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Project 201637.00
23 February 2021
R.001.Rev0
PH

Attention: Sarkis Elia

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Report on Geotechnical Assessment
Proposed Seniors Living, Multi-storey Development
5 Skyline Place, Frenchs Forest

1. Introduction

This report presents the results of a geotechnical assessment undertaken for a proposed multi-storey mixed-use development at 5 Skyline Place, Frenchs Forest.

It is understood that the development of the site by Platino Properties will be carried out over two stages, with Stage 1 including a 7-storey mixed-use development over a two-level basement car park and Stage 2 including a 12 storey mixed-use development over a two-level basement car park.

The aim of the assessment is to provide preliminary subsurface soil and groundwater conditions across the site, including:

- a review of published information;
- a preliminary geological site profile;
- preliminary comments on excavation conditions, excavation support, founding conditions, groundwater, constructions issues; and
- recommendations for further investigations.

The assessment comprised a site visit and a desktop study of available data including geotechnical investigation reports for nearby developments; together with preliminary comments on relevant geotechnical and contamination issues.

2. Site Description

The site is approximately rectangular in shape with street frontages to both Frenchs Forest Road East (to the north) and Skyline Place (to the east), with plan dimensions of about 105 m wide (parallel to Frenchs Forest Road East) by about 120 m. It is bounded by commercial buildings to the west and south. The site is split into Stage 1 to the north and Stage 2 to the south (see attached drawings).

Stage 1 comprises the northern third of the site with an approximate 45 m strip along Frenchs Forest Road East. Stage 2 comprises the southern two-thirds of the site.

Stage 1 is currently occupied by an open, on-grade, concrete pavement car park, with a three story commercial building and adjacent warehouse located along the western boundary. The ground surface gradually falls to the north, from about RL156.8 m in the south east corner to RL153.9 m in the north. The fall across the site is about 3 m over 150 m (i.e. about 1 degree). However, adjacent to Frenchs Forest Road East there is a sloped area, which at the steepest point falls towards the north from RL155.3 m to RL148.9 m over 15 m (i.e. at approximately 30 degrees).

Stage 2 is currently occupied by a two storey commercial development. The ground surface has been flattened across the site to around RL157.5 m, with the existing development excavated into the ground by up to 1.0 m in places. The site is generally located on the crest of the hill, with a slight fall to the north in the northern third of the site, to approximately RL156.8 m.

3. Geology

Reference to the Sydney 1:100 000 Geological Series Sheet suggests that the site is underlain by laminite within the Hawkesbury Sandstone of Triassic age. The laminite usually comprises finely interbedded shale, siltstone and sandstone deposits which, near surface, are prone to weather to sandy clays. Above and below this laminite layer the Hawkesbury Sandstone typically comprises medium to coarse grained sandstone with some minor shale and laminite lenses.

4. Geotechnical Model

Douglas Partners has carried out a number of investigations in the commercial area on the northern side of Warringah Road. Some of these investigations include:

- A previous investigation at 5 Skyline Place;
- 49 Frenchs Forest Rd East; and
- 35 Frenchs Forest Rd East.

A geotechnical investigation report for Stage 1 of 5 Skyline Place by Benviron Group (Report No. G378-1 Rev0, dated October 2019) was also supplied to DP.

Based on the site observations and boreholes drilled both on the site and in nearby locations, a typical subsurface profile for the site is expected to comprise:

- Surface pavement: possibly to the order of 100 mm thick;
- Filling: clayey sand/sandy clay with some gravel possibly between 0.6 m and 1.8 m depth, with localised areas in the northern end of the site of up to 4.0 m depth;

- Residual clay and silty/sandy clay: stiff to very stiff to approximately 1 m to 2.5 m depth;
- Sandstone/Laminite: extremely low to low strength, extremely weathered to highly weathered rock to depths of about 3.0 m to 10.0 m below the ground surface, below which the rock strength is expected to increase to medium and high strength sandstone/laminite.

