00	110.95	29.46	531.08	29.46	29.46a	12806
12	74.40	0.00	118.58	31.49	567.62	31.49	31.49a	13042
13	73.80	0.00	129.96	34.51	622.09	34.51	34.51a	13395
14	73.20	0.00	141.26	37.51	676.18	37.51	37.51a	13748
15	72.60	0.00	152.49	40.49	729.93	40.49	40.49a	14102
16	72.00	0.00	163.66	43.46	783.38	59.61	59.61	14455
17	71.40	0.00	174.77	46.41	836.56	72.79	72.79	14808
18	70.80	0.00	185.83	49.35	889.52	82.40	82.40	26631
19	70.20	0.00	196.85	52.27	942.28	88.73	88.73	27251
20	69.60	0.00	207.84	55.19	994.86	92.12	92.12	27872
21	69.00	0.00	218.79	58.10	1047.30	93.58	93.58	45580
22	68.45	0.00	228.81	60.76	1095.26	93.08	93.08	46490
23	67.90	0.00	238.81	63.41	1143.12	92.32	92.32	47399

Run ID. Section_P-P_SLS

Newmarket Road, Royston

Sheet Pile design analysis (Section P-P)

| Sheet No.

| Date: 4-09-2025

| Checked :

(continued)

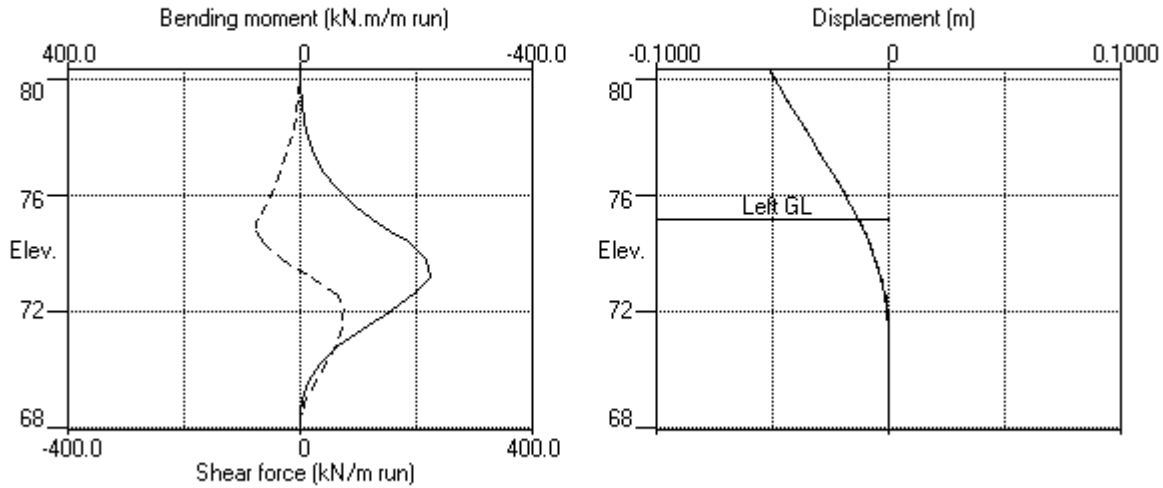
Stage No.5 Excavate to elevation 75.20 on LEFT side

Note: 40.49 a Soil pressure at active limit

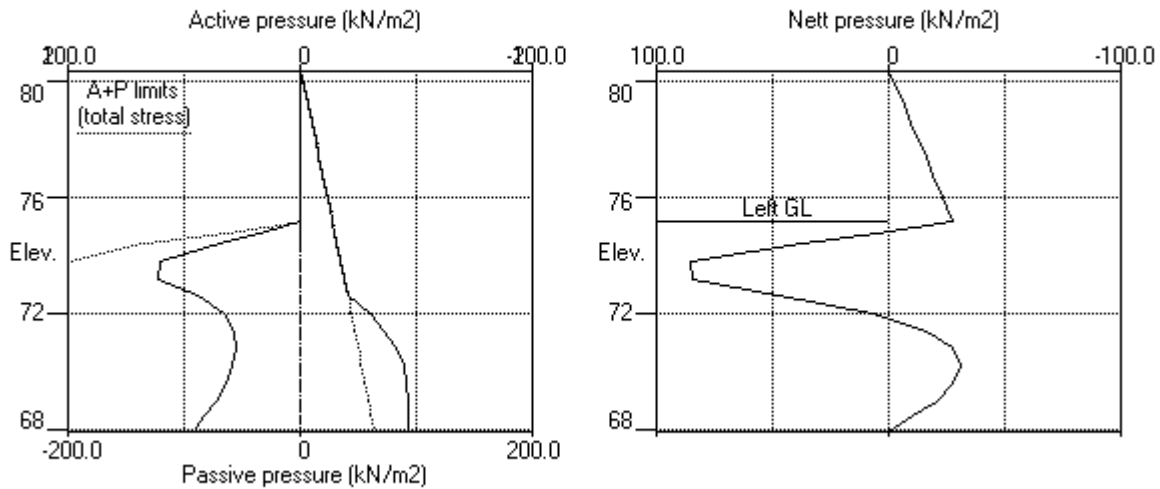
120.63 p Soil pressure at passive limit

Units: kN,m

Stage No.5 Excav. to elev. 75.20 on LEFT side



Stage No.5 Excav. to elev. 75.20 on LEFT side



RSK ENVIRONMENT LTD	Sheet No.
Program: WALLAP Version 6.09 Revision A59.B77.R60	Job No. 373447
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Data filename/Run ID: Section_P-P_SLS	
Newmarket Road, Royston	Date: 4-09-2025
Sheet Pile design analysis (Section P-P)	Checked :

Units: kN,m

Stage No. 7 Change EI of wall to 107440 kN.m2/m run
Allow wall to relax with new modulus value

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
Factor of safety on soil strength

Stage	Ground level	Prop	FoS for toe	Toe elev. for				
No.	Act.	Elev.	elev. = 67.90	FoS = 1.000				
	Pass.		Factor	Moment	Toe	Wall	Direction	
			of	at equil.	elev.	Penetr	of	
			Safety	at elev.		-ation	failure	
7	80.40	75.20	Cant.	1.551	68.72	71.35	3.85	R to L

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Length of wall perpendicular to section = 1000.00m
Rigid boundaries: Left side 50.00m from wall
Right side 50.00m from wall

Limit State: Serviceability Limit State

Calculated Bending Moments and Prop Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node	Y	Nett	Wall	Wall	Shear	Bending	Prop	EI of
no.	coord	pressure	disp.	rotation	force	moment	forces	wall
		kN/m2	m	rad.	kN/m	kN.m/m	kN/m	kN.m2/m
1	80.40	0.00	-0.064	-9.58E-03	0.0	-0.0		107440
2	79.80	-4.51	-0.059	-9.58E-03	-1.4	-0.3		107440
3	79.20	-7.70	-0.053	-9.57E-03	-5.0	-2.1		107440
4	78.60	-10.83	-0.047	-9.55E-03	-10.6	-6.7		107440
5	78.00	-13.91	-0.041	-9.49E-03	-18.0	-15.2		107440
6	77.40	-16.97	-0.036	-9.36E-03	-27.3	-28.7		107440
7	76.80	-20.01	-0.030	-9.15E-03	-38.4	-48.3		107440
8	76.20	-23.03	-0.025	-8.80E-03	-51.3	-75.2		107440
9	75.70	-25.54	-0.020	-8.39E-03	-63.4	-103.8		107440
10	75.20	-28.03	-0.016	-7.82E-03	-76.8	-138.8		107440
11	74.80	4.44	-0.013	-7.25E-03	-81.5	-170.9		107440
12	74.40	36.92	-0.011	-6.55E-03	-73.3	-202.3		107440
13	73.80	85.66	-0.007	-5.33E-03	-36.5	-236.7		107440
14	73.20	101.15	-0.004	-3.97E-03	19.6	-248.3		107440
15	72.60	54.37	-0.002	-2.67E-03	66.2	-218.4		107440
16	72.00	9.43	-0.001	-1.58E-03	85.4	-170.6		107440
17	71.40	-18.72	-0.000	-7.86E-04	82.6	-117.8		107440
18	70.80	-31.76	0.000	-2.60E-04	67.4	-71.6		107440
19	70.20	-34.59	0.000	4.03E-05	47.5	-36.8		107440
20	69.60	-30.79	0.000	1.81E-04	27.9	-14.4		107440
21	69.00	-22.57	-0.000	2.29E-04	11.9	-3.1		107440
22	68.45	-10.95	-0.000	2.36E-04	2.7	0.1		107440
23	67.90	1.17	-0.000	2.36E-04	-0.0	-0.0		---

(continued)

Stage No.7 Change EI of wall to 107440 kN.m2/m run
Allow wall to relax with new modulus value

LEFT side								
Node no.	Y coord	Water press. kN/m2	Effective stresses				Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
			Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	80.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	79.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	79.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	78.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	78.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	77.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	76.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	76.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	75.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	75.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	26384
11	74.80	0.00	7.20	1.91	34.46	34.46	34.46p	26878
12	74.40	0.00	14.40	3.82	68.93	68.93	68.93p	27372
13	73.80	0.00	25.20	6.69	120.63	120.63	120.63p	28114
14	73.20	0.00	36.00	9.56	172.33	139.07	139.07	28855
15	72.60	0.00	46.81	12.43	224.04	95.23	95.23	29596
16	72.00	0.00	57.61	15.30	275.76	68.59	68.59	19351
17	71.40	0.00	68.42	18.17	327.49	55.49	55.49	19824
18	70.80	0.00	79.23	21.04	379.24	52.80	52.80	20297
19	70.20	0.00	90.04	23.91	430.99	56.32	56.32	20769
20	69.60	0.00	100.85	26.78	482.76	63.15	63.15	21242
21	69.00	0.00	111.67	29.65	534.55	72.19	72.19	42141
22	68.45	0.00	121.60	32.29	582.04	82.51	82.51	42983
23	67.90	0.00	131.52	34.92	629.55	93.09	93.09	43824

RIGHT side								
Node no.	Y coord	Water press. kN/m2	Effective stresses				Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
			Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	80.40	0.00	0.00	0.00	0.00	0.00	0.00	9812
2	79.80	0.00	17.00	4.51	81.37	4.51	4.51a	10176
3	79.20	0.00	29.00	7.70	138.83	7.70	7.70a	10541
4	78.60	0.00	40.78	10.83	195.19	10.83	10.83a	10905
5	78.00	0.00	52.39	13.91	250.79	13.91	13.91a	11270
6	77.40	0.00	63.91	16.97	305.91	16.97	16.97a	11634
7	76.80	0.00	75.35	20.01	360.67	20.01	20.01a	11998
8	76.20	0.00	86.73	23.03	415.15	23.03	23.03a	12363
9	75.70	0.00	96.17	25.54	460.34	25.54	25.54a	12667
10	75.20	0.00	105.57	28.03	505.35	28.03	28.03a	12970
11	74.80	0.00	113.07	30.02	541.22	30.02	30.02a	13213
12	74.40	0.00	120.54	32.01	576.97	32.01	32.01a	13456
13	73.80	0.00	131.70	34.97	630.40	34.97	34.97a	13821
14	73.20	0.00	142.81	37.92	683.58	37.92	37.92a	14185
15	72.60	0.00	153.87	40.86	736.55	40.86	40.86a	14550
16	72.00	0.00	164.90	43.79	789.33	59.16	59.16	19351
17	71.40	0.00	175.89	46.71	841.93	74.21	74.21	19824
18	70.80	0.00	186.84	49.62	894.37	84.56	84.56	20297
19	70.20	0.00	197.77	52.52	946.68	90.91	90.91	20769
20	69.60	0.00	208.68	55.41	998.88	93.94	93.94	21242
21	69.00	0.00	219.56	58.30	1050.97	94.75	94.75	42141
22	68.45	0.00	229.52	60.95	1098.64	93.46	93.46	42983
23	67.90	0.00	239.47	63.59	1146.25	91.91	91.91	43824

Run ID. Section_P-P_SLS

Newmarket Road, Royston

Sheet Pile design analysis (Section P-P)

| Sheet No.

| Date: 4-09-2025

| Checked :

(continued)

Stage No.7 Change EI of wall to 107440 kN.m²/m run

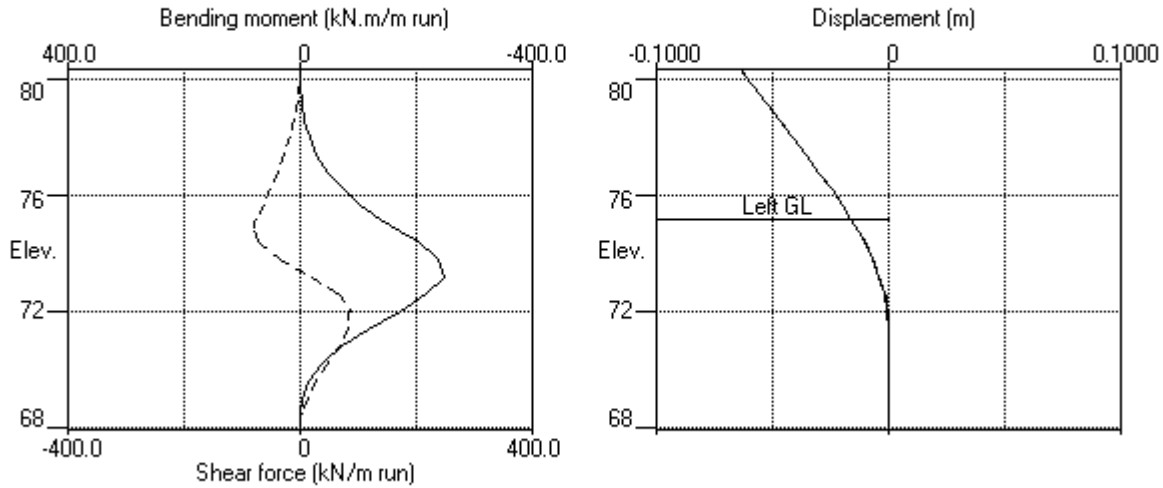
 Allow wall to relax with new modulus value

Note: 40.86 a Soil pressure at active limit

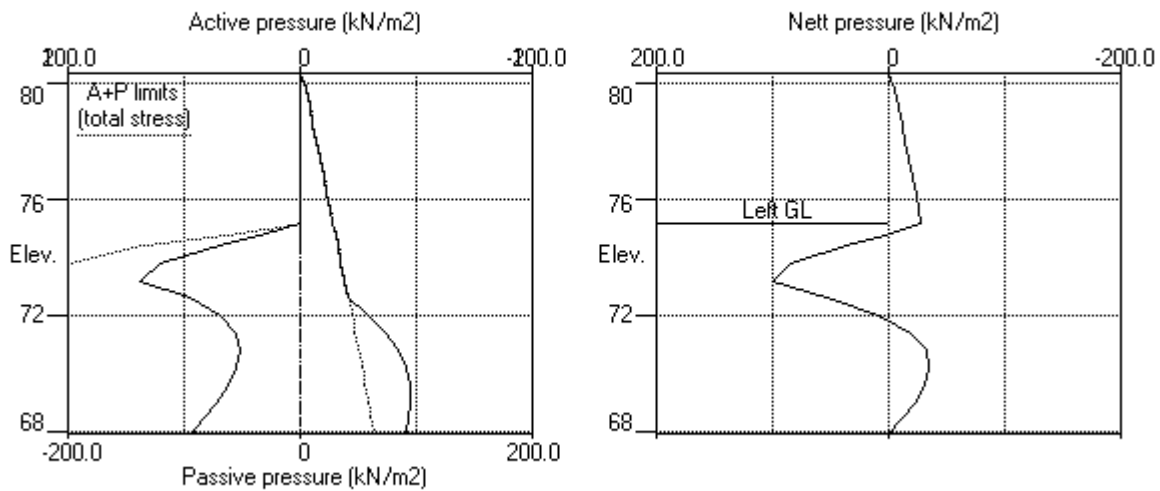
 120.63 p Soil pressure at passive limit

