SOUTH ROAD AND OUTER HARBOR RAIL LINE GRADE SEPARATION DETAILED DESIGN
INTRODUCTION

Feasibility Study

• 4 Options
  • Railway over pass
  • Railway under pass
  • Road under pass
  • Combination of railway over pass and road under pass
INTRODUCTION

Feasibility Study

- Railway overpass was chosen
  - Bridge to extend from approximately 420 metres west of Queen street to approximately 40 metres east of Coglin street
  - Croydon Station to be elevated on to the bridge and on the eastern side of Queen street
INTRODUCTION

Feasibility Study

- Railway over pass was chosen
  - Further recommendations that a car park be built beneath the bridge between Queen street and South road
COMPANY STRUCTURE

- Rail Bridge Design
- Civil Works
- Traffic Management
- Environmental and Urban Department
- Construction
- Quality Assurance Management
COMPANY STRUCTURE

- Project Manager
  - Assistant Project Manager/Quality Management
    - Drawings Advisor
  - Rail Bridge Design
    - 10 employees
  - Civil Works
    - 7 employees
  - Traffic Management
    - 4 employees
  - Environmental and Urban Department
    - 3 employees
  - Construction
    - 5 employees
DELIVERABLES

- The Detailed Design and Report
- A Quality Management System
- The Environmental Management Plan
- Technical Specifications and OH&S Document
- Construction Methodology and Gantt Charts
- Detailed Drawings of the Design
- Bill of Quantities
GOALS

• National Network Transport Link (South Road) fulfils its role

• Support Adelaide’s future economic prosperity and liveability

• Provide an integrated solution that directly and indirectly enhances transport system safety
OBJECTIVES

• To protect and provide freight priority consistent with a National Network Transport Link
• To improve travel time, reliability and vehicle operating costs
• To improve accessibility of Adelaide’s east-west traffic
• To contribute to the achievement of the SA Government’s public transport mode share target
• To minimise greenhouse gas emissions and improve air quality
• Reduce crashes
• To deliver a solution with positive net benefits
DESIGN REQUIREMENTS

The minimum requirements that must be met in the design of the grade separation include:

- reference to rail design guidelines for heavy passenger rail
- a design solution that primarily caters for existing passenger rail demands
- minimum separation of 800 metres between passenger rail stations
- minimum platform size for passenger rail stations is 7.8 metres wide by 120 metres long, in order to accommodate four passenger rail cars
- posted rail speed of 80 kph for passenger rail services
- a design solution that retains flexibility to accommodate the future widening of South Road, as part of the non-stop North-South Corridor
DESIGN REQUIREMENTS

• a design solution that retains flexibility to accommodate future electrification of the Outer Harbor passenger rail line

• a design solution that minimises redundant infrastructure and disruption to traffic flow and rail schedules during construction (minimum of one lane in each direction along South Road to be maintained at all times)

• Drainage design to comply with standards as defined by Council Stormwater Management Plans for the surrounding catchments.

• Maximum grade of 2% for rail services

• Minimum clearance of 5.8m above the roadway for a rail bridge overpass

• During construction a minimum of 1 lane either direction on South Rd must be maintained
FURTHER CONSIDERATION

- Connectivity requirements
- Impacts and opportunities
- Existing site conditions
- Land acquisition requirements
- Capital cost for design
- Operation and maintenance requirements
- Economic viability of the design.
BRIDGE WALK THROUGH
RAIL BRIDGE DESIGN

DETAILED DESIGN
RAILWAY BRIDGE DESIGN

Detail design stage
BRIDGE DESIGN

Critical spans:

- 44.34m over South Road
- 37.5m with Railway station (higher loading)
RAILWAY STATION DESIGN

Station platform top slab

- Concrete: 40Mpa
- Size: 10m * 8.4m
- Height: 0.3m
- Total span: 120m
RAILWAY STATION DESIGN

Side beams:
- Total 24, 12 each side
- Concrete: 32mpa
- Cover: 25mm
- Size: 10m * 0.8m * 1.225m

End/cross beams
- 13 of these beams at 10m intervals
- Concrete: 32mpa
- Cover: 25mm
- Size: 6.8m * 0.5m * 1.225m
RAILWAY STATION DESIGN

Station Ramp

The station ramp is made up of a reinforced top slab and then one way reinforced walls to hold it up. The ramp goes to the top of the rails height, meaning that total height of the ramp is 1.2m.

