NSW HEALTH

Liverpool Hospital Redevelopment - Stage 2

Infrastructure and Ancillary Hospital Works

Project Application and
Environmental Assessment

Appendix H
Vehicular Bridge

- Design report vehicle and pedestrian bridge
- Design drawings and Layout plan

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and
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In conjunction with: Connell Wagner

For: Department of Planning
On behalf of : NSW Health

Appendix H

Design Report Vehicle and Pedestrian Bridge

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Preliminary Design Report
Liverpool Hospital Bridges
NSW Department of Health

07 March 2008
Reference 26229-002
Revision C

Connell Wagner

Document Control

Connell Wagner

Document ID: I:\26229\ENG\REPORTS\PRELIMINARY DESIGN REPORT\REV C\PRELIMINARY DESIGN REPORT REV C.DOC

Rev No	Date	Revision Details	Typist	Author	Verifier	Approver
A	17.04.07	First Issue	DEM	DEM	TS	JAH
B	24.07.07	Issued with Revisions	DEM	DEM	TS	JAH
C	07.03.08	Additional Road Bridge Options Added	ADG	ADG	TS	JAH

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Contents

1. Executive summary

The SSFL passes through the precinct of Liverpool Hospital, which has developed over the rail corridor. At present, the only direct link across the rail corridor for the hospital is a level crossing on Elizabeth Drive, which presents a significant hazard to visitors, patients and staff at the hospital. With further development of the hospital and the proposed construction of a parking station on the east side of the rail corridor, new bridge links are required to cater for increased demand.

Two bridge links over the railway are proposed for both vehicles and pedestrians. Separate bridges have been planned for vehicular access and pedestrian access. Hospital services will be located on the road bridge.

The pedestrian bridge will form part of the main pedestrian thoroughfare between the patient care buildings and the parking station. The appearance of the bridge and its approach stairs and lifts are therefore an important part of the overall architectural fabric of the hospital. Architects Rice Daubney provided architectural expertise in the development of the pedestrian and road bridge (Option 1) options.

A steel Warren Truss pedestrian bridge is proposed, spanning approximately 40 m over the rail corridor. The deck is constructed from reinforced concrete and the clear width of the walkway is 2.4 m between handrails. Stairs and a lift are required at both the west and east ends of the bridge, which link into and form part of the hospital building and parking station respectively. The bridge is intended to be clad in accordance with the architectural requirements.

The road bridge will comprise either:

The original proposed structure comprising 1800 mm deep Super-T girders spanning over the rail corridor without a pier support within the corridor

Option 1: A main span of 1200 deep Super-T girders over the rail corridor with a pier support located within the rail corridor

Option 2: A main span structural steel through truss over the rail corridor without a pier support within the corridor

Option 3: A main span of two post-tensioned pre-cast concrete main longitudinal girders with post - tensioned pre-cast concrete cross planks, without a pier support within the corridor

In conjunction with the above options for the main span the bridge will also comprise a three-span continuous, curved voided slab bridge and a steel/concrete composite link span into the future parking station. Hospital services are located on the north side of the road bridge (a separate structure) and will be housed within a façade with a maintenance walkway down the middle. Anti-throw screens are required on the bridge over the rail tracks.

A separate services bridge structure over the rail corridor is proposed for location adjacent to the road bridge.

All foundations are proposed as diameter 900 mm bored or contiguous flight auger (CFA) piles, founded in shale bedrock. Piers and headstocks are of reinforced concrete construction.

Approach ramps to the overbridge will be constructed with reinforced soil walls, as there is insufficient site room for the side batters of a simple embankment. The proposed maximum gradient of the approach ramps is 12%.

A 33kV overhead conductor runs down the west side of the corridor and it is expected that it will be relocated to allow the two bridges to be constructed. The preferred option is to relocate the cable underground.

Preliminary design drawings and sketches are located in Appendix A.

Preliminary cost estimates for the bridges and ramps are located in Appendix B.

Comparative differences in costs for the three Road Bridge options are presented in Appendix C

The recommended roadway bridge is Option 1 which comprises a Super-T deck with a new pier located within the rail corridor as is the case at other locations along this rail corridor.

2. Introduction

2.1 Background

The Southern Sydney Freight Line (SSFL) is a dedicated single-track freight line that runs next to the existing rail tracks of the Main South railway. The SSFL runs from the southern outskirts of Sydney at Macarthur to Cabramatta and then up the New South railway to the existing freight yards at Enfield and Chullora. On the way, it passes through the precinct of Liverpool Hospital, which has developed on both sides of the rail corridor. Liverpool Hospital preceded the SSFL on the site.

At present, the only direct link across the rail corridor for the hospital is a level crossing on Elizabeth Drive, which is an internal road on the southern edge of the hospital compound. The crossing is skew to Elizabeth Drive and presents a significant hazard to visitors, patients and staff at the hospital. RailCorp have determined that once the SSFL comes into operation, the level crossing will be too dangerous to use on a routine basis.

There is an indirect link across the railway by use of the adjacent streets leading to the bridge over the railway on the Hume Highway at Warwick Farm, with street access being available to the hospital compound on both sides of the railway. However, while this link is suitable for tasks such as moving large equipment, it is too long and indirect for use by visitors and in the operation of the hospital.

At present, the hospital treatment facilities are mostly on the western side of the railway corridor, with the eastern side comprised mostly of supporting facilities, accommodation for administration and the helicopter pad. Further development of the hospital will require increased use of the compound on the western side of the railway, with a multistorey car park being anticipated as an early stage in the future development. This development will require the construction of a bridge link over the railway at the parking station location for vehicles and pedestrians. Separate bridges have been planned for vehicular access and pedestrian access.

2.2 This report

This Preliminary Design Report develops the preferred bridge options chosen from the Concept Options Report, which have been further developed in conjunction with Rice Daubney and Capital Insight. A more detailed analysis on the bridge structures has been performed and structural design has been developed to a 50% stage. The drawings present more details on the bridge structures, including the locations and types of foundations, member sizes, access details and ramp alignments.

Some issues are raised, including the location of underground services and the vertical alignments of the road bridge ramps. Locations of pile foundations may have to be re-examined once a detailed survey of buried services has been performed. Further development of the hospital services located on the separate services bridge is required, including sizes and weights.

2.3 Developments

The original report was presented as Revision B on the 27 July 2007. Since then the events as listed below have necessitated the presentation of this Revision C of the report.

- Capital Insight informed Connell Wagner that RaiCorp required that overhead electrical track cables were not be secured to the bridge deck.

