



Civil Engineers & Transport Planners

Wetherby House

Basement Impact
Assessment

July 2019

191188/BIA/MK/KTP/01



Civil Engineers & Transport Planners

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1 REPORT SUMMARY

1.1 Risk Key

1. Impacts to surface water flows and related flooding	High	
	Med	
	Low	
2. Impacts to ground water flows and related flooding	High	
	Med	
	Low	
3. Overall risk posed by the Site	High	
	Med	
	Low	

Key:	High		<i>There is a high potential risk</i>
	Med		<i>There is medium potential risk</i>
	Low		<i>There is a low potential risk</i>

1.1.1 Potential impacts of the proposed basement development at 15 Green Lane, Northwood have been considered. The following summary conclusions are made.

1.2 Summary – Surface Water

1.2.1 There will be an increase to the proportion of hard surfaced area, a reduction to the profile of inflows received by adjacent properties and a net reduction to surface water flows as a result of the increase in the proportion of buildings proposed for the site with the implementation of an underground facility to attenuate runoff.

1.3 Summary – Groundwater

1.3.1 The site lies on top of a Secondary A Aquifer (Lambeth Group), however these deposits are expected to have low permeability. The proposed change in permeable area will impact the volume of rainfall discharging to the ground.

1.4 Recommendation

- 1.4.1 The basement excavation will penetrate the Lambeth Group; groundwater was identified at 10m BGL therefore, as a precaution it will be advisable to monitor any groundwater levels encountered during construction to confirm any changes in the rest water level.
- 1.4.2 A detailed drainage plan should be reviewed to confirm the mitigation of the proposed changes in hard surfaced areas and the impacts on surface waters and groundwater.

2 INTRODUCTION

2.1 Scope

2.1.1 Lanmor Consulting Ltd has been appointed to prepare a Basement Impact Assessment (BIA) for the construction of residential apartment block on the site of 15 Green Lane, Northwood, HA6 2UZ. Figure 1.1 below shows the location of the site.



Figure 1.1 – Location Plan

- 2.1.2 This report has been commissioned to advise on the technical feasibility of providing a construction methodology for the proposed basement and the impact of the basement. This document is a desk study which considers the potential impact relating to the proposed basement development in terms of surface water and groundwater flow and flooding. This report will form part of the submission to the Planning Authority for planning consent for development of the above site.
- 2.1.3 There is currently a single dwelling at the site. It is proposed to demolish this and replace it with a new block of flats.
- 2.1.4 The proposed building will consist of four storeys including the lower ground floor/basement car park. The storey height for the basement will be approximately 3m. The external area of the existing building at ground level is 195m² and the proposed building at ground floor will extend to an area of 469m². The proposals include for a basement car park which will extend the full footprint of the proposed ground floor above.
- 2.1.5 This basement impact assessment will enable the Council to assess whether these proposals will adversely impact on the local water environment. The following scope of works provides an assessment of the impacts of the proposed development, the first part considers the methodology of constructing the basement and structural impacts on the surrounding areas. The second part deals with the impact the basement will have on surface water and groundwater.
- 2.1.6 The works undertaken follow the procedure outlined below:

Part 1

- **Section 3 Construction and design** – this section deals with design philosophy for the basement.
- **Section 4 Construction Principles** – this section deals with the form of construction and measures to mitigate the basement.

Part 2

- **Section 5 Screening** – this process aims to identify any matters of concern and determine whether or not a full BIA is required.
- **Section 6 Scoping** – this process identifies the potential impacts of the proposed scheme.
- **Section 7 Recommendations** – recommendations are made based on the outcome of the assessment.

3 CONSTRUCTION AND DESIGN

3.1 Site Investigation

- 3.1.1 Appendix A shows the topographical survey of the site. The site rises steeply from Green Lane by approximately 2.0m from 68.05m AOD to 70.0m AOD, the site then flattens out with a slight rise to the north of 300mm.
- 3.1.2 The proposed basement will be constructed to a depth of approximately 3.3mbgl into the Lambeth Group Formation. The Lambeth Group is a Secondary A Aquifer and consists of clay, silt and sand. The London Clay formation is shown in close proximity to the site to the north and east.
- 3.1.3 No geotechnical investigation has been undertaken on this site, historic borehole records for the area show the local soils to be stiff mottled reddish brown silty sandy clay. Borehole records further afield show the groundwater was struck at 10.0m below ground level.
- 3.1.4 The groundwater level should not affect the proposed basement, but full tanking has been assumed for this assessment and will be reviewed once a full geotechnical investigation has been completed. Openings in the basement such as vents etc. should be carefully positioned, and construction joints should be detailed appropriately to prevent ingress of groundwater. Integral pad and strip foundations within the basement slab may be designed based on an assumed maximum net allowable bearing capacity of 125kN/m² on the stiff clay materials. The overall slab should not exceed an overall maximum net allowable bearing capacity of 35-40kN/m². The raft should be of a suitable thickness and reinforced to be suitably rigid.
- 3.1.5 Whilst driven piles may give a higher working load compared to a bored pile, their use may be prevented due to the proximity of adjacent structures. Preliminary working load capacities have been assumed based the available borehole data for Lambeth Group Formation, as set out below:

Depth (m)	Preliminary Working Loads of Bored Piles (tonnes)		
	300mm Dia	450mm Dia	600mm Dia
7.00	5-10	15-20	20-25

Table 2.3 – Pile Working Loads

3.1.6 In accordance with the NHBC Standards, heave precautions may be required on the upper portions of piles and on ground beams within the zone of influence of trees.

3.1.7 All excavations taken beneath the water table are likely to become highly unstable, significant collapse and over-dig should be expected. Consideration should be given to the use of dewatering and full trench support. Any battered slope should be regularly inspected for signs of potential instability, and sufficient working space should be allowed.

3.2 Structural Design

3.2.1 The lower ground / basement floor walls and foundation for the block will be formed with 250mm thick walls and a 300mm thick floor of reinforced waterproof concrete construction. This will provide a rigid box construction to the new property.

3.2.2 The basement floor and walls will be designed to accommodate the hydrostatic pressure as if it were applied to the full depth of the basement walls, as well as the up thrust created from potential water table variances.

3.2.3 The lower ground floor slab will be a 300mm thick reinforced water proof concrete slab and will form a raft to support the structure, the raft will be designed based on a net allowable bearing capacity of 125kN/m², however not to exceed an overall net allowable bearing capacity of 35-40kN/m². The raft foundation will be tied into the perimeter pile walls where present, with appropriate thickness and reinforcement provided to ensure adequate rigidity.

- 3.2.4 The nearest building is approximately 17m to the east of the site. It is proposed to construct a contiguous pile wall along the perimeter of the building. The contiguous pile wall will be installed via boring, due to the presence of local structures within the area, the use of bored piles is proposed to minimise the disturbance. The piles will be designed to penetrate into the Clay to allow the material to be excavated for the basement construction. A ring beam will be installed along the top of the piles prior to any excavations for the basement.
- 3.2.5 Dewatering shouldn't be necessary but if required will be undertaken before excavation of the basement. Following excavation for the basement the perimeter walls for the basement will be cast as a 250mm thick waterproof reinforced concrete walls with a 300mm thick waterproof reinforced concrete slab over the full extent of the basement footprint. The walls will be designed ignoring any support provided by the piled retaining wall (basement walls will be designed to cater for full height of hydrostatic pressure, earth retaining and any superimposed loading from adjacent buildings etc). The detailed design of the temporary and permanent works (piled walls) will be carried out by the relevant contractor. The temporary works must be accompanied by risk assessments, drawings and method statements.
- 3.2.6 Horizontal props will be added as the construction of the basement progresses. The main horizontal props will not be removed until at least 28 days after casting the concrete base and ground slabs. The proposed sequencing of the works is appended to this report.
- 3.2.7 The proposed piled walls will be designed by the piling contractor. In the permanent case the basement walls will be restrained (propped) by the ground floor (if necessary) and basement slab.

3.2.8 The superstructure will be constructed off the ground floor slab in traditional brick/block cavity construction. The drawings and assumptions in this report are based on the information available. For the detailed basement design (which would follow once planning permission is obtained) the ground investigation will be used to determine the final pile wall lengths, reinforcement sizes and other structural details. Preliminary pile calculations have been carried out and are included in Appendix B of this report. These have been used to produce the initial scheme drawings for the basement structure also appended to this report as drawing 191188/1000/01 in Appendix B.

3.2.9 In accordance with Burland and Potts 'Building Damage Classification' table, we expect damage to any adjacent buildings to be negligible. As previously stated, the piled walls and capping beams will remain propped until the permanent structure is in place and therefore, we expect any movements to be negligible.

3.3 Basement Construction

3.3.1 It is proposed to construct the lower ground / basement of the building with contiguous piles. The principle consideration for the proposed basement works is the effect on adjacent properties during the construction stage. Stability of the adjacent buildings will be provided using temporary works. The detailed design of all temporary works and production of any accompanying method statements will be provided by the contractor.

3.3.2 After installation of the contiguous piles to the perimeter of the new development, the pile heads will be trimmed to cut-off levels and capping beams constructed. Temporary horizontal props will be installed across the basement once the concrete capping beams have cured. Drawing 191188/1000/02 in Appendix B shows potential temporary works to be confirmed by contractor. Upon completion of the temporary works the bulk excavation of the site can be carried out. The soil level will be lowered to the formation level of the basement slab. Reinforcement will be installed, and new basement floor slab poured. Construction of the reinforced side walls will be followed by the new ground floor RC slab. It will provide permanent restraint to the top of piles, therefore all temporary propping can be removed once the slab is cast and concrete cured.

- 3.3.3 The sequencing of temporary works and removal of fill is shown on drawing 191188/1000/03 in Appendix B.
- 3.3.4 Due to the presence of neighbouring properties the works may be subject to a party wall agreement. As part of this agreement a survey of the existing structures will be required and monitoring measures agreed between the respective surveyors and council. Monitoring of the adjacent properties should be undertaken in accordance with current guidance with the appropriate trigger levels set to the satisfaction of the adjoining owner's surveyor.
- 3.3.5 The monitoring shall be undertaken by specialist surveyors and consist as a minimum, of monitoring targets fixed the adjoining properties etc. the number and location to be agreed between party wall surveyors. The monitoring period should cover the full extent of works on site from piling to completion the frequency should depend on the activates being undertaken (more frequently during the piling) and agreed with the surveyors of the neighbouring properties.
- 3.3.6 In consideration of all the above points we do not consider that the proposed basement once completed will have an adverse effect on the surrounding area. However, during the works the basement construction will have an impact on the area particularly in terms of soil removal, construction traffic and deliveries. The contractor should proactively manage the works keeping local residents aware of any events that may impact them in good time.

4 CONSTRUCTION PRINCIPLES

4.1 Health and Safety

4.1.1 All work is to be carried out in accordance with current Health and Safety Regulations and all site personnel are to be made fully aware of these regulations and procedures.

4.1.2 The site management teams should actively promote clean and tidy sites as it enhances safety and productivity and at the same time reduces waste. This philosophy should also be applied equally to the work area as it is the sites compound.

4.2 Materials

4.2.1 All materials will be used in accordance with current standards and, where relevant, manufacturer's instructions. Results of the Sulphate and pH analyse will determine the class of concrete to be used, if required all buried concrete should be sulphate resisting suitable to the above class.

4.2.2 Material will be stored on site as close to their place of use as possible and in an orderable fashion. Pedestrian walkways and vehicle routes will be segregated and marked out with appropriate barriers. Lay down areas will be set out for trades such as steel work and cladding and suitably fenced off. No flammable materials will be stored near boundary fencing or existing buildings, unless authorised to do so. Storage of flammable materials in and around the new building under construction should be strictly monitored and controlled.

4.2.3 Plant should be stored on site in an orderable fashion. Keys will be removed and isolators if fitted will be activated. Fuel for plant will be housed in double skinned bunded tank.

4.2.4 Any non-compliant materials are to be quarantined in a specially designated area to prevent accidental incorporation into the works pending their removal from site.

4.3 Excavations and Earthworks

- 4.3.1 All excavations will be fully propped to suit the depth of excavation, no work will be carried out until the propping is in place and the props will not be removed until the basement and ground floor construction has been completed. All excavated material will be removed from site.

4.4 Site Access

- 4.4.1 Access to the works will be secure. The site area will be kept tidy and reasonably clean where possible.

4.5 Noise and Dust

- 4.5.1 Dust arising from the ground prevalent in dry spells and generated by wind and plant traversing the site will be controlled by spraying water over the ground from a water bowser towed behind a dumper. Dust generated by site works will be controlled by suitable water suppressant or vacuum system attached to the appropriate piece of plant.

4.6 Party Wall Agreement

- 4.6.1 Due the proximity of the adjacent land/structures to where the pile installation will occur a Party Wall Agreement is likely to be required that will outline specific details of the agreed works to take place. This document will include a schedule of conditions, monitoring of the existing buildings, drawings of the proposed works, agreed working hours, time limits for commencement as well as information regarding public liability insurance and indemnities.
- 4.6.2 The party wall agreement will either be agreed between two separate party wall surveyors, (usually one appointed by either landowner), or one agreed non-biased surveyor who will represent both landowners.

