North West Rail Link

Design and Construction of Surface and Viaduct Civil Works

Urban Design and Corridor Landscape Plan

NWRLSVC-ISJ-SVC-PM-PLN-121101

Revision 4.0

25 September 2014

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Document Revision History

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Revision	Description	Prepared by	Reviewed by	Approved by	Date
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4.0	Issued for Approval	DesignInc – Ian Armstrong			25-Sep-14

Signature

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Appendix A. Urban & Architectural Design Report

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1 DEFINITION AND ABBREVIATIONS

Abbreviation	Definition
CM	Construction Manager
C44	Ministerial Conditions of Approval – Condition 44
ESR	Environmental Site Representative/Project Environmental Manager
HP/WP	Hold Point Witness Point
IC	Independent Certifier
ISJV	Impregilo Salini Joint Venture
ISJV-SVC-PMS	Joint Venture – Project Management System
KPIs	Key Performance Indicators
OTS	Operations, Trains & Systems
PD	Project Director
PM	Project Manager
PMP	Project Management Plan
PMS	Project Management System
PQM	Project Quality Manager
PTMP	Project Training Management Plan (this plan)
RBTNA	Risk Based Training Needs Analysis
RTO	Registered Training Organisations
SI-BMS	Salini Impregilo – Business Management System
SSR	Site Safety Representative/Project Safety Manager
SVC	Surface Viaduct Contract
Suppliers	Including service providers, subcontractors and suppliers of goods

Abbreviation	Definition
SWMS	System Works Methods Statement (incorporating the Safe Work Method Statement, Environmental aspects, impacts and actions and Quality/Business risk and controls)
TSC	Tunnels and Station Civil
UDCLP	Urban Design and Corridor Landscape Plan

2 INTRODUCTION

2.1 Purpose

The Urban Design and Corridor Landscape Plan (UDCLP) is to:

1. Detail the design initiatives to integrate SVC related infrastructure into its existing and proposed settings and landscaping measures to minimise, mitigate and/or offset the impacts of the SVC works on property and other land uses (such as open space), visual amenity and local vistas and heritage values.
2. Provide a document by which compliance to Ministerial Condition of Approval – Condition 44 – *'Urban Design and Corridor Landscape Plan'* (C44) can be demonstrated.
3. Be endorsed by an Independent Design Review Panel, prior to the commencement of permanent built works and / or landscaping.

2.2 Background

The Project Deed nominates the Proponent (TfNSW) as having responsibility for the Urban Design and Corridor Landscape Plan, which is eventually intended to be prepared and implemented for the entire North West Rail Link Project. This Project is split into three separate contracts:

1. TSC – Tunnel and Stations Civil: Little to no urban design and landscaping impact;
2. SVC – Surface Viaduct Contract: High urban design and landscaping impact;
3. OTS – Operations, Trains & Systems: High urban design and landscaping impact.

Through agreement, TfNSW and ISJV are working collaboratively to satisfy C44 and the ISJV UDCLP addresses C44, in so far as it relates to the SVC works. The Plan will build on existing work that was conducted by TfNSW, through the EIS and approval process, prior to the commencement of the SVC. The ISJV UDCLP whilst direct to SVC works will also provide a framework on which the OTS contract can expand.

The Plan has been prepared by ISJV with urban design and architectural designs by DesignInc and landscaping designs by Turf Design Studio.

2.3 Scope

The scope of the ISJV UDCLP is specifically to address and demonstrate compliance with Ministerial Condition of Approval – Condition 44 (listed in the table below) in so far as it relates to the Surface Viaduct Contract (SVC).

The responsible party has been identified in the table. Where responsibility remains with TfNSW, the clauses have remained here for completeness.

	Condition 44 - Urban Design and Corridor Landscape Plan	Where addressed
Condition 44	The Proponent shall, prior to the commencement of permanent built works and/or landscaping, unless otherwise agreed by the Director-General, prepare and implement an Urban Design and Corridor Landscape Plan for the corresponding permanent built works and/or landscaping. The Plan shall be submitted to the Director-General and made publicly available.	
	In preparing the Plan, the Proponent shall consult with the Department (Land Release), RMS, relevant Councils and the community.	Section 3.4 + Appendix C
	The Plan shall be prepared by appropriately qualified person(s) and detail the design initiatives to integrate rail infrastructure, stations and facilities into their existing and proposed settings, and landscaping measures to minimise, mitigate and/or offset the impacts of the SSI (including acoustic barriers and embankments/cuttings) on property and other land uses (such as open space), visual amenity and local vistas and heritage values. The Plan shall include, but not necessarily be limited to:	Section 3.1 + 3.5
Condition 44 (a)	identification of design objectives and standards based on local environmental and heritage values, strategic and statutory planning, future land release form and function, sustainable design and maintenance, transport and land use integration, passenger and community safety and security, community amenity and privacy, and relevant design standards and guidelines;	Section 3.2
Condition 44 (b)	details on the plans to provide, mitigate and/or augment landscaped areas and elements, with landscaping works to enhance ecological	Appendix B

	values, including riparian areas and fauna corridors, the provision of water sensitive urban design initiatives and to mitigate impacts to heritage landscapes;	
Condition 44 (c)	design details of the built elements of the SSI, including retaining walls, embankments, viaducts, culverts, bridges and underpasses, noise barriers, train stabling facility, and substations, and the measures to minimise the impact of these elements, particularly with respect to the impacts on adjoining residences, educational facilities, open space areas and heritage items and landscapes, including the recommendations of the Visual Impact Strategy (condition C27);	Appendix B + Section 3.3
Condition 44 (d)	Relates to station precinct. This condition is retained by TfNSW and is not part of the ISJV UDCLP scope.	N/A
Condition 44 (e)	Relates to pedestrian and cycle access elements and fixtures. This condition is retained by TfNSW and is not part of the ISJV UDCLP scope.	N/A
Condition 44 (f)	Relates to parking elements. This condition is retained by TfNSW and is not part of the ISJV UDCLP scope.	N/A
Condition 44 (g)	Relates to parking elements public art and heritage interpretation installations. This condition is retained by TfNSW and is not part of the ISJV UDCLP scope.	N/A
Condition 44 (h)	implementation, management and monitoring strategies to ensure the establishment and ongoing maintenance of built elements and landscaped areas, including performance standards; and	Section 3.6
Condition 44 (i)	consideration of relevant design standards, such as the Sustainable Design Guidelines for Stations, Commuter Car Parks and Maintenance Facilities (2011).	Section 3.1 + 3.7

Condition 44	The Plan shall be endorsed by an independent Design Review Panel. The Design Review Panel shall consist of appropriately skilled professionals in the fields of architecture, landscape design, transport integration and heritage. The Panel representatives shall be approved by the Director-General.	Section 3.8

2.4 Relationship to Other PlansThe ISJV Management System and overarching documentation framework is shown in Figure 2-1

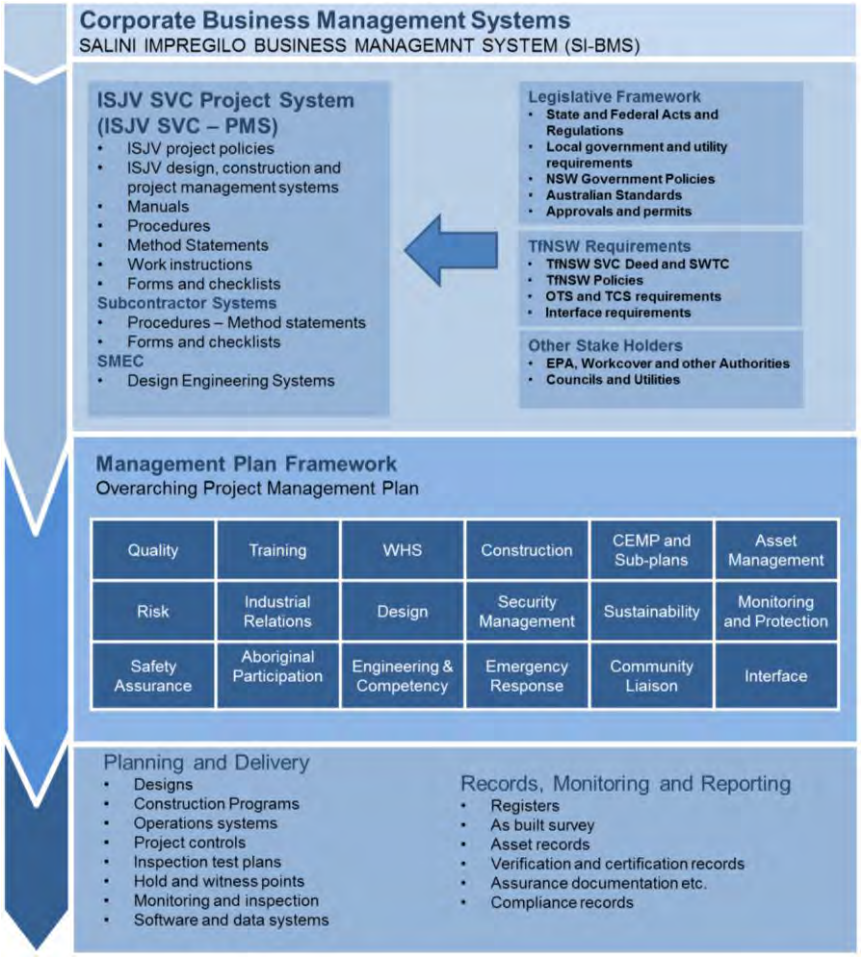


Figure 2-1 - ISJV SVC Management Systems and Document Framework

The Urban Design and Corridor Landscape Plan interfaces are the:

- Community Liaison Implementation Plan
- Design Plan
- Competency Management Plan
- Construction Heritage Management Plan
- Construction Flora and Fauna Management Plan
- Asset Management Information Delivery Plan

The relationship of this plan to the other plans is indicated in the Figure 2-2.

Project Management Plan			
Risk Management Plan	Design Plan	Construction Plan	Construction Environmental Management Plan
Technical Risk Management Plan	Engineering and Competency Management Plan	Waste Management and Recycling Plan	inputs to Compliance Tracking Procedure
Safety Assurance Plan	Engineering Management Plan	Earthworks Plan	Construction Compound Ancillary Facilities Management Plan
Assurance Documentation Management Plan	Requirements Management Plan	Spoil Management Plan	Construction Noise and Vibration Management Plan
Project Quality Plan	Competency Management Plan	Visual Amenity Management Plan	Construction Traffic Management Plan Including
Project Records Management Plan	Urban Design & Corridor Landscape Plan	Security Management Plan	Construction Soil and Water Management Plan
Project Purchasing Management Plan	Stormwater and Flooding Management Plan	Monitoring and Protection Plan	Soil Salinity Management Plan
Project Training Management Plan	Services Management Plan	Pollution Incident Response Management Plan	Water Quality Monitoring Program
Workplace Relations Management Plan		Site Specific Emergency Response Plan	Construction Heritage Management Plan
Project Aboriginal Participation Plan		Community Liaison Implementation Plan	Construction Flora and Fauna Management Plan

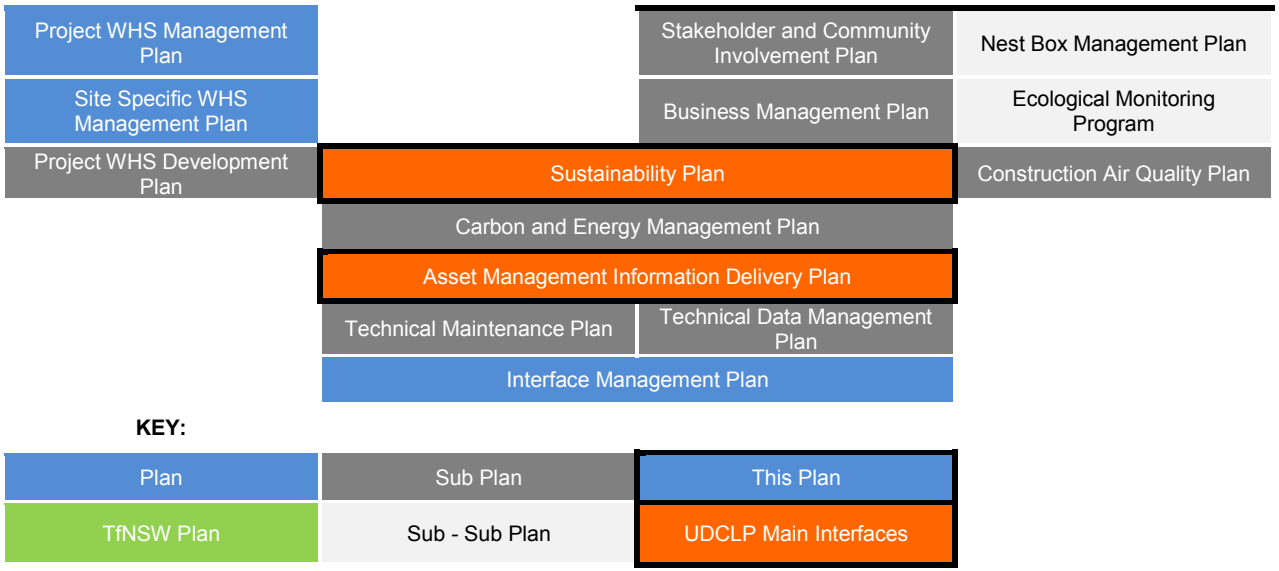


Figure 2-2 - Hierarchy of SVC Management Plans

2.5 Plan Preparation and Review

The Design Manager is responsible for preparing and updating the Urban Design and Corridor Landscape Plan .

Ongoing review and updating of the Plan will be undertaken, taking into account:

i) Changes in design or construction process, including the use of and development of new designs and materials
ii) New design and construction processes requiring documentation which the existing Urban Design and Corridor Landscape Plan does not address.

The Urban Design and Corridor Landscape Plan documentation will be reviewed on a regular basis as part of project review meetings in accordance with MSP47 Project Reviews.

All revisions including amendments of this plan will be authorised by the Project Director and the Design Manager prior to their issue.

3 URBAN DESIGN PLAN AND LANDSCAPE PLAN (Appendix A and B)

3.1 Introduction

The NWRL SVC Urban and Architectural Design report at Appendix A was prepared by Designinc on behalf of ISJV. The report aims to present ISJVs Substantial Developed Design (SDD) for the Urban Design scope to Transport for NSW (TfNSW) and demonstrate continued compliance with the brief. Design, value, cost, whole of life performance, timing and constructability has informed the development of the design. This report identifies the key contributors and their effect on the design solution. Each section in this report is structured to communicate the following:

1. Key Objective - as taken from the TfNSW Viaduct design guide and Appendix 13

2. Response - identifying how the design responds to this criteria from the concept design

3. Design Development - to identify any differences between the concept design and the current developed design. Where applicable, items requiring ongoing coordination or design development have also been noted.

The planning and design of the NWRL softworks included in Appendix B Landscape Design has been undertaken by Turf Design Studio (TDS) by ISJV. TDS are an experienced Urban Design and Landscape Architectural company with substantial experience in the design and implementation of rail transport projects. Softworks components are defined by the proposed track alignment which requires a range of treatments as it passes through a range of natural and modified landscapes.

Treatments are required to conform to the approved project Deed of Agreement “Exhibit A - SWTC - Appendix 13 - Architecture, Urban Design and Landscape Performance and Design Requirements”. However, the treatments recommended herein seek to both meet the requirements of the Deed, and incorporate more detailed and resolved information as the design evolves.

3.2 Technical report background, Site Analysis, Design Guidelines and Requirements

The Urban Design and Landscape material provided in Appendix A and B of this report was informed by a background of prior reports, technical papers, concept designs, reference designs, design guidelines, SVC EOI Concept Design Drawings and a technical requirements deed. These documents were prepared by or on behalf of TfNSW.

The relevant guidelines and standards have been considered and incorporated as required into the urban design elements being assessed by ISJV and TfNSW in consideration of Lot 80 Urban Design included in Appendix A of this report. The key guidelines are discussed below:

Environmental Impact Statements (EIS)

EIS 1 – Major Civil Works (approved 25.09.12)

Fig. 3-1 Cover Page NWRL EIS Stage 01

EIS 1 consists of included 22 Chapters including technical reports addressing matters including: analysis of the strategy context, statutory planning assessment framework, land use and community facilities, Ecology, Visual amenity, noise vibration, soils and groundwater, traffic, heritage (European and Indigenous). In addition the EIS included the proposed rail alignment, profiles, and station layouts.

Fig. 3-2 Alignment & Stations Location Plan (Source NWRL EIS 01)

EIS 2 – Stations, Rail Infrastructure and Systems (approved 08.05.2013)

Fig. 3-3 Cover Page NWRL EIS 2

EIS 2 Provided additional technical information and project overview concept design information regarding the design of the proposed viaduct structure and the eight new stations. The EIS noted that the concept design presented would undergo more detailed design and assessment.

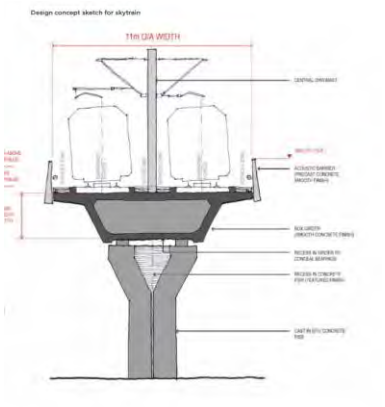


Fig. 3-4 Viaduct Concept Sketch Secton (Source EIS 2)

Design Concept Sketch for Skytrain (Source NWRL EIS 02).

NWRL Design Guidelines (Part 01 - Introduction + Part 02 – Viaduct)

NWRL Design Guidelines 1 and 2 dated 10 May 2013 represented the detailed design development of the concept design included in EIS 2. The design material contained in the Part 2 – Viaduct Guidelines formed the reference design material for the Surface and Viaduct Civil Works. This information was used as the basis for the NWRL SVC Project Deed - Appendix 13 Architecture, Urban Design and Landscape Performance and Design Requirements.

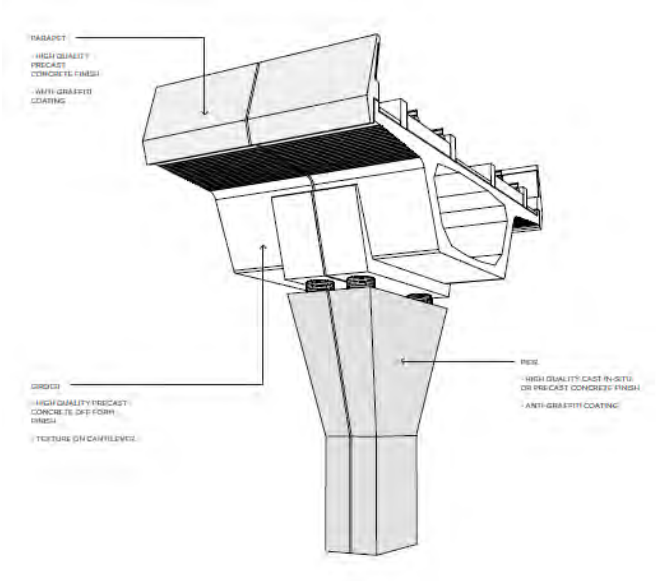


Figure 3-5 Viaduct Section 1.6 Materials and Finishes Source NWRL Design Guidelines - Part 2

NWRL SVC Project Deed - Appendix 13: Architecture, Urban Design and Landscape Performance and Design Requirements

NWRL SVC Project Deed Appendix 13 formed the base brief for the development of the urban design and landscape design included in Appendix A and B of this report. The Appended Urban Design and Landscape documents address the various aspects of the design based on the contents structure in Appendix 13.

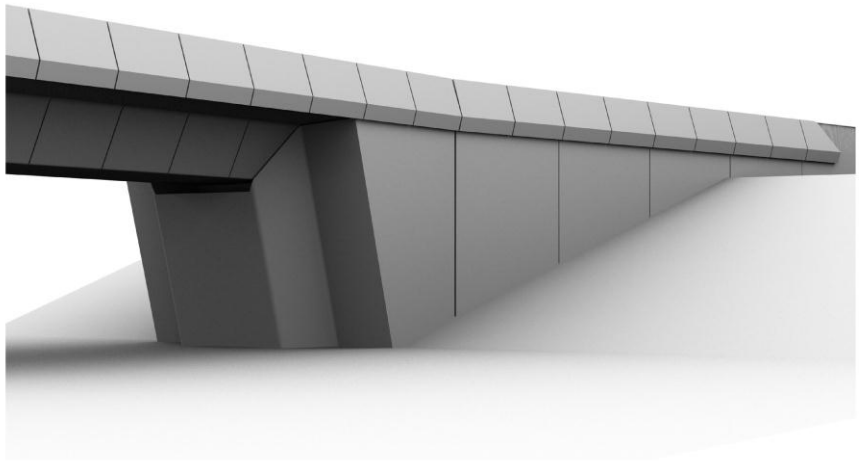


Fig. 3-6 Main Abutment Walls (Source SVC Project Deed Appendix 13)

3.3 Visual Impact Strategy

The NWRL Project Planning Approval 2 includes a number of heritage related conditions including condition C27, which states:

C27. The proponent shall prepare and implement a Visual Impact Strategy in consultation with the Department of the NSW Heritage Council to detail and minimise the visual impacts of SSI on heritage items , including Glenhope, Inala School, Castle Hill Showground, Mungerie House and the former Swann Inn: and the rehabilitation of bushland associated with works at Epping.

Mungerie House and the Swann Inn are located within the SVC corridor. The status of the ISJV work in preparing a Visual Impact Strategy for these items is discussed below. In addition an Urban Design and Visual Impact Assessment related to the Windsor Road Bridge Modification has been undertaken by GL Studio this is also discussed below:

Mungerie House

The NWRL Design and Construction of Surface and Viaduct Civil Works - Construction Heritage Management Plan (CHMP) prepared by Urbis on behalf of ISJV (Rev 6 dated 20th August 2014), provides a detailed description, impact assessment, list of mitigation measures, monitoring and reporting requirements for Mungerie House. The CHMP notes that Mungerie House is a locally listed heritage item within the SVC zone.

The approved SVC corridor cuts across the original driveway entrance into the Mungerie property and the construction of the viaduct structure would involve the removal of a number of existing trees screening the property from Windsor Road. Refer to Figure 3-1 below (source CHMP Section 3.1 Figure 1 – European built heritage – Mungerie House Location).

Figure 3-7 Mungerie House Location Plan

Section 3.3 of the CHMP provides the following Site Specific Mitigation Measures:

- *Install fence along the length of the construction area boundary adjacent to the Mungerie site.*
- *All items on the site are to be retained and protected throughout construction.*

- *Adequately protect any mature vegetation on the Mungerie site from the construction zone.*
- *A buffer of trees between Mungerie and the rail corridor is to be maintained. Any trees removed to facilitate construction would be reinstated on completion of works.*
- *Re-establish planted vegetation along the eastern side of the North-West T-way / construction zone following completion of the construction works.*
- *The area of the carriage drive that will be removed during construction works will be reinstated*
- *A Sensitive Area / No Go sign is to be located at the entry to the adjacent construction zone identifying the Mungerie House location"*
- *Monitoring of the property is to be conducted in accordance with the requirements of the Monitoring and Protection Plan.*

Bullet point number three above: *A buffer of trees between Mungerie and the rail corridor is to be maintained. Any trees removed to facilitate construction would be reinstated on completion of works,* is based on the mitigation measure EH11 provided in EIS 01, Chapter 11 'European Heritage', prepared by Godden McKay Logan. Chapter 11 noted that Item 183 - Mungerie listed was listed as an item under the Baulkham Hills LEP and DoP S170 Heritage Register.

In addition, EIS 1 Chapter 16 – Visual Amenity states:

Mungerie House is a small heritage listed cottage, including a visitor centre, and is set within attractive gardens. Although access to the house is now from the rear, it faces and is traditionally approached from Windsor Road. Some trees would be removed, however the remaining vegetation would provide filtered views to the viaduct and supporting structures. Intermittent train movements would be noticeable running across the view. The viaduct, although filtered by the intervening trees would be visually prominent. Due to the considerable reduction in visual amenity from a location of regional visual sensitivity, there would be a ***high adverse*** *visual impact at this location during operation and Stage 2 construction.*

Figure 16.20 Viaduct from Mungerie House - before development

Figure 16.21 Viaduct from Mungerie House - after development (showing general form and scale of development only)

Figure 3-8 Viaduct View from Mungerie House before and after viaduct construction *(Source NWRL - EIS 1 Chapter 16 Visual Amenity - Figure 16.20)*

Urbis has been commissioned by ISJV to undertake a Visual Impact Strategy (VIS) to investigate strategies to minimise the visual impacts of the North West Rail Link on Mungerie. The VIS will be a strategy document that clearly outlines design guidelines including mapping, to allow the future detailed preparation of landscape architecture designs that can successfully reduce the visual impact of the NWRL on these sites. In this regard a Heritage specialist from Urbis will work with the construction team and design team to ensure mitigation measures are implemented.

It is noted that the potential visual impact associated with the SVC works at Mungerie House related to the original reference design location of the piers which landed on the original carriage way of the property. In order to minimise the impact of the viaduct structure in the area, the location of the nearest piers have been arranged such that they are located either side of carriage way which leads towards Mungerie House.

Swann Inn Archaeological Site

The site is located around 150 meters south of the Merriville Road intersection with Old Windsor Road (Figures 5 & 6). Note that although listed separately in the EIS technical heritage report, it has since been determined by the heritage consultants that the Swan Inn and the White Hart Inn are the same structure which have historically been referred to by different names.

Figure 3-9 Location Plan Swann (White Hart) Inn (source CHMP Section 3.1)

The NWRL Design and Construction of Surface and Viaduct Civil Works - Construction Heritage Management Plan (CHMP) prepared by Urbis on behalf of ISJV (Rev 6 dated 20th August 2014), provides a detailed description, impact assessment, list of mitigation measures, monitoring and reporting requirements for the Swann Inn.

The proposed mitigation measures are given as:

An exclusion zone will be erected around the archaeological site during construction with access to this are strictly controlled.

In addition to the mitigation measures proposed in the CHMP above TfNSW (by letter dated 18 Feb 2014) required ISJV to further to mitigation measures to ensure recommend actions to preserve the archaeological site known as the White Hart Inn.

EMM heritage consultants were appointed to address these actions. In March 2013 EMM provided a methodology for covering the white Hart Inn archaeological site for protection against construction activities and site degradation including covering the site with geofabric, sandbagging exposed features, reburial of site, fencing and post burial maintenance. In addition, in February 2014 EMM provide formal advice relating to the construction exclusion zone around the White Hart Inn archaeological site (following preliminary archaeological excavation in October to November 2013).

EMM has confirmed that these works have been undertaken. In addition, the position of the piers in this location has been modified to sit outside the exclusion zone. Refer to the Urban Design Report in Appendix A.

EMM noted that as the item is an archaeological site it is not considered that there are any direct visual impacts related to the site as a result of the SVC. However, they noted that the proposed future heritage interpretation options for the site outlined by EMM in 2014 should be considered in relation to potential visual impacts.

Urbis has been commissioned by ISJV to undertake a Visual Impact Strategy (VIS) to investigate strategies to minimise the visual impacts of the North West Rail Link on the Swann Inn.

Windsor Road Bridge Modification Urban Design and Visual Impact Assessment

An Urban Design and Visual Impact Assessment Report dated January 2014 has been prepared by GL Studio to assess the impacts of the proposed modification to the SSI 5414 Project Approval . The modification involves the proposed substitution of the approved viaduct structure across Windsor Road with a clear span cable-stayed bridge at the same location.

Fig. 3-10 Perspective image of proposed Windsor Road Bridge (Source cover page Urban Design & Visual Impact Assessment – GL Studio Jan 2014)

The report notes that the changes increase the height and landmark characteristics of the bridge and will materially change the visual and heritage impacts compared with the project as approved. The report concludes that the proposed bridge:

- Is likely to become a recognizable structure in the landscape, a marker of the railway in the immediate and wider landscape context,
- Will reinforce the Rouse Hill Town Centre and subsequently its importance as a major town centre and
- Has been designed with consideration of the scale of the structure and its impact on the surrounding area.

3.4 Consultation (Appendix C)

There is a requirement to consult with the Department (Land Release), RMS, relevant Councils and the community on design details and urban design features of the SVC built elements.

This Plan will build on existing consultation that was conducted through the EIS and approval process, prior to the commencement of the SVC. Subsequent consultation carried out under this Plan aims to provide surety that the initial design intents are met and communicated accordingly.

3.4.1 Department (Land Release)

ISJV will communicate this Plan to the Department in order to demonstrate compliance with C44. It is noted that land boundary and railway viaduct alignment details are beyond the scope of this Plan as these were determined at a previous stage.

3.4.2 RMS and Relevant Councils

RMS and relevant Councils are consulted on urban design and landscaping via the design review process as outlined in the Design Plan. Their comments on each stage of the design are consolidated by the Independent Certifier (IC) and are progressively closed out at the design progresses.

3.4.3 Community

The community consultation strategy in relation to the SVC stage of the NWRL is outlined in the NWRL SVC Community Liaison Implementation Plan (CLIP), prepared by Urbis on behalf of ISJV. The program for the implementation of community liaison activities is linked to key design and construction activities and milestones. As specified in the CLIP, community consultation on design features and development occurs at CMCG meetings, weekly meetings with NWRL Stakeholder and Community Liaison team, community forums (four per year) and business forums (four per year)In regard to the implementation of the CLIP Urbis has advised that they are gathering evidence via:

- Survey form available at the four business and community forums held 24 July-2 August 2014 – responses can be provided up until 15 August
- Survey questions in the monthly community email update – responses can be provided up until 15 August
- TfNSW has also put these questions on its website – TfNSW will send us a summary of any feedback also by 15 August.

Appendix 4 page 84 of the CLIP addresses the consultation requirements under Condition 44:

Condition C44 forms part of the conditions of approval accorded by NSW Department of Planning and Infrastructure. C44 states the requirements of the proponent, Salini Impregilo, in preparing and implementing an Urban Design and Corridor Landscape Plan for the Surface Viaduct Civil Works

project. Community consultation on the C44 plan is a requirement by Transport for NSW and was undertaken by the Salini Impregilo community relations team over a one month period between mid-July-mid August 2014.

Details of the consultation process and consultation feedback is provided in the NWRL SVC Community Liaison Implementation Plan (CLIP).

3.5 Competency

There is a requirement for this Plan to be prepared by appropriately qualified person(s). This Report and associated Appendices has been prepared by the following appropriately qualified people:

• UDCLPlan	Ian Armstrong	Bachelor of Architecture (Hons. 1), Bachelor of Town Planning (Hons.), Post Grad. Diploma Urban Design, Post Grad. Diploma Town Planning
• Appendix A	Cathryn Drew-Bredin	Bachelor of Architecture (Hons 1), Bachelor of Science (Architecture)
• Appendix B	Matt Coggan	Bachelor of Landscape Architecture (UNSW)
	Scott Ibbotson	Bachelor of Landscape Architecture, Associate Diploma in Applied Science – Landscape Advance Certificate in Urban Horticulture Horticultural Science Certificate, Bush Regeneration Supervision Certificate
• Urban Design Verifier	Anthony Quan	Bachelor of Architecture, Bachelor of Science (Architecture)
• Landscape Verifier	Mike Horne	Master of Urban Design (University of Sydney), Bachelor of Landscape Architecture (University of Canberra)

3.6 Management and Monitoring Strategies

Ongoing maintenance of built elements will occur during the SVC project up until completion of works. After which, this is the responsibility of the OTS Contract.

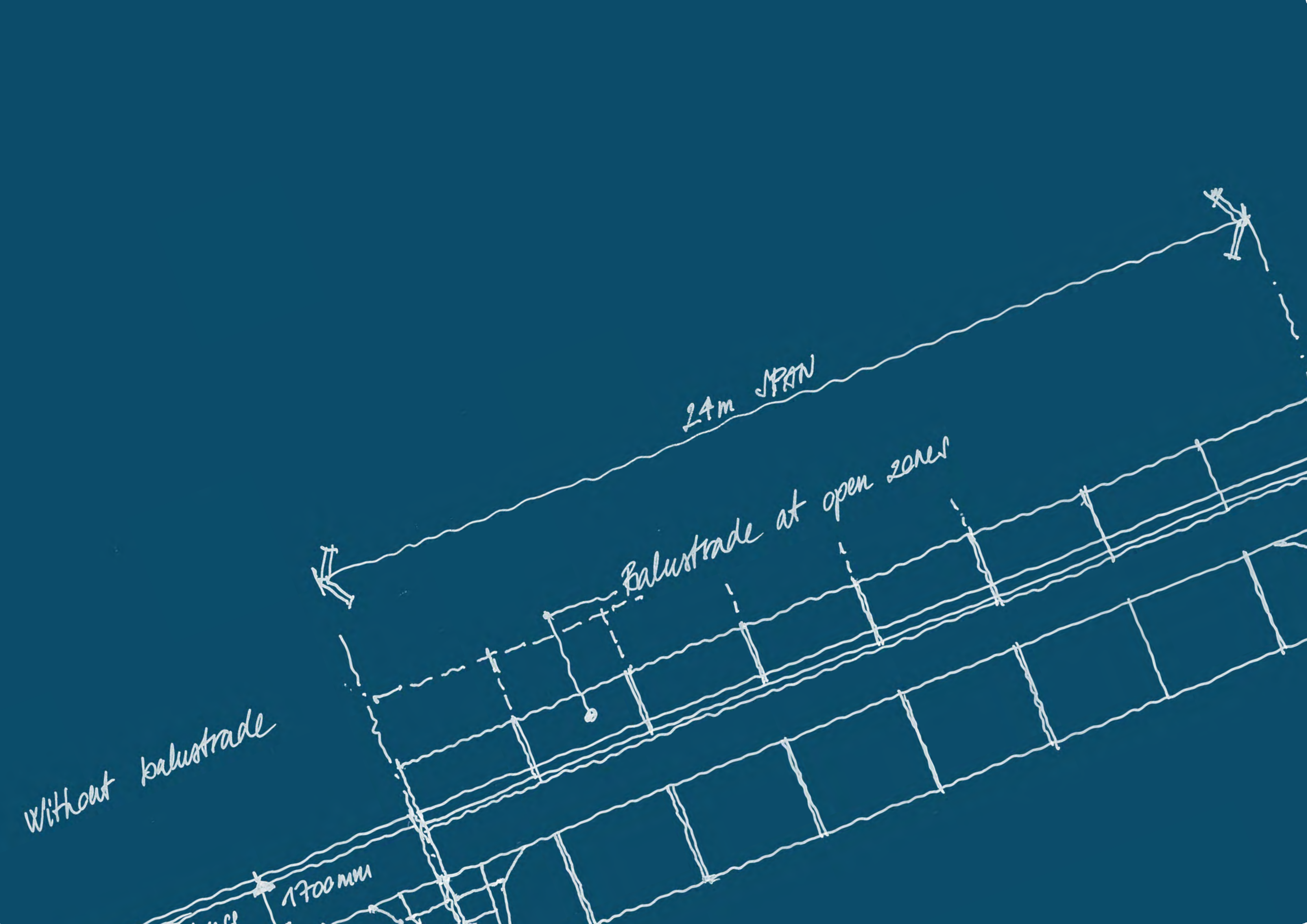
The Asset Management Information Delivery Plan describes how this will occur.

3.7 Sustainability

The Sustainability requirements contained in Appendix 10 have been considered and incorporated into the design. This work has been assessed through design certification and independently through the Infrastructure Sustainability Council of Australia (ISCA) and the TfNSW Sustainability Guidelines. Refer to the ISJV Sustainability Plan submitted to DP+E by TfNSW.

3.8 Design Review Panel Endorsement

At the NWRL Design Review Panel (DRP) meetings on 2 September 2014, the DRP endorsed the Urban Design and Corridor Landscape Plan for submission to the Department of Planning and Environment (DP+E)..


24m SPAN
Balustrade at open zones
Without balustrade
1700mm

Appendix A. Urban & Architectural Design Report (Design Lot 80)

NORTH WEST RAIL LINK

SURFACE AND VIADUCT CIVIL WORKS

Urban and Architectural Design Report (Package Lot 80) Substantial Developed Design (SDD) Stage

Prepared for	Transport for NSW (TfNSW)
Submitted by	IMPREGILO SALINI JOINT VENTURE (ISJV)
Date	29/08/2014
Doc. No.	**NWRLSVC-IDI-SVC-UD-DRT-809000**
Revision	**B**
Status	Substantial Developed Design (SDD)

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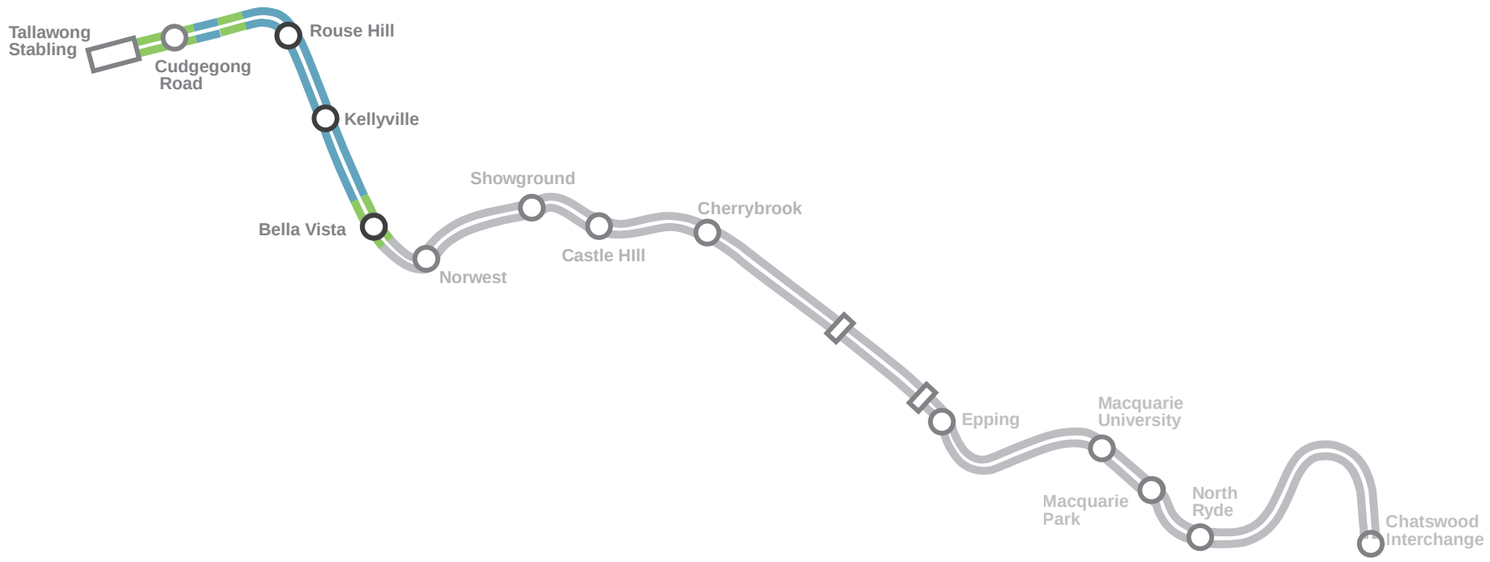


Above: North West Rail Link corridor diagram showing extent of surface and viaduct civil (SVC) works

Document Control

Revision	Date	Author	Checker	Verifier
DRAFT	19/05/14	Katie Fairbrother / Cathryn Drew-Bredin	Cathryn Drew-Bredin	Anthony Quan
A (DCD Submission)	02/06/14	Katie Fairbrother / Cathryn Drew-Bredin	Cathryn Drew-Bredin	Anthony Quan
A.1 (DRAFT for SDD)	31/07/14	Katie Fairbrother / Cathryn Drew-Bredin	Cathryn Drew-Bredin	Anthony Quan
B (SDD Submission)	29/08/14	Katie Fairbrother / Cathryn Drew-Bredin	Cathryn Drew-Bredin	Anthony Quan

1.0 INTRODUCTION

A) Purpose of this Report

This report aims to present ISJVs Substantial Developed Design (SDD) for the Urban Design scope to Transport for NSW (TfNSW) and demonstrate continued compliance with the brief.

Design, value, cost, whole of life performance, timing and constructibility has informed the development of the design. This report identifies the key contributors and their effect on the design solution.

Each section in this report is structured to communicate the following:

1. **Key Objective** - as taken from the TfNSW Viaduct design guide and Appendix 13
2. **Response** - identifying how the design responds to this criteria from the concept design
3. **Design Development** - to identify any differences between the concept design and the current developed design. Where applicable, items requiring ongoing coordination or design development, have also been noted.

The urban design solution is best understood in context with other packages of works outside of this SVC contract. Where elements by others are shown in this report for context, they are annotated as such.

B) Brief Compliance

The design is developed in accordance with the following briefing documents:

1. Appendix 13: Architecture, Urban Design & Landscape performance and design requirements
2. Exhibit A - SWTC - Appendix 30 - Concept Design - Architecture, Urban Design & Landscape Rev 2.2

A compliance table (RVTM) has been prepared by Atkins to enable TfNSW to review packages and confirm brief compliance.

Clauses applicable to the 'Urban and Architectural Design' Package are extracted from Atkins' master table and included as an attachment - refer Appendix B, section 11.

The design is also developed generally in accordance with the principles described in the following guideline documents. These documents are not addressed in the compliance table.

3. Principles and objectives as described in TfNSW's Viaduct Design Guidelines
4. NWRL Environmental Impact Statement (EIS) 1 & 2, Chapter 6.

Some elements excluded from SVC scope of work are shown graphically in this report for context and reference.

These are shown to strengthen the overall urban design solution and demonstrate how the various packages may interface together as a holistic approach.