- At a meeting on 31 January 2008 attended by the individuals as listed below, RailCorp were presented with two revised road bridge options as detailed in a letter from Connell Wagner to Capital Insight dated 31 January 2008. The two options presented in this communication are more fully described in this report as Option 1 and Option 2. A copy of the communication is included in Appendix D. RailCorp representatives confirmed that the overhead track lines were not to be connected to the bridge deck and of the two revised option they preferred

Option 2 which excludes a pier within the rail corridor. Meeting attendees were;
- Dr Richard Hemsworth - RailCorp
- Richard Wolfson - RailCorp
- Jeremy Wilson – Capital Insight
- Tom Sheasby – Connell Wagner
- Anthony Di Giacomo - Connell Wagner

- The status of project development was presented to ARTC on the 12 February 2008, the attendees being;
    - Greg Mullens – Australian Rail Track Corporation Ltd
    - Jeremy Wilson – Capital Insight
    - Tom Sheasby – Connell Wagner

  The two latest options for the road bridge were considered and ARTC requested the consideration of a third option comprising a deck section made up of pre-cast, post-tensioned side girders linked with a composite pre-cast and cast in-situ deck slab comprisisng prestress and post-tensioned cables.

- The services bridge over the rail corridor was now to be developed as a stand alone structure that could be constructed separately from the road bridge.

Note that since presentation of Revision B of this report Connell Wagner were requested to proceed with the preparation of the Preliminary Detail Design for the pedestrian bridge as presented in Revision B of the report. This updated Revision C of this report essentially includes the additional considerations for the road bridge with discussion on the pedestrian bridge unaltered.

3. Site survey and utility services

Survey of the hospital site and locations of utility services have been provided by Capital Insight. Connell Wagner has provided survey in the rail corridor, including the alignment and levels of the existing and new track lines.

3.1 Survey

Survey of the hospital sight has been provided by Capital Insight. This initial survey was undertaken by JMD surveyors. Connell Wagner surveyed the rail corridor for the South Sydney Freight Line project, including the alignment and levels of the existing and new track lines. A combination of the JMD survey and the Connell Wagner survey has been used to set out the road bridge and pedestrian bridge.

The rail corridor boundary lines of the JMD and Connell Wagner surveys did not exactly line up, so the JMD survey was adopted as the governing survey for set out of the bridges. This discrepancy between the two surveys has now been resolved; the Connell Wagner survey was coordinated with the JMD survey and the track alignment and levels were added to the JMD survey to determine vertical clearances of the bridges over the rail. The 'Combined Survey' was issued by Connell Wagner to Capital Insight and Rice Daubney on 24 May 2007.

3.2 Utility services

A detailed utility services search of existing underground services should be carried out and plotted on to the Combined Survey prior to detailed design. The locations of some buried existing services may be unknown and some services may have to be rerouted.

Rice Daubney provided to Connell Wagner the draft SKM drawings of existing and new services, which were used in the preliminary design. Capital Insight also provided a layout of existing sewer mains on the hospital site. All of these services drawings are in pdf format and had to be located approximately on the site survey.

The services that have a major impact on the bridge design are the sewer mains on the east and west campuses and the existing services along the rail boundary on the east campus. The sewer on the east campus is located adjacent to the approach ramp and the sewer on the west campus is located adjacent to the pedestrian bridge pier. Existing services along the eastern rail corridor boundary are located near to where the protection wall is to be located, as well as the road bridge abutment. More accurate locations for these services will need to be known prior to detailed design.

The 33kV overhead conductor runs down the west side of the corridor and it is expected that it will be relocated underground. In its current alignment, the cable is 18 m above ground level and travels over the top of the two proposed bridge alignments.

Connell Wagner has used the utility services drawings provided by Capital Insight and Rice Daubney in the placement of foundations for the bridge structures. Where possible, we have attempted to locate the foundations away from the currently defined locations of the underground services, however other unknown buried services may be located in these areas. Other buried services may include optical fibre cables, water mains, electrical cables and other hospital services.

4. Design criteria

4.1 Design life

The design life for all bridge structures, road support structures, reinforced soil walls and stairs is 100 years. Design life for lift shaft and stair structures is 50 years.

4.2 Design standards

The design has been undertaken in accordance with the following standards:

- AS 5100:2004 Australian bridge design code
- Austroads bridge design code:1992 (T44 truck loads only)
- AS 1428:2001 Design for access and mobility
- AS 1657:1992 Fixed platforms, walkways, stairways and ladders
- RailCorp standard ESC 215:2006 Transit Space

4.3 Design loads

- Road bridge traffic loading – T44 truck loads with dynamic load allowance of 0.4 and lane factor of 0.9 for 2 lanes
- Pedestrian walkway loading – 5 kPa
- Rail impact loading on bridge supports or deflection walls:
  - ➢ 1500 kN ultimate point load perpendicular to track
  - ➢ 3000 kN ultimate point load parallel to track
- Rail impact loading on bridge superstructure – 500 kN ultimate point load, which is directed vertically upwards or horizontally

4.4 Load factors

Live Loads	Serviceability Limit State	Ultimate Limit State	Dynamic Load Allowance	Lane Factor
T44	1	2	0.4	0.9
Walkways	1	1.8	-	-
Rail impact	-	1	-	-

4.5 Geotechnical parameters

Capital Insight provided Connell Wagner with two geotechnical reports that were used for the preliminary design:

- Environmental assessment report by Environmental Investigation Services, July 2006, Ref: E20303F-RPT
- Geotechnical investigation report by Jeffery and Katauskas Pty Ltd, 13 July 1006, Ref: M20303ZArpt

Following is a list of parameters taken from the geotechnical report and used in the preliminary design of the bridges:

- Alluvial soils comprising silty sands and clayey sands, of medium dense to dense consistency, overlay the shale bedrock.
- Class III shale bedrock is located approximately 16.5 m below surface level
- It is recommended that CFA (continuous flight auger) piles founded in shale bedrock be used for the bridge foundations
- Maximum diameter of CFA piles is 900 mm
- CFA piles founded in Class III shale with a 0.3 m socket have an allowable bearing capacity of 3500 kPa

- Allowable shaft adhesion for Class III shale can be taken as 350 kPa

The bridges have been designed with a maximum pile diameter of 900 mm, in accordance with the geotechnical report.

4.6 Durability

Exposure classification B2 has been adopted for all concrete structural elements.

Surface protection of steel structures will comprise a surface blast clean and coating system, with maintenance after every 15 years.