5 SCREENING

5.1.1 The screening stage for Impact Assessment has been considered as follows;

5.1 Surface Water

Impact Question	Answer	Justification	Reference
1) Will the proposed development be subject to flooding?	NO	The proposed development is located in Flood Zone 1. The site is not at fluvial flooding.	EA Flood Maps
2) As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	YES	The proposed development will increase the proportion of the Site that is built on; therefore, the surface water flows will be materially changed.	Site Plans Drainage Strategy
3) Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	YES	The proposed development will increase the proportion of the Site that is built on; therefore the proportion of impermeable surfaces will increase.	Site plans
4) Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?	YES	The changes in the extent of buildings on the Site and the implementation of a drainage scheme to attenuate runoff in an underground facility will result in a decrease to the profile of surface water received by adjacent properties. There are no downstream watercourses in proximity to the site that could be affected.	Site plans Ordnance Survey Mapping. 2016. Drainage Strategy
5) Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	NO	The quality of surface water being received by adjacent properties or downstream watercourses will not be affected by the proposed development.	Site plans
6) Is the Site in an area known to be at risk from surface water flooding or is it at risk from flooding, for example because the proposed basement is below the static water level of a nearby surface water feature?	NO	The site is not in a surface water flood risk area for an event with a probability of 1.0% or greater. The development is not at risk of surface water flooding.	EA Flood Maps

Table 5.1 – Screening – Surface Water

5.2 Ground Water

Impact Question	Answer	Justification	Reference
1a) Is the Site located directly above an aquifer?	YES	The site lies on top of a Secondary A Aquifer as identified in the Environment Agency website Map. The bedrock beneath the site is the Lambeth Group that consists of silty clay. No superficial deposits are identified.	GOV.UK Magic maps website British Geological Survey, 2016.
1b) Will the proposed basement extend beneath the water table surface?	NO	The proposed depth of the basement is 3.3 metres below ground level (mbgl). Borehole records indicate the ground water levels to be 10mbgl.	Site plans; British Geological Survey, 2016.
2) Is the Site within 100 m of a watercourse, well (used/disused) or potential spring line?	NO	The site is not within 100 m of a watercourse, well or potential spring line.	Ordnance Survey Mapping. 2016.
3) Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	YES	The proposed development will increase the proportion of the Site that is built on, therefore the proportion of hard surfaces will change.	Site plans.
4) As part of the Site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	NO	The volume of surface water from buildings and hardstanding will not discharge to the ground.	Site Plans. Drainage Strategy
5) Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond or spring line.	NO	There are no known ponds or spring lines within close proximity to the Site. There are no surface water features within 500m of the Site.	Ordnance Survey Mapping, 2016.

Table 5.2 – Screening –Ground Water

5.3 Stability

Impact Question	Answer	Justification	Reference
1) Does the existing site include slopes, natural or manmade, greater than about 1 in 8?	NO	No relevant slopes where noted on site	Ordnance Survey Mapping, 2016.
2) Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 1 in 8?	NO	The proposed development does not comprise a re-profiling of the existing slopes	Site Layout Plans
3) Does the development neighbour land, including railway cuttings and the like, with a slope greater than 1 in 8?	NO	Neighbouring land is level with site.	Ordnance Survey Mapping, 2016.
4) Will any trees be felled as part of the proposed development and / or are any works proposed within any tree protection zones where trees are to be retained?	NO	Works within proximity of tree is required but suitable tree protection zones will be established as part of these proposals	
5) Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	YES	Seasonal shrink-swell is considered likely due to the underlying geology.	
6) Is the site within 100m of a watercourse or potential spring line?	NO	No water features were identified in a radius of 100m from the site. No disused rivers were noted at less than 100m	Ordnance Survey Mapping, 2016.
7) Is the site in an area of previously worked ground?	NO	No information was recorded regarding to the eventual presence of pits and quarries.	
8) Is the site within 5m of highway or pedestrian right of way?	NO	Green Lane is 11m from the nearest building.	Ordnance Survey Mapping, 2016.

9) Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	YES	The development will increase the depths of foundation at the site, although the foundation depths of adjacent properties are not known. Contiguous piled walls will be installed along the boundary of the property.	
10) Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	NO	No underground facilities were understood to be present beneath the site of interest.	

Table 5.3 – Screening Stability

6 SCOPING

6.1.1 Impact questions that were answered “Yes” at the screening stage are taken forward to the Scoping stage for further assessment;

6.1 Surface Water

Impact Question	Answer	Justification	Reference
2) As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	Yes	The proposed development will increase the proportion of buildings on the Site; these will have a new drainage system such that run off from hard standing and roof areas will be attenuated with an underground facility. Therefore, the proposed development will deliver a net reduction in the rate surface water flows. A detailed drainage plan and report is submitted with reference; 191188/DS/MK/RS/01	Site Plans. Drainage Strategy
3) Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	Yes	The proposed development will increase the proportion of buildings on the Site. The proportion of hard surfaced area across the Site will increase, however the presence of Clay close to the surface indicates low permeability soils that would have reduced infiltration prior to any increase in built up area. Therefore, the proposed changes will not have a significant impact. The detailed drainage plan shows a reduction in permeable surfaces, all impermeable surfaces will be positively drained and will not permeate into the near surface deposits.	Site Plans. British Geological Survey, 2016.
4) Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?	Yes	The proposed development will incorporate an underground drainage system to attenuate runoff from hard standing and roof areas. This will result in a reduction to the profile of surface water received by adjacent properties.	Site plans. Ordnance Survey Mapping. 2016.

		Drainage plan and report reference; - 191188/DS/MK/RS/01 shows the scale of changes and the impacts. There are no downstream watercourses that may receive a change in their inflow profile as a result of the proposed development.	
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Table 6.1 – Scoping – Surface Water

6.2 Ground Water

Impact Question	Answer	Justification	Reference
1a) Is the Site located directly above an aquifer?	Yes	The site lies on top of a Secondary A Aquifer as identified in the Environment Agency website Map. Borehole records indicate the soil to be silty clay no groundwater was struck to a depth of 10m suggesting upper clay layer has limited permeability.	Site plans; British Geological Survey, 2016.
3) Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	Yes	The proposed development will increase the proportion of buildings on the Site. As a result of the increase in the proportion of hard surface area across the Site, there will be a reduction in the volume of rainfall absorbed by the topsoil clay of the Lambeth Group is in the region of 10m deep in the local area, the proposed changes are not anticipated to have a significant impact Detailed drainage plan and reference; 191188/DS/MK/RS/01 confirms any changes in the volumes of water able to permeate into the near surface deposits.	Site Plans. British Geological Survey, 2016.

Table 6.2 – Scoping – Ground Water

6.3 Stability

Impact Question	Answer	Justification	Reference
5) Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	Yes	Seasonal shrink-swell is considered likely due to the underlying geology and influence of trees on the proposed development, therefore precautions against shrinkage /swelling of foundation soils on basement and uplift shall be taken in to account in accordance with NHBC Standards Chapter 4.2.	
9) Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes	The development will increase the depths of foundation at the site, although the foundation depths of adjacent properties are not known. Basement design should incorporate loading from adjacent building and prevent movement.	

Table 6.3 – Scoping Stability

7 CONCLUSIONS

7.1 General

- 7.1.1 Potential impacts of the proposed basement development at 15 Green Lane have been considered. The following summary conclusions are made.

7.2 Screening Stage – Surface Water

- 7.2.1 There will be no change to the quality of surface waters; however there will be an increase to the proportion of hard surfaced area, a reduction to the profile of inflows received by adjacent properties and a net decrease to the change to surface water flows as a result of the increase in the proportion of buildings proposed for the site and the implementation of an underground facility to attenuate runoff.

7.3 Screening Stage – Ground Water

- 7.3.1 The site lies on top of a Secondary A Aquifer, the proposed depth of the basement is expected to be 3.3m below ground level. Boreholes records for the area show groundwater strikes at 10m below ground in the clay. There is no watercourse, well or spring within 100 m of the site. The proposed change in permeable area will impact the volume of rainfall discharging to the ground.

7.4 Screening Stage – Stability

There are no slopes within the site that are greater than 1 in 8, due to the nature of soil on site, there may be a potential for shrink-swelling of the soil. The site is not located in any known exclusion zones. Contiguous piled walls will be installed along the boundary of the property where it is not practical to provide batter slopes to the basement.

7.5 Scoping Stage – Surface Water

- 7.5.1 The proposed development will incorporate an underground drainage system to attenuate runoff that will mitigate the impacts identified in the scoping stage; changes to inflows, hard surfaced area and surface water flows. There is no identified risk of surface water flooding to the proposed development.

7.6 Scoping Stage – Ground Water

- 7.6.1 The proposed basement will be constructed to a depth of approximately 3.3 m bgl into the Lambeth Group Formation. The site is identified as being over secondary aquifer and is unlikely to permit significant lateral groundwater flow.
- 7.6.2 Appropriate dewatering techniques should not be required unless excavation exceeds 10m but will be reviewed as part of the geotechnical investigation. If necessary dewatering will be undertaken to provide a safe, dry working environment, the flow of ground water will not be restricted by the piles as ground water will still be able to flow through them and around the basement, monitoring of groundwater levels and appropriate mitigation measures should be employed during the construction phase.
- 7.6.3 The reduction of the permeable area will reduce the recharge into the ground however, these clay soil below have poor permeability and therefore, the proposed changes will have negligible impacts on any water level beneath the site.

7.7 Scoping – Stability

- 7.7.1 Due to the geology on site and the trees there may be a potential for seasonal shrink-swell, the basement / foundation will therefore be designed against shrinkage/swelling of foundation soils in accordance with NHBC Standards Chapter 4.2.
- 7.7.2 Ground water was not encountered however the basement construction should be designed to withstand the full height of hydrostatic pressure up to the surface level of the existing ground. The full tanking of the basement may also be required to prevent in the ingress of water.
- 7.7.3 Safe angle of repose for cutting slopes should not exceed 20 degrees, piled walls should be provided around the basement excavation. Piles should be designed to take any loadings from adjacent buildings and prevent any movement of the neighbouring ground.

7.7.4 Heave forces caused by the removal of overburden are not expected to be significant as long as there is no undue delay in the construction program. The basement will however be designed in accordance with NHBC Standards for soils with a shrinkage/swelling potential.

7.8 Recommendations

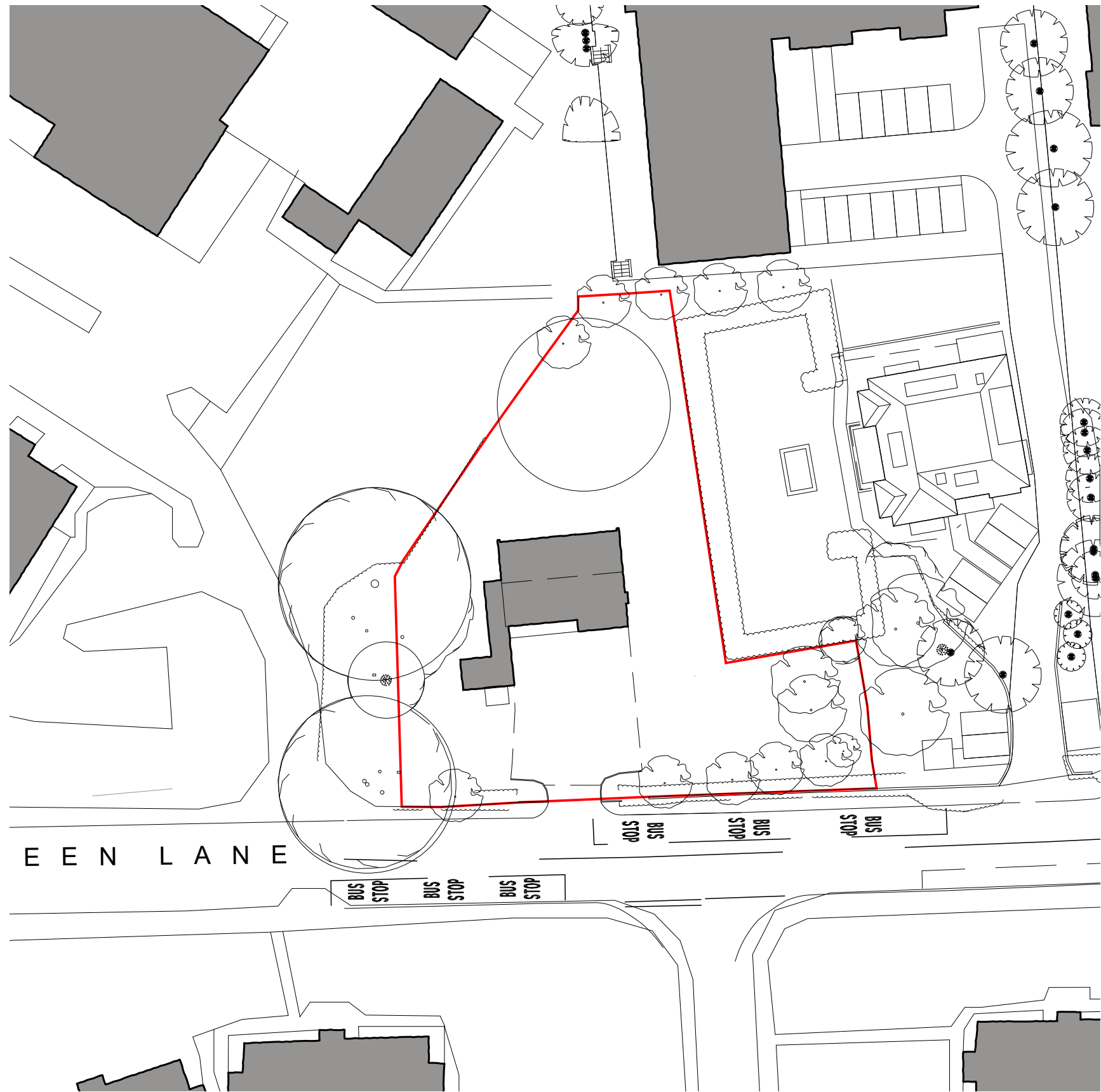
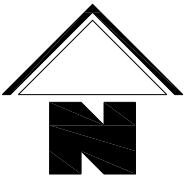
7.8.1 The basement excavation will penetrate the Lambeth Group formation therefore, as a precaution it will be advisable to maintain groundwater monitoring to confirm any changes in the rest water level to better inform the measures required for excavating the basement. Groundwater monitoring should also be maintained through the construction process.

