Structural Engineering Design Report

Lismore South Public School (The Activity)

Prepared on behalf of the NSW Department of Education

6 June 2025

231882 SAAA

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Revision	Date	Prepared By	Approved By	Remarks
A	29.11.2024	DB	GB	Schematic Design
B	13.02.2025	DB	GB	Schematic Design
C	20.02.2025	DB	GB	Schematic Design
D	6.06.2025	DB	GB	Schematic Design

1 Introduction

This Structural Engineering Report has been prepared to support a Review of Environmental Factors (REF) for the rebuild of Lismore South Public School (the activity). The purpose of the REF is to assess the potential environmental impacts of the activity prescribed by State Environmental Planning Policy (Transport and Infrastructure) 2021 (T&I SEPP) as "development permitted without consent" on land carried out by or on behalf of a public authority under Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The activity is to be undertaken pursuant to Chapter 3, Part 3.4, Section 3.37 of the T&I SEPP.

The activity will be carried out at Lismore South Public School (LSPS) located 69-79 Kyogle Street, South Lismore (the site).

The purpose of this report is to address the structural engineering design of the LSPS activity including building structure and foundation design. The relevant requirements of SINSW's 'Educational Facilities Standards and Guidelines' (EFSG) will be addressed.

1.1 Guidance Documents

The following documents have been reviewed and referenced in preparing this report:

- Geotechnical Desktop Assessment – JK Geotechnics, 25 October 2023;
- Geotechnical Contamination – Desktop Site Investigation – JK Geotechnics, 23 October 2023;
- Geotechnical Investigation Report – JK Geotechnics, 36310LTrpt, 13 December 2024
- NSW Department of Education Educational Facilities Standards and Guidelines.
- Construction of buildings in flood hazard areas - ABCB Standard -2012.3
- The NSW Planning System and the Building Code of Australia 2013: Construction Buildings in Flood Hazard Areas
- Department of Planning and Environment: Flood Hazard – Flood Risk Management Guide FB03

1.2 Greenstar

The Lismore South Public School redevelopment is targeting a 4 Star Design & As-Built certified rating as required by School Infrastructure NSW.

The structure will be designed with consideration to the requirements outlined in the Greenstar Design and As Built v1.3 Submission Guidelines. In particular, the structure will aim to utilise environmentally preferable & responsible building materials, such as low carbon concrete and steel & recycled water.

2 Existing Conditions

2.1 Site Description

The site, located at 69-79 Kyogle Street, South Lismore, consists of two separate land parcels situated on either side of Wilson Street. The proposed activity will be undertaken on the eastern parcel, where most of the school's existing structures are located. The western parcel contains sports fields and temporary learning facilities. Figure 2.1 outlines the school's boundary, covering approximately 2.5 hectares. Due to flood damage, the existing buildings on the eastern parcel are currently unused, and students are temporarily using facilities on the sports field and oval, located on the western side of Wilson Street, adjacent to the primary school.

The eastern parcel's site topography is generally flat, consisting of the existing school site. The site's high point is in the middle of the site at approximately RL11.00 and falls to approximately RL10.50 at each boundary, equating to a fall of approximately 1%.

Existing structures on the subject site are primarily two storey brick construction, as well as some single-storey weatherboard buildings. The north-eastern corner of the subject site comprises a grassed play area. Existing structures on the western site are elevated single-storey demountables.

Figure 2.1: Site Location of the proposed redevelopment of the Public School at Lismore South

3 Proposed Activity Description

The proposed activity comprises the rebuild of the LSPS on the eastern parcel of the existing site, in South Lismore, and will be delivered in a single stage. The western parcel is out of the scope of the activity. Any works required on the western parcel (such as removal of demountable classrooms) will be subject to separate approval (if required).

A detailed description of the proposal is as follows:

1. Retention of the existing play equipment, Building K and covered outdoor learning area (COLA) on the western parcel.
2. Bulk earthworks, comprising fill and excavation and other site preparation works on the eastern parcel.
3. Construction of a new building on the eastern parcel for LSPS including:
    a. A one storey building (with undercroft areas below) fronting Kyogle Street containing a general learning space (GLS) hub, hall, library, support hub, administration, and pre-school.
    b. Undercroft outdoor learning areas as well as amenities and storage located on ground level.
4. Landscaping and public domain works, including tree planting, a games court in the northeast corner and an outdoor playing area adjacent to the preschool.
5. A car park on the eastern side of the site, with access from Kyogle Street.
6. Waste collection area access from Kyogle Street.
7. Multiple entrance points, including:
    a. Primary and secondary entries distributed on site frontages.
    b. Vehicular access point to provide access to waste collection/delivery areas and car parking.
8. Ancillary public domain mitigation measures.