4.7 Clearances

The vertical clearances above track level for the bridges are in accordance with the minimum vertical clearance requirements of RailCorp Standard ESC 215 Transit Space - October 2006. The minimum vertical clearance requirements are:

- Pedestrian Bridge - 6.5 m (OHW not attached to bridge)
- Road Bridge - 5.9 m with OHW attached to the bridge deck in the original proposed solution
- Road Bridge - 6.5 m without OHW attachment to the bridge deck for Options 1,2 and 3

5. Pedestrian bridge

5.1 General features

The pedestrian bridge will be visible from the main pedestrian thoroughfare that is being developed between the patient care buildings. Therefore an important part of the overall architectural fabric of the hospital is the appearance of the bridge and its approach stairs and lifts. The bridge has to be fully enclosed to protect the tracks below from falling objects and to provide patrons with a sheltered crossing during inclement weather. It is expected that pedestrian bridge will be an elegant structure that presents an extension of the new Clinical Services Block of the hospital.

The clear width of the bridge deck between handrails has been adopted as 2.4 m minimum. The height of the bridge deck has been set at RL 17.8 m in order to meet the minimum clearance of 6.5 m over the tracks. Car Park Level 6 of the new parking station will be required to tie into the bridge deck level.

5.2 Superstructure

The chosen option for the pedestrian bridge is a steel Warren Truss. The structure spans approximately 40 m over the rail corridor and comprises 250 SHS top structural chords, bottom chords and diagonal members. The final configuration of the diagonal chords meets the architectural preferences of having an angle to horizontal of approximately 40 degrees. Horizontal cross bracing in the line of the top and bottom chords comprise 150 EA's. A pre-camber will be built into the structure to account for the self weight and additional dead loads from the concrete deck, glass cladding, hand railing and other permanent fixtures.

The mass of the steel bridge superstructure is approximately 31 tonne, including the short span to the lift. The bridge deck is constructed from concrete, poured in-situ after the superstructure has been erected. It is proposed to clad the sides of the bridge in glass the top is to be clad in sheet metal roofing, to the architects recommendations and details. An additional short span is required to link the main bridge structure to the lift shaft approximately 7 m from the wester pier, which will be in the same form as the Warren truss.

5.3 Substructure

A concrete blade pier, which also acts as the core wall for the access stairs, provides the support for the west side of the truss bridge. The blade pier is located just outside the 20 m clearance line, so that it does not have to be designed for train impact. The short span on the west side will be supported off the lift structure.

On the east side, the bridge is supported on a raised portion of the concrete deflection wall. This part of the deflection wall, which is designed to protect the parking station from train impact, is to be constructed prior to the parking station.

Diameter 900 mm bored or continuous flight auger (CFA) piles are proposed for the foundation support. All piles are founded into shale bedrock.

5.4 Access

A set of stairs and a lift is required at each end of the pedestrian bridge and the eastern end of the bridge is designed to frame into the future parking station. These stairs and lift need to be built such that they can be integrated into the parking station structure when it's constructed. The concrete lift shaft is designed to service the whole parking station in its final form. As a temporary structure, the lift shaft will service the bridge only, but will have knock-out panels for access to the future car park levels.

The stairs and lift at the western end serve as temporary access until the new Clinical Services Block is completed, or may be retained as permanent access. The shot bridge span to the western lift is designed to accommodate a future ramp to the Clinical Services Block.

5.5 Construction

Bridge piers, lift structures, stairs and deflection walls are all outside the rail corridor, so can be constructed without hindrance from rail traffic. Piling rigs may require some soil platforms to be constructed, depending on the slope of the ground.

Erection of the steel trusses will need to take place during a track possession, with finishing work carried out with the railway fully operational. The main steel truss will be fabricated in three segments, with bolting or welding of the segments taking place during the track possession. It is envisaged that scaffold platforms will be erected in the rail corridor with will form temporary support piers during erection.

5.6 Issues

Some issues that need to be addressed on the pedestrian bridge prior to detailed design include:

- Locations of buried services need to be confirmed by a detailed services survey, which may have an impact on the locations of the bridge foundations
- Relocation of the 33kV overhead cable underground needs to be confirmed
- Confirm the type of side cladding preferred by the architects

6. Road Bridge

6.1 General features

Serving as an important link from the East Campus to the West Campus of Liverpool Hospital, the new overbridge caters for vehicular traffic and critical hospital services over the SSFL. The road bridge comprises one of four options for the main span over the rail corridor. All options also identical approach spans on the north approach. This configuration includes a three-span continuous portion which incorporates two curved voided slab spans. Reinforced concrete headstock abutments, piers and piles are proposed for the substructures. Both approach embankments are retained by reinforced soils walls with the south side wall located on the rail corridor boundary.

The four options for the main span over the rail corridor are:

The original option, with 1800 mm deep Super-T girders over the rail corridor spanning some 39 m and without a pier support within the rail corridor

Option 1, a main span of 1200 deep Super-T girders over the rail corridor with a pier support located within the rail corridor

Option 2, a main span structural steel through truss over the rail corridor without a pier support located within the corridor

Option 3, a main span of two post-tensioned pre-cast concrete main longitudinal girders with post - tensioned pre-cast concrete cross planks, without a pier support within the corridor

Hospital engineering services infrastructure is to be accommodated in a separate services bridge. The services bridge will be located on the north side of the road bridge as a stand alone structure. The services will be housed within a façade with a maintenance walkway down the middle. SKM is performing the services design. We understand that there are at least 4 No. 500 mm diameter pipes and other services required to pass over the bridge to serve the Control Services Building.

Concrete parapets with steel railings are proposed on each side of the road carriageway and throw screens are attached to the main span over the rail lines. The concrete parapets are required to be 1300 mm high 'medium' barriers over the rail corridor. Variations to this arrangement will be proposed depending on which option is selected for further development.

6.2 Superstructure

A 1500 mm deep voided slab is proposed for the first three approach spans of the road bridge which curves around the Ron Dumbier building on the west approach. This type of bridge structure was chosen for this section of the bridge as it can be built cast in-situ with a double curvature. A horizontal curve is required around the Ron Dumbier building and, due to the steep incline of the ramp; a tight vertical curve is required to meet the flat grade of the main span. Only two piers are required, opening up the land area under the bridge. The bridge deck has a clear width between traffic barriers of 7.6 m, allowing a 3.5 m wide traffic lane in each direction and a shoulder of 300 mm on each side.

The horizontal curve of the voided slab bridge deck is 15.75 m at the centreline of the road. A standard vehicle of 8.8 m in length was used as the design vehicle with a design speed of 40 km/h. As the standard vehicle turns on this sharp bend, it must use the whole bridge deck, so crossing the centreline of the road. The maximum grade of the ramp is 12%, which changes to a 1% grade to meet the main span over the rail corridor. A 33 m vertical curve would be required to comply with the Austroads road design guidelines for an 11% change in grade, however we can only achieve a maximum vertical curve of 28.5 m due to the tight constraints on ramp grade and length. The road is private, so the facility owner would have to be in agreement with this non-conformance.