Bores drilled in the area did not encounter groundwater within the soil. A local groundwater bore established the groundwater level at a depth of 8.3 m. Therefore, groundwater is expected to be relatively deep within the rock mass, with a possible ephemeral water table perched at the soil/rock interface following periods of rain.

5. Proposed Development

The provided preliminary design drawings for the proposed development show that the Stage 1 development will include one seven-storey building with commercial spaces on the Ground Floor and residential living spaces on the Ground Floor to Level 6. A two-level basement carpark is shown occupying the footprint of the building with the basement floor level proposed to be at RL150.2 m.

The Stage 2 development will include three buildings, west building, community building and east building up to twelve-storeys in height with a common two level basement. The basement floor level is also proposed to be at about RL150.2 m

Given the difference in level across the site, it is expected that the excavation depth will be 4 m to 8 m deep.

6. Comments

6.1 Groundwater

Based on groundwater levels obtained in the area, the permanent groundwater table is expected to be below the proposed basement finished level of RL150.3 m. Groundwater seepage could be expected at the interface between the residual clay and rock, and from the rock defects, particularly following periods of wet weather.

It is expected that seepage into the excavation will be readily controlled by perimeter drains connected to a sump and a pump system which can periodically pump the collected water off-site, subject to meeting the relevant criteria for groundwater control and disposal.

Groundwater seepage through the laminite/sandstone often has high iron content and as such may lead to the formation of a gelatinous iron oxide sludge that could block drains and seize pumps. Thus, periodic maintenance and cleaning of drains and pumps can be expected.

6.2 Site Works and Excavation Conditions

It is expected that site preparation will include the removal of the existing pavement surfaces, kerbs and gutters. Excavation for the proposed two-level basements will be approximately 4 m to 8 m deep, allowing for the ground surface slope, and would be mainly in filling, residual clay and low strength rock. In areas of deeper excavation, some medium strength rock is likely to be encountered.

Excavation of the soil and very low strength rock should be achievable using conventional earthmoving equipment such as tracked excavators. Excavation of low and medium strength rock, such as in the deeper level of the basement, will generally require moderate ripping and rock hammering.

Trafficability on the clay and weathered rock during bulk earthworks will generally require the use of tracked plant and machinery. Trafficability after bulk excavation could be improved by placement of a layer of compacted crushed concrete or similar, which may subsequently be used as sub-base for the basement floor slab.

During bulk excavation, and if space permits, temporary batter slopes of 1.5H:1V (Horizontal : Vertical) could be left in the filling and 1H:1V in the very low to low strength rock. If space does not permit, shoring would be required to support basement excavations.

All excavated materials will need to be disposed of in accordance with the provisions of current legislation and guidelines including the *Waste Classification Guidelines* (EPA, 2014).

Investigation should be undertaken to determine the founding conditions of the neighbouring buildings on the western and southern boundaries, and whether they need to be supported prior to bulk excavation.

6.3 Slope Stability

Adjacent to Frenchs Forest Road East there is a sloped area, which at the steepest point falls towards the north from RL155.3 m to RL148.9 m over 15 m (i.e. at approximately 30 degrees). At the time of the inspection, no groundwater seepage was observed seeping from the steeper slope along the northern boundary of the site. This area is likely to be stable with a low probability of failure. This area, according to the preliminary design drawings, will be excavated and regraded to a shallower slope, further reducing the likelihood of instability.

6.4 Vibration

During excavation, it will be necessary to use appropriate methods and equipment to keep ground vibration at adjacent buildings and structures within acceptable limits. The level of acceptable vibration is dependent on various factors including the type of building structure (e.g. reinforced concrete, brick, etc.), its structural condition, founding conditions, the frequency range of vibrations produced by the construction equipment, the natural frequency of the building and the vibration transmitting medium.

Ground vibration can be strongly perceptible to humans at levels above 2 mm/s peak particle velocity (PPV). This is much lower than the vibration levels required to cause structural damage to most buildings. The Standard AS/ISO 2631.2 – 2014 "Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Vibration in buildings (1 Hz to 80 Hz)" suggests an acceptable daytime limit of 8 mm/s PPVi for human comfort.

