Property and Development NSW (PDNSW)

Coffs Harbour Jetty Foreshore State Assessed Planning Proposal

Structural Report

February 2025

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Rev	Date	Details
Draft2	25/10/2023	Updated with Comments
Rev 1	11/3/2023	Final
Rev 2	5/9/2024	Final incorporating TOA comments
Rev 3	25/2/2025	Updated Masterplan diagram
Rev 4	26/2/2025	Updated Masterplan diagram
Rev 5	28/2/2025	Updated Images Fig 7 & 14

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WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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Glossary of Terms

Term	Definition
Low-rise	Up to 4 storeys
Mid-rise	5-15 storeys
ARTC	Australian Rail Track Corporation
DBPA	Design and Building Practitioners Act
iCIRT	Independent Construction Industry Rating Tool
BCA Consultant	Building Code of Australia Consultant
DA	Development Application
Pad	Type of foundation to carry a structural load into the ground
Pile	A column of concrete placed into ground to carry a structural load usually used to carry load deeper into ground where more support resistance is found.
Secant	Type of pile wall used for basements
Contiguous	Type of pile wall used for basements
Aggressivity	Aggression level in relation to environment or ground
Corrosivity	Corrosion level in relation to environment or ground
Salinity	Salt level in relation to environment or ground
Induced Ground Borne Vibrations	The vibrations that travel through the ground usually from a source such as road or rail.
Bearing	A vibration isolation mechanism that reduces the transmission of vibration across it.

Executive summary

In collaboration with the consultant team commissioned by Property & Development NSW (PDNSW), WSP has carried out a structural feasibility study for the proposed State Assessed Planning Proposal of the Coffs Harbour Jetty Foreshore Precinct (Precinct) as outlined in the Illustrative Masterplan. It's imperative to understand that this Structural Study, as part of the State Assessed Planning Proposal process, does not delve into specific architectural designs or detailed planning for any proposed buildings; rather, it evaluates the potential for altering land use designations based on structural feasibility, including the assessment of building heights, scales, and bulk sets the groundwork for what could be permissible within the rezoned areas.

Should the State Assessed Planning Proposal be approved, it will pave the way for the second phase, which involves detailed design and Development Application (DA) submissions. This subsequent phase will see each proposed building undergoing a design and planning processes tailored to meet specific requirements, including local topography, geotechnical conditions, and architectural design standards. This distinction clarifies that the proposal itself is not an intention to advance any specific building designs or DAs but rather to establish a framework within which future development can occur.

Our study concludes that the structural aspects of the State Assessed Planning Proposal are feasible, with the proposed buildings' locations and heights being deemed appropriate based on the outlined feasibility plan. The geotechnical analysis, a cornerstone of this study, supports the varied foundation solutions needed for different types of buildings, from low to medium rise structures with and without basements. Despite proximity to the coast requiring specific design considerations for salt resistance and basement waterproofing measures, our findings indicate no insurmountable challenges that cannot be addressed in the normal design process.

In summary, WSP's structural feasibility study supports the State Assessed Planning Proposal plan for the Precinct, highlighting that the initial phase is but a step in a comprehensive process. Approval of this State Assessed Planning Proposal does not predetermine specific building designs but rather enables the progression to the design and DA phase for individual buildings within the rezoned precinct.

1 The Site

1.1 Project Description

Property and Development NSW (PDNSW) is continuing to lead the revitalisation of the Coffs Harbour Jetty Foreshore Precinct (the Precinct) on behalf of the NSW Government. WSP has been engaged by PDNSW to prepare a Structural Report that provides advice on the viability and constructability of the design elements and provides an outline review of the development lots, including information on the buildings' structural forms and possible method of design.

This structural report supports a Planning Justification Report that outlines proposed amendments to the Coffs Harbour Local Environmental Plan (CHLEP) 2013 and will be submitted to the Department of Planning, Housing and Infrastructure (DPHI) as part of a State Assessed Planning Proposal (planning proposal).

As Coffs Harbour continues to grow as a Regional City, the NSW Government and Coffs Harbour City Council have, through various strategic planning exercises, identified four key strategic priorities to reimagine its direction and respond to current and future challenges and opportunities:

- Deliver a regional economy (CHCC LSPS, 2020; CH Economic Development Strategy, 2017) that is diverse, sophisticated and able to retain businesses and skills
- Evolve the tourism offering CHCC LSPS, 2020) with improved attractions, activities and accommodation
- Provide more housing (CHCC LSPS, 2020) in accessible locations, including affordable housing
- Provide better connections between places with more sustainable movement choices (CHRCAP, 2021; CHCC, 2020)
-

As a large, strategically located and wholly government owned site, the Precinct represents a significant opportunity to deliver on each of these key regional priorities. In this planning proposal, PDNSW seeks to celebrate the unique location, history and culture of the Jetty Foreshore to deliver outcomes for the benefit of the Coffs Harbour community. The revitalisation will be staged and funded, over time, to deliver the shared community vision.

Our shared community vision

Coffs' family playground, a precinct of parks and places, that connects community with Country. The community is and always has been at the heart of creating a thriving regional economy and destination for Coffs Harbour. Shaped with the community, our vision is to ensure The Jetty Foreshore will become a world-class oceanfront precinct through the vision shown in **Figure 1**.

Figure 1 Vision for the Coffs Harbour Jetty Foreshore

The Precinct

The Precinct, wholly owned by the NSW Government, is strategically significant to the State and to the Coffs Harbour region. The Precinct is located on the traditional lands of the Gumbaynggirr people, in saltwater freshwater Country. It encompasses approximately 62 hectares of foreshore land, 5km east of the Coffs Harbour CBD, located on the Coffs Harbour coast with direct access to the Pacific Ocean. Access is provided on Marina Drive in the north, and Camperdown Street in the south, with Jordan Esplanade bisecting the site north to south. A Precinct map showing existing conditions is provided at **Figure 2**.

The west boundary is generally defined by the railway line and Coffs Harbour Railway Station. To the north the Precinct borders a culturally significant site known as “Happy Valley”, which has been returned as freehold land to the Coffs Harbour and District Local Aboriginal Land Council (LALC). Gallows and Boambee Beaches are located to the south of the Precinct, where Littoral Rainforest occurs. Coffs Harbour itself, the Pacific Ocean, Muttonbird Island and South Coffs Island (Corambirra Point) form the eastern boundary.

The Precinct is a popular destination for both locals and tourists offering a variety of attractions and amenities. These include Jetty Beach and extensive parklands with biodiversity value, as well as items of heritage significance such as the Coffs Harbour Jetty and Ferguson’s Cottage, owned by the Coffs Harbour LALC. Further, the Coffs Harbour Fisherman’s Co-op, the Coffs Harbour Yacht Club, weekly Sunday markets, and community hub building (recently delivered by PDNSW) are located within the Precinct. Various public works including breakwater and boat ramp upgrades have been undertaken over recent years to support the marina function.

There are redeveloped and well-maintained parts in the area however, much can be done to enhance the Coffs Harbour Jetty Foreshore Precinct. A large portion of the Precinct is currently gravelled, and a large area of residual railway land is fenced off and inaccessible to the public, as shown in **Figure 3**. While gravelled areas provide informal overflow parking, they do not reflect the potential of this foreshore.