The horizontal and vertical alignment of the road bridge can be found in Appendix A, along with the Preliminary Design Drawings.

Due to the tight vertical curve, the use of prestressed girders has been ruled out for Span 3. A maximum concrete deck thickness of approximately 600 mm would be required to meet the vertical road alignment, which is not recommended. The voided slab is ideal for achieving the horizontal and vertical curves required.

Over the rail corridor, the main span will comprise any of the four options described in Section 6.1 of this report.

The total carriageway width for all options is 7.6 m.

A link span to the parking station on the east approach will comprise a short composite steel beam and cast in-situ concrete deck type structure.

Placing the hospital services on a dedicated services bridge deck, as opposed to hanging them underneath, somewhat protects the services from train impact loads and provides easy access to the services. The services on the bridge deck cannot be completely safeguarded against damage from train impact. The superstructure is designed to withstand direct impact from a train so as to not fall into the corridor, however it cannot be assured that items on the bridge will not be damaged. Articulation of the hospital services is important for bridge movements, including earthquake design. Bridge movements will be assessed in the Preliminary Detailed Design.

The finished surface level the services bridge deck has been set to RL 18.450 m and the minimum clearance over the rail lines is 6.5 m.

6.3 Substructure

The western abutment is nested into the western ramp structure and comprises a concrete headstock with three diameter 900 mm concrete CFA piles. A cladding finish will be applied to the abutment in the same reinforced soil panels or blocks as used in the approach ramps to provide a uniform surface finish. The eastern abutment is of similar construction.

Piers 1 and 2 support the continuous voided slab and are proposed to be circular piers of 1500 mm diameter. Pier 3 is proposed as twin blade piers supporting the main span option and the eastern end of the voided slab. Pile caps are generally 1500 mm deep with CFA piles, socketed into shale bedrock, forming the foundation.

6.4 Approach embankments

Approach embankments are proposed to be retained by reinforced soil walls. Details of the proposed ramps can be found in the Section 7.

6.5 Connection of overhead electrical cable to the bridge deck

No overhead electrical cables will be attached to the underside of any of the three options proposed for the main span over the rail corridor. All three options lift the deck soffit by some 600 mm which allows the overhead wires to span under the bridge deck. The current location of cable support gantries, one either side and well clear of the bridge favours non relocation of gantries.

The original proposed structure does however rely on support of the overhead electrical cables due to the fact that the deck soffit is lower.

6.6 Construction

Erection of the main span of the bridge over the SSFL will need to take place during a track possession with finishing work being carried out with the railway fully operational. We believe that pouring the in-situ concrete for the bridge deck over the corridor while the trains are operational can be done with adequate safe work practices put in place by the contractor. This matter will need to be confirmed by RailCorp. Our understanding is that a major track possession is planned for the whole of January 2009. This period affords an ideal period over which most construction, especially of the main span components, can be completed.

The voided slab is a standard reinforced cast in-situ concrete bridge using false work and formwork. Construction of concrete foundations, piers and other bridge elements outside of the rail corridor will not impact on train movements.

6.7 Issues

Some issues that need to be addressed on the road bridge prior to detailed design include:

- Locations of buried services need to be confirmed by a detailed services survey, which may have an impact on the locations of the bridge foundations
- Relocation of the 33kV overhead cable underground needs to be confirmed
- Sizes and weights of hospital services on the bridge deck need to be confirmed
- The implications of train impact on the services bridge superstructure and the subsequent rupture of critical hospital services may need to be discussed with the NSW Health
- Confirmation that in-situ concrete deck can be constructed over live rail needs to be sought from RailCorp in case this construction practice is required
- Acceptance by the owner of the roadway that the proposed vertical and horizontal alignments as proposed include a non-conformance as noted in Section 6.2 of this report

7. Reinforced Soil Ramps

7.1 General features

It is anticipated that the approach ramps will be constructed with reinforced soil walls, as there is insufficient site room for the side batters of a simple embankment. There is a choice in reinforced soil wall construction systems between concrete panels or masonry blocks. The masonry block solution is expected to be slightly more economical with the advantage that it is a less attractive surface upon which to apply graffiti.

Standard concrete traffic parapets are located on each side of the carriageway. The road surface will comprise compacted road subbase overlaid by asphalt.

7.2 Horizontal and vertical alignment

The ramps and bridge are considered private roads, and accordingly may not necessarily have to comply with RTA design standards. The ramp lengths and alignments have been developed by others to suit the adjacent surface road geometry.

The western ramp has been kept short in order to open up the visual area around the Ron Dumbier building, while the eastern ramp has been lengthened to extend to the rail corridor. A walkway is proposed to pass through the eastern ramp near the parking station.

Maximum grade on the ramp is set at 12% and the lengths of the ramps are currently at their maximum to tie in with surface roads.

7.3 Services

There are two underground sewer mains located adjacent to the eastern ramp alignment, and there may be other buried services located within the ramp alignment that have to be protected. The precise locations of the sewer mains and other services are uncertain at this time, so the extent of protection is not known. A detailed services survey is being done and is required prior to detailed design of the approach ramps.

7.4 Construction

The approach ramps will be constructed using standard construction methods for reinforced soil walls. Strip footings are constructed, then the panels are placed in series, with the soil compacted in layers behind. There do to appear to be any construction issues at this time.

7.5 Issues

Some issues that need to be addressed on the approach ramps prior to detailed design include:

- Locations of buried services need to be confirmed by a detailed services survey, which may have an impact on the design of the reinforced soil walls

8. Costs

8.1 General

Indicative cost estimates for the pedestrian bridge, road bridge and ramp structures are provided in this report. Cost estimates presented by Connell Wagner are made on the basis of Connell Wagner's experience and qualifications and represent Connell Wagner's judgement as an experienced and qualified professional engineer, familiar with the construction industry. Connell Wagner however, has no control over the cost of labour, materials, equipment or services furnished by others, or over Contractor's methods of determining prices, or over competitive bidding or market conditions. Connell Wagner therefore, cannot and does not guarantee that proposals, bids or actual construction costs will not vary from Connell Wagner's estimates.

8.2 Pedestrian Br

The estimated cost of the pedestrian bridge as presented in Appendix B is $1.8 m. Note that this cost excludes design and documentation costs and must be regarded as a preliminary estimate with an accuracy no better than plus or minus 40% of the base figure.

8.3 Road Bridge

A cost estimate is included in Appendix B for the original developed scheme which requires connection of overhead wires to the superstructure and no pier support within the rail corridor. The cost estimate is $3.6 m.

