ACOR CONSULTANTS

1% AEP FLOOD IMPACT STUDY

Client: Erilyan Pty Ltd

Property: Northside West Clinic
23-27 Lytton Street, Wentworthville

Date: 28 October 2021

Document Identification

Our Reference: **NSW210629**

For and on behalf of ACOR Consultants Pty Ltd

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Annexure C	ACOR Flood Plans, Reference NSW210629, Sheets F1 to F20, Revision 1, dated 21st October 2021.

1.0 Introduction

ACOR Consultants Pty Ltd (ACOR) has been commissioned to prepare a Flood Study in accordance with the requirements of the Holroyd Development Control Plan 2013 and Holroyd Local Environmental Plan 2000. The Flood Study investigates flood behaviour throughout the overland flooding catchment impacting the subject site. This includes the analysis of:

- Surface runoff across the catchment;
- Flooding towards the lower part of the catchment; and
- Impact of flooding on the proposed development and vice versa.

A two-dimensional computer model of the catchment was established to analyse overland flood behaviour under existing and proposed catchment conditions. The model provides information on the extent of flood inundation, flood depths and flood velocities throughout the catchment for the 1% AEP overland flood event.

1.1 Objective

The objective of the study is to define local overland flooding in accordance with the Floodplain Development Manual (NSW DIPNR 2005) and Part B Section 8 Part C4 Stormwater of the Holroyd Development Control Plan 2013. It involved the following steps:

- Attend the site to assess the anticipated extent and nature of flooding and identify hydraulic controls likely to impact on flooding behaviour.
- Develop a hydraulic model to determine 1% AEP flood levels, velocities and provisional hazard categories.
- Review the hydraulic model to ascertain flood impacts on the proposed development at 23-27 Lytton Street, Wentworthville, and neighbouring properties; and
- Provide recommendations to ensure that flood waters do not adversely impact the proposed car park extension & building development on 23-27 Lytton Street, Wentworthville, and neighbouring properties. This will be achieved with the inclusion of increased threshold levels provided by the proposed driveway and the design of flood management and diversion infrastructure.

1.2 Site Description

The subject site abuts the Finlayson Creek stormwater drainage reserve at the rear of the property with the frontage to Lytton Street and is known as Lot 1 in DP 787784.

The subject site consists of building infrastructure and existing undercover carparks facilitating Northwest Clinic operations. The proposed development consists demolition of existing wards along the western side of the building to provide multi-level carparks and hospital wards on upper levels and conversion of existing open carpark along the southern end of the site into an undercover parking space and some landscaping space with hospital wards on the floor above.

The subject site slopes from Lytton Street at the East to the Finlayson Creek reserve at the West with an average slope of 5%. The site is also traversed by 600mm diameter stormwater drainage pipe along the open carpark at the South. There is an existing 1.22m wide drainage easement burdened on the lot and established over the drainage pipe. The development also proposes to divert the pipe with similar sized reinforced concrete pipe along the Southern boundary of the site.

1.3 Flood Characteristics

The subject site is impacted by overland flows draining towards the Finlayson Creek drainage reserve at the rear of the property. The catchment upstream of the site is dominated by residential land use. Elevations within the upstream catchment are generally within the range 47 m AHD to 22 m AHD.

The site is impacted by flooding during the 1% AEP flood event, with 1% AEP floodwater levels within the range of 22.50 m AHD to 19 m AHD, resulting in partial inundation of the site. Inundation depths vary within overland areas, with flood depths generally less than 0.30 m.

The 1% AEP overland floodwaters generally pose Low Hazard to occupants, vehicles and building structure of the surrounding areas.

Analysis of the broader Finlayson Creek catchment producing the mainstream flooding event at the rear of the site is beyond the scope of this study.

2.0 Available Data

ACOR have been tasked to undertake this flood study and have used topographic, flooding and rainfall data obtained from several sources. The origin and types of information underpinning the assumptions used in this study are presented below.

2.1 Published Flood Data

Council has adopted Holroyd City LGA overland flood study prepared by Lyall and Associates which incorporates the Finlayson Creek flooding component. The flood study report has been referenced on several occasion during this study for maintaining consistency with Council flood data.

2.2 Survey Data

Survey information adopted for this study has been collated from the following sources:

- LTS Lockley Survey Plan, Reference 40317 002DT, Revision D, dated 12th October 2021
- LIDAR data obtained from the Department of NSW Governments' cloud-based platform Elvis;
- GIS layers of cadastre and satellite imagery provided by the NSW LPI.

2.3 Design Storm Event Data

This study uses design rainfall intensity-frequency-duration (IFD) data, derived for the latitude and longitude at the development site. This IFD data was issued by the Hydrometeorological Advisory Service of the Australian Bureau of Meteorology. The IFD data provides average rainfall intensities of design storm events for recurrence intervals up to and including the 1% AEP storm event.

Uniform areal distribution of design storms has been assumed for the catchment due to its small area. Rainfall depths and temporal patterns were developed for the 1% AEP design storm events using the Australian Rainfall and Runoff 2016 (ARR2016).

Estimated average design storm rainfall intensities for the full range of 1% AEP storm events considered are presented in Table 1.

Table 1: Average design rainfall intensities.

Duration	Intensity (mm/hr)	Duration	Intensity (mm/hr)
5 min	279	2 hour	52.0
10 min	224	3 hour	40.5
20 min	160	6 hour	27.3
30 min	127	12 hour	19.1
1 hour	81.4		

3.0 Hydrologic Modelling

Hydrologic modelling was undertaken within TUFLOW using the Direct Rainfall ('rainfall on the grid') methodology. In the hydraulic model, rainfall is applied directly to the 2D terrain, and the hydraulic model automatically routes the flow as determined by the elevation and roughness grids and any included 1D pipeline network.

Direct rainfall modelling is a relatively new feature of hydraulic modelling, and it is still being tested on several catchments to ensure it is reliably representing the flood behaviour of a given catchment. Runoff is generated over the entire catchment, rather than the more traditional approach of calculating an inflow hydrograph and lumping this in at an assumed location(s). This 'direct rainfall' approach means the whole catchment will be 'wet' and the hydraulic modelling results need to be filtered to show only those cells that genuinely represent areas of catchment flooding. This was achieved by only mapping inundation at cells with a flood depth greater than 0.05 metres.

Hydrological assessment was carried out using ARR 2016 methodology generating 10 ensemble patterns of rainfall for every duration during 1% AEP storm event. Each of the 10 ensemble rainfall depths were applied to the entire 2D grids separately to obtain the individual flow hydrographs and the hydrographs were compared to obtain the median hydrograph. The rainfall burst that resulted in the median flow hydrograph was selected as the design storm for further use in hydraulic modelling for 1% AEP event.

The design storm events applied to the catchment during the direct rainfall simulation are the design storm events described in Section 2.3. Direct rainfall was applied to the area indicated as 'Catchment' in Figure C1 (refer NSW210629/F1/1, copy enclosed under Annexure C).

4.0 Hydraulic Modelling

A TUFLOW 1D/2D model was used to hydraulically route flows through the catchment and to derive flow depths, velocities and hazards for the pre-development and post-development scenarios. This section describes the hydraulic modelling approach and hydraulic model development.

4.1 Choice of Hydraulic Model

Different hydraulic modelling approaches can be applied according to the floodplain's hydraulic characteristics and the objectives of the study. The simpler methods lump the left and right overbank floodplain areas and the main channel into a one-dimensional (1D) representation. This approach is relatively simple and computationally fast and is generally appropriate for modelling flows through pipe networks and straight sections of formed open channels. The main limitation of such 1D modelling approaches is that flow is assumed to occur in a linear direction, and the water levels across the floodplain are assumed to be at the same level as the main channel.
A more detailed two-dimensional (2D) approach is recommended in areas where significant differences can occur between the channel flood level and the floodplain flood levels. This approach is also preferable where separate flow paths and flow around catchment obstructions occur, as is the case in this study. This is a more complex analysis, which requires greater data requirements and computational resources.

The TUFLOW 1D/2D model was chosen to model the catchment hydraulics. This modelling system dynamically couples the one-dimensional and two-dimensional flow paths in the floodplain.

4.2 TUFLOW 1D Model Domain

The existing pit and pipe drainage network within the immediate vicinity of the site have been incorporated into the TUFLOW model with 25% blockage applied during the 1% AEP flood event. As the study focuses on the development within 23-27 Lytton Street, Wentworthville, the drainage network outside the immediate vicinity has not been modelled within TUFLOW. During the post-development scenario, a proposed pipe diversion was incorporated into the model.

4.3 TUFLOW 2D Model Domain

The 2D hydraulic model domain covers the area indicated as 'Catchment' in Figure 1 (refer NSW210629/F1/1, copy enclosed under Annexure C). A 2-metre square grid was utilised for this study. Each grid element contains information on ground topography (see Section 4.3.1), surface resistance to flow (see Section 4.3.4) and initial water level.

The grid cell size of 2 metre is sufficiently fine to appropriately represent the variations in floodplain topography and land use within the study area. It should be noted that TUFLOW samples elevation points at the cell centres, mid-sides and corners, as a consequence a 2-metre square cell size results in surface elevations being sampled every 1 m.

Linear features that potentially influence flow behaviour, such as gullies and levees were incorporated into the topography using 3D 'break lines' to ensure that these were accurately represented in the model. It is noted that fences have not been explicitly incorporated into the model in urban areas unless deemed critical to the study and were instead considered in the setting of appropriate Manning's 'n' values for these areas.

4.3.1 Topography

A 2 m grid Digital Elevation Model (DEM) was generated for the catchment using LIDAR and the survey data. This DEM was used to represent ground elevations throughout the catchment.

Land use categories were assigned to areas of the catchment based on examination of aerial photography and satellite imagery. These land use categories were used to assign roughness and infiltration parameters during modelling. Further detail on the modelling of infiltration and catchments roughness is contained in Section 4.3.3 and Section 4.3.4 respectively.

4.3.2 Building Footprint

The footprints of buildings surrounding critical flow paths are modelled as blocked elements within the 2D domain. Building outlines were determined from aerial photographs and site survey, and the building footprint was removed from the 2D active domain.

In general, buildings far away from the subject site or far from critical flow paths were modelled as full obstructions.

4.3.3 Infiltration

Infiltration losses were modelled using an Initial Loss/Continuing Loss (IL/CL) infiltration model. Initial losses and continuing loss rates were defined for each land use category. The adopted loss parameters are presented in Table 2 in Section 4.3.4, alongside the roughness parameters, for each land use category.

4.3.4 Roughness

The hydraulic roughness of a material is an estimate of the resistance to flow and energy loss due to friction between a surface and the flowing water. A higher hydraulic roughness indicates more flow resistance; for example, a concrete path has a lower hydraulic roughness than a rough vegetated channel as water flows more freely over concrete than through a vegetated channel. Roughness in TUFLOW is modelled using the Manning's 'n' roughness co-efficient. Table 2 lists the adopted Manning's roughness for each land use.

Table 2: Adopted roughness and infiltration parameters.

Land use category	Initial loss (mm)	Continuing loss (mm/hr)	Manning's n
Built up areas	1	3	0.040
Road	0	0	0.022
Buildings	0	0	3
Paved Areas	0	0	0.025
Ponds & water features	1	5	0.03

4.4 Boundary Conditions

This section describes the boundary conditions imposed upon the model. Typical model boundary conditions include flows entering the model domain from upstream, backwater effects from hydraulic controls such as chokes and streams downstream, and the flow predicted through the model domain by a separate hydrologic model.