7.8.2 The detailed drainage plan and report should be reviewed during design development to confirm the mitigation of the proposed changes in hard surfaced areas and the impacts on surface waters.

7.8.3 Basements should be designed to current Eurocodes assuming full height of hydrostatic pressure acting on the basement walls, basements should be fully waterproofed due to the presence of perched ground water in some areas of the site.

APPENDIX A

Topographical Survey



Rev	Date	Description

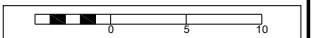


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Client :
Green Lane Estates Ltd

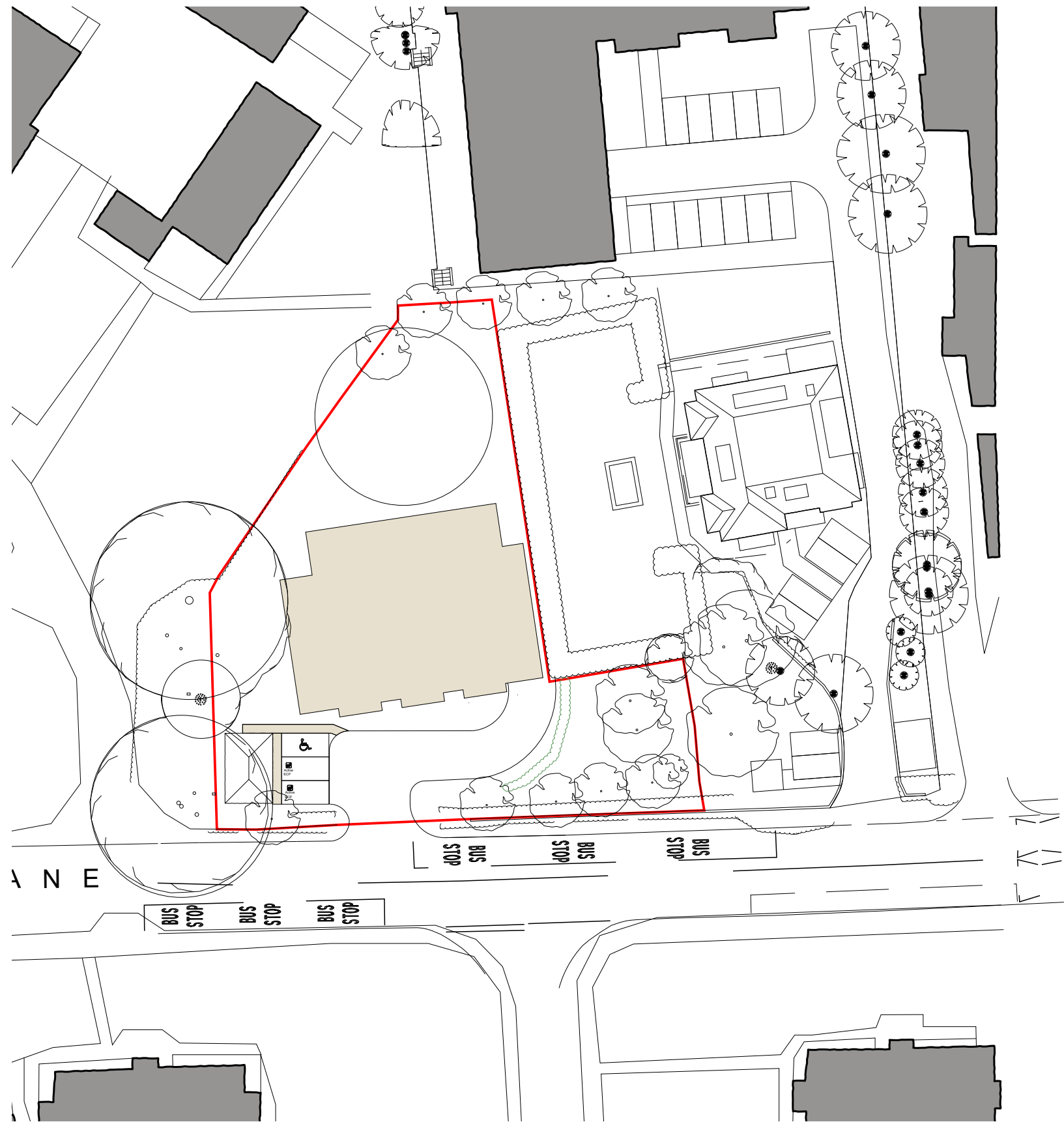
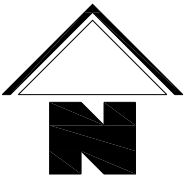
Wetherbys Nursery
Green Lane, Northwood

Existing Site Plan



Scale 1:500 @ A3	Dwg No. FLU.441.3.16
Date 24.02.19	Rev
Drawn N.Millin	

Proposed Layout



Rev	Date	Description

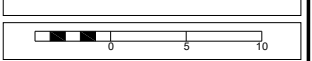


FLUENT
ARCHITECTURAL DESIGN SERVICES LTD
MONKEY PUZZLE HOUSE, 69-71 WINDMILL RD,
SUNBURTON/TAMES TW16 7DT
TEL: 0800 043 8838
EMAIL: INFO@FLUENT-ADS.CO.UK
WEB: FLUENT-ADS.CO.UK

Client :
Green Lane Estates Ltd

Wetherbys Nursery
Green Lane, Northwood

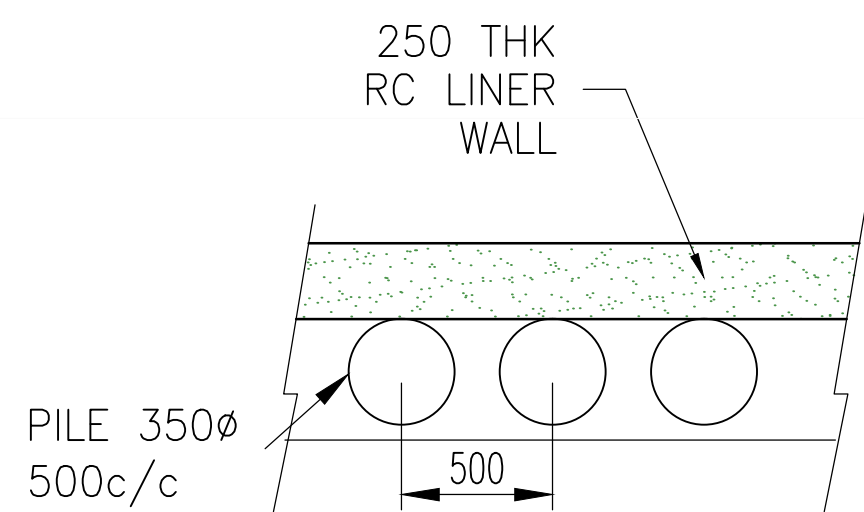
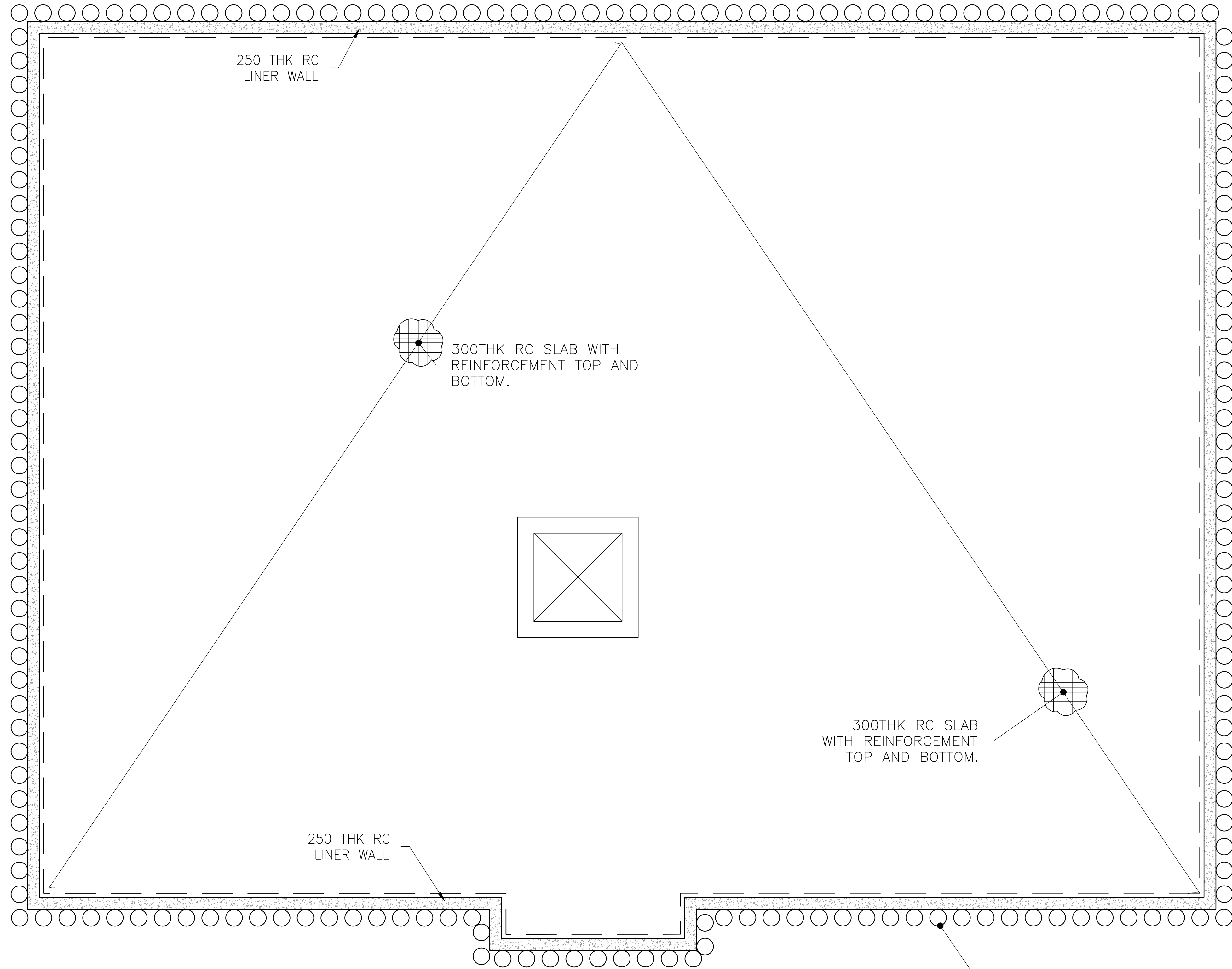
Site Plan



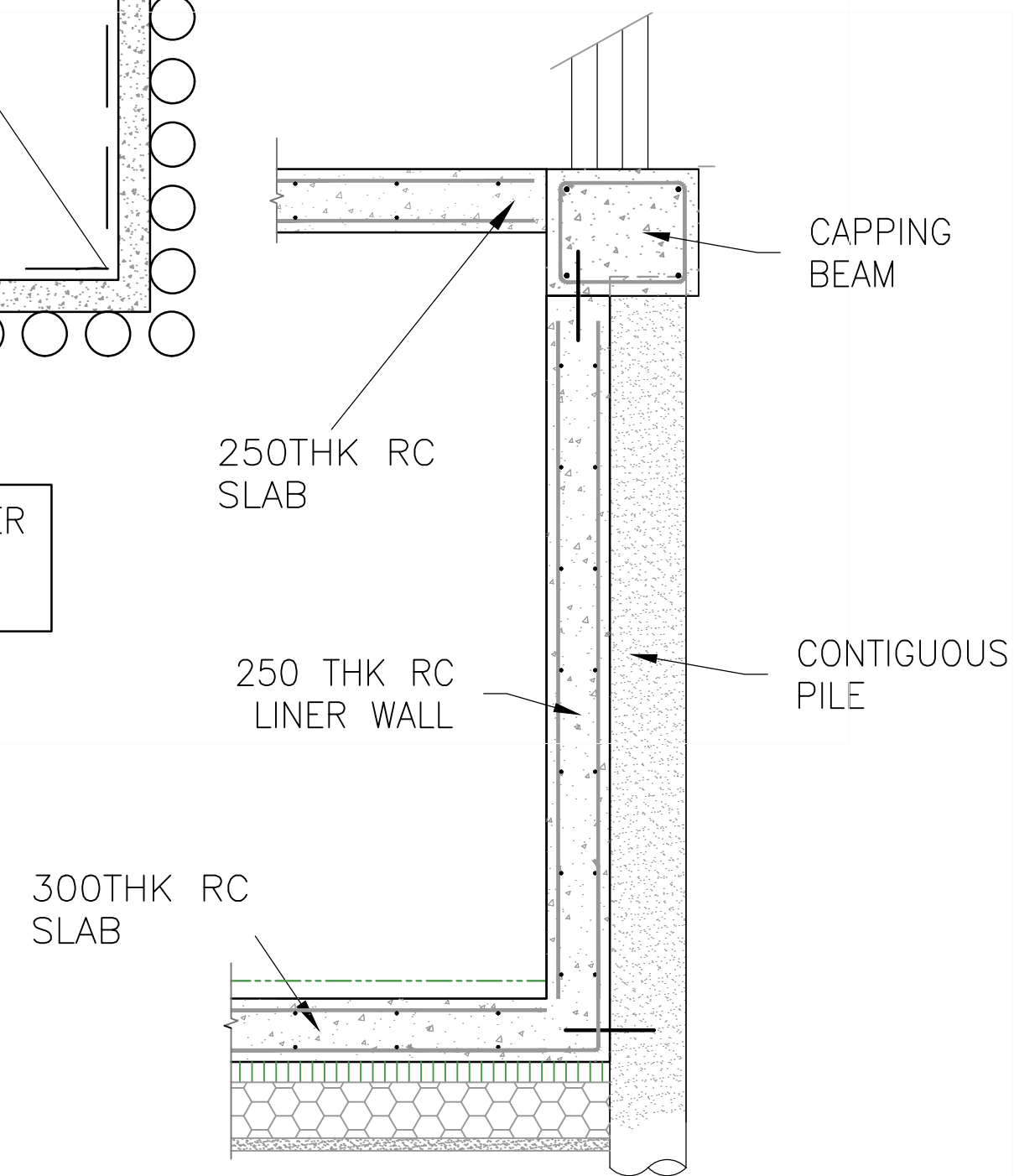
Scale 1:500 @ A3	Dwg No. Sk.01
Date 25.01.19	Rev A
Drawn N.Millin	