Works by others include:

- Overhead Wiring Masts
- Station soffit linings
- Track Slab
- Acoustic Panels
- Station Elements
- Noise Walls
- Security Screens, Fences, Gates
- Safety Protection Screens to Overbridges

The Landscape content is now included within the following Civil Packages:

- Design Package 11
- Design Package 12
- Design Package 15
- Design Package 21-26
- Design Package 77

Please refer to the Urban Design & Landscape Plan for a comprehensive Landscape Design Report.

C) Outstanding Coordination Issues

The following areas / elements are still undergoing further detailed design and will be resolved during the next stage, Final Detailed Design (FDD).

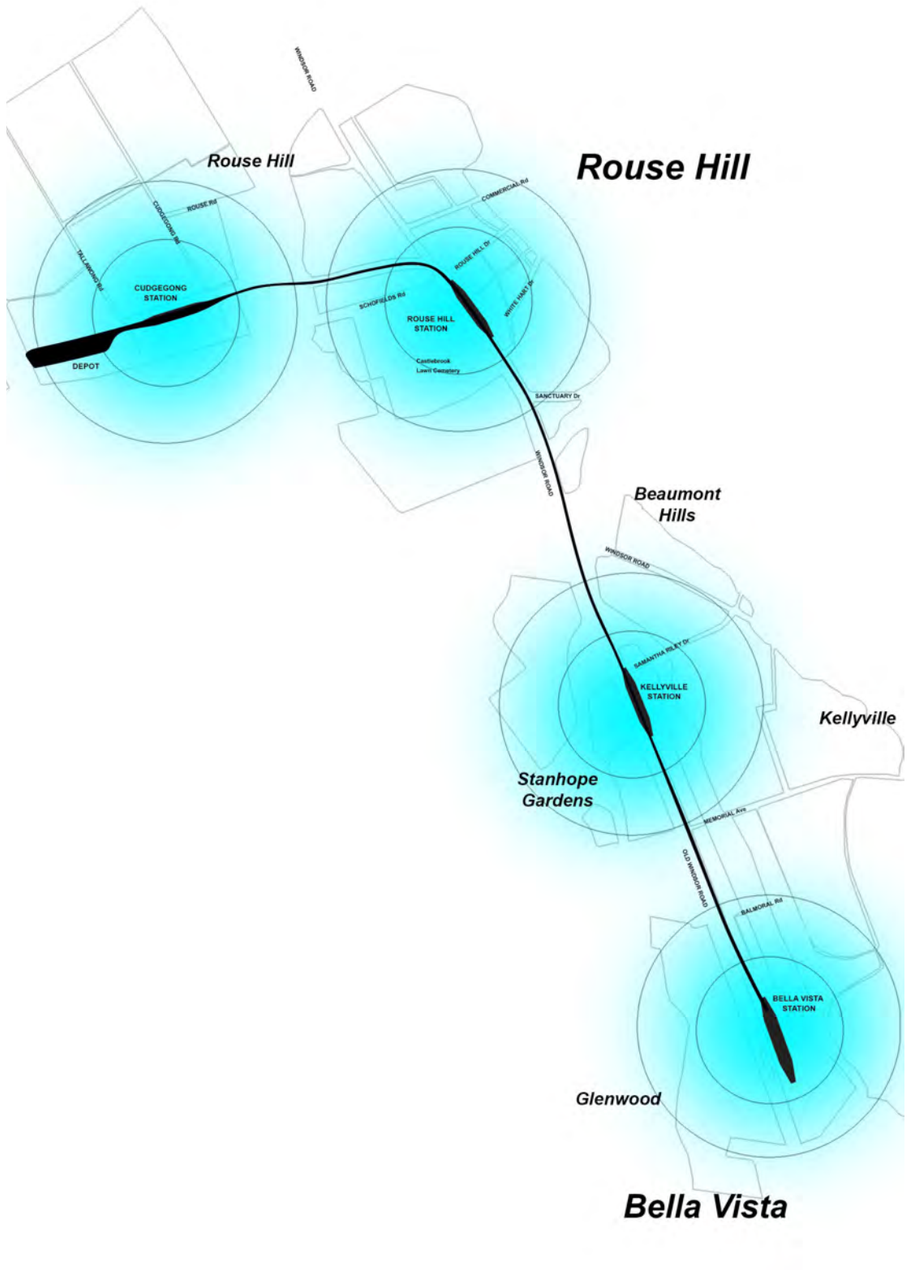
1. Groove depth to retaining wall structures to be further resolved during FDD. Currently as follows:
   - Shotcrete: to be 35mm
   - RSW: to be 20mm (panel thickness issues, cost, smaller joint to minimise accessible footholds)
   - Abutment walls: to be 20mm (structural issue, too much cover to front face, possible cracking issues).
2. Textured corrugation in pier recess
3. Final anti-graffiti coating system - testing still required to determine most appropriate coating system.
4. Final detailed design for the transition girder element at Rouse Hill Station.

Above: Photomontage - Looking north west along Windsor Road

C) Glossary of Terms

BVR	Bella Vista to Rouse Hill
EIS	Environmental Impact Statement
ISJV	Impregilo Salini Joint Venture
JV	Joint Venture
NATA	National Association of Testing Authorities
NWRL	North West Rail Link
OTS	Operations, Trains and Systems
QA	Quality Assurance
QC	Quality Control
RFT	Request for Tender
RMS	Roads and Maritime Service
RTA	Roads and Traffic Authority
SPC	Second Ponds Creek
SVC	Surface and Viaduct Civil
SWTC	Scope of Works and Technical Criteria
TfNSW	Transport for NSW
TOR	Top of Rail


1800 200 90
T-WAY



Photomontage - view along T-Way (opposite page)

Above: Diagram - possible future density showing walk up catchments for future stations

2.0 GENERAL DESIGN CONTEXT

A) Urban Design Strategy

Key Objective

The viaducts and station platforms must integrate structural and architectural elements to create a high quality, simple and elegant piece of civic infrastructure that relates to its existing and future environment and expresses the identity of the North West Rail Link...

Reinforce the local identity through a locally informed response.

Response

The viaduct runs through a portion of the Sydney basin which is currently expanding in population and will see exciting new development as indicated in the NWRL Corridor Strategy report by TfNSW Government Planning and Infrastructure.

The viaduct is a major physical and visual infrastructure element. In response to the local context, the current and future mapped urban densities informs the shape and form of various components of the viaduct and civil structures along the 4.6 km stretch from Bella Vista to Cudgegong Road.

To soften the viaduct's presence and strengthen local way finding, acoustic noise walls, abutments, cuttings and embankments are articulated as a 'family of elements'.

B) Family of Elements

The following considerations informed the creation of a unique family of elements within the existing urban and green context:

- Similar proportioned and angled surfaces on the piers and viaduct structures from ground to parapet,
- Appropriately articulated elements suitable in size and located to ensure best fit within their context,
- Consistent and rhythmical horizontal and vertical expressed and aligned joints, and
- Consistent tapered parapets to provide a ribbon like silhouette through the landscape.

The Family of Elements within the corridor comprise:

Viaduct Piers & Parapets - refer Section 3.0 (B) of this report for more information

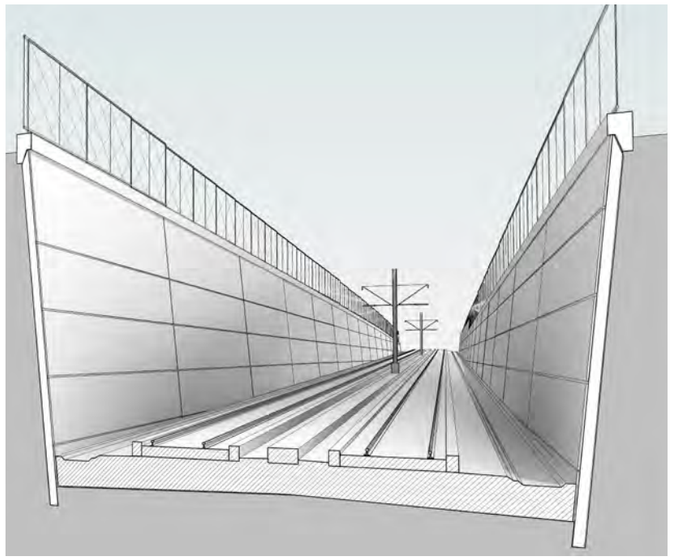
Abutments refer Section 5.0 of this report for more information

Reinforced Soil Walls - refer Section 7.0 of this report for more information

Soil Nail Walls - refer Section 7.0 of this report for more information

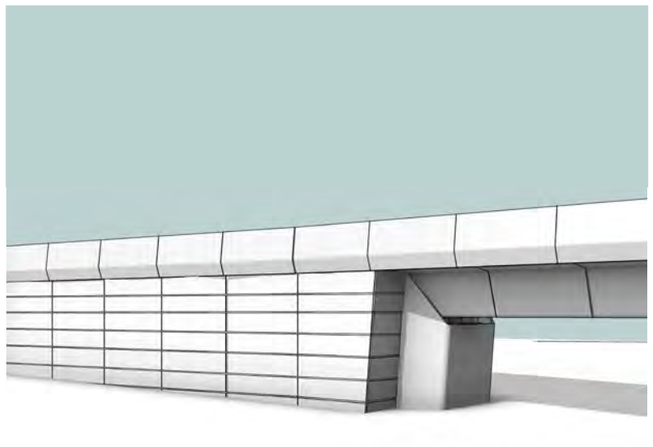
The development of the design of these elements is also described in the Appendices section of the report under A) Design Development Workstreams.

Soil Nail Walls

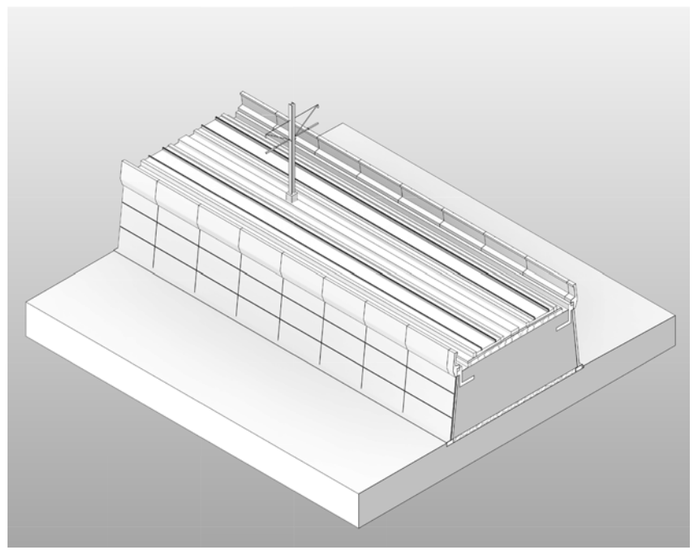


Viaduct Piers & Parapets

Abutments



Reinforced Soil Walls

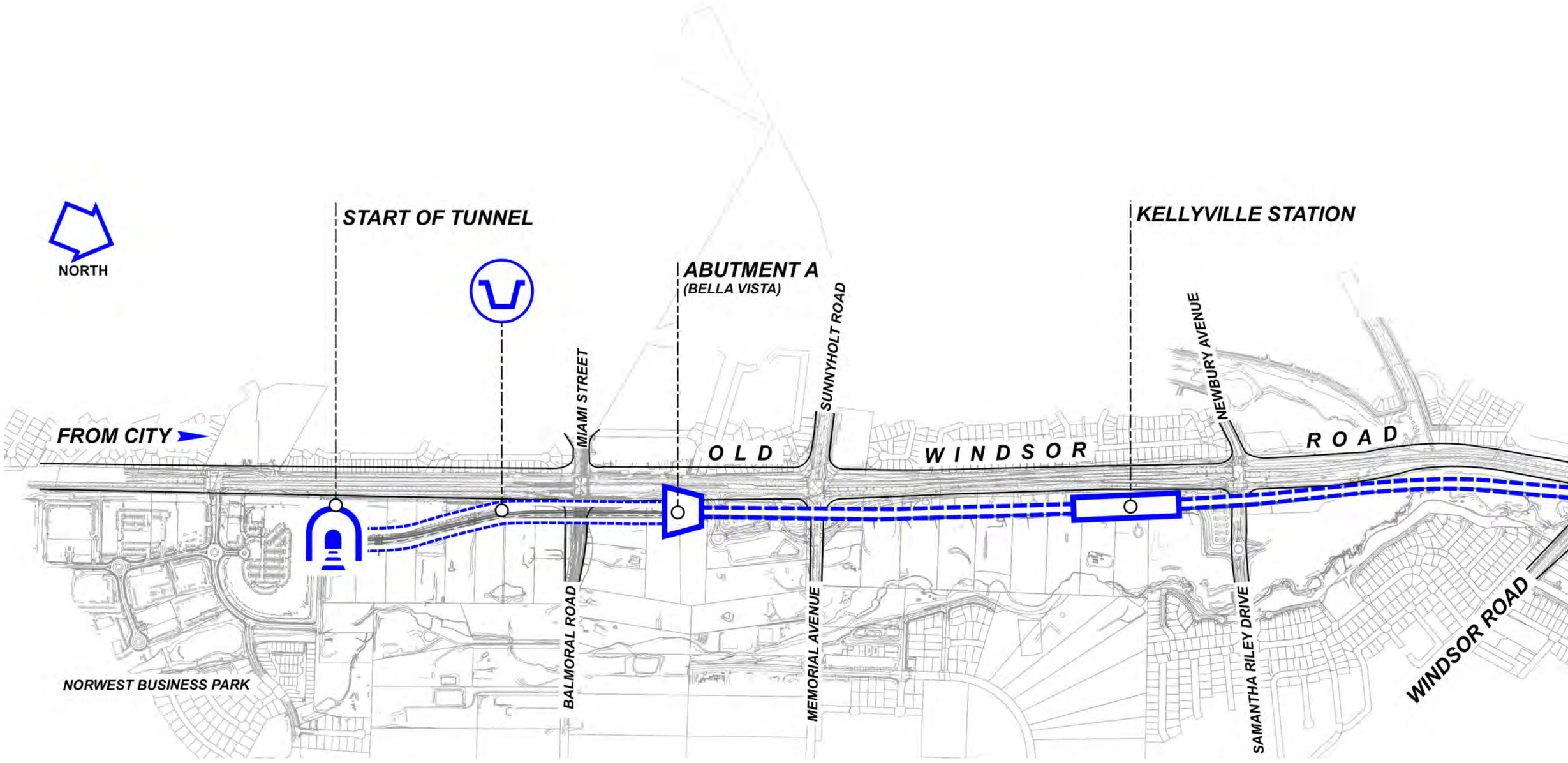


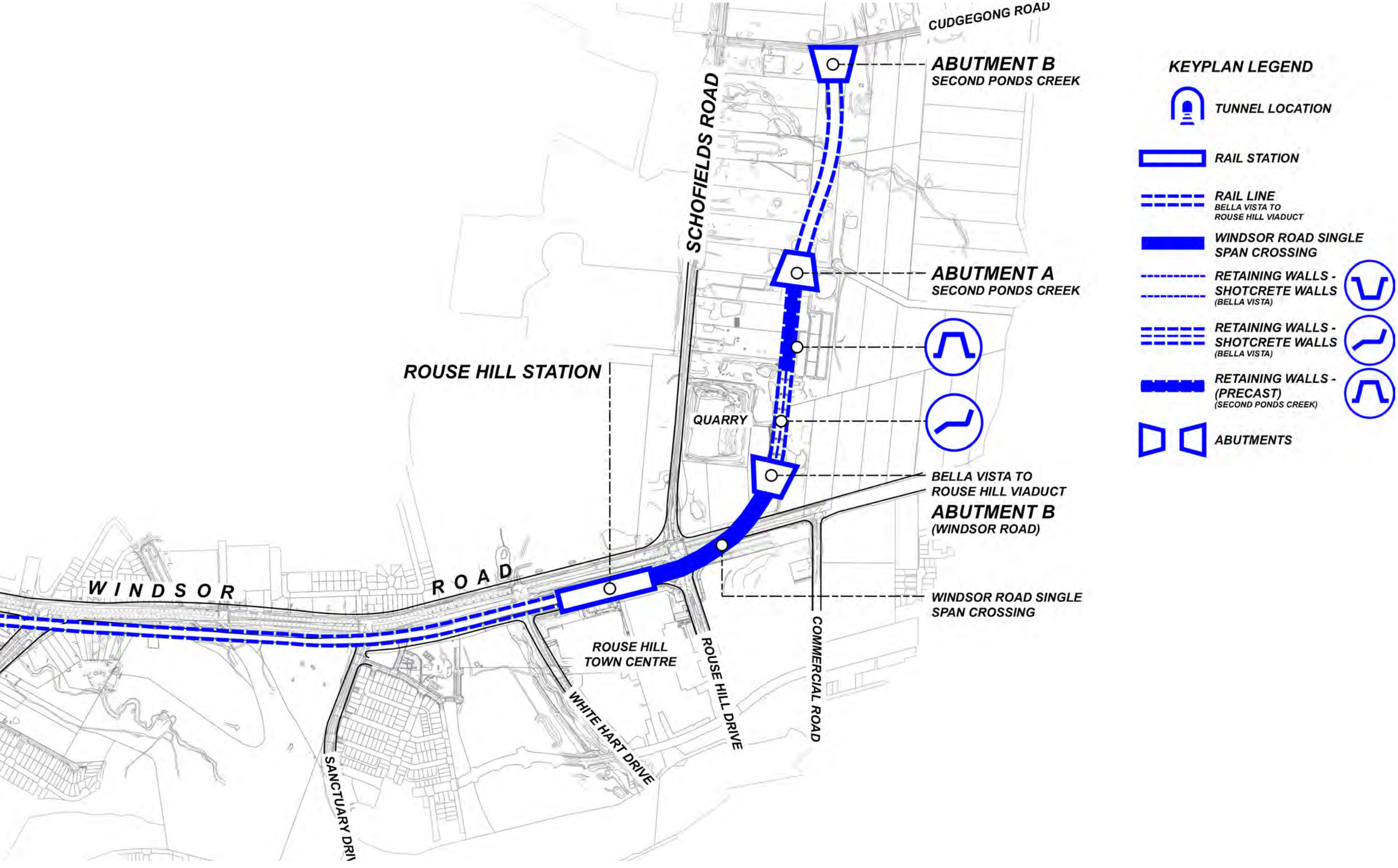
Opposite page: Photomontage - view along T-Way adjacent to Picket Place.


Sanctuary

C) Key Plan

This key plan will assist to navigate the urban design strategy as it relates to the family of elements.




CUDGEGONG ROAD
ABUTMENT B
SECOND PONDS CREEK
SCHOFIELDS ROAD
ABUTMENT A
SECOND PONDS CREEK
ROUSE HILL STATION
QUARRY
BELLA VISTA TO
ROUSE HILL VIADUCT
ABUTMENT B
(WINDSOR ROAD)
WINDSOR ROAD SINGLE
SPAN CROSSING
WINDSOR ROAD
ROUSE HILL
TOWN CENTRE
WHITE HART DRIVE
ROUSE HILL DRIVE
COMMERCIAL ROAD
SANCTUARY DRI
KEYPLAN LEGEND
TUNNEL LOCATION
RAIL STATION
RAIL LINE
BELLA VISTA TO
ROUSE HILL VIADUCT
WINDSOR ROAD SINGLE
SPAN CROSSING
RETAINING WALLS -
SHOTCRETE WALLS
(BELLA VISTA)
RETAINING WALLS -
SHOTCRETE WALLS
(BELLA VISTA)
RETAINING WALLS -
(PRECAST)
(SECOND PONDS CREEK)
ABUTMENTS

3.0 VIADUCT DESIGN

A) Context

Key Objective

The viaduct should be an elegant, consistent structure that integrates with its urban setting and is a defining feature of its surrounding natural and built environment

Create a viaduct that is visually light that promotes the activation of the linear park

Create a beautiful viaduct that is proportionally well resolved taking into account the numerous variations in height along the alignment.

Response

The design of the viaduct includes two structures:

1. Bella Vista to Rouse Hill Viaduct (BVR Viaduct)
2. Second Ponds Creek Viaduct (SPC Viaduct).

Key features of this conforming tender design:

Elegant and efficient design - the viaduct design maintains visual lightness of the reference scheme via an efficient structure that minimises the size of the viaduct while maximising the span. The visual and physical impact on the existing community and context is reduced.

Articulation - height and articulation of the structure is elegant and visually appealing at all heights along the viaduct length, particularly where the viaduct meets the abutments.

Reduced visual impact - to strengthen and elongate the sweeping viaduct form, cradles have been removed to allow the viaduct girder to sail continuously past the pier head. This minimises the bulk of the viaduct pier and further reduces the visual impact on the surrounding context.

Maximised spans - viaduct simply supported spans are maximised at 39m with 51m for continuous spans to provide a consistent pier spacing and uninterrupted visual and physical connections across the ground plane. This also reduces impacts on existing vegetation.

Uninterrupted access - height of the viaduct over the urban pathways provides uninterrupted movement across the rail corridor. This space allows for the future integration of urban precincts.

Noise control - viaduct parapets are shaped to minimise and control visual and noise impacts of the Skytrain and comply with noise level required under the SVC Contract.

Reduced visual clutter - overhead wiring is located centrally to minimise visual impact and clutter.

Design Development

Please refer section 11.0 Appendices - A) Design Development.

Above: Photomontage - shared path, Sanctuary Drive (Rouse Hill)


1800 200 902
just add you.
thenewrousehill.com.au
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1 WAY
ONLY

B) Viaduct Design

Key Objectives

The viaduct should be a consistent, well-proportioned, timeless and elegant structure

Girders should be an elegant, architecturally and structurally engineered solution

Parapets should provide effective noise mitigation, and form an integrated, modular solution within the overall structure

Piers and bearings should be efficient and treated consistently at each support location.

Response

Key features of the conforming design:

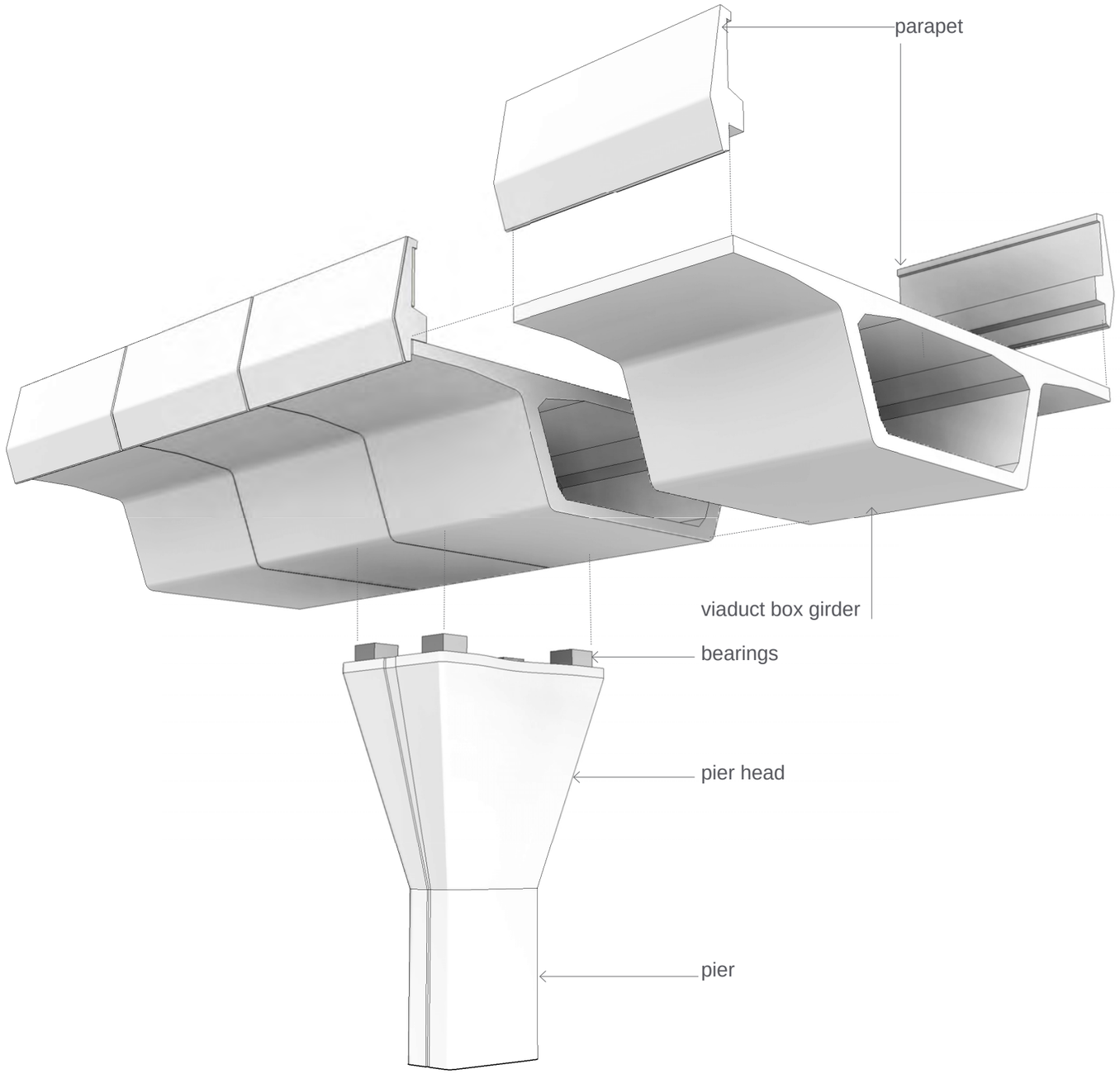
- Match-cast single cell segmental box girder
- Simply supported spans, typically 39 m
- Typical 4 m girder segment length

As outlined on the following pages, key structural elements of the conforming design are:

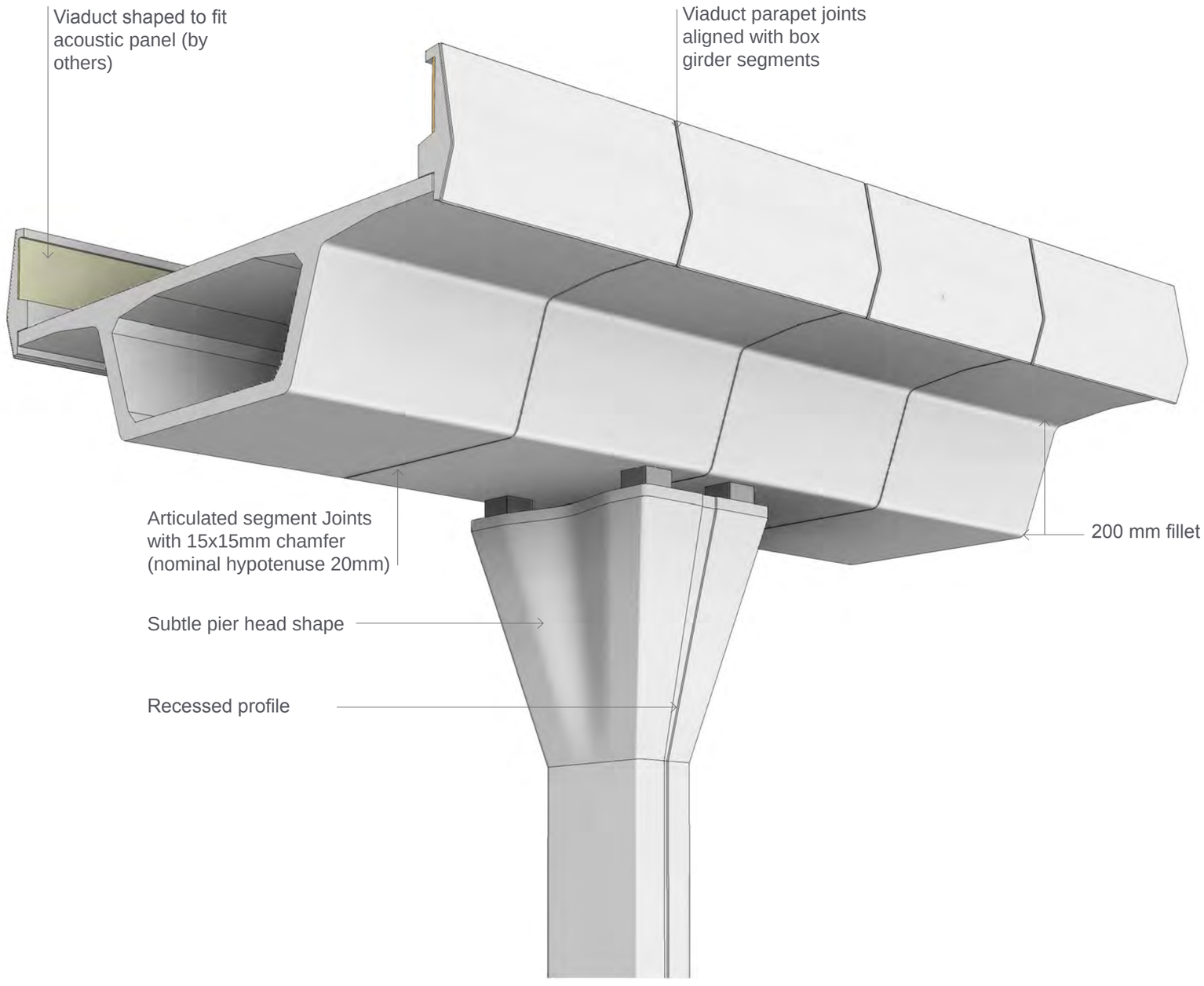
- Viaduct Box Girder
- Piers and Bearings
- Parapet
- Details

Design Development

Please refer section 11.0 Appendices - A) Design Development.



Above: Viaduct structural elements



Above: Viaduct box girder profile extrusion at pier

Viaduct Box Girder

The viaduct design achieves an elegant, subtle and timeless profile complementing the surrounding landscape and environment from all viewpoints. This is achieved by:

Creating visual slenderness through rationalisation of form and engineering.

Minimising the box girder size by shaping and careful articulation of corners and edges. The geometry includes a 200 mm fillet between the girder beam and cantilever, and a 200 mm fillet at the edges of the girder beam.

Strengthening the geometry of the viaduct elements by removing the cradle, as in the reference scheme, produces strong elegant lines flowing continuously and seamlessly past the pier head. This removal of structure reduces both physical and perceived visual bulk.

Reducing the pier head to maintain the viaduct and pier proportion even at its lowest height along the line.

Clear, structural rhythm established through consistent pier spans, viaduct girder segments and joint articulation.

Simple articulation of the viaduct deck to reinforce its graceful and clutter-free shape. Maximising segment lengths (i.e. up to 4 m) further reinforces the clean and smooth lines of the viaduct as they pass over the pier head and streamline the construction process.

Consistent clear relationships between elements such as subtle echoing geometries, proportion and detail.

B) Viaduct Design - continued...

Piers & Bearings

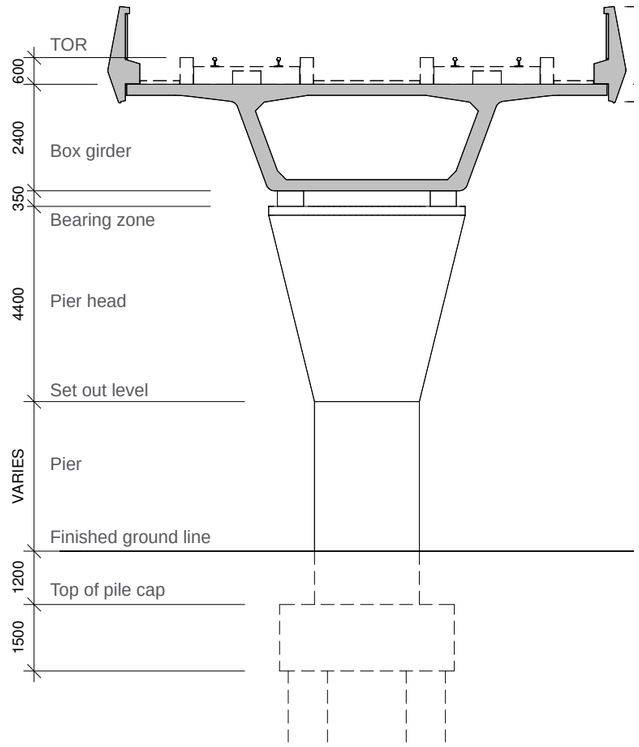
Single pier - a single pier is adopted to avoid the need for a head stock. The piers taper uniformly above the set out level.

Slenderness - the thickness of the pier is optimised to achieve a proportionally elegant outcome. The smaller face is articulated and aligned with the viaduct movement joints to extend its line and further elongate the pier. The top of the pier head is subtly shaped to cap the line of the pier.

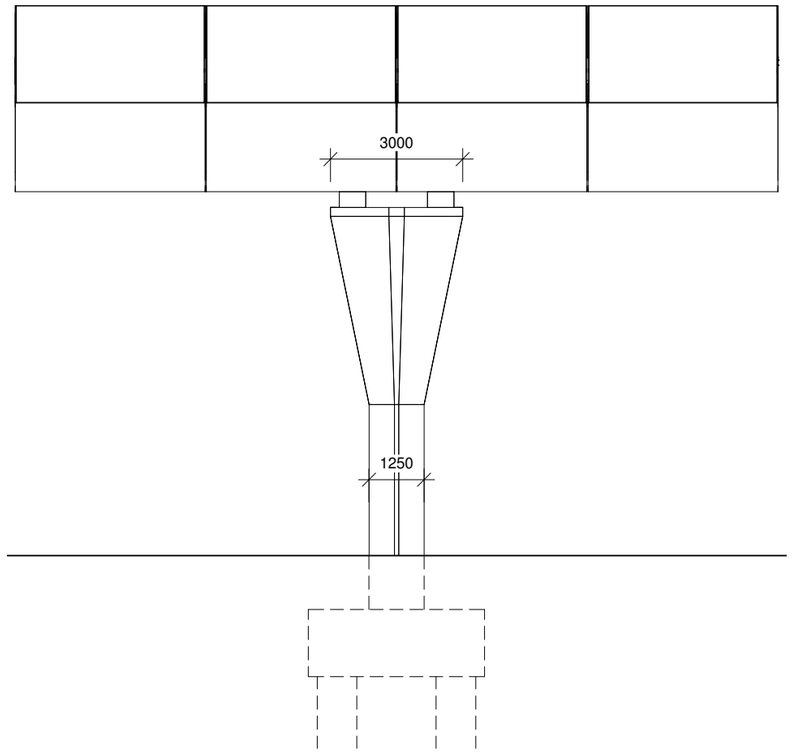
Unified - pier and viaduct box girders are a unified system ensuring a well-designed and consistent aesthetic between elements.

Maintenance - a 350 mm zone is provided for maintenance access to replace the two or four bearings as required.

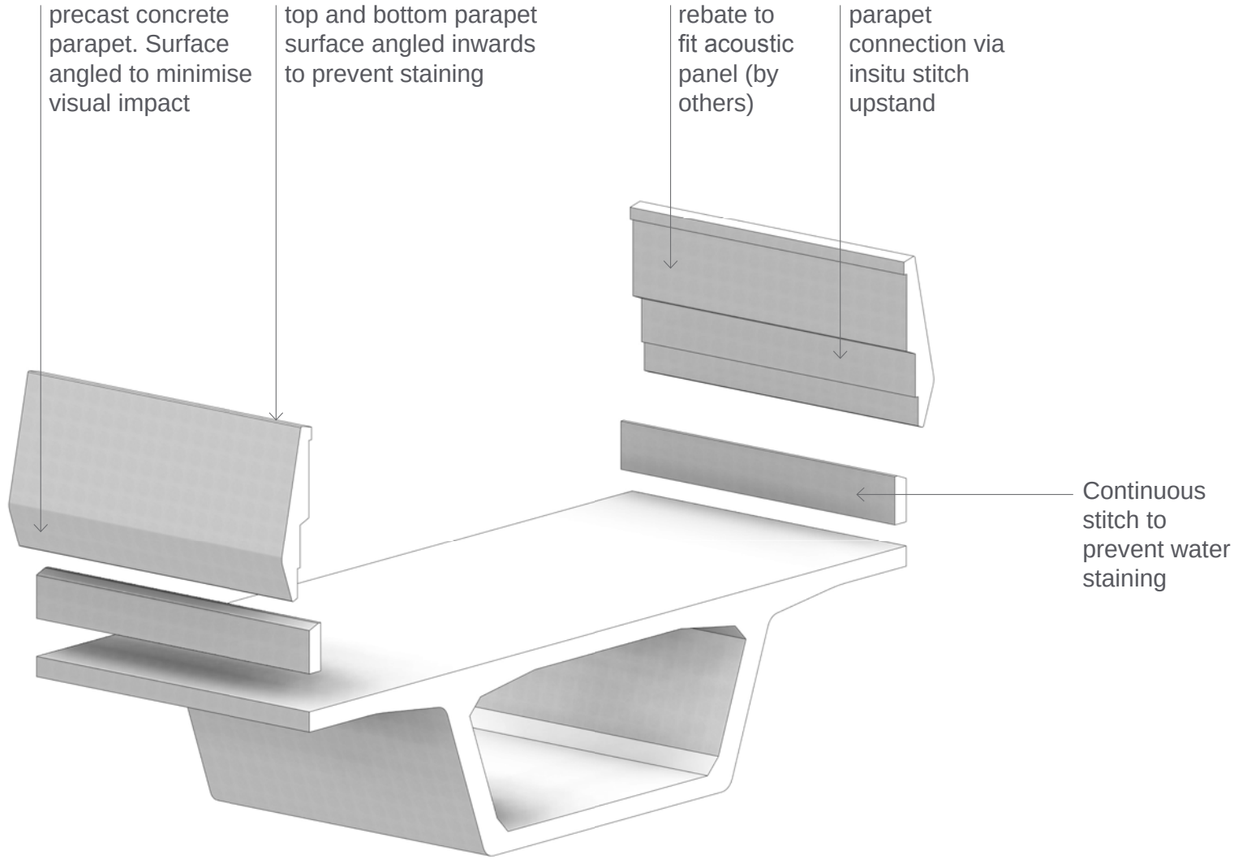
Services - allowance is made for service conduits, storm water pipes and service hatches.



Above: section



Above: elevation



Above: Viaduct parapet details

Parapets

Consistency - is achieved with vertical parapet joints that align with the girder joints.

Corners are chamfered (maximum 20 mm x 20 mm) and profiled to reduce visual bulk promoting a unified, modular and integrated structure.

Shaped parapets to minimise the potential for staining at the top and below the viaduct girder.

Recessed acoustic panels to parapet track-side to mitigate air borne noise transmission (by others).

Consistent horizontal edge and 1300 mm parapet height above formation control line, balanced with acoustic requirements, is provided to maintain views from the train.

Details

Staining - is minimised with a continuous insitu stitch connection between the noise barrier and deck structure mitigates any water travel and subsequent stain marks in the temporary and permanent conditions. Refer to Section 9.0 for more detail on staining prevention measure throughout

Bird proofing - is provided with appropriate, discreet bird and vermin proofing between piers and the underside of the girder in the form of stainless steel wire set-back from the edge. Similar mitigation measures are located at abutment bearing zones. Section 9.0 for more detail on extents

A graffiti coating will be applied to exposed surfaces. Refer to Section 9.0 for more detail on extents of treatment for various elements.

C) Viaduct Spans

Key Objective

Spans should be maximised and structurally efficient, while maintaining a slim and light structure.

Response

To improve the slenderness ratio, the reference design simply supported span is increased from 36 m to 39 m.

Simply supported span - the span is typically, a consistent 39 m simply supported span.

Reduced customer and community impact - spans are maximised to reduce visual and physical impact on the existing context.

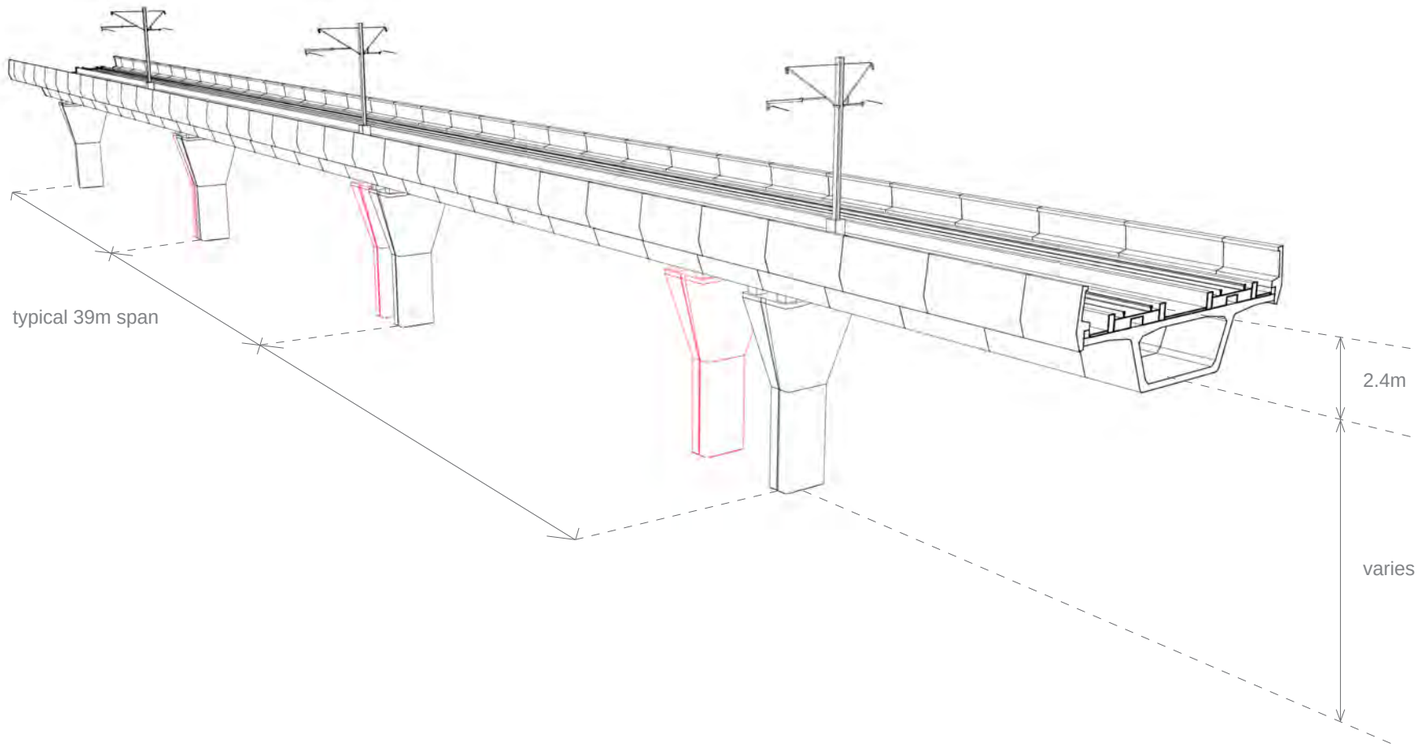
Station spans - 24 m spans through the full length of the stations at Kellyville and Rouse Hill.