Note that this cost excludes design and documentation costs and must be regarded as a preliminary estimate with an accuracy no better than plus or minus 40% of the base figure.

A comparative estimate has also been undertaken for the three alternative options and presented in Appendix C. The purpose of this exercise was to only determine cost difference between the three options. These cost estimates do not include items common to the various options. The comparison has determined the following:

- Option 1 (Super-T deck with pier support in rail corridor), is the lowest cost option
- Option 2 (Steel through truss without pier support in rail corridor), is $1.285 m costly than Option 1
- Option 3 (Concrete through girders without pier support in rail corridor), is $0.650 m more expensive than Option 1 but $0.636 m less costly than Option 2

Clearly Option 1 has significant cost benefits over the other options particularly Option 2, the steel through truss option.

8.4 Reinforced Soil Walls

The estimated cost of the reinforced soil walls as presented in Appendix B is $1.334 m. Note that this cost excludes design and documentation costs and must be regarded as a preliminary estimate with an accuracy no better than plus or minus 30% of the base figure.

9. Comparison of road bridge options

There are two main factors that influence the selection of the preferred option for the road bridge. Firstly, cost of the capital works and secondly construction methodology that can take full benefit of the major track possession that occurs in January 2009.

Option 1 (Super-T deck with pier a support in rail corridor) requires the construction of industry standard Super-T units of only 1200 mm in depth. Being standard units that are of the smaller size, opens supply to more likely sources. These units are likely to be readily available. They also offer simplicity of construction and the pre-cast construction industry is familiar with these unit types. The risks associated with production of non standard elements are removed.

Option 2 (Steel through truss without pier support in rail corridor) is the most expensive option requiring at least an additional $1.285 m up-front construction cost. In addition, as this option comprises large steel sections it requires considerable more time for fabrication. The design and verification process too is more than would be the case for Option 1.

Option 3 (Concrete through girders without a pier support in the rail corridor) while not as costly as Option 2 it is still more costly than Option 1. Comprising non-standard pre-cast elements for the main girders does present a higher degree of complexity in the manufacture of pre-cast elements when compared to Option 1. In addition construction activities on site within the rail corridor are more extensive and complex than required for Option 1.

A summary of the ranking for each of the three bridge options considered against each of the following project influences is as follows, noting that 5 = handles influence very well and 0 = handles influence poorly.

Influencing Consideration	**Option No.**		
	1	2	3
	Super- T with pier in Rail Corridor	**Steel Trough Girder**	**Concrete Through Girder**
Standard Pre-cast Deck Units	5	0	1
Constructability	4	0	2
Construction risk associated with not meeting major track closure	4	0	2
Pier located in Rail Corridor	0	5	5
Maintenance Cost	4	1	4
Construction Cost	5	0	1
Design documentation and fabrication intricacy	0	5	3
Total	**22**	**11**	**18**

A simple summation of the ranking for each constraint indicates that Option 1 scores best.

On this basis, Option 1, the Super-T deck with a pier support in the rail corridor is recommended for adoption.

The pier located within in the rail corridor will need to be designed to resist the rail collision/derailment loads defined in AS5100. Note that similar piers to that recommended for Option 1 have been successfully designed for other structures on the Southern Sydney Freight Line and other projects.

Appendix H
Design Drawings and Layout Plan

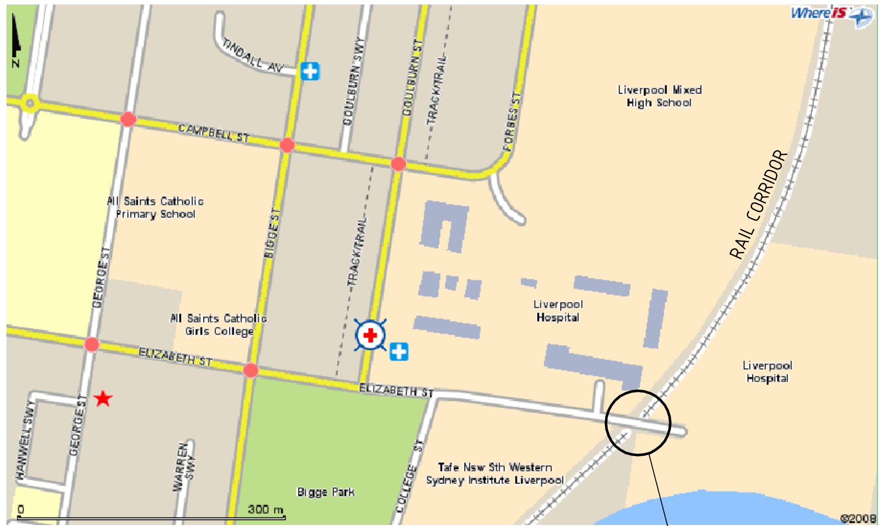
October 2008

Prepared by: Connell Wagner

A1

LIVERPOOL HOSPITAL BRIDGES
ROAD OVER RAIL BRIDGE
NSW HEALTH
PRELIMINARY DETAIL DESIGN DRAWINGS

DRAWING INDEX



LOCALITY PLAN
NTS

CATHODIC PROTECTION AND PROTECTION FROM STRAY CURRENTS

WHERE CONSTRUCTION IS BELOW SURFACE LEVEL THE REINFORCEMENT HAS TO BE PROTECTED FROM STRAY CURRENTS AND CONSTRUCTED SO THAT CATHODIC PROTECTION CAN BE APPLIED IN THE FUTURE. THESE OBJECTIVES ARE SATISFIED BY THE FOLLOWING REQUIREMENTS.

1. REINFORCEMENT FOR EACH PILE SHALL BE INSTALLED AS A WELDED CAGE.
2. IN EACH SECTION OF CAST IN PLACE HEADSTOCK CONSTRUCTION ONE LONGITUDINAL BAR NEXT TO THE EDGE OF THE ROOF SHALL BECOME THE ELECTRICAL CONNECTION BAR.
3. IN EACH SECTION OF A FOOTING PILECAP ONE LONGITUDINAL BAR SHALL BECOME THE ELECTRICAL CONNECTION BAR.
4. IN A FLAT SHOTCRETE PANEL BELOW THE PILE ANCHORS;
   - ONE BAR SHALL BECOME THE ELECTRICAL CONNECTION BAR.
   - EACH ROCK NAIL SHALL BE TIED TO ONE BAR IN THE SHOTCRETE PANEL.
5. THE ELECTRICAL CONNECTION BAR SHALL BE TIED TO ONE OF THE BARS PROTRUDING FROM THE TOP OF EACH PILE CAGE.
6. THE ELECTRICAL CONNECTION BAR SHALL BE TIED TO EACH TRANSVERSE BAR THAT IT CROSSES.
7. A TACK WELD IS TO BE PROVIDED AT EACH SPLICE IN THE ELECTRICAL CONNECTION BAR.