Units: kN,m

Stage No.7 Change EI of wall to 107440kN.m²/m run



Stage No.7 Change EI of wall to 107440kN.m²/m run



Units: kN,m

Summary of results

LIMIT STATE PARAMETERS

Limit State: Serviceability Limit State
All loads and soil strengths are unfactored

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

			FoS for toe		Toe elev. for		
			elev. = 67.90		FoS = 1.000		
<u>Stage</u>	<u>Ground level</u>	<u>Prop</u>	<u>Factor</u>	<u>Moment</u>	<u>Toe</u>	<u>Wall</u>	<u>Direction</u>
<u>No.</u>	<u>Act.</u>	<u>Pass.</u>	<u>Elev.</u>	<u>of</u>	<u>equilib.</u>	<u>elev.</u>	<u>Penetr</u>
				<u>Safety</u>	<u>at elev.</u>		<u>-ation</u>
							<u>failure</u>
1	80.40	80.40	Cant.	<u>Conditions not suitable for FoS calc.</u>			
2	80.40	80.40	Cant.	<u>Conditions not suitable for FoS calc.</u>			
3	80.40	80.40	Cant.	<u>Conditions not suitable for FoS calc.</u>			
4	80.40	80.40	Cant.	<u>Conditions not suitable for FoS calc.</u>			
5	80.40	75.20	Cant.	1.585	68.71	71.47	3.73
6	80.40	75.20	Cant.	1.551	68.72	71.35	3.85
7	80.40	75.20	Cant.	1.551	68.72	71.35	3.85
							R to L
							R to L
							R to L

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Left side 50.00m from wall

Right side 50.00m from wall

Limit State: Serviceability Limit State

Calculated Bending Moments and Prop Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment				Shear force			
				Calculated		Factored		Calculated		Factored	
		max.	min.	max.	min.	max.	min.	max.	min.	max.	min.
		m	m	kN.m/m		kN.m/m		kN/m	kN/m	kN/m	kN/m
1	80.40	0.000	-0.064	0	-0	0	-0	0	0	0	0
2	79.80	0.000	-0.059	0	-0	0	-0	0	-1	0	-2
3	79.20	0.000	-0.053	0	-2	0	-3	0	-5	0	-7
4	78.60	0.000	-0.047	0	-7	0	-9	0	-11	0	-14
5	78.00	0.000	-0.041	0	-15	0	-21	0	-18	0	-24
6	77.40	0.000	-0.036	0	-29	1	-39	0	-27	0	-37
7	76.80	0.000	-0.030	1	-48	1	-65	0	-38	0	-52
8	76.20	0.000	-0.025	1	-75	1	-101	0	-51	0	-69
9	75.70	0.000	-0.020	1	-104	1	-140	0	-63	0	-86
10	75.20	0.000	-0.016	1	-139	1	-187	0	-77	0	-104
11	74.80	0.000	-0.013	1	-171	1	-231	0	-82	0	-110
12	74.40	0.000	-0.011	1	-202	1	-273	0	-73	0	-99
13	73.80	0.000	-0.007	1	-237	1	-320	0	-36	0	-49
14	73.20	0.000	-0.004	0	-248	1	-335	20	-0	28	-0
15	72.60	0.000	-0.002	0	-220	1	-297	66	-0	89	-0
16	72.00	0.000	-0.001	0	-174	0	-234	85	-0	115	-0
17	71.40	0.000	-0.000	0	-122	0	-164	83	-0	111	-0
18	70.80	0.000	-0.000	0	-76	0	-102	68	-0	92	-0
19	70.20	0.000	-0.000	0	-40	0	-55	49	-0	66	-0
20	69.60	0.000	-0.000	0	-17	0	-23	30	-0	40	-0
21	69.00	0.000	-0.000	0	-4	0	-6	14	-0	19	-0
22	68.45	0.000	-0.000	0	-0	0	-0	4	-0	5	-0
23	67.90	0.000	-0.000	0	-0	0	-0	0	-0	0	-0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment						Shear force					
	Calculated				Factored		Calculated				Factored	
	max.	elev.	min.	elev.	max.	min.	max.	elev.	min.	elev.	max.	min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	
1	1	75.70	-0	79.80	1	-0	0	78.60	-0	73.20	0	-0
2	1	75.70	-0	79.80	1	-0	0	78.00	-0	72.60	0	-0
3	1	75.20	-0	79.80	1	-0	0	78.00	-0	72.00	0	-0
4	1	75.20	-0	79.80	1	-0	0	78.00	-0	72.00	0	-0
5	0	68.45	-224	73.20	0	-302	76	72.00	-76	74.80	103	-103
6	0	80.40	-248	73.20	0	-335	83	72.00	-82	74.80	112	-110
7	0	68.45	-248	73.20	0	-335	85	72.00	-82	74.80	115	-110

Summary of results (continued)

Maximum and minimum displacement at each stage

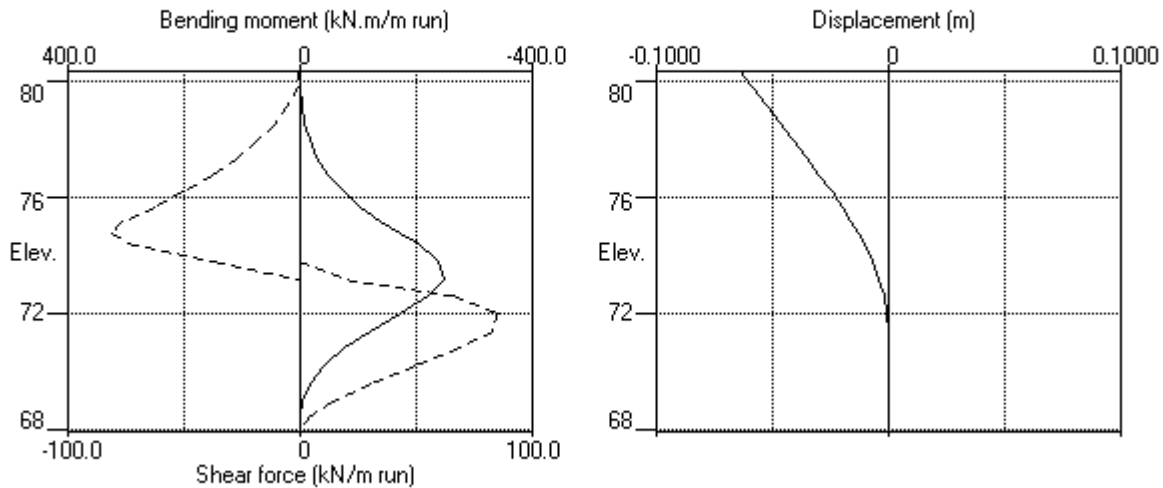
Stage		----- Displacement -----			
no.	<u>maximum</u> m	<u>elev.</u>	<u>minimum</u> m	<u>elev.</u>	<u>Stage description</u>
1	0.000	80.40	-0.000	74.40	Apply surcharge no.1 at elev. 80.40
2	0.000	80.40	-0.000	73.80	Apply surcharge no.2 at elev. 80.40
3	0.000	80.40	-0.000	73.20	Apply surcharge no.3 at elev. 80.40
4	0.000	80.40	-0.000	72.00	Apply surcharge no.4 at elev. 80.40
5	0.000	80.40	-0.052	80.40	Excav. to elev. 75.20 on LEFT side
6	0.000	70.20	-0.059	80.40	Apply surcharge no.5 at elev. 80.40
7	0.000	70.20	-0.064	80.40	Change EI of wall to 107440kN.m2/m run

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Newmarket Road, Royston
Sheet Pile design analysis (Section P-P)

| Sheet No.
| Job No. 373447
| Made by : MS
|
| Date: 4-09-2025
Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



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Data filename/Run ID: Section_P-P_ULS1	
Newmarket Road, Royston	Date: 4-09-2025
Sheet Pile design analysis (Section P-P)	Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types	
		Left side	Right side
1	80.40	1 W Chalk (up 75)	1 W Chalk (up 75)
2	55.00	3 Chalk GC	3 Chalk GC

SOIL PROPERTIES (Unfactored SLS soil strengths)

	Bulk density	Young's Modulus	At rest coeff.	Consol state.	Active limit	Passive limit	Cohesion
No. Description	kN/m3	Eh, kN/m2	Ko	NC/OC	Ka	Kp	kN/m2
(Datum elev.)		(dEh/dy)	(dKo/dy)	(Nu)	(Kac)	(Kpc)	(dc/dy)
1 W Chalk (.. (80.40)	18.00a 19.00b	33000 (2043)	0.455	OC (0.200)	0.266 (1.131)	4.787 (5.831)	0.0d
2 Not defined							
3 Chalk GC	18.00a 19.00b	80000	0.455	OC (0.200)	0.266 (1.131)	4.787 (5.831)	0.0d

Note: (a) and (b) are Bulk Densities above and below the water table

Additional soil parameters associated with Ka and Kp

--- parameters for Ka ---			--- parameters for Kp ---		
Soil	Wall	Back-	Soil	Wall	Back-
friction	adhesion	fill	friction	adhesion	fill
angle	coeff.	angle	angle	coeff.	angle
1 W Chalk (up 75)	33.00	0.350	0.00	33.00	0.350
2 Not defined					
3 Chalk GC	33.00	0.350	0.00	33.00	0.350

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	67.90	67.90

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 67.90
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 2.0000E+08 kN/m2
Moment of inertia of wall I = 5.9800E-04 m4/m run
(Arcelor AZ26-700N*) E.I = 119600 kN.m2/m run
Yield Moment of wall = Not defined

SURCHARGE LOADS

	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge (kN/m2)		Surcharge		Part	Short Q
no.	Elev.			Near edge	Far edge	Cat.	Soil type	fact.	reduc. fact.
1	80.40	-0.00(R)	20.00	7.56	0.00	26.48	-- --	1.00U	--
2	80.40	-7.56(R)	20.00	1.70	26.48	=	-- --	1.00U	--
3	80.40	-9.97(R)	20.00	5.68	26.48	52.73	-- --	1.00U	--
4	80.40	-15.64(R)	20.00	27.87	52.73	107.02	-- --	1.00U	--
5	80.40	-0.01(R)	5.00	5.00	5.00	=	-- --	1.10V	--

Note: L = Left side, R = Right side
A ramp surcharge is defined by two values:
N = at edge near to wall, F = at edge far from wall
Limit State Categories: U = Permanent Unfavourable
F = Permanent Favourable
V = Variable (unfavourable)

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 80.40
2	Apply surcharge no.2 at elevation 80.40
3	Apply surcharge no.3 at elevation 80.40
4	Apply surcharge no.4 at elevation 80.40
5	Excavate to elevation 75.20 on LEFT side
6	Apply surcharge no.5 at elevation 80.40
7	Change EI of wall to 107440 kN.m ² /m run Allow wall to relax with new modulus value

LIMIT STATE PARAMETERS

Limit State: ULS DA1 Combination 1
Water pressures : Moderately Conservative
Partial factor on C' = 1.000
Partial factor on Phi' = 1.000
Partial factor on Cu = 1.000
Partial factor on Soil Modulus = 1.000
Partial factor on Permanent Unfavourable loads = 1.000
Partial factor on Permanent Favourable loads = 1.000
Partial factor on Variable Unfavourable loads = 1.100

FACTORS OF SAFETY and ANALYSIS OPTIONS

Limit State options: ULS DA1 Combination 1
Water pressures : Moderately Conservative
Partial factor on C' = 1.000
Partial factor on Phi' = 1.000
Partial factor on Cu = 1.000
Partial factor on Soil Modulus = 1.000
Partial factor on Permanent Unfavourable loads = 1.000
Partial factor on Permanent Favourable loads = 1.000
Partial factor on Variable Unfavourable loads = 1.100
Design factor on calculated Bending Moments = 1.350

Parameters for undrained strata:

Minimum equivalent fluid density = 5.00 kN/m³
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:

Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 7.000 m

Boundary conditions:

Length of wall (normal to plane of analysis) = 1000.00 m

Width of excavation/fill on Left side of wall = 50.00 m

Width of excavation/fill on Right side of wall = 50.00 m

Distance to rigid boundary on Left side = 50.00 m

Distance to rigid boundary on Right side = 50.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 80.40	Yes	Yes	Yes
2	Apply surcharge no.2 at elev. 80.40	Yes	Yes	Yes
3	Apply surcharge no.3 at elev. 80.40	Yes	Yes	Yes
4	Apply surcharge no.4 at elev. 80.40	Yes	Yes	Yes
5	Excav. to elev. 75.20 on LEFT side	Yes	Yes	Yes
6	Apply surcharge no.5 at elev. 80.40	Yes	Yes	Yes
7	Change EI of wall to 107440kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

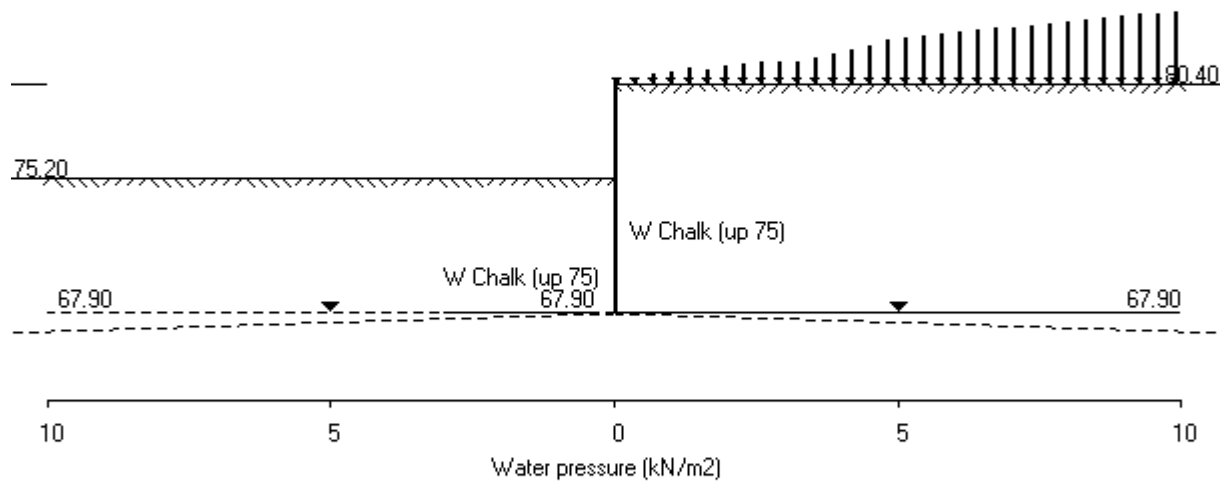
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| Job No. 373447
| Made by : MS
| Date: 4-09-2025
Checked :

Units: kN,m

Stage No.7 Change EI of wall to 107440kN.m²/m run



Units: kN,m

Stage No. 5 Excavate to elevation 75.20 on LEFT side

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Open Tension Crack analysis - No

Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Left side 50.00m from wall

Right side 50.00m from wall

Limit State: ULS DAI Combination 1

Calculated Bending Moments and Prop Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m	EI of wall kN.m2/m
1	80.40	0.00	-0.052	-7.76E-03	0.0	-0.0		119600
2	79.80	-3.22	-0.048	-7.76E-03	-1.0	-0.2		119600
3	79.20	-6.44	-0.043	-7.75E-03	-3.9	-1.6		119600
4	78.60	-9.65	-0.038	-7.73E-03	-8.7	-5.3		119600
5	78.00	-12.84	-0.034	-7.69E-03	-15.4	-12.4		119600
6	77.40	-16.01	-0.029	-7.60E-03	-24.1	-24.2		119600
7	76.80	-19.16	-0.025	-7.43E-03	-34.6	-41.8		119600
8	76.20	-22.28	-0.020	-7.16E-03	-47.1	-66.2		119600
9	75.70	-24.86	-0.017	-6.83E-03	-58.9	-92.6		119600
10	75.20	-27.42	-0.013	-6.37E-03	-71.9	-125.3		119600
11	74.80	5.00	-0.011	-5.91E-03	-76.4	-155.4		119600
12	74.40	37.44	-0.009	-5.34E-03	-67.9	-184.7		119600
13	73.80	86.12	-0.006	-4.33E-03	-30.9	-215.8		119600
14	73.20	84.83	-0.004	-3.23E-03	20.4	-224.0		119600
15	72.60	47.31	-0.002	-2.17E-03	60.1	-196.4		119600
16	72.00	6.99	-0.001	-1.30E-03	76.4	-153.3		119600
17	71.40	-16.29	-0.000	-6.51E-04	73.6	-106.2		119600
18	70.80	-27.69	-0.000	-2.22E-04	60.4	-65.0		119600
19	70.20	-30.46	-0.000	2.54E-05	42.9	-33.8		119600
20	69.60	-27.36	-0.000	1.44E-04	25.6	-13.5		119600
21	69.00	-20.40	-0.000	1.85E-04	11.3	-3.1		119600
22	68.45	-10.36	-0.000	1.92E-04	2.8	0.0		119600
23	67.90	0.19	-0.000	1.92E-04	-0.0	-0.0		---

LEFT side

Node no.	Y coord	Water press. kN/m2	Vertic -al kN/m2	Effective stresses			Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
				Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	80.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	79.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	79.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	78.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	78.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	77.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	76.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	76.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	75.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	75.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	22973
11	74.80	0.00	7.20	1.91	34.46	34.46	34.46p	23403

(continued)

Stage No.5 Excavate to elevation 75.20 on LEFT side

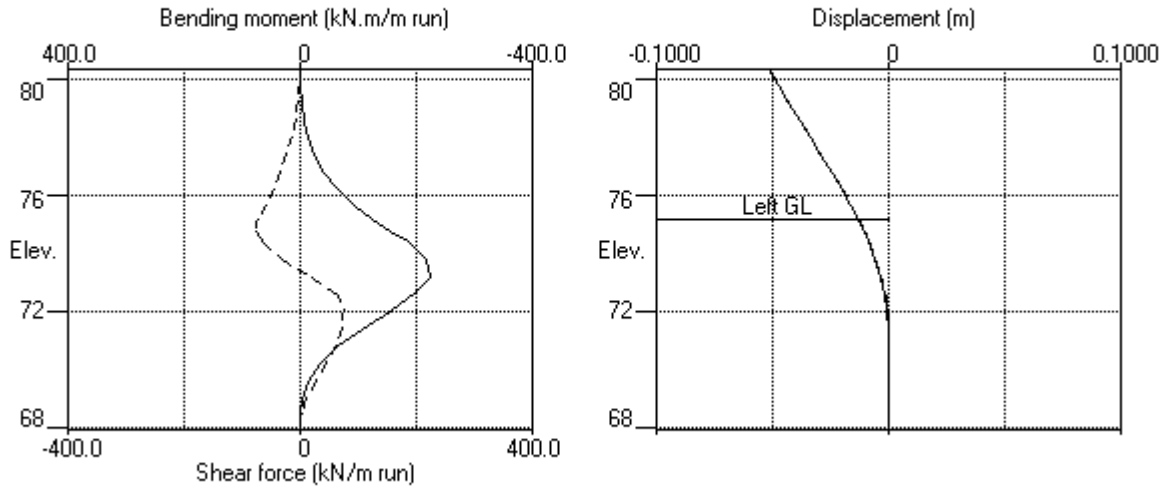
LEFT side								
Node no.	Y coord	Water press. kN/m2	Vertic -al kN/m2	Effective stresses		Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
				Active limit kN/m2	Passive limit kN/m2			
12	74.40	0.00	14.40	3.82	68.93	68.93	68.93p	23834
13	73.80	0.00	25.20	6.69	120.63	120.63	120.63p	24479
14	73.20	0.00	36.00	9.56	172.33	122.34	122.34	25125
15	72.60	0.00	46.81	12.43	224.04	87.80	87.80	25770
16	72.00	0.00	57.61	15.30	275.76	66.59	66.59	26416
17	71.40	0.00	68.42	18.17	327.49	56.50	56.50	27061
18	70.80	0.00	79.23	21.04	379.23	54.71	54.71	26631
19	70.20	0.00	90.04	23.91	430.99	58.27	58.27	27252
20	69.60	0.00	100.85	26.78	482.76	64.76	64.76	27872
21	69.00	0.00	111.67	29.65	534.55	73.17	73.17	45579
22	68.45	0.00	121.60	32.29	582.04	82.71	82.71	46489
23	67.90	0.00	131.52	34.92	629.55	92.51	92.51	47399

RIGHT side								
Node no.	Y coord	Water press. kN/m2	Vertic -al kN/m2	Effective stresses		Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
				Active limit kN/m2	Passive limit kN/m2			
1	80.40	0.00	0.00	0.00	0.00	0.00	0.00	9510
2	79.80	0.00	12.14	3.22	58.09	3.22	3.22a	9863
3	79.20	0.00	24.25	6.44	116.08	6.44	6.44a	10216
4	78.60	0.00	36.33	9.65	173.89	9.65	9.65a	10569
5	78.00	0.00	48.35	12.84	231.42	12.84	12.84a	10923
6	77.40	0.00	60.29	16.01	288.58	16.01	16.01a	11276
7	76.80	0.00	72.14	19.16	345.31	19.16	19.16a	11629
8	76.20	0.00	83.90	22.28	401.59	22.28	22.28a	11982
9	75.70	0.00	93.62	24.86	448.13	24.86	24.86a	12277
10	75.20	0.00	103.27	27.42	494.34	27.42	27.42a	12571
11	74.80	0.00	110.95	29.46	531.08	29.46	29.46a	12806
12	74.40	0.00	118.58	31.49	567.62	31.49	31.49a	13042
13	73.80	0.00	129.96	34.51	622.09	34.51	34.51a	13395
14	73.20	0.00	141.26	37.51	676.18	37.51	37.51a	13748
15	72.60	0.00	152.49	40.49	729.93	40.49	40.49a	14102
16	72.00	0.00	163.66	43.46	783.38	59.61	59.61	14455
17	71.40	0.00	174.77	46.41	836.56	72.79	72.79	14808
18	70.80	0.00	185.83	49.35	889.52	82.40	82.40	26631
19	70.20	0.00	196.85	52.27	942.28	88.73	88.73	27252
20	69.60	0.00	207.84	55.19	994.86	92.12	92.12	27872
21	69.00	0.00	218.79	58.10	1047.30	93.57	93.57	45579
22	68.45	0.00	228.81	60.76	1095.25	93.08	93.08	46489
23	67.90	0.00	238.81	63.41	1143.12	92.32	92.32	47399

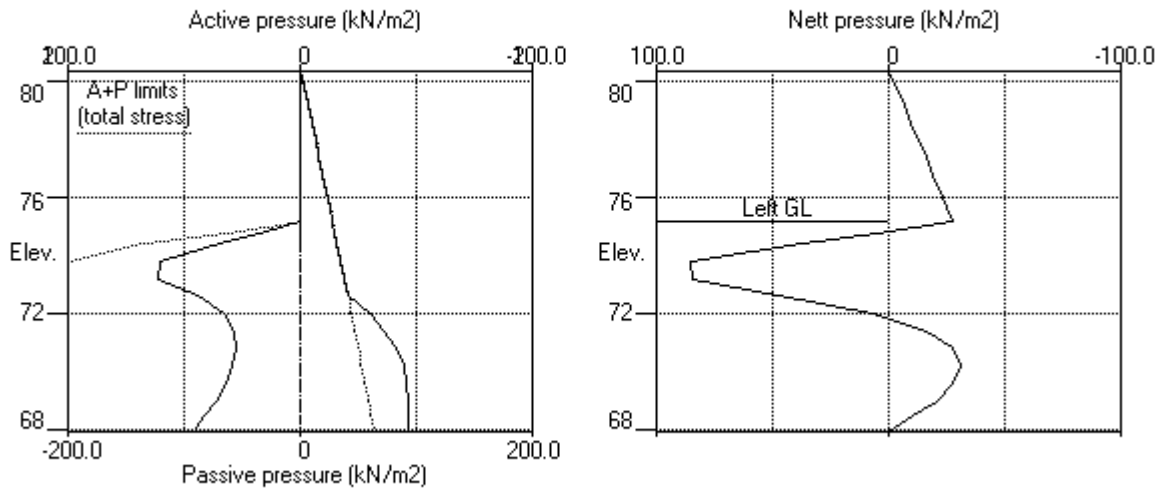
Note: 40.49 a Soil pressure at active limit
120.63 p Soil pressure at passive limit

Units: kN,m

Stage No.5 Excav. to elev. 75.20 on LEFT side



Stage No.5 Excav. to elev. 75.20 on LEFT side



[illegible]

(continued)

Stage No.7 Change EI of wall to 107440 kN.m2/m run
Allow wall to relax with new modulus value

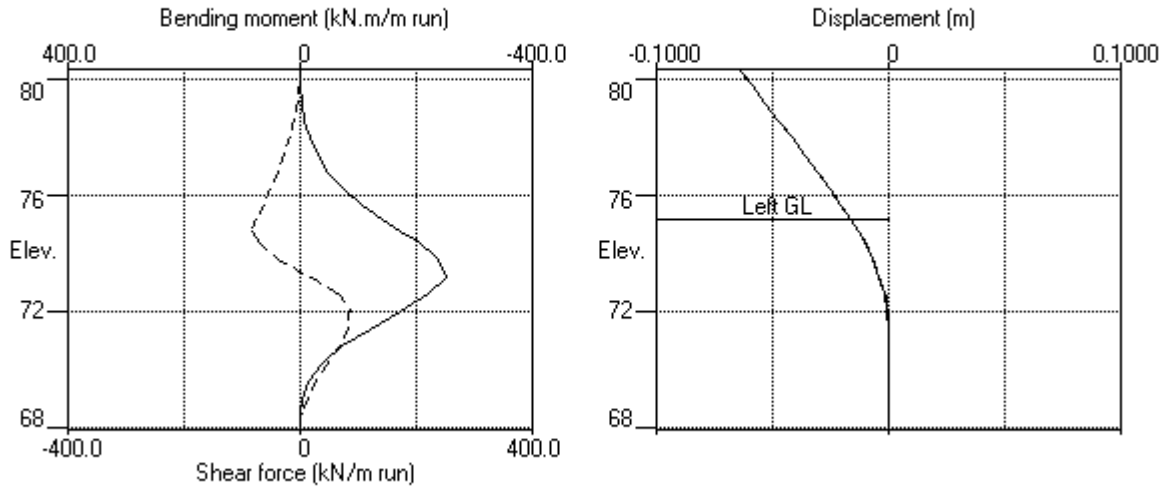
LEFT side								
Node no.	Y coord	Effective stresses					Total earth pressure	Coeff. of subgrade reaction
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
11	74.80	0.00	7.20	1.91	34.46	34.46	34.46p	26867
12	74.40	0.00	14.40	3.82	68.93	68.93	68.93p	27362
13	73.80	0.00	25.20	6.69	120.63	120.63	120.63p	28103
14	73.20	0.00	36.00	9.56	172.33	140.35	140.35	28844
15	72.60	0.00	46.81	12.43	224.04	95.93	95.93	29585
16	72.00	0.00	57.61	15.30	275.76	68.87	68.87	19340
17	71.40	0.00	68.42	18.17	327.49	55.50	55.50	19813
18	70.80	0.00	79.23	21.04	379.23	52.71	52.71	20285
19	70.20	0.00	90.04	23.91	430.99	56.19	56.19	20758
20	69.60	0.00	100.85	26.78	482.76	63.01	63.01	21230
21	69.00	0.00	111.67	29.65	534.55	72.06	72.06	42207
22	68.45	0.00	121.60	32.29	582.04	82.41	82.41	43050
23	67.90	0.00	131.52	34.92	629.55	93.01	93.01	43892

RIGHT side								
Node no.	Y coord	Effective stresses					Total earth pressure	Coeff. of subgrade reaction
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	80.40	0.00	0.00	0.00	0.00	0.00	0.00	9812
2	79.80	0.00	17.49	4.64	83.70	4.64	4.64a	10176
3	79.20	0.00	29.48	7.83	141.10	7.83	7.83a	10541
4	78.60	0.00	41.22	10.95	197.32	10.95	10.95a	10905
5	78.00	0.00	52.80	14.02	252.73	14.02	14.02a	11270
6	77.40	0.00	64.27	17.07	307.64	17.07	17.07a	11634
7	76.80	0.00	75.67	20.09	362.21	20.09	20.09a	11999
8	76.20	0.00	87.01	23.11	416.51	23.11	23.11a	12363
9	75.70	0.00	96.43	25.60	461.56	25.60	25.60a	12667
10	75.20	0.00	105.80	28.09	506.45	28.09	28.09a	12971
11	74.80	0.00	113.28	30.08	542.23	30.08	30.08a	13214
12	74.40	0.00	120.73	32.06	577.91	32.06	32.06a	13457
13	73.80	0.00	131.87	35.02	631.23	35.02	35.02a	13821
14	73.20	0.00	142.96	37.96	684.32	37.96	37.96a	14186
15	72.60	0.00	154.01	40.90	737.21	40.90	40.90a	14550
16	72.00	0.00	165.02	43.82	789.92	59.04	59.04	19340
17	71.40	0.00	176.00	46.74	842.46	74.23	74.23	19813
18	70.80	0.00	186.95	49.64	894.85	84.68	84.68	20285
19	70.20	0.00	197.87	52.54	947.12	91.06	91.06	20758
20	69.60	0.00	208.76	55.43	999.28	94.10	94.10	21230
21	69.00	0.00	219.64	58.32	1051.33	94.90	94.90	42207
22	68.45	0.00	229.59	60.97	1098.98	93.58	93.58	43050
23	67.90	0.00	239.53	63.61	1146.57	92.00	92.00	43892

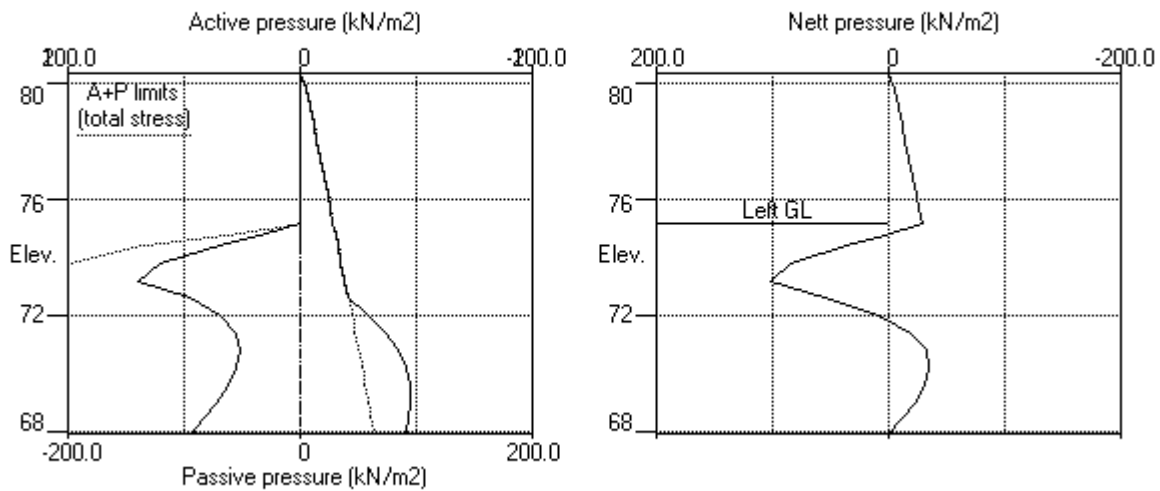
Note: 40.90 a Soil pressure at active limit
120.63 p Soil pressure at passive limit