Continuous spans - all RMS roads (with the exception of Windsor Road & Memorial Ave) are crossed with a single span within continuously supported sections. Continuously supported spans are provided over Windsor Road and Memorial Road. (Refer Structural Engineering report for more detail.)

Reduced impact - spans are maximised to reduce impacts on existing infrastructure, services and landscape. Spans are proportionally elegant, slim, visually lighter and to meet the requirements of the SVC Project Deed.

Design Development

Please refer section 11.0 Appendices - A) Design Development.



Above: 39 m continuous span with 36 m reference design span shown in red. This conforms with ideal ratios as described by Cardiff University and Frederick Gottemoeller in the RMS 'Bridge Aesthetics Guidelines'.


Sanctuary

4.0 STATION PLATFORM DESIGN

A) Context, Shape & Form

Key Objective

Elevated station platforms should be supported by the viaduct structure and contribute to a high quality customer experience.

Response

The seven viaduct girders span 24 m and simply support the main platform segments. The following design response is developed for the two elevated stations at Kellyville and Rouse Hill with a platform length of 168 m.

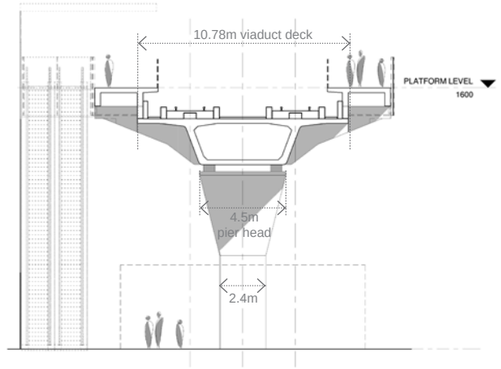
As outlined on the following pages, key structural elements of the conforming design are:

- Viaduct Box Girder & Station Platform
- Struts
- Transitions
- Services & Maintenance

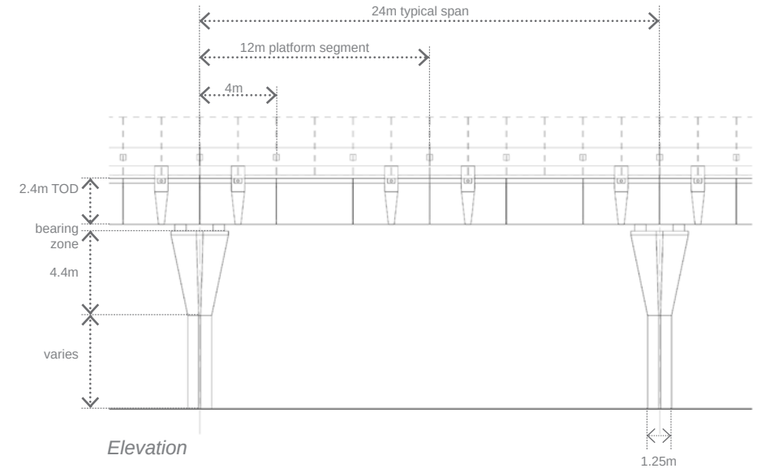
Minimising visual impact - to minimise ground level obstructions, maximise natural light, improve sight lines and pedestrian flow below, the station platform is supported by the viaduct structure.

Design Development

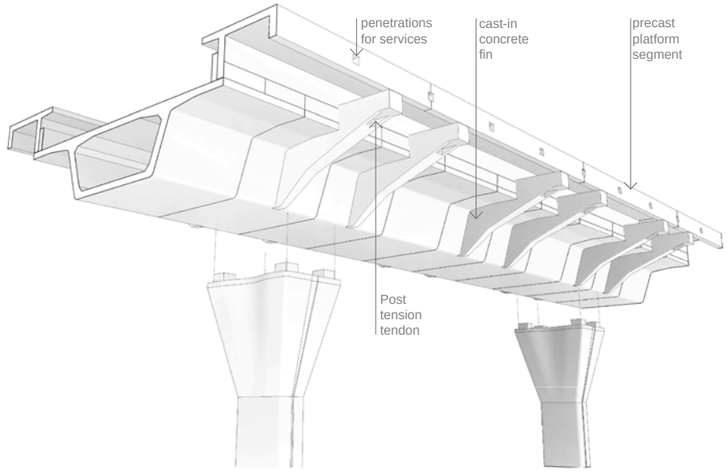
Please refer section 11.0 Appendices - A) Design Development.



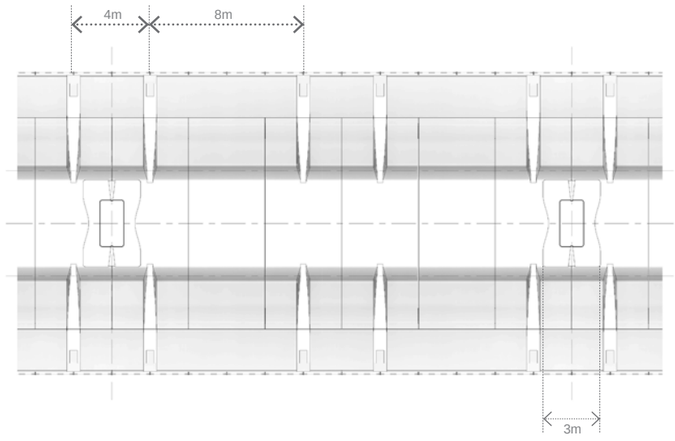
Typical section - through vertical transport & platform zone



Elevation



Above: Cast-in fin arrangement for typical platform span. (Station elements by others shown dotted)



Above: Reflected ceiling plan - illustrating concrete fin spacing

Opposite page: Typical elevated station showing strut and platform integration. Reference Design station elements shown transparent to demonstrate ease of future integration.

B) Station Details

Viaduct Box Girder & Platform

The structural system to support the station platform consists of a concrete fin, cast-in with the viaduct box girder segment, with a match-cast precast concrete cantilever beam segment. It is pre-stressed transversely against the deck slab to create a local cantilever support for the precast station platform element above.

Unity of design - platform segment joints are aligned with the viaduct at 4 m and 8 m intervals.

Struts

Consistency - the elevated station platform is constructed of precast concrete struts, which provide a finish consistent with the viaduct. Segments are 4 m to match the viaduct design.

Honesty - the precast concrete struts provide an honest structural response to support the station platform segments. They are robust and sculptural, in keeping with the calm language of the viaduct and pier structural family of elements

Reduced bulk - precast concrete struts are equally spaced at 4 m either side of every station pier at 8 m intervals. This arrangement reduces the visual bulk of these components.

Future flexibility - the strut shape maximises future design and planning flexibility to assist the Operations, Trains and Systems (OTS) contractor. The level of the soffit can be varied accordingly. The strut aligns harmoniously with the future station elements such as the vertical transport (lift, escalators etc).

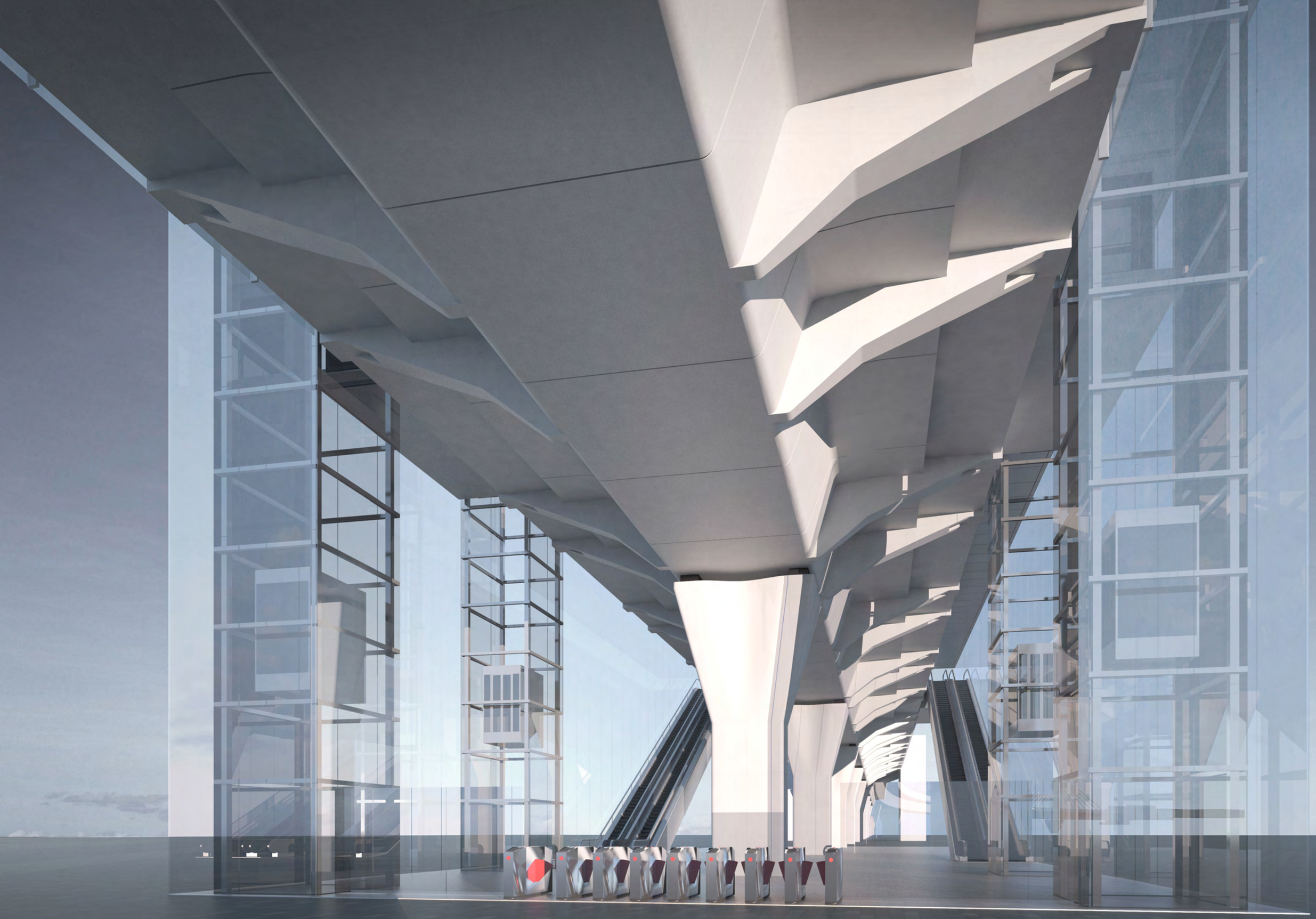
Multi purpose - the precast concrete struts support the station platform segments, control deflections and provide a working platform during construction.

Above: Typical elevated station showing strut and platform integration. Reference Design station elements shown transparent to demonstrate ease of future integration.

Efficient design - no bird-proofing is required as the struts sit flush to the underside of the viaduct girder and aligns with future soffit levels.

Performance - no applied fire proofing is required to the strut elements.

Opposite page: Typical elevated station showing strut and platform integration. Reference Design station elements shown transparent to demonstrate ease of future integration.



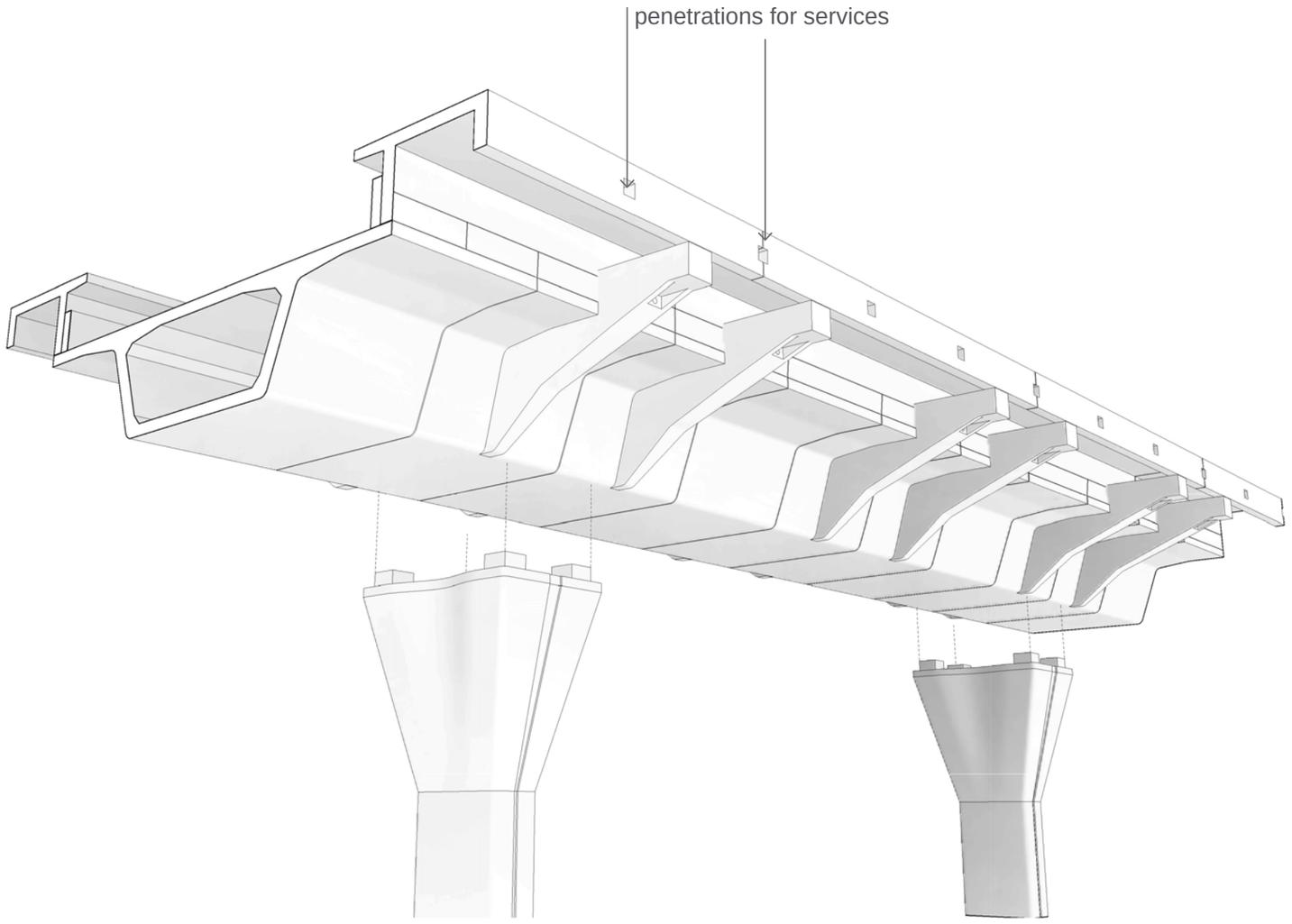
B) Station Details - continued...

Maintenance & Services

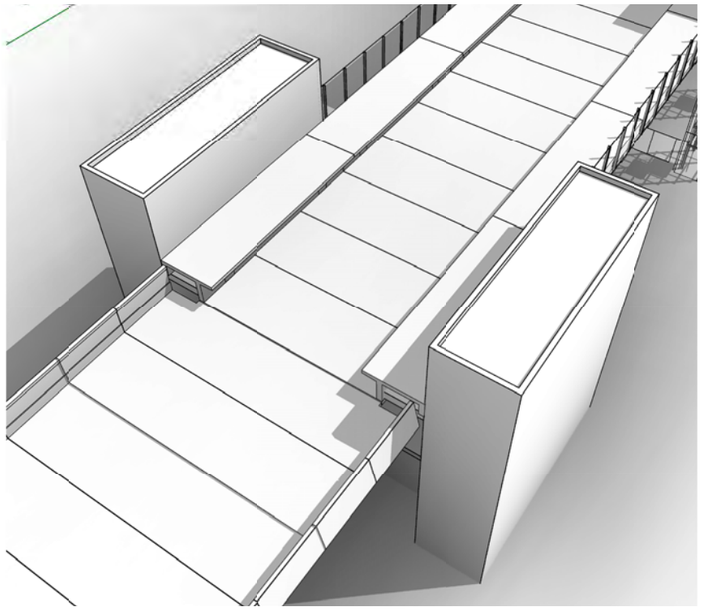
Maintenance - to prevent staining of the deck, girders and piers, the station platform segments are detailed using a continuous drip groove which runs the length of the platform.

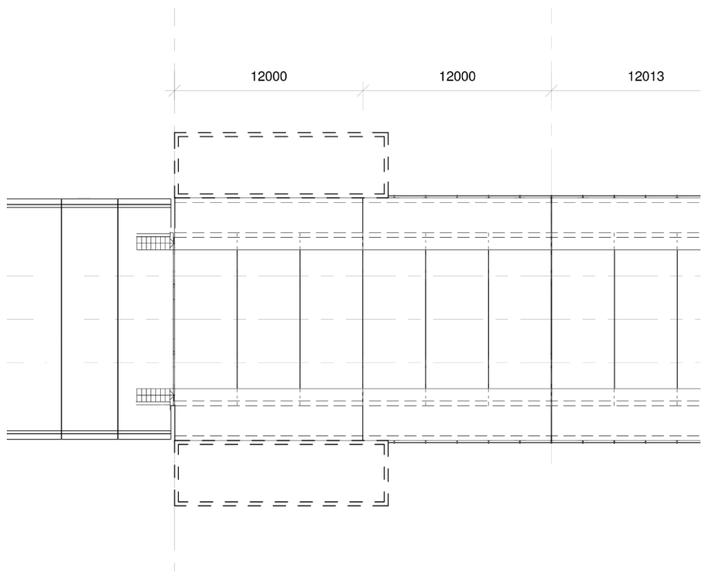
Ease of servicing - penetrations are provided within each platform segment for conduits, pipework and services.

Flexibility - the height of the soffit lining to be installed by OTS can vary in height with this design, giving the OTS maximum flexibility to appropriately service the station.



Above: Precast fin arrangement for typical platform span.





Above & Left: Bridge viaduct deck to Rouse Hill Station Platform transition

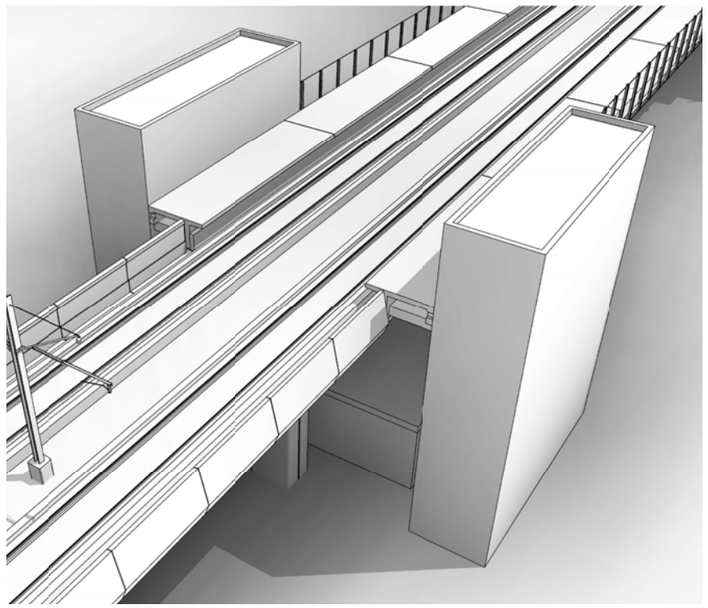
Transitions - Deck

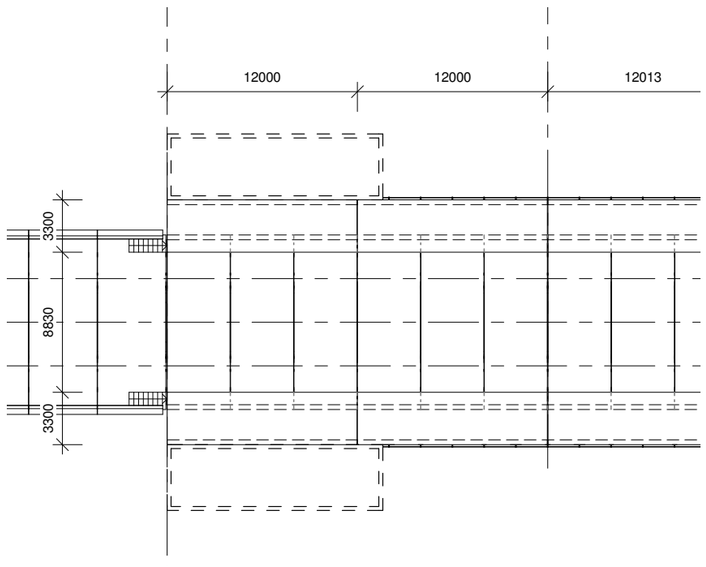
There are two types of deck transition:

- Windsor Rd Single Span Crossing Bridge Viaduct Deck to Rouse Hill Station Viaduct deck transition
- Typical Station deck and viaduct deck transition

Flexibility - A 200mm parapet offset will be maintained at the ends of stations. This will allow an zone of interface with the OTS contractor. This design does not rely on the future fire stair positioning affording the OTS maximum design flexibility.

Visual Continuity - A minimal offset maintains the best visual horizontal continuity between structural elements.





Above & Left: Viaduct deck transition from viaduct to Station Platform

B) Station Details - continued...

Transitions - Box Girder transition at Rouse Hill Station

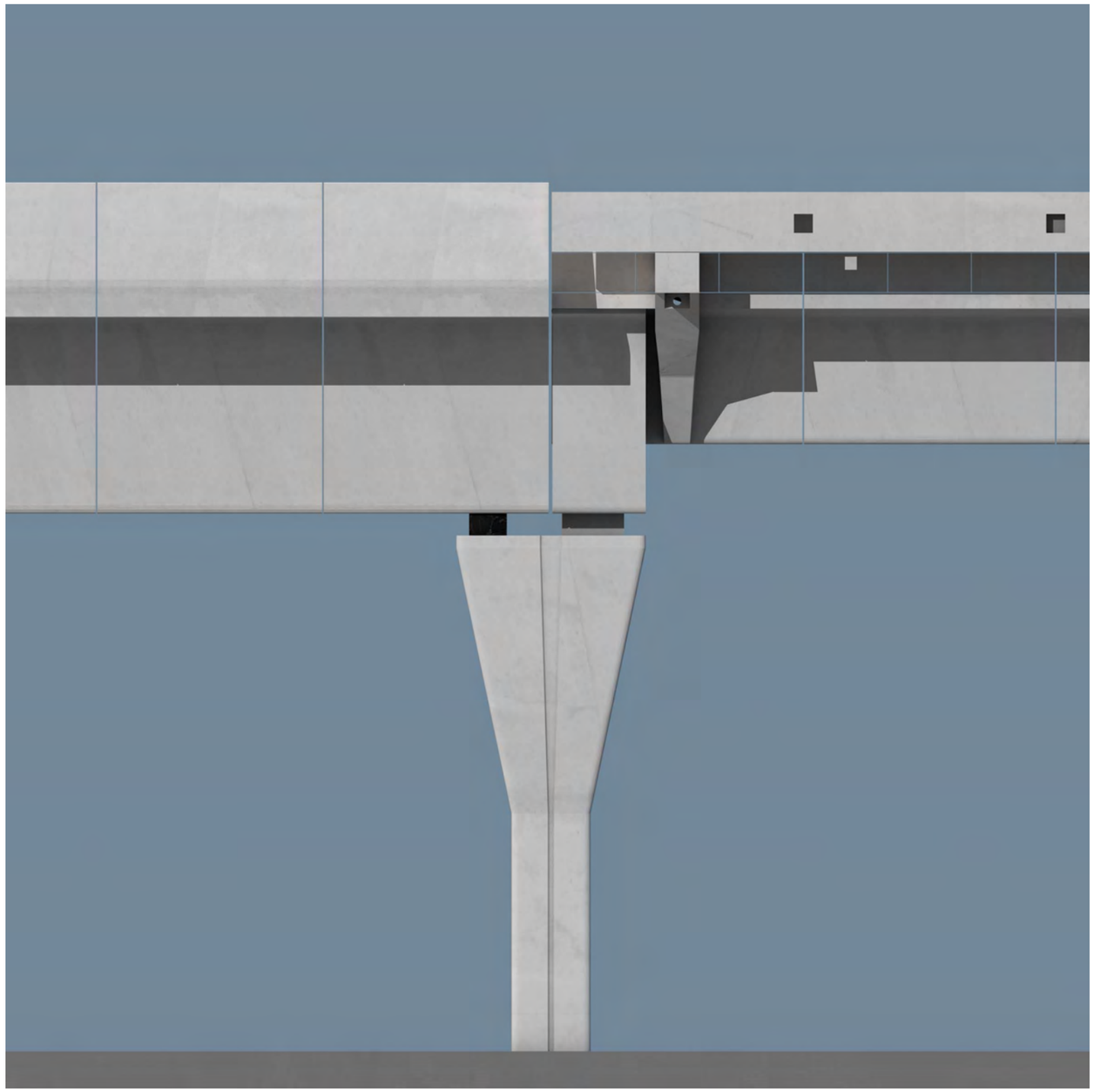
This transition element was reviewed during detailed design to refine the structural response and construction methodology.

This design best addressed visual, structural and maintenance concerns by creating:

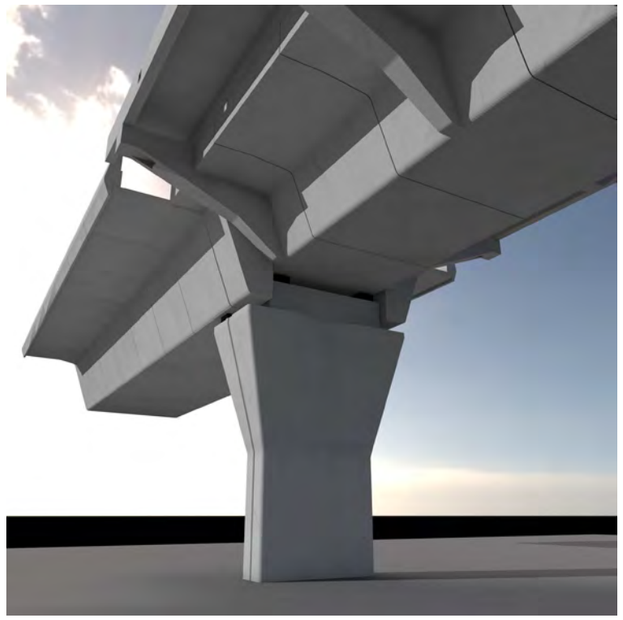
- a more harmonious unity of intersecting elements
- visual continuity from bridge deck to bridge transition pier completing comfortably the larger structural element over the full extent of the pier
- a united structural and architectural response to the various meeting of numerous different elements
- a closed structure to control and prevent bird and vermin access
- the differing structural elements have been separated to clearly define each form and it's inherent structural intent.

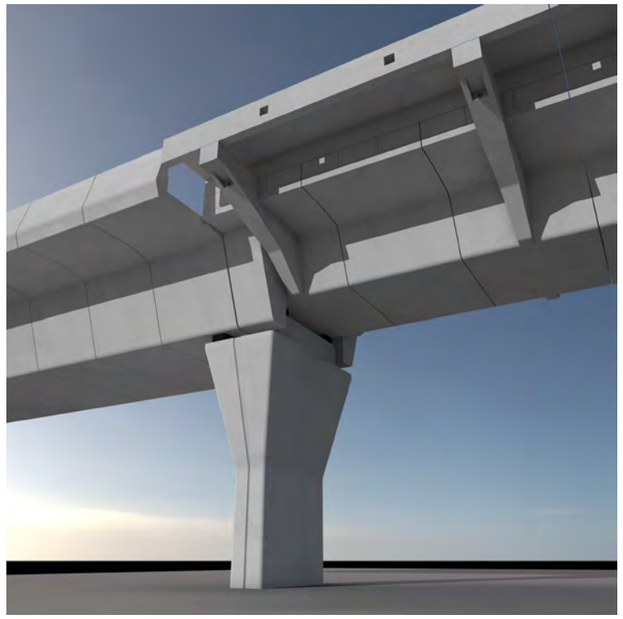
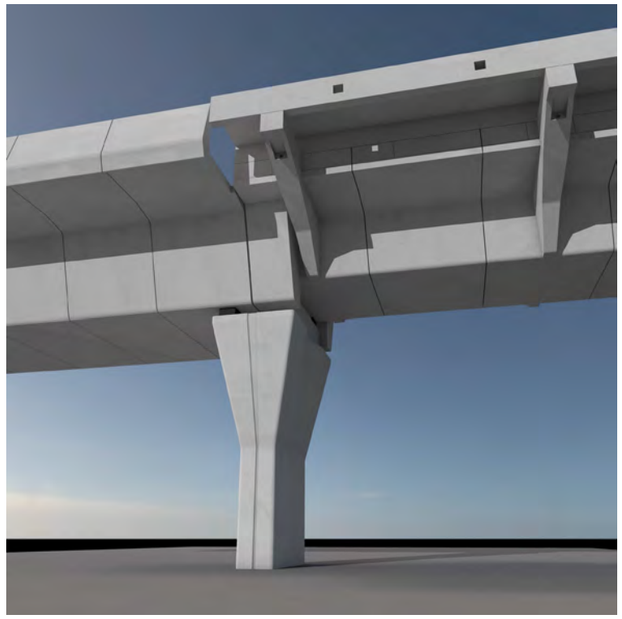
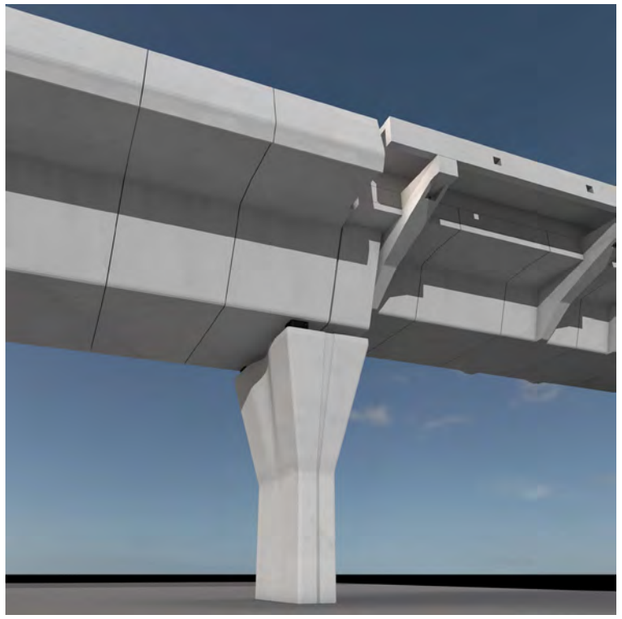
Design Development

Please refer section 11.0, Appendices - A) Design Development.



The image above illustrates the precast concrete transition element and slightly recessed plinth design which carries the load down through to the larger than typical bridge transition pier



Views explaining the shape, form and integration from different angles

5.0 ABUTMENTS

A) *Context, Shape, Form & Detail*

Key Objective

Abutments should be designed to support the viaduct and embankment structural requirements and be well integrated into their landscape.

Response

Abutments act as the interface between the ‘at grade’ and elevated portions of the rail line. There are two distinct abutment types & locations:

1. **Typical Abutments**
2. **Bridge Abutment**

Both designs respond to the considerations below:

Articulation and unity - 3m wide precast panels to the abutment’s reinforced soil nail walls are articulated panels with widths aligning with the viaduct parapets above with expressed horizontal jointing at 1m centres.

Parapets

Parapet - viaduct parapets extend beyond the end of the deck by 30 m where they transition to a noise wall / parapet element of similar height (by others).

Transition Zone (Girder Return)

Transition - the abutment is a simple and symmetrical form that calmly transitions and cradles the end of the viaduct box girder form.

Context - the proposed ground line and landscape gently integrate the structural form within the existing context.

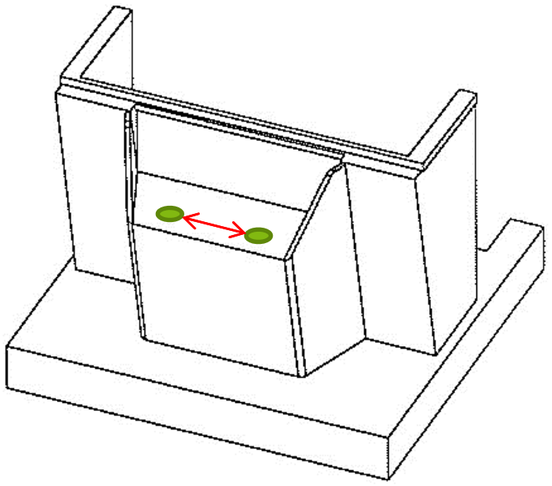
Gradients - maximum 1v:3h gradient to abutment slopes.

Piers & Bearings

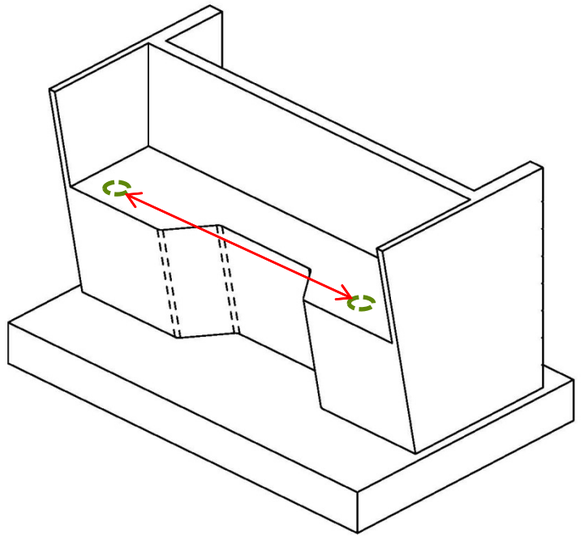
Maintenance - 350 mm bearing clear access zone provided. Bird and vermin-proofing measures are concealed from view.

Design Development

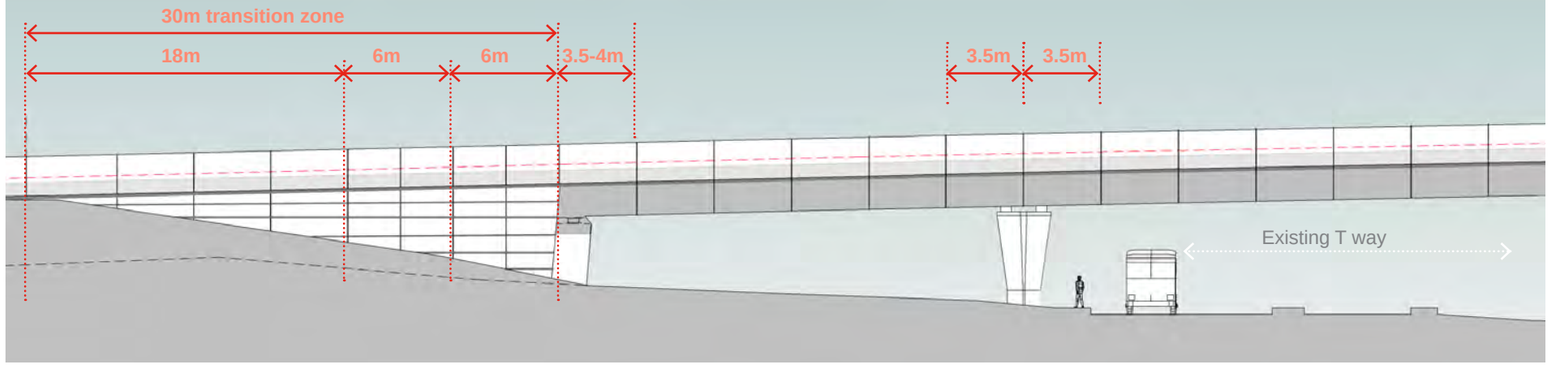
Please refer section 11.0, Appendices - A) Design Development.



Typical Abutment



Bridge Abutment - bearings spaced wider apart to support larger bridge loads



Above: Bella Vista abutment A elevation - typical abutment

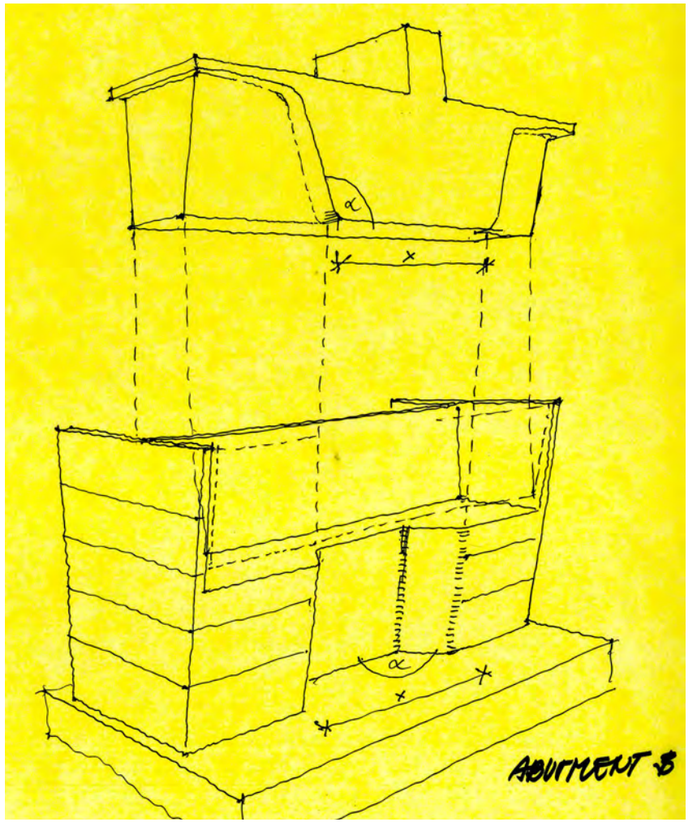
Photomontage - Abutment A looking from existing T-way

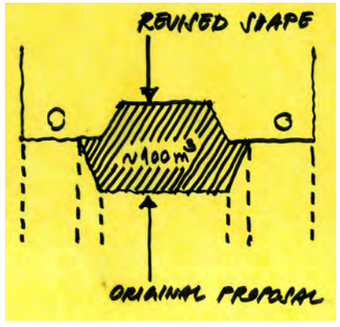
B) Bridge Abutment

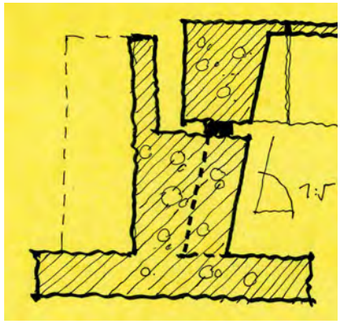
With the incorporation of the Windsor Road Single Span Crossing, the design team reviewed their approach to the design of Abutment B in order to simplify the structural solution and provide safer and more logical maintenance access to the bearings (spaced wider apart to support a wider bridge deck and loads) for this very different abutment condition.

This abutment supports a much bigger viaduct box girder for the single span bridge. As a consequence a more honest structural approach was required to best address the structural and aesthetic issues that were encountered in the original tender submission design. The benefits of this design are described below:

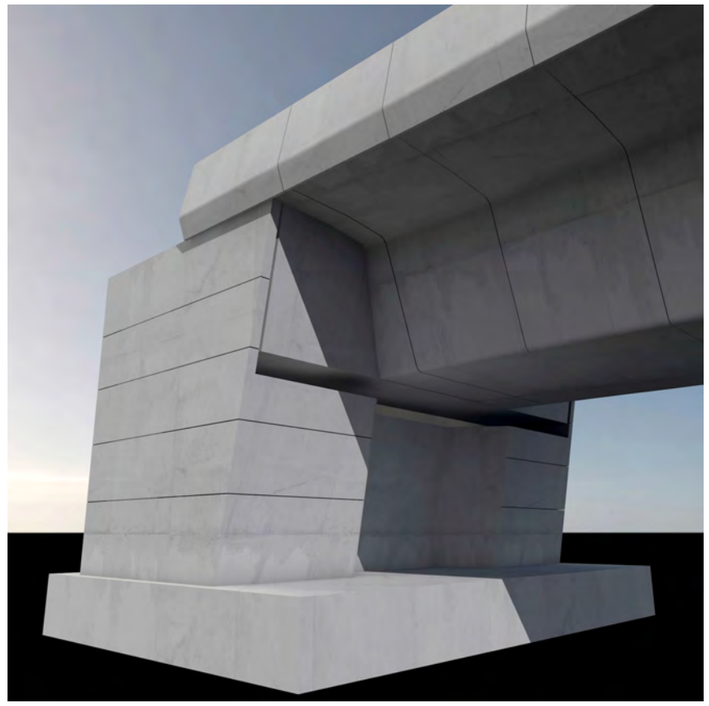
- This design closely reflects the nature, simplicity, logic and articulation of form of the Standard Viaduct Abutment and viaduct box girder it connects to but in the negative.
- The structural form and lines of the bridge box girder return into the abutment to form a negative shallow articulated recess.
- The depth of the recess at grade is slightly reduced, as is the superstructure width, to better link to the girder over. The recess depth is driven by the balance between gantry crane access and CPTED considerations.
- Reduction in space and 100m3 of concrete making it a more sustainable option and therefore cheaper to construct and easier to maintain (no access hatches).
- Maintains a holistic design approach of all abutment elements.
- Safe access to bearings for maintenance and replacement.
- The opening of the bearing shelf and adjacent horizontal wall joints are aligned and continued through the abutment wing walls and the retaining wall structures beyond.