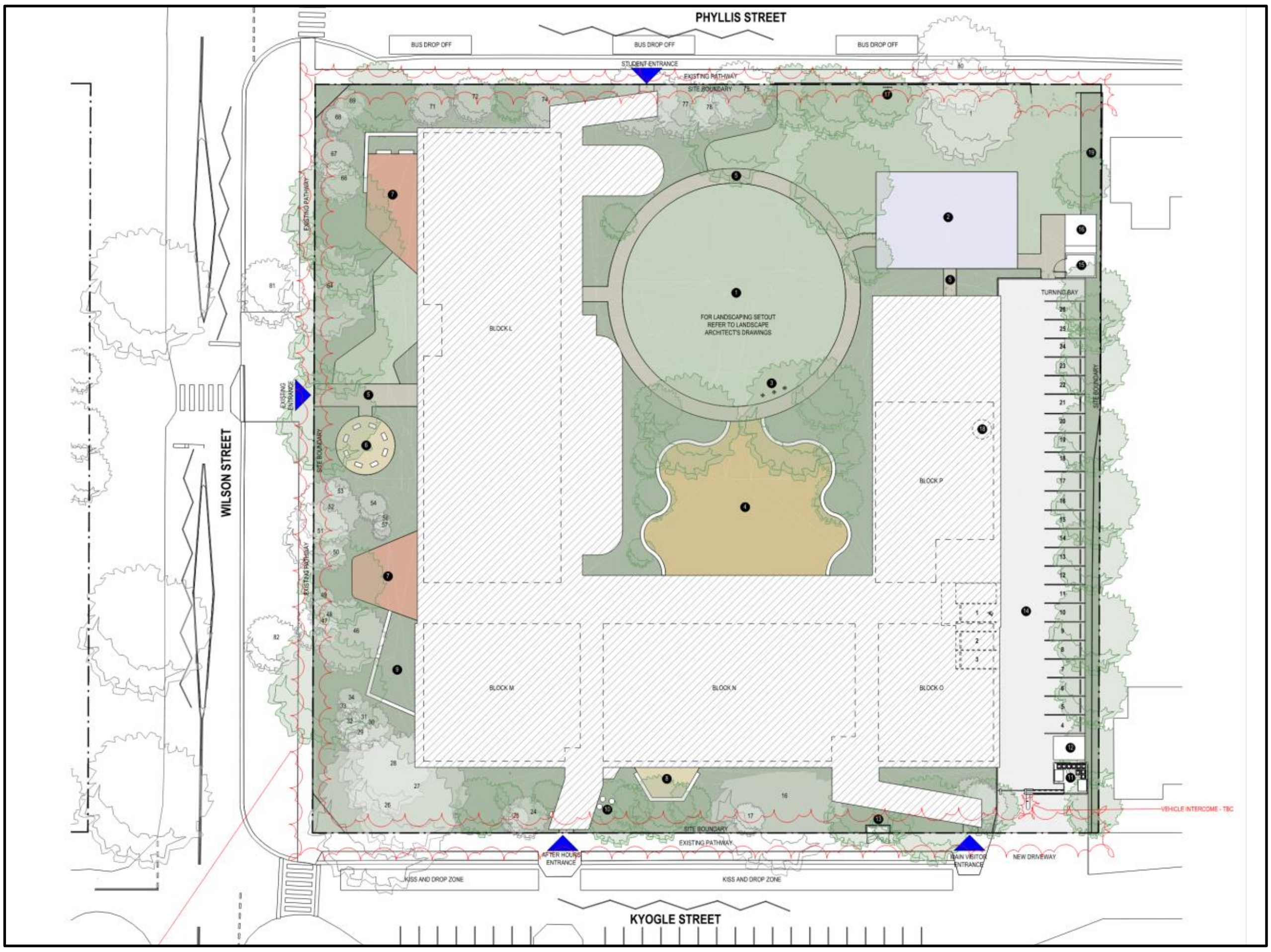

Figure 3-1: Architectural Proposed Site Plan

4 Geotechnical Conditions

4.1 Site Description

The site is located within relatively level topography associated with a floodplain bound by Leycester Creek, Wilsons River and Hollingworth Creek. Surface levels within the site appear to be relatively level.

