



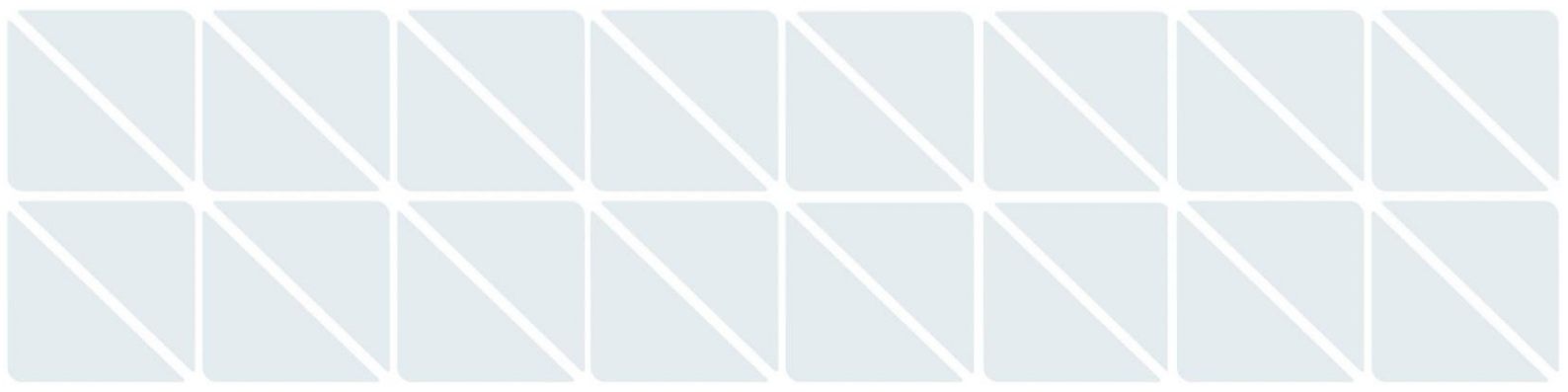
A-squared Studio

Highgate Mallinson Sports Centre

Basement Impact Assessment

October 2024

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Project Name	Highgate Mallinson Sports Centre
Project Number	3244
Client	Highgate School
Document Name	Basement Impact Assessment

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Contents

1.	Non-Technical Summary.....	1
2.	Introduction	3
3.	Desk Study	8
4.	Screening	9
5.	Scoping.....	12
6.	Site Investigation	16
7.	Construction Methodology / Engineer Statements	19
8.	Basement Impact Assessment	22

Appendices

Appendix A: Structural Drawings

Appendix B: Flood Storage Basin Drawings

Appendix C: Site Investigation Reports & Groundwater Monitoring Data

Appendix D: Arboriculturist Letter

Appendix E: Flood Risk Assessment

Appendix F: Ground Movement Assessment

Appendix G: WALLAP Outputs

Appendix H: Hydrogeological Assessment

Appendix I: Outline Construction Management Plan



1. Non-Technical Summary

- 1.1.1. The site is located at Highgate Mallinson Sports Centre, Bishopswood Road, London, N6 4PB.
- 1.1.2. The site is currently occupied by a fives courts building, a pool hall, squash courts and a sports hall which are surrounded by soft landscaping. There are no existing basements.
- 1.1.3. The proposed development will take place over four Phases and will comprise the demolition of the fives courts, squash courts, part of the pool building and areas of hardstanding, construction of a second sports hall in place of the old fives courts and squash courts, and construction of new fives courts adjacent to the existing sports hall. The new sports hall and fives courts will include basements of 3.7 and 4.0m depth respectively.
- 1.1.4. A 1.5m-deep flood storage basin will be constructed to the east of the site which is designed to receive surface water flowing overland from the upstream catchment area. Hydraulic modelling supporting the design has been carried out by Edenvale Young.
- 1.1.5. The excavation is proposed to be retained by a contiguous piled wall.
- 1.1.6. The bulk excavation works, and construction of permanent works elements will take place following the installation of the contiguous pile wall.
- 1.1.7. Temporary propping / shoring measures may be required at ground level, prior to proceeding with bulk excavation works.
- 1.1.8. The following assessments are presented in the current document:
- Screening.
 - Scoping.
 - Additional evidence/assessments (as required), including:
 - Architectural and structural drawings.
 - Ground movement assessment.
 - Basement impact assessment.
- 1.1.9. The ground model for the site comprises:
- Made Ground to a depth of 0.3m below ground level (bgl),
 - Head Deposits to a depth of 2.4mbgl,
 - Claygate Member to a maximum depth of 7.5mbgl,
 - The London Clay Formation to a depth of >20.0m. The thickness and base of this stratum has not been proven; however, the strata below are not considered to be of engineering significance to the scheme as the anticipated *zone of influence* of the proposed works will remain within the London Clay Formation.
- 1.1.10. The hydrogeological conditions at the site, relevant to the proposed development, are anticipated to comprise:
- Groundwater within the Head Deposits at approximately 1.8mbgl to 1.6mbgl at the location of the proposed development. It is noted that the boreholes surrounding the proposed sports hall were dry during drilling, other than BH2 which had a water inflow at 3.6mbgl, rising to 3.1mbgl after 20 minutes.
 - Groundwater generally at 1.2 to 1.8mbgl across the wider site.
 - Potential for flooding at the area surrounding the proposed flood storage basin (the Orchard). Objections made to the planning submission state that the area becomes waterlogged during winter.
 - Groundwater flow direction to the northwest.



- A hydrostatic porewater pressure distribution within the Head Deposits, Claygate Member and London Clay Formation.

- 1.1.11. The BIA has assessed land stability, and the impacts of the proposed development on neighbouring structures will be limited to Category 1 – Very Slight, in accordance with the Burland Damage Scale.
- 1.1.12. The BIA has identified that the site is underlain by the Head Deposits and the Claygate Member which are secondary A aquifers.



2. Introduction

- 2.1.1. A-squared Studio Engineers Limited (A-squared) has been engaged by Pringuer-James Consulting Engineers Limited (PJCE) on behalf of Highgate School to prepare a Basement Impact Assessment (BIA) for the proposed development at Highgate Mallinson Sports Centre, Bishopswood Road, London, N6 4PB.
- 2.1.2. The purpose of this assessment is to consider the potential effects of the design on the local hydrology, geology, and hydrogeology, and to determine the potential impacts to neighbours and the wider environment.
- 2.1.3. The location of the proposed development is shown in Figure 2.1, and a plan of the wider site including the flood storage basin is presented in Figure 2.2.



Approximate site boundary marked by red line.

Figure 2.1 Location of the proposed development

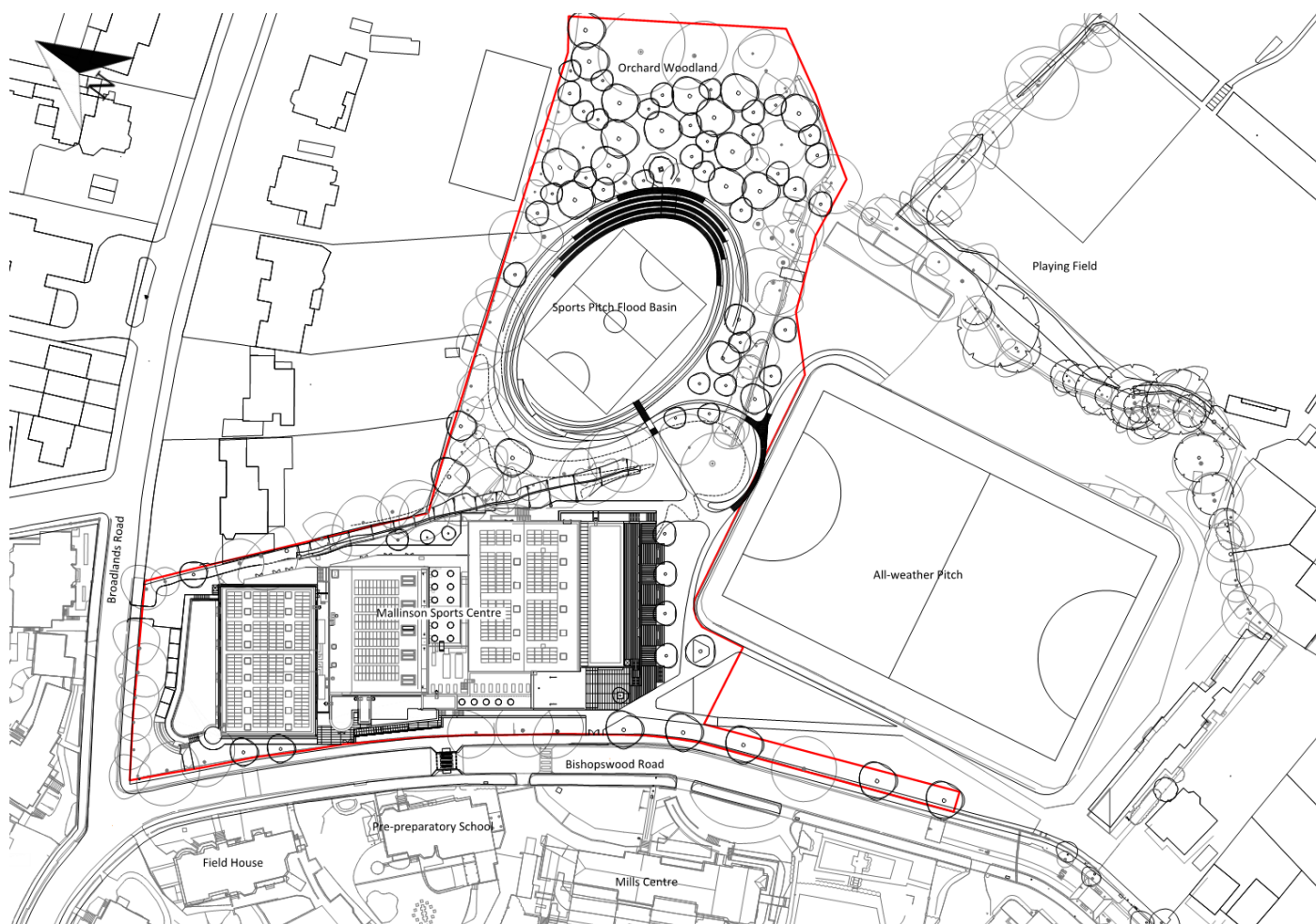


Figure 2.2 Wider site plan

2.1.4. The development site is located within the London Borough of Haringey.

2.1.5. The BIA comprises the following elements:

- Screening.
- Scoping.
- Additional evidence/assessments (as required), including:
 - Architectural and structural drawings.
 - Ground movement assessment (GMA).
 - Basement Impact Assessment.

2.2. Credentials

2.2.1. The BIA has been approved by Alex Nikolic. Alex is a Chartered Member of the Institution of Civil Engineers (MICE) with over 20 years of industry experience in geotechnical design and construction of ground engineering works. Alex has attained post-graduate qualifications, including a Master of Science in Soil Mechanics (MSc DIC) from the Imperial College London and a Master of Studies (MSt Cantab) in Sustainable Development from the University of Cambridge. Alex was formerly the Director of Ground Engineering at Buro Happold Ltd.



- 2.2.2. The BIA has been reviewed by Neil Morris. Neil is a Chartered Geologist, and a Registered Ground Engineering Adviser (RoGEP) with a specialism in geo-environmental engineering and contaminated land assessment, having 25 years of industry experience. Neil has a postgraduate MSc in Environmental Geotechnology, and BSc in Environmental & Resource Science, and is currently serving as part time visiting lecturer at the University of Hertfordshire.

2.3. Sources of Information

- 2.3.1. The following baseline data has been referenced to complete the BIA in relation to the proposed development:
- *Highgate School MSC 4Phase Landscape strategy report* prepared by Robert Myres Associates, dated June 2022 (ref. 733.01(RP)001).
 - *Flood Risk Assessment: Highgate School* prepared by Edenvale Young, dated June 2024.
 - *Site Investigation Report* prepared by Soil Consultants, dated February 2016 (ref. 9916/JRCH/OT).
 - *Report on Supplementary Ground Investigation* prepared by Soil Consultants, dated February 2019 (ref. 9916A/MR.JRCB).
 - *Factual Report on Ground Preliminary Investigation* prepared by Soil Consultants, dated February 2024 (ref. 10930/OS).
 - Additional borehole logs and groundwater monitoring data supplied by Soil Consultants, dated August 2024.
 - Architectural drawings prepared by Ed Toovey Architects, dated August 2018.
 - Landscape architecture drawings prepared by Robert Myres Associates, dated July 2022.
 - SuDS Strategy Concept prepared by PJCE.
 - *Outline Construction Management Plan* prepared by Blue Sky Building, dated August 2024.
 - Environment Agency Statutory Main River Map (online).

2.4. Existing Development

- 2.4.1. The development is located at Highgate Mallinson Sports Centre, Bishopswood Road, London, N6 4PB.
- 2.4.2. The ground surface elevation of the site ranges from 105.7 to 109.9m above ordnance datum (OD), and ground levels at the proposed basement are approximately 106.8mOD. Ground surface levels in the surrounding area generally fall towards the West with a gradient of approximately 1 in 25.
- 2.4.3. The site is currently occupied by a fives courts building, a pool hall, squash courts and a sports hall which are surrounded by soft landscaping. There are no existing basements.
- 2.4.4. The existing building is expected to be founded on a ground bearing raft foundation system.

2.5. Neighbouring Properties and Infrastructure

- 2.5.1. The existing on-site buildings do not share a party wall with other structures. The closest building to the site is 27 Broadlands Road, approximately 7.0m Northeast of the site boundary.
- 2.5.2. Asset owners with existing underground services that may be impacted by the proposed development include the following:
- London Borough of Camden and the Greater London Authority.
 - Virgin Media Ltd and BT (BT Group Plc) – Telecoms.
 - UK Power Networks Ltd and National Grid Electricity Transmissions Plc – Electricity distribution.
 - Southern Gas Network and Cadent Gas – Gas.
 - Thames Water – Clean and wastewater.



2.5.3. Asset protection teams for the assets listed under Section 2.5.2 will be engaged as the design of the proposed development progresses. Where necessary, separate GMAs will be prepared in order to meet design assurance requirements.

2.6. Proposed Development

2.6.1. Structural drawings of the proposed development are included in Appendix A.

2.6.2. The proposed development comprises the demolition of the fives courts, squash courts, part of the pool building and areas of hardstanding, construction of a second sports hall in place of the old fives courts and squash courts, and construction of new fives courts adjacent to the existing sports hall. Demolition plans and proposed ground floor plans are presented in Figure 2.3 and Figure 2.4 respectively. The development will be carried out in five phases which are marked on the proposed ground floor plan in Figure 2.4.

2.6.3. Two basements are proposed as part of the development. The first is an approximately 4.0m-deep basement and will form the new fives court (Phase 2A), adjacent to the existing sports hall. The second will form the new sports hall to the North (Phase 2B), directly adjacent to the existing pool hall block and is approximately 3.7m-deep. Both excavations will be supported by contiguous piled walls with internal in-situ RC lining walls, except for the Southern edge of the new fives courts, which will be supported by in-situ RC retaining walls. Both basement areas are proposed to be supported by an RC ground-bearing raft system with tension piles to restrict uplift forces on the basement box.

2.6.4. A 1.5m-deep flood storage basin will be constructed to the east of the site in which is designed to receive surface water flowing overland from the upstream catchment area. Drawings of the flood storage basin are included in Appendix B.