Units: kN,m

Stage No.7 Change EI of wall to 107440kN.m2/m run



Stage No.7 Change EI of wall to 107440kN.m2/m run



Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Left side 50.00m from wall

Right side 50.00m from wall

Limit State: ULS DAL Combination 1

Calculated Bending Moments and Prop Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment				Shear force			
				Calculated		Factored		Calculated		Factored	
		max.	min.	max.	min.	max.	min.	max.	min.	max.	min.
		m	m	kN.m/m		kN.m/m		kN/m	kN/m	kN/m	kN/m
1	80.40	0.000	-0.065	0	-0	0	-0	0	0	0	0
2	79.80	0.000	-0.059	0	-0	0	-0	0	-1	0	-2
3	79.20	0.000	-0.053	0	-2	0	-3	0	-5	0	-7
4	78.60	0.000	-0.048	0	-7	0	-9	0	-11	0	-15
5	78.00	0.000	-0.042	0	-16	0	-21	0	-18	0	-25
6	77.40	0.000	-0.036	0	-29	1	-39	0	-28	0	-37
7	76.80	0.000	-0.030	1	-49	1	-66	0	-39	0	-52
8	76.20	0.000	-0.025	1	-76	1	-103	0	-52	0	-70
9	75.70	0.000	-0.021	1	-105	1	-142	0	-64	0	-86
10	75.20	0.000	-0.017	1	-140	1	-189	0	-77	0	-104
11	74.80	0.000	-0.014	1	-172	1	-233	0	-82	0	-111
12	74.40	0.000	-0.011	1	-204	1	-275	0	-74	0	-100
13	73.80	0.000	-0.007	1	-239	1	-322	0	-37	0	-50
14	73.20	0.000	-0.004	0	-251	1	-339	20	-0	28	-0
15	72.60	0.000	-0.002	0	-222	1	-300	67	-0	90	-0
16	72.00	0.000	-0.001	0	-176	0	-237	86	-0	116	-0
17	71.40	0.000	-0.000	0	-123	0	-167	83	-0	113	-0
18	70.80	0.000	-0.000	0	-77	0	-104	69	-0	93	-0
19	70.20	0.000	-0.000	0	-41	0	-56	50	-0	67	-0
20	69.60	0.000	-0.000	0	-17	0	-23	30	-0	41	-0
21	69.00	0.000	-0.000	0	-5	0	-6	14	-0	19	-0
22	68.45	0.000	-0.000	0	-0	0	-0	4	-0	6	-0
23	67.90	0.000	-0.000	0	-0	0	-0	0	-0	0	-0

Maximum and minimum bending moment and shear force at each stage

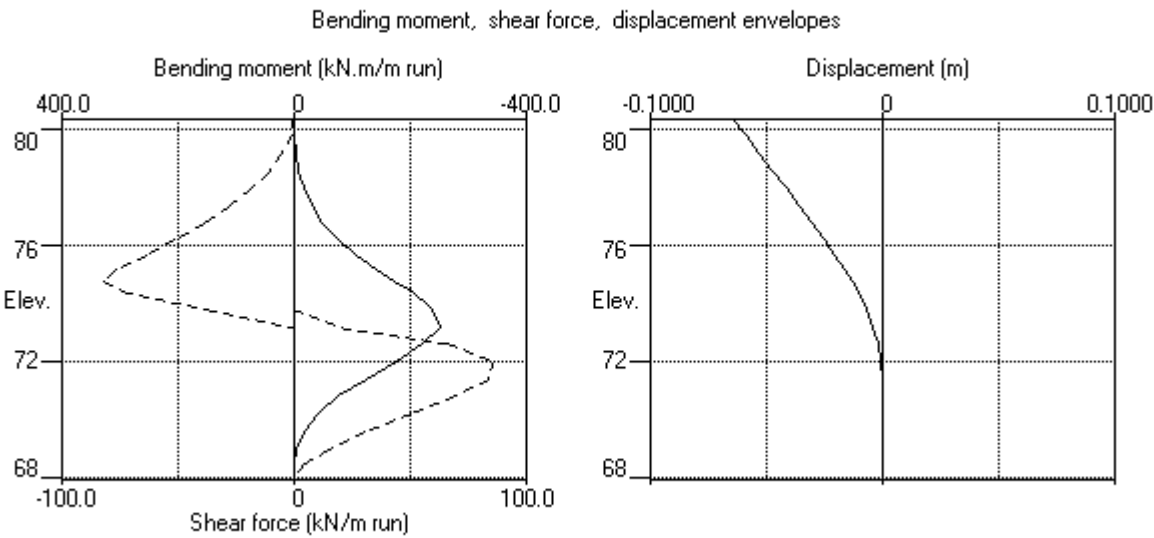
Stage no.	Bending moment						Shear force					
	Calculated				Factored		Calculated				Factored	
	max.	elev.	min.	elev.	max.	min.	max.	elev.	min.	elev.	max.	min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	
1	1	75.70	-0	79.80	1	-0	0	78.60	-0	73.20	0	-0
2	1	75.70	-0	79.80	1	-0	0	78.00	-0	72.60	0	-0
3	1	75.20	-0	79.80	1	-0	0	78.00	-0	72.00	0	-0
4	1	75.20	-0	79.80	1	-0	0	78.00	-0	72.00	0	-0
5	0	68.45	-224	73.20	0	-302	76	72.00	-76	74.80	103	-103
6	0	80.40	-251	73.20	0	-339	84	72.00	-82	74.80	113	-111
7	0	68.45	-251	73.20	0	-339	86	72.00	-82	74.80	116	-111

Summary of results (continued)

Maximum and minimum displacement at each stage

Stage ----- Displacement -----					
no.	<u>maximum</u>	<u>elev.</u>	<u>minimum</u>	<u>elev.</u>	<u>Stage description</u>
	m		m		
1	0.000	80.40	-0.000	74.40	Apply surcharge no.1 at elev. 80.40
2	0.000	80.40	-0.000	73.80	Apply surcharge no.2 at elev. 80.40
3	0.000	80.40	-0.000	73.20	Apply surcharge no.3 at elev. 80.40
4	0.000	80.40	-0.000	72.00	Apply surcharge no.4 at elev. 80.40
5	0.000	80.40	-0.052	80.40	Excav. to elev. 75.20 on LEFT side
6	0.000	70.20	-0.060	80.40	Apply surcharge no.5 at elev. 80.40
7	0.000	70.20	-0.065	80.40	Change EI of wall to 107440kN.m2/m run

Units: kN,m



RSK ENVIRONMENT LTD	Sheet No.
Program: WALLAP Version 6.09 Revision A59.B77.R60	Job No. 373447
Licensed from GEOSOLVE	Made by : MS
Data filename/Run ID: Section_P-P_ULS2	
Newmarket Road, Royston	Date: 4-09-2025
Sheet Pile design analysis (Section P-P)	Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types	
		Left side	Right side
1	80.40	1 W Chalk (up 75)	1 W Chalk (up 75)
2	55.00	3 Chalk GC	3 Chalk GC

SOIL PROPERTIES (Unfactored SLS soil strengths)

	Bulk density	Young's Modulus	At rest coeff.	Consol state.	Active limit	Passive limit	Cohesion
No. Description	kN/m3	Eh, kN/m2	Ko	NC/OC	Ka	Kp	kN/m2
(Datum elev.)		(dEh/dy)	(dKo/dy)	(Nu)	(Kac)	(Kpc)	(dc/dy)
1 W Chalk (.. (80.40)	18.00a	33000	0.455	OC	0.266	4.787	0.0d
	19.00b	(2043)		(0.200)	(1.131)	(5.831)	
2 Not defined							
3 Chalk GC	18.00a	80000	0.455	OC	0.266	4.787	0.0d
	19.00b			(0.200)	(1.131)	(5.831)	

Note: (a) and (b) are Bulk Densities above and below the water table

Additional soil parameters associated with Ka and Kp

	--- parameters for Ka ---			--- parameters for Kp ---		
	Soil friction	Wall adhesion	Back-fill	Soil friction	Wall adhesion	Back-fill
----- Soil type -----	angle	coeff.	angle	angle	coeff.	angle
No. Description						
1 W Chalk (up 75)	33.00	0.350	0.00	33.00	0.350	0.00
2 Not defined						
3 Chalk GC	33.00	0.350	0.00	33.00	0.350	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	67.90	67.90

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 67.90
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 2.0000E+08 kN/m2
Moment of inertia of wall I = 5.9800E-04 m4/m run
(Arcelor AZ26-700N*) E.I = 119600 kN.m2/m run
Yield Moment of wall = Not defined

SURCHARGE LOADS

	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge (kN/m2)		Surcharge		Part fact.	Short Q reduc. fact.
Surcharge no.	Elev.			Near edge	Far edge	Soil Cat.	type		
1	80.40	-0.00(R)	20.00	7.56	0.00	26.48	-- --	1.00U	--
2	80.40	-7.56(R)	20.00	1.70	26.48	=	-- --	1.00U	--
3	80.40	-9.97(R)	20.00	5.68	26.48	52.73	-- --	1.00U	--
4	80.40	-15.64(R)	20.00	27.87	52.73	107.02	-- --	1.00U	--
5	80.40	-0.01(R)	5.00	5.00	5.00	=	-- --	1.30V	--

Note: L = Left side, R = Right side
A ramp surcharge is defined by two values:
N = at edge near to wall, F = at edge far from wall
Limit State Categories: U = Permanent Unfavourable
F = Permanent Favourable
V = Variable (unfavourable)

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 80.40
2	Apply surcharge no.2 at elevation 80.40
3	Apply surcharge no.3 at elevation 80.40
4	Apply surcharge no.4 at elevation 80.40
5	Excavate to elevation 75.20 on LEFT side
6	Apply surcharge no.5 at elevation 80.40
7	Change EI of wall to 107440 kN.m2/m run Allow wall to relax with new modulus value

LIMIT STATE PARAMETERS

Limit State: ULS DA1 Combination 2
Water pressures : Worst Credible
Partial factor on C' = 1.250
Partial factor on Φ' = 1.250
Partial factor on C_u = 1.400
Partial factor on Soil Modulus = 1.000
Partial factor on Permanent Unfavourable loads = 1.000
Partial factor on Permanent Favourable loads = 1.000
Partial factor on Variable Unfavourable loads = 1.300

FACTORS OF SAFETY and ANALYSIS OPTIONS

Limit State options: ULS DA1 Combination 2
Water pressures : Worst Credible
Partial factor on C' = 1.250
Partial factor on Φ' = 1.250
Partial factor on C_u = 1.400
Partial factor on Soil Modulus = 1.000
Partial factor on Permanent Unfavourable loads = 1.000
Partial factor on Permanent Favourable loads = 1.000
Partial factor on Variable Unfavourable loads = 1.300
Stability analysis:
Method of analysis - Strength Factor method
Overall factor on soil strength for calculating wall depth = 1.00

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 7.000 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 1000.00 m

Width of excavation/fill on Left side of wall = 50.00 m
Width of excavation/fill on Right side of wall = 50.00 m

Distance to rigid boundary on Left side = 50.00 m
Distance to rigid boundary on Right side = 50.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 80.40	Yes	Yes	Yes
2	Apply surcharge no.2 at elev. 80.40	Yes	Yes	Yes
3	Apply surcharge no.3 at elev. 80.40	Yes	Yes	Yes
4	Apply surcharge no.4 at elev. 80.40	Yes	Yes	Yes
5	Excav. to elev. 75.20 on LEFT side	Yes	Yes	Yes
6	Apply surcharge no.5 at elev. 80.40	Yes	Yes	Yes
7	Change EI of wall to 107440kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

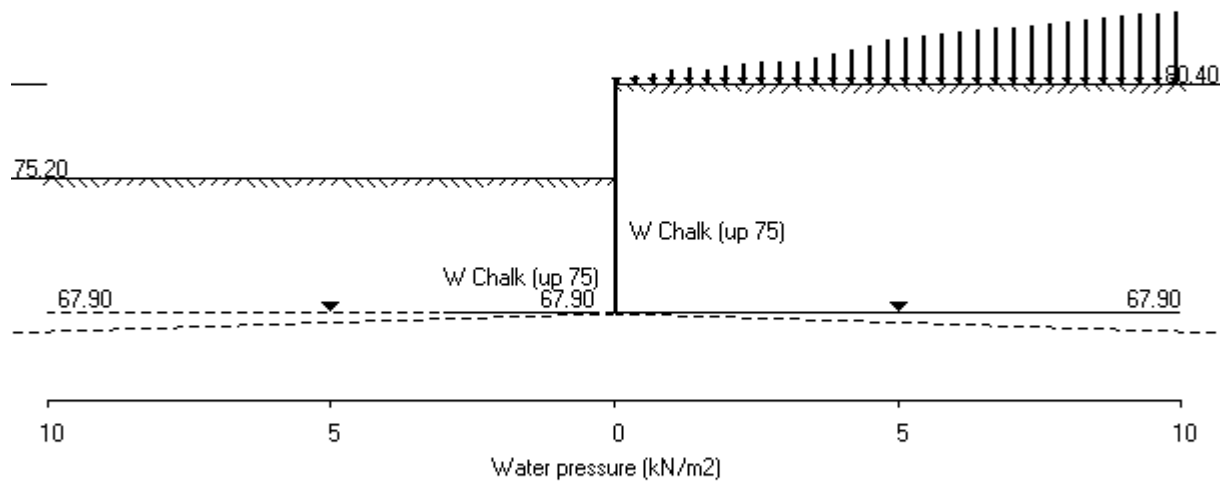
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Data filename/Run ID: Section_P-P_ULS2
Newmarket Road, Royston
Sheet Pile design analysis (Section P-P)

| Sheet No.
| Job No. 373447
| Made by : MS
| Date: 4-09-2025
Checked :

Units: kN,m

Stage No.7 Change EI of wall to 107440kN.m²/m run



Units: kN,m

Stage No. 5 Excavate to elevation 75.20 on LEFT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

		Overall							
		FoS for toe		Toe elev. for					
		elev. = 67.90		FoS = 1.000					
<u>Stage</u>	<u>Ground level</u>	<u>Prop</u>	<u>Factor</u>	<u>Moment</u>	<u>Toe</u>	<u>Wall</u>	<u>Direction</u>		
<u>No.</u>	<u>Act.</u>	<u>Pass.</u>	<u>Elev.</u>	<u>of</u>	<u>equilib.</u>	<u>elev.</u>	<u>Penetr</u>	<u>of</u>	
				<u>Safety</u>	<u>at elev.</u>		<u>-ation</u>	<u>failure</u>	
5	80.40	75.20	Cant.	1.269	68.71	69.98	5.22	R to L	

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Subgrade reaction model - Boussinesq Influence coefficients