APPENDIX B

191188/1000/01 – Basement Construction Layout



CONTIGUOUS PILE DETAIL



TYPICAL RETAINING WALL SECTION

NOTES

General

All dimensions in millimetres unless noted otherwise

drawing are not to be scaled

this drawing is to be read in conjunction with architects, engineers and other specialists drawings

the contractor is to ensure that adequate temporary support is provided to the structure during the works

All setting-out level and dimensions set by architect

Structural drawings to be read in conjunction with specifications

Rev	Amendment	Drawn	Checked	Approved	Date

LANMOR Consulting
Civil Engineers & Transport Planning
Thorogood House, 34 Tolworth Close, Surbiton, Surrey, KT6 7EW
Telephone: 0208 339 7899 Fax: 0208 339 7898
e-mail: info@lanmor.co.uk
www.lanmor.co.uk

Green Lane Estates Ltd

Wetherby House

Proposed Basement Plan and Typical Section

DRAWN	JC	CHECKED	AH	APPROVED	KBL
DATE	4/7/2019	DATE	4/7/2019	DATE	4/7/2019
SCALE	1 : 50	PRJ No.	191188	SIZE	REV
DWG No.	191188/1000/01			A1	A

191188/1000/02 – Basement Temporary Works

[illegible]

General

All dimensions in millimetres unless noted otherwise

drawing are not to be scaled

this drawing is to be read in conjunction with architects, engineers and other specialists drawings

the contractor is to ensure that adequate temporary support is provided to the structure during the works

All setting-out level and dimensions set by architect

Structural drawings to be read in conjunction with specifications

Rev	Amendment	Drawn	Checked	Approved	Date



Thorogood House, 34 Tolworth Close, Surbiton, Surrey, KT6 7EW
Telephone: 0208 339 7899 Fax: 0208 339 7898
e-mail: info@lanmor.co.uk
www.lanmor.co.uk

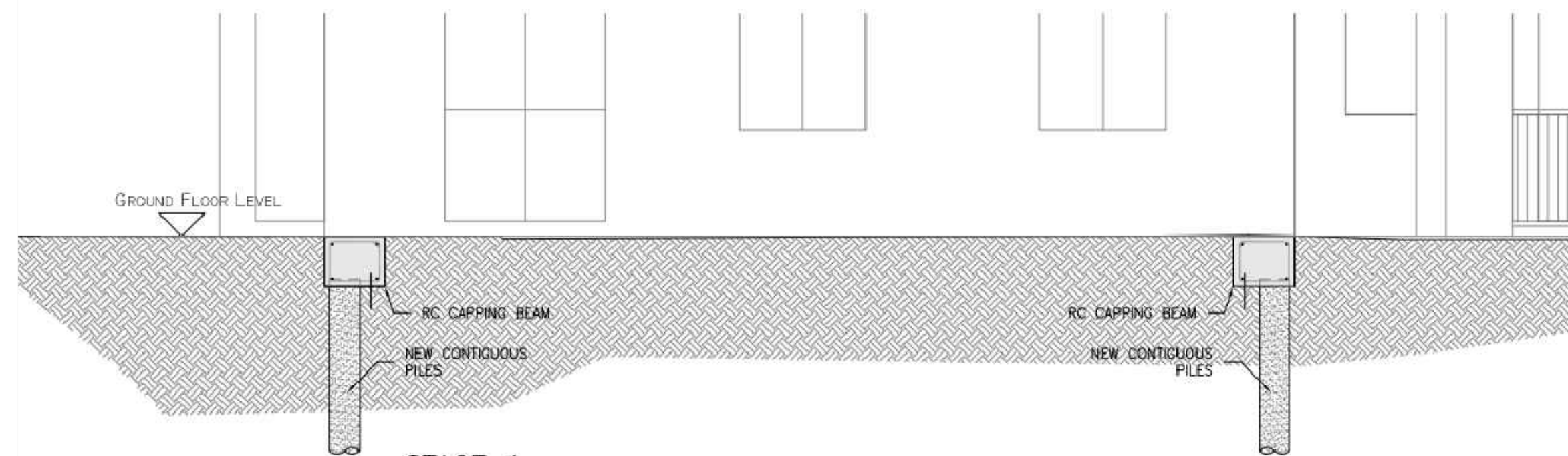
Green Lane
Estates Ltd

Wetherby
House

Temporary Works Propping and Bases

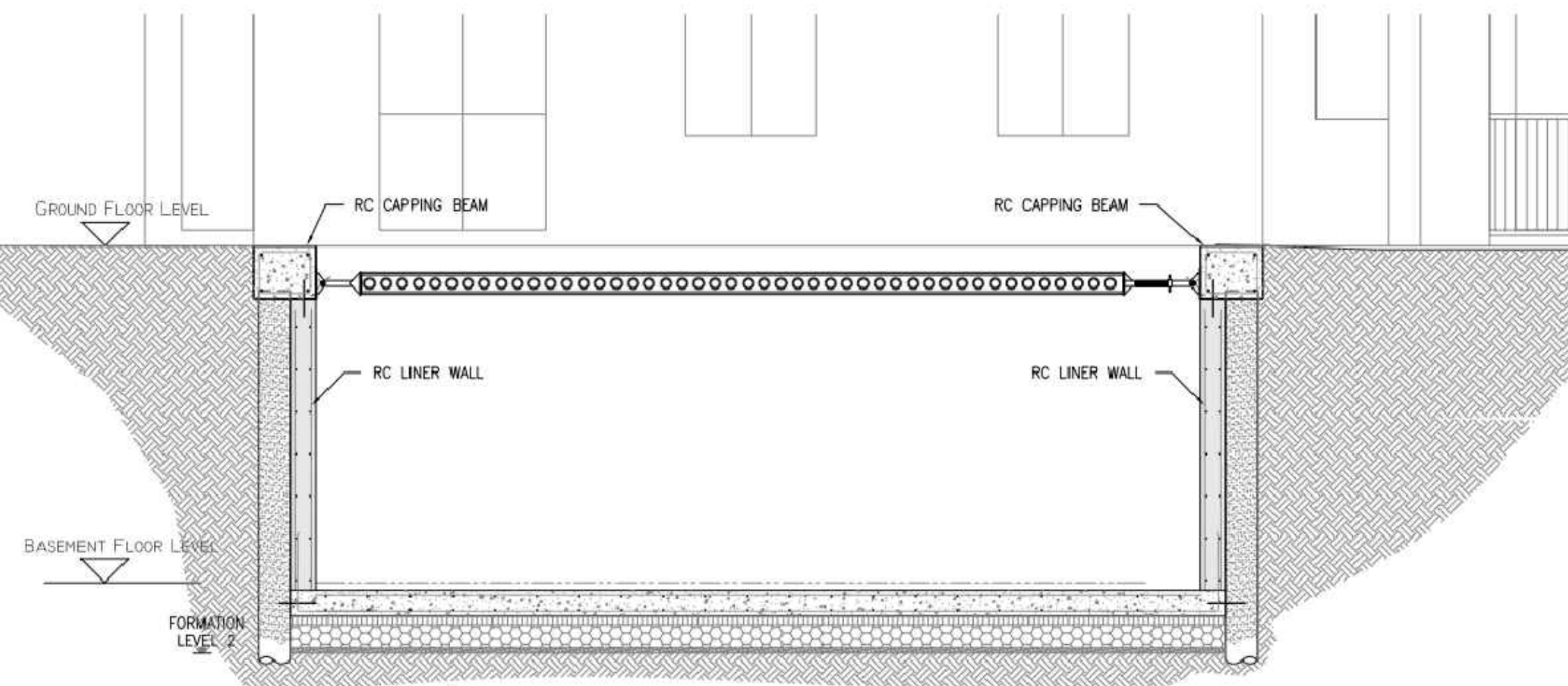
DRAWN	JC	CHECKED	AH	APPROVED	KBL
DATE	4/7/2019	DATE	4/7/2019	DATE	4/7/2019
SCALE	1 : 50	PRJ No.	191188	SIZE	REV
DWG No.	191188/1000/02			A1	A

191188/1000/03 – Temporary Works Sequencing

**STAGE 1**

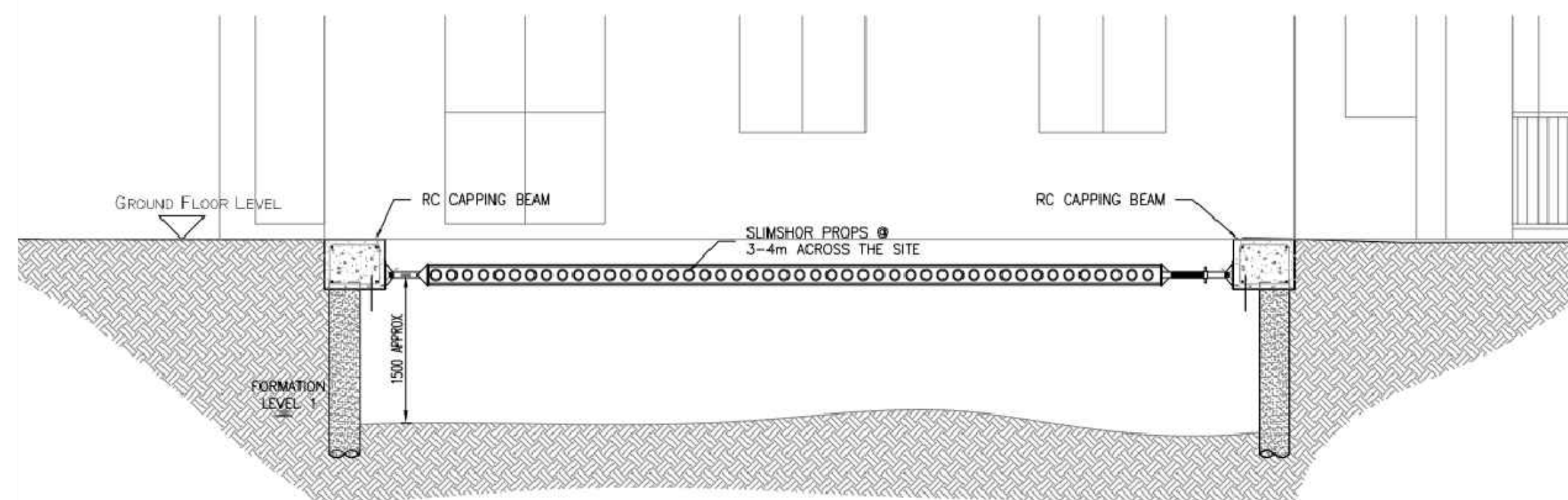
INSTALL NEW CONTIGUOUS PILE WALLS AROUND PERIMETER OF NEW BASEMENT ONCE THE EXISTING BUILDING HAS BEEN DEMOLISHED AND SITE CLEARED TO REQUIRED LEVEL. TRIM PILE HEADS TO REQUIRED CUT OFF LEVELS. EXCAVATE THE PERIMETER OF THE BASEMENT TO CAPPING BEAM FORMATION LEVEL. INSTALL FORMWORK AND REINFORCEMENT INCLUDING STARTER BARS FOR NEW LINING WALL AND GROUND RC SLAB. POUR CONCRETE FOR CAPPING BEAM.