Based on DP's experience of and with reference to AS/ISO 2631.2, it is suggested that a maximum PPVi of 8 mm/s (measured at the first occupied level of existing buildings) be employed at this site for both architectural and human comfort considerations, although this vibration limit may need to be reduced if there are sensitive buildings or equipment in the area.

As the magnitude of vibration transmission is site specific, it is recommended that a vibration trial be carried out at the commencement of rock excavation. These trials may indicate that smaller or different types of excavation equipment are required to reduce vibration to acceptable levels.

6.5 Retaining Walls for Basements

Vertical excavations within the filling, clay and very low to low strength rock will require retention both during construction and as part of the final structure. An anchored shoring wall with one or two rows of anchors could be constructed utilising a system of anchored soldier piles, at 2 – 3 m spacings, drilled along the excavation line to below excavation level, with structural panels between the soldiers being progressively shotcreted during excavation in lifts of approximately 2 m. Along sections of the eastern and western boundaries, it is expected that full support will be required in the temporary case to support the adjacent buildings. This could comprise a contiguous soldier piled wall.

For a multi-propped wall (i.e. at least one row of anchors and an embedded wall toe), the magnitude of lateral earth pressure acting on perimeter shoring walls may be approximated as a uniform rectangular pressure of 6H (kPa), where H is the height of the retained material (of less than medium strength) in metres.

Additional pressures should be allowed for, where surcharging occurs either from loadings from traffic and/or other loadings associated with the use of the adjoining properties, or arising from construction plant. Unless positive drainage measures can be incorporated to prevent water pressure build-up behind the wall, the full hydrostatic head should be allowed for in design, allowing for the soil unit weight to reduce to buoyant conditions.

To estimate the passive resistance of the piles, it is suggested that an ultimate passive pressure of 2000 kPa be adopted for low strength rock over any "toe in" length developed at the base of the piles, from about 1 m below the base level of the excavation, or below any service trench or other excavation adjacent to the wall, whichever is deeper.

Detailed geological mapping should be carried out progressively (every 1.5 m depth) during bulk excavation, by an experienced geotechnical practitioner, to check for the presence of major, continuous,

adverse jointing. If present, additional anchoring may be required dependent on the size and properties of the rock wedge.

6.6 Anchor Design

Anchoring of soldier piles can be accomplished by pre-stressed type anchors. It is suggested that these be inclined as steeply as possible, but not exceeding 30°, to allow anchoring in the stronger rock. For estimating purposes it is suggested that ultimate bond stresses of 150 kPa be adopted in low strength laminite/sandstone, 350 kPa for low to medium strength laminite/sandstone and 600 kPa for medium strength or better laminite/sandstone.

Most anchoring contracts are “performance contracts” in which the anchoring contractor designs and constructs the anchors to carry the design loads. Therefore, it is the contractor’s responsibility to ensure that the correct design values, specific to the anchor system, rock type and strength and method of installation are used and that each anchor is properly constructed and tested. After anchors have been installed, it is recommended that they be tested to 125% of nominal working load and then locked off at between 60% and 80% of their working loads. Checks should be carried out, however, to ensure that the load is maintained in the anchors throughout the construction period and is not lost due to creep effects or to other causes.

Permission is required from adjacent land owners if anchors are to go under their site.

It is anticipated that the building floors will support any shoring walls over the long term and therefore anchors are expected to be only temporary.

6.7 Foundations

Assuming a basement level at approximately RL150.3 m for both Stages, it is expected that low strength laminite/sandstone, with some medium strength laminite/sandstone in the deeper areas of the excavation, will be exposed after bulk excavation works have been completed.

Shallow footings founded on rock should be considered for this site. A typical allowable bearing pressure would be 1,500 kPa for low strength laminite/sandstone, which is expected at a depth of between about 3.0 m to 10.0 m below current surface levels. It would be possible to increase the allowable bearing pressure to 3,500 kPa, where medium strength rock is exposed in deeper areas of the excavation, but detailed assessment would be required to differentiate the rock strengths across the site.