4.4.1 Direct Rainfall

A direct rainfall boundary condition was applied to the area indicated as 'Catchment' in Figure C1 (refer NSW210629/F1/1, copy enclosed under Annexure C). The direct rainfall method is described in Section 3.

4.4.2 Upstream Boundary

The use of direct rainfall and selected 2D model domain means hydrologic and hydraulic modelling commenced at the top of the catchment. As such, no upstream boundary conditions were applied. Upstream flows are included via the direct rainfall method instead.

4.4.3 Downstream Boundary

A stage-discharge (water level vs. flow) hydrograph was used as the downstream boundary condition of the TUFLOW model. The stage-discharge relationship is generated by TUFLOW by specifying a downstream boundary slope.

5.0 Flood Model Results

This section summarises the results of the hydrologic and hydraulic modelling of overland flows within the catchment. PO lines have been used in modelling to extract the overland flood discharge and velocity around the vicinity of the subject site. Location of the PO lines are shown in flood map results in Appendix C. The 1% AEP flood event critical duration and peak flowrate through the catchment are presented. The behaviour of the 1% AEP floodwaters within the vicinity of the subject site are described in general terms, and the impact of flooding on the subject site is discussed.

5.1 Flood Model Validation

Attempts have been made to maintain consistency with Council's overland flood study. Flood levels issued by Council for the subject site was utilised to validate the flood model.

5.2 Critical Duration

The design storm from Table 1 which produced the median peak discharge through the site was selected as the critical duration storm event as per ARR 2016 methodology. The critical duration for the 1% AEP storm event was found to be 20 minutes.

5.3 Design Peak Flood Flow

The 1% AEP peak flowrate passing through the site area and its vicinity are tabulated below:

Table 3: 1% AEP Peak Flowrates at PO lines

PO Line Name/Location	Peak Flowrate (m^3/s)	
	Pre-development	Post development
PO_1 (subject site)	0.21	0.21
PO_3 (11 Lytton & subject site)	0.27	0.27
PO_2 (35-37 Lytton)	2.60	2.60

5.4 Design Flood Characteristics

The flood velocity, flood depth, and provisional flood hazard of the 1% AEP flood event are mapped for the existing and proposed site conditions. The following flood maps are enclosed under Annexure C:

- Sheet C1. Catchment Map and Model Boundary Condition;
- Sheet C2.1. 1% AEP flood depth and level map – Pre Development;
- Sheet C2.2. 1% AEP flood velocity map – Pre Development;
- Sheet C2.3. 1% AEP flood hazard map – Pre Development;
- Sheet C3.1. 1% AEP flood depth and level map – Post Development;

- Sheet C3.2. 1% AEP flood velocity map – Post Development;
- Sheet C3.3. 1% AEP flood hazard map – Post Development;
- Sheet C4. 1% AEP flood afflux map – Post Development.

During this study, the design storm was applied to the entire upstream catchment of the site which extended up to the Bridge Road along the east, Killeen Street to the south and Jordan Street to the north. The flood model shows there are three major branches of overland flow paths along Lytton Street that traverses through the properties along Lytton Street. As seen from Table 3 above, the main flow path for the catchment passes through No. 35 and 37 Lytton Street, approximately 60 m south of the subject site, with a peak overland flow of 2.60 m^3/s. The total overland flow passing through the subject is 0.48 m^3/s approximately, out of which 0.21 m^3/s passes through south of the existing building and the remaining 0.27 m^3/s enters the subject site via 11 Lytton Street from the North.

The 1% AEP flood level in the vicinity of the site is within the range of 22.2 m AHD to 19.00 m AHD, with majority of depths of less than 0.25 m.

Flood waters enter the site from 11 Lytton Street and the frontage of 23-27 Lytton Street, flows are then guided to the Finlayson creek via undercover carpark at the northern end and via paved driveway along the southern end. The existing 600 mm diameter pipe passing through the open carpark helps to relieve some of the overland flooding from the street. The pipe conveys approximately 0.39 m^3/s of discharge during Predeveloped condition, while during the post developed condition, the diverted pipe can capture discharge up to 0.34 m^3/s from the street.

Inundation is largely confined to the existing drainage route passing through the northern carpark of the site, with floodwaters also flowing between the proposed and existing buildings within the driveway.

The 1% AEP floodwater velocities are generally between 0.1 – 1.0 m/s, which are in accordance with pre-development conditions.

The proposed development does not result in any flood levels increase external to the site. The entire incremental flood levels are within the site and lies within landscaped area at the rear of the carparks. A change in flood level of upto 150 mm has been noticed at the rear end of the northern and the southern carpark area. Once the floodwaters leave the building footprint, they match to the existing flood levels external to the site. In spite of increase in flood levels, the flood hazard ratings within the area are still within Low category which justifies the suitability of the proposal.

The crest provided at RL 20.35 m AHD at the top of driveway ramp leading to the proposed western undercover car park has not only protected the entrance of floodwaters to the carpark, but also provided a freeboard of 150mm above the peak flood level of RL 20.20 m AHD at that spot.

5.5 Provisional Flood Hazard

The degree of Provisional Hazard attributed to flooding at the subject site is a function of Hydraulic Hazard (relating to the depth and velocity of floodwaters) and is adjusted to account for the following factors:

- Size of flood;
- Effective warning time;
- Flood awareness;
- Rate of rise of floodwater;
- Duration of flooding;
- Evacuation problems;
- Effective flood access; and
- Type of development.

Hazard categories are defined as either high, intermediate or low and are based on the guidelines outlined in the Floodplain Development Manual (NSW DIPNR 2005), in particular Figure L.2 of that document.

Hazard categories on site is Low flood hazards situated outside of habitable areas and trafficable areas for pedestrians. 1% AEP floodwaters generally pose Low Hazard to people, vehicles and building infrastructure at 23-27 Lytton Street, Wentworthville.

5.6 Flood Affectation of the Site

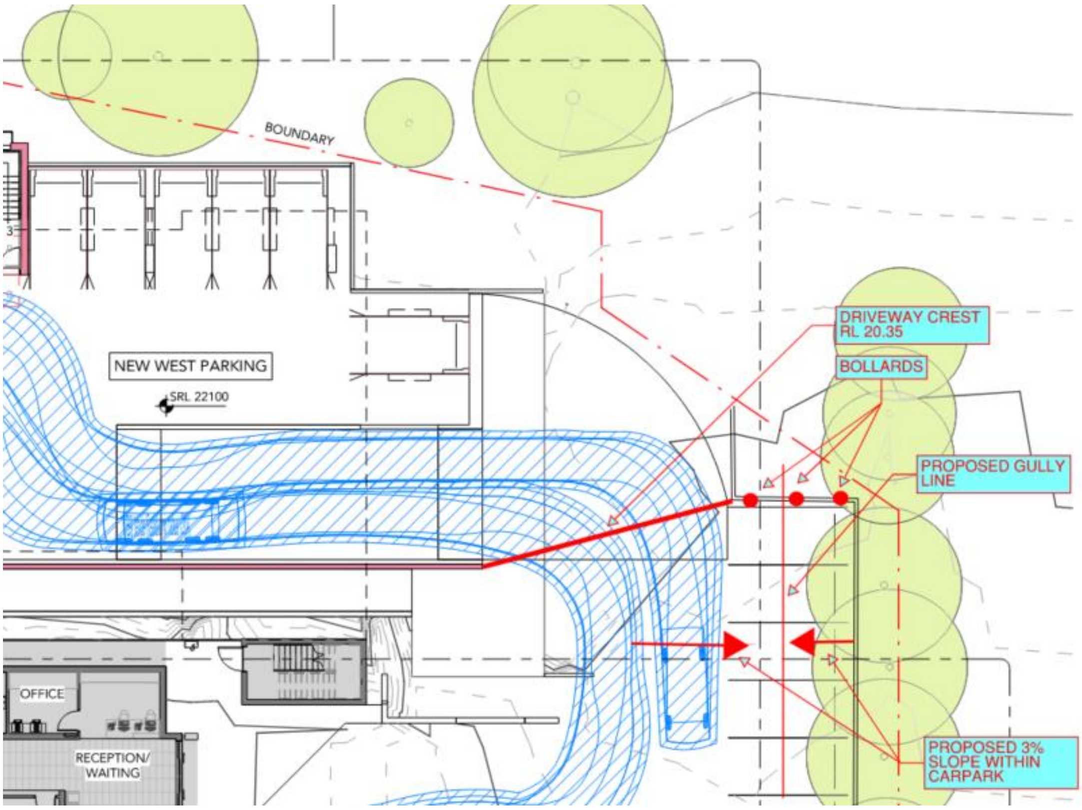
The site is impacted by flooding during the 1% AEP flood event, with 1% AEP floodwater levels within the range of 22.20 m AHD to 19 m AHD, resulting in partial inundation of the site. Inundation depths vary greatly by location.

The proposed entrance lobby at the southern face of the existing building, which is simple change of existing building, has recorded a peak flood level of RL 19.25 m AHD. Based on Council's DCP requirements, the minimum floor level at the lobby can be maintained at the current level of RL 19.25 m AHD as it will be impractical to raise the existing level.

The proposed building within southern end of the site is unaffected by flooding as the floodwater is confined within the driveway area between the proposed and the existing buildings.

The crest provided at RL 20.35 m AHD at the top of driveway ramp leading to the proposed western undercover car park has prevented from an ingress of floodwaters from level above. The floodwaters running along the northern side of the carpark continues to its westerly flow towards the Finlayson reserve without impacting the proposed carpark area. A low gully line will be provided along the rear car parking bays as indicated below with the kerb replaced with bollards next to the parking bay to allow for floodwater to flow through unhindered as shown in Figure 1 below.

Figure 1 Proposed Flood Mitigation Strategy



There are not any changes to the flood waters along Lytton Street frontage to the east of the site.

The PMF flood event was not modelled. PMF floodwater velocities and hazards are not presented in this flood study. We anticipate the severity of flooding during the PMF event could be higher around the rear of the site being received from Finlayson Creek flooding. As the mainstream flood from Finlayson Creek has not been analysed during this study, severity of PMF flooding could not be quantified. However, from the evacuation perspective, the upper levels within the existing and the proposed building could provide a safe refuge during such rarer flooding events.

6.0 Flood Risk Management

Based on the foregoing, we offer the following response having due regard for the requirements of the Holroyd Development Control Plan 2013 Part B Section 8 Part C4 Stormwater and Holroyd Local Environmental Plan 2013 Part 5.21 Flooding and the Floodplain Development Manual (NSW DIPNR 2005).

Based on the Holroyd DCP Table 7, the site falls within 'Redevelopment' land use category and within Medium Flood Risk Precinct. Based on this, the following major flood controls will be applicable to this development:

6.1 Floor Levels

The entrance lobby to the existing building along the southern face is currently proposed at RL 19.25 m AHD where the floodwaters peak at RL 19.21, slightly under the existing floor level. Since the proposed entrance lobby is just a change of use and the peak water surface during 1% AEP flooding is below the existing floor level and it is impractical to raise the existing floor levels to Flood Planning Level (FPL) of RL 19.71, the design floor level control 6 under Council's DCP Part J Section 8 allows to maintain the floor level as high as practicable subject to Council approval. Therefore, we believe the RL 19.25m AHD at the proposed entrance lobby is suitable.