Scale 1:50

**STAGE 4**

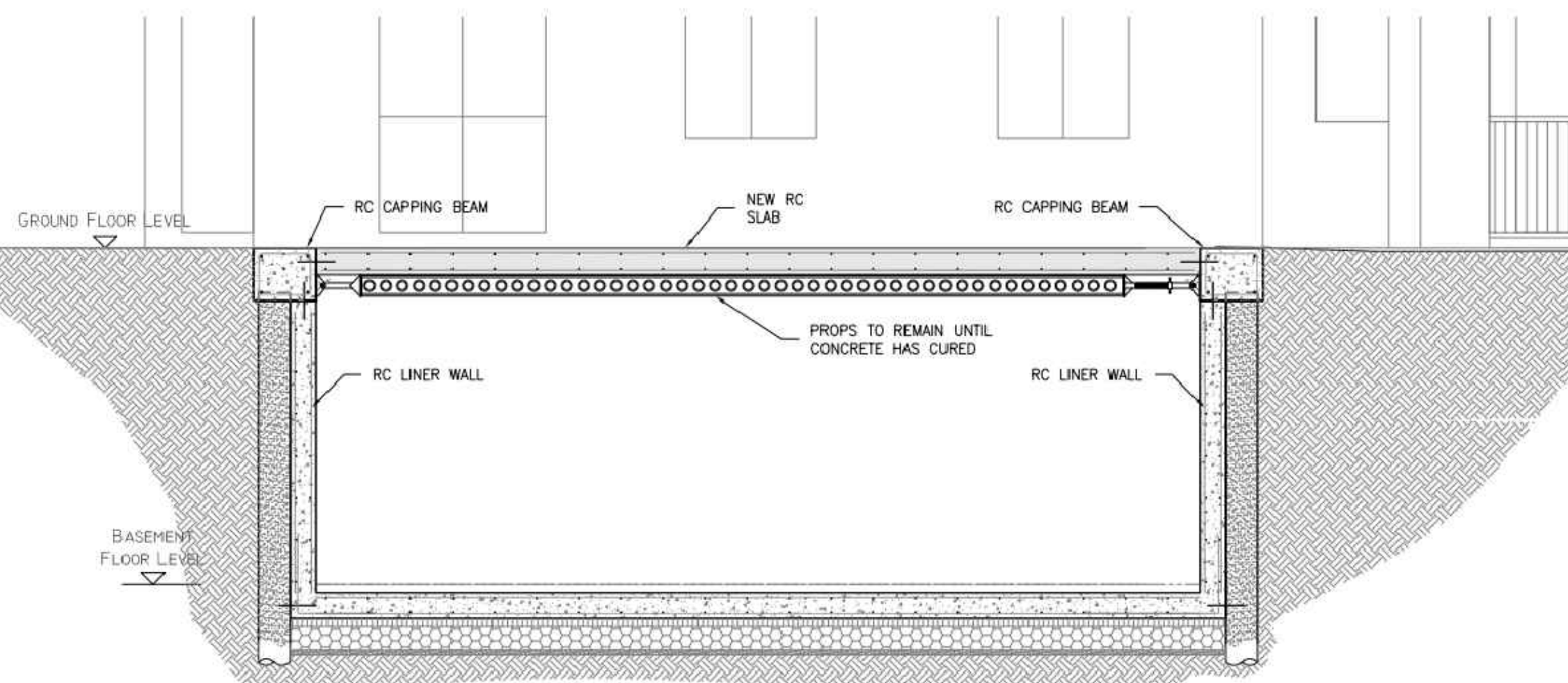
PREPARE SHUTTERING AND REINFORCEMENT FOR NEW PERIMETER LINING WALL. POUR CONCRETE AND ALLOW CURING.

Scale 1:50

**STAGE 2**

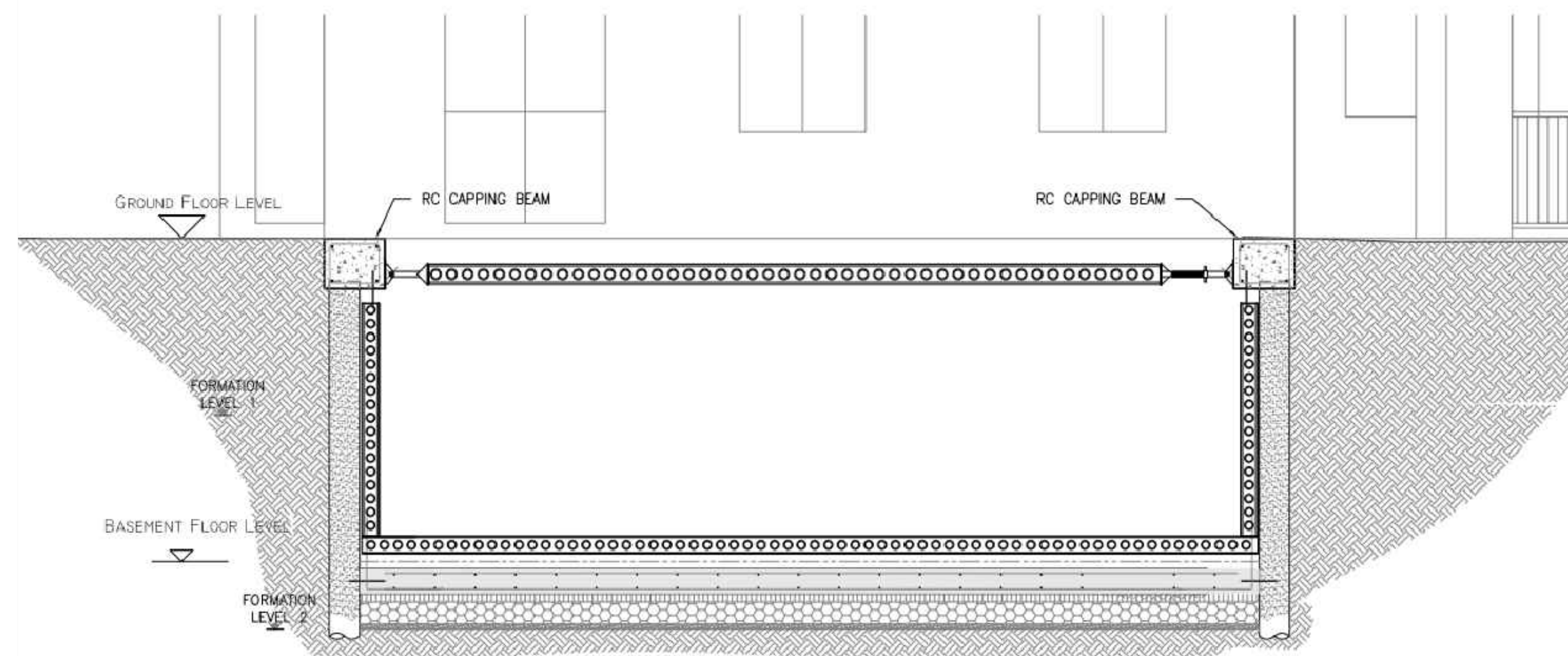
ONCE THE CONCRETE HAS CURED, LOWER THE INTERNAL SOIL LEVEL SUFFICIENTLY TO ALLOW INSTALLATION OF PROPS. LOWER THE INTERNAL LEVEL BY FURTHER 1.5M. CAREFULLY BREAK OFF AND REMOVE THE EXISTING UNWANTED FOUNDATIONS AND SERVICES IF REQUIRED.

Scale 1:50

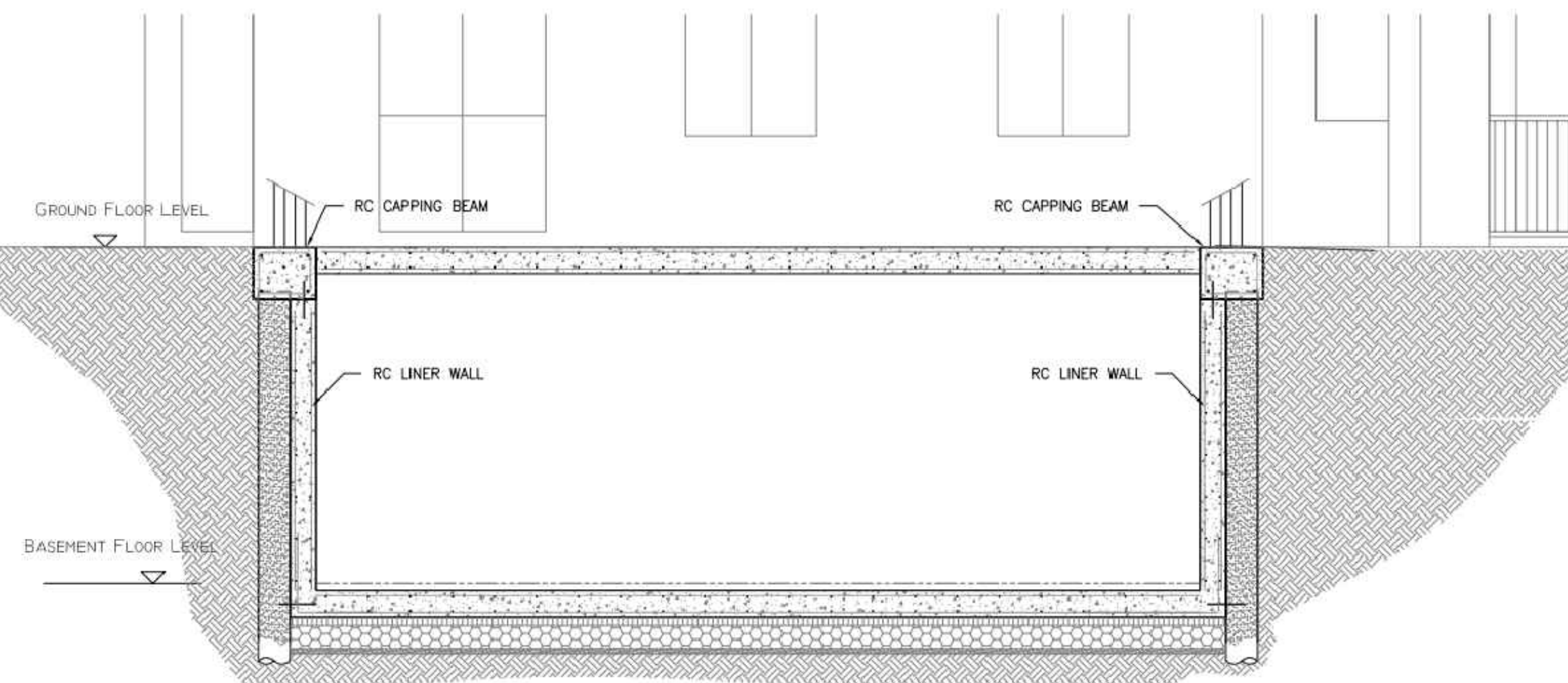
**STAGE 5**

PREPARE FORMWORK AND REINFORCEMENT FOR NEW GROUND FLOOR RC SLAB. CAST THE SLAB AND ALLOW CURING.

Scale 1:50

**STAGE 3**

UPON COMPLETION OF THE TEMPORARY WORKS THE BULK EXCAVATION OF THE SITE CAN BE REMOVED. LOWER THE SOIL LEVEL TO REACH THE FORMATION LEVEL 2 OF THE BASEMENT SLAB. PREPARE THE SUB-BASE AND REINFORCEMENT INCLUDING STARTER BARS FOR RC WALLS EXTENDING UP. INSTALL DOWEL BARS TO FIX SLAB TO PILES. POUR CONCRETE AND ALLOW CURING.

**STAGE 6**

THE NEW GROUND FLOOR SLAB PROVIDES PERMANENT RESTRAINT TO THE TOP OF PILES THEREFORE ALL TEMPORARY PROPPING CAN BE REMOVED AT THIS STAGE. INSTALL WATERPROOFING AS PER ARCHITECT'S DETAILS. COMPLETE SUPERSTRUCTURE ABOVE.

Scale 1:50

NOTES**General**

All dimensions in millimetres unless noted otherwise

drawing are not to be scaled

this drawing is to be read in conjunction with architects, engineers and other specialists drawings

the contractor is to ensure that adequate temporary support is provided to the structure during the works

All setting-out level and dimensions set by architect

Structural drawings to be read in conjunction with specifications

Rev	Amendment	Drawn	Checked	Approved	Date

LANMOR Consulting
Civil Engineers & Transport Planning

Thorogood House, 34 Tolworth Close, Surbiton, Surrey, KT6 7EW
Telephone: 0208 339 7899 Fax: 0208 339 7898
e-mail: info@lanmor.co.uk
www.lanmor.co.uk

**Green Lane
Estates Ltd**

**Wetherby
House**

**Temporary Works
Sequencing**

DRAWN	JC	CHECKED	AH	APPROVED	KBL
DATE	4/7/2019	DATE	4/7/2019	DATE	4/7/2019
SCALE	1 : 50	PRJ No.	191188	SIZE	REV
DWG No.	191188/1000/03			A1	A

Pilling Walls Calculations

	Page No 1 Analysis
CADS Piled Wall Suite Version 5.31 Design of embedded retaining walls and cofferdams	Project 1327 File Name bia pile design.pws
Wetherby House, Green Lane CantileveredPile Wall Design	Engineer MD Date 07/06/2019

Pile geometry

Pile top Level 0 m
 Pile Length 8 m
 Pile toe level -8 m
 Active ground slope 0 Degrees (To horizontal)

Soils and ground water initial data (Soils data given for active and passive sides)

Initial Ground Water level 0

Top Level m	Description	Bulk Dens kN/m3	Sat' Dens kN/m3	Young Mod kN/m2	Young Inc. kN/m3	Cu C' kN/m2	C Inc. kN/m3	Phi Deg	Wall Shear Ratio	Ka Kp	Kac Kpc
.00	Silty CLAY	19.00	19.00	12000	0	20 20			.50 .50	1.00 1.00	2.45 2.45
-.50	Sandy CLAY	19.50	19.50	30000	0			28 28	.50 .50	.32 4.15	
-1.00	Gravely CLAY	20.50	20.50	60000	0	100 100				1.00 1.00	2.00 2.00
-1.80	CLAY	20.50	20.50	90000	0	100 100				1.00 1.00	2.00 2.00

