Structural Engineering Design Report

Northern Rivers Flood Recovery – Richmond River High Campus Redevelopment

Prepared for NSW Department of Education | 14 July 2025

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Revision	Date	Prepared By	Approved By	Remarks
A	6/12/2024	DB	GB	Schematic Design
B	16/05/2025	DB	GB	Schematic Design
C	23/06/2025	DB	GB	REF Submission
D	14/07/2025	DB	GB	REF Submission

1 Introduction

The Department of Education (the department) is the landowner, and proponent pursuant to Section 5.1 of the *Environmental Planning and Assessment Act 1979* (the Act). The activity will be determined by the Reconstruction Authority (RA) under the Ministerial powers in Section 68 of the NSW Reconstruction Authority Act 2022 (RA Act).

This Structural Engineering Design Report has been prepared to support a Review of Environmental Factors (REF) for the rebuild of Richmond River High Campus (the activity) (RRHC). The REF has been prepared to support an approval for the RRHC development under Section 68 of the NSW Reconstruction Authority Act 2022 (RA Act).

The activity will be carried out at Dunoon Road, North Lismore, also known as 163 and 170 Alexandra Parade, North Lismore (the site).

The purpose of this report is to address the structural engineering design of the RRHC redevelopment including building structures and foundations. The relevant requirements of the Lismore City Council Development Control Plan and engineering specifications as well as 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, 26 October 2023.
- 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
- Geotechnical Investigation Report by JK Geotechnics dated 11 January 2025, ref 36314LT2let.

1.2 Greenstar

The Richmond River High Campus 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 Site

2.1 Site Description

The site is located at Dunoon Road, North Lismore, also known as 163 and 170 Alexandra Parade, North Lismore. The site comprises of three separate lots, located to the north of Alexandra Parade, with Dunoon Road running parallel to the eastern boundary of the site.

The site is legally described as:

- Lot 1 DP 539012
- Lot 2 DP 539012
- Lot 1 DP 376007

The site area is approximately 33.53 hectares. The proposed activity will be undertaken mainly within the southeastern portion of the site. The site is outlined in Figure 1.

Figure 1: Aerial image of site (Source: Nearmap)

2.2 Existing topography

The site topography is varied. The eastern portion of the site is generally flat (gradient approx. 1V:200H) and the western portion is relatively steep (gradient approx. 1V:2H). The levels vary from approx. RL 100m at the western site boundary to approx. RL 8m to the eastern site boundary. An existing dam is located to the west of the site at approx. RL 34m and a surface area of approx. 0.1 ha. Stormwater generally flows from the west to the east towards existing culverts under Dunoon Road. Two existing residual dwellings are located around the centre of the site at approx. RL 25m.

2.3 Geotechnical Conditions

Existing geotechnical conditions of the site are documented in the "Preliminary Geotechnical Investigation" report by JKE (dated 22 November 2024). The general findings of the report are listed below:

- Evidence of slope instability (landsliding) encountered with boreholes drilled within the western portion of the site and the area of the proposed activity.
- Topsoil was encountered from the surface ranging depths from 0.1 to 0.5m and generally 0.1 to 0.3m thick.
- Alluvial clay of high plasticity and high strength was identified within the lower, eastern portion of the site.
- Colluvial and residual clays of high plasticity identified in the western portion of the site. Colluvial clays were of stiff to very stiff strength with basalt gravels, cobbles and boulders. Residual clays was very still to hard strength with basalt gravels.
- Weathered basalt was encountered at depths ranging 1.5m to 11.4m below ground level (approx. RL 20.25 to RL 5.75m).
- Depth of competent bedrock increases towards the eastern portion of the site.
- Test results indicate natural clays are of high plasticity and have a high potential of shrink-swell movement with changes in moisture content.
- CBR tests generally returned values of 1.5% to 2.5%.