DESIGN CRITERIA

1. DESIGN IN ACCORDANCE WITH AS5100 - 2004 BRIDGE DESIGN CODE.
2. TRAFFIC LOADS - T44 TO AUSTROADS 1992
3. BRAKING, UNIFORM AND DIFFERENTIAL TEMPERATURE. LOADS ARE IN ACCORDANCE WITH AS5100.

Connell Wagner

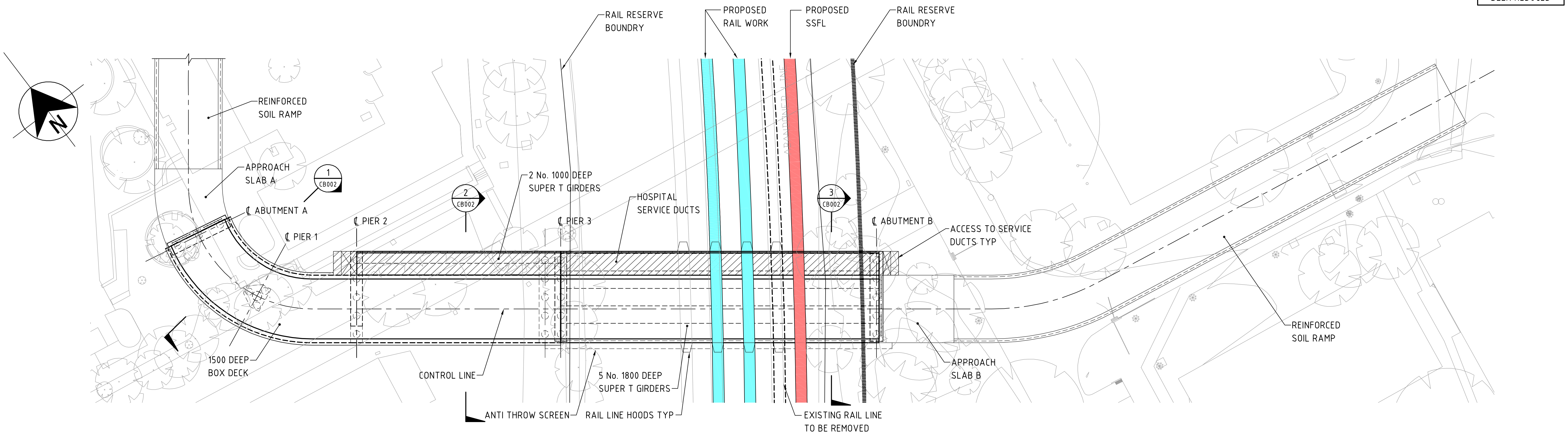
- SHADING DENOTES DRAWINGS NOT ISSUED

PRELIMINARY

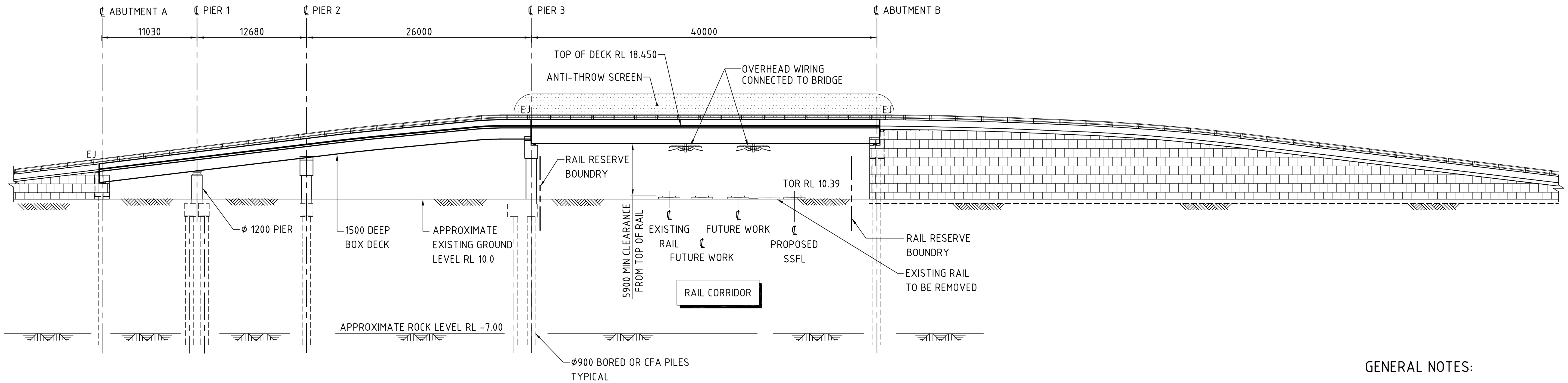
CW Project No.	Drawing No.	Revision:
26229	CB100	02

Cad File: I:\26229\CAD\Drg\CB100.dwg Plot Date: 13/05/2008 11:45:47 AM Name: SchembriJ Xrefs:

THIS DRAWING HAS BEEN REDUCED



PLAN
1:250



ELEVATION
1:250
ELEVATION TAKEN ALONG CONTROL LINE

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. CHANIAGES AND REDUCED LEVELS ARE IN METRES
3. EJ DENOTES EXPANSION JOINT

5 0 5 10 15 20 25m
SCALE 1:250

PRELIMINARY

Rev.	Date	Revision Details	Drn	Ver.	App.
02	13.05.08	REVISED PRELIMINARY	JJS		
01	08.05.08	PRELIMINARY	JJS		