- Concrete: 32mpa
- Cover: 25mm
- Size: L10m * W0.8m * D1.225m
BRIDGE DECK DESIGN

- Transfer the traffic loads to the super tees
- Designed as continuous one way slab
- Webs of super tees acting as supports
BRIDGE DECK DESIGN

- **200mm slab deck**

- **N12 at 250cts top and N12 at 200cts bottom**
BRIDGE GIRDER DESIGN

• Function:
  Support Loads from bridge

• Two critical spans
  (span 37.5m, 44.34 wide)

• Consider:
  Train load
  Dead loads – deck slab, station etc.
  Self weight – super tee
BRIDGE GIRDER DESIGN

Girders for station cases
BRIDGE GIRDER DESIGN

Girders for no station cases
BRIDGE GIRDER DESIGN

- The designed girder is a closed flanged T5 Super-Tee. It is 1.8 m deep and 2.1 m wide, suitable for the height requirement. It provides a safe working platform after erection and also allows immediate placement of deck reinforcement. Super-Tee is also chosen because of its high span-to-depth ratio. The girders were designed in accordance with AS 3600, AS 5100.2 and AS 5100.5.
HEADSTOCK (1)

- Types of headstock:
  - Type 1 (South Road)
  - Type 2 (Standard)
  - Type 3 (Station)

<table>
<thead>
<tr>
<th></th>
<th>Length (m)</th>
<th>Height (m)</th>
<th>Width (m)</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>18.2</td>
<td>1.5</td>
<td>1.7</td>
<td>2</td>
</tr>
<tr>
<td>Type 2</td>
<td>15.8</td>
<td>1.5</td>
<td>1.7</td>
<td>12</td>
</tr>
<tr>
<td>Type 3</td>
<td>24.2</td>
<td>1.5</td>
<td>2.2</td>
<td>7</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
<td><strong>21</strong></td>
</tr>
</tbody>
</table>

Summary of Design Headstocks

- The materials needed for the headstocks are mainly concrete (40MPa), reinforced steel bars, and bearings
HEADSTOCK (2)

Type 1 Headstock Cross-Section
(Front View)

Type 3 Headstock Cross-Section
(Front View)
• **Bearings**

Elastomeric bearings – rubber and steel plate

Type 1 (South Road) & Type 2 (Standard):
- 8 bearing pads & pedestals

Type 3 (Station):
- 12 bearing pads & pedestals

Although the length of Type 1 is longer than Type 2, the number of bearings will still be the same because the headstock is skew (60°)

Side walls to protect the bearings from weathering or chemical attack (Corrosion).
HEADSTOCK (4)

- Reinforcement

Type 1 (South Road) & Type 2 (Average):
  - 13N36 (Top)
  - 25N14 (Bottom)
  - N36@400mm Ligatures

Type 3 (Station):
  - 25N40 (Top)
  - 18N40 (Bottom)
  - N28@200mm Ligatures

30mm cover
PIER (1)

- There are total 56 piers needed for the rail bridge (1.13km)

- Type 1 is the standard piers where Type 2 – 6 piers is located at the slope of the bridge

- The constructed materials for the piers are concrete (40MPa) and reinforced steel bars.

<table>
<thead>
<tr>
<th>Type</th>
<th>Cross-Section (m²)</th>
<th>Height (m)</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>1.5 x 1.5</td>
<td>4.5</td>
<td>36</td>
</tr>
<tr>
<td>Type 2</td>
<td>1.5 x 1.5</td>
<td>3.8</td>
<td>4</td>
</tr>
<tr>
<td>Type 3</td>
<td>1.5 x 1.5</td>
<td>3.1</td>
<td>4</td>
</tr>
<tr>
<td>Type 4</td>
<td>1.5 x 1.5</td>
<td>2.4</td>
<td>4</td>
</tr>
<tr>
<td>Type 5</td>
<td>1.5 x 1.5</td>
<td>1.7</td>
<td>4</td>
</tr>
<tr>
<td>Type 6</td>
<td>1.5 x 1.5</td>
<td>1.0</td>
<td>4</td>
</tr>
</tbody>
</table>

Summary of Design Piers
PIER (2)

• Loadings

Each standard headstock (Type 1 and 2) supported by two piers. Whereas, the Station consists of 7 headstocks (Type 3) and each headstock requires 4 piers.