The proposed undercover carpark at RL 22.73 m AHD at the southern side of the site is not affected by flooding. The peak floodwater next to the area has been estimated at RL 22.20 m AHD which is 0.53 m below the proposed car park level.

A peak flood level of RL 20.20 m AHD was estimated at the entrance to the western under croft car park. The proposed driveway crest at top of the entrance ramp at RL 20.35 m AHD will prevent an ingress of floodwaters during 1% AEP flood event. The crest has been provided to achieve 150 mm freeboard as per Council's DCP requirement.

The under croft carpark at the northern end of the site is partially affected by flooding during the pre-developed condition. During the post developed scenario, some minor grading of the new segment of carpark with provision of a low gully line across the rear parking bays and bollards next to the end parking bay will assure the floodwaters get captured within the northern carpark and leave the site without any impediments.

6.2 Building Components and Method

All building components below the 1% AEP flood level plus 500mm freeboard are to be constructed from flood compatible building materials. Flood affected building components for the proposed development that needs such flood compatible materials are floors and walls near the lobby entrance to the existing building, new undercover carpark & its associated structure along the western part of the site.

The suitable wall structure materials include solid brickwork, blockwork, concrete, timber stud walls constructed from Class 1 (highly durable), Class 2 (durable) or H3 treated timber.

Extensive guidance on flood compatible building materials and methods is provided in 'Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas' (HNFMSC 2006).

6.3 Structural Soundness

Proposed building structure with the flood exposure should be capable of withstanding the forces of the 1% AEP floodwaters, including hydrostatic, hydrodynamic, debris impact and buoyancy forces.

Due to the nature of the proposed works including concreting, it is unlikely that structural soundness will be required. Any slabs should be designed to be capable of withstanding the forces imposed by the 1% AEP floodwaters, including hydrostatic, hydrodynamic, debris impact and buoyancy forces. The concrete design should be certified by a practicing Civil Engineer.

6.4 Fencing

Due the flooded nature of the site, a mixture of light / open style fences and solid flood walls must be provided around all boundaries to provide a safe passage for floodwaters.

6.5 Evacuation

The proposed hospital building provides multiple levels above the ground level where evacuation can be facilitated. Floor levels of 27.50 m AHD are available on the first floor of the dwelling which would provide adequate shelter in place scenarios for existing and the proposed buildings.

In the event that the 1% AEP flood event is expected to be exceeded, strategies should be adopted in accordance with NSW Government operational guidelines and NSW SES Emergency Evacuation operational guidelines.

As mentioned earlier, upper floor levels within the existing and the proposed building could provide safe refuge during the rarer events such as PMF flooding. The proposed lifts and access stairs to upper levels will provide reliable evacuation routes during such flood events.

6.6 Climate Change

Based on our experience, analysis of climate change on flood model is generally not required for development proposals of this extent. Therefore, we have excluded modelling of climate change scenario for this study.

7.0 Conclusion

The subject site (17-19 Lytton Street, Wentworthville) is subject to overland flooding. It has been confirmed through the flood study undertaken, that flood waters enter 17-19 Lytton Street through the boundary of 17-19 Lytton Street and drain towards the Finlayson Creek drainage reserve at the rear of the property and into Finlayson Creek.

The site is impacted by flooding during the 1% AEP flood event, with 1% AEP floodwater levels within the range 22.2 m AHD to 19.00 m AHD, resulting in partial inundation of the site. Inundation depths are generally less than 0.25 m.

The selection and development of the 1% AEP flood model has been described in Sections 2 to 4 of this report. Flood modelling results were presented and discussed in Section 5. Flood risk management measures are described in Section 6.

Floodwaters which enter the site traverses through the paved areas within the carpark and through the existing driveway of the site without entering the existing building. There are very minor deviations to such floodwaters seen during the post developed condition within the site boundary.

There is an existing drainage easement and 600 mm diameter drainage pipe that runs via open carpark at the southern side of the site which is proposed to be diverted along the southern boundary (Refer to Stellen Consulting Stormwater Plans – DR-200 through to DR-201 Rev. B for details). The diverted pipe size will match up with the existing and it has been demonstrated from the proposed diversion has not compromised the existing capacity of the drainage system.

The 1% AEP floodwaters produced low hazard categories throughout the entire site with the peak 1% AEP flowrate passing through the part of the site where the existing building is located is approximately 0.48 m^3/s.

There are no flood impacts identified external to the site. The increase in flood levels identified is limited to within the subject site with maximum change in flood level being recorded up to 0.15 m. However, as the associated hazard rating is low within the area of 0.15 m increment, it is reasonable to consider this flood rise as acceptable.

Based on the forgoing, we are of the view the proposed works generally meets the intent of the provisions for sites affected by flooding outlined within Holroyd Development Control Plan 2013.

8.0 References

Cumberland Council. *Holroyd Development Control Plan 2013*.

Cumberland Council. *Holroyd Local Environmental Plan 2013*.

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New South Wales Department of Infrastructure, Planning and Natural Resources (NSW DIPNR). (2005). *Floodplain Development Manual: the management of flood liable land*.

Pilgrim D H (Ed.). (1998). *Australian Rainfall and Runoff*. Institution of Engineers Australia. Barton ACT.

9.0 Glossary

Terminology in this Glossary has been derived or adapted from the Floodplain Development Manual (NSW DIPNR 2005), where appropriate.

Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, expressed as a percentage.
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
Average recurrence interval (ARI)	The long-term average number of years between the occurrence of a flood as big as or larger than the selected event.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
Design flood	A flood event to be considered in the design process.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
Flood hazard	A measure of the floodwaters potential to cause harm or loss. Full definitions of hazard categories are provided in Appendix L of the Floodplain Development Manual (NSW Government, 2005). In summary: • High: conditions that pose a possible danger to personal safety; evacuation by trucks difficult; able-bodied adults would have difficulty wading to safety; potential for significant structural damage to buildings.

	• Low: conditions such that people and their possessions could be evacuated by trucks; able-bodied adults would have little difficulty wading to safety.
Flood planning area	The area of land below the FPL and thus subject to flood related development controls.
Flood planning levels (FPLs)	Combinations of flood levels (derived from significant historical flood events or floods of specific ARIs) and freeboards selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans.
Floodplain, flood-prone land	Land susceptible to inundation by the probable maximum flood (PMF) event, i.e. the maximum extent of flood liable land.
Floodplain risk management options	The measures that might be feasible for the management of a particular area of the floodplain.
Freeboard	Provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the FPL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. (See Section K5 of Floodplain Development Manual).
Geographical information systems (GIS)	A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data.
Hydraulics	The term given to the study of water flow in a river, channel or pipe, in particular, the evaluation of flow parameters such as stage and velocity.
Hydraulic category	A classification of floodwater hydraulic behaviour. The categories are:

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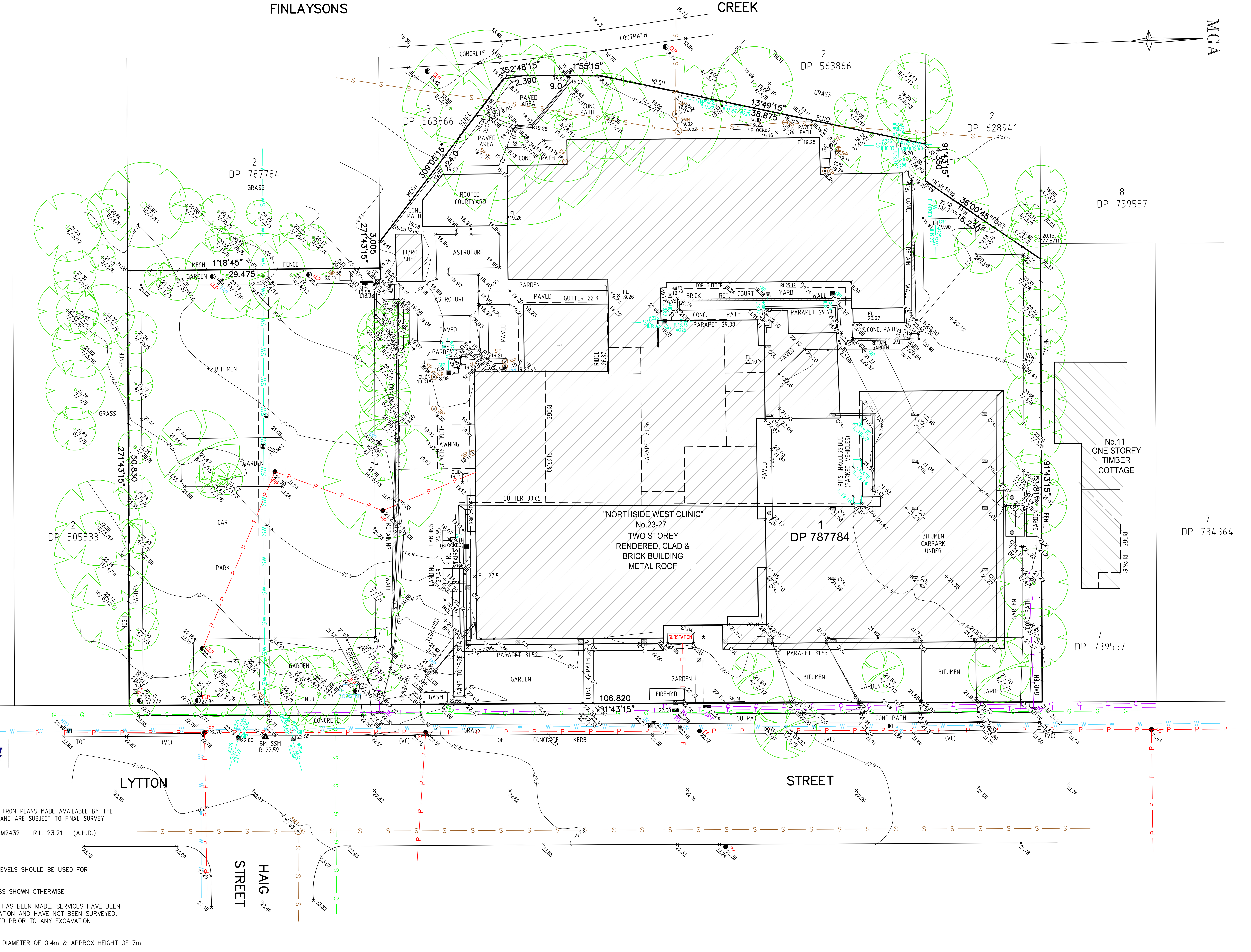
	• Floodway: those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels. • Flood storage: those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. Loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. • Flood fringe: remaining area of flood-prone land after floodway and flood storage areas have been defined
Hydrograph	A graph that shows how the discharge changes with time at any particular location.
Hydrology	The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.
Local overland flooding	Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.
Mainstream flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.
Peak discharge	The maximum discharge occurring during a flood event.
Probable maximum flood (PMF)	The PMF is the largest flood that could conceivably occur at a particular location.
Probable Maximum Precipitation (PMP)	The PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location.
Probability	A statistical measure of the expected frequency or occurrence of flooding.

Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. For this study, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
Runoff	The amount of rainfall that actually ends up as stream or pipe flow, also known as rainfall excess.

ANNEXURE A

LTS Lockley Survey Plan, Reference 40317 002DT, Revision D, dated 12th October 2021.