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Client: NSW HEALTH

Project: LIVERPOOL HOSPITAL BRIDGES ROAD OVER RAIL BRIDGE

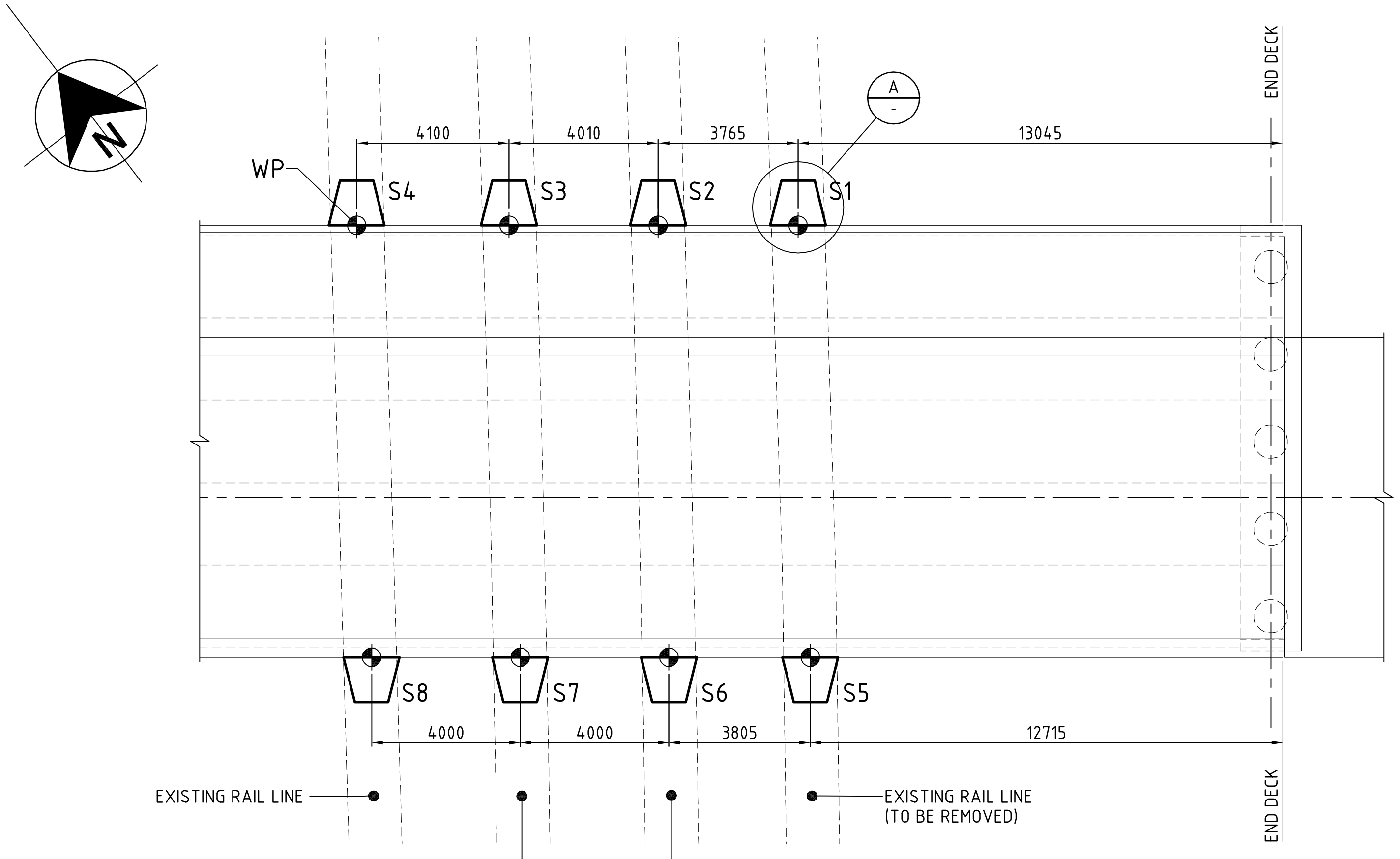
Drawn: SF | Signed | Date
Designed: ADG | Signed | Date
Verified | Signed | Date
Approved | Signed | Date

Drawing Title: GENERAL ARRANGEMENT PLAN AND ELEVATION

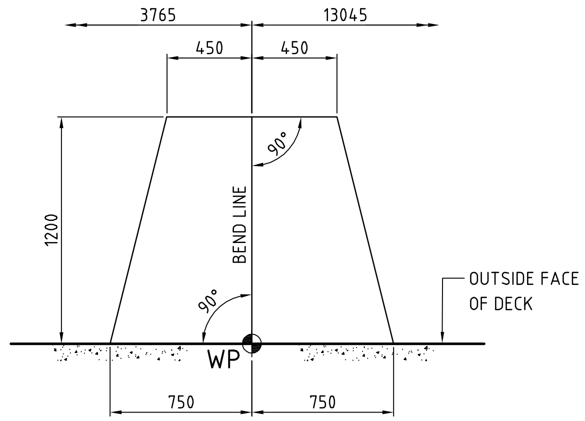
Project No. 26229
Scale: AS SHOWN
Sheet Size: A1
Drawing No. CB101
Rev. 02