Type 1: Critical loading for each pier is 17000kN

Type 2-6: Critical loading for each pier is more than 17000kN (shorter than Type 1)
PIER (4)

- Reinforcement
  
  25N36
  
  N12@540mm Ligatures
  
  60mm cover

PIers Cross-section
ABUTMENT (1)

- Type: Stub Abutment supported on piles

- The abutment was divided into 3 major sections:
  1. Back wall as a retaining wall
  2. Front wall as a pier and headstock
  3. Bottom wall as a pile cap

- The type of materials needed for the abutment are concrete (50MPa), reinforced steel bars, and bearings.
ABUTMENT (2)

- **Piling**

  The abutment supported by 16 piles

  Each pile has a diameter of 900mm and 25m long

  Consists of 8N32 bars and N12@300mm Ligatures (Helical)

  Spacing between each pile is 2m
ABUTMENT (3)

- **Bearings**

Elastomeric bearing pads
(most economical solution use in construction of large span bridge)

Compress on vertical load, accommodate horizontal rotation and provide lateral shear movement

8 Elastomeric bearings pads

8 Bearing pedestal (concrete)
ABUTMENT (4)

- Reinforcement

Back wall: N28@333cts (Vertical)
  N28@300cts (Horizontal)

Front wall: N50@450cts (Vertical)
  N40@167cts (Horizontal)

Bottom wall: N50@333cts (Vertical)
  N50@200cts (Horizontal)

Pile: 8N32 (Vertical)

*50mm cover
FOUNDATION DESIGN

Pile cap design

- Transfer axial load from piers to piles
  - non-station case
    - 2 pile caps -normal
  - station case
    - 2 smaller pile caps for the edge piers
    - 2 normal caps for the middle piers
FOUNDATION DESIGN

Normal pile cap design

- 5.4 m x 5.4 m
- 1.3 m deep
- 9 x 900mm piles
FOUNDATION DESIGN

Smaller Pile cap design

- 4.5 m x 4.5 m
- 650 mm deep
- 4 x 900mm piles
FOUNDATION DESIGN

Pile cap reinforcement

- N24 @ 300 cts
- 2N20 ligs @ 300 cts

side view of pile cap reinforcement

top view of pile cap reinforcement
FOUNDATION DESIGN

Pile design

- Bored cast-in-place piles
- 900 mm diameter
- 25 meters deep/ 20 meters deep
- 8N 32 reinforcement
- Helix N12 fitments @ 300 cts
BRIDGE DRAINAGE

- Pit design
  - Width x Breadth x Height:
    450 x 450 x 150 mm
    (114 kg )
  - Cast iron grate cover
  - Location:
    Within the deck & atop of girder
  - Pit spacing:
    40 meters
BRIDGE DRAINAGE

- Pipe design
  - Bike path
    Reinforced concrete: 0.2 m diameter
    PVC: 0.15 m diameter
  - Rail track
    Reinforced concrete: 0.2 m diameter
    PVC: 0.15 m diameter
  - Station
    PVC: 0.15 m diameter
## BRIDGE DRAINAGE