Conditions of existing groundwater on the site are documented in the "SGIA" report by JKE (dated 10 December 2024). The general findings of the report are listed below:

- Groundwater generally flows in a down gradient towards the lower eastern portion of the site. Groundwater levels generally grade down towards the east.
- The groundwater at the site is generally non-aggressive to mildly aggressive towards buried concrete and non-aggressive towards buried steel. Management measures should be implemented as outlined in the JKE Salinity Management Plan (SMP).
- Report indicates that groundwater is likely to be intercepted during excavation activities. JKE understands that dewatering during construction will be required.
- The SIGA has identified that the groundwater is impacted by heavy metals, turbidity and microbial organisms.

3 Proposed Activity Description

The proposed activity comprises the relocation and rebuild of the Richmond River High Campus from its existing temporary location alongside The Rivers Secondary College Lismore High Campus at East Lismore to the site at 163 and 170 Alexandra Parade, North Lismore.

The school will be delivered in one stage. A detailed description of the proposal is as follows:

1. Demolition of existing features including existing buildings, cattle drinking well, cattle sheds, and wire fencing, and removal of trees to accommodate school development.
2. Construction of new 3 storey buildings on the southeastern portion of the site for the proposed public secondary school including:
    a. General and Specialist Learning Spaces, and Workshops.
    b. Administration, and Staff facilities.
    c. Library, Hall, and Movement Studio.
    d. Construction, Hospitality, and Agricultural Learning Facilities.
    e. Amenity, Plant, Circulation, and Storage areas.
    f. Outdoor Learning Spaces and play spaces.
3. Landscaping including tree planting.
4. Public domain works comprising:
    - Access road off Dunoon Road, comprising a separate shared bicycle/pedestrian pathway, and internal access roundabout.
    - Kiss and ride drop-off and pick up zones.
    - Bus transport arrangements with a separate bus zone.
5. Outdoor spaces including assembly zones, agricultural spaces, sports fields, games courts, dancing circles, yarning and dancing circles, seating and shade structures.
6. On-site carparking, including accessible spaces and provision for EV charging spaces.

Figure 2 indicates the scope of works.