Figure 2 Coffs Harbour Jetty Foreshore Precinct

Source: SJB

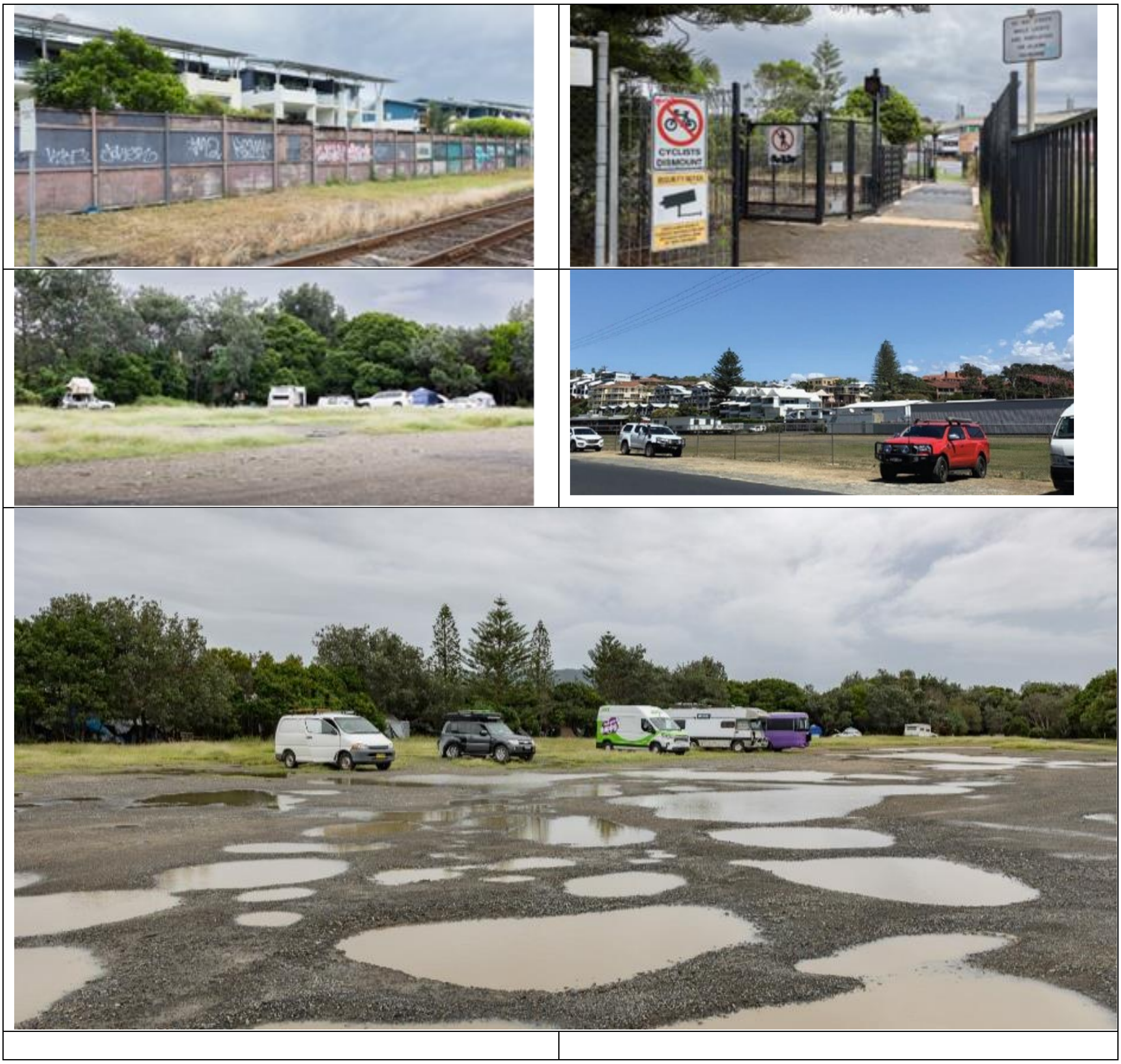


Figure 3 Existing state of the Precinct rail lands and gravelled areas

Source: PDNSW

The Illustrative Masterplan

The planning proposal is supported by an Illustrative Masterplan (**Figure 4**) that presents a potential development outcome that could be realised at the Coffs Harbour Jetty Foreshore Precinct – it is not prescriptive nor is it determined. The Illustrative Masterplan builds on the shared vision created via extensive community and stakeholder consultation and provides further detail in relation to land use and development outcomes sought for the Precinct. The Place Principles shown in **Figure 5**, agreed with the community, guided the formation of the Illustrative Masterplan.

The Illustrative Masterplan is broadly organised across six sub-precincts that will each have a distinct character and function. These are identified as:

1. Foreshore Parklands – with improved amenities, proposed new board walk and nature-based playground.
2. The Marina – An active marina revitalised to accommodate local marine based businesses that reflect their regional importance.
3. North Park – Functional open space with recreational courts and formalised parking.
4. Jetty Hub – A hub of residential and tourist accommodation supporting activation, tourism and regional attraction located adjacent to the current Jetty Walkway, with massing capped at 6 storeys stepping down in scale when closer to public areas.
5. Activity Hub and Village Green – An active village green that delivers increased public open space connected to the existing foreshore parklands and may include family-friendly food and beverage, community uses and club houses or facilities to support events. A local business activity zone connected to the rail station.
6. Corambirra Point – A new regional tourist destination on the site of the former Deep Sea Fishing Club site including publicly accessible cafes and restaurants, a function space, activity centre and tourist accommodation.

A precinct map showing the Illustrative Masterplan and the six distinct zones is provided at **Figure 6**.

