



GROUNDTECH
CONSULTING

Job title: Hollingsworth Gate,
Littleborough

Report type: Design Submission

Prepared for: Countryside Partnerships -
Wakefield

Date: June 2023

Document Control Form	
PROJECT	HOLLINGSWORTH GATE, LITTLEBOROUGH
REPORT NAME	DESIGN SUBMISSION
REPORT REFERENCE	GRO-23131-4507
STATUS	FINAL
ISSUE DATE	06 JUNE 2023
REVISION	1.1 10 JULY 2023
	1.2 18 JULY 2023
	1.3 06 OCTOBER 2023
CLIENT	COUNTRYSIDE PARTNERSHIPS – WAKEFIELD OFFICE
CLIENT CONTACT	SAM BUSWELL
For and Behalf of Groundtech Consulting	
SIGNATURE	
AUTHOR	James Doyle BSc (Hons) CGeol FGS
SIGNATURE	
CHECKED	Richard Wyatt MEng (Hons) FGS
SIGNATURE	
REVIEWED	James Doyle BSc (Hons) CGeol FGS

CONTENTS

1.0	INTRODUCTION.....	1
1.1	BACKGROUND	1
1.2	SOURCES OF INFORMATION.....	1
2.0	DESIGN BRIEF.....	2
3.0	DESIGN CALCULATIONS.....	8
4.0	CONSTRUCTION SEQUENCE.....	9
5.0	PRODUCT SPECIFICATION.....	10
6.0	PLANS.....	11
7.0	DESIGN BRIEF CONFIRMATION FORM.....	12
8.0	SETTLEMENT ASSESSMENT.....	13
9.0	SLOPE STABILITY ASSESSMENT.....	14
9.1	HISTORY	14
9.2	GEOLOGY	14
9.3	HYDROLOGY	14
9.4	GROUND INVESTIGATION INFORMATION	14
9.5	ASSESSMENT.....	14
9.6	PARAMETERS	14
9.7	SLOPE MODEL RESULTS (ROTATIONAL FAILURE).....	15
9.8	LIMITATIONS.....	17
9.9	SUMMARY.....	17

APPENDIX 1 - PLANS

APPENDIX 2 - SECTION A MODELLING OUTPUTS

APPENDIX 3 - SECTION B MODELLING OUTPUTS

APPENDIX 4 - SECTION D MODELLING OUTPUTS

APPENDIX 5 - SECTION E MODELLING OUTPUTS

APPENDIX 6 - SECTION F MODELLING OUTPUTS

APPENDIX 7 - GEOTECHNICAL TESTING RESULTS

APPENDIX 8 - LIMITATIONS

Plans		
Plan Reference	Revision	Title
GRO-23131-P01	-	Project Location Plan
GRO-23131-P03A-G (exc C)	1.2/1.4	Tensar Profile Plan
GRO-23131-P04	1.2	Slope Section Plan
GRO-23131-P05	1.3	Tensar Areas Plan
GRO-23131-P06	-	Manhole Detail – Section View
GRO-23131-P07	-	Manhole Detail – Plan View

1.0 INTRODUCTION

1.1 Background

Groundtech Consulting Ltd have been appointed to design the TensarTech Natural GreenSlope reinforced soil slope for the residential housing project at Hollingworth Gate, Littleborough.

The Design Submission is based solely on the information provided by the client Countryside Partnerships Yorkshire.

The reinforced soil design is strictly in accordance with the information contained within the Design Brief attached. Variations to the information contained within the Design Brief or the scope of the services detailed may affect the design of the reinforcement and should be notified to Groundtech prior to commencement of construction.

1.2 Sources of Information

In preparing this Design Submission the following documents and Plans were reviewed and should be read in conjunction with this report:

- *HOLL-WBA-XX-XX-DR-A-PL_501-P15_Proposed Masterplan*
- *10861-01 Topographical Survey*
- *45466_015H - Canal Sections Plan*
- *45466_016H Canal Sections 1*
- *45466_017K Canal Sections 2*
- *45466_018G Canal Sections 3*
- *45466_004P - Levels Appraisal Sheet 1*
- *45466_005P - Levels Appraisal Sheet 2*
- *Ground Investigation Report (Factual) - Hollingworth Gate, Littleborough 21-763 by ARC Environmental, dated 20 December 2021*

2.0 DESIGN BRIEF

2.1 Summary

The purpose of this document is to set out the agreed design parameters and scope of the design services on which the design of the Tensar soil reinforcement has been based. The responsibility on providing representative strength parameters for the soil lies with the Client. Groundtech assumes no liability for interpretation or verification of subsurface conditions, for suitability of soil design parameters or for interpretation of subsurface groundwater conditions. The Client is responsible to verify that actual site conditions, parameters, loadings and structure geometries are as described herein prior to construction commencement.

2.2 Slope Stability

A slope stability assessment for the existing slope along the sites northern boundary has been undertaken by Groundtech Consulting to assess the overall stability and the findings are discussed in Section 9.0.

2.3 Reinforced Slope details

1) Type of Structure

TensarTech NaturalGreen Slope with select areas of Tensar reinforcement in a single retaining structure along the sites northern boundary adjacent to the canal. The area to be reinforced is shown on Eastwood and Partners Drawings 45466_016E to C as sections:

- *Section A-A – Proposed 1:1 slope*
- *Section B-B – Proposed 1:1.2 slope*
- *Section C-C – Proposed 1:2 slope*
- *Section D-D – Proposed 1:1 slope*
- *Section E-E – Proposed 1:1 slope*
- *Section F-F – Proposed 1:1 slope*
- *Section G-G – Proposed 1:1.5 slope*

2) Facing

TensarTech erosion control mat on all the faces of the engineered slope.

3) Reinforcement

Tensar uniaxial geogrids with Tensar triaxial secondary geogrids.

4) Geometry

Max. Design Height: 6.0m

Slope Face Angle: 30° to 45°

(Stability of Toe slope is to be checked and confirmed by Client Geotechnical Engineer prior to commencement of Construction)

5) Method of Analysis

Internal Stability only - Limit equilibrium Bishop method of slices with minimum factor of safety of 1.3 or higher.

External stability – Slope stability was modelled by Groundtech Consulting utilising Oasys software using the Bishop (circular failures) method to determine a range of Over Design Factors (ODF).

External stability – Slope stability was modelled by Groundtech Consulting utilising Oasys software using the Janbu (non-circular failures) method to determine a range of Over Design Factors (ODF).

Bearing capacity (including stability of toe slope if required) is by others and outside the scope of Groundtech. The stability of the unreinforced slope is the responsibility of the Client.

6) Reinforced Fill

Geotechnical parameters were derived from the Ground Investigation undertaken by Arc Environmental, additional trial pits have been undertaken by Groundtech Consulting. The existing slope is predominantly constructed from Made Ground Clay and clayey sand/gravel. A bulk density of $\gamma_b = 17.5\text{kN/m}^3$ has been utilised for the Tensor design.

Earthworks testing of the site won material has been undertaken and site specific results have been used. A conservative friction angle of $\phi' = 29^\circ$ has been selected for the Tensor design.

7) Retained fill

Indicated to be soft to firm and firm Made Ground Clay or clayey gravel/sand as such the following bulk density and phi values have been utilised for the Tensor design. Design Properties: $\gamma_b = 17.5\text{kN/m}^3$ $\phi' = 29^\circ$.

8) Foundation Soil

Foundation soil is presented by the clients Geotechnical Engineer within the Arc Environmental Reports. Foundation soils generally comprise bedrock, however in the locations of Section B and Section F the bearing strata appears to be Made Ground and Stiff Clay respectively. Inspection of the foundation soils will be required prior to construction, this forms a fundamental part of the design and suitable preparation should be implemented. The reinforced earth will not be constructed on soft clay.

9) Water Conditions

Based on the Ground Investigation by others, no groundwater has been modelled, a slight seepage has been recorded at the base of the Made Ground locally – this should be further assessed during construction and the risk removed by the proposed drainage strategy. Canal is located immediately to the north of the reinforced slope, it has been assumed the watercourse does not encroach on the reinforced earth slope and does not affect the stability.

The wall has been modelled in the overall stability, exact construction details of the canal are not known.

10) External Loading

10kPa temporary (live) surcharge considered to model traffic for private drives and carriageways.

75 to 100 kPa permanent surcharge for considered to model gabion wall for Section F.

No other loads (vertical/horizontal loads) are modelled for the proposed Tensartech NaturalGreen Slope System. It is assumed that plots adjacent to the crest of the slope will be piled and no loadings have been applied in the model.

An acceleration of 0.2g taken from Barkins equation and published values has been modelled to assess the potential affect of vibration from driven piling. The loadings of the piling rig has not been modelled.

2.4 Modelling

Introduction

The following selected relevant sections were modelled by Groundtech Consulting:

- Section A-A – Proposed 1:1 slope
- Section B-B – Proposed 1:1.2 slope
- Section C-C – Proposed 1:2 slope
- Section D-D – Proposed 1:1 slope
- Section E-E – Proposed 1:1 slope
- Section F-F – Proposed 1:1 slope
- Section G-G – Proposed 1:1.5 slope

Modelling Results

The sections listed above were modelled in TensarSoil to check the internal stability of the reinforced earth and the results are presented in the table below:

Section	Height (m)	Load 1 (kN/m ²)	Distance load applied from crest (m)	Load 2 (kN/m ²)	Distance load applied from crest (m)	Design Acceptable (Yes/No)	Strap Length Required (m)
A-A	4.1- 4.45	10.0 variable	1.0 – 4.0	n/a	n/a	Yes	4.3
B-B	2.1 -2.4	10.0 variable	1.0 – 4.0	n/a	n/a	Yes	4.0
C-C	3.2	10.0 variable	1.0 – 4.0	n/a	n/a	No Reinforced Earth Required	
D-D	4.2-4.9	10.0 variable	1.0 – 4.0	n/a	n/a	Yes	4.8
E-E	5.85-7.45	10.0 variable	1.0 – 4.0	10.0 variable	5.0 – 9.45	Yes	4.5 to 8.0

F-F	3.5-4.5	10.0 variable	1.0 – 4.0	100 Permanent	7.4 – 9.6	Yes	5.0
G-G	4.0	10.0 variable	1.0 – 11.0	n/a	n/a	Yes	4.6

Variable loads have generally been modelled for the driveways and carriageways adjacent to the proposed slope crest. Permanent loads have not been modelled for the proposed plots as it is assumed these will be piled to bedrock.

A permanent load has been modelled for the proposed gabion adjacent to the crest of section F-F. Based on the angle of friction (ϕ') of 29° selected, the straps do not extend beneath the gabion structure.

2.5 Project Specific Notes

- *The maximum height of the slope is 6.0m therefore the maximum exerted unfactored imposed bearing pressure at the base of the 6.0m (max. height) TensarTech NaturalGreen Slope itself is approximately 120kPa.*
- *Any proposed barriers or fences on top of TensarTech Natural Green Slope should be self-stable and should not impose any horizontal loads onto the face of TensarTech structure. Minimum distance to any barrier foundation should be 0.7m.*
- *Geogrid should be curtailed longitudinally around any tree root bulbs, drainage pipes or inverts to be installed. Ideally this should be done during construction of the slope and not retroactively to ensure the cuts are neat and accurate.*
- *No structures have been assumed to be supported by the slope and therefore no allowance has been made for loadings on the reinforced soil slope.*
- *Please also note that the reinforced soil slopes are flexible structures and may accommodate larger differential settlement compared to rigid form of structures. The building foundations must not rely on the surrounding soil as any movement within reinforced soil slope will have a direct impact on the serviceability of the house.*
- *Drainage requirements to be assessed by others. The reinforced soil has been assessed for dry conditions and should remain reasonably dry both during the construction phase and its design life. The customer's geotechnical engineer should assess the need for an appropriate drainage layer at the base and back of the reinforced soil block.*
- *The mine shaft on the site has not been included in the model, subject to suitable earthworks the slope in this area will not require reinforced earth.*
- *Piling of the plots at the crest of the slope should not be within 3m, piling should commence away from the crest and sequence progress towards the slope.*
- *The existing slope continues below the reinforced earth towards the canal and allowances should be made for working on existing slope and preparation at toe will be required. Permissions will be required from the Rivers and Canal Trust.*

- *The angle of the toe slope should not exceed 20°.*
- *When cutting back the existing slope, to aid in construction the retained material face should be left stepped, with each step spacing being the associated geogrid spacing. During the upfill and geogrid placement exercise each layer horizon would then be easily identifiable as the next step up for the contractor onsite.*
- *As base strata is assumed to be competent the lower proportion of existing slope should be assessed during the cutting back exercise to confirm this and it forms a fundamental part of the design.*
- *From the recent trial pitting exercise the Made Ground is variable and will require processing if to be reused in the reinforced earth and placed in accordance with an agreed specification in accordance with Series 600.*
- *Organic contamination was also encountered and will require consideration in the design and construction of the reinforced earth, specifically where remedial work is proposed.*
- *To facilitate the most viable design the material may need to be improved via treatment/drying or additional material would need to be imported to for use in the slope, particularly in the lower levels where the associated failure forces are the largest and the highest strength material would be required. Reuse of material is subject to processing and additional confirmatory testing.*
- *The material is generally less than 4% wet of optimum and within the allowable moisture content range. Some of the material is dry and outside the allowable range.*
- *Earthworks testing has classified the Made Ground as 2A/2B, 2C and 1B. The appropriate methods of compaction, number of passes and thickness layers should be adhered to.*
- *Groundwater level to be observed during construction and remodelled if required.*
- *Proposed roads will be underlain by geogrid such as at Section G, requires consideration for roads and sewers.*
- *Utilities including chambers are present along the crest of the existing slope and a pipe is present that exits from the existing slope and crosses the adjacent canal to the north. The position of these utilities and substructure to remain will require consideration prior to the construction of the reinforced earth.*
- *The ground conditions adjacent to the canal are not known and if they vary during construction to the models produced, the design should be reassessed.*

2.4 Exclusions

1. *Bearing Capacity of foundation soils to be assessed by the Client.*
2. *All other design methods, modes of failure, limit states etc. not specifically detailed above are outside the limits of the services offered and arrangements should be made for these to be covered by others.*

3. *Any proposed/existing manholes, lampposts, fence/sign posts, parapets etc should be notified to Groundtech so they can be incorporated in the reinforced earth design prior to detailed design. Foundation design of any such structures is beyond the scope of Groundtechs services and should be designed by the Client as stand-alone structures and without transferring any horizontal loading on the Tensar structure.*
4. *Appropriate surface water and erosion control systems should be designed by the Client to operate during construction and during the design life of the Tensar structure. The reinforced earth zone should remain free-drained and pore water pressures should be appropriately assessed by the Client to dissipate by capturing and disposing of groundwater that might build up behind the Tensar structure.*
5. *Utilities carrying water within the reinforced zone or on the face of the Tensar structure must be designed (by the Client) to prevent/contain leakage. The potential of differential soil movement within the reinforced zone and its effect on any utilities would also need to be considered by the Client.*
6. *Groundtech exercises the right to rely on geometries, strength parameters, groundwater and loading conditions stated by the Client for the purpose of determining the geogrid layout for the Project. In the absence of the above explicitly stated by the Client, Groundtech recommends that the Client retain the services of a Geotechnical Engineer to confirm the appropriateness of the assumptions above.*
7. *Unless specifically stated no allowance has been included for entering into any warranties or collateral warranties and the contract will be solely between Groundtech and the company placing the order.*
8. *Treatment of mine entries is not covered by the design.*
9. *Modelling of the mine shaft, substructure and unidentified structures requires consideration where appropriate.*



3.0 DESIGN CALCULATIONS

The following designs were produced using TensorSoils modelling software, with the design parameters and geometric provided by the clients plans.

Client: Vistry

Project: Hollingworth Gate, Littleborough

Tensar
Structural Systems

TensarTech
NaturalGreen System



This document contains Tensar Software Output which has been prepared by Groundtech Consulting on a confidential basis, to enable the application of **Tensar** geogrids to be evaluated. The Tensar Software Output is merely illustrative and is not a detailed design. It is specific to the unique characteristics of the **Tensar** geogrids which are referenced within the calculations.

Copyright in this document belongs to Tensar International Limited. It may not be reproduced in whole or in part without the prior written permission of Tensar International. It must not be disclosed other than for the purpose of evaluating its commercial application for the use of geogrids.

This Tensar Software Output does not form the whole or any part of a contract. Its suitability for any project is the sole responsibility of the user and its professional advisors. Neither Tensar International Limited nor Groundtech Consulting are responsible for any application of the Tensar Software Output other than in conjunction with the sale of **Tensar**.

Tensar is a registered trademark.

**Method of
analysis**

The Tensar 2-part Wedge Slope Design Method is based on the 2-part wedge calculation procedure described in Advice Note HA68/94 "Design Methods for the Reinforcement of Highway Slopes by Reinforced Soil and Soil Nailing Techniques" (Design Manual for Roads and Bridges, Volume 4, Section 1, Part 4, now withdrawn). Partial material factors are applied to the soil strength and the resistance provided by the geogrid reinforcement.

Reference

GRO-23131

Date

18 Jul 2023

Page

1 of 3

Design analysis
prepared by

Groundtech Consulting

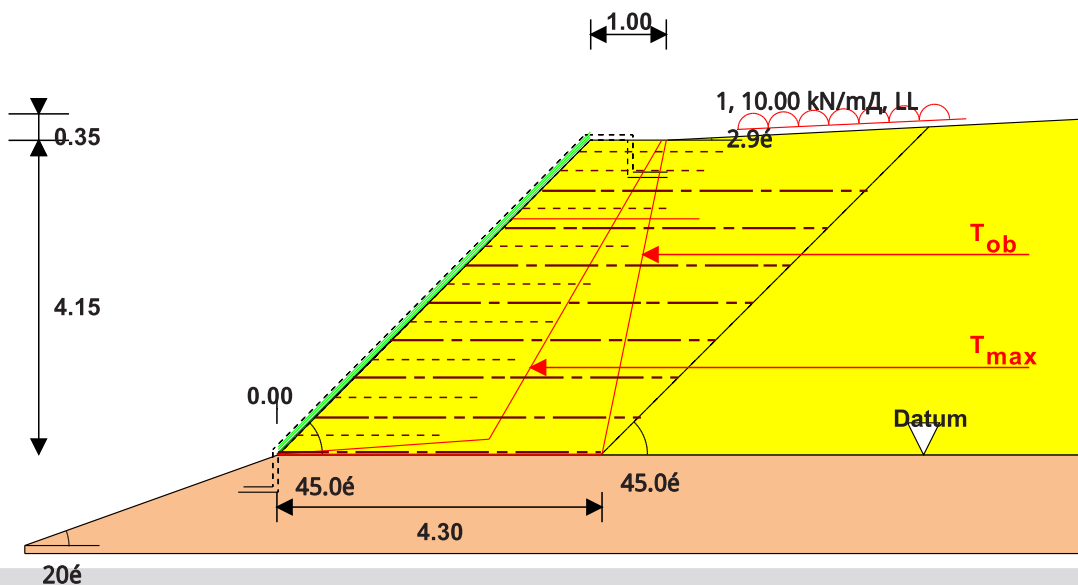
Telephone:

Fax:

E-mail:

Input data and Section

Project: Hollingworth Gate, Littleborough



Tensar Structural Systems **TensarTech** NaturalGreen System

Static loading case

All dimensions in metres

Scale 1:100

Fill/foundation properties

Design soil strength parameters are peak values

Soil zone	Drained/ undrained	c' (kN/m ²)	φ' (°)	γ _{bulk} (kN/m ³)
Reinforced fill	Drained	0.0	29.0	17.5
Retained fill	Drained	0.0	29.0	17.5
Foundation soil	Assumed to be competent			

Surcharges

No	Load acts from x (m)	To x (m)	Load (kN/m ²)	Temporary/Permanent
1	1.95	4.95	10	Temporary

x coordinates are measured from the top of the reinforced fill block.

Water pressure data

Location	Height of water level above datum (m)	r _u
In front of structure	No water pressures	
Within fill	No water pressures	NA

Reference

GRO-23131

Date

18 Jul 2023

Page

2 of 3

Stability results	T _{ob} mechanism gives the minimum length of the base geogrid (m)		4.3
	T _{max} mechanism gives minimum length of theoretical top grid (m)		2.48
	Two-part wedge searches starting at various heights above the datum require percentage of available geogrid strength as shown	0.0 m	26.6%
		1.04 m	33.4%
		2.08 m	39.5%
		3.11 m	40.5%

Reinforcement layout Starting and finishing levels are related to datum	Tensar Geogrid	No of layers	Starting level (m)	Vertical spacing (m)	Finishing level (m)	Coverage (%)	f _b
	RE520	7	0.50	0.50	3.50	100	0.85
	RE520	1	0.00	-	-	100	0.85

Secondary reinforcement layout	Tensar Geogrid	No of layers	Length (m)	Vertical spacing (m)
	TX150	9	2.00	0.250 m where primary spacing >0.250 m

Further information relevant to this Tensar Earth Retention System	Further information, specifications and bill of quantities descriptions for this TensarTechEarth Retaining Structure are given in the following documents which form part of this Design Analysis		System overview Installation guide Case histories Construction Animation Link
	The current versions of these documents may be found by following the website link to "Tensar Documentation" in the Help menu of the TensarS oil+ program		
	For program users who do not have a link to the internet contact your nearest Tensar representative or distributor	Tensar International Limited software@tensar.co.uk Web: www.tensar.co.uk	

Client: Vistry

Project: Hollingworth Gate, Littleborough

Tensar
Structural Systems

TensarTech
NaturalGreen System



This document contains Tensar Software Output which has been prepared by Groundtech Consulting on a confidential basis, to enable the application of **Tensar** geogrids to be evaluated. The Tensar Software Output is merely illustrative and is not a detailed design. It is specific to the unique characteristics of the **Tensar** geogrids which are referenced within the calculations.

Copyright in this document belongs to Tensar International Limited. It may not be reproduced in whole or in part without the prior written permission of Tensar International. It must not be disclosed other than for the purpose of evaluating its commercial application for the use of geogrids.

This Tensar Software Output does not form the whole or any part of a contract. Its suitability for any project is the sole responsibility of the user and its professional advisors. Neither Tensar International Limited nor Groundtech Consulting are responsible for any application of the Tensar Software Output other than in conjunction with the sale of **Tensar**.

Tensar is a registered trademark.

**Method of
analysis**

The Tensar 2-part Wedge Slope Design Method is based on the 2-part wedge calculation procedure described in Advice Note HA68/94 "Design Methods for the Reinforcement of Highway Slopes by Reinforced Soil and Soil Nailing Techniques" (Design Manual for Roads and Bridges, Volume 4, Section 1, Part 4, now withdrawn). Partial material factors are applied to the soil strength and the resistance provided by the geogrid reinforcement.

Reference

GRO-23131

Date

18 Jul 2023

Page

1 of 3

Design analysis
prepared by

Groundtech Consulting

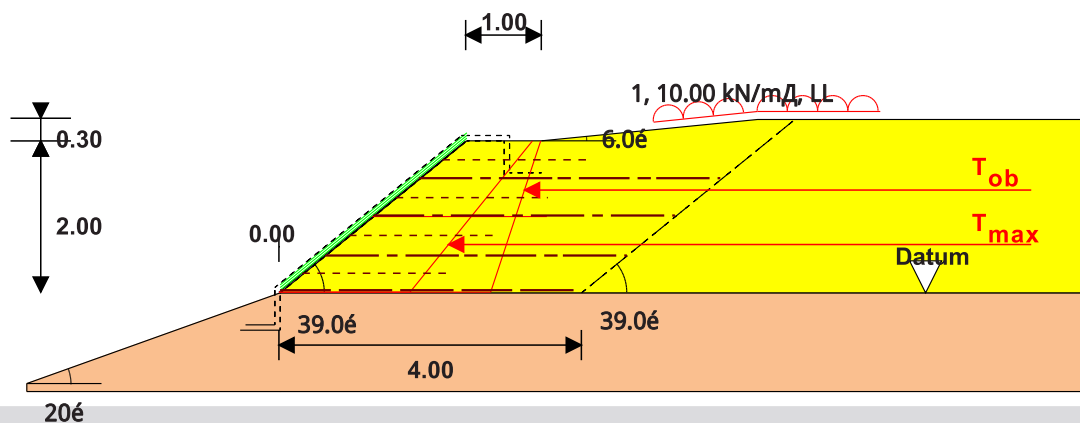
Telephone:

Fax:

E-mail:

Input data and Section

Project: Hollingworth Gate, Littleborough



Tensar Structural Systems **TensarTech** NaturalGreen System

Static loading case

All dimensions in metres

Scale 1:100

Fill/foundation properties

Design soil strength parameters are peak values

Soil zone	Drained/ undrained	c' (kN/m²)	φ' (°)	γ _{bulk} (kN/m³)
Reinforced fill	Drained	0.0	29.0	17.5
Retained fill	Drained	0.0	29.0	17.5
Foundation soil	Assumed to be competent			

Surcharges

No	Load acts from x (m)	To x (m)	Load (kN/m²)	Temporary/Permanent
1	2.48	5.48	10	Temporary

x coordinates are measured from the top of the reinforced fill block.

Water pressure data

Location	Height of water level above datum (m)	r _u
In front of structure	No water pressures	
Within fill	No water pressures	NA

Reference

GRO-23131

Date

18 Jul 2023

Page

2 of 3

Stability results	T _{ob} mechanism gives the minimum length of the base geogrid (m)		2.8
	T _{max} mechanism gives minimum length of theoretical top grid (m)		2.31
	Two-part wedge searches starting at various heights above the datum require percentage of available geogrid strength as shown	0.0 m	27.0%
		0.5 m	23.9%
		1.0 m	33.4%

Reinforcement layout Starting and finishing levels are related to datum	Tensar Geogrid	No of layers	Starting level (m)	Vertical spacing (m)	Finishing level (m)	Coverage (%)	f _b
	RE520	3	0.50	0.50	1.50	100	0.85
	RE510	1	0.00	-	-	100	0.85

Secondary reinforcement layout	Tensar Geogrid	No of layers	Length (m)	Vertical spacing (m)
	TX150	4	2.00	0.250 m where primary spacing >0.250 m

Further information relevant to this Tensar Earth Retention System	Further information, specifications and bill of quantities descriptions for this TensarTechEarth Retaining Structure are given in the following documents which form part of this Design Analysis		System overview Installation guide Case histories Construction Animation Link
	The current versions of these documents may be found by following the website link to "Tensar Documentation" in the Help menu of the TensarS oil+ program		
	For program users who do not have a link to the internet contact your nearest Tensar representative or distributor	Tensar International Limited software@tensar.co.uk Web: www.tensar.co.uk	

Client: Vistry

Project: Hollingworth Gate, Littleborough

Tensar
Structural Systems

TensarTech
NaturalGreen System



This document contains Tensar Software Output which has been prepared by Groundtech Consulting on a confidential basis, to enable the application of **Tensar** geogrids to be evaluated. The Tensar Software Output is merely illustrative and is not a detailed design. It is specific to the unique characteristics of the **Tensar** geogrids which are referenced within the calculations.

Copyright in this document belongs to Tensar International Limited. It may not be reproduced in whole or in part without the prior written permission of Tensar International. It must not be disclosed other than for the purpose of evaluating its commercial application for the use of geogrids.

This Tensar Software Output does not form the whole or any part of a contract. Its suitability for any project is the sole responsibility of the user and its professional advisors. Neither Tensar International Limited nor Groundtech Consulting are responsible for any application of the Tensar Software Output other than in conjunction with the sale of **Tensar**.

Tensar is a registered trademark.

Method of analysis

The Tensar 2-part Wedge Slope Design Method is based on the 2-part wedge calculation procedure described in Advice Note HA68/94 "Design Methods for the Reinforcement of Highway Slopes by Reinforced Soil and Soil Nailing Techniques" (Design Manual for Roads and Bridges, Volume 4, Section 1, Part 4, now withdrawn). Partial material factors are applied to the soil strength and the resistance provided by the geogrid reinforcement.

Reference

GRO-23131

Date

13 Jul 2023

Page

1 of 3

Design analysis
prepared by

Groundtech Consulting

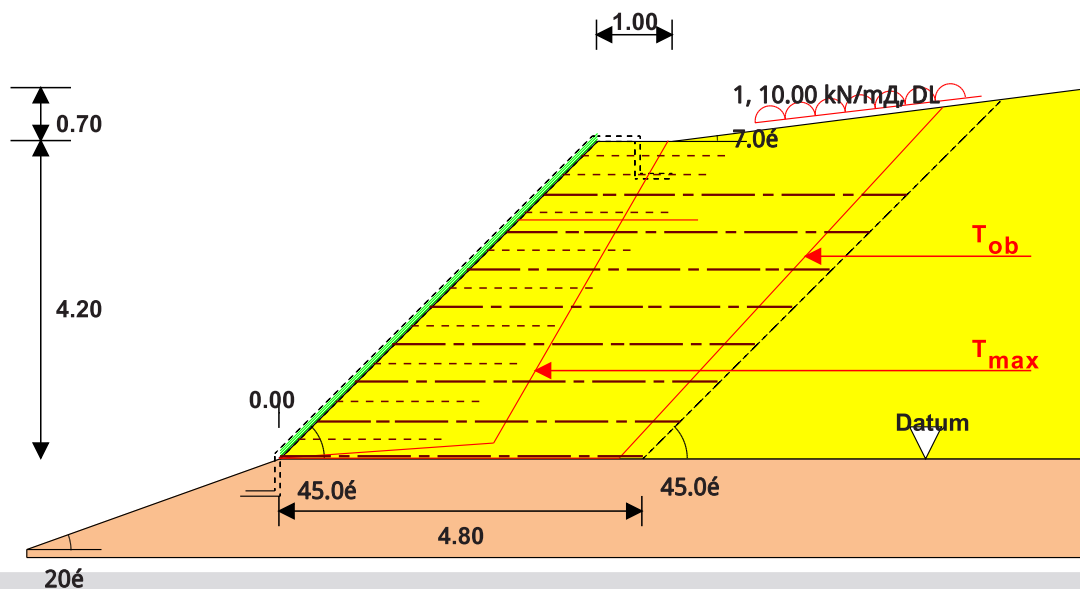
Telephone:

Fax:

E-mail:

Input data and Section

Project: Hollingworth Gate, Littleborough



Tensar Structural Systems TensarTech NaturalGreen System

Static loading case

All dimensions in metres

Scale 1:100

Fill/foundation properties

Design soil strength parameters are peak values

Soil zone	Drained/ undrained	c' (kN/m²)	φ' (°)	γ _{bulk} (kN/m³)
Reinforced fill	Drained	0.0	29.0	17.5
Retained fill	Drained	0.0	29.0	17.5
Foundation soil	Assumed to be competent			

Surcharges

No	Load acts from x (m)	To x (m)	Load (kN/m²)	Temporary/Permanent
1	2.10	5.10	10	Permanent

x coordinates are measured from the top of the reinforced fill block.

Water pressure data

Location	Height of water level above datum (m)	r _u
In front of structure	No water pressures	
Within fill	No water pressures	NA

Reference

GRO-23131

Date

13 Jul 2023

Page

2 of 3

Stability results	T _{ob} mechanism gives the minimum length of the base geogrid (m)		4.5
	T _{max} mechanism gives minimum length of theoretical top grid (m)		2.39
	Two-part wedge searches starting at various heights above the datum require percentage of available geogrid strength as shown	0.0 m	36.3%
		1.05 m	31.0%
		2.1 m	34.0%
		3.15 m	40.0%

Reinforcement layout	Tensar Geogrid	No of layers	Starting level (m)	Vertical spacing (m)	Finishing level (m)	Coverage (%)	f _b
Starting and finishing levels are related to datum	RE520	7	0.50	0.50	3.50	100	0.85
	RE520	1	0.00	-	-	100	0.85

Secondary reinforcement layout	Tensar Geogrid	No of layers	Length (m)	Vertical spacing (m)
	TX150	9	2.00	0.250 m where primary spacing >0.250 m

Further information relevant to this Tensar Earth Retention System	Further information, specifications and bill of quantities descriptions for this TensarTechEarth Retaining Structure are given in the following documents which form part of this Design Analysis		System overview Installation guide Case histories Construction Animation Link
	The current versions of these documents may be found by following the website link to "Tensar Documentation" in the Help menu of the TensarS oil+ program		
	For program users who do not have a link to the internet contact your nearest Tensar representative or distributor	Tensar International Limited software@tensar.co.uk Web: www.tensar.co.uk	

Client: Vistry

Project: Hollingsworth Gate, Littleborough

Tensar
Structural Systems

TensarTech
NaturalGreen System



This document contains Tensar Software Output which has been prepared by Groundtech Consulting on a confidential basis, to enable the application of **Tensar** geogrids to be evaluated. The Tensar Software Output is merely illustrative and is not a detailed design. It is specific to the unique characteristics of the **Tensar** geogrids which are referenced within the calculations.

Copyright in this document belongs to Tensar International Limited. It may not be reproduced in whole or in part without the prior written permission of Tensar International. It must not be disclosed other than for the purpose of evaluating its commercial application for the use of geogrids.

This Tensar Software Output does not form the whole or any part of a contract. Its suitability for any project is the sole responsibility of the user and its professional advisors. Neither Tensar International Limited nor Groundtech Consulting are responsible for any application of the Tensar Software Output other than in conjunction with the sale of **Tensar**.

Tensar is a registered trademark.

**Method of
analysis**

The Tensar 2-part Wedge Slope Design Method is based on the 2-part wedge calculation procedure described in Advice Note HA68/94 "Design Methods for the Reinforcement of Highway Slopes by Reinforced Soil and Soil Nailing Techniques" (Design Manual for Roads and Bridges, Volume 4, Section 1, Part 4, now withdrawn). Partial material factors are applied to the soil strength and the resistance provided by the geogrid reinforcement.

Reference

GRO-23131

Date

17 Jul 2023

Page

1 of 3

Design analysis
prepared by

Groundtech Consulting

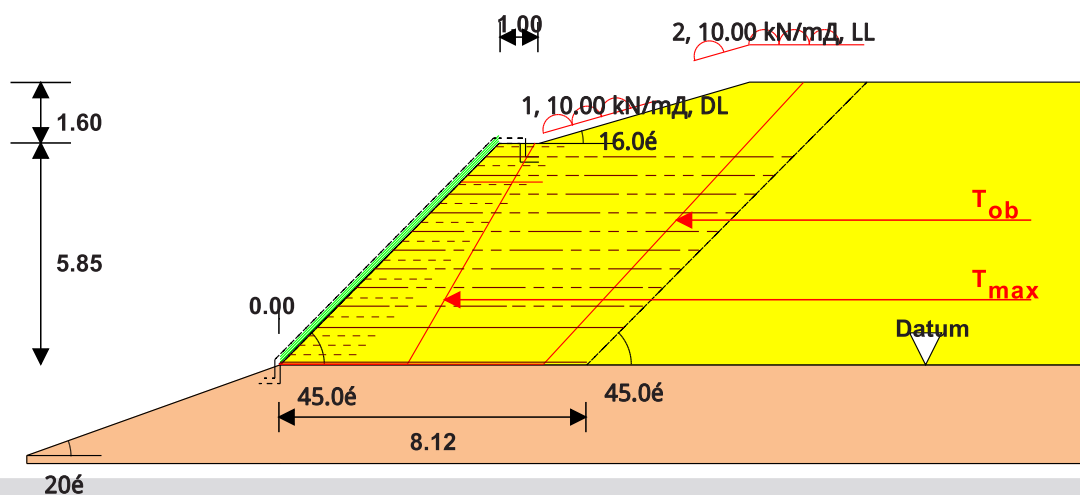
Telephone:

Fax:

E-mail:

Input data and Section

Project: Hollingsworth Gate, Littleborough



Tensar Structural Systems **TensarTech** NaturalGreen System

Static loading case

All dimensions in metres

Scale 1:200

Fill/foundation properties

Design soil strength parameters are peak values

Soil zone	Drained/ undrained	c' (kN/m ²)	φ' (°)	γ _{bulk} (kN/m ³)
Reinforced fill	Drained	0.0	29.0	20.0
Retained fill	Drained	0.0	29.0	20.0
Foundation soil	Assumed to be competent			

Surcharges

No	Load acts from x (m)	To x (m)	Load (kN/m ²)	Temporary/Permanent
1	1.15	4.15	10	Permanent
2	5.15	9.60	10	Temporary

x coordinates are measured from the top of the reinforced fill block.

Water pressure data	Location	Height of water level above datum (m)	r_u
	In front of structure	No water pressures	
	Within fill	No water pressures	NA

Stability results	T_{ob} mechanism gives the minimum length of the base geogrid (m)		7.0
	T_{max} mechanism gives minimum length of theoretical top grid (m)		2.16
	Two-part wedge searches starting at various heights above the datum require percentage of available geogrid strength as shown	0.0 m	26.4%
		1.0 m	32.4%
		2.92 m	27.7%
		4.39 m	21.0%

Reinforcement layout Starting and finishing levels are related to datum	Tensar Geogrid	No of layers	Starting level (m)	Vertical spacing (m)	Finishing level (m)	Coverage (%)	f_b
	RE560	9	1.50	0.50	5.50	100	0.85
	RE580	1	1.00	-	1.00	75	0.85
	RE580	1	0.00	-	-	75	0.85

Secondary reinforcement layout	Tensar Geogrid	No of layers	Length (m)	Vertical spacing (m)
	TX150	13	2.00	0.250 m where primary spacing >0.250 m

Further information relevant to this Tensar Earth Retention System	Further information, specifications and bill of quantities descriptions for this TensarTechEarth Retaining Structure are given in the following documents which form part of this Design Analysis		System overview Installation guide Case histories Construction Animation Link
	The current versions of these documents may be found by following the website link to "Tensar Documentation" in the Help menu of the TensarS oil+ program		
	For program users who do not have a link to the internet contact your nearest Tensar representative or distributor	Tensar International Limited software@tensar.co.uk Web: www.tensar.co.uk	

Client: Vistry

Project: Hollingsworth Gate, Littleborough

Tensar
Structural Systems

Tensar tech
NaturalGreen System



IMPORTANT NOTES

This document contains an Application Suggestion which has been prepared by Tensar International Limited on a confidential basis, to enable the application of **Tensar** geogrids to be evaluated. The Application Suggestion is merely illustrative and is not a detailed design. It is specific to the unique characteristics of the **Tensar** geogrids which are referenced within the calculations.

Copyright in this document belongs to Tensar International Limited. It must not be disclosed to any third party other than for the purpose of evaluating its commercial application for the use of **Tensar** geogrids.

The information provided in this document is supplied without charge. It does not form part of any contract or intended contract with the recipient. No liability in negligence will arise from the construction of any project based on such information or material. Final determination of the suitability of any information or material for the use contemplated and the manner of use is the sole responsibility of the user and its professional advisors, who must assume all risk and liability in connection therewith. Tensar International Limited assumes no responsibility to the recipient or any third party for the whole or any part of the content of this document.

Tensar is a registered trademark.

Method of analysis

The calculation method used to create this Application Suggestion is the simplified method of slices using a circular slip surface following the method given by Bishop (Geotechnique, Vol 5, No 1, 1955) modified to take into account the stabilising effect of layers of geogrid reinforcement

Reference

GRO-23131

Date

18 Jul 2023

Page

1 of 5

Tel:

Fax:

E-mail:



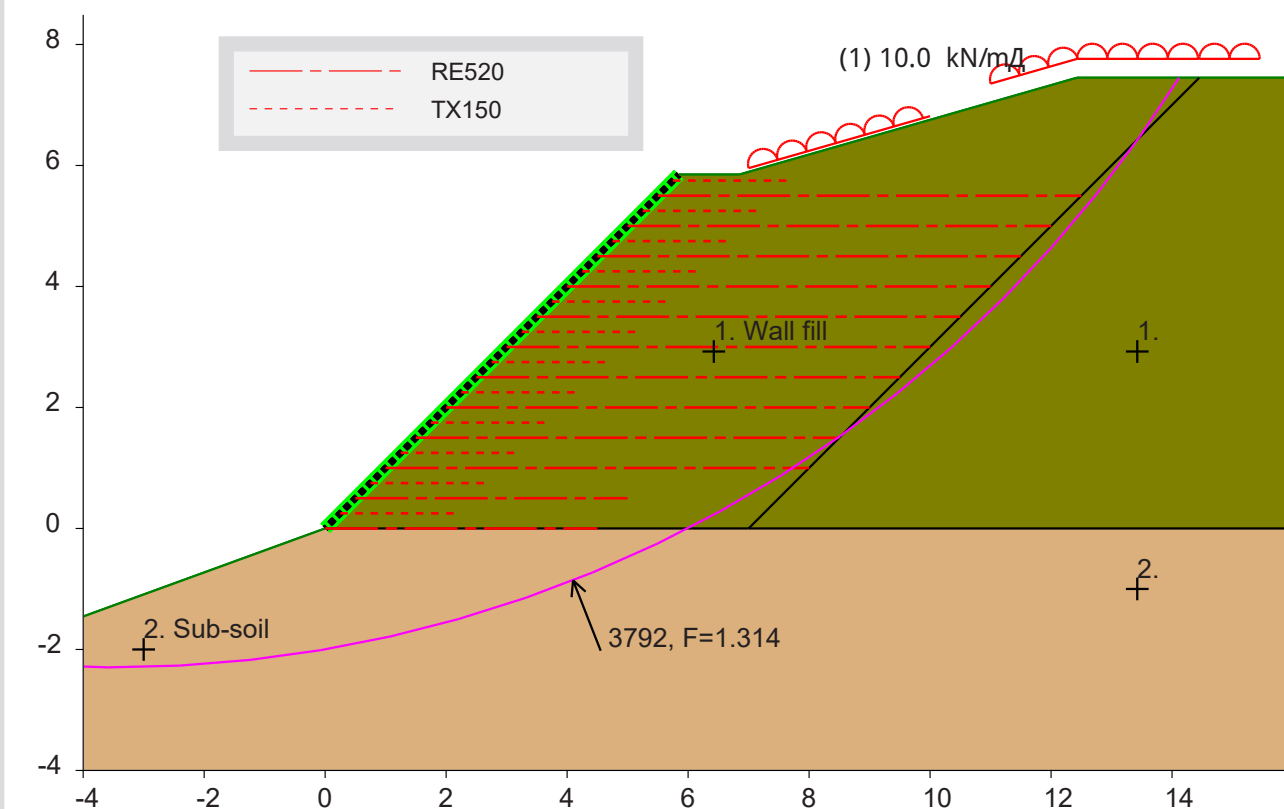
Cert – QM505288
Applicable to Tensar International
and Tensar Manufacturing Ltd



Cert – EMS86463
Applicable to Tensar Manufacturing Ltd

Input data and Section

Project: Hollingsworth Gate, Littleborough



Tensar Structural Systems Tensar *tech* NaturalGreen System

Static loading case

All dimensions in metres

Scale 1:125

Soil properties

Soil zone	Drained/ undrained	c' (kN/m ²)	ϕ' (°)	$\gamma_{bulk,k}$ (kN/m ³)
1, Wall fill	Drained	0.0	29.0	20.0
2, Sub-soil	Drained	0.0	36.0	17.0

Soil strength values given above are characteristic values, design values are obtained by applying appropriate partial material factors. Design soil strength parameters are peak values

Surcharges

Load	Load acts from x (m)	To x (m)	Load (kN/m ²)	Live/Dead
1	7.000	10.000	10.00	Dead
2	11.000	15.450	10.00	Live

x values are measured from X=0

Reference

GRO-23131

Date

18 Jul 2023

Page

2 of 5

Stability results	Circle number	Disturbing moment (kNm/m)	Resisting moment soil (kNm/m)	Resisting moment geogrids (kNm/m)	Factor of safety
Moments per linear metre of structure	3792	11932	15432	247	1.314

Further information relevant to this Design Analysis	Further information, specifications and bill of quantities descriptions for this Tensar Earth Retaining Structure are given in the following documents which form part of this Design Analysis	System overview Installation guide Case histories Construction Animation Link
	The current versions of these documents may be found by following the website link to "Tensar Documentation" in the Help menu of the TensarSlope program	
	For program users who do not have a link to the internet contact your nearest Tensar representative or distributor	Tensar International Limited +7 812 3275067 +7 812 3242560 info@tensar.ru

Detailed input information

The following tables provide the detailed input information used to define the reinforced fill structure including: coordinates of soil lines and water pressure lines (both internal water pressure and external standing water), geogrid design data and geogrid layout.

In all the tables which follow, X and Y are cartesian coordinates in metres, with Y measured vertically upwards, and measured from X = 0 in the horizontal direction and Y = 0 in the vertical direction.

Soil lines

The soil type found beneath each line is indicated in the table below.

Where a facing is associated with any line, this is also indicated in the table below.

Line No.	X ₁ (m)	Y ₁ (m)	X ₂ (m)	Y ₂ (m)	Soil No.	Facing type
1	-20.000	-7.279	0.000	0.000	2	NaturalGreen
2	0.000	0.000	5.850	5.850	1	
3	5.850	5.850	6.850	5.850	1	
4	6.850	5.850	12.430	7.450	1	
5	12.430	7.450	14.450	7.450	1	
6	14.450	7.450	57.280	7.450	1	
7	0.000	0.000	7.000	0.000	2	
8	7.000	0.000	62.280	0.000	2	
9	7.000	0.000	14.450	7.450	1	

Water pressures

Pore pressures only exist where a soil-specific pore pressure ratio is not zero (see 'Soil properties' above).

Reinforcement design data

Reinforcement design strength is calculated using the strengths and factors given below

In soil type 1 - Wall fill			Design life (years) 60		Design temperature (°C) 10	
Tensar Geogrid	Creep rupture strength (kN/m)	Extrapolation & manufacturing variation	Installation damage factor	Environmental effects	Characteristic design strength (kN/m)	Sliding coefficient
	P _c	f _m	f _d	f _e	P _{des}	s
RE520	27.85	1.00	1.07	1.00	26.02	0.85
TX150	1.41	1.00	1.00	1.00	1.41	0.85

Reinforcement layout

Reinforcement level is defined by its Y co-ordinate

Tensar geogrid	Level	Left end	Right end	Length	Coverage	Pullout interaction factor	Fixed at	
	Y (m)	X (m)	X (m)	(m)	(%)	≅ B	left	right
RE520	0.000	0.000	4.500	4.500	100	0.85	No	No

Reinforcement continued on next page . . .

Reinforcement layout continued

Tensar geogrid	Level	Left end	Right end	Length	Coverage	Pullout interaction factor	Fixed at	
	Y (m)	X (m)	X (m)	(m)	(%)	$\cong B$	left	right
TX150	0.250	0.250	2.250	2.000	100	0.85	No	No
RE520	0.500	0.500	5.000	4.500	100	0.85	No	No
TX150	0.750	0.750	2.750	2.000	100	0.85	No	No
RE520	1.000	1.000	8.000	7.000	100	0.85	No	No
TX150	1.250	1.250	3.250	2.000	100	0.85	No	No
RE520	1.500	1.500	8.500	7.000	100	0.85	No	No
TX150	1.750	1.750	3.750	2.000	100	0.85	No	No
RE520	2.000	2.000	9.000	7.000	100	0.85	No	No
TX150	2.250	2.250	4.250	2.000	100	0.85	No	No
RE520	2.500	2.500	9.500	7.000	100	0.85	No	No
TX150	2.750	2.750	4.750	2.000	100	0.85	No	No
RE520	3.000	3.000	10.000	7.000	100	0.85	No	No
TX150	3.250	3.250	5.250	2.000	100	0.85	No	No
RE520	3.500	3.500	10.500	7.000	100	0.85	No	No
TX150	3.750	3.750	5.750	2.000	100	0.85	No	No
RE520	4.000	4.000	11.000	7.000	100	0.85	No	No
TX150	4.250	4.250	6.250	2.000	100	0.85	No	No
RE520	4.500	4.500	11.500	7.000	100	0.85	No	No
TX150	4.750	4.750	6.750	2.000	100	0.85	No	No
RE520	5.000	5.000	12.000	7.000	100	0.85	No	No
TX150	5.250	5.250	7.250	2.000	100	0.85	No	No
RE520	5.500	5.500	12.500	7.000	100	0.85	No	No
TX150	5.750	5.750	7.750	2.000	100	0.85	No	No

Client: Vistry

Project: Hollingsworth Gate, Littleborough

Tensar
Structural Systems

TensarTech
NaturalGreen System



This document contains Tensar Software Output which has been prepared by Groundtech Consulting on a confidential basis, to enable the application of **Tensar** geogrids to be evaluated. The Tensar Software Output is merely illustrative and is not a detailed design. It is specific to the unique characteristics of the **Tensar** geogrids which are referenced within the calculations.

Copyright in this document belongs to Tensar International Limited. It may not be reproduced in whole or in part without the prior written permission of Tensar International. It must not be disclosed other than for the purpose of evaluating its commercial application for the use of geogrids.

This Tensar Software Output does not form the whole or any part of a contract. Its suitability for any project is the sole responsibility of the user and its professional advisors. Neither Tensar International Limited nor Groundtech Consulting are responsible for any application of the Tensar Software Output other than in conjunction with the sale of **Tensar**.

Tensar is a registered trademark.

Method of analysis

The Tensar 2-part Wedge Slope Design Method is based on the 2-part wedge calculation procedure described in Advice Note HA68/94 "Design Methods for the Reinforcement of Highway Slopes by Reinforced Soil and Soil Nailing Techniques" (Design Manual for Roads and Bridges, Volume 4, Section 1, Part 4, now withdrawn). Partial material factors are applied to the soil strength and the resistance provided by the geogrid reinforcement.

Reference

GRO-23131

Date

13 Jul 2023

Page

1 of 3

Design analysis
prepared by

Groundtech Consulting

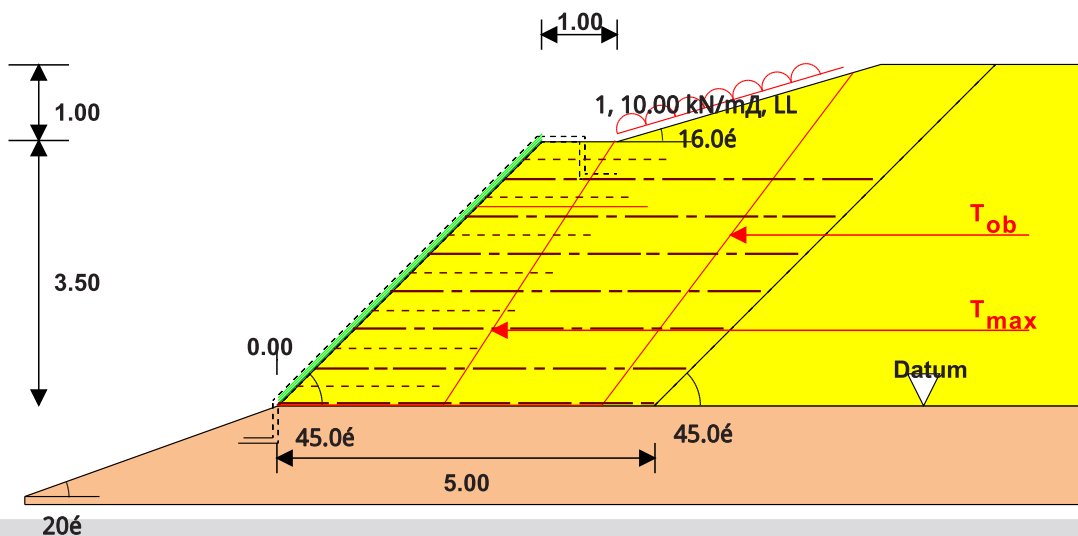
Telephone:

Fax:

E-mail:

Input data and Section

Project: Hollingsworth Gate, Littleborough



Tensar Structural Systems **TensarTech** NaturalGreen System

Static loading case

All dimensions in metres

Scale 1:100

Fill/foundation properties

Design soil strength parameters are peak values

Soil zone	Drained/ undrained	c' (kN/m ²)	φ' (°)	γ _{bulk} (kN/m ³)
Reinforced fill	Drained	0.0	29.0	17.5
Retained fill	Drained	0.0	29.0	17.5
Foundation soil	Assumed to be competent			

Surcharges

No	Load acts from x (m)	To x (m)	Load (kN/m ²)	Temporary/Permanent
1	1.00	4.00	10	Temporary
2	7.40	9.60	100	Permanent

x coordinates are measured from the top of the reinforced fill block.

Water pressure data	Location	Height of water level above datum (m)	r_u
	In front of structure	No water pressures	
	Within fill	No water pressures	NA

Stability results	T_{ob} mechanism gives the minimum length of the base geogrid (m)		4.3
	T_{max} mechanism gives minimum length of theoretical top grid (m)		2.28
	Two-part wedge searches starting at various heights above the datum require percentage of available geogrid strength as shown	0.0 m	32.6%
		0.88 m	29.1%
		1.75 m	32.1%
		2.63 m	36.4%

Reinforcement layout Starting and finishing levels are related to datum	Tensar Geogrid	No of layers	Starting level (m)	Vertical spacing (m)	Finishing level (m)	Coverage (%)	f_b
	RE520	6	0.50	0.50	3.00	100	0.85
	RE510	1	0.00	-	-	100	0.85

Secondary reinforcement layout	Tensar Geogrid	No of layers	Length (m)	Vertical spacing (m)
	TX150	7	2.00	0.250 m where primary spacing >0.250 m

Further information relevant to this Tensar Earth Retention System	Further information, specifications and bill of quantities descriptions for this TensarTechEarth Retaining Structure are given in the following documents which form part of this Design Analysis		System overview Installation guide Case histories Construction Animation Link
	The current versions of these documents may be found by following the website link to "Tensar Documentation" in the Help menu of the TensarS oil+ program		
	For program users who do not have a link to the internet contact your nearest Tensar representative or distributor	Tensar International Limited software@tensar.co.uk Web: www.tensar.co.uk	

Client: Vistry

Project: Hollingworth Gate, Littleborough

Tensar
Structural Systems

TensarTech
NaturalGreen System



This document contains Tensar Software Output which has been prepared by Groundtech Consulting on a confidential basis, to enable the application of **Tensar** geogrids to be evaluated. The Tensar Software Output is merely illustrative and is not a detailed design. It is specific to the unique characteristics of the **Tensar** geogrids which are referenced within the calculations.

Copyright in this document belongs to Tensar International Limited. It may not be reproduced in whole or in part without the prior written permission of Tensar International. It must not be disclosed other than for the purpose of evaluating its commercial application for the use of geogrids.

This Tensar Software Output does not form the whole or any part of a contract. Its suitability for any project is the sole responsibility of the user and its professional advisors. Neither Tensar International Limited nor Groundtech Consulting are responsible for any application of the Tensar Software Output other than in conjunction with the sale of **Tensar**.

Tensar is a registered trademark.

Method of analysis

The Tensar 2-part Wedge Slope Design Method is based on the 2-part wedge calculation procedure described in Advice Note HA68/94 "Design Methods for the Reinforcement of Highway Slopes by Reinforced Soil and Soil Nailing Techniques" (Design Manual for Roads and Bridges, Volume 4, Section 1, Part 4, now withdrawn). Partial material factors are applied to the soil strength and the resistance provided by the geogrid reinforcement.

Reference

GRO-23131

Date

13 Jul 2023

Page

1 of 3

Design analysis
prepared by

Groundtech Consulting

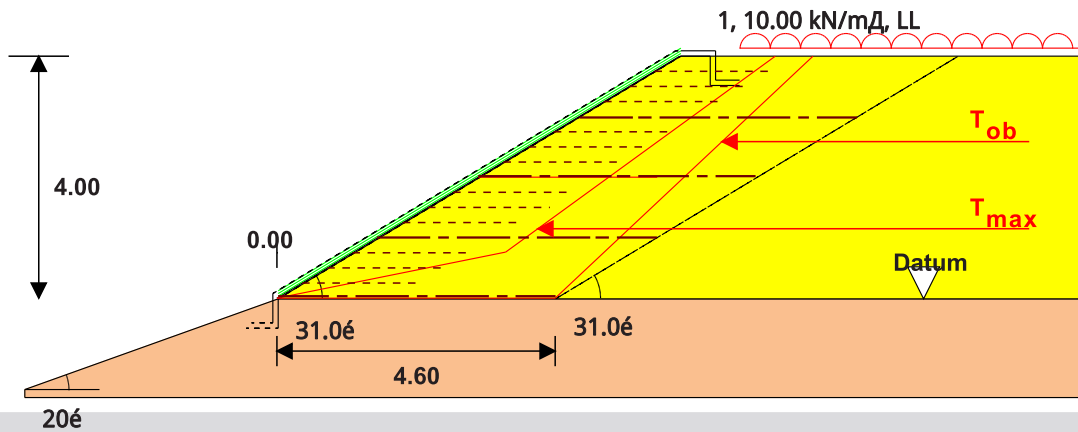
Telephone:

Fax:

E-mail:

Input data and Section

Project: Hollingworth Gate, Littleborough



Tensar Structural Systems **TensarTech** NaturalGreen System

Static loading case

All dimensions in metres

Scale 1:125

Fill/foundation properties

Design soil strength parameters are peak values

Soil zone	Drained/ undrained	c' (kN/m ²)	ϕ' (°)	γ_{bulk} (kN/m ³)
Reinforced fill	Drained	0.0	29.0	17.5
Retained fill	Drained	0.0	29.0	17.5
Foundation soil	Assumed to be competent			

Surcharges

No	Load acts from x (m)	To x (m)	Load (kN/m ²)	Temporary/Permanent
1	1.00	11.00	10	Temporary

x coordinates are measured from the top of the reinforced fill block.

Water pressure data

Location	Height of water level above datum (m)	r_u
In front of structure	No water pressures	
Within fill	No water pressures	NA

Reference

GRO-23131

Date

13 Jul 2023

Page

2 of 3

Stability results	T _{ob} mechanism gives the minimum length of the base geogrid (m)		4.6
	T _{max} mechanism gives minimum length of theoretical top grid (m)		2.96
	Two-part wedge searches starting at various heights above the datum require percentage of available geogrid strength as shown	0.0 m	20.0%
		1.0 m	20.5%
		2.0 m	16.6%

Reinforcement layout Starting and finishing levels are related to datum	Tensar Geogrid	No of layers	Starting level (m)	Vertical spacing (m)	Finishing level (m)	Coverage (%)	f _b
	RE520	3	1.00	1.00	3.00	100	0.85
	RE520	1	0.00	-	-	100	0.85

Secondary reinforcement layout	Tensar Geogrid	No of layers	Length (m)	Vertical spacing (m)
	TX150	12	2.00	0.250 m where primary spacing >0.250 m

Further information relevant to this Tensar Earth Retention System	Further information, specifications and bill of quantities descriptions for this TensarTechEarth Retaining Structure are given in the following documents which form part of this Design Analysis		System overview Installation guide Case histories Construction Animation Link
	The current versions of these documents may be found by following the website link to "Tensar Documentation" in the Help menu of the TensarS oil+ program		
	For program users who do not have a link to the internet contact your nearest Tensar representative or distributor	Tensar International Limited software@tensar.co.uk Web: www.tensar.co.uk	

4.0 CONSTRUCTION SEQUENCE

The following construction sequence has been provided by Tensar for the TensarTech NaturalGreen Earth Retaining Systems.

Installation Guideline for TensarTech® NaturalGreen™ Reinforced Embankment System



Introduction

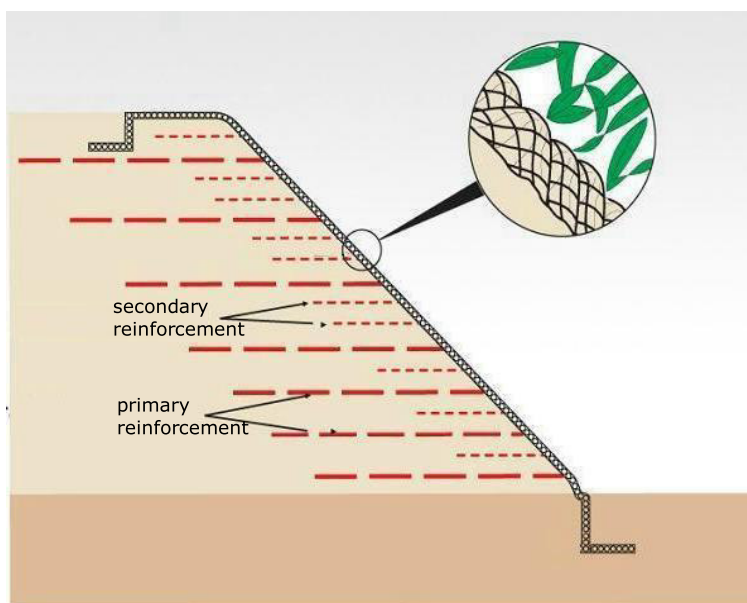
This Installation Guideline provides a step-by-step guide intended for use by contractors planning to construct a reinforced soil slope using TensarTech® NaturalGreen™ system.

TensarTech NaturalGreen System has been developed to provide engineers, architects and builders with an attractive and economical solution for the construction of embankments with a face slope angle up to 45° to the horizontal.

TensarTech NaturalGreen is one of a range of earth retaining systems available from Tensar International Limited, comprising proprietary Tensar uniaxial geogrid as primary reinforcement, TriAx® geogrid as secondary reinforcement and a rolled erosion control product secured with Tensar pegs.

Where applicable, the Contractor shall ensure that the installation fully complies with CDM Regulations 2015 and should refer to the Designer's Risk Assessment and COSHH statements.

The Tensar uniaxial geogrid for primary reinforcement are available in different strength grades identified by coloured banding. All supplied in 1.3m wide rolls either 50m or 75m long. TriAx geogrid for secondary reinforcement is supplied in 4m wide rolls 75m long. Both materials are supplied unwrapped and bound using coloured identifying tape. Both materials are UV protected and may be stored outside until use.



Typical section - TensarTech® NaturalGreen™ Slope

Rolled erosion control product can be supplied by Tensar depending on the project. A suitable erosion product is P300, supplied in rolls 35.0m long by 2.4m wide and comprising 100% UV stable polypropylene fibres incorporated between two layers of UV stable polypropylene netting. Erosion control materials are normally wrapped in polythene but should be stored in a cool dry place avoiding exposure to naked flame or spark, as they may be readily flammable, particularly bio-degradable erosion products comprising natural materials. They are vulnerable until installed and have had the opportunity to absorb moisture.

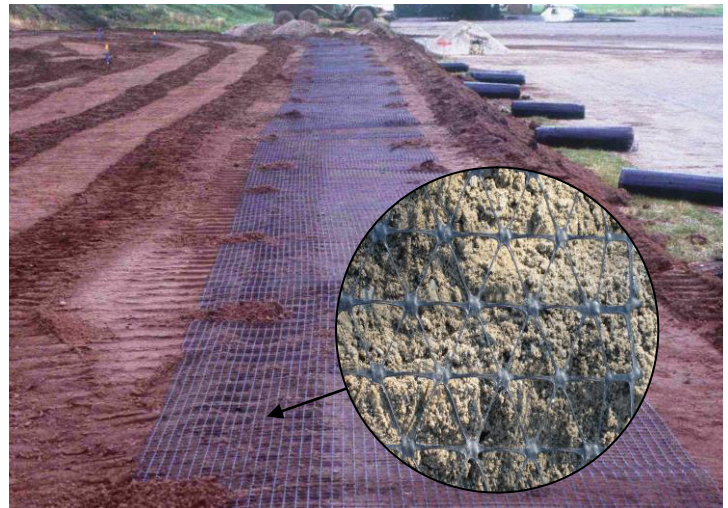
Tensar pegs to secure the rolled erosion control product are supplied in bags of 25 and may be stored outside if necessary.

Installation

1. The Contractor shall excavate to the lines and grades shown on the construction drawings and should take precautions to minimize over-excavation. Over-excavation should be filled with compacted approved infill material, or as directed by the Engineer.
2. Following the excavation, the foundation soil should be examined by the Engineer to assure actual foundation soil strength meets or exceeds the design bearing strength. Soils not meeting the required strength should be removed and replaced with infill soils, as directed.
3. Foundation soil shall be proof rolled and compacted then inspected by the Engineer prior to commencement of construction of the reinforced soil slopes.
4. Cut and position the base layer of Tensar uniaxial geogrid primary reinforcement at the formation level shown on the contract drawings. The uniaxial geogrid grades are identified by the letters RE and a number which will correspond with the geogrid layout shown on the construction drawing(s). The principle strength direction of the uniaxial geogrid is along the roll length and as such primary geogrid should be laid perpendicular to the slope face alignment.
5. Each geogrid reinforcement length shall be positioned to intercept the line of the final slope face at that elevation (after slope trim). Adjacent lengths of geogrid are butt jointed side-to-side at the slope face.
6. All geogrid should be installed to the levels, lengths and orientations as shown on the construction drawings.
7. Selected suitable fill material should be in full compliance with the needs of the design and have the approval of the engineer.
8. Place and compact the fill in layers as specified in the Contract Documents, incorporating primary reinforcement and secondary reinforcement as shown on the construction drawings.
9. The TriAx geogrid secondary reinforcement must be laid in the correct direction rolled out parallel to the slope face. The 4m wide rolls may be cut whilst still on the roll to widths corresponding with the construction drawing; normally 2m, but this must be checked.
10. Fill should be placed by plant such as an excavator with an opening bucket, which causes the fill to cascade onto the geogrid. A 150mm thick cover of fill must be maintained between the tracks of any plant and the geogrid to avoid damage to the geogrid.



11. The embankment may be overfilled, compacted and then trimmed to the final face slope profile in the conventional manner.
12. Use of a toothless excavator bucket is recommended for face trimming to prevent snagging on the edge of the buried geogrid. Although care should be taken not to over cut, the machine performing the face trim will not cause structural damage whilst performing this task.
13. On completion of the filling operation the slope surface should be covered with a minimum 100mm layer of suitable topsoil in accordance with BS3882, or as specified in the Contract Documents. Over-compaction of the topsoil should be avoided.
14. Where a grass cover is specified, scatter the chosen seed mix on to the slope at the specified rate per square metre.



TriAx geogrid secondary reinforcement cut from the roll 2m wide and rolled-out parallel to the slope face.

15. The rolled erosion control product should then be installed.

16. The rolled erosion control product is rolled down the slope face lapping adjacent rolls by a minimum of 100mm. Tensar pegs should be used to fix the rolled erosion control product at 1.0m centres along the laps by driving them into the soil using an appropriate rubber hammer. Rolled erosion control product must follow the slope profile and remain in contact with the underlying topsoil layer. Additional pinning and/or pinning of the centre of roll may be required.



17. Roll ends shall be buried at the shoulder and toe respectively in shallow trenches approximately 450mm wide by 250mm deep.

18. If specified, the slope may be planted with a suitable ground cover plant species as per the Contract Documents. The rolled erosion control product should be slit to allow the chosen plants pushed through the product into the topsoil below.

19. Care should be taken at this stage when using biodegradable rolled erosion control products to avoid exposure to naked flame or spark, as the product may be flammable until it has had the opportunity to absorb moisture.

20. The Contractor must fully assess the safety risk associated with working on the slope and at height and where appropriate install any necessary temporary edge protection and provide operatives with the appropriate safety equipment.

Notes

The contractor is responsible for checking slope geometry during construction and taking necessary action to ensure that tolerance are met in accordance with Tensar recommendations.

For cellular confinement erosion control products this construction sequence should be read in conjunction with IG_NaturalGreen_Cellular.

Please refer to Tensar International Limited if more specific advice is required.

This document was formerly published with the reference:CS/NaturalGreen

The information in this document supersedes any and all prior Construction Sequences for the products/system designated above and is supplied by Tensar International Limited without charge. Tensar International Limited excludes to the fullest extent lawfully permitted any and all liability whatsoever for any loss or damage howsoever arising out of the use of and reliance upon this information. It is your sole responsibility and you must assume all risk and liability for the final determination as to the suitability of any Tensar International Limited product and/or design for the use and in the manner contemplated by you in connection with a particular project.

Tensar, **TensarTech** and **TriAx** are registered trademarks

Copyright © Tensar International Limited 2020

Tensar International Limited

Tel: +44 (0) 1254 262431

Fax: +44 (0) 1254 266867

E-mail: sales@tensar.co.uk

UK Head Office

Units 2 – 4 Cunningham Court

Shadsworth Business Park

Blackburn

BB1 2QX



Cert – QM505288
Applicable to Tensar International
and Tensar Manufacturing Ltd



Cert – EM586463
Applicable to Tensar Manufacturing Ltd



5.0 PRODUCT SPECIFICATION

The following product specification has been provided by Tensar for the RE520 GeoGrid, RE580 Gagrid and TX150 Grid which is being utilised for the retaining slope design.

TensarTech® NaturalGreen™ Earth Retaining Structures: Model Specification

This document is intended to form a basis for Tender documents where the TensarTech® NaturalGreen™ reinforced soil system is required.

1. GENERAL

This work shall consist of constructing reinforced soil steep slopes (often referred to as strengthened embankments) typically using a proprietary system, constructed in accordance with the suppliers drawings and specifications and in conformity with the alignment, grades and dimensions shown on the contract documents or as established by the Engineer. Where necessary the Contractor shall provide complete set of drawings issued for construction, design calculations and complete specifications of the proposed system for the approval of the Engineer 90 days prior construction. Any particular requirements of approved detailed specifications for the approved proprietary system shall override any conflicting or incompatible requirement contained within this section.

The proposed solution must demonstrate previous use for reinforced soil steep slopes with a minimum height of 20.0m and a minimum in service life of 20 years.

The soil reinforcement must have a current British Board of Agrément (BBA) HAPAS certificate, demonstrating suitability for use in highways structures with a minimum 60-year design life.

2. DESIGN

The design shall address the climatic and soil conditions existing in UK and the specifically the site in question and provide a minimum design life of 60 years. The specifications as presented to the Engineer shall state any requirements for or limitations on the backfill used in the structure to ensure the design life. The tender submission shall be accompanied by:

- A. A copy of the current BBA certificate
- B. Sample design calculations for the proposed slopes in compliance with HA68/94 or BS8006 as appropriate
- C. Soils test information of the proposed reinforced soil fill
- D. Method statement for construction
- E. Confirmation of the Professional Indemnity and Product Liability insurance cover provided by the Slope System Supplier

3. STANDARDS

The following standards and codes in their latest edition shall be particularly applied to work covered by this specification where applicable; together with any further standards or codes as described within the approved Specification for the approved reinforced soil slope system.

3.01 Geogrid Reinforcement

- | | | |
|---|------------------------------|--|
| A | ISO 2602: 1980 | Statistical Interpretation of Test Results |
| B | BS EN ISO 9001: 2000 | Quality Systems – Model for Quality Assurance in Production, design and development Installation & Servicing |
| C | BS 2782: Part 4 | Methods of Testing Plastics. Part 4: Chemical Properties |
| D | GRI GG2 - 87 | Geogrid Junction Strength |
| E | BS EN ISO 10321: 1996 | Geotextiles – Tensile Test for Joints-Seams by Wide-Width Method |
| F | BS EN ISO 10319: 1996 | Wide-Width Tensile Test |
| G | BS EN ISO 13431: 1999 | Geotextiles and geotextiles related products. Determination of tensile creep and creep rupture behaviour |

3.02 Soils

- | | | |
|---|---------------------|--|
| A | BS1377: 1990 | Moisture Density Relationship for Soils, Standard Method |
| B | BS1377: 1990 | Gradation of Soils |
| C | BS1377: 1990 | Atterberg Limits of Soil |
| D | BS1377: 1990 | Shear Box Test |
| E | BS3882: 1994 | Specification for topsoil |

4. MATERIALS

The slope system will comprise primary horizontal layers of uniaxially orientated high density polyethylene (HDPE) geogrids and secondary polypropylene geogrids with a rolled erosion control product for erosion protection to the slope face helping establish and reinforce the root system of the vegetation in the long-term.