4.2 Geotechnical Investigations

Geotechnical investigations have been undertaken by **JK Geotechnics** and documented in the report numbered **36310LTrpt** dated 13 December 2024.

The fieldwork for the geotechnical investigations involved:

- 6 boreholes drilled to depths ranging from 3m to 6m.
- SPT tests
- Seven CPT tests to depths ranging from 30.31m to 40.52m.
- Groundwater monitoring
- Selection of soil samples for geotechnical and environmental testing.

Key advice and comments from the geotechnical investigations, relating to the structural design, are summarised below.

4.2.1 Subsurface Conditions

The subsurface profile encountered comprised of:

- Pavements and fill to depths of between 0.2m and 0.6m
- Alluvial soils assessed as primarily silty clays to depths of:
    - Unit 1: stiff clay extending to depths ranging from 2.2m to 4.2m.
    - Unit 2: very stiff clay extending to depths ranging from 14.5m to 16.5m.
    - Unit 3: Stiff to very stiff clay extending to depths ranging from 25.4m to 36.5m.
    - Unit 4: Very stiff to hard clay extending to depths ranging from 32.3m to 38.8m.

4.2.2 Groundwater

All boreholes were 'dry' during and on completion of drilling. Groundwater was measured at a depth of 5.3m in BH2 during a return visit to site.

4.2.3 Site Classification

The site is classified as 'Class H2' in accordance with AS2870 due to the presence of highly reactive clays, assuming no earthworks.

However, due to the likelihood of adverse moisture conditions, structures are recommended to be designed to accommodate shrink-swell movements normally associated with a Class 'E' site.

4.2.4 Foundations

Lightweight structures may be designed to be supported on shallow footings founded on the residual soils or engineered fill, such as shallow pad/strip footings or stiffened rafts. The design parameters for shallow foundations are summarized in Table 4.2.

Table 4.2: Preliminary Shallow Foundation Design Parameters (Source – JK Geotechnics)

Material	Maximum Allowable Bearing Pressure [kPa]
Unit 1	80

For the main building foundations, piles founded into the Unit 2 or Unit 3 alluvial clays are recommended. The design parameters for piles are summarised in Table 4.3.

Table 4.3: Preliminary Design Parameters for Bored Piles (Source – JK Geotechnics)

Material	Maximum Allowable Bearing Pressure [kPa]	Maximum Allowable Shaft Adhesion	
		Compression [kPa]	Tension [kPa]
Unit 2	400	20	10
Unit 3	300	15	7.5

4.2.5 Soil Aggression

Based on soil aggression tests for concrete and steel elements in contact with the soil, the following exposure classifications are recommended in accordance with AS2159-2009 'Piling-Design and Installation'.

- Concrete: Mild
- Steel: Non-aggressive

4.2.6 Ground Floor Slabs

Where ground floor slabs are suspended on piles, the use of void formers is required to isolate the structure from the reactive clays and prevent swelling surcharges on the slab. Void formers made from a degradable material is to have a minimum thickness of 75mm.

5 Design Standards

5.1 Design Standards

The structural design has been carried out in accordance with the latest revision of all relevant Australian Design Standards, Codes and other statutory requirements. As a minimum requirement, the design is based on, but not limited to, the following Australian Standards, as well as the guidelines outlined in Section 1.1 of this report.