Figure 4 Illustrative Masterplan

Source: SJB

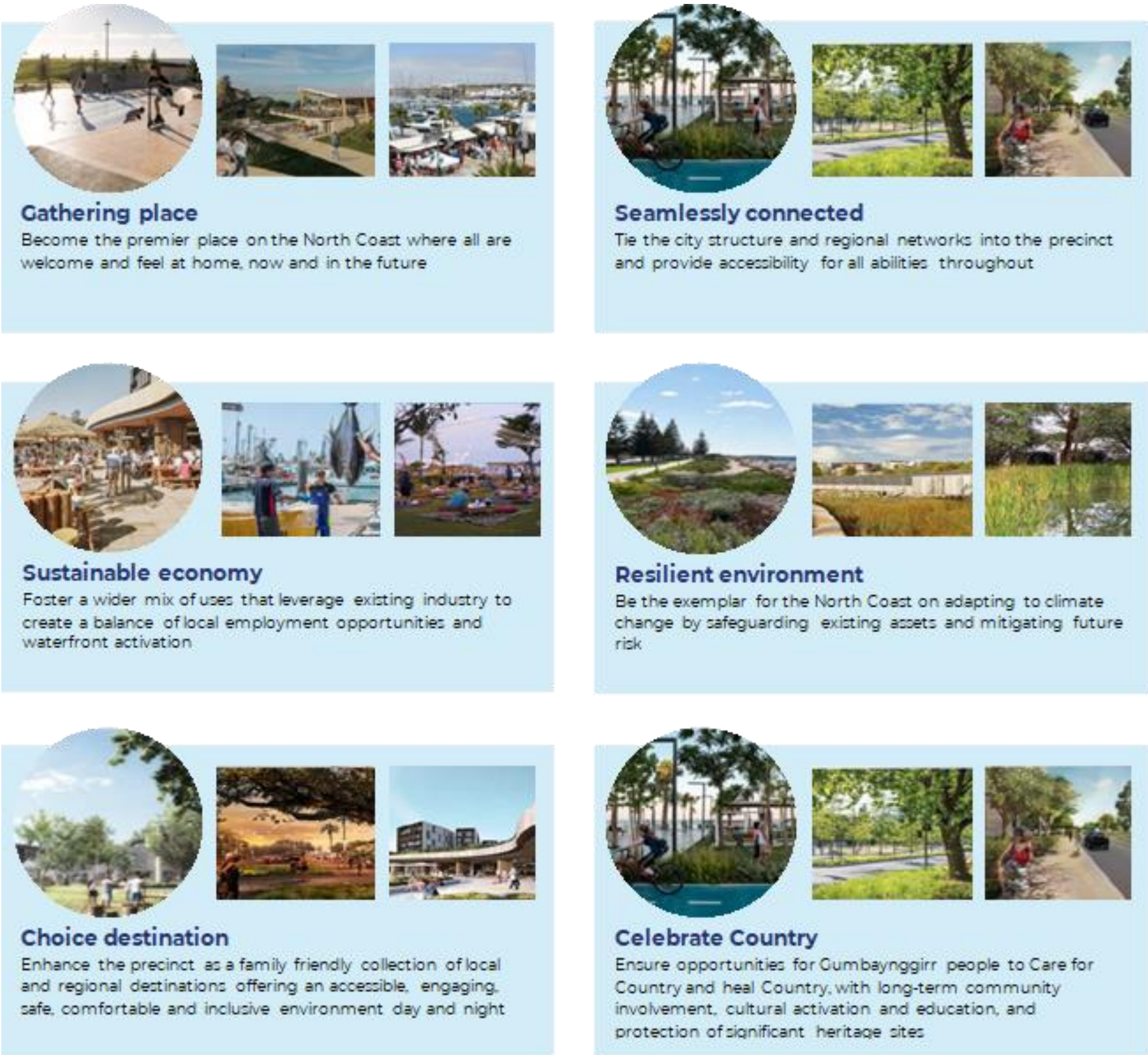


Figure 5 Community-led-places principles

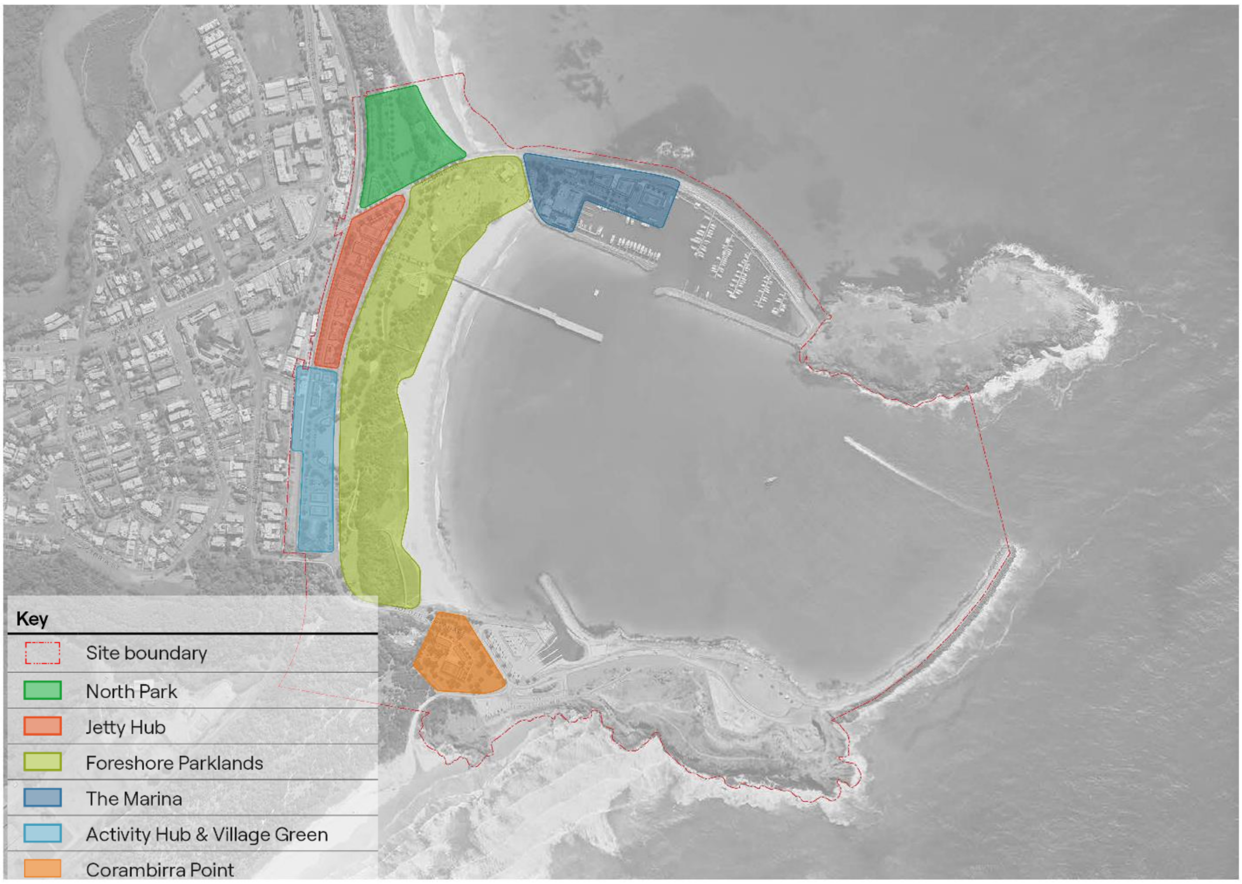


Figure 6 Sub-precinct

Source: SJB

The planning proposal

The master planning of large-scale precincts follows a highly consultative and stepped approach. The current step, which paves the way for the revitalisation of the Coffs Harbour Jetty Foreshore Precinct, is the application for a State Assessed Planning Proposal, which is a legislated process.

PDNSW is lodging a planning proposal with the Department of Planning, Housing and Infrastructure that seeks approval for:

- Changes to permissible land uses
- Changes to permissible maximum building heights
- Planning controls for future State Significant Development Applications including design guidelines and design excellence processes
-

This structural report supports this planning proposal.

1.1 Superstructure

The illustrative masterplan includes various developable lots located adjacent to the existing railway line. WSP has considered the main types of potential buildings permissible in the rezoned area. While the specific design response for each building will be completed by its respective design team during the development application process, WSP has taken a high-level approach to test the practicalities of the buildings and as a result of our assessment - show that the proposed development is structurally feasible.

Alternatives for foundations, vibration isolation and basements (for underground carparking or plant etc.) have also been included to show feasible solutions in support of the planning proposal and also to provide early guidance to the respective design teams who will be appointed during the design and DA stages.

1.1.1 Lateral Resistance

It is common structural practice to utilize the lift and stair core as the structural stability system for the building. It is recommended that this approach is used for the buildings within the rezoned area. Stair cores and lift shafts are to be constructed of in-situ concrete which will provide lateral stability to the structures. Additionally, shear walls or a braced bay (along perimeter is preferred structurally) may also be required. This is subject to the chosen floor option and detailed analysis. Floor layout options should also take into consideration the noise and acoustic report given the proximity to the railway corridor.

In cases where the building's service core is positioned off-center, as seen in the referenced structure, additional stability measures are required along the building's most distant edge. This can be achieved through the implementation of a shear wall, brace, or portal frame, with a suggested location indicated previously.

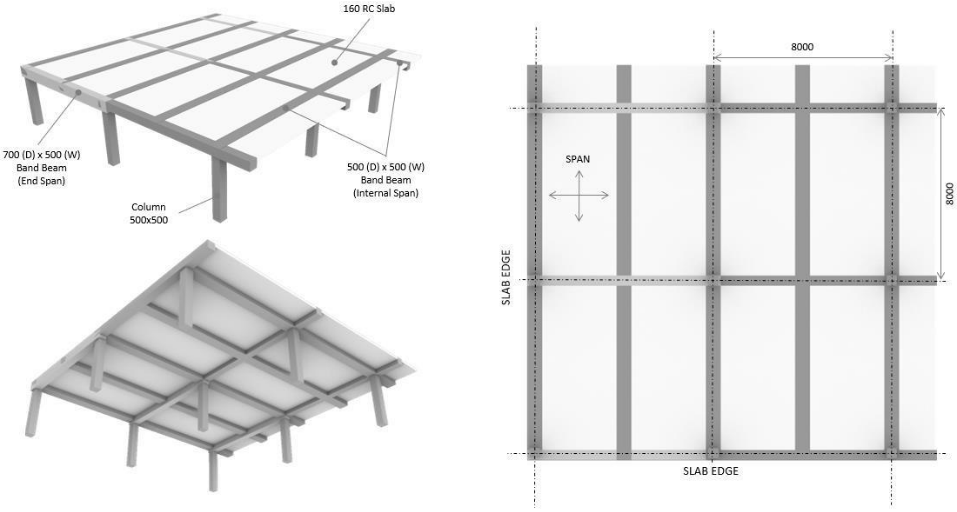
The primary distinction between residential, office, and retail spaces in low and mid-rise buildings lies in their specific loading needs. Commercial and retail spaces demand higher load capacities compared to residential areas, owing to increased requirements for storage and machinery space necessary for air conditioning and power systems. While both typically utilize an 8m x 8m grid layout for low and mid-rise structures, the exact grid configuration is determined based on individual building requirements.

The choice of structural frame for each building will be influenced by a unique set of advantages and disadvantages, which must be carefully evaluated by a future design team during the development application stage.

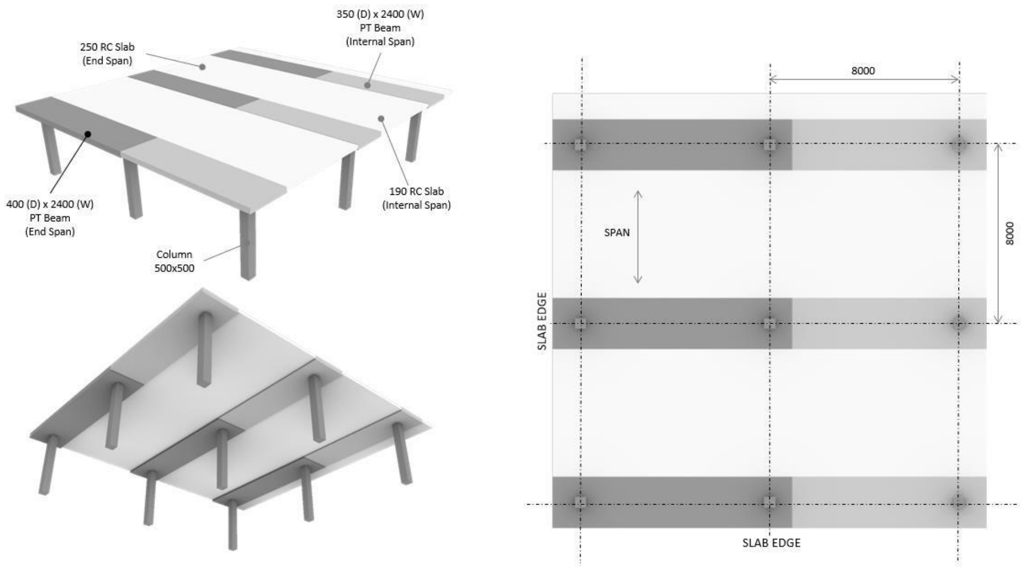
To support the State Assessed Planning Proposal application WSP has examined the categories of residential and commercial uses, and has considered some common methods for constructing floor plates to illustrate possible solutions that may be suitable. These methods are shown for hypothetical viability purposes only and no not represent an exhaustive list of structural forms. These are detailed below:

1.1.2 Office

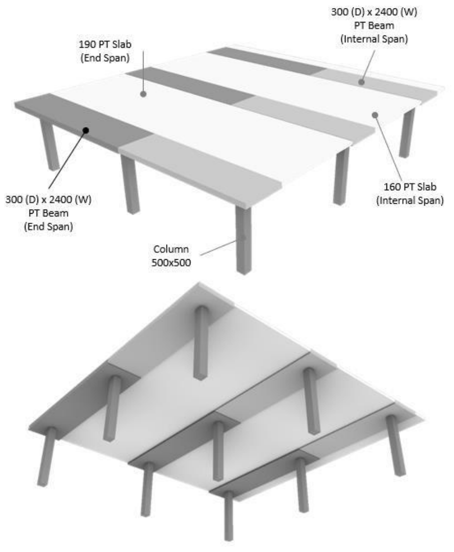
WSP has looked at some of the available options for the construction of the office superstructure, below are the outlined schemes:

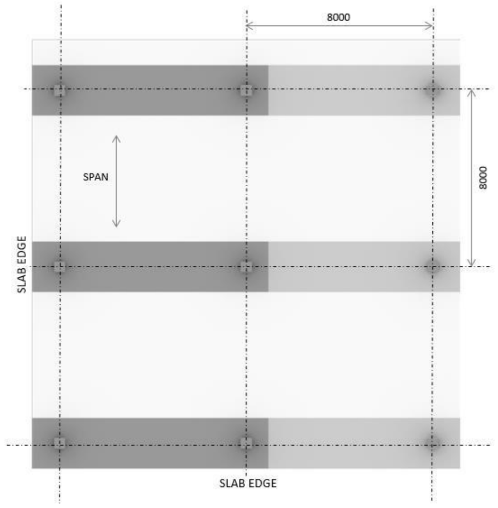


Option 1: Conventional Reinforced Structure

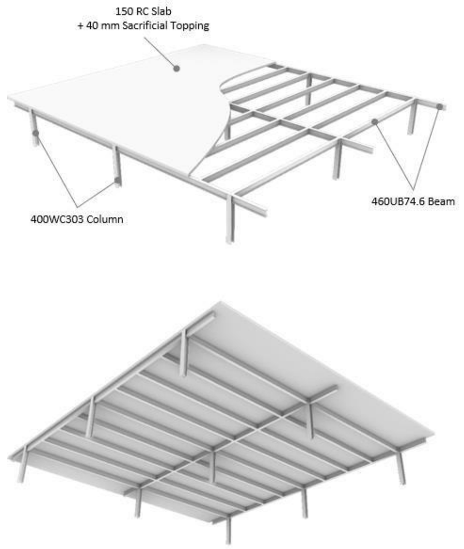


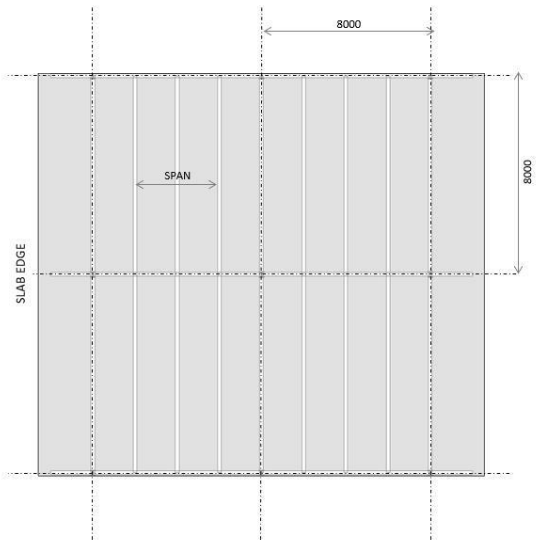
Option 2: Post Tensioned concrete beam/ Reinforced Concrete slab



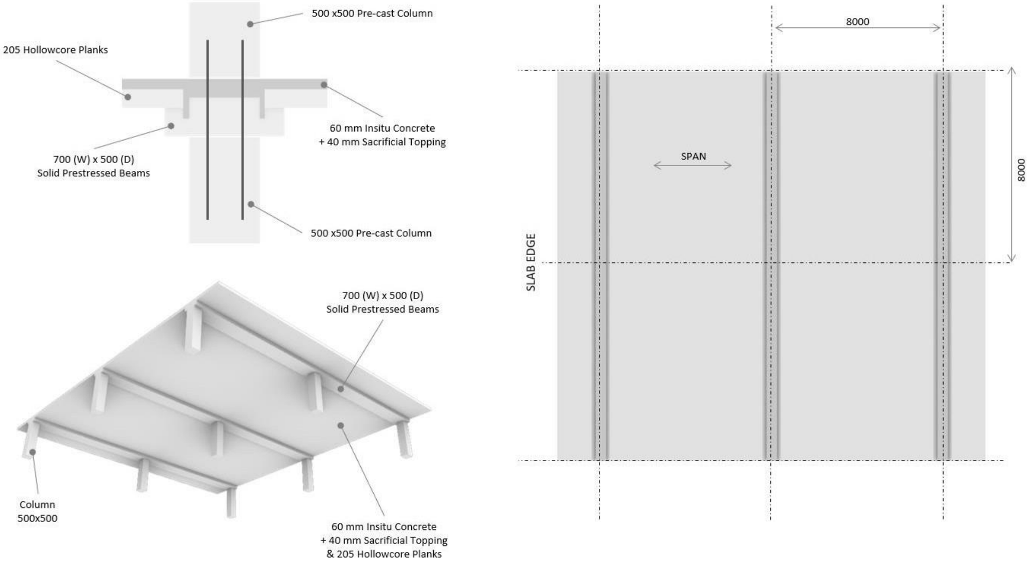


Option 3: Post Tension banded beam and slab





Option 4 : Composite steel solution

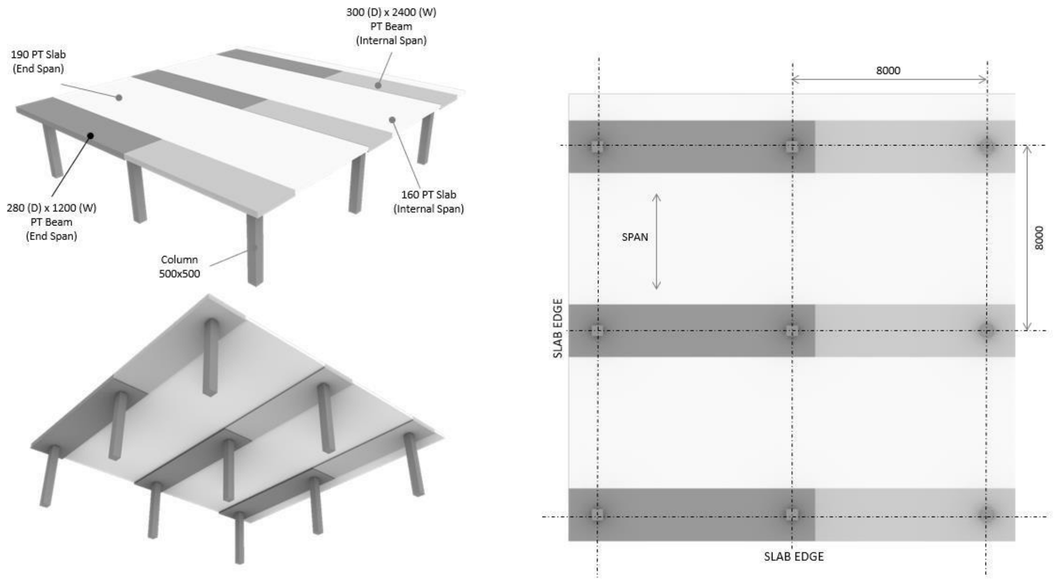


Option 5: Precast concrete

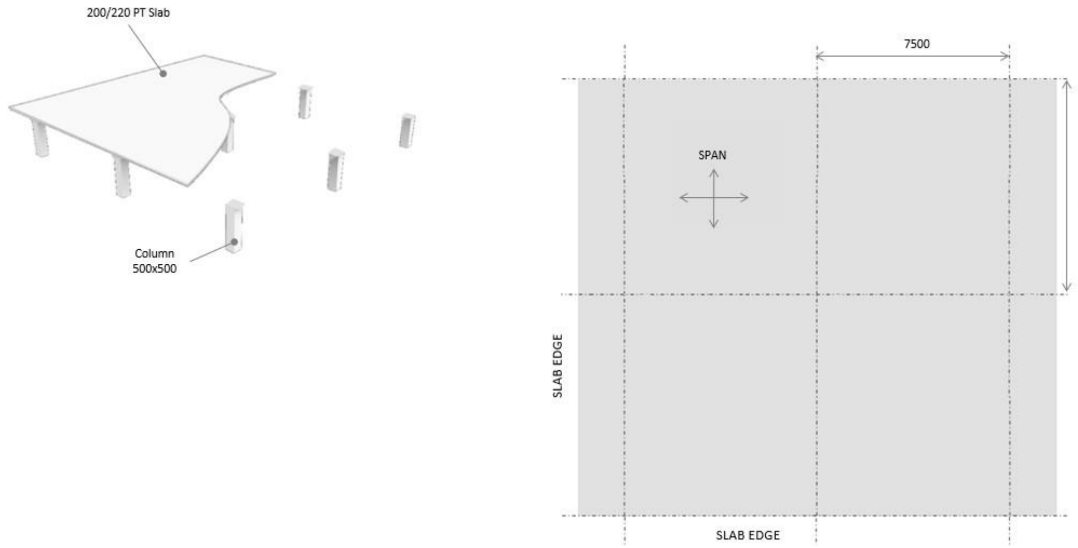
For midrise commercial structures, Option 3 is the most common solution and is recommended here as a base case for the planning proposal application

1.1.3 Residential

Residential construction is generally formed of two options, Post Tension (PT) banded slab and Flat Slab. Engineered timber such as Cross Laminated Timber (CLT) is also a structurally feasible option and provides significant embodied carbon benefits. However, due to market supply and cost reasons, this option is less common and hence not described here.



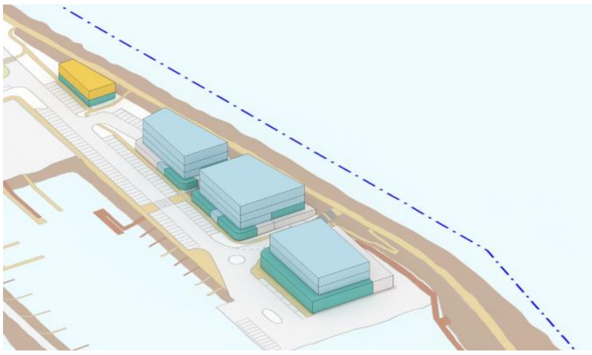
Option 1: Post Tension banded Slab



Option 2: Flat Slab

For residential structures, option 2 is the most common solution and is recommended here as a base case for the planning proposal. The noise or vibration due to the proximity of the railway does not impact the choice these structural floor slab options.

To further test the potential illustrative building designs, the approx. 8m x 8m grid is applied to some of the main building footprints to assess the practicalities of the schemes and show that viable solutions can be found to support the planning proposal.