4.01 Geogrid Reinforcement

4.01.1 Primary Geogrid reinforcement

- A. The primary reinforcing element shall be a geogrid manufactured in accordance with a Quality Management System which complies with the requirements of BS EN ISO 9001:2000. If required by the Engineer, the Contractor shall provide evidence that the manufacturer's Quality Assurance System has been certified to conform with BS EN ISO 9001:2000 by an external authenticating authority approved by the Department of Trade and Industry.
- B. The reinforcing element shall be a geogrid manufactured from high density polyethylene sheet, oriented in one direction so that the resulting ribs shall have a high degree of molecular orientation, which is continued through the integral transverse bar.
- C. The long term creep rupture strength P_C (Ultimate Limit State), for a design life of 60 or 120 years, shall be in accordance with the following table at a mean temperature for design country (10°C, 20°C or 30°C). This shall be determined by application of standard extrapolation techniques to creep data obtained in accordance with BS EN ISO 13431:1999 and shall be a lower bound value. Values shall be based on a minimum 100,000 hour of continuous creep testing.

		Geogrid Type - design life of 60 years					
	Units	RE510	RE520	RE540	RE560	RE570	RE580
$P_{C\ 10^\circ C}$	kN/m	21.10	27.85	34.02	46.78	62.44	72.41
$P_{C\ 20^\circ C}$	kN/m	19.37	25.56	31.23	42.95	57.33	66.48
$P_{C\ 30^\circ C}$	kN/m	17.56	23.18	28.32	38.94	51.98	60.27

		Geogrid Type - design life of 120 years					
	Units	RE510	RE520	RE540	RE560	RE570	RE580
$P_{C\ 10^\circ C}$	kN/m	20.71	27.34	33.40	45.93	61.31	71.09
$P_{C\ 20^\circ C}$	kN/m	19.01	25.10	30.66	42.16	56.28	65.27
$P_{C\ 30^\circ C}$	kN/m	17.24	22.76	27.80	38.23	51.03	59.17

- D. The geogrid shall have an appropriate partial factor for site installation and construction damage, determined by the particle size distribution of the reinforced fill and in accordance with the values used in the design. This factor shall be based on full-scale tests carried out in accordance with BS8006 Annex D and witnessed by an independent Approval Authority. If required by the Engineer, the Contractor shall provide supporting documented evidence of testing for this and any other partial factors assumed in the design. Partial factors for site installation and construction damage based on limited laboratory based testing are not acceptable.
- E. The strength of the junctions between the longitudinal ribs and transverse bars, as determined by the Geosynthetics Research Institute, Drexel University, USA, Test Method GG2-87, shall be not less than 95% of the Quality Control Strength.
- F. Any site joints in the reinforcement roll length shall be capable of carrying 100% of the geogrid long term creep rupture strength. If required by the Engineer, the Contractor shall provide evidence of this.
- G. The geogrid shall be inert to all chemicals naturally found in soils and shall have no solvents at ambient temperature. It shall not be susceptible to hydrolysis, shall be resistant to aqueous solutions of salts, acids and alkalis, shall be non-biodegradable and shall have a minimum of 2% finely divided carbon black, as determined by BS 2782 Part 4, Method 452B 1993, to inhibit attack by ultraviolet light.
- H. The primary geogrid shall have an independent test certificate proving resistance and durability in a pH range of 2.0 to 12.5. Specifically, 'The sample of the primary geogrid chosen shall have a test certificate from a recognised independent test authority, showing that when tested to ENV ISO 12960, March 1998, they can withstand immersion in a saturated solution of calcium hydroxide with a pH of 12.5, at 60 deg C for 3 days with no loss of tensile strength'.
- I. The geogrid shall be CE Marked by an independent, authorised Certification Body to demonstrate that the product has been tested in accordance with the relevant European Standard relating to its specific use in construction, in accordance with the EU Construction Products Directive.
- J. The product labelling must show the CE Mark, together with the Certification Body Number and the FPC (factory production control) number. 'Accompanying Documentation' indicating the relevant testing 'declared values', should be available on request.

4.01.2 Erosion Control Product

To establish a grass cover to the finished structure by dry seeding, the face should be covered with one of the following as determined by the engineer:

- A. rolled erosion control product comprising of biodegradable coconut fibres incorporated into a permanent three-dimensional polypropylene mesh.
- B. Non-biodegradable rolled erosion control product comprising of four layers of polyethylene mesh which are heat bonded together to form a three-dimensional mat.

- C. Where a depth of topsoil greater than 150mm is required, a cellular confinement erosion control product should be used.

4.02 Erosion control to slope face

- A. Horticultural topsoil should be applied to the face of the slope to a thickness determined for the contract, but typically not greater than 100mm. The rolled erosion control product should be fixed to the slope face, in accordance with specification clause 5.03.

4.03 Reinforced (Infill) Soil

The reinforced soil material proposed should conform to the following:

- A. Minimum angle of friction (ϕ_{cv}) of 30 degrees unless agreed with the Engineer.
- B. The Contractor should provide the Slope System supplier and the Engineer/Client with Effective Stress Parameters soil test information including soil density to allow completion and checking of the final design.

4.04 Horticultural Topsoil Layer

- A. The horticultural soil layer shall be a medium loam with a workable 'crumb-like' consistency placed and lightly compacted immediately onto the trimmed fully compacted reinforced soil for the purpose of supporting vegetation and in accordance with BS3882:2007 'Specification for Topsoil'.
- B. It shall have moisture content in the range 20 to 25% when placed.

4.05 Vegetation

4.05.01 Primary vegetation

- A. Grass cover will be established by applying the specified seed mix at the specified rate (typically 60g/m²)
- B. One suggested specification of seed mix is as follows or as proposed by the engineer.

75%	Creeping Red Fescue
25%	Smooth Stalked Meadow Grass

4.05.02 Secondary vegetation (where detailed on the construction drawings)

- A. Ground cover vegetation will be established by planting healthy plants from an approved supplier at the base and on the face of the structure.
- B. Plants on the face should be planted on a 2m square grid pattern. This is may be carried out either during or post construction but with the approval and agreement of the engineer.
- C. All plants should be well established in 75mm pots prior to planting and should be seen to have a good quality rootball.
- D. All plants should be correctly irrigated when necessary during the first 3 months after completion of the structure.
- E. One suggested specification for ground cover planting is: Vinca Major Variegate or as specified elsewhere by the Engineer.

5. Construction

5.01 Excavation

- A. Contractor shall excavate to the lines and grades shown on the Contract Drawings. Contractor shall take precautions to minimize over-excavation. Over-excavation shall be filled with compacted approved infill material, or as directed by the client's Engineer.
- B. Contractor shall verify the location of existing structures and utilities prior to excavation. Contractor shall ensure all surrounding structures are protected from the effects of any excavation. Excavation support, if required, is the responsibility of the Contractor.

5.02 Foundation Preparation

- A. Following the excavation, the foundation soil shall be examined by the Engineer to assure actual foundation soil strength meets or exceeds the design bearing strength. Soils not meeting the required strength shall be removed and replaced with infill soils, as directed by the Engineer.
- B. Foundation soil shall be proof rolled and compacted to 95% standard Proctor density and inspected by the Engineer prior to commencement of construction of the reinforced soil slopes.

5.03 Construction of Steep Slope

- A. Cut and position the base layer of primary uniaxial geogrid reinforcement at the formation level shown on the contract drawings. The principle strength direction of the uniaxial geogrids is along the roll length and as such should be laid perpendicular to the longitudinal alignment of the slope structure. Adjacent lengths of geogrid are butt jointed at the slope face.
- B. The geogrid reinforcement need not be folded up the face on NaturalGreen slopes which have a maximum face angle of 45° to the horizontal.
- C. All of the geogrids should be installed to the levels, lengths and orientations as shown on the construction drawings.

- D. Selected suitable fill material should be in full compliance with the needs of the design and have the approval of the engineer. Place and compact the fill in layers to the Contract's specification incorporating primary reinforcement and secondary reinforcement as shown on the construction drawings.
- E. The secondary reinforcement geogrid must be laid in the correct direction. As such the material must be rolled out parallel to the face. The 4m wide material may be cut whilst still on the roll, into the widths which correspond with the construction drawing; normally 2m, but this must be checked. The newly cut narrower roll may now be laid out easily and parallel with the slope face.
- F. Fill should be placed by plant such as an excavator with an opening bucket, which causes the fill to cascade onto the geogrids. A 150mm thick cover of fill must be maintained between the tracks of any plant and the geogrid to avoid damage.
- G. The embankment may be overfilled, compacted and face trimmed in a conventional manner to the design angle.
- H. Use of a toothless excavator bucket is recommended for face trimming to prevent snagging on the edge of the buried geogrids. Although care should be taken not to over cut, the machine performing the face trim will not cause structural damage whilst performing this task.
- I. On completion of the structural filling operation the slope surface should be covered with a layer of suitable topsoil in accordance with BS3882 and the landscaping requirements. The thickness of the topsoil layer is typically 100mm thick or as indicated on the construction drawing. Over compaction of the topsoil should be avoided.
- J. Where a grass cover is detailed, scatter the chosen seed mix on to the slope at the specified rate per square metre.
- K. The rolled erosion control product should then be carefully installed.
- L. The rolled erosion control product is rolled down the slope face lapping adjacent rolls by a minimum of 100mm. The barbed polymer pegs supplied should be used to fix the mat at 1.0m centres along the laps by driving them into the soil using an appropriate hammer, preferably rubber to prevent damage. Rolled erosion control product must follow exact slope profile and remain in contact with the underlying topsoil layer. Additional pinning and/or pinning of the centre of roll may be required.
- M. Roll ends shall be buried at the shoulder and toe respectively in shallow trenches approximately 450mm wide by 250mm deep.
- N. Where the rolled erosion control used is a non-biodegradable product the finished slope surface should be filled with a friable topsoil brushed into the mat and sown with selected grass seed mix.
- O. If demanded by the Client, the slope may be planted with a suitable ground cover plant species as per the Client's requirements. The rolled erosion control product should be carefully cut and the chosen plants pushed into the topsoil below.
- P. Care should be taken at this stage when using biodegradable rolled erosion control products to avoid exposing it to naked flame or spark, as it may be flammable until it has had the opportunity to absorb moisture.
- Q. The Contractor must fully assess the safety risk associated with working on the slope and at height and where appropriate install any necessary temporary edge protection and provide operatives with the appropriate safety equipment.

6. Submission of Alternatives

- 6.01** Any alternative to the specified system for Reinforced Steep Slopes proposed by the Tenderer shall be submitted with the tender and shall include:
- the names of the supplier and designer
 - a full set of calculations
 - outline drawings
 - product samples and specifications
 - test certificates for the reinforcing elements

The outline drawings must be sufficient to indicate the details of the construction of the Reinforced Steep Slopes including:

- typical plans
- elevations and section drawings
- foundations
- facing details (including vegetation if appropriate)
- anchoring reinforcing elements at the face
- reinforcing element joints and overlaps
- The width and length of the soil reinforcing elements should be clearly shown along with details of their orientation in the works.

This document is drafted on an entirely generic basis and its use in any tender documentation in any way must be reviewed by the user and made specific to their project

The information in this document supersedes any and all prior specifications for the product(s) designated above, is of an illustrative nature and supplied by Tensar International Limited free of charge for general information purposes only. Tensar reserves the right to amend product descriptions, properties and specifications at any time and without prior notice. This document does not form part of any contract or intended contract. Tensar International Limited excludes to the fullest extent lawfully permitted any and all liability whatsoever for any loss or damage howsoever arising out of the use of and reliance upon this information. It is your sole responsibility and you must assume all risk and liability for the final determination as to the suitability of any Tensar International Limited product and/or design for the use and in the manner contemplated by you in connection with a particular project.

Tensar and **TriAx** are registered trademarks

Copyright © Tensar International Limited 2020

Tensar International Limited
Tel: **+44 (0) 1254 262431**
Fax: **+44 (0) 1254 266867**
E-mail: **sales@tensar.co.uk**
www.tensar-international.com

UK Head Office
Units 2 - 4 Cunningham Court
Shadsworth Business Park
Blackburn
BB1 2QX
United Kingdom



Tensar RE500 series geogrids

Product specifications design temperature 10°C

Tensar RE500 geogrids are used for the reinforcement of soils in the construction of structures such as retaining walls, load bearing bridge abutments, steep slopes, slip repairs and TensarTech® Stratum® mattresses.



Properties	Units	Tensar RE500 geogrids (1), (2), (3)					
		RE510	RE520	RE540	RE560	RE570	RE580
Polymer		High density polyethylene					
Minimum carbon black (4)	%	2	2	2	2	2	2
Roll width	m	1.3	1.3	1.3	1.3	1.3	1.3
Roll length	m	75	75	50	50	50	50
Unit weight	kg/m ²	0.29	0.36	0.45	0.63	0.87	0.98
Roll weight	kg	30.0	37.0	31.0	45.0	59.0	67.0
Junction strength (5)	%	95	95	95	95	95	95
Long term strength at 10°C (6)							
ULS T _{CR} for 120 yrs (7)	kN/m	20.71	27.34	33.40	45.93	61.31	71.09
SLS T _{CS} for 1 month to 120 yrs (8)	kN/m	8.99	11.87	14.50	19.94	26.61	30.86
Partial factors of safety to calculate safe ultimate limit state (ULS) design strength (T_D) (9)							
Extrapolation of chemical and creep rupture data		$f_s = 1 + \sqrt{((1-R_1)^2 + (1-R_2)^2)} = 1.0$					
Installation damage D ₁₀₀ < 2mm, D ₈₅ < 0.65mm		RF _{ID} = 1.01	RF _{ID} = 1.00	RF _{ID} = 1.00	RF _{ID} = 1.00	RF _{ID} = 1.00	RF _{ID} = 1.00
Installation damage D ₁₀₀ < 37.5mm, D ₈₅ < 28mm		RF _{ID} = 1.18	RF _{ID} = 1.07	RF _{ID} = 1.07	RF _{ID} = 1.07	RF _{ID} = 1.07	RF _{ID} = 1.00
Installation damage D ₁₀₀ < 75mm, D ₈₅ < 69mm		RF _{ID} = 1.30	RF _{ID} = 1.25	RF _{ID} = 1.20	RF _{ID} = 1.15	RF _{ID} = 1.12	RF _{ID} = 1.06
Installation damage D ₁₀₀ < 125mm, D ₈₅ < 110mm		RF _{ID} = 1.60	RF _{ID} = 1.48	RF _{ID} = 1.36	RF _{ID} = 1.25	RF _{ID} = 1.19	RF _{ID} = 1.12
Weathering (including exposure to UV light)		RF _W = 1.00					
Chemical/environmental effects (10)		RF _{CH} = 1.05 for pH = 2 to 4, RF _{CH} = 1.00 for pH = 4 to 12.5					

- Tensar RE500 geogrids** are stiff monolithic geogrids with integral junctions and are manufactured in accordance with Quality and Environmental Management Systems which comply with the requirements of BS EN ISO 9001:2015 and BS EN ISO 14001:2015 respectively.
- All quoted dimensions and values are typical unless stated otherwise.
- Tensar RE500 geogrids** accreditation includes:
 - The British Board of Agrément (BBA) has awarded HAPAS Certificates: No 13/H201 and No 13/H202
 - The Geotechnical Engineering Office of the Civil Engineering & Development Department of the Government of Hong Kong SAR has awarded Certificate RF 2/2017
- Carbon black inhibits attack by UV light. Determined in accordance with ASTM D1603-14. Any section of grid fully exposed to sunlight can be expected to retain 90% of its quality control strength for periods in excess of 40 years in temperature climates and 20 years in tropical climates.
- Determined in accordance with GRI Test Method GG2-87, and expressed as a % of the quality control strength.
- In-soil temperature.
- ULS determined as a lower bound using standard extrapolation techniques to creep rupture data (real time test duration > 100,000 hours) obtained following the test procedure in BS EN ISO 13431:1999 for 120 year design life.
- SLS determined as the lower bound load which limits post-construction strain to 1% over the period from 1 month until design life, based on isochronous curves derived from creep tests carried out to BS EN ISO 13431:1999.
- Partial factors are determined following the requirements of BS EN 13251:2016 and guidelines given in PD ISO/TR 20432:2007, and are used to derive the ULS design strength which is given as: $T_D = T_{CR} / (f_s \times RF_{ID} \times RF_W \times RF_{CH})$
- Tensar RE500 geogrids** are inert to all chemicals naturally found in soils and have no solvents at ambient temperature. They are not susceptible to hydrolysis and are resistant to aqueous solutions of salts, acids and alkalis (pH 2.0 to 12.5) and are non-biodegradable.



The information in this document supersedes any and all prior specifications for the product(s) designated above, is of an illustrative nature and supplied by Tensar International Limited free of charge for general information purposes only. Tensar reserves the right to amend product descriptions, properties and specifications at any time and without prior notice. This document does not form part of any contract or intended contract. Tensar International Limited excludes to the fullest extent lawfully permitted any and all liability whatsoever for any loss or damage howsoever arising out of the use of and reliance upon this information. It is your sole responsibility and you must assume all risk and liability for the final determination as to the suitability of any Tensar International Limited product and/or design for the use and in the manner contemplated by you in connection with a particular project.

Tensar, Tensartech and TriAx are registered trademarks

Copyright © Tensar International Limited 2019

Tensar International Limited

Tel: +44 (0) 1254 262431
Fax: +44 (0) 1254 266867
E-mail: sales@tensar.co.uk
www.tensar-international.com

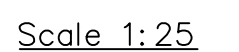
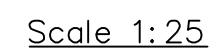
UK Head Office

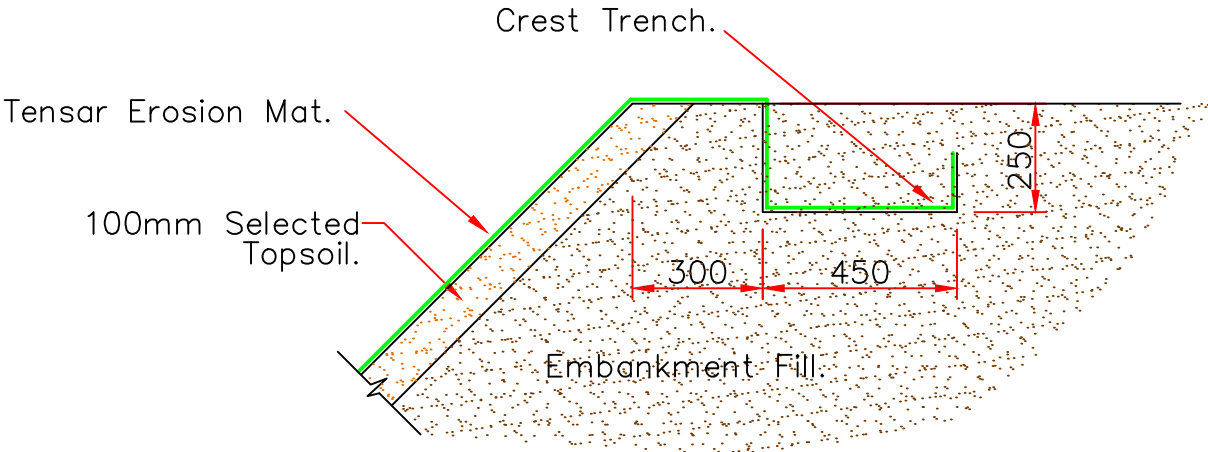
Units 2 - 4 Cunningham Court
Shadsworth Business Park
Blackburn
BB1 2QX
United Kingdom



6.0 PLANS

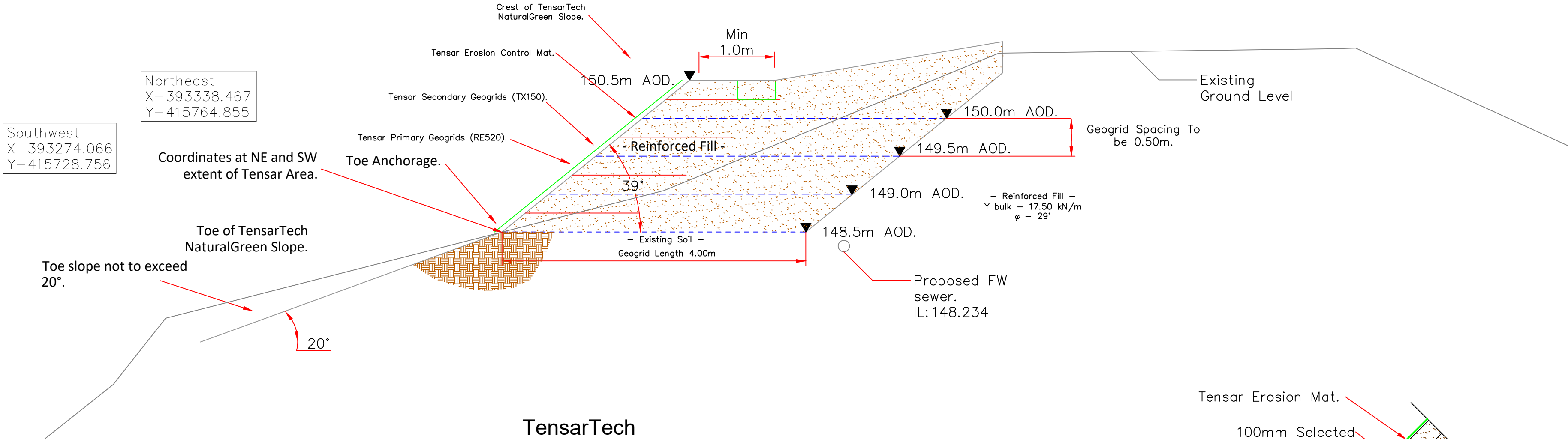
The following designs were produced using CAD software, based off the TensarSoils modelling software with the design parameters and geometric provided by the clients plans.



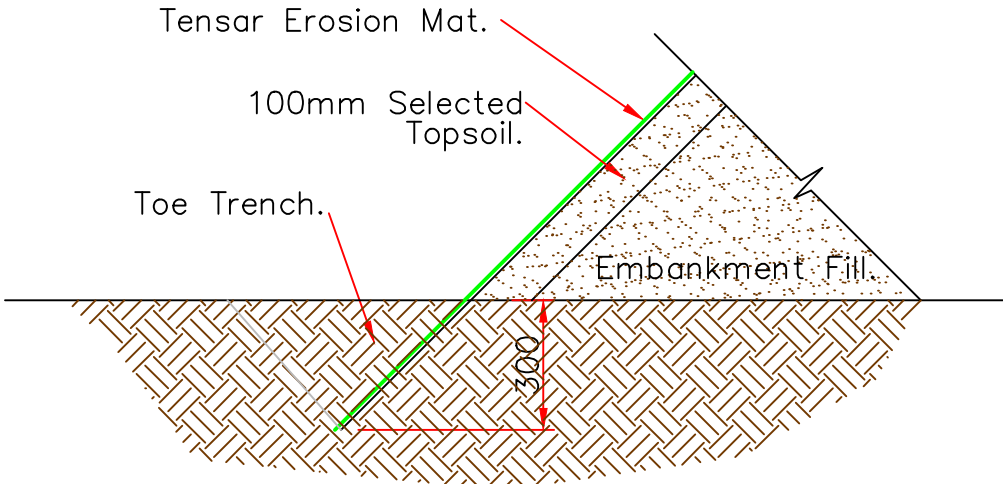


TENSAR MAT CREST ANCHORAGE

Scale 1:25



TensarTech
NaturalGreen System Through Section B-B



TENSAR MAT TOE ANCHORAGE

Scale 1:25

GROUNDTECH
CONSULTING



CLIENT

COUNTRYSIDE HOMES

PROJECT TITLE

HOLLINGWORTH GATE, LITTLEBOROUGH

PLAN TITLE

TENSARTECH NATURAL GREEN PROFILE PLAN - SECTION B

DATE

JULY 2023

SCALE

NTS

PLAN NUMBER

GRO-23131-P03B_1.2

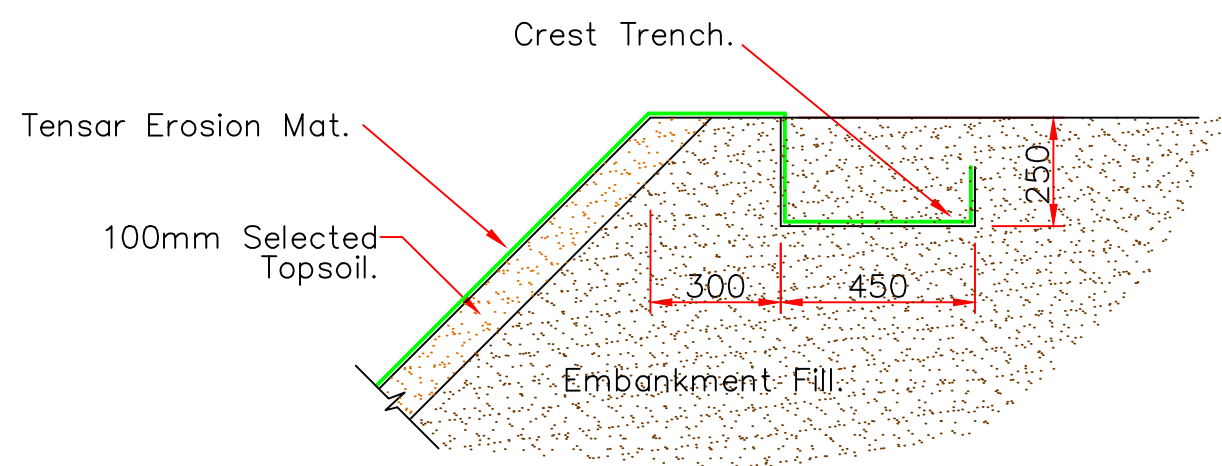
_1.2	Added coordinates to toe of slope	19/07/23
_1.1	Adjustment of levels	13/07/23
Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes

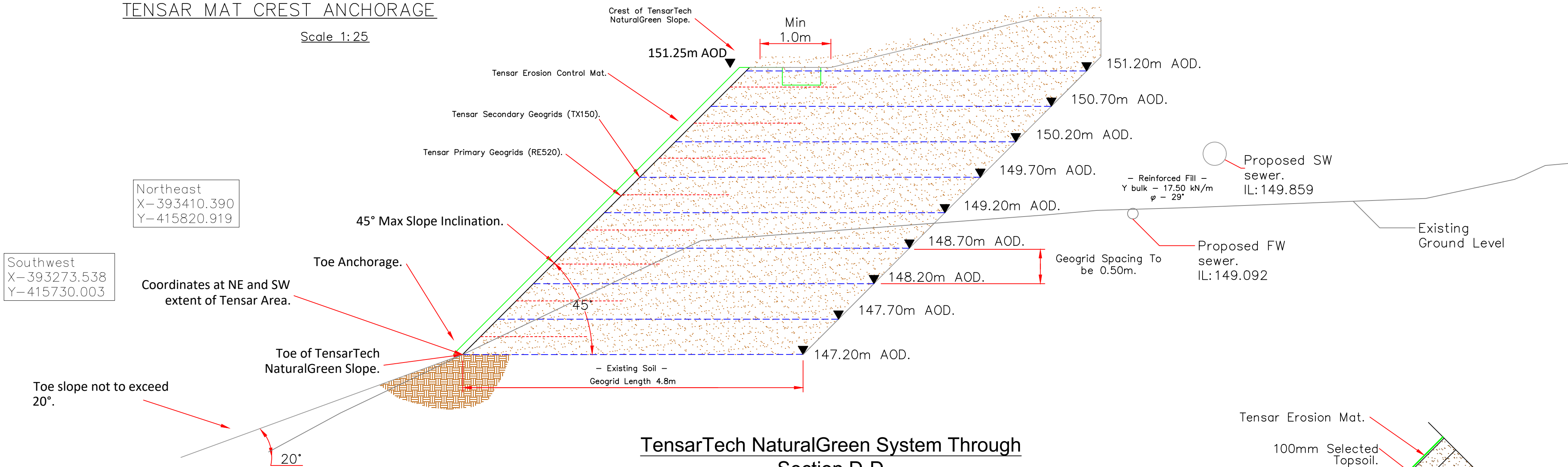
Proposed services to be installed during the construction of Tensar Slopes.
Proposed services to be undisturbed during the construction of Tensar Slopes.



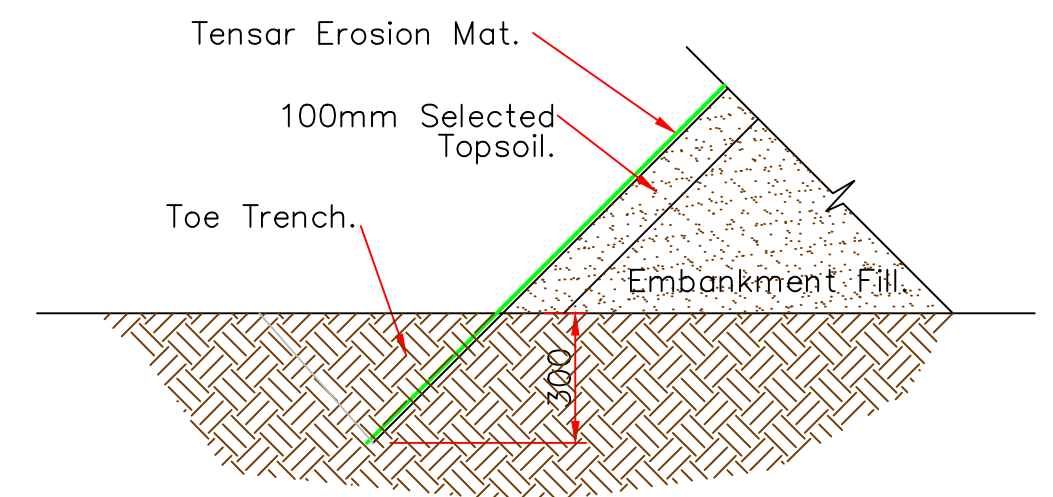


TENSAR MAT CREST ANCHORAGE

Scale 1:25

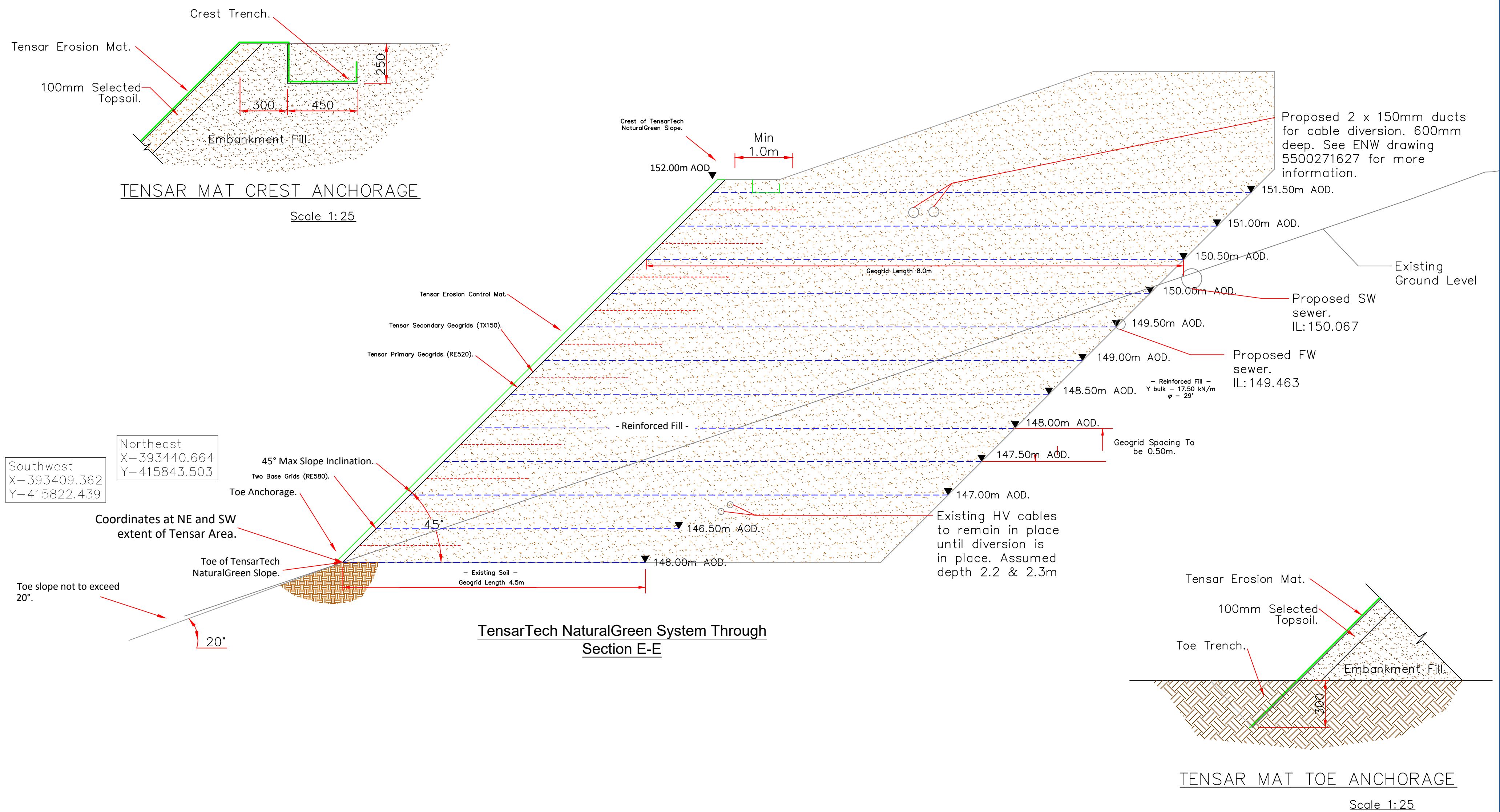


TensarTech NaturalGreen System Through
Section D-D

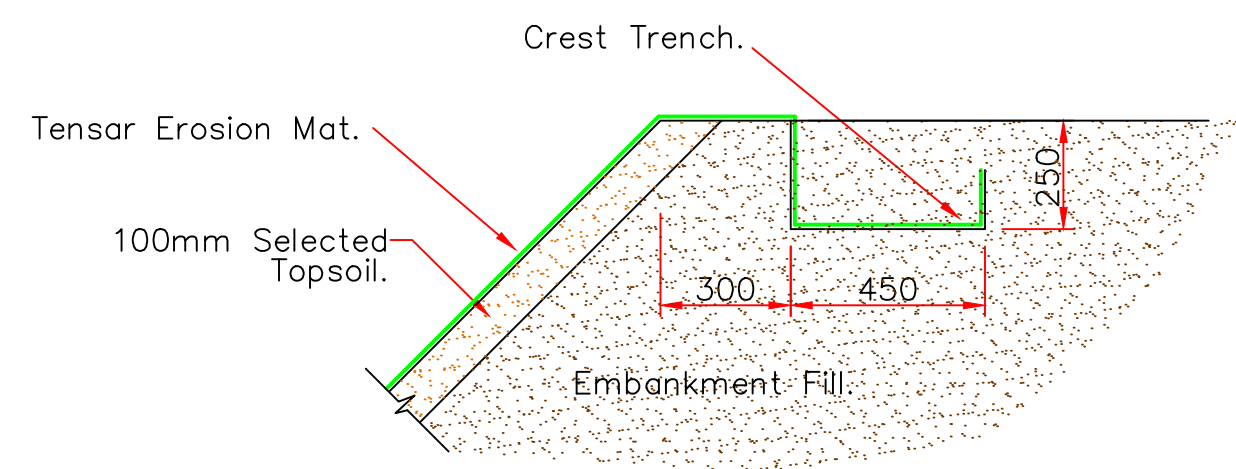


TENSAR MAT TOE ANCHORAGE

Scale 1:25

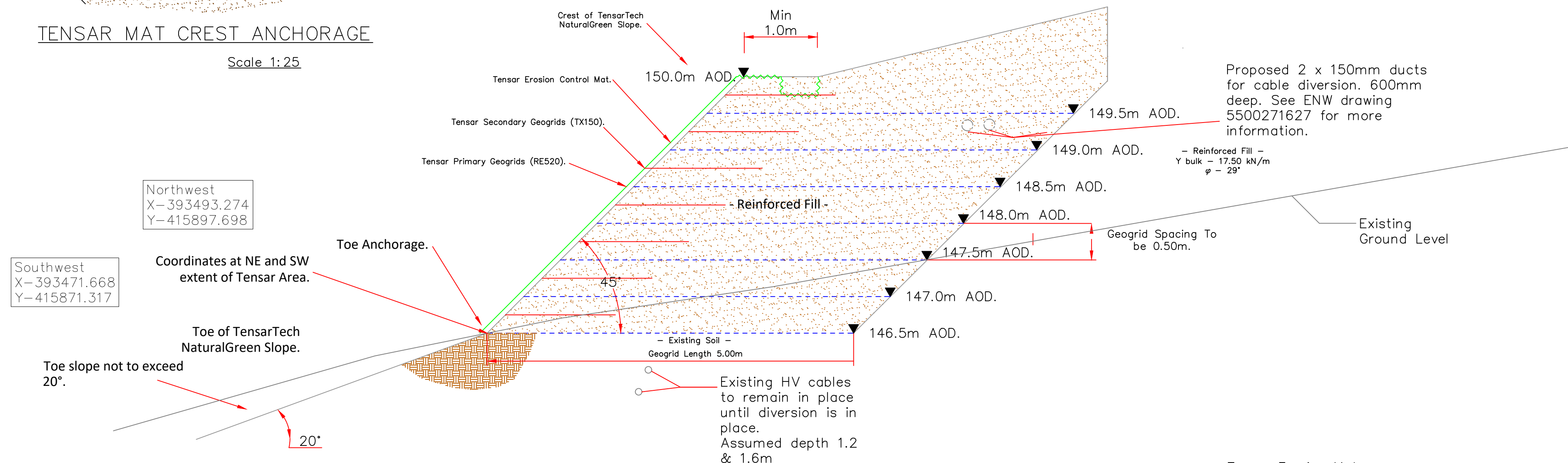


GROUNDTECH CONSULTING 	CLIENT	DATE				Status		Notes Proposed services to be installed during the construction of Tensar Slopes. Proposed services to be undisturbed during the construction of Tensar Slopes.
	COUNTRYSIDE HOMES	JULY 2023	_1.4	Amended coordinates	27/07/23	Preliminary		
	PROJECT TITLE	SCALE	_1.3	Added coordinates to toe of slope	19/07/23	Draft		
	HOLLINGWORTH GATE, LITTLEBOROUGH	NTS	_1.2	Adjustment of grid sizes to accommodate for existing services	18/07/23	Issued		
	PLAN TITLE	PLAN NUMBER	_1.1	Adjustment of levels	13/07/23	For Comment		
	TENSARTECH NATURAL GREEN PROFILE PLAN - SECTION E	GRO-23131-P03E_1.4	Rev.	Details	Date	Approved		

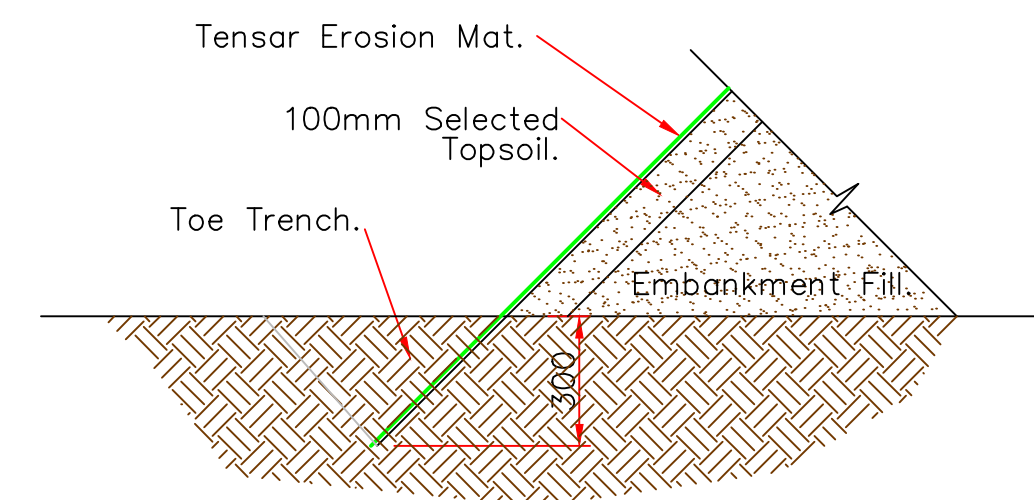


TENSAR MAT CREST ANCHORAGE

Scale 1:25



Section of TensarTech
NaturalGreen System Through Section F-F



TENSAR MAT TOE ANCHORAGE

Scale 1:25

GROUNDTECH
CONSULTING



CLIENT	COUNTRYSIDE HOMES
PROJECT TITLE	HOLLINGWORTH GATE, LITTLEBOROUGH
PLAN TITLE	TENSARTECH NATURAL GREEN PROFILE PLAN - SECTION F

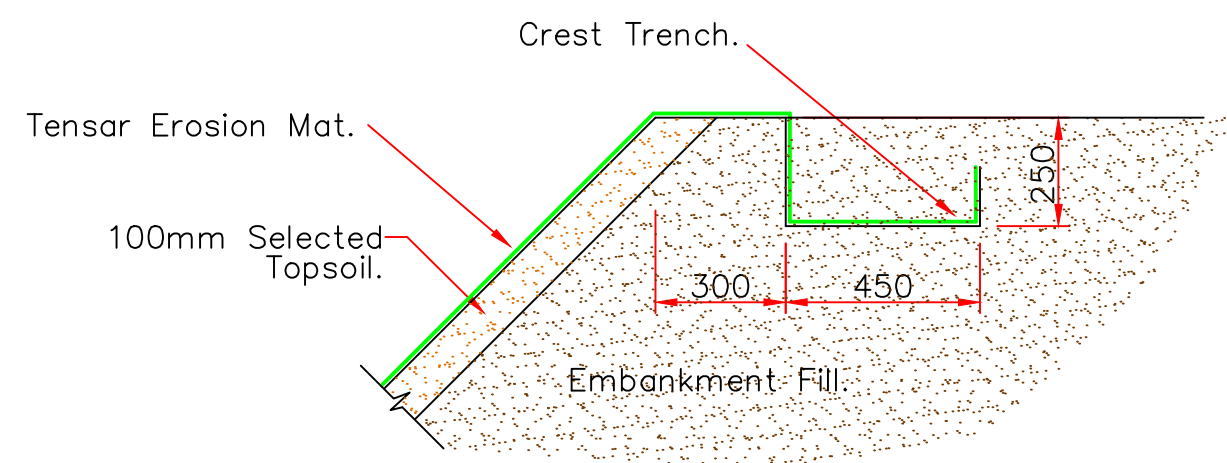
DATE	JULY 2023
SCALE	NTS
PLAN NUMBER	GRO-23131-P03F_1.2

_1.2	Added coordinates to toe of slope	19/07/23
_1.1	Adjustment of levels	13/07/23
Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes
Proposed services to be installed during the construction of Tensar Slopes.
Proposed services to be undisturbed during the construction of Tensar Slopes.





TENSAR MAT CREST ANCHORAGE

Scale 1:25

Northeast
X-393469.610
Y-415873.446

Southwest
X-393440.258
Y-415844.097

Coordinates at NE and SW
extent of Tensar Area.

Toe slope not to exceed
20°.

Toe of TensarTech
NaturalGreen Slope.

Toe Anchorage.

Tensar Primary Geogrids (RE520).

Tensar Secondary Geogrids (TX150).

Tensar Erosion Control Mat.

Crest of TensarTech
NaturalGreen Slope.

151.85m AOD

Min
1.0m

151.1m AOD

150.1m AOD

149.1m AOD

148.1m AOD

- Existing Soil -
Geogrid Length 4.60m

Existing 525ø
culvert.
Approx
IL: 146.75

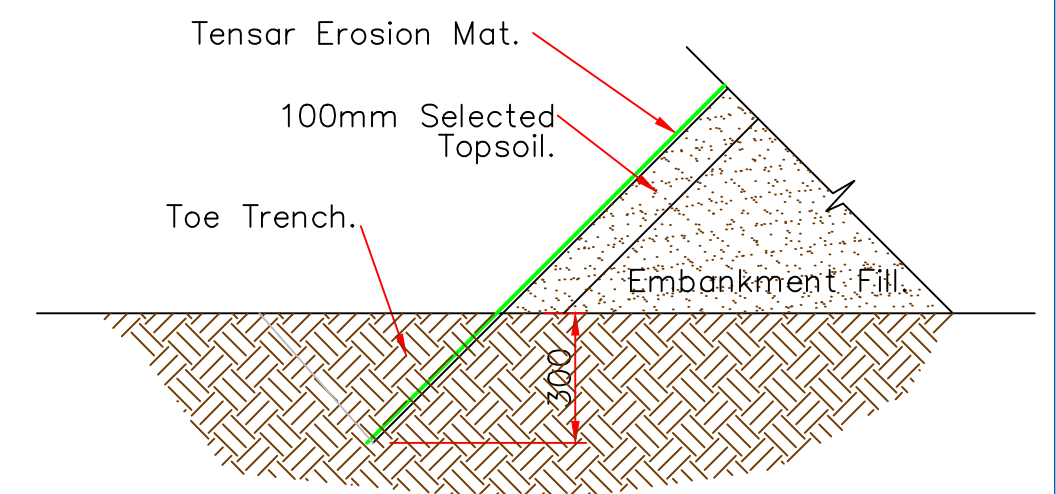
Existing HV cables
to remain in
place until
diversion is in
place.
Assumed depth
1.3 & 1.4m

- Reinforced Fill -
Y bulk - 17.5 kN/m
φ - 29°

Existing
Ground Level

Geogrid Spacing To
be 1.00m.

TensarTech NaturalGreen System Through Section G-G



TENSAR MAT TOE ANCHORAGE

Scale 1:25

GROUNDTECH
CONSULTING



CLIENT

COUNTRYSIDE HOMES

PROJECT TITLE

HOLLINGWORTH GATE, LITTLEBOROUGH

PLAN TITLE

TENSARTECH NATURAL GREEN PROFILE PLAN - SECTION G

DATE

JULY 2023

SCALE

NTS

PLAN NUMBER

GRO-23131-P03G_1.2

Rev.	Details	Date
_1.2	Added coordinates to toe of slope	19/07/23
_1.1	Adjustment of levels	13/07/23

Status

Preliminary

Draft

Issued

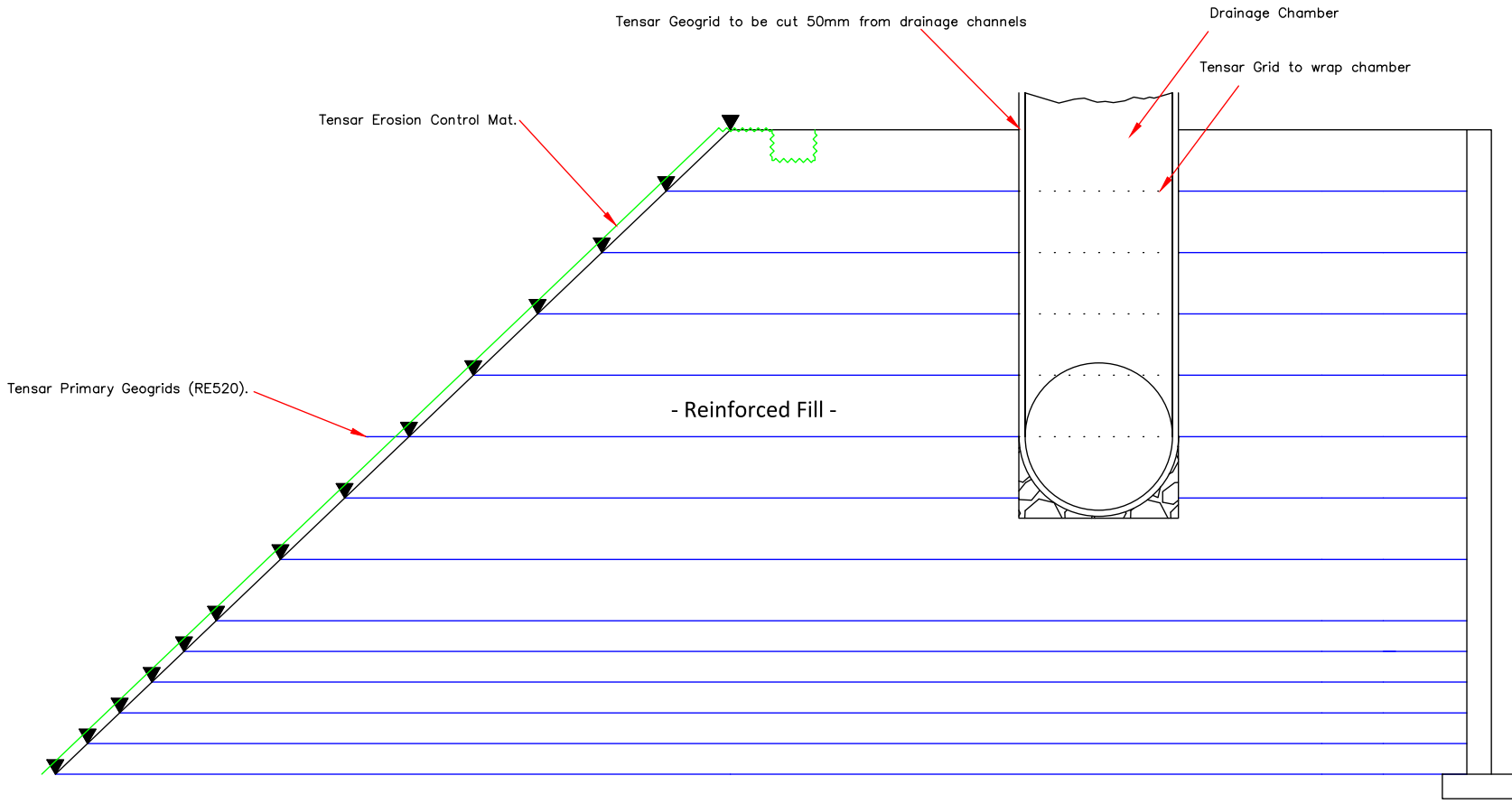
For Comment

Approved

Notes

Proposed services to be installed during the construction of Tensar Slopes.
Proposed services to be undisturbed during the construction of Tensar Slopes.





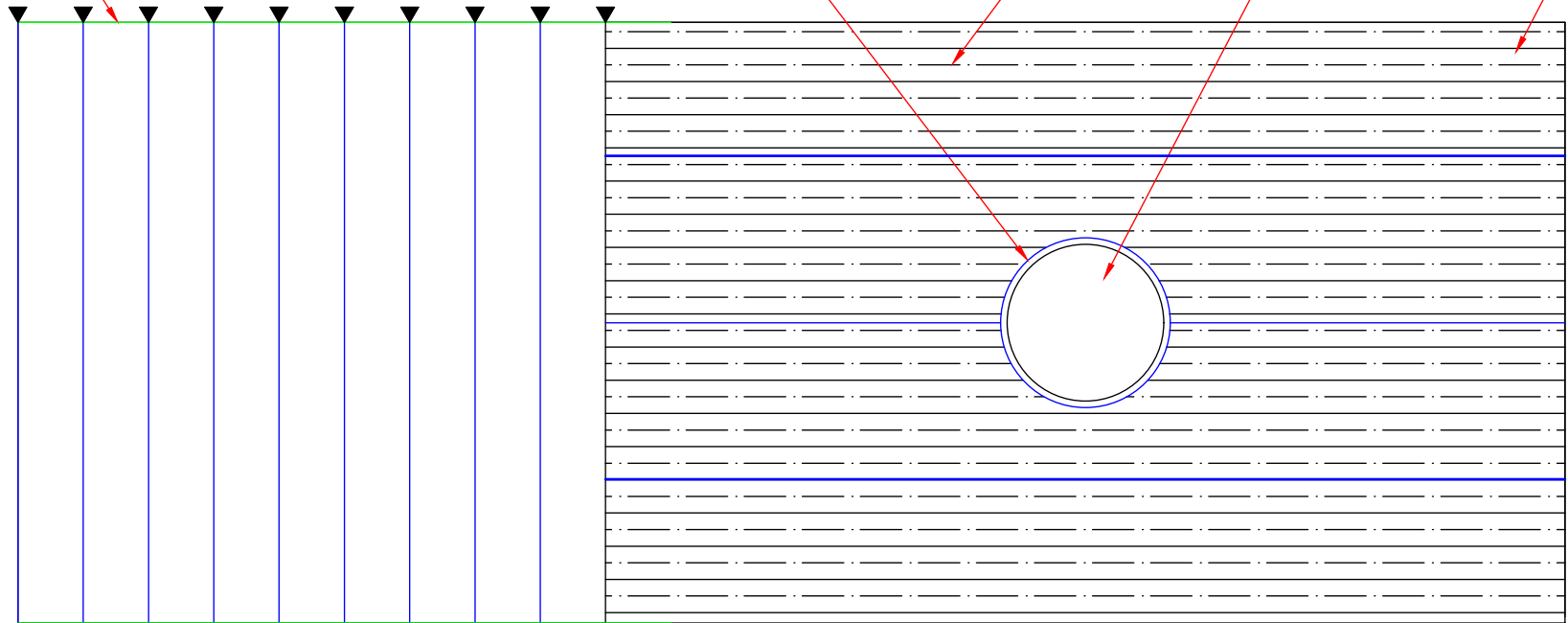
Tensar Erosion Control Mat.

Tensar Geogrid to be cut 50mm from drainage channels

Tensar Grid to wrap chamber

Drainage Chamber

Tensar Uniaxial Grid



GROUNDTECH
CONSULTING



CLIENT
COUNTRYSIDE PROPERTIES

PROJECT TITLE
HOLLINGWORTH GATE, LITTLEBOROUGH

PLAN TITLE
MANHOLE LOCALISED DETAIL - PLAN VIEW

DATE
JUNE 2023

SCALE
NTS

PLAN NUMBER
GRO-23131-P07

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes
Drainage installation should be programmed/sequenced with Tensar reinforced earth construction as levels raised



7.0 DESIGN BRIEF CONFIRMATION FORM

Please complete, sign and return to:

*Groundtech Consulting Ltd
1st Floor Lloyd House
Orford Court
Greenfold Way
Leigh
WN7 3XJ*

We hereby confirm that the contents of the Design Brief as stated in Section 2 of this document are representative of the actual site conditions and are hereby agreed to be used for the detailed design of the reinforced soil structure for the above project.

Company:.....

Signed:

Name:

Title:.....

Date:.....

Notes

As Groundtech carries no liability for the accuracy of the assumed geotechnical components of this project, it is strongly recommended that the client assigns a suitably qualified Geotechnical engineer to carry out a review and confirmation of the Design Brief prepared by Groundtech.

8.0 SETTLEMENT ASSESSMENT

Settlement assessment has been undertaken for the proposed embankment.

The proposed embankment will have a slope angle of 30 to 45°. The largest change in loading will be applied where the reinforced earth is circa 6m in height.

Settlement calculations have been undertaken and where bedrock forms the foundation, settlement will be negligible. Where the stiff Clay is anticipated to be present, settlement will be less than 25mm.

The Made Ground is variable and also requires excavation and processing due to cobbles and boulders. Further assessment is required where Made Ground is encountered at formation level. The risk from total and differential settlement may be able to be designed out by preparing the foundation soils during construction. The settlement calculations are based on the available ground conditions information.

9.0 SLOPE STABILITY ASSESSMENT

The objective of the Slope Stability Appraisal is to demonstrate that the proposed reprofiling of the embankment using reinforced earth is stable. The appraisal has been undertaken in accordance with EC7-1 and BS 8006.

9.1 History

The site comprises a former chemical works, the site is currently disused comprising different levels generally sloping down to the canal to the north/north east.

9.2 Geology

Glacial Till and Head Deposits are indicated to underlie the site, the solid geology is the Pennine Lower Coal Measures including the Milnrow Sandstone Formation and Undifferentiated Mudstone.

9.3 Hydrology

A canal abuts the site to the north. A small pond is located to the south of the site and Hollingworth Lake is located further to the south.

9.4 Ground Investigation Information

The depth of Made Ground was highly variable, generally the Made Ground was deeper along the northern boundary. Clay was encountered on the eastern and western areas of the site and was variable in consistency.

The bedrock varied between Mudstone, Sandstone and Siltstone.

9.5 Assessment

A Slope Stability Appraisal has been undertaken using Oasys modelling software, both the graphical and tabular outputs are appended.

9.6 Parameters

Parameters were obtained from a range of sources and are summarised in the table below:

Parameter	Value	Source
Angle of proposed slope	30 to 45°	Tensar Green Slope
Groundwater level	NGW	-
Canal Water Level	145.0 – 145.2m AOD	Surveyed in by surveyor
Strata	Section A	Ground model in CP05
	Section B	Ground Model in CP05, TP21
	Section D	Ground Model in MW03, MW05, TP19, TP20
	Section E	Ground Model in TP07
	Section F	Ground Model in MW01, TP01, TP02
Topography	-	From topographical survey and canal bank by additional surveying 1 to 1.65m beyond canal bank

The stability assessment has been undertaken using the above parameters.

Geotechnical Parameters

The parameters for the strata on the subject site have been obtained from the Arc Environmental Ground Investigation and Slope Stability Assessment.

The following geotechnical parameters and properties were considered to be representative of the soils:

Strata	Friction angle ϕ' (°)	Unit weight γ (kNm ³)
<i>Reinforced Earth</i>	29	17.5
<i>Backfill Made Ground</i>	29	17.5
<i>Soft Clay</i>	24	20
<i>Stiff Clay (conservative in the absence of testing results)</i>	24	20
<i>Sand</i>	34	20
<i>Mudstone</i>	33	21
<i>Siltstone/Sandstone</i>	40	21

Drained analysis has been carried out for long term stability, the model was run using a c' of 0 kPa for cohesive strata.

9.7 Slope Model Results (Rotational Failure)

The software model was run using the Bishop (circular failures) method to determine a range of Over Design Factors (ODF) which is the reciprocal of the Degree of Utilization for rotational failure. The results for Bishop Method are presented in the table below, non-circular failures were also assessed where relevant using the Janbu Method and the results are also presented in the below.

Design Situation	Computation Method	Sensitivity Analysis	ODF
<i>Section A</i>	<i>Bishop</i>	<i>Circular</i>	1.043
<i>Section B</i>	<i>Bishop</i>	<i>Circular</i>	1.218
<i>Section B</i>	<i>Janbu</i>	<i>Non-Circular</i>	1.512
<i>Section D</i>	<i>Bishop</i>	<i>Circular</i>	1.539
<i>Section E</i>	<i>Bishop</i>	<i>Circular</i>	1.210
<i>Section F</i>	<i>Bishop</i>	<i>Circular</i>	1.214
<i>Section F</i>	<i>Janbu</i>	<i>Non-Circular</i>	1.462
<i>Section F</i>	<i>Bishop</i>	<i>Vibration</i>	1.194

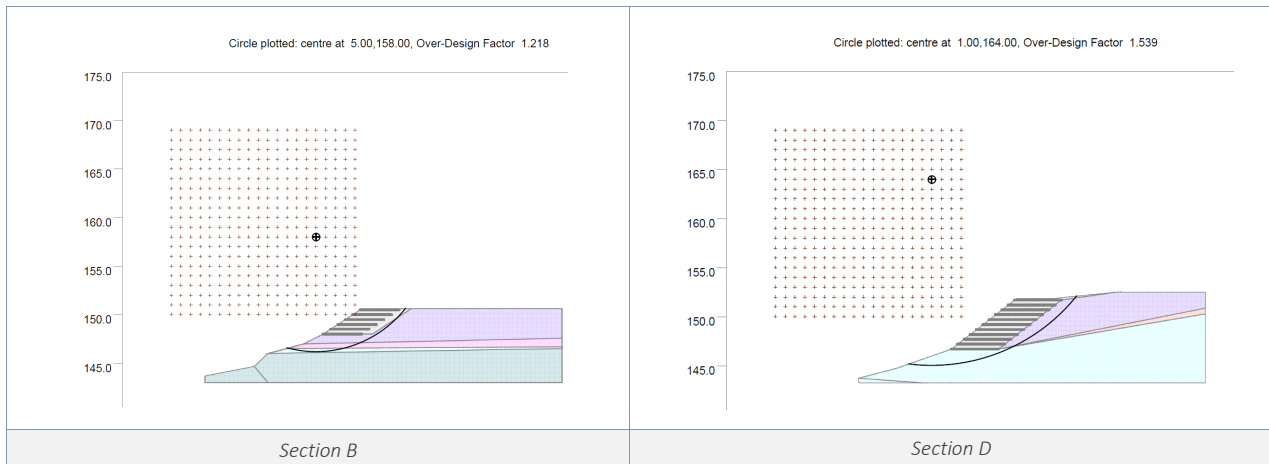
The results presented in the table above confirm the overall stability is acceptable as an ODF of greater than 1 has been generated using partial factor analysis in accordance with EC7 Design Approach 1 Combination 2 (BS EN 1997-1:2011 DA1-2).

The horizontal acceleration function in the model has been used to assess the potential vibration risk from piling.

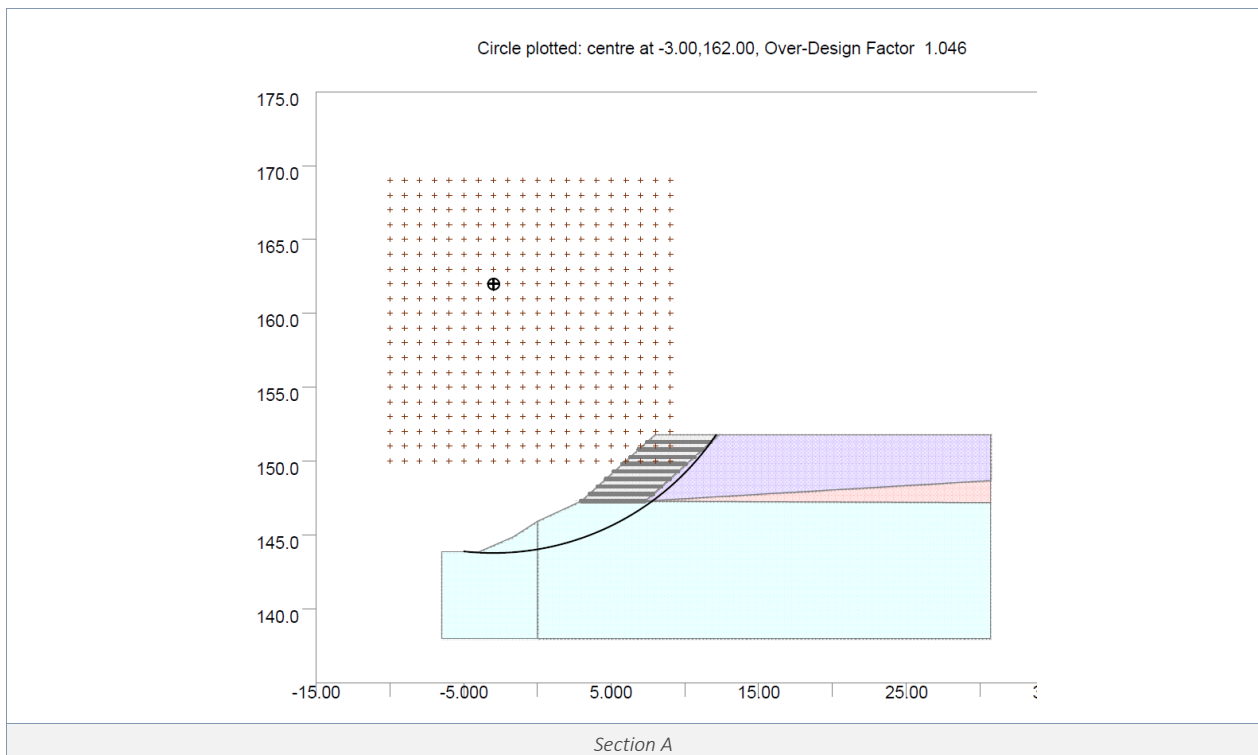
The model was initially run with the reinforcement not active using defined radii, using these results a common point was identified behind the reinforced earth wedge to assess the most sensitive failure plane for global stability.

The site reconnaissance noted the absence of a canal wall and the sections have been remodelled with the new topographical information.

Below are the graphical outputs for Section B and Section D showing the circular failure behind the reinforced block with ODFs greater than 1.



Below is the graphical output for Sections A, and ODF slightly above 1 was generated. Mudstone is anticipated at formation level and an inspection should confirm this is the case.



The length of the straps in Section F is 5m which doesn't extend beneath the proposed gabion structure. No permanent structures should be constructed over the reinforced earth and requires consideration.

The Public Open Space area in the vicinity of Section C does not require reinforced earth as shown on GRO-23131-P04_1.1. This will also be dependent on the treatment of the mine shaft in this area.

9.8 Limitations

The following assumptions and exclusions have been made in the modelling of the slope stability, if the assumptions are varied in the design or construction the modelling results are not applicable and the slope should be remodelled:

- *Ground models are generated from available Ground Investigation information by others, assessment applicable to geometrics and ground conditions in modelling sections. Inspection of formation level is required.*
- *Based on levels provided on dwg plans and canal sections.*
- *Treatment of the mine entry may have an effect on the proposed design, further details should be provided when available.*
- *No groundwater modelled based on Ground Investigation information provided, if this differs in construction or drainage strategy changes groundwater regime – design should be revisited.*
- *Design does not account for contamination or remedial activities.*
- *Based on the levels provided, some excavation into bedrock may be required and the contractor should allow for this.*
- *Processing of Made Ground will be required if proposed to be used in the reinforced earth construction.*
- *An earthworks specification in accordance with Series 600 is required to inform installation of material in reinforced earth. Fill material should be placed within the allowable moisture content range and suitably compacted.*
- *Foundations are assumed to be piles and no additional loads are being applied to the reinforced earth or backfill material.*

9.9 Summary

The slope stability results demonstrate the embankment is stable. Peak ϕ' values have been used in the assessment as there is no evidence of ancient slippages, if observed during the earthworks, the modelling should be revised using residual values.