LEGEND

BENCH MARK	▲
COMMS PIT	COM
TELSTRA PIT	TEL
TELSTRA PILLAR	TP
LIGHT (MOUNTED)	ELP
ELECTRICITY PIT	EPIT
ELECTRICITY BOX	EL
POWER POLE	PP
BOLLARD	BOL
COLUMN	COL
PIT WITH CONCRETE LID	CLID
PIT WITH METAL LID	MLID
STREET SIGN	SS
GRATED INLET PIT	GIP
KERB INLET PIT	KIP
SEWER INSPECTION POINT	SIP
SEWER VENT	SEV
SEWER MANHOLE	SMH
STOP VALVE	SV
IRRIGATION CONTROL VALVE	ICV
HYDRANT	HYD
WATER TAP	TAP
GAS VALVE	GAS
WINDOW	W
DOOR	D
VEHICLE CROSSING	(VC)
PRAM CROSSING	(PC)
GAS PIPE	— G —
TELSTRA	— T —
COMMUNICATIONS (DBYD)	— C —
WATER PIPE	— W —
STORMWATER	— SW —
SEWER	— S —
ELECTRICITY (OVERHEAD)	— P —
ELECTRICITY (U'GROUND)	— E —

EASEMENT NOTES

Ø EASEMENT FOR ELECTRICITY PURPOSES (VIDE M955707)

◒ EASEMENT FOR DRAINAGE 1.22 WIDE (VIDE G307375)

DIAL BEFORE YOU DIG www.1100.com.au

GDA94

NOTES

1) THE BOUNDARIES HAVE NOT BEEN MARKED

2) ALL AREAS AND DIMENSIONS HAVE BEEN COMPILED FROM PLANS MADE AVAILABLE BY THE OFFICE of LAND & PROPERTY INFORMATION (NSW) AND ARE SUBJECT TO FINAL SURVEY

3) ORIGIN OF LEVELS ON A.H.D. IS TAKEN FROM **PM2432** R.L. **23.21** (A.H.D.) IN LYTTON STREET.

4) CONTOUR INTERVAL 0.5m

5) CONTOURS ARE INDICATIVE ONLY. ONLY SPOT LEVELS SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION

6) KERB LEVELS ARE TO THE TOP OF KERB UNLESS SHOWN OTHERWISE

7) NO INVESTIGATION OF UNDERGROUND SERVICES HAS BEEN MADE. SERVICES HAVE BEEN PLOTTED FROM RELEVANT AUTHORITIES INFORMATION AND HAVE NOT BEEN SURVEYED. ALL RELEVANT AUTHORITIES SHOULD BE NOTIFIED PRIOR TO ANY EXCAVATION ON OR NEAR THE SITE

8) 8/.4/7 DENOTES TREE SPREAD OF 8m, TRUNK DIAMETER OF 0.4m & APPROX HEIGHT OF 7m

9) NO INVESTIGATION OF CERTIFICATE OF TITLE HAS BEEN MADE IN THIS AREA

10) SHOWS APPROXIMATE POSITION OF ROAD LINEMARKING AND IS INDICATIVE ONLY

11) BEARINGS SHOWN ARE MGA (MAP GRID OF AUSTRALIA) ADD APPROX. 1° FOR TRUE NORTH BEARINGS

Revision	Date	Description	Reference
D	00/00/00	-	00
C	12/10/21	TRANSLATED TO GDA94	002
B	20/09/21	DTM'S MERGED AND AMENDED	002
A	01/09/20	DETAIL UPDATED	002

THIS IS THE PLAN REFERRED TO IN MY LETTER DATED:

....

Registered Surveyor NSW

LTS LOCKLEY
Registered Surveyors NSW
www.ltsl.com.au
Suite 1, Level 1,
810 Pacific Highway
Gordon NSW 2072
LOCKED BAG 5
GORDON NSW 2072
P 1300 587 000
F 02 9499 7760

Client RAMSAY HEALTHCARE

Drawing title
PLAN OF DETAIL AND LEVELS OVER LOT 1 IN DP787784 KNOWN AS NORTHSIDE WEST CLINIC AT No.23-27 LYTTON ST, WENTWORTHVILLE.

datum: AHD	project number: -	reference number: 40317 002DT
site Area: 6655m²	scale: 1:200 @A1	date of survey: 28/10/2013
LGA: HOLROYD	SHEET 1 OF 1 SHEETS	

ANNEXURE B

Team2 Architects Architectural Plans, Reference 903, Revision 1, dated 28th July 2021.

NORTHSIDE WEST CLINIC
WENTWORTHVILLE

ARCHITECTURAL DRAWING SET FOR:

DEVELOPMENT APPLICATION

NORTHSIDE WEST CLINIC
27 LYTTON ST, WENTWORTHVILLE
NEW SOUTH WALES

CLIENT:
ERILYAN

DA Sheet List

Sheet Number	Sheet Name	Current Revision	Current Revision Date
DA			
000-Specification + Site			
DA0000	COVER SHEET	1	28.07.21
DA0010	SITE PLAN - EXISTING	1	28.07.21
DA0011	SITE ANALYSIS	1	28.07.21
010 Overall Plan			
DA0100	OVERALL SITE PLAN - LOWER GROUND	1	28.07.21
DA0101	OVERALL SITE PLAN - GROUND FLOOR	1	28.07.21
DA0102	OVERALL SITE PLAN - LEVEL 1	1	28.07.21
DA0103	OVERALL SITE PLAN - LEVEL 2	1	28.07.21
DA0104	OVERALL SITE PLAN - LEVEL 3	1	28.07.21
DA0105	OVERALL SITE PLAN	1	28.07.21
100-General Arrangement Plan			
DA1000	LOWER GROUND - STAGE 2	1	28.07.21
DA1001	LOWER GROUND - WEST PARKING	1	28.07.21
DA1002	GROUND - STAGE 2	1	28.07.21
DA1003	GROUND - STAGE 1	1	28.07.21
DA1004	GROUND -WEST PARKING	1	28.07.21
DA1005	LEVEL 1 - STAGE 2	1	28.07.21
DA1006	LEVEL 1 - WEST BLOCK	1	28.07.21
DA1007	LEVEL 2 - STAGE 2	1	28.07.21
DA1008	LEVEL 2 - WEST BLOCK	1	28.07.21
DA1009	LEVEL 3 - STAGE 2	1	28.07.21
DA1010	ROOF - STAGE 2	1	28.07.21
200-Elevations			
DA2000	ELEVATION	1	28.07.21
DA2001	ELEVATION	1	28.07.21
300-Sections			
DA3000	SECTIONS	1	28.07.21
800-Shadow Studies			
DA8000	SHADOW DIAGRAMS - SUMMER SOLSTICE	1	28.07.21
DA8002	SHADOW DIAGRAMS - WINTER SOLSTICE	1	28.07.21

DRAWING STATUS:

PRELIMINARY

Rev	Revision Description	Date
1	Preliminary Issue	28.07.21

DRAWING LEGEND:

1. Architectural drawings shall be read in conjunction with other consultant drawings and specifications. Any discrepancies shall be referred to team 2 architects before proceeding with work.
2. All dimensions and levels are in millimeters unless noted otherwise. No dimension shall be obtained by scaling the drawing.
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4. All work to be carried out in accordance with the requirements of the principal certifying authority, current ncc & australian standards.

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Reg NSW: 9940

MELBOURNE
Suite 204/9-11 Claremont Street,
South Yarra, VIC 3141
ABN: 72 104 833 507
Reg Vic: 19340

Project:
Northside West Stage 2

Wentworthville. NSW 2145

Title:
COVER SHEET

Project #:	Scale:	Drw:	Ckd:
903	@A1	IK	IK

Drawing #:	Rev:
DA0000	1

1 DA Site Plan - Existing
Scale: 1 : 200

DRAWING STATUS:

PRELIMINARY

Rev	Revision Description	Date
1	Preliminary Issue	28.07.21

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ERILYAN

0 1 2 3 4 5
SCALE 1:100

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ABN: 72 104 833 507
Reg Vic: 19340