Source: SJB (20)

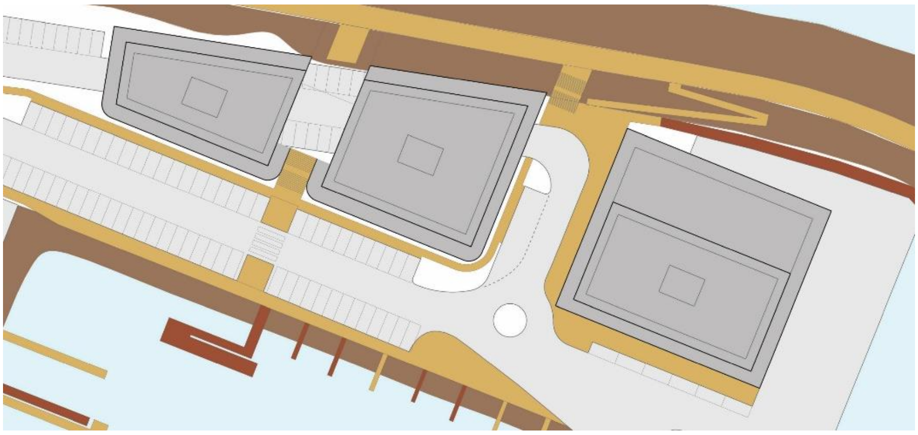


Figure 7 General arrangement and 3D perspective of reference building

Source: SJB (20)

Figure 8 General arrangement and 3D perspective of reference building

1.2 Substructure

WSP has reviewed the range of foundation options which will be impacted by building height and ground conditions in the vicinity of any intended building in section 1.3.1.

WSP has discussed the proximity of potential buildings to the on site railway corridor in section 1.3.2.

WSP has also looked at options for basement retention and use cases in section 1.3.3.

1.2.1 Foundation Options

As a separate addendum to this planning proposal, PSM have undertaken a Desktop Geotechnical Study as well and Intrusive Investigation (18). WSP has reviewed these documents and has selected suggested foundations for the different types of buildings in the scheme. These suggested foundations are not an exhaustive list and further design will be provided for each structure at DA stages.

The geotechnical report generally provides recommended options for the foundation based on the site testing. At this stage of the project a range of options has to be considered which will be narrowed down to the selected option based upon the results of the site-specific geotechnical testing, and the size and layout of the proposed buildings structural grid.

For the low-rise, up to 4 floors, lightweight buildings, the geotechnical report recommends a pad foundation is used. For the mid-rise buildings, 5 to 15 floors, the geotechnical report recommends piled foundations are used, these can be founded in the Natural Sand or Clay. Note the Masterplan only contemplates buildings up to 6 floors. Basements (for underground carparking or plant etc.) may allow for mid-rise buildings to utilize pad foundations bearing directly on the bedrock in lieu of the piled option.

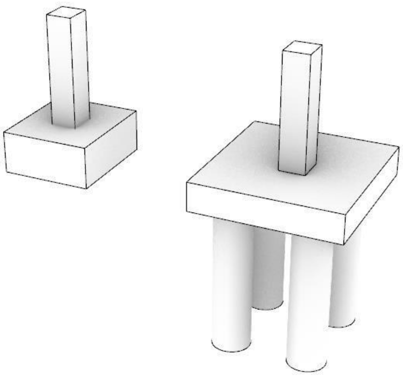


Figure 9 Example of pad footing and pile cap foundations

Consideration of the aggressivity and corrosivity of the sulphates and salinity in the foreshore will be required. Concrete piles are subject to salinity that is categorised as “Very Severe” within the tidal splash zone and the design of concrete structures requires this exposure classification of B2 for coastal zones according to AS3600:2018 - Concrete structures. (6). It is not anticipated that an exposure classification of C1 in “spray zones” will be required as the buildings will be further away from the sea and this is more in line with a maritime/jetty type construction.

This classification is not unexpected given the location on the foreshore of the coast, the mitigating requirement for superstructure due to these classifications is a minimum concrete grade (minimum 40MPa for B2 exposure classification depending on soil properties) and an increased minimum cover to reinforcement (55mm for saline soils in B2 classification). This is common practice for all costal construction.

1.2.2 Basement proximity to railway

WSP has reviewed the potential construction of basement floor(s) in proximity to the railway line. The planned buildings are generally situated more than 15 meters from the active railway tracks, with basements reaching depths of approximately 6 meters for a two-story basement and approximately 9 meters for a three-story basement. Utilising a 45-degree line of influence drawn from the railway, it has been determined that the proposed foundations fall outside of this line, indicating that the basements and their construction will have a minimal impact on the railway. While increasing the distance from the railway offers benefits, it is not strictly necessary.

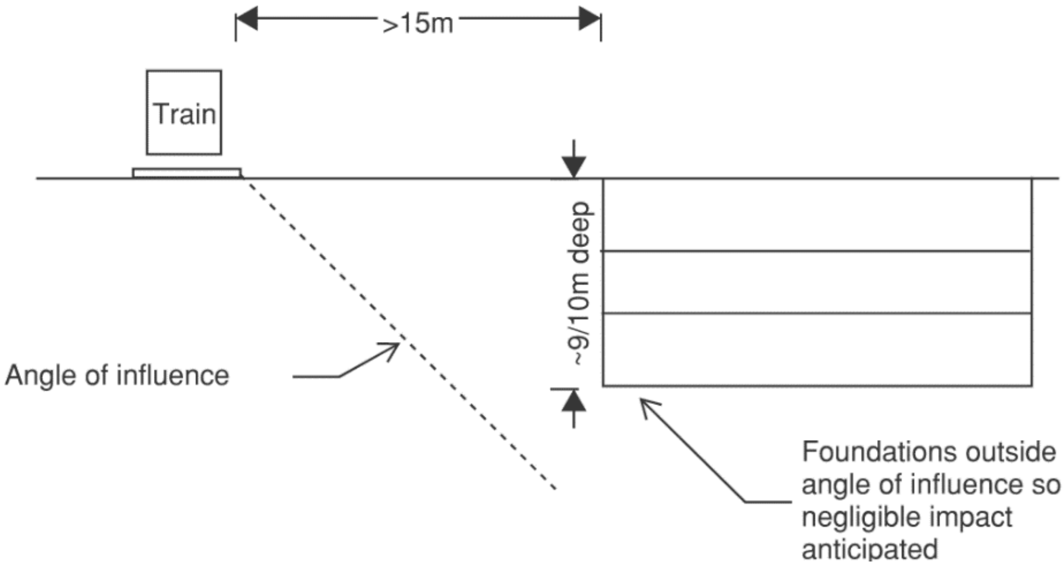


Figure 10 Example influence line from railway on basement.

1.2.3 Basement Options

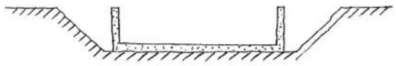
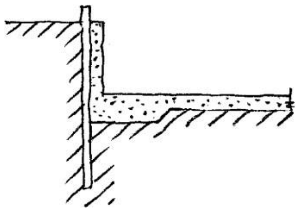
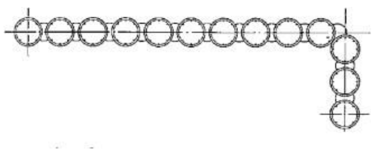
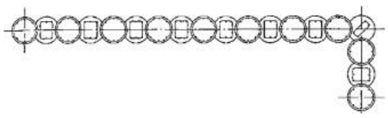
The buildings in the planning proposal area have the potential to have 2 or 3 basement floors, choosing not to include basements can reduce construction costs and accelerate the building process. However, this decision necessitates relocating parking and utility rooms to the ground level, which may be less desirable.

For mid-rise buildings lacking a basement or featuring only one basement level, the geotechnical report suggests the likely need for pile foundations. Incorporating two or three basement levels, while more expensive and time-consuming, enhances the capacity for parking and utility spaces. This choice might also enable the use of bedrock foundations with pad systems for more buildings, contingent on their specific site locations. Geotechnical findings highlight bedrock presence primarily to the north and south of the area. Although extracting basements from this rock is labor-intensive and costly, it is a feasible approach.

Central site buildings are expected to primarily encounter clay. The medium-strength rock identified necessitates excavation. With the area's high water table, implementing secant piles that interlock with the rock can safeguard against water infiltration during basement construction, followed by targeted rock removal for the basement's completion.

Determining the value of adding a third basement level, especially considering the need to excavate rock, requires a site-specific cost-benefit analysis. The presence of rock layers does not inhibit the construction of basement levels.

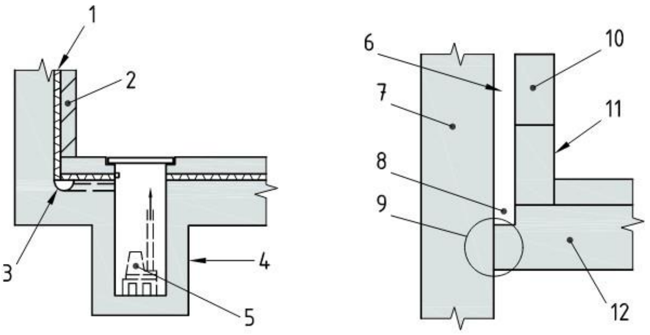
Table 1 Basement Options

Method	Diagram	Comments
Open Cut **Recommended option for 1 storey basement**		• Only possible if sufficient site area is available. • Only suitable for limited depths. • Permeability dependent on specification for wall and lining • Walls may be designed as propped cantilevers; • Dependent on construction sequence.
Sheet Pile and RC wall		• May be environmental constraints on driving sheet piles. • Only suitable for limited depths. • Depends on soil type (sheet piles perform differently in different soils) • Permeability dependent on specification for wall and lining • Temporary props to top of wall may be required if walls are to be designed as propped cantilevers.
Pile wall		• Quick construction sequence. • Flexible, can accommodate changes to retained height and plan shape. • Requires internal drained cavity or lining wall to deal with potential long-term seepage • Not watertight. • May not be suitable in sands and gravels where soil loss could occur
Secant Hard/Soft Pile wall		As above, but provides temporary water cut off and eliminates loss of soil behind wall. • These are not generally recommended, as there is some doubt regarding the durability of the 'soft' core.
Secant Hard/Firm Pile wall **Recommended option for 2 or 3 storey basement**		• Stiffer construction leads to reduced deflections. • Can require internal drained cavity or lining wall to deal with potential long-term seepage depending on grade of waterproofing protection required • Slab connections formed using bars grouted into drilled holes. • Limited to a depth where interlock of piles can be guaranteed. • Can be formed using a CFA rig. Can use plunged columns for greater depths.