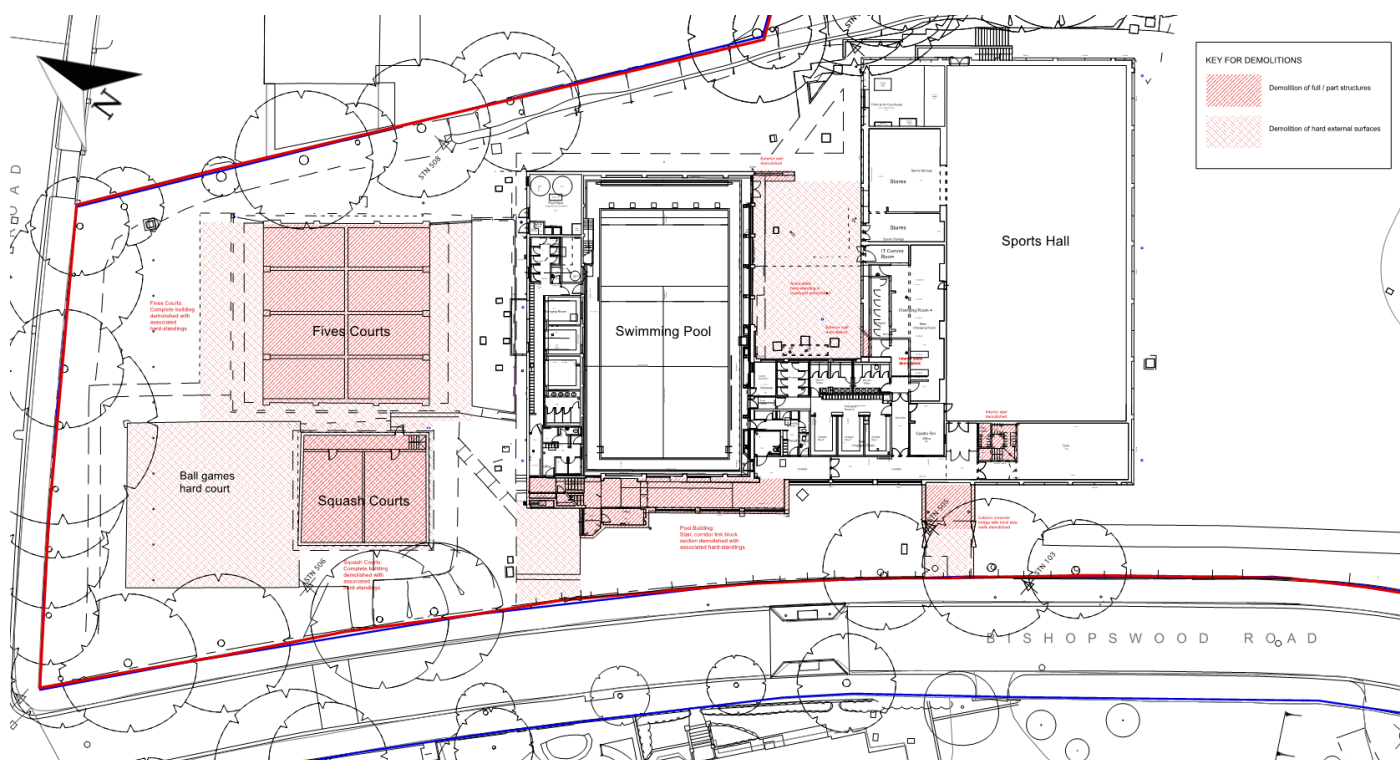


Figure 2.3 Demolition plan

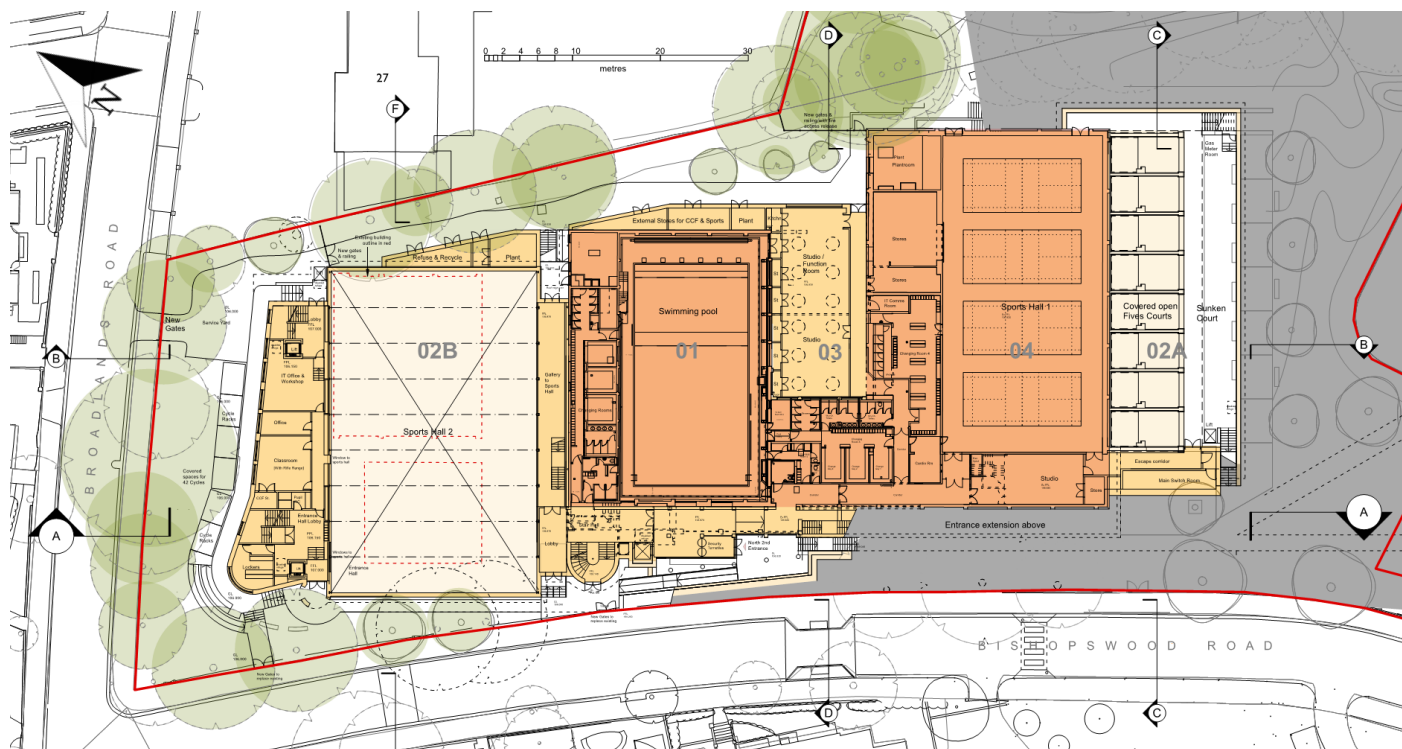


Figure 2.4 Proposed ground floor plan



3. Desk Study

- 3.1.1. A Phase I Desk Study has been undertaken for the site and has been used to inform this BIA. The Desk Study informs further actions in relation to site investigation and ground contamination risks. The desk study is appended to the site investigation report which is included in Appendix C.



4. Screening

4.1. Subterranean (Groundwater) Flow, Screening Flowchart

Question	Response	Details
1a. Is the site located directly above an aquifer?	Yes	The site is underlain by the Head Deposits and Claygate Member which are secondary A aquifers.
1b. Will the proposed basement extend beneath the water table surface?	Yes	The proposed basement will extend to a maximum depth of 4.0mbgl, approximately 2.0m below the water table surface.
2. Is the site within 100m of a watercourse, well (used / disused) or potential spring line?	No	The nearest watercourse is a secondary river 320m Southwest of the site.
3. Will the proposed basement development result in a change in the proportion of the hard surfaced / paved areas?	Yes	There will be an increase in the portion of hardstanding as part of the proposed development.
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 existing drainage system for the site is assumed to drain freely into the local authority drainage network. It is not anticipated that the proposed development will increase discharge into the ground.
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 ponds or spring lines within the vicinity of the site.

4.2. Stability Screening Flow Chart

Question	Response	Details
1. Does the existing site include slopes, natural or man-made, greater than 7 degrees (approximately 1 in 8)?	No	The greatest gradient of slope in the site and surrounding areas is approximately 1 in 25.
2. Will the proposed re-profiling or landscaping at the site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8)?	No	There will be no reprofiling as part of the proposed development.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8)?	No	The greatest gradient of slope in the site and surrounding areas is approximately 4 degrees.
4. Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8)?	No	The greatest gradient of slope in the site and surrounding areas is approximately 4 degrees.
5. Is the London Clay the shallowest strata at the site?	No	The shallowest stratum at the site is the Head Deposits.
6. Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained?	Yes	Trees will be felled as part of the proposed development.
7. Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site?	No	The London Clay Formation is classified as having a high-volume change potential, however there is no evidence of shrink-swell behaviour or desiccated soils on site. The shallowest stratum, the Claygate Member, has been



Question		Response	Details
			determined to be a low to medium plasticity material through laboratory testing.
8.	Is the site within 100m of a watercourse or a potential spring line?	No	The nearest watercourse is a secondary river 320m Southwest of the site.
9.	Is the site within an area of previously worked ground?	No	The site is not considered to be within an area of previously worked ground.
10.	Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	Yes	The site is located above the Head Deposits and Claygate Member which are secondary A aquifers.
11.	Is the site within 5m of a highway or pedestrian right of way?	Yes	There will be an increase in the portion of hardstanding as part of the proposed development.
12.	Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Unknown	The depth of foundations of the neighbouring properties is unknown.
13.	Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No	The site is not within the exclusion zone of any tunnels.

4.3. Surface Water and Flooding Screening Flowchart

Question		Response	Details
1.	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	Surface water flow may be materially changed from the existing route via the flood storage basin.
2.	Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	Yes	There will be an increase in the portion of hardstanding as part of the proposed development.
3.	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 comprises the construction of the flood storage basin which will result in a change to the profile of inflows or surface water being received by adjacent properties.
4.	Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	There will be no change to the quality of surface water being received by adjacent properties.
5.	Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment or is it at risk from flooding, for example because the proposed basement is below the static water level of nearby surface water feature?	Yes	A Surface Water Modelling Report has been prepared by Edenvale Young, which concluded that the site is susceptible to surface water flooding.

4.4. Non-technical Summary of Screening Process

4.4.1. The screening process identifies the following issues to be carried forward to scoping for further assessment:

- The site is located directly above an aquifer.
- The proposed basement will extend beneath the water table surface.
- Trees will be felled as part of the development



- The site is within an aquifer and dewatering may be required during construction.
- The proposed basement may increase the differential depth of foundations relative to neighbouring properties.
- Surface water flows (e.g. volume of rainfall and peak run-off) may be materially changed from the existing route.
- The proposed basement may result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses.
- The site is in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment.
- The proposed basement development result in a change in the proportion of hard surfaced / paved external areas.

4.4.2. The other potential concerns considered in the screening process have been demonstrated to be not applicable or not significant when applied to the proposed development.



5. Scoping

- 5.1. **Stability and Subterranean Flow:** The proposed development is located above an aquifer; the basement will extend below the water table; the proposed development may significantly increase the depth of foundations relative to the neighbouring properties and there will be a change in the proportion of hard surfaces / paved areas.

Hazards

- 5.1.1. An increase and/or decrease in groundwater levels surrounding the site.
- 5.1.2. A change in the groundwater flow regime.
- 5.1.3. Construction within a potentially water-bearing stratum.
- 5.1.4. Excavation near a neighbouring property.

Potential Impacts

- 5.1.5. Flooding of neighbouring properties.
- 5.1.6. Additional uplift and/or settlement of neighbouring properties due to changes in groundwater level.
- 5.1.7. Ground movements at neighbouring properties due to excavation & retaining wall installation.

Mitigating Factors

- 5.1.8. The Claygate Member at the location of the site is a cohesive material. Any groundwater detected during site investigation is likely perched water within sandy horizons of this unit and is not able to maintain any significant groundwater flow.
- 5.1.9. A ground movement assessment has been undertaken which has conservatively assumed that the neighbouring buildings are founded at ground level in the absence of specific information. All neighbouring facades have been assessed to experience a damage category of Category 1 or less as a result of the proposed development.
- 5.1.10. A hydrogeological assessment has been undertaken for the proposed development, included as Appendix H, which predicts a rise in groundwater of 77mm and a fall of 53mm at the location of the neighbouring properties. This is considered to be negligible in terms of flood risk and ground movements.

Assessments and Further Actions

- 5.1.11. Due to the conservative assumptions and nature of analysis of the GMA and results of the hydrogeological assessment, no further assessment is deemed to be necessary.

5.2. Stability: Trees will be felled as part of the proposed development.

Hazards

- 5.2.1. Swelling / heave effects due to the removal of trees.
- 5.2.2. Increased surface water into the local drainage system due to a reduction in uptake from vegetation.

Potential Impacts

- 5.2.3. Additional ground instability resulting from the removal of trees.
- 5.2.4. Properties downstream of the proposed development may be subjected to an increase in surface water flow.



Mitigating Factors

- 5.2.5. Using the BRE412 method, there is little evidence of desiccation of the soil on site. There are five out of 18 GI locations where $w < 0.4w_L$, three of which are at depths of $> 13.5\text{m}$ which would be out of the zone of water uptake of any trees.
- 5.2.6. The proposed development will comprise a ground bearing raft with tension piles which will act as a heave mitigation measure.
- 5.2.7. Any potential changes to the surface water run-off volume are anticipated to be mitigated by the proposed robust drainage system.
- 5.2.8. The shallowest stratum, the Claygate Member is a low to medium plasticity material.

Assessments and Further Actions

- 5.2.9. The neighbouring properties sit outside of the root zone of any trees which are to be felled. In addition to this, the neighbouring properties are at a lower elevation than the trees due to the sloped nature of the site and there is little evidence of desiccation of the soil on site (using the BRE412 method). The impact of the removal of trees on the neighbouring properties is expected to be insignificant.
- 5.2.10. The arboriculturist has been consulted regarding the felling of trees, who has concluded that the impact of felling the trees will have little to no impact on the proposed development. A letter stating this is included in Appendix D.

5.3. **Stability:** The proposed development is located above an aquifer, the proposed development may significantly increase the depth of foundations relative to the neighbouring properties & the site is located within 5m of a public highway.

Hazards

- 5.3.1. Excavation near neighbouring buildings.
- 5.3.2. The proposed excavation is adjacent to public roads.

Potential Impacts

- 5.3.3. Collapse of the excavation and associated impact on the surrounding buildings.
- 5.3.4. Damage to the road surface or buried services within the public road easement due to excessive ground movements.
- 5.3.5. Ground movements arising due to the construction and excavation of proposed basements may impact neighbouring buildings.

Mitigating Factors

- 5.3.6. A ground movement assessment has been undertaken which has conservatively assumed that the neighbouring buildings are founded at ground level in the absence of specific information. A wall deflection limit has been defined which the contractor will adhere to, to ensure that the neighbouring buildings experience a damage category of Category 1: Very Slight or less.
- 5.3.7. Deposits underlying the development are largely natural and are anticipated to be relatively stable i.e. the London Clay Formation.
- 5.3.8. Many basements of similar depths and scale have been successfully constructed throughout London with similar geological conditions and settings.
- 5.3.9. The proposed basement is offset from the neighbouring properties and adjacent public roads.



- 5.3.10. The scheme basement design and temporary works proposals shall be developed in a robust fashion and in line with current industry best practice, in order to limit the impact of ground movements resulting from basement construction.

Assessments and Further Actions

- 5.3.11. Various additional ground movement assessments may be required to determine the impact of the works on the surrounding buried utilities and other third-party assets surrounding the site. These assessments should confirm anticipated damage categories in accordance with performance limits set by the relevant third-party asset protection teams.
- 5.3.12. The design of the retaining walls will be carried out by an appropriately experienced and qualified specialist / engineer / ground engineering contractor in accordance with relevant Eurocodes / British Standards, Codes of Practice, and industry standards. The design will allow for appropriate surcharging behind the embedded walls to accurately reflect the type and intensity of traffic and building loads.
- 5.3.13. Appropriate ground movement monitoring should be implemented during construction in order to assess the performance of the earth retention system. Allowances should also be made for making good of any cracking / damage to adjacent pavement surfaces (if required). Criteria on which to develop trigger limits are presented in the Ground Movement Assessment.

5.4. **Surface Water and Flooding:** There will be a change in the portion of hard/paved areas, surface water and inflows may be materially changed from the existing route; the proposed basement may result in changes to the profile of the inflows of surface water being received by adjacent properties or downstream watercourses & the area is identified as being at risk of surface water flooding.

Hazards

- 5.4.1. An increase in surface water running into neighbouring properties/highways.
- 5.4.2. A change in the groundwater flow regime.
- 5.4.3. Development of an area at risk of flooding.

Potential Impacts

- 5.4.4. Flooding of adjacent properties due to a change in the profile of inflows being received by neighbours.