- **Exit Pipe design**

<table>
<thead>
<tr>
<th>Pipe</th>
<th>Description</th>
<th>Length (m)</th>
<th>Pipe Type</th>
<th>Diameter (m)</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Underground</td>
<td>5.8</td>
<td>Reinforced Concrete</td>
<td>0.2</td>
<td>Underground/loaded</td>
</tr>
<tr>
<td>B</td>
<td>Down abutment</td>
<td>5.8</td>
<td>PVC</td>
<td>0.1</td>
<td>Cheap/Light</td>
</tr>
<tr>
<td>C</td>
<td>Down Pier</td>
<td>5.8</td>
<td>PVC</td>
<td>0.1</td>
<td>Cheap/Light</td>
</tr>
<tr>
<td>D</td>
<td>Down Pier</td>
<td>5.8</td>
<td>PVC</td>
<td>0.1</td>
<td>Cheap/Light</td>
</tr>
<tr>
<td>E</td>
<td>Down Pier</td>
<td>5.8</td>
<td>PVC</td>
<td>0.1</td>
<td>Cheap/Light</td>
</tr>
<tr>
<td>F</td>
<td>Down Pier</td>
<td>5.8</td>
<td>PVC</td>
<td>0.1</td>
<td>Cheap/Light</td>
</tr>
<tr>
<td>G</td>
<td>Down Pier</td>
<td>5.8</td>
<td>PVC</td>
<td>0.1</td>
<td>Cheap/Light</td>
</tr>
<tr>
<td>H</td>
<td>Down abutment</td>
<td>5.8</td>
<td>PVC</td>
<td>0.1</td>
<td>Cheap/Light</td>
</tr>
<tr>
<td>I</td>
<td>Underground</td>
<td>5.8</td>
<td>Reinforced Concrete</td>
<td>0.2</td>
<td>Underground/loaded</td>
</tr>
</tbody>
</table>
BRIDGE DRAINAGE

• Pipe support
  □ The pipe hanging underneath the girders
  □ Standard riser clamps
  □ Spacing is 3 meters
CIVIL WORKS

DETAILED DESIGN
CIVIL WORKS

Work Completed

• Pavement Design Detail
• Track Support System
• Retaining Wall Design Detail
• Storm water
• Services
• Earthworks
PAVEMENT DESIGN DETAIL

The pavement design consist of one main road and two sides road to design which main road is South road and sides road is Queen Street, Euston Terrace, respectively.

Moreover, it is needed to design pavement for car park which is new structure under the rail bridge.
MAIN ROAD DESIGN

Pavement design has been undertaken using CIRCLY design software and the detailed results of the analysis is shown in table.
SIDES ROAD

Pavement design has been undertaken using CIRCLY design software and the detailed results of the analysis is shown in table.
CAR PARK

- Minimal Traffic Loads

<table>
<thead>
<tr>
<th>Thickness</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete, 80mm thick</td>
<td>Concrete</td>
</tr>
<tr>
<td>Unbound Granular Material, 90mm thick</td>
<td>PM3/30 Subbase</td>
</tr>
<tr>
<td>Unbound Granular Material, 90mm thick</td>
<td>PM3/30 Working Platform</td>
</tr>
<tr>
<td>Sub-grade</td>
<td>CBR 5%</td>
</tr>
</tbody>
</table>
TRACK CONFIGURATION DESIGN

Rail Type: Continuously Welded Rail (CWR)

Sleepers: concrete

Fastening system: resilient fastenings

Fastening components:

• 4 No. Lock-in shoulders
• 4 No. Resilient rail clips
• 4 No. Rail insulators
• 2 No. Rail pads
## TRACK CROSS SECTION

### Sleeper Profile

<table>
<thead>
<tr>
<th>Sleeper type</th>
<th>Sleeper depth</th>
<th>Sleeper Width</th>
<th>Sleeper spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>125mm</td>
<td>2500mm</td>
<td>670mm</td>
</tr>
</tbody>
</table>
The type of retaining wall is mechanical stable earth wall (MSE)

• Recommended in the feasibility study
• Cheapest Cost
RETAINING WALL DESIGN DETAIL

• The retaining walls are located at the both sides of bridge which have two sides wall on each sides.
• The retaining wall will be design along a maximum height 3.4m of soil.
• The size of retaining wall is triangle which is length of base side 180m with 2% slope.
# CROSS-SECTION OF MSE

<table>
<thead>
<tr>
<th></th>
<th>Reinforced backfill soil</th>
<th>Unreinforced backfill soil</th>
<th>Unreinforced backfill soil</th>
<th>Reinforced backfill soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st layer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd layers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd layers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th layers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Left sides retaining wall | Right sides retaining wall

- 1st layer: 400mm
- 2nd layers: 1000mm
- 3rd layers: 1000mm
- 4th layers: 1000mm
STRUCTURE OF MSE

The mechanical stability earth wall consist of some main parts as follow soil reinforcement, select backfill, unreinforced backfill, original ground, wall facing panel and so on.
STABILITY OF RETAINING WALL

There are two parts identify stability of retaining wall as follow external stability and internal stability.