Construction sequence

Stage Ref	Stage Type	Level or Angle m/deg.	Load kN(/m)	Offset m	Width m	Length m
1	Active surcharge	0.00	5.0	.0		
2 A	Passive side excavation	-0.40				
3 A	Passive side excavation	-1.50				
4 A	Passive side excavation	-3.50				
5	Insert prop	-3.00				
6 A	Line load	0.00	100.0	.0		

	Page No 2 Analysis
CADS Piled Wall Suite Version 5.31 Design of embedded retaining walls and cofferdams	Project 1327 File Name bia pile design.pws
Wetherby House, Green Lane Cantilevered Pile Wall Design	Engineer MD Date 07/06/2019

Code of practice

Code of practice or reference document	CIRIA R104 Burland and Potts Permanent Works
Application of pressures for stability	FOS on available passive
FOS on moments (stability check)	2.00
ULS factor on Tan(Phi) values	1.00
ULS fFactor on drained cohesion values	1.00
ULS factor on undrained cohesion values	1.00
ULS factor on active soil pressures	1.00
ULS factor on passive soil pressures	1.00
ULS factor on active water pressures	1.00
ULS factor on passive water pressures	1.00
ULS factor on loads applied to the soil	1.00
ULS factor on loads applied to the wall	1.00
FOS on embedment (stability check)	1.00
Correction factor on cantilever embedment	1.20

Wall analysis detail options

Nominal Phi for load distribution	30.0 Degrees
Depth of water filled tension cracks	.0 m
Density of water	10.0 kN/m3
Minimum equivalent fluid density	5.0 kN/m3
Depth of passive softened soil	1.0 m
Continuity model for wall analysis	Continuous over props

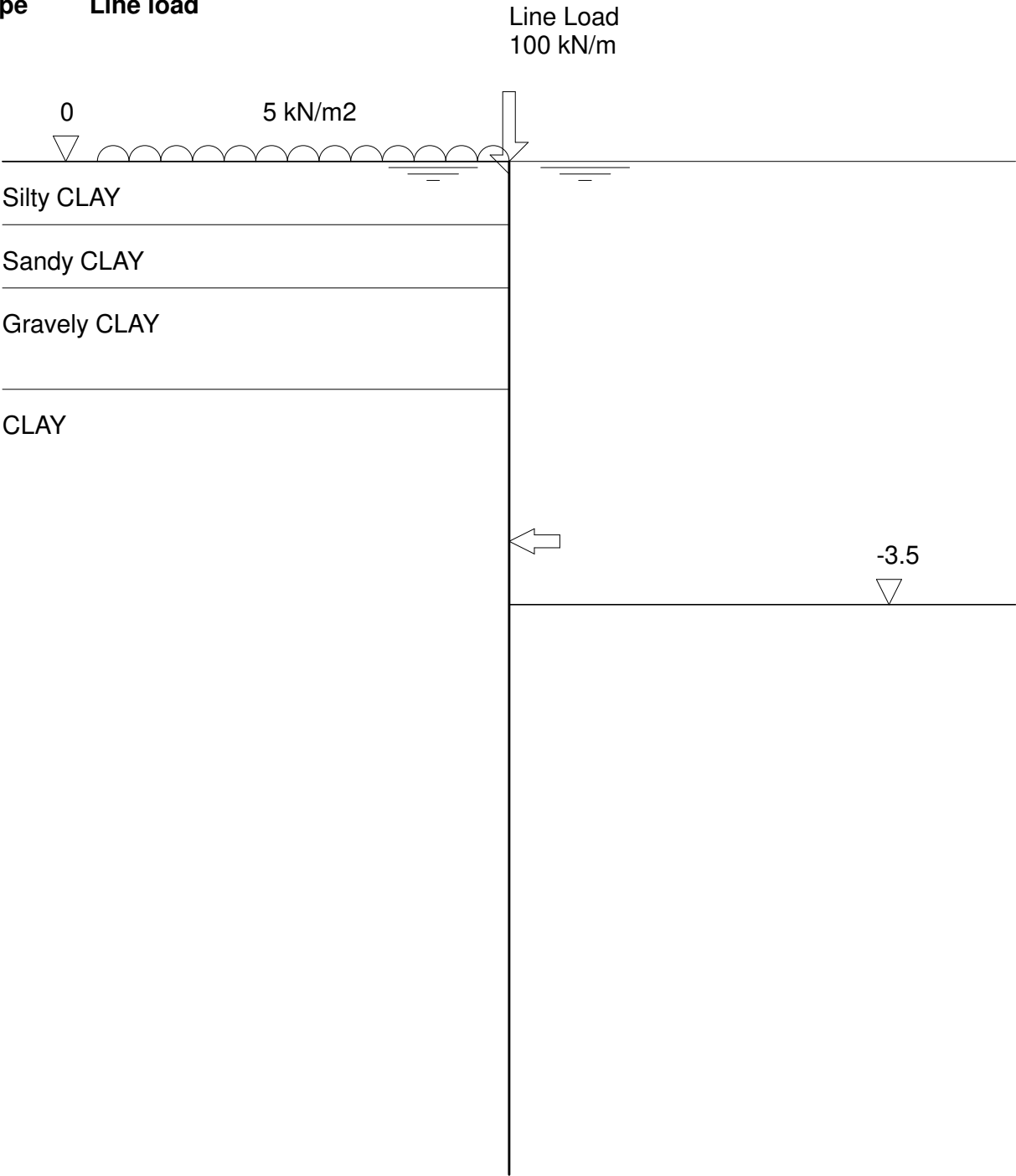
Deflection parameters

Wall moment of inertia	147324 cm4/m
Wall Youngs modulus	27000000 kN/m2
Properties for prop at -3.0	
Prop/Tie cross sectional area	200 cm2 each
Prop/Tie Youngs modulus	210000000 kN/m2
Prop/Tie length	10.0 m
Prop/Tie spacing	6.0 m
Waling moment of inertia	Waling deflection not included
Waling Youngs modulus	Waling deflection not included
Prop/Tie preload	0 kN
Initial lack of fit	0.0 mm

	Page No 3 Analysis
CADS Piled Wall Suite Version 5.31 Design of embedded retaining walls and cofferdams	Project 1327 File Name bia pile design.pws
Wetherby House, Green Lane CantileveredPile Wall Design	Engineer MD Date 07/06/2019

Stage ref.
Stage type

6
Line load

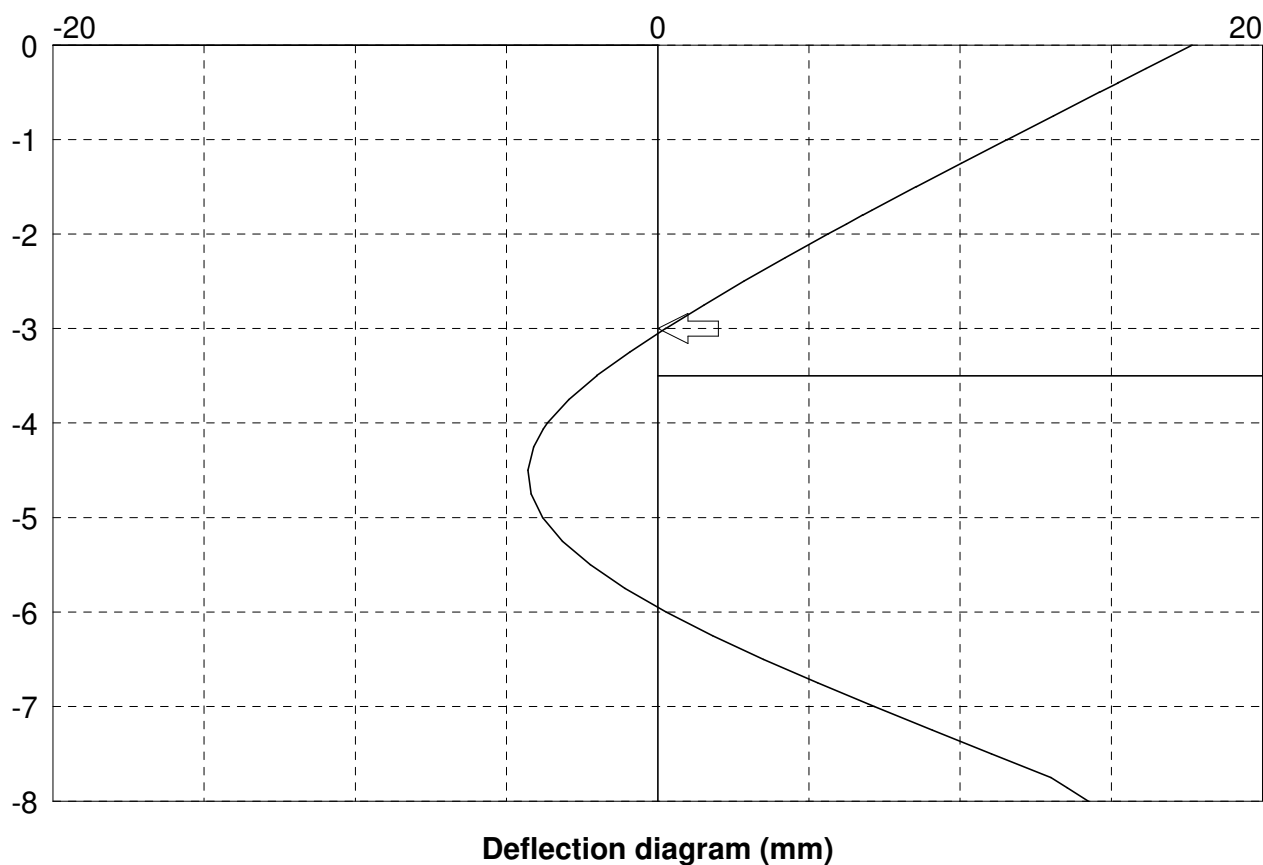
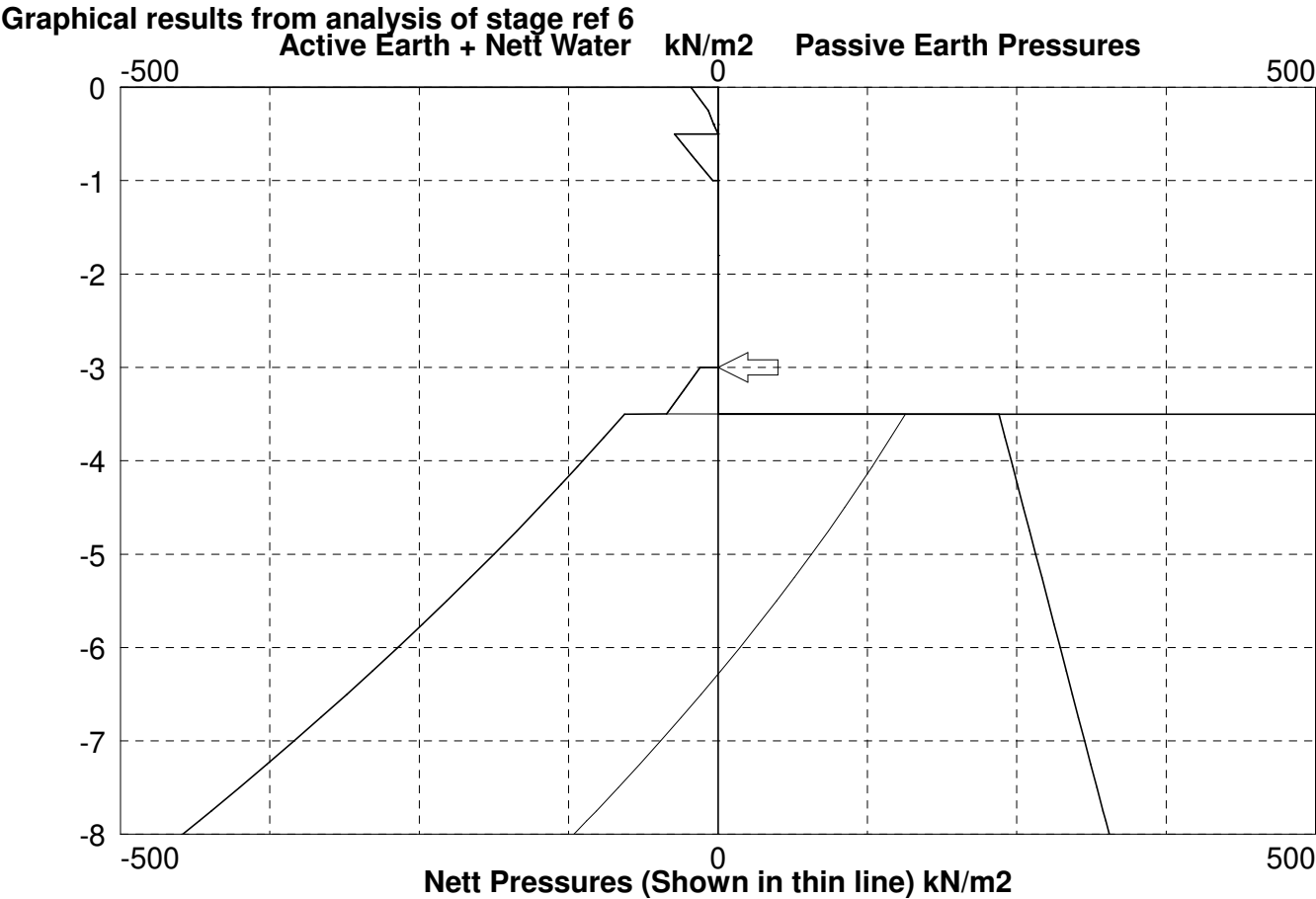