Mitigating Factors

- 5.4.5. The flood storage basin may change the profile of surface water, and inflows of surface water being received by neighbouring properties, however it has been designed to intercept and receive water flowing from the upstream catchment area (thus mitigating surface water flood risk); the risk of flooding of neighbouring properties will remain the same or be reduced. This has been supported by hydraulic modelling carried out by Eden Young, included in Appendix D. The following conditions have been assessed:

- Normal conditions (up to the 1 in 30 year +20% Climate Change storm): No Flooding (Dry at surface) – all surface water draining into the Basin is intercepted by the bottom-of-Basin drainage system (filtration trenches and perforated pipe) and conveyed through the Bund and into the receiving ditch via the outlet SW outlet pipe with concrete collars.
- Flood conditions (up to the 1 in 100 year +20% Climate Change storm): Contained Flooding up to 109.0mOD – flood water (volume 2,600m³) is entirely contained within the Basin, rising up to the Spillway Sill level. All flood water eventually discharges through the Bund and into the receiving ditch via the SW outlet pipe with concrete collars.
- Exceedance conditions (above the 1 in 100 year +20% Climate Change storm): Excess flood water discharges over Spillway – any flooding volume above the design volume (2,600m³) will discharge over the Spillway Sill, convey down



the Spillway Swale and into the receiving ditch with riprap lining to dissipate energy. The Bund is structurally safe, and the ditch will receive lower flows of water than it would in equivalent storms in its existing configuration (the proposed Bund will reduce flooding in the ditch as well as downstream).

- 5.4.6. Site-specific ground investigation has confirmed that the Claygate Member and London Clay Formation are the shallowest stratum. Due to their low permeability, they are unable to provide significant drainage and the development is unlikely to alter the site from its current run-off condition, or discharge into the ground.

Assessments and Further Actions

- 5.4.7. The hydraulic modelling has proven that the flood storage basin and earth bund will perform as intended and there will be a negligible risk of impact to the surrounding surface and ground water flow regime as part of the proposed development. No further assessment is deemed to be necessary.



6. Site Investigation

- 6.1.1. Site-specific ground investigation has been undertaken by Soil Consultants Ltd in four phases. An initial and supplementary phase were undertaken in February 2016 to investigate the ground conditions surrounding the school buildings, followed by a third phase to investigate the conditions of the flood storage basin area in February 2024. No groundwater monitoring was undertaken as part of these phases of GI, so another phase was undertaken which comprised additional boreholes near the school buildings and proposed flood storage basin, with groundwater monitoring included. The data from the investigation has been used to derive a ground model and geotechnical parameters for the site to inform the ground movement assessment. The findings of the site investigation are included as Appendix C.
- 6.1.2. The locations of the ground investigation positions from the initial and supplementary phases are presented in Figure 6.1 and Figure 6.2 respectively.

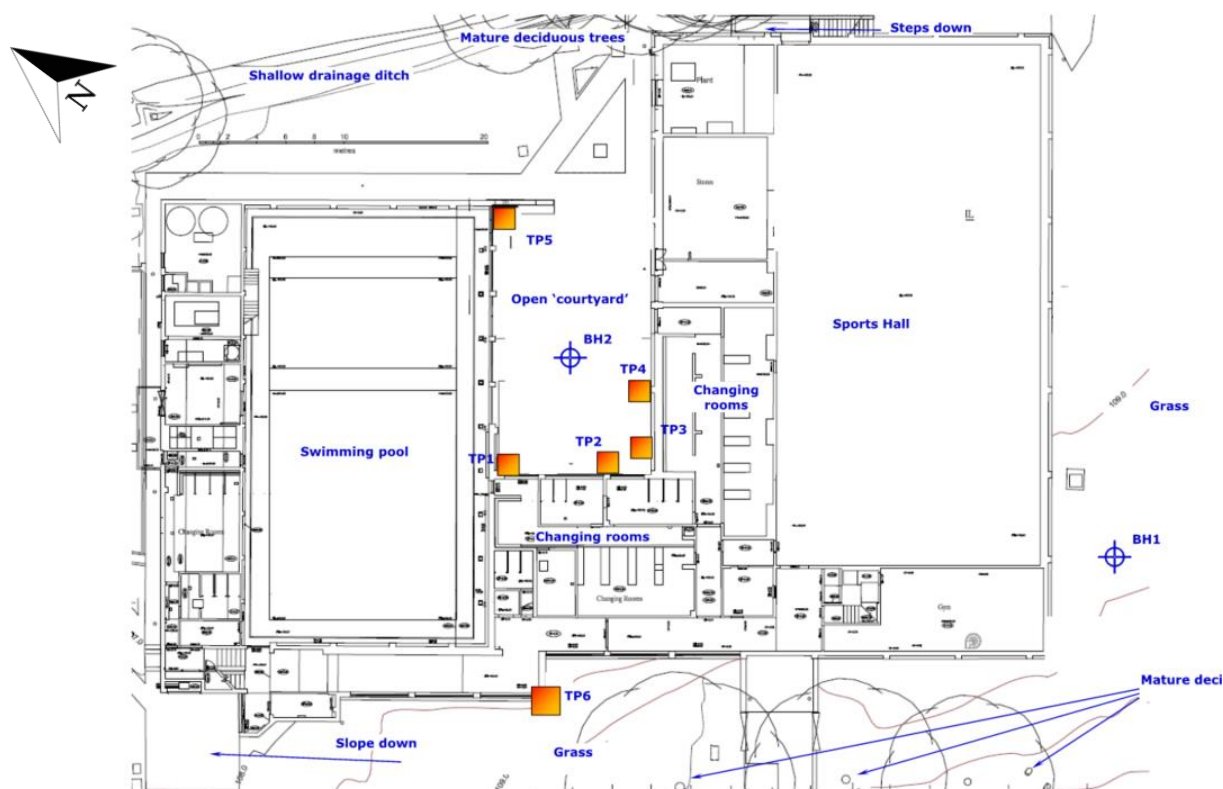


Figure 6.1 Ground investigation locations from the initial phase



Figure 6.2 Ground investigation locations from the supplementary phase

6.1.3. The ground model derived from the site investigation data is presented in Table 6.1.

6.1.4. Groundwater was observed to have a general groundwater flow direction to the northwest.



Table 6.1 Ground model and geotechnical parameters

Stratum	Top of stratum (mOD)	Thickness (m)	Undrained Shear Strength c_u (kPa)	Undrained Young's Modulus, $E_u^{[3][5]}$ (MPa)	Drained Young's Modulus, $E'^{[4]}$ (MPa)
Made Ground	+106.8 ^[1]	0.3	-	-	V: 10.0 H: 10.0
Head Deposits	+106.5	2.1	32.0	V: 16.0 H: 25.6	V: 12.8 H: 20.48
Claygate Member	+104.4	5.1	$32.0 + 17.4z^{[6]}$	V: $16.0 + 8.7z^{[6]}$ H: $25.6 + 13.92z^{[6]}$	V: $12.8 + 6.9z^{[6]}$ H: $20.48 + 11.14z^{[6]}$
London Clay Formation	+99.3	Unproven	$120.0 + 8.2z^{[6]}$	V: $60.0 + 4.1z^{[6]}$ H: $120.0 + 8.2z^{[6]}$	V: $48.0 + 3.3z^{[6]}$ H: $96.0 + 6.56z^{[6]}$

1. The ground level adjacent to the proposed basement has been adopted as ground level in the GMA.
2. The ground model and geotechnical parameters have been derived solely for the purposes of this assessment.
3. Vertical undrained Young's Modulus has been derived using the relationship $E_u = 500c_u$.
4. Vertical and horizontal drained Young's Modulus has been derived using the relationship $E' = 0.8E_u$.
5. Horizontal undrained Young's Modulus for the Head Deposits and Claygate Member has been derived using the relationship $E_u = 800c_u$. Horizontal undrained Young's Modulus for the London Clay Formation has been derived using the relationship $E_u = 1000c_u$.
6. z refers to metres below top of stratum.
7. *Rigid boundary* assumed at approximately +34.11mOD for analytical purposes.
8. V: vertical, H: horizontal.



7. Construction Methodology / Engineer Statements

7.1. Outline Temporary and Permanent Works Proposals

- 7.1.1. The outline basement construction proposal is to construct the basement from top-down sequencing.
- 7.1.2. Standard means and methods of excavation are expected to be suitable to excavate the basement, based on the ground conditions proven by means of ground investigation works.
- 7.1.3. The basement excavation will be retained by a contiguous pile wall. The wall is not expected to be load-bearing.
- 7.1.4. Design of the retaining walls and temporary propping shall be carried out in accordance with the relevant Eurocodes/British Standards, non-conflicting codes of practice, and associated design best practice.
- 7.1.5. Groundwater control will be implemented through pumping during excavation and injection of an inert material behind the contiguous piled wall, to prevent any locally higher rates of groundwater inflow through finite granular horizons / bands.
- 7.1.6. The proposed construction sequence is as follows:
- Deconstruct existing structures on site;
 - Temporarily divert any services required to ensure other structures on site remain operational.
 - Level site and install piling mat;
 - Install contiguous piled wall on full perimeter of basement, with rebar not exceeding piling mat level;
 - Once concrete has reached full strength within the piles, partially dig down on top of piled wall to allow for construction of capping beam and provide bracing to sides of excavation;
 - Clean the top of the piles thoroughly and construct RC capping beam on full perimeter of contiguous piled wall with cast in pipes to allow for later concreting of the lining walls at a later stage;
 - Once concrete has reached full strength within the capping beam, dig down entire area within the contiguous piled wall down to foundation formation level;
 - Install piling mat at basement formation level;
 - Install piles forming new foundations under proposed main columns, with rebar not exceeding piling mat level;
 - Once concrete in foundation piles has reached full strength, dig down to basement slab formation level;
 - Construct new basement slab with new thickenings;
 - Once concrete has reached full strength in basement slab, install proposed main columns on top of basement slab with temporary props;
 - Install proposed timber ground floor and remove temporary props of main timber columns;
 - Install superstructure above;

7.2. Ground Movement and Damage Impact Assessment

- 7.2.1. A GMA has been carried out in accordance with CIRIA C760 and takes into account the construction methodology and preliminary site-specific ground and groundwater conditions. The ground movement assessment is included in Appendix F.
- 7.2.2. All structures / properties within the zone of influence of the proposed development have been assessed.
- 7.2.3. The following assumptions have been made within the GMA:
- The basement will be retained by a 450mm diameter contiguous piled wall at 600mm c/c.
 - The buildings adjacent to the site included in the GMA are assumed to be founded on ground surface to provide a conservative assessment.
 - The walls of the above-mentioned buildings are assumed to behave as equivalent beams.



- The basement will be largely unpropped in the permanent condition.
- The contiguous piled wall has a length of 7.8m. The wall is not expected to be load bearing.

7.2.4. The ground movements resulting from the works comprise deformations arising from the following mechanisms:

- Installation of the contiguous pile wall.
- Bulk excavation works.
- Heave and settlement of the Claygate Member and London Clay Formation due to unloading / load redistribution / loading.

7.2.5. The assessed facades in the XDisp model are shown in Figure 7.1.

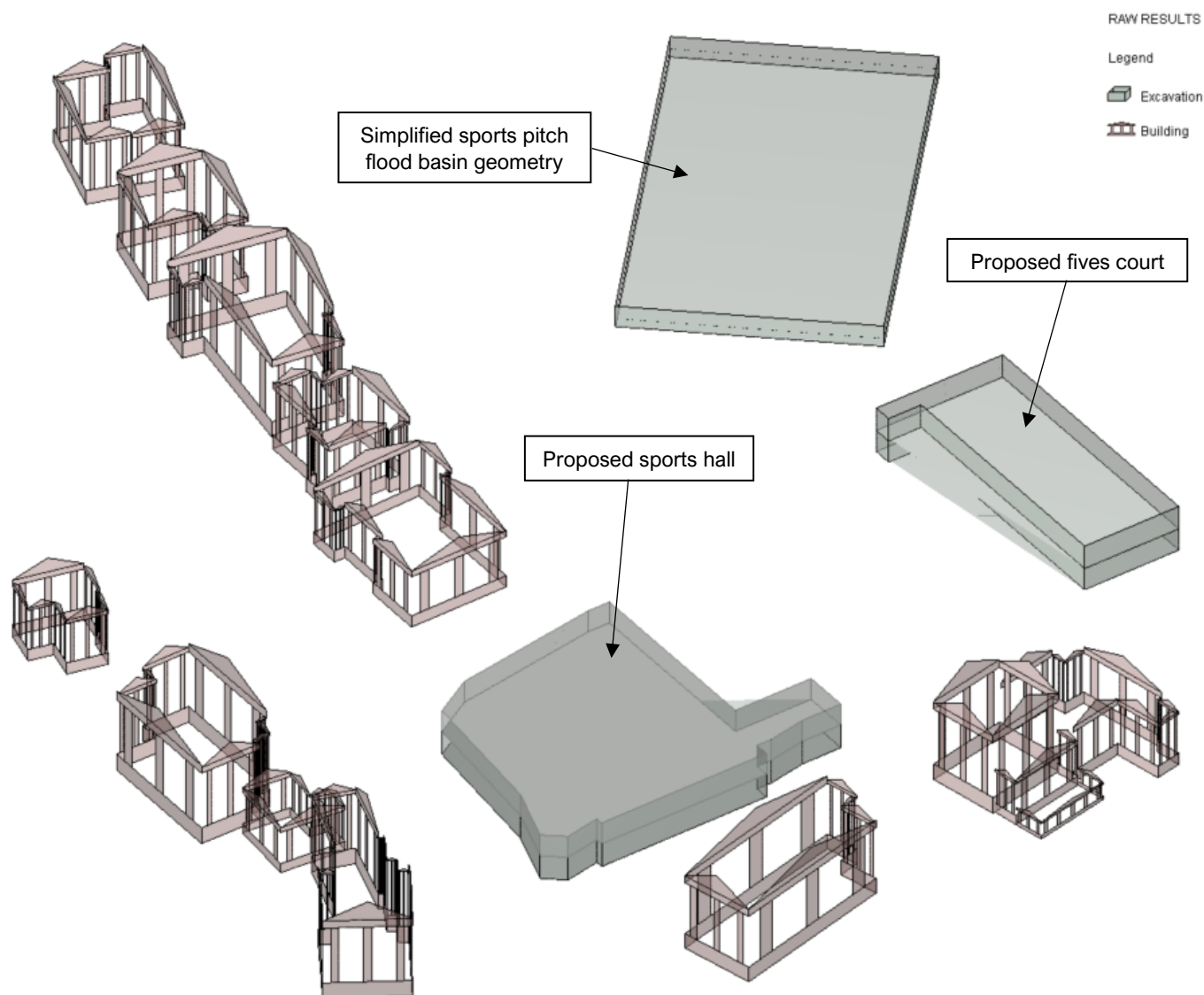


Figure 7.1 Indicative plot of three-dimensional analytical model in XDisp

7.2.6. The following mitigation measures are proposed to reduce ground movements and damage:

- Design of the contiguous pile wall and open-cut excavations shall be carried out in accordance with the relevant Eurocodes, non-conflicting codes of practice, and associated design best practice.
- Retaining wall construction to be performed by an experienced ground engineering contractor.



- Frequent monitoring of neighbouring properties to be carried out during excavation, to validate ground movement predictions against reality.
- Development of a monitoring-trigger-action plan that identifies trigger levels, responsible personnel and actions to be followed in the event of a trigger level exceedance.
- Designated areas for stacking and storing materials behind the embedded retaining wall should be identified. These should be located away from sensitive structures. The design of the retaining wall should incorporate an appropriate surcharge load to the rear of the wall, to capture effects of stacking and storing materials, vehicle traffic, etc.

- 7.2.7. It should also be noted that this GMA considers adjacent properties and does not assess the impact of the works on buried utilities. There remains the possibility that further propping measures may be required to safeguard such assets. Additional scheme GMAs will need to be performed in order to review the impact of the scheme on various third-party assets, such as Thames Water, at an early stage of the design development. These assessments will be brought forward post-planning and further refined based on the ongoing scheme development, prior to issue to the relevant asset protection teams, for review and approval ahead of construction work commencement.
- 7.2.8. It is recommended that ground movement / earth retention system design and construction movement criteria are developed based on the results presented in the Ground Movement Assessment report. This will enable the design of the retaining wall and any required temporary propping measures to be undertaken in a holistic fashion, ensuring ground movements are limited to no greater than that presented in the report.
- 7.2.9. Specific wall/façade deflection limits and trigger levels may also be developed as part of the scheme monitoring regime. Such limits and trigger levels should be coordinated with the scheme monitoring specification and monitoring action plan / emergency preparedness plan.
- 7.2.10. The proposed basement walls have been analysed in WALLAP which has demonstrated that the wall deflection during the excavation stage will be less than those predicted by the GMA. The wall calculations are included in Appendix G.