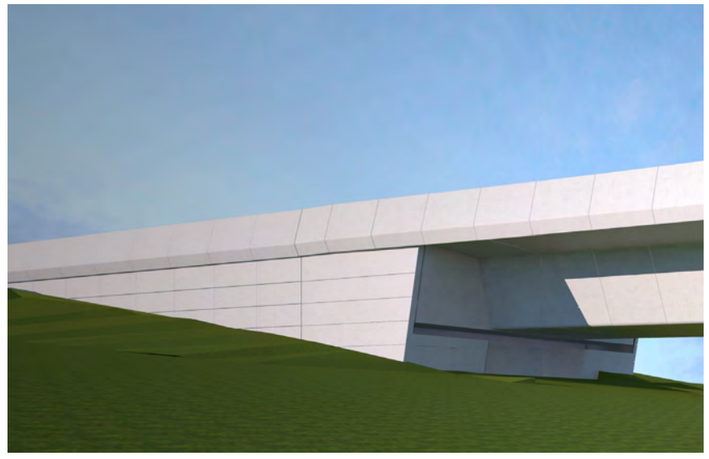






Top: Image illustrates the deck connection with the abutment structure Bottom LHS: illustrating concrete and space reduction between the typical abutment type and abutment B.





Gantry crane supports require a minimum 1m clear from the front face of abutment to the back wall of recess. This and CPTED requirements drive the maximum depth of the recess.

Early concept renders for Abutment B looking north along Windsor Road

6.0 WINDSOR ROAD SINGLE SPAN CROSSING

A) Design

Key Objective

The viaduct structural form should continue over Windsor Road.

Response

Key features of the 'Windsor Road Single Span Crossing' are outlined below.

Context - It sits comfortably and harmoniously within the existing surrounds and complements the established family of elements for the main viaduct. Structural elements, such as masts and piers are streamlined to reduce visual and physical impacts on community and context. In doing so, uninterrupted visual and physical connections improved compared to the base tender viaduct crossing.

Viaduct Box Girder & Parapets

Consistency - the cable-stayed bridge is a holistic design of structure, piers, masts and parapets achieving a high quality outcome. The shape and form of the viaduct box girder increases in size to reflect the bridge and subsequent span loadings yet retains similar visual language and continuous form along the full extent of the crossing.

Continuity - the precast concrete segments and parapets are a continuous curved form over the length of the crossing.

Maximised spans - the bridge main span is 131 m. It has large spans to the south to maximise the structural capacity of the increased box girder and minimise impacts at ground level.

Above: Plan - Windsor Road crossing

Above: Photomontage - looking north along Windsor Road

Opposite page: Photomontage - looking south along Windsor Road

B) Bridge Design

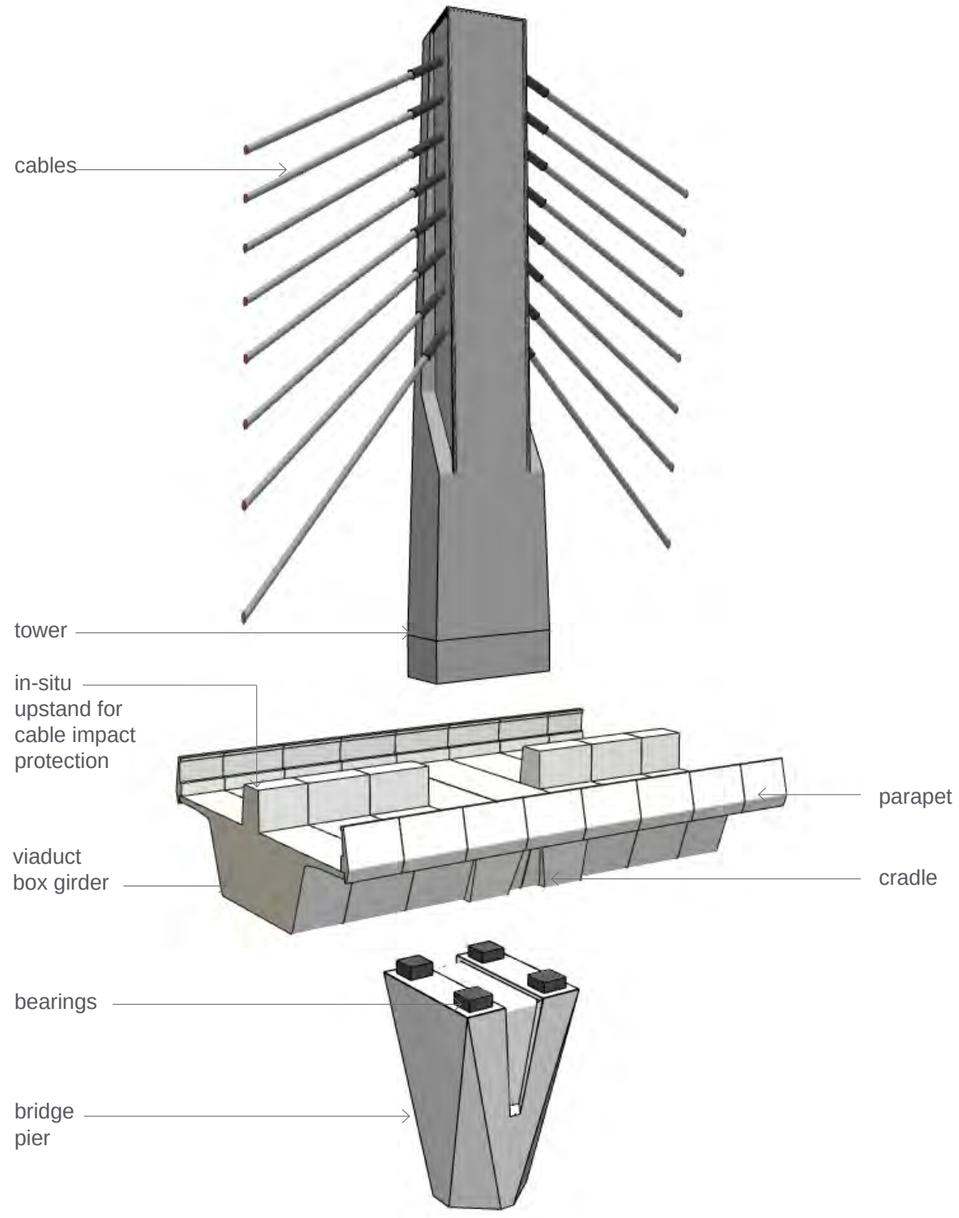
CradleDesign

Refinement of the viaduct box girder shape to suit the viaduct box girder (reduced girder base width) required a review and redesign of the bridge pier and cradle elements.

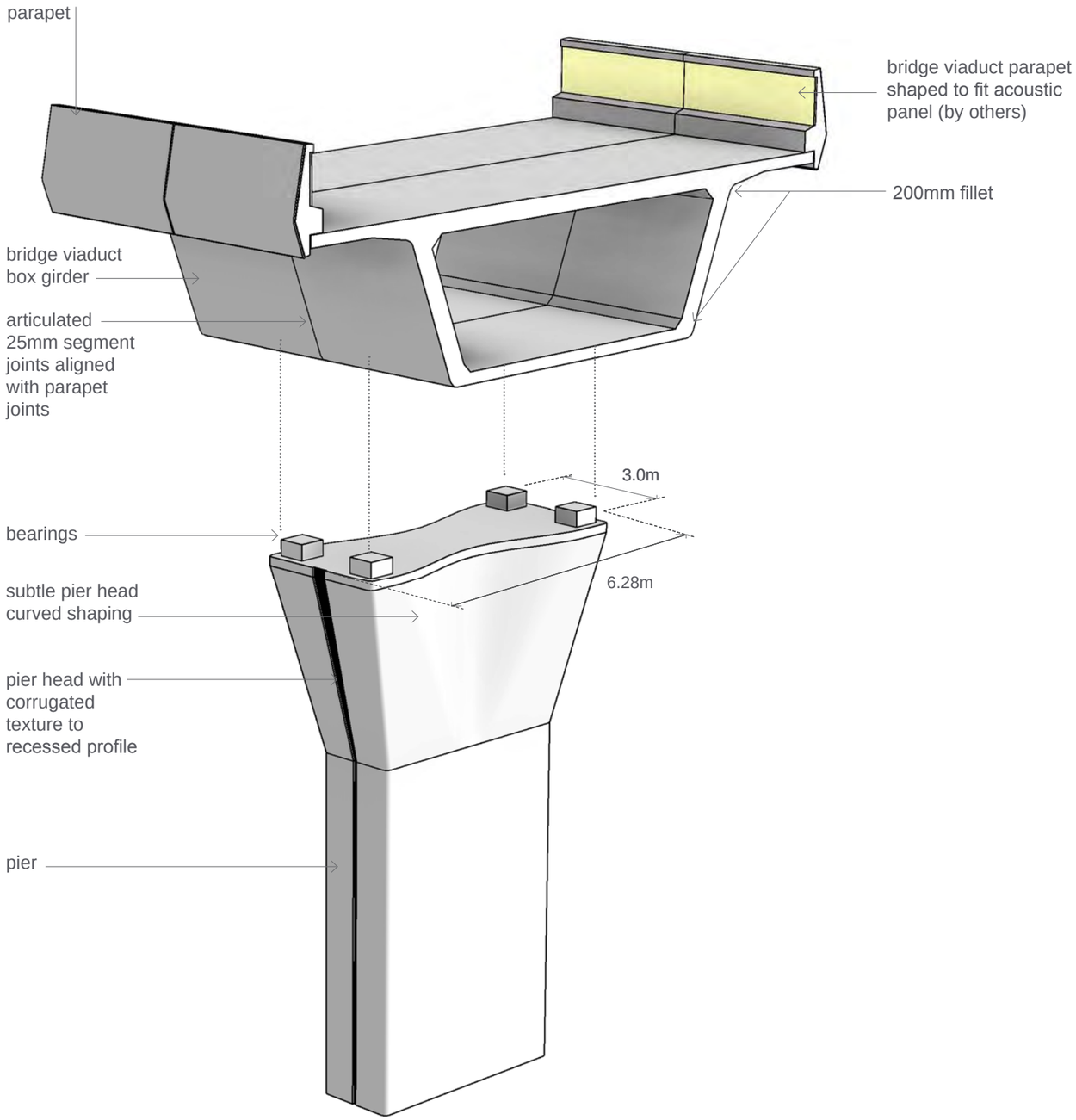
The introduction of the cradle provided an elegant, articulated and harmonious design solution to the viaduct box girder base width refinement. The design also further visually reinforced the connection of the pier with the viaduct deck, strengthening the overall visual connection with the tower.

Cable-stay Tower

Elegance - the cable-stay tower is a simple and proportionally elegant structure which effortlessly supports the bridge deck. It sits calmly and harmoniously within context, providing a timeless and fitting landmark for Windsor Road, Rouse Hill and the surrounding areas.



Above: Cable-stay tower structural elements



Above: Transition pier

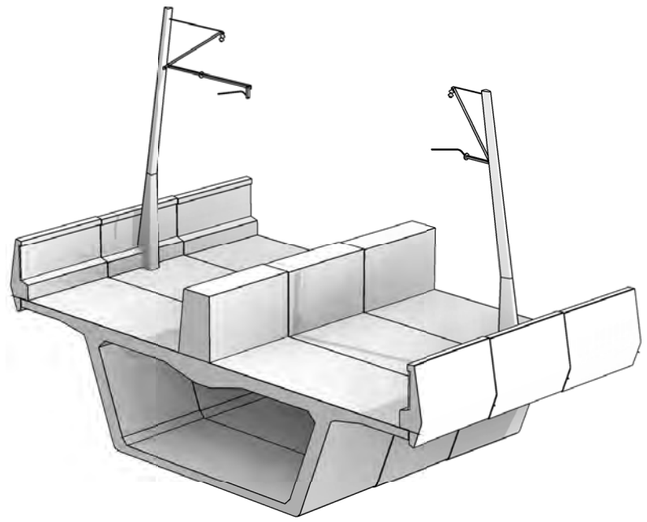
Lighting - installing lighting to up-light the mast was reviewed during safety in design workshops and ruled out given safety issues it proposes for train drivers.

Low maintenance - designed to be simple and low maintenance. The mast will be finished with a micaceous iron oxide paint in a subtle mid matt grey - colour to be reviewed and agreed by TfNSW. The cable colour and finish is a combination of dark grey sleevs at key connections with the mast and light grey cable ducting elsewhere.

Refer to section 10.0 for design development of Bridge Cable colour.

Overhead Wire Masts

Overhead wire masts are purposefully shaped and integrated with the parapet structure to reinforce a consistent family of elements and to provide a cohesive aesthetic. OHW falls within the OTS package, however, these have been shown for design intent purposes only.



Above: Overhead wiring mast integrated into parapet structure to demonstrate shape and form integration with bridge. (OHW and masts by others.)

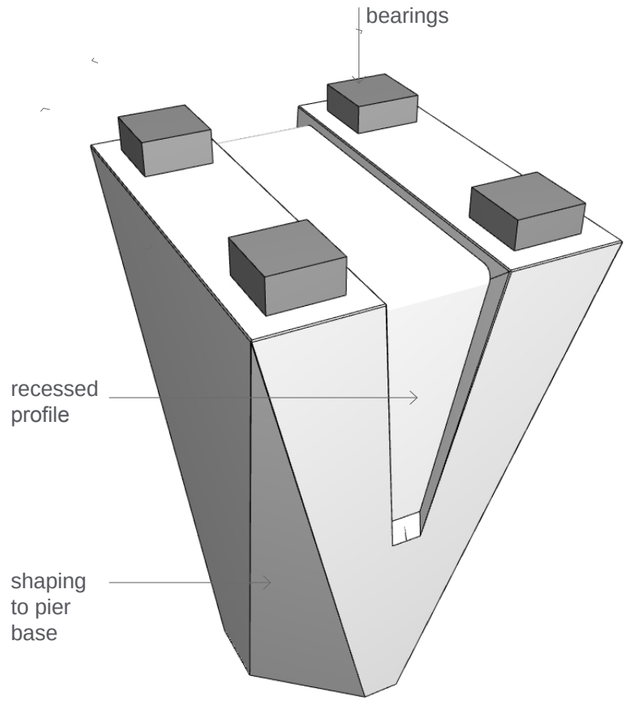
Piers & Bearings

Bridge and transition piers mimic the language of the standard viaduct piers. They are articulated with a recessed profile on the short elevation and a shaped smooth curved profile on the longer elevation. Consistency of elements reinforces the contextual response by achieving a unified design outcome.

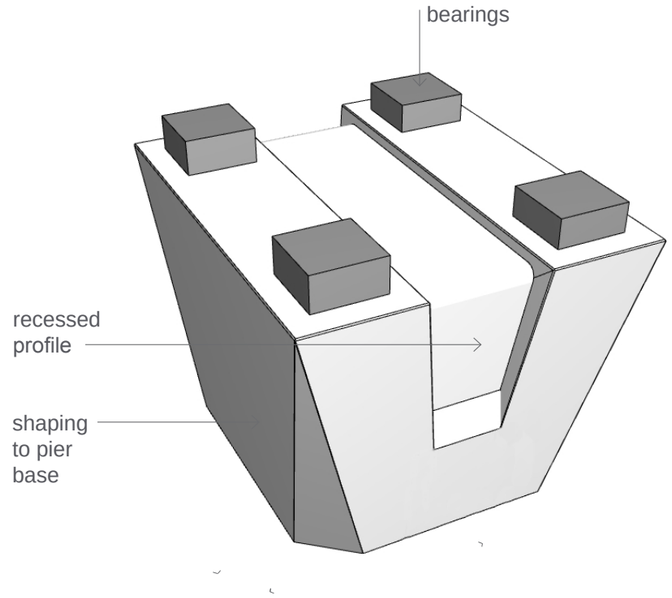
Future-proofing - piers have been shaped to suit future widening of Windsor Road and grade separation requirements. Piled footings under the bridge piers are used to minimise local area traffic impact during construction and are designed to extend below the future re-alignments of the intersection.

The design of the bridge piers considers both the current and future grade separation between Windsor Road, Schofield's Road and Rouse Hill Drive. It does this by articulating both piers in such a way as to look sensible and in proportion and scale regardless of the ground levels in the future. Refer images opposite.

Bearings - are easily accessible. Space is provided for replacement and maintenance of bearings. Bird and vermin-proofing measures are concealed from view.



Above: Bridge pier - tall



Above: Bridge pier - short

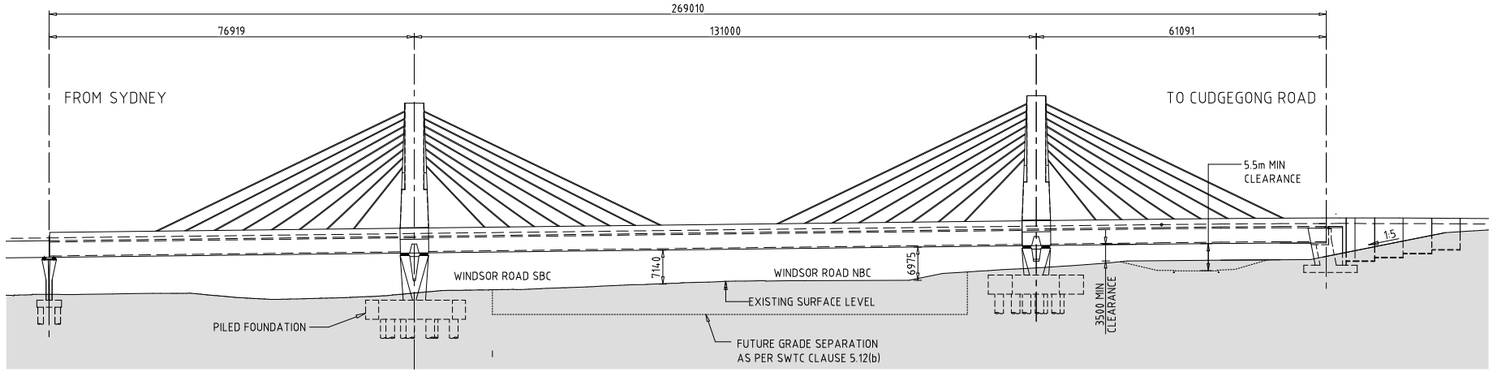
Cable-stay Colour

The colour of the cable stays was the subject of detailed design due to concerns on darker colours, black, having too great a thermal expansion issues. The design therefore adopted light grey stays with dark grey sleeve at the mast connection.

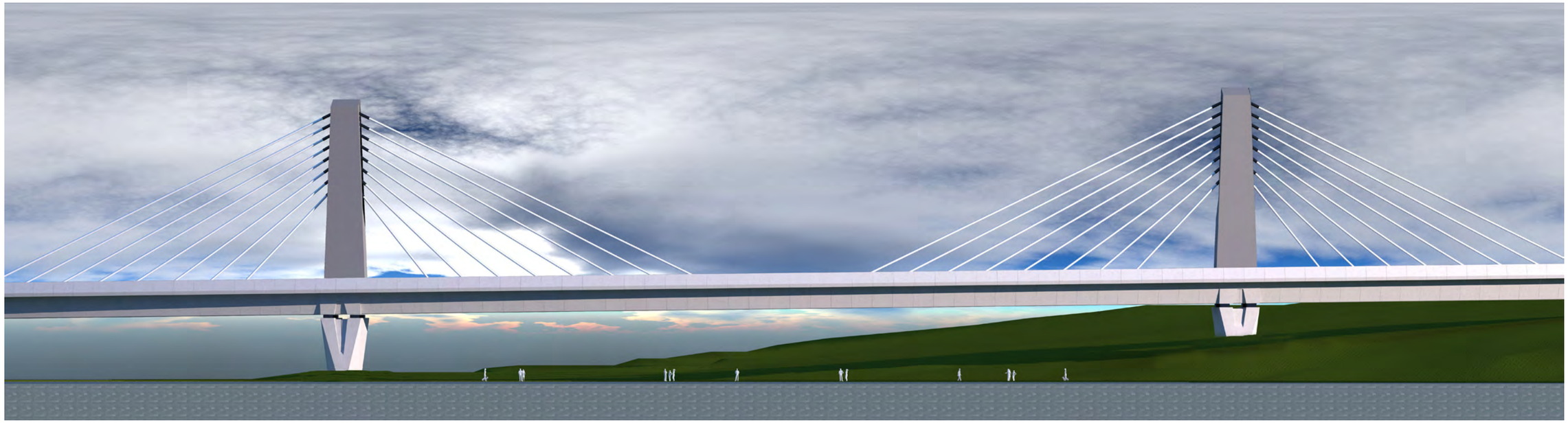
Dark grey sleeves articulate the cable connection to the mast strengthening and framing the mast.

The use of a lighter cable addresses the concerns of thermal expansion.

Further study required for reflectivity of cable stay product.



Above: Elevation of bridge illustrating the location of the future grade separation. Note the level of the new road does not seem to impact on the final height of the RHS bridge pier.



Elevation illustrating light grey cables with dark grey sleeves

7.0 RETAINING WALL STRUCTURES

A) Context, Shape & Form

Key Objective

Retaining structures must be designed to be cohesive and unified with adjacent and associated elements including the Viaducts, Station Platforms, landscape works and other retaining structures.

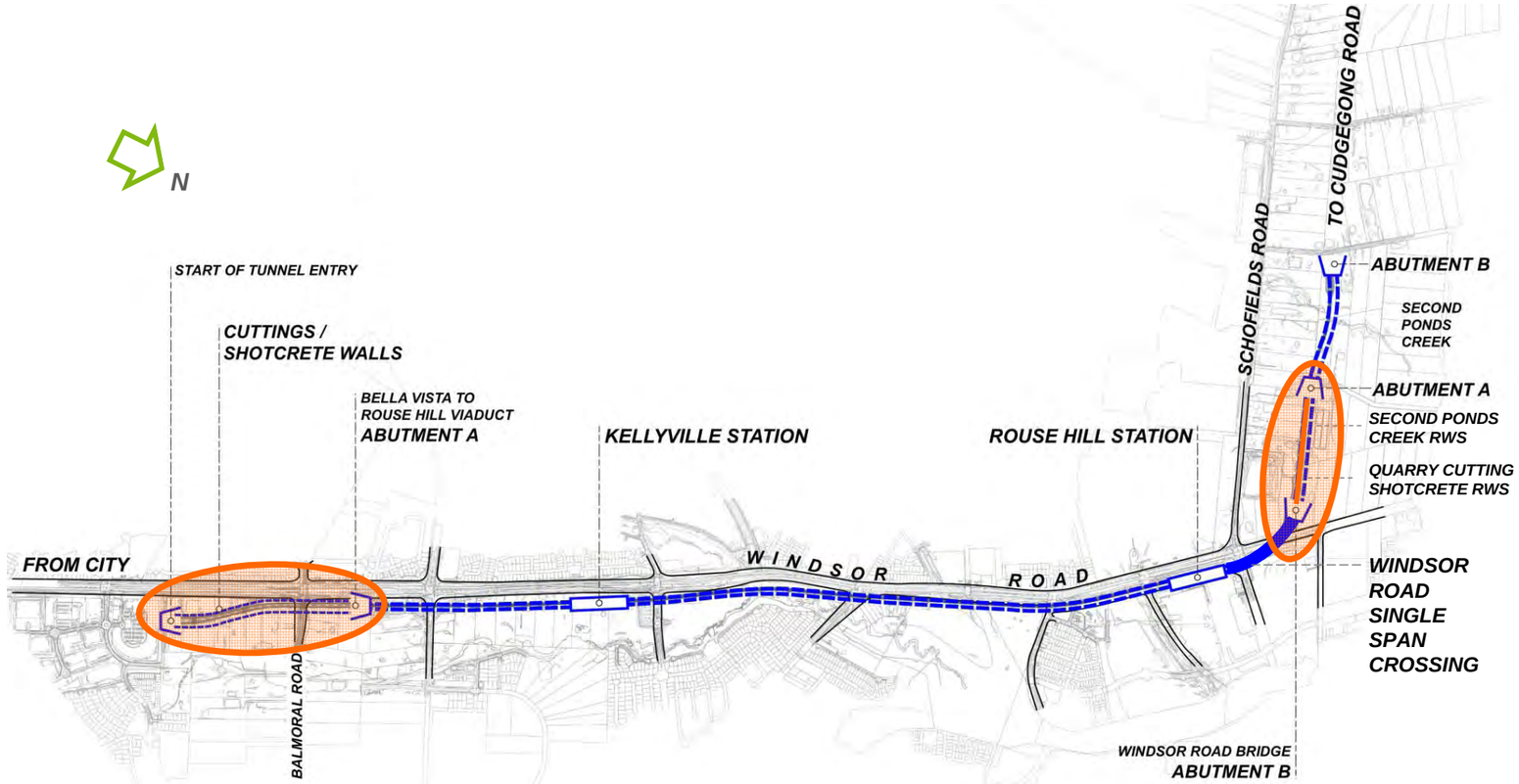
Achieve a durable and consistent finish to shotcrete surfaces

Response

Modular components - consistent horizontal joints achieve simplicity and reduced visual impact. The facing panels are a canvas for texture and pattern, which will soften the scale and provide visual relief and a human scale.

Unity of design - cuttings and embankments are important structural components which unify the major structural forms and define their relationship to the landscape. Our designs consider form, scale and proportion contextually and between elements to achieve simple solutions which are functional, recede into the landscape, yet provide visual interest.

Visual relief - vertical faces are gently angled in cuttings to minimise the expanse and visual impact. The edges and batters are feathered to meet adjoining landscape and forms. Facing panels provide visual relief by expressing the horizontal joints and enable continuity of the overall urban design concept using texture and patterns.



B) *Reinforced Soil Walls*

Second Ponds Creek is the significant retaining wall structure within the SVC Works and is designed with the following features and considerations:

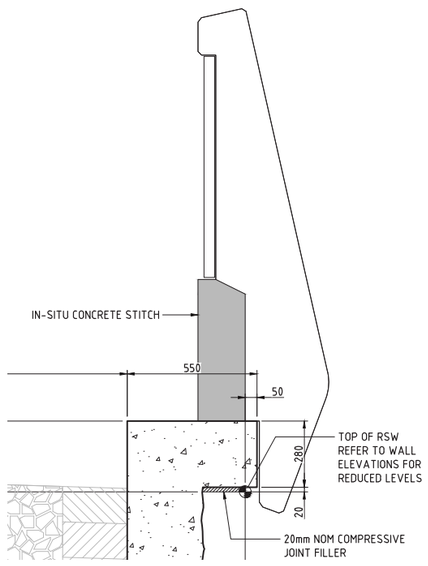
Context - the reinforced soil walls at Second Ponds Creek is significant due to its scale and proximity to residences. This retaining wall structure is an important link between infrastructure and landscape. It has high visual impact for the surrounding community and the design aims to soften this impact by expressing the horizontal precast concrete joints and connects simply with other structural elements.

Panel Size & Articulation - The design development process tested various precast panel sizes across the length of the RSW wall at seconds creek to determine a panel size which better reinforces the horizontal expressed jointing balanced against appropriate structural and construction requirements.

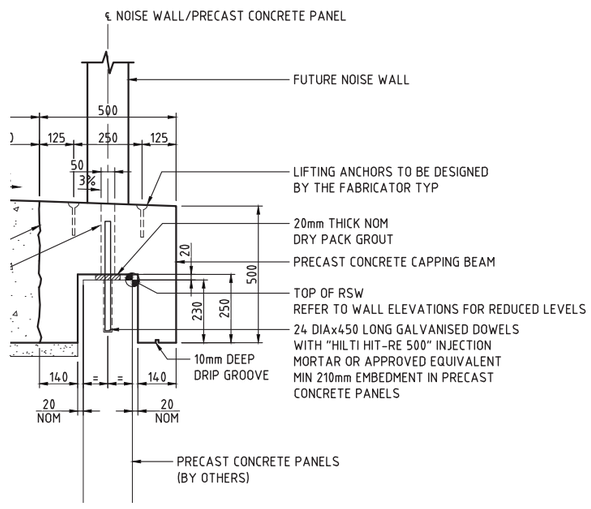
The refinement of the original design included a small 1m high horizontal groove within the 2m x 2m panel. This smaller panel size also better reflected the local urban context break down the size and scale of this structural element.

This approach was preferred by the design team as it was quicker to construct and better reflected the scale of the locality, working in well with adjacent abutment precast panel articulation.

Above: Photomontage - Second Ponds Creek retaining wall structure. (Future noise wall / parapet, by others)



Above: Parapet detail at abutments



Above: Capping beam detail

C) Soil Nail Walls - Shotcrete

Shape, form and finish

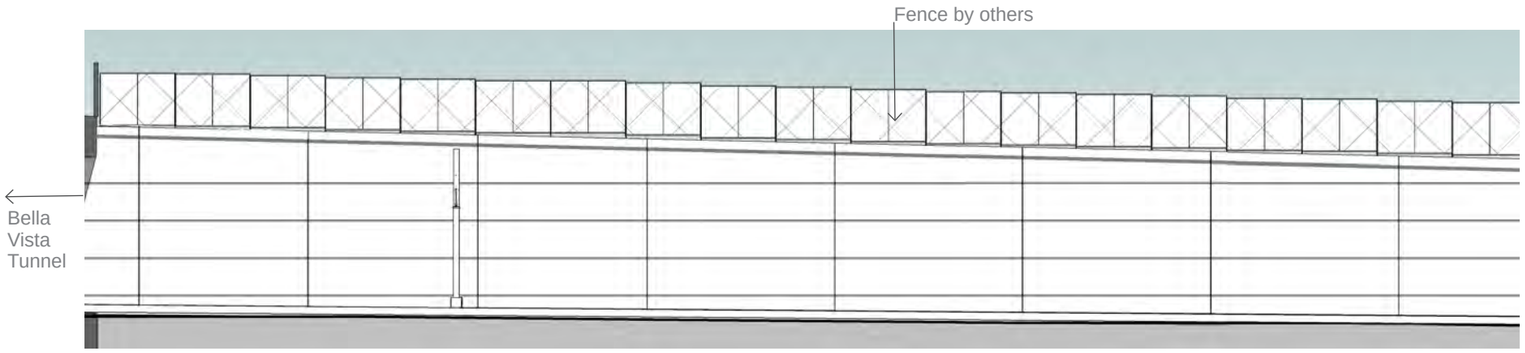
The design and aesthetic of Bella Vista cutting, the major component of SVC Works applicable to this section, is described below:

- **A durable consistent finish -** the thickness and finish of the shotcrete is important to get right to ensure a quality outcome
- **Simplified Articulation -** Vertical jointing to reinforce a more consistent rhythm
- **Strengthened Horizontal Expressed Joint -** horizontal jointing was reviewed along the extent of deeper cuttings and a strategy for the stepping of the banding has been established.
- **Impact of the reduced ground line** on the Bella Vista Cutting and subsequent review of a revised construction methodology.
- **Benefits** - horizontal jointing aids the graffiti management process by defining clean edges for surface application, removal and re-application.

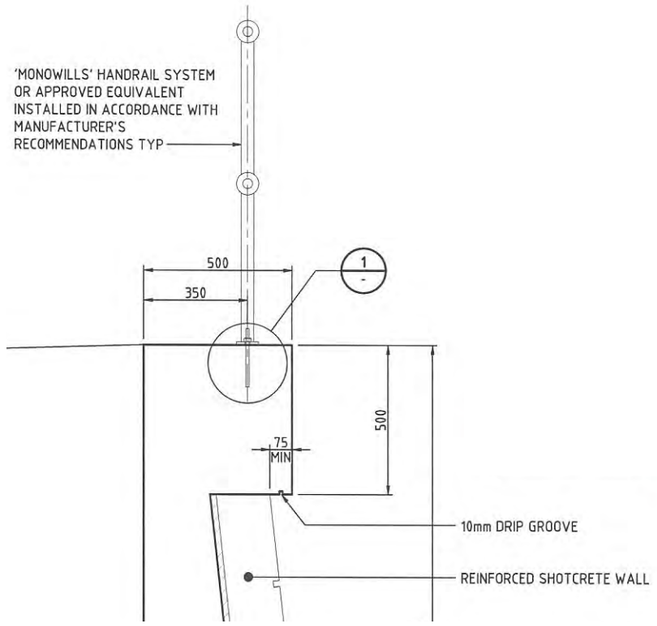
Details

The total shotcrete thickness and finish for the cut walls is:

- 180 mm (first stage shotcrete) - wood float finish to a tolerance of ± 10 mm over 1 m, then finished with a stiff broom.
- Shotcrete walls are capped with a 500 mm wide concrete capping beam which projects 75 mm beyond the face of the shotcrete. Joints in the capping beam align with the vertical joints in the retaining structure.
- Vertical pattern grooves will be created by inserting void formers with a wood float finish. Maximum 35 mm deep by 35mm high with bottom edge angled to allow water egress.
- Capping beam has a continuous drip groove to minimise staining. Refer adjacent image.



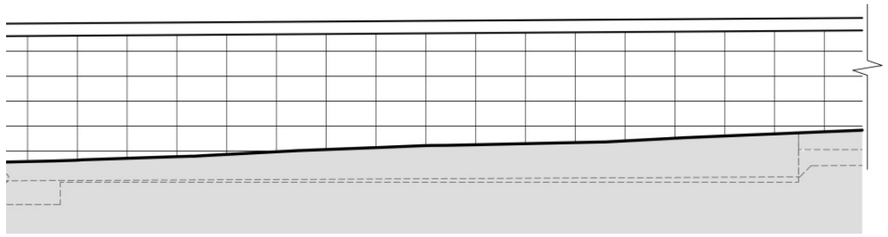
Above: Elevation Balmoral Road cutting



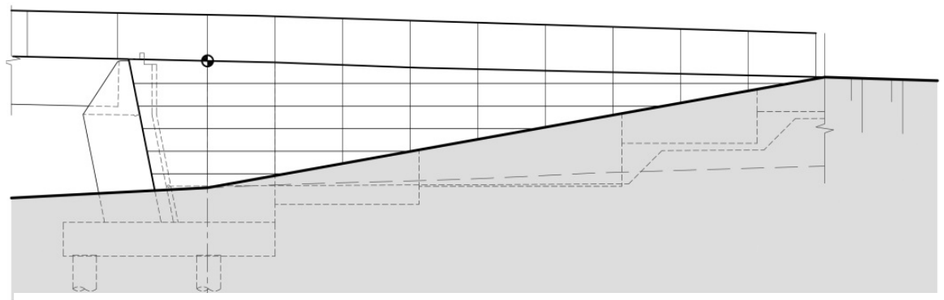
Above: Shotcrete wall capping beam detail

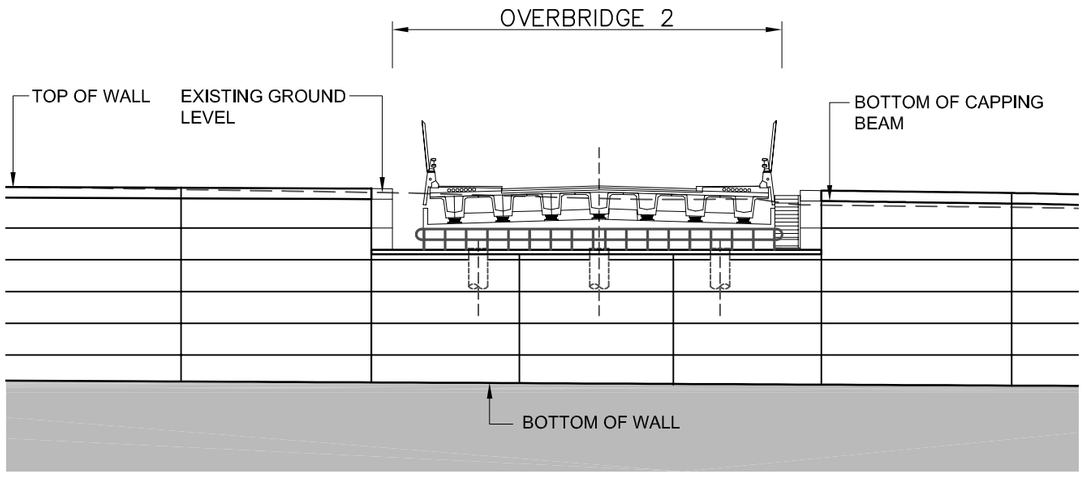
Opposite page: Photomontage - Bella Vista cutting looking towards tunnel portal (fence by others)

Reinforced Soil Walls



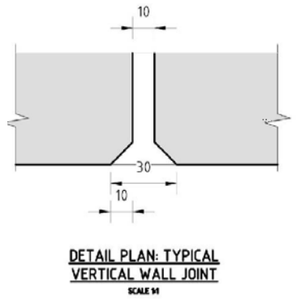
Typical Abutment Retaining Wall

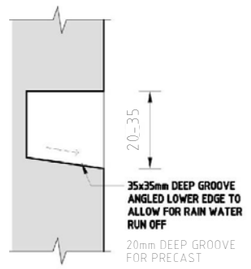


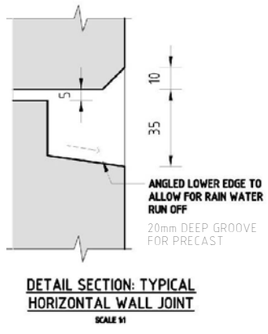


Soil Nail Walls - Shotcrete

Typical Joint Details







D) Wall Types & Details

Uniform articulation - all retaining wall structures have been holistically considered across the length of the viaduct. These structures have been articulated to reflect the nature and scale of the context, inherent structural requirements and related construction methodologies.

Strong horizontal expression - all strengthen the horizontal expression through appropriate sizing of the horizontal grooves balanced against with a more subtle vertical joint.

Articulation, Details & Drainage

1. Reinforced Soil Walls

Location: Seconds pond creek

Panel Articulation: 2m W x 2m H precast panels with horizontal grooves at 1m intervals. Vertical joints aligned with capping beams over at 9-10m intervals.

2. Abutments

Location: Bella Vista, Windsor Road SPC, and Second Ponds Creek.

Panel Articulation: 3m W x full height precast panels. Vertical joints aligned with capping beams over at 9m intervals.

3. Soil Nail Walls - Shotcrete

Location: Bella Vista Cutting & the Quarry

Panel Articulation: 9m W x 1.5m high grooves. Capping beams align with the vertical shotcrete joints. Overbridges centred between.

Weep holes will be located as low as possible subject to structural requirements to minimise impact of staining.

Photomontage - view looking along reinforced soil nail wall at Second Ponds Creek. (Future noise wall/parapet, by others)

8.0 OVERBRIDGES

A) Context, Shape & Form

Key Objective

The design of Overbridges must present smooth, clean lines and have a minimum structural depth that is consistent with their spans and method of construction... be elegant and attractive with neat, evenly spaced joints, smooth even lines and consistent high quality surfaces and colour;

Overbridges must be designed as holistic, coherent and symmetrical structures considering the proportion of all elements of the structure including any parapets, barriers, fencing, safety screens and other critical elements.

Response

Balmoral Bridge is the significant bridge structure applicable to this section and is designed with the features as noted below.

Modularity - precast parapet components communicate a slim and linear form. Repetition of components, modules and joints achieves a coherent aesthetic.

A simple palette - concrete structures with steel fixtures minimise visual clutter and achieve a sympathetic contextual response.

Context - surrounded by substantial hard surfaces and built form, the bridge designs aim to enhance the experiential context through simplicity. Motorists, pedestrians and cyclists will experience these bridges from different heights and speeds and parts will be visible by customers on platforms. The rhythm of modular elements and linear forms gives an appropriate tempo when experiencing these bridges.

Integration - adjacent retaining shotcrete walls and capping beams will chamfer and return into the overbridge abutment stair to provide continuous, considered and integrated elements which express and maintain the strong horizontal visual emphasis.

Parapet & Traffic Barriers

Integration - the parapet profile will accommodate future connection of safety barriers and be shaped for self-cleaning and provide a low maintenance design. The outer face and top edge of the parapet will be angled and rebated for fixings as required as well as water shed to deck.

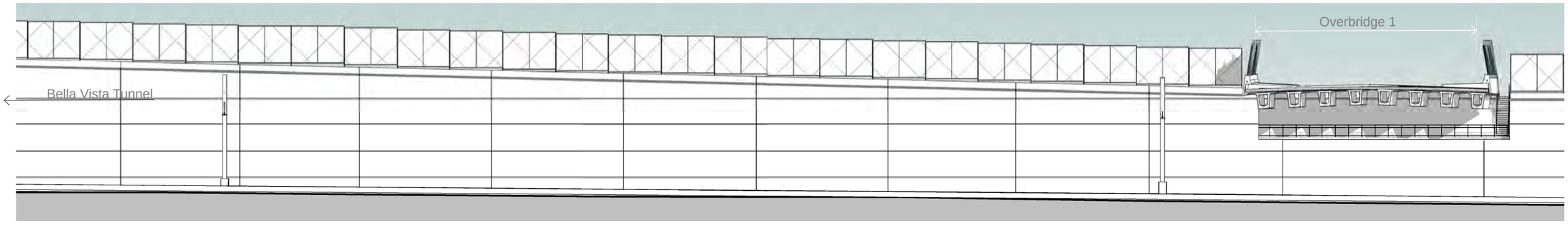
All essential components (girders, deck, parapet, safety barriers etc.) will be detailed to achieve an integrated solution that will nestle unobtrusively into the landscape and adjacent structures and abutments.