Soil deformations are elastic until the active or passive limit is reached

Open Tension Crack analysis - No

Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Left side 50.00m from wall

Right side 50.00m from wall

Limit State: ULS DA1 Combination 2

<u>Node</u>	<u>Y</u>	<u>Nett</u>	<u>Wall</u>	<u>Wall</u>	<u>Shear</u>	<u>Bending</u>	<u>Prop</u>	<u>EI of</u>
<u>no.</u>	<u>coord</u>	<u>pressure</u>	<u>disp.</u>	<u>rotation</u>	<u>force</u>	<u>moment</u>	<u>forces</u>	<u>wall</u>
		kN/m2	m	rad.	kN/m	kN.m/m	kN/m	kN.m2/m
1	80.40	0.00	-0.102	-1.38E-02	0.0	-0.0		119600
2	79.80	-4.08	-0.094	-1.38E-02	-1.2	-0.3		119600
3	79.20	-8.15	-0.085	-1.38E-02	-4.9	-2.0		119600
4	78.60	-12.21	-0.077	-1.37E-02	-11.0	-6.7		119600
5	78.00	-16.24	-0.069	-1.37E-02	-19.5	-15.7		119600
6	77.40	-20.26	-0.061	-1.36E-02	-30.5	-30.6		119600
7	76.80	-24.24	-0.053	-1.34E-02	-43.8	-52.8		119600
8	76.20	-28.19	-0.045	-1.30E-02	-59.6	-83.7		119600
9	75.70	-31.45	-0.038	-1.26E-02	-74.5	-117.2		119600
10	75.20	-34.70	-0.032	-1.20E-02	-91.0	-158.5		119600
11	74.80	-12.27	-0.027	-1.14E-02	-100.4	-197.0		119600
12	74.40	10.17	-0.023	-1.07E-02	-100.8	-237.6		119600
13	73.80	43.86	-0.017	-9.41E-03	-84.6	-294.2		119600
14	73.20	77.57	-0.012	-7.83E-03	-48.2	-335.1		119600
15	72.60	111.32	-0.007	-6.12E-03	8.5	-348.0		119600
16	72.00	87.30	-0.004	-4.42E-03	68.1	-330.1		119600
17	71.40	39.19	-0.002	-2.90E-03	106.0	-273.4		119600
18	70.80	-1.05	-0.001	-1.71E-03	117.5	-203.8		119600
19	70.20	-30.59	0.000	-8.66E-04	108.0	-133.5		119600
20	69.60	-45.21	0.000	-3.45E-04	85.2	-74.2		119600
21	69.00	-50.58	0.000	-8.08E-05	56.5	-31.2		119600
22	68.45	-51.64	0.000	8.89E-06	28.4	-7.8		119600
23	67.90	-51.56	0.000	2.68E-05	-0.0	-0.0		---

(continued)

Stage No.5 Excavate to elevation 75.20 on LEFT side

LEFT side								
Node no.	Y coord	Water press. kN/m2	Effective stresses				Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
			Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	80.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	79.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	79.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	78.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	78.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	77.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	76.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	76.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	75.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	75.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	20078
11	74.80	0.00	7.20	2.42	25.01	25.01	25.01p	20454
12	74.40	0.00	14.40	4.84	50.01	50.01	50.01p	20830
13	73.80	0.00	25.20	8.47	87.52	87.52	87.52p	21394
14	73.20	0.00	36.00	12.10	125.04	125.04	125.04p	21958
15	72.60	0.00	46.81	15.73	162.55	162.55	162.55p	22523
16	72.00	0.00	57.61	19.36	200.08	142.29	142.29	23087
17	71.40	0.00	68.42	22.99	237.61	97.91	97.91	23651
18	70.80	0.00	79.23	26.62	275.15	70.84	70.84	24215
19	70.20	0.00	90.04	30.25	312.70	58.20	58.20	20429
20	69.60	0.00	100.85	33.89	350.27	55.83	55.83	20894
21	69.00	0.00	111.67	37.52	387.84	58.09	58.09	21359
22	68.45	0.00	121.60	40.85	422.30	62.07	62.07	21786
23	67.90	0.00	131.52	44.19	456.77	66.64	66.64	22212

RIGHT side								
Node no.	Y coord	Water press. kN/m2	Effective stresses				Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
			Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	80.40	0.00	0.00	0.00	0.00	0.00	0.00	9079
2	79.80	0.00	12.14	4.08	42.15	4.08	4.08a	9417
3	79.20	0.00	24.25	8.15	84.23	8.15	8.15a	9754
4	78.60	0.00	36.33	12.21	126.17	12.21	12.21a	10091
5	78.00	0.00	48.35	16.24	167.90	16.24	16.24a	10428
6	77.40	0.00	60.29	20.26	209.38	20.26	20.26a	10766
7	76.80	0.00	72.14	24.24	250.54	24.24	24.24a	11103
8	76.20	0.00	83.90	28.19	291.37	28.19	28.19a	11440
9	75.70	0.00	93.62	31.45	325.14	31.45	31.45a	11721
10	75.20	0.00	103.27	34.70	358.66	34.70	34.70a	12002
11	74.80	0.00	110.95	37.28	385.32	37.28	37.28a	12227
12	74.40	0.00	118.58	39.84	411.83	39.84	39.84a	12452
13	73.80	0.00	129.96	43.66	451.36	43.66	43.66a	12789
14	73.20	0.00	141.26	47.46	490.60	47.46	47.46a	13126
15	72.60	0.00	152.49	51.23	529.60	51.23	51.23a	13464
16	72.00	0.00	163.66	54.99	568.38	54.99	54.99a	13801
17	71.40	0.00	174.77	58.72	606.97	58.72	58.72a	14138
18	70.80	0.00	185.83	62.44	645.39	71.89	71.89	14475
19	70.20	0.00	196.85	66.14	683.67	88.80	88.80	20429
20	69.60	0.00	207.84	69.83	721.82	101.05	101.05	20894
21	69.00	0.00	218.79	73.51	759.87	108.66	108.66	21359
22	68.45	0.00	228.81	76.88	794.66	113.72	113.72	21786
23	67.90	0.00	238.81	80.24	829.38	118.20	118.20	22212

Run ID. Section_P-P_U LS2

Newmarket Road, Royston

Sheet Pile design analysis (Section P-P)

| Sheet No.

| Date: 4-09-2025

| Checked :

(continued)

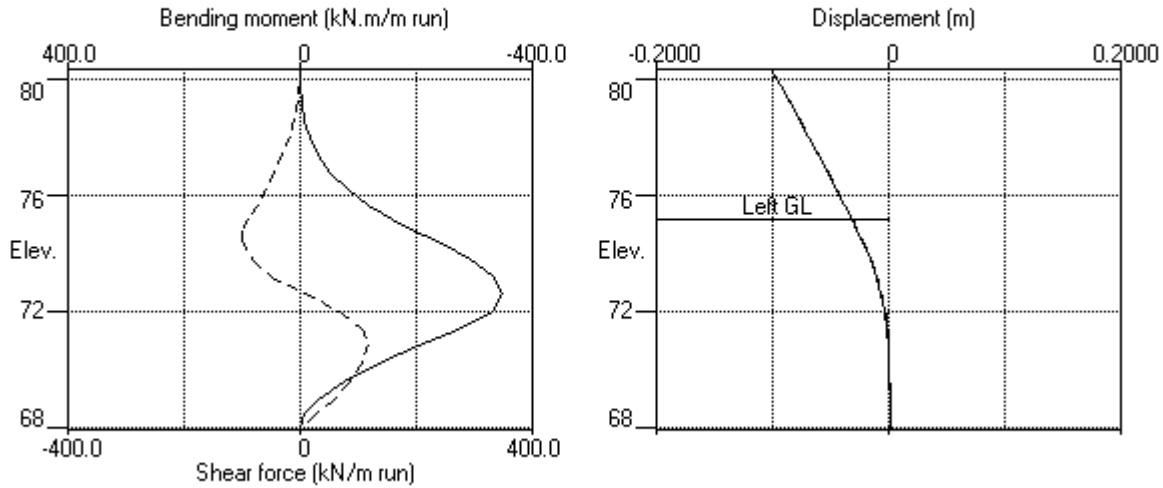
Stage No.5 Excavate to elevation 75.20 on LEFT side

Note: 58.72 a Soil pressure at active limit

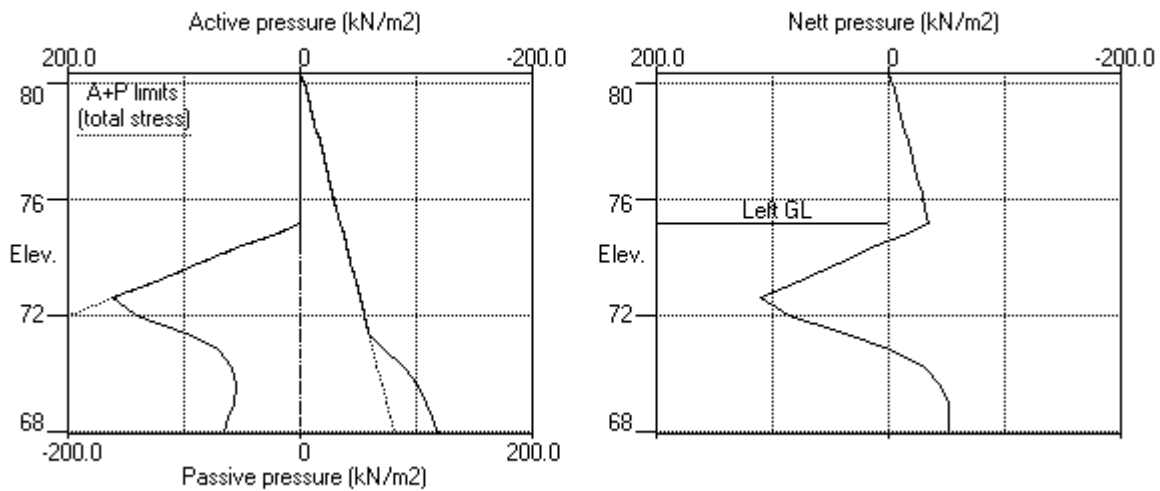
 162.55 p Soil pressure at passive limit

Units: kN,m

Stage No.5 Excav. to elev. 75.20 on LEFT side



Stage No.5 Excav. to elev. 75.20 on LEFT side



RSK ENVIRONMENT LTD	Sheet No.
Program: WALLAP Version 6.09 Revision A59.B77.R60	Job No. 373447
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Data filename/Run ID: Section_P-P_ULS2	
Newmarket Road, Royston	Date: 4-09-2025
Sheet Pile design analysis (Section P-P)	Checked :

Units: kN,m

Stage No. 7 Change EI of wall to 107440 kN.m2/m run
Allow wall to relax with new modulus value

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
Factor of safety on soil strength

		Overall							
		FoS for toe		Toe elev. for					
		elev. = 67.90		FoS = 1.000					
<u>Stage</u>	<u>Ground level</u>	<u>Prop</u>	<u>Factor</u>	<u>Moment</u>	<u>Toe</u>	<u>Wall</u>	<u>Direction</u>		
<u>No.</u>	<u>Act.</u>	<u>Pass.</u>	<u>Elev.</u>	<u>of</u>	<u>elev.</u>	<u>Penetr</u>	<u>of</u>		
				<u>Safety</u>	<u>at elev.</u>	<u>-ation</u>	<u>failure</u>		
7	80.40	75.20	Cant.	1.233	68.72	69.76	5.44	R to L	

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Left side 50.00m from wall

Right side 50.00m from wall

Limit State: ULS DA1 Combination 2

<u>Node</u>	<u>Y</u>	<u>Nett</u>	<u>Wall</u>	<u>Wall</u>	<u>Shear</u>	<u>Bending</u>	<u>Prop</u>	<u>EI of</u>
<u>no.</u>	<u>coord</u>	<u>pressure</u>	<u>disp.</u>	<u>rotation</u>	<u>force</u>	<u>moment</u>	<u>forces</u>	<u>wall</u>
		kN/m2	m	rad.	kN/m	kN.m/m	kN/m	kN.m2/m
1	80.40	0.00	-0.131	-1.77E-02	0.0	-0.0		107440
2	79.80	-6.20	-0.120	-1.77E-02	-1.9	-0.4		107440
3	79.20	-10.22	-0.110	-1.77E-02	-6.8	-2.9		107440
4	78.60	-14.15	-0.099	-1.76E-02	-14.1	-9.1		107440
5	78.00	-18.01	-0.089	-1.76E-02	-23.7	-20.3		107440
6	77.40	-21.84	-0.078	-1.74E-02	-35.7	-38.0		107440
7	76.80	-25.64	-0.068	-1.71E-02	-49.9	-63.6		107440
8	76.20	-29.43	-0.058	-1.67E-02	-66.5	-98.5		107440
9	75.70	-32.57	-0.049	-1.61E-02	-82.0	-135.5		107440
10	75.20	-35.70	-0.041	-1.54E-02	-99.0	-180.7		107440
11	74.80	-13.20	-0.035	-1.46E-02	-108.8	-222.6		107440
12	74.40	9.32	-0.030	-1.37E-02	-109.6	-266.6		107440
13	73.80	43.10	-0.022	-1.21E-02	-93.9	-328.6		107440
14	73.20	76.90	-0.015	-1.01E-02	-57.9	-375.2		107440
15	72.60	110.72	-0.010	-7.98E-03	-1.6	-394.0		107440
16	72.00	116.63	-0.006	-5.82E-03	66.6	-382.2		107440
17	71.40	53.46	-0.003	-3.85E-03	117.7	-321.3		107440
18	70.80	6.39	-0.001	-2.28E-03	135.6	-242.3		107440
19	70.20	-32.59	0.000	-1.16E-03	127.7	-159.9		107440
20	69.60	-53.06	0.001	-4.73E-04	102.1	-89.1		107440
21	69.00	-61.48	0.001	-1.22E-04	67.7	-37.2		107440
22	68.45	-62.51	0.001	-4.89E-06	33.6	-9.1		107440
23	67.90	-59.65	0.001	1.81E-05	-0.0	-0.0		---

(continued)

Stage No.7 Change EI of wall to 107440 kN.m2/m run
Allow wall to relax with new modulus value

LEFT side								
Node no.	Y coord	Water press.	Effective stresses				Total earth pressure	Coeff. of subgrade reaction
			Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	80.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	79.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	79.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	78.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	78.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	77.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	76.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	76.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	75.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	75.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	21591
11	74.80	0.00	7.20	2.42	25.01	25.01	25.01p	21996
12	74.40	0.00	14.40	4.84	50.01	50.01	50.01p	22400
13	73.80	0.00	25.20	8.47	87.52	87.52	87.52p	23007
14	73.20	0.00	36.00	12.10	125.04	125.04	125.04p	23613
15	72.60	0.00	46.81	15.73	162.55	162.55	162.55p	24220
16	72.00	0.00	57.61	19.36	200.08	172.16	172.16	24827
17	71.40	0.00	68.42	22.99	237.61	112.67	112.67	25433
18	70.80	0.00	79.23	26.62	275.15	75.90	75.90	22308
19	70.20	0.00	90.04	30.25	312.70	57.60	57.60	22828
20	69.60	0.00	100.85	33.89	350.27	52.05	52.05	23348
21	69.00	0.00	111.67	37.52	387.84	52.76	52.76	23867
22	68.45	0.00	121.60	40.85	422.30	56.76	56.76	67198
23	67.90	0.00	131.52	44.19	456.77	62.70	62.70	68513

RIGHT side								
Node no.	Y coord	Water press.	Effective stresses				Total earth pressure	Coeff. of subgrade reaction
			Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	80.40	0.00	0.00	0.00	0.00	0.00	0.00	9270
2	79.80	0.00	18.46	6.20	64.11	6.20	6.20a	9615
3	79.20	0.00	30.43	10.22	105.68	10.22	10.22a	9959
4	78.60	0.00	42.11	14.15	146.25	14.15	14.15a	10303
5	78.00	0.00	53.61	18.01	186.18	18.01	18.01a	10648
6	77.40	0.00	64.99	21.84	225.72	21.84	21.84a	10992
7	76.80	0.00	76.31	25.64	265.03	25.64	25.64a	11336
8	76.20	0.00	87.58	29.43	304.16	29.43	29.43a	11681
9	75.70	0.00	96.94	32.57	336.66	32.57	32.57a	11968
10	75.20	0.00	106.26	35.70	369.05	35.70	35.70a	12255
11	74.80	0.00	113.70	38.20	394.89	38.20	38.20a	12484
12	74.40	0.00	121.12	40.70	420.66	40.70	40.70a	12714
13	73.80	0.00	132.22	44.42	459.19	44.42	44.42a	13058
14	73.20	0.00	143.27	48.14	497.58	48.14	48.14a	13403
15	72.60	0.00	154.29	51.84	535.85	51.84	51.84a	13747
16	72.00	0.00	165.27	55.53	573.99	55.53	55.53a	14091
17	71.40	0.00	176.22	59.21	612.02	59.21	59.21a	14436
18	70.80	0.00	187.15	62.88	649.96	69.52	69.52	22308
19	70.20	0.00	198.05	66.54	687.82	90.20	90.20	22828
20	69.60	0.00	208.93	70.20	725.60	105.10	105.10	23348
21	69.00	0.00	219.79	73.85	763.33	114.24	114.24	23867
22	68.45	0.00	229.73	77.19	797.86	119.26	119.26	67198
23	67.90	0.00	239.66	80.52	832.34	122.35	122.35	68513