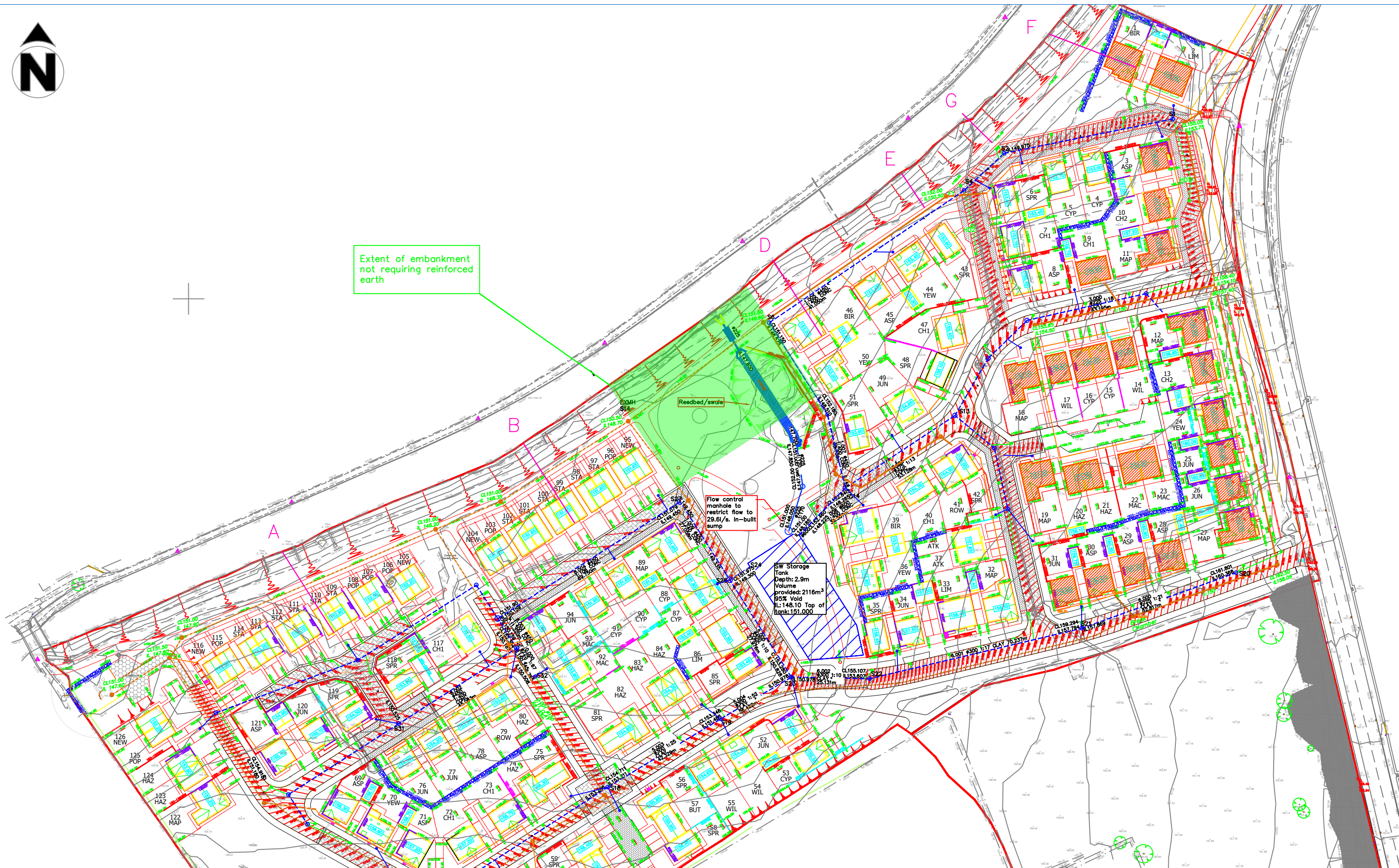
APPENDIX 1 - Plans



GROUNDTECH CONSULTING	CLIENT		DATE		Status		Notes Site Location		
	COUNTRYSIDE PARTNERSHIPS		JUNE 2023		Preliminary				
	PROJECT TITLE		SCALE		Draft				
	HOLLINGWORTH GATE, LITTLEBOROUGH		NTS		Issued				
	PLAN TITLE		PLAN NUMBER		For Comment				
	PROJECT LOCATION PLAN		GRO-23131-P01		Rev.	Details	Date	Approved	



Extent of embankment
not requiring reinforced
earth



GROUNDTECH
CONSULTING



CLIENT
COUNTRYSIDE PARTNERSHIPS - WAKEFIELD

PROJECT TITLE
HOLLINGSWORTH GATE, LITTLEBOROUGH

PLAN TITLE
SLOPE SECTION PLAN

DATE
JULY 2023

SCALE
NTS

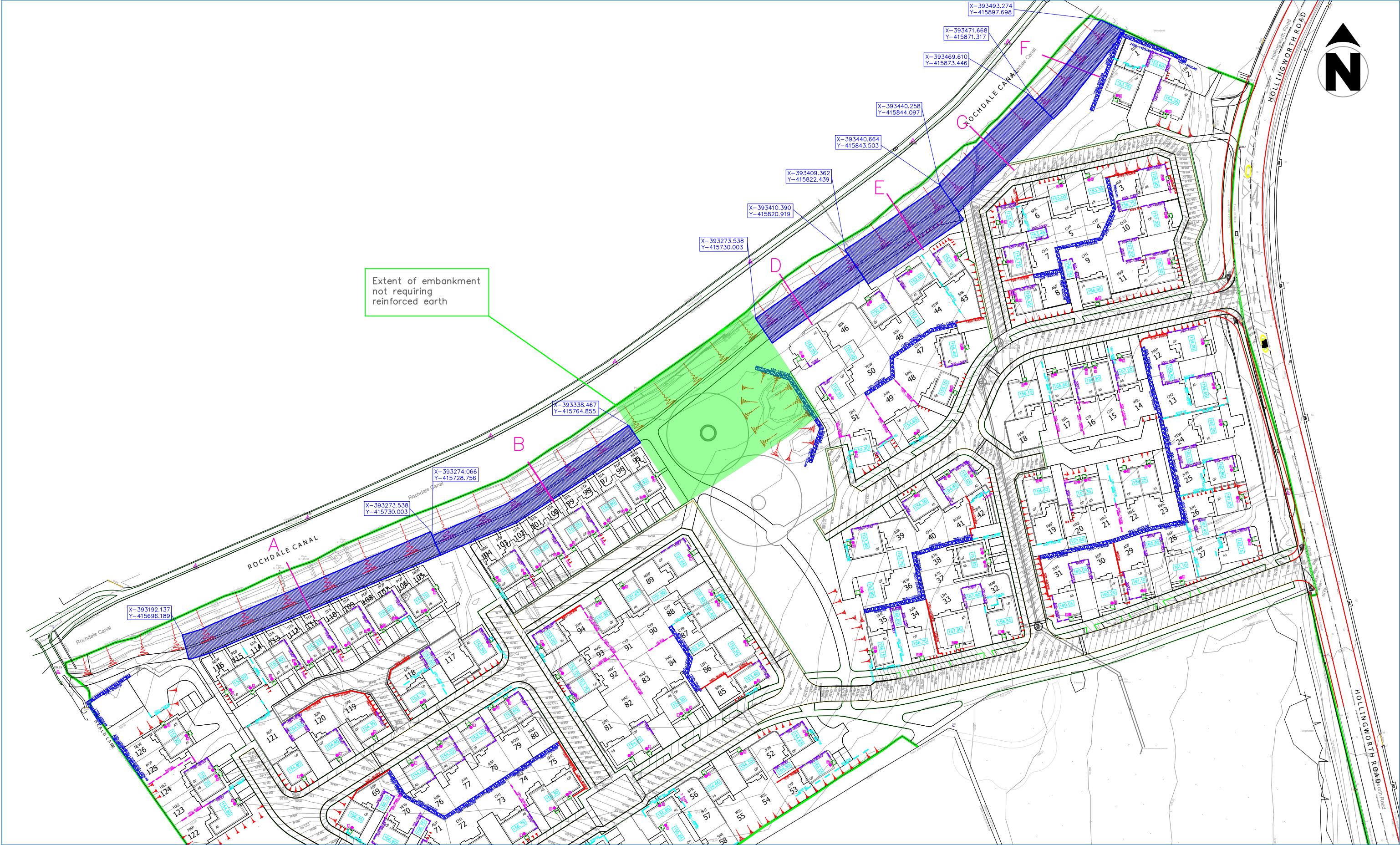
PLAN NUMBER
GRO-23131-P04_1.2

1.2	Added area G	
1.1	Text change for area of no reinforcement	10 July 2023
Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes





GROUNDTECH
CONSULTING



CLIENT

COUNTRYSIDE PARTNERSHIPS - WAKEFIELD

PROJECT TITLE

HOLLINGSWORTH GATE, LITTLEBOROUGH

PLAN TITLE

TENSAR AREAS PLAN

DATE

JULY 2023

SCALE

NTS

PLAN NUMBER

GRO-23131-P05_1.3

1.3.	Area E and D moved for existing services	27 July 2023
1.2.	Coordinates Added for Tensar Areas	19 July 2023
1.1.	Width of reinforced earth reduced	10 July 2023
Rev.	Details	Date

Status

Preliminary

Draft

Issued

For Comment

Approved

Notes

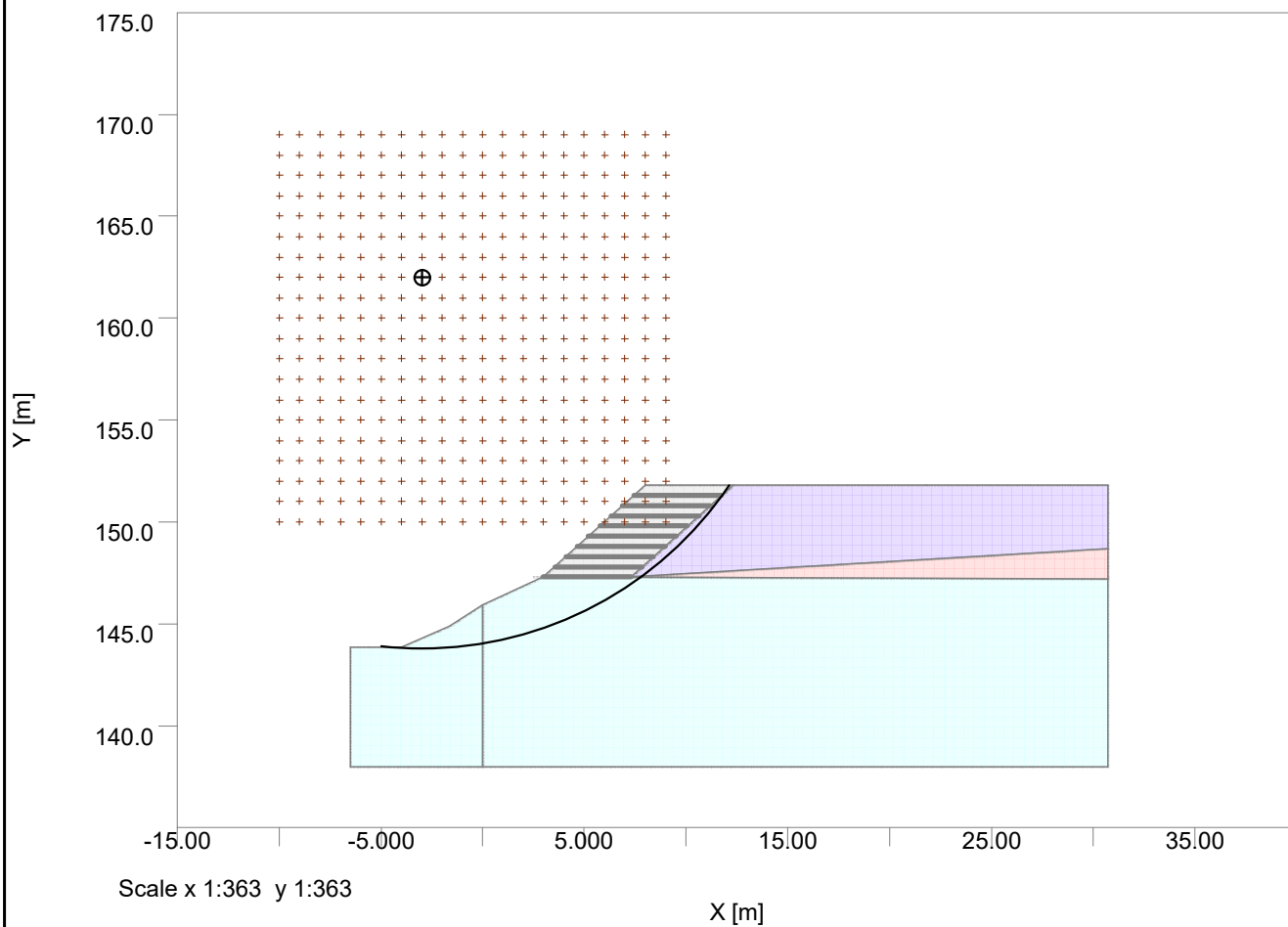
 - Extent of Tensar Geogrids for each Section





APPENDIX 2 - Section A Modelling Outputs

Circle plotted: centre at -3.00,162.00, Over-Design Factor 1.046




```

Inclination of grid: 0.00000 deg
(positive anticlockwise direction about bottom left of grid)
Centres on grid: 20 in x direction at 1.00000m spacing
                 20 in y direction at 1.00000m spacing
Grid extended to find minimum FoS
All circles pass through common point at x = 8.05000 m, y = 147.50000 m

```

In the following tables, values in italics are factored values using the currently selected Method Partial Factors.

Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]
-10.000	150.00	18.222		Only 1 intersection with ground level			
-10.000	151.00	18.386		Only 1 intersection with ground level			
-10.000	152.00	18.602		Only 1 intersection with ground level			
-10.000	153.00	18.869		Only 1 intersection with ground level			
-10.000	154.00	19.185		Only 1 intersection with ground level			
-10.000	155.00	19.546		Only 1 intersection with ground level			
-10.000	156.00	19.951		Only 1 intersection with ground level			
-10.000	157.00	20.397		Only 1 intersection with ground level			
-10.000	158.00	20.882		Only 1 intersection with ground level			
-10.000	159.00	21.402		Only 1 intersection with ground level			
-10.000	160.00	21.956		Only 1 intersection with ground level			
-10.000	161.00	22.540		Only 1 intersection with ground level			
-10.000	162.00	23.153		Only 1 intersection with ground level			
-10.000	163.00	23.792		Only 1 intersection with ground level			
-10.000	164.00	24.455		Only 1 intersection with ground level			
-10.000	165.00	25.141		Only 1 intersection with ground level			
-10.000	166.00	25.847		Only 1 intersection with ground level			
-10.000	167.00	26.572		Only 1 intersection with ground level			
-10.000	168.00	27.314		Only 1 intersection with ground level			
-10.000	169.00	28.072		Only 1 intersection with ground level			
-9.0000	150.00	17.232		Only 1 intersection with ground level			
-9.0000	151.00	17.406		Only 1 intersection with ground level			
-9.0000	152.00	17.634		Only 1 intersection with ground level			
-9.0000	153.00	17.915		Only 1 intersection with ground level			
-9.0000	154.00	18.247		Only 1 intersection with ground level			
-9.0000	155.00	18.627		Only 1 intersection with ground level			
-9.0000	156.00	19.051		Only 1 intersection with ground level			
-9.0000	157.00	19.518		Only 1 intersection with ground level			
-9.0000	158.00	20.024		Only 1 intersection with ground level			
-9.0000	159.00	20.566		Only 1 intersection with ground level			
-9.0000	160.00	21.141		Only 1 intersection with ground level			
-9.0000	161.00	21.747		Only 1 intersection with ground level			
-9.0000	162.00	22.382		Only 1 intersection with ground level			
-9.0000	163.00	23.042		Only 1 intersection with ground level			
-9.0000	164.00	23.727		Only 1 intersection with ground level			
-9.0000	165.00	24.433		Only 1 intersection with ground level			
-9.0000	166.00	25.159		Only 1 intersection with ground level			
-9.0000	167.00	25.903		Only 1 intersection with ground level			
-9.0000	168.00	26.664		Only 1 intersection with ground level			
-9.0000	169.00	27.440		Only 1 intersection with ground level			
-8.0000	150.00	16.244		Only 1 intersection with ground level			
-8.0000	151.00	16.427		Only 1 intersection with ground level			
-8.0000	152.00	16.669		Only 1 intersection with ground level			
-8.0000	153.00	16.966		Only 1 intersection with ground level			
-8.0000	154.00	17.316		Only 1 intersection with ground level			
-8.0000	155.00	17.716		Only 1 intersection with ground level			
-8.0000	156.00	18.162		Only 1 intersection with ground level			
-8.0000	157.00	18.651		Only 1 intersection with ground level			
-8.0000	158.00	19.179		Only 1 intersection with ground level			
-8.0000	159.00	19.745		Only 1 intersection with ground level			
-8.0000	160.00	20.343		Only 1 intersection with ground level			
-8.0000	161.00	20.973		Only 1 intersection with ground level			
-8.0000	162.00	21.630		Only 1 intersection with ground level			
-8.0000	163.00	22.313		Only 1 intersection with ground level			
-8.0000	164.00	23.019		Only 1 intersection with ground level			
-8.0000	165.00	23.746		Only 1 intersection with ground level			
-8.0000	166.00	24.492		Only 1 intersection with ground level			
-8.0000	167.00	25.256		Only 1 intersection with ground level			
-8.0000	168.00	26.036		Only 1 intersection with ground level			
-8.0000	169.00	26.830		Only 1 intersection with ground level			
-7.0000	150.00	15.256		Only 1 intersection with ground level			
-7.0000	151.00	15.452		Only 1 intersection with ground level			

Oasys Hollingsworth Gate, Littleborough Section A					Job No.		Sheet No.	Rev.
					GRO-23131			
					Drg. Ref.			
					Made by JD	Date 08 Jun 2023	Checked	Date
Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment	
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]	
-7.0000	152.00	15.708		Only 1 intersection with ground level				
-7.0000	153.00	16.023		Only 1 intersection with ground level				
-7.0000	154.00	16.394		Only 1 intersection with ground level				
-7.0000	155.00	16.815		Only 1 intersection with ground level				
-7.0000	156.00	17.284		Only 1 intersection with ground level				
-7.0000	157.00	17.798		Only 1 intersection with ground level				
-7.0000	158.00	18.351		Only 1 intersection with ground level				
-7.0000	159.00	18.941		Only 1 intersection with ground level				
-7.0000	160.00	19.564		Only 1 intersection with ground level				
-7.0000	161.00	20.218		Only 1 intersection with ground level				
-7.0000	162.00	20.899		Only 1 intersection with ground level				
-7.0000	163.00	21.604		Only 1 intersection with ground level				
-7.0000	164.00	22.333		Only 1 intersection with ground level				
-7.0000	165.00	23.081		Only 1 intersection with ground level				
-7.0000	166.00	23.849		Only 1 intersection with ground level				
-7.0000	167.00	24.632		Only 1 intersection with ground level				
-7.0000	168.00	25.431		Only 1 intersection with ground level				
-7.0000	169.00	26.244		Only 1 intersection with ground level				
-6.0000	150.00	14.271		Only 1 intersection with ground level				
-6.0000	151.00	14.479		Only 1 intersection with ground level				
-6.0000	152.00	14.753		Only 1 intersection with ground level				
-6.0000	153.00	15.088		Only 1 intersection with ground level				
-6.0000	154.00	15.481		Only 1 intersection with ground level				
-6.0000	155.00	15.926		Only 1 intersection with ground level				
-6.0000	156.00	16.421		Only 1 intersection with ground level				
-6.0000	157.00	16.960		Only 1 intersection with ground level				
-6.0000	158.00	17.540		Only 1 intersection with ground level				
-6.0000	159.00	18.156		Only 1 intersection with ground level				
-6.0000	160.00	18.806		Only 1 intersection with ground level				
-6.0000	161.00	19.485		Only 1 intersection with ground level				
-6.0000	162.00	20.190		Only 1 intersection with ground level				
-6.0000	163.00	20.920		Only 1 intersection with ground level				
-6.0000	164.00	21.671		Only 1 intersection with ground level				
-6.0000	165.00	22.442		Only 1 intersection with ground level				
-6.0000	166.00	23.230		Only 1 intersection with ground level				
-6.0000	167.00	24.034		Only 1 intersection with ground level				
-6.0000	168.00	24.853		Only 1 intersection with ground level				
-6.0000	169.00	25.684		Only 1 intersection with ground level				
-5.0000	150.00	13.287		Only 1 intersection with ground level				
-5.0000	151.00	13.511		Only 1 intersection with ground level				
-5.0000	152.00	13.804		Only 1 intersection with ground level				
-5.0000	153.00	14.162		Only 1 intersection with ground level				
-5.0000	154.00	14.579		Only 1 intersection with ground level				
-5.0000	155.00	15.052		Only 1 intersection with ground level				
-5.0000	156.00	15.574		Only 1 intersection with ground level				
-5.0000	157.00	16.142		Only 1 intersection with ground level				
-5.0000	158.00	16.750		Only 1 intersection with ground level				
-5.0000	159.00	17.394		Only 1 intersection with ground level				
-5.0000	160.00	18.071		Only 1 intersection with ground level				
-5.0000	161.00	18.776		Only 1 intersection with ground level				
-5.0000	162.00	19.508		Only 1 intersection with ground level				
-5.0000	163.00	20.262		Only 1 intersection with ground level				
-5.0000	164.00	21.037		Only 1 intersection with ground level				
-5.0000	165.00	21.830		Only 1 intersection with ground level				
-5.0000	166.00	22.640		Only 1 intersection with ground level				
-5.0000	167.00	23.464		Only 1 intersection with ground level				
-5.0000	168.00	24.301		Only 1 intersection with ground level				
-5.0000	169.00	25.151	720.56	1.0759	7489.1	8057.3	0.0	
-4.0000	150.00	12.307		Only 1 intersection with ground level				
-4.0000	151.00	12.548		Only 1 intersection with ground level				
-4.0000	152.00	12.863		Only 1 intersection with ground level				
-4.0000	153.00	13.246		Only 1 intersection with ground level				
-4.0000	154.00	13.691		Only 1 intersection with ground level				
-4.0000	155.00	14.193		Only 1 intersection with ground level				
-4.0000	156.00	14.746		Only 1 intersection with ground level				
-4.0000	157.00	15.344		Only 1 intersection with ground level				
-4.0000	158.00	15.983		Only 1 intersection with ground level				
-4.0000	159.00	16.657		Only 1 intersection with ground level				
-4.0000	160.00	17.362		Only 1 intersection with ground level				
-4.0000	161.00	18.096		Only 1 intersection with ground level				
-4.0000	162.00	18.853		Only 1 intersection with ground level				
-4.0000	163.00	19.633		Only 1 intersection with ground level				
-4.0000	164.00	20.432		Only 1 intersection with ground level				
-4.0000	165.00	21.247	740.79	1.0549	6567.1	6927.5	0.0	
-4.0000	166.00	22.078	715.90	1.0558	6673.0	7045.5	0.0	
-4.0000	167.00	22.923	698.95	1.0722	6736.5	7222.8	0.0	
-4.0000	168.00	23.779	685.25	1.0956	6793.3	7442.6	0.0	

Oasys Hollingsworth Gate, Littleborough Section A					Job No.	Sheet No.	Rev.
					GRO-23131		
					Drg. Ref.		
					Made by JD	Date 08 Jun 2023	Checked Date
Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment	
x [m]	y [m]	[m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]	
-4.0000	169.00	24.647	674.40	1.1144	6869.3	7655.2	0.0
-3.0000	150.00	11.329	Only 1	intersection with	ground level		
-3.0000	151.00	11.591	Only 1	intersection with	ground level		
-3.0000	152.00	11.931	Only 1	intersection with	ground level		
-3.0000	153.00	12.343	Only 1	intersection with	ground level		
-3.0000	154.00	12.820	Only 1	intersection with	ground level		
-3.0000	155.00	13.355	Only 1	intersection with	ground level		
-3.0000	156.00	13.941	Only 1	intersection with	ground level		
-3.0000	157.00	14.572	Only 1	intersection with	ground level		
-3.0000	158.00	15.243	Only 1	intersection with	ground level		
-3.0000	159.00	15.948	Only 1	intersection with	ground level		
-3.0000	160.00	16.684	Only 1	intersection with	ground level		
-3.0000	161.00	17.446	778.70	1.0484	5642.6	5899.4	16.381
-3.0000	162.00	18.231	740.59	1.0458	5695.0	5955.8	0.0
-3.0000	163.00	19.036	714.22	1.0537	5785.8	6096.4	0.0
-3.0000	164.00	19.858	693.54	1.0699	5849.0	6257.8	0.0
-3.0000	165.00	20.697	677.15	1.1013	5894.1	6491.1	0.0
-3.0000	166.00	21.549	664.27	1.1052	6001.9	6633.2	0.0
-3.0000	167.00	22.413	654.38	1.1301	6075.7	6866.1	0.0
-3.0000	168.00	23.288	647.11	1.1516	6163.3	7097.9	0.0
-3.0000	169.00	24.173	641.95	1.1771	6247.9	7354.4	0.0
-2.0000	150.00	10.356	Only 1	intersection with	ground level		
-2.0000	151.00	10.642	Only 1	intersection with	ground level		
-2.0000	152.00	11.011	Only 1	intersection with	ground level		
-2.0000	153.00	11.457	Only 1	intersection with	ground level		
-2.0000	154.00	11.969	Only 1	intersection with	ground level		
-2.0000	155.00	12.540	Only 1	intersection with	ground level		
-2.0000	156.00	13.163	Only 1	intersection with	ground level		
-2.0000	157.00	13.829	851.93	1.0804	4712.6	5050.3	40.995
-2.0000	158.00	14.535	793.02	1.0621	4767.0	5024.5	38.740
-2.0000	159.00	15.273	748.84	1.0660	4818.2	5104.4	31.980
-2.0000	160.00	16.039	716.00	1.0478	4926.3	5145.6	16.355
-2.0000	161.00	16.830	690.12	1.0559	4996.6	5276.1	0.0
-2.0000	162.00	17.642	669.74	1.0791	5058.5	5458.7	0.0
-2.0000	163.00	18.473	654.00	1.0975	5139.7	5640.7	0.0
-2.0000	164.00	19.320	642.08	1.1253	5212.5	5865.6	0.0
-2.0000	165.00	20.180	633.31	1.1456	5304.9	6077.4	0.0
-2.0000	166.00	21.054	627.27	1.1650	5406.7	6298.5	0.0
-2.0000	167.00	21.937	623.12	1.1870	5503.6	6533.0	0.0
-2.0000	168.00	22.831	620.56	1.2068	5605.8	6765.1	0.0
-2.0000	169.00	23.733	619.49	1.2246	5713.8	6997.2	0.0
-1.0000	150.00	9.3890	Only 1	intersection with	ground level		
-1.0000	151.00	9.7032	Only 1	intersection with	ground level		
-1.0000	152.00	10.107	Only 1	intersection with	ground level		
-1.0000	153.00	10.590	1003.4	1.2118	3758.1	4531.0	23.010
-1.0000	154.00	11.142	904.28	1.1416	3828.5	4339.8	30.810
-1.0000	155.00	11.754	828.00	1.1028	3894.4	4264.1	30.550
-1.0000	156.00	12.416	770.19	1.0685	3994.1	4230.6	37.050
-1.0000	157.00	13.121	725.85	1.0701	4050.7	4300.9	33.540
-1.0000	158.00	13.862	691.24	1.0739	4121.7	4398.0	28.080
-1.0000	159.00	14.634	664.61	1.0820	4200.0	4528.5	16.079
-1.0000	160.00	15.432	644.30	1.0989	4275.9	4699.0	0.0
-1.0000	161.00	16.253	629.20	1.1186	4363.5	4881.0	0.0
-1.0000	162.00	17.092	618.36	1.1388	4459.7	5078.5	0.0
-1.0000	163.00	17.949	610.67	1.1603	4557.1	5287.4	0.0
-1.0000	164.00	18.819	605.46	1.1801	4659.3	5498.4	0.0
-1.0000	165.00	19.702	602.43	1.1958	4767.7	5701.3	0.0
-1.0000	166.00	20.595	601.02	1.2128	4881.1	5919.7	0.0
-1.0000	167.00	21.498	601.05	1.2313	4999.1	6155.5	0.0
-1.0000	168.00	22.409	602.23	1.2509	5121.2	6406.0	0.0
-1.0000	169.00	23.327	604.43	1.2715	5246.9	6671.2	0.0
0.0	150.00	8.4293	Centre embedded/below end of slip				
0.0	151.00	8.7780	Centre embedded/below end of slip				
0.0	152.00	9.2224	901.82	1.2283	3004.5	3675.4	15.210
0.0	153.00	9.7495	816.43	1.1540	3103.6	3558.4	23.010
0.0	154.00	10.347	752.01	1.1279	3175.4	3553.8	27.886
0.0	155.00	11.002	702.35	1.1146	3252.2	3594.5	30.550
0.0	156.00	11.707	664.90	1.1129	3334.4	3682.4	28.340
0.0	157.00	12.452	636.92	1.1200	3420.6	3806.9	24.180
0.0	158.00	13.231	616.68	1.1366	3506.9	3970.2	15.695
0.0	159.00	14.038	602.07	1.1457	3609.9	4135.5	0.29589
0.0	160.00	14.868	591.85	1.1637	3711.9	4319.4	0.0
0.0	161.00	15.718	585.14	1.1751	3820.7	4489.6	0.0
0.0	162.00	16.585	581.18	1.1870	3935.4	4671.4	0.0

Oasys Hollingsworth Gate, Littleborough Section A						Job No.	Sheet No.	Rev.	
						GRO-23131			
						Drg. Ref.			
						Made by JD	Date 08 Jun 2023	Checked	Date
Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment			
x [m]	y [m]	[m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]			
0.0	163.00	17.466	579.28	1.2020	4054.8	4873.7	0.0		
0.0	164.00	18.359	579.22	1.2193	4178.6	5095.0	0.0		
0.0	165.00	19.263	580.63	1.2385	4306.7	5333.9	0.0		
0.0	166.00	20.176	583.17	1.2593	4437.2	5587.7	0.0		
0.0	167.00	21.096	586.68	1.2811	4571.2	5856.1	0.0		
0.0	168.00	22.024	591.06	1.3040	4707.5	6138.6	0.0		
0.0	169.00	22.958	596.09	1.3276	4846.0	6433.5	0.0		
1.0000	150.00	7.4801	Centre embedded/below end of slip						
1.0000	151.00	7.8710	Centre embedded/below end of slip						
1.0000	152.00	8.3638	736.18	1.2365	2370.4	2915.9	15.210		
1.0000	153.00	8.9416	679.02	1.1979	2469.1	2934.7	23.010		
1.0000	154.00	9.5892	636.85	1.1834	2560.9	3006.5	24.050		
1.0000	155.00	10.293	606.76	1.1783	2662.5	3114.1	23.140		
1.0000	156.00	11.043	585.43	1.1848	2763.8	3254.3	20.280		
1.0000	157.00	11.830	570.97	1.1897	2873.8	3403.7	15.173		
1.0000	158.00	12.647	561.50	1.1826	2989.7	3534.9	0.64000		
1.0000	159.00	13.489	555.91	1.1865	3111.2	3691.3	0.0		
1.0000	160.00	14.351	553.30	1.1960	3237.4	3872.0	0.0		
1.0000	161.00	15.230	553.07	1.2098	3367.9	4074.5	0.0		
1.0000	162.00	16.123	554.68	1.2270	3501.7	4296.4	0.0		
1.0000	163.00	17.028	557.78	1.2468	3638.4	4536.4	0.0		
1.0000	164.00	17.943	562.19	1.2689	3778.0	4793.9	0.0		
1.0000	165.00	18.867	567.46	1.2927	3919.1	5066.3	0.0		
1.0000	166.00	19.798	573.72	1.3178	4063.0	5354.3	0.0		
1.0000	167.00	20.735	580.48	1.3439	4207.6	5654.7	0.0		
1.0000	168.00	21.678	587.86	1.3708	4354.2	5968.6	0.0		
1.0000	169.00	22.626	595.66	1.3981	4502.3	6294.6	0.0		
2.0000	150.00	6.5462	Centre embedded/below end of slip						
2.0000	151.00	6.9895	Centre embedded/below end of slip						
2.0000	152.00	7.5401	605.59	1.3204	1802.3	2364.7	15.210		
2.0000	153.00	8.1763	572.10	1.2834	1924.2	2452.1	17.550		
2.0000	154.00	8.8799	549.01	1.2592	2043.9	2555.8	17.940		
2.0000	155.00	9.6360	534.29	1.2297	2169.1	2651.0	16.380		
2.0000	156.00	10.433	525.72	1.2123	2299.1	2774.3	12.870		
2.0000	157.00	11.263	521.51	1.2037	2432.3	2926.8	0.94711		
2.0000	158.00	12.118	520.87	1.2086	2569.5	3105.6	0.0		
2.0000	159.00	12.994	522.96	1.2206	2710.2	3308.1	0.0		
2.0000	160.00	13.887	526.97	1.2379	2852.6	3531.2	0.0		
2.0000	161.00	14.794	532.60	1.2590	2997.6	3774.0	0.0		
2.0000	162.00	15.712	539.39	1.2830	3144.5	4034.3	0.0		
2.0000	163.00	16.639	547.04	1.3092	3292.6	4310.5	0.0		
2.0000	164.00	17.574	555.43	1.3369	3442.2	4601.9	0.0		
2.0000	165.00	18.516	564.30	1.3657	3592.6	4906.6	0.0		
2.0000	166.00	19.464	573.67	1.3953	3744.8	5224.9	0.0		
2.0000	167.00	20.417	583.21	1.4250	3897.4	5553.9	0.0		
2.0000	168.00	21.374	593.18	1.4553	4051.3	5896.0	0.0		
2.0000	169.00	22.335	603.21	1.4882	4205.7	6248.7	10.405		
3.0000	150.00	5.6349	Centre embedded/below end of slip						
3.0000	151.00	6.1443	Centre embedded/below end of slip						
3.0000	152.00	6.7641	503.61	1.3836	1356.9	1865.5	11.884		
3.0000	153.00	7.4668	488.74	1.3042	1499.2	1938.7	16.558		
3.0000	154.00	8.2312	481.88	1.2581	1642.5	2054.0	12.480		
3.0000	155.00	9.0417	480.54	1.2385	1787.4	2203.4	10.270		
3.0000	156.00	9.8870	483.11	1.2320	1934.0	2381.6	1.1924		
3.0000	157.00	10.759	488.57	1.2408	2083.1	2584.8	0.0		
3.0000	158.00	11.651	496.00	1.2577	2233.7	2809.4	0.0		
3.0000	159.00	12.560	504.70	1.2799	2385.1	3052.7	0.0		
3.0000	160.00	13.482	514.43	1.3057	2537.8	3313.7	0.0		
3.0000	161.00	14.414	524.98	1.3340	2691.9	3591.1	0.0		
3.0000	162.00	15.354	536.00	1.3642	2846.8	3883.6	0.0		
3.0000	163.00	16.302	547.40	1.3956	3002.4	4190.2	0.0		
3.0000	164.00	17.256	559.07	1.4279	3158.6	4510.2	0.0		
3.0000	165.00	18.214	570.80	1.4615	3314.6	4842.3	2.1194		
3.0000	166.00	19.177	582.75	1.5012	3472.1	5187.9	24.310		
3.0000	167.00	20.143	594.69	1.5346	3630.1	5544.9	25.610		
3.0000	168.00	21.113	606.69	1.5682	3788.2	5913.6	26.910		
3.0000	169.00	22.085	618.59	1.6018	3945.7	6291.9	28.210		
4.0000	150.00	4.7595	Centre embedded/below end of slip						
4.0000	151.00	5.3528	Centre embedded/below end of slip						
4.0000	152.00	6.0541	426.74	1.3742	1021.1	1392.1	11.050		
4.0000	153.00	6.8303	429.89	1.3150	1175.8	1534.3	11.842		
4.0000	154.00	7.6585	437.68	1.2879	1332.8	1708.8	7.6700		
4.0000	155.00	8.5236	447.95	1.2831	1488.9	1909.1	1.3340		

Oasys Hollingsworth Gate, Littleborough Section A						Job No.	Sheet No.	Rev.	
						GRO-23131			
						Drg. Ref.			
						Made by JD	Date 08 Jun 2023	Checked	Date
Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment			
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]		
4.0000	156.00	9.4155	459.96	1.2955	1645.7	2131.9	0.0		
4.0000	157.00	10.327	473.02	1.3169	1802.9	2374.3	0.0		
4.0000	158.00	11.254	486.74	1.3437	1960.7	2634.6	0.0		
4.0000	159.00	12.192	500.89	1.3737	2119.1	2911.0	0.0		
4.0000	160.00	13.140	515.26	1.4060	2277.9	3202.8	0.0		
4.0000	161.00	14.094	529.64	1.4395	2436.8	3507.8	0.0		
4.0000	162.00	15.055	544.11	1.4820	2596.2	3828.5	19.110		
4.0000	163.00	16.020	558.52	1.5177	2756.0	4162.4	20.410		
4.0000	164.00	16.990	572.75	1.5539	2915.4	4508.6	21.710		
4.0000	165.00	17.963	586.96	1.5899	3075.8	4867.2	23.010		
4.0000	166.00	18.938	600.99	1.6257	3236.1	5236.8	24.310		
4.0000	167.00	19.916	614.79	1.6614	3396.0	5616.7	25.610		
4.0000	168.00	20.896	628.48	1.6968	3556.5	6007.7	26.910		
4.0000	169.00	21.878	642.05	1.7317	3717.3	6409.1	28.210		
5.0000	150.00	3.9437	Centre embedded/below end of slip						
5.0000	151.00	4.6425	Centre embedded/below end of slip						
5.0000	152.00	5.4362	378.35	1.4347	766.78	1092.6	7.5400		
5.0000	153.00	6.2891	397.10	1.3878	930.71	1286.5	5.0700		
5.0000	154.00	7.1800	416.31	1.3782	1092.1	1503.7	1.3542		
5.0000	155.00	8.0964	435.63	1.3895	1253.0	1741.1	0.0		
5.0000	156.00	9.0306	454.92	1.4125	1414.0	1997.4	0.0		
5.0000	157.00	9.9776	473.90	1.4411	1575.0	2269.7	0.0		
5.0000	158.00	10.934	492.61	1.4816	1736.2	2558.4	13.910		
5.0000	159.00	11.898	510.97	1.5165	1897.7	2862.7	15.210		
5.0000	160.00	12.867	528.93	1.5526	2059.3	3180.8	16.510		
5.0000	161.00	13.840	546.44	1.5894	2220.3	3511.1	17.810		
5.0000	162.00	14.817	563.55	1.6258	2381.8	3853.2	19.110		
5.0000	163.00	15.797	580.38	1.6621	2543.6	4207.3	20.410		
5.0000	164.00	16.780	596.78	1.6982	2705.0	4571.9	21.710		
5.0000	165.00	17.764	612.86	1.7336	2866.4	4946.1	23.010		
5.0000	166.00	18.750	628.59	1.7678	3028.2	5328.9	24.310		
5.0000	167.00	19.737	644.05	1.8011	3189.7	5719.3	25.610		
5.0000	168.00	20.726	659.18	1.8328	3351.2	6115.1	26.910		
5.0000	169.00	21.715	674.00	1.8621	3512.3	6512.1	28.210		
6.0000	150.00	3.2330	Centre embedded/below end of slip						
6.0000	151.00	4.0562	Centre embedded/below end of slip						
6.0000	152.00	4.9449	357.63	1.6008	575.53	912.73	8.5800		
6.0000	153.00	5.8696	388.60	1.5466	740.67	1136.9	8.5908		
6.0000	154.00	6.8156	416.60	1.5350	902.25	1376.2	8.7100		
6.0000	155.00	7.7751	442.89	1.5434	1064.0	1632.1	10.010		
6.0000	156.00	8.7437	467.72	1.5594	1225.4	1899.6	11.310		
6.0000	157.00	9.7187	491.32	1.5749	1386.9	2171.6	12.610		
6.0000	158.00	10.698	513.85	1.5619	1548.4	2418.3	0.0		
6.0000	159.00	11.681	535.49	1.6074	1710.0	2748.5	0.0		
6.0000	160.00	12.667	556.20	1.6529	1871.4	3093.3	0.0		
6.0000	161.00	13.655	576.21	1.6983	2033.1	3452.8	0.0		
6.0000	162.00	14.644	595.50	1.7432	2194.7	3826.0	0.0		
6.0000	163.00	15.635	614.20	1.7877	2356.4	4212.6	0.0		
6.0000	164.00	16.627	632.28	1.8316	2517.8	4611.6	0.0		
6.0000	165.00	17.620	649.88	1.8748	2679.5	5023.5	0.0		
6.0000	166.00	18.613	666.99	1.9173	2841.2	5447.3	0.0		
6.0000	167.00	19.607	683.70	1.9591	3003.0	5883.1	0.0		
6.0000	168.00	20.602	699.95	2.0001	3164.7	6329.7	0.0		
6.0000	169.00	21.598	715.83	2.0404	3326.6	6787.5	0.0		
7.0000	150.00	2.7115	Centre embedded/below end of slip						
7.0000	151.00	3.6541	Centre embedded/below end of slip						
7.0000	152.00	4.6209	364.90	1.8329	439.01	793.69	10.947		
7.0000	153.00	5.5993	403.91	1.7690	595.29	1046.3	6.7600		
7.0000	154.00	6.5843	438.52	1.7633	752.98	1319.7	8.0600		
7.0000	155.00	7.5731	469.74	1.7799	911.04	1612.2	9.3600		
7.0000	156.00	8.5646	498.60	1.8071	1070.2	1923.4	10.660		
7.0000	157.00	9.5578	525.41	1.8407	1229.7	2251.6	11.960		
7.0000	158.00	10.552	550.53	1.8784	1389.1	2596.0	13.260		
7.0000	159.00	11.548	574.34	1.9177	1549.1	2956.1	14.560		
7.0000	160.00	12.544	597.02	1.9578	1709.6	3331.1	15.860		
7.0000	161.00	13.541	618.67	1.9992	1869.6	3720.4	17.160		
7.0000	162.00	14.538	639.49	2.0402	2030.4	4123.9	18.460		
7.0000	163.00	15.536	659.39	2.0815	2190.4	4539.6	19.760		
7.0000	164.00	16.533	678.75	2.1222	2351.4	4969.2	21.060		
7.0000	165.00	17.531	697.35	2.1626	2512.0	5410.1	22.360		
7.0000	166.00	18.530	715.41	2.1934	2673.2	5863.5	0.0		
7.0000	167.00	19.528	733.01	2.2330	2834.3	6329.1	0.0		
7.0000	168.00	20.527	750.08	2.2721	2995.3	6805.7	0.0		

Oasys Hollingsworth Gate, Littleborough Section A						Job No.		Sheet No.		Rev.	
						GRO-23131					
						Drg. Ref.					
						Made by JD		Date 08 Jun 2023		Checked	
Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment				
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]				
7.0000	169.00	21.526	766.70	2.3104	3156.8	7293.3	0.0				
8.0000	150.00	2.5005	Centre embedded/below end of slip								
8.0000	151.00	3.5004	Centre embedded/below end of slip								
8.0000	152.00	4.5003	398.67	2.6264	336.72	869.92	14.430				
8.0000	153.00	5.5002	443.20	2.4133	484.90	1157.3	12.870				
8.0000	154.00	6.5002	481.54	2.3272	635.41	1463.3	15.470				
8.0000	155.00	7.5002	515.80	2.2926	787.90	1788.2	18.070				
8.0000	156.00	8.5001	546.98	2.2841	942.12	2131.2	20.670				
8.0000	157.00	9.5001	575.77	2.2912	1097.5	2491.3	23.270				
8.0000	158.00	10.500	602.57	2.2977	1253.7	2867.4	13.260				
8.0000	159.00	11.500	627.87	2.3210	1410.7	3259.7	14.560				
8.0000	160.00	12.500	651.76	2.3480	1568.3	3666.5	15.860				
8.0000	161.00	13.500	674.45	2.3774	1726.5	4087.3	17.160				
8.0000	162.00	14.500	696.16	2.4088	1884.9	4521.9	18.460				
8.0000	163.00	15.500	716.99	2.4418	2043.5	4970.0	19.760				
8.0000	164.00	16.500	737.08	2.4750	2202.8	5430.9	21.060				
8.0000	165.00	17.500	756.36	2.5091	2361.8	5903.8	22.360				
8.0000	166.00	18.500	775.05	2.5437	2521.0	6388.9	23.660				
8.0000	167.00	19.500	793.21	2.5779	2680.9	6886.2	24.960				
8.0000	168.00	20.500	810.76	2.6119	2840.9	7393.9	26.260				
8.0000	169.00	21.500	827.84	2.6463	3000.6	7913.1	27.560				
9.0000	150.00	2.6744	Centre embedded/below end of slip								
9.0000	151.00	3.6266	Centre embedded/below end of slip								
9.0000	152.00	4.5992	464.08	4.2117	261.35	1082.8	17.940				
9.0000	153.00	5.5814	510.06	3.5029	400.04	1383.0	18.330				
9.0000	154.00	6.5691	549.36	3.2162	542.14	1721.4	22.230				
9.0000	155.00	7.5599	584.40	3.0601	687.83	2078.7	26.130				
9.0000	156.00	8.5529	616.20	2.9596	836.14	2454.0	20.670				
9.0000	157.00	9.5474	645.54	2.9091	986.52	2846.6	23.270				
9.0000	158.00	10.543	672.79	2.8826	1138.3	3255.5	25.870				
9.0000	159.00	11.539	698.46	2.8726	1291.1	3680.5	28.470				
9.0000	160.00	12.536	722.68	2.8724	1445.2	4120.1	31.070				
9.0000	161.00	13.533	745.78	2.8798	1600.2	4574.6	33.670				
9.0000	162.00	14.531	767.77	2.8922	1756.0	5042.3	36.270				
9.0000	163.00	15.529	788.84	2.8991	1912.1	5523.6	19.760				
9.0000	164.00	16.527	809.19	2.9187	2069.1	6018.1	21.060				
9.0000	165.00	17.526	828.71	2.9409	2226.1	6524.4	22.360				
9.0000	166.00	18.524	847.58	2.9644	2383.7	7042.8	23.660				
9.0000	167.00	19.523	865.87	2.9891	2541.8	7572.8	24.960				
9.0000	168.00	20.522	883.69	3.0153	2700.0	8115.2	26.260				
9.0000	169.00	21.521	900.96	3.0421	2858.5	8668.1	27.560				

Program Oasys Slope Version 21.0.0.46

Copyright (C) 1997-2023

Printed

09-Oct-2023

Page

7

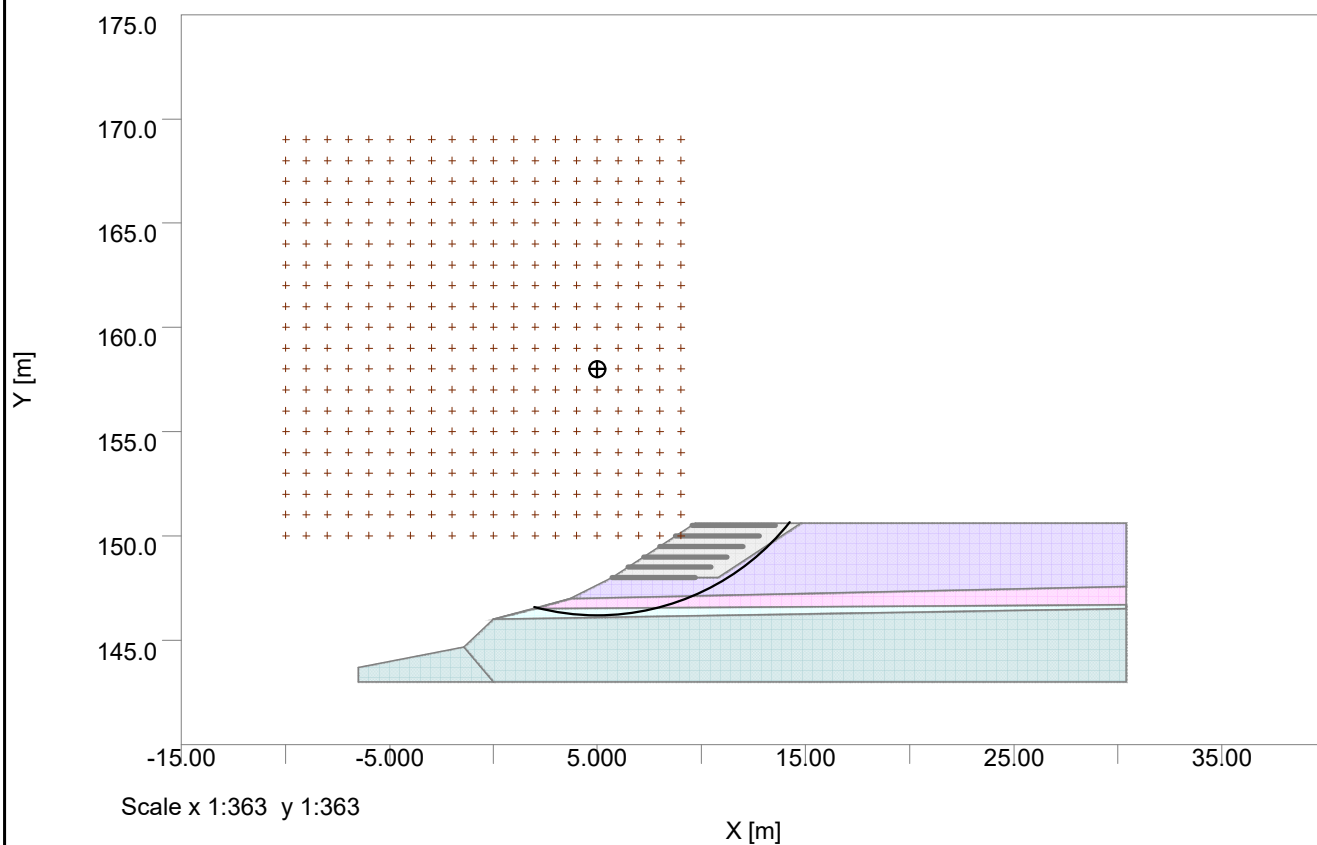
Time

21:51

APPENDIX 3 - Section B Modelling Outputs

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

Circle plotted: centre at 5.00,158.00, Over-Design Factor 1.218



Specification

```
Slip Type: CIRCULAR
Direction of slip: Downhill
Minimum slip weight [kN/m] :80.00000
Type of analysis: STATIC
Partial factor analysis
Minimum number of slices 25
Method: Bishop (Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: ACTIVE
```

Material Partial Factors

[illegible]

Material Properties

No	Description	Unit Weight		Shear Strength Parameters Condition	Phi or c
		Above GWL	Below GWL		
or c0'					
		[kN/m3]	[kN/m3]		Phi0 [°]
0.0	1 Canal Wall	25.000	25.000	Drained	40.000
0.0	2 Reinforced Earth	17.500	20.000	Drained	29.000
0.0	3 Backfilled Made Ground	17.500	20.000	Drained	29.000
0.0	4 SAND	20.000	22.000	Drained	34.000
0.0	5 Firm CLAY	20.000	22.000	Drained	24.000
0.0	6 Soft CLAY	20.000	22.000	Drained	24.000
0.0	7 MUDSTONE	21.000	23.000	Drained	35.000

Reinforcement

Layers	Level of top layer [m]	Vertical Spacing [m]	Length Top [m]	Length Btm [m]	Offset from surface [m]	Angle from horizon [°]
6	150.50	0.50000	4.0000	4.0000	0.0	0

Bond Length	Bond Strength	Prestress	Grout Diameter
	[kN/m]	[kN]	[mm]
0.0%	0.0	0.0	0.0

Out of plane spacing	Tensile Capacity	Plate Capacity	Material Partial Factor
[m]	[kN]	[kN]	
0.0	1.3000	0.0	

Slip Surface Specification

Circle centre specification:
 Bottom left of grid: x = -10.00000 m y = 150.00000 m
 Inclination of grid: 0.00000 deg
 (positive anticlockwise direction about bottom left of grid)
 Centres on grid: 20 in x direction at 1.00000m spacing
 20 in y direction at 1.00000m spacing
 Grid extended to find minimum FoS
 All circles pass through common point at x = 10.50000 m, y = 147.50000 m

RESULTS OF ANALYSIS

In the following tables, values in italics are factored values

Oasys Hollingsworth Gate, Littleborough Section B					Job No.		Sheet No.		Rev.	
					GRO-23131					
					Drg. Ref.					
					Made by JD		Date		Checked	
Out of plane spacing Tensile Capacity Plate Capacity Material Partial Factor [m] [kN] [kN] using the currently selected Method Partial Factors. Slip Centre Radius Slip Weight Comment/Over-Design Factor Disturbing Moment Soil Strength Restoring Moment Reinforcement Restoring Moment x [m] y [m] [m] [kN/m] [kNm/m] [kNm/m] [kNm/m]										
-10.000 150.00 20.652 Only 1 intersection with ground level										
-10.000 151.00 20.797 Only 1 intersection with ground level										
10.000 152.00 20.988 Only 1 intersection with ground level										
-10.000 153.00 21.225 Only 1 intersection with ground level										
-10.000 154.00 21.506 Only 1 intersection with ground level										
-10.000 155.00 21.829 Only 1 intersection with ground level										
-10.000 156.00 22.192 Only 1 intersection with ground level										
-10.000 157.00 22.594 Only 1 intersection with ground level										
-10.000 158.00 23.033 Only 1 intersection with ground level										
-10.000 159.00 23.505 Only 1 intersection with ground level										
-10.000 160.00 24.010 Only 1 intersection with ground level										
-10.000 161.00 24.546 Only 1 intersection with ground level										
-10.000 162.00 25.110 Only 1 intersection with ground level										
-10.000 163.00 25.700 Only 1 intersection with ground level										
-10.000 164.00 26.315 Only 1 intersection with ground level										
-10.000 165.00 26.954 Only 1 intersection with ground level										
-10.000 166.00 27.613 Only 1 intersection with ground level										
-10.000 167.00 28.293 Only 1 intersection with ground level										
-10.000 168.00 28.991 Only 1 intersection with ground level										
-10.000 169.00 29.707 Only 1 intersection with ground level										
-9.0000 150.00 19.660 Only 1 intersection with ground level										
-9.0000 151.00 19.812 Only 1 intersection with ground level										
-9.0000 152.00 20.012 Only 1 intersection with ground level										
-9.0000 153.00 20.261 Only 1 intersection with ground level										
-9.0000 154.00 20.555 Only 1 intersection with ground level										
-9.0000 155.00 20.893 Only 1 intersection with ground level										
-9.0000 156.00 21.272 Only 1 intersection with ground level										
-9.0000 157.00 21.691 Only 1 intersection with ground level										
-9.0000 158.00 22.147 Only 1 intersection with ground level										
-9.0000 159.00 22.638 Only 1 intersection with ground level										
-9.0000 160.00 23.162 Only 1 intersection with ground level										
-9.0000 161.00 23.717 Only 1 intersection with ground level										
-9.0000 162.00 24.300 Only 1 intersection with ground level										
-9.0000 163.00 24.910 Only 1 intersection with ground level										
-9.0000 164.00 25.544 Only 1 intersection with ground level										
-9.0000 165.00 26.201 Only 1 intersection with ground level										
-9.0000 166.00 26.879 Only 1 intersection with ground level										
-9.0000 167.00 27.577 Only 1 intersection with ground level										
-9.0000 168.00 28.293 Only 1 intersection with ground level										
-9.0000 169.00 29.026 Only 1 intersection with ground level										
-8.0000 150.00 18.668 Only 1 intersection with ground level										
-8.0000 151.00 18.828 Only 1 intersection with ground level										
-8.0000 152.00 19.039 Only 1 intersection with ground level										
-8.0000 153.00 19.300 Only 1 intersection with ground level										
-8.0000 154.00 19.609 Only 1 intersection with ground level										
-8.0000 155.00 19.962 Only 1 intersection with ground level										
-8.0000 156.00 20.359 Only 1 intersection with ground level										
-8.0000 157.00 20.797 Only 1 intersection with ground level										
-8.0000 158.00 21.272 Only 1 intersection with ground level										
-8.0000 159.00 21.783 Only 1 intersection with ground level										
-8.0000 160.00 22.327 Only 1 intersection with ground level										
-8.0000 161.00 22.902 Only 1 intersection with ground level										
-8.0000 162.00 23.505 Only 1 intersection with ground level										
-8.0000 163.00 24.135 Only 1 intersection with ground level										
-8.0000 164.00 24.789 Only 1 intersection with ground level										
-8.0000 165.00 25.466 Only 1 intersection with ground level										
-8.0000 166.00 26.163 Only 1 intersection with ground level										
-8.0000 167.00 26.879 Only 1 intersection with ground level										
-8.0000 168.00 27.613 Only 1 intersection with ground level										
-8.0000 169.00 28.364 Only 1 intersection with ground level										
-7.0000 150.00 17.678 Only 1 intersection with ground level										
-7.0000 151.00 17.847 Only 1 intersection with ground level										
-7.0000 152.00 18.069 Only 1 intersection with ground level										
-7.0000 153.00 18.344 Only 1 intersection with ground level										
-7.0000 154.00 18.668 Only 1 intersection with ground level										
-7.0000 155.00 19.039 Only 1 intersection with ground level										
-7.0000 156.00 19.455 Only 1 intersection with ground level										
-7.0000 157.00 19.912 Only 1 intersection with ground level										
-7.0000 158.00 20.408 Only 1 intersection with ground level										
-7.0000 159.00 20.940 Only 1 intersection with ground level										
-7.0000 160.00 21.506 Only 1 intersection with ground level										
-7.0000 161.00 22.102 Only 1 intersection with ground level										

-10.000	150.00	20.652	Only 1 intersection with ground level			
-10.000	151.00	20.797	Only 1 intersection with ground level			
-10.000	152.00	20.988	Only 1 intersection with ground level			
-10.000	153.00	21.225	Only 1 intersection with ground level			
-10.000	154.00	21.506	Only 1 intersection with ground level			
-10.000	155.00	21.829	Only 1 intersection with ground level			
-10.000	156.00	22.192	Only 1 intersection with ground level			
-10.000	157.00	22.594	Only 1 intersection with ground level			
-10.000	158.00	23.033	Only 1 intersection with ground level			
-10.000	159.00	23.505	Only 1 intersection with ground level			
-10.000	160.00	24.010	Only 1 intersection with ground level			
-10.000	161.00	24.546	Only 1 intersection with ground level			
-10.000	162.00	25.110	Only 1 intersection with ground level			
-10.000	163.00	25.700	Only 1 intersection with ground level			
-10.000	164.00	26.315	Only 1 intersection with ground level			
-10.000	165.00	26.954	Only 1 intersection with ground level			
-10.000	166.00	27.613	Only 1 intersection with ground level			
-10.000	167.00	28.293	Only 1 intersection with ground level			
-10.000	168.00	28.991	Only 1 intersection with ground level			
-10.000	169.00	29.707	Only 1 intersection with ground level			
-9.00000	150.00	19.660	Only 1 intersection with ground level			
-9.00000	151.00	19.812	Only 1 intersection with ground level			
-9.00000	152.00	20.012	Only 1 intersection with ground level			
-9.00000	153.00	20.261	Only 1 intersection with ground level			
-9.00000	154.00	20.555	Only 1 intersection with ground level			
-9.00000	155.00	20.893	Only 1 intersection with ground level			
-9.00000	156.00	21.272	Only 1 intersection with ground level			
-9.00000	157.00	21.691	Only 1 intersection with ground level			
-9.00000	158.00	22.147	Only 1 intersection with ground level			
-9.00000	159.00	22.638	Only 1 intersection with ground level			
-9.00000	160.00	23.162	Only 1 intersection with ground level			
-9.00000	161.00	23.717	Only 1 intersection with ground level			
-9.00000	162.00	24.300	Only 1 intersection with ground level			
-9.00000	163.00	24.910	Only 1 intersection with ground level			
-9.00000	164.00	25.544	Only 1 intersection with ground level			
-9.00000	165.00	26.201	Only 1 intersection with ground level			
-9.00000	166.00	26.879	Only 1 intersection with ground level			
-9.00000	167.00	27.577	Only 1 intersection with ground level			
-9.00000	168.00	28.293	Only 1 intersection with ground level			
-9.00000	169.00	29.026	Only 1 intersection with ground level			
-8.00000	150.00	18.668	Only 1 intersection with ground level			
-8.00000	151.00	18.828	Only 1 intersection with ground level			
-8.00000	152.00	19.039	Only 1 intersection with ground level			
-8.00000	153.00	19.300	Only 1 intersection with ground level			
-8.00000	154.00	19.609	Only 1 intersection with ground level			
-8.00000	155.00	19.962	Only 1 intersection with ground level			
-8.00000	156.00	20.359	Only 1 intersection with ground level			
-8.00000	157.00	20.797	Only 1 intersection with ground level			
-8.00000	158.00	21.272	Only 1 intersection with ground level			
-8.00000	159.00	21.783	Only 1 intersection with ground level			
-8.00000	160.00	22.327	Only 1 intersection with ground level			
-8.00000	161.00	22.902	Only 1 intersection with ground level			
-8.00000	162.00	23.505	Only 1 intersection with ground level			
-8.00000	163.00	24.135	Only 1 intersection with ground level			
-8.00000	164.00	24.789	Only 1 intersection with ground level			
-8.00000	165.00	25.466	Only 1 intersection with ground level			
-8.00000	166.00	26.163	Only 1 intersection with ground level			
-8.00000	167.00	26.879	Only 1 intersection with ground level			
-8.00000	168.00	27.613	Only 1 intersection with ground level			
-8.00000	169.00	28.364	Only 1 intersection with ground level			
-7.00000	150.00	17.678	Only 1 intersection with ground level			
-7.00000	151.00	17.847	Only 1 intersection with ground level			
-7.00000	152.00	18.069	Only 1 intersection with ground level			
-7.00000	153.00	18.344	Only 1 intersection with ground level			
-7.00000	154.00	18.668	Only 1 intersection with ground level			
-7.00000	155.00	19.039	Only 1 intersection with ground level			
-7.00000	156.00	19.455	Only 1 intersection with ground level			
-7.00000	157.00	19.912	Only 1 intersection with ground level			
-7.00000	158.00	20.408	Only 1 intersection with ground level			
-7.00000	159.00	20.940	Only 1 intersection with ground level			
-7.00000	160.00	21.506	Only 1 intersection with ground level			
-7.00000	161.00	22.102	Only 1 intersection with ground level			

 Hollingsworth Gate, Littleborough Section B					Job No.		Sheet No.	Rev.
					GRO-23131			
					Drg. Ref.			
					Made by JD	Date	Checked	Date
Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment	
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]	
-7.0000	162.00	22.727		Only 1 intersection with ground level				
-7.0000	163.00	23.377		Only 1 intersection with ground level				
-7.0000	164.00	24.052		Only 1 intersection with ground level				
-7.0000	165.00	24.749		Only 1 intersection with ground level				
-7.0000	166.00	25.466		Only 1 intersection with ground level				
-7.0000	167.00	26.201		Only 1 intersection with ground level				
-7.0000	168.00	26.954		Only 1 intersection with ground level				
-7.0000	169.00	27.722		Only 1 intersection with ground level				
-6.0000	150.00	16.688		Only 1 intersection with ground level				
-6.0000	151.00	16.867		Only 1 intersection with ground level				
-6.0000	152.00	17.103		Only 1 intersection with ground level				
-6.0000	153.00	17.393		Only 1 intersection with ground level				
-6.0000	154.00	17.734		Only 1 intersection with ground level				
-6.0000	155.00	18.125		Only 1 intersection with ground level				
-6.0000	156.00	18.561		Only 1 intersection with ground level				
-6.0000	157.00	19.039		Only 1 intersection with ground level				
-6.0000	158.00	19.558		Only 1 intersection with ground level				
-6.0000	159.00	20.112		Only 1 intersection with ground level				
-6.0000	160.00	20.700		Only 1 intersection with ground level				
-6.0000	161.00	21.319		Only 1 intersection with ground level				
-6.0000	162.00	21.966		Only 1 intersection with ground level				
-6.0000	163.00	22.638		Only 1 intersection with ground level				
-6.0000	164.00	23.335		Only 1 intersection with ground level				
-6.0000	165.00	24.052		Only 1 intersection with ground level				
-6.0000	166.00	24.789		Only 1 intersection with ground level				
-6.0000	167.00	25.544		Only 1 intersection with ground level				
-6.0000	168.00	26.315		Only 1 intersection with ground level				
-6.0000	169.00	27.102		Only 1 intersection with ground level				
-5.0000	150.00	15.700		Only 1 intersection with ground level				
-5.0000	151.00	15.890		Only 1 intersection with ground level				
-5.0000	152.00	16.140		Only 1 intersection with ground level				
-5.0000	153.00	16.447		Only 1 intersection with ground level				
-5.0000	154.00	16.808		Only 1 intersection with ground level				
-5.0000	155.00	17.219		Only 1 intersection with ground level				
-5.0000	156.00	17.678		Only 1 intersection with ground level				
-5.0000	157.00	18.180		Only 1 intersection with ground level				
-5.0000	158.00	18.722		Only 1 intersection with ground level				
-5.0000	159.00	19.300		Only 1 intersection with ground level				
-5.0000	160.00	19.912		Only 1 intersection with ground level				
-5.0000	161.00	20.555		Only 1 intersection with ground level				
-5.0000	162.00	21.225		Only 1 intersection with ground level				
-5.0000	163.00	21.920		Only 1 intersection with ground level				
-5.0000	164.00	22.638		Only 1 intersection with ground level				
-5.0000	165.00	23.377		Only 1 intersection with ground level				
-5.0000	166.00	24.135		Only 1 intersection with ground level				
-5.0000	167.00	24.910		Only 1 intersection with ground level				
-5.0000	168.00	25.700		Only 1 intersection with ground level				
-5.0000	169.00	26.505		Only 1 intersection with ground level				
-4.0000	150.00	14.714		Only 1 intersection with ground level				
-4.0000	151.00	14.916		Only 1 intersection with ground level				
-4.0000	152.00	15.182		Only 1 intersection with ground level				
-4.0000	153.00	15.508		Only 1 intersection with ground level				
-4.0000	154.00	15.890		Only 1 intersection with ground level				
-4.0000	155.00	16.325		Only 1 intersection with ground level				
-4.0000	156.00	16.808		Only 1 intersection with ground level				
-4.0000	157.00	17.335		Only 1 intersection with ground level				
-4.0000	158.00	17.903		Only 1 intersection with ground level				
-4.0000	159.00	18.507		Only 1 intersection with ground level				
-4.0000	160.00	19.144		Only 1 intersection with ground level				
-4.0000	161.00	19.812		Only 1 intersection with ground level				
-4.0000	162.00	20.506		Only 1 intersection with ground level				
-4.0000	163.00	21.225		Only 1 intersection with ground level				
-4.0000	164.00	21.966		Only 1 intersection with ground level				
-4.0000	165.00	22.727		Only 1 intersection with ground level				
-4.0000	166.00	23.505		Only 1 intersection with ground level				
-4.0000	167.00	24.300		Only 1 intersection with ground level				
-4.0000	168.00	25.110		Only 1 intersection with ground level				
-4.0000	168.00	25.110		Only 1 intersection with ground level				
-4.0000	169.00	25.933		Only 1 intersection with ground level				
-3.0000	150.00	13.730		Only 1 intersection with ground level				
-3.0000	151.00	13.946		Only 1 intersection with ground level				
-3.0000	152.00	14.230		Only 1 intersection with ground level				
-3.0000	153.00	14.577		Only 1 intersection with ground level				
-3.0000	154.00	14.983		Only 1 intersection with ground level				
-3.0000	155.00	15.443		Only 1 intersection with ground level				
-3.0000	156.00	15.953		Only 1 intersection with ground level				
-3.0000	157.00	16.508		Only 1 intersection with ground level				



Hollingsworth Gate, Littleborough
Section B

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]
-3.0000	158.00	17.103		Only 1 intersection with ground level			
-3.0000	159.00	17.734		Only 1 intersection with ground level			
-3.0000	160.00	18.398		Only 1 intersection with ground level			
-3.0000	161.00	19.092		Only 1 intersection with ground level			
-3.0000	162.00	19.812		Only 1 intersection with ground level			
-3.0000	163.00	20.555		Only 1 intersection with ground level			
-3.0000	164.00	21.319		Only 1 intersection with ground level			
-3.0000	165.00	22.102		Only 1 intersection with ground level			
-3.0000	165.00	22.102		Only 1 intersection with ground level			
-3.0000	166.00	22.902		Only 1 intersection with ground level			
-3.0000	167.00	23.717		Only 1 intersection with ground level			
-3.0000	168.00	24.546	842.23	1.3050	6568.2	8571.3	0.0
-3.0000	169.00	25.387	804.15	1.3019	6549.9	8527.0	0.0
-2.0000	150.00	12.748		Only 1 intersection with ground level			
-2.0000	151.00	12.981		Only 1 intersection with ground level			
-2.0000	152.00	13.285		Only 1 intersection with ground level			
-2.0000	153.00	13.656		Only 1 intersection with ground level			
-2.0000	154.00	14.089		Only 1 intersection with ground level			
-2.0000	155.00	14.577		Only 1 intersection with ground level			
-2.0000	156.00	15.116		Only 1 intersection with ground level			
-2.0000	157.00	15.700		Only 1 intersection with ground level			
-2.0000	158.00	16.325		Only 1 intersection with ground level			
-2.0000	159.00	16.985		Only 1 intersection with ground level			
-2.0000	160.00	17.678		Only 1 intersection with ground level			
-2.0000	161.00	18.398		Only 1 intersection with ground level			
-2.0000	161.00	18.398		Only 1 intersection with ground level			
-2.0000	162.00	19.144		Only 1 intersection with ground level			
-2.0000	162.00	19.144		Only 1 intersection with ground level			
-2.0000	163.00	19.912		Only 1 intersection with ground level			
-2.0000	164.00	20.700	891.43	1.3122	5833.6	7654.6	0.0
-2.0000	165.00	21.506	843.43	1.3043	5817.3	7587.7	0.0
-2.0000	166.00	22.327	801.77	1.3077	5791.9	7574.1	0.0
-2.0000	167.00	23.162	765.62	1.3074	5782.2	7559.9	0.0
-2.0000	168.00	24.010	734.30	1.3181	5763.2	7596.3	0.0
-2.0000	169.00	24.870	707.30	1.3265	5753.4	7632.0	0.0
-1.0000	150.00	11.769		Only 1 intersection with ground level			
-1.0000	151.00	12.021		Only 1 intersection with ground level			
-1.0000	152.00	12.349		Only 1 intersection with ground level			
-1.0000	153.00	12.748		Only 1 intersection with ground level			
-1.0000	154.00	13.210		Only 1 intersection with ground level			
-1.0000	155.00	13.730		Only 1 intersection with ground level			
-1.0000	156.00	14.300		Only 1 intersection with ground level			
-1.0000	157.00	14.916		Only 1 intersection with ground level			
-1.0000	157.00	14.916		Only 1 intersection with ground level			
-1.0000	158.00	15.572		Only 1 intersection with ground level			
-1.0000	158.00	15.572		Only 1 intersection with ground level			
-1.0000	159.00	16.263		Only 1 intersection with ground level			
-1.0000	159.00	16.263		Only 1 intersection with ground level			
-1.0000	160.00	16.985	969.38	1.3387	5104.4	6825.0	8.0120
-1.0000	161.00	17.734	905.62	1.3286	5076.5	6741.6	2.8021
-1.0000	162.00	18.507	851.00	1.3164	5067.0	6669.5	0.58849
-1.0000	163.00	19.300	804.09	1.3174	5049.4	6652.2	0.0
-1.0000	164.00	20.112	763.96	1.3161	5044.8	6639.6	0.0
-1.0000	165.00	20.940	729.83	1.3268	5032.0	6676.7	0.0
-1.0000	166.00	21.783	701.03	1.3364	5028.9	6720.4	0.0
-1.0000	167.00	22.638	676.17	1.3466	5030.5	6774.3	0.0
-1.0000	168.00	23.505	655.41	1.3675	5026.7	6874.0	0.0
-1.0000	169.00	24.382	638.23	1.3868	5032.3	6978.7	0.0
0.0	150.00	10.794		Only 1 intersection with ground level			
0.0	151.00	11.068		Only 1 intersection with ground level			
0.0	152.00	11.424		Only 1 intersection with ground level			
0.0	153.00	11.853		Only 1 intersection with ground level			
0.0	153.00	11.853		Only 1 intersection with ground level			
0.0	154.00	12.349		Only 1 intersection with ground level			
0.0	154.00	12.349		Only 1 intersection with ground level			
0.0	155.00	12.903		Only 1 intersection with ground level			
0.0	155.00	12.903		Only 1 intersection with ground level			
0.0	156.00	13.509		Only 1 intersection with ground level			
0.0	156.00	13.509		Only 1 intersection with ground level			
0.0	157.00	14.160		Only 1 intersection with ground level			
0.0	157.00	14.160		Only 1 intersection with ground level			
0.0	158.00	14.849	934.09	1.3641	4334.8	5896.7	16.099
0.0	159.00	15.572	868.91	1.3517	4318.3	5828.3	8.6980
0.0	160.00	16.325	814.02	1.3400	4316.9	5781.9	2.6944
0.0	161.00	17.103	767.93	1.3417	4310.1	5782.5	0.54200
0.0	162.00	17.903	729.11	1.3461	4308.4	5799.5	0.0

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]
0.0	163.00	18.722	697.00	1.3547	4311.8	5841.3
0.0	164.00	19.558	669.91	1.3650	4319.4	5895.8
0.0	165.00	20.408	647.63	1.3923	4315.2	6008.2
0.0	166.00	21.272	629.10	1.4000	4347.7	6086.6
0.0	167.00	22.147	613.07	1.4193	4357.7	6185.0
0.0	168.00	23.033	599.23	1.4365	4374.4	6283.9
0.0	169.00	23.927	587.11	1.4474	4402.7	6372.3
1.0000	150.00	9.8234	Only 1 intersection with ground level			
1.0000	150.00	9.8234	Only 1 intersection with ground level			
1.0000	151.00	10.124	Only 1 intersection with ground level			
1.0000	151.00	10.124	Only 1 intersection with ground level			
1.0000	152.00	10.512	Only 1 intersection with ground level			
1.0000	152.00	10.512	Only 1 intersection with ground level			
1.0000	153.00	10.977	Only 1 intersection with ground level			
1.0000	153.00	10.977	Only 1 intersection with ground level			
1.0000	154.00	11.511	Only 1 intersection with ground level			
1.0000	154.00	11.511	Only 1 intersection with ground level			
1.0000	155.00	12.104	Only 1 intersection with ground level			
1.0000	155.00	12.104	Only 1 intersection with ground level			
1.0000	156.00	12.748	905.16	1.4119	3590.5	5052.3
1.0000	157.00	13.435	836.94	1.3899	3592.2	4978.4
1.0000	158.00	14.160	780.83	1.3850	3589.8	4962.5
1.0000	159.00	14.916	735.19	1.3861	3592.1	4976.3
1.0000	160.00	15.700	697.17	1.3916	3599.9	5009.1
1.0000	161.00	16.508	666.47	1.4001	3623.5	5073.2
1.0000	162.00	17.335	641.02	1.4197	3629.0	5152.2
1.0000	163.00	18.180	619.37	1.4375	3642.2	5235.8
1.0000	164.00	19.039	600.80	1.4526	3661.4	5318.7
1.0000	165.00	19.912	585.00	1.4609	3693.5	5396.0
1.0000	166.00	20.797	571.58	1.4672	3725.1	5465.6
1.0000	167.00	21.691	560.06	1.4632	3761.1	5503.3
1.0000	168.00	22.594	550.18	1.4602	3800.2	5549.1
1.0000	169.00	23.505	541.85	1.4579	3843.7	5603.8
2.0000	150.00	8.8600	Only 1 intersection with ground level			
2.0000	150.00	8.8600	Only 1 intersection with ground level			
2.0000	151.00	9.1924	Only 1 intersection with ground level			
2.0000	151.00	9.1924	Only 1 intersection with ground level			
2.0000	152.00	9.6177	Only 1 intersection with ground level			
2.0000	152.00	9.6177	Only 1 intersection with ground level			
2.0000	153.00	10.124	Only 1 intersection with ground level			
2.0000	153.00	10.124	Only 1 intersection with ground level			
2.0000	154.00	10.700	884.53	1.5056	2865.4	4298.5
2.0000	155.00	11.336	811.00	1.4768	2874.8	4227.4
2.0000	156.00	12.021	752.27	1.4675	2880.6	4214.6
2.0000	157.00	12.748	705.26	1.4624	2902.1	4234.3
2.0000	158.00	13.509	666.94	1.4726	2910.5	4283.7
2.0000	159.00	14.300	635.30	1.4840	2928.0	4344.8
2.0000	160.00	15.116	608.90	1.4901	2957.6	4407.1
2.0000	161.00	15.953	586.88	1.4967	2988.7	4473.2
2.0000	162.00	16.808	568.54	1.4949	3025.6	4522.8
2.0000	163.00	17.678	553.21	1.4806	3067.1	4541.2
2.0000	164.00	18.561	540.34	1.4674	3112.7	4567.6
2.0000	165.00	19.455	529.58	1.4559	3161.6	4603.0
2.0000	166.00	20.359	520.65	1.4460	3213.6	4646.7
2.0000	167.00	21.272	513.31	1.4374	3268.8	4698.5
2.0000	168.00	22.192	507.24	1.4299	3326.2	4755.9
2.0000	169.00	23.119	502.33	1.4227	3385.9	4817.1
3.0000	150.00	7.9057	Only 1 intersection with ground level			
3.0000	150.00	7.9057	Only 1 intersection with ground level			
3.0000	151.00	8.2765	Only 1 intersection with ground level			
3.0000	151.00	8.2765	Only 1 intersection with ground level			
3.0000	152.00	8.7464	877.31	1.6921	2156.8	3640.3
3.0000	153.00	9.3005	793.64	1.6356	2180.9	3555.4
3.0000	154.00	9.9247	727.53	1.6169	2194.0	3531.8
3.0000	155.00	10.607	674.83	1.5972	2220.7	3535.9
3.0000	156.00	11.336	632.80	1.5874	2252.6	3565.8
3.0000	157.00	12.104	598.83	1.5742	2290.7	3603.6
3.0000	158.00	12.903	571.48	1.5589	2334.7	3639.1
3.0000	159.00	13.730	549.25	1.5309	2383.2	3648.4
3.0000	160.00	14.577	531.15	1.4993	2435.7	3651.7
3.0000	161.00	15.443	516.55	1.4714	2492.2	3667.0
3.0000	162.00	16.325	504.63	1.4466	2551.0	3690.3
3.0000	163.00	17.219	494.99	1.4233	2612.1	3717.7
3.0000	164.00	18.125	487.65	1.4006	2675.8	3747.7