Maintenance Access & Services

Safe easy access is provided to maintain bridges provide via secure gate and stairs down to the face of the abutment.

C**ontinuity -** horizontal concrete components provide simplicity and legibility of the bridge designs. Horizontal elements include the pre-cast concrete Super-T girders with shallow depth suitable for the structural spans to provide visually aesthetic proportions yet conceal required and future services.

Below: Elevation Balmoral Road cutting



Photomontage Balmoral Road overbridge and cutting

9.0 MATERIALS & FINISHES

A) Materials & Finishes

Key Objective

Materials and finishes should be robust, easily maintainable and consider graffiti protection and effects of weathering.

Response

Our approach to manage surface finish and colour control, including concrete mix components during the construction of the SVC Works is outlined below.

Concrete Quality

See adjacent images which represent the performance specification as set out in the reference design viaduct guidelines and the SWTC.

Colour

“Class 2C finish” - ”C” refers to the Colour tonal range as above suitable for use with most grey concretes. Class 2 requires a minimum tonal range of 5 tones. Refer adjacent image (taken from AS 3610.1) that identifies the 5 tone range acceptable to TfNSW on this project.

Test Panels, Prototypes and Quality Benchmarks

On this project, as lightness is deemed an important requirement, it is assumed that tones would be used to assess the colour variation on test panels. Production of consistent light colour is documented in the Concrete Mix Design Strategy report - NWRLSVC-ISJ-SVC-DN-RPT-230001. This report sets out how ISJV intend to meet the SWTC requirements setting out a distinct and fit for purpose concrete mix design for the various concrete elements taking into account early strength, colour and sustainability objectives.

ISJV will provide prototypes and test samples to demonstrate quality compliance to the Independent Certifier and the Principal Representative. Panels will be produced to test colour, repair method testing and coated half height showing the proposed anti-graffiti coating system.

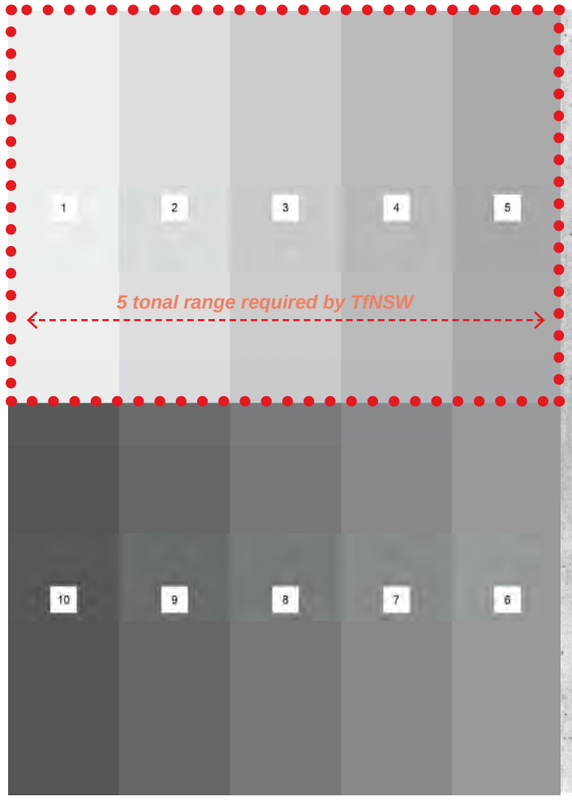
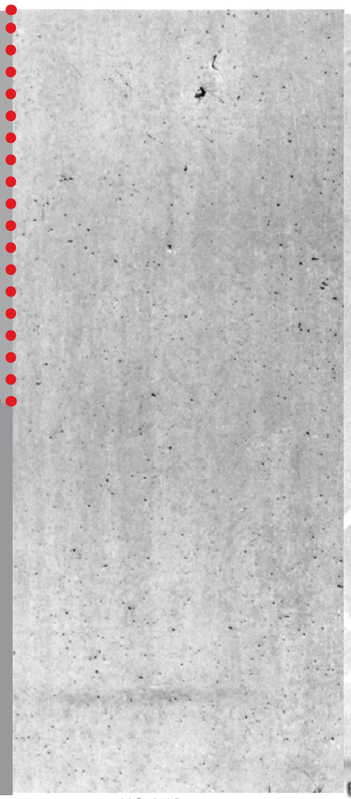


FIGURE A4 TYPICAL GREY SCALE



(a) Scale 1:5

FIGURE A2 CLASS 2 FINISH (in part)

(b) Scale 1:1

FIGURE A2 CLASS 2 FINISH (in part)

Above: AS 3610.1-2010 Blowhole and Colour Evaluation quality

Anti-vandal Treatments & Extent

Anti-graffiti, vandal coatings and surface finishes will be designed and specified to be:

- Vandal and tamper resistant access hatches keyed to ensure opening using only specialist equipment
- Graffiti will be easily removable without damage to the concrete surface under
- Application of the coatings shall have a consistent appearance and will minimise difference in the visual appearance of treated and untreated areas. It will be capable of being reapplied to maintain the performance of the coating system.

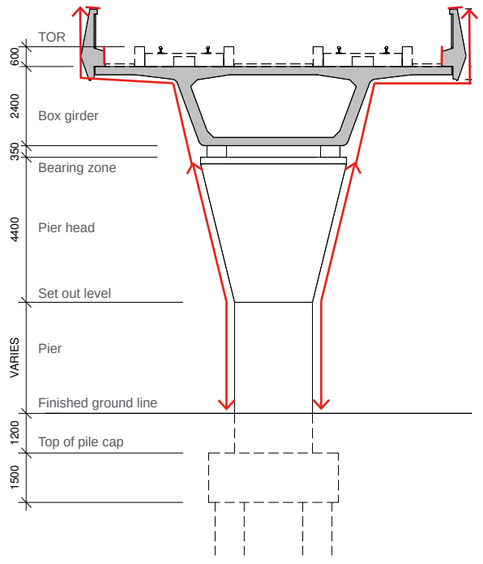
Anti-graffiti coatings will be applied as per instruction from TfNSW as described below:

Piers - All exposed concrete surfaces are to be treated with an approved anti-graffiti coating in accordance with the manufacturers instructions. This includes treatment to both the pier and pier heads.

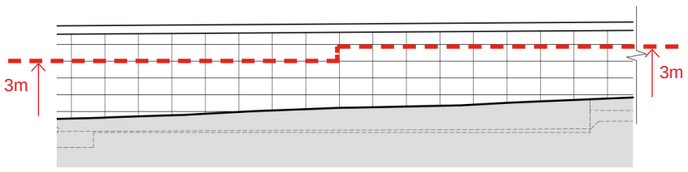
Parapets - All surfaces visible from inside or outside of the rail corridor are to be treated with an approved anti-graffiti coating. This includes the outer surface of the parapets as well as the top surface and all inside vertical surfaces including the in-situ stitch. It excludes the recess for the acoustic material (subject to confirmation from the OTS contractor that this recess is required for acoustic infill). Parapets that extend beyond the bridge or viaduct to the abutment and approach embankment will also be treated

Retaining Walls and Abutments - All exposed concrete surfaces to a minimum height of 3m above adjacent finished surface levels or any accessible foothold shall be treated with an approved anti-graffiti coating in accordance with the manufacturer's instructions. Compliance may require application of anti graffiti treatment to the next horizontal joint line above or the whole of the retaining wall if difference in visual appearance of treated and untreated parts are significant. (See Section 11.0 (A) Design Development for more information)

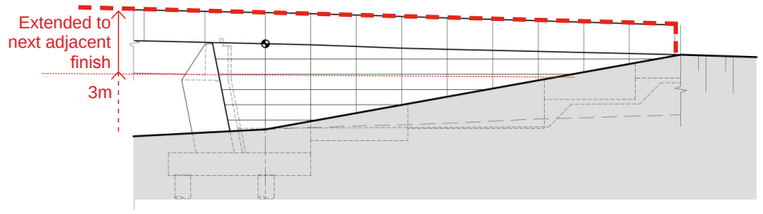
Compliance may require application of anti graffiti treatment to the next horizontal joint line above or the whole of the retaining wall if difference in visual appearance of treated and untreated parts are significant. The decision as to whether the difference is significant or not will be determined following inspection of test panels and prototypes in accordance with SWTC Appendix 13, Clause 13.8.



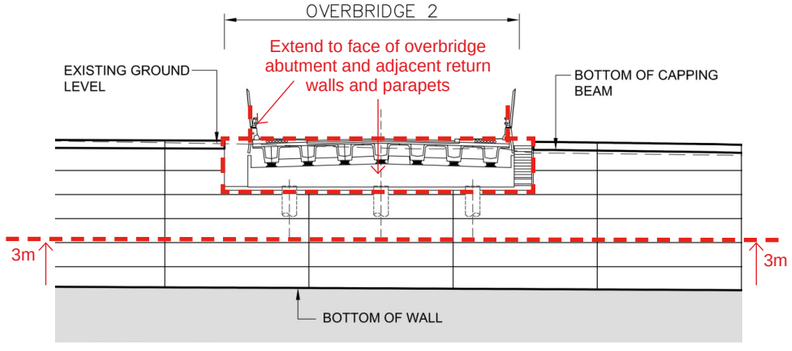
Section through typical pier and viaduct box girder



Retaining Wall - Reinforced Soil Walls



Abutment Retaining Wall & Parapet - Reinforced Soil Walls



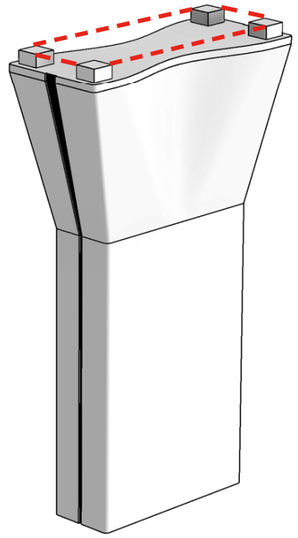
Overbridge & Retaining Wall - Soil Nail Walls

Bird and Vermin Proofing

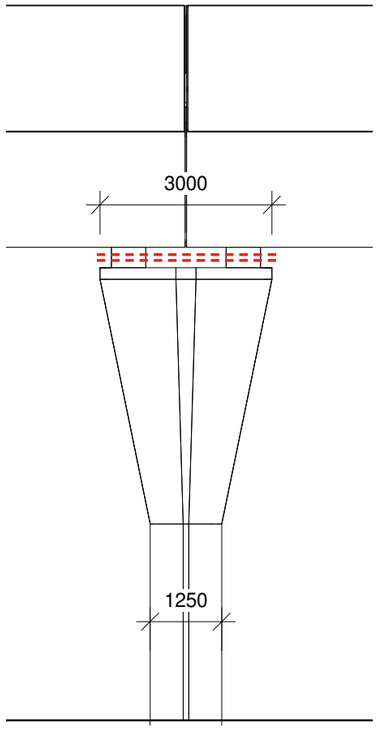
Bird and Vermin proofing at the pier head will be stainless steel wire. The structure has been designed to limit the need for bird proofing by eliminating wherever possible nesting ledges. Locations where bird or vermin proofing are still required are as follows:

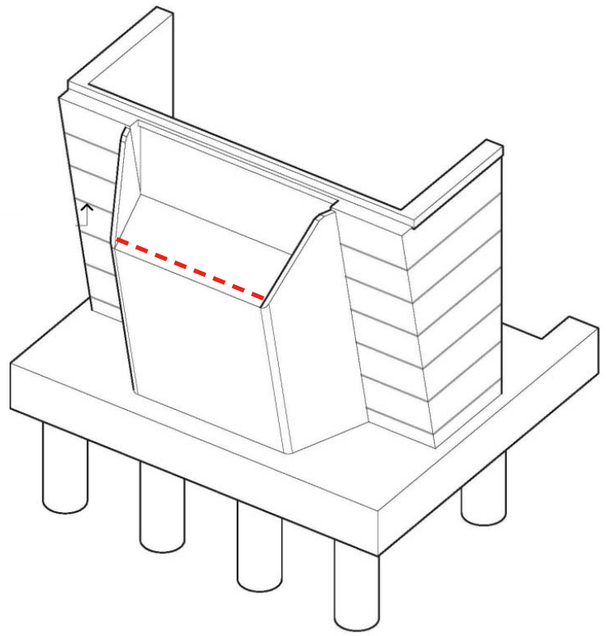
- Pier bearing shelf (bridge & typical)
- Transition pier at Rouse Hill Station
- Abutment bearing shelf

Above: Example of bird deterrent wire system

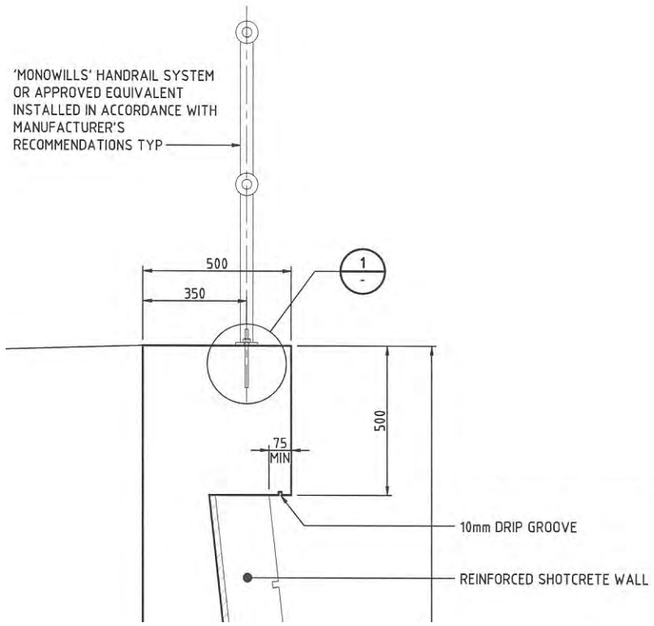


Piers

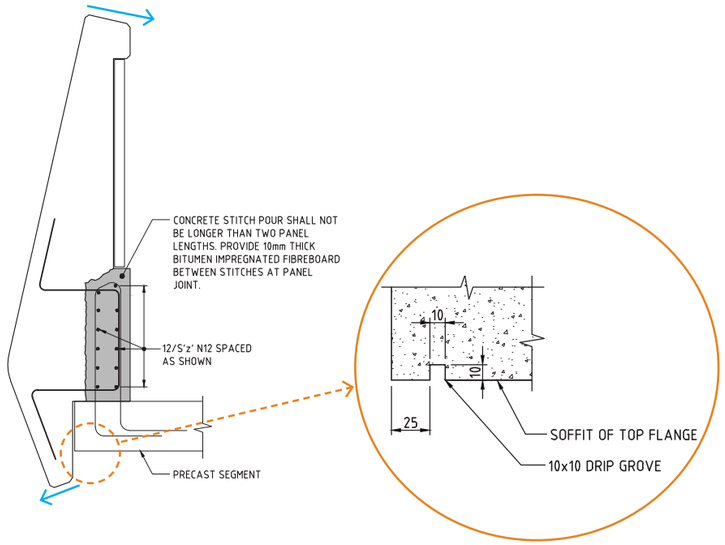




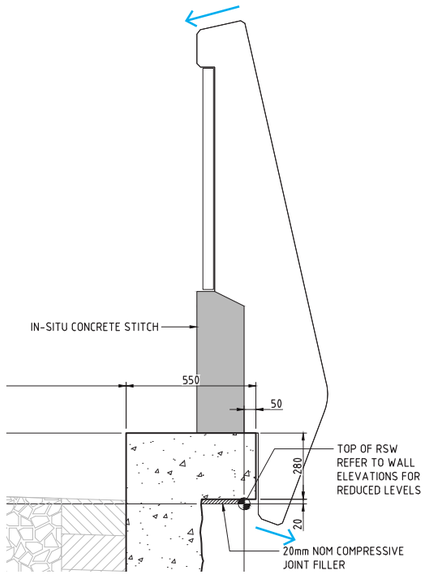
Typical Abutment



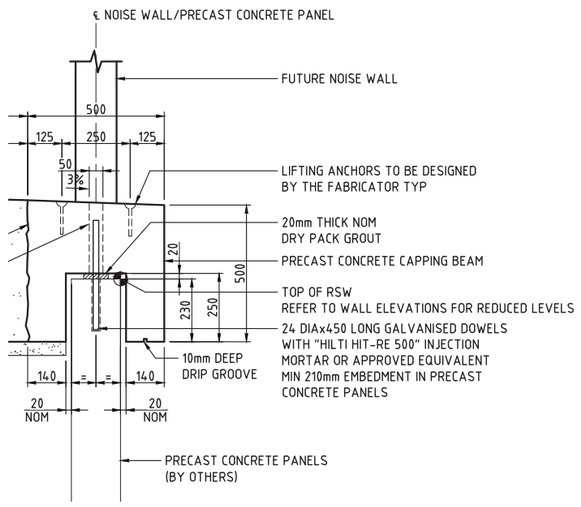
Above: RWS - Shotcrete wall capping beam detail, 75mm overhang with continuous drip groove



Above: Typical viaduct box girder deck - with continuous drip groove detail and insitu stitch to minimise water staining. Parapet surfaces are also angled to shed water away from structure.



Above: RWS - Parapet detail at abutments. Parapets are also angled to shed water away from structure



Above: RWS - Capping beam detail, 75mm overhang and continuous drip groove

Staining Prevention

The effects of weathering were investigated during the SDD phase. Strategies agreed to be implemented generally, include gently angling faces to direct water as required, inclusion of drip grooves, consideration of water ingress through various joint types. Stain prevention measures are required for:

- Viaduct parapets
- Viaduct Decks
- Soil Nail Walls - Shotcrete
- Reinforced Soil Walls

Shotcrete drainage - this is provided by a strip drain spaced at 3m centres. The discharge point is located 200mm above the base of the formation.

10 ANCILLARY STRUCTURES

A) Context, Shape & Form

Key Objective

Materials and finishes should be robust, easily maintainable and consider graffiti protection and effects of weathering.

Response

Southern Bus Layover

At Southern Bus Layover a temporary meal room and kitchen facility to accommodate 12 persons, temporary male toilet facility with, at minimum, 1 urinal, 2 cubicles and 2 wash basins, and a temporary female toilet facility with, at minimum, 2 cubicles and 2 wash basins, including all necessary service connections will be provided.

These facilities will be Ausco (or similar) demountable structures. (refer typical example).

The location and layout of buildings is shown in Design Lot - 25 - Southern Bus Layover.

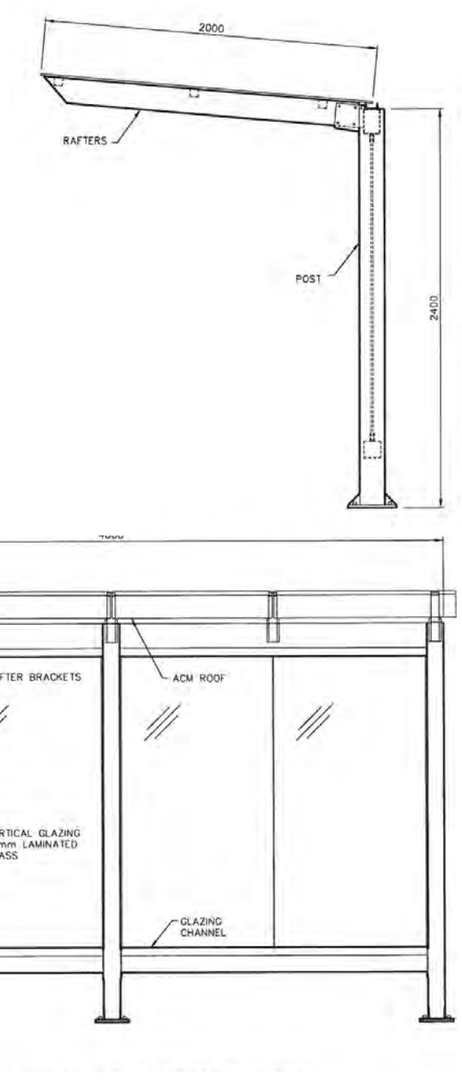
Bus Driver Amenities - Tempus

At Tempus St, temporary male and female amenities will be provided for bus drivers. These facilities will be Ausco (or similar) demountable structures. (refer typical example). 8 no. temporary bus shelters are to be provided.

The shelters will be lit and positively drained, with dimensions as follows - length 4m, width 2m and height 2.5m. The location and layout of buildings /shelters are shown in Design Lot - 23 - Tempus St Roadworks.

Above: Example of similar demountable structure proposed for the bus driver amenities buildings

Above: Example of similar proprietary bus shelters



Bus Stops

Temporary Bus stops will be designed and constructed as follows:

- 4m long cantilevered shelters with 2m roof width
- Structural aluminum powder coated framing
- Mains powered LED lighting to meet DDA requirements

11 APPENDICES

A) APPENDIX A - Design Development

The following detailed design development has been undertaken in close collaboration with the Structural and Civil Engineers, SMEC:

1. **Span and Segment Analysis**
2. **Continuous Spans - White Hart Inn**
3. **Continuous Spans & Pier Size Analysis**
4. **Station Platform Strut Design**
5. **Viaduct Deck Transition at Stations**
6. **Abutment Viaduct Transitions**
7. **Abutment B - Bridge Viaduct Transition**
8. **Transition Girder at Rouse Hill Station**
9. **Transition Pier at Rouse Hill Station**
10. **Bridge Pier Articulation**
11. **Bridge Pier Height**
12. **Bridge Cable Stays - Colour**

1. Span & Segment Analysis

Description:
Spans have been adjusted in response to a review of contextual impacts. These factors contributed to the revised spans:

- Utilities & existing landscape: In ground services and creek alignments required the team to review in detail the location of the piers.

- Heritage: The structural design had to be reviewed at span 69 to avoid the heritage remains of White Hart Inn. After the award of the project over 500 archaeological artifacts were found on the alignment of the viaduct. The remains of the foundations of the 180 year old White Hart Inn were found.

- Construction Methodology: The segment maximum size is limited to 3.5 m at the pier due to the load limits of the temporary support of the erection gantry.

Taking into consideration the above constraints the team proposed to move the position of Kellyville Station to achieve a consistency of span across the 4.6km.

Benefits, Risks, Assumptions:
This had numerous benefits such as:

- Visual urban design objectives maintained with the rhythmical segmentation in spans with a subtle articulation over piers;
- Maximum span clearance at White Hart Inn;
- There is a saving of approximately 315 segments, thereby reducing the cycles of delivery and erecting of segments. This will allow a more efficient production and construction sequence;

- Station moulds when not being used for station segments can produce the typical 4 m segment thereby increasing production;

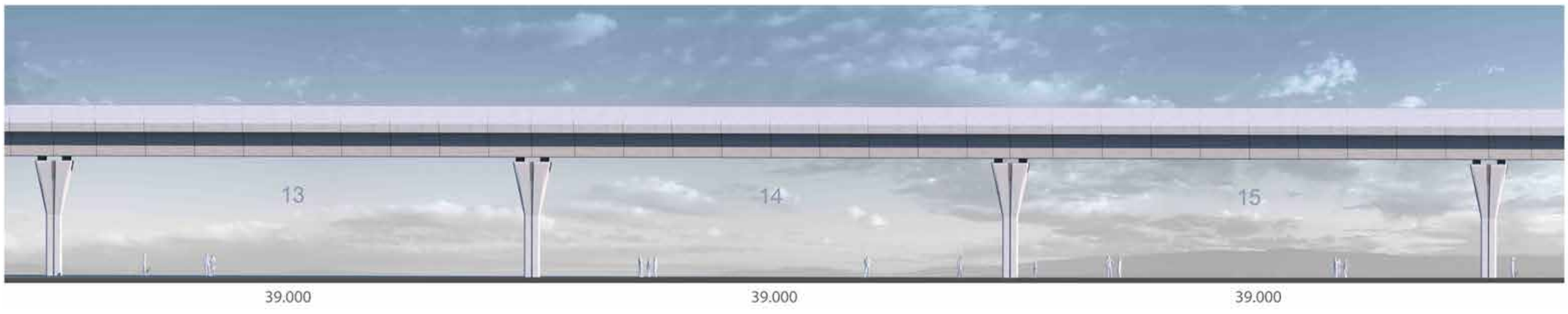
- Reduction in the number of lifts required to complete a span;

- Fewer segments will be required therefore potential quality risk through production issues will also be reduced;

Conclusion:

This design change was accepted by TfNSW and incorporated into the design.

Image: Span Analysis diagrams illustrating consistent 39m simply supported spans with 3.5m subtly articulated segments over pier heads

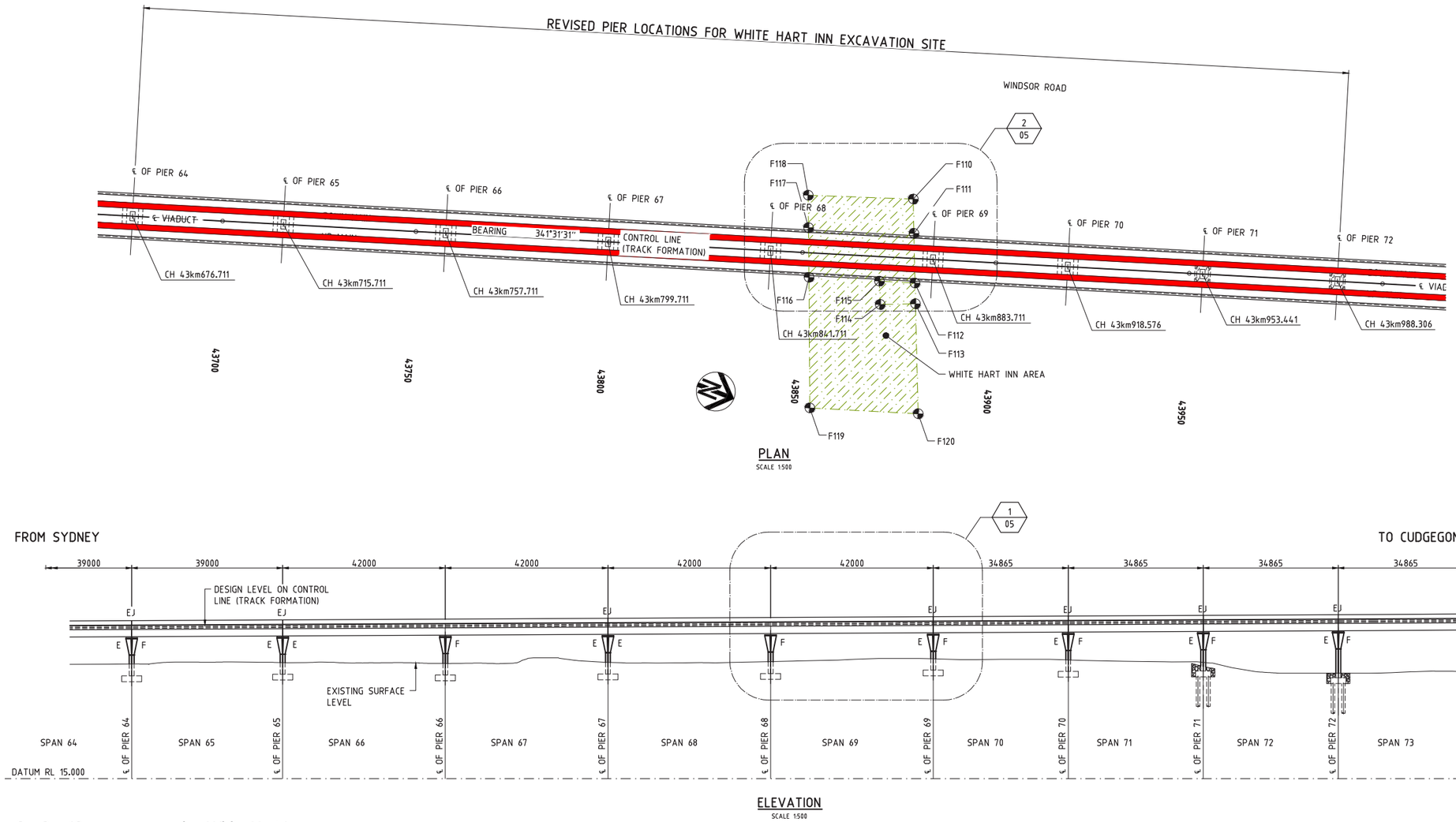


A) *Design Development - continued...*

2. Continuous Spans- White Hart Inn

Description / Conclusion:
This was subject to a design variation request from TfNSW. Continuous spans were added in response to a review of contextual impacts.

One of which, as mentioned previously, was span 68 and 69. The structural design had to be reviewed at span to avoid the heritage remains of White Hart Inn.



Above: Plan and elevation of continuous 2 x 2 x 42m spans crossing White Hart Inn

Above & Below: Perspective and elevation of continuous 42m spans crossing Windsor Road

3. Continuous Spans & Pier Size Analysis

Description:

Detail structural review was undertaken on the continuous spans over Memorial Avenue, Windsor Road & White Hart Inn. It was determined that piers either side of the roads had to thicken in the longitudinal direction to withstand the additional span loads.

Benefits:

Visual assessment determined that as long as the piers grew proportionally wider then the original design objective of a well-proportioned /scaled pier was maintained and further strengthened by this subtle articulation and “gateway” effect.

Conclusion:

This natural design development was accepted as strengthening the original design objectives and incorporated into the design.

A) *Design Development - continued...*

4. Station Platform Strut Design

Description:

Three areas of the design development were investigated:

1. Review of the structural and visual slenderness of the precast struts. The objective was to determine if struts could be slimmed down to a more elegant shape.
2. Review of cast in strut detail - review of whether a full cast in strut be achieved to remove the obvious line between the cast in and precast strut sections.
3. Post tension cable - end cap detail reviewed.

Above: Combined Precast and cast insitu cantilevered strut - note line evident

Above: Precast cantilevered strut

Benefits:

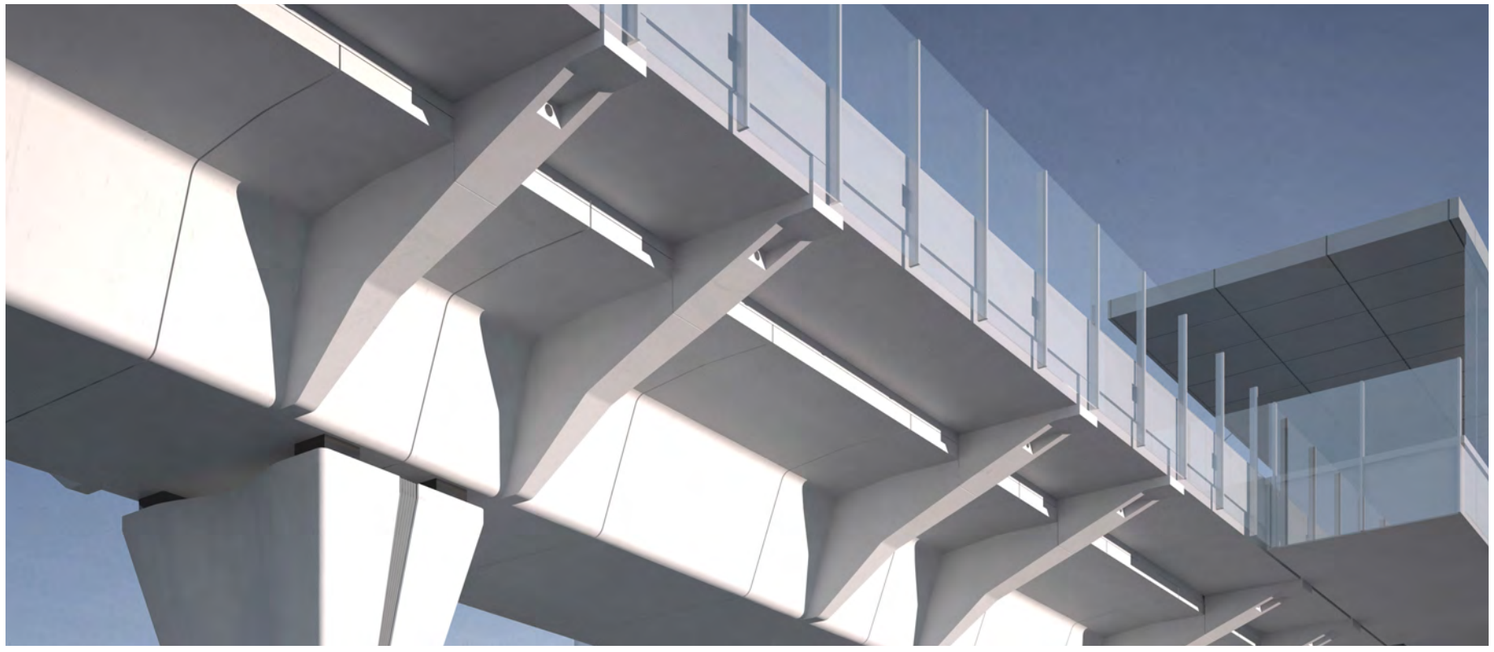
Slight refinement was made, however, further slenderness was difficult to achieve.

A fully precast strut has meant the removal of the joint line and more visual consistent and elegant element.

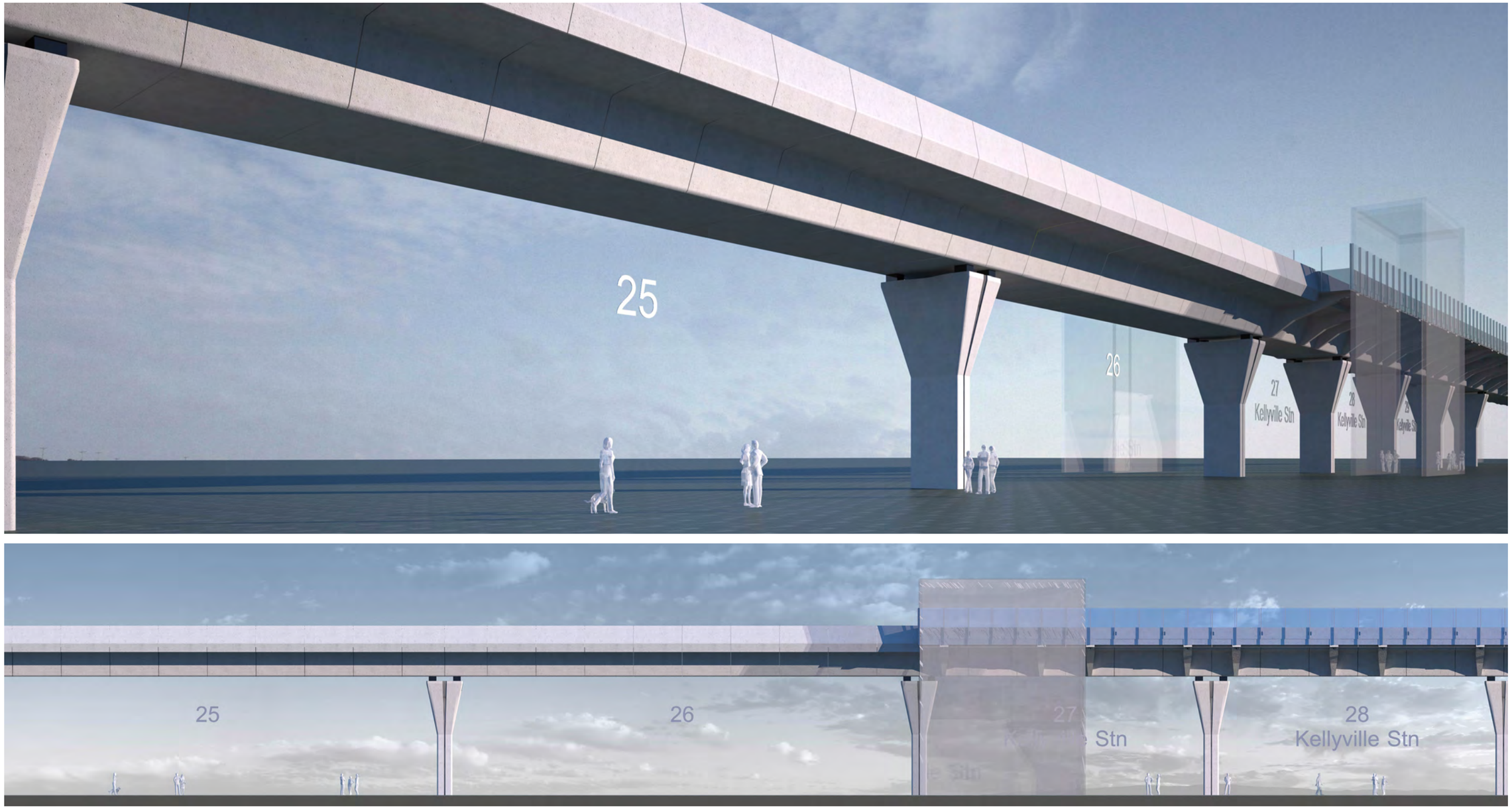
Conclusion:

A fully precast strut was agreed as the best design approach strengthening the original design objectives of elegance and efficiency in design.

A fire rated capping is required to the post tension cable. therefore the cable will be grouted over. More detail is provided in Design Lots 01-03 and 01-05 Kellyville and Rouse Hill Station Platform Viaduct.



Above: Box girder transition from viaduct to Kellyville Station Platform segment structure


25
26
27
Kellyville Stn
28
Kellyville Stn
25
26
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Stn
28
Kellyville Stn

A) *Design Development - continued...*

5. Viaduct Deck Transition at Stations

Description:

How to best transition from the typical viaduct box girder to station platforms box girders and platform segment structure. Analysis and assessment of key interactions with station fire stairs and cladding was considered in detail.

The following options were explored:

1. 200 mm offset
2. Tapered viaduct deck bookended by the fire stairs
3. Parapet return with 500 mm - 1 m offset

Benefits:

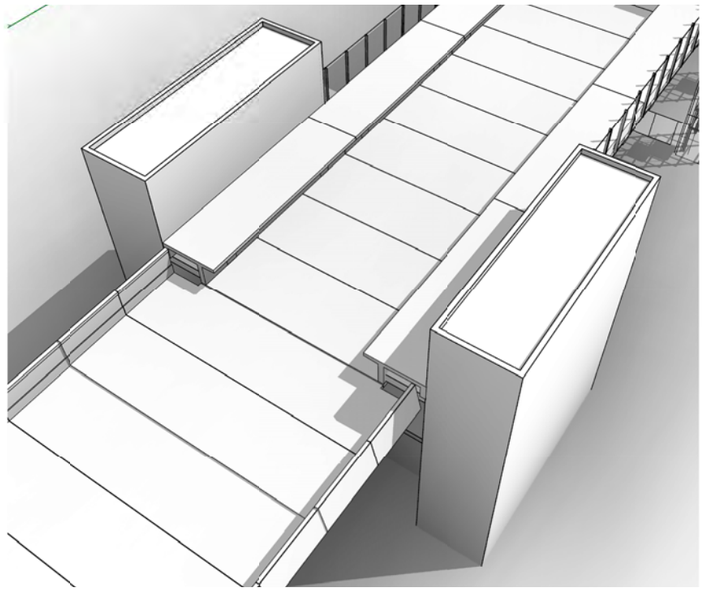
Refer adjacent option advantages and disadvantages.

Conclusion:

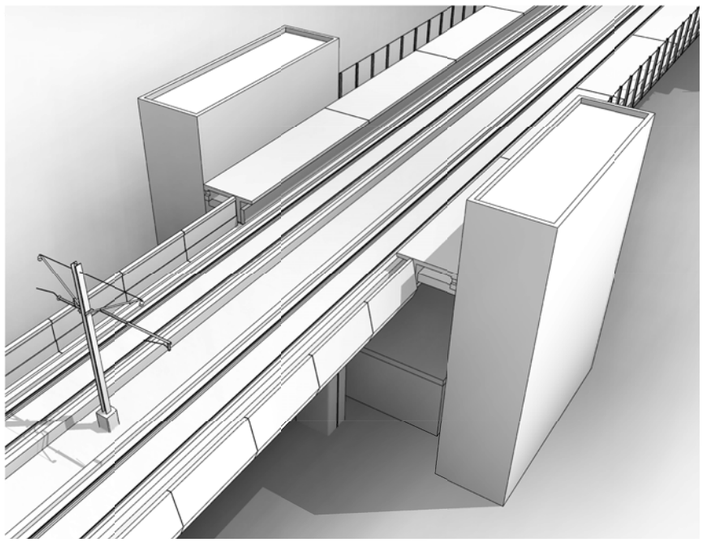
Option 1 was selected as the preferred option given its inherent future flexibility to meet the OTS design requirements in tandem with maintaining the original visual continuity and design intent.

Interface:

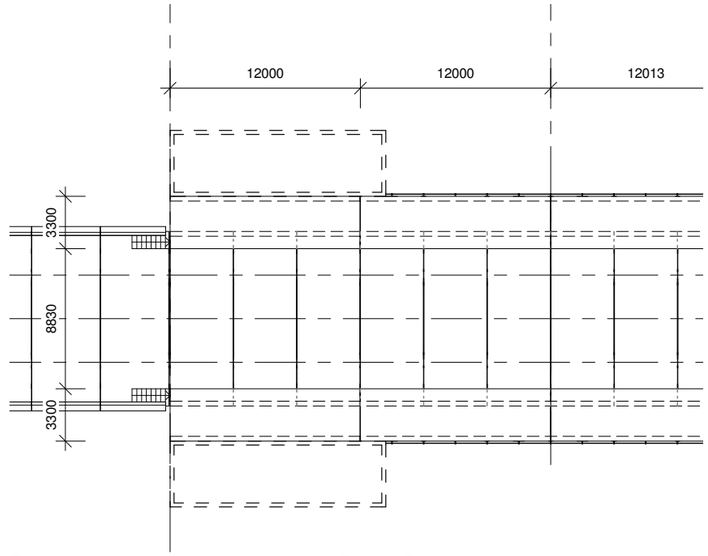
This area to be given due consideration by the OTS contractor during detailed design.