Table 5.1: Australian Standards relevant to Structure Design

Number	Edition	Title
AS/NZS 1170.0	2002	Structural Design Actions Part 0: General Principles
AS/NZS 1170.1	2011	Structural Design Actions Part 1: Permanent, imposed and other actions
AS/NZS 1170.2	2002	Structural Design Actions Part 2: Wind actions
AS 1170.4	2007	Structural Design Actions Part 4: Earthquake loads
AS 1720.1	2010	Timber Structures Part 1: Design Methods
AS 2159	2009	Piling – Design and installation
AS 3600	2018	Concrete Structures
AS 3700	2011	Masonry Structures
AS 4100	2020	Steel Structures
AS 4600	2018	Cold-formed Steel Structures
AS 4678	2002	Earth-Retaining Structures
AS 5100.2	2017	Bridge Design – Design loads

6 Loading

6.1 Permanent Loads

The permanent loads which have been allowed for in the structural design are listed in Table 6.1 below, in addition to the gravitational self-weight.

Table 6.1: Permanent Loads

Area	Services (kN/m2)	Ceiling (kN/m2)	Finish (kN/m2)	Partitions (kN/m2)
Classrooms/Offices	0.2	0.2	0.2	0.4
Laboratory/ Workshop	0.3	0.3	0.2	0.4

The structural design has considered a reasonable façade permanent load of 1kPa on elevation.

6.2 Imposed Actions – Live Loads

The floor design live load allowance has been selected to satisfy the minimum provisions of AS1170.1, with consideration also to the requirements in the EFSG. In particular, the following live loads have been adopted:

Table 6.2: Imposed Actions – Live Loads

Usage	Uniformly Distributed Actions [kPa]	Concentrated Actions [kN]
Classrooms	3.0	2.7
Library	4.0	4.5
Stairs & Corridors	4.0	4.5
Kitchen/Dance studio/gymnasium	5.0	4.5
Laboratory/Workshop (other than wood and metal)	3.0	4.5
Workshop for wood and metal	5.0	4.5
Wood/metal store	10	7.0
Other bulk materials store/kiln area and stages	7.5	7.0

The roof live load allowance for all buildings is 0.25 kPa for a non-trafficable roof in accordance with AS1170.1.

Live Load reduction will be applied to appropriate occupancy types in accordance with AS1170.1.

6.3 Wind Loads

The building size and shape is within the scope of AS1170.2 *Structural Design Actions: Wind Actions* and as such the following design parameters have been adopted:

Table 6.3: Wind Load Parameters

Parameter	Value
Region:	B
Importance Level (BCA Table B1.2a):	3
Annual probability of exceedance (BCA Table B1.2b):	1:1000 (ultimate) 1:25 (serviceability)
Regional Wind Speed:	V1000 = 60 m/s (ultimate) V25 = 39 m/s (serviceability)
Terrain Category (all directions):	2.5

6.4 Earthquake Loads

New buildings have been designed for earthquake loading as required by the National Construction Code (NCC).

Earthquake loading has been determined in accordance with AS1170.4 – 2007 (Earthquake actions in Australia) and AS/NZS1170.0 – 2002. The following parameters have been adopted:

Table 6.4: Earthquake Design Parameters

Parameter	Value
Hazard Factor (0.08)	0.08
Probability Factor	1.3
Site Sub-Soil Class	De

6.5 Flood Loads

Structure designed to resist flood forces to AS5100.2 Section 16, with consideration to the following.

- Debris loading
- Hydrostatic & hydrodynamic forces
- Local scour (based upon geotechnical advice)
- Buoyancy of structure

The structure design approach and methodology will be based upon the recommendations in the relevant guidance documents listed in Section 1.1 of this report.

Based upon current advice we understand the Lismore South Public School site is a H6 hazard class.

The flood design parameters have been determined through modelling by TTW's Flood team, and are summarised in Table 6.5 below:

Table 6.5: Flood Design Parameters

Flood Event	Maximum Flood Water Velocity [m/s]	Maximum Flood Level [mAHD]
0.2% AEP	0.24	13.34
2022 Flood	0.77	14.45
Probable Maximum Flood (PMF)	0.43	16.75

6.6 Thermal Effects

Thermal effects have been considered in the design of the structure through the provision of building movement joints, isolation joints and wall expansion joints in accordance with accepted engineering principles. The concrete structures are also designed with the appropriate degree of crack control in accordance with AS3600 *Concrete Structures* depending on the exposure classification.

6.7 Balustrades

Balustrades, including parapets and railings, are to be designed by the manufacturer in accordance with Table 3.3 of AS/NZS 1170.1.