A single storey basement has the added benefit that it can be constructed using an opencut batter system which is a simple and financially efficient way to form the basement. For a 2 or 3 storey basement a Hard/Firm secant pile solution is recommended, which can be keyed into the encountered bedrock. This secant wall acts as a cut off for the ground water to simplify the basement tanking system. Nothing is inhibiting the construction of basements, only the cost benefit impact.

1.2.4 Basement waterproofing

Basements at the site will need to respect the water table, it is recommended that the basements, are designed with reference to BS 8102: Protection of Below Ground Structures Against Water Ingress (17). The Masterplan includes and allowance for basements up to 3 storeys deep. The water table should be considered at ground level according to the geotechnical report (18) so the basement will be required to be constructed to prevent water ingress, this can be achieved either with a tanked solution keeping water out, or with a drained solution such as a cavity wall. It should be noted that a cavity solution will need to ensure that the basement wall is constructed such that seepage and damp areas are limited as required by ICE’s Specification for piling and embedded retaining walls. Below is an extract of BS8102 Figure 2 which is a schematic arrangement for a drained solution:



c) Type C (drained) protection

Key

1 Cavity drain membrane
2 Inner skin (render, dry lining or walling, depending on system)
3 Maintainable drainage channel with pipe connection to suitable discharge point
4 Sump formed in situ or pre-formed
5 Pump
6 Wall cavity
7 Reinforced concrete/steel pile or diaphragm wall
8 Drainage channel
9 Waterstop at junction to follow wall profile
10 Internal block wall
11 Access point(s) to drainage
12 Floor slab with integral protection and/or added membrane (internal or external)

Figure 11 Schematic Arrangement for a Drained Solution

1.3 Rail Induced Airborne Noise

Rail induced Airbourne noise is not a structural item, however acoustic hardening of the façade, installation of a noise wall along the rail corridor or planting of trees can all benefit and reduce airborne noise into the buildings. For further information refer to the Acoustic Report prepared as an addendum to this State Assessed Planning Proposal Application.

1.4 Rail Induced Ground Borne Vibrations

The Acoustic Report finds that the structural borne noise will be above the codified acceptable criteria, a further study will be required to assess each specific building at DA stages. This is not an unusual situation when constructing adjacent to a rail corridor. There are tried and tested solutions that are used around the world that enable mitigations to the structural borne noise that can be implemented if the final study requires them. Mitigations such as vibration isolation can be considered and are outlined in the section below, showing that the structures are feasible if site specific assessment identifies the need to isolate vibration.

1.7.1.1 Vibration Isolation under building

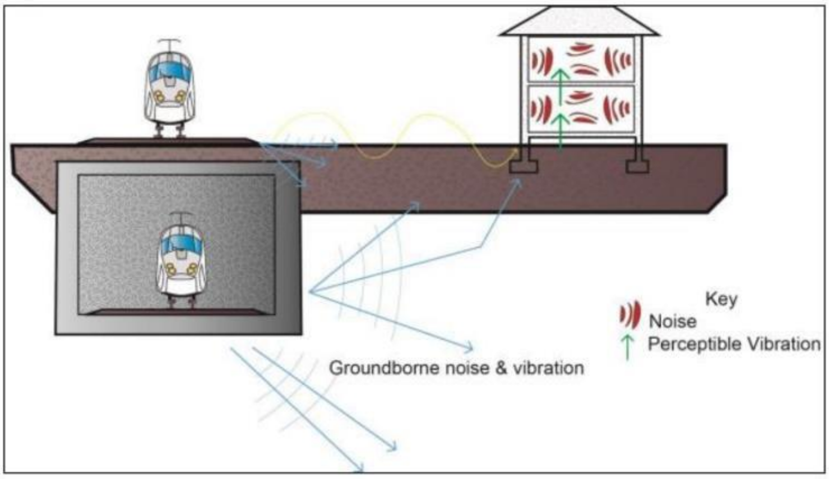


Figure 12 Vibration Isolation under building

There are several options available to mitigate the effects of ground borne vibrations that can be considered during the site specific design of these buildings, these mitigations include:

Distance

Employing the simple fact that energy decays with distance, early strategic planning of a development may allow buildings (or more noise sensitive areas with the building) to be located further away from the source of rail vibration. This can be done through floor configurations or ensuring non-inhabited areas (such as service cores) are located closest to the noise source.

Sleeved Piles

It is possible to decouple basement piles from surface waves by double sleeving. Double sleeving creates an air void around the pile using concentric steel tubes the air void prevents ground vibrations travelling into the structure and vibrating the building frame. The tubes are held apart with top and bottom welded collar plates and once inserted, pile boring continues through the inner steel tube.

Trenches Parallel to Track

Constructing trenches filled with sand parallel to the vibration source has been proved to reduce the level of vibration transmitted to the structure.

Isolate the Source

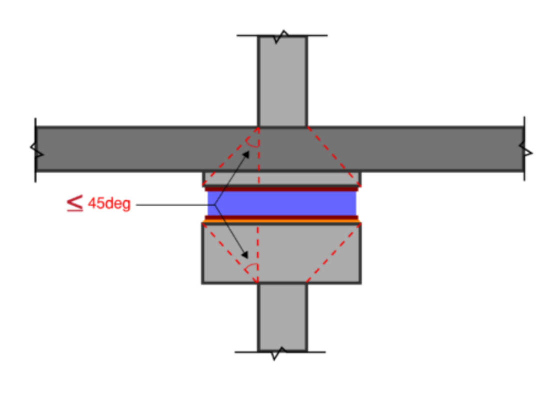
Rail tracks and track beds can be constructed with a vibration isolation system which controls vibration at its source, mitigating transmittance to near-by buildings. Further details are provided below however it is important to note that this recommendation does not fall within the study area and it is noted the area is owned by another government agency. For this reason, the idea of isolating the track will need to be discussed early in the design process with the risk of not reaching an agreement with the rail track owners a plausible outcome.

Base Isolation

Base-isolation of buildings is regarded as one of the most effective means of limiting the disturbance caused by ground- borne vibration from sources such as roads and railways. The concept is that the building is mounted on an isolation system composed of either rubber or steel bearings which de-couples it from the soil-foundation system to reduce the levels of vibration and re-radiated noise.

Below is an example of base isolation that WSP has used on a number of buildings when building adjacent to a rail corridor. The below examples were used on a building that was built abutting the rail corridor, i.e. the structural column was within 4m of a busy rail track. At the Coffs Harbour site the columns will be >15m away, the noise intensity will be lower and the isolation solution will be less onerous.

Table 2 Example of Base Isolation



One of the biggest decisions to make is choosing where the bearings will be positioned within the building, as any primary structure located between the bearings and the vibration source will not be isolated. Generally, the isolation is placed either at ground level or at first floor. There are pros and cons for both, however it is likely that commercial will be isolated at first floor, due to the expected busier and noisier commercial entrance and lobby area. For residential it would typically be at ground floor, where a quieter entrance lobby is expected and there is the potential for a residential apartment.

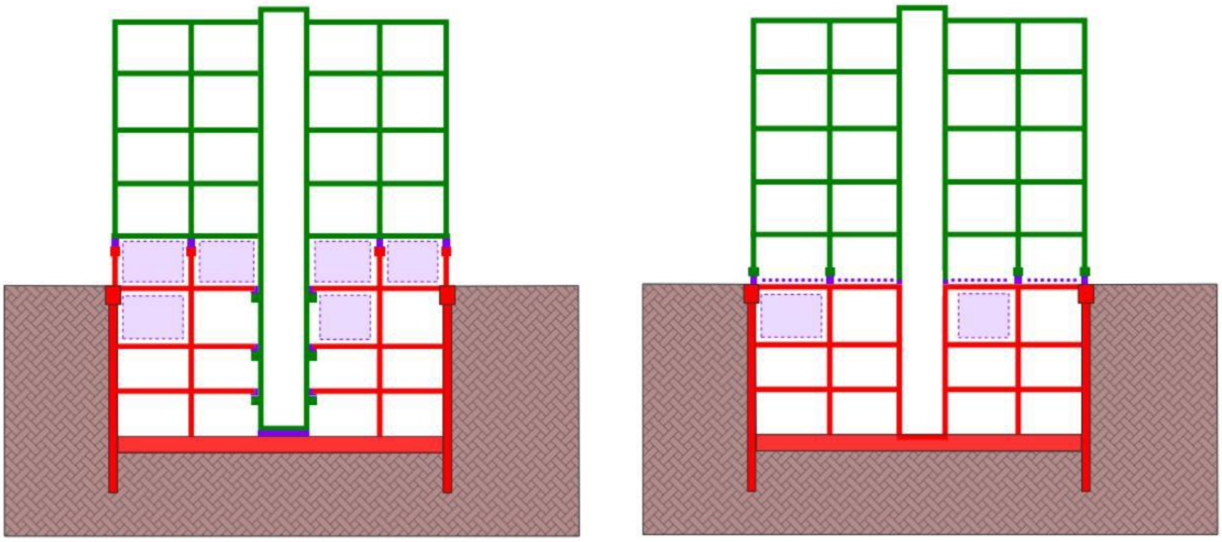


Figure 13 Examples of locations of acoustic isolation strategies

A decision on the appropriate mitigation measures for ground born noise will need to be taken on a building by building basis for each future development.