Above: Bridge viaduct deck transition to Rouse Hill Station Platform transition



Above: Typical viaduct deck transition to Station Platform transition



Above: Typical viaduct deck transition from to Station Platform transition

OPTION 1 - 200 mm OFFSET

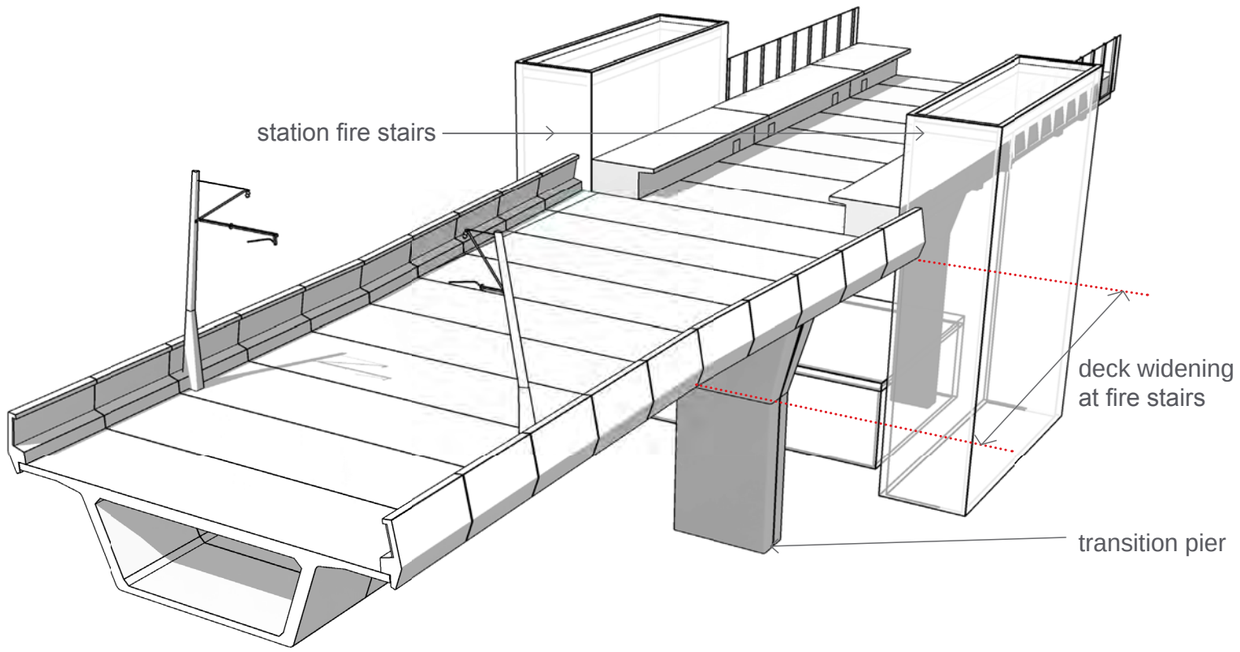
Advantages:

- Provides the best visual continuity between the horizontal elements.
- Allows the best future flexibility and interface with the OTS contractor.

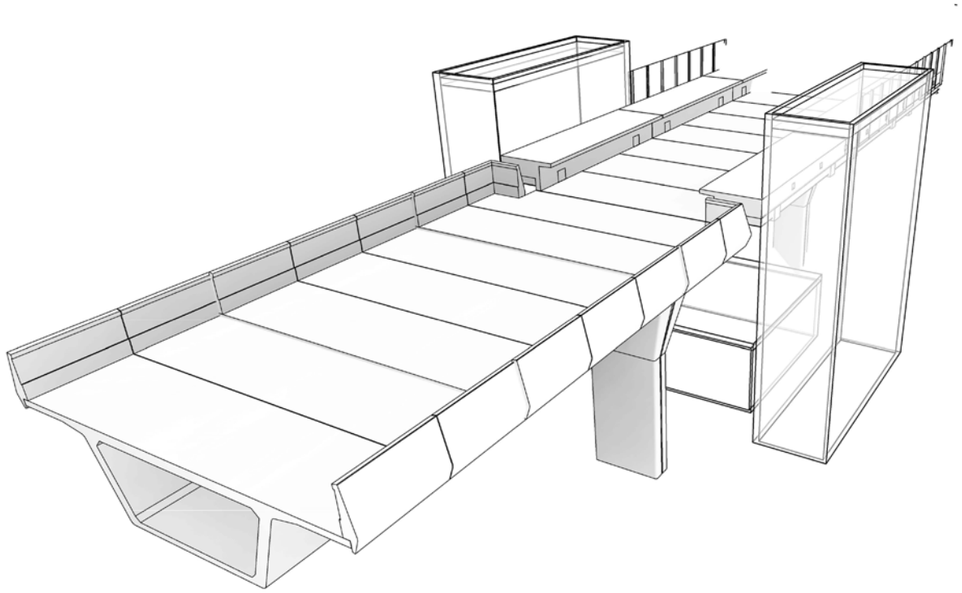
Disadvantages:

- Precast platform will need to be capped.

Deck transition - illustrating widening of deck to meet station fire stairs



Deck transition - illustrating parapet return 1m from end of platform



OPTION 2 - TAPERED VIADUCT DECK

Advantages:

- This provides good visual continuity between the horizontal elements with the fire stairs creating a natural book end.

Disadvantages:

- OTS responsible for the final location of the fire stairs. The fire stairs may not be in this final location, therefore the SVC team cannot assume the fire stair location is fixed.
- After in depth structural investigation widening the deck is structurally not possible.

OPTION 3 - PARAPET RETURN

Advantages:

- This provides a very clear visual separation between SVC and the OTS contractor’s works

Disadvantages:

- Poor visual continuity between horizontally expressed structures.
- Difficult to coordinate fire escape stair alignments with the OTS works.

A) Design Development - continued...

6. Abutment Viaduct Transitions

Description:
The wing wall construction and transition zones (30 m = 6 m + 6 m +18 m) has been reviewed to ensure the best transition of elements such as the parapet and the reinforced soil wall precast panels.

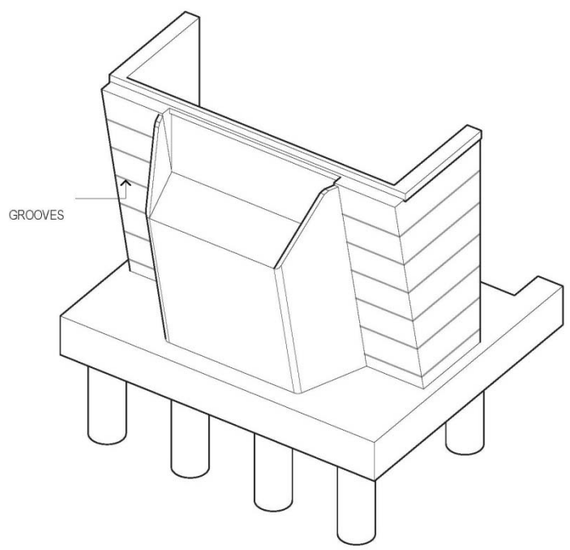
In addition,a detailed review was also undertaken of the RSW precast panels sizes across the 30m transition zone. The final size was determined by many factors:

- Construction methodology
- Relationship to other articulated structural elements such as shotcrete walls
- Viaduct parapet size
- Relationship with Second Ponds Creek RSW

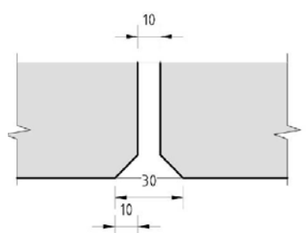
Benefits:

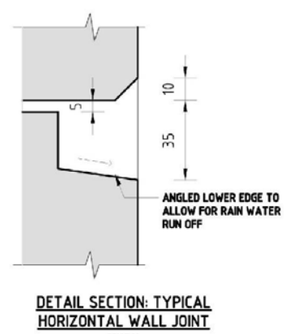
1. Related better to the viaduct parapet 30m transition a
2. More strongly reinforced the expressed the horizontal jointing

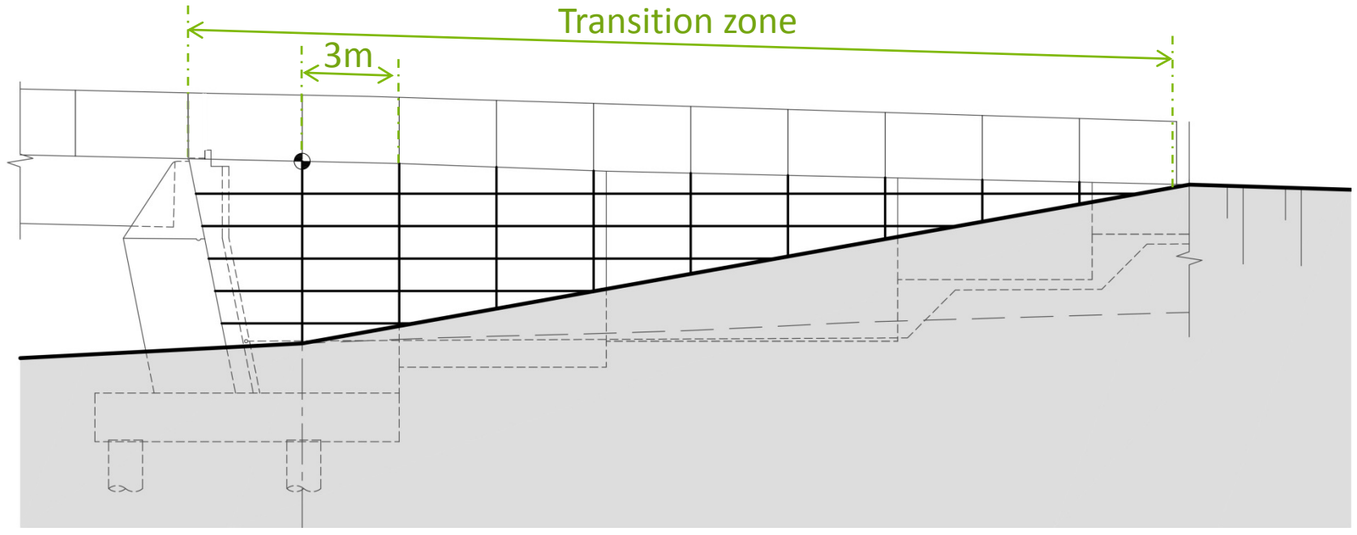
Conclusion:
The final size of panel agreed was a 3m wide full height panel with 1m articulated horizontal grooves to maintain the original intent of the urban design objectives as set out in the deed.



Typical Abutment







7. Abutment B - Bridge Viaduct Transition

Description:

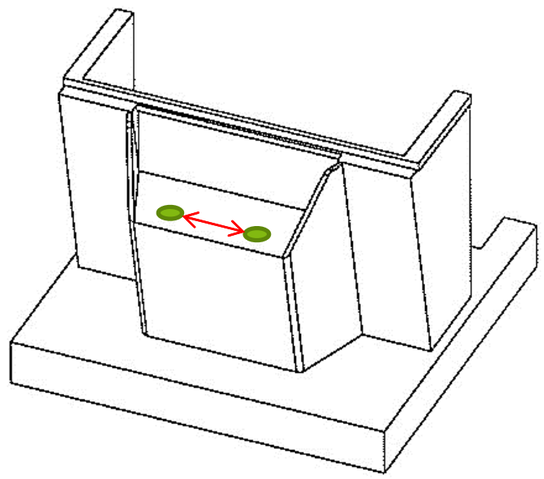
The design team reviewed their approach to the design of Abutment B in order to simplify the structural solution and future maintenance of bearings for this very different abutment condition. This abutment supports a much bigger viaduct box girder for the single span bridge. As a consequence a more honest structural approach was required to best address the structural and aesthetic issues that were encountered in the original tender submission design.

The following options have been developed:

- **Option 1** - The original typical abutment B design
- **Option 2 -** A version of the original option with a slot cut out for access to the bearings.
- **Option 3 -** Revised design approach to allow the full bearing shelf to be visible and the viaduct box girder shape to form a reverse downturn
- **Option 4** - As above with a clean cut abutment wall more in keeping with the original option 1.

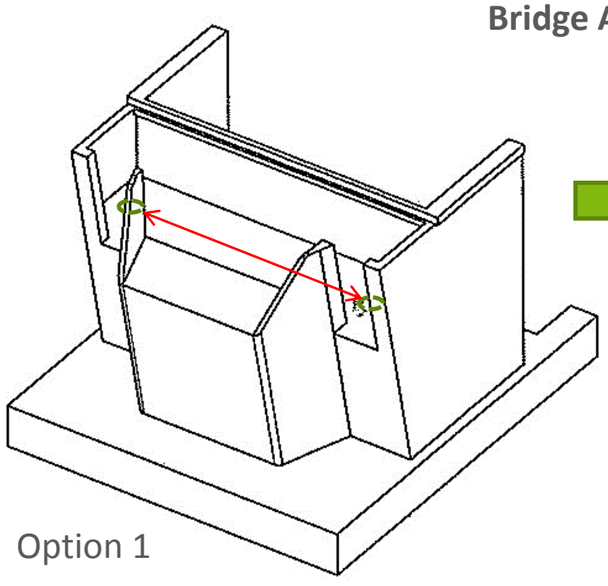
Conclusion:

Option 4 was adopted. for reasons as described over.



Typical Viaduct Abutment

Bridge Abutment



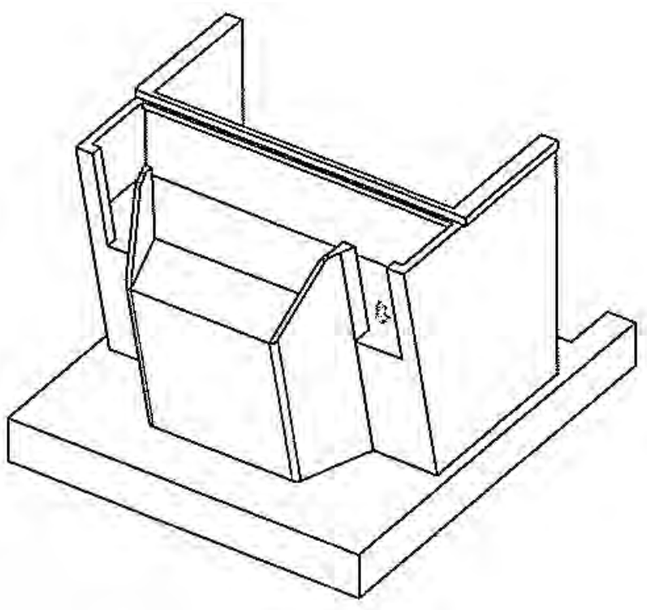
OPTION 1 - Typical Abutment Aesthetic

Advantages:

- Similar aesthetic to all other abutments

Disadvantages:

- Structurally inefficient. More a cladding element than a structural requirement.
- Bearing position is very different from the standard abutment with the bearings located at the edges.
- 100m3 of additional concrete required - not sustainable
- Difficult and more costly to construct & maintain.
- Heavy access panels required to the face of the abutment which differs from the standard abutment aesthetic.



Option1 - Original Typical Bridge Viaduct Abutment B

Reflects deed design requirements. Note bearings located at the edges and accessed through access panels to the face of the abutment

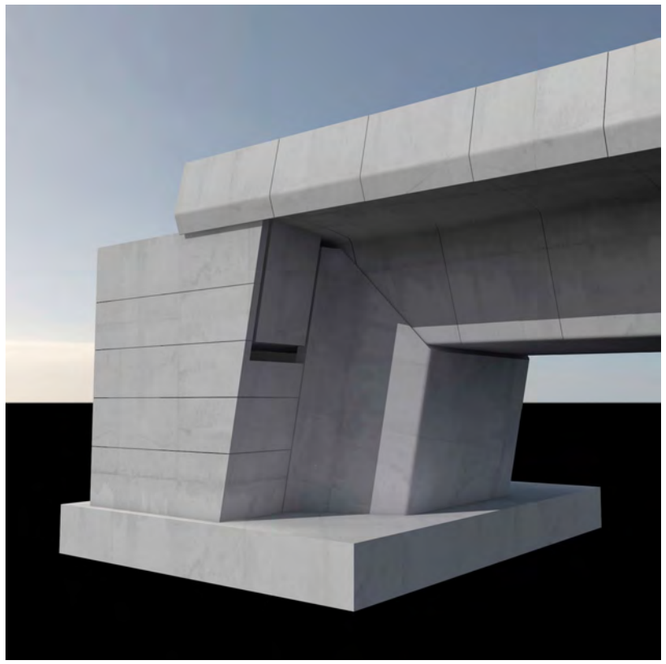
OPTION 2 - Similar Typical Abutment Aesthetic with open bearing shelf

Advantages:

- Similar aesthetic to all other abutments, however, better addresses bearing access. No need for large, heavy obtrusive access panels / hatches

Disadvantages:

- Structurally inefficient. More a cladding element than a structural requirement in opposition to the deed which prohibits the use of cladding.
- 100m3 of additional concrete required - not sustainable.
- Difficult and more costly to construct.



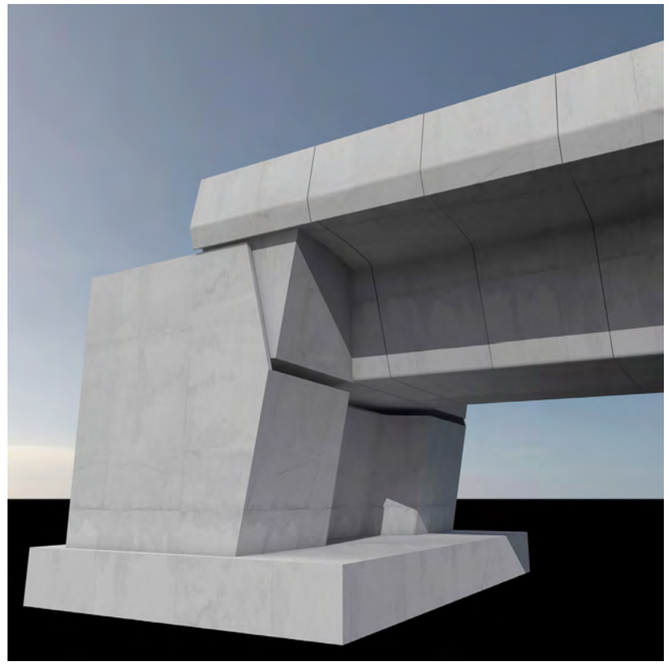
OPTION 3

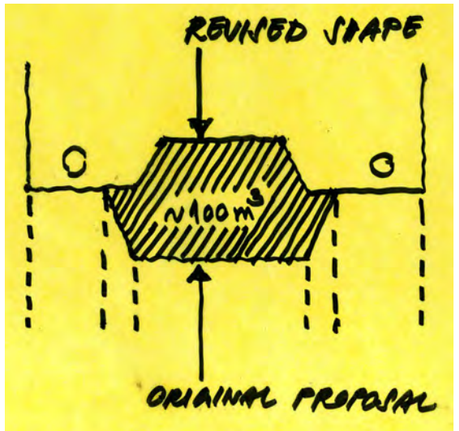
Advantages:

- This option presents an honest approach to the structural requirements for the abutment.
- It acknowledges and clearly allows for the bearing locations and unique loads transferring from the bridge viaduct box girders.
- 100m3 of concrete reduced making it a more sustainable option
- Cheaper to construct & easier to maintain.

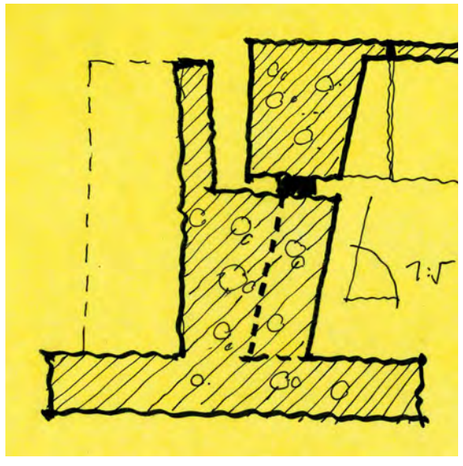
Disadvantages:

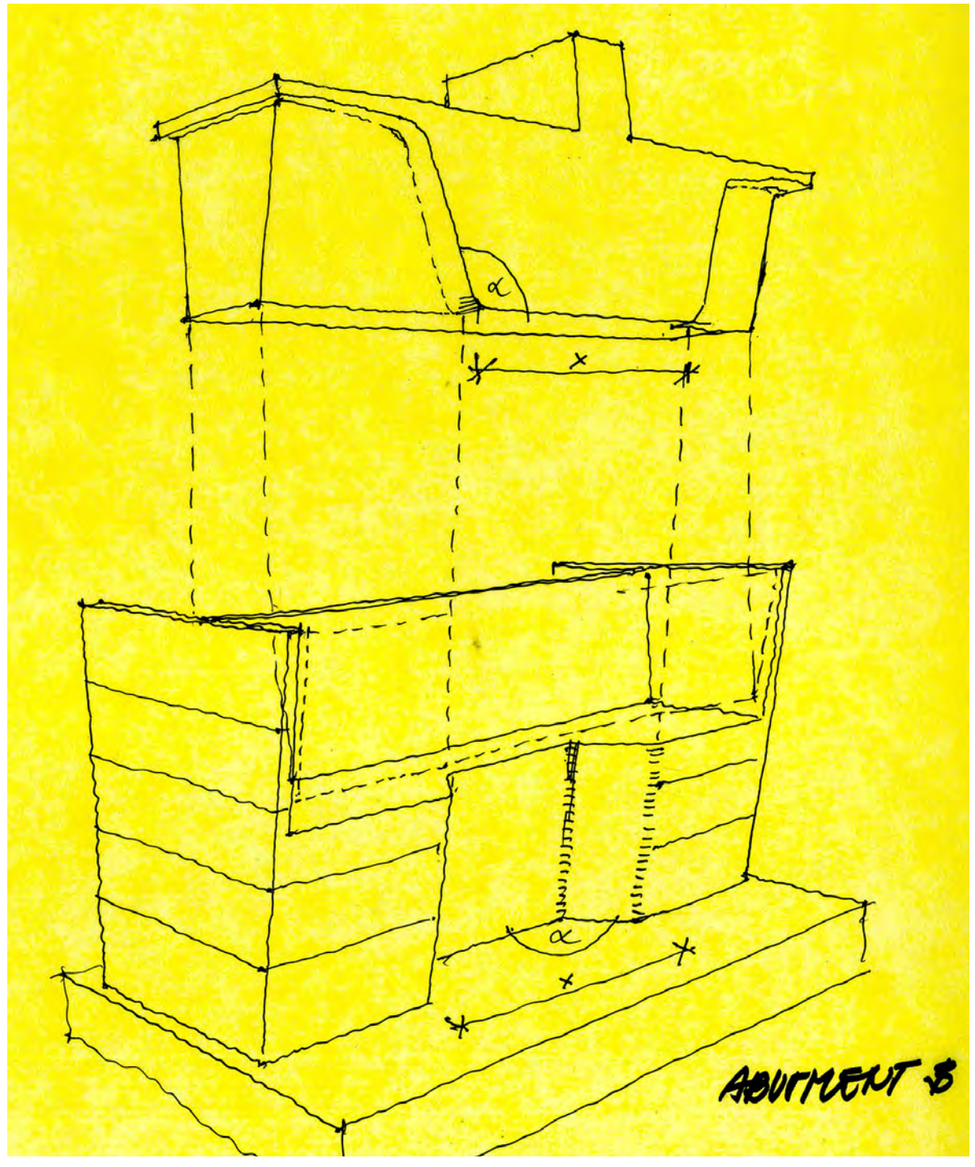
- Does not fulfill the look and feel as specifically described in the deed with regard to articulation of form and expression of jointing.
- The recess is deep and may pose security and safety concerns.





Option 1 sketched over Option 2-4 illustrating concrete and space reduction





Gantry crane supports require a minimum 1m clear from the front face of abutment to the back wall of recess. This and CPTED requirements drive the depth of the recess.

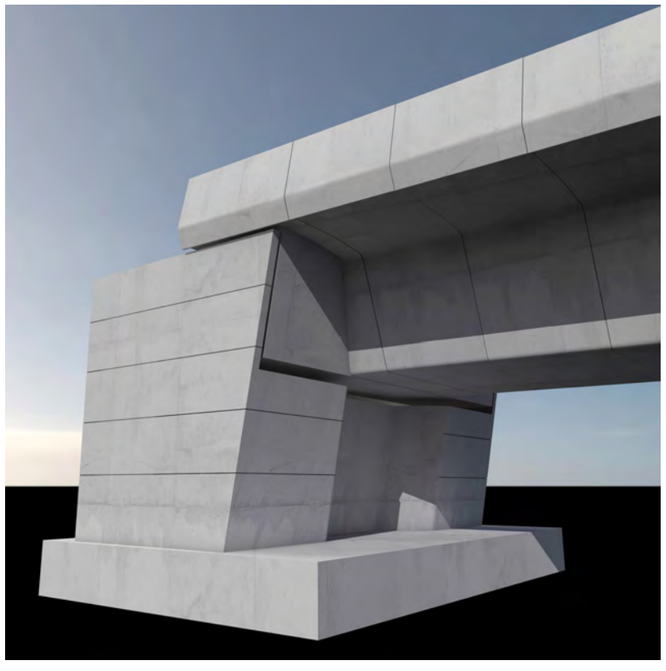
OPTION 4

Advantages:

- This option has all the advantages of Option 3 but more closely reflects the nature, simplicity, logic and articulation of form of the Standard Viaduct Abutment and viaduct box girder it connects to.
- The depth of the recess at grade is reduced, as is the superstructure width, to better link to the girder over.
- Reduction in space and 100m3 of concrete making it a more sustainable option and therefore cheaper to construct and easier to maintain (no access hatches).
- Maintains a holistic design approach of all abutment elements.

Disadvantages:

- Does not conform to precisely to the visual and architectural outcomes in Figure 13.1 of the deed as this only works with a typical standard viaduct size & form.



A) *Design Development - continued...*

8. Transition Girder at Rouse Hill Station

Description:
The larger box girder size and structural capacity enables maximisation of spans across Rouse Hill Drive (approx. 46 m). This creates a visual transition from station to bridge structure that appears seamless. However, transition of the bridge viaduct box girder to the standard girder size at the Rouse Hill Station had to be closely studied to ensure continuity of the line of structure

The first approach was to taper the box girder itself. The following option studies were undertaken:

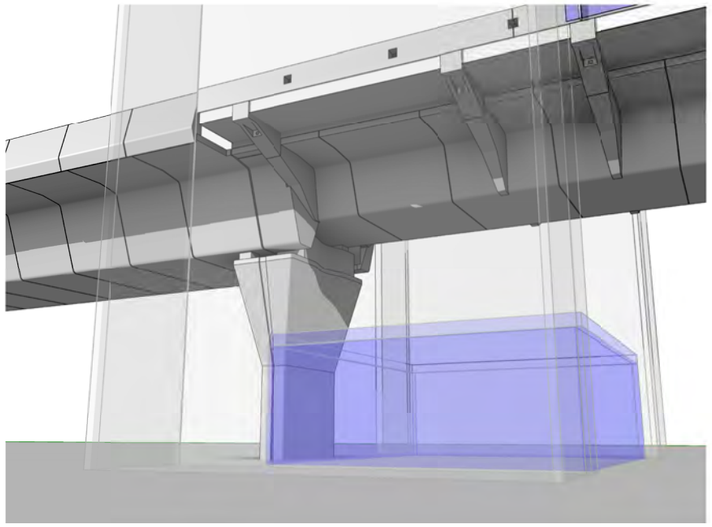
Summary of Options:

1. Option 1 - Steep Taper at pier edge
2. Option 2 - Shallow taper at pier edge
3. Option 3 - Taper starts beyond bracket
4. Option 4 - Taper starts a full segment beyond edge of pier

Advantages, Disadvantages & Assumptions:
Described in the table opposite.

Conclusion:
Option 1 was preferred by the team and TfNSW, however further study was required to refine this approach. Please refer to the next Workstream *9 -Transition Pier at Rouse Hill Station.*

MAIN FEATURES COMPARISON	Option 1	Option 2	Option 3	Option 4
Best aesthetic (most honest structurally)	X			
Worst aesthetic (least honest structurally)				X
Lightest	X			
Heaviest				X
Bearing is open - easy access for maintenance	X			
Bearing concealed – access can be provided with a recess or opening in transition element		X	X	X
Simple installation / construction	X			
Complex installation / construction		X	X	X
Smallest additional element	X			
Medium sizes additional element		X	X	
Largest additional element				X
Conforming to approved original concept	X			
Non-conforming to approved original concept		X	X	X



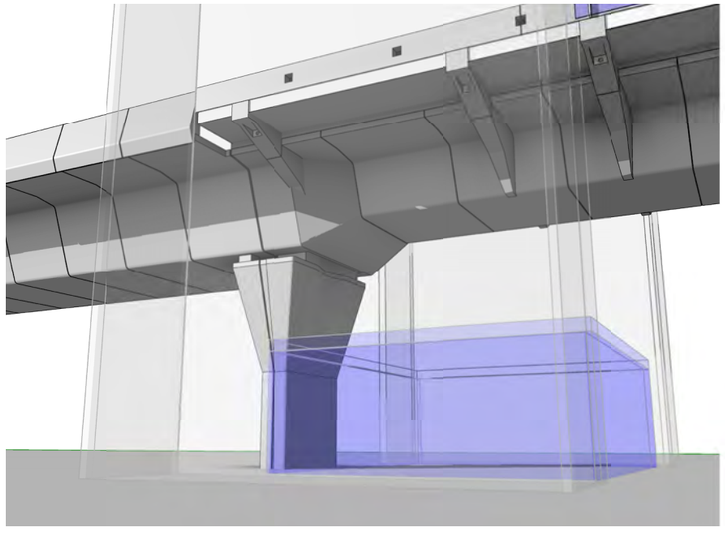
OPTION 1 - Steep taper at pier edge (precast transition element)

Advantages:

- Least obvious transition when viewed from station vantage point (smallest size)
- Closest option to the approved original concept
- Aesthetically most appealing, least obtrusive, most authentic structurally
- Transition occurs at centreline of bracket, whole bracket is visible
- Can access bearings for inspection and maintenance
- Four precast elements easily connected to segment
- No major structural changes to the station segment
- Can access the precast panel supports for maintenance
- Smallest additional element to create transition
- Could be supported from the pier on top of a bearing, or connected to the segment

Disadvantages:

- Adding a non-structural element
- Additional maintenance element
- Adding additional weight to the segment



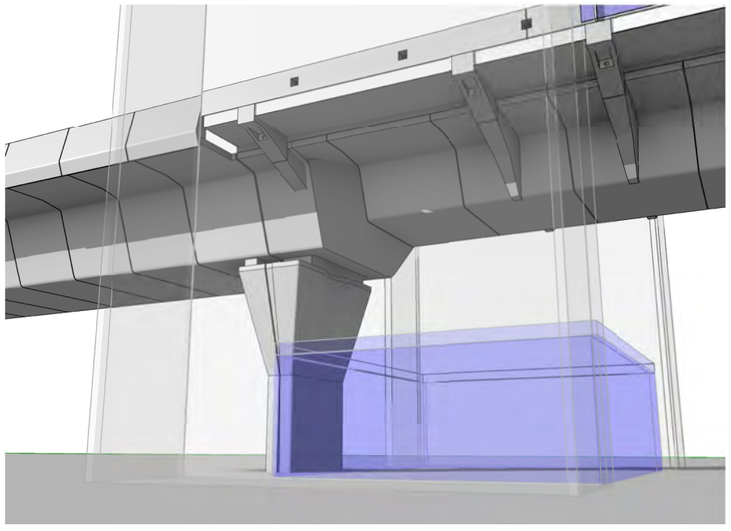
OPTION 2 - Shallow taper at pier edge

Advantages:

- Medium sized additional element to create transition
- Size and weight of transition is manageable for construction
- Bearings can be made accessible with a removal panel

Disadvantages:

- Recess or opening required to provide access to bearings
- Transition is strange relationship to bracket, bracket is truncated
- Possibly 5-7 pieces required to construct the transition
- Difficult connection into the segment
- A non-structural element
- An additional maintenance item
- Removal panel to access bearings may be too heavy for a person to remove
- Significant additional weight on the end segment
- Cannot be supported from the top of the pier



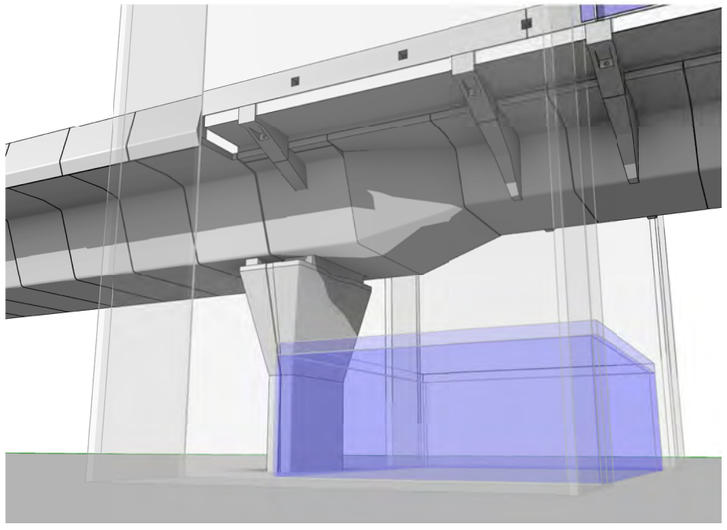
OPTION 3 - Taper starts beyond pier

Advantages:

- Medium sized additional element to create transition
- Size and weight of transition is manageable for construction
- Bearings can be made accessible with recesses in the vertical face of the end panel

Disadvantages:

- Recess or opening required to provide access to bearings
- Transition truncates bracket in half – inconsistent aesthetic and rhythm
- Possibly 5-7 pieces required to construct
- Difficult connection into the segment
- A non-structural element
- An additional maintenance item
- Significant additional weight on the end segment
- Cannot be supported from the top of the pier



OPTION 4 - Taper starts a full segment beyond edge of pier

Advantages:

- Most shallow angled transition
- Bearings can be made accessible with recesses in the soffit of the last segment panel

Disadvantages:

- Similar disadvantages to option 3
- Possibly 6-8 pieces required to construct. Difficult connection into the segment
- Largest, heaviest and least manageable sized additional element to create transition
- Most obvious transition when viewed from station vantage point (largest size)
- Removal panel to access bearings may be too heavy for a person to remove
- Difficult to access the support / connection locations of the panels for maintenance inspections

A) *Design Development - continued...*

9. Transition Pier at Rouse Hill Station

Description:

Following on from Work Stream 8, the transition was reviewed during detailed design to refine the strut and structural approach to the transition given the inherent construction difficulties when casting a viaduct transfer element as in the previous Work Stream.

The then collaborated to review options that looked at using the pier to help transfer to the station viaduct box girder.

The following three options were investigated:

- Option 1 - Stepped Pier
- Option 2 - Plinth Pier
- Option 3 - Plinth Pier with precast transition element

Advantages, Disadvantages & Assumptions:
Refer adjacent specific option advantages and disadvantages.

Conclusion:
Option 3 was selected as the preferred option by TfNSW as the option which best addressed visual, structural and maintenance concerns. This option was selected on the basis that the transition piece is to be a precast element.

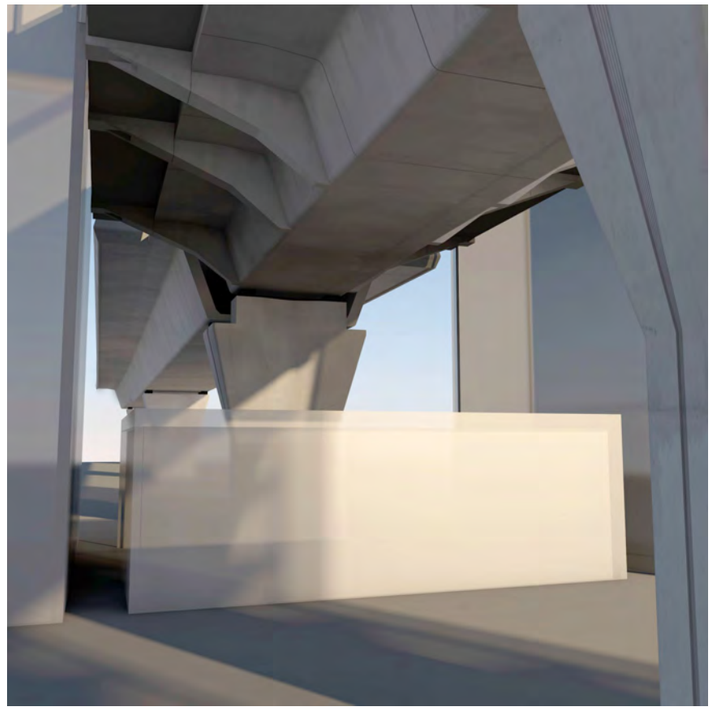
OPTION 1 - Stepped Pier

Advantages:

- Simple to construct.

Disadvantages:

- A series of disparate and confused elements meeting awkwardly.



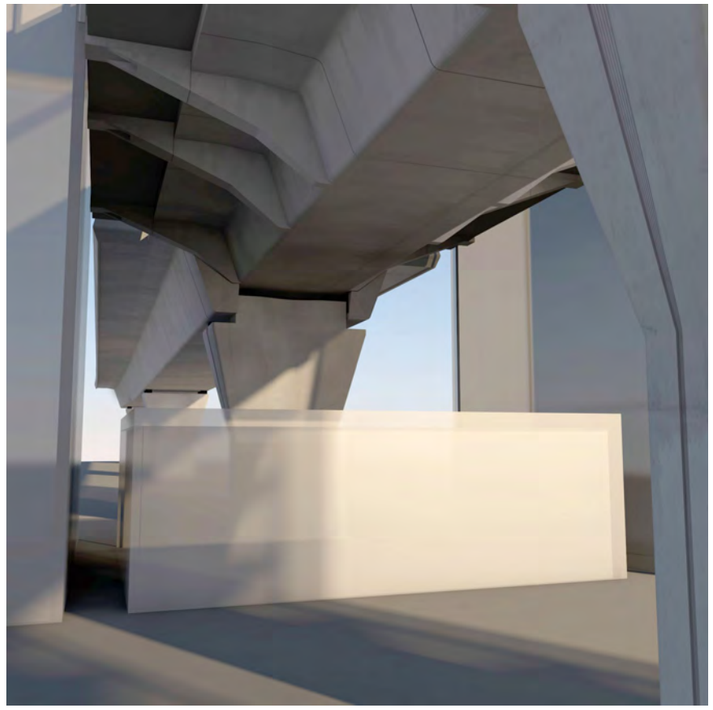
OPTION 2 - Plinth Pier

Advantages:

- More harmonious unity of intersecting elements.
- A pure structural approach.

Disadvantages:

- Unfinished look.
- Deep recesses in the structure which present opportunity for birds and vermin access.
- More maintenance required.
- Cheap to construct



OPTION 3 - Plinth pier and precast transition element

Advantages:

- More harmonious unity of intersecting elements.
- A united structural and architectural response to the various meeting of numerous different elements.
- Closed structure - controls and prevents bird and vermin access.

Disadvantages:

- The transition piece must be of a precast concrete material and costs more to construct
- Bird and vermin proofing required

The image above illustrates in close detail Option 3's the precast concrete transition element and plinth aligned and following the curved linear form of the main face of the pier.

A) Design Development - continued...

10. Bridge Pier Articulation

Description:

Refinement of the viaduct box girder shape to suit the viaduct box girder (reduced girder base width) required a review and redesign of the bridge pier and cradle elements. The following describes the design development of these elements in support of this refinement.

Advantages & Disadvantages:

Cradle Design

Option 1 - Sloping face

This option was discontinued due to the lack of articulation of structure as it disappears into the viaduct deck above.

Option 2 - Straight face articulation

This option was preferred as it visually reinforced the viaduct deck over strengthening the cradle element.

Bridge Pier Design

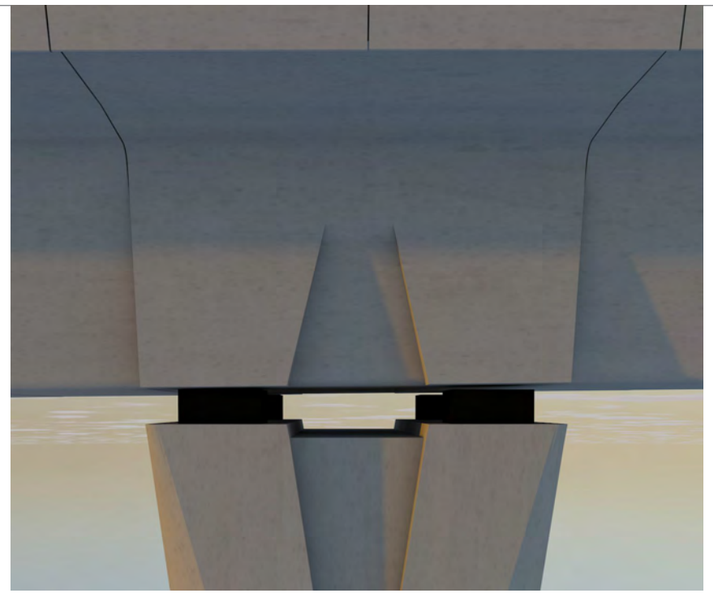
Option 1 - Sloping face

This option was preferred as it reduced the potential for staining and naturally lengthened and elongated the proportion of the pier face lending flexibility to the design to suit both pier conditions which differ significantly in height.