20 10 0 10 20 30 40 50 100mm

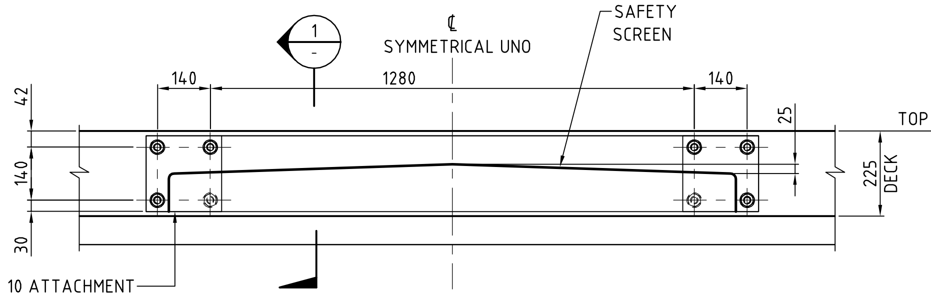
THIS DRAWING HAS BEEN REDUCED



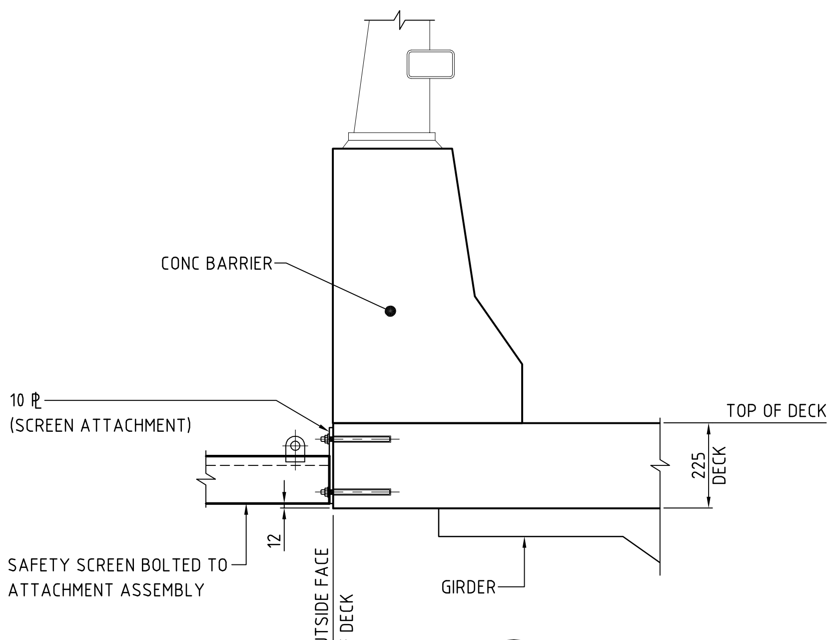
PLAN
ELECTRICAL SAFETY SCREENS
1:100



DETAIL (A / -) TYPICAL
1:20



ELEVATION AT OUTSIDE FACE OF DECK
SHOWING SCREEN ATTACHED TO DECK
1:10



SECTION (1 / -)
1:10

NOTES

1. FOR OTHER NOTES REFER TO CB100
2. ALL DIMENSIONS ARE IN MILLIMETRES.
3. ALL DIMENSIONS TO BE CONFIRMED WITH RAILCORP PRIOR TO FABRICATION.
4. LOCATION OF ALL ELECTRICAL SAFETY SCREENS ARE SETOUT TO SUIT RAIL TRACK.
5. ALL WELDS SHALL BE 6mm CONTINUOUS FILLET UNO.

SCALE 1:10 — SCALE 1:20 — SCALE 1:100

PRELIMINARY

Rev.	Date	Revision Details	Drn	Ver.	App.
01	13.05.08	PRELIMINARY	JJS		

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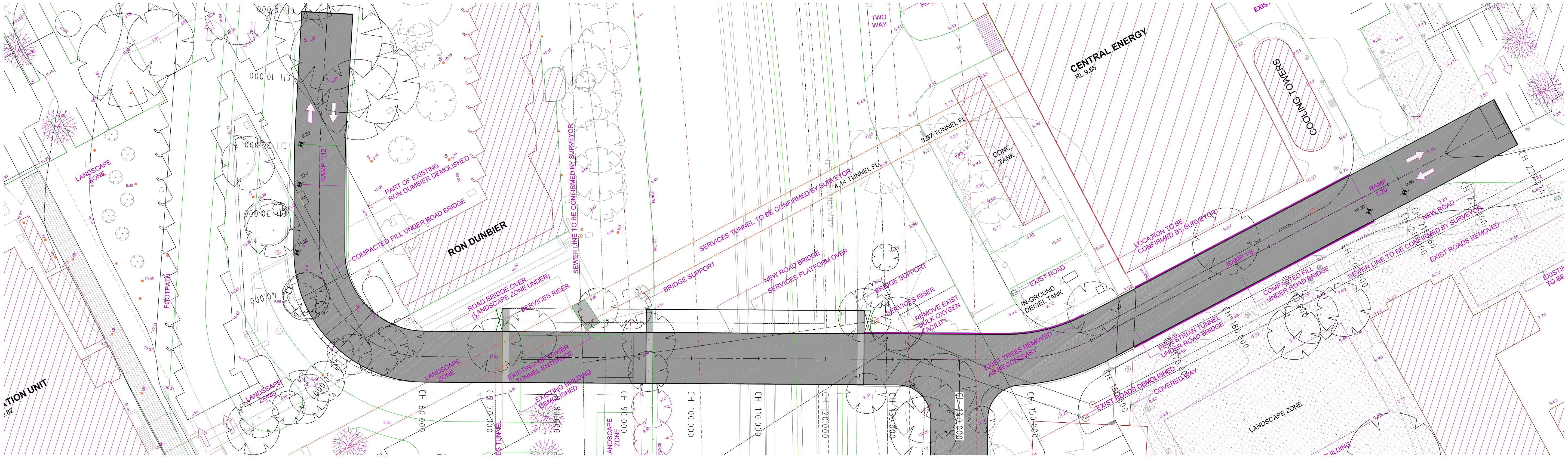
Client: NSW HEALTH

Project: LIVERPOOL HOSPITAL BRIDGES ROAD OVER RAIL BRIDGE

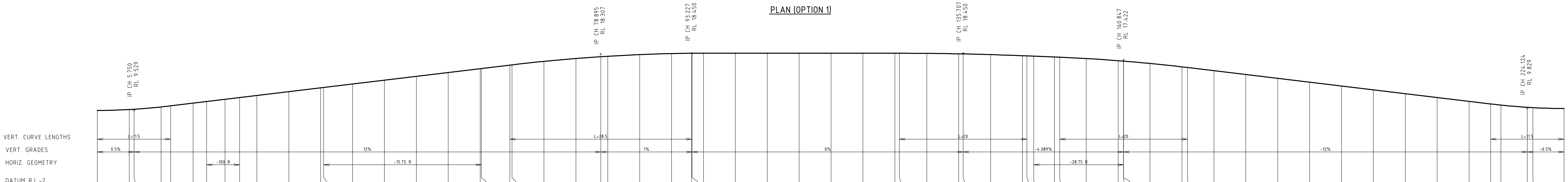
Drawn JJS	Signed	Date
Designed ADG	Signed	Date
Verified	Signed	Date
Approved	Signed	Date

Drawing Title: ELECTRICAL SAFETY SCREENS

Project No. 26229
Scale AS SHOWN
Sheet Size A1
Drawing No. CB135
Rev. 01



PLAN (OPTION 1)



CHAINAGE	DESIGN SURFACE LEVEL
0.000	9.501
5.000	9.651
5.750	9.695
10.000	10.051
11.500	10.219
15.000	10.639
17.132	10.895
20.000	11.239
22.293	11.514
25.000	11.839
30.000	12.439
35.000	13.039
35.462	13.095
40.000	13.639
45.000	14.239
50.000	14.839
55.000	15.439
60.000	16.039
60.188	16.062
64.645	16.597
65.000	16.639
70.000	17.184
75.000	17.632
78.895	17.915
80.000	17.984
85.000	18.240
90.000	18.399
93.145	18.449
93.227	18.450
95.000	18.450
100.000	18.450
105.000	18.450
110.000	18.450
115.000	18.450
120.000	18.450
125.000	18.450
125.707	18.450
130.000	18.431
135.000	18.362
135.707	18.348
140.000	18.241
145.000	18.070
145.707	18.041
146.748	17.999
150.000	17.866
150.847	17.831
155.000	17.627
160.000	17.291
160.847	17.224
160.847	17.224
165.000	16.856
170.000	16.322
170.847	16.222
175.000	15.724
180.000	15.124
185.000	14.524
190.000	13.924
195.000	13.324
200.000	12.724
205.000	12.124
210.000	11.524
215.000	10.924
218.374	10.519
220.000	10.337
224.124	9.994
225.000	9.943
229.874	9.800

LONGITUDINAL SECTION ALONG
DESIGN CONTROL LINE MC00 (OPTION 1)