1.5 Road and Rail Proximity

The illustrative masterplan includes the possibility of constructing a pedestrian overpass across the road and railway, aiming to enhance connectivity between the proposed rezoned development and the broader Coffs Harbour area. Given its proximity to both road and railway infrastructure, this initiative will necessitate further discussions with the respective infrastructure owners to facilitate its realization. This process will involve adhering to established standards and guidelines for construction near such infrastructure.

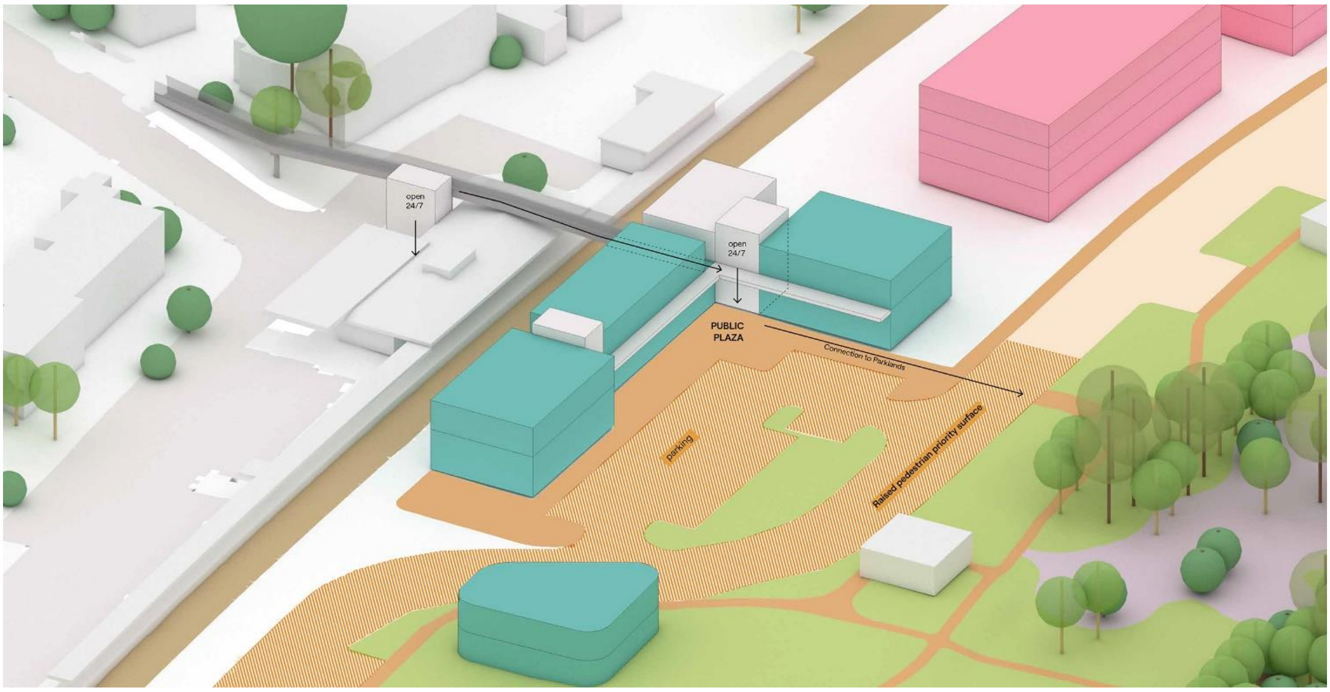


Figure 14 Examples of illustrative masterplan bridge

Source: SJB (20)

Generally, the Australian Standard for Bridge Structures AS5100 should be consulted, however various standards are applicable to the design of structures near to railway, these include rail standards, bridge standards along with specific operator standard documents. The desktop study identified that ARTC operate the rail corridor so their specification should also be consulted.

1.5.1 Rail Minimum Offsets

1.5.1.1 AS5100 Vertical Clearance Requirement

The vertical clearance refers to the rail authority guidance AS5100:9.2: The geometric arrangement of railway bridges shall be as specified by railway authority.

1.5.1.2 ESC215 Vertical Clearance Requirement

For non-electrified areas an assumption of 5000mm vertical clearance should be taken. For the electrified areas 6500mm clearance should be taken.

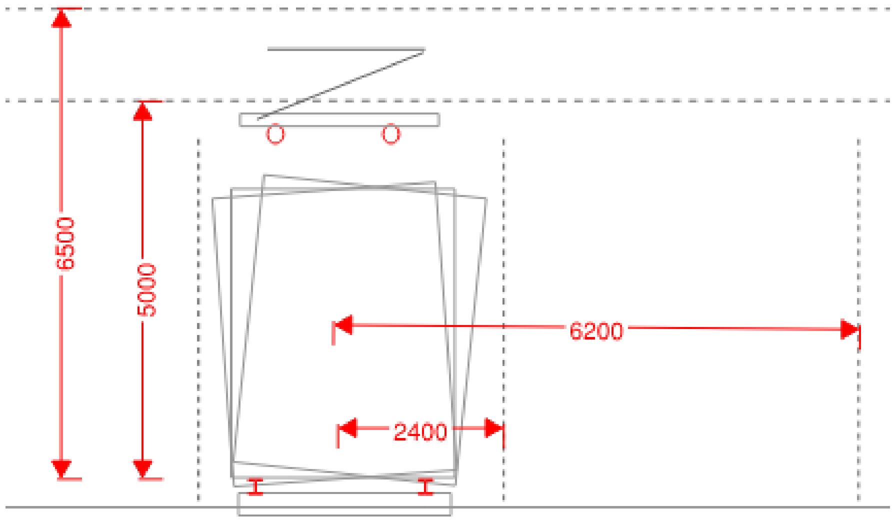


Figure 15 Summary of clearances derived from AS5100

Table 3 ESC215 Vertical Clearance Requirement

Dimension	**Structure**
4300mm	Bridge substructures and deflection walls (except between tracks) Cuttings without road access Station bridges Columns, footbridges OHWS masts and signal masts on platforms Other structures located adjacent to non-electrified tracs where road access is not required
5000mm	Other structures located adjacent to electrified tracks and where road access is not required.
5500mm	Other structures and cuttings located adjacent to non-electrified tracks and where road access is required between the structure and the track located adjacent to electrified tracks and where road access is not required.
6200mm	Other structures and cuttings located adjacent to electrified tracks and where road access is required between the structure and the track. Bridges or air-space developments where a overhead wiring or signal mast is required within the structure limits.
Summary of clearances derived from ESC215	

1.5.1.3 ARTC Vertical Clearance Requirement

Table 4 ARTC Vertical Clearance Requirment

Dimension	Rollingstock Outline
4670 + 1.3Ea	Narrow nonelectric Narrow square Narrow container Intersystem
	Narrow hopper NZZA Wagon
6250 + Ea	Double Stack

This provides for the safe passage of approved Rolling Stock and loading outlines and includes a minimum vertical clearance of 400mm above approved outline. The 400mm margin includes a design allowance for 150mm for track resurfacing.

Extract from ARTC vertical clearance Table 7.6

1.5.1.4 Structural Impact

Depending on the proximity to the rail corridor, differing considerations need to be given to the possibility of impact from a derailment. The following criteria defined in AS5100, depending on offset, should be used to assess:

Table 5 Structural Impact

Offset from rail	Assessment
>20m	No consideration
10-20m	Risk analysis structural enhancement (submitted to Rail Authority)
<10m	Deflection wall high structural requirement

1.5.2 Road Minimum Offsets

1.5.2.1 AS5100 Vertical Clearance Requirement

For pedestrian bridges over roads according to AS5100 Vertical clearance of bridges over roadways shall be:

a) At least 200mm greater than adjacent bridges, but not less than 5.3m;

b) 5.5m minimum where there are no adjacent bridges; and

c) 6.0m minimum on designated high clearance routes.

Vertical clearance over footpaths shall be 2.4m minimum.

1.5.2.2 AS5100 Lateral Clearance Requirement

For pedestrian bridges over roads according to AS5100 Horizontal clearances to substructure components shall be determined by the authority making allowance for the following:

a) Pavement width

b) Shoulder width or edge clearance

c) Pier protection barriers, including allowance for deflection of flexible safety barriers.

d) Curve widening

e) Sight clearances.

Shoulder width or edge clearances, or both shall be determined from the vehicle volumes and speeds, and road geometry.

1.6 Potential Pedestrian Bridge

1.6.1 Outline Plan

Within the illustrative masterplan there is an option for a pedestrian overpass across the road and railway. Considered below is an approach on how this could be achieved. The diagram indicates the bridge's position and provides approximate dimensions for this initial design concept. It also marks the placement of support columns, highlighting that the maximum span is around 25 meters. WSP endorses this preliminary concept for the pedestrian bridge. Pending a comprehensive design phase, this initial plan aligns with the relevant standards mentioned in the preceding and following sections.