8. Basement Impact Assessment

8.1. General

8.1.1. The Conceptual Site Model (CSM) is described below:

- The ground conditions of the site comprise Made Ground over Claygate Member and the London Clay Formation.
- Groundwater within the Head Deposits at approximately 1.8mbgl to 1.6mbgl at the location of the proposed development. It is noted that the boreholes surrounding the proposed sports hall were dry during drilling, other than BH2 which had a water inflow at 3.6mbgl, rising to 3.1mbgl after 20 minutes.
- Groundwater generally at 1.8 to 1.2mbgl across the wider site.
- Potential for flooding at the area surrounding the proposed flood storage basin (the Orchard). Objections made to planning state that the area becomes waterlogged during winter.
- Groundwater flow direction to the northwest.
- The areas surrounding the site are gently sloped and fall towards the West with a gradient of approximately 1 in 25.
- The site is currently occupied by a fives courts building, a pool hall, squash courts and a sports hall which are surrounded by soft landscaping. There are no existing basements.
- The proposed development will take place over four Phases and will comprise the demolition of the fives courts, squash courts, part of the pool building and areas of hardstanding, construction of a second sports hall in place of the old fives courts and squash courts, and construction of new fives courts adjacent to the existing sports hall. The new sports hall will include an approximately 3.7m-deep basement, and the fives court will include an approximately 4.0m-deep basement.
- Foundation depths of the neighbouring buildings are unknown. They have been conservatively assumed to be founded at ground level for the purposes of the Ground Movement Assessment, and at 4mbgl for the hydrogeological assessment.
- The nearest public highway is Bishopswood Road, within 5m from the proposed development.
- The proposed development may result in ground movements in the vicinity of the neighbouring properties and adjoining public highways. These ground movements will be managed by appropriate construction means and methods and controlled excavation operations.



Figure 8.1 Conceptual site model

8.2. Land Stability / Slope Stability

- 8.2.1. It is assumed that all new substructure elements will be founded in the Head Deposits and Claygate Member which are considered to be a suitable founding stratum.
- 8.2.2. The ground movement assessment has concluded that ground movements caused by excavation and construction of the proposed development will be limited. The upper bound damage category for surrounding structures within the zone of influence of the proposed development has been assessed as *Category 1 – Very Slight* in accordance with the Burland Scale.
- 8.2.3. The BIA has concluded that the risks to the adjacent properties, slopes, and infrastructure (including ultimate and serviceability limit state considerations) is limited and will be mitigated in a reasonable fashion as part of design development.



8.3. Hydrogeology and Groundwater Flooding

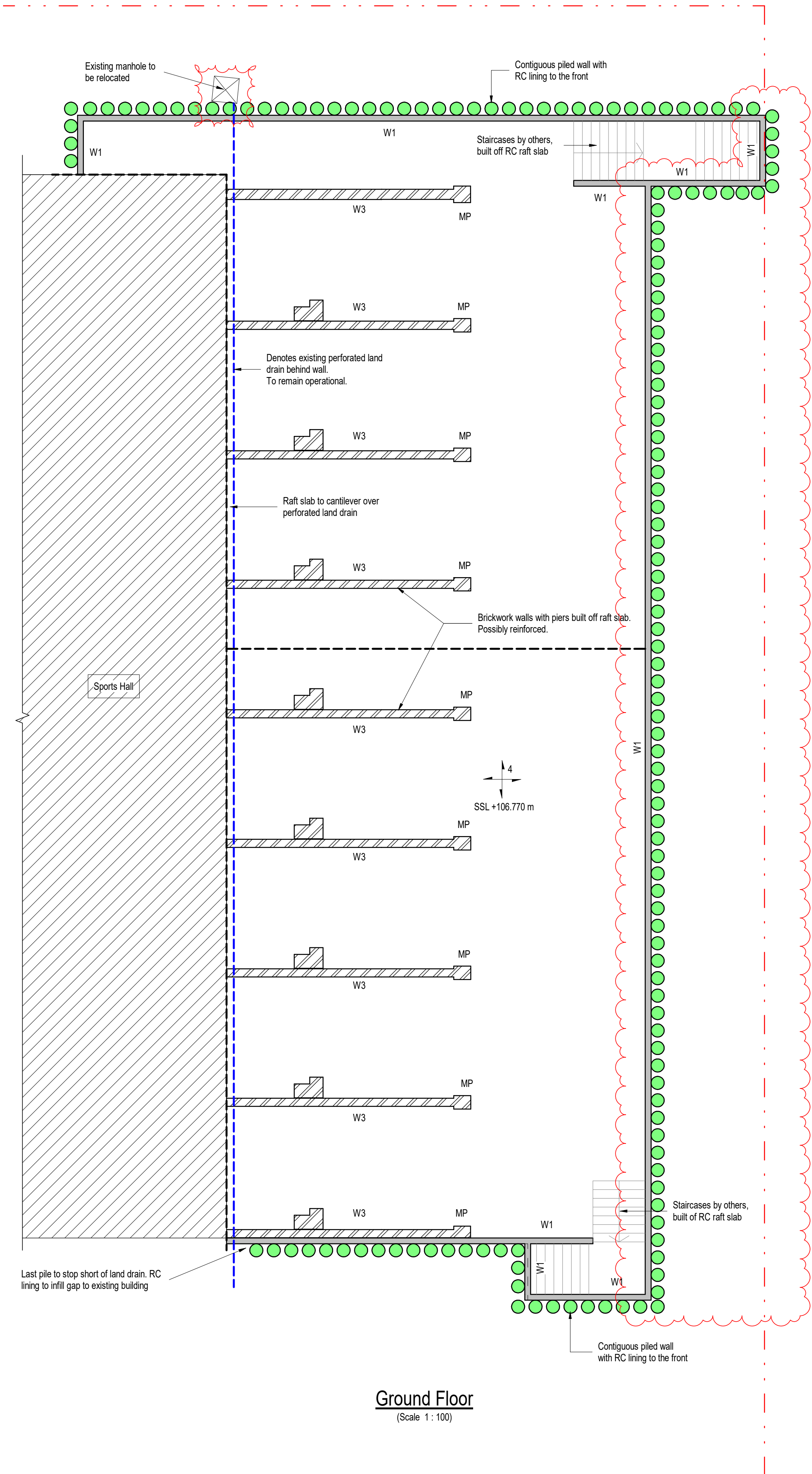
- 8.3.1. Groundwater was identified within the Head Deposits at approximately 1.8mbgl (105mOD) and the location of the proposed basement during site investigation with a flow direction to the north west. The groundwater level across the wider site varies from 1.2 to 1.8mbgl.
- 8.3.2. The area surrounding the proposed flood storage basin (the Orchard) may have the potential to flood during winter months. Objections made to planning state that the area becomes waterlogged during winter.
- 8.3.3. A hydrogeological assessment has been undertaken which concludes that a rise in groundwater of 77mm and a fall in groundwater of 53mm can be expected due to the construction of the proposed basement.

8.4. Hydrology, Surface Water Flooding and Sewer Flooding

- 8.4.1. A Surface Water Modelling Report has been prepared by Edenvale Young, which concluded that the site is susceptible to surface water flooding. Surface water will be managed by the construction of the flood storage basin.
- 8.4.2. The BIA has concluded that there are no impacts to the wider hydrological environment.
- 8.4.3. For further details of the proposed scheme flood risk mitigation measures reference should be made to the scheme Flood Risk Assessment report, provided in Appendix E.

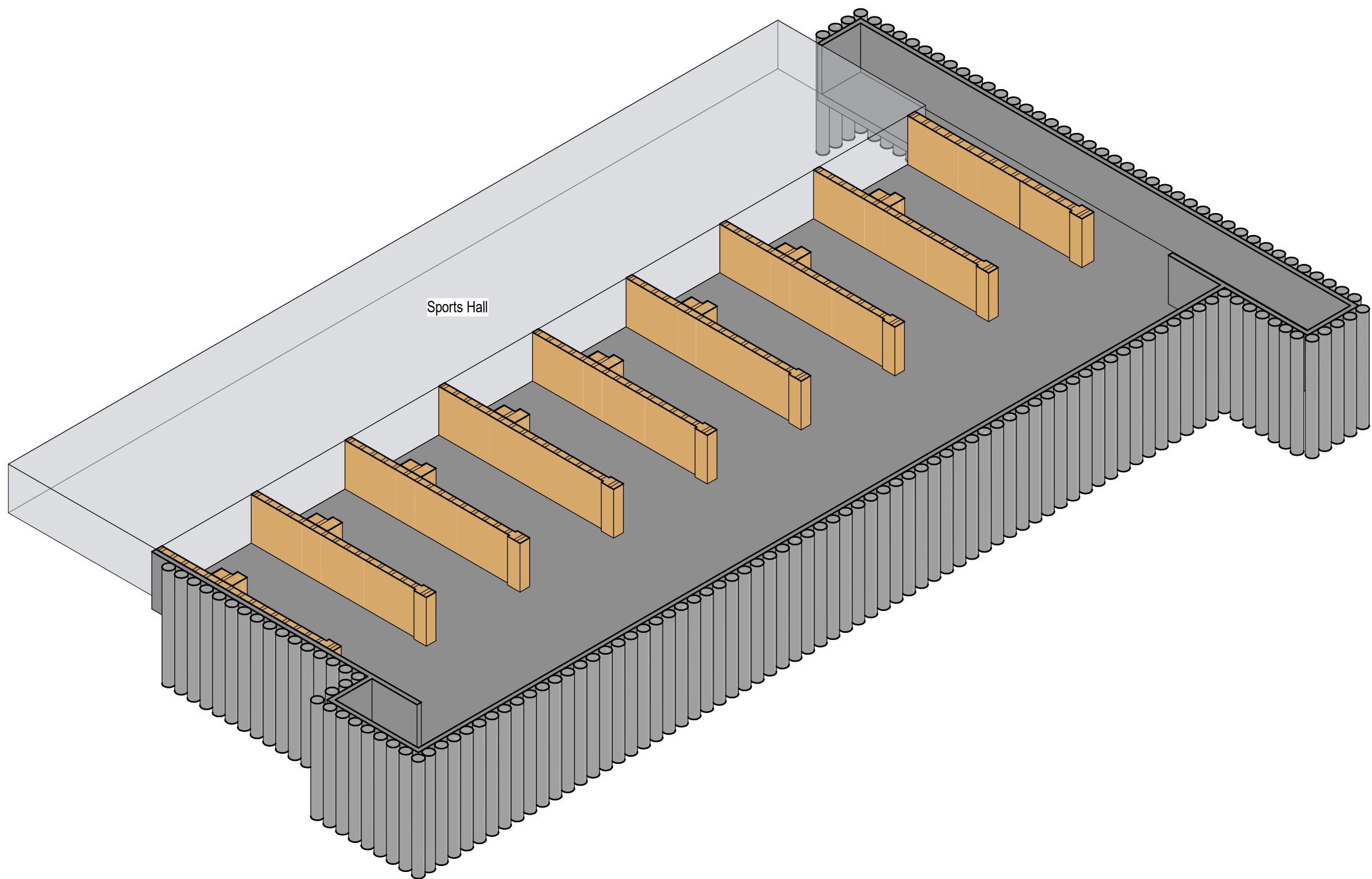


Appendix A: Structural Drawings



Legend:

- Denotes boundary line
- 10mm thk movement joint
- 350mm thk RC raft slab on 50mm thk blinding
- W1 200mm thk RC lining wall
- W3 430mm thk brickwork wall
- MP Masonry Piers, possibly reinforced
- Assumed Ø450mm CFA contiguous piles @ 600mm c/c by piling specialist



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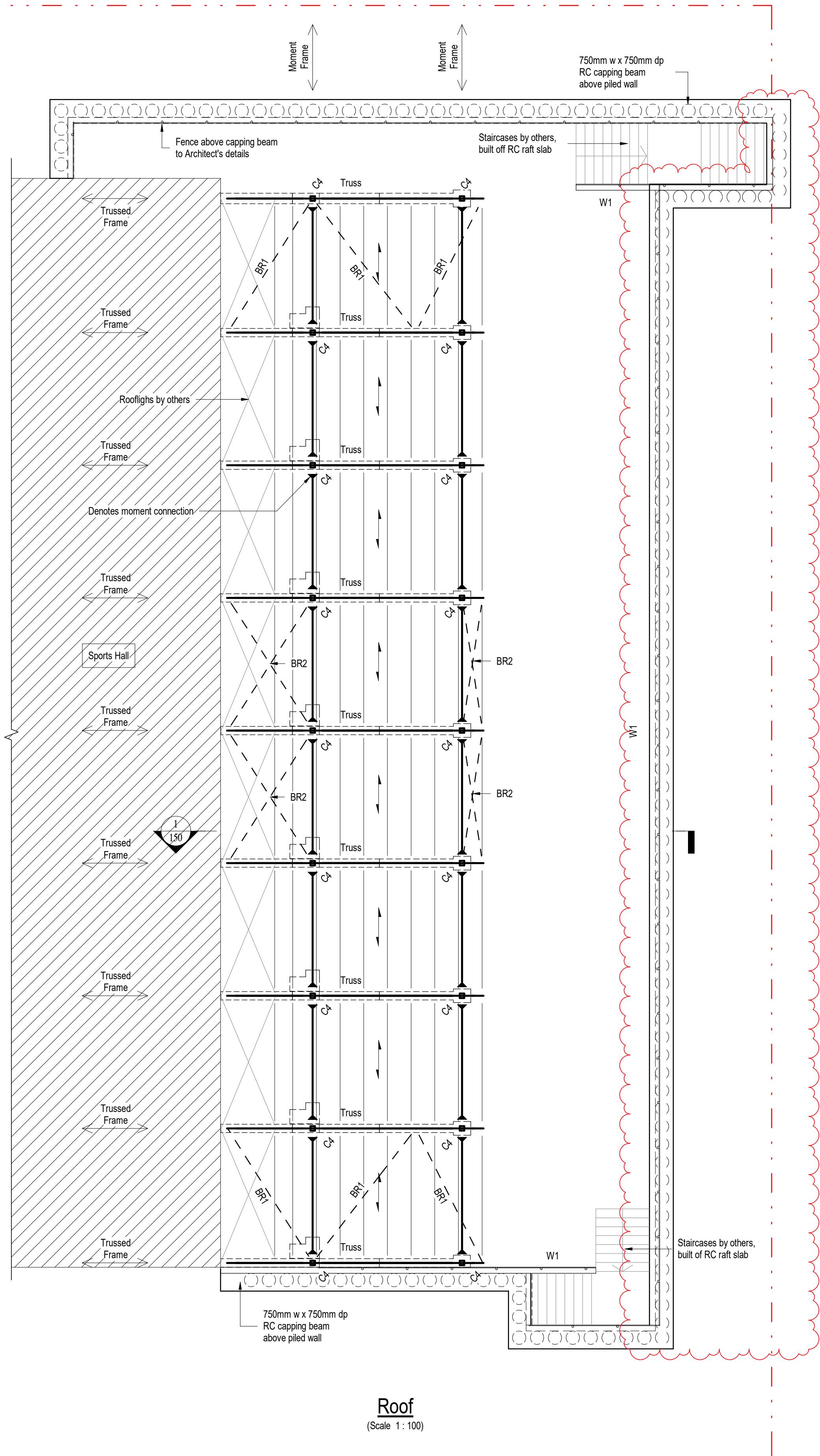
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-	15.03.19	KK	TF	Issued for Information
Rev	Date	Drawn	Chk	Amendment
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FIVES COURT PHASE 2A