Alternatively, piles could be designed to transfer the loads to higher strength rocks. Typical allowable (i.e. serviceability) bearing pressures would be of the order of 3,500 kPa with an allowable shaft adhesion of 350 kPa in medium strength laminite/sandstone.

All footings should be inspected by a geotechnical engineer/engineering geologist to confirm that the required bearing capacities have been achieved.

Local underpinning of foundations of adjacent buildings may be required, depending on the founding level of the building foundations, lateral support provided and rock conditions. This should be determined prior to basement excavation, and carried out on a design and construct basis.

6.8 Ground Slabs

The floor at basement level can be designed as a slab on ground. It may be necessary to over-excavate the rock in the basement floor to provide a trafficable working surface, utilising a suitable imported material such as crushed sandstone or recycled concrete. In either case, the subgrade surface should be compacted to a minimum 98% standard maximum density prior to the casting of the slabs. If this material is to be left in place beneath the slab, it will need to also be free-draining and durable, to act as under-floor drainage.

Where the floor is excavated within rock it is suggested that slab design be based on a CBR for the subgrade material not exceeding 10%.

It will be necessary to provide under-floor drainage to safeguard against uplift pressures if the basement floor and walls are designed for drained conditions. This could comprise a minimum 100 mm thick durable open graded crushed rock with subsurface drains and sumps.

6.9 Seismic Design

The site sub-soil class for seismic design, as given in AS 1170.4-2007, is Class Ce – Shallow Soil, on the basis that there is soil against the basement walls and the depth to rock is relatively shallow. If the building base and structure are founded on rock, and isolated from the surrounding soil and rock (within the meaning shown in Figure 1.5C (b) in AS 1170.4-2007), then the site sub-soil class would be Class B_e – Rock.

A Hazard Factor (*Z*) of 0.08 would be appropriate for the development site in accordance with Australian Standard AS 1170.4 – 2007 *Structural design actions – Part 4: Earthquake actions in Australia*.

7. Limitations

Douglas Partners (DP) has prepared this report for this project at 5 Skyline Place, Frenches Forest in accordance with DP's email proposal dated 16 February 2021 and acceptance received from Sarkis Elia dated the same day. The work was carried out under DP's Conditions of Engagement). This report is provided for the exclusive use of Platino Properties Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or be relied upon for another project or purpose on the

same or another site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Please contact the undersigned if you have any questions on this matter.

Yours faithfully
Douglas Partners Pty Ltd

Reviewed by

Peter Hunt
Associate

John Braybrooke
Principal

Attachments: About this Report
Site Drawings

About this Report

November 2020

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

continued next page

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

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FRENCHS FOREST ROAD EAST

BUS STOP

Printed 10-02-2021

N

EASEMENT (SHOWN HATCHED) TO BENEFIT LOT 1

No 79
FRENCHS
FOREST RD

LOT AREA
4,760 m²

GROUND FLOOR

Stage 1

COUNCIL APPROVED DA2018/0995 (LOT 2)

1,250 m²

NEW PARKING SPACES

ACCESS RAMP DOWN TO CARPARK

NEW VEHICULAR CROSSING

DRIVEWAY UNDER

LANDSCAPING BUFFER

DROP OFF BAY

EXISTING 3-STOREY
BRICK BUILDING AT
No.1 SKYLINE PLACE

SKYLINE PLACE

LANDSCAPED
CENTRAL OPEN SPACE

Stage 2

WEST BUILDING

EAST BUILDING

COMMUNITY
BUILDING

AFFORDABLE

PROJECT
INDEPENDENCE

PROJECT INDEPENDENCE
572 m²

Outdoor Area
93 m²

ENTRY 1
27 m²

EXIT 3

EXIT 2

POND

WOMEN'S YARD

MEN'S YARD

GARBAGE
HOLDING BAY

LOADING BAY

CARPARK EXIT

NEW VEHICULAR
CROSSING

2 DROP-OFF BAYS

+157.49

+157.50

+157.05

+156.15

TRANSMISSION
TOWER

GROUND FLOOR

SITE PLAN - LOT1

1:500

A	ORIGINAL ISSUE 15.01.21
ISSUE	REVISIONS DATE

PROJECT:

MIXED USE AND SENIORS LIVING DEVELOPMENT
5 Skyline Place Frenchs Forest NSW 2086
SP 49558

SITE PLAN

PA STUDIO
LEVEL 2, 20 YOUNG ST. NEUTRAL BAY, NSW 2089
TEL: 8968 1900 FAX: 8968 1999 ACN: 603 389 288

SCALE:	AS SHOWN	DRAWING	DA101
SUBSET:	SITE PLAN		
DRAWN BY:	SU/WH/SP	ISSUE	A

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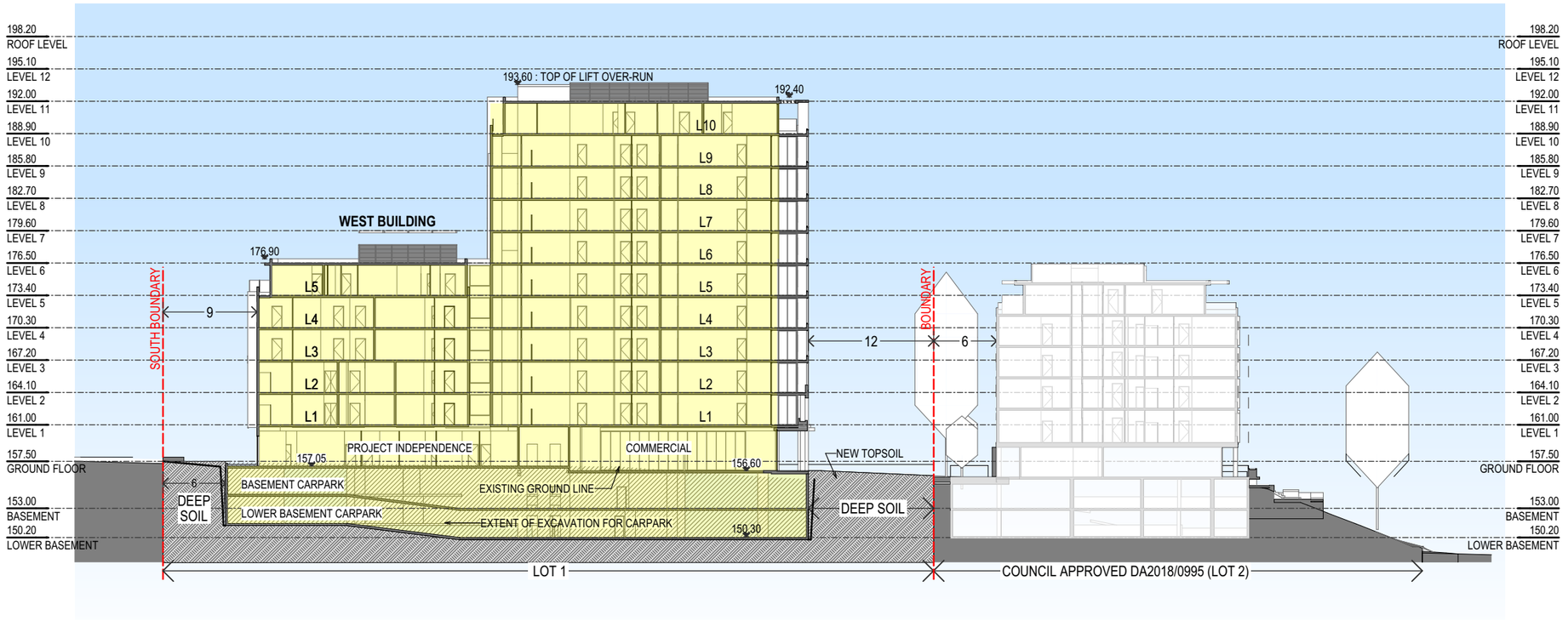
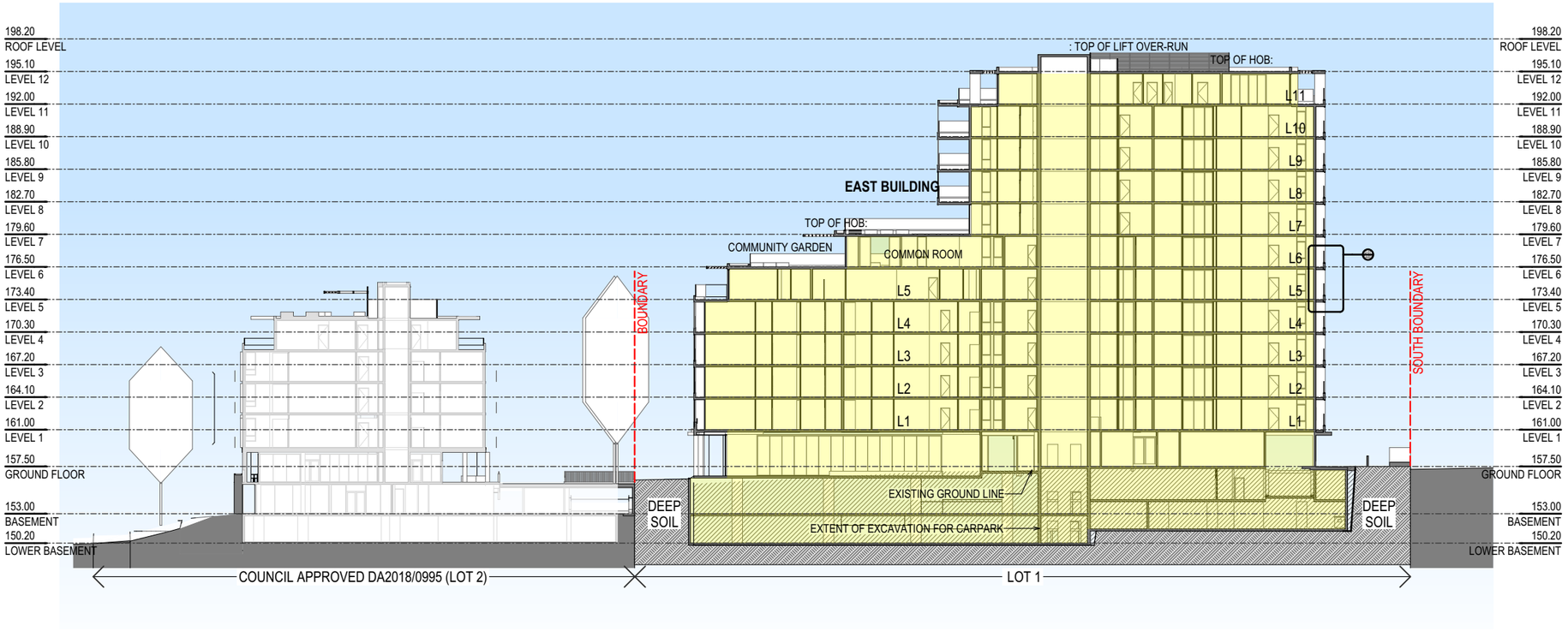


SECTION S1: LOOKING WEST

1:500



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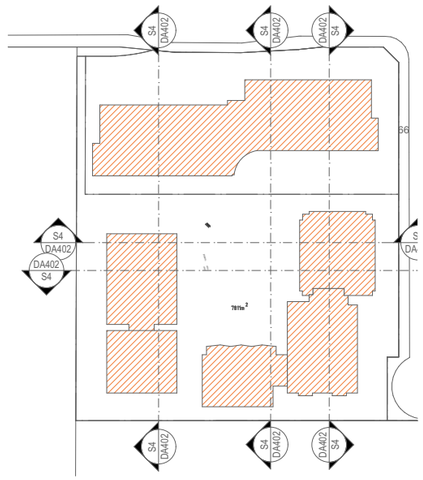