TTW have considered the architectural balustrade framing intent and designed the supporting base structure for the following loads on the balustrade:

1. Dead loads due to self-weight gravity loads.
2. Live load to AS1170.1, as summarised in Table 6.6 below.
3. Wind loads to AS1170.2

Table 6.6: Balustrade design live loads

Top Edge			Infill	
Horizontal [kN/m]	Vertical [kN/m]	Inwards, outwards or downwards	Horizontal [kPa]	Any Direction [kN]
0.75	0.75	0.6	1.0	0.5

7 Serviceability

7.1 Deflection Limits

7.1.1 Vertical Loads

Serviceability deflection limits for all floors and concrete roofs are summarised in Table 7.1.

Table 7.1: Floor Deflection Limits

	Maximum Floor Deflection Limit			
	Dead	Incremental	Live	DL + LL
Supporting non-masonry partitions	Span/360 (25mm max.)	-	Span/500	Span/300 (30mm max.)
Supporting masonry partitions	Span/360 (25mm max.)	Span/1000 or Span/750 if masonry is articulated	Span/500	Span/360 (25mm max.)
Compactus Areas	Span/360 (25mm max.)	Span/750 (10 mm max.)	Span/500	Span/300 (25mm max.)

Serviceability deflection limits for all steel framed roofs is summarised in Table 7.2.

Table 7.2: Roof Deflection Limits

	Maximum Floor Deflection Limit			
	Dead	Imposed	Wind	DL + LL
No ceilings with roof pitch > 3°	Span/360	Span/250	Span/150	Span/150
No ceilings with roof pitch < 3°	Span/500	Span/250	Span/150	Span/150
Lightweight ceilings with roof pitch > 3°	Span/360 (25mm max.)	Span/300	Span/250	Span/250
Lightweight ceilings with roof pitch < 3°	Span/500	Span/300	Span/250	Span/250
Commercial plasterboard and acoustic ceilings	Span/500 (25mm max.)	Span/600	Span/600	Span/250

7.1.2 Horizontal Loads – Lateral Sway Limits

The building sway deflection limits that have been considered in the structural analysis and design are summarized in Table 7.3.

Table 7.3: Lateral Sway Deflection Limits

Building Structure	Deflection Limit
Concrete Structure	Overall – H/500
Steel Structure	Overall - H/250; Relative – B/200

The inter-storey drift limits are taken in accordance with AS1170.4.

7.1.3 Vibration limits

Suspended floors are designed to consider the floor vibrations caused by dynamic loads resulting from human activity (e.g. walking, running, jumping) or mechanical loads (e.g. plant equipment). The Response Factors (RF) considered in the structural design are summarised in Table 7.4.

Table 7.4: Minimum RF Limit for floors

Learning Unit/Hub (occupancy/Receiver)	Vibration Source	Number of Participants (Source)	RF Limit
General Learning Space Hub Support Learning Hub Library Hub Science Learning Hub Visual Arts Learning Hub Food + Textiles Learning Hub Health/PE Learning Hub Performing Arts Learning Hub Additional Learning Hubs Wood + Metal Technology Learning Hub External Circulation Student Amenities	Single walker in the same space	1	8
	Small groups of runners in the same space	1-3	60
	Rhythmic activities in a neighbouring room	30	8
	Rhythmic activities in the same room but separated (e.g. the other side of the room) (e.g. consider concentrated mass rhythmic load from a Performing Arts workshop) (e.g. consider vibration from Wood/Metal Technology machinery)	30	16
Administration Hub Staff Hub OSCH Canteen	Single walker in the same space	1	8
	Unsynchronised groups of walkers (e.g. class moving as a group in corridors)	30	16
Gymnasium / Hall PE Fitness Laboratory	Rhythmic activities – passive bystanders/spectators	30	55-100
	Rhythmic activities – passive active/participants	30	120-200
Stairs	Stairs – heavy use (public)	30	32

The structural design of all floors also considers a minimum natural frequency as summarised in Table 7.5.