GENERAL ARRANGEMENT OF GROUND FLOOR

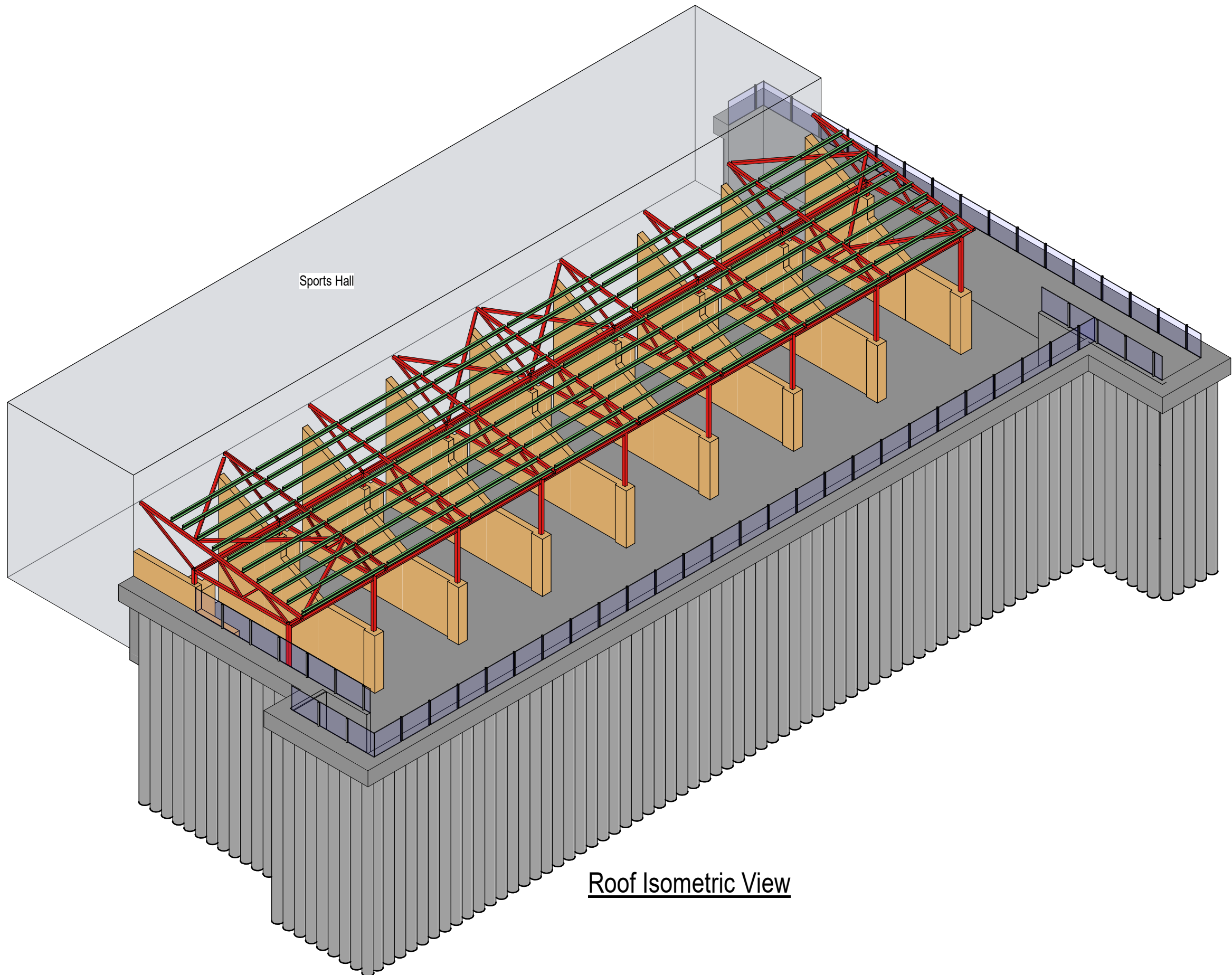
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Drawn:	KK	Engineer:	TF	Checked: SPJ
Drawing No:	L2384-PJC-P2A-00-DR-S-110			Revision: 01



Legend:

- - - - Denotes boundary line
- Denotes steel beams. Size TBC
- W1 200mm thk RC lining wall
- ← → Metal purlins & crinkly tin decking to support green roof
- BR1 Denotes horizontal roof bracing @ top chord level
- BR2 Longitudinal vertical bracing (Angled from top to bottom chord)
- ● ● Assumed Ø450mm CFA contiguous piles @ 600mm c/c by piling specialist

Fives Court Steel Column Schedule					
Column Ref.	Type	Grade	Axial (kN)	Moment (kN-m)	Comments
C4	SHS150x150x10	S355			



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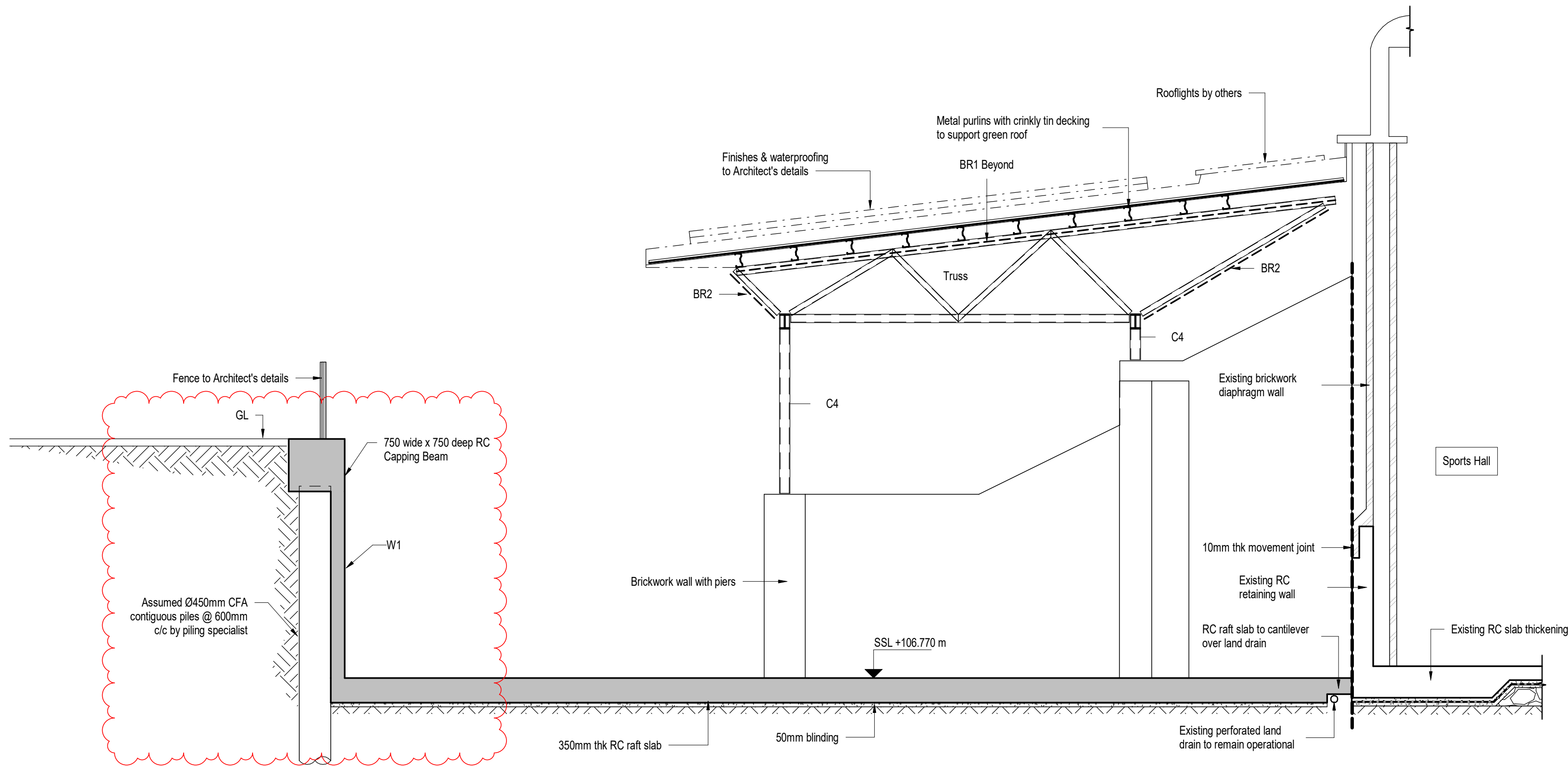
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FIVES COURT PHASE 2A

GENERAL ARRANGEMENT OF ROOF

Status: INFORMATION				
Scale:	As indicated@ A1	Date:	15.03.19	
Drawn:	KK	Engineer:	TF	Checked: SPJ
Drawing No:	L2384-PJC-P2A-01-DR-S-111	Revision:	01	



Section 1-1
(Scale 1 : 50)

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-	15.03.19	KK	TF	Issued for Information

Rev	Date	Drawn	Chk	Amendment
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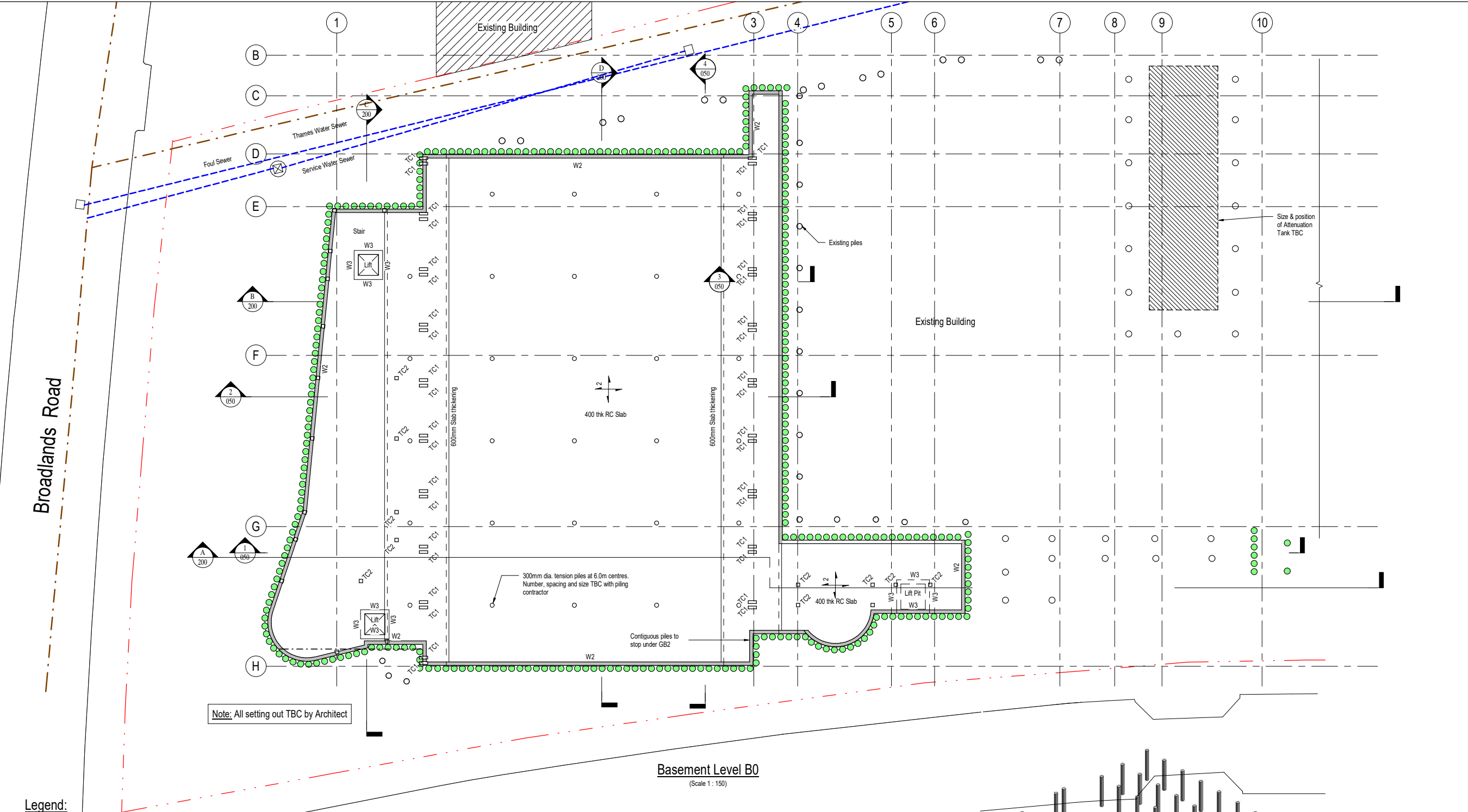
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FIVES COURT PHASE 2A

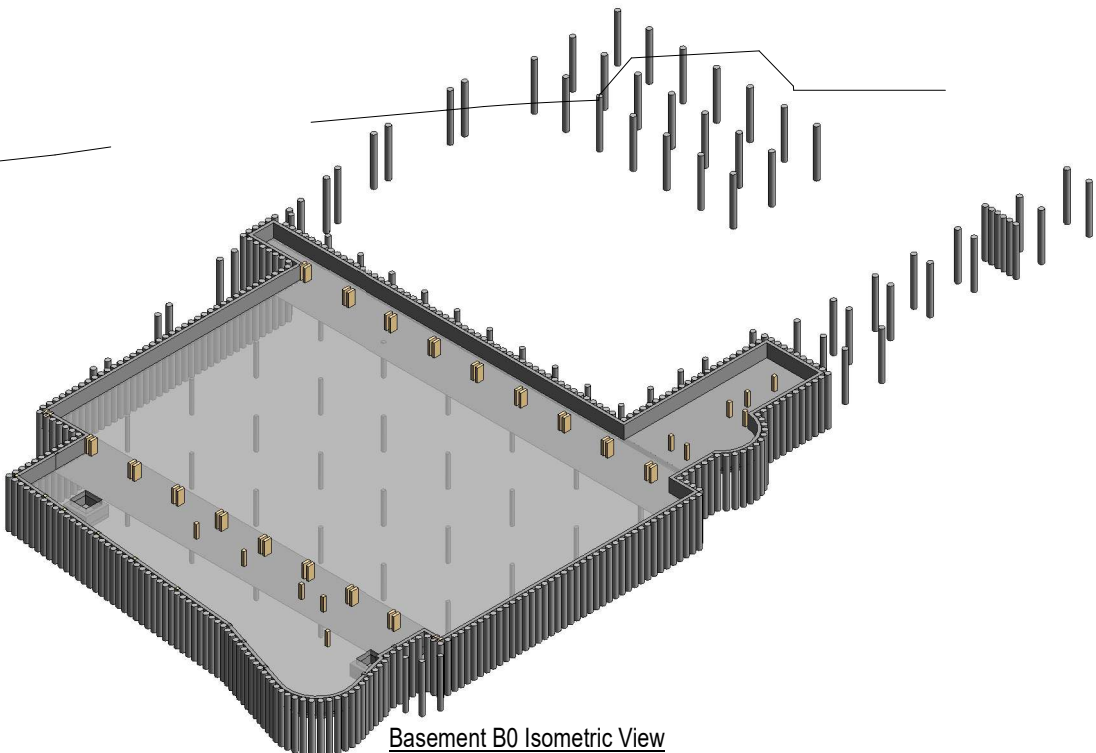
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Drawing No: L2384-PJC-P2A-XX-DR-S-150			Revision: 01



- Legend:**
- Denotes boundary line
 - - - 100x100x10 continuous RSA for support of edge anchored into lining wall with Hilti M16 HIT-V rods (8.8) @ 400mm c/c using HY-200 resin
 - Denotes steel beams. Size TBC
 - - - Movement joint
 - BR Diagonal steel bracing
 - 400mm thk RC ground bearing slab on 50mm thk blinding
 - 300mm thk RC suspended slab on piles
 - CLT1 160mm Deep CLT flooring
 - W1 200mm thk RC lining wall
 - W2 250mm thk RC lining wall
 - W3 300mm thk RC wall
 - Assumed Ø450mm CFA contiguous piles @ 600mm c/c by piling specialist

TC Timber Column Schedule		
Column Ref.	Type	Grade
TC1	200 x 600	Wood - Glulam GL28c
TC2	250 x 250	Wood - Glulam GL28c