	Page No 4 Analysis
CADS Piled Wall Suite Version 5.31 Design of embedded retaining walls and cofferdams	Project 1327 File Name bia pile design.pws
Wetherby House, Green Lane CantileveredPile Wall Design	Engineer MD Date 07/06/2019

Tabular results from analysis of stage ref 6

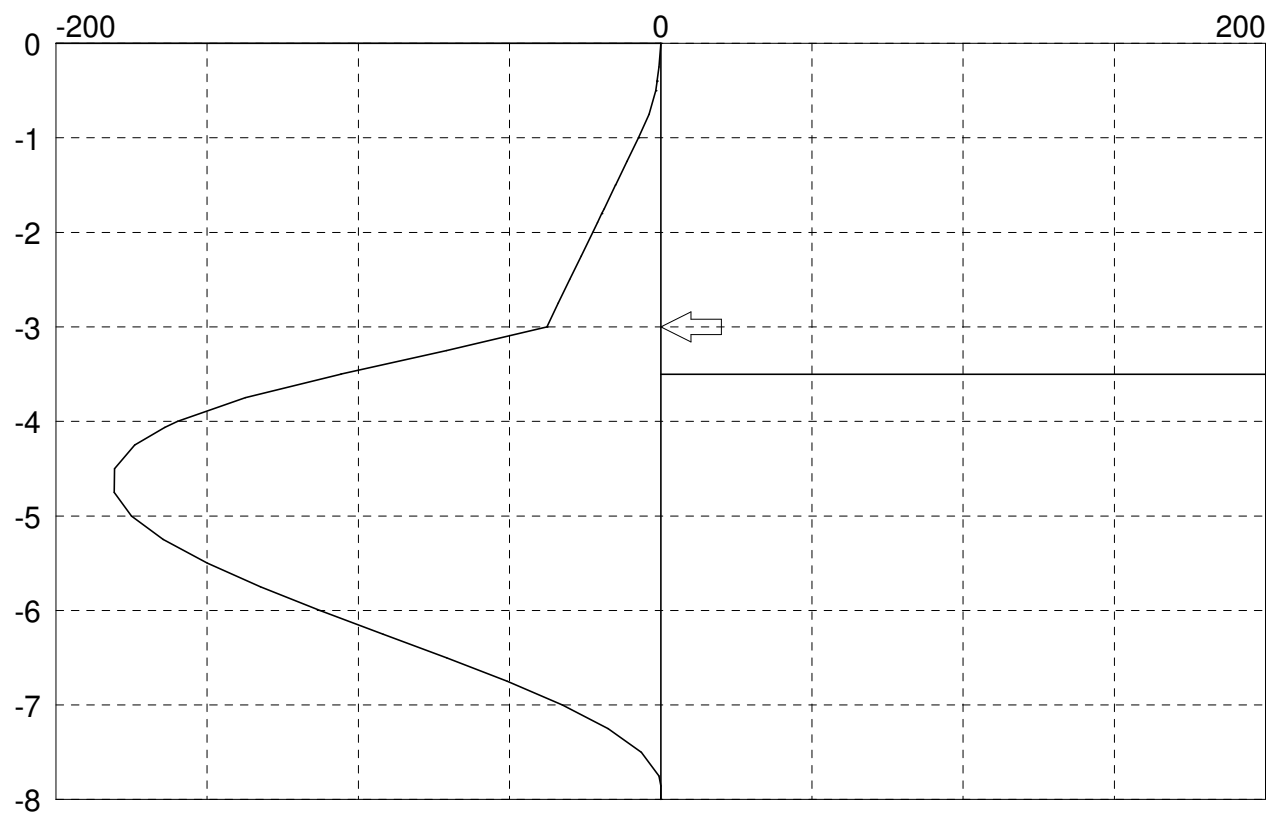
Calc Level m	Active Vert kN/m2	Active Earth kN/m2	Active Water kN/m2	Pas' Vert kN/m2	Pas' Earth kN/m2	Pas' Water kN/m2	Total Nett kN/m2	Bend. Moment kNm/m	Shear Force kN/m	Defl't mm	Prop Force kN/m	FOS
.00	5.0	22.7	.0	.0	.0	.0	22.7	0	0	17.7		.00
w -.40	12.6	3.7	4.0	.0	.0	4.0	3.7	1.2	-4.8	15.2		.00
w -.40	12.6	3.6	4.0	.0	.0	4.0	3.6	1.2	-4.8	15.2		.00
w -.40	12.7	3.4	4.0	.0	.0	4.0	3.4	1.2	-4.8	15.2		.00
w -.50	14.5	.0	5.0	.0	.0	5.0	0	1.7	-4.9	14.6		.00
-.50	9.5	36.3	5.0	.0	.0	5.0	36.3	1.7	-4.9	14.6		.00
-1.00	14.3	4.5	10.0	.0	.0	10.0	4.5	7.4	-15.2	11.6		.00
w -1.00	24.3	.0	10.0	.0	.0	10.0	0	7.4	-15.2	11.5		.00
w -1.50	34.5	.0	15.0	.0	.0	15.0	0	14.9	-15.2	8.6		.00
w -1.50	34.5	.0	15.0	.0	.0	15.0	0	15.0	-15.2	8.5		.00
w -1.80	40.7	.0	18.0	.0	.0	18.0	0	19.5	-15.2	6.8		.00
w -1.80	40.7	.0	18.0	.0	.0	18.0	0	19.5	-15.2	6.8		.00
w -1.89	42.6	.0	18.9	.0	.0	18.9	0	20.9	-15.2	6.2		.00
w -2.00	44.8	.0	20.0	.0	.0	20.0	0	22.5	-15.2	5.6		.00
w -3.00	65.3	.0	30.0	.0	.0	30.0	0	37.7	-15.2	.3	-115.3	.00
w -3.00	65.3	15.0	30.0	.0	.0	30.0	15.0	37.7	-130.5	.3		.00
w -3.50	75.5	43.2	35.0	.0	.0	35.0	43.2	105.7	-144.9	-2.0		.11
w -3.50	75.5	43.3	35.0	35.0	235.0	.0	-156.7	106.0	-144.8	-2.0		.11
w -4.00	85.8	73.2	40.0	45.2	245.2	.0	-132.1	159.8	-72.6	-3.7		.32
w -4.06	87.0	77.0	40.6	46.5	246.5	.0	-128.9	164.0	-64.5	-3.8		.34
w -5.00	106.3	137.5	50.0	65.7	265.7	.0	-78.2	175.1	33.1	-3.8		.53
w -6.00	126.8	208.1	60.0	86.2	286.2	.0	-18.2	112.6	81.8	.3		.70
w -7.00	147.3	284.8	70.0	106.7	306.7	.0	48.1	32.6	67.3	7.2		.87
w -7.86	164.8	355.6	78.6	124.3	324.3	.0	109.9	0	0	13.5		1.00
w -8.00	167.8	367.8	80.0	127.2	327.2	.0	120.5	0	0	14.2		1.02

	Page No 5 Analysis
CADS Piled Wall Suite Version 5.31 Design of embedded retaining walls and cofferdams	Project 1327 File Name bia pile design.pws
Wetherby House, Green Lane CantileveredPile Wall Design	Engineer MD Date 07/06/2019

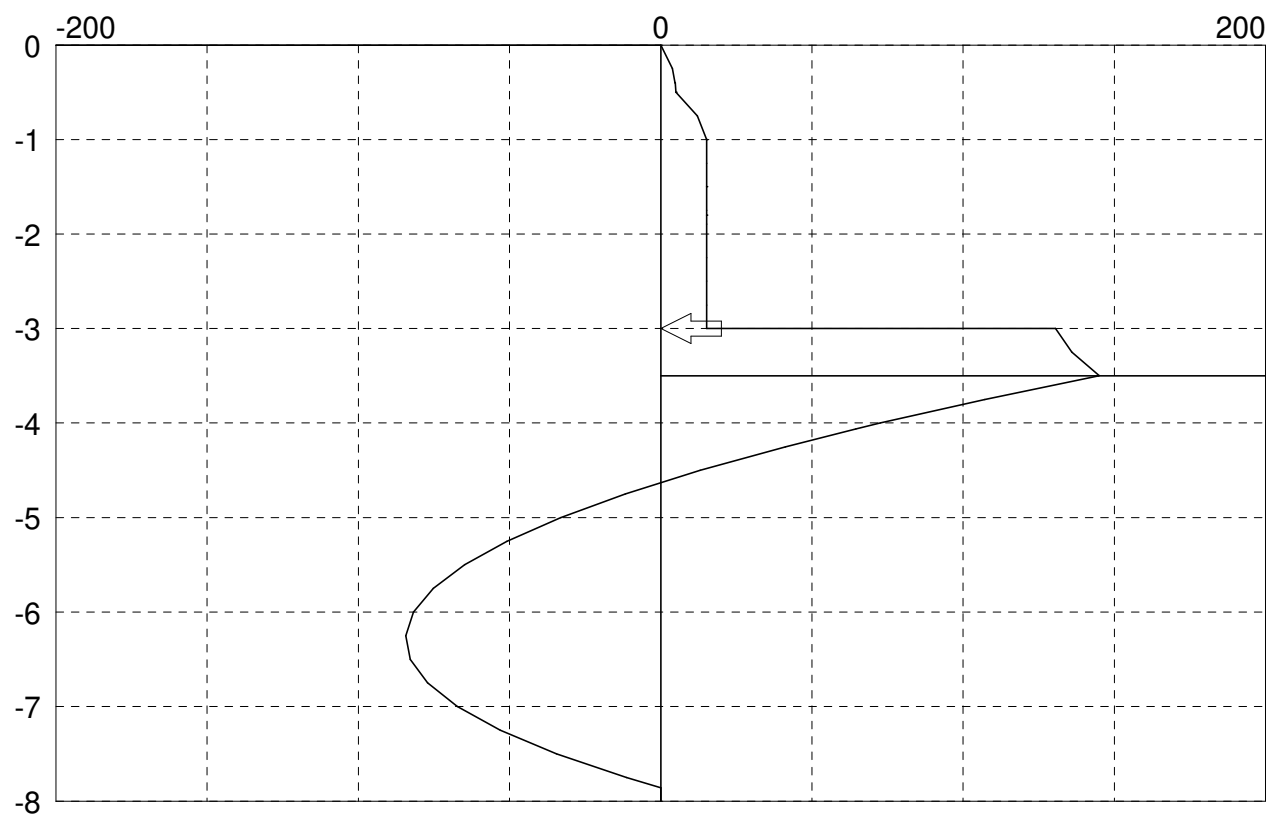


	Page No 6 Analysis
CADS Piled Wall Suite Version 5.31 Design of embedded retaining walls and cofferdams	Project 1327 File Name bia pile design.pws
Wetherby House, Green Lane CantileveredPile Wall Design	Engineer MD Date 07/06/2019

Graphical results from analysis of stage ref 6 continued



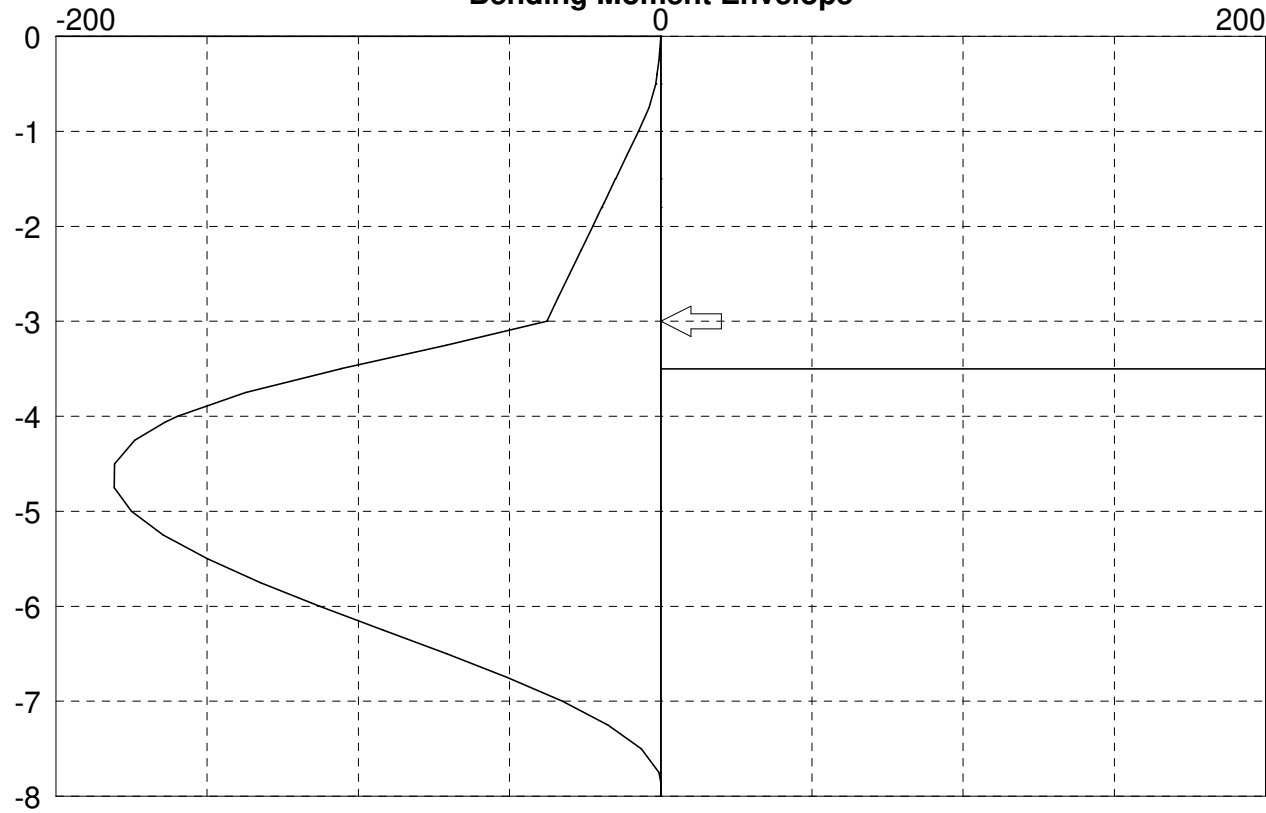
Bending Moment Diagram (kNm/m)