Project:
Northside West Stage 2

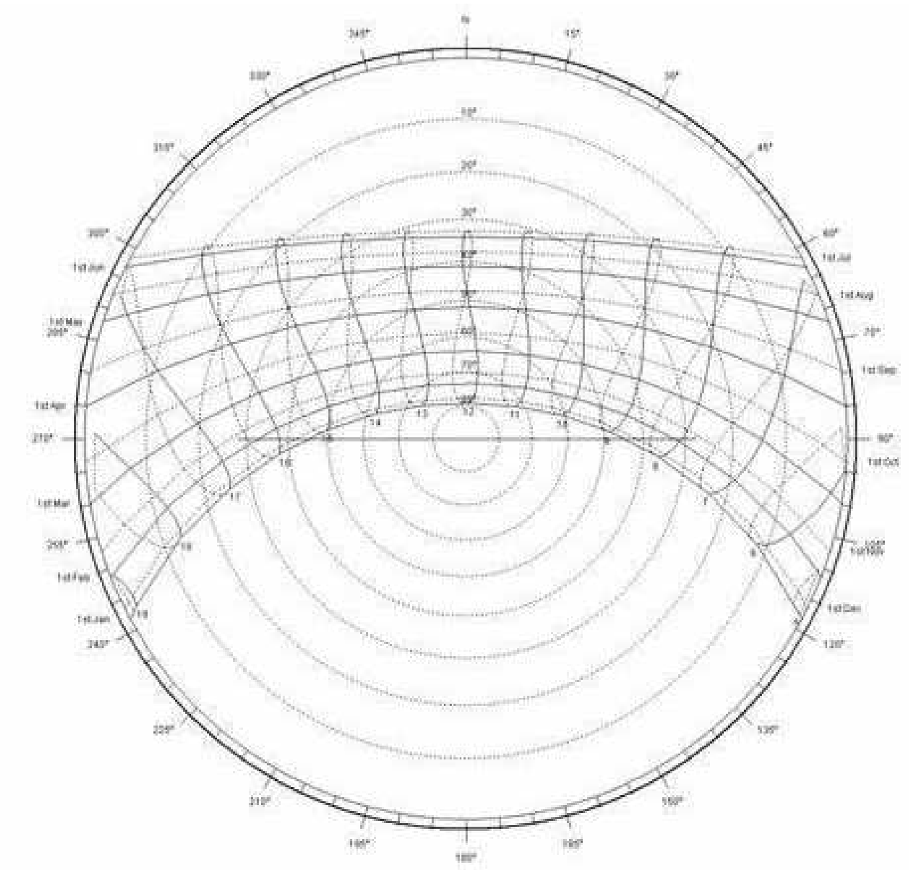
Wentworthville. NSW 2145

Title:
SITE PLAN - EXISTING

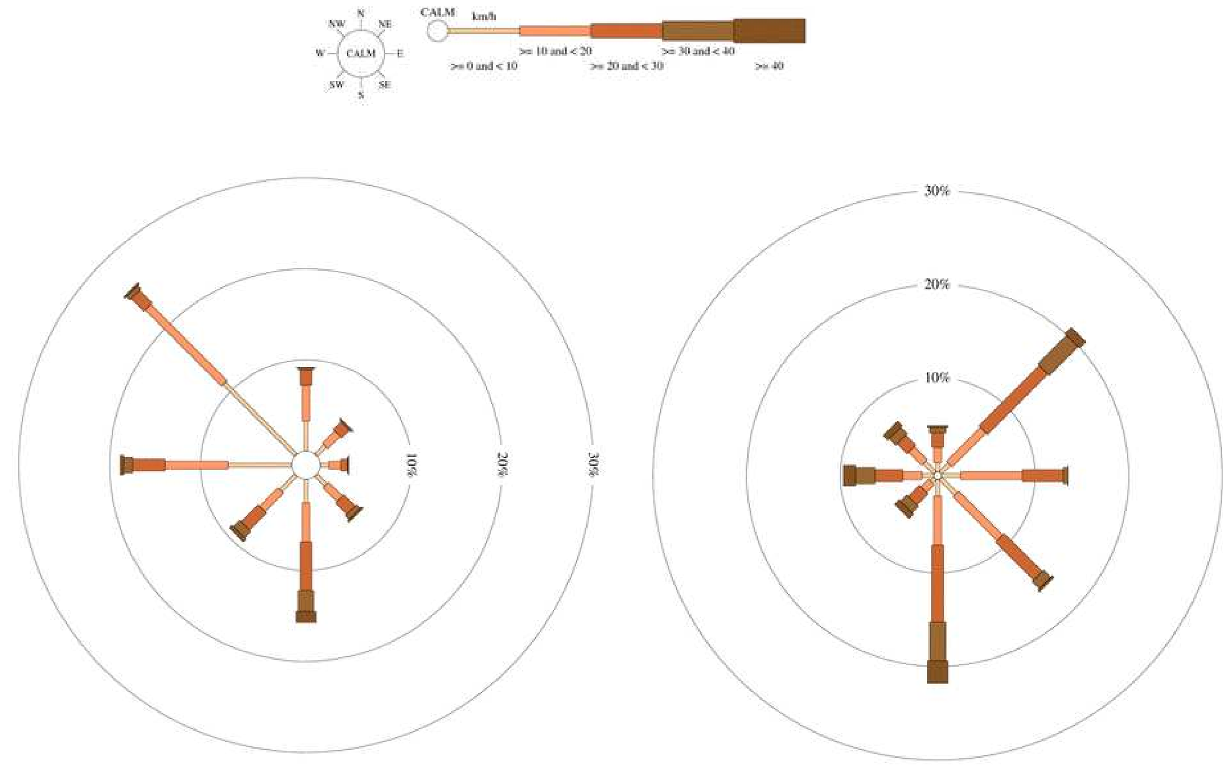
Project #:	Scale:	Drw:	Ckd:
903	1 : 200 @A1	IK	VM

Drawing #:	Rev:
DA0010	1

LOCATION PLAN - OVERALL



SUN PATH DIAGRAM
SYDNEY

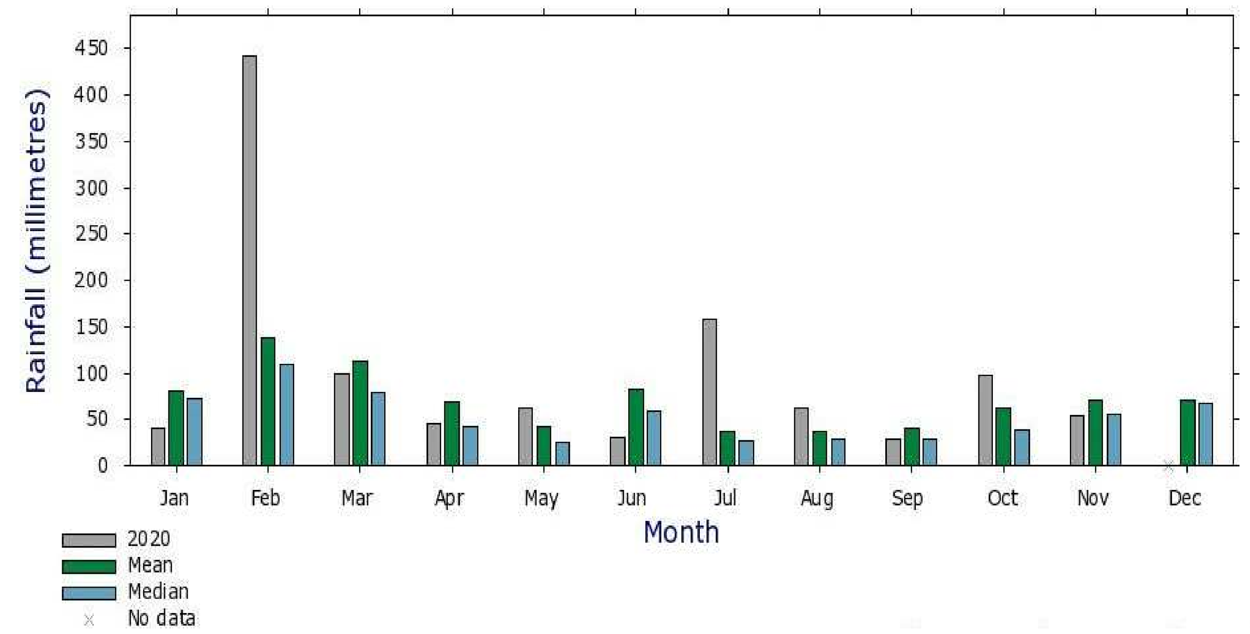


WIND ROSE AT 9AM
SYDNEY

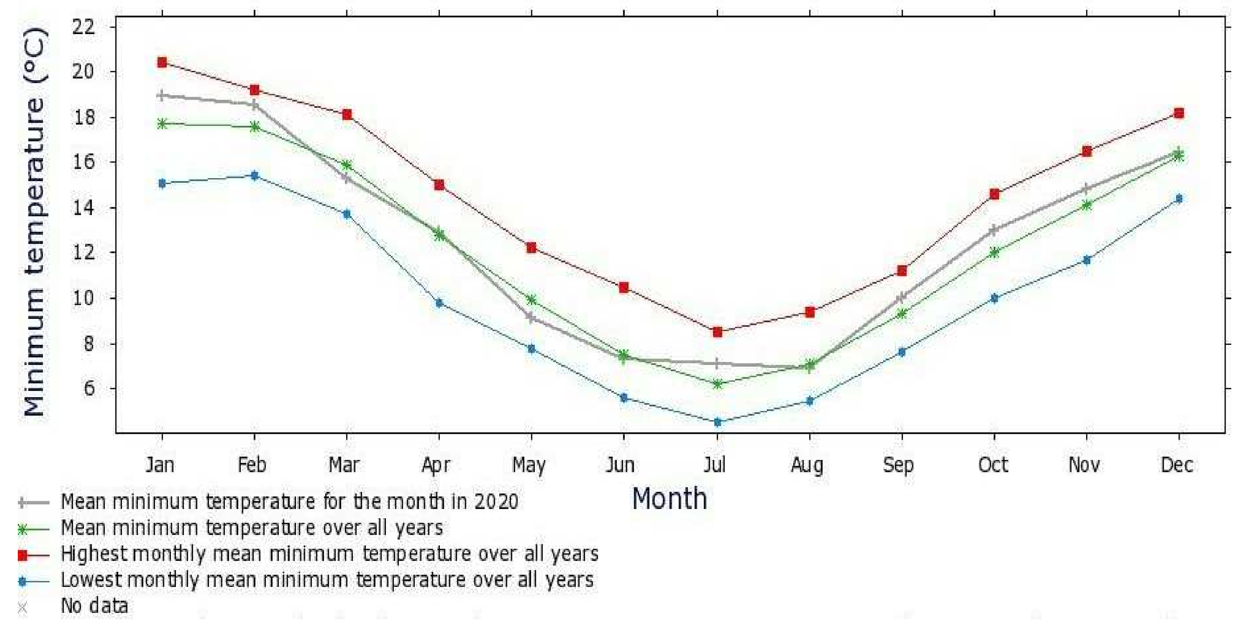
WIND ROSE AT 3PM
SYDNEY

LOCATION PLAN

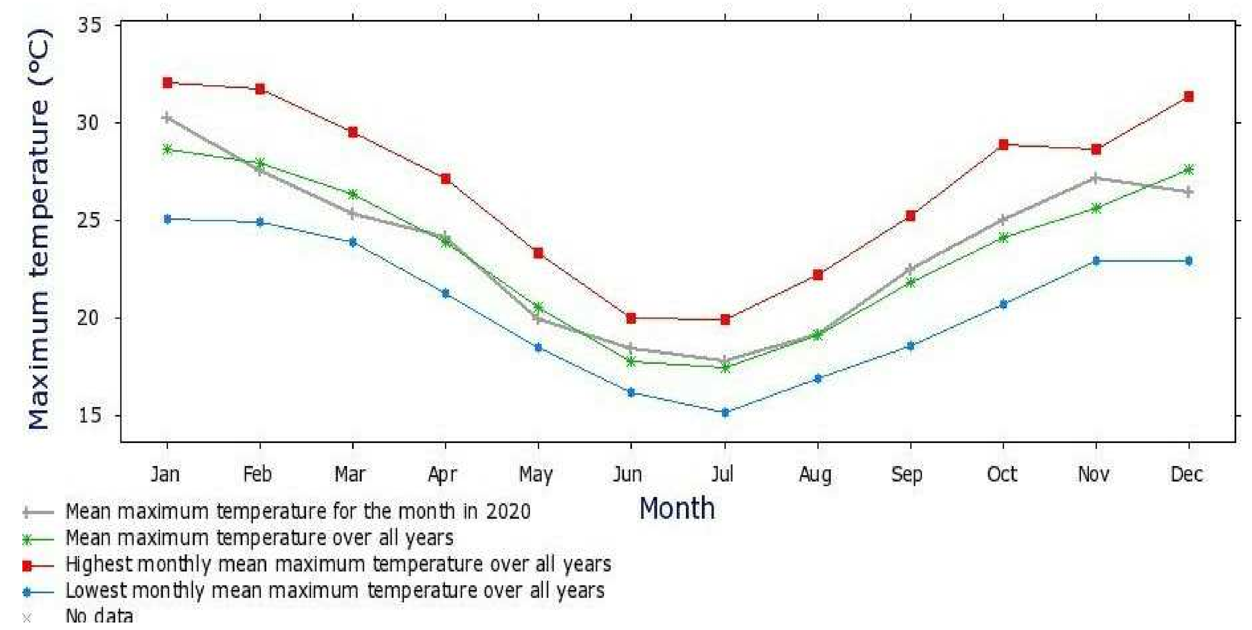
SITE PLAN



RAINFALL DATA: WENWORTHVILLE (GREYSTANES)
CLIMATE DATA FROM BUREAU OF METEOROLOGY



MINIMUM TEMPERATURE DATA: WENTWORTHVILLE (PARAMATTA NORTH)
CLIMATE DATA FROM BUREAU OF METEOROLOGY



MAXIMUM TEMPERATURE DATA: WENTWORTHVILLE (PARAMATTA NORTH)
CLIMATE DATA FROM BUREAU OF METEOROLOGY

DRAWING STATUS:

PRELIMINARY

Rev	Revision Description	Date
1	Preliminary Issue	28.07.21

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ERILYAN

0 1 2 3 4 5
SCALE 1:100

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ABN: 72 104 833 507
Reg Vic: 19340