For General Notes refer to PJCE drawing L11234-22-215

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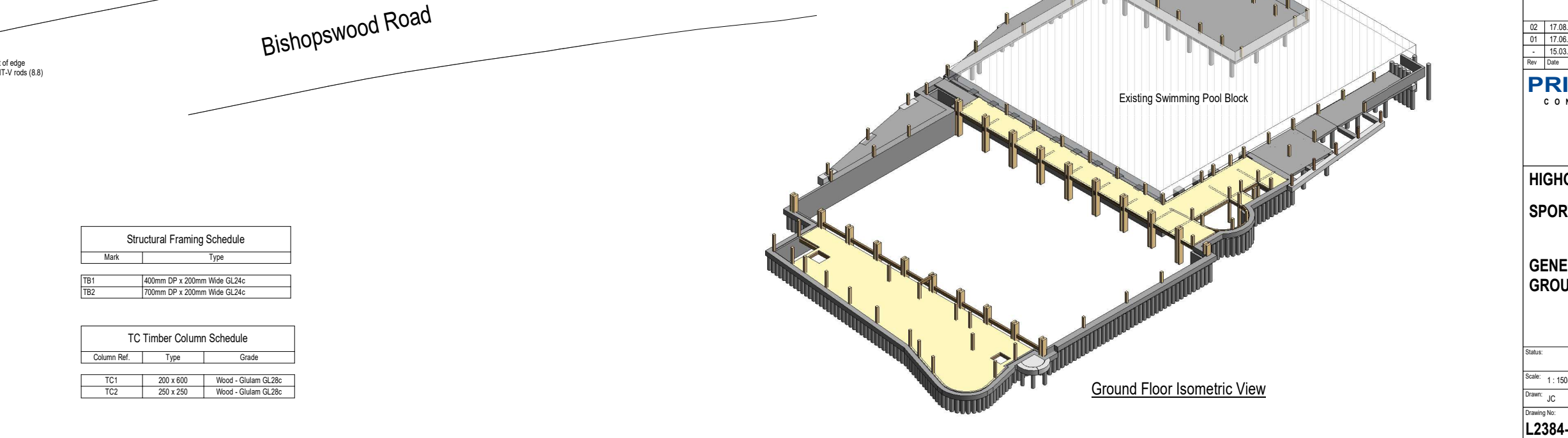
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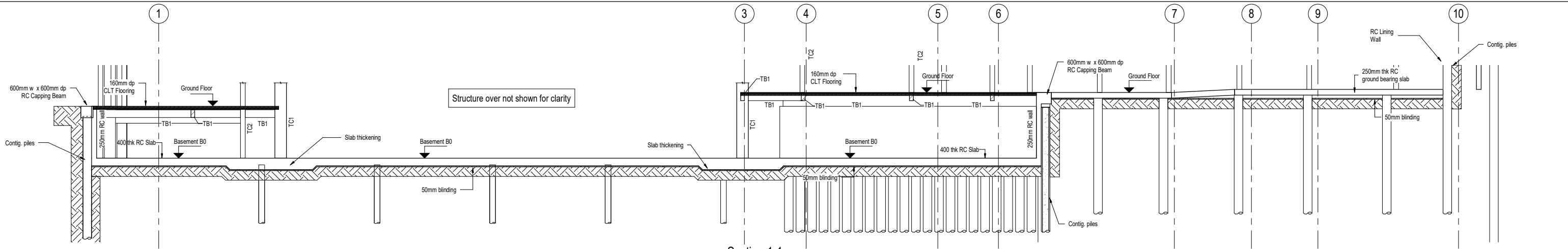


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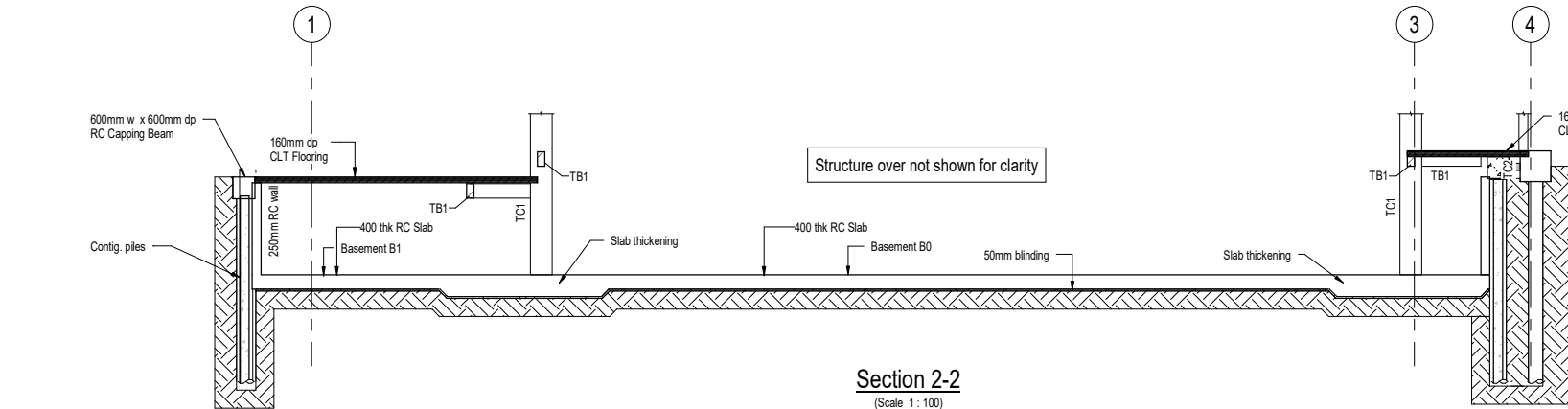
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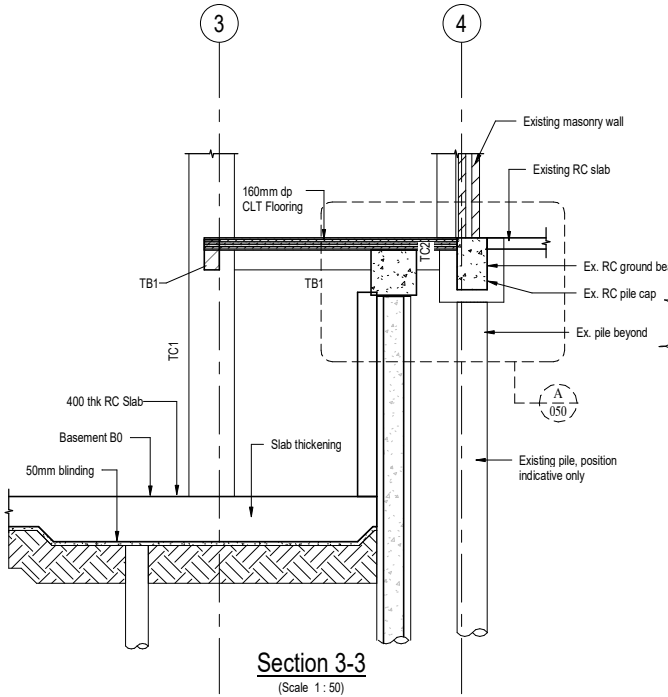
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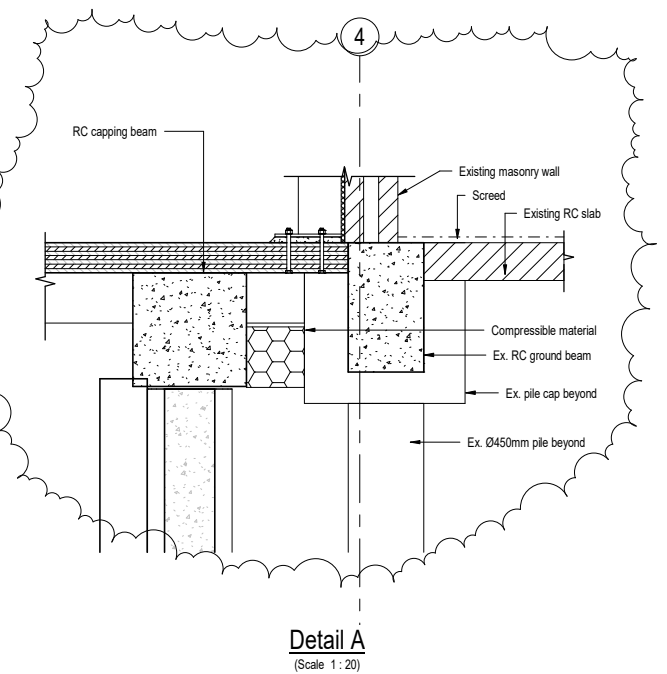
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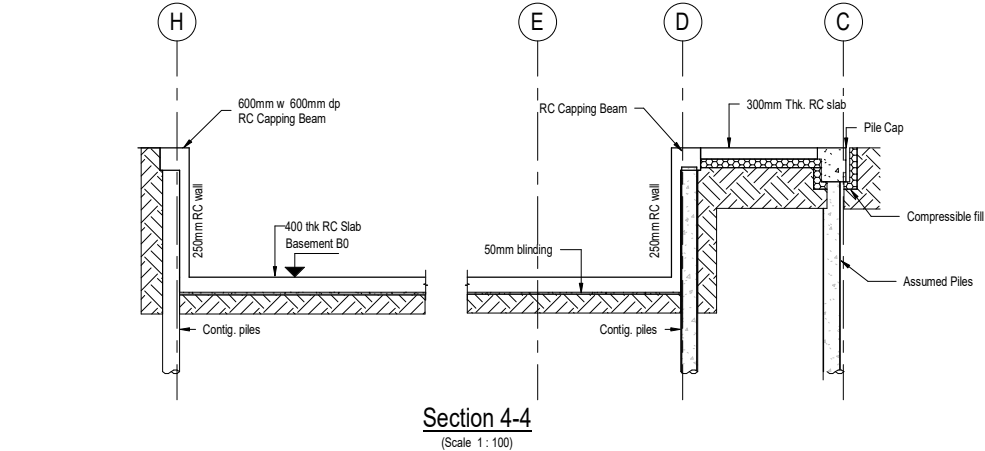
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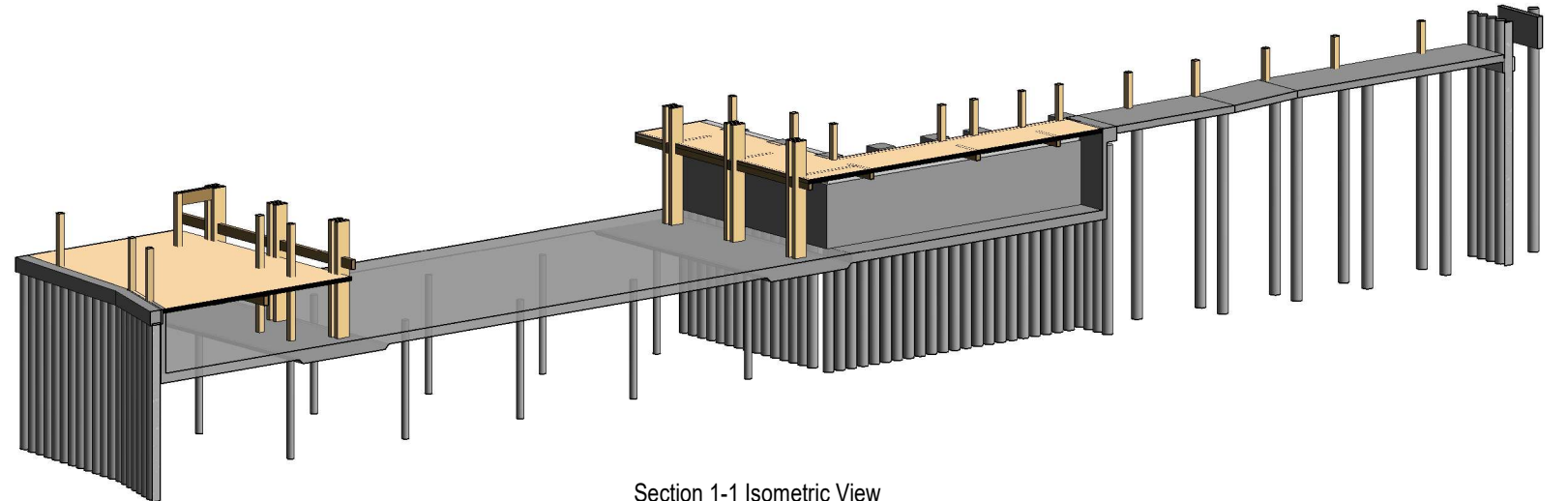
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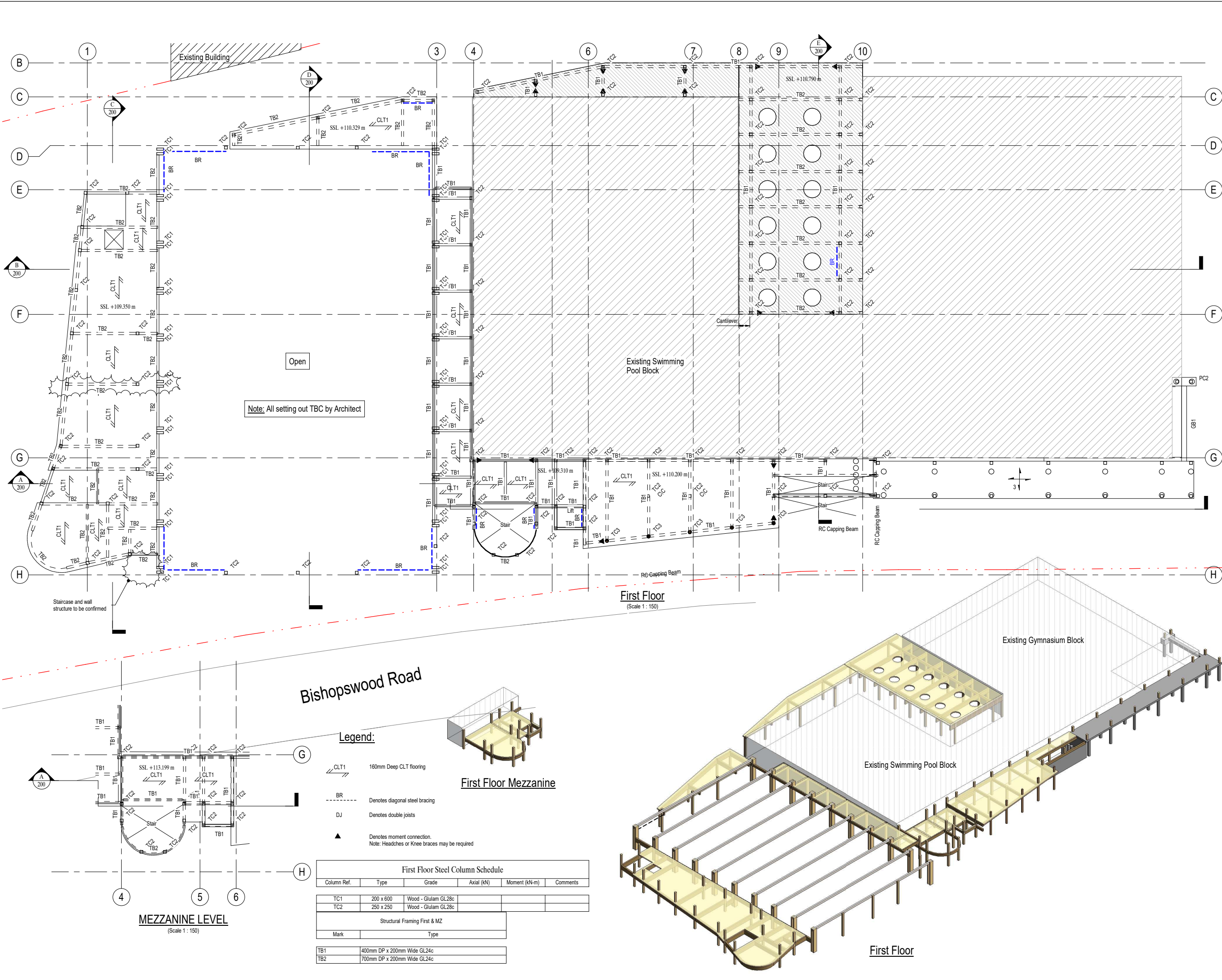
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Section 1-1 Isometric View