KEY PLAN

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ISSUE	REVISIONS	DATE
A	ORIGINAL ISSUE	15.01.21

PROJECT:

MIXED USE AND SENIORS LIVING DEVELOPMENT
5 Skyline Place Frenchs Forest NSW 2086
SP 49558

SECTIONS S1 & S2

PA STUDIO
LEVEL 2, 20 YOUNG ST, NEUTRAL BAY, NSW 2089
TEL: 8968 1900 FAX: 8968 1999 ACN: 603 389 288

SCALE:	AS SHOWN	DRAWING	DA301
SUBSET:	SECTIONS		
DRAWN BY:	SU/WH/SP	ISSUE	A

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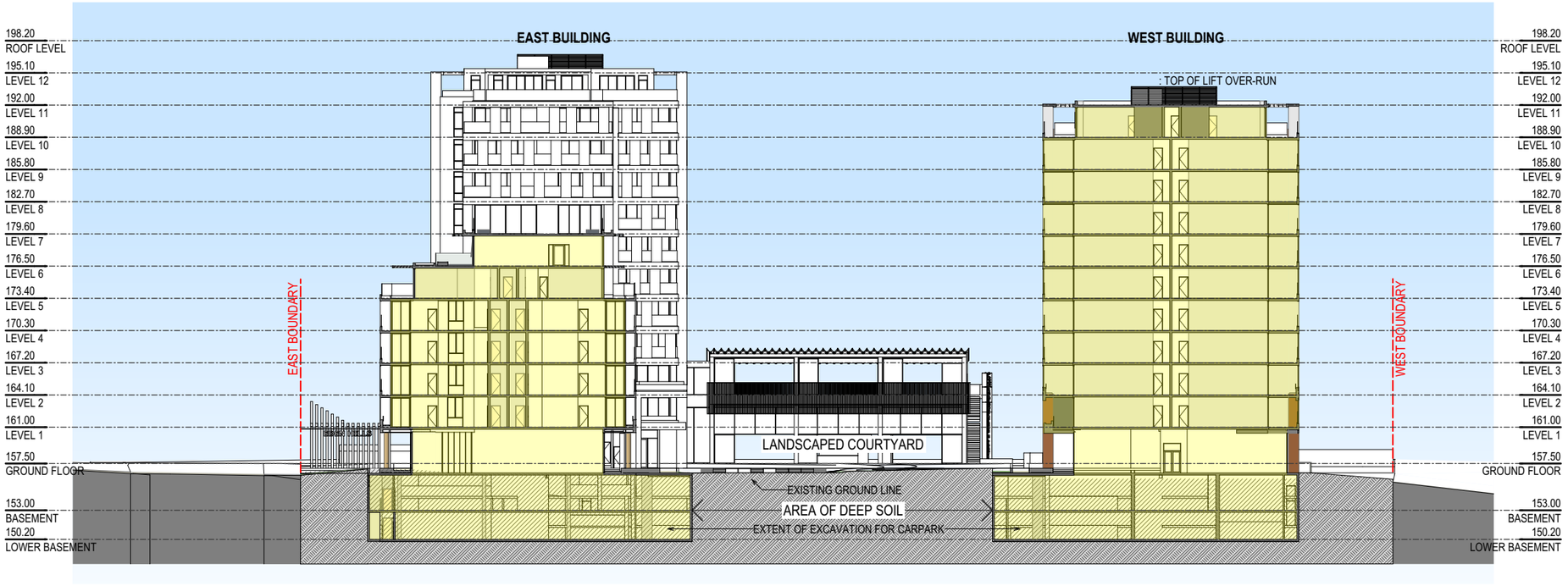