Option 2 - Straight face articulation

This option was discontinued given it's greater potential for staining and long term maintenance requirements.

The opposite page presents the final combined options studied to achieve a holistic pier design.



Cradle Design - Option 1

Cradle Design - Option 2

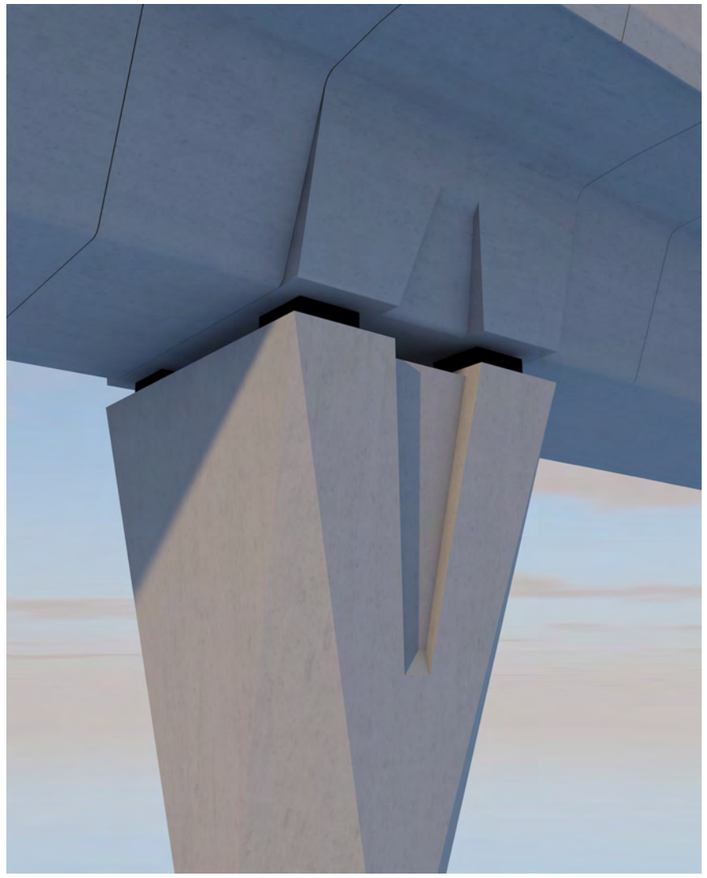
Bridge Pier Design - Option 1

Bridge Pier Design - Option 2

Conclusion:

Option 3 was TfNSW's preferred option providing an elegant, articulated and harmonious design solution to the viaduct box girder base width refinement. The design also further reduces the risk of staining in line with the overarching urban design objectives.

TfNSW agreed that additional design investigation was required to understand the impact of the future grade separation on the bridge pier height.



Final Combined Options Study

Option 1 - Sloping face TOP AND BOTTOM
Given the lack of strength in the articulation of the cradle and it's relationship to the bridge deck above, this option was discontinued.

Option 2 - Straight face TOP AND BOTTOM
This option was discontinued as the straight face of the pier base cut the proportion of the pier in half weakening it's elegant proportion and increasing the potential for staining.

Option 3 - Straight face TOP / SLOPING BOTTOM
This option provides a combined unified elegant solution for both elements and reduces the risk of staining.

11 . Bridge Pier Height

Description:
Refinement of the viaduct box girder shape (reduced girder base width) required a review and redesign of the bridge pier and cradle elements as in the previous Workstream 10 - Bridge Pier Articulation to suit Viaduct Box Girder.

The following options describes further the design development of these elements in context with the ground plane in recognition of the significant height difference between the two bridge piers and the future road widening close to Abutment B bridge pier. This was considered a influencing factor in the final options selection.

Three options were explored:
- Option 1 - Narrow base width to the pier articulation which stops above the ground plane
- Option 2 - Elongated pier articulation which continues below ground level copying exactly the shape and proportion of the taller pier near Windsor Road.
- Option 3 - Wide base to the pier articulation which stops above the ground plane

Advantages & Disadvantages:
Refer adjacent specific option advantages and disadvantages.

Conclusion:
Option 3 was TfNSW's preferred option providing the best balance of proportion and articulation in combination with the two different pier heights and ground planes now and in the future. This option also worked holistically with the bridge elements over maintaining the overarching urban design objectives of creating a consistent family of elements.

However, TfNSW agreed that additional design investigation was required to understand the impact of the future grade separation on the bridge pier height.

OPTION 1 - Narrow base

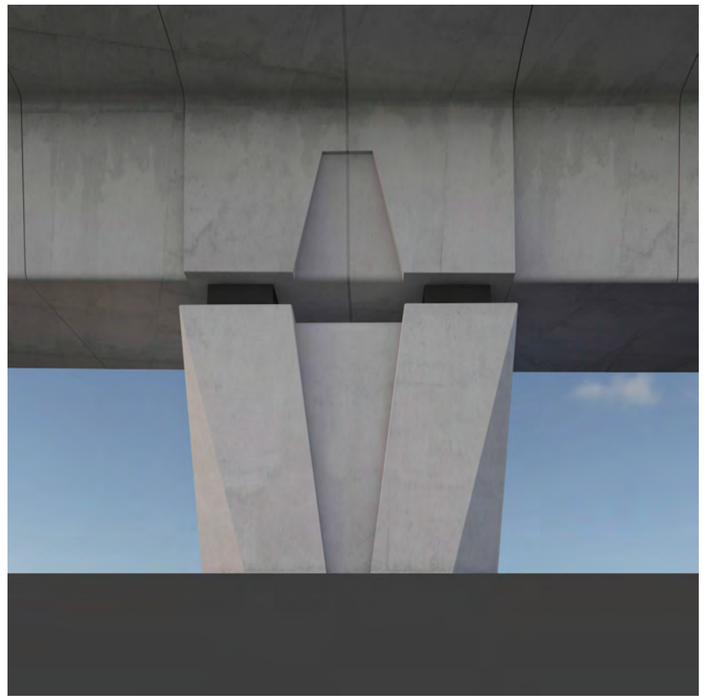
Advantages:
- Allows for future road widening and ground plane realignment

Disadvantages:
- Proportion emphasises the stumpy nature of the pier
- The size of the recess is smaller than the cradle recess even though it's in a much larger element face

OPTION 2 - Articulation below ground plane

Advantages:
- The recess on the pier face is the most elegant proportion .

Disadvantages:
- Does not allow for future road widening and ground plane reduction. With this ground plane lowering the concrete face of the pier will be discoloured. This will be further emphasised in the areas of the recess.
- No base / finish zone to complete the articulation. The pier face looks incomplete



OPTION 3 - Wide base

Advantages:

- This is a better balanced, proportional articulation between the pier and cradle elements.
- This option will work better if the ground line is lowered as the discoloration of the concrete will be on a flush, smooth face.

Disadvantages:

- Not as elegant a proportion as the elongated recess in option 2.Future grade separation levels to be further investigated.

Bridge Pier Design illustrating the final preferred Option 3 in context with the other bridge elements for the low height bridge pier.

A) Design Development - continued...

12. Bridge Cable Stays - Colour

Description:
The colour of the cable stays was the subject of detailed design due to concerns on darker colours, black, having too great a thermal expansion issues. In light of this two options were developed to look at both cable and sleeve colours which are lighter and still maintain the original design and objectives.

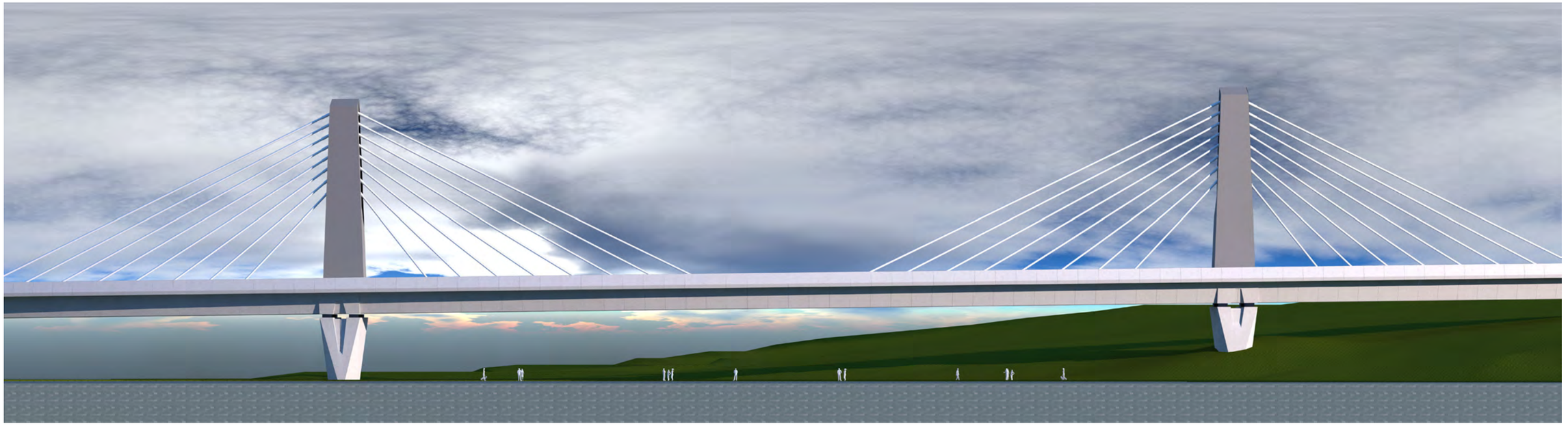
Two options were explored:
- Option 1 - Light grey cables with light grey cable sleeve
- Option 2 - Light grey stays with dark grey sleeve

Advantages & Disadvantages:
Option 1 had a much weaker articulation at the connection to the mast.

Option 2 with a dark grey sleeve better articulated the cable connection to the mast strengthening and framing the mast.

Conclusion:
Option 2 was TfNSW's preferred option providing the best articulation in combination with the required use of a lighter cable in answer to the concerns of thermal expansion.

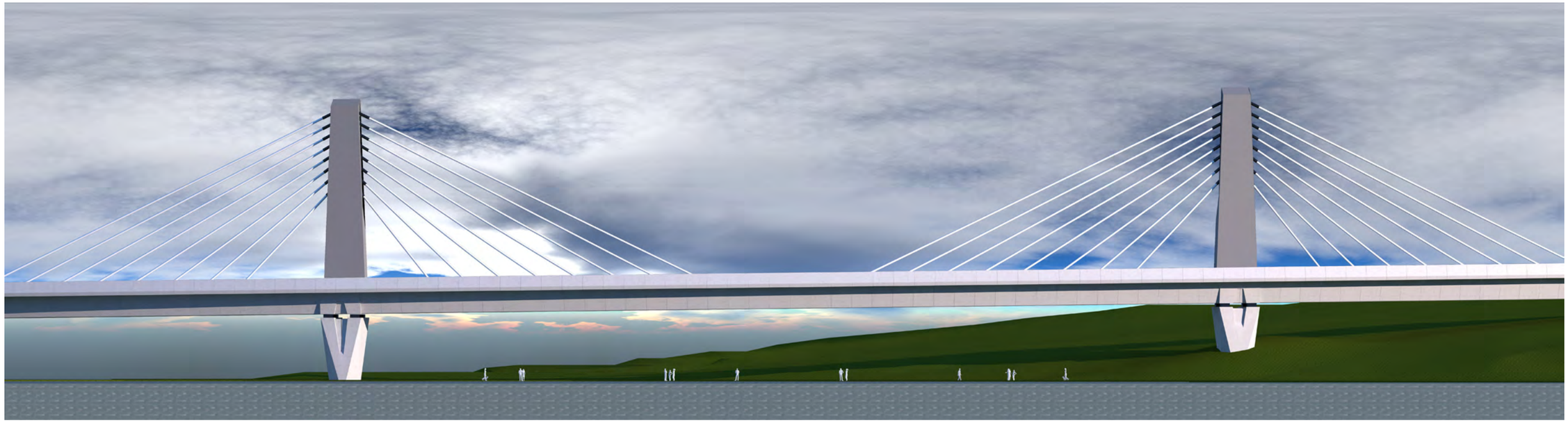
Further study required for reflectivity of cable stay product.



OPTION 1 - light grey cables with light grey sleeves

Light Grey

Dark Grey



OPTION 2 - light grey cables with dark grey sleeves

10 APPENDICES

B) APPENDIX B - RVTM Compliance Table

Contract Requirement Analysis

As detailed in the SVC Requirements Management Plan [TFNSWSVC-ISJ-SVC-PM-PLN-120802], the Project Deed including the SWTC and its appendices have been analysed to identify the technical requirements for the Project. The documents identified as containing technical requirements have been uploaded onto IBM Rational DOORS © (Dynamic Object Oriented Requirements System) requirements management tool for central requirements database management control.

The engineering assurance management registers in the form of a Requirements Verification Traceability Matrix (RVTM) for this design package has been generated and enclosed in this Appendix A for the detailed design stage of the project. These requirements have been developed in accordance with the requirements development process described in the SVC Requirement Management Plan, and has extracted the relevant design requirements from the SWTC contract documents.

During the DCD phase these requirements where categorised into the different requirements types. ‘Technical’ requirements form the ‘design to’ criteria and establish the baseline against which the contractor (including designers or subcontractors) can verify compliance and subsequently validate the implemented systems. ‘Technical’ requirements have been selected to be recorded in the relevant RVTM design packages. ‘Technical Process’ requirements however, are either linked to a relevant management plan or a technical process for satisfying compliance identified as a management action. Each Technical Process Requirement will therefore be allocated to the Manager responsible for the management plan / management activity to provide the relevant verification mechanism and evidence to support compliance. Other requirement types not identified as ‘Technical’ or ‘Technical Process’ are classified as ‘Information’ or ‘Commercial’ type requirements, have been saved in the DOORS database for reference purposes.

For SDD each requirement in the RVTM is further assessed for applicability to the design package. Requirements that are not applicable to the specific design package are nominated for removal. Applicable requirements have been populated with the nominated verification method and verification evidence to demonstrate compliance to each requirement identified at DCD. This has been progressively completed by the designer throughout the design development and checked by the design verifier. During the design phase, the verification evidence may take the form of design drawings, reports, calculations, analysis, etc. The requirements which have been agreed as not applicable to the specific design package will be removed from the RVTM at FDD. In addition the RVTM has been updated to reflect Change Orders and newly derived safety requirements from the safety assurance processes that may have an impact on the technical requirements presented in the RVTM.

Requirements Verification Traceability Matrix (RVTM) for SDD Stage Design Lot 80 - Urban & Architectural

Req-ID	Section / Reference No.	Requirement Description	Status	Requirement Type	Technical Classification	System	Sub-system	Clarification	Interface	Owner	Design Verifier	Verification Method	Verification Status	Verification Evidence
T13-0001	Exhibit A Appendix13 13.2.1 (a)	The Viaducts and Station Platforms must integrate structural and architectural elements to create a high quality, simple and elegant piece of civic infrastructure that relates to its existing and future environment and expresses the identity of the North West Rail Link, where the existing and future environment being as described in Chapter 6 of the environmental impact statement prepared in relation to Project Planning Approval 2.	Applied	Technical	Design	Urban & Architectural		Urban & Architectural Design Report. DI commentary provided only on design elements / approach which mitigate staining. Technical and dimensional requirements are as set out in the engineering drawings and reports.	Viaduct & Station Platforms and Landscape	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0.
T13-0002	Exhibit A Appendix13 13.2.2 (a)	The design of the Viaducts must provide a holistic, coherent and symmetrical structure demonstrating well proportioned relationships between the: (i) overall height and span; (ii) relative dimensions of the piers and precast concrete box girders; and (iii) precast concrete box girder overhang and depth.	Applied	Technical	Design	Urban & Architectural		Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0.
T13-0003	Exhibit A Appendix13 13.2.2 (b)	The Viaducts must present smooth, clean lines and have a minimum structural depth consistent with the spans and method of construction.	Applied	Technical	Design	Urban & Architectural		Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0.
T13-0004	Exhibit A Appendix13 13.2.2 (c)	The design of the Viaducts must incorporate a repeating form that provides a well-ordered assembly of structural elements over the full length of the Viaducts.	Applied	Technical	Design	Urban & Architectural		Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0.

T13-0005	Exhibit A Appendix13 13.2.2 (d)	The design of the Viaducts must eliminate unnecessary visual clutter.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0.
T13-0010	Exhibit A Appendix13 13.2.3 (b)(iv)	Where the Viaduct span is curved, the precast concrete box girders must have a continuous form; A. with a maximum facet length of 3m measured on the Track Formation (Control Line); and B. be constructed with equal modular segments.	Applied	Technical	Design	Urban & Architectural	"Continuous form" - Urban & Architectural Design Report. DI commentary provided only on architectural visual proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. F)
T13-0011	Exhibit A Appendix13 13.2.3 (b)(v)	The Viaducts, including the girder and parapet geometry and edges must be designed to minimise and control the potential for staining or streaking of the concrete surfaces.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on design elements / approach which mitigate staining. Technical and dimensional requirements are as set out in the engineering drawings and reports.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B), 7.0 A)
T13-0012	Exhibit A Appendix13 13.2.3 (b)(vi)	The Viaducts must incorporate a solid precast concrete parapet containing recesses as identified in Appendix 17.The Viaduct parapets must: A. incorporate a downstand designed to prevent seeping and staining of the concrete surfaces of the Viaduct; B. have a top surface that angles inwards towards the Viaduct deck to channel rainwater onto the deck and minimise staining of the outside face of the parapet; and C. not have curved faces.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on design elements / approach which mitigate staining. Technical and dimensional requirements are as set out in the engineering drawings and reports.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B), Section 7, A)
T13-0013	Exhibit A Appendix13 13.2.3 (b)(vii)	Precast concrete box girder segment joints must be expressed to create a consistent and regular jointing pattern. Segment joints must be formed by a recess of at least 20mm x 20mm.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)

T13-0014	Exhibit A Appendix13 13.2.3 (b)(viii)	Parapet joints must be aligned with the precast concrete box girder segment joints.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)
T13-0015	Exhibit A Appendix 13 13.2.3 (b)(ix)	Any recesses in the top flange of the girder for Viaduct deck drainage must not be visible from the underside of the Viaduct.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)
T13-0016	Exhibit A Appendix 13 13.2.3 (b)(x)	No fittings or fixtures may be mounted on the underside of the Viaducts.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)
T13-0017	Exhibit A Appendix 13 13.2.3 (b)(xi)	No services hatches may be incorporated into the underside of the Viaducts.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)
T13-0018	Exhibit A Appendix13 13.2.3 (c)(i)	A single pier must be used at each support location. Split piers must not be used to support the Viaduct structure.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)

T13-0019	Exhibit A Appendix13 13.2.3 (c)(ii)	Visible or expressed headstocks must not be used in the Viaduct structure.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)
T13-0020	Exhibit A Appendix13 13.2.3 (c)(iii)	The maximum height of the bearing zone at all piers must be 350mm, and must be a constant height at all piers throughout the full length of the Viaduct.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)
T13-0021	Exhibit A Appendix13 13.2.3 (c)(iv)	The pier design must be proportionally elegant considering the varying heights of piers from the adjacent finished surface levels to the underside of the Viaduct girders.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)
T13-0022	Exhibit A Appendix 13 13.2.3 (c)(v)	Any service conduits and stormwater pipes must be fully cast into the piers and not mounted or exposed on the external surfaces of the piers.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)
T13-0023	Exhibit A Appendix 13 13.2.3 (c)(vi)	No fittings or fixtures may be mounted on the surfaces of the piers.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)

T13-0024	Exhibit A Appendix 13 13.2.3 (c)(vii)	No services hatches may be incorporated into the visible surfaces of the piers.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)
T13-0025	13.2.3 (c)(viii)	Access to pipework in piers must be from above the pier bearing support surface and from below existing ground level.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)
T13-0026	Exhibit A Appendix13 13.2.4 (a)	The Station Platforms must be concrete and provide a consistent finish with the Viaducts, including the alignment of any joints with the Viaduct precast concrete box girder segment joints.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. D)
T13-0027	Exhibit A Appendix13 13.2.4 (b)	Station Platforms must be structurally supported from the Viaduct structure. Support for the Station Platforms from the Viaduct structure may be concrete or structural steel.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. D)
T13-0028	Exhibit A Appendix13 13.2.4 (c)	The Station Platforms, including the platform geometry and edges must be designed to minimise and control the potential for staining or streaking of the concrete surfaces.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. D)

T13-0029	Exhibit A Appendix13 13.2.5 (a)	Chamfers on all visible faces of the Viaduct structure must be no larger than 20mm by 20mm.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. B)
T13-0030	Exhibit A Appendix 13 13.2.5 (b) (i)	The vermin protection and anti-bird requirements identified in Appendix 17 to the Scope of Works and Technical Criteria must not be fixed to the face of the piers and abutments.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 7.0. A), B)
T13-0031	Exhibit A Appendix13 13.2.5 (b) (ii)	The vermin protection and anti-bird requirements identified in Appendix 17 to the Scope of Works and Technical Criteria must not project outside the face of the piers and abutments.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 7.0. A), B)
T13-0032	Exhibit A Appendix13 13.2.5 (b) (iii)	The vermin protection and anti-bird requirements identified in Appendix 17 to the Scope of Works and Technical Criteria must have concealed fixings.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 7.0. A), B)
T13-0033	Exhibit A Appendix13 13.2.5 (b) (iv)	The vermin protection and anti-bird requirements identified in Appendix 17 to the Scope of Works and Technical Criteria must be removable and easily replaced.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 7.0. A), B)

T13-0034	Exhibit A Appendix13 13.2.5 (b) (v)	The vermin protection and anti-bird requirements identified in Appendix 17 to the Scope of Works and Technical Criteria must be durable and not visibly degrade during the Design Life of the vermin protection and anti-bird requirements.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 7.0. A), B)
T13-0036	Exhibit A Appendix13 13.2.6 (a) (ii)	Any textured finishes must be achieved through the pre-casting process and be uniform in appearance.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 7.0. A), B)
T13-0039	Exhibit A Appendix13 13.2.6 (b) (iii)	The visible Viaduct concrete elements must be uniform in colour over the full length of the Viaducts.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 7.0. A), B)
T13-0042	Exhibit A Appendix13 13.2.7 (a)	Abutments must be designed to visually integrate the Viaducts within their landscape context (the landscape context being as described in Chapter 6 of the environmental impact statement prepared in relation to Project Planning Approval 2).	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. E)
T13-0043	Exhibit A Appendix13 13.2.7 (b)	Abutments must be designed as simple and symmetrical forms.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. E)

T13-0044	Exhibit A Appendix13 13.2.7 (c)	Spill through abutments must not be used.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. E)
T13-0045	Exhibit A Appendix13 13.2.7 (d)	Abutments must be designed to achieve the visual and architectural outcomes described in Figure 13.1. Figure 13.1 – Main Abutment Walls	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. E)
T13-0046	Exhibit A Appendix13 13.2.7 (f)	Abutment headwalls must integrate with the Viaduct shape and be articulated to create a solid visual termination point for the Viaducts.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. E)
T13-0047	Exhibit A Appendix13 13.2.7 (g)	Abutment headwalls must not be plain or flat faced over the full width of the headwall.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. E)
T13-0048	Exhibit A Appendix13 13.2.7 (h)	Abutment return walls must be vertical and parallel with the Track Formation Control Line, and must return a minimum of 6m from the face of the abutment curtain wall as identified and defined on drawing NWRL-10013-60-SWD-DRG-CI-32233.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. E)

T13-0049	Exhibit A Appendix13 13.2.7 (i)	Abutment parapets must extend beyond the front face of the abutment curtain wall by at least 30m as identified and defined on drawing NWRL-10013-60-SWD-DRG-CI-32233 and drawing NWRL-10013-60-SWD-DRG-BRG-32241.The width of the front face of the abutment must align with the width of the Viaduct's superstructure.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct Formation and Walls	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. E)
T13-0050	Exhibit A Appendix13 13.2.7 (j)	All elements of the abutments must be integrated as part of a holistic design.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion and scale. All dimensional and technical requirements covered by SMEC.	Viaduct	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 3.0. E)
T13-0052	Exhibit A Appendix13 13.3 (b)	The design of Overbridges must present smooth, clean lines and have a minimum structural depth that is consistent with their spans and method of construction.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, scale and visual aesthetics between key interface areas with Retaining wall structures. All dimensional and technical requirements covered by URS. Standard RMS bridge types used.	Overbridges	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)
T13-0053	Exhibit A Appendix13 13.3 (c)	Overbridges must be designed as holistic, coherent and symmetrical structures considering the proportion of all elements of the structure including any parapets, barriers, fencing, safety screens and other critical elements.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, scale and visual aesthetics between key interface areas with Retaining wall structures. All dimensional and technical requirements covered by URS. Standard RMS bridge types used.	Overbridges	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)

T13-0056	Exhibit A Appendix13 13.3 (f)	The junction between Overbridges and adjacent retaining walls must establish a clear separation from, or integration with, the bridge girder.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, scale and visual aesthetics between key interface areas with Retaining wall structures. All dimensional and technical requirements covered by URS. Standard RMS bridge types used.	Overbridges Formation and Walls	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)
T13-0057	Exhibit A Appendix13 13.3 (g) (i)	Overbridge parapets must be elegant and attractive with neat, evenly spaced joints, smooth even lines and consistent high quality surfaces and colour.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, scale and visual aesthetics between key interface areas with Retaining wall structures. All dimensional and technical requirements covered by URS. Standard RMS bridge types used.	Overbridges Formation and Walls	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)
T13-0058	Exhibit A Appendix13 13.3 (g) (ii)	Overbridge parapets must extend parallel to the centreline of the Overbridge for the full length of the Overbridge.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, scale and visual aesthetics between key interface areas with Retaining wall structures. All dimensional and technical requirements covered by URS. Standard RMS bridge types used.	Overbridges Formation and Walls	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)

T13-0059	Exhibit A Appendix13 13.3 (g) (iii)	Overbridge parapets must extend at least 6m beyond the face of the abutments.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, scale and visual aesthetics between key interface areas with Retaining wall structures. All dimensional and technical requirements covered by URS. Standard RMS bridge types used.	Overbridges Formation and Walls	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)
T13-0060	Exhibit A Appendix13 13.3 (g) (iv)	Overbridge parapets must have outside faces angled to catch the sunlight, such that the bottom of the parapet is furthest from the centreline of the bridge.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, scale and visual aesthetics between key interface areas with Retaining wall structures. All dimensional and technical requirements covered by URS. Standard RMS bridge types used.	Overbridges Formation and Walls	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)
T13-0061	Exhibit A Appendix13 13.3 (g) (v)	Overbridge parapets must have a top surface that angles towards the road to channel rainwater onto the Overbridge and minimise staining of the outside face of the parapet.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, scale and visual aesthetics between key interface areas with Retaining wall structures. All dimensional and technical requirements covered by URS. Standard RMS bridge types used.	Overbridges Formation and Walls	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)

T13-0069	Exhibit A Appendix13 13.3 (l)	Overbridge abutments must be designed such that they are easily maintainable and do not promote vandalism or graffiti. Methods of providing safe access for maintenance activities must be integrated into the overall design of the bridge.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, scale and visual aesthetics between key interface areas with Retaining wall structures. All dimensional and technical requirements covered by URS. Standard RMS bridge types used.	Overbridges	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)
T13-0071	Exhibit A Appendix13 13.3 (n)	The appearance of concrete retaining structures associated with Overbridges must have a strong horizontal visual emphasis	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, scale and visual aesthetics between key interface areas with Retaining wall structures. All dimensional and technical requirements covered by URS. Standard RMS bridge types used.	Overbridges Formation and Walls	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)
T13-0073	Exhibit A Appendix13 13.4 (c)	Retaining structures must be designed to be cohesive and unified with adjacent and associated elements including the Viaducts, Station Platforms, landscape works and other retaining structures.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, articulation and scale. All dimensional and technical requirements covered by SMEC	Formation and Walls	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)
T13-0076	Exhibit A Appendix13 13.4 (f)	All retaining structures must be capped with a concrete capping beam 500mm wide x 500mm deep, which must project at least 75mm beyond the face of the retaining structure. Concrete capping beams must be integrated with the abutment parapets to create a strong horizontal visual emphasis. Joints in the capping beam must align with the vertical joints in the retaining structure.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, articulation and scale. All dimensional and technical requirements covered by SMEC	Formation and Walls	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)

T13-0077	Exhibit A Appendix13 13.4 (g)	Retaining structures and capping beams must be designed and constructed with common materials, finishes, proportions and detailing.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, articulation and scale. All dimensional and technical requirements covered by SMEC	Formation and Walls	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)
T13-0078	Exhibit A Appendix13 13.4 (h)	Retaining structures must be designed and constructed to prevent water draining down the outer face of the retaining structure, and must be detailed to prevent staining.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, articulation and scale. All dimensional and technical requirements covered by SMEC	Formation and Walls	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)
T13-0081	Exhibit A Appendix13 13.4 (k)	All finished surfaces on all retaining structures must have an inscribed horizontal and vertical joint arrangement that: (i) incorporates and expresses horizontal construction joints; (ii) has a modular arrangement over the full face of the structure; and (iii) aligns with any other adjacent modular elements including capping beam jointing and Overbridge elements.	Applied	Technical	Design	Urban & Architectural	Urban & Architectural Design Report. DI commentary provided only on architectural visual aesthetics, proportion, articulation and scale. All dimensional and technical requirements covered by SMEC	Formation and Walls	DI	Anthony Quan	Review	Open	NWRLSVC-IDI-SVC-UD-DTR-809000. Section 6.0. A)

C) APPENDIX C - Urban and Architectural Design Drawings (Package Lot 80)

NWRLSVC-IDI-SVC-UD-DRG-800001 - Context / Locality Plan

NWRLSVC-IDI-SVC-UD-DRG-801001 - Bella Vista to Rouse Hill Viaduct - Abutment A (Bella Vista)

NWRLSVC-IDI-SVC-UD-DRG-801002 - Bella Vista to Rouse Hill Viaduct - Abutment B (Windsor Road)

NWRLSVC-IDI-SVC-UD-DRG-801003 - Second Pond's Creek - Abutment A

NWRLSVC-IDI-SVC-UD-DRG-801004 - Second Pond's Creek - Abutment B

NWRLSVC-IDI-SVC-UD-DRG-802000 - Typical Wall Details Precast Retaining Wall, Soil Nail (Shotcrete) Wall

NWRLSVC-IDI-SVC-UD-DRG-802001 - Precast Retaining Wall RW1U (EAST) & RW1D (WEST) Elevation - Bella Vista to Rouse Hill Viaduct Abutment A

NWRLSVC-IDI-SVC-UD-DRG-802002 - Precast Retaining Wall RW-2U (NORTH) & RW-2D (SOUTH) Elevation - Windsor Road Abutment B

NWRLSVC-IDI-SVC-UD-DRG-802003 - Precast Retaining Wall RW-3D (SOUTH) Elevation - Second Ponds Creek Abutment A

NWRLSVC-IDI-SVC-UD-DRG-802004 - Precast Retaining Wall RW-3U (NORTH) Elevation - Second Ponds Creek Abutment A

NWRLSVC-IDI-SVC-UD-DRG-802005 - Precast Retaining Wall RW-4U (NORTH) & RW-4D (SOUTH) Elevation - Second Ponds Creek Abutment B

NWRLSVC-IDI-SVC-UR-DRG-803001 - Soil Nail (Shotcrete) Wall CW1D Elevation 1 of 2

NWRLSVC-IDI-SVC-UD-DRG-803002 - Soil Nail (Shotcrete) Wall CW1D Elevation 2 of 2

NWRLSVC-IDI-SVC-UD-DRG-803003 - Soil Nail (Shotcrete) Wall CW1U Elevation 1 of 2

NWRLSVC-IDI-SVC-UD-DRG-803004 - Soil Nail (Shotcrete) Wall CW1U Elevation 2 of 2

NWRLSVC-IDI-SVC-UD-DRG-803005 - Soil Nail (Shotcrete) Wall CW2U Elevation

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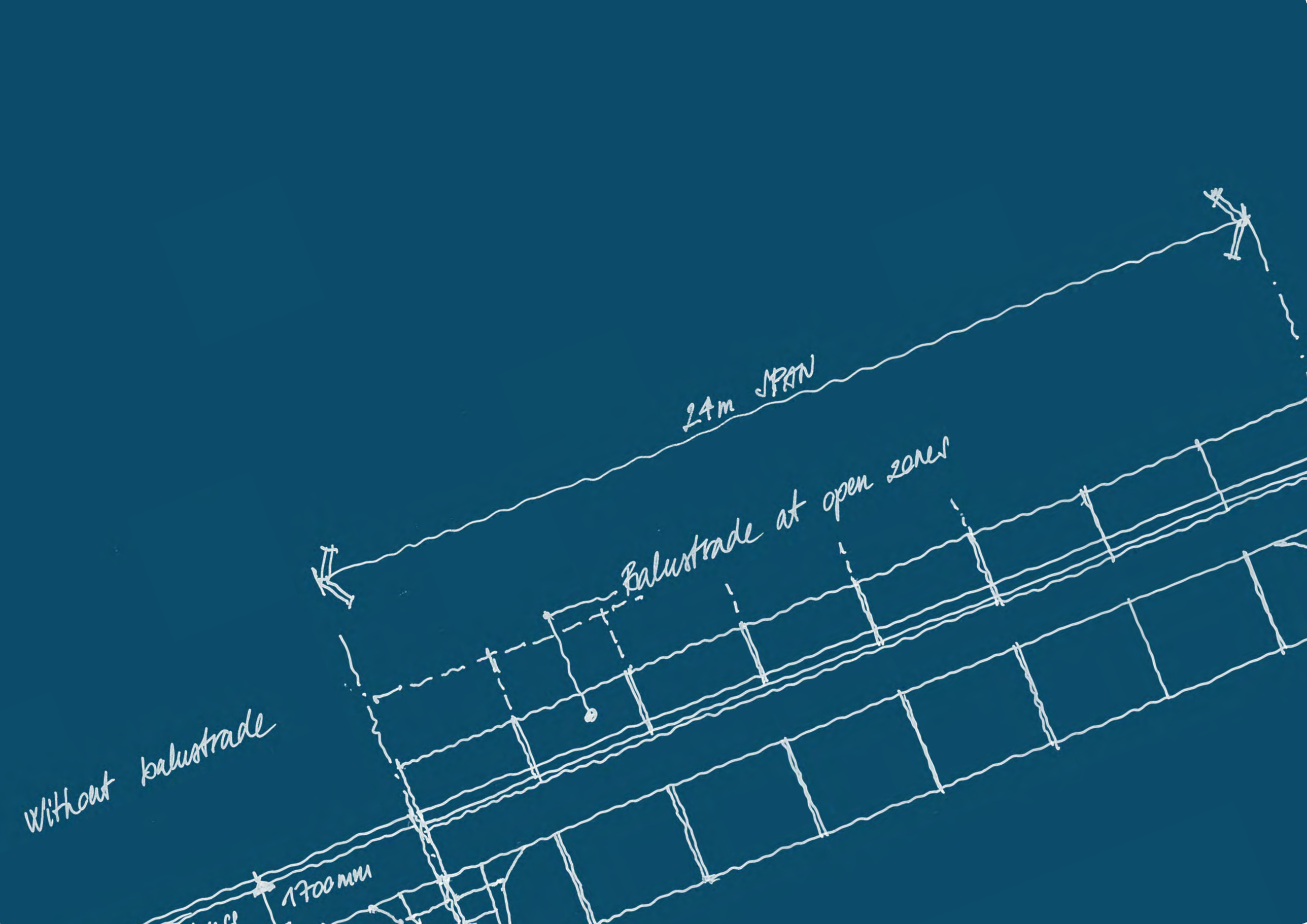
24m SPAN
Balustrade at open zones
Without balustrade
1700mm

Appendix B. **Landscaping Design Plan**

NORTH WEST RAIL LINK

SURFACE AND VIADUCT CIVIL WORKS

Urban Design and Landscape Plan (Appendix - Landscape)

Prepared for	Transport for NSW (TfNSW)
Submitted by	TURF DESIGN STUDIO (TDS)
Date	29 August 2014
Doc. No.	**NWRLSVC-ITF-SVC-LA-DRT-000001**
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CONTENTS

Document Control

Revision	Date	Author	Checker	Verifier
DRAFT	29/08/14	Matt Coggan / Scott Ibbotson	Scott Ibbotson	Mike Horne

1.0 Introduction

The North West Rail Link (NWRL) will deliver a new high frequency single deck train system to Sydney's North West; initially operating as a shuttle between Cudgegong Road and Chatswood. The project includes 8 new stations, approximately 15.5 kilometres of tunnels from Epping to Bella Vista, a 4.5 kilometre elevated 'skytrain' (viaduct) between Bella Vista and Rouse Hill, and conversion of the Epping to Chatswood Rail Link to deliver high frequency rapid transit services.

TfNSW is constructing the NWRL under three main contracts; the second of which encompasses the Surface and Viaduct Civil (SVC) Project Works.

The planning and design of the NWRL softworks has been contracted to Turf Design Studio (TDS) by ISJV. TDS are an experienced Urban Design and Landscape Architectural company with substantial experience in the design and implementation of rail transport projects.

Softworks components are defined by the proposed track alignment which requires a range of treatments as it passes through a range of natural and modified landscapes.

Treatments are required to conform to the approved project Deed of Agreement "Exhibit A - SWTC - Appendix 13 - Architecture, Urban Design and Landscape Performance and Design Requirements". However, the treatments recommended herein seek to both meet the requirements of the Deed, and incorporate more detailed and resolved information as the design evolves. Where deviations from approved Deed are incorporated within the design, these are identified and the deviation substantiated.

It should be noted that the current stage under which TDS is engaged is early in the development of the NWRL development corridor, and the landscape treatments outlined within the Project Deed are substantially temporary in nature. The resultant recommendations are therefore tailored to provide appropriate finishes for the short term ensuring capital outlay is comparable to the proposed design life.

2.0 Design parameters

2.1 Design standards

The design standards used in the development of the landscape design are as follows:

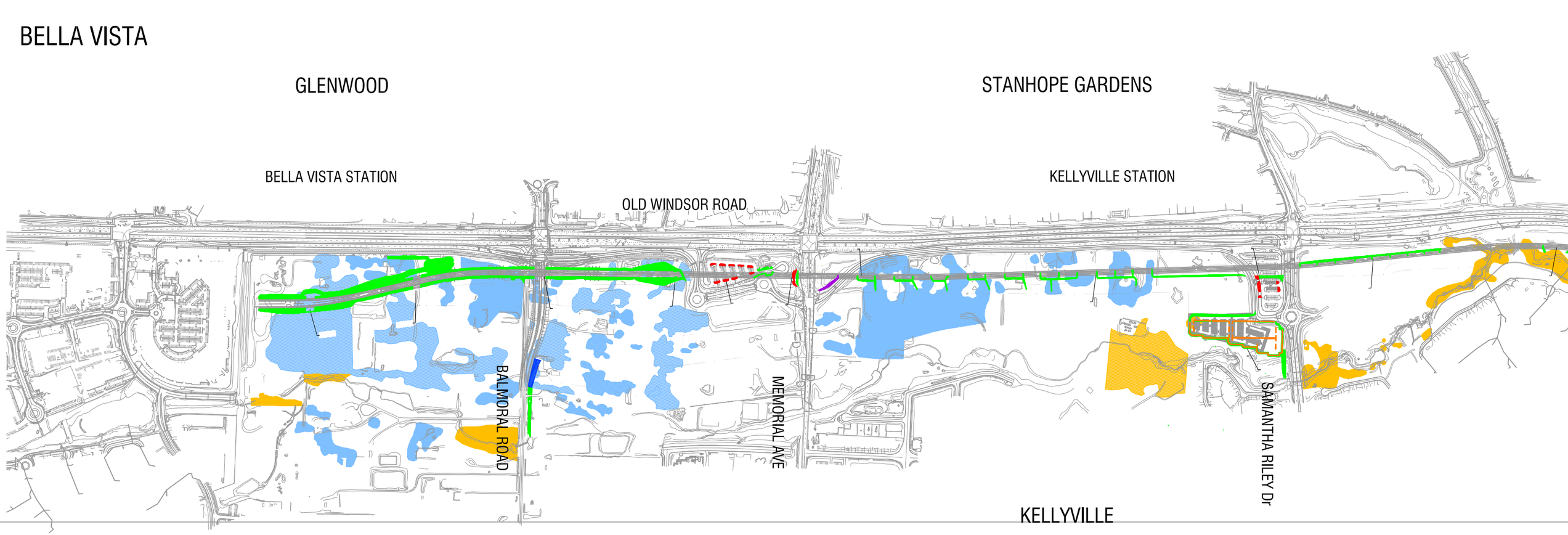
- Project Specification ISJV R178
- Project Specification ISJV R179 Landscape Planting
- RTA Landscape Guideline, April 2008.
- EMS-09-GD-0074-Revegetation Guide
- EMS-09-TP-0063-BiodiversityManagementPlan
- EMS-09-TP-0066-Revegetation Technical Specification
- Vegetation Management in the Rail Corridor' document EMS-09-GD-0067
- 7TP-ST-114 Sustainable Design Guidelines
- TfNSW NSW Sustainable Design Guidelines For Rail V2.0
- AS 4970 - Protection of trees on development sites
- AS 4373 - Pruning of Amenity Trees
- AS 4419 - Soils for landscaping and garden use
- AS 4454 - Compost, soil conditioners and mulches
- TfNSW's Vegetation Offset Guideline

2.2 SWTC documents

The design of the landscaping for the SVC works has been carried out to meet the requirements of the project documentation listed below and is in accordance with relevant design standards, specifications and guidelines.