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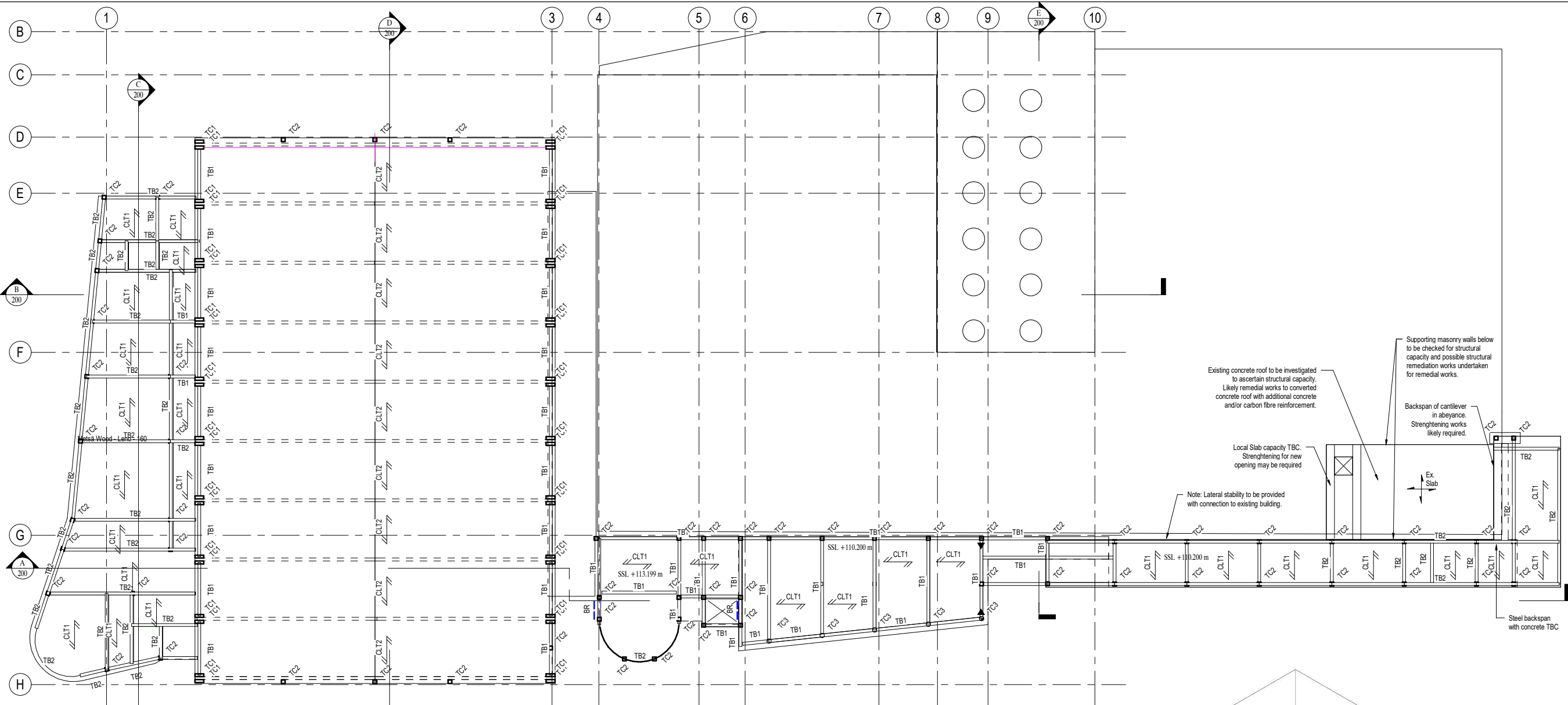
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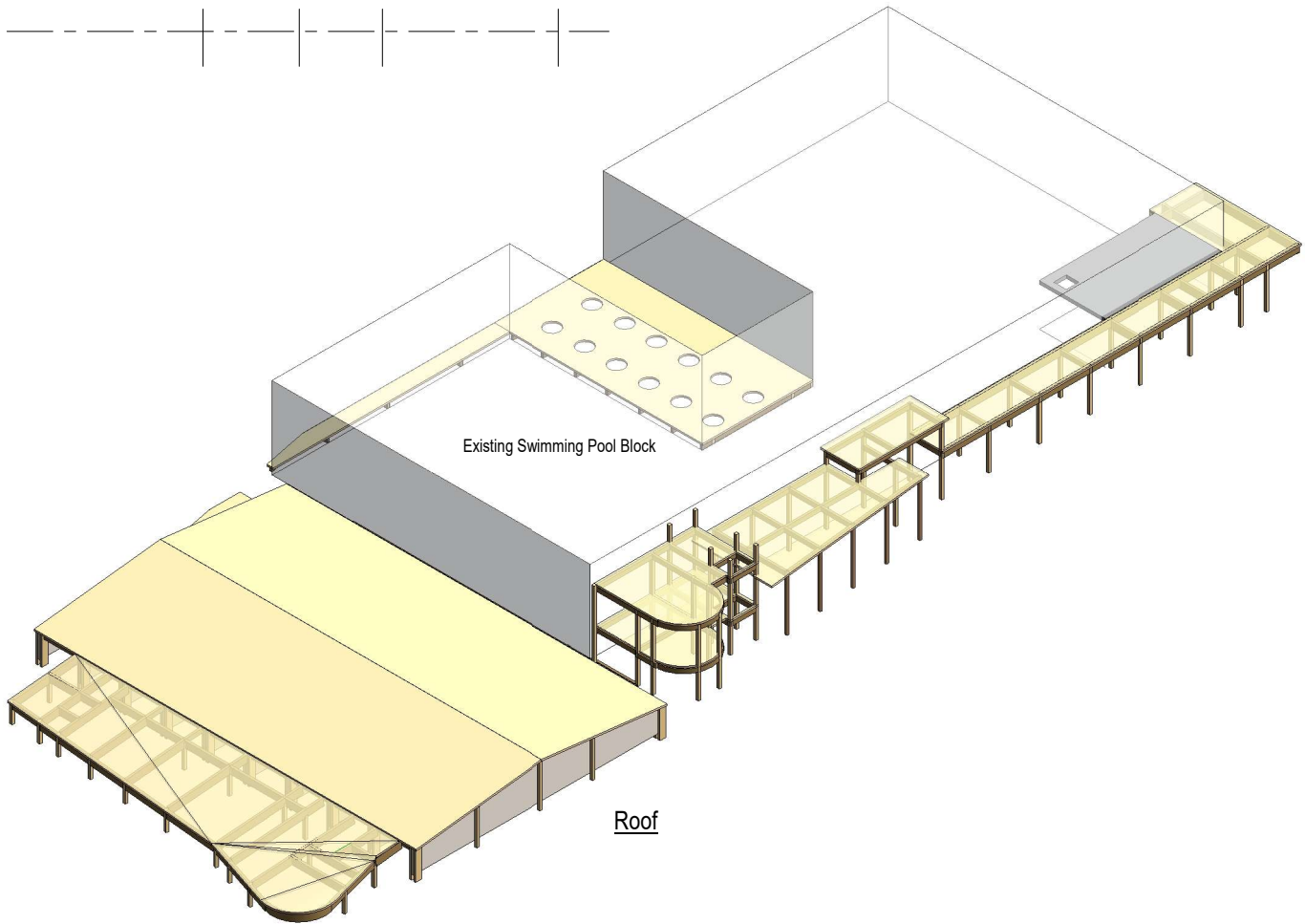
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Drawing No: L2384-PJC-XX-01-DR-S-011 Revision: -



Legend:

- CU Denotes column under
- CLT1 Denotes 160mm deep CLT flooring
- CLT2 TBC with options design
- Denotes full height bracing
- Denotes full height moment frame



For General Notes refer to PJCE drawing L11234-22-215

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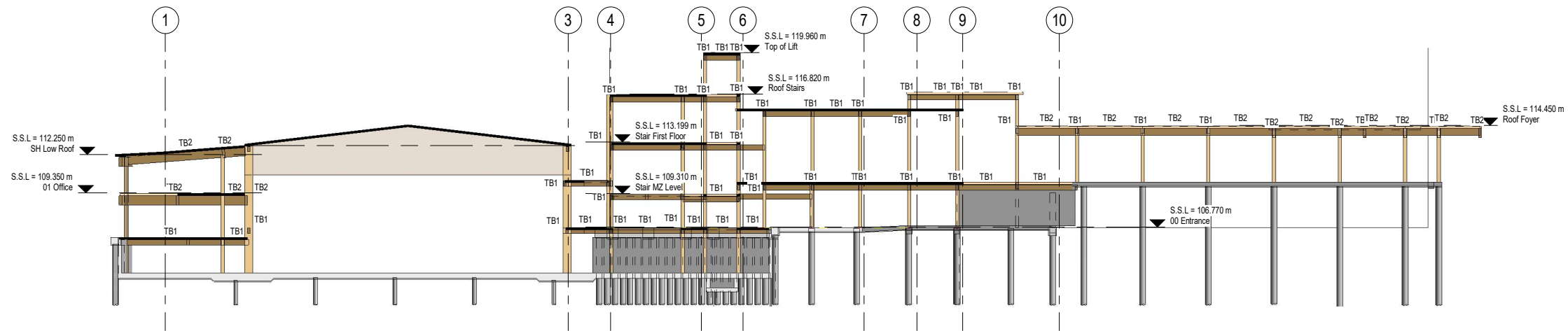
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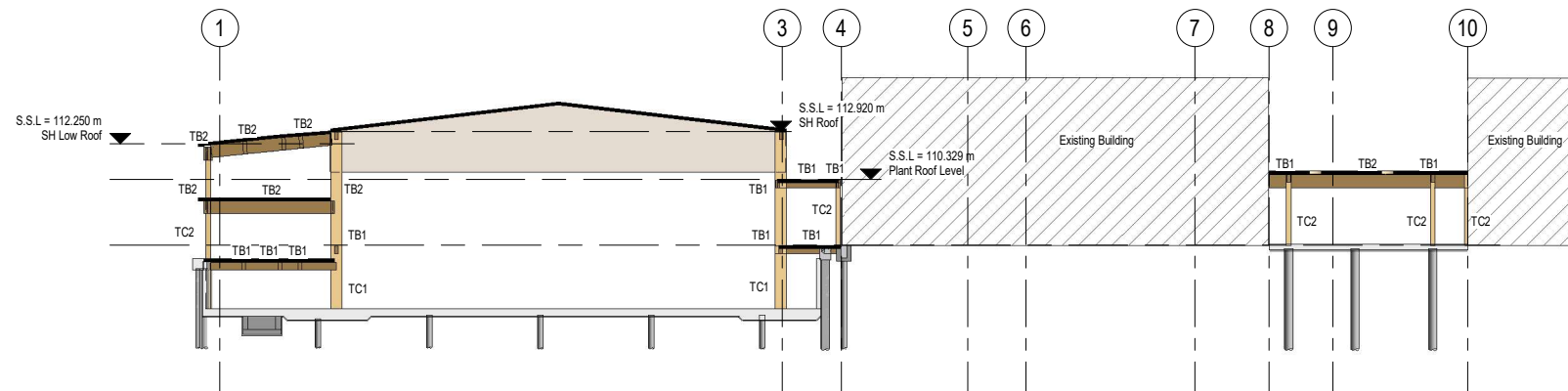
SPORTS HALL PHASE 2B

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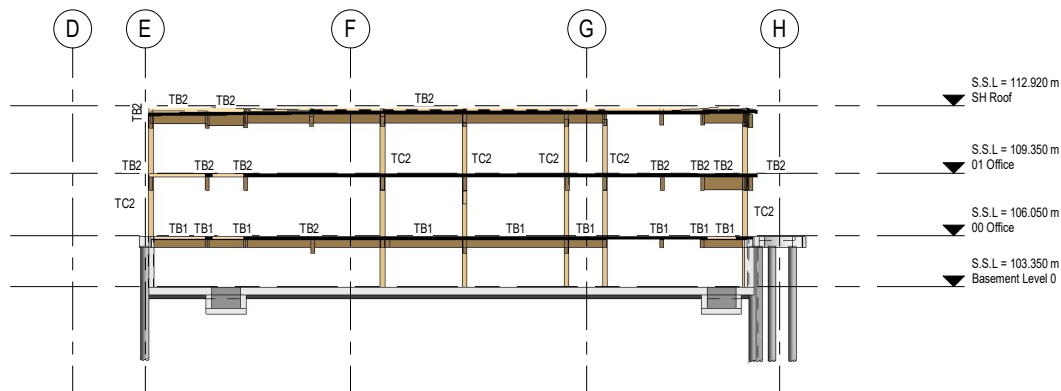
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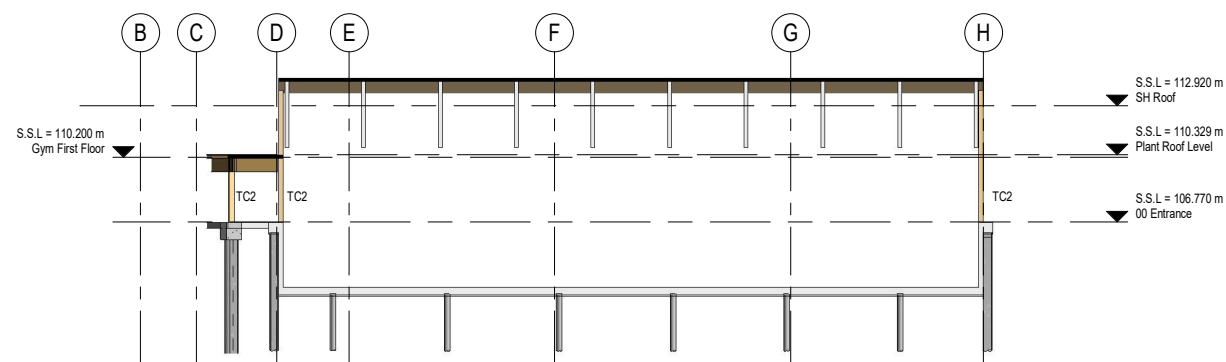
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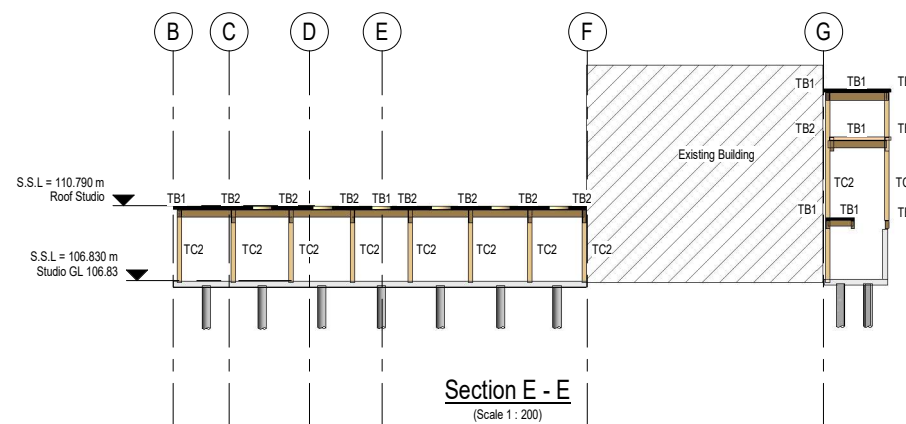
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Section C - C
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Section D - D
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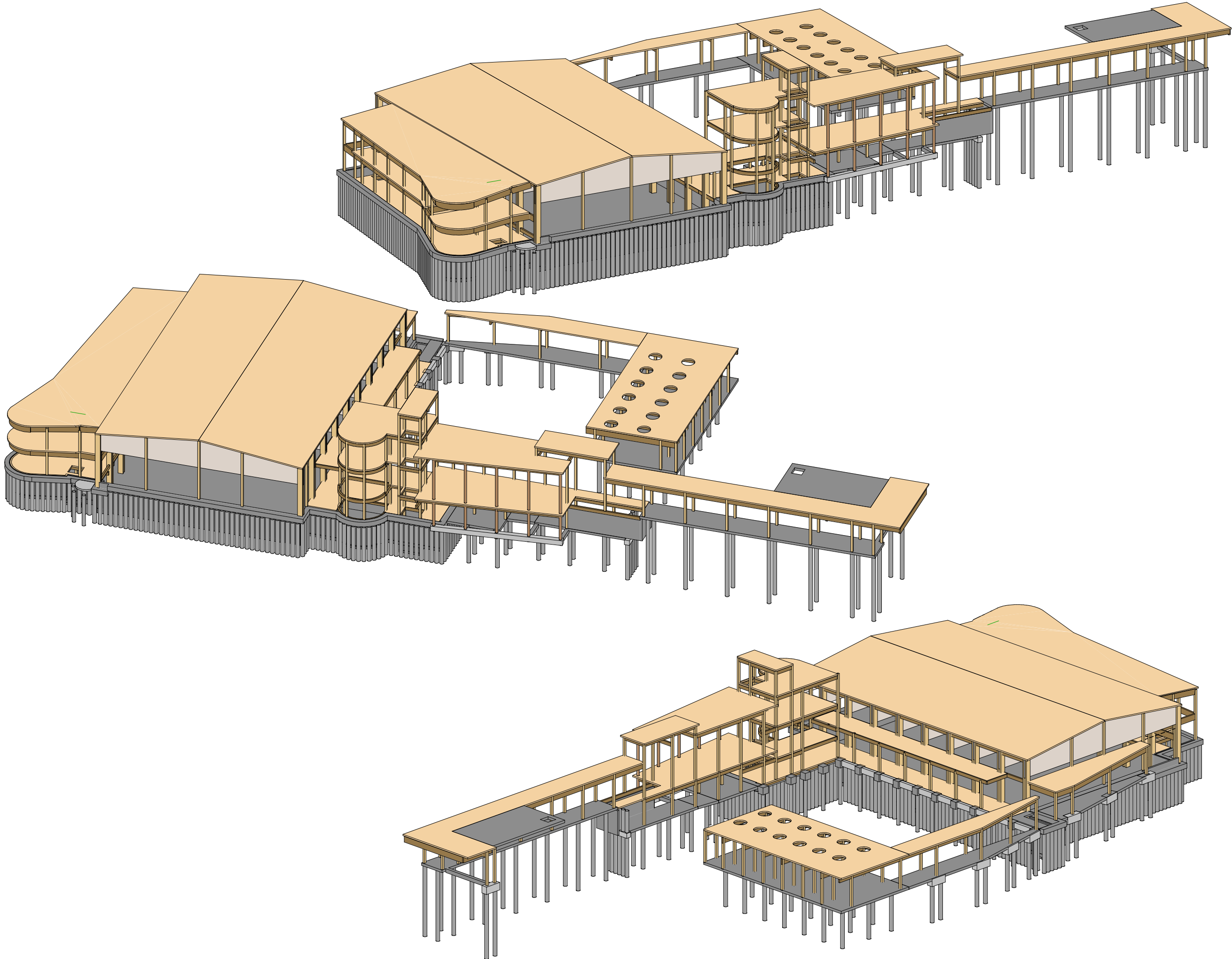
For General Notes refer to PJCE drawing L11234-22-215
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-	17.08.22	JC	GB	Issued for Information
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GLOBAL SECTIONS