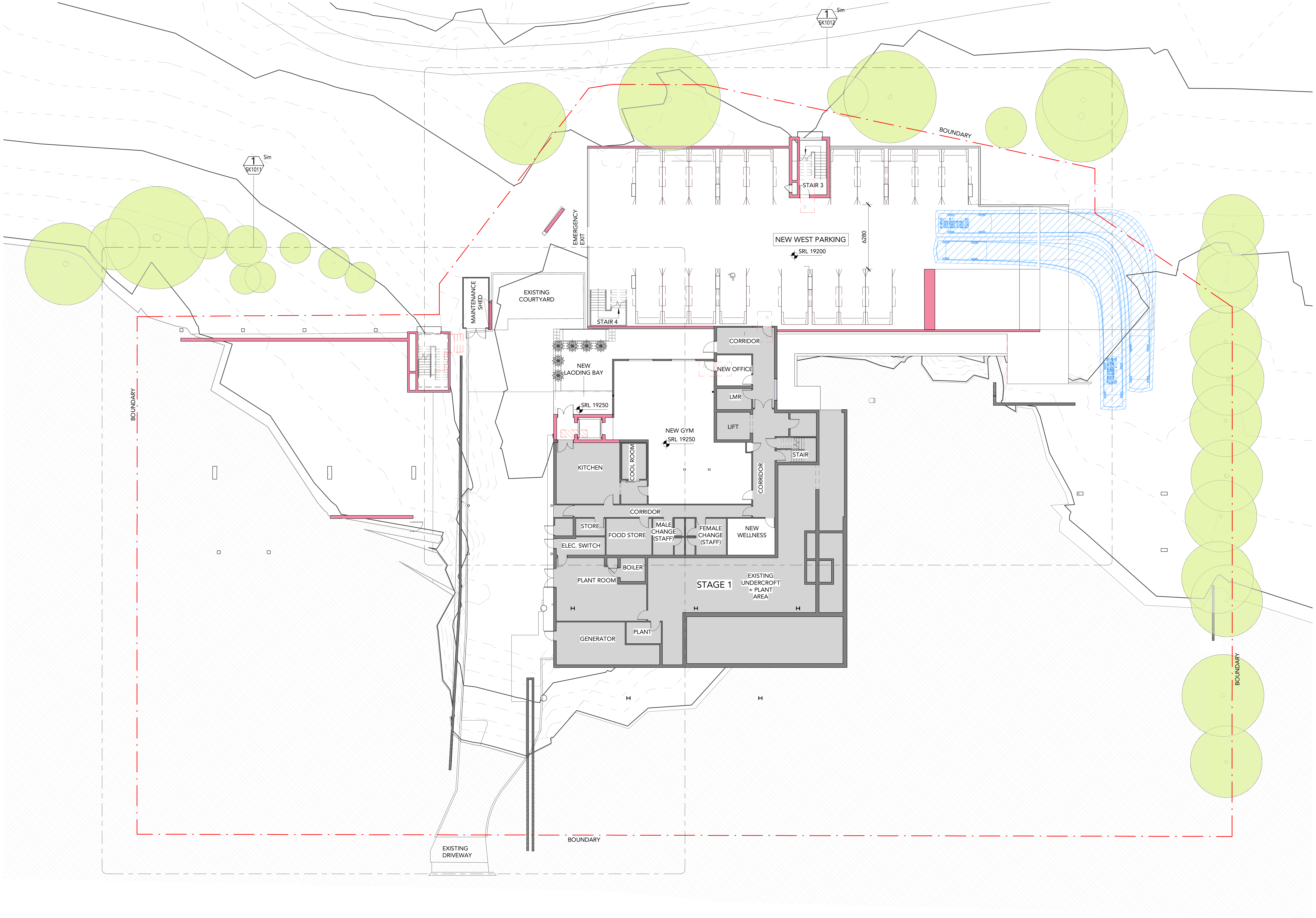
Project:
Northside West Stage 2

Wentworthville. NSW 2145

Title:
SITE ANALYSIS

Project #:	Scale:	Drw:	Ckd:
903	@A1	IK	VM

Drawing #:	Rev:
DA0011	1



1 DA Overall - Lower Ground
Scale: 1 : 200

DRAWING STATUS:

PRELIMINARY

Rev	Revision Description	Date
1	Preliminary Issue	28.07.21

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LEGEND

NOT IN SCOPE

ERILYAN

0 1 2 3 4 5
SCALE 1:100

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Reg Vic: 19340

Project:
Northside West Stage 2

Wentworthville. NSW 2145

Title:
OVERALL SITE PLAN - LOWER GROUND

Project #:	Scale:	Drw:	Ckd:
903	As indicated @A1	IK	VM

Drawing #:	Rev:
DA0100	1

1 DA Overall - Ground Floor
Scale: 1 : 200

DRAWING STATUS:

PRELIMINARY

Rev	Revision Description	Date
1	Preliminary Issue	28.07.21

DRAWING LEGEND:

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LEGEND

NOT IN SCOPE

ERILYAN

0 1 2 3 4 5
SCALE 1:100

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ABN: 72 104 833 507
Reg Vic: 19340

Project:
Northside West Stage 2

Wentworthville. NSW 2145

Title:
OVERALL SITE PLAN - GROUND FLOOR

Project #:	Scale:	Drw:	Ckd:
903	As indicated @A1	IK	VM

Drawing #:	Rev:
DA0101	1

ANNEXURE C

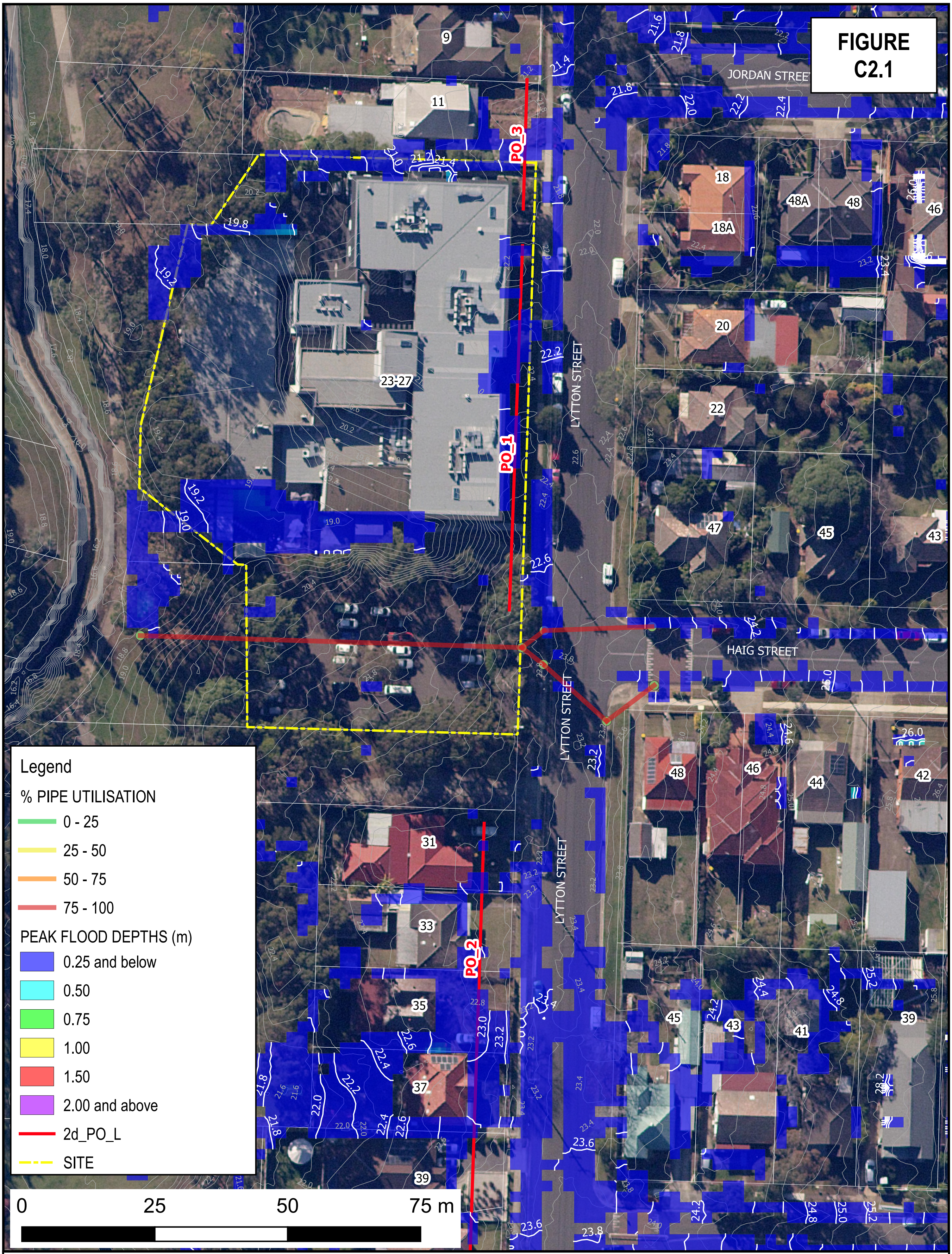
ACOR Flood Plans, Reference NSW210629, Sheets F1 to F20, Revision 1, dated 21st October 2021.

CATCHMENT PLAN

PROJECT: NORTHSIDE WEST CLINIC FLOOD STUDY - NSW210629
LOCATION: 23-27 LYTTON STREET, WENTWORTHVILLE

PREPARED BY ACOR CONSULTANTS PTY LTD

ACOR Consultants Pty Ltd
Suite 2, Level 1, 33 Herbert Street
St Leonards NSW 2065
T +61 2 9438 5098
ENGINEERS | MANAGERS | INFRASTRUCTURE PLANNERS | DEVELOPMENT CONSULTANTS