Oasys Hollingsworth Gate, Littleborough Section B						Job No.	Sheet No.	Rev.	
						GRO-23131			
						Drg. Ref.			
						Made by JD	Date	Checked	Date

Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]
3.0000	165.00	19.039	482.05	1.3766	2740.6	3772.7	0.0
3.0000	166.00	19.962	477.96	1.3352	2806.5	3747.2	0.0
3.0000	167.00	20.893	475.22	1.3228	2873.7	3801.3	0.0
3.0000	168.00	21.829	473.62	1.3536	2942.4	3983.0	0.0
3.0000	169.00	22.771	472.81	1.3854	3012.1	4173.1	0.0
4.0000	150.00	6.9642		Centre embedded/below end of slip			
4.0000	151.00	7.3824	783.13	1.9601	1509.7	2952.8	6.5000
4.0000	152.00	7.9057	701.70	1.8568	1551.9	2873.8	7.8000
4.0000	153.00	8.5147	639.84	1.7784	1603.4	2839.7	11.700
4.0000	154.00	9.1924	592.06	1.7141	1657.0	2831.2	9.0133
4.0000	155.00	9.9247	555.16	1.6575	1715.2	2833.2	9.7881
4.0000	156.00	10.700	526.60	1.5857	1776.9	2815.6	2.1202
4.0000	157.00	11.511	504.69	1.5214	1840.6	2800.1	0.33814
4.0000	158.00	12.349	488.02	1.4689	1906.0	2799.7	0.0
4.0000	159.00	13.210	475.34	1.4227	1972.6	2806.3	0.0
4.0000	160.00	14.089	465.89	1.3779	2040.3	2811.4	0.0
4.0000	161.00	14.983	459.21	1.3237	2109.8	2792.7	0.0
4.0000	162.00	15.890	454.67	1.2549	2180.2	2735.9	0.0
4.0000	163.00	16.808	451.78	1.2860	2251.6	2895.5	0.0
4.0000	164.00	17.734	450.25	1.3192	2324.1	3066.0	0.0
4.0000	165.00	18.668	449.77	1.3543	2397.3	3246.7	0.0
4.0000	166.00	19.609	450.13	1.3905	2471.2	3436.3	0.0
4.0000	167.00	20.555	451.20	1.4277	2545.9	3634.7	0.0
4.0000	168.00	21.506	452.96	1.4658	2621.3	3842.2	0.0
4.0000	169.00	22.461	455.19	1.5043	2697.3	4057.5	0.0
5.0000	150.00	6.0415		Centre embedded/below end of slip			
5.0000	151.00	6.5192	600.59	2.0197	1064.3	2143.9	5.7684
5.0000	152.00	7.1063	545.66	1.8537	1136.9	2099.6	7.8000
5.0000	153.00	7.7782	505.84	1.7221	1206.3	2067.8	9.5742
5.0000	154.00	8.5147	477.61	1.5977	1277.7	2033.4	8.0586
5.0000	155.00	9.3005	457.34	1.4976	1349.0	2018.3	1.9199
5.0000	156.00	10.124	443.27	1.4126	1422.0	2008.5	0.28807
5.0000	157.00	10.977	433.71	1.3190	1495.9	1973.0	0.0
5.0000	158.00	11.853	427.62	1.2177	1570.2	1912.0	0.0
5.0000	159.00	12.748	424.07	1.2473	1645.6	2052.7	0.0
5.0000	160.00	13.656	422.48	1.2818	1721.9	2207.0	0.0
5.0000	161.00	14.577	422.32	1.3195	1798.6	2373.3	0.0
5.0000	162.00	15.508	423.32	1.3595	1876.1	2550.6	0.0
5.0000	163.00	16.447	425.18	1.4014	1953.8	2738.0	0.0
5.0000	164.00	17.393	427.84	1.4444	2032.3	2935.4	0.0
5.0000	165.00	18.344	431.13	1.4885	2111.2	3142.5	0.0
5.0000	166.00	19.300	434.82	1.5331	2190.4	3358.0	0.0
5.0000	167.00	20.261	438.94	1.5780	2270.2	3582.4	0.0
5.0000	168.00	21.225	443.35	1.6234	2350.0	3815.1	0.0
5.0000	169.00	22.192	448.02	1.6689	2430.3	4055.9	0.0
6.0000	150.00	5.1478		Centre embedded/below end of slip			
6.0000	151.00	5.7009	455.91	1.9058	743.15	1412.4	3.9000
6.0000	152.00	6.3640	426.19	1.6769	821.60	1369.9	7.8000
6.0000	153.00	7.1063	407.75	1.4957	900.94	1341.3	6.2273
6.0000	154.00	7.9057	396.73	1.2570	979.70	1229.8	1.6738
6.0000	155.00	8.7464	390.91	1.2264	1058.8	1298.2	0.23745
6.0000	156.00	9.6177	388.53	1.2534	1138.6	1427.0	0.0
6.0000	157.00	10.512	388.50	1.2891	1218.8	1571.2	0.0
6.0000	158.00	11.424	390.19	1.3312	1299.0	1729.3	0.0
6.0000	159.00	12.349	393.18	1.3772	1379.8	1900.3	0.0
6.0000	160.00	13.285	397.14	1.4260	1460.8	2083.2	0.0
6.0000	161.00	14.230	401.80	1.4765	1542.3	2277.3	0.0
6.0000	162.00	15.182	406.99	1.5282	1624.1	2481.9	0.0
6.0000	163.00	16.140	412.55	1.5810	1705.8	2696.9	0.0
6.0000	164.00	17.103	418.44	1.6344	1787.9	2922.2	0.0
6.0000	165.00	18.069	424.53	1.6888	1870.0	3157.9	0.0
6.0000	166.00	19.039	430.82	1.7438	1952.5	3404.7	0.0
6.0000	167.00	20.012	437.24	1.8004	2034.7	3663.3	0.0
6.0000	168.00	20.988	443.80	1.8584	2117.8	3935.8	0.0
6.0000	169.00	21.966	450.36	1.9207	2200.4	4226.4	0.0
7.0000	150.00	4.3012		Centre embedded/below end of slip			
7.0000	151.00	4.9497	352.55	1.5821	492.92	775.93	3.9000
7.0000	152.00	5.7009	345.72	1.3340	578.02	766.85	4.2355
7.0000	153.00	6.5192	344.43	1.3242	661.53	874.62	1.3732
7.0000	154.00	7.3824	346.58	1.3460	744.69	1002.2	0.18417
7.0000	155.00	8.2765	351.05	1.3861	828.03	1147.7	0.0
7.0000	156.00	9.1924	356.87	1.4363	911.34	1308.9	0.0
7.0000	157.00	10.124	363.73	1.4931	995.00	1485.6	0.0

Oasys Hollingsworth Gate, Littleborough Section B						Job No.		Sheet No.		Rev.	
						GRO-23131					
						Drg. Ref.					
						Made by JD		Date		Checked	
Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment				
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]				
7.0000	158.00	11.068	371.12	1.5551	1078.3	1676.8	0.0				
7.0000	159.00	12.021	378.97	1.6207	1162.0	1883.2	0.0				
7.0000	160.00	12.981	387.05	1.6909	1245.8	2106.4	0.0				
7.0000	161.00	13.946	395.33	1.7709	1329.4	2354.2	0.0				
7.0000	162.00	14.916	403.74	1.8691	1413.0	2641.1	0.0				
7.0000	163.00	15.890	412.19	1.9188	1496.9	2872.3	0.0				
7.0000	164.00	16.867	420.61	1.9684	1580.7	3111.5	0.0				
7.0000	165.00	17.847	428.98	2.0173	1664.7	3358.3	0.0				
7.0000	166.00	18.828	437.25	2.0659	1748.4	3612.2	0.0				
7.0000	167.00	19.812	445.46	2.1139	1832.2	3873.1	0.0				
7.0000	168.00	20.797	453.53	2.1607	1916.2	4140.4	0.0				
7.0000	169.00	21.783	461.57	2.2074	2000.0	4414.9	0.0				
8.0000	150.00	3.5355	Centre embedded/below end of slip								
8.0000	151.00	4.3012	285.94	1.6396	312.29	510.07	1.9500				
8.0000	152.00	5.1478	296.15	1.6034	397.20	635.30	1.5855				
8.0000	153.00	6.0415	307.70	1.6269	481.45	783.15	0.13289				
8.0000	154.00	6.9642	319.71	1.6897	565.21	955.06	0.0				
8.0000	155.00	7.9057	331.92	1.8148	648.98	1177.8	0.0				
8.0000	156.00	8.8600	344.13	1.8589	732.71	1362.0	0.0				
8.0000	157.00	9.8234	356.17	1.9073	816.67	1557.7	0.0				
8.0000	158.00	10.794	367.89	1.9583	900.57	1763.6	0.0				
8.0000	159.00	11.769	379.33	2.0106	984.40	1979.3	0.0				
8.0000	160.00	12.748	390.44	2.0633	1068.2	2203.9	0.0				
8.0000	161.00	13.730	401.39	2.1157	1152.3	2437.9	0.0				
8.0000	162.00	14.714	412.00	2.1679	1236.2	2679.9	0.0				
8.0000	163.00	15.700	422.36	2.2195	1320.1	2930.0	0.0				
8.0000	164.00	16.688	432.51	2.2703	1404.3	3188.1	0.0				
8.0000	165.00	17.678	442.40	2.3204	1488.3	3453.5	0.0				
8.0000	166.00	18.668	452.06	2.3701	1572.1	3726.0	0.0				
8.0000	167.00	19.660	461.60	2.4190	1656.1	4006.2	0.0				
8.0000	168.00	20.652	470.83	2.4668	1740.1	4292.3	0.0				
8.0000	169.00	21.645	479.91	2.5146	1823.5	4585.4	0.0				
9.0000	150.00	2.9155	Centre embedded/below end of slip								
9.0000	151.00	3.8079	250.93	2.4644	189.49	461.88	5.0990				
9.0000	152.00	4.7434	274.33	2.3071	268.31	613.75	5.2838				
9.0000	153.00	5.7009	295.22	2.2589	348.40	780.51	6.5000				
9.0000	154.00	6.6708	314.12	2.2590	428.72	960.69	7.8000				
9.0000	155.00	7.6485	331.69	2.2804	509.92	1153.7	9.1000				
9.0000	156.00	8.6313	348.04	2.3139	591.47	1358.2	10.400				
9.0000	157.00	9.6177	363.46	2.3376	673.25	1573.8	0.0				
9.0000	158.00	10.607	378.07	2.3821	755.42	1799.5	0.0				
9.0000	159.00	11.597	391.93	2.4286	837.72	2034.5	0.0				
9.0000	160.00	12.590	405.24	2.4766	920.25	2279.1	0.0				
9.0000	161.00	13.583	418.00	2.5249	1003.0	2532.4	0.0				
9.0000	162.00	14.577	430.28	2.5730	1085.9	2794.1	0.0				
9.0000	163.00	15.572	442.13	2.6217	1168.7	3063.9	0.0				
9.0000	164.00	16.568	453.59	2.6692	1251.9	3341.5	0.0				
9.0000	165.00	17.564	464.71	2.7168	1335.0	3626.8	0.0				
9.0000	166.00	18.561	475.51	2.7640	1418.1	3919.5	0.0				
9.0000	167.00	19.558	485.95	2.8103	1501.2	4218.8	0.0				
9.0000	168.00	20.555	496.18	2.8561	1584.5	4525.4	0.0				
9.0000	169.00	21.552	506.14	2.9010	1667.9	4838.6	0.0				

Program Oasys Slope Version 21.0.0.46

Copyright (C) 1997-2023

Printed

09-Oct-2023

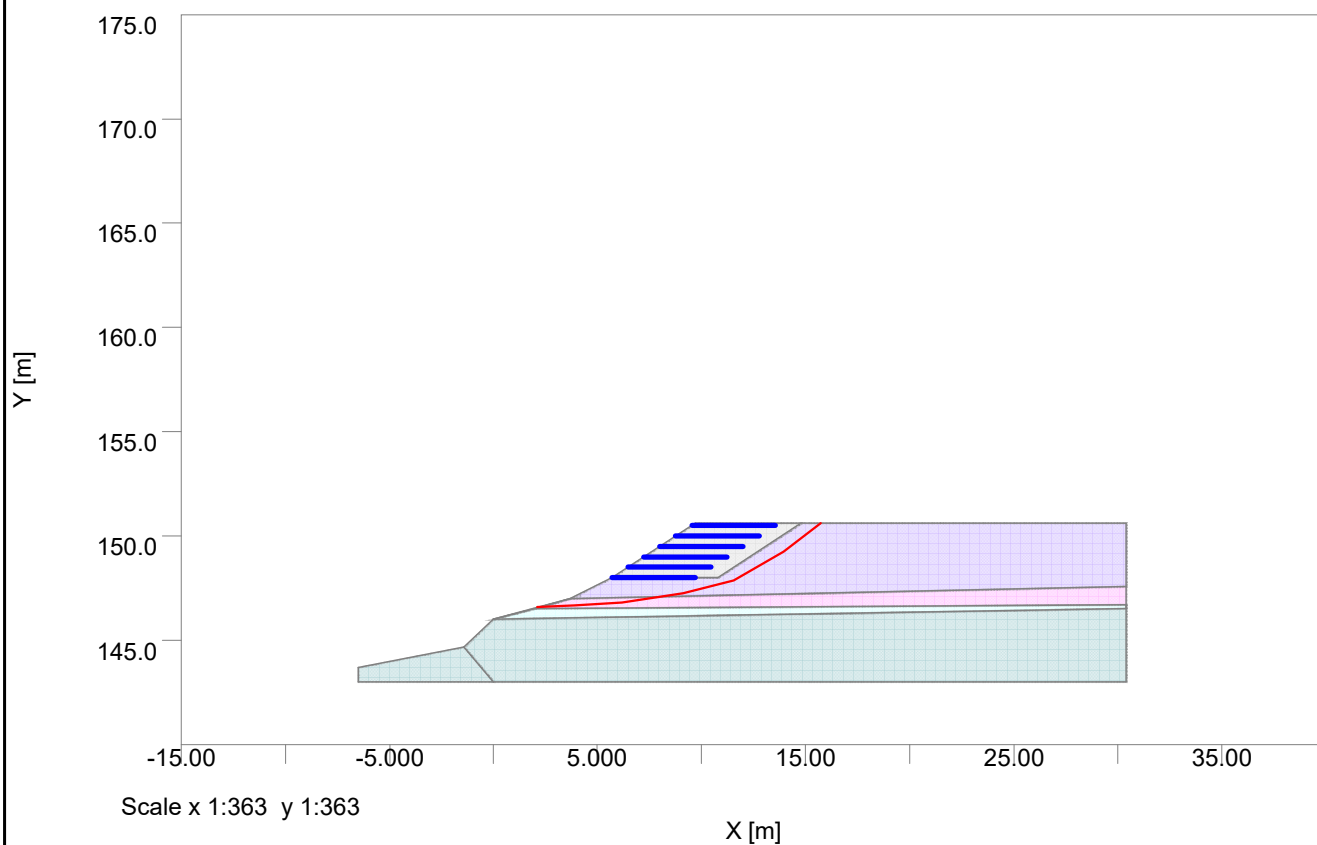
Page

7

Time

21:49

Moments taken about 3.80,165.87, Over-Design Factor 1.512



Oasys

Hollingsworth Gate, Littleborough

Section B

Job No.

GRO-23131

Sheet No.

Rev.

Drg. Ref.

Made by

JD

Date

Checked

Date

Specification

Slip Type: NON-CIRCULAR

Direction of slip: Downhill

Minimum slip weight [kN/m] :80.00000

Type of analysis: STATIC

Partial factor analysis

Minimum number of slices 25

Method: Janbu(Variably inclined interslice forces)

Maximum number of iterations: 300

Reinforcement: ACTIVE

Material Partial Factors

Description	Friction	Adhesion	Creep	Manufacture	Extrapolation	Damage	Environment
	Interaction	Interaction	Reduction		of Test Data		
	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Material Properties

No	Description	Unit Weight	Shear Strength Parameters	Phi or c	
		Above GWL	Below GWL	Condition	
		[kN/m3]	[kN/m3]		Phi0 [°]
0.0	1 Canal Wall	25.000	25.000	Drained	40.000
0.0	2 Reinforced Earth	17.500	20.000	Drained	29.000
0.0	3 Backfilled Made Ground	17.500	20.000	Drained	29.000
0.0	4 SAND	20.000	22.000	Drained	34.000
0.0	5 Firm CLAY	20.000	22.000	Drained	24.000
0.0	6 Soft CLAY	20.000	22.000	Drained	24.000
0.0	7 MUDSTONE	21.000	23.000	Drained	35.000

Reinforcement

Geotextile Reinforcement 1

Layers	Level of top layer	Vertical Spacing [m]	Length [m]	Top [m]	Btm [m]	Offset from surface [m]	Angle from horiz [°]
6	150.50	0.50000	4.0000	4.0000		0.0	0

Bond Length	Bond Strength [kN/m]	Prestress [kN]	Grout Diameter [mm]
0.0%	0.0	0.0	0.0

Out of plane spacing [m]	Tensile Capacity [kN]	Plate Capacity [kN]	Material Partial Factor
0.0	1.3000	0.0	

Non Circular Slips

No	Name	Coordinates
1	Slip 1	(15.7, 151) (14, 149) (11.5, 148) (9.14, 147) (6.19, 147) (3.89, 147) (2.12, 147)

RESULTS OF ANALYSIS

In the following tables, values in italics are factored values using the currently selected Method Partial Factors.

Slip Description	Slip Centre	Slip	Comment/	Disturbing Soil
Reinforcement				

Program Oasys Slope Version 21.0.0.46

Copyright (C) 1997-2023

Page 1

Printed 09-Oct-2023

Time 23:39



Hollingsworth Gate, Littleborough
Section B

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

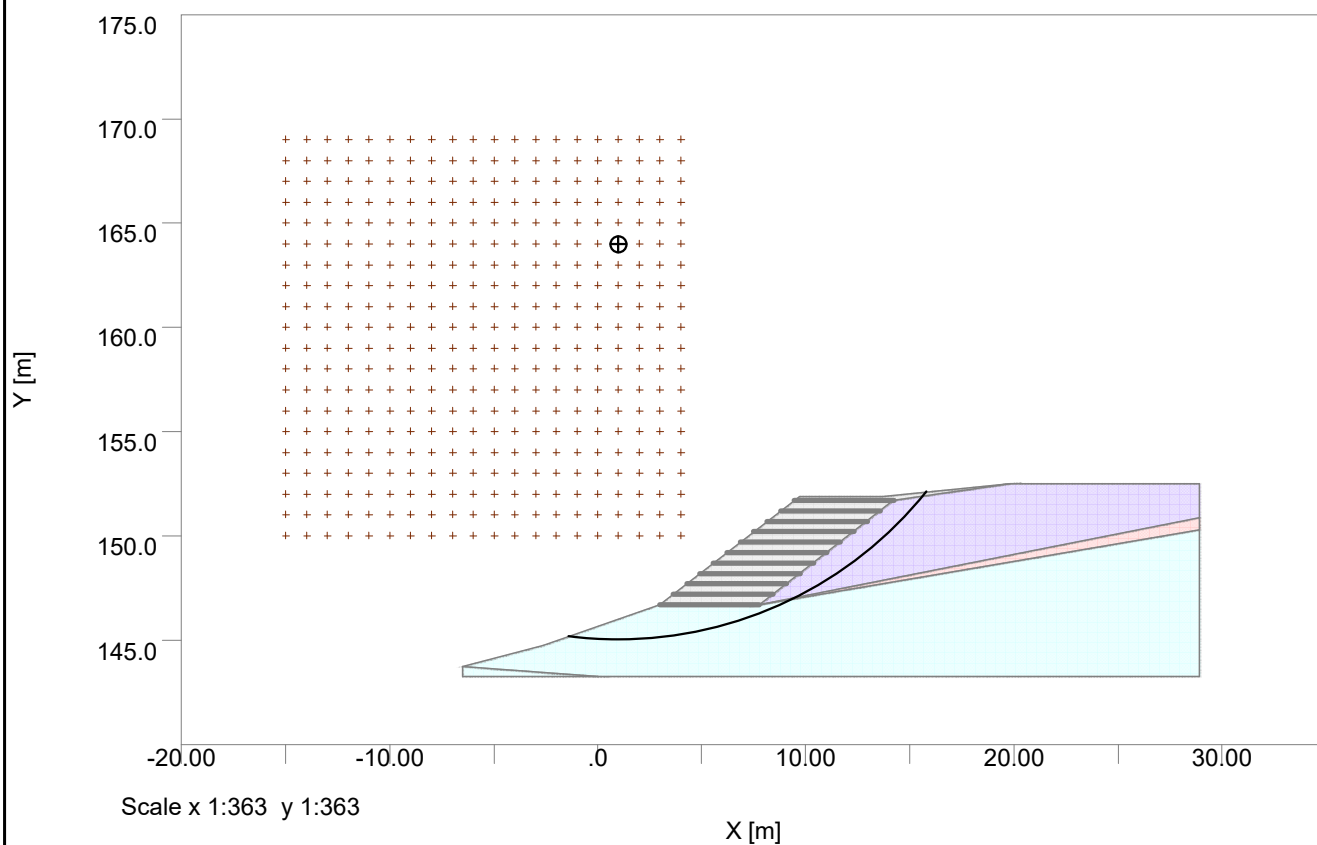
		Weight	Over-Design	Moment	Strength	Restoring
			Factor		Restoring	Moment
					Moment	
	x [m]	y [m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]
Slip 1	3.7956	165.87	397.22	1.5121	2071.5	3132.3
0.0						



APPENDIX 4 - Section D Modelling Outputs

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date 07 Jun 2023	Checked Date

Circle plotted: centre at 1.00,164.00, Over-Design Factor 1.539



Specification

```
Slip Type: CIRCULAR
Direction of slip: Downhill
Minimum slip weight [kN/m] :80.00000
Type of analysis: STATIC
Partial factor analysis
Minimum number of slices 25
Method: Bishop (Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: ACTIVE
```

Material Partial Factors

[illegible]

Material Properties

No	Description	Unit Weight		Shear Strength Parameters	Phi or c
		Above GWL	Below GWL		
	or c0'			Condition	
		[kN/m3]	[kN/m3]		Phi0 [°]
0.0	1 Canal Wall	35.000	35.000	Drained	40.000
0.0	2 Reinforced Earth	17.500	20.000	Drained	29.000
0.0	3 Made Ground Backfill	17.500	20.000	Drained	29.000
0.0	4 Made Ground Gravel	17.500	20.000	Drained	29.000
0.0	5 SANDSTONE	22.000	24.000	Drained	40.000

Reinforcement

Geotextile Reinforcement 1						
Layers	Level of top layer	Vertical Spacing	Length		Offset from surface	Angle from horizon
	[m]	[m]	Top [m]	Btm [m]	[m]	[°]
11	151.70	0.50000	4.8000	4.8000	0.0	0

Bond Length	Bond Strength	Prestress	Grout Diameter
	[kN/m]	[kN]	[mm]
0.0%	0.0	0.0	0.0

Out of plane spacing	Tensile Capacity	Plate Capacity	Material Partial Factor
[m]	[kN]	[kN]	
0.0	1.3000	0.0	

Slip Surface Specification

Circle centre specification:
 Bottom left of grid: x = -15.00000 m y = 150.00000 m
 Inclination of grid: 0.00000 deg
 (positive anticlockwise direction about bottom left of grid)
 Centres on grid: 20 in x direction at 1.00000m spacing
 20 in y direction at 1.00000m spacing
 Grid extended to find minimum FoS
 All circles pass through common point at x = 9.50000 m, y = 147.00000 m

RESULTS OF ANALYSIS

In the following tables, values in italics are factored values using the currently selected Method Partial Factors.

Slip Centre	Radius Slip	Comment/ Weight Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
-------------	-------------	--	----------------------	--------------------------------------	--------------------------------------

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date 07 Jun 2023	Checked Date

x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]
-15.000	150.00	24.683		Only 1	intersection	with	ground level
-15.000	151.00	24.824		Only 1	intersection	with	ground level
-15.000	152.00	25.005		Only 1	intersection	with	ground level
-15.000	153.00	25.224		Only 1	intersection	with	ground level
-15.000	154.00	25.480		Only 1	intersection	with	ground level
-15.000	155.00	25.773		Only 1	intersection	with	ground level
-15.000	156.00	26.101		Only 1	intersection	with	ground level
-15.000	157.00	26.462		Only 1	intersection	with	ground level
-15.000	158.00	26.856		Only 1	intersection	with	ground level
-15.000	159.00	27.281		Only 1	intersection	with	ground level
-15.000	160.00	27.735		Only 1	intersection	with	ground level
-15.000	161.00	28.218		Only 1	intersection	with	ground level
-15.000	162.00	28.727		Only 1	intersection	with	ground level
-15.000	163.00	29.262		Only 1	intersection	with	ground level
-15.000	164.00	29.820		Only 1	intersection	with	ground level
-15.000	165.00	30.401		Only 1	intersection	with	ground level
-15.000	166.00	31.004		Only 1	intersection	with	ground level
-15.000	167.00	31.627		Only 1	intersection	with	ground level
-15.000	168.00	32.268		Only 1	intersection	with	ground level
-15.000	169.00	32.928		Only 1	intersection	with	ground level
-14.000	150.00	23.691		Only 1	intersection	with	ground level
-14.000	151.00	23.838		Only 1	intersection	with	ground level
-14.000	152.00	24.026		Only 1	intersection	with	ground level
-14.000	153.00	24.254		Only 1	intersection	with	ground level
-14.000	154.00	24.520		Only 1	intersection	with	ground level
-14.000	155.00	24.824		Only 1	intersection	with	ground level
-14.000	156.00	25.164		Only 1	intersection	with	ground level
-14.000	157.00	25.539		Only 1	intersection	with	ground level
-14.000	158.00	25.947		Only 1	intersection	with	ground level
-14.000	159.00	26.387		Only 1	intersection	with	ground level
-14.000	160.00	26.856		Only 1	intersection	with	ground level
-14.000	161.00	27.354		Only 1	intersection	with	ground level
-14.000	162.00	27.879		Only 1	intersection	with	ground level
-14.000	163.00	28.430		Only 1	intersection	with	ground level
-14.000	164.00	29.004		Only 1	intersection	with	ground level
-14.000	165.00	29.602		Only 1	intersection	with	ground level
-14.000	166.00	30.220		Only 1	intersection	with	ground level
-14.000	167.00	30.859		Only 1	intersection	with	ground level
-14.000	168.00	31.516		Only 1	intersection	with	ground level
-14.000	169.00	32.191		Only 1	intersection	with	ground level
-13.000	150.00	22.699		Only 1	intersection	with	ground level
-13.000	151.00	22.853		Only 1	intersection	with	ground level
-13.000	152.00	23.049		Only 1	intersection	with	ground level
-13.000	153.00	23.286		Only 1	intersection	with	ground level
-13.000	154.00	23.564		Only 1	intersection	with	ground level
-13.000	155.00	23.880		Only 1	intersection	with	ground level
-13.000	156.00	24.233		Only 1	intersection	with	ground level
-13.000	157.00	24.622		Only 1	intersection	with	ground level
-13.000	158.00	25.045		Only 1	intersection	with	ground level
-13.000	159.00	25.500		Only 1	intersection	with	ground level
-13.000	160.00	25.986		Only 1	intersection	with	ground level
-13.000	161.00	26.500		Only 1	intersection	with	ground level
-13.000	162.00	27.042		Only 1	intersection	with	ground level
-13.000	163.00	27.609		Only 1	intersection	with	ground level
-13.000	164.00	28.200		Only 1	intersection	with	ground level
-13.000	165.00	28.814		Only 1	intersection	with	ground level
-13.000	166.00	29.449		Only 1	intersection	with	ground level
-13.000	167.00	30.104		Only 1	intersection	with	ground level
-13.000	168.00	30.777		Only 1	intersection	with	ground level
-13.000	169.00	31.468		Only 1	intersection	with	ground level
-12.000	150.00	21.708		Only 1	intersection	with	ground level
-12.000	151.00	21.869		Only 1	intersection	with	ground level
-12.000	152.00	22.074		Only 1	intersection	with	ground level
-12.000	153.00	22.322		Only 1	intersection	with	ground level
-12.000	154.00	22.611		Only 1	intersection	with	ground level
-12.000	155.00	22.940		Only 1	intersection	with	ground level
-12.000	156.00	23.308		Only 1	intersection	with	ground level
-12.000	157.00	23.712		Only 1	intersection	with	ground level
-12.000	158.00	24.151		Only 1	intersection	with	ground level
-12.000	159.00	24.622		Only 1	intersection	with	ground level
-12.000	160.00	25.125		Only 1	intersection	with	ground level
-12.000	161.00	25.656		Only 1	intersection	with	ground level
-12.000	162.00	26.215		Only 1	intersection	with	ground level
-12.000	163.00	26.800		Only 1	intersection	with	ground level
-12.000	164.00	27.409		Only 1	intersection	with	ground level
-12.000	165.00	28.040		Only 1	intersection	with	ground level

Oasys Hollingsworth Gate, Littleborough Section D							Job No.		Sheet No.		Rev.	
							GRO-23131					
							Drg. Ref.					
							Made by JD		Date 07 Jun 2023		Checked	Date
Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment					
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]					
-12.000	166.00	28.692		Only 1 intersection with ground level								
-12.000	167.00	29.364		Only 1 intersection with ground level								
-12.000	168.00	30.054		Only 1 intersection with ground level								
-12.000	169.00	30.761		Only 1 intersection with ground level								
-11.000	150.00	20.718		Only 1 intersection with ground level								
-11.000	151.00	20.887		Only 1 intersection with ground level								
-11.000	152.00	21.101		Only 1 intersection with ground level								
-11.000	153.00	21.360		Only 1 intersection with ground level								
-11.000	154.00	21.662		Only 1 intersection with ground level								
-11.000	155.00	22.006		Only 1 intersection with ground level								
-11.000	156.00	22.389		Only 1 intersection with ground level								
-11.000	157.00	22.809		Only 1 intersection with ground level								
-11.000	158.00	23.265		Only 1 intersection with ground level								
-11.000	159.00	23.754		Only 1 intersection with ground level								
-11.000	160.00	24.274		Only 1 intersection with ground level								
-11.000	161.00	24.824		Only 1 intersection with ground level								
-11.000	162.00	25.402		Only 1 intersection with ground level								
-11.000	163.00	26.005		Only 1 intersection with ground level								
-11.000	164.00	26.632		Only 1 intersection with ground level								
-11.000	165.00	27.281		Only 1 intersection with ground level								
-11.000	166.00	27.951		Only 1 intersection with ground level								
-11.000	167.00	28.640		Only 1 intersection with ground level								
-11.000	168.00	29.347		Only 1 intersection with ground level								
-11.000	169.00	30.071		Only 1 intersection with ground level								
-10.000	150.00	19.729		Only 1 intersection with ground level								
-10.000	151.00	19.906		Only 1 intersection with ground level								
-10.000	152.00	20.131		Only 1 intersection with ground level								
-10.000	153.00	20.402		Only 1 intersection with ground level								
-10.000	154.00	20.718		Only 1 intersection with ground level								
-10.000	155.00	21.077		Only 1 intersection with ground level								
-10.000	156.00	21.477		Only 1 intersection with ground level								
-10.000	157.00	21.915		Only 1 intersection with ground level								
-10.000	158.00	22.389		Only 1 intersection with ground level								
-10.000	159.00	22.897		Only 1 intersection with ground level								
-10.000	160.00	23.436		Only 1 intersection with ground level								
-10.000	161.00	24.005		Only 1 intersection with ground level								
-10.000	162.00	24.602		Only 1 intersection with ground level								
-10.000	163.00	25.224		Only 1 intersection with ground level								
-10.000	164.00	25.870		Only 1 intersection with ground level								
-10.000	165.00	26.538		Only 1 intersection with ground level								
-10.000	166.00	27.226		Only 1 intersection with ground level								
-10.000	167.00	27.933		Only 1 intersection with ground level								
-10.000	168.00	28.657		Only 1 intersection with ground level								
-10.000	169.00	29.398		Only 1 intersection with ground level								
-9.0000	150.00	18.742		Only 1 intersection with ground level								
-9.0000	151.00	18.927		Only 1 intersection with ground level								
-9.0000	152.00	19.164		Only 1 intersection with ground level								
-9.0000	153.00	19.449		Only 1 intersection with ground level								
-9.0000	154.00	19.780		Only 1 intersection with ground level								
-9.0000	155.00	20.156		Only 1 intersection with ground level								
-9.0000	156.00	20.573		Only 1 intersection with ground level								
-9.0000	157.00	21.030		Only 1 intersection with ground level								
-9.0000	158.00	21.523		Only 1 intersection with ground level								
-9.0000	159.00	22.051		Only 1 intersection with ground level								
-9.0000	160.00	22.611		Only 1 intersection with ground level								
-9.0000	161.00	23.200		Only 1 intersection with ground level								
-9.0000	162.00	23.817		Only 1 intersection with ground level								
-9.0000	163.00	24.459		Only 1 intersection with ground level								
-9.0000	164.00	25.125		Only 1 intersection with ground level								
-9.0000	165.00	25.812		Only 1 intersection with ground level								
-9.0000	166.00	26.519		Only 1 intersection with ground level								
-9.0000	167.00	27.244		Only 1 intersection with ground level								
-9.0000	168.00	27.987		Only 1 intersection with ground level								
-9.0000	169.00	28.745		Only 1 intersection with ground level								
-8.0000	150.00	17.755		Only 1 intersection with ground level								
-8.0000	151.00	17.951		Only 1 intersection with ground level								
-8.0000	152.00	18.200		Only 1 intersection with ground level								
-8.0000	153.00	18.500		Only 1 intersection with ground level								
-8.0000	154.00	18.848		Only 1 intersection with ground level								
-8.0000	155.00	19.242		Only 1 intersection with ground level								
-8.0000	156.00	19.679		Only 1 intersection with ground level								
-8.0000	157.00	20.156		Only 1 intersection with ground level								
-8.0000	158.00	20.670		Only 1 intersection with ground level								
-8.0000	159.00	21.219		Only 1 intersection with ground level								
-8.0000	160.00	21.800		Only 1 intersection with ground level								
-8.0000	161.00	22.411		Only 1 intersection with ground level								
-8.0000	162.00	23.049		Only 1 intersection with ground level								

Oasys Hollingsworth Gate, Littleborough Section D							Job No.		Sheet No.		Rev.
							GRO-23131				
							Drg. Ref.				
							Made by JD		Date 07 Jun 2023		Checked
Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment				
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]				
-8.0000	163.00	23.712		Only 1 intersection with ground level							
-8.0000	164.00	24.398		Only 1 intersection with ground level							
-8.0000	165.00	25.105		Only 1 intersection with ground level							
-8.0000	166.00	25.831		Only 1 intersection with ground level							
-8.0000	167.00	26.575		Only 1 intersection with ground level							
-8.0000	168.00	27.336		Only 1 intersection with ground level							
-8.0000	169.00	28.111		Only 1 intersection with ground level							
-7.0000	150.00	16.771		Only 1 intersection with ground level							
-7.0000	151.00	16.978		Only 1 intersection with ground level							
-7.0000	152.00	17.241		Only 1 intersection with ground level							
-7.0000	153.00	17.557		Only 1 intersection with ground level							
-7.0000	154.00	17.923		Only 1 intersection with ground level							
-7.0000	155.00	18.337		Only 1 intersection with ground level							
-7.0000	156.00	18.795		Only 1 intersection with ground level							
-7.0000	157.00	19.294		Only 1 intersection with ground level							
-7.0000	158.00	19.831		Only 1 intersection with ground level							
-7.0000	159.00	20.402		Only 1 intersection with ground level							
-7.0000	160.00	21.006		Only 1 intersection with ground level							
-7.0000	161.00	21.639		Only 1 intersection with ground level							
-7.0000	162.00	22.299		Only 1 intersection with ground level							
-7.0000	163.00	22.984		Only 1 intersection with ground level							
-7.0000	164.00	23.691		Only 1 intersection with ground level							
-7.0000	165.00	24.418		Only 1 intersection with ground level							
-7.0000	166.00	25.164		Only 1 intersection with ground level							
-7.0000	167.00	25.928		Only 1 intersection with ground level							
-7.0000	168.00	26.707		Only 1 intersection with ground level							
-7.0000	169.00	27.500		Only 1 intersection with ground level							
-6.0000	150.00	15.788		Only 1 intersection with ground level							
-6.0000	151.00	16.008		Only 1 intersection with ground level							
-6.0000	152.00	16.286		Only 1 intersection with ground level							
-6.0000	153.00	16.621		Only 1 intersection with ground level							
-6.0000	154.00	17.007		Only 1 intersection with ground level							
-6.0000	155.00	17.443		Only 1 intersection with ground level							
-6.0000	156.00	17.923		Only 1 intersection with ground level							
-6.0000	157.00	18.446		Only 1 intersection with ground level							
-6.0000	158.00	19.007		Only 1 intersection with ground level							
-6.0000	159.00	19.602		Only 1 intersection with ground level							
-6.0000	160.00	20.230		Only 1 intersection with ground level							
-6.0000	161.00	20.887		Only 1 intersection with ground level							
-6.0000	162.00	21.570		Only 1 intersection with ground level							
-6.0000	163.00	22.277		Only 1 intersection with ground level							
-6.0000	164.00	23.005		Only 1 intersection with ground level							
-6.0000	165.00	23.754		Only 1 intersection with ground level							
-6.0000	166.00	24.520		Only 1 intersection with ground level							
-6.0000	167.00	25.303		Only 1 intersection with ground level							
-6.0000	168.00	26.101		Only 1 intersection with ground level							
-6.0000	169.00	26.912		Only 1 intersection with ground level							
-5.0000	150.00	14.807		Only 1 intersection with ground level							
-5.0000	151.00	15.042		Only 1 intersection with ground level							
-5.0000	152.00	15.338		Only 1 intersection with ground level							
-5.0000	153.00	15.692		Only 1 intersection with ground level							
-5.0000	154.00	16.101		Only 1 intersection with ground level							
-5.0000	155.00	16.560		Only 1 intersection with ground level							
-5.0000	156.00	17.066		Only 1 intersection with ground level							
-5.0000	157.00	17.614		Only 1 intersection with ground level							
-5.0000	158.00	18.200		Only 1 intersection with ground level							
-5.0000	159.00	18.822		Only 1 intersection with ground level							
-5.0000	160.00	19.474		Only 1 intersection with ground level							
-5.0000	161.00	20.156		Only 1 intersection with ground level							
-5.0000	162.00	20.863		Only 1 intersection with ground level							
-5.0000	163.00	21.593		Only 1 intersection with ground level							
-5.0000	164.00	22.344		Only 1 intersection with ground level							
-5.0000	165.00	23.114		Only 1 intersection with ground level							
-5.0000	166.00	23.901		Only 1 intersection with ground level							
-5.0000	167.00	24.703		Only 1 intersection with ground level							
-5.0000	168.00	25.520		Only 1 intersection with ground level							
-5.0000	169.00	26.349		Only 1 intersection with ground level							
-4.0000	150.00	13.829		Only 1 intersection with ground level							
-4.0000	151.00	14.080		Only 1 intersection with ground level							
-4.0000	152.00	14.396		Only 1 intersection with ground level							
-4.0000	153.00	14.773		Only 1 intersection with ground level							
-4.0000	154.00	15.207		Only 1 intersection with ground level							
-4.0000	155.00	15.692		Only 1 intersection with ground level							
-4.0000	156.00	16.225		Only 1 intersection with ground level							
-4.0000	157.00	16.800		Only 1 intersection with ground level							
-4.0000	158.00	17.414		Only 1 intersection with ground level							
-4.0000	159.00	18.062		Only 1 intersection with ground level							

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date 07 Jun 2023	Checked Date

Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]
-4.0000	160.00	18.742	Only 1	intersection with ground level		
-4.0000	161.00	19.449	Only 1	intersection with ground level		
-4.0000	162.00	20.180	Only 1	intersection with ground level		
-4.0000	163.00	20.934	Only 1	intersection with ground level		
-4.0000	164.00	21.708	Only 1	intersection with ground level		
-4.0000	165.00	22.500	Only 1	intersection with ground level		
-4.0000	166.00	23.308	Only 1	intersection with ground level		
-4.0000	167.00	24.130	Only 1	intersection with ground level		
-4.0000	168.00	24.965	Only 1	intersection with ground level		
-4.0000	169.00	25.812	Only 1	intersection with ground level		
-4.0000	169.00	25.812	Only 1	intersection with ground level		
-3.0000	150.00	12.855	Only 1	intersection with ground level		
-3.0000	151.00	13.124	Only 1	intersection with ground level		
-3.0000	152.00	13.463	Only 1	intersection with ground level		
-3.0000	153.00	13.865	Only 1	intersection with ground level		
-3.0000	154.00	14.327	Only 1	intersection with ground level		
-3.0000	155.00	14.841	Only 1	intersection with ground level		
-3.0000	156.00	15.403	Only 1	intersection with ground level		
-3.0000	157.00	16.008	Only 1	intersection with ground level		
-3.0000	158.00	16.651	Only 1	intersection with ground level		
-3.0000	159.00	17.328	Only 1	intersection with ground level		
-3.0000	160.00	18.035	Only 1	intersection with ground level		
-3.0000	161.00	18.768	Only 1	intersection with ground level		
-3.0000	162.00	19.526	Only 1	intersection with ground level		
-3.0000	163.00	20.304	Only 1	intersection with ground level		
-3.0000	164.00	21.101	Only 1	intersection with ground level		
-3.0000	165.00	21.915	Only 1	intersection with ground level		
-3.0000	165.00	21.915	Only 1	intersection with ground level		
-3.0000	166.00	22.743	Only 1	intersection with ground level		
-3.0000	166.00	22.743	Only 1	intersection with ground level		
-3.0000	167.00	23.585	Only 1	intersection with ground level		
-3.0000	168.00	24.439	1037.7	1.6206 9269.9	15023.	0.0
-3.0000	169.00	25.303	1014.8	1.6041 9387.0	15058.	0.0
-2.0000	150.00	11.885	Only 1	intersection with ground level		
-2.0000	151.00	12.176	Only 1	intersection with ground level		
-2.0000	152.00	12.540	Only 1	intersection with ground level		
-2.0000	153.00	12.971	Only 1	intersection with ground level		
-2.0000	154.00	13.463	Only 1	intersection with ground level		
-2.0000	155.00	14.009	Only 1	intersection with ground level		
-2.0000	156.00	14.603	Only 1	intersection with ground level		
-2.0000	157.00	15.240	Only 1	intersection with ground level		
-2.0000	158.00	15.914	Only 1	intersection with ground level		
-2.0000	159.00	16.621	Only 1	intersection with ground level		
-2.0000	160.00	17.357	Only 1	intersection with ground level		
-2.0000	161.00	18.118	Only 1	intersection with ground level		
-2.0000	161.00	18.118	Only 1	intersection with ground level		
-2.0000	162.00	18.901	Only 1	intersection with ground level		
-2.0000	162.00	18.901	Only 1	intersection with ground level		
-2.0000	163.00	19.704	1075.2	1.6792 7753.0	13016.	2.9411
-2.0000	164.00	20.524	1040.1	1.6471 7862.2	12950.	0.0
-2.0000	165.00	21.360	1010.5	1.6212 7978.9	12936.	0.0
-2.0000	166.00	22.209	985.93	1.6004 8105.0	12971.	0.0
-2.0000	167.00	23.071	965.45	1.5842 8237.6	13050.	0.0
-2.0000	168.00	23.943	948.67	1.5722 8378.0	13172.	0.0
-2.0000	169.00	24.824	935.21	1.5637 8526.5	13332.	0.0
-1.0000	150.00	10.920	Only 1	intersection with ground level		
-1.0000	151.00	11.236	Only 1	intersection with ground level		
-1.0000	152.00	11.630	Only 1	intersection with ground level		
-1.0000	153.00	12.093	Only 1	intersection with ground level		
-1.0000	154.00	12.619	Only 1	intersection with ground level		
-1.0000	155.00	13.200	Only 1	intersection with ground level		
-1.0000	156.00	13.829	Only 1	intersection with ground level		
-1.0000	156.00	13.829	Only 1	intersection with ground level		
-1.0000	157.00	14.500	Only 1	intersection with ground level		
-1.0000	157.00	14.500	Only 1	intersection with ground level		
-1.0000	158.00	15.207	Only 1	intersection with ground level		
-1.0000	158.00	15.207	Only 1	intersection with ground level		
-1.0000	159.00	15.945	Only 1	intersection with ground level		
-1.0000	159.00	15.945	Only 1	intersection with ground level		
-1.0000	160.00	16.711	1058.8	1.7152 6484.0	11091.	30.450
-1.0000	161.00	17.500	1018.2	1.6697 6599.9	11003.	16.586
-1.0000	162.00	18.310	984.66	1.6331 6723.6	10977.	2.7853
-1.0000	163.00	19.138	957.11	1.6053 6855.0	11004.	0.0
-1.0000	164.00	19.981	934.72	1.5841 6993.9	11079.	0.0
-1.0000	165.00	20.839	916.77	1.5683 7140.5	11198.	0.0
-1.0000	166.00	21.708	902.59	1.5572 7293.9	11358.	0.0

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date 07 Jun 2023	Checked Date

Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]
-1.0000	167.00	22.589	891.74	1.5501	7454.7	11556.
-1.0000	168.00	23.479	883.70	1.5468	7621.8	11789.
-1.0000	169.00	24.377	878.12	1.5465	7795.7	12056.
0.0	150.00	9.9624	Only	1 intersection with ground level		0.0
0.0	151.00	10.308	Only	1 intersection with ground level		0.0
0.0	152.00	10.735	Only	1 intersection with ground level		0.0
0.0	152.00	10.735	Only	1 intersection with ground level		0.0
0.0	153.00	11.236	Only	1 intersection with ground level		0.0
0.0	153.00	11.236	Only	1 intersection with ground level		0.0
0.0	154.00	11.800	Only	1 intersection with ground level		0.0
0.0	154.00	11.800	Only	1 intersection with ground level		0.0
0.0	155.00	12.420	Only	1 intersection with ground level		0.0
0.0	155.00	12.420	Only	1 intersection with ground level		0.0
0.0	156.00	13.086	Only	1 intersection with ground level		0.0
0.0	156.00	13.086	Only	1 intersection with ground level		0.0
0.0	157.00	13.793	Only	1 intersection with ground level		0.0
0.0	157.00	13.793	Only	1 intersection with ground level		0.0
0.0	158.00	14.534	1000.9	1.7205	5371.9	9209.3
0.0	159.00	15.305	961.19	1.6689	5503.8	9155.8
0.0	160.00	16.101	929.07	1.6274	5640.1	9162.3
0.0	161.00	16.919	903.70	1.5953	5784.5	9225.4
0.0	162.00	17.755	883.68	1.5730	5935.3	9336.1
0.0	163.00	18.608	868.25	1.5575	6092.3	9489.0
0.0	164.00	19.474	856.85	1.5476	6257.0	9683.1
0.0	165.00	20.353	848.81	1.5423	6428.2	9914.3
0.0	166.00	21.243	843.61	1.5408	6607.1	10180.
0.0	167.00	22.142	840.52	1.5420	6791.1	10472.
0.0	168.00	23.049	839.50	1.5456	6982.6	10792.
0.0	169.00	23.964	840.23	1.5517	7179.0	11140.
1.0000	150.00	9.0139	Only	1 intersection with ground level		0.0
1.0000	150.00	9.0139	Only	1 intersection with ground level		0.0
1.0000	151.00	9.3941	Only	1 intersection with ground level		0.0
1.0000	151.00	9.3941	Only	1 intersection with ground level		0.0
1.0000	152.00	9.8615	Only	1 intersection with ground level		0.0
1.0000	152.00	9.8615	Only	1 intersection with ground level		0.0
1.0000	153.00	10.404	Only	1 intersection with ground level		0.0
1.0000	153.00	10.404	Only	1 intersection with ground level		0.0
1.0000	154.00	11.011	Only	1 intersection with ground level		0.0
1.0000	154.00	11.011	Only	1 intersection with ground level		0.0
1.0000	155.00	11.673	993.46	1.8344	4166.4	7614.7
1.0000	156.00	12.379	943.63	1.7477	4311.8	7508.2
1.0000	157.00	13.124	904.39	1.6837	4459.9	7477.6
1.0000	158.00	13.901	873.84	1.6351	4610.9	7512.8
1.0000	159.00	14.705	850.27	1.5988	4765.0	7602.4
1.0000	160.00	15.532	832.46	1.5719	4925.6	7740.1
1.0000	161.00	16.378	819.65	1.5551	5093.4	7920.9
1.0000	162.00	17.241	810.72	1.5446	5268.7	8138.0
1.0000	163.00	18.118	805.20	1.5397	5449.5	8390.5
1.0000	164.00	19.007	802.47	1.5386	5637.1	8673.3
1.0000	165.00	19.906	801.93	1.5408	5830.5	8983.4
1.0000	166.00	20.815	803.41	1.5456	6030.4	9320.8
1.0000	167.00	21.731	806.50	1.5528	6235.3	9682.4
1.0000	168.00	22.655	811.21	1.5622	6447.1	10072.
1.0000	169.00	23.585	816.99	1.5728	6663.4	10481.
2.0000	150.00	8.0777	Only	1 intersection with ground level		0.0
2.0000	150.00	8.0777	Only	1 intersection with ground level		0.0
2.0000	151.00	8.5000	Only	1 intersection with ground level		0.0
2.0000	151.00	8.5000	Only	1 intersection with ground level		0.0
2.0000	152.00	9.0139	Only	1 intersection with ground level		0.0
2.0000	152.00	9.0139	Only	1 intersection with ground level		0.0
2.0000	153.00	9.6047	938.28	1.9427	3139.3	6078.6
2.0000	154.00	10.259	885.72	1.8176	3299.7	5976.0
2.0000	155.00	10.966	845.94	1.7284	3462.7	5957.1
2.0000	156.00	11.715	816.48	1.6634	3628.3	6008.9
2.0000	157.00	12.500	794.56	1.6165	3796.3	6114.1
2.0000	158.00	13.314	779.06	1.5841	3967.3	6269.2
2.0000	159.00	14.151	768.61	1.5609	4144.1	6466.2
2.0000	160.00	15.008	762.46	1.5481	4327.7	6699.9
2.0000	161.00	15.882	759.74	1.5422	4517.9	6967.5
2.0000	162.00	16.771	759.75	1.5412	4713.7	7264.8
2.0000	163.00	17.671	762.09	1.5439	4915.6	7589.2
2.0000	164.00	18.581	766.26	1.5499	5122.1	7938.9
2.0000	165.00	19.500	772.17	1.5585	5335.3	8315.2
2.0000	166.00	20.427	779.36	1.5690	5553.2	8712.8

Oasys Hollingsworth Gate, Littleborough Section D						Job No.		Sheet No.		Rev.	
						GRO-23131					
						Drg. Ref.					
						Made by JD		Date 07 Jun 2023		Checked	
Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment				
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]				
2.0000	167.00	21.360	787.55	1.5815	5774.4	9132.0	0.0				
2.0000	168.00	22.299	796.89	1.5951	6002.7	9574.9	0.0				
2.0000	169.00	23.243	806.96	1.6100	6234.3	10037.	0.0				
3.0000	150.00	7.1589	Only 1 intersection with ground level								
3.0000	150.00	7.1589	Only 1 intersection with ground level								
3.0000	151.00	7.6322	Centre embedded/below end of slip								
3.0000	152.00	8.2006	824.62	1.9891	2321.3	4605.3	12.090				
3.0000	153.00	8.8459	784.40	1.8320	2514.8	4588.6	18.566				
3.0000	154.00	9.5525	754.85	1.7294	2695.5	4640.1	21.450				
3.0000	155.00	10.308	734.65	1.6588	2877.7	4752.4	21.060				
3.0000	156.00	11.102	721.65	1.6115	3062.1	4915.8	18.720				
3.0000	157.00	11.927	713.96	1.5812	3247.7	5120.8	14.430				
3.0000	158.00	12.777	710.87	1.5606	3438.8	5364.4	2.0741				
3.0000	159.00	13.647	711.40	1.5521	3635.5	5642.5	0.0				
3.0000	160.00	14.534	714.71	1.5504	3837.8	5950.2	0.0				
3.0000	161.00	15.435	720.20	1.5536	4045.1	6284.6	0.0				
3.0000	162.00	16.348	727.55	1.5606	4257.4	6644.2	0.0				
3.0000	163.00	17.270	736.48	1.5706	4475.5	7029.0	0.0				
3.0000	164.00	18.200	746.61	1.5828	4698.1	7436.1	0.0				
3.0000	165.00	19.138	757.79	1.5966	4926.1	7865.2	0.0				
3.0000	166.00	20.081	769.74	1.6120	5157.7	8314.0	0.0				
3.0000	167.00	21.030	782.41	1.6284	5394.3	8784.3	0.0				
3.0000	168.00	21.983	795.66	1.6457	5634.8	9273.3	0.0				
3.0000	169.00	22.940	809.34	1.6635	5879.4	9780.1	0.0				
4.0000	150.00	6.2650	Centre embedded/below end of slip								
4.0000	151.00	6.8007	Centre embedded/below end of slip								
4.0000	152.00	7.4330	685.55	1.8832	1813.2	3402.4	12.090				
4.0000	153.00	8.1394	667.18	1.7536	2011.0	3511.5	14.950				
4.0000	154.00	8.9022	657.33	1.6723	2207.7	3676.0	15.860				
4.0000	155.00	9.7082	653.58	1.6221	2404.6	3885.6	14.820				
4.0000	156.00	10.548	654.35	1.5934	2601.6	4133.5	11.830				
4.0000	157.00	11.413	658.89	1.5760	2803.2	4416.0	1.8462				
4.0000	158.00	12.298	666.13	1.5717	3009.0	4729.3	0.0				
4.0000	159.00	13.200	675.67	1.5745	3220.6	5070.9	0.0				
4.0000	160.00	14.116	686.88	1.5820	3437.2	5437.7	0.0				
4.0000	161.00	15.042	699.42	1.5932	3658.7	5828.9	0.0				
4.0000	162.00	15.977	712.91	1.6069	3884.3	6241.6	0.0				
4.0000	163.00	16.919	727.34	1.6224	4115.3	6676.5	0.0				
4.0000	164.00	17.868	742.39	1.6393	4350.4	7131.5	0.0				
4.0000	165.00	18.822	757.92	1.6572	4589.2	7605.1	0.0				
4.0000	166.00	19.780	773.99	1.6757	4833.3	8099.2	0.0				
4.0000	167.00	20.742	790.30	1.6949	5080.8	8611.3	0.0				
4.0000	168.00	21.708	807.00	1.7141	5333.1	9141.3	0.0				
4.0000	169.00	22.677	823.86	1.7332	5589.2	9687.1	0.0				

Program Oasys Slope Version 21.0.0.46

Copyright (C) 1997-2023

Printed

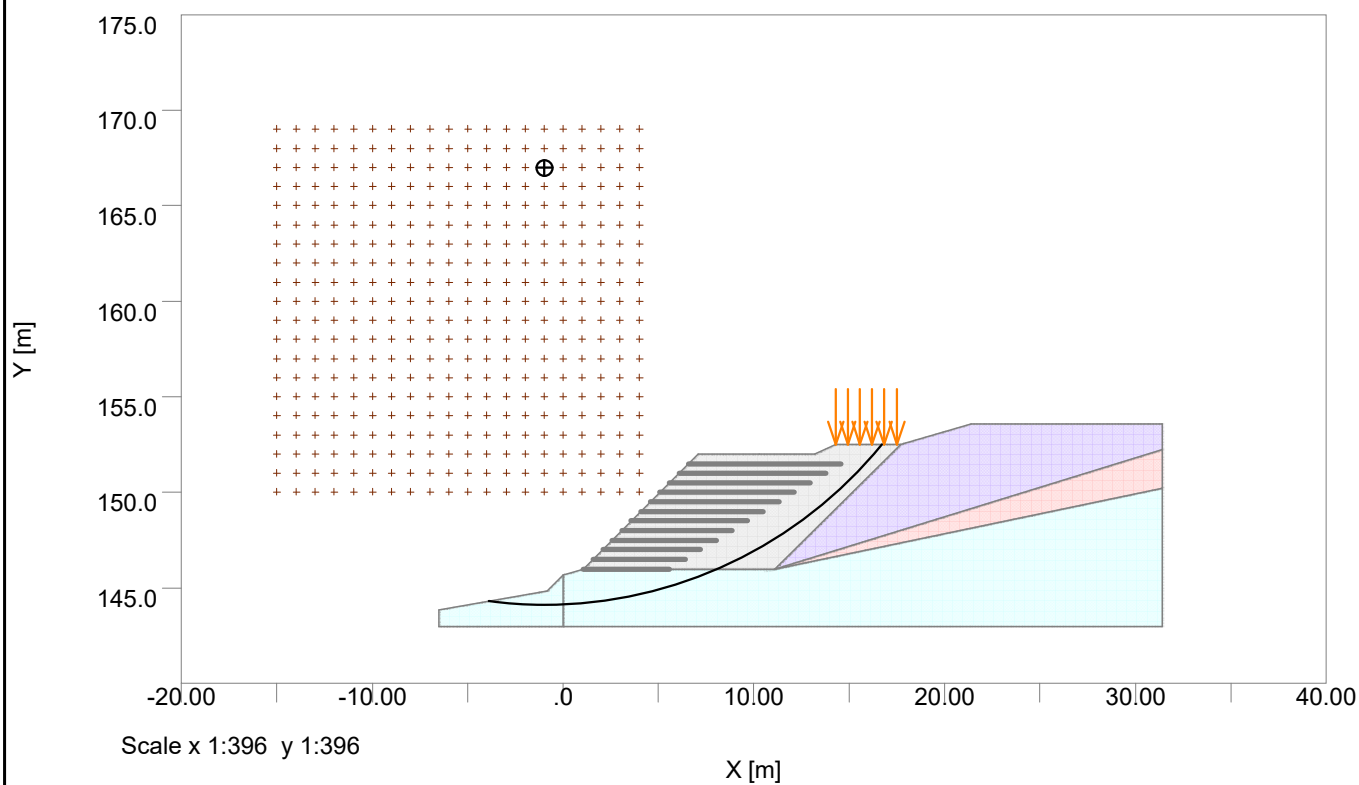
09-Oct-2023

Page

7

APPENDIX 5 - Section E Modelling Outputs

Circle plotted: centre at -1.00,167.00, Over-Design Factor 1.210



Oasys Hollingsworth Gate, Littleborough Section E	Job No.		Sheet No.		Rev.	
	GRO-23131					
	Drg. Ref.					
	Made by JD		Date		Checked Date	

Specification

Slip Type: CIRCULAR
Direction of slip: Downhill
Minimum slip weight [kN/m] :100.00000
Type of analysis: STATIC
Partial factor analysis
Minimum number of slices 25
Method: Bishop(Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: ACTIVE

Material Partial Factors

Description	Friction Interaction	Adhesion Interaction	Creep Reduction	Manufacture	Extrapolation of Test Data	Damage	Environment
	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Material Properties

No	Description	Unit Weight Above GWL	Unit Weight Below GWL	Shear Strength Condition	Parameters Phi or c
		[kN/m3]	[kN/m3]		Phi0 [°]
0.0	1 Canal Wall	25.000	25.000	Drained	40.000
0.0	2 Reinforced Earth	17.500	20.000	Drained	24.000
0.0	3 Clay Made Ground	17.500	20.000	Drained	24.000
0.0	4 Stiff CLAY	21.000	23.000	Drained	24.000
0.0	5 MUDSTONE	21.000	23.000	Drained	35.000

Surface loads

No.	Limits of loaded area		Distributed load	Permanent / Variable load	Favourable / Unfavourable load	Use in pull-out calc
	X1	X2	Vert	Horiz		
	[m]	[m]	[kN/m²]	[kN/m²]		
1	14.300	17.500	10.000	0.0	Variable	Unfavourable No

Reinforcement

Geotextile Reinforcement 1

Layers	Level	Vertical of top Spacing layer	Length	Offset from surface	Angle from horiz
	[m]	[m]	Top [m]	Btm [m]	[°]
12	151.50	0.50000	8.0000	4.5000	0.0 0

Bond Length	Bond Strength	Prestress	Grout Diameter
	[kN/m]	[kN]	[mm]
0.0%	0.0	0.0	0.0

Out of plane spacing	Tensile Capacity	Plate Capacity	Material Partial Factor
	[kN]	[kN]	
0.0	1.3000	0.0	

Slip Surface Specification

Circle centre specification:
Bottom left of grid: x = -15.00000 m y = 150.00000 m
Inclination of grid: 0.00000 deg
(positive anticlockwise direction about bottom left of grid)
Centres on grid: 20 in x direction at 1.00000m spacing
20 in y direction at 1.00000m spacing
Grid extended to find minimum FoS
All circles pass through common point at x = 8.10000 m, y = 146.00000 m

Out of plane spacing [m]	Tensile Capacity [kN]	Plate Capacity [kN]	Material Partial Factor
-----------------------------------	-----------------------------	---------------------------	-------------------------------

In the following tables, values in italics are factored values using the currently selected Method Partial Factors.

Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Restoring Moment	Strength Restoring Moment
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]
-15.000	150.00	23.444		Only 1	intersection	with ground	level
-15.000	151.00	23.635		Only 1	intersection	with ground	level
-15.000	152.00	23.867		Only 1	intersection	with ground	level
-15.000	153.00	24.137		Only 1	intersection	with ground	level
-15.000	154.00	24.446		Only 1	intersection	with ground	level
-15.000	155.00	24.791		Only 1	intersection	with ground	level
-15.000	156.00	25.172		Only 1	intersection	with ground	level
-15.000	157.00	25.585		Only 1	intersection	with ground	level
-15.000	158.00	26.031		Only 1	intersection	with ground	level
-15.000	159.00	26.507		Only 1	intersection	with ground	level
-15.000	160.00	27.011		Only 1	intersection	with ground	level
-15.000	161.00	27.543		Only 1	intersection	with ground	level
-15.000	162.00	28.100		Only 1	intersection	with ground	level
-15.000	163.00	28.681		Only 1	intersection	with ground	level
-15.000	164.00	29.285		Only 1	intersection	with ground	level
-15.000	165.00	29.910		Only 1	intersection	with ground	level
-15.000	166.00	30.555		Only 1	intersection	with ground	level
-15.000	167.00	31.219		Only 1	intersection	with ground	level
-15.000	168.00	31.900		Only 1	intersection	with ground	level
-15.000	169.00	32.598		Only 1	intersection	with ground	level
-14.000	150.00	22.459		Only 1	intersection	with ground	level
-14.000	151.00	22.659		Only 1	intersection	with ground	level
-14.000	152.00	22.900		Only 1	intersection	with ground	level
-14.000	153.00	23.182		Only 1	intersection	with ground	level
-14.000	154.00	23.503		Only 1	intersection	with ground	level
-14.000	155.00	23.862		Only 1	intersection	with ground	level
-14.000	156.00	24.257		Only 1	intersection	with ground	level
-14.000	157.00	24.686		Only 1	intersection	with ground	level
-14.000	158.00	25.148		Only 1	intersection	with ground	level
-14.000	159.00	25.640		Only 1	intersection	with ground	level
-14.000	160.00	26.161		Only 1	intersection	with ground	level
-14.000	161.00	26.710		Only 1	intersection	with ground	level
-14.000	162.00	27.284		Only 1	intersection	with ground	level
-14.000	163.00	27.882		Only 1	intersection	with ground	level
-14.000	164.00	28.503		Only 1	intersection	with ground	level
-14.000	165.00	29.145		Only 1	intersection	with ground	level
-14.000	166.00	29.806		Only 1	intersection	with ground	level
-14.000	167.00	30.486		Only 1	intersection	with ground	level
-14.000	168.00	31.183		Only 1	intersection	with ground	level
-14.000	169.00	31.897		Only 1	intersection	with ground	level
-13.000	150.00	21.476		Only 1	intersection	with ground	level
-13.000	151.00	21.684		Only 1	intersection	with ground	level
-13.000	152.00	21.936		Only 1	intersection	with ground	level
-13.000	153.00	22.231		Only 1	intersection	with ground	level
-13.000	154.00	22.566		Only 1	intersection	with ground	level
-13.000	155.00	22.939		Only 1	intersection	with ground	level
-13.000	156.00	23.350		Only 1	intersection	with ground	level
-13.000	157.00	23.795		Only 1	intersection	with ground	level
-13.000	158.00	24.274		Only 1	intersection	with ground	level
-13.000	159.00	24.783		Only 1	intersection	with ground	level
-13.000	160.00	25.322		Only 1	intersection	with ground	level
-13.000	161.00	25.888		Only 1	intersection	with ground	level
-13.000	162.00	26.480		Only 1	intersection	with ground	level
-13.000	163.00	27.096		Only 1	intersection	with ground	level
-13.000	164.00	27.735		Only 1	intersection	with ground	level
-13.000	165.00	28.394		Only 1	intersection	with ground	level
-13.000	166.00	29.072		Only 1	intersection	with ground	level
-13.000	167.00	29.769		Only 1	intersection	with ground	level
-13.000	168.00	30.483		Only 1	intersection	with ground	level
-13.000	169.00	31.212		Only 1	intersection	with ground	level
-12.000	150.00	20.494		Only 1	intersection	with ground	level
-12.000	151.00	20.713		Only 1	intersection	with ground	level
-12.000	152.00	20.976		Only 1	intersection	with ground	level
-12.000	153.00	21.284		Only 1	intersection	with ground	level
-12.000	154.00	21.634		Only 1	intersection	with ground	level
-12.000	155.00	22.023		Only 1	intersection	with ground	level
-12.000	156.00	22.450		Only 1	intersection	with ground	level
-12.000	157.00	22.913		Only 1	intersection	with ground	level



Hollingsworth Gate, Littleborough
Section E

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]
-12.000	158.00	23.410		Only 1 intersection with ground level			
-12.000	159.00	23.938		Only 1 intersection with ground level			
-12.000	160.00	24.495		Only 1 intersection with ground level			
-12.000	161.00	25.080		Only 1 intersection with ground level			
-12.000	162.00	25.691		Only 1 intersection with ground level			
-12.000	163.00	26.325		Only 1 intersection with ground level			
-12.000	164.00	26.982		Only 1 intersection with ground level			
-12.000	165.00	27.659		Only 1 intersection with ground level			
-12.000	166.00	28.355		Only 1 intersection with ground level			
-12.000	167.00	29.069		Only 1 intersection with ground level			
-12.000	168.00	29.799		Only 1 intersection with ground level			
-12.000	169.00	30.545		Only 1 intersection with ground level			
-11.000	150.00	19.514		Only 1 intersection with ground level			
-11.000	151.00	19.744		Only 1 intersection with ground level			
-11.000	152.00	20.020		Only 1 intersection with ground level			
-11.000	153.00	20.342		Only 1 intersection with ground level			
-11.000	154.00	20.708		Only 1 intersection with ground level			
-11.000	155.00	21.114		Only 1 intersection with ground level			
-11.000	156.00	21.559		Only 1 intersection with ground level			
-11.000	157.00	22.041		Only 1 intersection with ground level			
-11.000	158.00	22.557		Only 1 intersection with ground level			
-11.000	159.00	23.104		Only 1 intersection with ground level			
-11.000	160.00	23.681		Only 1 intersection with ground level			
-11.000	161.00	24.286		Only 1 intersection with ground level			
-11.000	162.00	24.916		Only 1 intersection with ground level			
-11.000	163.00	25.570		Only 1 intersection with ground level			
-11.000	164.00	26.245		Only 1 intersection with ground level			
-11.000	165.00	26.941		Only 1 intersection with ground level			
-11.000	166.00	27.655		Only 1 intersection with ground level			
-11.000	167.00	28.387		Only 1 intersection with ground level			
-11.000	168.00	29.134		Only 1 intersection with ground level			
-11.000	169.00	29.897		Only 1 intersection with ground level			
-10.000	150.00	18.537		Only 1 intersection with ground level			
-10.000	151.00	18.778		Only 1 intersection with ground level			
-10.000	152.00	19.069		Only 1 intersection with ground level			
-10.000	153.00	19.406		Only 1 intersection with ground level			
-10.000	154.00	19.789		Only 1 intersection with ground level			
-10.000	155.00	20.214		Only 1 intersection with ground level			
-10.000	156.00	20.679		Only 1 intersection with ground level			
-10.000	157.00	21.180		Only 1 intersection with ground level			
-10.000	158.00	21.717		Only 1 intersection with ground level			
-10.000	159.00	22.285		Only 1 intersection with ground level			
-10.000	160.00	22.883		Only 1 intersection with ground level			
-10.000	161.00	23.508		Only 1 intersection with ground level			
-10.000	162.00	24.158		Only 1 intersection with ground level			
-10.000	163.00	24.832		Only 1 intersection with ground level			
-10.000	164.00	25.527		Only 1 intersection with ground level			
-10.000	165.00	26.241		Only 1 intersection with ground level			
-10.000	166.00	26.974		Only 1 intersection with ground level			
-10.000	167.00	27.724		Only 1 intersection with ground level			
-10.000	168.00	28.489		Only 1 intersection with ground level			
-10.000	169.00	29.268		Only 1 intersection with ground level			
-9.0000	150.00	17.562		Only 1 intersection with ground level			
-9.0000	151.00	17.816		Only 1 intersection with ground level			
-9.0000	152.00	18.122		Only 1 intersection with ground level			
-9.0000	153.00	18.477		Only 1 intersection with ground level			
-9.0000	154.00	18.879		Only 1 intersection with ground level			
-9.0000	155.00	19.324		Only 1 intersection with ground level			
-9.0000	156.00	19.809		Only 1 intersection with ground level			
-9.0000	157.00	20.332		Only 1 intersection with ground level			
-9.0000	158.00	20.890		Only 1 intersection with ground level			
-9.0000	159.00	21.480		Only 1 intersection with ground level			
-9.0000	160.00	22.100		Only 1 intersection with ground level			
-9.0000	161.00	22.747		Only 1 intersection with ground level			
-9.0000	162.00	23.418		Only 1 intersection with ground level			
-9.0000	163.00	24.112		Only 1 intersection with ground level			
-9.0000	164.00	24.828		Only 1 intersection with ground level			
-9.0000	165.00	25.562		Only 1 intersection with ground level			
-9.0000	166.00	26.314		Only 1 intersection with ground level			
-9.0000	167.00	27.082		Only 1 intersection with ground level			
-9.0000	168.00	27.864		Only 1 intersection with ground level			
-9.0000	169.00	28.660		Only 1 intersection with ground level			
-8.0000	150.00	16.589		Only 1 intersection with ground level			
-8.0000	151.00	16.859		Only 1 intersection with ground level			
-8.0000	152.00	17.182		Only 1 intersection with ground level			
-8.0000	153.00	17.556		Only 1 intersection with ground level			
-8.0000	154.00	17.978		Only 1 intersection with ground level			