Status:	INFORMATION		
Scale:	1 : 200@ A1	Date:	AUG. 22
Drawn:	JC	Engineer:	TF
Checked:	SP-J	Revision:	-
Drawing No:	L2384-PJC-XX-XX-DR-S-200		



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3D GLOBAL VIEWS

Status:				INFORMATION	
Scale: @ A1		Date:			
Drawn:	Author	Engineer:	Designer	Checked:	Checker
Drawing No:		Revision:			
L2384-PJC-XX-XX-DR-S-201				-	



Appendix B: Flood Storage Basin Drawings

Notes:

1. Do not scale from this drawing
2. All dimensions are in millimetres unless otherwise stated.
3. All levels are in metres unless otherwise stated.
4. This drawing should be read in conjunction with all relevant architects, structural engineers and m&e engineers drawings and specification.
5. For setting out of rainwater and foul water drain points refer to architects and M.E.P. drawings.
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11. All pipes are 1000 unless noted otherwise.
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BH4 - corresponding to the downstream side of the bund crest

Level	Notes
111.00	Ground level at bund crest
110.00	Maximum Water Level (spillway level and 1 in 100 year +40% storm level)
109.00	Existing Ground Level
108.00	Top soil
107.00	1000 U.N.O. level
106.00	1500 U.N.O. level
105.00	1000 U.N.O. level
104.00	1500 U.N.O. level
103.00	1000 U.N.O. level
102.00	1500 U.N.O. level
101.00	1000 U.N.O. level
100.00	1500 U.N.O. level
99.00	1000 U.N.O. level
98.00	1500 U.N.O. level
97.00	1000 U.N.O. level
96.00	1500 U.N.O. level
95.00	1000 U.N.O. level
94.00	1500 U.N.O. level
93.00	1000 U.N.O. level
92.00	1500 U.N.O. level
91.00	1000 U.N.O. level
90.00	1500 U.N.O. level
89.00	1000 U.N.O. level
88.00	1500 U.N.O. level
87.00	1000 U.N.O. level
86.00	1500 U.N.O. level
85.00	1000 U.N.O. level
84.00	1500 U.N.O. level
83.00	1000 U.N.O. level
82.00	1500 U.N.O. level
81.00	1000 U.N.O. level
80.00	1500 U.N.O. level
79.00	1000 U.N.O. level
78.00	1500 U.N.O. level
77.00	1000 U.N.O. level
76.00	1500 U.N.O. level
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74.00	1500 U.N.O. level
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70.00	1500 U.N.O. level
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47.00	1000 U.N.O. level
46.00	1500 U.N.O. level
45.00	1000 U.N.O. level
44.00	1500 U.N.O. level
43.00	1000 U.N.O. level
42.00	1500 U.N.O. level
41.00	1000 U.N.O. level
40.00	1500 U.N.O. level
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38.00	1500 U.N.O. level
37.00	1000 U.N.O. level
36.00	1500 U.N.O. level
35.00	1000 U.N.O. level
34.00	1500 U.N.O. level
33.00	1000 U.N.O. level
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6.00	1500 U.N.O. level
5.00	1000 U.N.O. level
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-92.00	1500 U.N.O. level
-93.00	1000 U.N.O. level
-94.00	1500 U.N.O. level
-95.00	1000 U.N.O. level
-96.00	1500 U.N.O. level
-97.00	1000 U.N.O. level
-98.00	1500 U.N.O. level
-99.00	1000 U.N.O. level
-100.00	1500 U.N.O. level

Section A-A: Earth Bund Cross-Section
(Scale 1:50)

Mallinson Sports Centre
Proposed Fives Courts

Section D-D: Earth Bund Footpath
(Scale 1:40)

-	06.03.24	DV	DV	Issued For Information
Rev.	Date	Drawn	Chk	Amendment

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Pringuer-James Consulting Engineers
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HIGHGATE SCHOOL

MALLINSON SPORTS CENTRE
LONDON

EARTH BUND AND SPILLWAY
SECTIONS (1/2)

Status :		INFORMATION	
Scales : As shown @ A1		Date : MAR 2024	
Drawn : DV	Engineer : DV	Checked : SPJ	
Drawing No.		L2384-PJC-XX-XX-DR-C-730 -	

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Rev.	Date	Drawn	Chk	Amendment

PJCE

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Overseas House, Elm Grove, London, SW19 4HE

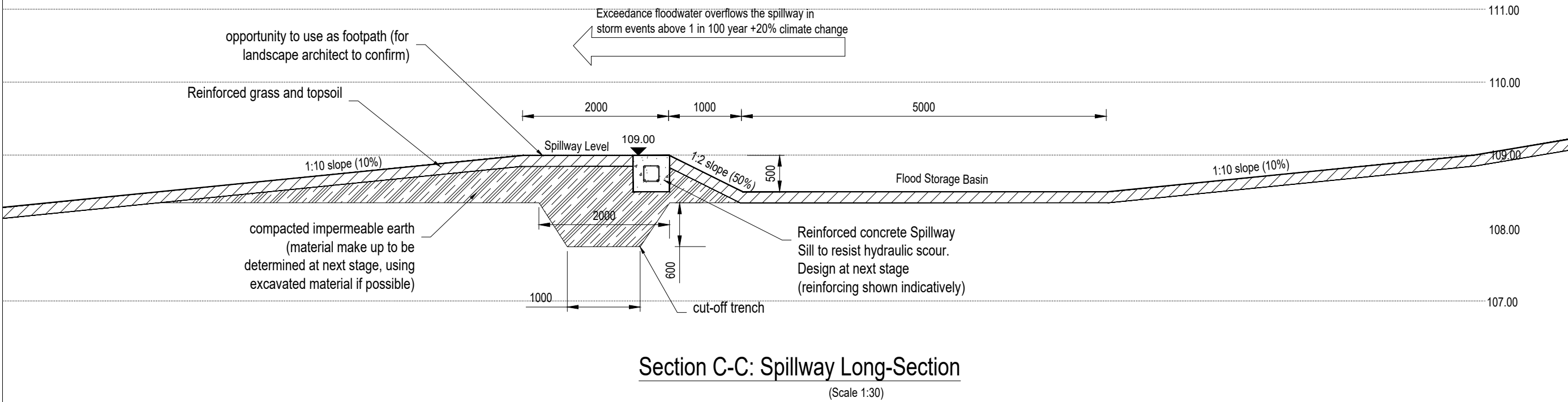
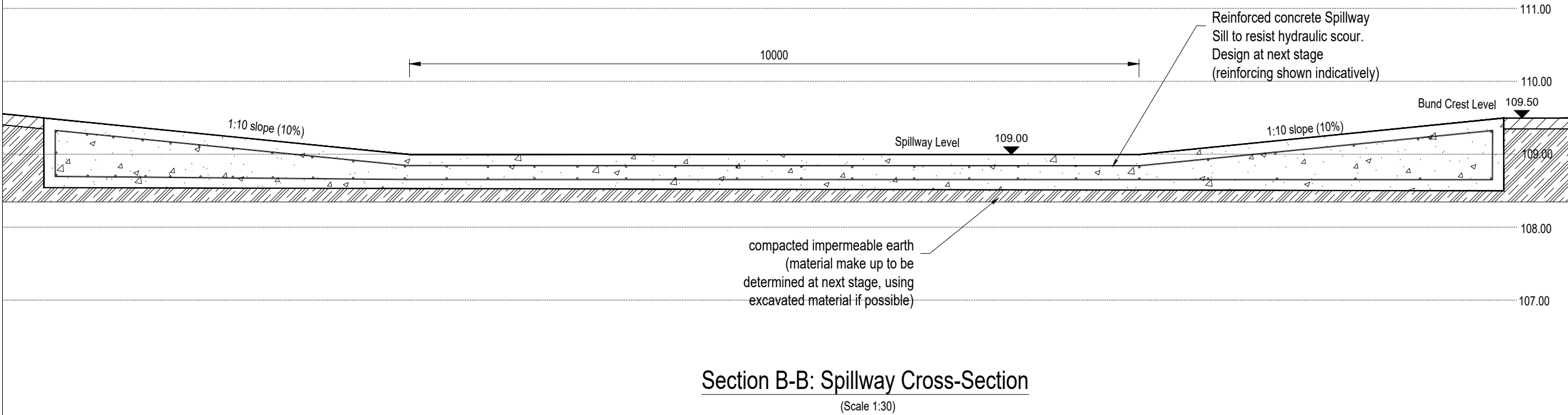
Phone:+44 (020) 8940 4159 Email:mail@pjce.com Website:www.pjce.com

HIGHGATE SCHOOL

MALLINSON SPORTS CENTRE
LONDON

EATRH BUND AND SPILLWAY
SECTIONS (2/2)

Status : INFORMATION			
Scales : As shown @ A1		Date : MAR 2024	
Drawn : DV	Engineer : DV	Checked : SPJ	
Drawing No.			-
L2384-PJC-XX-XX-DR-C-740			-



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Rev.	Date	Drawn	Chk	Amendment	

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HIGHGATE SCHOOL

MALLINSON SPORTS CENTRE
LONDON

GENERAL ARRANGEMENT OF
FLOOD STORAGE BASIN (1/2)

Status :		INFORMATION	
Scales : As shown @ A1		Date : MAR 2024	
Drawn : DV	Engineer : DV	Checked : SPJ	
Drawing No.		-	
L2834-PJC-XX-GR-DR-C-700			

LEGEND

Earthworks

Earth Bund outline

Earth Bund contours

High water line

falling ground elevation (R-L)

109.5

Elevation (mAOD)

Indicative earthworks contours

indicative earthworks outline

Impermeable core

Drainage

SW pipe

SW perforated pipe

SW sports pitch perforated pipe

SW circumventing perforated pipe

SW pipe with concrete collars

Spillway Sill

Filtration trench

Headwall

indicative circumventing drainage system (e.g. perforated pipe and filter material surround) as may be required to maintain existing ground water flowpaths around the Basin. Design at next stage including more detailed Geotechnical Survey and analysis

Pitch falls at 1:200 from north-side southwards to the outlet headwall structure. Pitch will remain dry except in rare extreme storm events (e.g. it will be full during the 1 in 100 +40% event). Pitch drainage to be designed at next stage.

Cutting shown indicatively in yellow (design by others). Spatially allowed for cutting slope of 1:3 as would be a stable slope.

Dam crest is 2m wide and level at 109.50mAOD (0.5m above spillway level)

up-side slope of dam at 1:3 gradient (see details drawing)

Pitch drainage: perforated pipe, filter surround, impermeable membrane

outlet pipe through dam to include collars to limit seepage along pipe

down-side slope of dam at 1:3 gradient (see details drawing). Landscaping could build upon this slope to flatten it and blend into the existing terrain better

toe drain. perforated pipe and filter surround

outlet headwall structure

riprap ditch lining to dissipate energy from spillway flood flow.

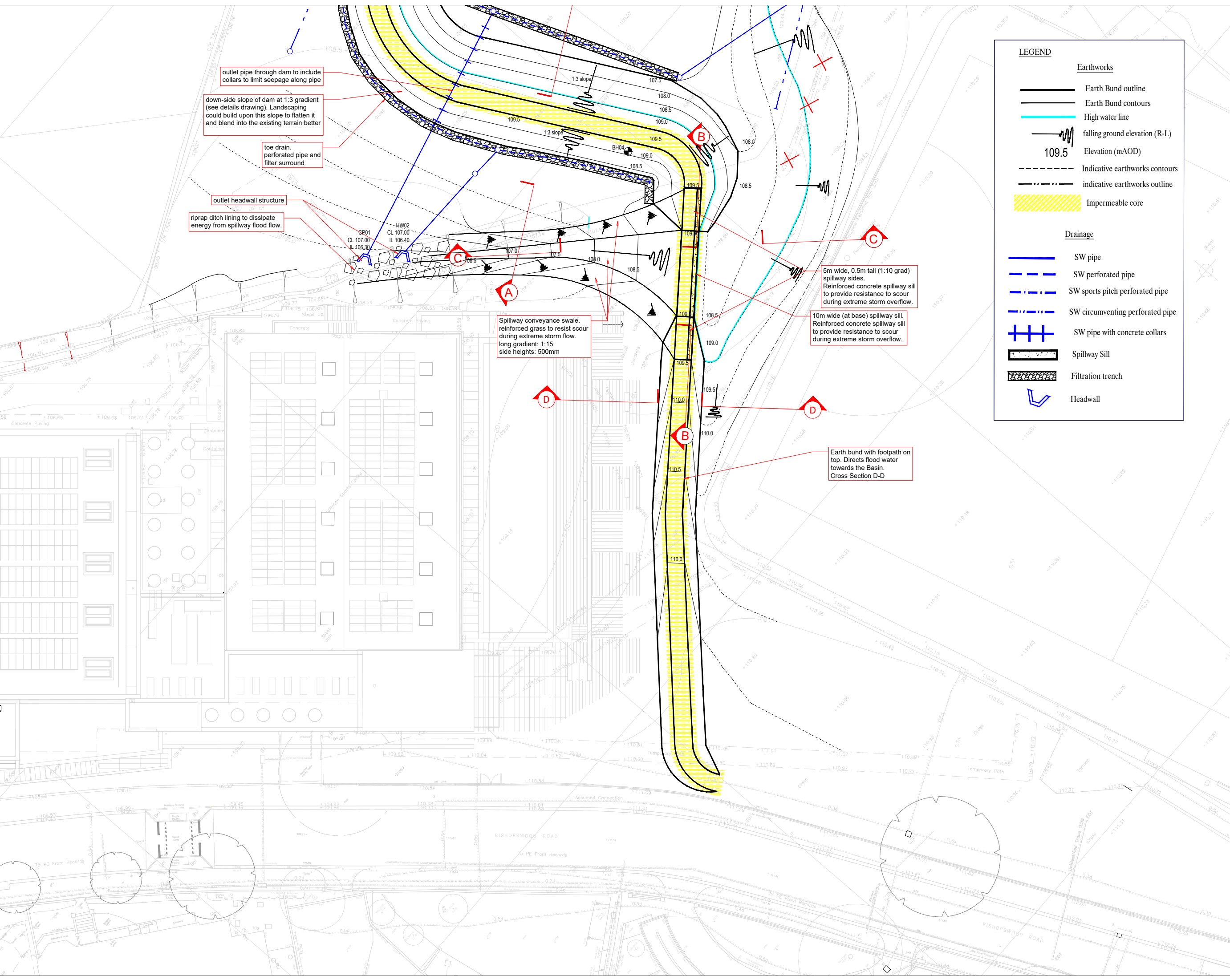
existing ditch retained until headwall diversion into Flood Retention Basin

5m wide, 0.5m tall (1:10 grad) spillway sides. Reinforced concrete spillway sill to provide resistance to scour during extreme storm overflow.

10m wide (at base) spillway sill. Reinforced concrete spillway sill to provide resistance to scour during extreme storm overflow.

Spillway conveyance swale. reinforced grass to resist scour during extreme storm flow. long gradient: 1:15 side heights: 500mm

Earth bund with footpath on top. Directs flood water towards the Basin. Cross Section D-D



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HIGHGATE SCHOOL

MALLINSON SPORTS CENTRE LONDON

GENERAL ARRANGEMENT OF FLOD STORAGE BASIN (2/2)

Status : INFORMATION		
Scales : As shown @ A1		Date : MAR 2024
Drawn : DV	Engineer : DV	Checked : SPJ
Drawing No. L2834-PJC-XX-GR-DR-C-710 -		



Appendix C: Site Investigation Reports & Groundwater Monitoring Data