Run ID. Section_P-P_U LS2

Newmarket Road, Royston

Sheet Pile design analysis (Section P-P)

| Sheet No.

| Date: 4-09-2025

| Checked :

(continued)

Stage No.7 Change EI of wall to 107440 kN.m2/m run

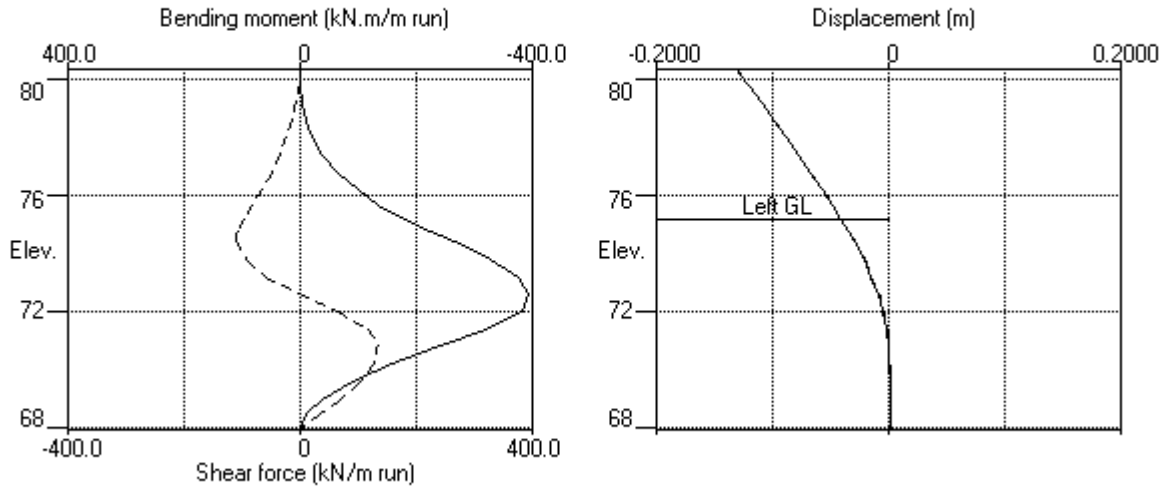
 Allow wall to relax with new modulus value

Note: 59.21 a Soil pressure at active limit

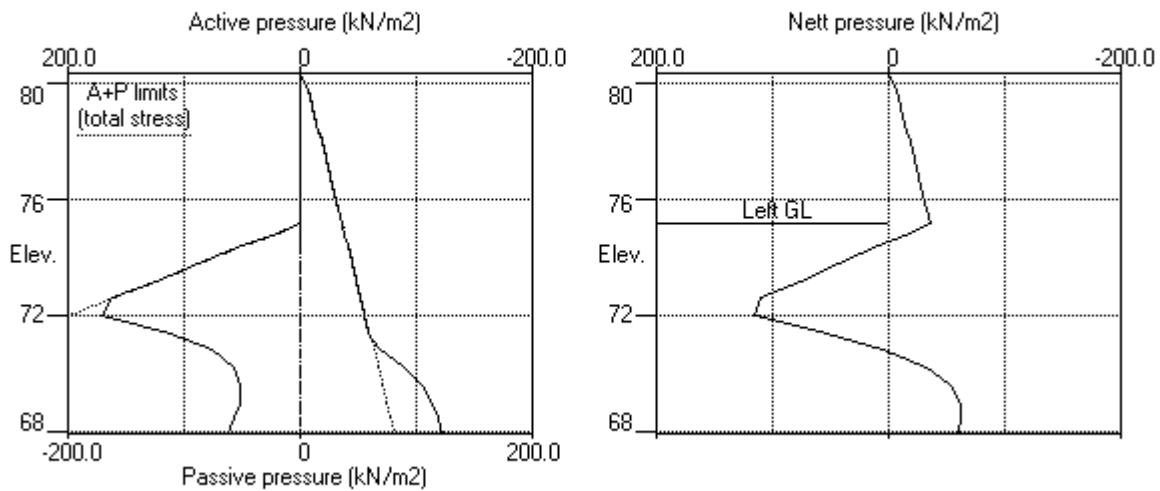
 162.55 p Soil pressure at passive limit

Units: kN,m

Stage No.7 Change EI of wall to 107440kN.m²/m run



Stage No.7 Change EI of wall to 107440kN.m²/m run



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 Program: WALLAP Version 6.09 Revision A59.B77.R60
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 Data filename/Run ID: Section_P-P_ULS2
 Newmarket Road, Royston
 Sheet Pile design analysis (Section P-P)

| Sheet No.
 | Job No. 373447
 | Made by : MS
 |
 | Date: 4-09-2025
Checked :

Units: kN,m

Summary of results

LIMIT STATE PARAMETERS

Limit State: ULS DA1 Combination 2
 Water pressures : Worst Credible
 Partial factor on C' = 1.250
 Partial factor on Phi' = 1.250
 Partial factor on Cu = 1.400
 Partial factor on Soil Modulus = 1.000
 Partial factor on Permanent Unfavourable loads = 1.000
 Partial factor on Permanent Favourable loads = 1.000
 Partial factor on Variable Unfavourable loads = 1.300

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Overall								
			FoS for toe		Toe elev. for			
			elev. = 67.90		FoS = 1.000			
<u>Stage</u>	<u>Ground level</u>		<u>Prop</u>	<u>Factor</u>	<u>Moment</u>	<u>Toe</u>	<u>Wall</u>	<u>Direction</u>
<u>No.</u>	<u>Act.</u>	<u>Pass.</u>	<u>Elev.</u>	<u>of</u>	<u>equilib.</u>	<u>elev.</u>	<u>Penetr</u>	<u>of</u>
				<u>Safety</u>	<u>at elev.</u>		<u>-ation</u>	<u>failure</u>
1	80.40	80.40	Cant.	<u>Conditions not suitable for FoS calc.</u>				
2	80.40	80.40	Cant.	<u>Conditions not suitable for FoS calc.</u>				
3	80.40	80.40	Cant.	<u>Conditions not suitable for FoS calc.</u>				
4	80.40	80.40	Cant.	<u>Conditions not suitable for FoS calc.</u>				
5	80.40	75.20	Cant.	1.269	68.71	69.98	5.22	R to L
6	80.40	75.20	Cant.	1.233	68.72	69.76	5.44	R to L
7	80.40	75.20	Cant.	1.233	68.72	69.76	5.44	R to L

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Open Tension Crack analysis - No

Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Left side 50.00m from wall

Right side 50.00m from wall

Limit State: ULS DAL Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum	minimum	maximum	minimum	maximum	minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
1	80.40	0.000	-0.131	0.0	-0.0	0.0	0.0
2	79.80	0.000	-0.120	0.0	-0.4	0.1	-1.9
3	79.20	0.000	-0.110	0.1	-2.9	0.2	-6.8
4	78.60	0.000	-0.099	0.2	-9.1	0.3	-14.1
5	78.00	0.000	-0.089	0.4	-20.3	0.3	-23.7
6	77.40	0.000	-0.078	0.5	-38.0	0.2	-35.7
7	76.80	0.000	-0.068	0.6	-63.6	0.2	-49.9
8	76.20	0.000	-0.058	0.6	-98.5	0.1	-66.5
9	75.70	0.000	-0.049	0.7	-135.5	0.1	-82.0
10	75.20	0.000	-0.041	0.7	-180.7	0.0	-99.0
11	74.80	0.000	-0.035	0.6	-222.6	0.0	-108.8
12	74.40	0.000	-0.030	0.6	-266.6	0.0	-109.6
13	73.80	0.000	-0.022	0.6	-328.6	0.0	-93.9
14	73.20	0.000	-0.015	0.5	-375.2	0.0	-57.9
15	72.60	0.000	-0.010	0.4	-394.0	8.5	-1.6
16	72.00	0.000	-0.006	0.3	-382.2	68.1	-0.1
17	71.40	0.000	-0.003	0.3	-323.1	117.7	-0.1
18	70.80	0.000	-0.001	0.2	-245.9	135.6	-0.1
19	70.20	0.000	-0.000	0.1	-164.4	127.7	-0.1
20	69.60	0.001	-0.000	0.1	-93.2	103.7	-0.1
21	69.00	0.001	-0.000	0.0	-39.9	70.6	-0.1
22	68.45	0.001	-0.000	0.0	-10.2	36.3	-0.0
23	67.90	0.001	-0.000	0.0	-0.0	0.0	-0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment				Shear force			
	maximum	elev.	minimum	elev.	maximum	elev.	minimum	elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	0.6	75.70	-0.0	79.80	0.3	78.60	-0.2	73.20
2	0.7	75.70	-0.0	79.80	0.3	78.00	-0.1	72.60
3	0.6	75.20	-0.0	79.80	0.2	78.00	-0.1	72.00
4	0.6	75.20	-0.0	79.80	0.2	78.00	-0.1	72.00
5	0.0	80.40	-348.0	72.60	117.5	70.80	-100.8	74.40
6	0.0	80.40	-394.0	72.60	133.0	70.80	-109.6	74.40
7	0.0	80.40	-394.0	72.60	135.6	70.80	-109.6	74.40

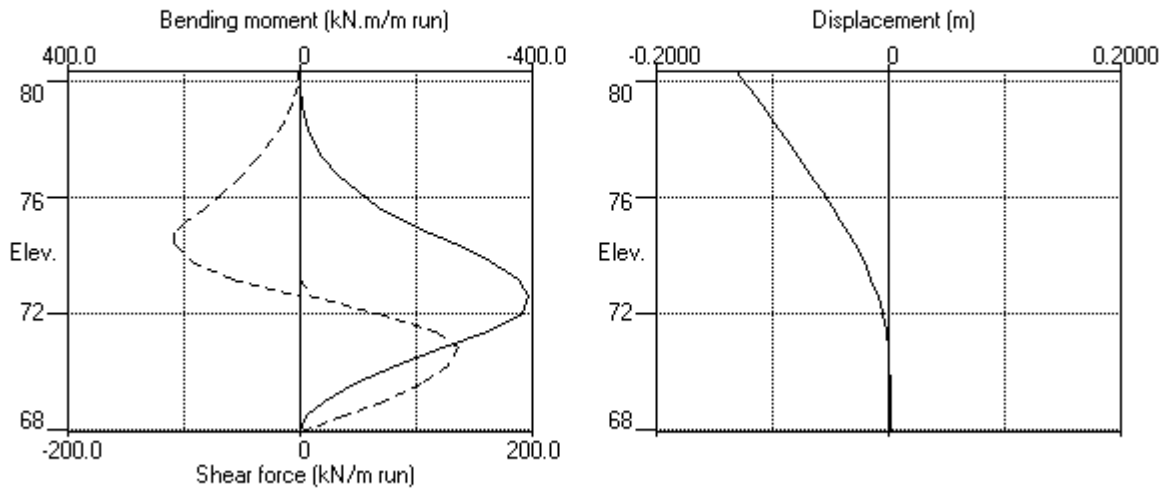
Summary of results (continued)

Maximum and minimum displacement at each stage

Stage -----		Displacement -----			
no.	<u>maximum</u>	<u>elev.</u>	<u>minimum</u>	<u>elev.</u>	<u>Stage description</u>
	m		m		
1	0.000	80.40	-0.000	74.40	Apply surcharge no.1 at elev. 80.40
2	0.000	80.40	-0.000	73.80	Apply surcharge no.2 at elev. 80.40
3	0.000	80.40	-0.000	73.20	Apply surcharge no.3 at elev. 80.40
4	0.000	80.40	-0.000	72.00	Apply surcharge no.4 at elev. 80.40
5	0.000	68.45	-0.102	80.40	Excav. to elev. 75.20 on LEFT side
6	0.001	67.90	-0.120	80.40	Apply surcharge no.5 at elev. 80.40
7	0.001	68.45	-0.131	80.40	Change EI of wall to 107440kN.m2/m run