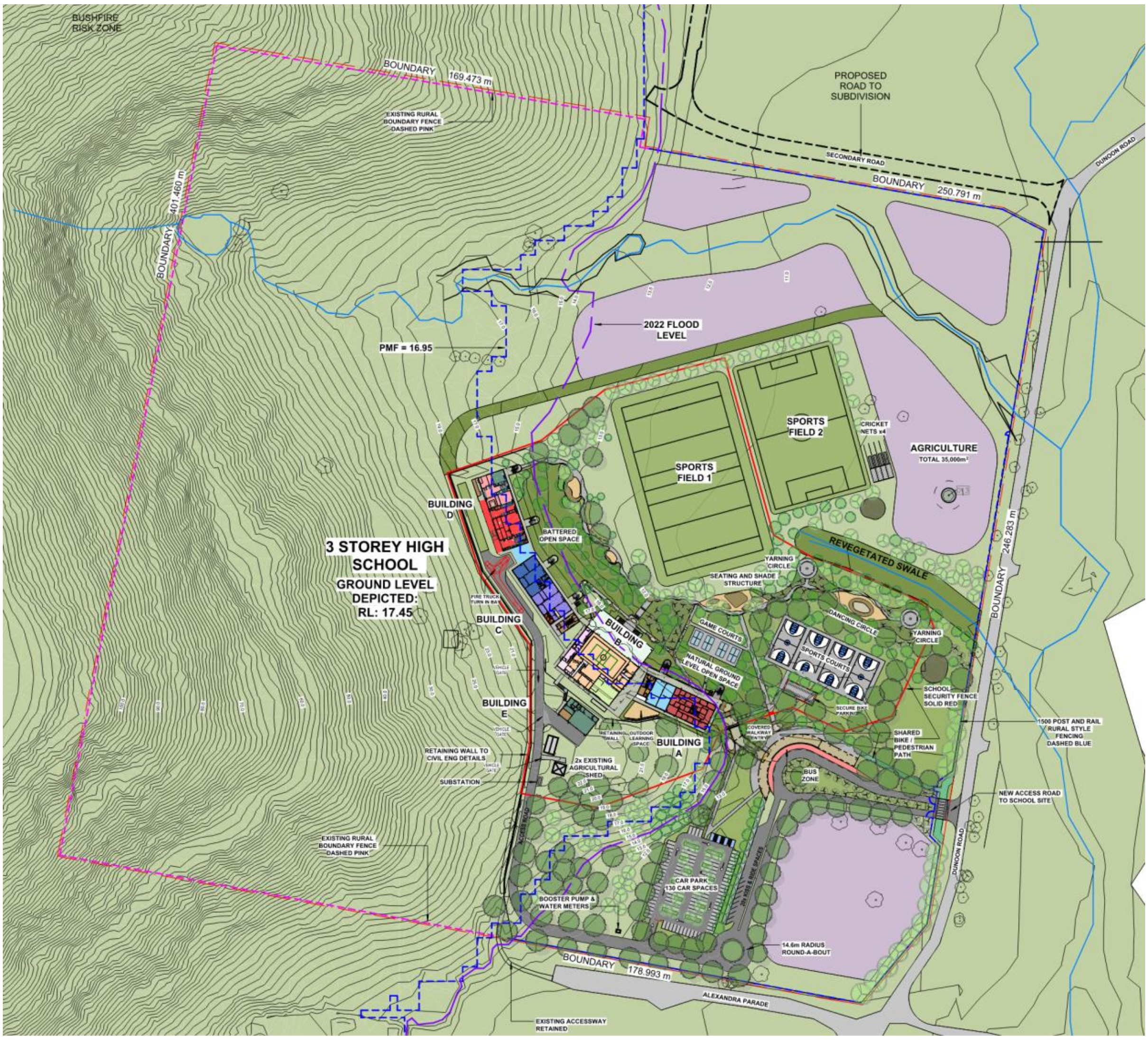

Figure 2: Overall Site Context Plan (source: EJE Architects)

4 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

5 Loading

5.1 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.

5.2 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.

5.3 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

5.4 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	Ce

5.5 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, the Dunoon Road site has been estimated to have a H6 Hazard Class.

5.6 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 environment and associated thermal effects.

5.7 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 6.5 below.
3. Wind loads to AS1170.2

Table 6.5: 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

6 Serviceability

6.1 Deflection Limits

6.1.1 Vertical Loads

Serviceability deflection limits for all floors and concrete roofs is 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

6.1.2 Horizontal Loads – Lateral Sway Limits

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

6.1.3 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	Rhythmic activities – passive bystanders/spectators	30	55-100

PE Fitness Laboratory	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

6.2 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 be required to be changed depending on results of a geotechnical investigation of soil contaminants.

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

6.3 Fire Rating

Fire-rating requirements will be developed during Concept 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.

Steel structure would require application of a fire rated coating, options could include vermiculite spray, intumescent coatings and boarding. Careful consideration of required maintenance and inspection requirements needs to be made with the use of fire rated coatings.

Timber structure would resolve fire rating by utilising the char of the timber to AS1720, alternatively application of a secondary fire protection system.

7 Structural Design

Key structural elements are discussed below.

7.1 Foundations and retentions systems

The current foundation system for the building are as follows.

- Reinforced concrete pile socketed into rock for stability due to landslip risk and proximity to flood plain.
- Reinforced concrete pile cap/capping beams.
- Reinforced concrete or reinforced blockwork retaining walls.

7.2 New Buildings

The superstructure is designed to suit the current SINSW hub layout, which generally creates a standard 9000mm x 7500mm grid layout.

The current intended structural systems are follows.

- Reinforced concrete ground floor slabs on void former.
- Reinforced concrete columns.
- Reinforced concrete shear walls.
- Post-tensioned suspended floors.
- Concrete columns extend to the roof to provide stability and support the conventional steel-framed roof.
- Steel portal-framed structure to the hall/COLA and Agricultural shed.

8 Departures from the EFSG

8.1 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.

9 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.

10 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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