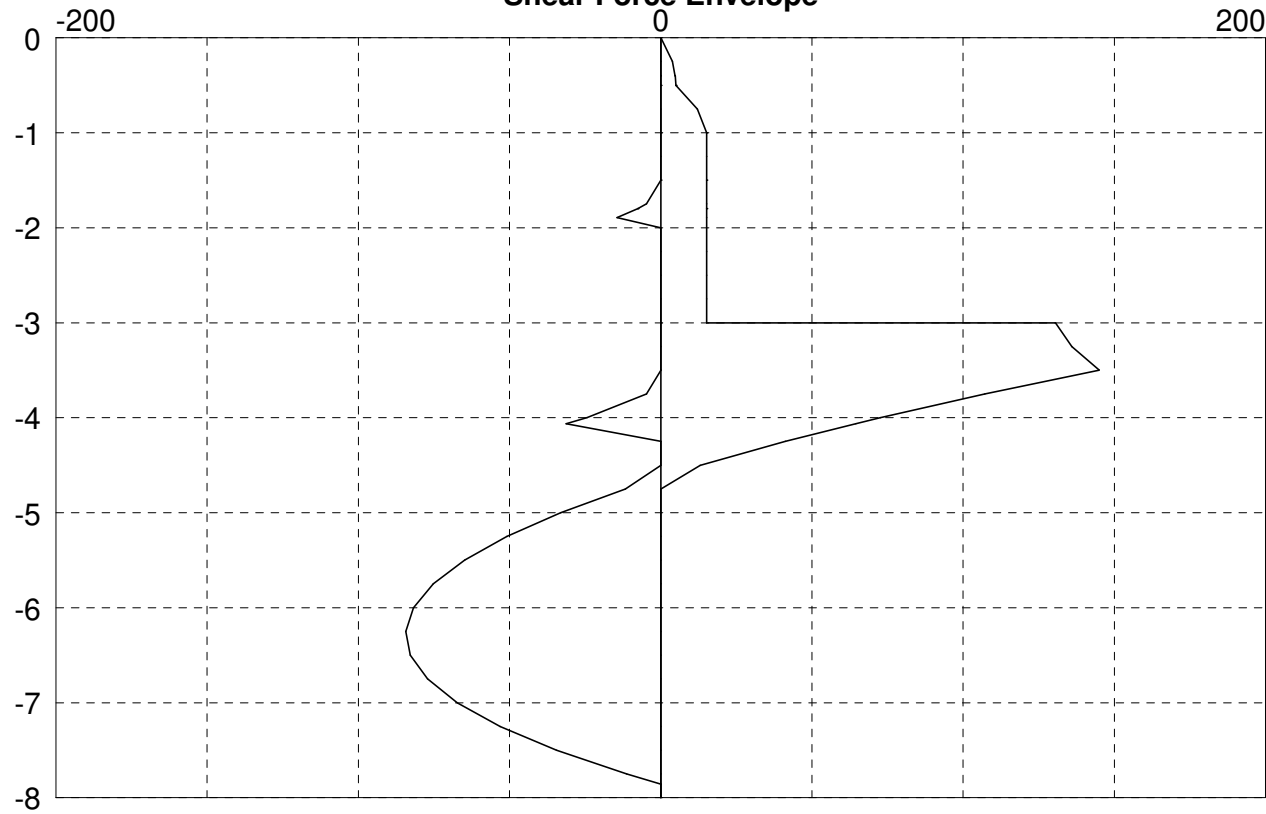
Shear Force Diagram (kN/m)

	Page No 7 Analysis
CADS Piled Wall Suite Version 5.31 Design of embedded retaining walls and cofferdams	Project 1327 File Name bia pile design.pws
Wetherby House, Green Lane CantileveredPile Wall Design	Engineer MD Date 07/06/2019

Graphical plot of envelope from selected construction stages
Bending Moment Envelope



Shear Force Envelope



	Page No 8 Analysis
CADS Piled Wall Suite Version 5.31 Design of embedded retaining walls and cofferdams	Project 1327 File Name bia pile design.pws
Wetherby House, Green Lane CantileveredPile Wall Design	Engineer MD Date 07/06/2019

Table of envelope for wall forces

Calc Level m	Bending Minimum kNm/m	Bending Maximum kNm/m	Shear Minimum kN/m	Shear Maximum kN/m	Prop Force kN/m
.00	.0	.0	.0	.0	
-.40	.0	1.2	-4.8	.0	
-.40	.0	1.2	-4.8	.0	
-.40	.0	1.2	-4.8	.0	
-.50	.0	1.7	-4.9	.0	
-.50	.0	1.7	-4.9	.0	
-1.00	.0	7.4	-15.2	.0	
-1.00	.0	7.4	-15.2	.0	
-1.50	.0	14.9	-15.2	.0	
-1.50	.0	15.0	-15.2	.0	
-1.80	.0	19.5	-15.2	7.6	
-1.80	.0	19.5	-15.2	7.6	
-1.89	.0	20.9	-15.2	14.5	
-2.00	.0	22.5	-15.2	.0	
-3.00	.0	37.7	-15.2	.0	.0
-3.00	.0	37.7	-130.5	.0	
-3.50	.0	105.7	-144.9	.0	
-3.50	.0	106.0	-144.8	.0	
-4.00	.0	159.8	-72.6	24.4	
-4.06	.0	164.0	-64.5	31.4	
-5.00	.0	175.1	.0	33.1	
-6.00	.0	112.6	.0	81.8	
-7.00	.0	32.6	.0	67.3	
-7.86	.0	.0	.0	.0	
-8.00	.0	.0	.0	.0	

	Page No 9 Analysis
CADS Piled Wall Suite Version 5.31 Design of embedded retaining walls and cofferdams	Project 1327 File Name bia pile design.pws
Wetherby House, Green Lane Cantilevered Pile Wall Design	Engineer MD Date 07/06/2019

Structural design of wall

Wall section properties

Primary pile diameter	350 mm
Primary pile spacing	500 mm
Infill pile diameter	mm
Main rebar bar diameter	25 mm
Main rebar number of bars	9
Links/Helix bar diameter	12 mm
Links/Helix spacing/pitch	100 mm

Wall material properties

Concrete cube strength	40 N/mm ²
Concrete cover	50 mm
Main rebar steel grade	500 N/mm ²
Link rebar steel grade	500 N/mm ²
Ultimate load factor	1.50

Wall structural design checks

Check description	Required or Limit	Provided or Actual	Units
Max. ultimate moment BS8110, Ultimate resistance	135	144	kNm
Maximum longitudinal steel BS8110, Max 6% by area	5772	4417	mm ²
Minimum longitudinal steel BS8110, Min 0.4% by area	384	4417	mm ²
Maximum ultimate shear BS8110 Ultimate resistance	108	288	kN
Minimum link diameter BS8110, 6mm or 0.25x bar dia	6	12	mm
Max. link spacing/pitch BS8110, 12x main bar dia or 0.75d	174	100	mm
Minimum shear link area BS8110, Clause 3.4.5	292	2261	mm ² /m

APPENDIX C

BGS Borehole Logs

Contract Name GREEN LANE, NORTHWOOD**Borehole No.** HA2**Sheet** 1 of 1**Method of boring** Hand auger
Diameter 100 mm nominal**Ground level** 71.0 m O.D. 0890
Start 10.9.76
Finish 10.9.76 9186

Daily progress	Water levels	In-situ tests	Samples	Depth (m)	Reduced level (m O.D.)	Thickness (m)	Description of Strata
				0.15	70.95	0.15	Topsoil
			U*			0.85	Soft mottled light brown grey silty clay with numerous traces of organic material and some root fibres
			U*	1.00	70.10		
			U*			1.73	Firm to very stiff light brown grey silty clay with traces of organic material
			U*				
			U*				
			U*				
10/9				2.73	68.37		Bottom of Borehole

Notes



British Geological Survey

Site

Northwood College, Dining Hub, MUGA/Early Years Centre,
Northwood

**Borehole
Number**
BH3

Boring Method
Cable Percussion

Casing Diameter

Ground Level (mOD)	67.61
--------------------	-------

Client	Northwood College
---------------	-------------------

Job Number
P4632

Location

508927.44 E 191267.05 N

Dates	24/08/2007- 28/08/2007
--------------	---------------------------

Engineer

Sheet
1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					67.56	(0.05)	MADE GROUND : Paving slabs		
					67.31	0.05 (0.25) 0.30	MADE GROUND : Clayey sand FILL, (bedding for paving slabs). (Drillers description)		
0.50-0.50	I01						Firm to stiff orange-brown mottled grey and light brown slightly sandy CLAY. Rare fine to medium gravel sized calcareous concretions.		
0.50-0.50	H01								
0.50-1.00	B01								
0.50-0.50	D01								
0.50-0.50	D01								
0.51-0.51	D01					(1.70)			
1.00-1.00	D02								
1.00-1.00	D02								
1.00-1.00	D02								
1.20-1.65	U01								
1.50-1.50	D03								
1.50-1.50	D03								
1.50-1.50	D03				65.61	2.00	Stiff red-brown mottled light brown-grey CLAY. Rare fine gravel sized calcareous concretions.		
2.00-2.45	SPT N=19			3,4/4,4,5,6					
1.70-1.70	D04								
1.80-1.80	D05								
2.00-2.00	I02								
2.00-2.00	H02								
2.00-2.50	B02			Strike at 2.80m bgl.(1) at 2.80m, no rise after 20 mins.			From 2.80m to 3.00m bgl, band of green-grey and light brown slightly clayey fine to medium sand.		▼1
2.00-2.00	D04								
2.00-2.00	D06								
2.01-2.01	D04								
2.50-2.50	D05								
2.50-2.50	D07								
2.50-2.50	D05								
2.80-2.80	D08								
3.00-3.45	U02								
3.50-3.50	H03								
3.50-3.50	D09						Below 4.00m bgl, locally mottled orange-brown - very stiff.		
3.80-3.80	D10								
4.00-4.45	SPT N=35			6,6/7,8,9,11					
4.00-4.50	B03								
4.00-4.00	D11					(5.20)			
4.80-4.80	D12								
5.00-5.45	SPT N=38			6,6/7,8,10,13			From 5.00m to 6.80m bgl, slightly sandy.		
5.00-5.50	B04								
5.00-5.50	D13								
5.80-5.80	D14								
6.00-6.45	SPT N=45			8,9/9,11,12,13					
6.00-6.45	B05								
6.00-6.00	D15								
6.00-6.50	D16								
7.00-7.45	SPT N=52			3,7/10,13,29					
7.00-7.50	B06				60.41	7.20	Dense to very dense dark grey clayey SAND.		▼*
7.00-7.00	D17			Strike at 7.20m bgl.(2) at 7.20m, no rise after 20 mins.		(0.60)			
					59.81	7.80	Medium dense to dense green-grey very clayey SAND.		
						(1.00)			
				Strike at 8.80m bgl.(3) at 8.80m, no rise after 20 mins.	58.81	8.80	Medium dense to dense green-grey mottled brown slightly clayey slightly sandy GRAVEL. Gravel is angular to subrounded fine to coarse flint. Occasional to frequent flint cobbles.		▼*
9.00-9.45	B07			4,5/7,6,6,9					
9.00-9.45	SPT(C) N=28								
9.80-9.80	D18			7,8/9,15,10,7					
10.00-10.45	SPT(C) N=41								

(1) Hand dug service pit to 1.20m bgl. (2) Chiselling from 8.80m, from 12.10m, from 22.90m to 23.50m from 23.50m to 25.00m bgl. (3) Water strike at 2.80m, rising to 2.20m after 20 mins. Water strike at 7.20m. Water strike at 8.80m, rising to 7.90m after 20 mins. Water strike at 22.90m bgl, rising to 20.90m after 20 mins. (4) 50mm dia. standpipe to 25.00m bgl. Plain pipe from gl to 13.00m. Bentonite seal from gl to 11.50m. Slotted pipe from 11.50m to 25.00m. Gravel from 11.50m to 25.00m. Bung gas valve and cemented cover fitted.

Scale (approx)

1:50

Logged
By gls survey

SJ

Figure No.

EA Fluvial Flood Map



EA Surface Water



Medium risk scenario

Flood depth
(millimetres)



Over 900mm



300 to 900mm



Below 300mm



Location you
selected