1% AEP MAX FLOOD DEPTHS - PRE DEVELOPMENT

PROJECT: NORTHSIDE WEST CLINIC FLOOD STUDY - NSW210629
LOCATION: 23-27 LYTTON STREET, WENTWORTHVILLE

PREPARED BY ACOR CONSULTANTS PTY LTD

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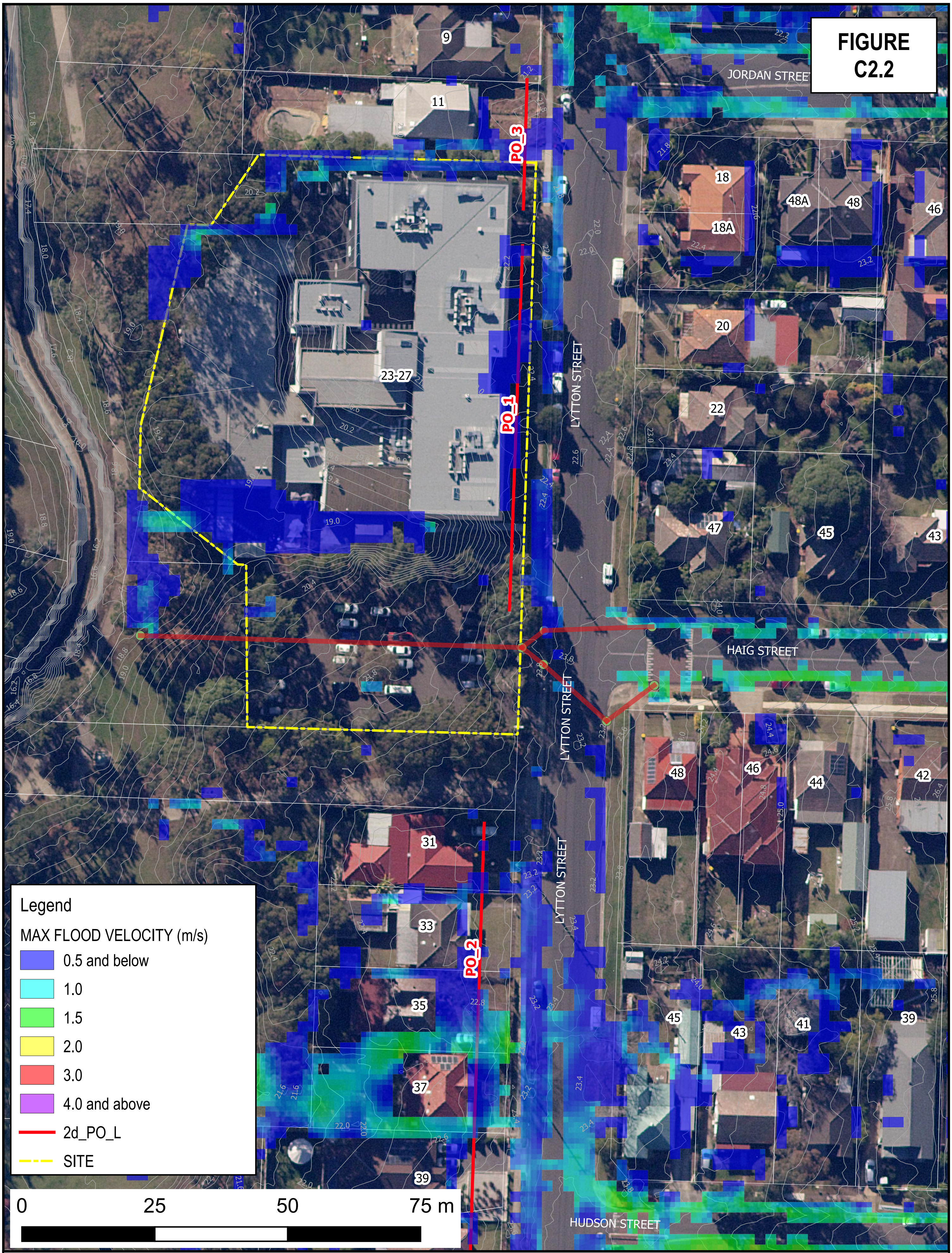

1% AEP MAX FLOOD VELOCITY - PRE DEVELOPMENT

PROJECT: NORTHSIDE WEST CLINIC FLOOD STUDY - NSW210629
LOCATION: 23-27 LYTTON STREET, WENTWORTHVILLE

PREPARED BY ACOR CONSULTANTS PTY LTD

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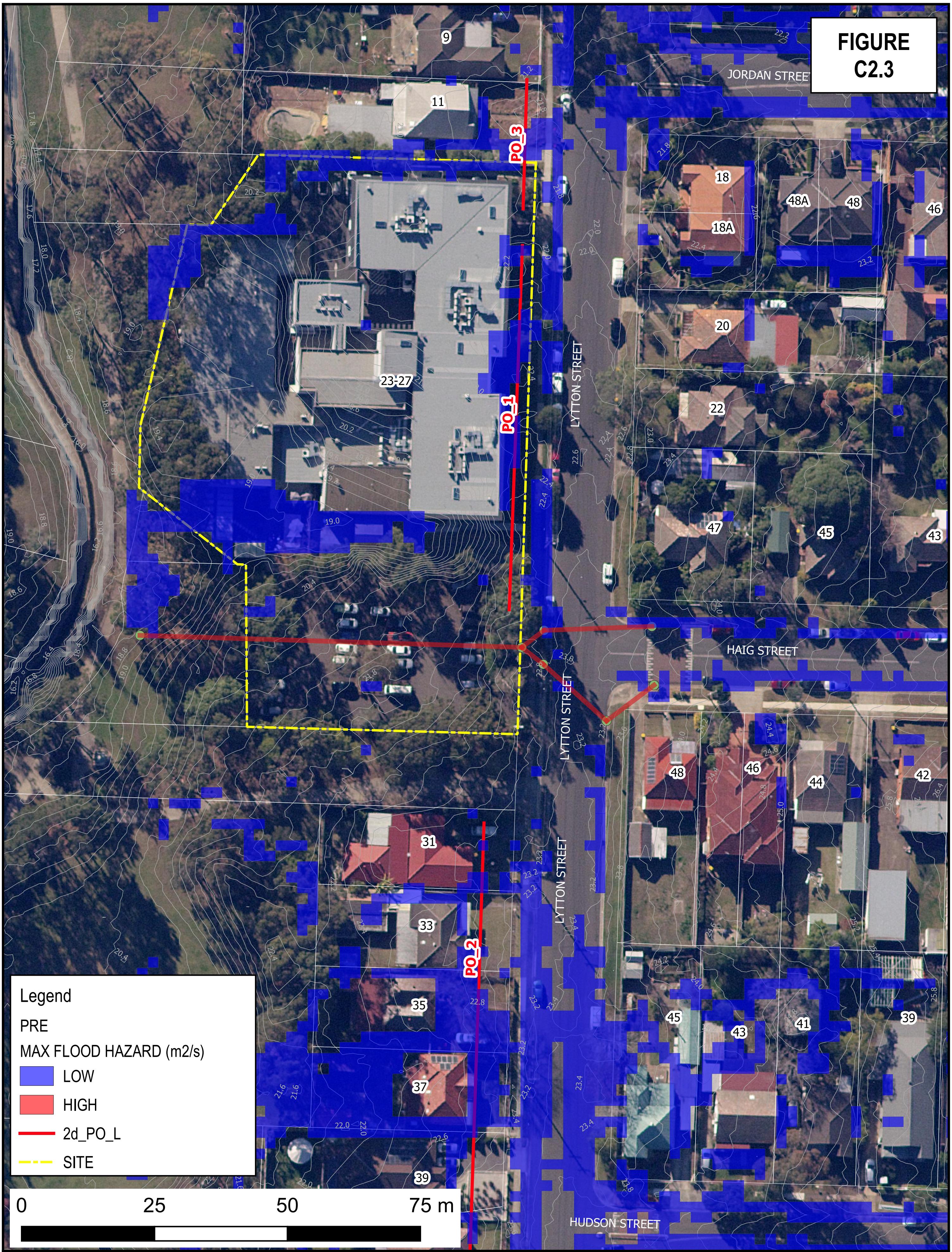

1% AEP MAX FLOOD HAZARD - PRE DEVELOPMENT

PROJECT: NORTHSIDE WEST CLINIC FLOOD STUDY - NSW210629
LOCATION: 23-27 LYTTON STREET, WENTWORTHVILLE

PREPARED BY ACOR CONSULTANTS PTY LTD

ACOR Consultants Pty Ltd
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T +61 2 9438 5098
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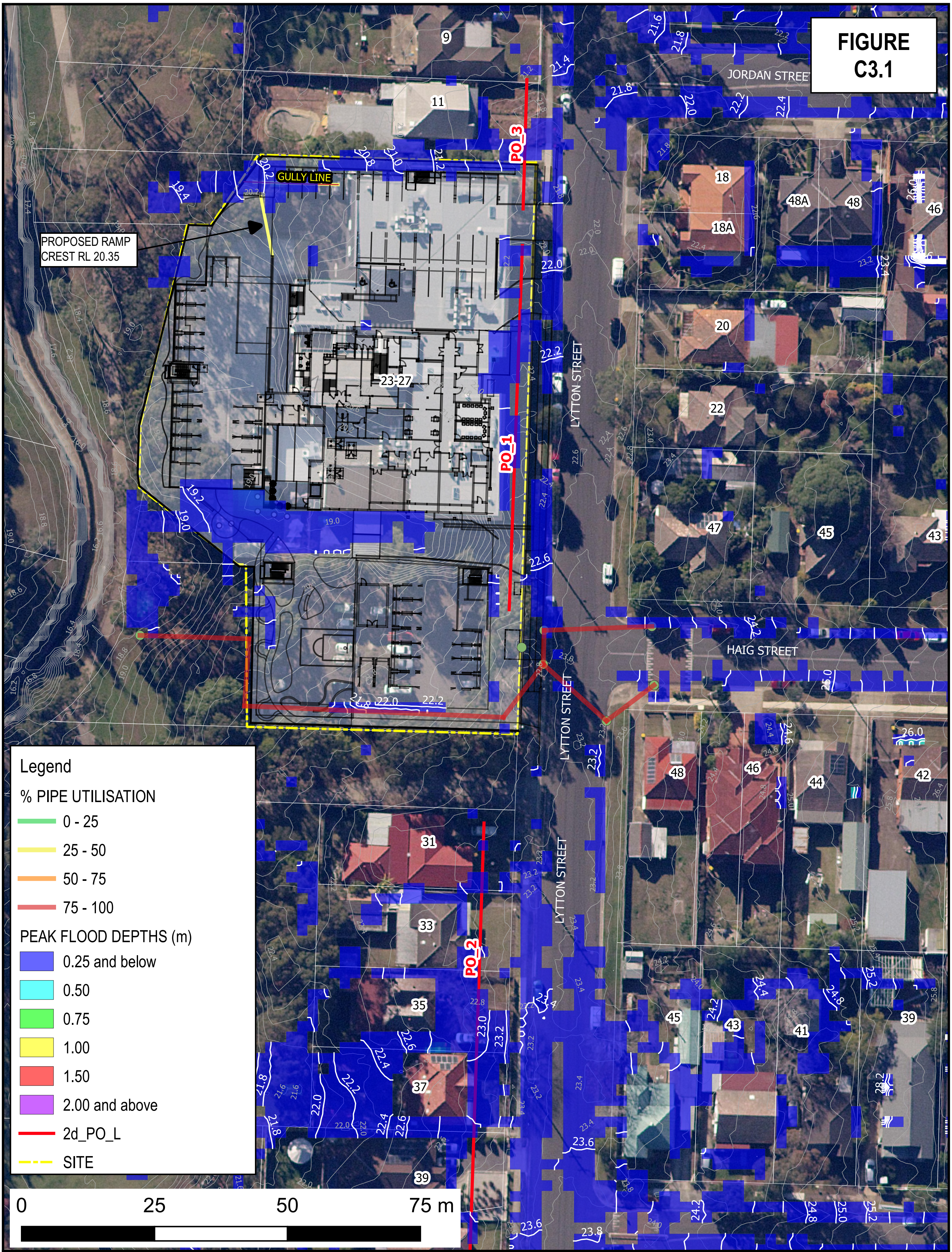