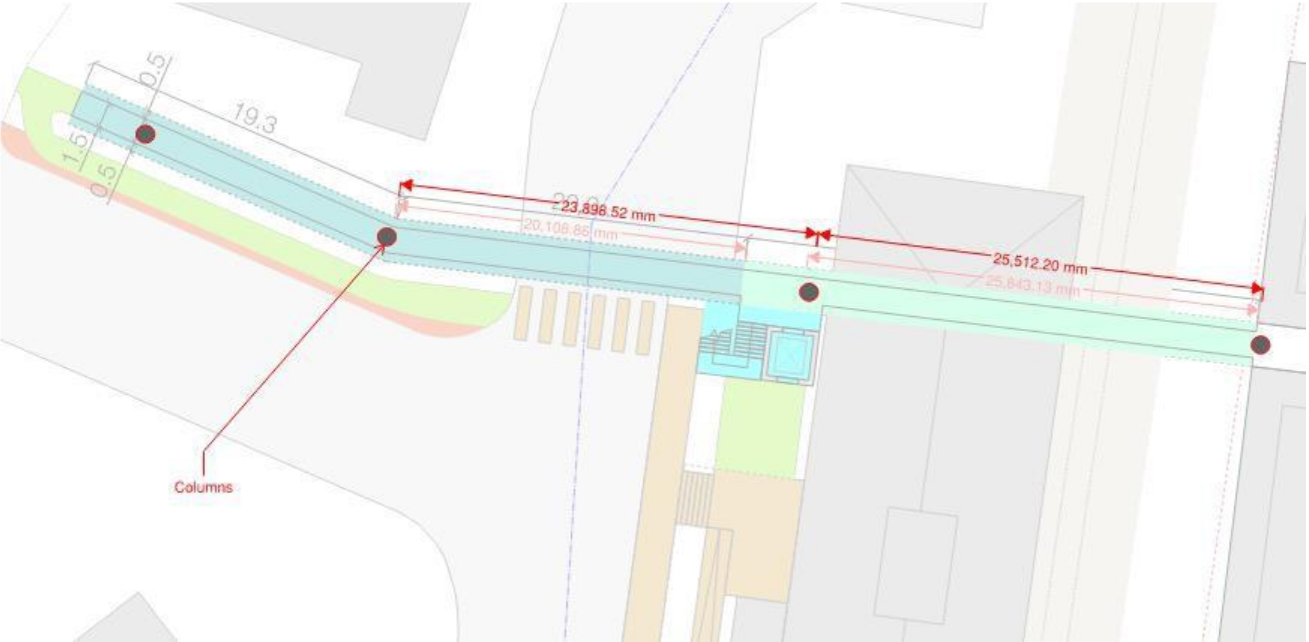


Figure 16 Potential Pedestrian Bridge Outline Plan

Source: SJB (20)

1.6.2 Geometry

With reference to AS5100 minimum dimensions need to be maintained for pedestrian bridges:

Table 6 Geometry Dimensions for Pedestrian Bridges

Clear width between handrails	1.8m min
Ramp gradient	As specified by the authority, but not steeper than 1 in 8
Stairway gradient	As specified by the authority, but not steeper than 1 in 1.6

1.6.3 Over Road Vertical and Horizontal Clearance Requirements

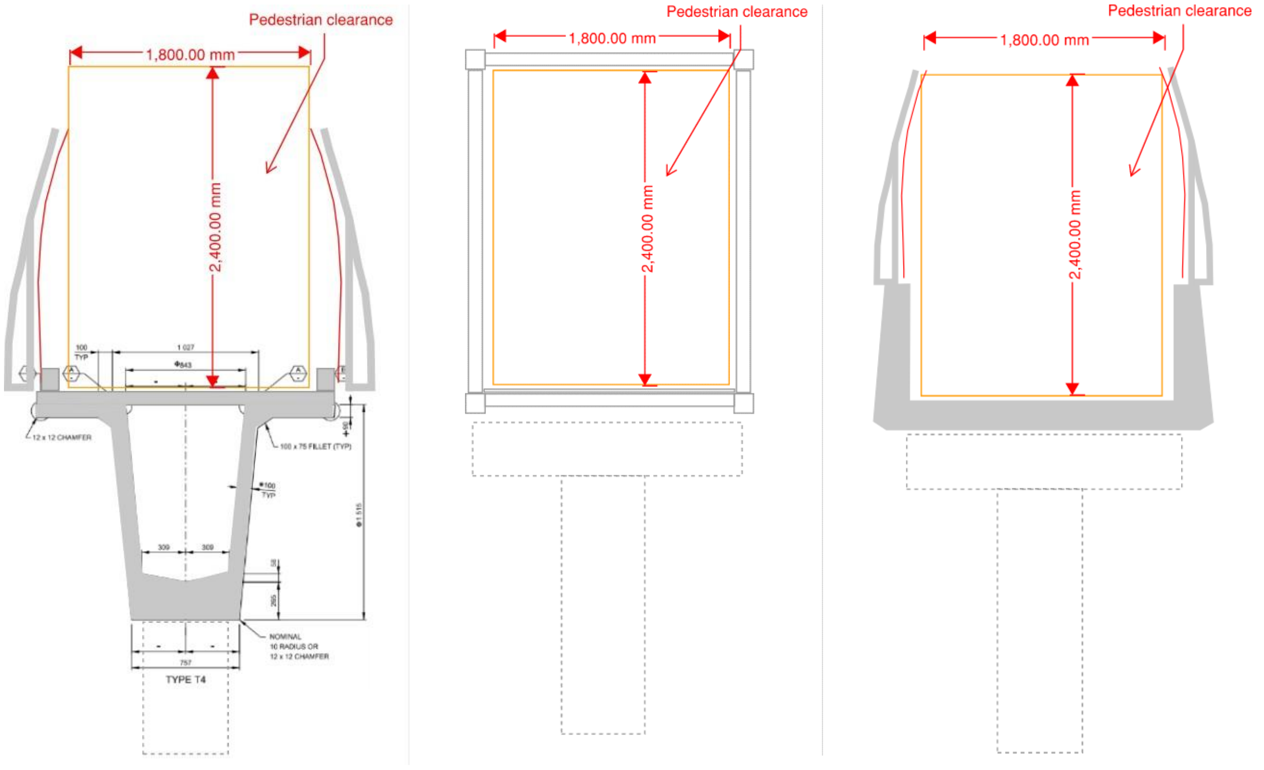
Refer to 1.8.2.1 and 1.8.2.2 for vertical and horizontal clearance requirements from AS5100.

1.6.4 Structural Options

Three options were considered for the potential pedestrian bridge:

- Option1: Super T beam
- Option 2: Steel Truss
- Option 3: Post Tension Concrete U-Bridge

Table 7 Structural Options for Potential Pedestrian Bridge



Option 1: SuperTee	Option 2: Steel Truss	Option 3: Post Tension Concrete U-Bridge

- **Option 1** has been ruled out as a feasible choice owing to its inability to meet the vertical clearance needs within the road and rail corridors, which also adversely affects the slope of the western approach ramp.

- **Option 2** emerges as the favoured structural strategy, primarily because its offsite fabrication offers several advantages, such as accelerating the construction process and the lighter structure facilitating easier foundation work and lifting procedures during installation.

- **Option** 3 stands as the alternative preference. Its conventional construction approach means it is familiar to a broader range of contractors, potentially leading to cost savings through competitive bidding.

2 Standards & References

The standards outlined below are some key references that need to be considered in the design of the buildings and pedestrian bridges, this list is not exhaustive and is for guidance and information purposes only:

Table 7 Performance Parameters Standards

Reference	Number	Title
1	**AS/NZS 1170.0**	Structural Design Actions Part 0 General Principles
2	**AS/NZS 1170.1**	Structural Design Actions Part 1 Permanent, Imposed and Other Actions
3	**AS/NZS 1170.2**	Structural Design Actions Part 2 Wind Loads
4	**AS 1170.4**	Structural Design Actions Part 4 Earthquake Actions in Australia
5	**AS 2159**	Piling – Design and Installation
6	**AS 3600**	Concrete structures
7	**AS 3700**	Masonry structures
8	**AS 4100**	Steel structures
9	**AS 4678**	Earth Retaining structures
10	**AS5100.1**	Bridge design Part 1: Scope and general principles
11	**AS5100.2**	Bridge design Part 2: Design Loads
12	**t-hr-ci-12090-st**	Airspace and External Developments
13	**ESC-215**	Transit Space
14	**ARTC Section 7**	Code of Practice. Section 7 Clearances
15	**AS 7366**	Rail Clearances
16	**ISBN 978-0-7347-5504-9**	Development near rail corridors and busy roads – Interim Guidline
17	**2022**	BS 8102: Protection of Below Ground Structures Against Water Ingress
18	**PSM4842-007R 6-Sept-2023**	Intrusive Geotechnical Investigation Report
19	**20220977.2/2903 A/R0/RG Rev 0**	Noise and Vibration Impact Assessment
20	**-**	SJB Coffs Harbour Foreshore Urban Design Study

3 Conclusion

In conclusion, WSP's structural study supports the State Assessed Planning Proposal for the Precinct. Despite site features such as proximity to the railway, coastal influences, a high-water table, and diverse geotechnical conditions, nothing within the study indicates that these factors would prevent future built form outcomes and therefore impede the planning proposal. The Illustrative Masterplan's exploration of potential building configurations, including those with various levels of basement parking, further validates the feasibility and reinforces the case for planning proposal approval.