Hollingsworth Gate, Littleborough
Section E

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]
-8.0000	155.00	18.445		Only 1 intersection with ground level			
-8.0000	156.00	18.953		Only 1 intersection with ground level			
-8.0000	157.00	19.499		Only 1 intersection with ground level			
-8.0000	158.00	20.080		Only 1 intersection with ground level			
-8.0000	159.00	20.693		Only 1 intersection with ground level			
-8.0000	160.00	21.336		Only 1 intersection with ground level			
-8.0000	161.00	22.005		Only 1 intersection with ground level			
-8.0000	162.00	22.698		Only 1 intersection with ground level			
-8.0000	163.00	23.414		Only 1 intersection with ground level			
-8.0000	164.00	24.150		Only 1 intersection with ground level			
-8.0000	165.00	24.904		Only 1 intersection with ground level			
-8.0000	166.00	25.675		Only 1 intersection with ground level			
-8.0000	167.00	26.461		Only 1 intersection with ground level			
-8.0000	168.00	27.262		Only 1 intersection with ground level			
-8.0000	169.00	28.075		Only 1 intersection with ground level			
-7.0000	150.00	15.621		Only 1 intersection with ground level			
-7.0000	151.00	15.906		Only 1 intersection with ground level			
-7.0000	152.00	16.248		Only 1 intersection with ground level			
-7.0000	153.00	16.644		Only 1 intersection with ground level			
-7.0000	154.00	17.088		Only 1 intersection with ground level			
-7.0000	155.00	17.579		Only 1 intersection with ground level			
-7.0000	156.00	18.111		Only 1 intersection with ground level			
-7.0000	157.00	18.682		Only 1 intersection with ground level			
-7.0000	158.00	19.288		Only 1 intersection with ground level			
-7.0000	159.00	19.925		Only 1 intersection with ground level			
-7.0000	160.00	20.592		Only 1 intersection with ground level			
-7.0000	161.00	21.284		Only 1 intersection with ground level			
-7.0000	162.00	22.000		Only 1 intersection with ground level			
-7.0000	163.00	22.738		Only 1 intersection with ground level			
-7.0000	164.00	23.495		Only 1 intersection with ground level			
-7.0000	165.00	24.270		Only 1 intersection with ground level			
-7.0000	166.00	25.060		Only 1 intersection with ground level			
-7.0000	167.00	25.865		Only 1 intersection with ground level			
-7.0000	168.00	26.684		Only 1 intersection with ground level			
-7.0000	169.00	27.514		Only 1 intersection with ground level			
-6.0000	150.00	14.656		Only 1 intersection with ground level			
-6.0000	151.00	14.960		Only 1 intersection with ground level			
-6.0000	152.00	15.324		Only 1 intersection with ground level			
-6.0000	153.00	15.742		Only 1 intersection with ground level			
-6.0000	154.00	16.211		Only 1 intersection with ground level			
-6.0000	155.00	16.728		Only 1 intersection with ground level			
-6.0000	156.00	17.286		Only 1 intersection with ground level			
-6.0000	157.00	17.883		Only 1 intersection with ground level			
-6.0000	158.00	18.515		Only 1 intersection with ground level			
-6.0000	159.00	19.178		Only 1 intersection with ground level			
-6.0000	160.00	19.870		Only 1 intersection with ground level			
-6.0000	161.00	20.587		Only 1 intersection with ground level			
-6.0000	162.00	21.326		Only 1 intersection with ground level			
-6.0000	163.00	22.086		Only 1 intersection with ground level			
-6.0000	164.00	22.865		Only 1 intersection with ground level			
-6.0000	165.00	23.660		Only 1 intersection with ground level			
-6.0000	166.00	24.471		Only 1 intersection with ground level			
-6.0000	167.00	25.294		Only 1 intersection with ground level			
-6.0000	168.00	26.131		Only 1 intersection with ground level			
-6.0000	169.00	26.978		Only 1 intersection with ground level			
-5.0000	150.00	13.697		Only 1 intersection with ground level			
-5.0000	151.00	14.022		Only 1 intersection with ground level			
-5.0000	152.00	14.409		Only 1 intersection with ground level			
-5.0000	153.00	14.853		Only 1 intersection with ground level			
-5.0000	154.00	15.350		Only 1 intersection with ground level			
-5.0000	155.00	15.894		Only 1 intersection with ground level			
-5.0000	156.00	16.481		Only 1 intersection with ground level			
-5.0000	157.00	17.106		Only 1 intersection with ground level			
-5.0000	158.00	17.765		Only 1 intersection with ground level			
-5.0000	159.00	18.456		Only 1 intersection with ground level			
-5.0000	160.00	19.173		Only 1 intersection with ground level			
-5.0000	161.00	19.915		Only 1 intersection with ground level			
-5.0000	162.00	20.679		Only 1 intersection with ground level			
-5.0000	163.00	21.462		Only 1 intersection with ground level			
-5.0000	164.00	22.262		Only 1 intersection with ground level			
-5.0000	165.00	23.078		Only 1 intersection with ground level			
-5.0000	166.00	23.908		Only 1 intersection with ground level			
-5.0000	167.00	24.751		Only 1 intersection with ground level			
-5.0000	168.00	25.605		Only 1 intersection with ground level			
-5.0000	169.00	26.469		Only 1 intersection with ground level			
-4.0000	150.00	12.744		Only 1 intersection with ground level			
-4.0000	151.00	13.092		Only 1 intersection with ground level			

Oasys Hollingsworth Gate, Littleborough Section E						Job No.	Sheet No.	Rev.
						GRO-23131		
						Drg. Ref.		
						Made by JD	Date	Checked Date
Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment	
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]	
-4.0000	152.00	13.506		Only 1 intersection with ground level				
-4.0000	153.00	13.979		Only 1 intersection with ground level				
-4.0000	154.00	14.506		Only 1 intersection with ground level				
-4.0000	155.00	15.080		Only 1 intersection with ground level				
-4.0000	156.00	15.697		Only 1 intersection with ground level				
-4.0000	157.00	16.353		Only 1 intersection with ground level				
-4.0000	158.00	17.041		Only 1 intersection with ground level				
-4.0000	159.00	17.760		Only 1 intersection with ground level				
-4.0000	160.00	18.504		Only 1 intersection with ground level				
-4.0000	161.00	19.272		Only 1 intersection with ground level				
-4.0000	162.00	20.060		Only 1 intersection with ground level				
-4.0000	163.00	20.866		Only 1 intersection with ground level				
-4.0000	164.00	21.689		Only 1 intersection with ground level				
-4.0000	165.00	22.526		Only 1 intersection with ground level				
-4.0000	166.00	23.375		Only 1 intersection with ground level				
-4.0000	167.00	24.237		Only 1 intersection with ground level				
-4.0000	168.00	25.108		Only 1 intersection with ground level				
-4.0000	168.00	25.108		Only 1 intersection with ground level				
-4.0000	169.00	25.989		Only 1 intersection with ground level				
-3.0000	150.00	11.799		Only 1 intersection with ground level				
-3.0000	151.00	12.174		Only 1 intersection with ground level				
-3.0000	152.00	12.618		Only 1 intersection with ground level				
-3.0000	153.00	13.123		Only 1 intersection with ground level				
-3.0000	154.00	13.682		Only 1 intersection with ground level				
-3.0000	155.00	14.290		Only 1 intersection with ground level				
-3.0000	156.00	14.940		Only 1 intersection with ground level				
-3.0000	157.00	15.627		Only 1 intersection with ground level				
-3.0000	158.00	16.347		Only 1 intersection with ground level				
-3.0000	159.00	17.094		Only 1 intersection with ground level				
-3.0000	160.00	17.866		Only 1 intersection with ground level				
-3.0000	161.00	18.660		Only 1 intersection with ground level				
-3.0000	162.00	19.473		Only 1 intersection with ground level				
-3.0000	163.00	20.303		Only 1 intersection with ground level				
-3.0000	163.00	20.303		Only 1 intersection with ground level				
-3.0000	164.00	21.147		Only 1 intersection with ground level				
-3.0000	164.00	21.147		Only 1 intersection with ground level				
-3.0000	165.00	22.005		Only 1 intersection with ground level				
-3.0000	166.00	22.874		Only 1 intersection with ground level				
-3.0000	167.00	23.753		Only 1 intersection with ground level				
-3.0000	168.00	24.642		Only 1 intersection with ground level				
-3.0000	169.00	25.538		Only 1 intersection with ground level				
-2.0000	150.00	10.863		Only 1 intersection with ground level				
-2.0000	151.00	11.270		Only 1 intersection with ground level				
-2.0000	152.00	11.748		Only 1 intersection with ground level				
-2.0000	153.00	12.289		Only 1 intersection with ground level				
-2.0000	154.00	12.884		Only 1 intersection with ground level				
-2.0000	155.00	13.528		Only 1 intersection with ground level				
-2.0000	156.00	14.213		Only 1 intersection with ground level				
-2.0000	157.00	14.934		Only 1 intersection with ground level				
-2.0000	158.00	15.685		Only 1 intersection with ground level				
-2.0000	158.00	15.685		Only 1 intersection with ground level				
-2.0000	159.00	16.462		Only 1 intersection with ground level				
-2.0000	159.00	16.462		Only 1 intersection with ground level				
-2.0000	160.00	17.263		Only 1 intersection with ground level				
-2.0000	160.00	17.263		Only 1 intersection with ground level				
-2.0000	161.00	18.083		Only 1 intersection with ground level				
-2.0000	161.00	18.083		Only 1 intersection with ground level				
-2.0000	162.00	18.921		Only 1 intersection with ground level				
-2.0000	163.00	19.774		Only 1 intersection with ground level				
-2.0000	164.00	20.640	1240.7	1.2577	9915.5	12455.	16.250	
-2.0000	165.00	21.518	1235.2	1.2408	10325.	12811.	0.0	
-2.0000	166.00	22.406	1232.2	1.2297	10735.	13200.	0.0	
-2.0000	167.00	23.303	1232.0	1.2222	11148.	13625.	0.0	
-2.0000	168.00	24.208	1233.5	1.2176	11561.	14076.	0.0	
-2.0000	169.00	25.120	1236.8	1.2156	11976.	14558.	0.0	
-1.0000	150.00	9.9403		Only 1 intersection with ground level				
-1.0000	151.00	10.383		Only 1 intersection with ground level				
-1.0000	152.00	10.900		Only 1 intersection with ground level				
-1.0000	153.00	11.481		Only 1 intersection with ground level				
-1.0000	154.00	12.117		Only 1 intersection with ground level				
-1.0000	154.00	12.117		Only 1 intersection with ground level				
-1.0000	155.00	12.799		Only 1 intersection with ground level				
-1.0000	155.00	12.799		Only 1 intersection with ground level				
-1.0000	156.00	13.521		Only 1 intersection with ground level				
-1.0000	156.00	13.521		Only 1 intersection with ground level				
-1.0000	157.00	14.276		Only 1 intersection with ground level				
-1.0000	157.00	14.276		Only 1 intersection with ground level				

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]
-1.0000	158.00	15.060	Only 1	intersection with ground level		
-1.0000	158.00	15.060	Only 1	intersection with ground level		
-1.0000	159.00	15.869	1198.8	1.3125	7356.2	9612.1
-1.0000	160.00	16.698	1183.6	1.2900	7647.6	9830.4
-1.0000	161.00	17.545	1174.8	1.2700	7977.2	10106.
-1.0000	162.00	18.407	1170.7	1.2476	8394.9	10457.
-1.0000	163.00	19.282	1169.5	1.2317	8813.0	10843.
-1.0000	164.00	20.170	1171.1	1.2198	9232.5	11262.
-1.0000	165.00	21.067	1175.0	1.2133	9653.9	11713.
-1.0000	166.00	21.973	1180.6	1.2101	10075.	12193.
-1.0000	167.00	22.887	1188.0	1.2098	10499.	12702.
-1.0000	168.00	23.808	1196.8	1.2118	10926.	13239.
-1.0000	169.00	24.735	1206.7	1.2158	11352.	13802.
0.0	150.00	9.0338	Only 1	intersection with ground level		
0.0	150.00	9.0338	Only 1	intersection with ground level		
0.0	151.00	9.5189	Only 1	intersection with ground level		
0.0	151.00	9.5189	Only 1	intersection with ground level		
0.0	152.00	10.080	Only 1	intersection with ground level		
0.0	152.00	10.080	Only 1	intersection with ground level		
0.0	153.00	10.706	Only 1	intersection with ground level		
0.0	153.00	10.706	Only 1	intersection with ground level		
0.0	154.00	11.385	Only 1	intersection with ground level		
0.0	154.00	11.385	Only 1	intersection with ground level		
0.0	155.00	12.108	Only 1	intersection with ground level		
0.0	155.00	12.108	Only 1	intersection with ground level		
0.0	156.00	12.869	1137.4	1.3353	5717.5	7598.8
0.0	157.00	13.661	1119.7	1.3023	6003.3	7785.6
0.0	158.00	14.478	1107.8	1.2816	6288.4	8021.3
0.0	159.00	15.317	1101.5	1.2657	6585.8	8304.3
0.0	160.00	16.174	1101.1	1.2521	6918.6	8640.4
0.0	161.00	17.047	1104.8	1.2337	7345.9	9050.0
0.0	162.00	17.933	1111.3	1.2220	7774.3	9494.2
0.0	163.00	18.831	1119.6	1.2153	8201.4	9967.6
0.0	164.00	19.739	1129.9	1.2131	8631.7	10471.
0.0	165.00	20.655	1141.5	1.2141	9063.0	11003.
0.0	166.00	21.578	1154.4	1.2176	9495.6	11562.
0.0	167.00	22.508	1168.2	1.2232	9928.7	12145.
0.0	168.00	23.444	1182.9	1.2322	10343.	12745.
0.0	169.00	24.385	1198.5	1.2469	10699.	13340.
1.0000	150.00	8.1492	Only 1	intersection with ground level		
1.0000	150.00	8.1492	Only 1	intersection with ground level		
1.0000	151.00	8.6839	Only 1	intersection with ground level		
1.0000	151.00	8.6839	Only 1	intersection with ground level		
1.0000	152.00	9.2957	Only 1	intersection with ground level		
1.0000	152.00	9.2957	Only 1	intersection with ground level		
1.0000	153.00	9.9705	1075.1	1.4172	4112.6	5807.1
1.0000	154.00	10.696	1051.9	1.3581	4397.2	5942.7
1.0000	155.00	11.463	1038.6	1.3156	4693.2	6145.3
1.0000	156.00	12.264	1031.7	1.2884	4987.4	6398.6
1.0000	157.00	13.092	1029.7	1.2739	5281.3	6695.6
1.0000	158.00	13.943	1032.4	1.2649	5584.1	7035.9
1.0000	159.00	14.812	1040.5	1.2578	5918.8	7424.3
1.0000	160.00	15.697	1052.3	1.2429	6353.7	7886.1
1.0000	161.00	16.595	1065.9	1.2342	6789.1	8379.2
1.0000	162.00	17.505	1081.2	1.2318	7226.1	8901.4
1.0000	163.00	18.423	1097.4	1.2332	7662.5	9449.1
1.0000	164.00	19.350	1114.7	1.2373	8101.2	10024.
1.0000	165.00	20.283	1132.7	1.2439	8540.5	10624.
1.0000	166.00	21.223	1151.2	1.2525	8980.4	11248.
1.0000	167.00	22.168	1170.1	1.2676	9364.1	11870.
1.0000	168.00	23.117	1189.8	1.2846	9733.0	12503.
1.0000	169.00	24.071	1210.8	1.3006	10121.	13164.
2.0000	150.00	7.2945	Only 1	intersection with ground level		
2.0000	150.00	7.2945	Only 1	intersection with ground level		
2.0000	151.00	7.8873	Centre embedded/below end of slip			
2.0000	152.00	8.5563	Centre embedded/below end of slip			
2.0000	153.00	9.2849	953.64	1.3746	3422.5	4683.2
2.0000	154.00	10.060	952.52	1.3344	3724.3	4946.9
2.0000	155.00	10.872	956.61	1.3114	4025.1	5256.2
2.0000	156.00	11.714	964.85	1.3023	4325.7	5606.2
2.0000	157.00	12.578	976.59	1.2990	4632.7	5994.4
2.0000	158.00	13.461	993.06	1.2966	4969.8	6426.5
2.0000	159.00	14.360	1012.6	1.2833	5409.8	6932.6
2.0000	160.00	15.271	1032.9	1.2755	5852.4	7465.0

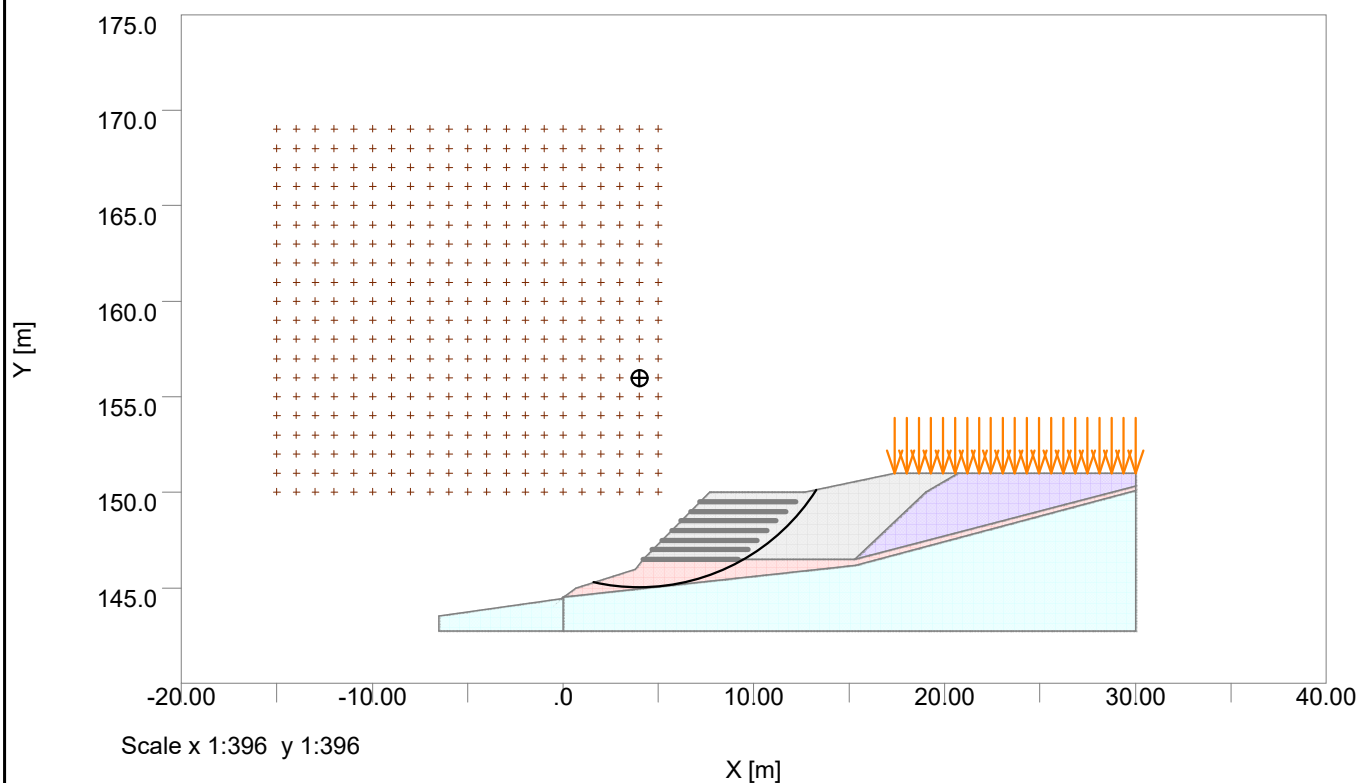
Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]		[kNm/m]	[kNm/m]	[kNm/m]
2.0000	161.00	16.193	1053.8	1.2741	6296.6	8022.5
2.0000	162.00	17.123	1075.1	1.2763	6740.2	8602.5
2.0000	163.00	18.061	1096.8	1.2810	7186.6	9206.0
2.0000	164.00	19.006	1118.6	1.2880	7633.1	9831.3
2.0000	165.00	19.955	1140.7	1.2978	8069.9	10473.
2.0000	166.00	20.910	1162.6	1.3157	8436.7	11101.
2.0000	167.00	21.868	1185.9	1.3326	8821.8	11756.
2.0000	168.00	22.830	1210.2	1.3482	9226.2	12439.
2.0000	169.00	23.795	1235.6	1.3623	9652.1	13150.
3.0000	150.00	6.4815	Centre embedded/below end of slip			
3.0000	151.00	7.1421	Centre embedded/below end of slip			
3.0000	152.00	7.8746	Centre embedded/below end of slip			
3.0000	153.00	8.6608	877.00	1.4199	2803.9	3965.0
3.0000	154.00	9.4874	891.87	1.3904	3114.5	4313.6
3.0000	155.00	10.345	909.26	1.3776	3425.3	4696.7
3.0000	156.00	11.225	928.76	1.3717	3741.1	5112.2
3.0000	157.00	12.125	951.74	1.3666	4084.1	5566.4
3.0000	158.00	13.039	977.39	1.3467	4528.5	6089.9
3.0000	159.00	13.965	1003.4	1.3340	4979.6	6642.6
3.0000	160.00	14.900	1029.4	1.3293	5430.4	7218.8
3.0000	161.00	15.843	1055.5	1.3294	5882.1	7819.8
3.0000	162.00	16.793	1081.2	1.3330	6332.9	8441.5
3.0000	163.00	17.749	1107.0	1.3392	6784.5	9085.9
3.0000	164.00	18.709	1132.5	1.3534	7188.8	9729.6
3.0000	165.00	19.673	1158.5	1.3716	7568.6	10381.
3.0000	166.00	20.640	1185.6	1.3881	7968.3	11061.
3.0000	167.00	21.610	1213.7	1.4027	8389.3	11767.
3.0000	168.00	22.583	1242.5	1.4160	8829.4	12502.
3.0000	169.00	23.559	1272.3	1.4277	9291.7	13265.
4.0000	150.00	5.7280	Centre embedded/below end of slip			
4.0000	151.00	6.4661	Centre embedded/below end of slip			
4.0000	152.00	7.2670	Centre embedded/below end of slip			
4.0000	153.00	8.1123	823.02	1.5023	2298.8	3439.8
4.0000	154.00	8.9894	850.85	1.4763	2616.1	3845.4
4.0000	155.00	9.8899	879.36	1.4634	2936.2	4281.3
4.0000	156.00	10.808	910.27	1.4529	3280.7	4754.3
4.0000	157.00	11.739	943.31	1.4239	3724.6	5296.1
4.0000	158.00	12.681	975.75	1.4043	4178.7	5868.0
4.0000	159.00	13.631	1007.7	1.3954	4633.1	6464.8
4.0000	160.00	14.588	1039.0	1.3928	5086.8	7084.8
4.0000	161.00	15.550	1069.7	1.3946	5541.3	7727.9
4.0000	162.00	16.517	1099.7	1.4002	5992.9	8391.4
4.0000	163.00	17.487	1129.5	1.4201	6366.8	9041.1
4.0000	164.00	18.461	1160.0	1.4376	6759.5	9717.7
4.0000	165.00	19.437	1191.2	1.4532	7171.8	10422.
4.0000	166.00	20.416	1223.3	1.4666	7606.0	11155.
4.0000	167.00	21.396	1256.0	1.4781	8062.0	11917.
4.0000	168.00	22.379	1289.7	1.4880	8542.1	12711.
4.0000	169.00	23.363	1323.9	1.4964	9042.9	13532.

APPENDIX 6 - Section F Modelling Outputs

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

Circle plotted: centre at 4.00,156.00, Over-Design Factor 1.200



Oasys Hollingsworth Gate, Littleborough Section F	Job No.		Sheet No.		Rev.	
	GRO-23131					
	Drg. Ref.					
	Made by JD		Date		Checked Date	

Specification

Slip Type: CIRCULAR
Direction of slip: Downhill
Minimum slip weight [kN/m] :80.00000
Type of analysis: STATIC
Partial factor analysis
Minimum number of slices 25
Method: Bishop(Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: ACTIVE

Method Partial Factors

BS EN 1997-1:2011 DA1-2
Factor on FAVOURABLE PERMANENT LOAD: 1.00000
Factor on UNFAVOURABLE PERMANENT LOAD: 1.00000
Factor on FAVOURABLE VARIABLE LOAD: 0.00000
Factor on UNFAVOURABLE VARIABLE LOAD: 1.30000
Factor on UNIT WEIGHT: 1.00000
Factor on DRAINED COHESION: 1.25000
Factor on UNDRAINED COHESION: 1.40000
Factor on TAN PHI': 1.25000
Factor on REINFORCEMENT PULLOUT: 1.50000
Factor on ECONOMIC FAILURE: 1.00000
Factor on SLIDING ALONG REINFORCEMENT: 1.50000

Material Partial Factors

Description	Friction Interaction	Adhesion Interaction	Creep Reduction	Manufacture	Extrapolation of Test Data	Damage	Environment
	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Material Properties

No	Description	Unit Weight Above GWL	Unit Weight Below GWL	Shear Strength Condition	Parameters Phi or c
		[kN/m3]	[kN/m3]		Phi0 [°]
0.0	1 Canal Wall	25.000	25.000	Drained	40.000
0.0	2 Reinforced Earth	17.500	2.0000	Drained	29.000
0.0	3 Backfill Made Ground	17.500	20.000	Drained	29.000
0.0	4 Stiff CLAY	20.000	22.000	Drained	29.000
0.0	5 SILTSTONE	21.000	23.000	Drained	40.000

Surface loads

No.	Limits of loaded area		Distributed load	Permanent / Variable load	Favourable / Unfavourable load	Use in pull-out calc
	X1	X2	Vert	Horiz		
	[m]	[m]	[kN/m²]	[kN/m²]		
1	17.400	30.000	100.00	0.0	Permanent	Unfavourable No

Reinforcement

Geotextile Reinforcement 1

Layers	Level of top layer	Vertical Spacing	Length	Offset from surface	Angle from horiz
	[m]	[m]	Top [m]	Btm [m]	[°]
7	149.50	0.50000	5.0000	5.0000	0.0 0

Bond Length	Bond Strength	Prestress	Grout Diameter
	[kN/m]	[kN]	[mm]
0.0%	0.0	0.0	0.0

Out of	Tensile	Plate	Material
--------	---------	-------	----------

Program Oasys Slope Version 21.0.0.46

Copyright (C) 1997-2023

Printed 10-Oct-2023

Page 1
Time 02:22

plane	Capacity	Capacity	Partial
spacing			Factor
[m]	[kN]	[kN]	
0.0	1.3000	0.0	

Circle centre specification:

Circle centre specification:
 Bottom left of grid: x = -15.00000 m y = 150.00000 m
 Inclination of grid: 0.00000 deg
 (positive anticlockwise direction about bottom left of grid)
 Centres on grid: 20 in x direction at 1.00000m spacing
 20 in y direction at 1.00000m spacing
 Grid extended to find minimum FoS
 All circles pass through common point at x = 9.50000 m, y = 146.50000 m

Non Circular Slips

No	Name	Coordinates
1	Slip 1	
2	Slip 2	(18.3, 151) (15.9, 149) (13.6, 148) (10.4, 146) (7.09, 146) (3.9, 146) (2.16, 145)

RESULTS OF ANALYSIS

In the following tables, values in italics are factored values using the currently selected Method Partial Factors.

Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Restoring Moment	Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]		[kNm/m]		[kNm/m]	[kNm/m]
-15.000	150.00	24.749	Only 1	intersection	with ground	level	
-15.000	151.00	24.910	Only 1	intersection	with ground	level	
-15.000	152.00	25.110	Only 1	intersection	with ground	level	
-15.000	153.00	25.348	Only 1	intersection	with ground	level	
-15.000	154.00	25.622	Only 1	intersection	with ground	level	
-15.000	155.00	25.933	Only 1	intersection	with ground	level	
-15.000	156.00	26.277	Only 1	intersection	with ground	level	
-15.000	157.00	26.655	Only 1	intersection	with ground	level	
-15.000	158.00	27.065	Only 1	intersection	with ground	level	
-15.000	159.00	27.505	Only 1	intersection	with ground	level	
-15.000	160.00	27.973	Only 1	intersection	with ground	level	
-15.000	161.00	28.469	Only 1	intersection	with ground	level	
-15.000	162.00	28.991	Only 1	intersection	with ground	level	
-15.000	163.00	29.538	Only 1	intersection	with ground	level	
-15.000	164.00	30.108	Only 1	intersection	with ground	level	
-15.000	165.00	30.700	Only 1	intersection	with ground	level	
-15.000	166.00	31.313	Only 1	intersection	with ground	level	
-15.000	167.00	31.945	Only 1	intersection	with ground	level	
-15.000	168.00	32.596	Only 1	intersection	with ground	level	
-15.000	169.00	33.264	Only 1	intersection	with ground	level	
-14.000	150.00	23.759	Only 1	intersection	with ground	level	
-14.000	151.00	23.927	Only 1	intersection	with ground	level	
-14.000	152.00	24.135	Only 1	intersection	with ground	level	
-14.000	153.00	24.382	Only 1	intersection	with ground	level	
-14.000	154.00	24.668	Only 1	intersection	with ground	level	
-14.000	155.00	24.990	Only 1	intersection	with ground	level	
-14.000	156.00	25.348	Only 1	intersection	with ground	level	
-14.000	157.00	25.739	Only 1	intersection	with ground	level	
-14.000	158.00	26.163	Only 1	intersection	with ground	level	
-14.000	159.00	26.618	Only 1	intersection	with ground	level	
-14.000	160.00	27.102	Only 1	intersection	with ground	level	
-14.000	161.00	27.613	Only 1	intersection	with ground	level	
-14.000	162.00	28.151	Only 1	intersection	with ground	level	
-14.000	163.00	28.714	Only 1	intersection	with ground	level	
-14.000	164.00	29.300	Only 1	intersection	with ground	level	
-14.000	165.00	29.908	Only 1	intersection	with ground	level	
-14.000	166.00	30.537	Only 1	intersection	with ground	level	
-14.000	167.00	31.185	Only 1	intersection	with ground	level	
-14.000	168.00	31.851	Only 1	intersection	with ground	level	
-14.000	169.00	32.535	Only 1	intersection	with ground	level	
-13.000	150.00	22.771	Only 1	intersection	with ground	level	
-13.000	151.00	22.946	Only 1	intersection	with ground	level	
-13.000	152.00	23.162	Only 1	intersection	with ground	level	
-13.000	153.00	23.420	Only 1	intersection	with ground	level	
-13.000	154.00	23.717	Only 1	intersection	with ground	level	

 Hollingsworth Gate, Littleborough Section F					Job No.		Sheet No.	Rev.
					GRO-23131			
					Drg. Ref.			
					Made by JD	Date	Checked	Date
Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment	
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]	
-13.000	155.00	24.052		Only 1 intersection with ground level				
-13.000	156.00	24.423		Only 1 intersection with ground level				
-13.000	157.00	24.829		Only 1 intersection with ground level				
-13.000	158.00	25.269		Only 1 intersection with ground level				
-13.000	159.00	25.739		Only 1 intersection with ground level				
-13.000	160.00	26.239		Only 1 intersection with ground level				
-13.000	161.00	26.768		Only 1 intersection with ground level				
-13.000	162.00	27.322		Only 1 intersection with ground level				
-13.000	163.00	27.902		Only 1 intersection with ground level				
-13.000	164.00	28.504		Only 1 intersection with ground level				
-13.000	165.00	29.129		Only 1 intersection with ground level				
-13.000	166.00	29.774		Only 1 intersection with ground level				
-13.000	167.00	30.438		Only 1 intersection with ground level				
-13.000	168.00	31.121		Only 1 intersection with ground level				
-13.000	169.00	31.820		Only 1 intersection with ground level				
-12.000	150.00	21.783		Only 1 intersection with ground level				
-12.000	151.00	21.966		Only 1 intersection with ground level				
-12.000	152.00	22.192		Only 1 intersection with ground level				
-12.000	153.00	22.461		Only 1 intersection with ground level				
-12.000	154.00	22.771		Only 1 intersection with ground level				
-12.000	155.00	23.119		Only 1 intersection with ground level				
-12.000	156.00	23.505		Only 1 intersection with ground level				
-12.000	157.00	23.927		Only 1 intersection with ground level				
-12.000	158.00	24.382		Only 1 intersection with ground level				
-12.000	159.00	24.870		Only 1 intersection with ground level				
-12.000	160.00	25.387		Only 1 intersection with ground level				
-12.000	161.00	25.933		Only 1 intersection with ground level				
-12.000	162.00	26.505		Only 1 intersection with ground level				
-12.000	163.00	27.102		Only 1 intersection with ground level				
-12.000	164.00	27.722		Only 1 intersection with ground level				
-12.000	165.00	28.364		Only 1 intersection with ground level				
-12.000	166.00	29.026		Only 1 intersection with ground level				
-12.000	167.00	29.707		Only 1 intersection with ground level				
-12.000	168.00	30.406		Only 1 intersection with ground level				
-12.000	169.00	31.121		Only 1 intersection with ground level				
-11.000	150.00	20.797		Only 1 intersection with ground level				
-11.000	151.00	20.988		Only 1 intersection with ground level				
-11.000	152.00	21.225		Only 1 intersection with ground level				
-11.000	153.00	21.506		Only 1 intersection with ground level				
-11.000	154.00	21.829		Only 1 intersection with ground level				
-11.000	155.00	22.192		Only 1 intersection with ground level				
-11.000	156.00	22.594		Only 1 intersection with ground level				
-11.000	157.00	23.033		Only 1 intersection with ground level				
-11.000	158.00	23.505		Only 1 intersection with ground level				
-11.000	159.00	24.010		Only 1 intersection with ground level				
-11.000	160.00	24.546		Only 1 intersection with ground level				
-11.000	161.00	25.110		Only 1 intersection with ground level				
-11.000	162.00	25.700		Only 1 intersection with ground level				
-11.000	163.00	26.315		Only 1 intersection with ground level				
-11.000	164.00	26.954		Only 1 intersection with ground level				
-11.000	165.00	27.613		Only 1 intersection with ground level				
-11.000	166.00	28.293		Only 1 intersection with ground level				
-11.000	167.00	28.991		Only 1 intersection with ground level				
-11.000	168.00	29.707		Only 1 intersection with ground level				
-11.000	169.00	30.438		Only 1 intersection with ground level				
-10.000	150.00	19.812		Only 1 intersection with ground level				
-10.000	151.00	20.012		Only 1 intersection with ground level				
-10.000	152.00	20.261		Only 1 intersection with ground level				
-10.000	153.00	20.555		Only 1 intersection with ground level				
-10.000	154.00	20.893		Only 1 intersection with ground level				
-10.000	155.00	21.272		Only 1 intersection with ground level				
-10.000	156.00	21.691		Only 1 intersection with ground level				
-10.000	157.00	22.147		Only 1 intersection with ground level				
-10.000	158.00	22.638		Only 1 intersection with ground level				
-10.000	159.00	23.162		Only 1 intersection with ground level				
-10.000	160.00	23.717		Only 1 intersection with ground level				
-10.000	161.00	24.300		Only 1 intersection with ground level				
-10.000	162.00	24.910		Only 1 intersection with ground level				
-10.000	163.00	25.544		Only 1 intersection with ground level				
-10.000	164.00	26.201		Only 1 intersection with ground level				
-10.000	165.00	26.879		Only 1 intersection with ground level				
-10.000	166.00	27.577		Only 1 intersection with ground level				
-10.000	167.00	28.293		Only 1 intersection with ground level				
-10.000	168.00	29.026		Only 1 intersection with ground level				
-10.000	169.00	29.774		Only 1 intersection with ground level				
-9.0000	150.00	18.828		Only 1 intersection with ground level				
-9.0000	151.00	19.039		Only 1 intersection with ground level				

Oasys Hollingsworth Gate, Littleborough Section F							Job No.		Sheet No.		Rev.
							GRO-23131				
							Drg. Ref.				
							Made by JD		Date		Checked
Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment				
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]				
-9.0000	152.00	19.300		Only 1 intersection with ground level							
-9.0000	153.00	19.609		Only 1 intersection with ground level							
-9.0000	154.00	19.962		Only 1 intersection with ground level							
-9.0000	155.00	20.359		Only 1 intersection with ground level							
-9.0000	156.00	20.797		Only 1 intersection with ground level							
-9.0000	157.00	21.272		Only 1 intersection with ground level							
-9.0000	158.00	21.783		Only 1 intersection with ground level							
-9.0000	159.00	22.327		Only 1 intersection with ground level							
-9.0000	160.00	22.902		Only 1 intersection with ground level							
-9.0000	161.00	23.505		Only 1 intersection with ground level							
-9.0000	162.00	24.135		Only 1 intersection with ground level							
-9.0000	163.00	24.789		Only 1 intersection with ground level							
-9.0000	164.00	25.466		Only 1 intersection with ground level							
-9.0000	165.00	26.163		Only 1 intersection with ground level							
-9.0000	166.00	26.879		Only 1 intersection with ground level							
-9.0000	167.00	27.613		Only 1 intersection with ground level							
-9.0000	168.00	28.364		Only 1 intersection with ground level							
-9.0000	169.00	29.129		Only 1 intersection with ground level							
-8.0000	150.00	17.847		Only 1 intersection with ground level							
-8.0000	151.00	18.069		Only 1 intersection with ground level							
-8.0000	152.00	18.344		Only 1 intersection with ground level							
-8.0000	153.00	18.668		Only 1 intersection with ground level							
-8.0000	154.00	19.039		Only 1 intersection with ground level							
-8.0000	155.00	19.455		Only 1 intersection with ground level							
-8.0000	156.00	19.912		Only 1 intersection with ground level							
-8.0000	157.00	20.408		Only 1 intersection with ground level							
-8.0000	158.00	20.940		Only 1 intersection with ground level							
-8.0000	159.00	21.506		Only 1 intersection with ground level							
-8.0000	160.00	22.102		Only 1 intersection with ground level							
-8.0000	161.00	22.727		Only 1 intersection with ground level							
-8.0000	162.00	23.377		Only 1 intersection with ground level							
-8.0000	163.00	24.052		Only 1 intersection with ground level							
-8.0000	164.00	24.749		Only 1 intersection with ground level							
-8.0000	165.00	25.466		Only 1 intersection with ground level							
-8.0000	166.00	26.201		Only 1 intersection with ground level							
-8.0000	167.00	26.954		Only 1 intersection with ground level							
-8.0000	168.00	27.722		Only 1 intersection with ground level							
-8.0000	169.00	28.504		Only 1 intersection with ground level							
-7.0000	150.00	16.867		Only 1 intersection with ground level							
-7.0000	151.00	17.103		Only 1 intersection with ground level							
-7.0000	152.00	17.393		Only 1 intersection with ground level							
-7.0000	153.00	17.734		Only 1 intersection with ground level							
-7.0000	154.00	18.125		Only 1 intersection with ground level							
-7.0000	155.00	18.561		Only 1 intersection with ground level							
-7.0000	156.00	19.039		Only 1 intersection with ground level							
-7.0000	157.00	19.558		Only 1 intersection with ground level							
-7.0000	158.00	20.112		Only 1 intersection with ground level							
-7.0000	159.00	20.700		Only 1 intersection with ground level							
-7.0000	160.00	21.319		Only 1 intersection with ground level							
-7.0000	161.00	21.966		Only 1 intersection with ground level							
-7.0000	162.00	22.638		Only 1 intersection with ground level							
-7.0000	163.00	23.335		Only 1 intersection with ground level							
-7.0000	164.00	24.052		Only 1 intersection with ground level							
-7.0000	165.00	24.789		Only 1 intersection with ground level							
-7.0000	166.00	25.544		Only 1 intersection with ground level							
-7.0000	167.00	26.315		Only 1 intersection with ground level							
-7.0000	168.00	27.102		Only 1 intersection with ground level							
-7.0000	169.00	27.902		Only 1 intersection with ground level							
-6.0000	150.00	15.890		Only 1 intersection with ground level							
-6.0000	151.00	16.140		Only 1 intersection with ground level							
-6.0000	152.00	16.447		Only 1 intersection with ground level							
-6.0000	153.00	16.808		Only 1 intersection with ground level							
-6.0000	154.00	17.219		Only 1 intersection with ground level							
-6.0000	155.00	17.678		Only 1 intersection with ground level							
-6.0000	156.00	18.180		Only 1 intersection with ground level							
-6.0000	157.00	18.722		Only 1 intersection with ground level							
-6.0000	158.00	19.300		Only 1 intersection with ground level							
-6.0000	159.00	19.912		Only 1 intersection with ground level							
-6.0000	160.00	20.555		Only 1 intersection with ground level							
-6.0000	161.00	21.225		Only 1 intersection with ground level							
-6.0000	162.00	21.920		Only 1 intersection with ground level							
-6.0000	163.00	22.638		Only 1 intersection with ground level							
-6.0000	164.00	23.377		Only 1 intersection with ground level							
-6.0000	165.00	24.135		Only 1 intersection with ground level							
-6.0000	166.00	24.910		Only 1 intersection with ground level							
-6.0000	167.00	25.700		Only 1 intersection with ground level							
-6.0000	168.00	26.505		Only 1 intersection with ground level							



Hollingsworth Gate, Littleborough
Section F

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]
-6.0000	169.00	27.322		Only 1 intersection with ground level			
-5.0000	150.00	14.916		Only 1 intersection with ground level			
-5.0000	151.00	15.182		Only 1 intersection with ground level			
-5.0000	152.00	15.508		Only 1 intersection with ground level			
-5.0000	153.00	15.890		Only 1 intersection with ground level			
-5.0000	154.00	16.325		Only 1 intersection with ground level			
-5.0000	155.00	16.808		Only 1 intersection with ground level			
-5.0000	156.00	17.335		Only 1 intersection with ground level			
-5.0000	157.00	17.903		Only 1 intersection with ground level			
-5.0000	158.00	18.507		Only 1 intersection with ground level			
-5.0000	159.00	19.144		Only 1 intersection with ground level			
-5.0000	160.00	19.812		Only 1 intersection with ground level			
-5.0000	161.00	20.506		Only 1 intersection with ground level			
-5.0000	162.00	21.225		Only 1 intersection with ground level			
-5.0000	163.00	21.966		Only 1 intersection with ground level			
-5.0000	164.00	22.727		Only 1 intersection with ground level			
-5.0000	165.00	23.505		Only 1 intersection with ground level			
-5.0000	166.00	24.300		Only 1 intersection with ground level			
-5.0000	167.00	25.110		Only 1 intersection with ground level			
-5.0000	168.00	25.933		Only 1 intersection with ground level			
-5.0000	169.00	26.768		Only 1 intersection with ground level			
-4.0000	150.00	13.946		Only 1 intersection with ground level			
-4.0000	151.00	14.230		Only 1 intersection with ground level			
-4.0000	152.00	14.577		Only 1 intersection with ground level			
-4.0000	153.00	14.983		Only 1 intersection with ground level			
-4.0000	154.00	15.443		Only 1 intersection with ground level			
-4.0000	155.00	15.953		Only 1 intersection with ground level			
-4.0000	156.00	16.508		Only 1 intersection with ground level			
-4.0000	157.00	17.103		Only 1 intersection with ground level			
-4.0000	158.00	17.734		Only 1 intersection with ground level			
-4.0000	159.00	18.398		Only 1 intersection with ground level			
-4.0000	160.00	19.092		Only 1 intersection with ground level			
-4.0000	161.00	19.812		Only 1 intersection with ground level			
-4.0000	162.00	20.555		Only 1 intersection with ground level			
-4.0000	163.00	21.319		Only 1 intersection with ground level			
-4.0000	164.00	22.102		Only 1 intersection with ground level			
-4.0000	165.00	22.902		Only 1 intersection with ground level			
-4.0000	166.00	23.717		Only 1 intersection with ground level			
-4.0000	167.00	24.546		Only 1 intersection with ground level			
-4.0000	168.00	25.387		Only 1 intersection with ground level			
-4.0000	168.00	25.387		Only 1 intersection with ground level			
-4.0000	169.00	26.239		Only 1 intersection with ground level			
-3.0000	150.00	12.981		Only 1 intersection with ground level			
-3.0000	151.00	13.285		Only 1 intersection with ground level			
-3.0000	152.00	13.656		Only 1 intersection with ground level			
-3.0000	153.00	14.089		Only 1 intersection with ground level			
-3.0000	154.00	14.577		Only 1 intersection with ground level			
-3.0000	155.00	15.116		Only 1 intersection with ground level			
-3.0000	156.00	15.700		Only 1 intersection with ground level			
-3.0000	157.00	16.325		Only 1 intersection with ground level			
-3.0000	158.00	16.985		Only 1 intersection with ground level			
-3.0000	159.00	17.678		Only 1 intersection with ground level			
-3.0000	160.00	18.398		Only 1 intersection with ground level			
-3.0000	161.00	19.144		Only 1 intersection with ground level			
-3.0000	162.00	19.912		Only 1 intersection with ground level			
-3.0000	163.00	20.700		Only 1 intersection with ground level			
-3.0000	164.00	21.506		Only 1 intersection with ground level			
-3.0000	164.00	21.506		Only 1 intersection with ground level			
-3.0000	165.00	22.327		Only 1 intersection with ground level			
-3.0000	165.00	22.327		Only 1 intersection with ground level			
-3.0000	166.00	23.162		Only 1 intersection with ground level			
-3.0000	167.00	24.010		Only 1 intersection with ground level			
-3.0000	168.00	24.870		Only 1 intersection with ground level			
-3.0000	169.00	25.739		Only 1 intersection with ground level			
-2.0000	150.00	12.021		Only 1 intersection with ground level			
-2.0000	151.00	12.349		Only 1 intersection with ground level			
-2.0000	152.00	12.748		Only 1 intersection with ground level			
-2.0000	153.00	13.210		Only 1 intersection with ground level			
-2.0000	154.00	13.730		Only 1 intersection with ground level			
-2.0000	155.00	14.300		Only 1 intersection with ground level			
-2.0000	156.00	14.916		Only 1 intersection with ground level			
-2.0000	157.00	15.572		Only 1 intersection with ground level			
-2.0000	158.00	16.263		Only 1 intersection with ground level			
-2.0000	159.00	16.985		Only 1 intersection with ground level			
-2.0000	160.00	17.734		Only 1 intersection with ground level			
-2.0000	160.00	17.734		Only 1 intersection with ground level			
-2.0000	161.00	18.507		Only 1 intersection with ground level			

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]
-2.0000	161.00	18.507	Only 1	intersection with ground level		
-2.0000	162.00	19.300	Only 1	intersection with ground level		
-2.0000	162.00	19.300	Only 1	intersection with ground level		
-2.0000	163.00	20.112	Only 1	intersection with ground level		
-2.0000	164.00	20.940	798.22	1.3680	5431.1	7429.9
-2.0000	165.00	21.783	764.37	1.3505	5487.9	7411.2
-2.0000	166.00	22.638	735.67	1.3270	5563.9	7383.4
-2.0000	167.00	23.505	711.10	1.3170	5632.2	7417.3
-2.0000	168.00	24.382	690.52	1.2999	5718.4	7433.2
-2.0000	169.00	25.269	673.67	1.2962	5800.0	7517.8
-1.0000	150.00	11.068	Only 1	intersection with ground level		
-1.0000	151.00	11.424	Only 1	intersection with ground level		
-1.0000	152.00	11.853	Only 1	intersection with ground level		
-1.0000	153.00	12.349	Only 1	intersection with ground level		
-1.0000	154.00	12.903	Only 1	intersection with ground level		
-1.0000	155.00	13.509	Only 1	intersection with ground level		
-1.0000	156.00	14.160	Only 1	intersection with ground level		
-1.0000	156.00	14.160	Only 1	intersection with ground level		
-1.0000	157.00	14.849	Only 1	intersection with ground level		
-1.0000	157.00	14.849	Only 1	intersection with ground level		
-1.0000	158.00	15.572	Only 1	intersection with ground level		
-1.0000	158.00	15.572	Only 1	intersection with ground level		
-1.0000	159.00	16.325	Only 1	intersection with ground level		
-1.0000	159.00	16.325	Only 1	intersection with ground level		
-1.0000	160.00	17.103	826.17	1.3937	4596.1	6405.7
-1.0000	161.00	17.903	782.39	1.3674	4649.5	6357.7
-1.0000	162.00	18.722	745.31	1.3390	4716.0	6314.8
-1.0000	163.00	19.558	714.21	1.3151	4787.9	6296.8
-1.0000	164.00	20.408	688.26	1.3049	4854.9	6335.0
-1.0000	165.00	21.272	666.98	1.2886	4938.3	6363.2
-1.0000	166.00	22.147	649.72	1.2853	5017.6	6449.0
-1.0000	167.00	23.033	636.03	1.2753	5112.2	6519.7
-1.0000	168.00	23.927	625.50	1.2776	5203.5	6648.2
-1.0000	169.00	24.829	617.85	1.2731	5309.4	6759.3
0.0	150.00	10.124	Only 1	intersection with ground level		
0.0	151.00	10.512	Only 1	intersection with ground level		
0.0	151.00	10.512	Only 1	intersection with ground level		
0.0	152.00	10.977	Only 1	intersection with ground level		
0.0	152.00	10.977	Only 1	intersection with ground level		
0.0	153.00	11.511	Only 1	intersection with ground level		
0.0	153.00	11.511	Only 1	intersection with ground level		
0.0	154.00	12.104	Only 1	intersection with ground level		
0.0	154.00	12.104	Only 1	intersection with ground level		
0.0	155.00	12.748	Only 1	intersection with ground level		
0.0	155.00	12.748	Only 1	intersection with ground level		
0.0	156.00	13.435	Only 1	intersection with ground level		
0.0	156.00	13.435	Only 1	intersection with ground level		
0.0	157.00	14.160	825.45	1.4143	3843.7	5426.6
0.0	158.00	14.916	774.38	1.3700	3906.5	5352.1
0.0	159.00	15.700	731.78	1.3371	3969.9	5308.1
0.0	160.00	16.508	696.79	1.3194	4029.5	5316.6
0.0	161.00	17.335	668.41	1.3001	4103.0	5334.4
0.0	162.00	18.180	645.48	1.2925	4174.7	5395.9
0.0	163.00	19.039	627.40	1.2815	4258.9	5458.0
0.0	164.00	19.912	613.38	1.2731	4348.2	5535.8
0.0	165.00	20.797	603.20	1.2757	4438.3	5661.8
0.0	166.00	21.691	596.11	1.2728	4539.5	5777.8
0.0	167.00	22.594	592.05	1.2741	4646.3	5919.7
0.0	168.00	23.505	590.40	1.2776	4760.5	6081.8
0.0	169.00	24.423	590.39	1.2491	4925.6	6152.7
1.0000	150.00	9.1924	Only 1	intersection with ground level		
1.0000	150.00	9.1924	Only 1	intersection with ground level		
1.0000	151.00	9.6177	Only 1	intersection with ground level		
1.0000	151.00	9.6177	Only 1	intersection with ground level		
1.0000	152.00	10.124	Only 1	intersection with ground level		
1.0000	152.00	10.124	Only 1	intersection with ground level		
1.0000	153.00	10.700	Only 1	intersection with ground level		
1.0000	153.00	10.700	Only 1	intersection with ground level		
1.0000	154.00	11.336	Only 1	intersection with ground level		
1.0000	154.00	11.336	Only 1	intersection with ground level		
1.0000	155.00	12.021	778.42	1.4091	3175.6	4451.5
1.0000	156.00	12.748	727.27	1.3681	3237.5	4417.2
1.0000	157.00	13.509	685.83	1.3324	3304.7	4403.3
1.0000	158.00	14.300	652.70	1.3102	3373.4	4419.7
1.0000	159.00	15.116	626.81	1.3029	3440.7	4482.9

Oasys Hollingsworth Gate, Littleborough Section F						Job No.	Sheet No.	Rev.	
						GRO-23131			
						Drg. Ref.			
						Made by JD	Date	Checked	Date
Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment			
x [m]	y [m]	[m]		[kNm/m]	[kNm/m]	[kNm/m]			
1.0000	160.00	15.953	606.88	1.2931	3519.1	4550.5 0.0			
1.0000	161.00	16.808	592.20	1.2869	3604.2	4638.3 0.0			
1.0000	162.00	17.678	581.74	1.2839	3694.0	4742.7 0.0			
1.0000	163.00	18.561	575.04	1.2951	3782.4	4898.6 0.0			
1.0000	164.00	19.455	570.96	1.2713	3916.4	4978.9 0.0			
1.0000	165.00	20.359	568.92	1.2553	4030.9	5059.9 0.0			
1.0000	166.00	21.272	568.67	1.2223	4144.2	5065.3 0.0			
1.0000	167.00	22.192	570.12	1.2216	4266.9	5212.3 0.0			
1.0000	168.00	23.119	572.78	1.2511	4398.1	5502.5 0.0			
1.0000	169.00	24.052	576.66	1.2791	4537.8	5804.4 0.0			
2.0000	150.00	8.2765	Only 1 intersection with ground level						
2.0000	150.00	8.2765							
2.0000	151.00	8.7464							
2.0000	151.00	8.7464							
2.0000	152.00	9.3005							
2.0000	152.00	9.3005							
2.0000	152.00	9.3005							
2.0000	153.00	9.9247	738.35	1.4409	2522.4	3612.4 22.100			
2.0000	154.00	10.607	685.16	1.3859	2593.7	3575.0 19.500			
2.0000	155.00	11.336	644.35	1.3497	2666.4	3586.2 12.541			
2.0000	156.00	12.104	613.11	1.3243	2739.0	3627.1 0.0			
2.0000	157.00	12.903	589.58	1.3253	2804.8	3717.1 0.0			
2.0000	158.00	13.730	572.59	1.3280	2877.7	3821.4 0.0			
2.0000	159.00	14.577	560.74	1.3124	2976.8	3906.7 0.0			
2.0000	160.00	15.443	552.61	1.2943	3080.1	3986.4 0.0			
2.0000	161.00	16.325	547.31	1.2811	3175.2	4067.6 0.0			
2.0000	162.00	17.219	544.65	1.2495	3278.1	4095.8 0.0			
2.0000	163.00	18.125	544.31	1.2018	3390.7	4074.8 0.0			
2.0000	164.00	19.039	545.60	1.2318	3513.6	4328.1 0.0			
2.0000	165.00	19.962	548.48	1.2629	3642.4	4600.0 0.0			
2.0000	166.00	20.893	552.77	1.2909	3780.5	4880.3 0.0			
2.0000	167.00	21.829	558.33	1.3182	3925.0	5173.8 0.0			
2.0000	168.00	22.771	564.85	1.3422	4076.2	5471.3 0.0			
2.0000	169.00	23.717	572.41	1.3533	4302.9	5823.1 0.0			
3.0000	150.00	7.3824	Only 1 intersection with ground level						
3.0000	150.00	7.3824							
3.0000	151.00	7.9057	706.82	1.5310	1887.7	2873.8 16.250			
3.0000	152.00	8.5147	649.32	1.4565	1964.9	2844.9 16.900			
3.0000	153.00	9.1924	607.26	1.4189	2037.6	2875.7 15.600			
3.0000	154.00	9.9247	576.80	1.3979	2113.2	2941.7 12.350			
3.0000	155.00	10.700	554.49	1.3606	2204.4	2998.4 0.90708			
3.0000	156.00	11.511	538.41	1.3506	2282.1	3082.3 0.0			
3.0000	157.00	12.349	527.24	1.3359	2365.7	3160.3 0.0			
3.0000	158.00	13.210	520.19	1.3076	2457.6	3213.5 0.0			
3.0000	159.00	14.089	516.71	1.2215	2561.6	3129.1 0.0			
3.0000	160.00	14.983	516.18	1.2132	2672.3	3241.9 0.0			
3.0000	161.00	15.890	517.88	1.2475	2789.2	3479.6 0.0			
3.0000	162.00	16.808	521.37	1.2785	2913.7	3725.0 0.0			
3.0000	163.00	17.734	526.48	1.3046	3045.9	3973.6 0.0			
3.0000	164.00	18.668	532.95	1.3304	3186.4	4239.2 0.0			
3.0000	165.00	19.609	540.44	1.3563	3333.4	4521.1 0.0			
3.0000	166.00	20.555	548.95	1.3818	3487.9	4819.7 0.0			
3.0000	167.00	21.506	558.36	1.4064	3651.1	5135.1 0.0			
3.0000	168.00	22.461	568.35	1.3536	4226.0	5720.5 0.0			
3.0000	169.00	23.420	578.54	1.3128	4843.9	6359.3 0.0			
4.0000	150.00	6.5192	Centre embedded/below end of slip						
4.0000	151.00	7.1063	571.54	1.5466	1436.1	2207.1 13.928			
4.0000	152.00	7.7782	537.62	1.4957	1519.1	2257.4 14.790			
4.0000	153.00	8.5147	514.53	1.4507	1607.0	2321.6 9.7500			
4.0000	154.00	9.3005	499.25	1.4096	1694.8	2387.2 1.7235			
4.0000	155.00	10.124	489.90	1.3605	1784.9	2428.3 0.0			
4.0000	156.00	10.977	485.32	1.2000	1881.0	2257.2 0.0			
4.0000	157.00	11.853	484.53	1.2352	1985.0	2451.9 0.0			
4.0000	158.00	12.748	486.57	1.2645	2096.7	2651.4 0.0			
4.0000	159.00	13.656	490.75	1.2932	2215.6	2865.2 0.0			
4.0000	160.00	14.577	496.70	1.3225	2342.0	3097.3 0.0			
4.0000	161.00	15.508	504.25	1.3519	2476.4	3347.8 0.0			
4.0000	162.00	16.447	513.03	1.3810	2618.3	3616.0 0.0			
4.0000	163.00	17.393	522.79	1.4095	2767.6	3900.8 0.0			
4.0000	164.00	18.344	533.57	1.4371	2925.0	4203.4 0.0			
4.0000	165.00	19.300	545.03	1.4639	3089.1	4522.2 0.0			
4.0000	166.00	20.261	557.19	1.4167	3558.2	5040.9 0.0			
4.0000	167.00	21.225	569.36	1.3587	4178.9	5678.0 0.0			
4.0000	168.00	22.192	581.60	1.3215	4801.3	6344.7 0.0			

Oasys Hollingsworth Gate, Littleborough Section F						Job No.		Sheet No.		Rev.	
						GRO-23131					
						Drg. Ref.					
						Made by JD		Date		Checked	
Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment				
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]				
4.0000	169.00	23.162	593.90	1.2981	5424.7	7041.7	0.0				
5.0000	150.00	5.7009		Centre embedded/below end of slip							
5.0000	151.00	6.3640	469.25	1.6215	1045.8	1684.0	11.700				
5.0000	152.00	7.1063	455.76	1.5194	1142.3	1727.3	8.3750				
5.0000	153.00	7.9057	449.41	1.3105	1240.1	1622.8	2.2427				
5.0000	154.00	8.7464	447.99	1.2716	1338.9	1702.6	0.0				
5.0000	155.00	9.6177	450.17	1.2993	1443.1	1875.1	0.0				
5.0000	156.00	10.512	455.18	1.3305	1554.6	2068.5	0.0				
5.0000	157.00	11.424	462.43	1.3632	1673.9	2281.9	0.0				
5.0000	158.00	12.349	471.41	1.3962	1800.7	2514.0	0.0				
5.0000	159.00	13.285	481.76	1.4285	1935.3	2764.5	0.0				
5.0000	160.00	14.230	493.25	1.4599	2077.6	3033.0	0.0				
5.0000	161.00	15.182	505.60	1.4900	2227.4	3318.8	0.0				
5.0000	162.00	16.140	518.82	1.5190	2385.0	3622.7	0.0				
5.0000	163.00	17.103	532.71	1.5461	2550.9	3943.9	0.0				
5.0000	164.00	18.069	547.10	1.5102	2910.5	4395.3	0.0				
5.0000	165.00	19.039	561.58	1.4230	3535.0	5030.3	0.0				
5.0000	166.00	20.012	575.91	1.3691	4160.1	5695.5	0.0				
5.0000	167.00	20.988	590.07	1.3356	4784.4	6389.9	0.0				
5.0000	168.00	21.966	604.05	1.3153	5409.4	7115.2	0.0				
5.0000	169.00	22.946	617.93	1.3045	6035.0	7872.6	0.0				

Program Oasys Slope Version 21.0.0.46

Copyright (C) 1997-2023

Printed

10-Oct-2023

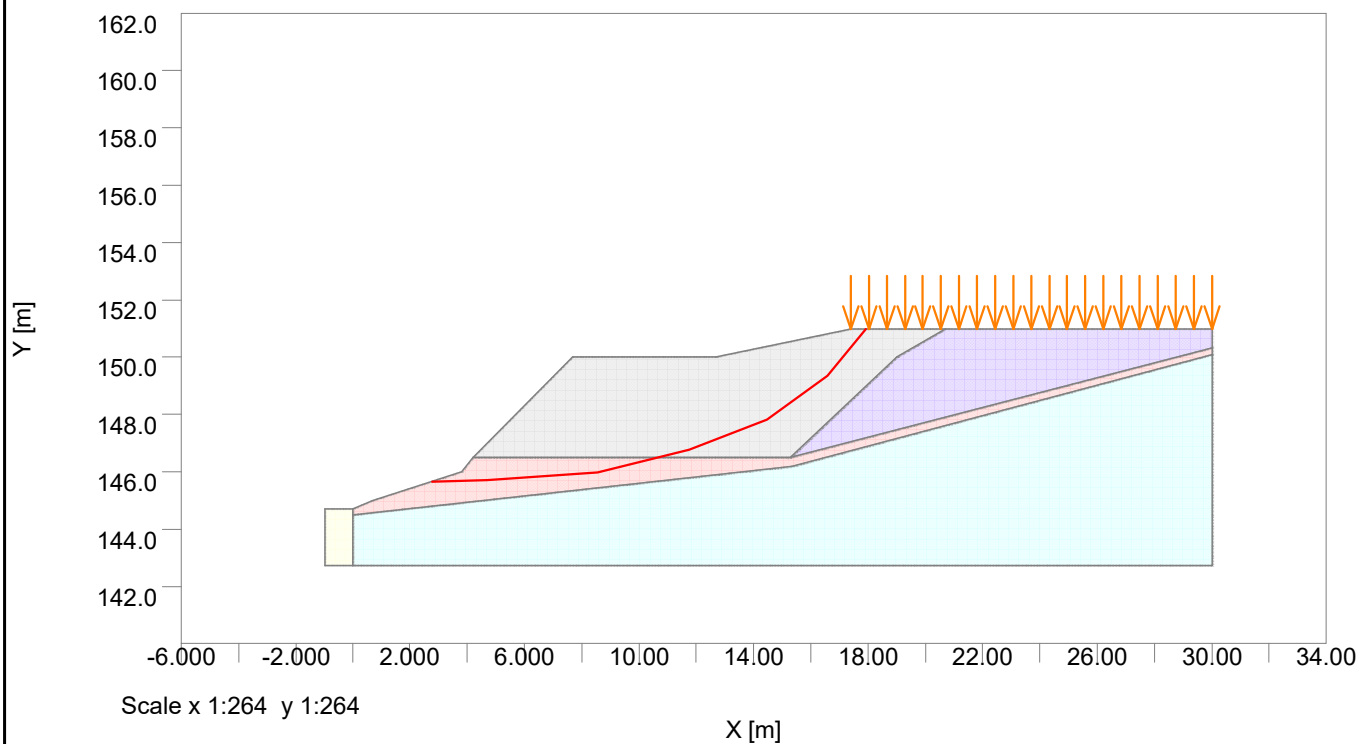
Page

8

Time

02:22

Moments taken about 4.98,163.57, Over-Design Factor 1.462



Oasys Hollingsworth Gate, Littleborough Section F	Job No.		Sheet No.		Rev.	
	GRO-23131					
	Drg. Ref.					
	Made by JD		Date		Checked Date	

Specification

Slip Type: NON-CIRCULAR
Direction of slip: Downhill
Minimum slip weight [kN/m] :80.00000
Type of analysis: STATIC
Partial factor analysis
Minimum number of slices 25
Method: Janbu(Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: NOT ACTIVE

Material Properties

No	Description	Unit Weight		Shear Strength Parameters Condition	Phi or c
		Above GWL	Below GWL		
		[kN/m3]	[kN/m3]		Phi0 [°]
0.0	1 Canal Wall	25.000	25.000	Drained	40.000
0.0	2 Reinforced Earth	17.500	2.0000	Drained	29.000
0.0	3 Backfill Made Ground	17.500	20.000	Drained	29.000
0.0	4 Stiff CLAY	20.000	22.000	Drained	29.000
0.0	5 SILTSTONE	21.000	23.000	Drained	34.000

Surface loads

No.	Limits of loaded area		Distributed load	Permanent / Variable load	Favourable / Unfavourable load	Use in pull-out calc
	X1	X2	Vert	Horiz		
	[m]	[m]	[kN/m²]	[kN/m²]		
1	17.400	30.000	100.00	0.0	Permanent	Unfavourable No

Reinforcement

NB: REINFORCEMENT IS DEFINED BUT NOT ACTIVE

Geotextile Reinforcement 1

Layers	Level of top layer	Vertical Spacing	Length	Offset from surface		Angle from horiz
	[m]	[m]	Top [m]	Btm [m]	[m]	[°]
7	149.50	0.50000	5.0000	5.0000	0.0	0

Bond Length	Bond Strength	Prestress	Grout Diameter
	[kN/m]	[kN]	[mm]
0.0%	0.0	0.0	0.0

Out of plane spacing	Tensile Capacity	Plate Capacity	Material Partial Factor
[m]	[kN]	[kN]	
0.0	1.3000	0.0	

Non Circular Slips

No	Name	Coordinates			
1	Slip 1	(17.9, 151)	(16.6, 149)	(14.5, 148)	(11.7, 147)
		(8.56, 146)	(4.72, 146)	(2.77, 146)	

RESULTS OF ANALYSIS

In the following tables, values in italics are factored values using the currently selected Method Partial Factors.

Slip Description	Slip Centre	Slip	Comment/	Disturbing Soil
Reinforcement				



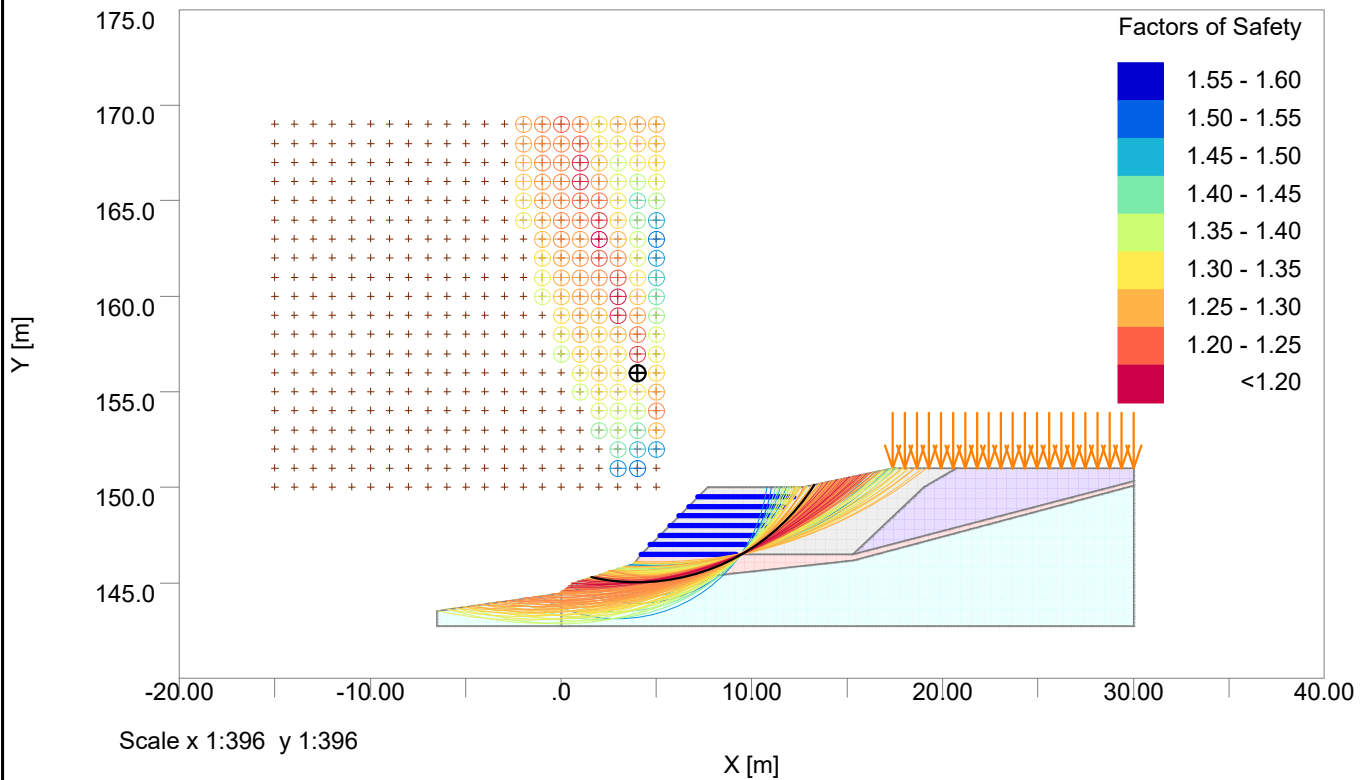
Hollingsworth Gate, Littleborough
Section F

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

		Weight	Over-Design	Moment	Strength	Restoring
			Factor		Restoring	Moment
					Moment	
x [m]	y [m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]
Slip 1		4.9827	163.57	655.16	1.4624	3791.4
0.0						5544.6

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

More than one slip surface shown, minimum factor of 1.194



Specification

```
Slip Type: CIRCULAR
Direction of slip: Downhill
Minimum slip weight [kN/m] :80.00000
Type of analysis: Downhill
Partial factor analysis
Minimum number of slices 25
Method: Bishop (Variably inclined interslice forces)
Maximum number of iterations: 300
Reinforcement: ACTIVE
```

Material Partial Factors

[illegible]

Material Properties

No	Description	Unit Weight		Shear Strength Parameters	Phi or c
		Above GWL	Below GWL		
	or c0'				
		[kN/m3]	[kN/m3]		Phi0 [°]
0.0	1 Canal Wall	25.000	25.000	Drained	40.000
0.0	2 Reinforced Earth	17.500	2.0000	Drained	29.000
0.0	3 Backfill Made Ground	17.500	20.000	Drained	29.000
0.0	4 Stiff CLAY	20.000	22.000	Drained	29.000
0.0	5 SILTSTONE	21.000	23.000	Drained	40.000

Surface loads

No.	Limits of loaded area		Distributed load		Permanent / Variable load	Favourable / Unfavourable load	Use in pull-out calc
	X1 [m]	X2 [m]	Vert [kN/m ²]	Horiz [kN/m ²]			
1	17.400	30.000	100.00	0.0	Permanent	Unfavourable	No

Reinforcement

Geotextile Reinforcement 1						
Layers	Level of top layer	Vertical Spacing	Length		Offset from surface	Angle from horizon
	[m]	[m]	Top [m]	Btm [m]	[m]	[°]
7	149.50	0.50000	5.0000	5.0000	0.0	0

Bond Length	Bond Strength [kN/m]	Prestress [kN]	Grout Diameter [mm]
0.0%	0.0	0.0	0.0

Out of plane spacing	Tensile Capacity	Plate Capacity	Material Partial Factor
[m]	[kN]	[kN]	
0.0	1.3000	0.0	

Slip Surface Specification

Circle centre specification:
Bottom left of grid: x = -15.00000 m y = 150.00000 m
Inclination of grid: 0.00000 deg
(positive anticlockwise direction about bottom left of grid)
Centres on grid: 20 in x direction at 1.00000m spacing
 20 in y direction at 1.00000m spacing
Grid extended to find minimum FoS
All circles pass through common point at x = 9.50000 m, y = 146.50000 m

Out of plane spacing [m]	Tensile Capacity [kN]	Plate Capacity [kN]	Material Partial Factor
-----------------------------------	-----------------------------	---------------------------	-------------------------------

Non Circular Slips

No

Name

Coordinates

1

Slip 1

2

Slip 2

(18.3, 151) (15.9, 149) (13.6, 148) (10.4, 146)
(7.09, 146) (3.9, 146) (2.16, 145)

RESULTS OF ANALYSIS

In the following tables, values in italics are factored values using the currently selected Method Partial Factors.

Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]

-15.000	150.00	24.749	Only 1 intersection with ground level
-15.000	151.00	24.910	Only 1 intersection with ground level
-15.000	152.00	25.110	Only 1 intersection with ground level
-15.000	153.00	25.348	Only 1 intersection with ground level
-15.000	154.00	25.622	Only 1 intersection with ground level
-15.000	155.00	25.933	Only 1 intersection with ground level
-15.000	156.00	26.277	Only 1 intersection with ground level
-15.000	157.00	26.655	Only 1 intersection with ground level
-15.000	158.00	27.065	Only 1 intersection with ground level
-15.000	159.00	27.505	Only 1 intersection with ground level
-15.000	160.00	27.973	Only 1 intersection with ground level
-15.000	161.00	28.469	Only 1 intersection with ground level
-15.000	162.00	28.991	Only 1 intersection with ground level
-15.000	163.00	29.538	Only 1 intersection with ground level
-15.000	164.00	30.108	Only 1 intersection with ground level
-15.000	165.00	30.700	Only 1 intersection with ground level
-15.000	166.00	31.313	Only 1 intersection with ground level
-15.000	167.00	31.945	Only 1 intersection with ground level
-15.000	168.00	32.596	Only 1 intersection with ground level
-15.000	169.00	33.264	Only 1 intersection with ground level
-14.000	150.00	23.759	Only 1 intersection with ground level
-14.000	151.00	23.927	Only 1 intersection with ground level
-14.000	152.00	24.135	Only 1 intersection with ground level
-14.000	153.00	24.382	Only 1 intersection with ground level
-14.000	154.00	24.668	Only 1 intersection with ground level
-14.000	155.00	24.990	Only 1 intersection with ground level
-14.000	156.00	25.348	Only 1 intersection with ground level
-14.000	157.00	25.739	Only 1 intersection with ground level
-14.000	158.00	26.163	Only 1 intersection with ground level
-14.000	159.00	26.618	Only 1 intersection with ground level
-14.000	160.00	27.102	Only 1 intersection with ground level
-14.000	161.00	27.613	Only 1 intersection with ground level
-14.000	162.00	28.151	Only 1 intersection with ground level
-14.000	163.00	28.714	Only 1 intersection with ground level
-14.000	164.00	29.300	Only 1 intersection with ground level
-14.000	165.00	29.908	Only 1 intersection with ground level
-14.000	166.00	30.537	Only 1 intersection with ground level
-14.000	167.00	31.185	Only 1 intersection with ground level
-14.000	168.00	31.851	Only 1 intersection with ground level
-14.000	169.00	32.535	Only 1 intersection with ground level
-13.000	150.00	22.771	Only 1 intersection with ground level
-13.000	151.00	22.946	Only 1 intersection with ground level
-13.000	152.00	23.162	Only 1 intersection with ground level
-13.000	153.00	23.420	Only 1 intersection with ground level
-13.000	154.00	23.717	Only 1 intersection with ground level
-13.000	155.00	24.052	Only 1 intersection with ground level
-13.000	156.00	24.423	Only 1 intersection with ground level
-13.000	157.00	24.829	Only 1 intersection with ground level
-13.000	158.00	25.269	Only 1 intersection with ground level
-13.000	159.00	25.739	Only 1 intersection with ground level
-13.000	160.00	26.239	Only 1 intersection with ground level
-13.000	161.00	26.768	Only 1 intersection with ground level
-13.000	162.00	27.322	Only 1 intersection with ground level
-13.000	163.00	27.902	Only 1 intersection with ground level
-13.000	164.00	28.504	Only 1 intersection with ground level
-13.000	165.00	29.129	Only 1 intersection with ground level
-13.000	166.00	29.774	Only 1 intersection with ground level
-13.000	167.00	30.438	Only 1 intersection with ground level
-13.000	168.00	31.121	Only 1 intersection with ground level
-13.000	169.00	31.820	Only 1 intersection with ground level



Hollingsworth Gate, Littleborough
Section F

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]
-12.000	150.00	21.783		Only 1 intersection with ground level			
-12.000	151.00	21.966		Only 1 intersection with ground level			
-12.000	152.00	22.192		Only 1 intersection with ground level			
-12.000	153.00	22.461		Only 1 intersection with ground level			
-12.000	154.00	22.771		Only 1 intersection with ground level			
-12.000	155.00	23.119		Only 1 intersection with ground level			
-12.000	156.00	23.505		Only 1 intersection with ground level			
-12.000	157.00	23.927		Only 1 intersection with ground level			
-12.000	158.00	24.382		Only 1 intersection with ground level			
-12.000	159.00	24.870		Only 1 intersection with ground level			
-12.000	160.00	25.387		Only 1 intersection with ground level			
-12.000	161.00	25.933		Only 1 intersection with ground level			
-12.000	162.00	26.505		Only 1 intersection with ground level			
-12.000	163.00	27.102		Only 1 intersection with ground level			
-12.000	164.00	27.722		Only 1 intersection with ground level			
-12.000	165.00	28.364		Only 1 intersection with ground level			
-12.000	166.00	29.026		Only 1 intersection with ground level			
-12.000	167.00	29.707		Only 1 intersection with ground level			
-12.000	168.00	30.406		Only 1 intersection with ground level			
-12.000	169.00	31.121		Only 1 intersection with ground level			
-11.000	150.00	20.797		Only 1 intersection with ground level			
-11.000	151.00	20.988		Only 1 intersection with ground level			
-11.000	152.00	21.225		Only 1 intersection with ground level			
-11.000	153.00	21.506		Only 1 intersection with ground level			
-11.000	154.00	21.829		Only 1 intersection with ground level			
-11.000	155.00	22.192		Only 1 intersection with ground level			
-11.000	156.00	22.594		Only 1 intersection with ground level			
-11.000	157.00	23.033		Only 1 intersection with ground level			
-11.000	158.00	23.505		Only 1 intersection with ground level			
-11.000	159.00	24.010		Only 1 intersection with ground level			
-11.000	160.00	24.546		Only 1 intersection with ground level			
-11.000	161.00	25.110		Only 1 intersection with ground level			
-11.000	162.00	25.700		Only 1 intersection with ground level			
-11.000	163.00	26.315		Only 1 intersection with ground level			
-11.000	164.00	26.954		Only 1 intersection with ground level			
-11.000	165.00	27.613		Only 1 intersection with ground level			
-11.000	166.00	28.293		Only 1 intersection with ground level			
-11.000	167.00	28.991		Only 1 intersection with ground level			
-11.000	168.00	29.707		Only 1 intersection with ground level			
-11.000	169.00	30.438		Only 1 intersection with ground level			
-10.000	150.00	19.812		Only 1 intersection with ground level			
-10.000	151.00	20.012		Only 1 intersection with ground level			
-10.000	152.00	20.261		Only 1 intersection with ground level			
-10.000	153.00	20.555		Only 1 intersection with ground level			
-10.000	154.00	20.893		Only 1 intersection with ground level			
-10.000	155.00	21.272		Only 1 intersection with ground level			
-10.000	156.00	21.691		Only 1 intersection with ground level			
-10.000	157.00	22.147		Only 1 intersection with ground level			
-10.000	158.00	22.638		Only 1 intersection with ground level			
-10.000	159.00	23.162		Only 1 intersection with ground level			
-10.000	160.00	23.717		Only 1 intersection with ground level			
-10.000	161.00	24.300		Only 1 intersection with ground level			
-10.000	162.00	24.910		Only 1 intersection with ground level			
-10.000	163.00	25.544		Only 1 intersection with ground level			
-10.000	164.00	26.201		Only 1 intersection with ground level			
-10.000	165.00	26.879		Only 1 intersection with ground level			
-10.000	166.00	27.577		Only 1 intersection with ground level			
-10.000	167.00	28.293		Only 1 intersection with ground level			
-10.000	168.00	29.026		Only 1 intersection with ground level			
-10.000	169.00	29.774		Only 1 intersection with ground level			
-9.0000	150.00	18.828		Only 1 intersection with ground level			
-9.0000	151.00	19.039		Only 1 intersection with ground level			
-9.0000	152.00	19.300		Only 1 intersection with ground level			
-9.0000	153.00	19.609		Only 1 intersection with ground level			
-9.0000	154.00	19.962		Only 1 intersection with ground level			
-9.0000	155.00	20.359		Only 1 intersection with ground level			
-9.0000	156.00	20.797		Only 1 intersection with ground level			
-9.0000	157.00	21.272		Only 1 intersection with ground level			
-9.0000	158.00	21.783		Only 1 intersection with ground level			
-9.0000	159.00	22.327		Only 1 intersection with ground level			
-9.0000	160.00	22.902		Only 1 intersection with ground level			
-9.0000	161.00	23.505		Only 1 intersection with ground level			
-9.0000	162.00	24.135		Only 1 intersection with ground level			
-9.0000	163.00	24.789		Only 1 intersection with ground level			
-9.0000	164.00	25.466		Only 1 intersection with ground level			
-9.0000	165.00	26.163		Only 1 intersection with ground level			
-9.0000	166.00	26.879		Only 1 intersection with ground level			

 Hollingsworth Gate, Littleborough Section F					Job No.		Sheet No.	Rev.
					GRO-23131			
					Drg. Ref.			
					Made by JD	Date	Checked	Date
Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment		
x [m]	y [m]	[m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]		
-9.0000	167.00	27.613	Only 1	intersection with	ground level			
-9.0000	168.00	28.364	Only 1	intersection with	ground level			
-9.0000	169.00	29.129	Only 1	intersection with	ground level			
-8.0000	150.00	17.847	Only 1	intersection with	ground level			
-8.0000	151.00	18.069	Only 1	intersection with	ground level			
-8.0000	152.00	18.344	Only 1	intersection with	ground level			
-8.0000	153.00	18.668	Only 1	intersection with	ground level			
-8.0000	154.00	19.039	Only 1	intersection with	ground level			
-8.0000	155.00	19.455	Only 1	intersection with	ground level			
-8.0000	156.00	19.912	Only 1	intersection with	ground level			
-8.0000	157.00	20.408	Only 1	intersection with	ground level			
-8.0000	158.00	20.940	Only 1	intersection with	ground level			
-8.0000	159.00	21.506	Only 1	intersection with	ground level			
-8.0000	160.00	22.102	Only 1	intersection with	ground level			
-8.0000	161.00	22.727	Only 1	intersection with	ground level			
-8.0000	162.00	23.377	Only 1	intersection with	ground level			
-8.0000	163.00	24.052	Only 1	intersection with	ground level			
-8.0000	164.00	24.749	Only 1	intersection with	ground level			
-8.0000	165.00	25.466	Only 1	intersection with	ground level			
-8.0000	166.00	26.201	Only 1	intersection with	ground level			
-8.0000	167.00	26.954	Only 1	intersection with	ground level			
-8.0000	168.00	27.722	Only 1	intersection with	ground level			
-8.0000	169.00	28.504	Only 1	intersection with	ground level			
-7.0000	150.00	16.867	Only 1	intersection with	ground level			
-7.0000	151.00	17.103	Only 1	intersection with	ground level			
-7.0000	152.00	17.393	Only 1	intersection with	ground level			
-7.0000	153.00	17.734	Only 1	intersection with	ground level			
-7.0000	154.00	18.125	Only 1	intersection with	ground level			
-7.0000	155.00	18.561	Only 1	intersection with	ground level			
-7.0000	156.00	19.039	Only 1	intersection with	ground level			
-7.0000	157.00	19.558	Only 1	intersection with	ground level			
-7.0000	158.00	20.112	Only 1	intersection with	ground level			
-7.0000	159.00	20.700	Only 1	intersection with	ground level			
-7.0000	160.00	21.319	Only 1	intersection with	ground level			
-7.0000	161.00	21.966	Only 1	intersection with	ground level			
-7.0000	162.00	22.638	Only 1	intersection with	ground level			
-7.0000	163.00	23.335	Only 1	intersection with	ground level			
-7.0000	164.00	24.052	Only 1	intersection with	ground level			
-7.0000	165.00	24.789	Only 1	intersection with	ground level			
-7.0000	166.00	25.544	Only 1	intersection with	ground level			
-7.0000	167.00	26.315	Only 1	intersection with	ground level			
-7.0000	168.00	27.102	Only 1	intersection with	ground level			
-7.0000	169.00	27.902	Only 1	intersection with	ground level			
-6.0000	150.00	15.890	Only 1	intersection with	ground level			
-6.0000	151.00	16.140	Only 1	intersection with	ground level			
-6.0000	152.00	16.447	Only 1	intersection with	ground level			
-6.0000	153.00	16.808	Only 1	intersection with	ground level			
-6.0000	154.00	17.219	Only 1	intersection with	ground level			
-6.0000	155.00	17.678	Only 1	intersection with	ground level			
-6.0000	156.00	18.180	Only 1	intersection with	ground level			
-6.0000	157.00	18.722	Only 1	intersection with	ground level			
-6.0000	158.00	19.300	Only 1	intersection with	ground level			
-6.0000	159.00	19.912	Only 1	intersection with	ground level			
-6.0000	160.00	20.555	Only 1	intersection with	ground level			
-6.0000	161.00	21.225	Only 1	intersection with	ground level			
-6.0000	162.00	21.920	Only 1	intersection with	ground level			
-6.0000	163.00	22.638	Only 1	intersection with	ground level			
-6.0000	164.00	23.377	Only 1	intersection with	ground level			
-6.0000	165.00	24.135	Only 1	intersection with	ground level			
-6.0000	166.00	24.910	Only 1	intersection with	ground level			
-6.0000	167.00	25.700	Only 1	intersection with	ground level			
-6.0000	168.00	26.505	Only 1	intersection with	ground level			
-6.0000	169.00	27.322	Only 1	intersection with	ground level			
-5.0000	150.00	14.916	Only 1	intersection with	ground level			
-5.0000	151.00	15.182	Only 1	intersection with	ground level			
-5.0000	152.00	15.508	Only 1	intersection with	ground level			
-5.0000	153.00	15.890	Only 1	intersection with	ground level			
-5.0000	154.00	16.325	Only 1	intersection with	ground level			
-5.0000	155.00	16.808	Only 1	intersection with	ground level			
-5.0000	156.00	17.335	Only 1	intersection with	ground level			
-5.0000	157.00	17.903	Only 1	intersection with	ground level			
-5.0000	158.00	18.507	Only 1	intersection with	ground level			
-5.0000	159.00	19.144	Only 1	intersection with	ground level			
-5.0000	160.00	19.812	Only 1	intersection with	ground level			
-5.0000	161.00	20.506	Only 1	intersection with	ground level			
-5.0000	162.00	21.225	Only 1	intersection with	ground level			
-5.0000	163.00	21.966	Only 1	intersection with	ground level			

Oasys Hollingsworth Gate, Littleborough Section F					Job No.		Sheet No.	Rev.
					GRO-23131			
					Drg. Ref.			
					Made by JD	Date	Checked	Date
Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment		
x [m]	y [m]	[m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]		
-5.0000	164.00	22.727	Only 1	intersection with ground level				
-5.0000	165.00	23.505	Only 1	intersection with ground level				
-5.0000	166.00	24.300	Only 1	intersection with ground level				
-5.0000	167.00	25.110	Only 1	intersection with ground level				
-5.0000	168.00	25.933	Only 1	intersection with ground level				
-5.0000	169.00	26.768	Only 1	intersection with ground level				
-4.0000	150.00	13.946	Only 1	intersection with ground level				
-4.0000	151.00	14.230	Only 1	intersection with ground level				
-4.0000	152.00	14.577	Only 1	intersection with ground level				
-4.0000	153.00	14.983	Only 1	intersection with ground level				
-4.0000	154.00	15.443	Only 1	intersection with ground level				
-4.0000	155.00	15.953	Only 1	intersection with ground level				
-4.0000	156.00	16.508	Only 1	intersection with ground level				
-4.0000	157.00	17.103	Only 1	intersection with ground level				
-4.0000	158.00	17.734	Only 1	intersection with ground level				
-4.0000	159.00	18.398	Only 1	intersection with ground level				
-4.0000	160.00	19.092	Only 1	intersection with ground level				
-4.0000	161.00	19.812	Only 1	intersection with ground level				
-4.0000	162.00	20.555	Only 1	intersection with ground level				
-4.0000	163.00	21.319	Only 1	intersection with ground level				
-4.0000	164.00	22.102	Only 1	intersection with ground level				
-4.0000	165.00	22.902	Only 1	intersection with ground level				
-4.0000	166.00	23.717	Only 1	intersection with ground level				
-4.0000	167.00	24.546	Only 1	intersection with ground level				
-4.0000	168.00	25.387	Only 1	intersection with ground level				
-4.0000	168.00	25.387	Only 1	intersection with ground level				
-4.0000	169.00	26.239	Only 1	intersection with ground level				
-3.0000	150.00	12.981	Only 1	intersection with ground level				
-3.0000	151.00	13.285	Only 1	intersection with ground level				
-3.0000	152.00	13.656	Only 1	intersection with ground level				
-3.0000	153.00	14.089	Only 1	intersection with ground level				
-3.0000	154.00	14.577	Only 1	intersection with ground level				
-3.0000	155.00	15.116	Only 1	intersection with ground level				
-3.0000	156.00	15.700	Only 1	intersection with ground level				
-3.0000	157.00	16.325	Only 1	intersection with ground level				
-3.0000	158.00	16.985	Only 1	intersection with ground level				
-3.0000	159.00	17.678	Only 1	intersection with ground level				
-3.0000	160.00	18.398	Only 1	intersection with ground level				
-3.0000	161.00	19.144	Only 1	intersection with ground level				
-3.0000	162.00	19.912	Only 1	intersection with ground level				
-3.0000	163.00	20.700	Only 1	intersection with ground level				
-3.0000	164.00	21.506	Only 1	intersection with ground level				
-3.0000	164.00	21.506	Only 1	intersection with ground level				
-3.0000	165.00	22.327	Only 1	intersection with ground level				
-3.0000	165.00	22.327	Only 1	intersection with ground level				
-3.0000	166.00	23.162	Only 1	intersection with ground level				
-3.0000	167.00	24.010	Only 1	intersection with ground level				
-3.0000	168.00	24.870	Only 1	intersection with ground level				
-3.0000	169.00	25.739	Only 1	intersection with ground level				
-2.0000	150.00	12.021	Only 1	intersection with ground level				
-2.0000	151.00	12.349	Only 1	intersection with ground level				
-2.0000	152.00	12.748	Only 1	intersection with ground level				
-2.0000	153.00	13.210	Only 1	intersection with ground level				
-2.0000	154.00	13.730	Only 1	intersection with ground level				
-2.0000	155.00	14.300	Only 1	intersection with ground level				
-2.0000	156.00	14.916	Only 1	intersection with ground level				
-2.0000	157.00	15.572	Only 1	intersection with ground level				
-2.0000	158.00	16.263	Only 1	intersection with ground level				
-2.0000	159.00	16.985	Only 1	intersection with ground level				
-2.0000	160.00	17.734	Only 1	intersection with ground level				
-2.0000	160.00	17.734	Only 1	intersection with ground level				
-2.0000	161.00	18.507	Only 1	intersection with ground level				
-2.0000	161.00	18.507	Only 1	intersection with ground level				
-2.0000	162.00	19.300	Only 1	intersection with ground level				
-2.0000	162.00	19.300	Only 1	intersection with ground level				
-2.0000	163.00	20.112	Only 1	intersection with ground level				
-2.0000	164.00	20.940	798.22	1.3558	5471.3	7418.1	0.0	
-2.0000	165.00	21.783	764.37	1.3389	5527.1	7400.4	0.0	
-2.0000	166.00	22.638	735.67	1.3164	5601.4	7373.9	0.0	
-2.0000	167.00	23.505	711.10	1.3068	5669.2	7408.7	0.0	
-2.0000	168.00	24.382	690.52	1.2905	5754.2	7425.8	0.0	
-2.0000	169.00	25.269	673.67	1.2871	5835.5	7510.9	0.0	
-1.0000	150.00	11.068	Only 1	intersection with ground level				
-1.0000	151.00	11.424	Only 1	intersection with ground level				
-1.0000	152.00	11.853	Only 1	intersection with ground level				
-1.0000	153.00	12.349	Only 1	intersection with ground level				
-1.0000	154.00	12.903	Only 1	intersection with ground level				

 Hollingsworth Gate, Littleborough Section F						Job No.	Sheet No.	Rev.
						GRO-23131		
						Drg. Ref.		
						Made by JD	Date	Checked Date
Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment		
x [m]	y [m]	[m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]		
-1.0000	155.00	13.509	Only 1	intersection with ground level				
-1.0000	156.00	14.160	Only 1	intersection with ground level				
-1.0000	156.00	14.160	Only 1	intersection with ground level				
-1.0000	157.00	14.849	Only 1	intersection with ground level				
-1.0000	157.00	14.849	Only 1	intersection with ground level				
-1.0000	158.00	15.572	Only 1	intersection with ground level				
-1.0000	158.00	15.572	Only 1	intersection with ground level				
-1.0000	159.00	16.325	Only 1	intersection with ground level				
-1.0000	159.00	16.325	Only 1	intersection with ground level				
-1.0000	160.00	17.103	826.17	1.3813	4629.9	6395.5	0.0	
-1.0000	161.00	17.903	782.39	1.3558	4682.1	6348.2	0.0	
-1.0000	162.00	18.722	745.31	1.3282	4747.6	6305.8	0.0	
-1.0000	163.00	19.558	714.21	1.3052	4818.3	6288.8	0.0	
-1.0000	164.00	20.408	688.26	1.2955	4884.6	6327.8	0.0	
-1.0000	165.00	21.272	666.98	1.2797	4967.5	6356.9	0.0	
-1.0000	166.00	22.147	649.72	1.2767	5046.5	6443.1	0.0	
-1.0000	167.00	23.033	636.03	1.2673	5140.4	6514.2	0.0	
-1.0000	168.00	23.927	625.50	1.2697	5231.9	6643.0	0.0	
-1.0000	169.00	24.829	617.85	1.2654	5337.5	6754.2	0.0	
0.0	150.00	10.124	Only 1	intersection with ground level				
0.0	151.00	10.512	Only 1	intersection with ground level				
0.0	151.00	10.512	Only 1	intersection with ground level				
0.0	152.00	10.977	Only 1	intersection with ground level				
0.0	152.00	10.977	Only 1	intersection with ground level				
0.0	153.00	11.511	Only 1	intersection with ground level				
0.0	153.00	11.511	Only 1	intersection with ground level				
0.0	154.00	12.104	Only 1	intersection with ground level				
0.0	154.00	12.104	Only 1	intersection with ground level				
0.0	155.00	12.748	Only 1	intersection with ground level				
0.0	155.00	12.748	Only 1	intersection with ground level				
0.0	156.00	13.435	Only 1	intersection with ground level				
0.0	156.00	13.435	Only 1	intersection with ground level				
0.0	157.00	14.160	825.45	1.4016	3872.2	5417.6	9.5033	
0.0	158.00	14.916	774.38	1.3585	3933.5	5343.8	0.0	
0.0	159.00	15.700	731.78	1.3268	3995.2	5300.8	0.0	
0.0	160.00	16.508	696.79	1.3097	4054.3	5309.8	0.0	
0.0	161.00	17.335	668.41	1.2912	4126.7	5328.5	0.0	
0.0	162.00	18.180	645.48	1.2842	4197.8	5390.9	0.0	
0.0	163.00	19.039	627.40	1.2735	4282.0	5453.3	0.0	
0.0	164.00	19.912	613.38	1.2654	4371.1	5531.4	0.0	
0.0	165.00	20.797	603.20	1.2682	4461.2	5657.6	0.0	
0.0	166.00	21.691	596.11	1.2654	4562.7	5773.6	0.0	
0.0	167.00	22.594	592.05	1.2667	4670.0	5915.4	0.0	
0.0	168.00	23.505	590.40	1.2701	4785.0	6077.5	0.0	
0.0	169.00	24.423	590.39	1.2418	4951.1	6148.3	0.0	
1.0000	150.00	9.1924	Only 1	intersection with ground level				
1.0000	150.00	9.1924	Only 1	intersection with ground level				
1.0000	151.00	9.6177	Only 1	intersection with ground level				
1.0000	151.00	9.6177	Only 1	intersection with ground level				
1.0000	152.00	10.124	Only 1	intersection with ground level				
1.0000	152.00	10.124	Only 1	intersection with ground level				
1.0000	153.00	10.700	Only 1	intersection with ground level				
1.0000	153.00	10.700	Only 1	intersection with ground level				
1.0000	154.00	11.336	Only 1	intersection with ground level				
1.0000	154.00	11.336	Only 1	intersection with ground level				
1.0000	155.00	12.021	778.42	1.3979	3196.8	4445.3	23.400	
1.0000	156.00	12.748	727.27	1.3579	3257.6	4411.6	11.988	
1.0000	157.00	13.509	685.83	1.3232	3323.9	4398.1	0.0	
1.0000	158.00	14.300	652.70	1.3019	3391.4	4415.4	0.0	
1.0000	159.00	15.116	626.81	1.2952	3458.3	4479.0	0.0	
1.0000	160.00	15.953	606.88	1.2856	3536.7	4546.9	0.0	
1.0000	161.00	16.808	592.20	1.2798	3621.7	4634.9	0.0	
1.0000	162.00	17.678	581.74	1.2770	3711.5	4739.5	0.0	
1.0000	163.00	18.561	575.04	1.2879	3800.9	4895.2	0.0	
1.0000	164.00	19.455	570.96	1.2642	3935.7	4975.5	0.0	
1.0000	165.00	20.359	568.92	1.2483	4050.7	5056.4	0.0	
1.0000	166.00	21.272	568.67	1.2153	4165.0	5061.7	0.0	
1.0000	167.00	22.192	570.12	1.2144	4288.8	5208.5	0.0	
1.0000	168.00	23.119	572.78	1.2436	4421.5	5498.6	0.0	
1.0000	169.00	24.052	576.66	1.2714	4562.3	5800.4	0.0	
2.0000	150.00	8.2765	Only 1	intersection with ground level				
2.0000	150.00	8.2765	Only 1	intersection with ground level				
2.0000	151.00	8.7464	Only 1	intersection with ground level				
2.0000	151.00	8.7464	Only 1	intersection with ground level				
2.0000	152.00	9.3005	Only 1	intersection with ground level				

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

Slip Centre	Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]	[kNm/m]	[kNm/m]	[kNm/m]
2.0000	152.00	9.3005	Only 1 intersection with ground level			
2.0000	153.00	9.9247	738.35	1.4309	2537.1	3608.4
2.0000	154.00	10.607	685.16	1.3769	2607.9	3571.3
2.0000	155.00	11.336	644.35	1.3417	2679.8	3583.0
2.0000	156.00	12.104	613.11	1.3170	2752.0	3624.4
2.0000	157.00	12.903	589.58	1.3186	2817.3	3714.8
2.0000	158.00	13.730	572.59	1.3213	2890.6	3819.4
2.0000	159.00	14.577	560.74	1.3059	2990.1	3904.6
2.0000	160.00	15.443	552.61	1.2876	3094.1	3984.0
2.0000	161.00	16.325	547.31	1.2743	3190.0	4064.9
2.0000	162.00	17.219	544.65	1.2427	3293.7	4093.0
2.0000	163.00	18.125	544.31	1.1950	3407.6	4071.9
2.0000	164.00	19.039	545.60	1.2248	3531.2	4325.0
2.0000	165.00	19.962	548.48	1.2555	3661.2	4596.8
2.0000	166.00	20.893	552.77	1.2833	3800.4	4877.0
2.0000	167.00	21.829	558.33	1.3102	3946.1	5170.4
2.0000	168.00	22.771	564.85	1.3339	4099.0	5467.7
2.0000	169.00	23.717	572.41	1.3450	4326.7	5819.3
3.0000	150.00	7.3824	Only 1 intersection with ground level			
3.0000	150.00	7.3824	Only 1 intersection with ground level			
3.0000	151.00	7.9057	706.82	1.5221	1897.2	2871.6
3.0000	152.00	8.5147	649.32	1.4489	1973.8	2843.0
3.0000	153.00	9.1924	607.26	1.4121	2046.3	2874.0
3.0000	154.00	9.9247	576.80	1.3912	2122.3	2940.0
3.0000	155.00	10.700	554.49	1.3541	2213.8	2996.8
3.0000	156.00	11.511	538.41	1.3443	2291.6	3080.7
3.0000	157.00	12.349	527.24	1.3294	2375.9	3158.5
3.0000	158.00	13.210	520.19	1.3010	2468.4	3211.5
3.0000	159.00	14.089	516.71	1.2151	2573.6	3127.0
3.0000	160.00	14.983	516.18	1.2066	2684.9	3239.7
3.0000	161.00	15.890	517.88	1.2405	2803.0	3477.2
3.0000	162.00	16.808	521.37	1.2712	2928.3	3722.5
3.0000	163.00	17.734	526.48	1.2969	3062.0	3970.9
3.0000	164.00	18.668	532.95	1.3224	3203.6	4236.4
3.0000	165.00	19.609	540.44	1.3480	3351.6	4518.1
3.0000	166.00	20.555	548.95	1.3732	3507.5	4816.6
3.0000	167.00	21.506	558.36	1.3974	3672.4	5131.9
3.0000	168.00	22.461	568.35	1.3456	4248.5	5717.0
3.0000	169.00	23.420	578.54	1.3055	4868.2	6355.4
4.0000	150.00	6.5192	Centre embedded/below end of slip			
4.0000	151.00	7.1063	571.54	1.5399	1441.7	2206.2
4.0000	152.00	7.7782	537.62	1.4892	1525.1	2256.4
4.0000	153.00	8.5147	514.53	1.4443	1613.4	2320.5
4.0000	154.00	9.3005	499.25	1.4030	1701.9	2386.0
4.0000	155.00	10.124	489.90	1.3542	1792.2	2427.1
4.0000	156.00	10.977	485.32	1.1941	1889.1	2255.9
4.0000	157.00	11.853	484.53	1.2289	1994.0	2450.4
4.0000	158.00	12.748	486.57	1.2579	2106.6	2649.8
4.0000	159.00	13.656	490.75	1.2860	2226.5	2863.3
4.0000	160.00	14.577	496.70	1.3148	2354.1	3095.3
4.0000	161.00	15.508	504.25	1.3438	2489.7	3345.7
4.0000	162.00	16.447	513.03	1.3727	2632.5	3613.8
4.0000	163.00	17.393	522.79	1.4006	2783.3	3898.4
4.0000	164.00	18.344	533.57	1.4279	2942.0	4200.8
4.0000	165.00	19.300	545.03	1.4543	3107.6	4519.5
4.0000	166.00	20.261	557.19	1.4081	3577.9	5037.9
4.0000	167.00	21.225	569.36	1.3510	4200.4	5674.7
4.0000	168.00	22.192	581.60	1.3144	4824.2	6341.1
4.0000	169.00	23.162	593.90	1.2915	5449.4	7037.7
5.0000	150.00	5.7009	Centre embedded/below end of slip			
5.0000	151.00	6.3640	469.25	1.6146	1049.8	1683.3
5.0000	152.00	7.1063	455.76	1.5127	1146.9	1726.6
5.0000	153.00	7.9057	449.41	1.3043	1245.3	1622.0
5.0000	154.00	8.7464	447.99	1.2657	1344.5	1701.7
5.0000	155.00	9.6177	450.17	1.2927	1449.7	1874.1
5.0000	156.00	10.512	455.18	1.3236	1562.0	2067.4
5.0000	157.00	11.424	462.43	1.3555	1682.4	2280.6
5.0000	158.00	12.349	471.41	1.3882	1810.0	2512.6
5.0000	159.00	13.285	481.76	1.4200	1945.7	2762.9
5.0000	160.00	14.230	493.25	1.4507	2089.4	3031.2
5.0000	161.00	15.182	505.60	1.4806	2240.3	3316.9
5.0000	162.00	16.140	518.82	1.5091	2399.2	3620.6
5.0000	163.00	17.103	532.71	1.5358	2566.6	3941.6



Hollingsworth Gate, Littleborough
Section F

Job No.	Sheet No.	Rev.
GRO-23131		
Drg. Ref.		
Made by JD	Date	Checked Date

Slip Centre		Radius	Slip Weight	Comment/ Over-Design Factor	Disturbing Moment	Soil Strength Restoring Moment	Reinforcement Restoring Moment
x [m]	y [m]	[m]	[kN/m]		[kNm/m]	[kNm/m]	[kNm/m]
5.0000	164.00	18.069	547.10	1.5005	2927.6	4392.8	0.0
5.0000	165.00	19.039	561.58	1.4146	3553.9	5027.4	0.0
5.0000	166.00	20.012	575.91	1.3616	4180.5	5692.3	0.0
5.0000	167.00	20.988	590.07	1.3287	4806.4	6386.4	0.0
5.0000	168.00	21.966	604.05	1.3089	5433.2	7111.5	0.0
5.0000	169.00	22.946	617.93	1.2983	6060.6	7868.5	0.0

APPENDIX 7 - Geotechnical Testing Results



LABORATORY REPORT



Contract Number: PSL23/4181

Report Date: 27 June 2023
Client's Reference: GRO-23131
Client Name: Groundtech Consulting
First Floor
Lloyd House
Orford Court
Greenfold Way
WN7 3XJ

For the attention of: Callum Holden

Contract Title: Hollingworth Gate - Littleborough

Date Received: 1/6/2023
Date Commenced: 1/6/2023
Date Completed: 27/6/2023

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

L Knight
(Assistant Laboratory Manager)

R Berriman
(Associate Director)

S Royle
(Laboratory Manager)

A Watkins
(Managing Director)


S Eyre
(Senior Technical Coordinator)

T Watkins
(Senior Technician)

5 – 7 Hexthorpe Road,
Hexthorpe,
Doncaster,
DN4 0AR
Tel: 01302 768098
Email: rberriman@prosoils.co.uk
awatkins@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

Hollingworth Gate - Littleborough

Contract No:

PSL23/4181

Client Ref:

GRO-23131

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

*** : Liquid Limit and Plastic Limit Wet Sieved.**



Hollingworth Gate - Littleborough

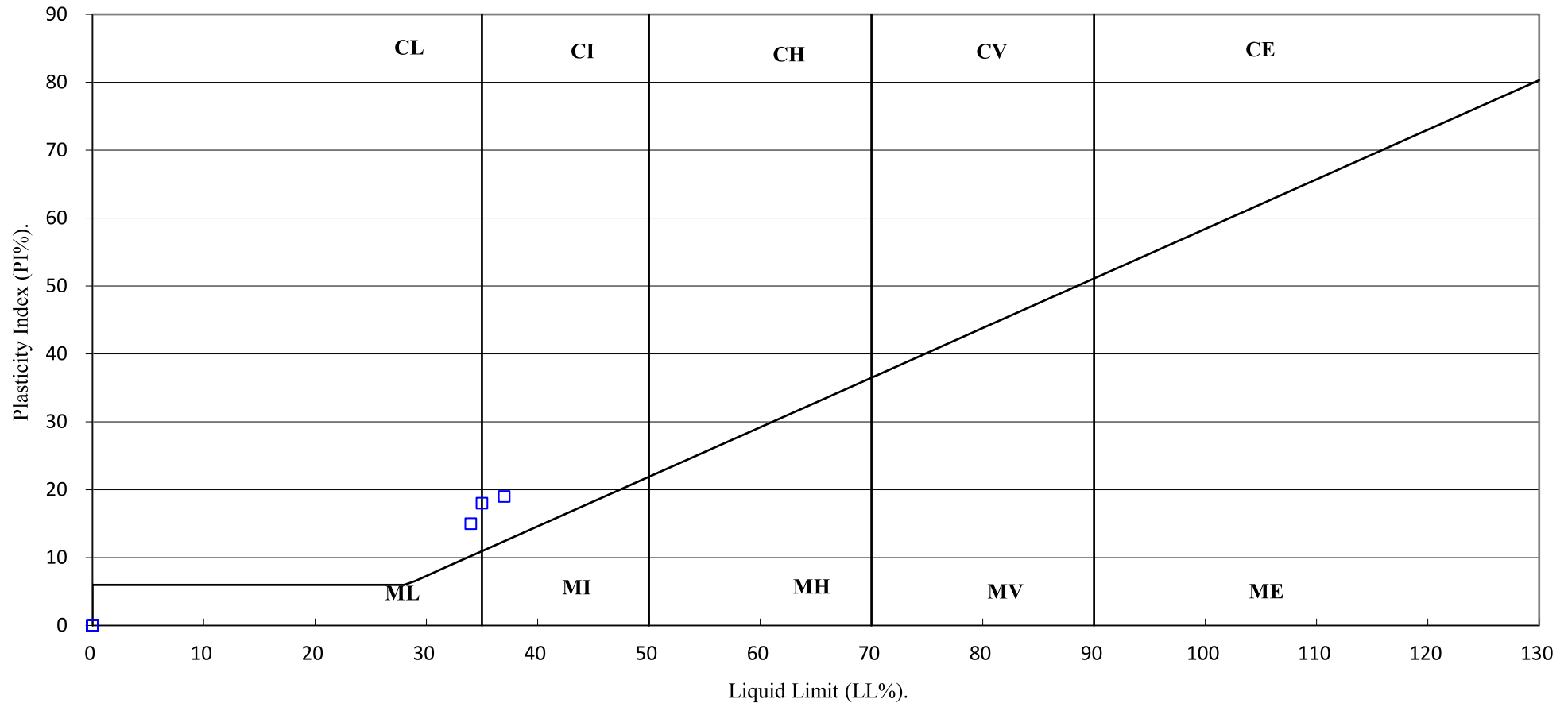
Contract No:

PSL23/4181

Client Ref:

GRO-23131

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



Hollingworth Gate - Littleborough

Contract No:

PSL23/4181

Client Ref:

GRO-23131

PARTICLE SIZE DISTRIBUTION TEST

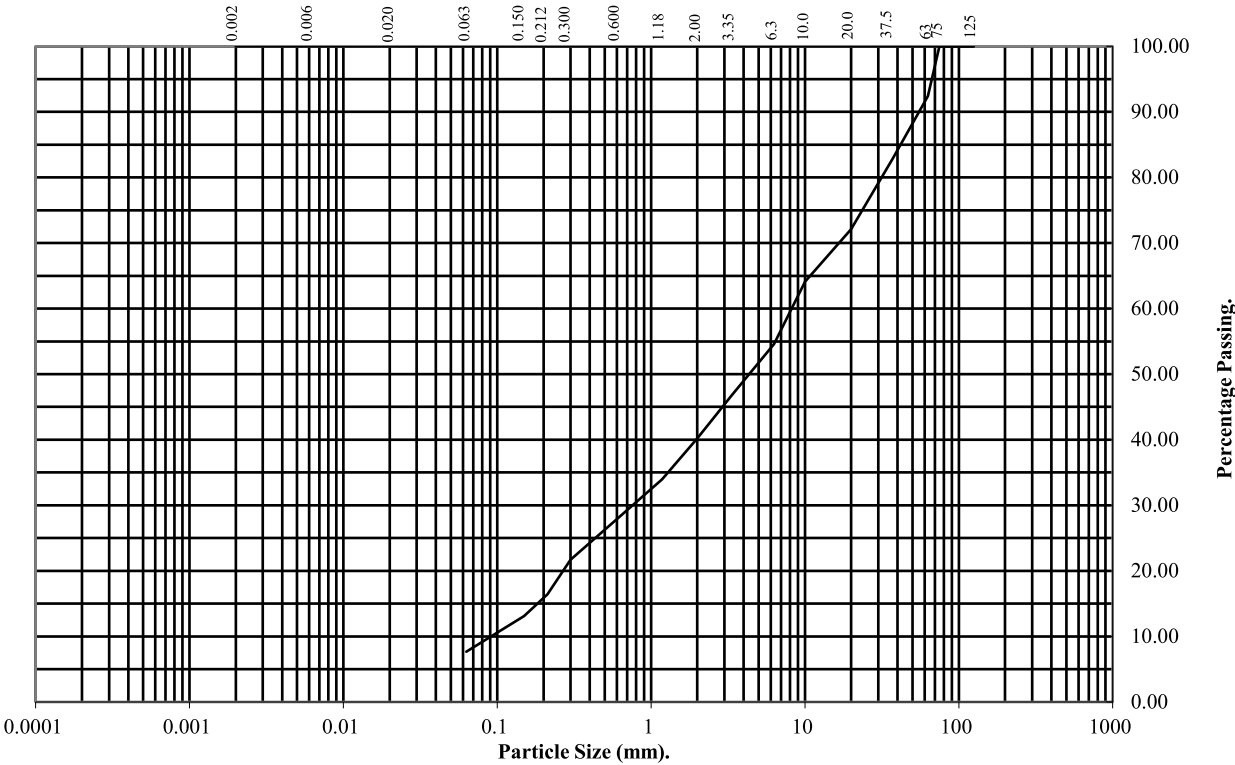
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: TP01 Top Depth (m): 0.20

Sample Number: Base Depth(m):

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	92
37.5	83
20	72
10	64
6.3	55
3.35	47
2	40
1.18	34
0.6	28
0.3	22
0.212	16
0.15	13
0.063	8

Soil Fraction	Total Percentage
Cobbles	8
Gravel	52
Sand	32
Silt/Clay	8

Remarks:

See Summary of Soil Descriptions



Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

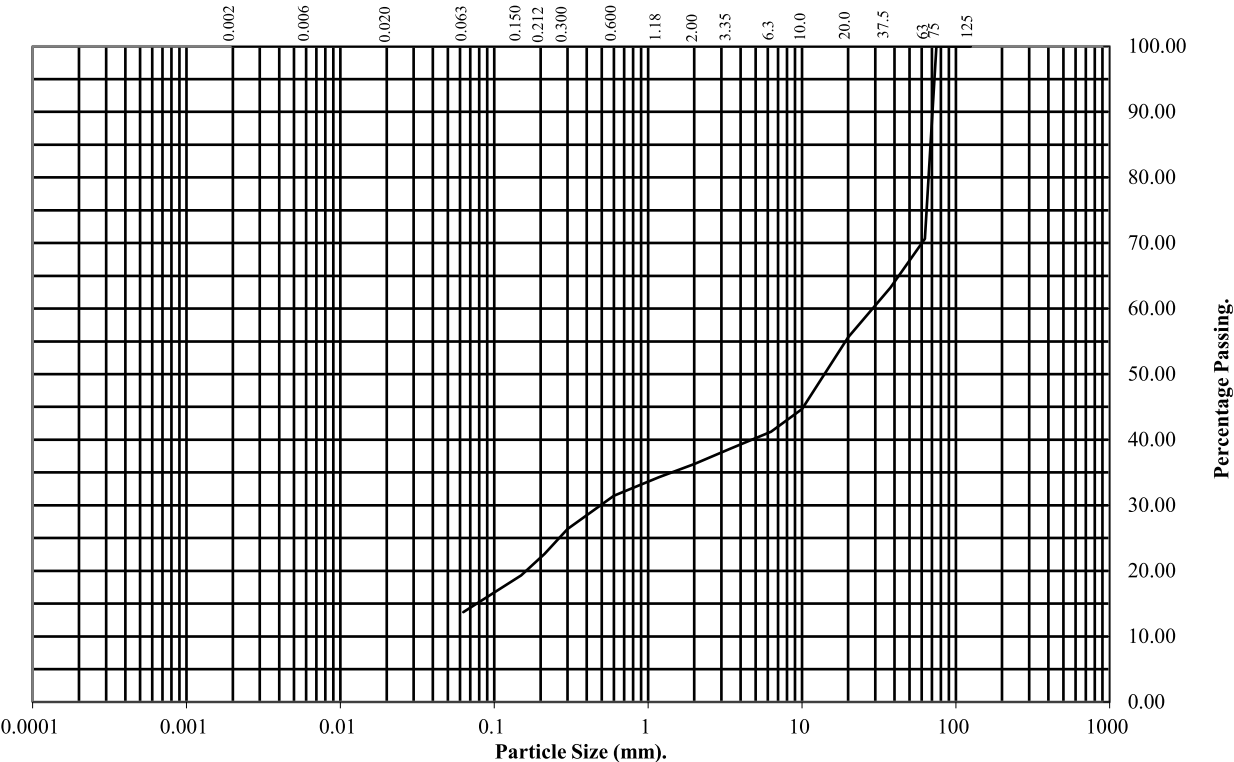
PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990
Wet Sieve, Clause 9.2

Hole Number: TP01 Top Depth (m): 1.50

Sample Number: Base Depth(m):

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	71
37.5	63
20	56
10	45
6.3	41
3.35	39
2	36
1.18	34
0.6	31
0.3	26
0.212	23
0.15	19
0.063	14

Soil Fraction	Total Percentage
Cobbles	29
Gravel	35
Sand	22
Silt/Clay	14

Remarks:
See Summary of Soil Descriptions



Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:

TP02

Top Depth (m):

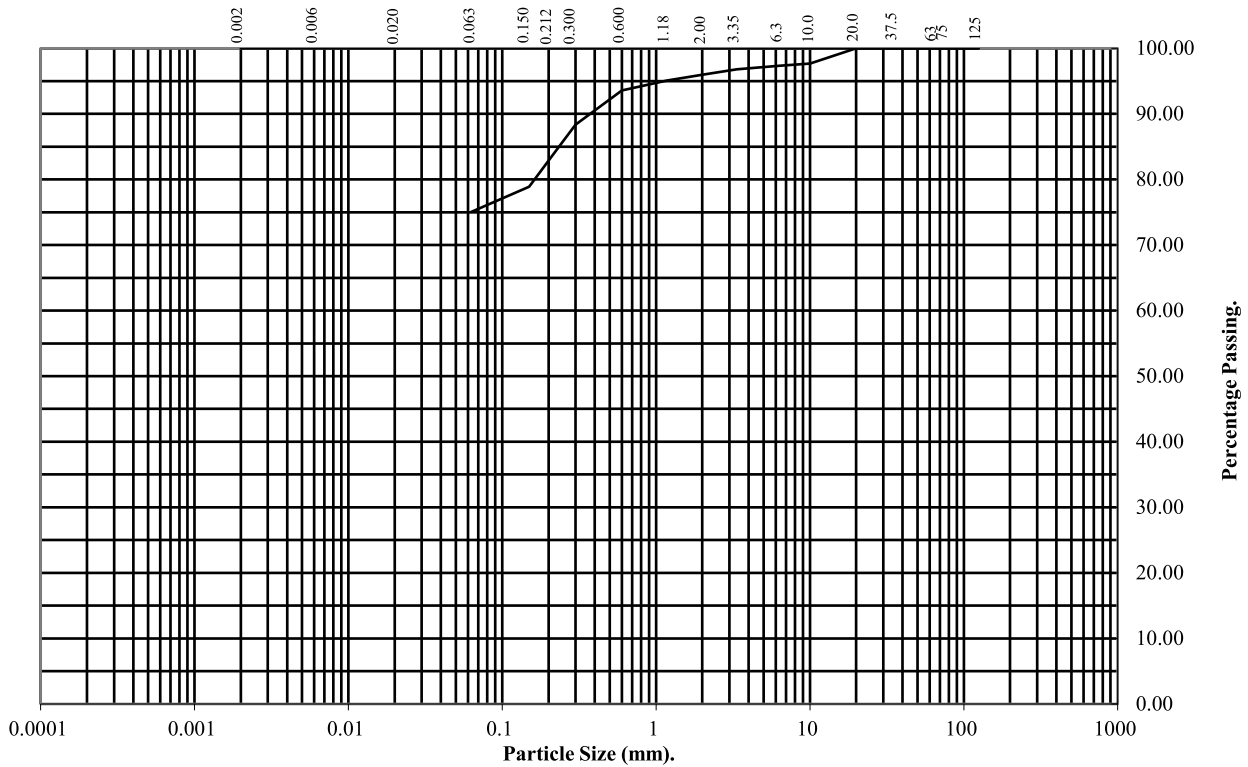
0.90

Sample Number:

Base Depth(m):

Sample Type:

B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	98
6.3	97
3.35	97
2	96
1.18	95
0.6	94
0.3	88
0.212	84
0.15	79
0.063	75

Soil Fraction	Total Percentage
Cobbles	0
Gravel	4
Sand	21
Silt/Clay	75

Remarks:

See Summary of Soil Descriptions



Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:

TP03

Top Depth (m):

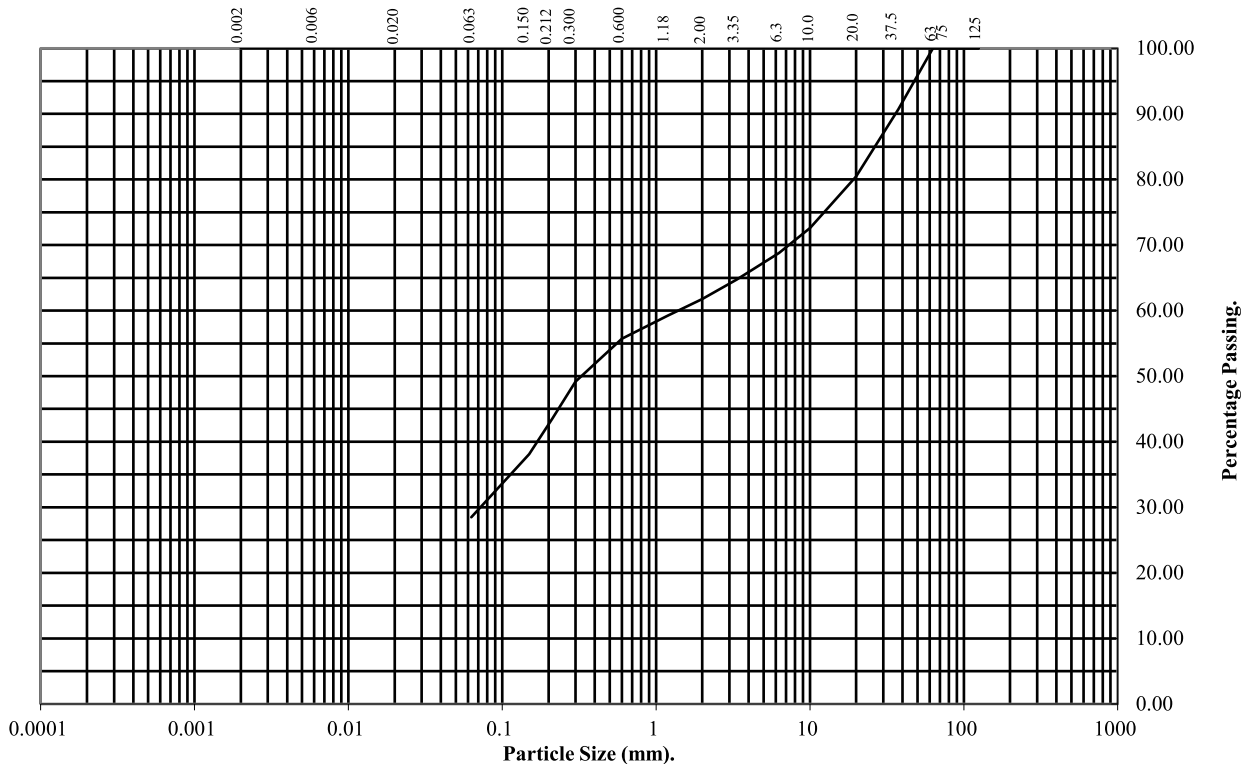
1.50

Sample Number:

Base Depth(m):

Sample Type:

B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	91
20	80
10	73
6.3	69
3.35	65
2	62
1.18	59
0.6	56
0.3	49
0.212	44
0.15	38
0.063	28

Soil Fraction	Total Percentage
Cobbles	0
Gravel	38
Sand	34
Silt/Clay	28

Remarks:

See Summary of Soil Descriptions



Hollingworth Gate - Littleborough

Contract No:

PSL23/4181

Client Ref:

GRO-23131

PARTICLE SIZE DISTRIBUTION TEST

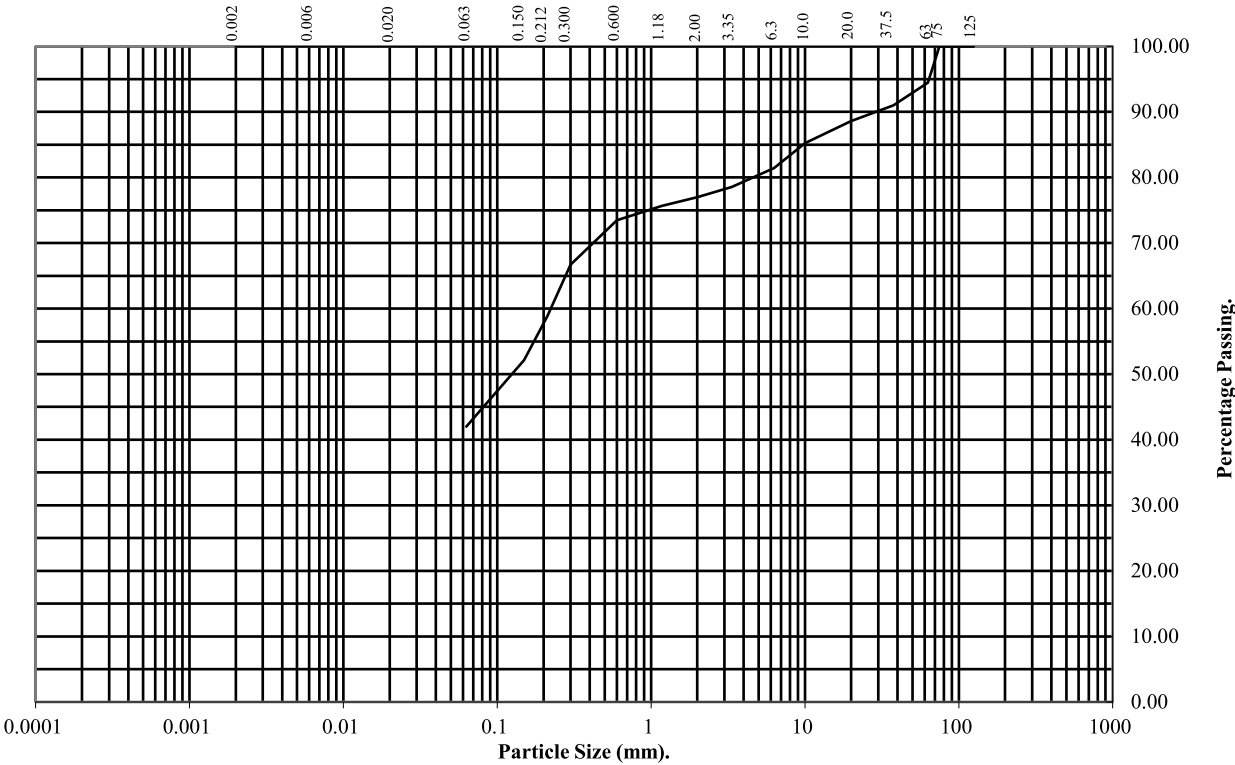
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: TP03 Top Depth (m): 2.50

Sample Number: Base Depth(m):

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	94
37.5	91
20	89
10	85
6.3	81
3.35	79
2	77
1.18	76
0.6	73
0.3	67
0.212	59
0.15	52
0.063	42

Soil Fraction	Total Percentage
Cobbles	6
Gravel	17
Sand	35
Silt/Clay	42

Remarks:
See Summary of Soil Descriptions



Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

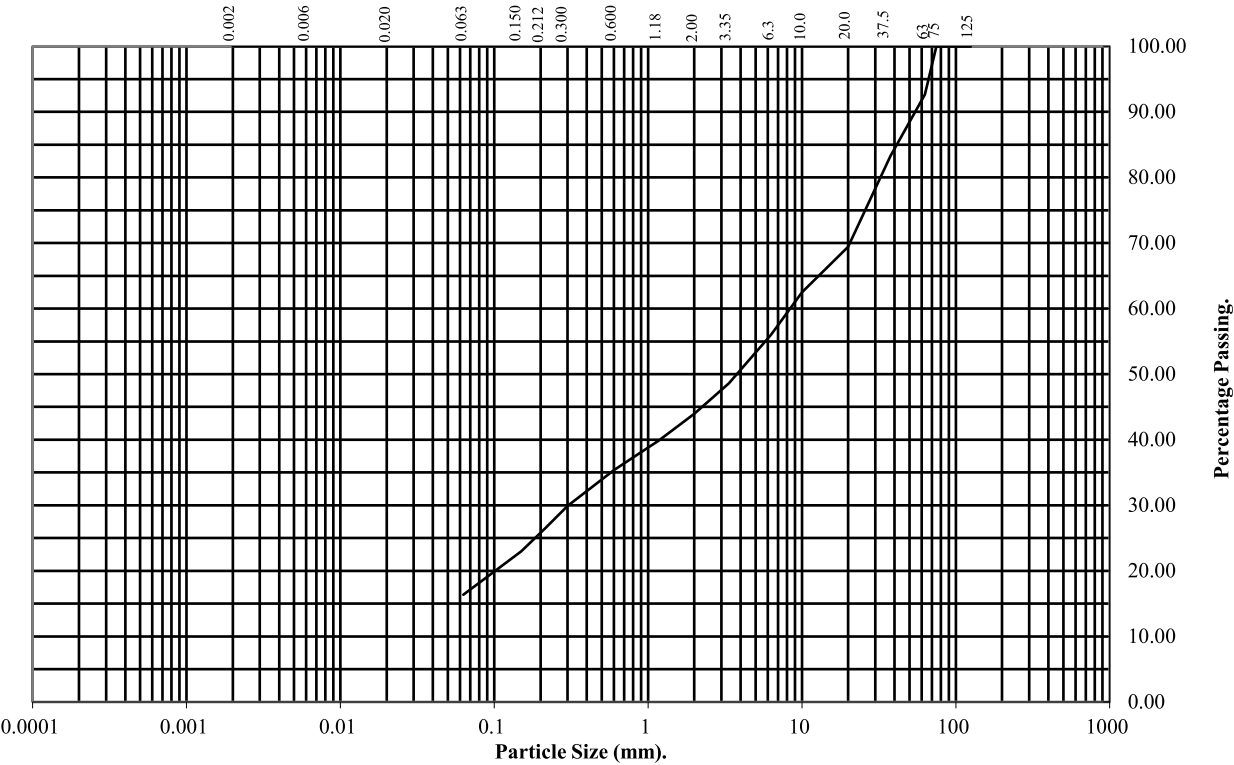
PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990
Wet Sieve, Clause 9.2

Hole Number: TP04 Top Depth (m): 0.50

Sample Number: Base Depth(m):

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	93
37.5	83
20	69
10	62
6.3	56
3.35	49
2	44
1.18	40
0.6	35
0.3	30
0.212	26
0.15	23
0.063	16

Soil Fraction	Total Percentage
Cobbles	7
Gravel	49
Sand	28
Silt/Clay	16

Remarks:
See Summary of Soil Descriptions



Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

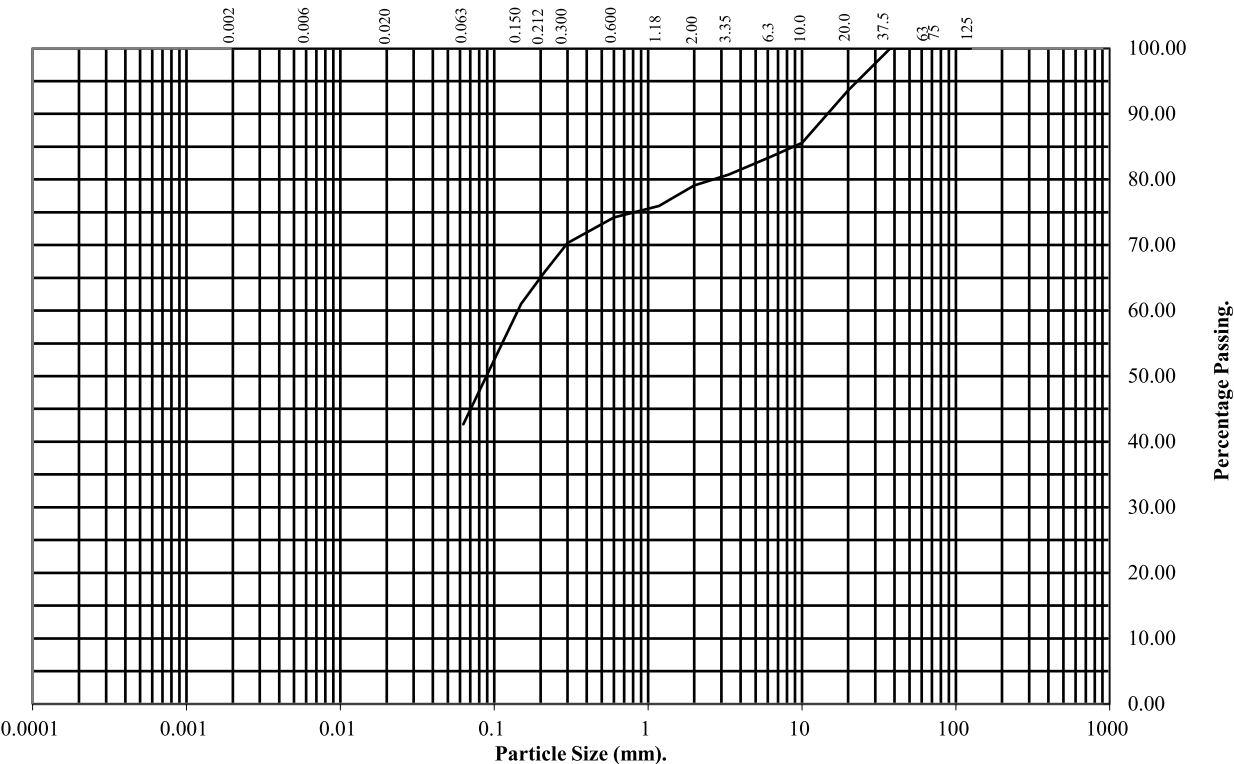
PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990
Wet Sieve, Clause 9.2

Hole Number: TP06 Top Depth (m): 1.00

Sample Number: Base Depth(m):

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	94
10	86
6.3	83
3.35	81
2	79
1.18	76
0.6	74
0.3	70
0.212	66
0.15	61
0.063	43

Soil Fraction	Total Percentage
Cobbles	0
Gravel	21
Sand	36
Silt/Clay	43

Remarks:
See Summary of Soil Descriptions



Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:

TP07

Top Depth (m):

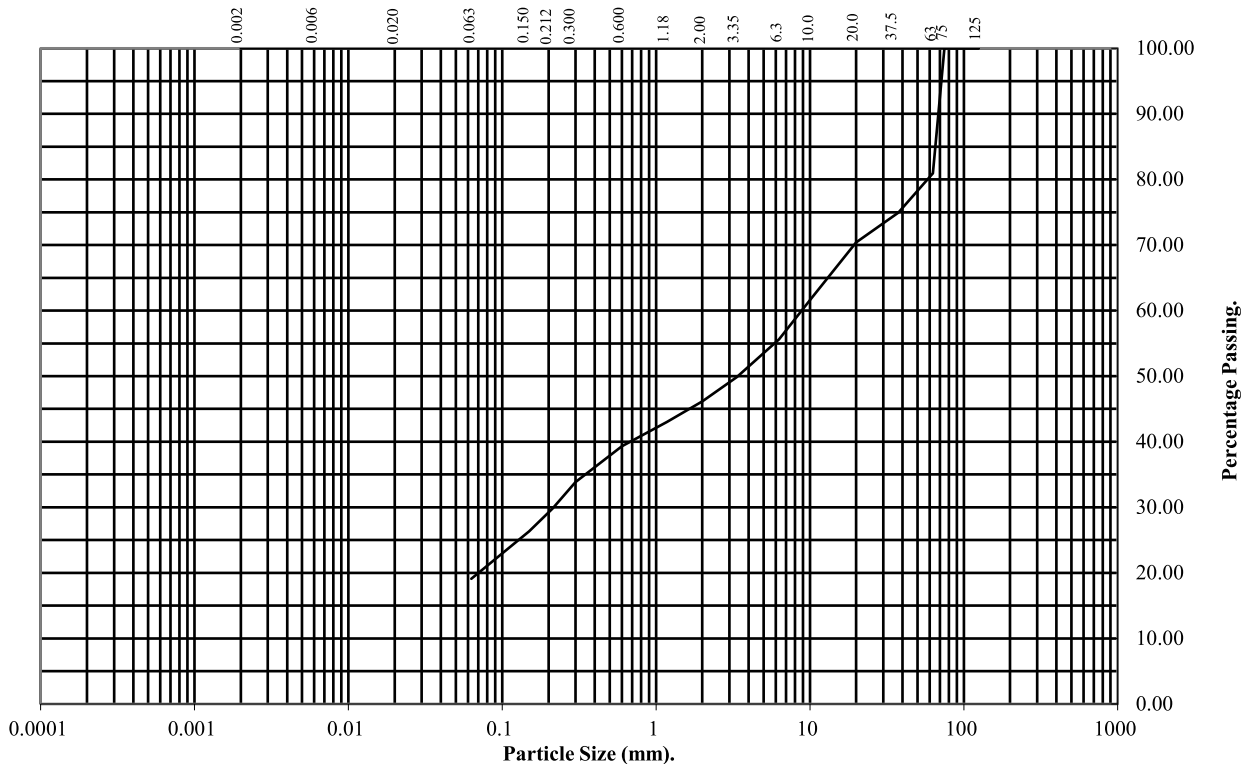
0.50

Sample Number:

Base Depth(m):

Sample Type:

B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	81
37.5	75
20	70
10	62
6.3	56
3.35	50
2	46
1.18	43
0.6	39
0.3	34
0.212	30
0.15	26
0.063	19

Soil Fraction	Total Percentage
Cobbles	19
Gravel	35
Sand	27
Silt/Clay	19

Remarks:

See Summary of Soil Descriptions



Hollingworth Gate - Littleborough

Contract No:

PSL23/4181

Client Ref:

GRO-23131

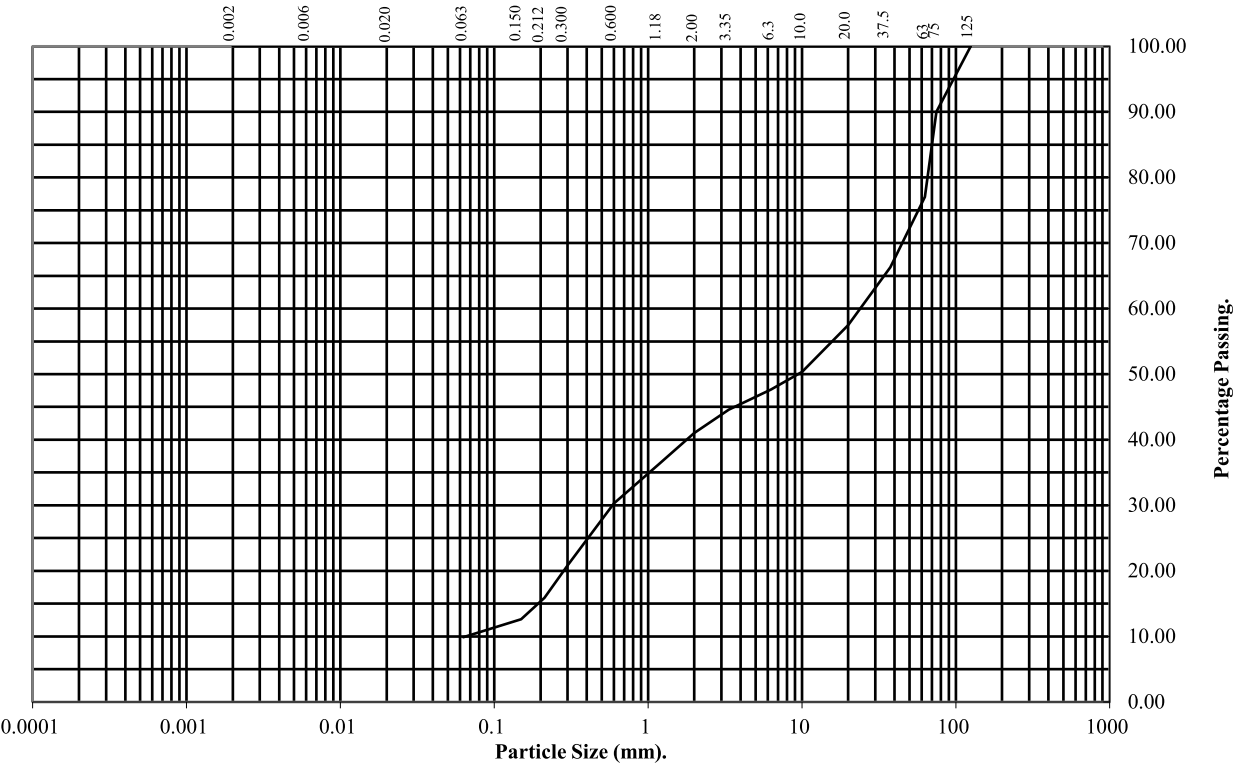
PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990
Wet Sieve, Clause 9.2

Hole Number: TP07 Top Depth (m): 1.50

Sample Number: Base Depth(m):

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	90
63	77
37.5	66
20	57
10	50
6.3	48
3.35	45
2	41
1.18	36
0.6	30
0.3	21
0.212	16
0.15	13
0.063	10

Soil Fraction	Total Percentage
Cobbles	23
Gravel	36
Sand	31
Silt/Clay	10

Remarks:
See Summary of Soil Descriptions



Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number:

TP08

Top Depth (m):

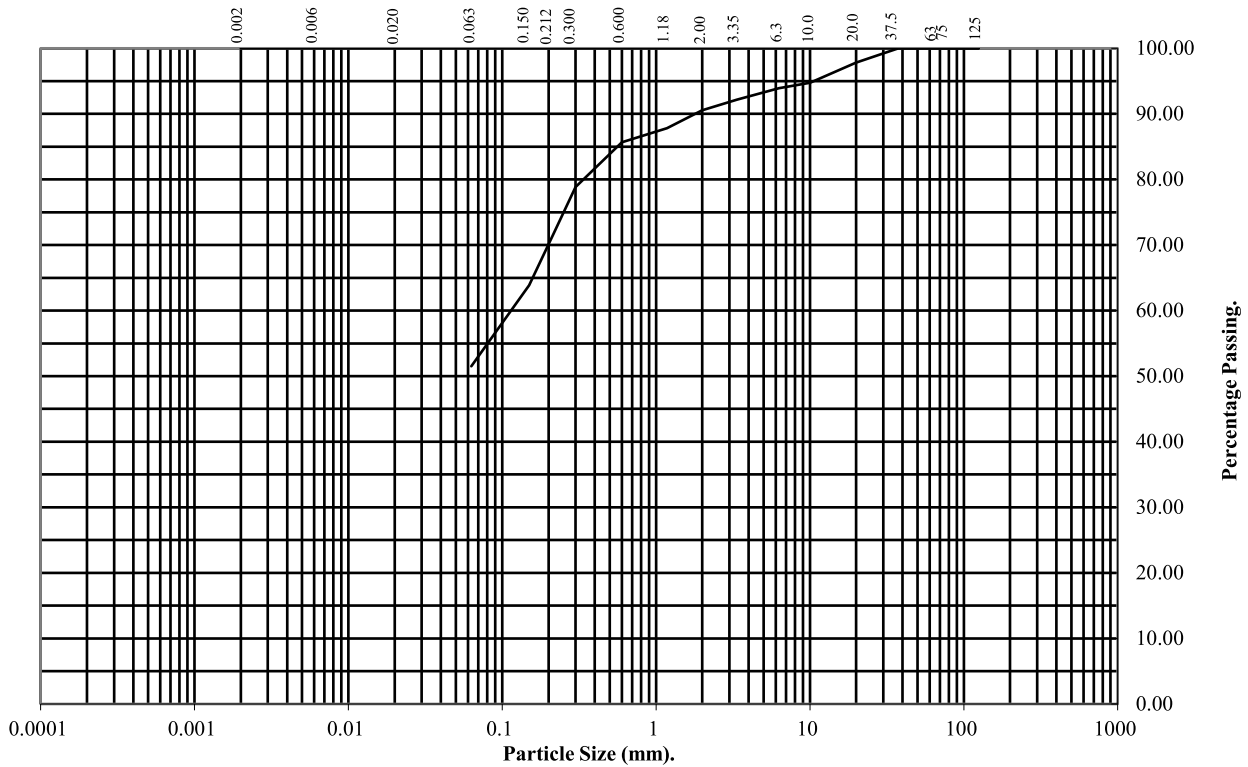
0.50

Sample Number:

Base Depth(m):

Sample Type:

B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	98
10	95
6.3	94
3.35	92
2	91
1.18	88
0.6	86
0.3	79
0.212	71
0.15	64
0.063	52

Soil Fraction	Total Percentage
Cobbles	0
Gravel	9
Sand	39
Silt/Clay	52

Remarks:

See Summary of Soil Descriptions



Hollingworth Gate - Littleborough

Contract No:

PSL23/4181

Client Ref:

GRO-23131

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.4 : 1990

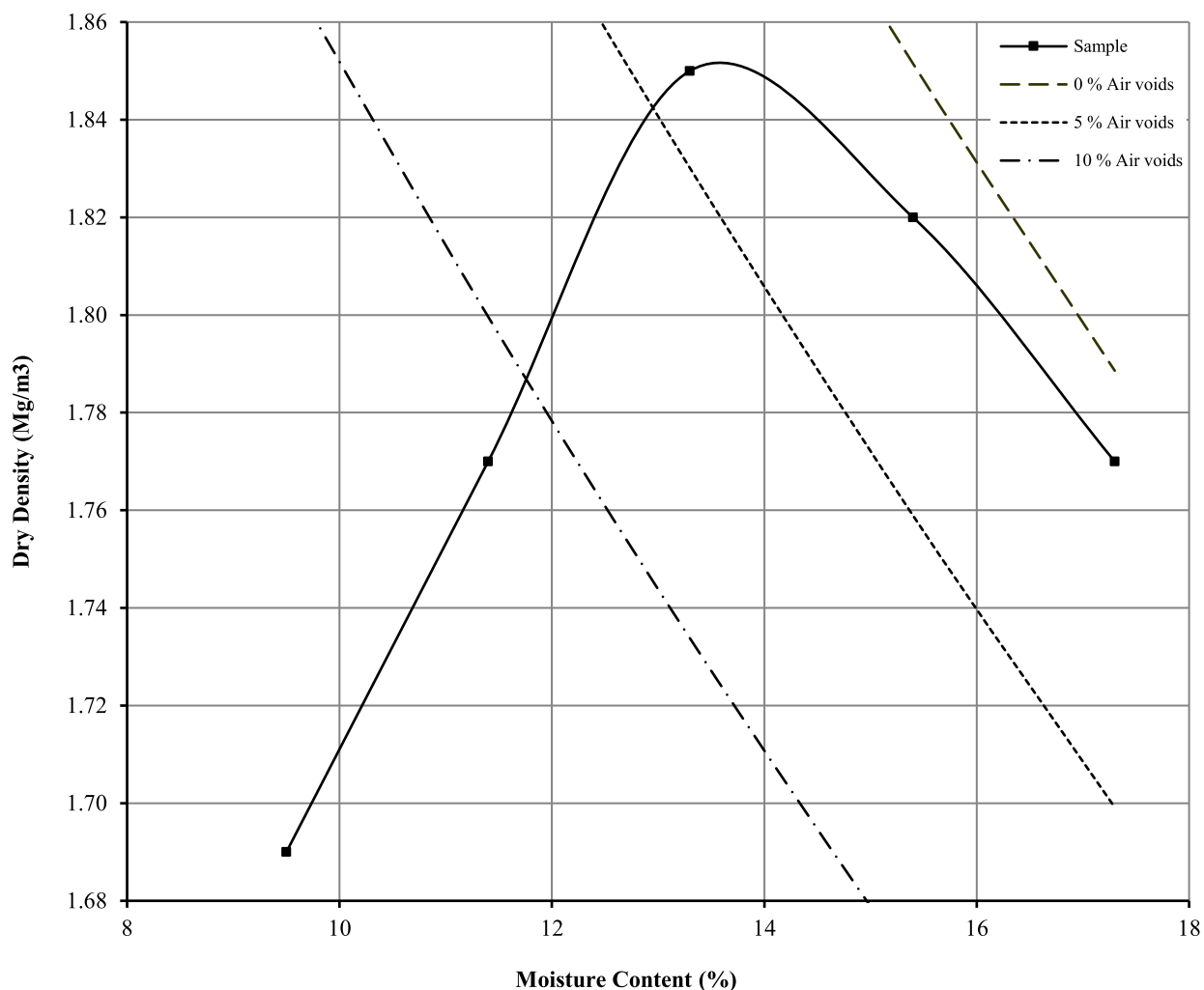
Hole Number: TP01

Top Depth (m) : 0.20

Sample Number:

Base Depth (m) :

Sample Type: B



Initial Moisture Content:	11	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m3):	2.59	Assumed	Material Retained on 37.5 mm Test Sieve (%):	17
Maximum Dry Density (Mg/m3):	1.85		Material Retained on 20.0 mm Test Sieve (%):	11
Optimum Moisture Content (%):	13			
Remarks See summary of soil descriptions				



Hollingworth Gate - Littleborough

Contract
PSL23/4181
Client Ref
GRO-23131

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.4 : 1990

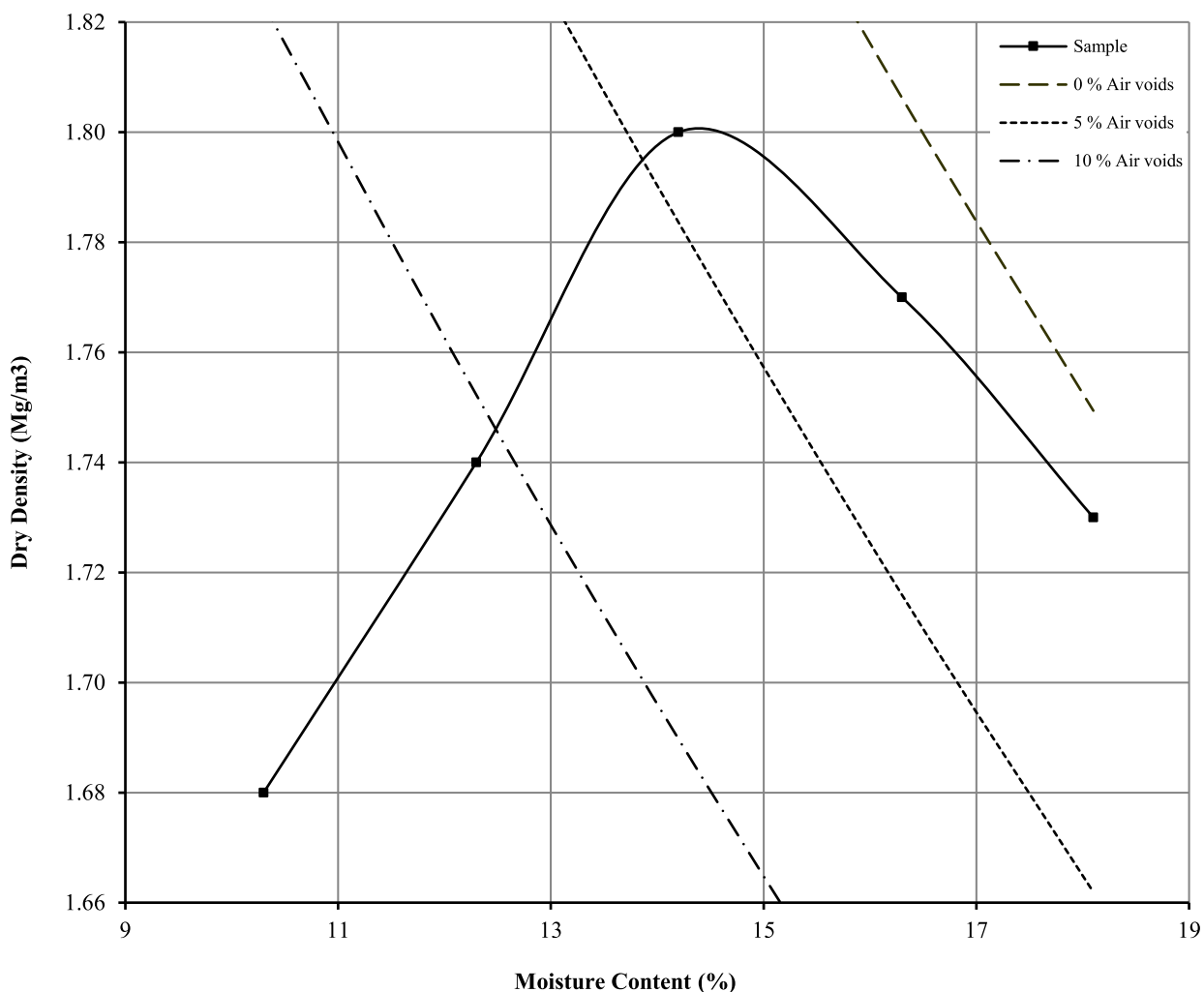
Hole Number: TP01

Top Depth (m) : 1.50

Sample Number:

Base Depth (m) :

Sample Type: B



Initial Moisture Content:	18	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m3):	2.56	Assumed	Material Retained on 37.5 mm Test Sieve (%):	37
Maximum Dry Density (Mg/m3):	1.80		Material Retained on 20.0 mm Test Sieve (%):	7
Optimum Moisture Content (%):	14			
Remarks See summary of soil descriptions				



Hollingworth Gate - Littleborough

Contract
PSL23/4181
Client Ref
GRO-23131

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.3 : 1990

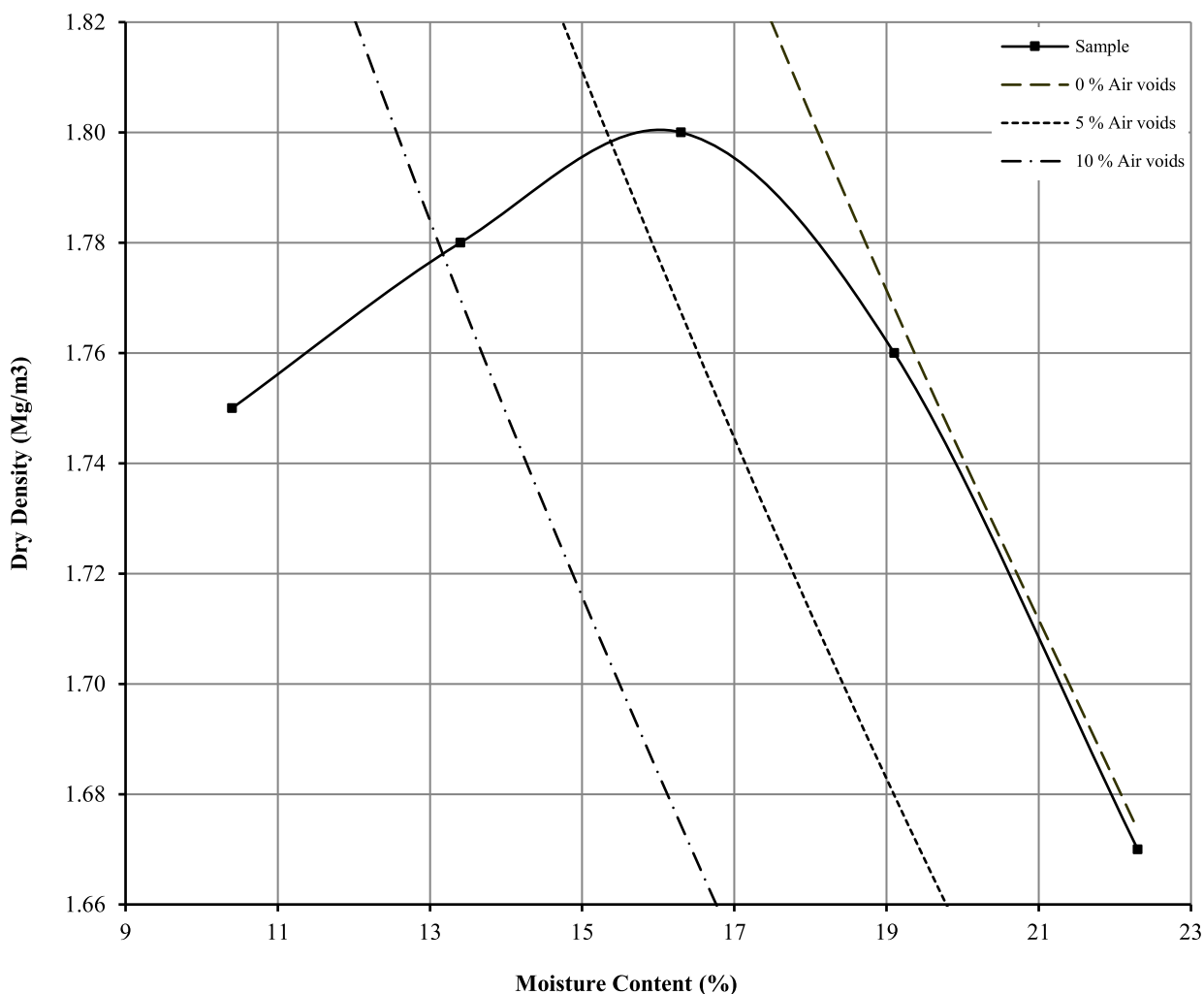
Hole Number: TP02

Top Depth (m) : 0.90

Sample Number:

Base Depth (m) :

Sample Type: B



Initial Moisture Content:	19	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m ³):	2.67	Assumed	Material Retained on 37.5 mm Test Sieve (%):	0
Maximum Dry Density (Mg/m ³):	1.80		Material Retained on 20.0 mm Test Sieve (%):	0
Optimum Moisture Content (%):	16			
Remarks See summary of soil descriptions				



Hollingworth Gate - Littleborough

Contract
PSL23/4181
Client Ref
GRO-23131

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.4 : 1990

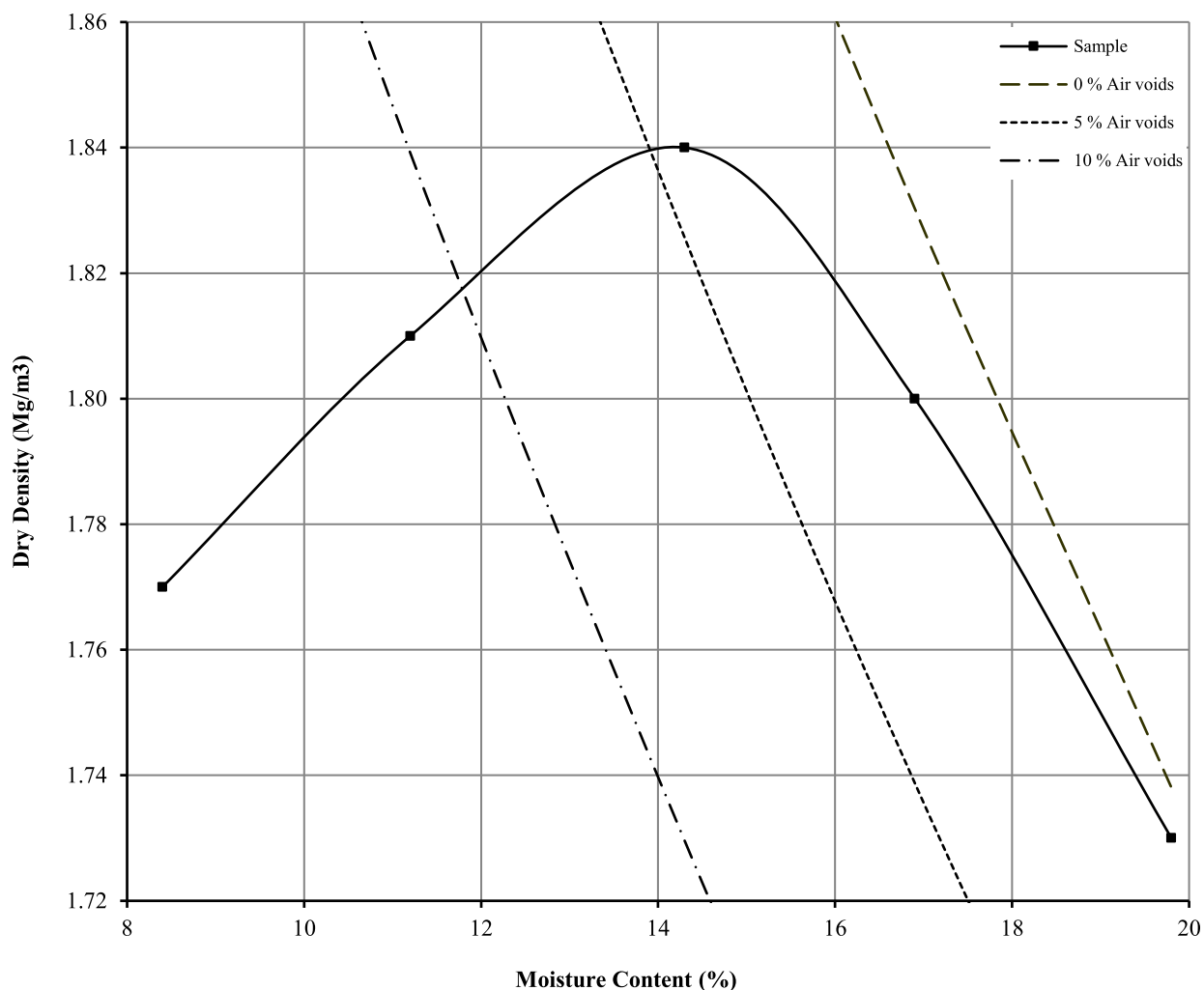
Hole Number: TP03

Top Depth (m) : 1.50

Sample Number:

Base Depth (m) :

Sample Type: B



Initial Moisture Content:	17	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m ³):	2.65	Assumed	Material Retained on 37.5 mm Test Sieve (%):	9
Maximum Dry Density (Mg/m ³):	1.84		Material Retained on 20.0 mm Test Sieve (%):	11
Optimum Moisture Content (%):	14			
Remarks See summary of soil descriptions				



Hollingworth Gate - Littleborough

Contract
PSL23/4181
Client Ref
GRO-23131

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.4 : 1990

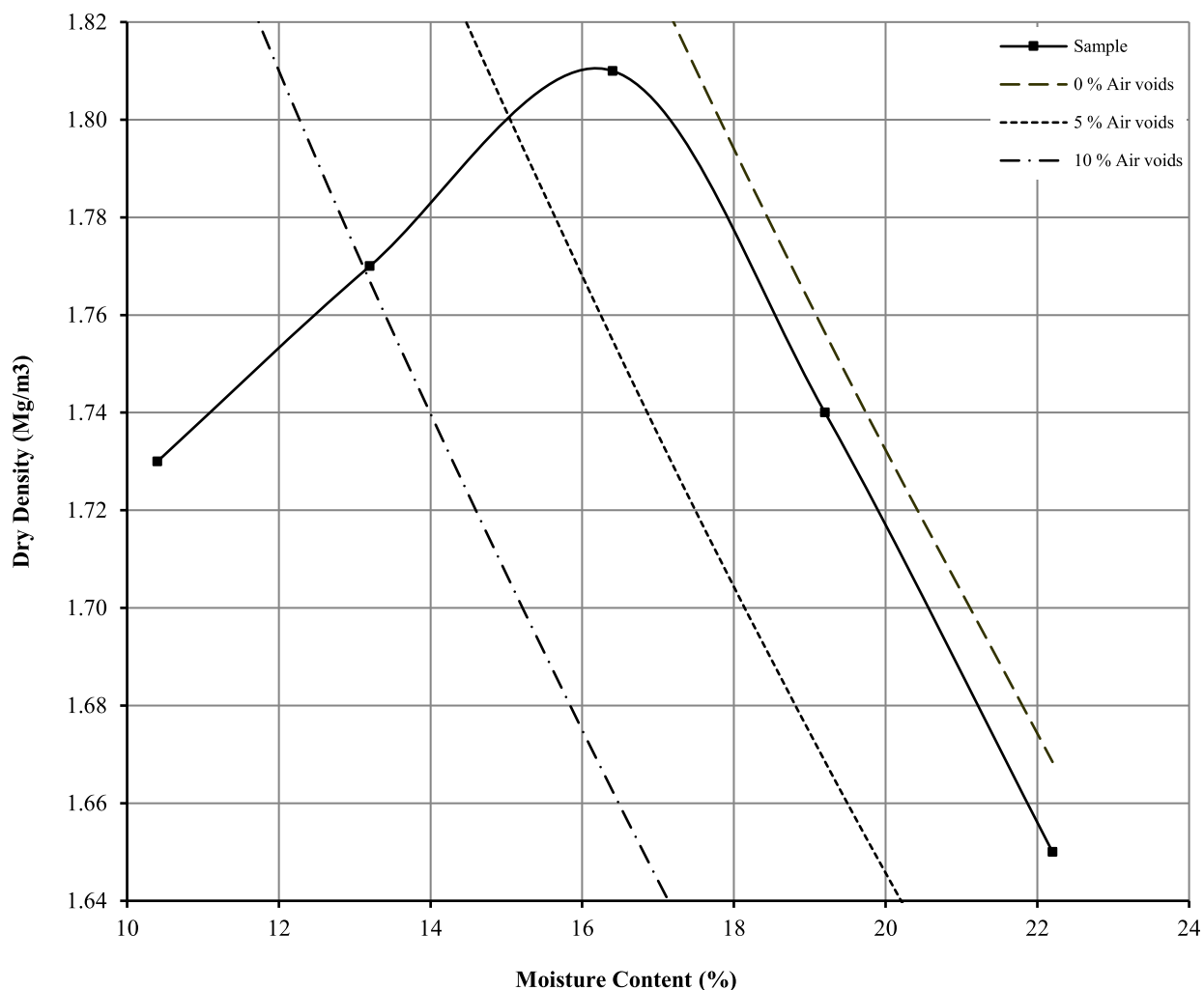
Hole Number: TP03

Top Depth (m) : 2.50

Sample Number:

Base Depth (m) :

Sample Type: B



Initial Moisture Content:	13	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m ³):	2.65	Assumed	Material Retained on 37.5 mm Test Sieve (%):	9
Maximum Dry Density (Mg/m ³):	1.81		Material Retained on 20.0 mm Test Sieve (%):	2
Optimum Moisture Content (%):	16			
Remarks See summary of soil descriptions				



Hollingworth Gate - Littleborough

Contract
PSL23/4181
Client Ref
GRO-23131

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.4 : 1990

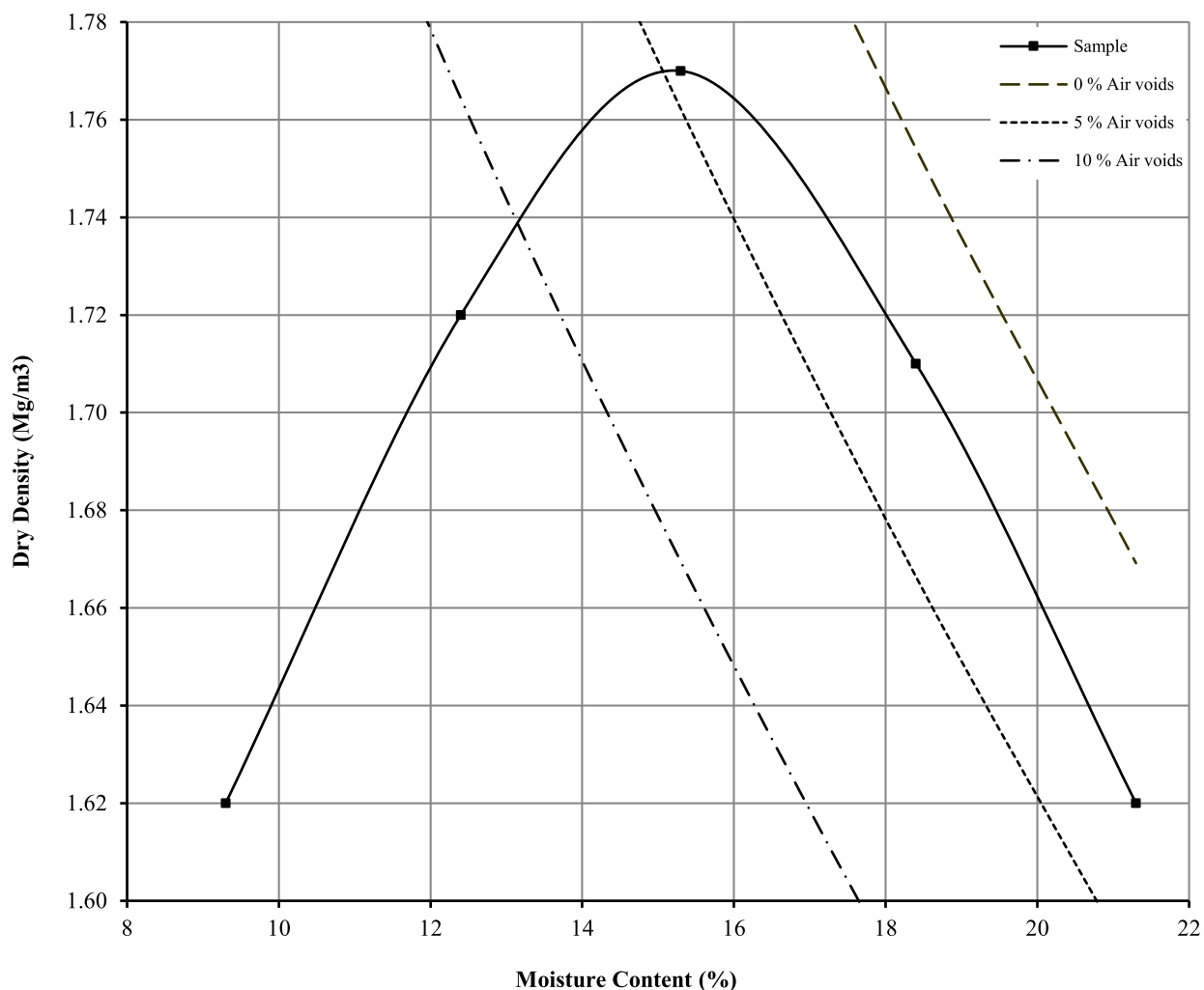
Hole Number: TP04

Top Depth (m) : 0.50

Sample Number:

Base Depth (m) :

Sample Type: B



Initial Moisture Content:	18	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m3):	2.59	Assumed	Material Retained on 37.5 mm Test Sieve (%):	17
Maximum Dry Density (Mg/m3):	1.77		Material Retained on 20.0 mm Test Sieve (%):	14
Optimum Moisture Content (%):	15			
Remarks See summary of soil descriptions				

		Hollingsworth Gate - Littleborough	Contract
			PSL23/4181
			Client Ref
			GRO-23131

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.4 : 1990

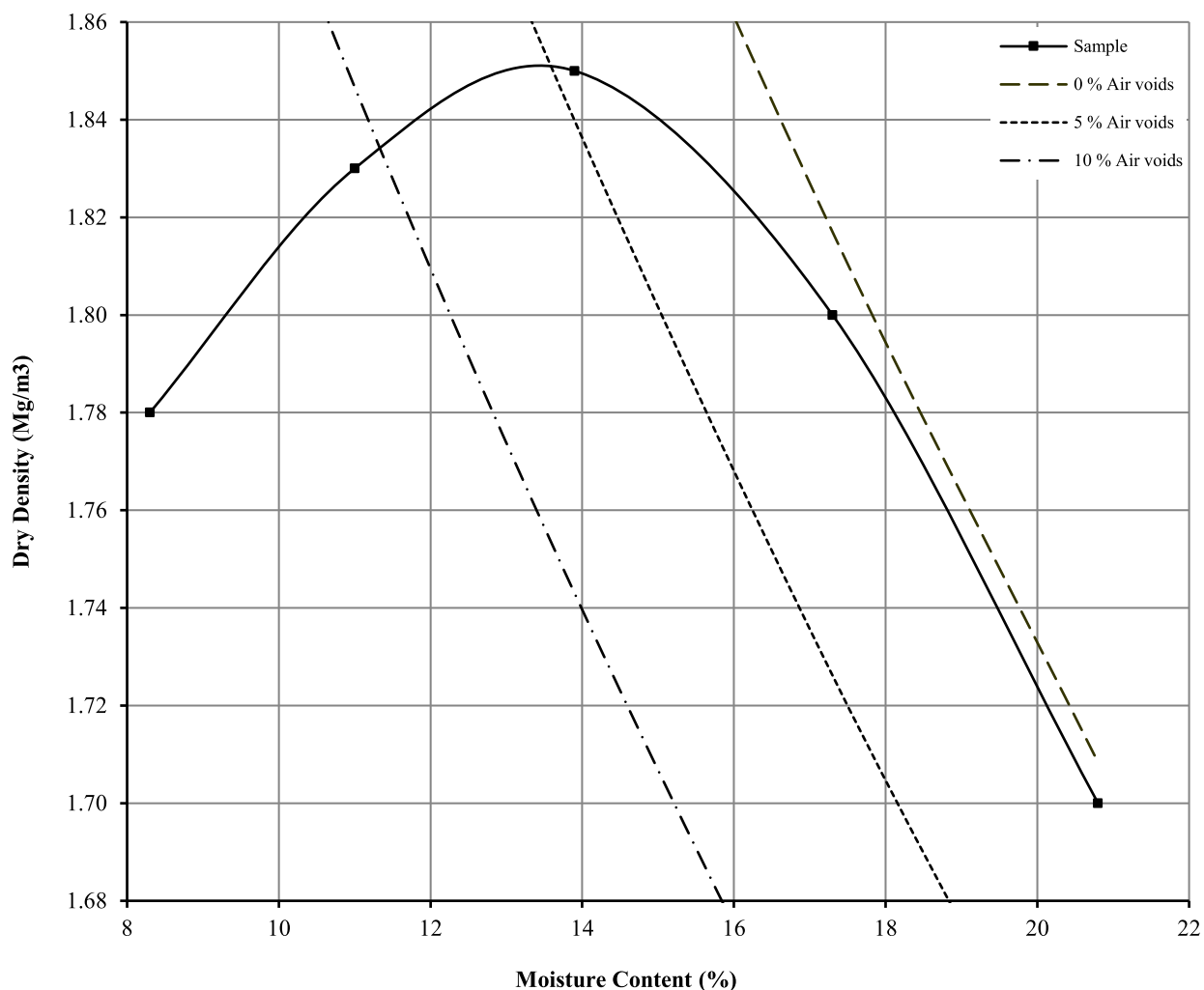
Hole Number: TP06

Top Depth (m) : 1.00

Sample Number:

Base Depth (m) :

Sample Type: B



Initial Moisture Content:	14	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m ³):	2.65	Assumed	Material Retained on 37.5 mm Test Sieve (%):	0
Maximum Dry Density (Mg/m ³):	1.85		Material Retained on 20.0 mm Test Sieve (%):	6
Optimum Moisture Content (%):	14			
Remarks See summary of soil descriptions				



Hollingworth Gate - Littleborough

Contract
PSL23/4181
Client Ref
GRO-23131

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.4 : 1990

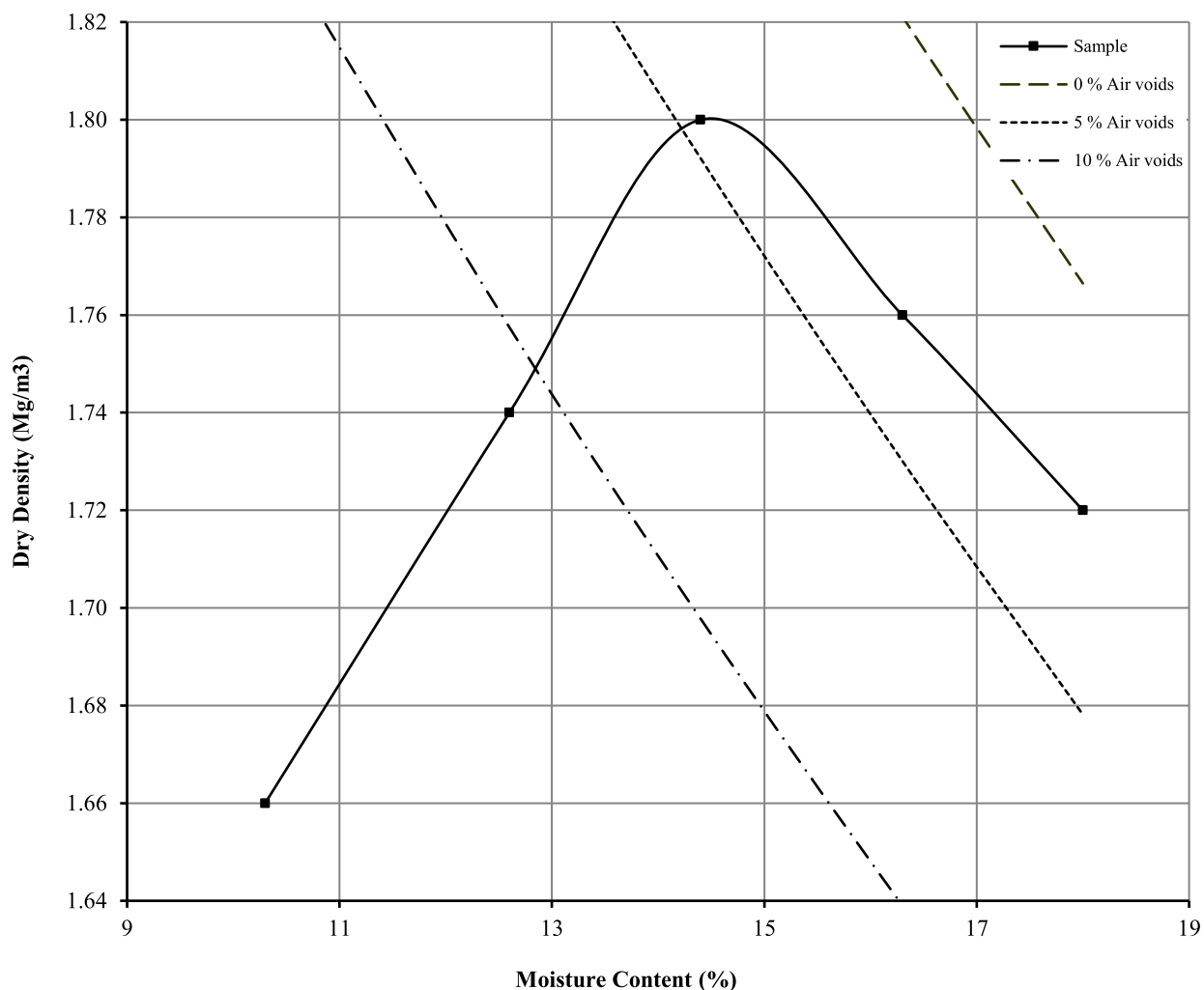
Hole Number: TP07

Top Depth (m) : 0.50

Sample Number:

Base Depth (m) :

Sample Type: B



Initial Moisture Content:	18	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m3):	2.59	Assumed	Material Retained on 37.5 mm Test Sieve (%):	25
Maximum Dry Density (Mg/m3):	1.80		Material Retained on 20.0 mm Test Sieve (%):	5
Optimum Moisture Content (%):	14			
Remarks See summary of soil descriptions				



Hollingworth Gate - Littleborough

Contract
PSL23/4181
Client Ref
GRO-23131

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.4 : 1990

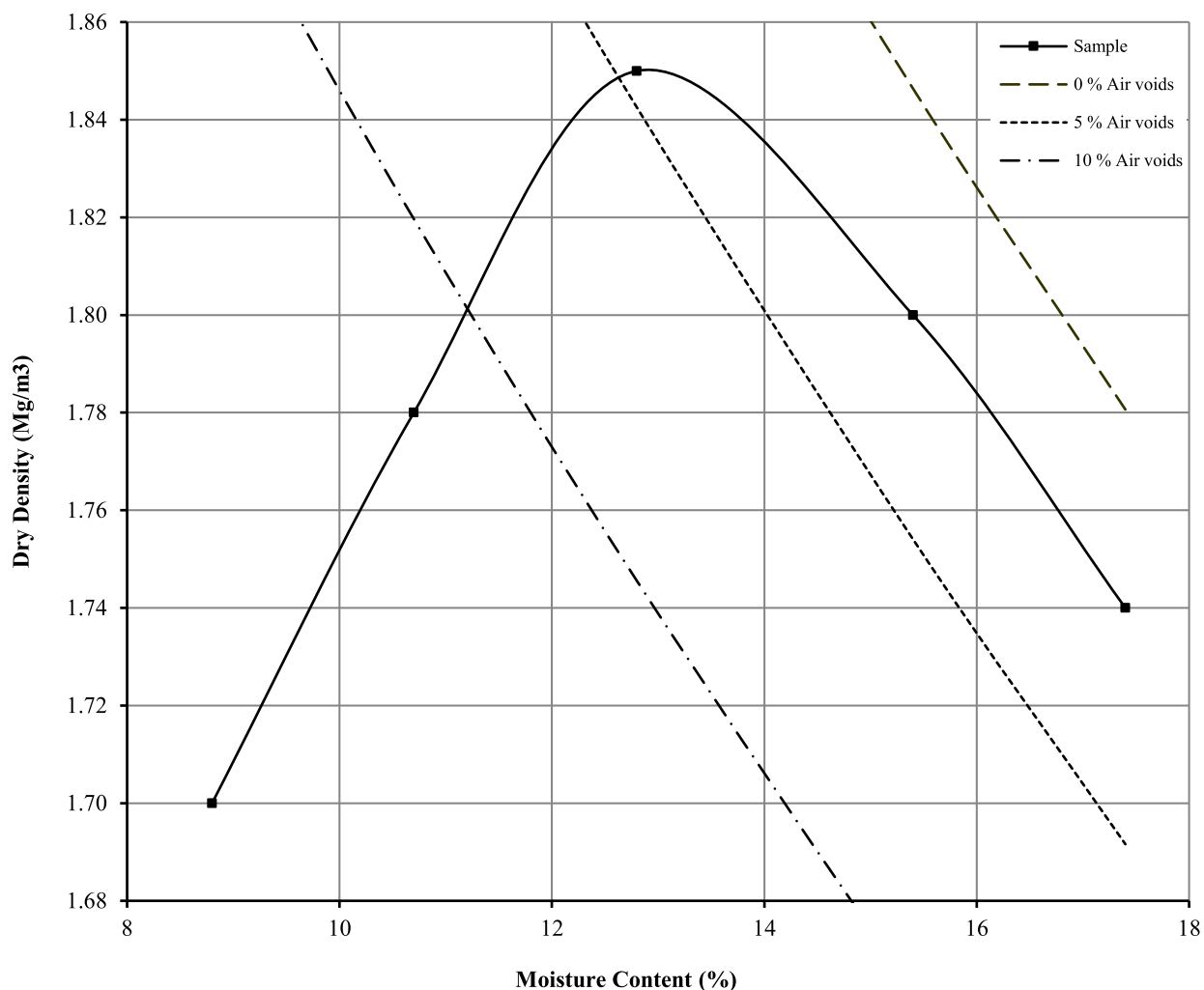
Hole Number: TP07

Top Depth (m) : 1.50

Sample Number:

Base Depth (m) :

Sample Type: B



Initial Moisture Content:	13	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m3):	2.58	Assumed	Material Retained on 37.5 mm Test Sieve (%):	34
Maximum Dry Density (Mg/m3):	1.85		Material Retained on 20.0 mm Test Sieve (%):	9
Optimum Moisture Content (%):	13			
Remarks See summary of soil descriptions				

		Hollingworth Gate - Littleborough	Contract
			PSL23/4181
			Client Ref
			GRO-23131

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.3 : 1990

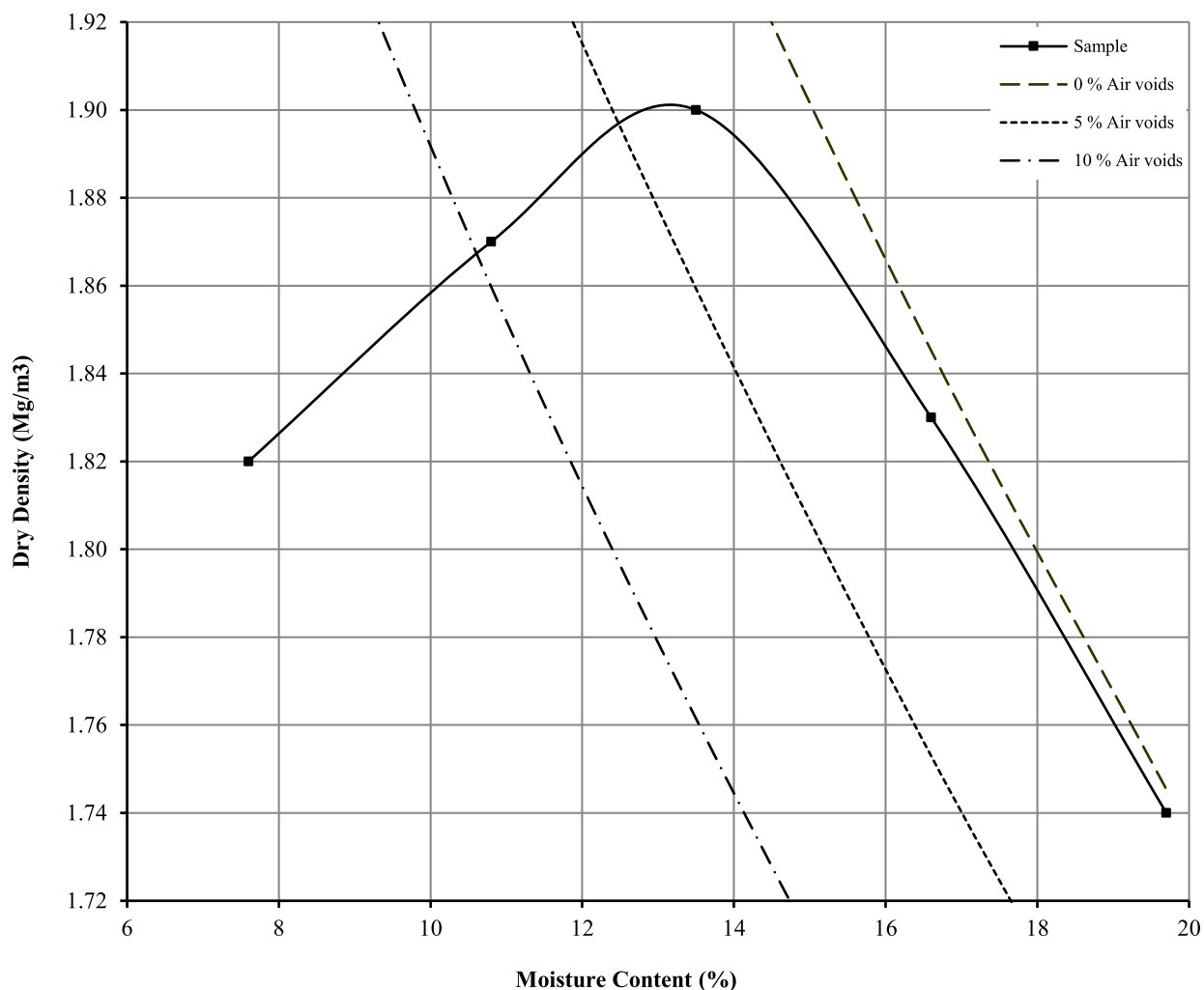
Hole Number: TP08

Top Depth (m) : 0.50

Sample Number:

Base Depth (m) :

Sample Type: B



Initial Moisture Content:	11	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m ³):	2.66	Assumed	Material Retained on 37.5 mm Test Sieve (%):	0
Maximum Dry Density (Mg/m ³):	1.90		Material Retained on 20.0 mm Test Sieve (%):	2
Optimum Moisture Content (%):	14			
Remarks See summary of soil descriptions				



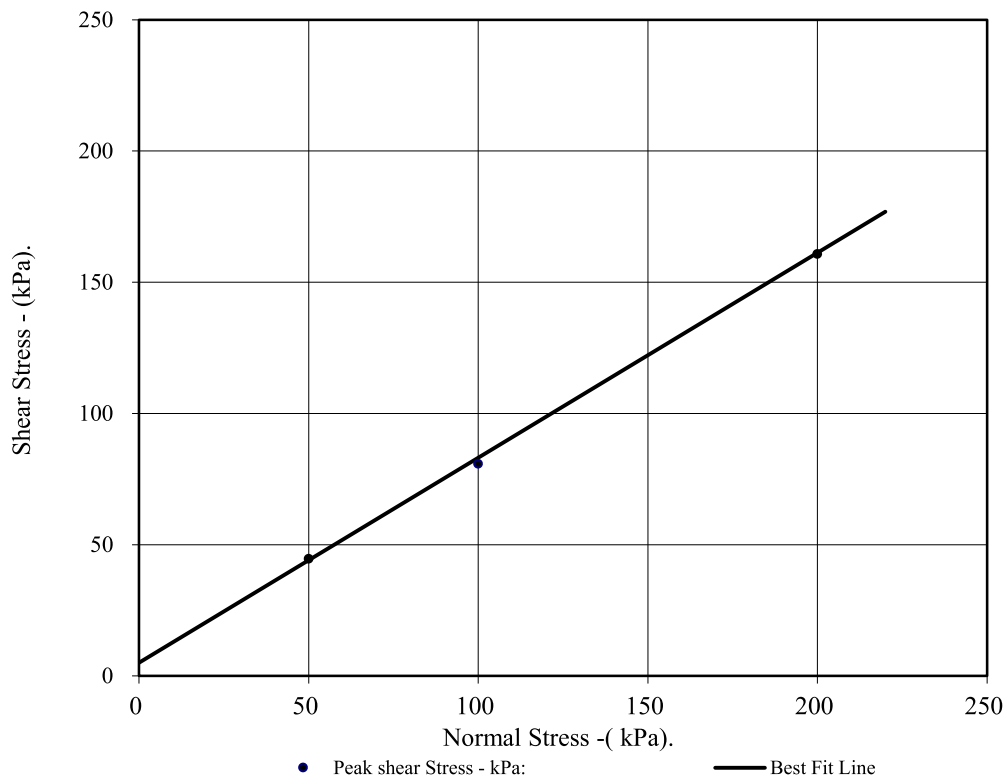
Hollingworth Gate - Littleborough

Contract
PSL23/4181
Client Ref
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP01		Top Depth:	0.20	
Sample Number:			Base Depth:		
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Material tested passing 2mm sieve Remoulded to 95% of MDD				
Sample Description:	See summary of soil descriptions.				
STAGE			1	2	3
Initial Conditions					
Height - mm:			20.05	20.05	20.05
Length - mm:			59.97	59.97	59.97
Moisture Content - %:			13	13	13
Bulk Density - Mg/m3:			2.00	2.00	2.00
Dry Density - Mg/m3:			1.76	1.76	1.76
Voids Ratio:			0.504	0.504	0.504
Normal Pressure- kPa			50	100	200
Consolidation Stage					
Consolidated Height - mm:			18.81	18.46	18.19
Shearing Stage					
Rate of Strain - mm/min			0.056	0.056	0.056
Displacement at peak shear stress - mm			6.30	6.30	8.40
Peak shear Stress - kPa:			45	81	161
Final Consolidated Conditions					
Moisture Content - %:			20	19	18
Bulk Density - Mg/m3:			2.13	2.17	2.20
Dry Density - Mg/m3:			1.77	1.83	1.87
Peak					
Angle of Shearing Resistance:(θ)			38		
Effective Cohesion - kPa:			5		



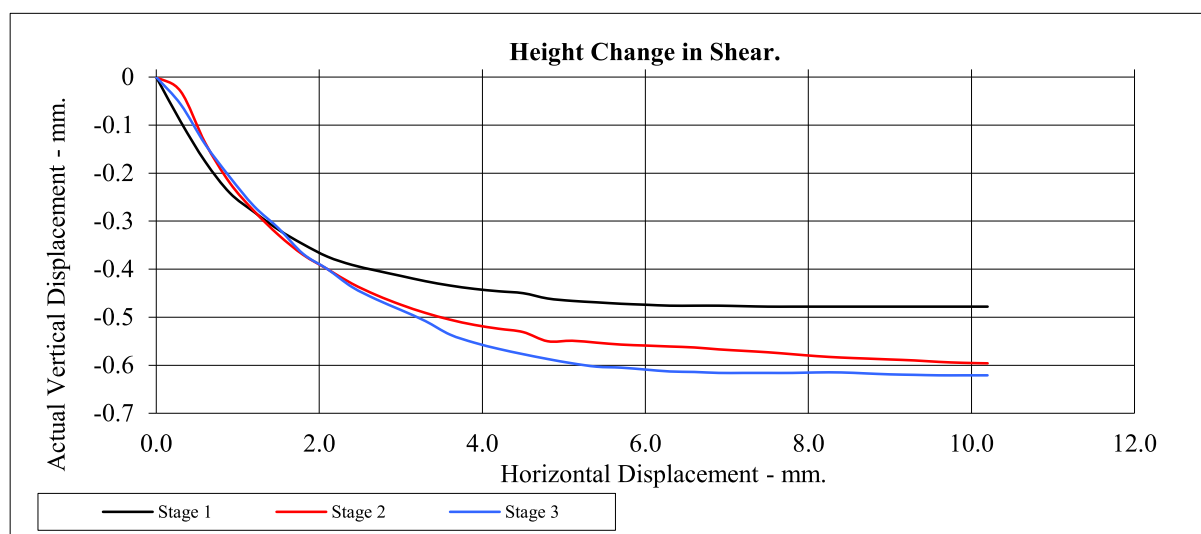
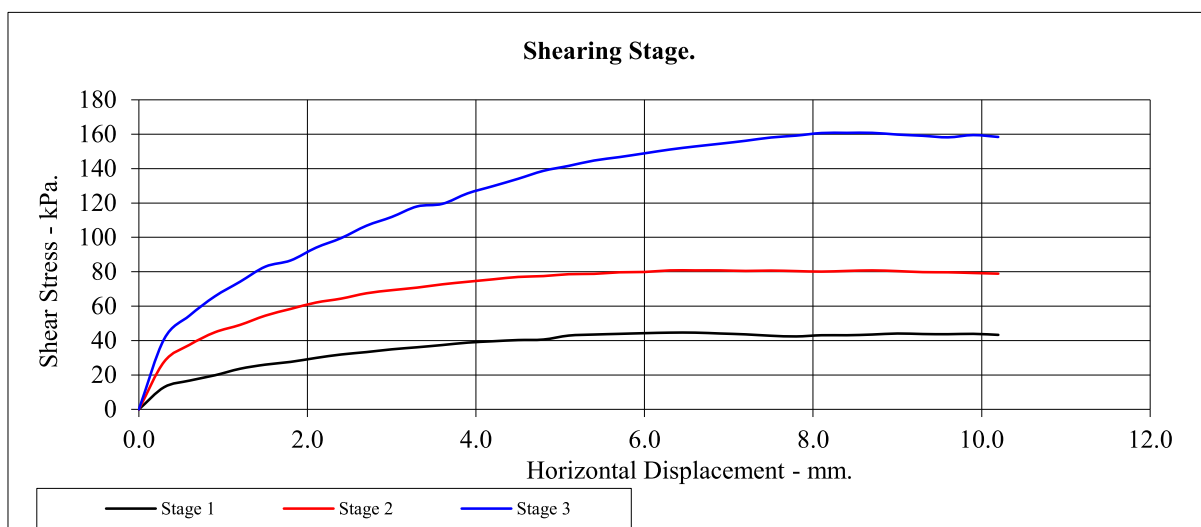
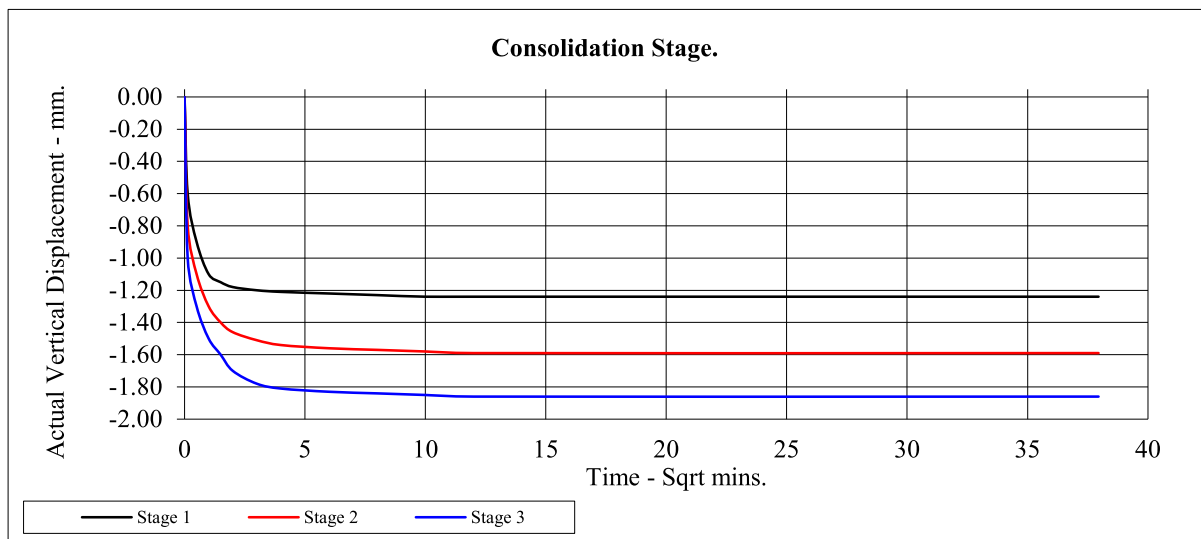
Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP01	Top Depth:	0.20
Sample Number:		Base Depth:	



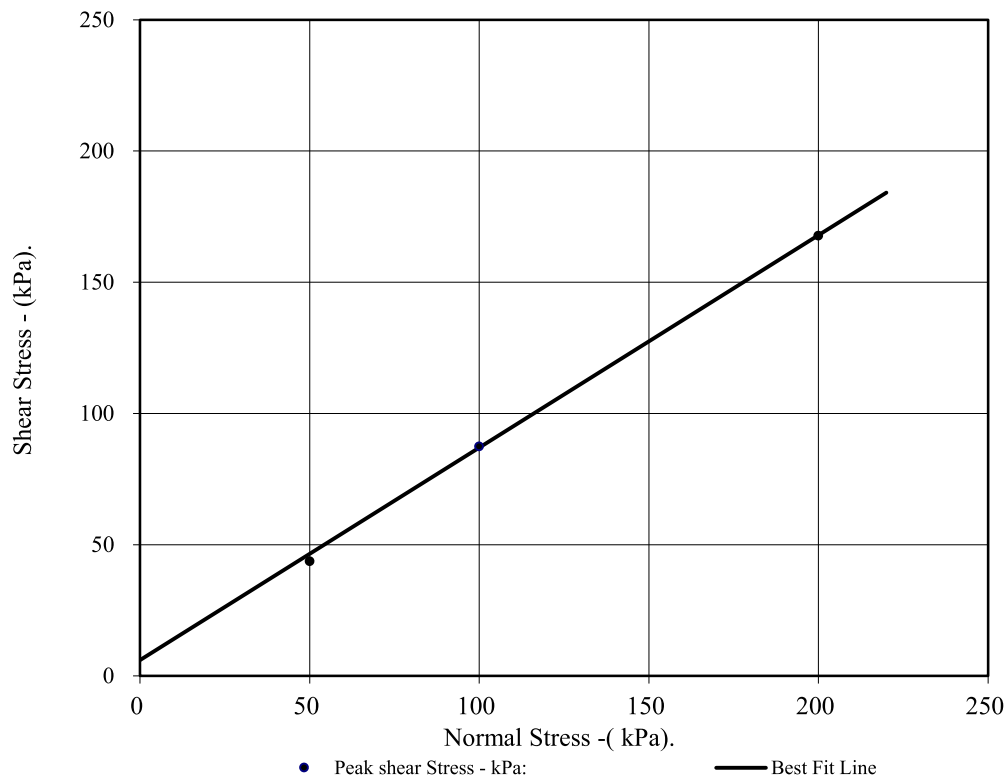
Hollingsworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP01		Top Depth:	1.50	
Sample Number:			Base Depth:		
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Material tested passing 2mm sieve Remoulded to 95% of MDD				
Sample Description:	See summary of soil descriptions.				
STAGE			1	2	3
Initial Conditions					
Height - mm:			20.05	20.05	20.05
Length - mm:			59.97	59.97	59.97
Moisture Content - %:			14	14	14
Bulk Density - Mg/m3:			1.95	1.95	1.95
Dry Density - Mg/m3:			1.71	1.71	1.71
Voids Ratio:			0.548	0.548	0.548
Normal Pressure- kPa			50	100	200
Consolidation Stage					
Consolidated Height - mm:			19.27	19.10	18.26
Shearing Stage					
Rate of Strain - mm/min			0.059	0.059	0.059
Displacement at peak shear stress - mm			6.90	3.30	7.20
Peak shear Stress - kPa:			44	87	168
Final Consolidated Conditions					
Moisture Content - %:			21	19	19
Bulk Density - Mg/m3:			2.03	2.05	2.15
Dry Density - Mg/m3:			1.68	1.73	1.81
Peak					
Angle of Shearing Resistance:(θ)			39		
Effective Cohesion - kPa:			6		



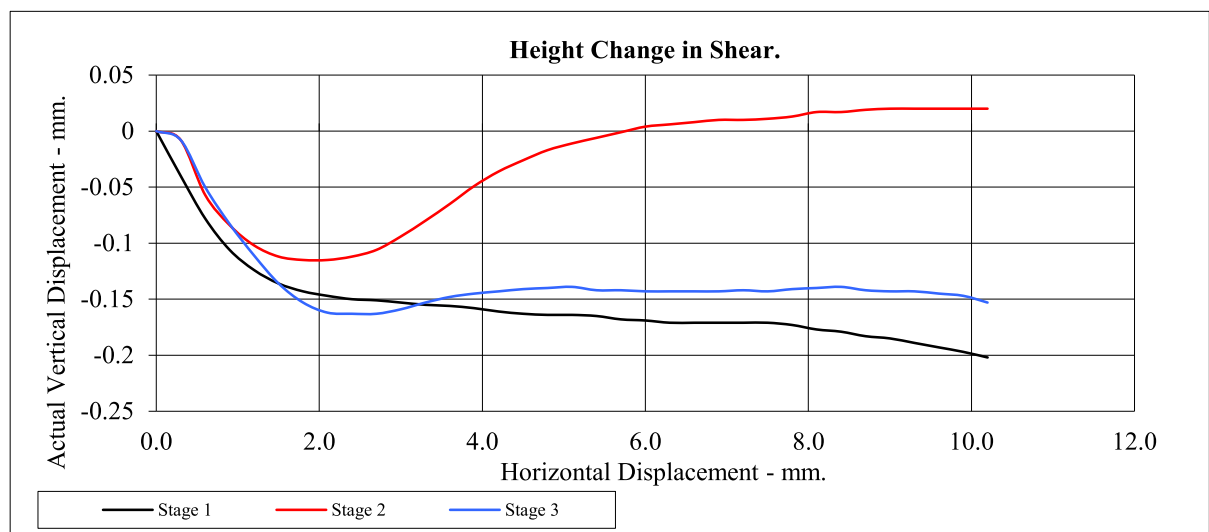
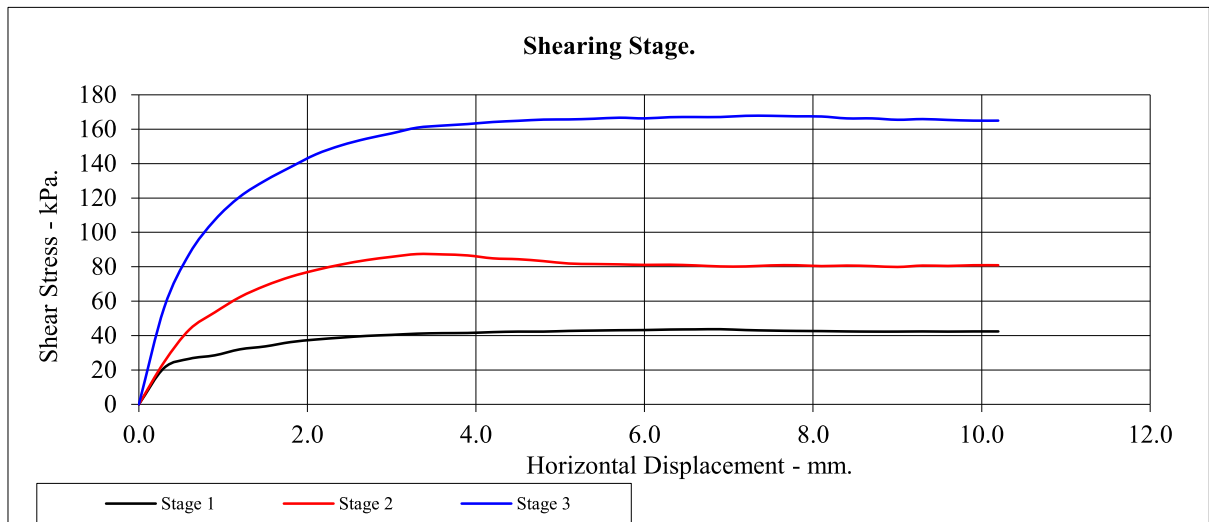
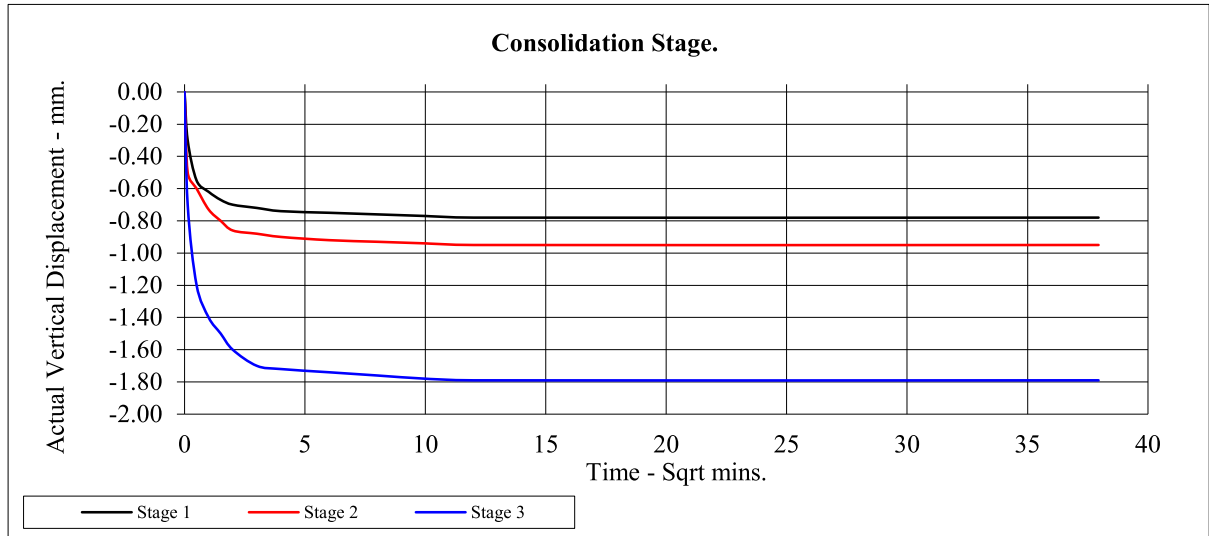
Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP01	Top Depth:	1.50
Sample Number:		Base Depth:	



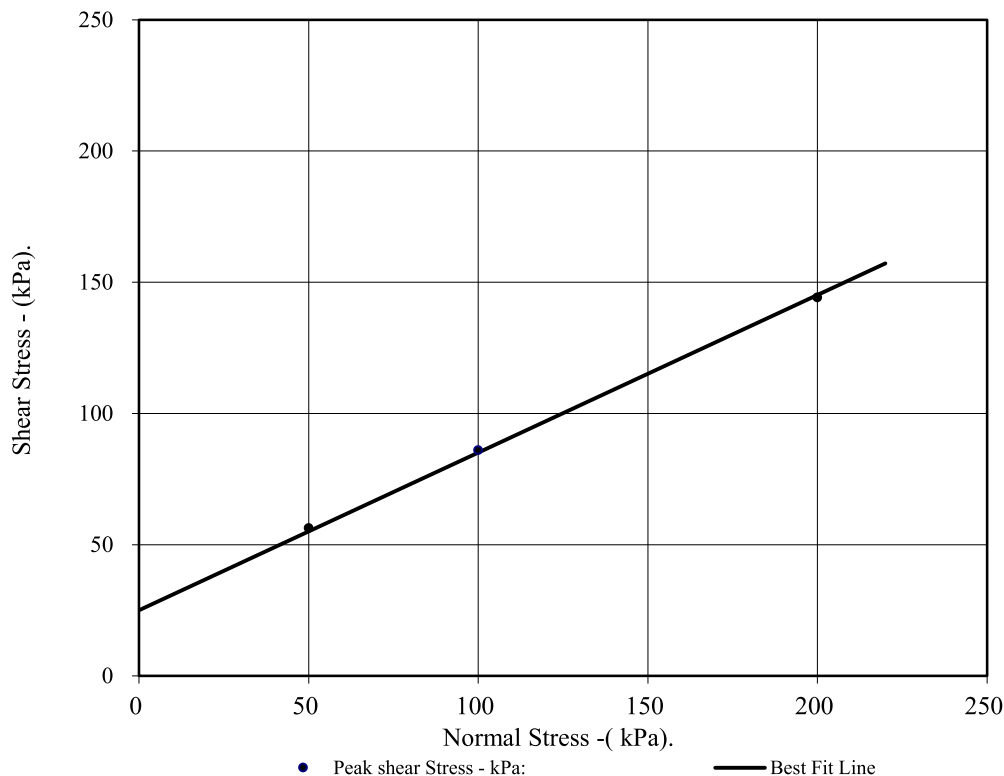
Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP02		Top Depth:	0.90	
Sample Number:			Base Depth:		
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Material tested passing 2mm sieve Remoulded to 95% of MDD				
Sample Description:	See summary of soil descriptions.				
STAGE			1	2	3
Initial Conditions					
Height - mm:			20.05	20.05	20.05
Length - mm:			59.97	59.97	59.97
Moisture Content - %:			16	16	16
Bulk Density - Mg/m3:			1.98	1.98	1.98
Dry Density - Mg/m3:			1.71	1.71	1.71
Voids Ratio:			0.550	0.550	0.550
Normal Pressure- kPa			50	100	200
Consolidation Stage					
Consolidated Height - mm:			19.46	19.21	19.06
Shearing Stage					
Rate of Strain - mm/min			0.049	0.049	0.049
Displacement at peak shear stress - mm			3.01	3.91	5.41
Peak shear Stress - kPa:			56	86	144
Final Consolidated Conditions					
Moisture Content - %:			19	18	18
Bulk Density - Mg/m3:			2.04	2.07	2.08
Dry Density - Mg/m3:			1.72	1.75	1.77
Peak					
Angle of Shearing Resistance:(θ)			31		
Effective Cohesion - kPa:			25		



Hollingworth Gate - Littleborough

Contract No:

PSL23/4181

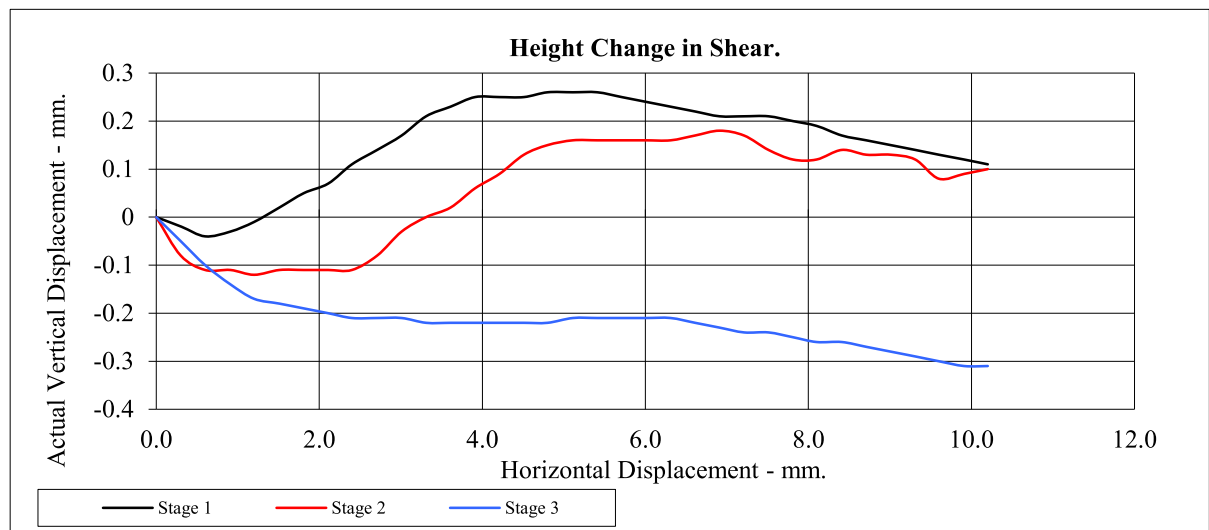
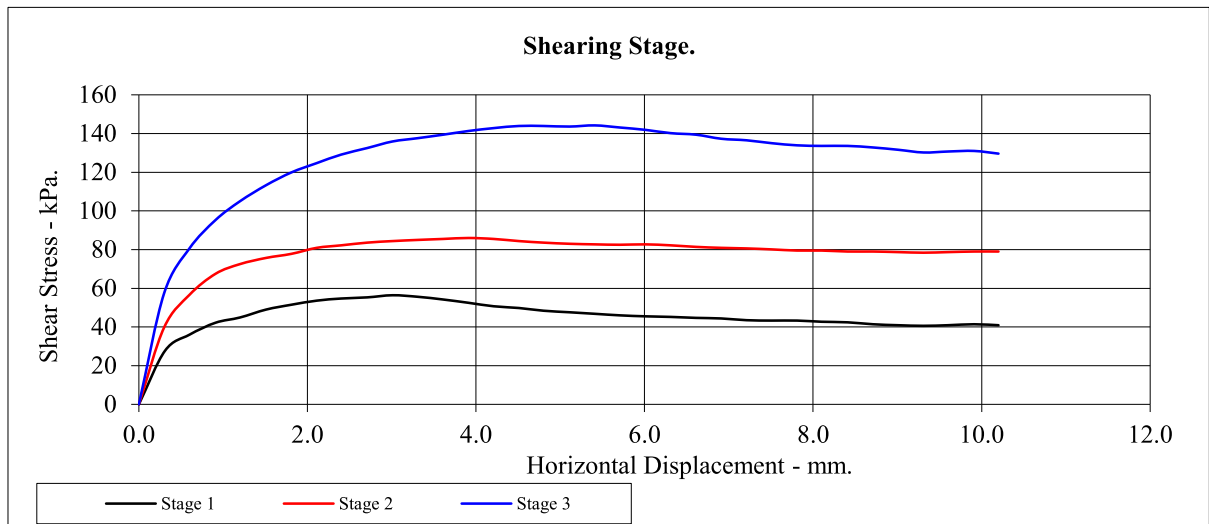
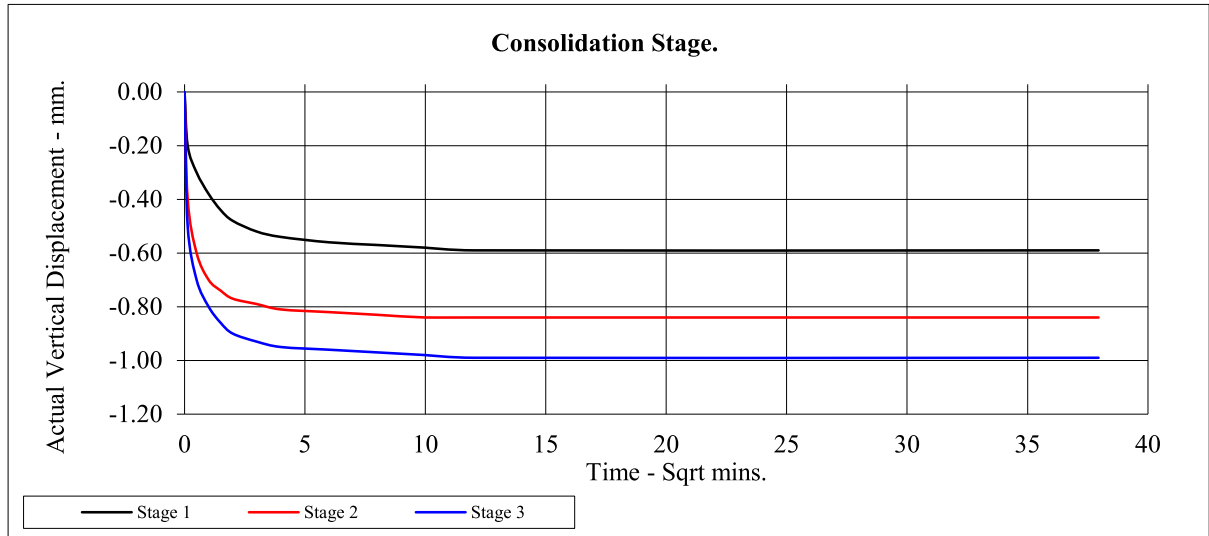
Client Ref:

GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP02	Top Depth:	0.90
Sample Number:		Base Depth:	