SECTION S3: LOOKING SOUTH

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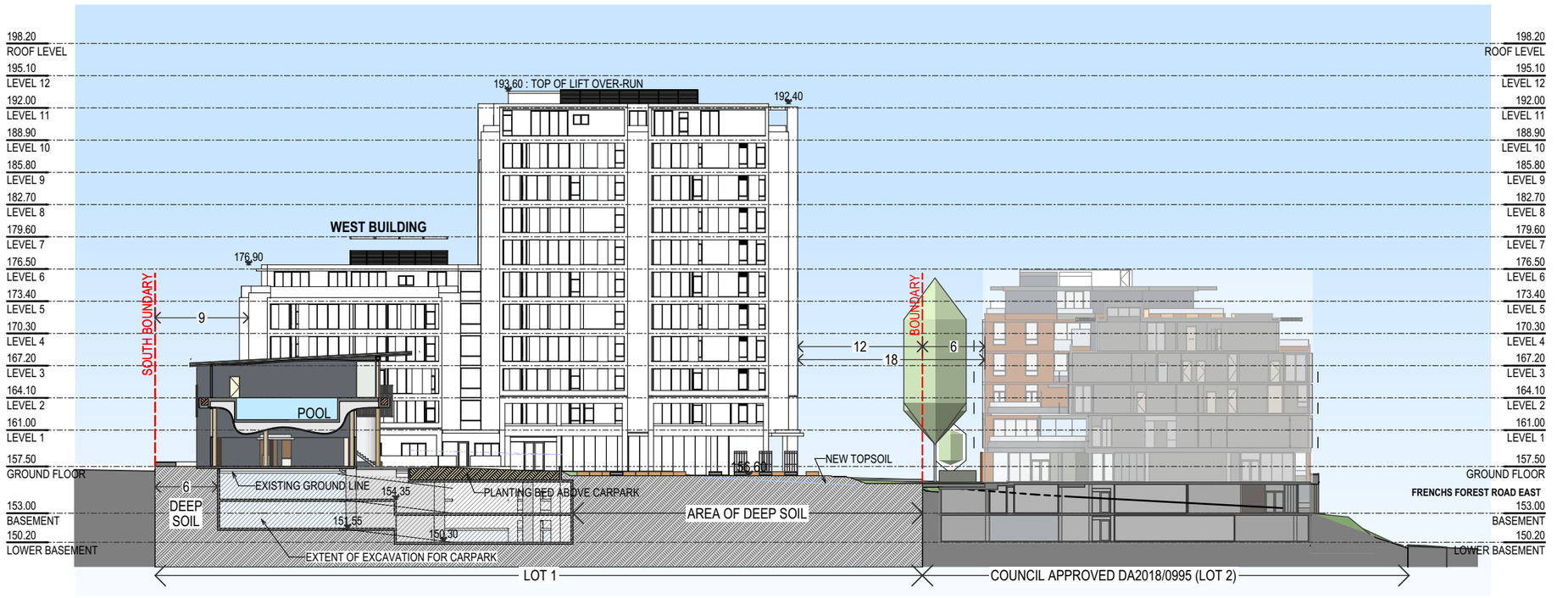

SECTION S4: LOOKING WEST

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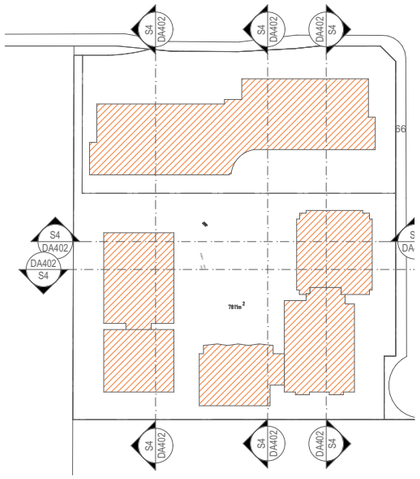
Printed 10-02-2021



KEY PLAN

ISSUE	REVISIONS	DATE
A	ORIGINAL ISSUE	15.01.21

PROJECT:

MIXED USE AND SENIORS LIVING DEVELOPMENT
5 Skyline Place Frenchs Forest NSW 2086
SP 49558

SECTIONS S3 & S4

PA STUDIO
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SUBSET:	SECTIONS	
DRAWN BY:	SU/WH/SP	ISSUE A

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