Table 7.5: Minimum Natural Frequency for floors

Structure	Minimum Natural Frequency
Concrete floors – walking	4 Hz
Concrete floors – rhythmic activities	8.4 Hz
Lightweight floors - walking	8 Hz
Lightweight floors – rhythmic activities	10 Hz

7.2 Durability

For concrete elements, durability will be achieved by specifying all elements in accordance with section 4 of AS 3600 which outlines the requirements for plain, reinforced and post tensioned concrete structures and members with a design life of 40 to 60 years. Exposure classifications are summarised in Table 7.6:

Table 7.6: Durability Requirements

Exposure Classification	Concrete Element
A2	Internal
B1	In Ground & External

In ground exposure may increase subject to the results of the geotechnical/environmental investigations of soil contaminants.

Protective coatings to structural steel elements shall comply with AS/NZS 2312 and ISO 2063 for the long-term protection category.

7.3 Fire Rating

Fire-rating requirements will be developed during Schematic Design Phase, however, based upon similar SINSW projects we expect the following will be required.

A fire rating period of 2.0 hours is expected to be required to all suspended floors and vertical supports, in accordance with the National Construction Code (NCC). The concrete structural elements have been appropriately sized to satisfy the minimum dimensional and cover requirements outlined in AS3600 Concrete Structures for this fire rating period.

8 Structural Design

8.1 Foundations

The structural system for the new building foundations is summarised as follows.

- Screw piles by the D&C Contractor.
- Reinforced concrete pile cap/capping beams.
- ‘Suspended’ flat slab on void former for the undercroft store/amenity rooms to prevent soil-swelling pressures.

8.2 New Buildings

The superstructure design for the new School building is summarised as follows.

- Reinforced blockwork walls within the undercroft rooms for durability and robustness under flood loads.
- Reinforced blockwork lift shaft & fire-separation wall.
- Steel-framed gantry structure with vertical steel cross bracing providing lateral stability.
- Steel-framed stairs & ramp with in-situ concrete topping floor slab.
- Composite steel-concrete floor within Level 1 Hall.
- Conventional steel-framed hall structure.
- Prefabricated modules above Level 1 by the volumetric sub-contractor.

9 Departures from the EFSG

9.1 Structural Engineering Design

The following departures from the ESFG & DGN007 have been requested.

EFSG Ref.	Clause No./Title	EFSG Requirement	Departure from EFSG/Justification
DG21.1.02	Design	DG21.1.02 Design states “flexible structural solutions that allow for future adaptability to suit changing planning needs should be considered.” The requirement implies that rooms and spaces should have the flexibility to change function and location in the future. Suggested EFSG loads are in Schedule 1 of DG21 and briefly summarized below. ▪ kPa – Highest load (generally for the heaviest storage areas) ▪ 3 kPa – minimum and most common Load per EFSG. ▪ 5 kPa – next most common Load stipulated. (e.g. for workshops and specialist learning).	If across a floor plate there are spaces with higher loading than others then this will limit the flexibility to reconfigure the layout in the future, i.e. light floor loads can be relocated to higher load zones, however higher load zones could not be relocated to lighter floor zones. TTW noted that the method in which the EFSG DG21 is written implies that a Design is compliant when requirements of either the minimum EFSG loading OR Schedule 1 OR the current Australian Standards is met. TTW propose to limit the future flexibility and accommodate live loads as per the current rooms functions according to Schedule 1 of DG21 in order to achieve higher cost efficiency in structures.

10 Mitigation Measures

The mitigation measures applicable to the structural design are listed below:

Mitigation Number/Name	Aspect/Section	Mitigation Measure	Reason for Mitigation Measure
Geotechnical Investigations	Sufficient Geotechnical investigations	Ensure sufficient geotechnical investigations are completed for the entire building footprint to inform the design.	Improve validity of geotechnical advice and ensure structural adequacy of the foundations.
Structural materials	Durable & robust structural materials	Ensure durable & robust structural materials are adopted to withstand the applicable loads as outlined in the Australian Standards, BCA & EFSG.	Ensure structural adequacy of the building superstructure for the design events.

11 Evaluation on Environmental Impacts

This section summarises the key findings of this report:

- The structure has been designed for the loads outlined in the Australian Standards, BCA, and EFSG guidelines.
- The foundation structure has been designed in accordance with the recommendations from the geotechnical engineer, as outlined in Section 4 of this report.

Overall, the activity – from a structural design perspective – will not cause any adverse or significant impact on the environment, subject to implementing the mitigation measures in Section 10 of this report.

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