Units: kN,m

Bending moment, shear force, displacement envelopes



Appendix E – OASYS SLOPE GRAPHICAL OUTPUT

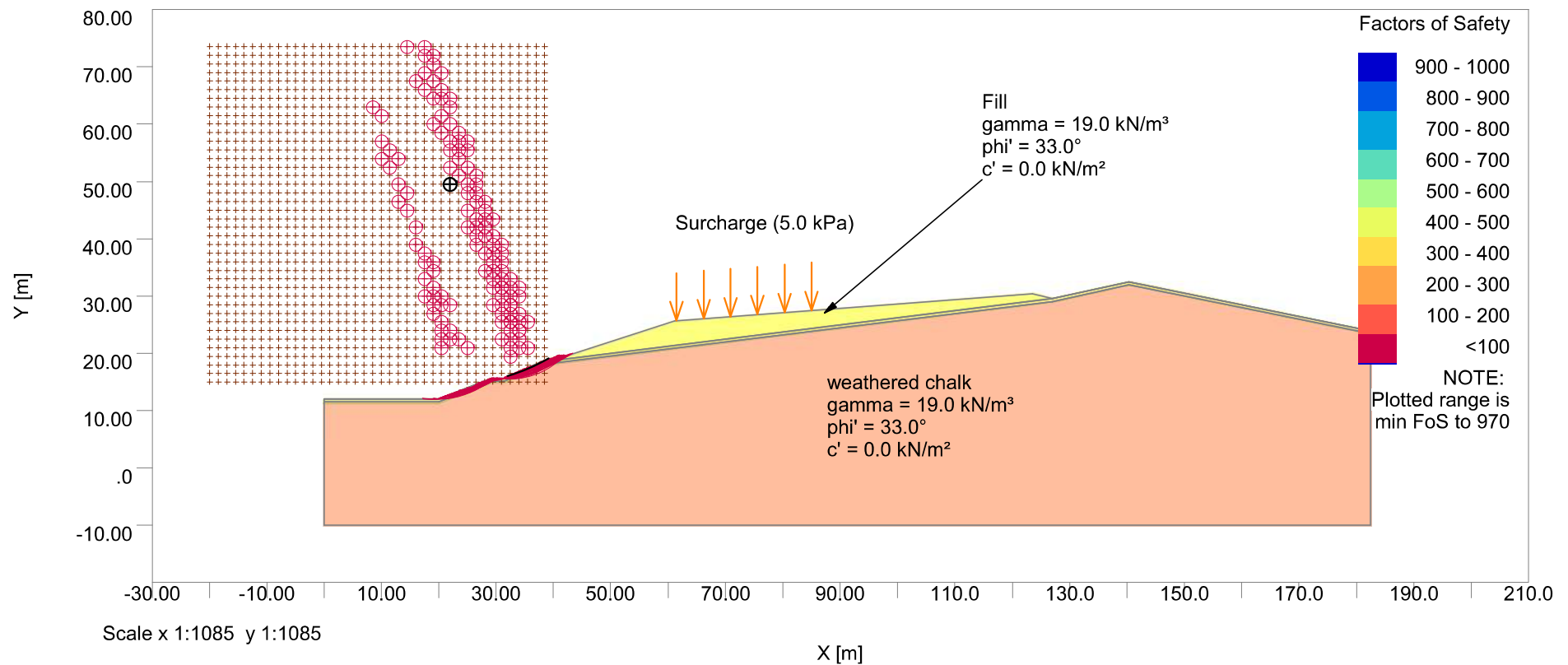
Meridian Gate

Long term analysis (section J-J) Global Stability

BS EN 1997-1:2011 DA1-1

Job No.	Sheet No.	Rev.
373447		
Drg. Ref.		
Made by MS	Date	Checked Date

More than one slip surface shown, minimum factor of 1.367



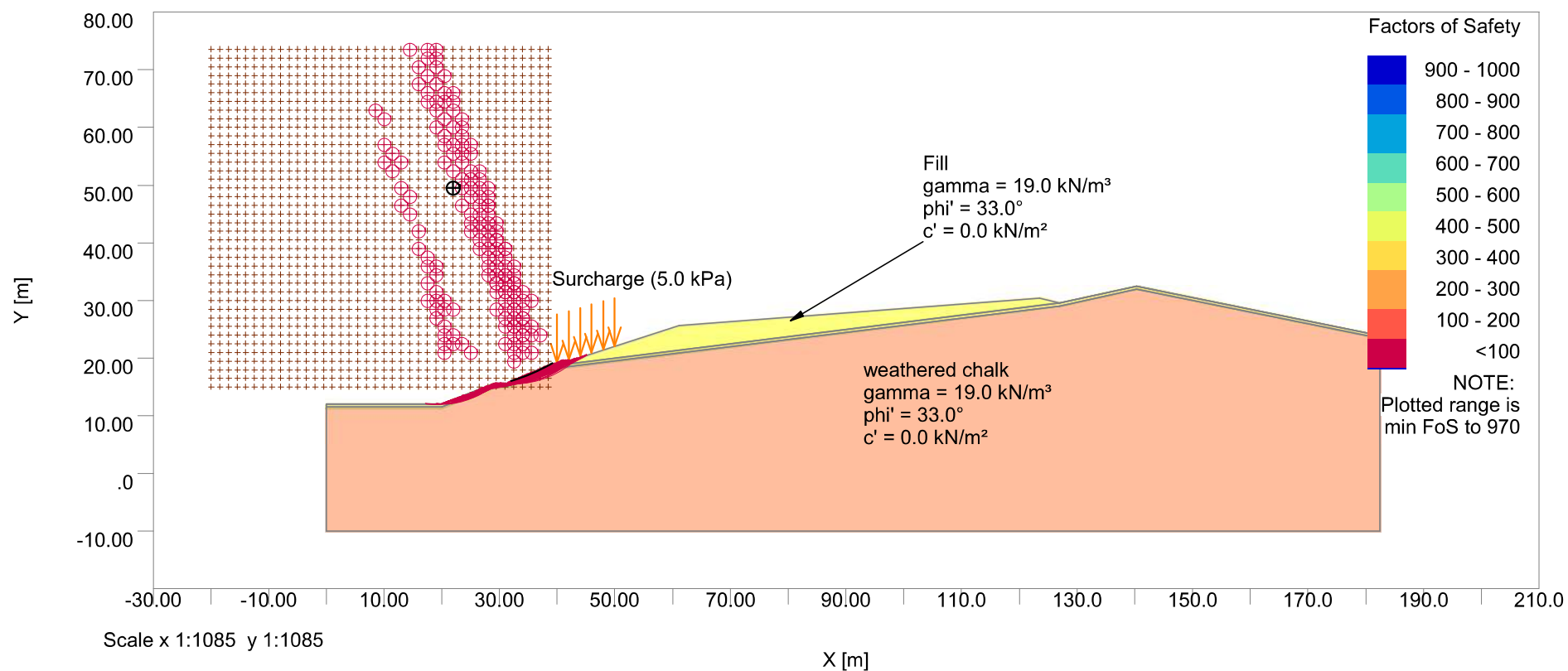
Meridian Gate

Long term analysis (section J-J) Local Stability

BS EN 1997-1:2011 DA1-1

Job No.	Sheet No.	Rev.
373447		
Drg. Ref.		
Made by MS	Date	Checked Date

More than one slip surface shown, minimum factor of 1.367



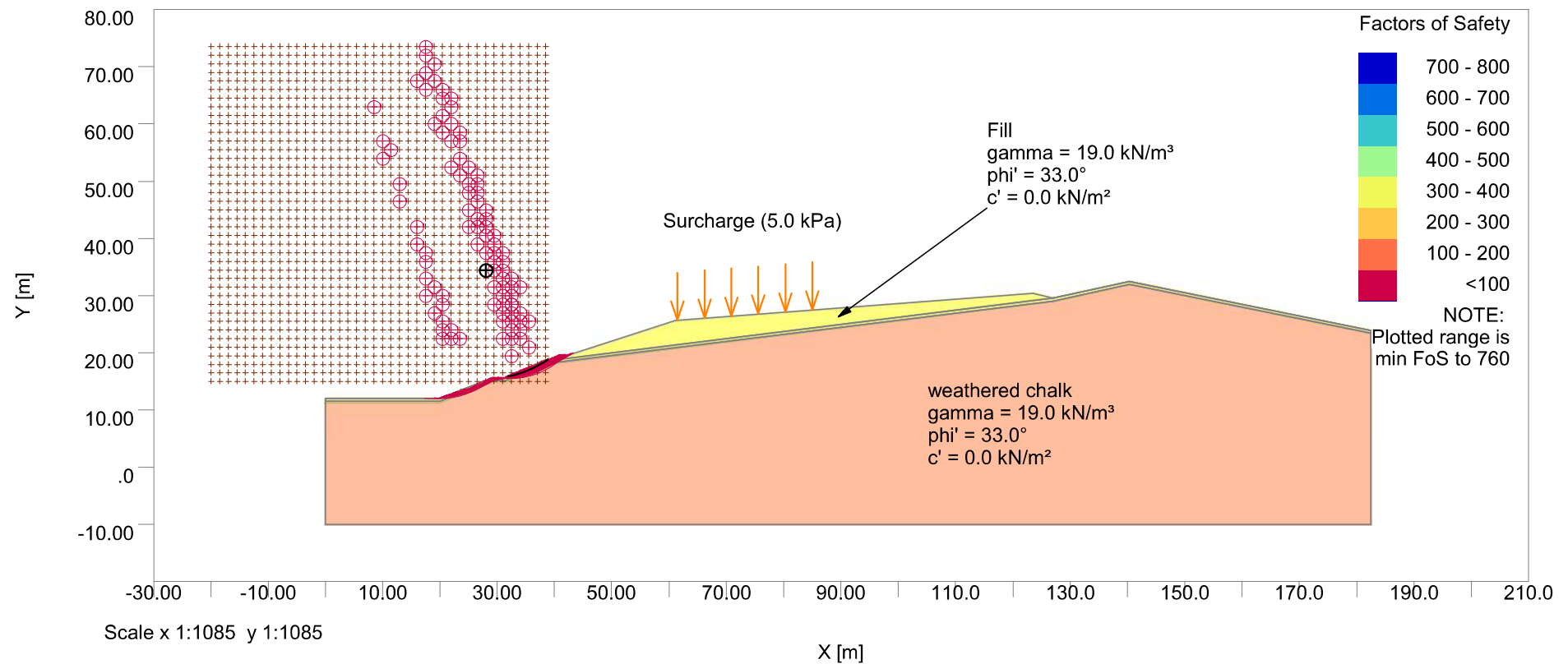
Meridian Gate

Long term analysis (section J-J) Global Stability

BS EN 1997-1:2011 DA1-2

Job No.	Sheet No.	Rev.
373447		
Drg. Ref.		
Made by MS	Date	Checked Date

More than one slip surface shown, minimum factor of 1.054



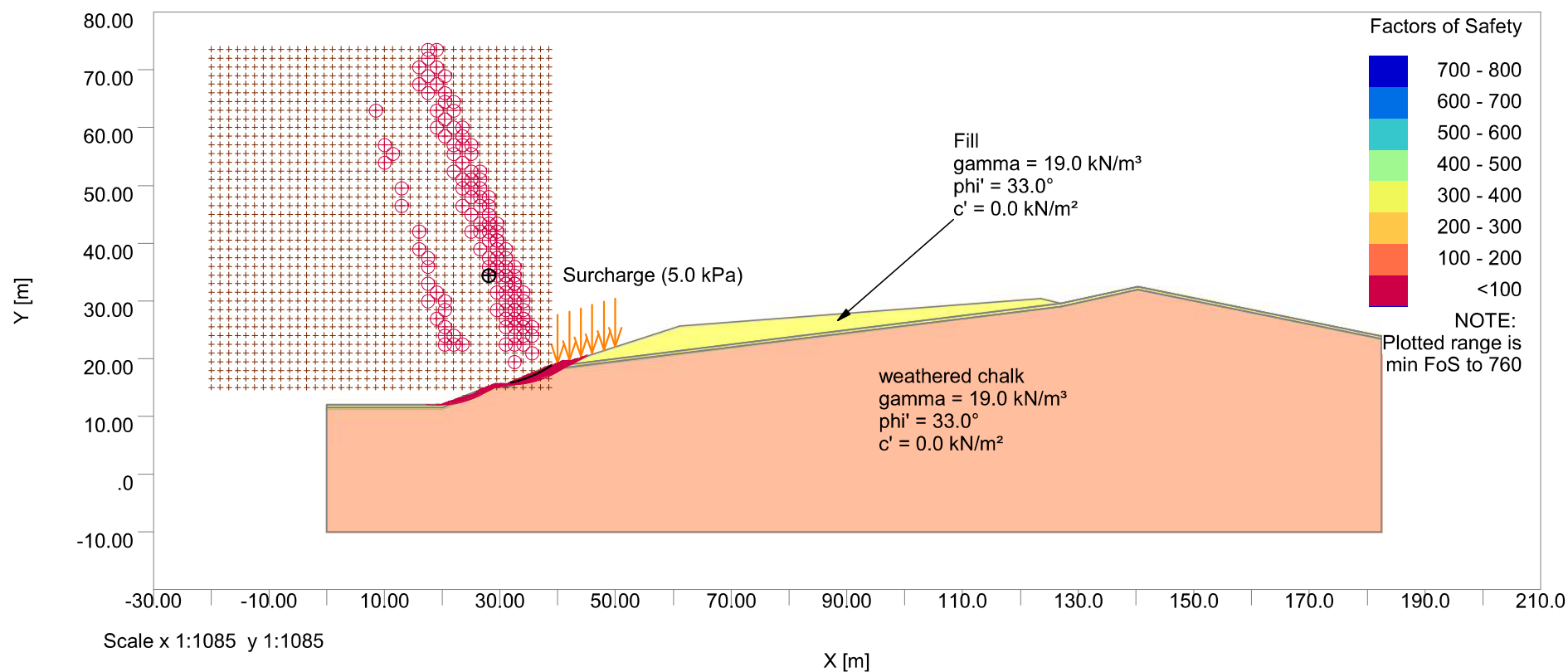
Meridian Gate

Long term analysis (section J-J) Local Stability

BS EN 1997-1:2011 DA1-2

Job No.	Sheet No.	Rev.
373447		
Drg. Ref.		
Made by MS	Date	Checked Date

More than one slip surface shown, minimum factor of 1.054



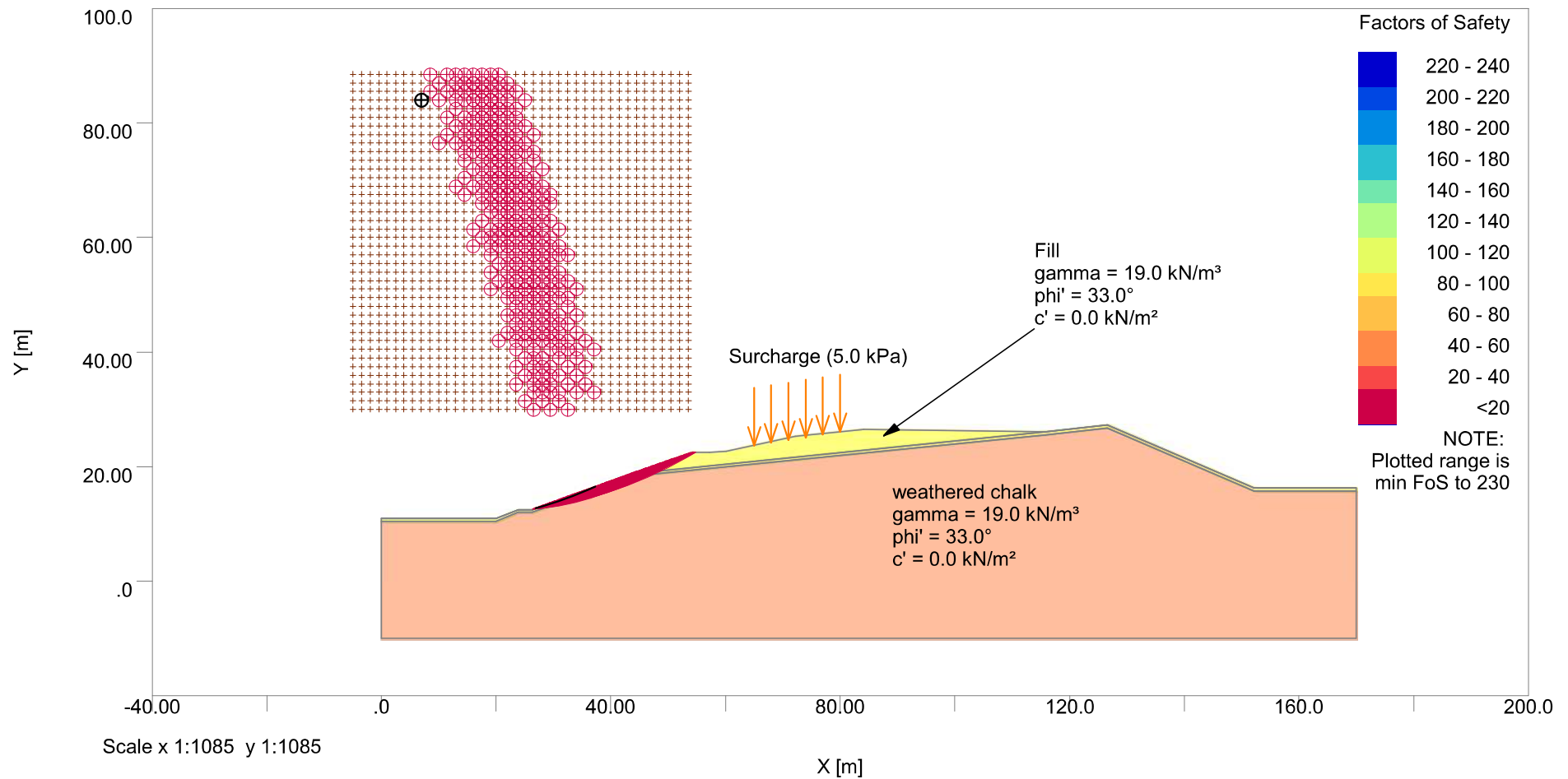
Meridian Gate

Long term analysis (section L-L) (global Stability)