1% AEP MAX FLOOD DEPTHS - POST DEVELOPMENT

PROJECT: NORTHSIDE WEST CLINIC FLOOD STUDY - NSW210629
LOCATION: 23-27 LYTTON STREET, WENTWORTHVILLE

PREPARED BY ACOR CONSULTANTS PTY LTD

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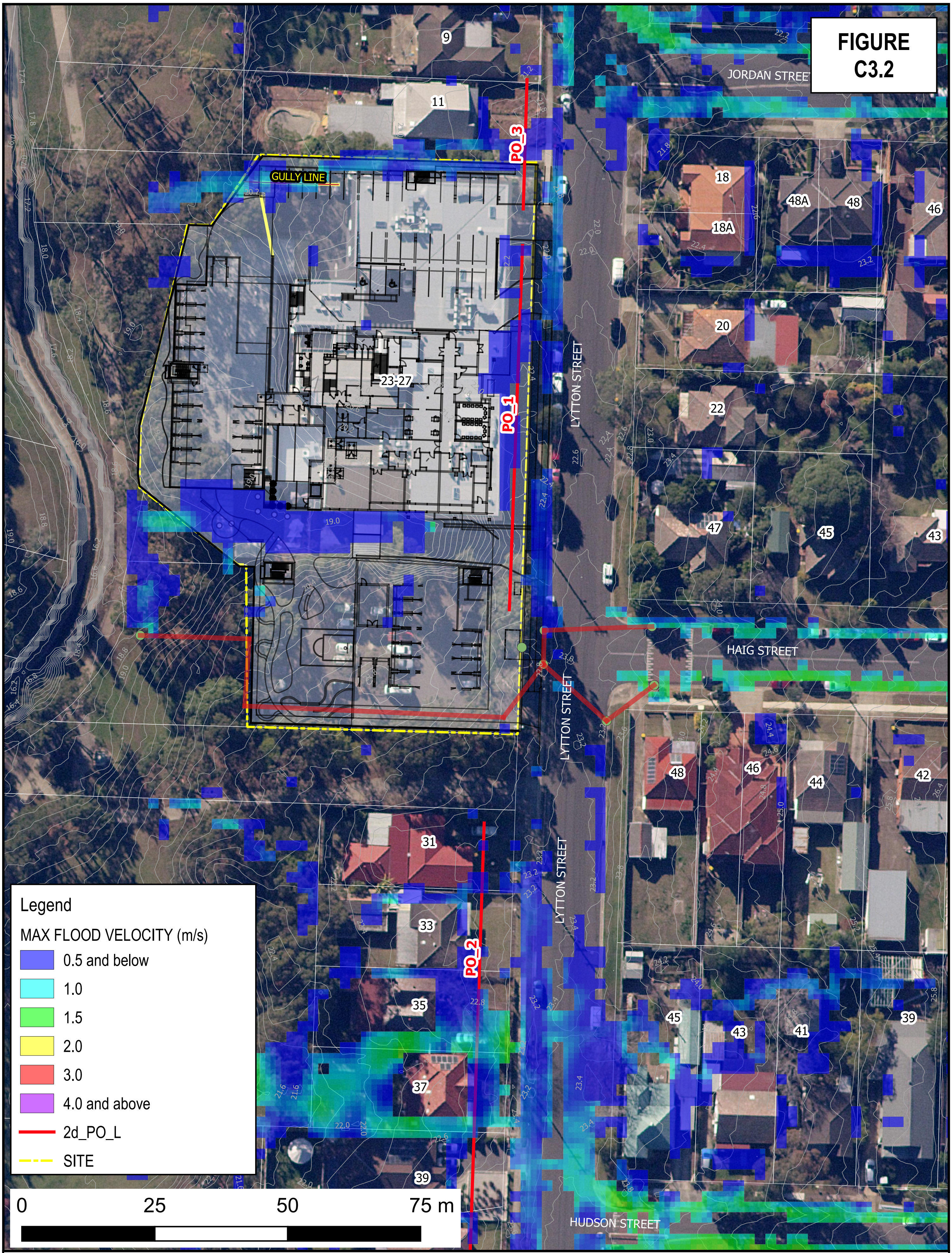

1% AEP MAX FLOOD VELOCITY - POST DEVELOPMENT

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LOCATION: 23-27 LYTTON STREET, WENTWORTHVILLE

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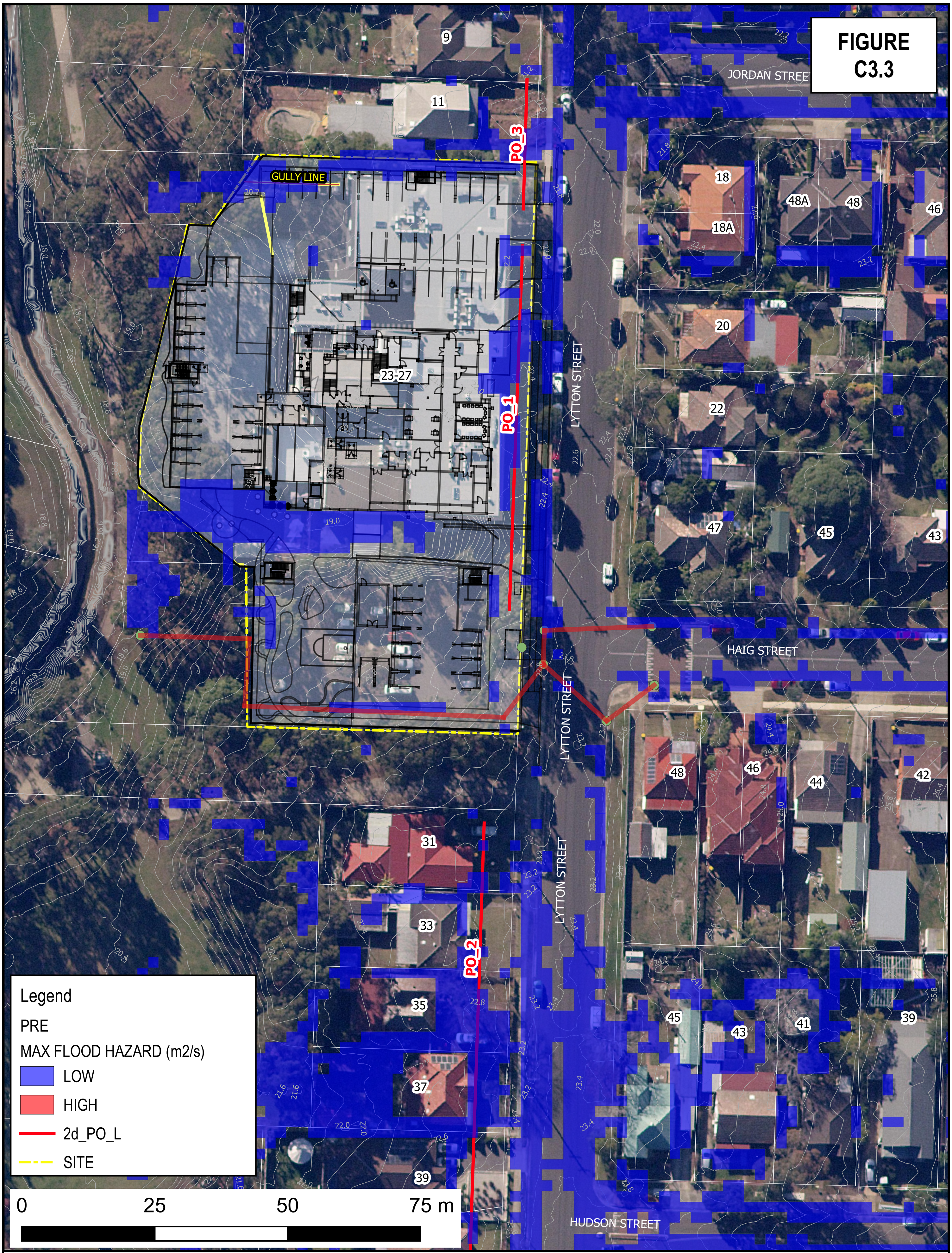

1% AEP MAX FLOOD HAZARD - POST DEVELOPMENT

PROJECT: NORTHSIDE WEST CLINIC FLOOD STUDY - NSW210629
LOCATION: 23-27 LYTTON STREET, WENTWORTHVILLE

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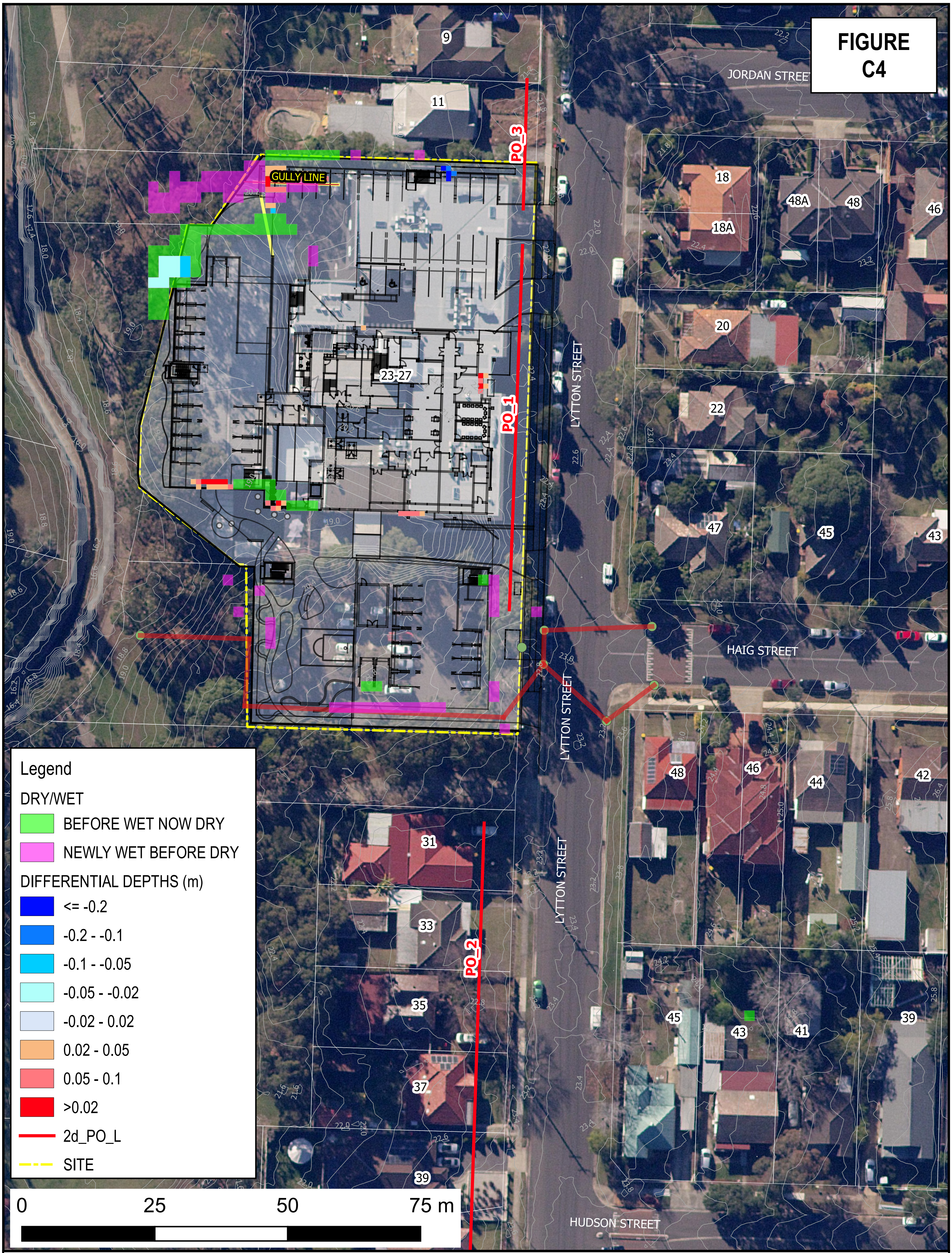

1% AEP MAX FLOOD AFFLUX - POST DEVELOPMENT

PROJECT: NORTHSIDE WEST CLINIC FLOOD STUDY - NSW210629
LOCATION: 23-27 LYTTON STREET, WENTWORTHVILLE

PREPARED BY ACOR CONSULTANTS PTY LTD

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