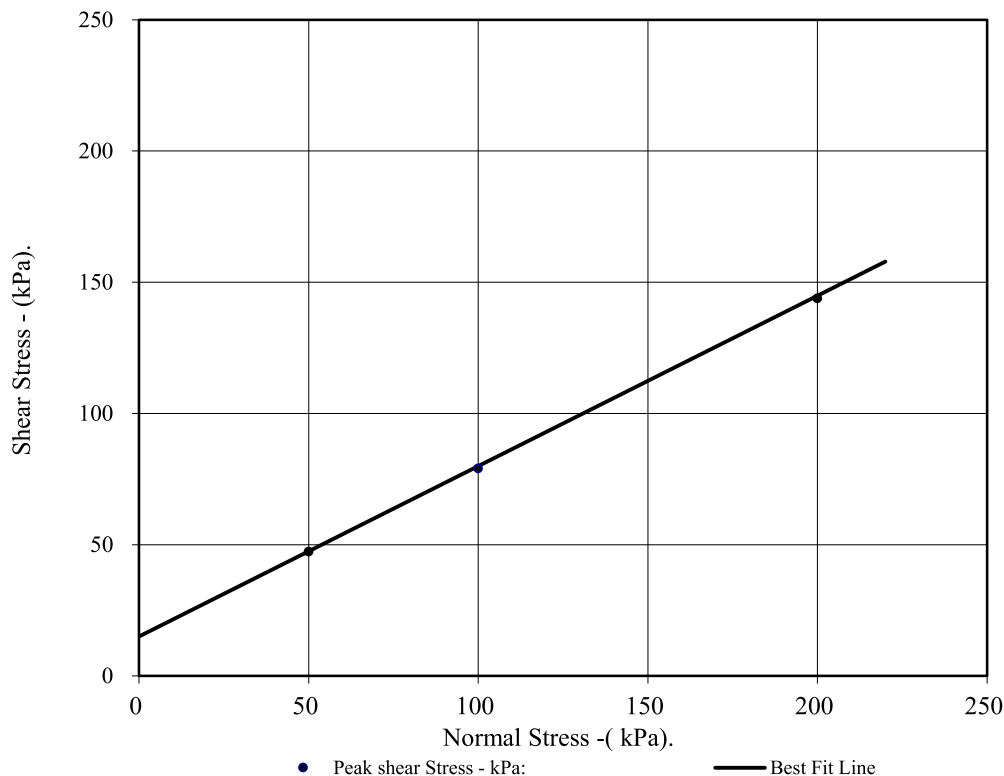
Hollingsworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP03		Top Depth:	1.50	
Sample Number:			Base Depth:		
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Material tested passing 2mm sieve Remoulded to 95% of MDD				
Sample Description:	See summary of soil descriptions.				
STAGE			1	2	3
Initial Conditions					
Height - mm:			20.05	20.05	20.05
Length - mm:			59.97	59.97	59.97
Moisture Content - %:			14	14	14
Bulk Density - Mg/m3:			2.00	2.00	2.00
Dry Density - Mg/m3:			1.75	1.75	1.75
Voids Ratio:			0.515	0.515	0.515
Normal Pressure- kPa			50	100	200
Consolidation Stage					
Consolidated Height - mm:			19.36	18.86	18.39
Shearing Stage					
Rate of Strain - mm/min			0.052	0.052	0.052
Displacement at peak shear stress - mm			2.70	10.20	6.00
Peak shear Stress - kPa:			47	79	144
Final Consolidated Conditions					
Moisture Content - %:			20	19	18
Bulk Density - Mg/m3:			2.07	2.12	2.18
Dry Density - Mg/m3:			1.73	1.78	1.84
Peak					
Angle of Shearing Resistance:(θ)			33		
Effective Cohesion - kPa:			15		



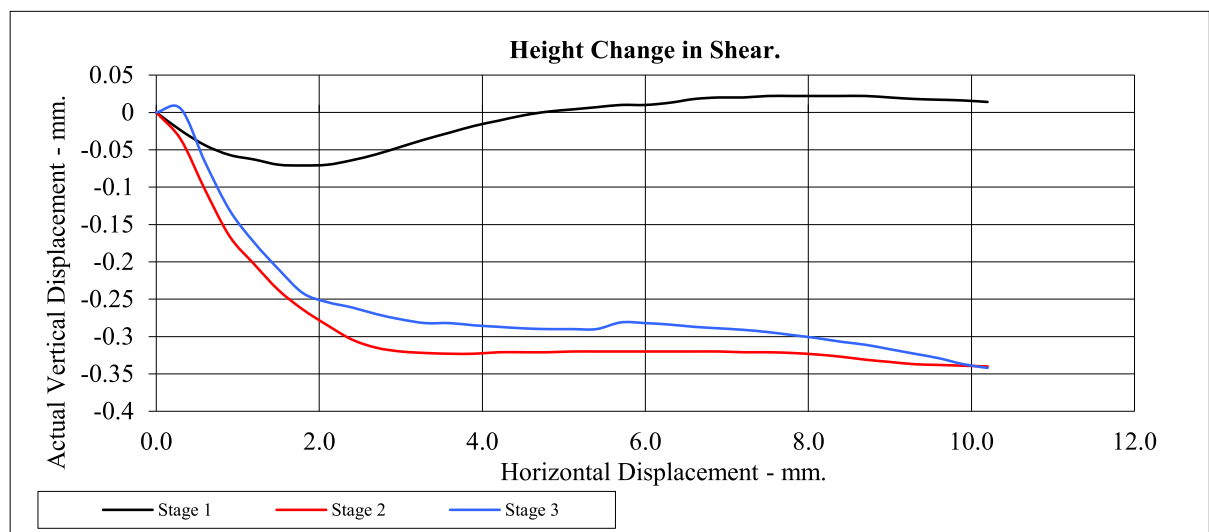
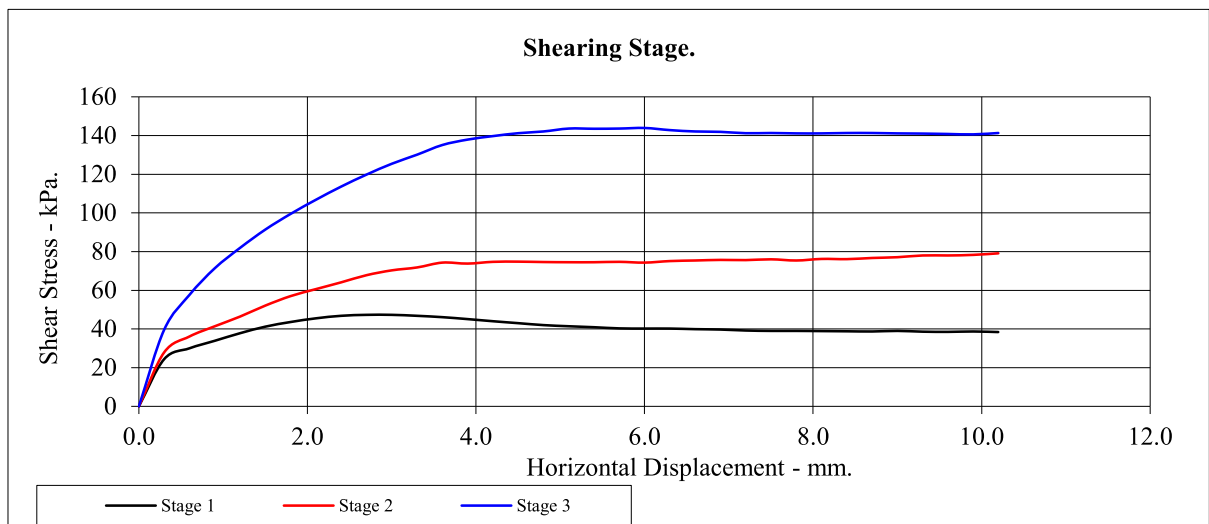
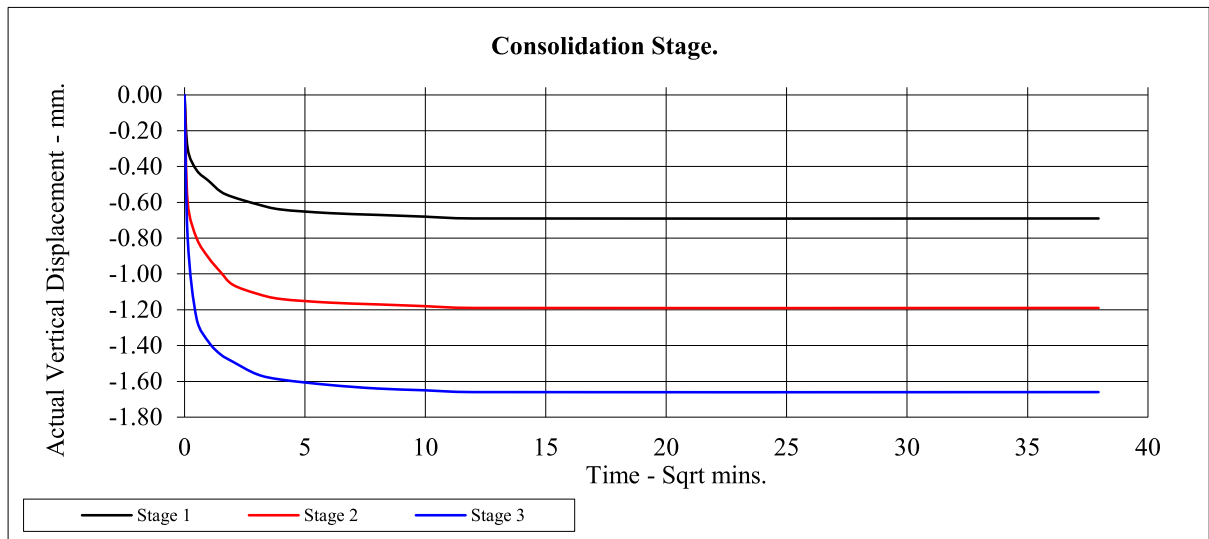
Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP03	Top Depth:	1.50
Sample Number:		Base Depth:	



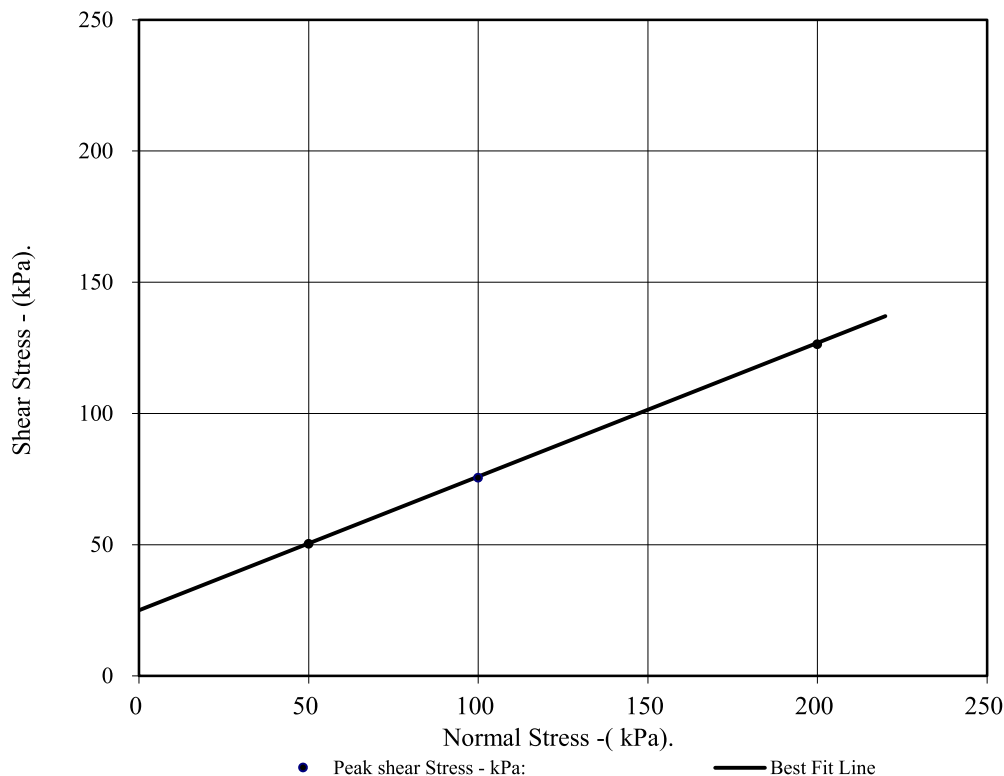
Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP03		Top Depth:	2.50	
Sample Number:			Base Depth:		
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Material tested passing 2mm sieve Remoulded to 95% of MDD				
Sample Description:	See summary of soil descriptions.				
STAGE			1	2	3
Initial Conditions					
Height - mm:			20.05	20.05	20.05
Length - mm:			59.97	59.97	59.97
Moisture Content - %:			16	16	16
Bulk Density - Mg/m3:			2.00	2.00	2.00
Dry Density - Mg/m3:			1.72	1.72	1.72
Voids Ratio:			0.539	0.539	0.539
Normal Pressure- kPa			50	100	200
Consolidation Stage					
Consolidated Height - mm:			19.28	19.13	18.85
Shearing Stage					
Rate of Strain - mm/min			0.047	0.047	0.047
Displacement at peak shear stress - mm			4.21	10.20	9.91
Peak shear Stress - kPa:			50	76	126
Final Consolidated Conditions					
Moisture Content - %:			18	17	17
Bulk Density - Mg/m3:			2.08	2.09	2.12
Dry Density - Mg/m3:			1.76	1.78	1.81
Peak					
Angle of Shearing Resistance:(θ)			27		
Effective Cohesion - kPa:			25		



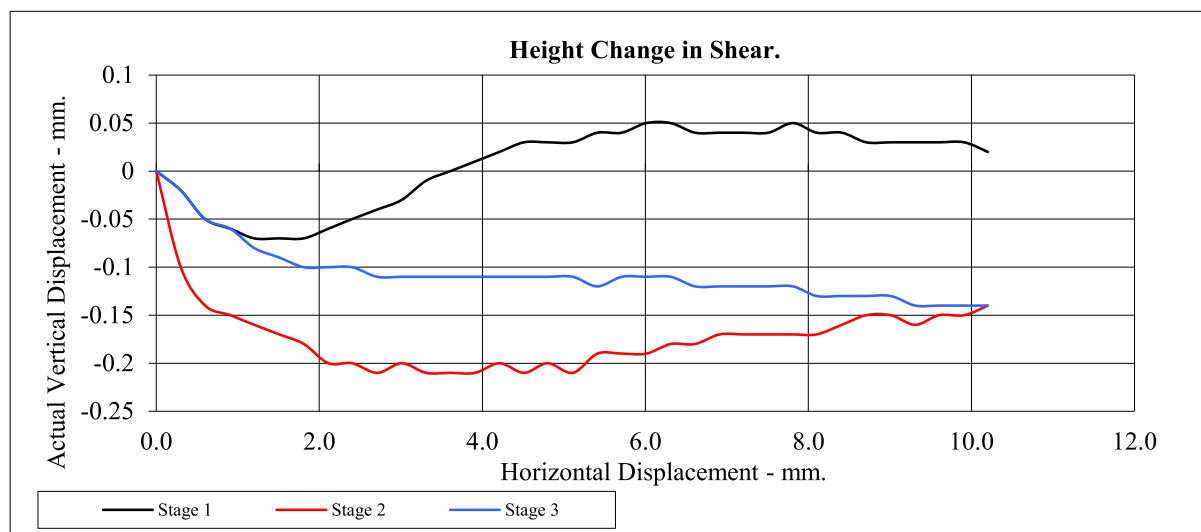
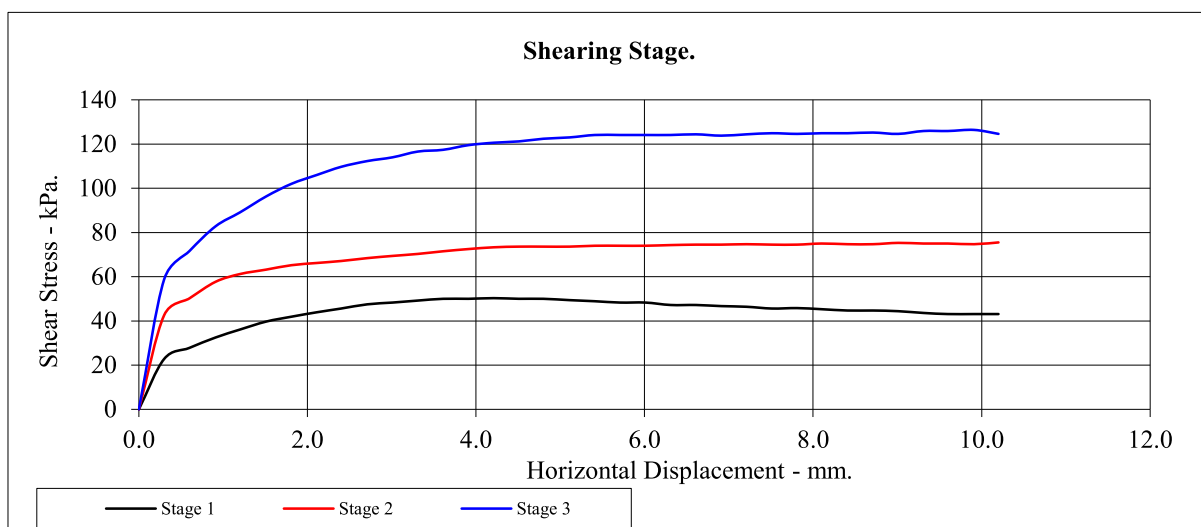
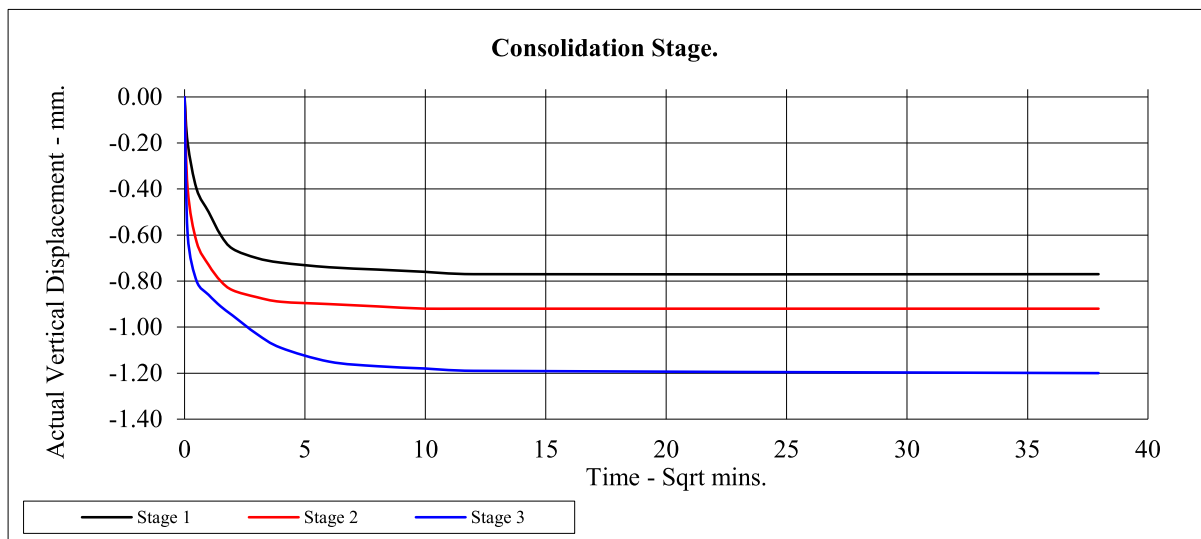
Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP03	Top Depth:	2.50
Sample Number:		Base Depth:	



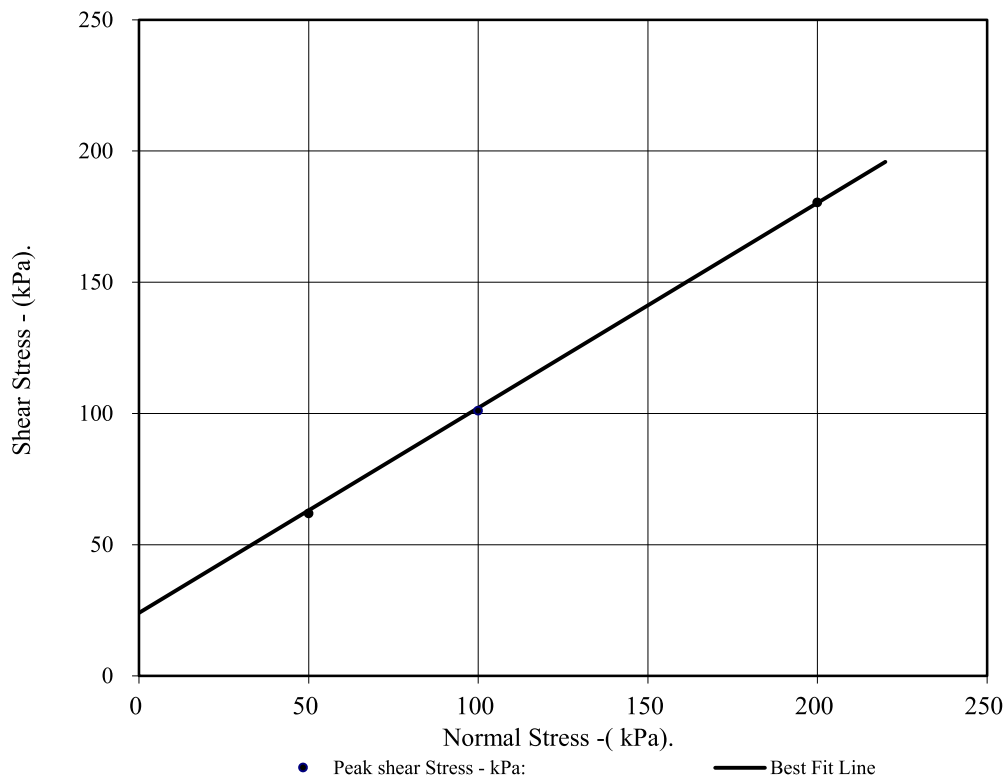
Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP04		Top Depth:	0.50	
Sample Number:			Base Depth:		
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Material tested passing 2mm sieve Remoulded to 95% of MDD				
Sample Description:	See summary of soil descriptions.				
STAGE			1	2	3
Initial Conditions					
Height - mm:			20.05	20.05	20.05
Length - mm:			59.97	59.97	59.97
Moisture Content - %:			15	15	15
Bulk Density - Mg/m3:			1.94	1.94	1.94
Dry Density - Mg/m3:			1.68	1.68	1.68
Voids Ratio:			0.574	0.574	0.574
Normal Pressure- kPa			50	100	200
Consolidation Stage					
Consolidated Height - mm:			19.04	18.71	18.03
Shearing Stage					
Rate of Strain - mm/min			0.054	0.054	0.054
Displacement at peak shear stress - mm			3.01	3.91	3.61
Peak shear Stress - kPa:			62	101	180
Final Consolidated Conditions					
Moisture Content - %:			21	20	20
Bulk Density - Mg/m3:			2.04	2.08	2.16
Dry Density - Mg/m3:			1.68	1.73	1.80
Peak					
Angle of Shearing Resistance:(θ)			38		
Effective Cohesion - kPa:			24		



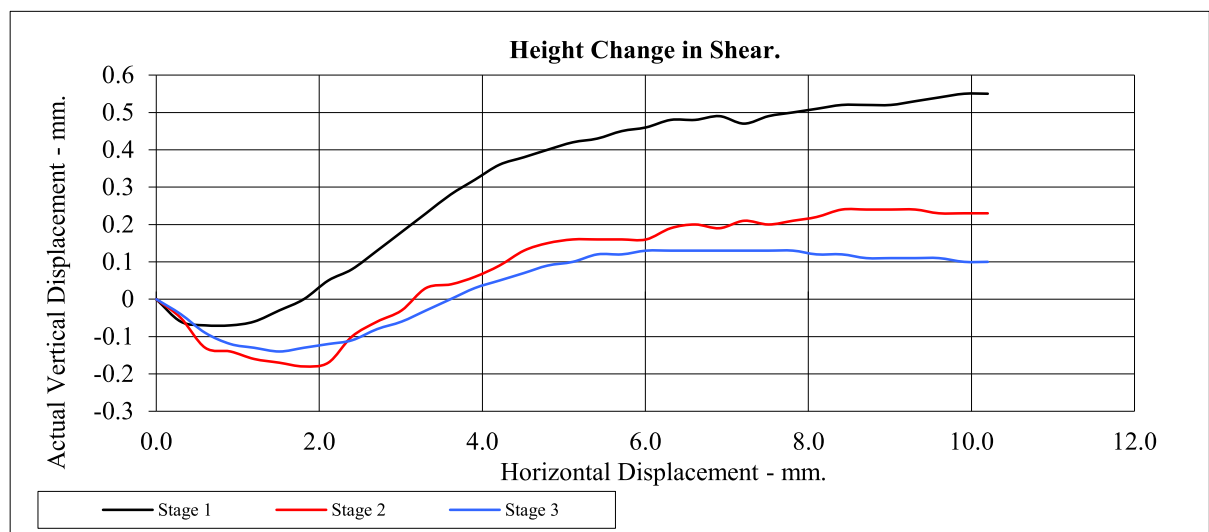
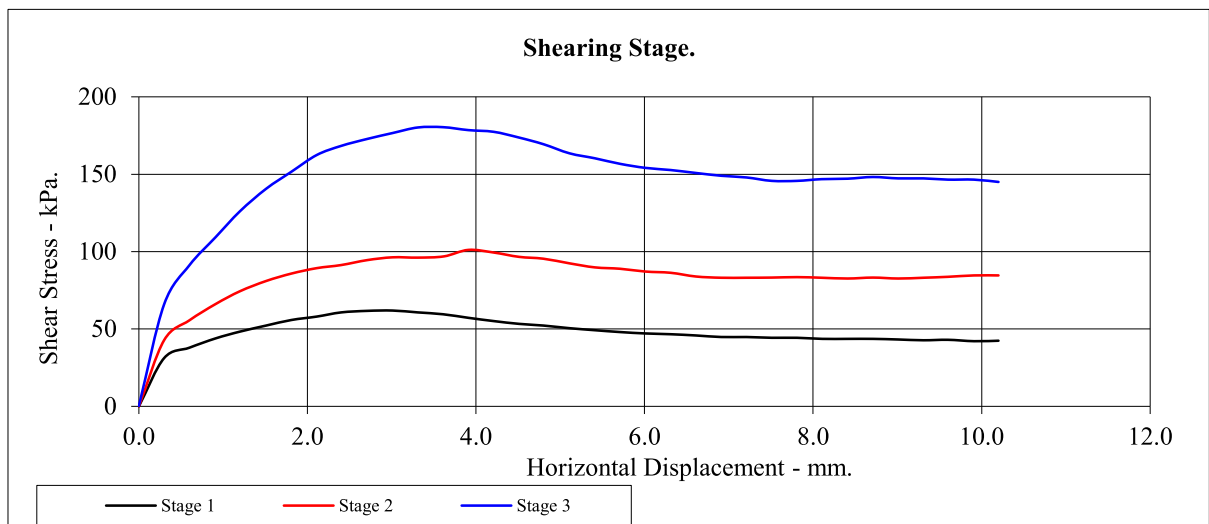
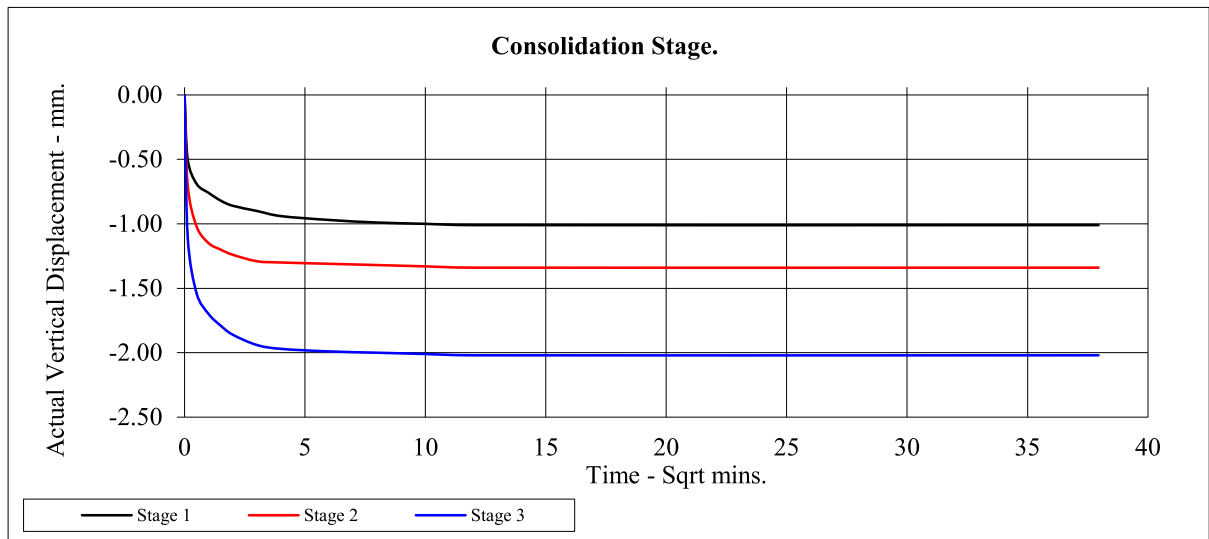
Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP04	Top Depth:	0.50
Sample Number:		Base Depth:	



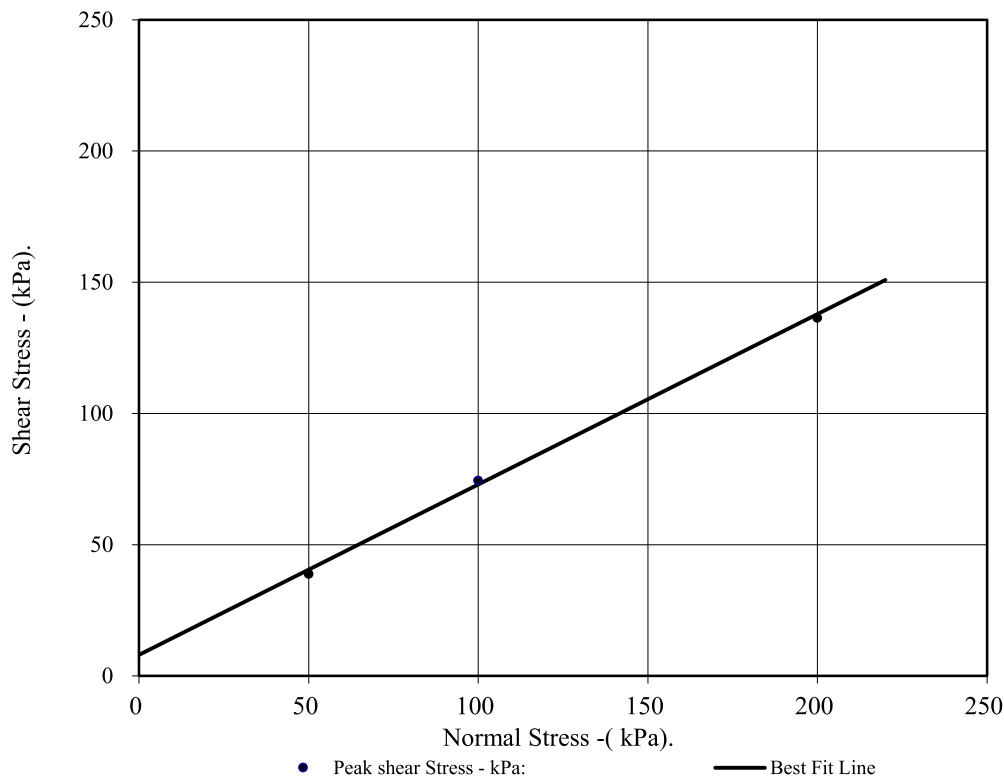
Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP06		Top Depth:	1.00	
Sample Number:			Base Depth:		
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Material tested passing 2mm sieve Remoulded to 95% of MDD				
Sample Description:	See summary of soil descriptions.				
STAGE			1	2	3
Initial Conditions					
Height - mm:			20.05	20.05	20.05
Length - mm:			59.97	59.97	59.97
Moisture Content - %:			14	14	14
Bulk Density - Mg/m3:			2.01	2.01	2.01
Dry Density - Mg/m3:			1.76	1.76	1.76
Voids Ratio:			0.505	0.505	0.505
Normal Pressure- kPa			50	100	200
Consolidation Stage					
Consolidated Height - mm:			19.51	19.33	18.30
Shearing Stage					
Rate of Strain - mm/min			0.051	0.051	0.051
Displacement at peak shear stress - mm			4.80	9.01	9.01
Peak shear Stress - kPa:			39	74	136
Final Consolidated Conditions					
Moisture Content - %:			18	17	17
Bulk Density - Mg/m3:			2.06	2.08	2.20
Dry Density - Mg/m3:			1.76	1.78	1.88
Peak					
Angle of Shearing Resistance:(θ)			33		
Effective Cohesion - kPa:			8		



Hollingworth Gate - Littleborough

Contract No:

PSL23/4181

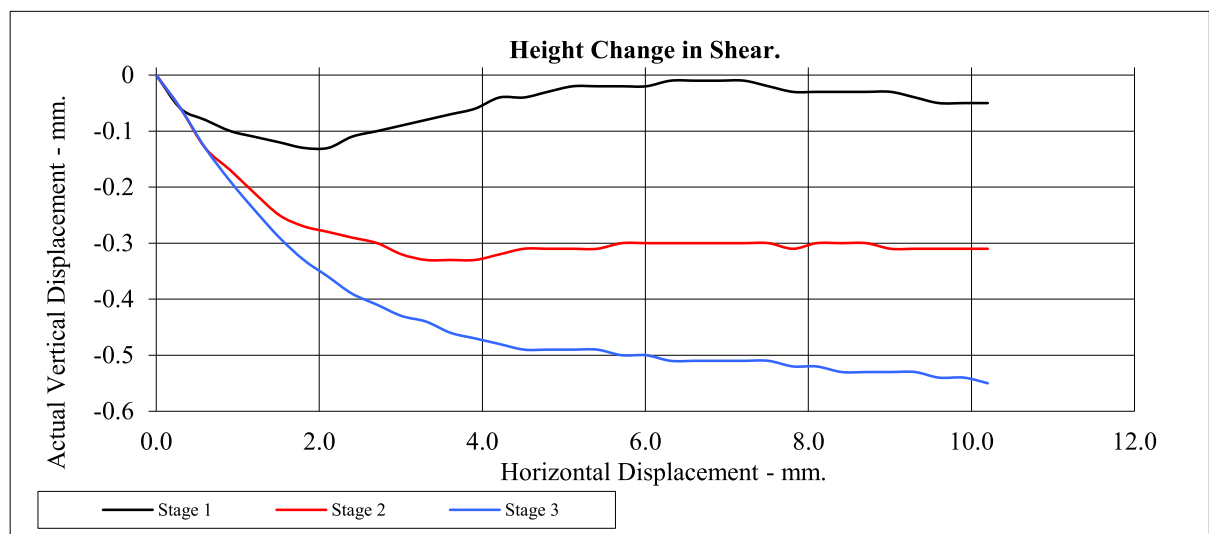
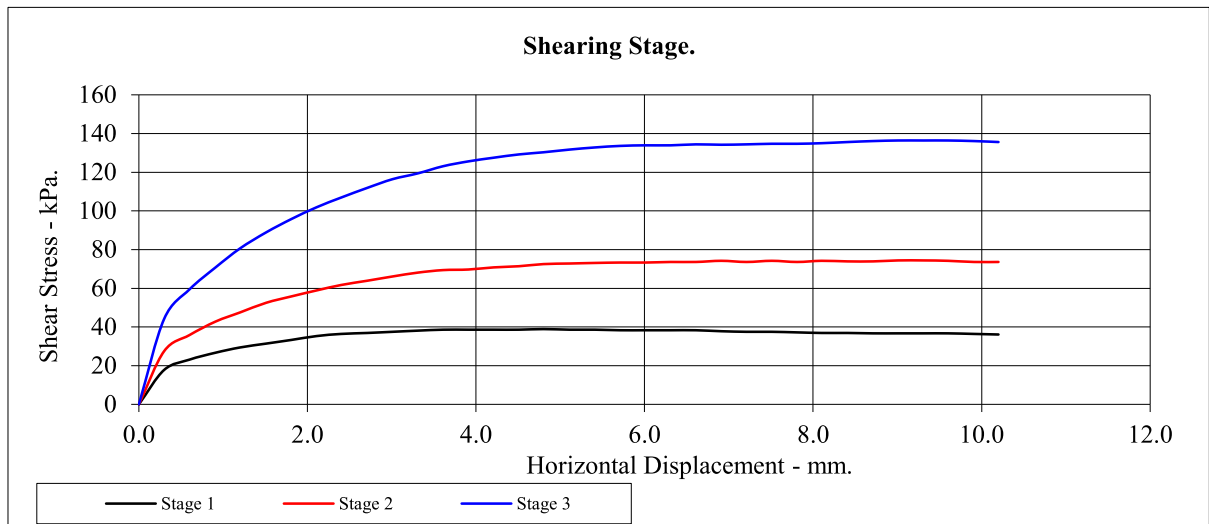
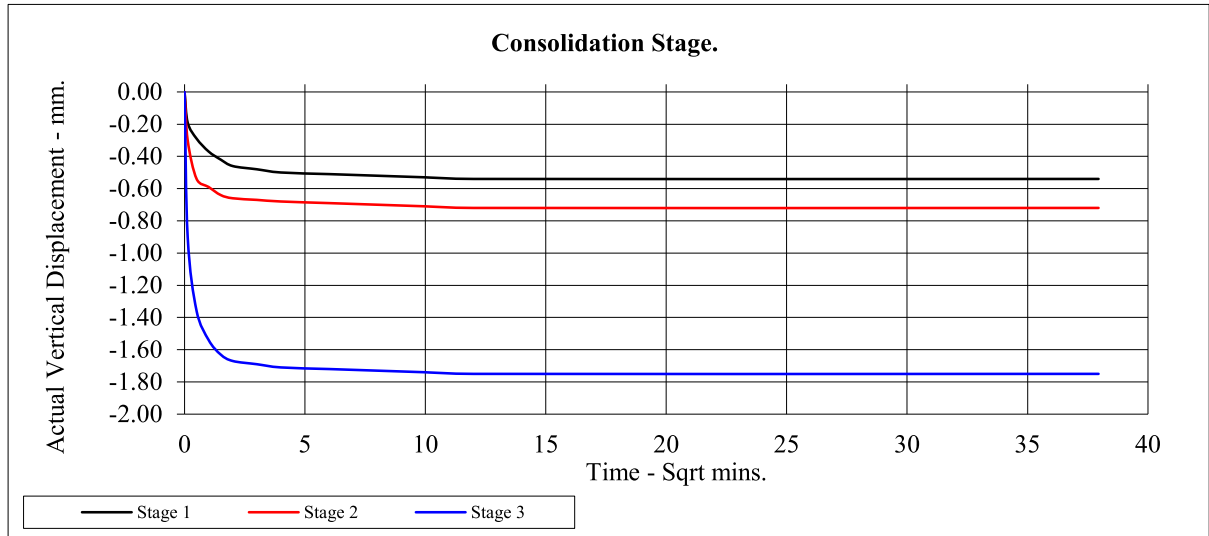
Client Ref:

GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP06	Top Depth:	1.00
Sample Number:		Base Depth:	



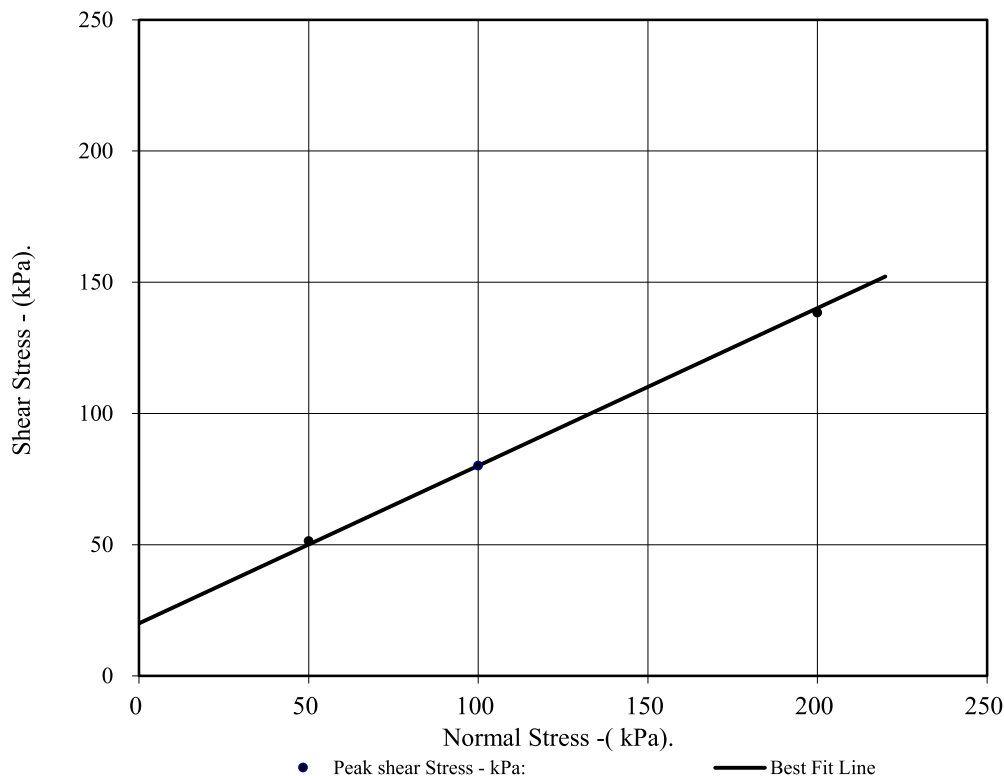
Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP07		Top Depth:	0.50	
Sample Number:			Base Depth:		
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Material tested passing 2mm sieve Remoulded to 95% of MDD				
Sample Description:	See summary of soil descriptions.				
STAGE			1	2	3
Initial Conditions					
Height - mm:			20.05	20.05	20.05
Length - mm:			59.97	59.97	59.97
Moisture Content - %:			14	14	14
Bulk Density - Mg/m3:			1.95	1.95	1.95
Dry Density - Mg/m3:			1.71	1.71	1.71
Voids Ratio:			0.550	0.550	0.550
Normal Pressure- kPa			50	100	200
Consolidation Stage					
Consolidated Height - mm:			19.16	18.98	17.77
Shearing Stage					
Rate of Strain - mm/min			0.053	0.053	0.053
Displacement at peak shear stress - mm			3.60	4.50	8.70
Peak shear Stress - kPa:			51	80	138
Final Consolidated Conditions					
Moisture Content - %:			20	19	18
Bulk Density - Mg/m3:			2.04	2.06	2.20
Dry Density - Mg/m3:			1.71	1.73	1.87
Peak					
Angle of Shearing Resistance:(θ)			31		
Effective Cohesion - kPa:			20		



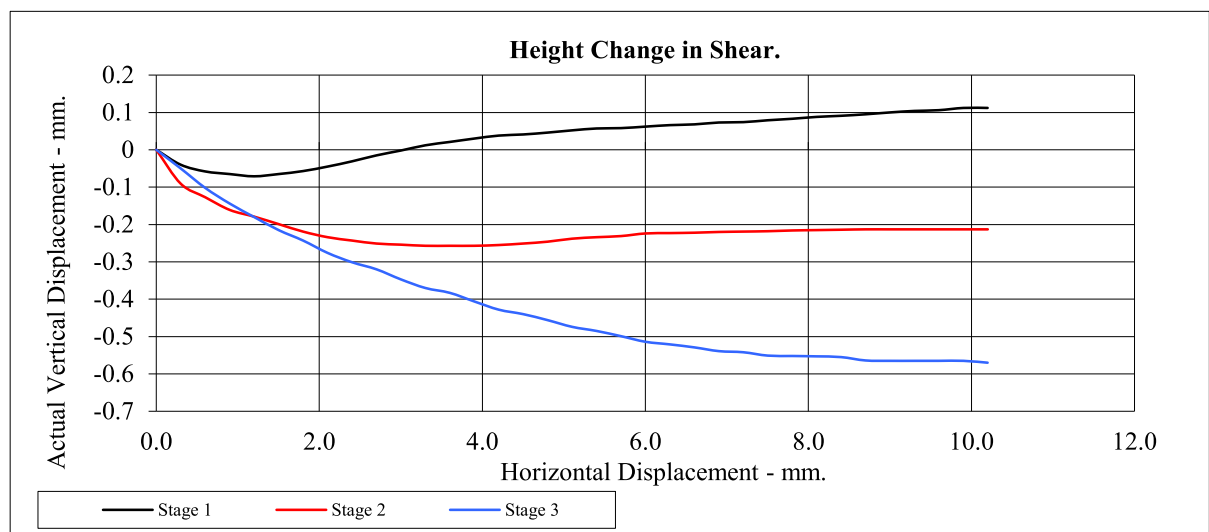
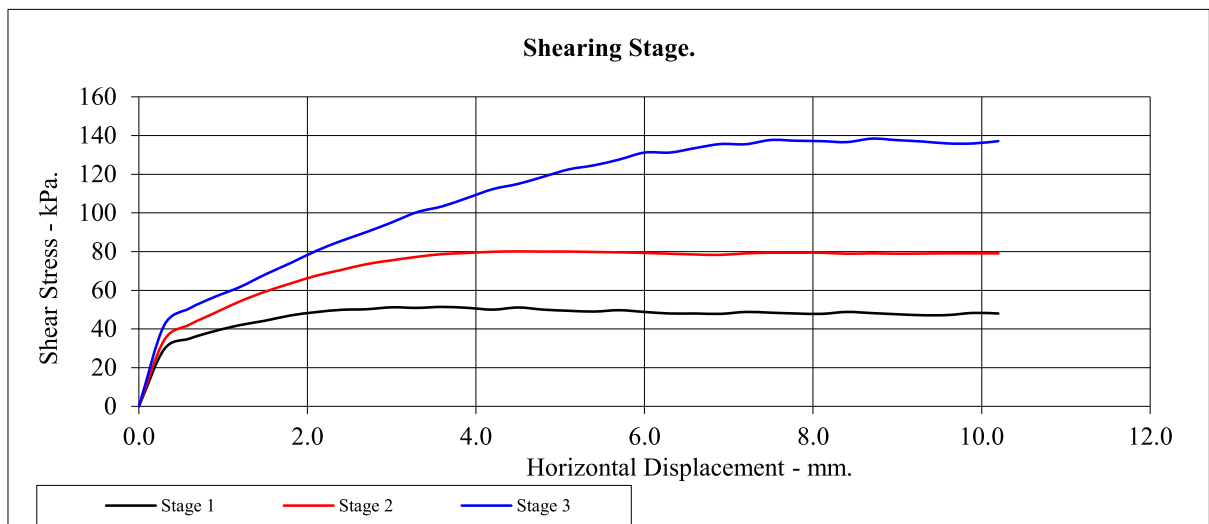
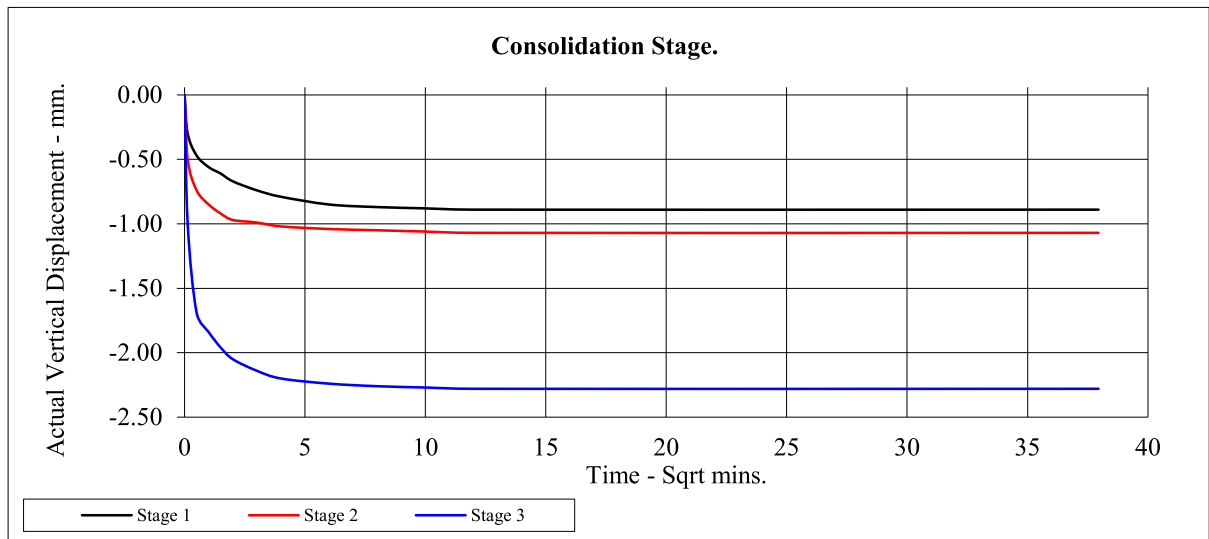
Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP07	Top Depth:	0.50
Sample Number:		Base Depth:	



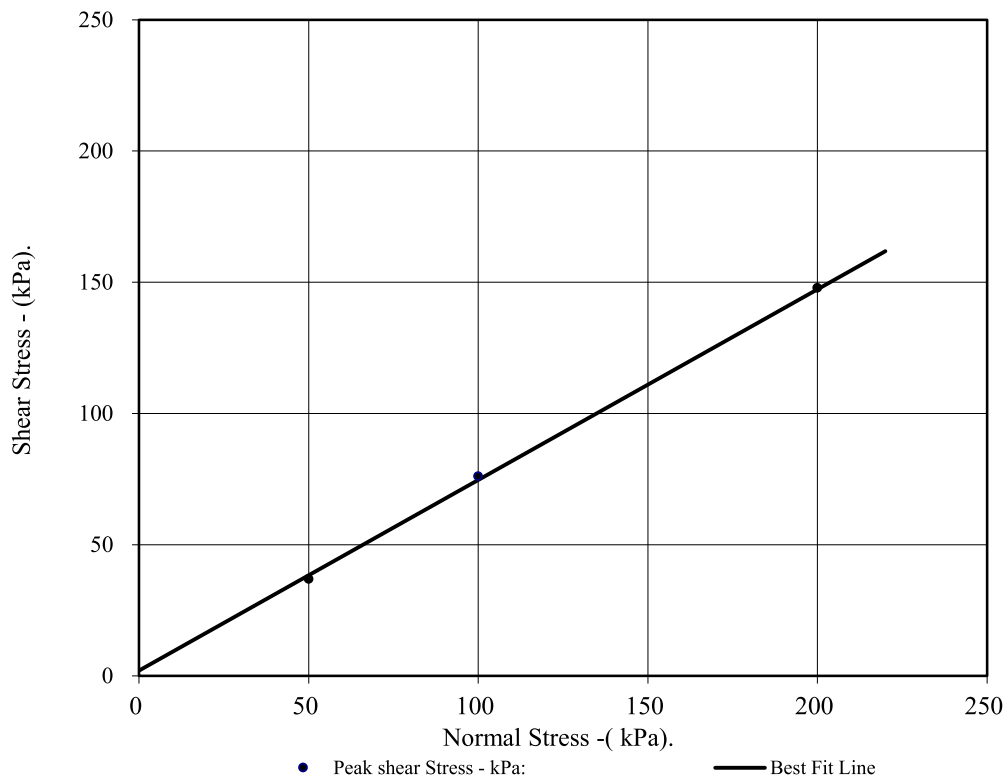
Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP07		Top Depth:	1.50	
Sample Number:			Base Depth:		
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Material tested passing 2mm sieve Remoulded to 95% of MDD				
Sample Description:	See summary of soil descriptions.				
STAGE			1	2	3
Initial Conditions					
Height - mm:			20.05	20.05	20.05
Length - mm:			59.97	59.97	59.97
Moisture Content - %:			13	13	13
Bulk Density - Mg/m3:			1.99	1.99	1.99
Dry Density - Mg/m3:			1.76	1.76	1.76
Voids Ratio:			0.506	0.506	0.506
Normal Pressure- kPa			50	100	200
Consolidation Stage					
Consolidated Height - mm:			19.54	19.06	18.50
Shearing Stage					
Rate of Strain - mm/min			0.055	0.055	0.055
Displacement at peak shear stress - mm			4.51	9.60	8.71
Peak shear Stress - kPa:			37	76	148
Final Consolidated Conditions					
Moisture Content - %:			20	20	19
Bulk Density - Mg/m3:			2.04	2.09	2.16
Dry Density - Mg/m3:			1.70	1.75	1.81
Peak					
Angle of Shearing Resistance:(θ)			36		
Effective Cohesion - kPa:			2		



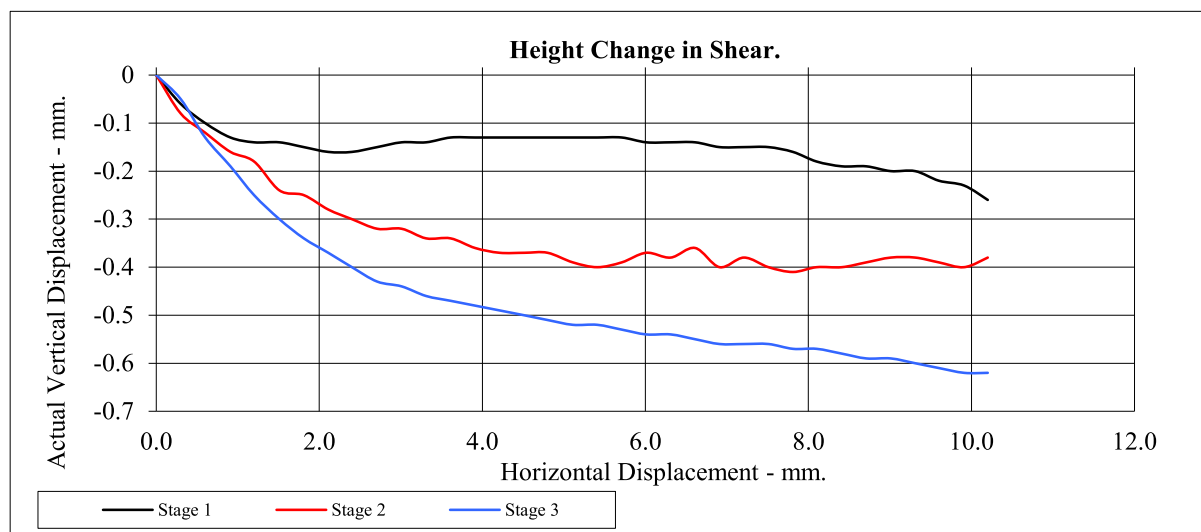
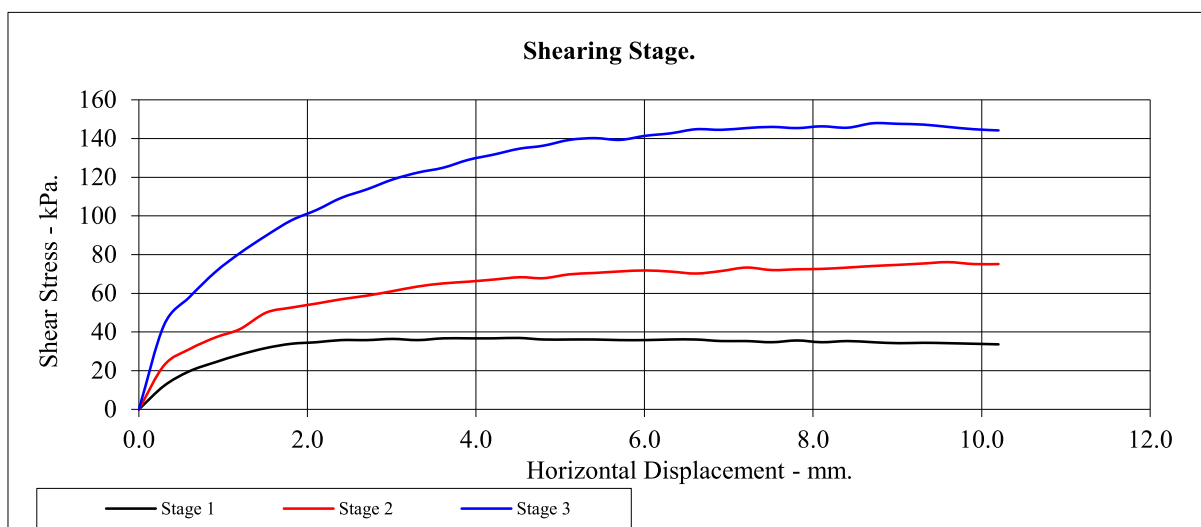
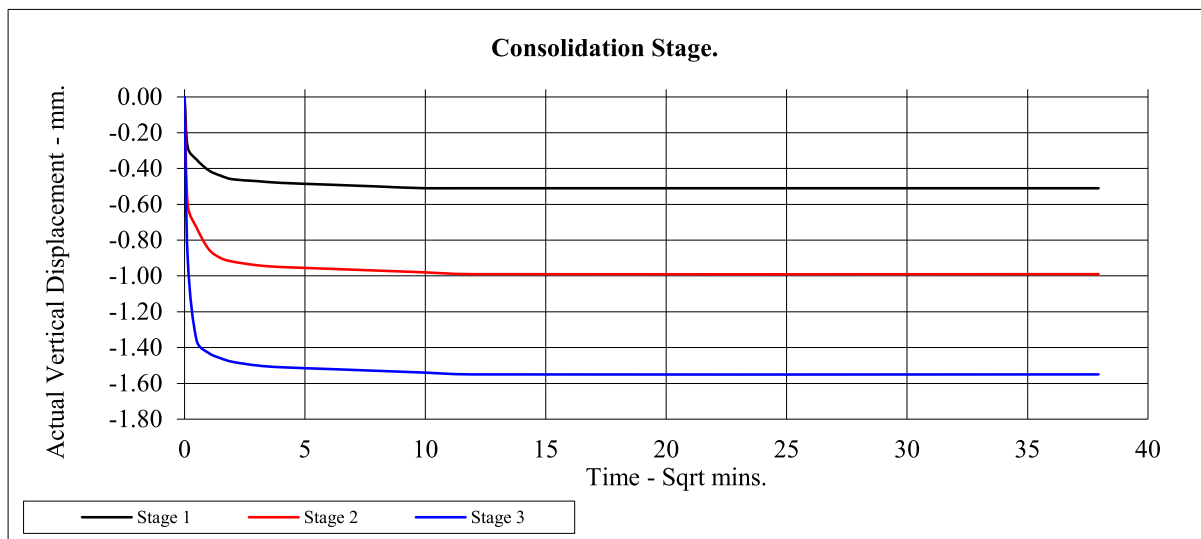
Hollingworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP07	Top Depth:	1.50
Sample Number:		Base Depth:	



Hollingworth Gate - Littleborough

Contract No:

PSL23/4181

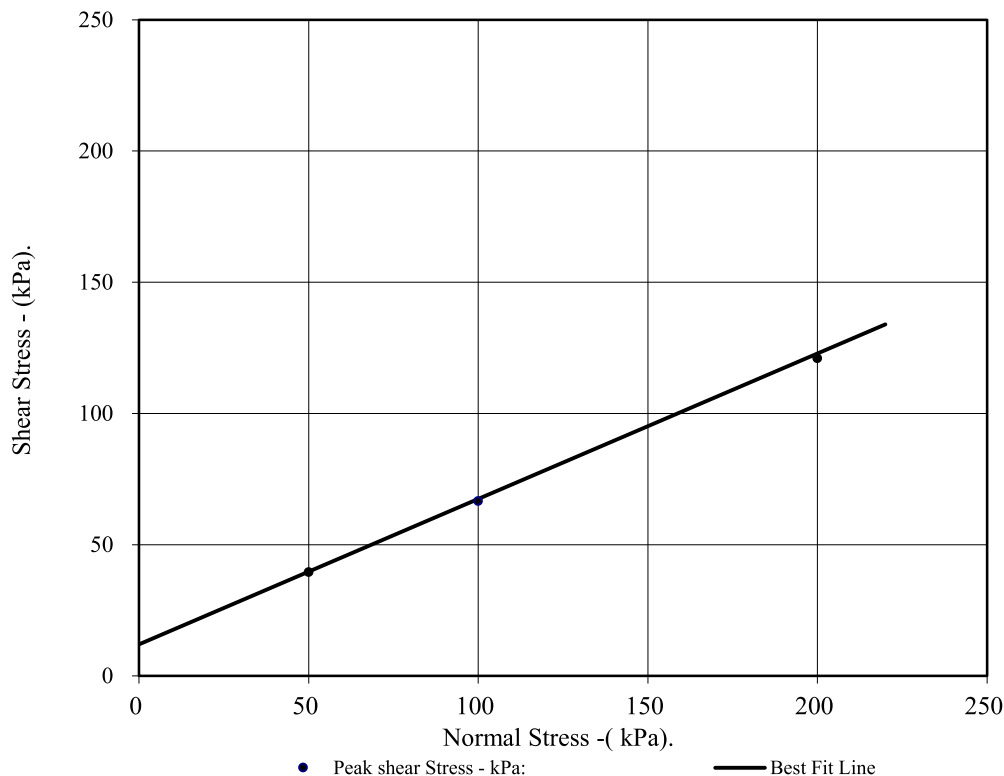
Client Ref:

GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP08		Top Depth:	0.50	
Sample Number:			Base Depth:		
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Material tested passing 2mm sieve Remoulded to 95% of MDD				
Sample Description:	See summary of soil descriptions.				
STAGE			1	2	3
Initial Conditions					
Height - mm:			20.05	20.05	20.05
Length - mm:			59.97	59.97	59.97
Moisture Content - %:			14	14	14
Bulk Density - Mg/m3:			2.06	2.06	2.06
Dry Density - Mg/m3:			1.81	1.81	1.81
Voids Ratio:			0.464	0.464	0.464
Normal Pressure- kPa			50	100	200
Consolidation Stage					
Consolidated Height - mm:			18.88	18.18	17.93
Shearing Stage					
Rate of Strain - mm/min			0.045	0.045	0.045
Displacement at peak shear stress - mm			4.50	6.30	7.20
Peak shear Stress - kPa:			40	67	121
Final Consolidated Conditions					
Moisture Content - %:			17	16	16
Bulk Density - Mg/m3:			2.19	2.27	2.30
Dry Density - Mg/m3:			1.86	1.96	1.99
Peak					
Angle of Shearing Resistance:(θ)			29		
Effective Cohesion - kPa:			12		



Hollingworth Gate - Littleborough

Contract No:

PSL23/4181

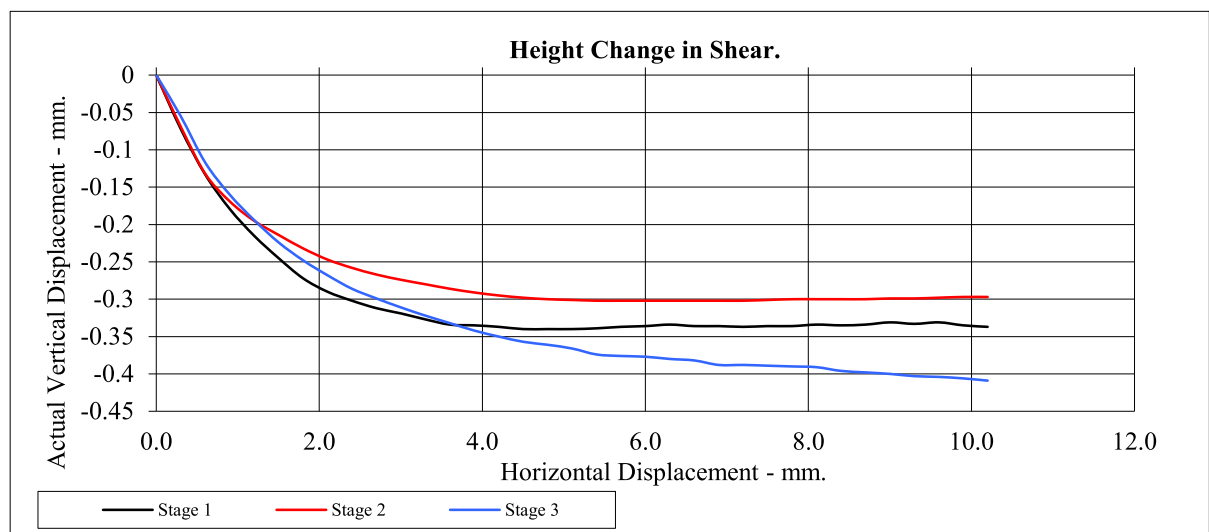
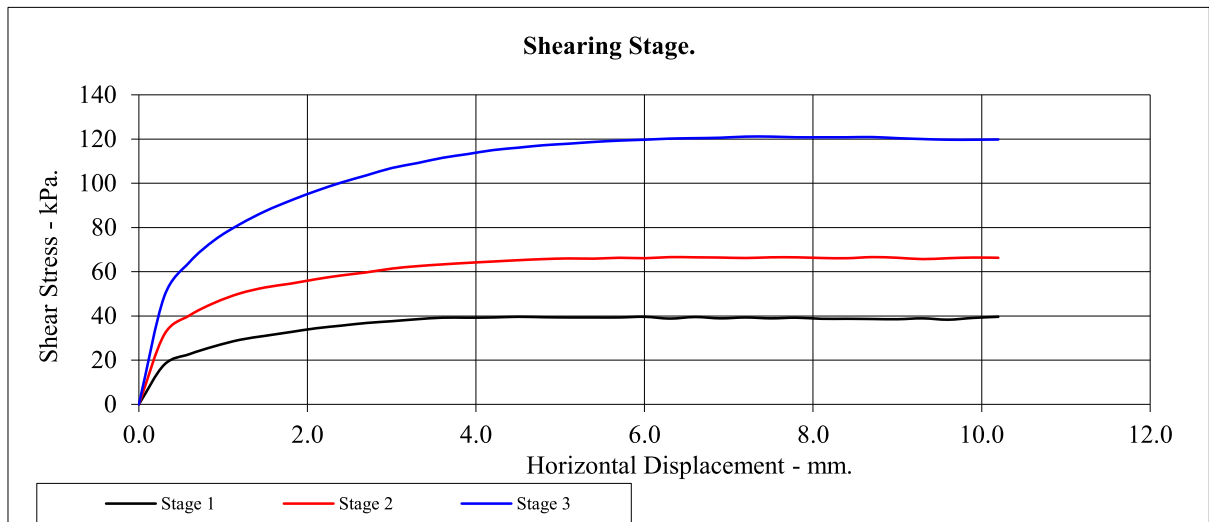
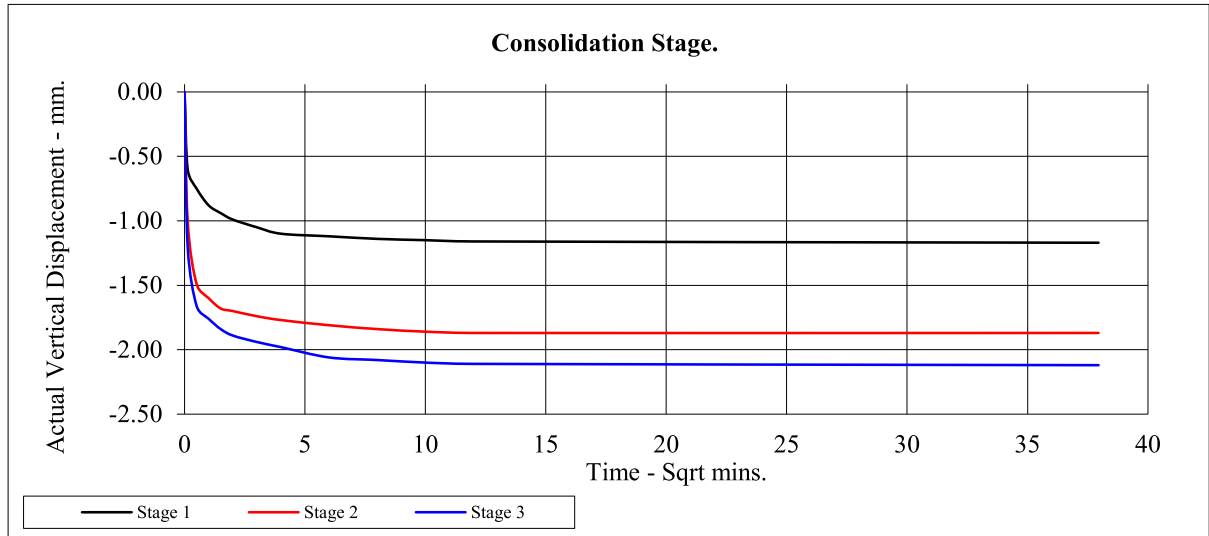
Client Ref:

GRO-23131

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	TP08	Top Depth:	0.50
Sample Number:		Base Depth:	



Hollingsworth Gate - Littleborough

Contract No:
PSL23/4181
Client Ref:
GRO-23131



APPENDIX 8 - Limitations

Limitations

This report (Report) forms part of the Services and if applicable Additional Services undertaken by Groundtech Consulting Ltd pursuant to a written contract (Agreement) which contains detailed provisions including express limitations of the liability of Groundtech Consulting Ltd.

This Report was prepared using reasonable skill and care as stated in the Agreement for the purpose including intended end use stated by the Client (Purpose) and the liability of Groundtech Consulting Ltd in respect of the form and content of this Report is no greater than its liability under the Agreement. All records, measurements notes, or any other data (Data) obtained by or for the benefit of the Consultant were obtained at a specific point in time and it may not be assumed by the Client or any person relying on this Report that the Data will remain unaffected by the passage of time, the seasons, weather conditions, changes in the water table or the carrying out and completion of works at the Site.

Unless otherwise agreed this Report has been prepared exclusively for the use and reliance of the Client and may not be relied upon, by any other party except as provided for in the Agreement. A third party who relies on this Report, does so at their own and sole risk and Groundtech Consulting Ltd has no liability to such parties.

Groundtech Consulting Ltd that this Report is to be used for the Purpose. The Purpose was instrumental in determining the scope and of the Services provided. If the Purpose should change, the Client may not be able to rely on the Report without the separate agreement of Groundtech Consulting Ltd.

Since the Report was written, later changes in legislation, statutory requirements and industry best practices have not been considered and this should be allowed for. Ground conditions can also change (see below) and should be investigated if there is any significant delay in acting on the findings of this Report. The period 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 in this Report should not be relied upon in the future without written confirmation from Groundtech Consulting Ltd that it is safe to do so.

The observations and conclusions outlined in this Report are based exclusively on the services that were provided as set out in the agreement between the client and Groundtech Consulting Ltd.

Groundtech Consulting Ltd is not liable for the existence of any condition, the discovery of which would require additional investigation outside the agreed scope of works or core competency. The Report is based upon Groundtech Consulting Ltd's observations of existing physical conditions at the Site gained from site reconnaissance together with interpretation of information including documentation, obtained from third parties and from the Client on the history and usage of the Site. The findings and recommendations contained in this Report are based in part upon information provided by third parties, and Groundtech Consulting Ltd have relied upon such information assuming it to be correct.

Groundtech Consulting Ltd accepts no responsibility for errors or inaccuracies in third party information presented in this Report. Groundtech Consulting Ltd was not authorised 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 or Additional Services. Groundtech Consulting Ltd is not liable for any inaccurate information, misrepresentation of data or conclusions, which may inform the scope of investigation undertaken by Groundtech Consulting Ltd and forms the contract with the client.

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions may also vary due to the ground's heterogeneous properties and because investigation exploratory locations only allow examination of the ground at discrete locations. The potential exists for ground conditions to be encountered which are different to those considered in this Report, particularly between exploratory holes. The extent of the limited area depends on the soil and groundwater conditions, together with other constraints such as the position of any existing structures and underground utilities. If so stipulated in the Agreement, geo-environmental testing was carried out for a limited number of parameters based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

Any groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The groundwater level often has not had time to reach equilibrium and a monitoring period is required. Furthermore, groundwater levels are subject to seasonal variation or changes in local drainage conditions and groundwater levels may occur at other times of the year which are higher than were recorded during this investigation.

Any site drawings provided in this Report are preliminary and used to present the general relative locations of features on, and surrounding, the Site.