BS EN 1997-1:2011 DA1-1

Job No.	Sheet No.	Rev.
373447		
Drg. Ref.		
Made by MS	Date	Checked Date

More than one slip surface shown, minimum factor of 1.635



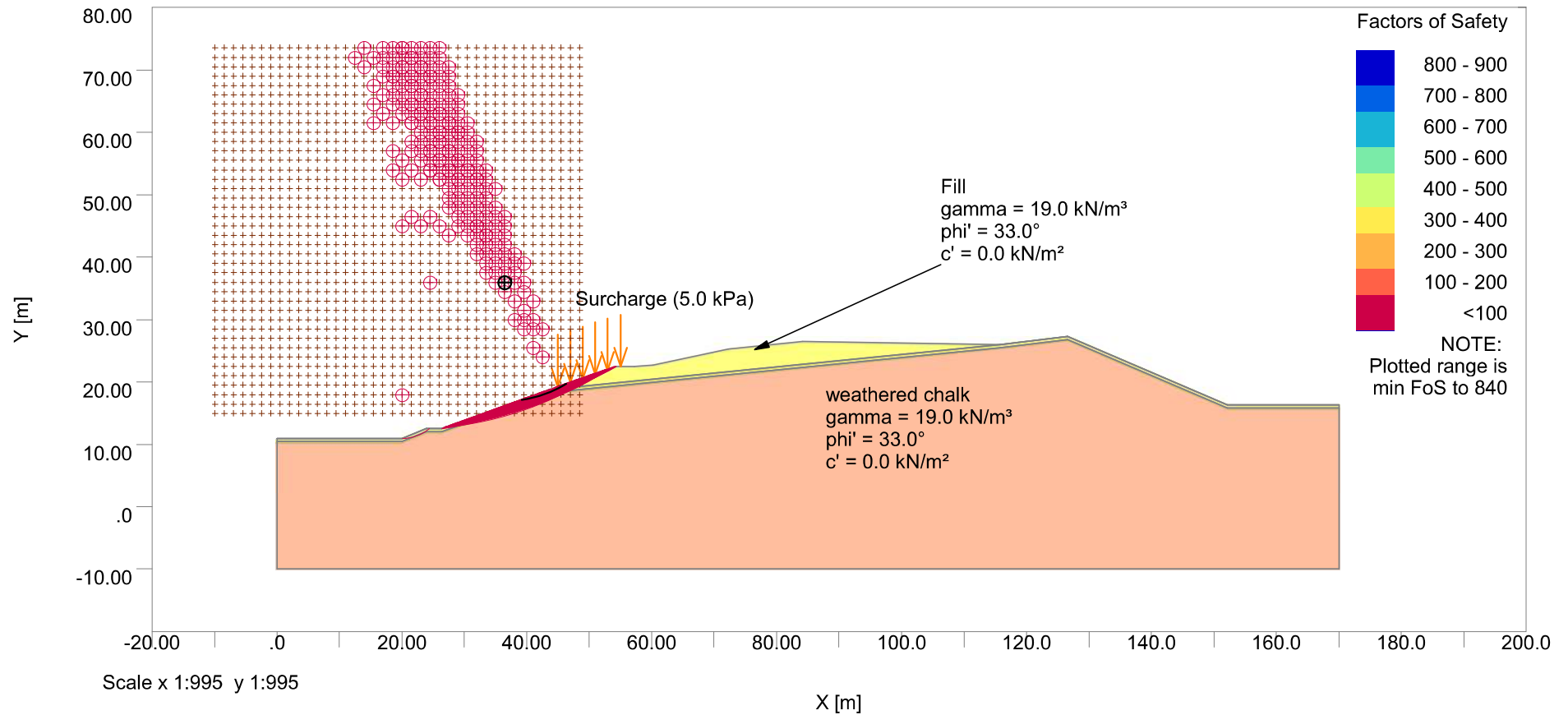
Meridian Gate

Long term analysis (section L-L) (Local Stability)

BS EN 1997-1:2011 DA1-1

Job No.	Sheet No.	Rev.
373447		
Drg. Ref.		
Made by MS	Date	Checked Date

More than one slip surface shown, minimum factor of 1.575



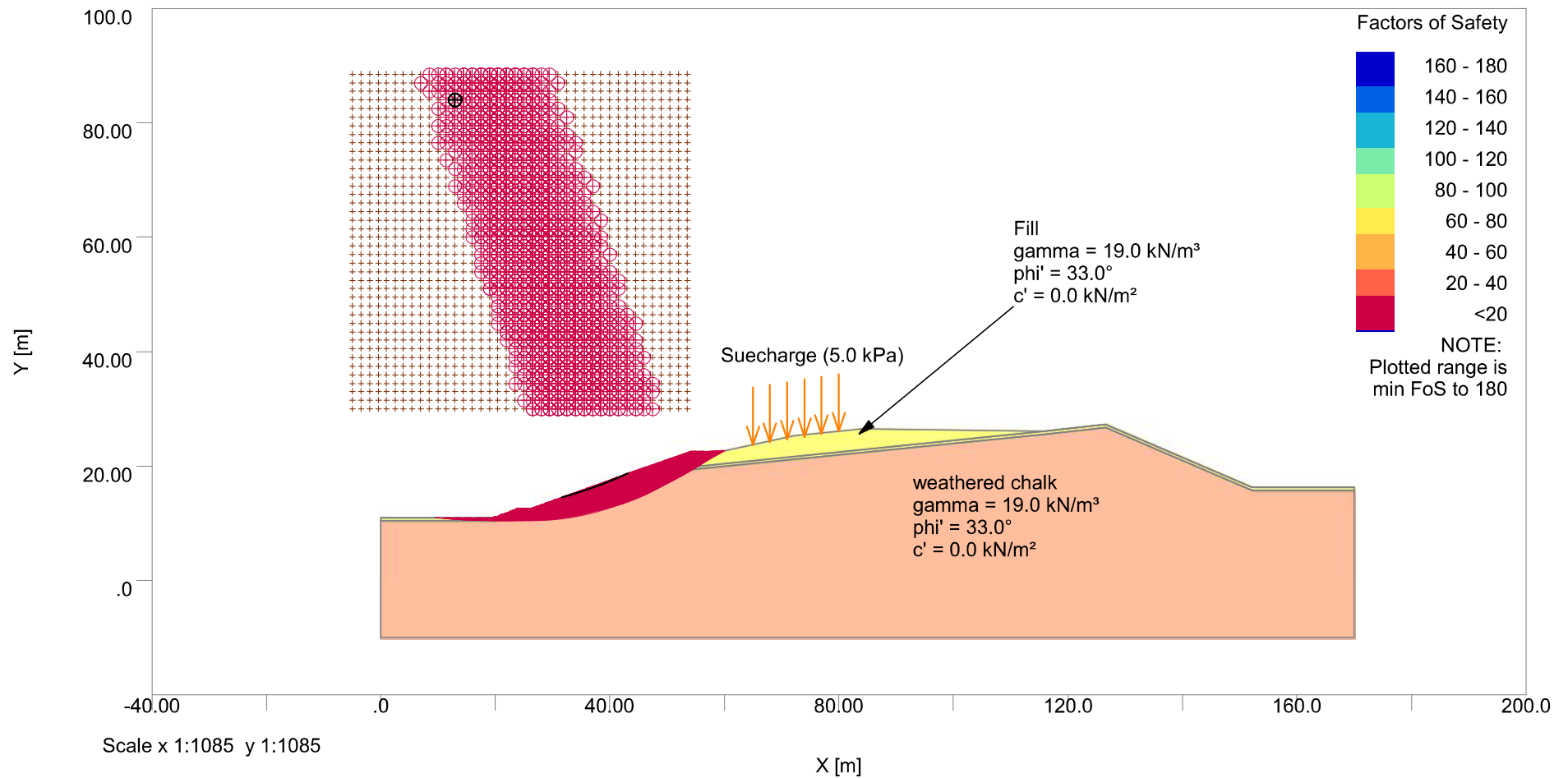
Meridian Gate

Long term analysis (section L-L) (global Stability)

BS EN 1997-1:2011 DA1-2

Job No.	Sheet No.	Rev.
373447		
Drg. Ref.		
Made by MS	Date	Checked Date

More than one slip surface shown, minimum factor of 1.264



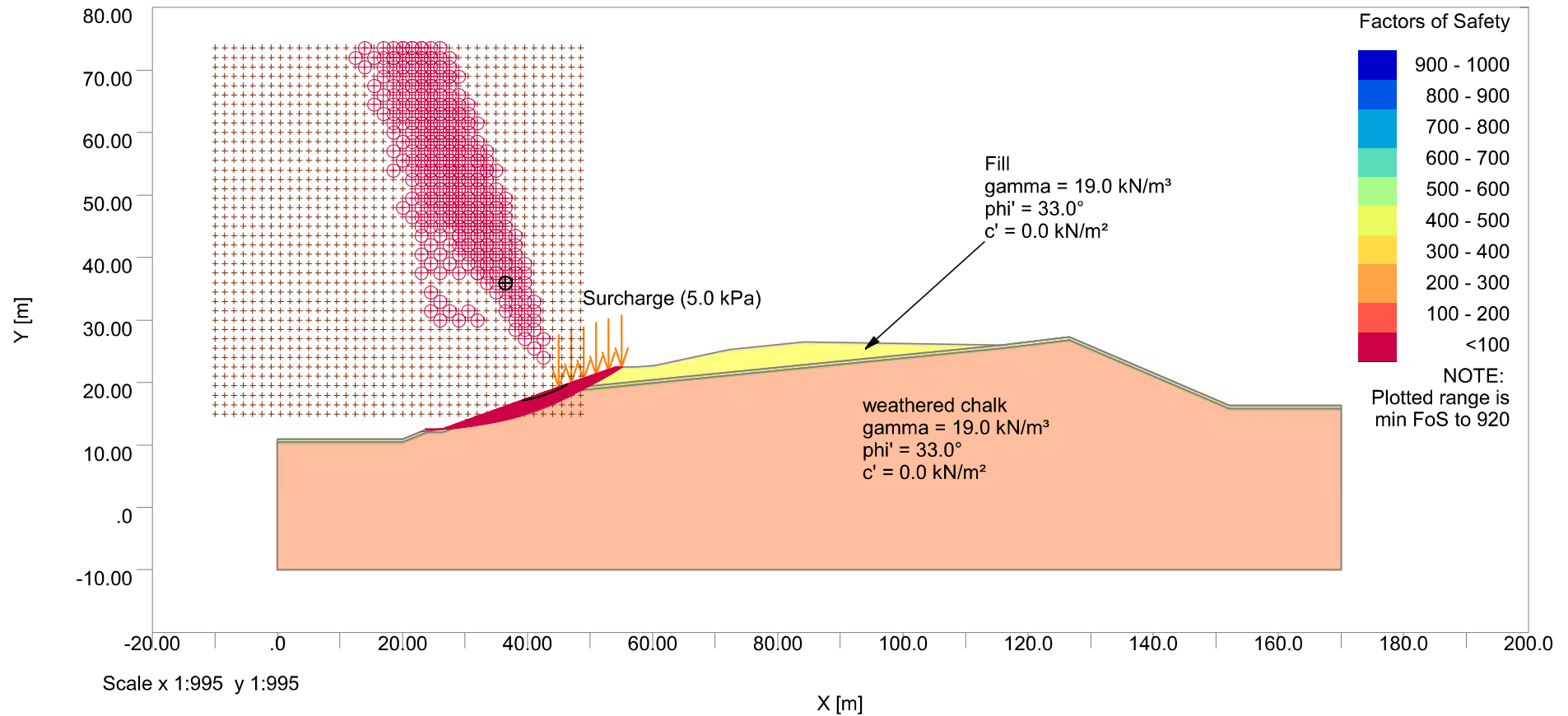
Meridian Gate

Long term analysis (section L-L) (Local Stability)

BS EN 1997-1:2011 DA1-2

Job No.	Sheet No.	Rev.
373447		
Drg. Ref.		
Made by MS	Date	Checked Date

More than one slip surface shown, minimum factor of 1.215



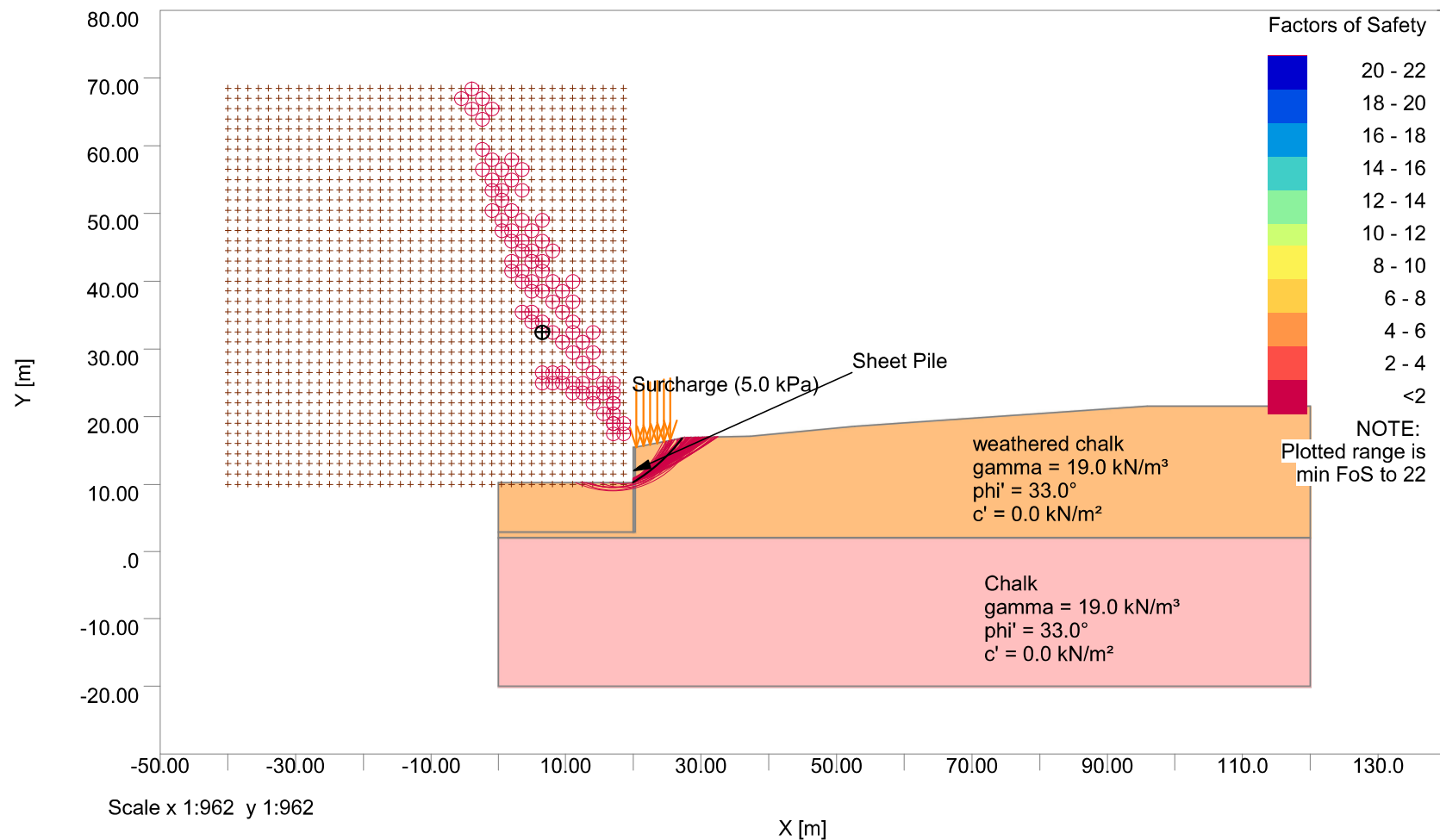
Meridian Gate

Long term analysis (section P-P)

BS EN 1997-1:2011 DA1-1

Job No.	Sheet No.	Rev.
373447		
Drg. Ref.		
Made by MS	Date	Checked Date

More than one slip surface shown, minimum factor of 1.738



Meridian Gate

Long term analysis (section P-P)

BS EN 1997-1:2011 DA1-2

Job No.	Sheet No.	Rev.
373447		
Drg. Ref.		
Made by MS	Date	Checked Date

More than one slip surface shown, minimum factor of 1.519