- C_GEN-NWRLSVC-ISJ-ISJ-C_GEN-000229-Abutment Drawings
- C_GEN-NWRLSVC-ISJ-ISJ-C_GEN-000229-Appendix 5.1
- C_GEN-NWRLSVC-ISJ-ISJ-C_GEN-000229-Appendix 30 Figures 2
- C_GEN-NWRLSVC-ISJ-ISJ-C_GEN-000229-Appendix 30-Table 30.1 Figures
- C_GEN-NWRLSVC-ISJ-ISJ-C_GEN-000229-Eathworks
- C_GEN-NWRLSVC-ISJ-ISJ-C_GEN-000229-Exhibit A - Appendix 05 - Handover Works rev 2.2
- C_GEN-NWRLSVC-ISJ-ISJ-C_GEN-000229-Exhibit A - Appendix 10 - Sustainability Requirements_Rev 2.2
- C_GEN-NWRLSVC-ISJ-ISJ-C_GEN-000229-Exhibit A - Appendix 13 - Rev 2.1

ANNEXURE - LANDSCAPE



LEGEND

PROPOSED LANDSCAPE WORKS

- STABILISATION
- RESTORATION
- PERMANENT
- BIOSWALE
- LOMANDRA LONGIFOLIA

EXISTING WOODLAND / FOREST

- CUMBERLAND PLAIN WOODLAND
- RIVER FLAT EUCALYPT FOREST

3.0 Sustainability

The proposed landscape treatments have been prepared under review of “TfNSW NSW Sustainable Design Guidelines for Rail V2.0”.

Reduction of waste to landfill is supported by the retention of existing trees and pavements, and the re-use of site topsoils wherever possible. Trees to be removed are to be chipped on site and re-used as garden area mulch or taken to a recycling depot for use as green waste products.

Protection from extreme weather is supported through the retention of trees where possible, plus the inclusion of additional tree planting within any specified permanent works. Tree cover will provide summer shade, mitigating solar radiation exposure.

The choice of plant material has sought to maximize ecological values in tandem with ensuring robustness and resilience of the landscape against the local climate and potential antisocial behavior. Temporary works such as hydroseeding has incorporated indigenous plant material along with sterile exotic grasses. The incorporation of indigenous seed will bolster local biodiversity, provide food forage for native fauna, and self seed ensuring resilience of landscape works. Furthermore, the incorporation of perennial native species will afford the opportunity of future retention should this be desirable and consistent with future works.

The density of seeding / planting has been set to assist rapid establishment of full foliage cover to minimize the encroachment of weed species.

Water efficiency has been incorporated through the use of low water use species suited to the local climate not requiring supplementary watering beyond establishment.

4.0 Existing vegetation management

The removal and retention of trees within the construction footprint has been surveyed and assessed and recommendations made within the Biosis Construction Flora and Fauna Management Plan (CFFMP) Revision 6, 6 August 2014.

The nominated trees, and all vegetation to be retained, is to be protected from development impact in accordance with Sydney Train’s ‘Vegetation Management in the Rail Corridor’ document EMS-09-GD-0067.

Protective temporary fencing is to be provided during construction phases (locations to be defined during detailed design). Contractors / sub-contractors are to be made aware of protection requirements during site inductions, toolbox meetings, and through area signage. Protection fencing will be 1.8m steel mesh fence secured by concrete blocks and covered in shade cloth. Access to protection zones will only be provided under the supervision of a nominated project Arborist. Regular inspections and maintenance of tree protection zones will be undertaken. Where existing trees require pruning this will comply with AS4373 Pruning of Amenity Trees.

Protective measures for existing vegetation will include:

Minimising machinery movement over and disturbance to seeded and vegetated surfaces and surfaces adjacent to existing trees;

- Keeping deleterious material including oil, petrol, cement, bitumen, spillage from washing operations and similar contaminants clear of trees, shrubs and grass including their root systems;
- No stockpiling of materials over root systems;

- Avoiding damage to overhead tree canopies by machine or truck operations; and
- Protection fencing - 1.8m steel mesh fence secured by concrete blocks and covered in shade cloth.

Planting work and methods will be organised so as to minimise damage to surface vegetative work already completed under the deed.

5.0 Weed management

Where weed infestation occurs, the following action is to be taken before clearing planting areas:

1. For those species listed by the relevant local government authority as noxious the contractor is to take action as required by current Noxious Weeds Act, and the local government authority,

2. For all other species, spray with herbicide, and

3. Topsoil re-use stockpiles are to be treated to continually suppress weed species to minimise infestation within newly planted landscapes.

A weed management plan is to be prepared by the contractor, and approved by TFNSW. It is to stipulate control and monitoring actions to be undertaken throughout the entire construction period.

6.0 Site soil use and management

In all areas of the Construction Site where the existing vegetation and landscape is disturbed by SVC construction activities, topsoil is to be stripped and stored for reuse in the landscape works. The contractor is to strip enough topsoil to account for the specified soil depth requirements.

Soil pedology survey and analysis of topsoil stripped shall be undertaken from each soil landscape and vegetation community type within the Construction Site. Topsoil testing is to be undertaken by a National Association of Testing Authorities (NATA) registered laboratory and include

pH, salinity, cation exchange capacity, plant available phosphorous, total organic matter, total nitrogen and carbon / nitrogen.

Topsoil testing and any improvement recommendations are to be made by an appropriately qualified professional soil scientist with expertise in re-vegetation.

Testing shall review appropriateness of site topsoil for re-use for each proposed landscape treatment.

A copy of these recommendations is to be provided TfNSW and nominated representatives for review.

All topsoils will be conditioned or improved if required to comply with recommendations in the topsoil report by the soil scientist.

Prior to the placement of topsoil ensure no weeds are present, and they have been continuously suppressed.

Prior to placing topsoil sub-grade surfaces are to be ripped / cultivated to a depth of 300mm immediately prior to spreading of topsoil.

Conditioned topsoil is to be placed to a minimum depth of:

- 400mm for planting beds (restoration areas and permanent landscape treatments); and
- 200mm for turf areas and stabilisation treatments.

Any topsoil used is to be of an appropriate quality / structure / mineralogy / chemically to support healthy growth of the documented plant species.

7.0 Landscape treatments

The approach for revegetation and new landscape in all areas of the construction site is broadly categorised into 5 treatments:

1. Stabilisation;
2. Restoration;
3. Permanent;
4. Bioswale;
5. Riparian corridors; and
6. Embankments and cuttings.

7.1 Stabilisation

Existing vegetation and landscape that is disturbed, and does not require restoration or permanent landscape treatments, will be stabilised in accordance with the requirements of the Construction Environmental Management Plan and the RTA Landscape guideline: ‘Landscape design and maintenance guidelines to improve the quality, safety and cost effectiveness of road corridor planting and seeding’ for cover crops. Cover crops will be as specified below, and will be installed in accordance with the application rate and sowing season requirements identified in Table 11 in the above mentioned RTA Landscape guideline.

Hydroseed will be applied after subgrade and topsoil has been prepared / installed.

Hydroseed with a 50/50 mixture of indigenous species and exotic sterile grasses, at the application rates per hectare shown below.

Genus species	*Sowing rate*	*Percentage*
Bothriochloa macra	10kg/ha	10%
Themeda australis	90kg/ha	15%
Microlaena stipoides	30kg/ha	5%
Capillipedium spicigerum	12kg/ha	5%
Poa labillardieri	3kg/ha	15%
Japanese Millet / Rye Corn - season dependent. Fertilizer: Dyna Pellets at 250kg/ha. Binder: Hydromulch Tackifier at 10kg/ha.		50%

As previously outlined under section 3.1 sustainability, the above hydroseed mixture incorporates indigenous plant material with sterile exotic grasses. Sterile exotic grasses will establish rapidly and assist with stabilistation in the short term. The indigenous plant material will be slower to germinate, but, over time, will self colonise through self seeding ensuring longer term resilience of the landscape. Additionally, the establishment of indigenous groundcover will offer opportunity for future retention should future designs deem it an appropriate treatment.

In the procurement of Hydroseed, seed material is not to be delivered more than 7 days prior to sowing. The seed is to be stored in clean, air tight containers in a dry dark place. The seed is to be pre treated by soaking in hot water or scarification on the day of use, prior to use in hydroseed mixtures.

The mulch used in Hydroseeding shall consist of straw, chaff, wood fibre, paper pulp or similar material finely shredded to a maximum dimension of 10mm, at the rate

of 1500kg/Ha (dry weight). Paper mulch shall not exceed 50% by mass, and be free of seeds, weeds, or other plant species not specified for use in the planting.

To assist establishment a wetting agent is to be used equal to ‘Aquasoil’ at a rate of 35ltr/Ha.

Hydroseed ingredients are to be mixed together in water at a rate of 35,000 ltr/Ha and the mixture applied uniformly over the surface.

Hydroseed must not be applied when temperatures are greater than 35 degrees C, when winds exceed 15km’s/hr, during rain or when rain is imminent. Dry surfaces are to be watered prior to installation of hydroseed. Times and climatic conditions during application are to be recorded by the contractor and submitted to TFNSW for review.

The contractor must maintain hydroseeded areas in accordance with the specified maintenance requirements giving additional attention as needed to ensure successful germination and throughout the critical first weeks to ensure vigorous healthy plant growth is achieved.

The mulch layer must be kept moist until full seed germination and establishment of young roots into the topsoil layer.

Works are recommended to be undertaken during cooler months to minimise watering maintenance and assist establishment.

Sprayed areas are to be fenced to prevent vehicle or pedestrian access until well established.

7.2 Restoration

Where the existing vegetation and landscape is disturbed by SVC construction activities, the vegetation and landscape will be restored to a condition equivalent to the condition at the date of the deed.

Restoration landscapes will incorporate groundworks, including; shaping, subsoil and topsoil treatments. New tree, shrub and groundcover planting, and turfing works.

Areas requiring restoration treatment within the deed:

Burns Road T-Way Car Park
(Areas ‘B8’, ‘B9’, ‘B10’, ‘B12’, ‘B14’)

Existing planted traffic island - Burns Road T-Way Car Park

Adjustments to the existing car park include reconfiguration of planted traffic islands throughout. The existing vegetation is comprised of native grasses and small shrubs in the understorey (including Grevillea and Lomandra species), and tall slender-trunked Eucalypt trees pruned above human head height.

This native palette will be adopted for restoration planting, ensuring appropriate species are selected to maintain sight lines for cars and pedestrians. New tree planting will not be proposed within 6m of the viaduct to prevent ongoing maintenance issues.

Installation of Pier 7, immediately north of Burns Rd T-Way Car Park, requires diversion of an existing pathway that runs parallel with Memorial Ave. The area of redundant path will become part of the roadside verge, which is currently sparsely planted with Agapanthus. To augment native planting and complement the Burns T-Way Car Park landscape character this area will be restored with native grasses. Trees are not proposed here due to close proximity of the viaduct. The path diversion will also require reinstatement of lawn to the south side of path, to match existing.

Existing lawn, pathway and planting adjacent Memorial Drive, looking west

Existing lawn and planting adjacent Memorial Drive, looking south

Cnr Memorial Ave and Old Windsor Road
(Areas 'C1', 'C2', 'C4', 'C5', 'C6', 'C7','C11')
Located on the north side of Memorial Ave, this area will be restored consistent with proposed restoration on the south side (Burns Road T-Way Car Park); ensuring continuity in the streetscape character.

Sanctuary Drive and Picket Place
(Areas 'G1', 'G3', 'G4', 'G5', 'G13', 'G14')
This area of the corridor is the gateway to Rouse Hill Town Centre. Feature bands of lavender plantings mark the corner of Sanctuary Drive and Windsor Road. The proposed viaduct passes directly over a portion of this planting area, and some disturbance to the existing planting will result. All planting disturbed in this area will be restored to it's current condition.

Rouse Hill gateway, lavender feature planting, looking west

The new track alignment requires slight modification to the existing Picket Place cul-de-sac, resulting in an area of redundant roadway in close proximity to proposed pier 87. In accord with the Deed, the redundant roadway area will be given Stabilisation treatment (refer 4.1), and the remaining areas will be re-turfed to match existing.

Picket Place cul-de-sac pathway connection to Windsor Rd, looking west

White Hart Drive
(Areas 'G10','H1')
Existing vegetation either side of White Hart Drive will be restored with a mix of shade tolerant native grasses including Dianella spp. following construction of the viaduct. These restoration areas are located directly under the viaduct structure. Therefore, the existing trees will be removed and will not be replaced.

South side of White Hart Drive, looking south

North side of White Hart Drive, looking north

7.3 Permanent

The selection of plant species within the permanent landscape areas has been carefully considered so as to relate to the local environment and existing landscape condition. In doing this, the local environment will benefit in both the long and short term, and the result will ensure a cohesive landscape aesthetic.

Over time the visual quality will increase providing rich and diverse planting. All plant species recommended are commonly used in major road and rail transport corridors throughout the Sydney region, and are chosen for their hardiness, resiliency and low maintenance requirements.

Areas requiring permanent landscape treatment within the deed:

Balmoral Road
(Areas 'A7' to 'A12')
A diverse mix of native trees, shrubs and groundcovers is proposed to augment existing native trees. Informal groupings of trees and an even mix of understorey species are proposed to mimic the existing informal, open woodland character. Proposed trees are adequately offset from roadway and driveway to ensure safe sight distances are maintained.

Balmoral Rd, looking west

Windsor Road Single Span Bridge
(Areas 'J3', 'J5', 'J7', 'J9', 'J11' and 'J13')
Landscaping to Windsor Rd at the single span bridge will continue and enhance the existing native landscape character. A robust, low maintenance species mix in the central verge is particularly important in order to minimise the time maintenance teams are required to work within the busy roadway. New tree planting will be offset a minimum of 6m from the new bridge.

Windsor Rd single span bridge location, looking south

Within the permanent landscaping areas:

- All groundcovers and grasses will be planted at a density of 6 plants/m2 and have a minimum 150mm diameter container size.
- All shrubs will be planted at a density of 4 plants/m2 and have a minimum 150mm diameter container size.
- All trees will have a minimum container size of 400 litres.

All permanent landscape treatments will:

- Be in accordance with "RTA Landscape Guideline: Landscape design and maintenance guidelines to improve the quality, safety and cost effectiveness of road corridor planting and seeding";
- Maximise the retention of existing vegetation (including root and above-ground plant mass);
- Ensure road safe sight distances are maintained and road signage is not obscured by planting; and
- Provide setbacks from planting to adjacent structures, roadside and other furniture and pathways to enable clear access for maintenance and visual inspections when landscape matures.

7.4 Bioswale

Bioswales occur along the rail corridor to intercept and polish water prior to delivery into adjacent creeklines and stormwater systems.

Further to engineering measures such as rock spalls at point source outlets the landscape proposal will provide an additional overlay of stabilsation measures coupled with biofiltration. Erosion control will be provided through the inclusion of jute mesh to all bio swale surfaces. Where bio swales pass through lawn 38mm(w) x 100mm(h) seasoned hardwood timber edging will be provided to prevent lawn encroachment. A robust species mix appropriate for western Sydney has been selected. The mix incorporates rhizomatous plant species to quickly colonise and stabilize soils, and quickly repair should damage occur. Species selected are suitable for both dry and moist conditions as typically experienced in bioswales.

All potted plant species will be planted at a density of 9 plants/m2 and have a minimum 45mm sq x 120mm deep (Forestry tube) container size.

Genus species	Percentage
Carex appressa	20%
Isolepis nodosa 'Arida'	20%
Juncus usitatus	20%
Imperata cylindrica	20%
Capillipedium spicigerum	20%

7.5 Riparian corridors

Riparian corridors are to receive stabilisation and re-vegetation treatments in accord with ecologist findings within the Biosis Construction Flora and Fauna Management Plan (CFFMP) Revision 6, 6 August 2014. This report identifies that two Endangered Ecological Communities (ECC) exist within or adjacent to the construction footprint. These are:

- Cumberland Plain woodland, Shale Woodlands, and
- River Flat Eucalypt Forest on Coastal Floodplains.

Any re-vegetation works within the required Riparian Buffer Widths are to incorporate species from these two critically endangered vegetation communities.

7.6 Embankments and cuttings

Embankment and cutting slopes steeper than 1:3 are to be stabilised with jute webbing after the installation of topsoil, and planted with a range of species that have stabilising rhizomes such as *Imperata cylindrica*, and *Dianella spp*. The topsoil requirements of slopes greater than 1:3 differ

from those on flat ground. Topsoils on slopes are to be structurally stable for this application. Highly erosive and dispersive soils are not to be used on embankments and cuttings.

Prior to installation topsoils used for each embankment or cutting treatment are to be tested and approved for that use by an independent NATA approved soil testing lab. Test results are to certify that erosion potential is within an acceptable level.

8.0 Planting considerations, practice, establishment and maintenance

Large scale planting procedures are to be clearly articulated within documentation packages to ensure design, sourcing, and cost is translated into successful re-vegetation and permanent landscape treatments that provide climatic amelioration, amenity and biodiversity over the long term.

There are a number of factors that are required to be successfully resolved if a planting operation is to be successful. These are:

1. Suitable edaphic factors,
2. Suitable species selection,
3. Procurement of stock,
4. Installation skill and technique,
5. Establishment maintenance, and
6. Independent quality control.

Failure in any one these can result in a poor vegetation outcome.

Project specifications are to ensure that each item above is thoroughly researched and clearly outlined to ensure that the roles and responsibilities of each party are well understood.

Climatic conditions during planting and plant establishment can also have a substantial effect on the success of the planting. It is recommended that planting works are undertaken over the milder months of spring and autumn. Where this cannot be achieved it will be clearly specified within tender documentation that additional maintenance tasks to offset extreme heat and cold will be required to ensure successful establishment.

To assist establishment through soil temperature moderation, weed suppression, and moisture retention, 100mm of organic surface mulch is to be provided for all re-vegetation and permanent works.

The location of plant types is to take into account offsets from rail tracks and utilities. No tree or shrub with a mature height over 4 m will be planted within 6.0m of any Rail Line, or directly underneath any overhead utility such as power lines. Only low shrubs and ground covers will be planted within 6.0m of any Rail Line or within 2.0 metres of any Access Road. Only shrubs with a mature height under 4 metres will be planted under utilities.

Plant establishment maintenance will be undertaken as each planting area is completed for a period of 12 months.

Maintenance tasks will include all that is necessary to ensure healthy and enduring landscape treatments are handed over.

9.0 Design life and durability

The suggested landscape treatments are hardy and robust, and appropriate to the project brief where implemented to a satisfactory standard. The design life and durability of the landscape is substantially governed by the quality of construction workmanship. It is recommended that independent auditing be undertaken throughout the landscape construction phase to ensure quality is controlled. Once installed and maintained to a satisfactory level it is anticipated that landscape works will survive with minimal maintenance. Long term maintenance would remain focused on weed removal and replanting where required.

10.0 Appendices

A) RVTM Compliance Table

Requirements Verification Traceability Matrix (RVTM) for Landscaping														
Req-ID	**Section / Reference No.**	**Requirement Description**	**Status**	**Requirement Type**	**Technical Classification**	**System**	**Subsystem**	**Clarification**	**Interface**	**Owner**	**Design Verifier**	**Verification Method**	**Verification Status**	**Verification Evidence**
TM-0085	Exhibit A SWTC 5.3(b)	The architecture, urban design and landscape design of the Works must comply with the requirements of Appendix 13.	Applied	Technical	Design	Landscaping		Landscape compliance noted in Landscape Design Report for each Lot (Section 1: Introduction)		Matt Coggan	Scott Ibbotson	Review	Open	e.g. NWRLSVC-ITF-KSP-LA-DRT-247500 (refer all TURF design reports ending XX7500)
T13-0083	Exhibit A Appendix13 13.5.1	Landscape works includes stabilisation, restoration and permanent landscape treatments	Applied	Technical	Design	Landscaping		Landscape treatments documented as per Project Deed for each design lot. Additional treatment type has been identified to address specific planting requirements in Bioswales.		Matt Coggan	Scott Ibbotson	Review	Open	e.g. NWRLSVC-ITF-SVC-LA-DRT-157500 (refer all TURF design reports ending XX7500) - SECTION 3.1.5
T13-0084	Exhibit A Appendix13 13.5.2 (a)	All areas of the Construction Site where the existing vegetation and landscape is disturbed by the SVC Contractor's Activities, that do not require restoration or permanent landscape treatments as identified in sections 13.5.3 and 13.5.4 of this Appendix 13, must be re-vegetated in accordance with the requirements of the Construction Environmental Management Plan and `RTA Landscape guideline: Landscape design and maintenance guidelines to improve the quality, safety and cost effectiveness of road corridor planting and seeding' for cover crops.	Applied	Technical	Design	Landscaping				Matt Coggan	Scott Ibbotson	Review	Open	e.g. NWRLSVC-ITF-SVC-LA-DRT-157500 (refer all TURF design reports ending XX7500) - SECTION 3.1.5
T13-0085	Exhibit A Appendix13 13.5.2 (b)	Cover crops must be Japanese Millet or Rye Corn, and must be planted in accordance with the application rate and sowing season requirements identified in Table 11 in the RTA Landscape guideline: Landscape design and maintenance guidelines to improve the quality, safety and cost effectiveness of road corridor planting and seeding'.	Applied	Technical	Design	Landscaping		Species mix augmented to include 50% native grasses. Refer "1. Introduction" of Landscape Design Report for further information.		Matt Coggan	Scott Ibbotson	Review	Open	e.g. NWRLSVC-ITF-SVC-LA-DRT-157500 (refer all TURF design reports ending XX7500) - SECTION 3.1.5

Req-ID	Section / Reference No.	Requirement Description	Status	Requirement Type	Technical Classification	System	Subsystem	Clarification	Interface	Owner	Design Verifier	Verification Method	Verification Status	Verification Evidence
T13-0086	Exhibit A Appendix13 13.5.3	The SVC Contractor must, in all areas of the Construction Site identified in Table 13.1, where the existing vegetation and landscape is disturbed by the SVC Contractor's Activities, restore the vegetation and landscape to a condition equivalent to the condition at the date of the deed. Table 13.1 Restoration Areas Sheet No. / Areas to be restored (Restoration Areas are identified in Figure 2.1 in Appendix 2 to the Scope of Works and Technical Criteria) 1 Nil 2 Area 'B8', Area 'B9', Area 'B10', Area 'B12', Area 'B14' 3 Area 'C1', Area 'C2', Area 'C4', Area 'C5', Area 'C6', Area 'C7',Area 'C11' 4 Nil 5 Nil 6 Nil 7 Area 'G1', Area 'G3', Area 'G4', Area 'G5', Area 'G10', Area 'G13', Area 'G14' 8 Area 'H1', Area 'H14' 9 Nil 10 Nil		Technical	Design	Landscaping		Confirmation is required from TfNSW with regard to their expectations for Restoration. The Project Deed does not specify landscaping requirements for these areas.		Matt Coggan	Scott Ibbotson	Review	Open	

Req-ID	Section / Reference No.	Requirement Description	Status	Requirement Type	Technical Classification	System	Subsystem	Clarification	Interface	Owner	Design Verifier	Verification Method	Verification Status	Verification Evidence
T13-0088	Exhibit A Appendix13 13.5.4	Sheet No. Permanent Landscape Treatment Areas (Areas for Permanent landscape treatments are identified in Figure 2.1 in Appendix 2 to the Scope of Works and Technical Criteria) 1 Area ‘A7’, Area ‘A8’, Area ‘A9’, Area ‘A10’, Area ‘A11’, Area ‘A12’, Area ‘A15’, Area ‘A16’ 2 Nil 3 Nil 4 Nil 5 Nil 6 Nil 7 Nil 8 Area ‘H12’ 9 Area ‘J3’, Area ‘J5’, Area ‘J7’, Area ‘J9’, Area ‘J11’, Area ‘J13’, Area ‘J15’, Area ‘J16’, Area ‘J19’, Area ‘J20’ 10 Nil 11 to 15 Identifies the co-ordinates for the Areas identified in Figure 2.1 Sheets 1 to 10.	Applied	Technical	Design	Landscaping				Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRG-117109-A-GENERAL ARRANGEMENT - SHEET 9
T13-0089	Exhibit A Appendix13 13.5.4 (b) (i)	All permanent landscape treatments must be designed to reflect adjoining landscape and vegetation patterns identified in Chapter 6 and 15 of the environmental impact statement prepared in relation to Project Planning Approval 2.	Applied	Technical	Design	Landscaping				Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRG-117109-A-GENERAL ARRANGEMENT - SHEET 9 NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD
T13-0090	Exhibit A Appendix13 13.5.4 (b) (ii)	All permanent landscape treatments must for Areas ‘A7’ to ‘A12’ and Area ‘A15’ and Area ‘A16’ in Figure 2.1 in Appendix 2 to the Scope of Works and Technical Criteria, be consistent with the established planting palette and style of the adjacent portion of Old Windsor Road.	Applied	Technical	Design	Landscaping				Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRG-117109-A-GENERAL ARRANGEMENT - SHEET 9 NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD
T13-0091	Exhibit A Appendix13 13.5.4 (b) (iii)	All permanent landscape treatments must for Areas ‘H12’, ‘J3’, ‘J5’, ‘J7’, ‘J9’, ‘J11’, ‘J13’, ‘J15’, ‘J16’, ‘J19’ and ‘J20’ in Figure 2.1 in Appendix 2 to the Scope of Works and Technical Criteria, be consistent with existing and adjacent established landscape treatments to Windsor Road at Rouse Hill Town Centre.	Applied	Technical	Design	Landscaping								NWRLSVC-ITF-SVC-LA-DRG-157129

Req-ID	Section / Reference No.	Requirement Description	Status	Requirement Type	Technical Classification	System	Subsystem	Clarification	Interface	Owner	Design Verifier	Verification Method	Verification Status	Verification Evidence
T13-0092	Exhibit A Appendix13 13.5.4 (b) (iv)	All permanent landscape treatments must be in accordance with “RTA Landscape Guideline: Landscape design and maintenance guidelines to improve the quality, safety and cost effectiveness of road corridor planting and seeding.	Applied	Technical	Design	Landscaping				Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRG-117109-A-GENERAL ARRANGEMENT - SHEET 9 NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD
T13-0093	Exhibit A Appendix13 13.5.4 (b) (v)	All permanent landscape treatments must maximise the retention of existing vegetation (including root and above-ground plant mass.	Applied	Technical	Design	Landscaping				Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRG-117109-A-GENERAL ARRANGEMENT - SHEET 9 NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD
T13-0094	Exhibit A Appendix13 13.5.4 (b) (vi)	All permanent landscape treatments must ensure road safe sight distances are maintained and road signage is not obscured by planting prepared in relation to Project Planning Approval 2.	Applied	Technical	Design	Landscaping				Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRG-117109-A-GENERAL ARRANGEMENT - SHEET 9 NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD
T13-0095	Exhibit A Appendix13 13.5.4 (b) (vii)	All permanent landscape treatments must provide setbacks from planting to adjacent structures, roadside and other furniture and pathways to enable clear access for maintenance and visual inspections when landscape matures.	Applied	Technical	Design	Landscaping				Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRG-117109-A-GENERAL ARRANGEMENT - SHEET 9 NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD
T13-0096	Exhibit A Appendix13 13.5.4 (c)	All groundcovers and grasses used in the permanent landscaping must be planted at a density of 6 plants/m2 and have a minimum 150mm diameter container size.	Applied	Technical	Design	Landscaping				Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRG-117109-A-GENERAL ARRANGEMENT - SHEET 9 NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD
T13-0097	Exhibit A Appendix13 13.5.4 (d)	All shrubs used in the permanent landscaping must be planted at a density of 4 plants/m2 and have a minimum 150mm diameter container size.	Applied	Technical	Design	Landscaping		Shrubs & Groundcovers mix specified at 6 plants / m2 see above						

Req-ID	Section / Reference No.	Requirement Description	Status	Requirement Type	Technical Classification	System	Subsystem	Clarification	Interface	Owner	Design Verifier	Verification Method	Verification Status	Verification Evidence
T13-0098	Exhibit A Appendix13 13.5.4 (e)	All trees used in the permanent landscaping must have a minimum container size of 400 litres.	Applied	Technical	Design	Landscaping				Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRG-117109-A-GENERAL ARRANGEMENT - SHEET 9 NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD
T13-0099	Exhibit A Appendix13 13.5.5 (a)	Seeding must not be used for the landscape works except for temporary stabilisation.	Applied	Technical	Design	Landscaping				Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD
T13-0100	Exhibit A Appendix13 13.5.5 (b)	All restoration and permanent landscape areas must be provided with minimum 100mm depth organic mulch.	Applied	Technical	Design	Landscaping				Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD - SECTION 3.1.5
T13-0101	Exhibit A Appendix13 13.5.6 (a)	The SVC Contractor must, in all areas of the Construction Site where the existing vegetation and landscape is disturbed by the SVC Contractor's Activities, strip and store topsoil for reuse in the landscape works.	Applied	Technical	Design	Landscaping		(in Landscape Design Reports for all Lots)		Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD - SECTION 3.1.4
T13-0102	Exhibit A Appendix13 13.5.6 (b)	The SVC Contractor must undertake soil pedology survey and analysis of topsoil stripped from each soil landscape and vegetation community type within the Construction Site. Topsoil testing must be undertaken by a National Association of Testing Authorities (NATA) registered laboratory and include pH, salinity, cation exchange capacity, plant available phosphorous, total organic matter, total nitrogen and carbon / nitrogen.	Applied	Technical	Design	Landscaping		(in Landscape Design Reports for all Lots)		Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD - SECTION 3.1.4
T13-0103	Exhibit A Appendix13 13.5.6 (c)	Topsoil testing and any recommendations for topsoil management must be made by an appropriately qualified professional soil scientist with expertise in revegetation. A copy of these recommendations must be provided to the Principals Representative and the Independent Certifier. This data must be used in the selection and design of the proposed landscape works.	Applied	Technical	Design	Landscaping		(in Landscape Design Reports for all Lots)		Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD - SECTION 3.1.4

Req-ID	Section / Reference No.	Requirement Description	Status	Requirement Type	Technical Classification	System	Subsystem	Clarification	Interface	Owner	Design Verifier	Verification Method	Verification Status	Verification Evidence
T13-0104	Exhibit A Appendix13 13.5.6 (d) (i)	All topsoil re-used within landscape works must be prepared in the following manner: A representative program of topsoil sampling of all topsoils to be used in landscape works areas to address any soil deficiencies, including soil pH analysis, must be undertaken and the results of these tests, together with advice from a qualified professional soil scientist, must be used to determine the requirements for soil improvement and stabilisation to enable the establishment and maintenance of successful long term plant growth and vegetation cover.	Applied	Technical	Design	Landscaping		(in Landscape Design Reports for all Lots)		Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD - SECTION 3.1.4
T13-0105	Exhibit A Appendix13 13.5.6 (d) (ii)	All topsoil re-used within landscape works must be prepared in the following manner: All topsoils must be conditioned or improved to comply with recommendations in the topsoil report by the soil scientist.	Applied	Technical	Design	Landscaping		(in Landscape Design Reports for all Lots)		Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD - SECTION 3.1.4
T13-0106	Exhibit A Appendix13 13.5.6 (d) (iii)	All topsoil re-used within landscape works must be prepared in the following manner: Prior to the placement of topsoil, the SVC Contractor must continuously eradicate weeds by spraying, and monitor the weed cover four (4) weeks after each spray. When the monitoring indicates that weed cover is reduced to less than 5%, a final eradication spray must be undertaken.	Applied	Technical	Design	Landscaping		(in Landscape Design Reports for all Lots)		Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD - SECTION 3.1.4
T13-0107	Exhibit A Appendix13 13.5.6 (e)	Finished subgrade surfaces to planting and turf areas must be cultivated to a minimum of 150mm depth immediately prior to spreading of topsoil.	Applied	Technical	Design	Landscaping		(in Landscape Design Reports for all Lots)		Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD - SECTION 3.1.4
T13-0108	Exhibit A Appendix13 13.5.6 (f)	(f) Conditioned topsoil must be placed to a minimum depth of: (i) 400mm in planting beds; and (ii) 200mm in turf areas.	Applied	Technical	Design	Landscaping		(in Landscape Design Reports for all Lots)		Matt Coggan	Scott Ibbotson	Review	Open	NWRLSVC-ITF-BVM-LA-DRT-117500-A-BELLA VISTA TO BALMORAL RD - SECTION 3.1.4

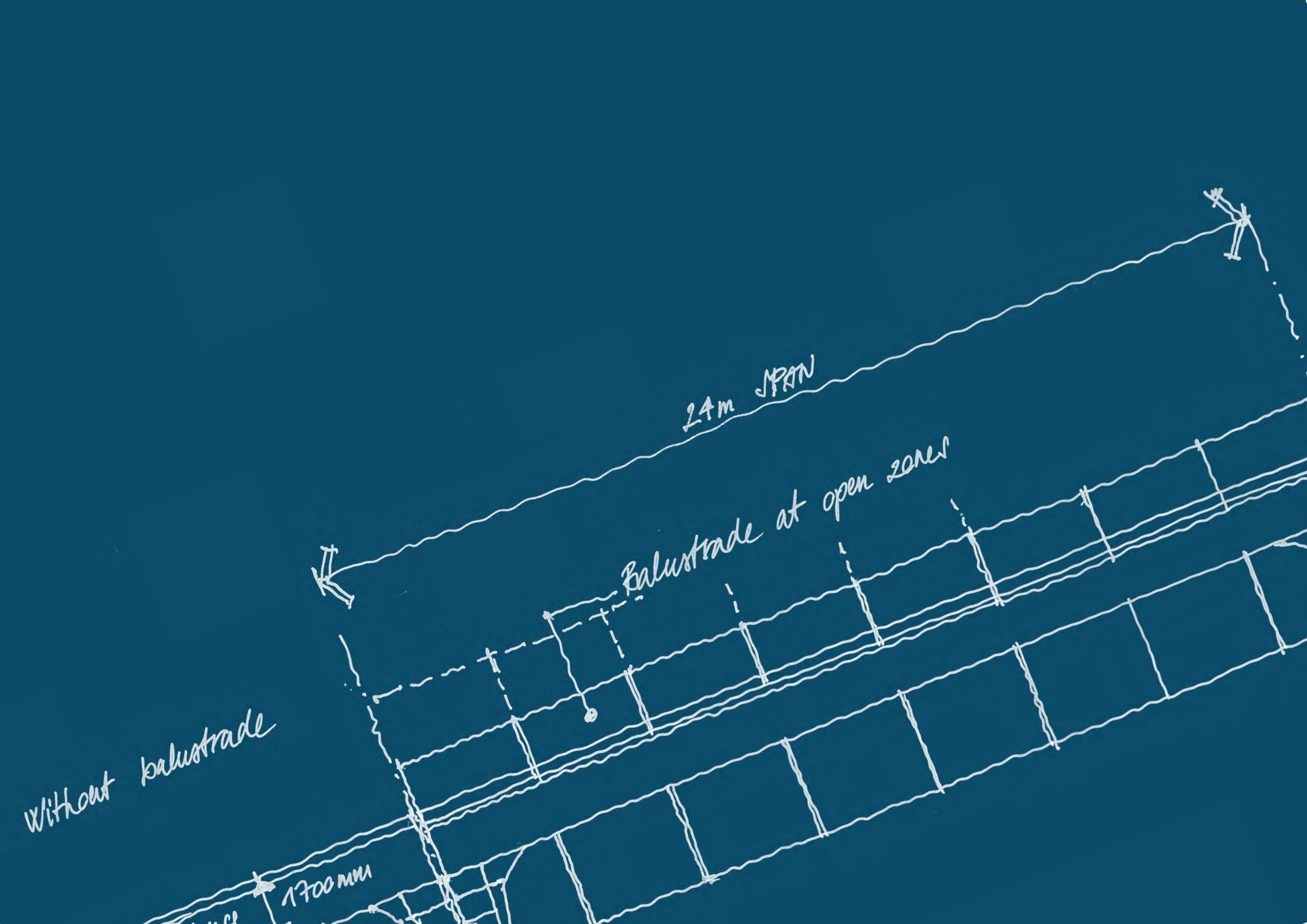
B) Plant Palette

The following species are proposed for Restoration (R) and Permanent (P) landscape treatments areas in locations as described in the report.

Image	Species	Common Name	Container Size	Density	Treatment Type (R/P)
	TREES				
	Corymbia maculata	Spotted Gum	400L	1 plant / 4m2	R, P
	Eucalyptus crebra	Narrow-leaved Ironbark	400L	1 plant / 4m2	R, P
	Eucalyptus eugenioides	Thin-leafed Stringybark	400L	1 plant / 4m2	R, P
	Eucalyptus moluccana	Grey Box	400L	1 plant / 4m2	R, P
	Eucalyptus paniculata	Grey Ironbark	400L	1 plant / 4m2	R, P
	Eucalyptus tereticornis	Forest Red Gum	400L	1 plant / 4m2	R, P
	Melaleuca linariifolia	Snow in Summer	150mm	1 plant / 4m2	R, P
	UNDERSTOREY				
	Bursaria spinosa	Sweet Bursaria	150mm	6 plants / m2	R, P
	Callistemon pallidus	Lemon Bottlebrush	150mm	6 plants / m2	R, P
	Dianella caerulea	Blue flax-lily	150mm	6 plants / m2	R, P

	Grevillea juniperina ‘Molonglo’	Grevillea		150mm	6 plants / m2	R, P
	Grevillea ‘Scarlet Sprite’	Grevillea		150mm	6 plants / m2	R, P
 *notechis.blogspot.com*	Indigofera australis	Australian Indigo		150mm	6 plants / m2	R, P
	Lavandula spp.	Lavender		150mm	4 plants / m2	R (Area G)
	Lomandra longifolia	Mat Rush		150mm	6 plants / m2	R, P
	Melaleuca thymifolia	Thyme-leaf Honey-myrtle		150mm	6 plants / m2	R, P
	Oleria microphylla	Small-leaved daisy bush		150mm	6 plants / m2	R, P
	Senna odorata	Southern Cassia		150mm	6 plants / m2	R, P
	Themeda australis	Kangaroo Grass		150mm	6 plants / m2	R, P

** Treatment types are Restoration (R) and/or Permanent (P) landscaping areas*


24m SPAN
Balustrade at open zones
Without balustrade
1700mm

Appendix C. C44 + DL80 Urban Design – Consultantation with External Parties (ISJV)

Organisation	Document Transmittal Ref.	DCD Comments (Recv'd) Transmittal Ref.	Comment	ISJV Response (Sent) Transmittal Ref.	Response to Comments
The Hills Shire Council	NWRLSVC-ISJ-TX-00270	NWRLSVC-HYD-TX-00081	Reference is made to a graffiti coating being applied to the first 3m of the pier surface. Shouldn't anti-graffiti coatings also be applied to the first 3m of any hard surface such as abutments that are accessible from the ground? Question should also be asked as to whether it should also include hard surfaces that are only accesible from within the railway corridor e.g. inside of viaduct parapets, cutting walls etc.	NWRLSVC-ISJ-TX-00194	09.07.14 DI - KF: this will be reworded for the next revision of report.
			Single span road crossings are not just limited to RMS roads (Windsor Rd and Memorial Ave) only. There are a number of local roads including Samantha Riley Dr (min. six lanes width plus median) , Sanctuary Dr (four lanes width plus median), White Hart Dr (six lanes width plus median) where the designers have also been able to manage a single span crossing for the viaduct. Should these roads also be listed?		09.07.14 DI - KF: Landscaping is now included as part of the Civil Design Packages. This package will be "Urban & Architectural Design Package". We will include a cross reference within the architectural report to landscape packages. Landscaping designs have been included from SDD stage onwards for the civil design packages.
			In commenting on other SVC design packages, I have raised issues pertaining to what appeared to be a lack of landscape design detail e.g. Picket Pl (DL 26), Balmoral Rd re-alignment(DL21). In relation to my comments on DL26, the response from ISJV stated *'For landscaping details, refer to Design Lot 80 - Architecture, Urban Design and Landscape. Reference to this design lot is included in the drawings of the SDD submission'* . However no information on, or reference to, the landscaping issues raised by me in relation to DL 26 are included in DL80. Similar comments on landscaping were made in response to DL21 . Awaiting ISJV's response to those comments to see if the situation is the same.		Planning Approval and compliance with Ministerial Condition is covered in the Urban Design and Corridor Landscape Plan (UDCLP) (NWRLSVC-ISJ-SVC-PM-PLN-121101) 1. Stakeholder consultation: covered by the UDCLP (This Plan) & Community Liaison Implementation Plan 2. Visual Impact Strategy: Covered by UDCLP & the Heritage Plan 3. Project Requirements compliance: will be provided in SDD submission 4. (a) Appendix 13 - Clause 13.3 Overbridge 1 & 2 and Balmoral Rd Overbridges will be detailed in the SDD submission. (b) Appendix 13 - Clause 13.4 Other Structures have been detailed in this submission e.g. retaining walls. (c) There is no requirement in Appendix 13 for urban design of: temporary at grade car parks, modifications to existing carparks, southern bus layover, road reconfigurations, Rouse Hill Temporary works (d) Permanent landscape treatments, refer comment 7 (e) Handover works - covered by UDCLP 5. Colour and Quality Samples and forms: Prototypes by ISJV. Refer p37 of DCD report which documents the approach to manage surface finish and colour. Samples, models, and prototypes are specified, controlled, managed by ISJV / SMEC - refer comment 12.
RMS		N/A			
Department of Planning	NWRLSVC-ISJ-TX-00243	Email -09/09/2014	No Comments - Report does not apply to Cudgegond Road Station or within Area 20, both of which within the North West Growth Centre. Report does not provide details in relation to any biodiversity strategic approvals. Any clearing of ENV in non-certified areas would need to be offset in accordance with teh relevant biodiversity measures of hte Biodiversity Certification		Noted . An overall Biodiversity Off set package has been approved and implemented as part of the total NWRL project. This package is managed directly by TfNSW and not individual Contractors (ie ISJV).