External stability

With the classical gravity and retaining wall structure, three potential external failure mechanisms are usually considered in sizing MSE walls.

- Factor of safety for sliding on the each layer bases
- Limiting the location of the resultant of all forces (overturning)
- Maximum value of bearing capacity

Internal stability

Calculation the maximum the tensile force in the reinforced soil parts to design reinforcement length.
# Unreinforced Soil Property

<table>
<thead>
<tr>
<th>MSE Wall Layers</th>
<th>Height (m)</th>
<th>Soil Type</th>
<th>$\gamma$ for Backfilled soil ($kN/m^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>0.4</td>
<td>Silty Sands</td>
<td>17.27</td>
</tr>
<tr>
<td>2nd</td>
<td>1</td>
<td>Silty Sands</td>
<td>17.27</td>
</tr>
<tr>
<td>3rd</td>
<td>1</td>
<td>Silty Sands</td>
<td>17.27</td>
</tr>
<tr>
<td>4th</td>
<td>1</td>
<td>Silty Sands</td>
<td>17.27</td>
</tr>
</tbody>
</table>
## EXTERNAL STABILITY

The factor of safety for sliding and overturning

<table>
<thead>
<tr>
<th>MSE Wall Layers</th>
<th>FOS for Sliding</th>
<th>FOS for Overturning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>2.259</td>
<td>&gt;1.5 OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.701032869</td>
</tr>
<tr>
<td>2nd</td>
<td>2.042</td>
<td>&gt;1.5 OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.622343316</td>
</tr>
<tr>
<td>3rd</td>
<td>1.937</td>
<td>&gt;1.5 OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.634395022</td>
</tr>
<tr>
<td>4th</td>
<td>1.776</td>
<td>&gt;1.5 OK</td>
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<tr>
<td></td>
<td></td>
<td>3.183361614</td>
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</tbody>
</table>

Check maximum stress for bearing capacity

<table>
<thead>
<tr>
<th>MSE Wall Layers</th>
<th>q max for Bearing Capacity (kPa)</th>
<th>&lt;300kPa OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>23.61421716</td>
<td>&lt;300kPa OK</td>
</tr>
<tr>
<td>2nd</td>
<td>90.75762082</td>
<td>&lt;300kPa OK</td>
</tr>
<tr>
<td>3rd</td>
<td>180.1264195</td>
<td>&lt;300kPa OK</td>
</tr>
<tr>
<td>4th</td>
<td>280.3157143</td>
<td>&lt;300kPa OK</td>
</tr>
</tbody>
</table>
## MSE Wall Layers

<table>
<thead>
<tr>
<th>MSE Wall Layers</th>
<th>Height (m)</th>
<th>Soil Type</th>
<th>$\gamma$ for Backfilled Soil $kN/m^3$</th>
<th>Total length of reinforcement (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>0.4</td>
<td>Sand and Gravel</td>
<td>18.055</td>
<td>1977.163512</td>
</tr>
<tr>
<td>2nd</td>
<td>1</td>
<td>Sand and Gravel</td>
<td>18.055</td>
<td>1523.6382</td>
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<tr>
<td>3rd</td>
<td>1</td>
<td>Sand and Gravel</td>
<td>19.625</td>
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<tr>
<td>4th</td>
<td>1</td>
<td>Sand and Gravel</td>
<td>19.625</td>
<td>314.4899003</td>
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</table>
# Car Park Drainage System Design

## Detail design

<table>
<thead>
<tr>
<th>Pipe Type</th>
<th>Size</th>
<th>Total Length (m)</th>
<th>Notice</th>
</tr>
</thead>
<tbody>
<tr>
<td>M200PP D depth channel</td>
<td>200x 220 (mm)</td>
<td>450</td>
<td>/</td>
</tr>
<tr>
<td>Concrete pipe</td>
<td>375 mm(diameter)</td>
<td>241</td>
<td>1/300 hydraulic gradient &amp; 600mm pavement cover</td>
</tr>
<tr>
<td>Other component required</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junction pit</td>
<td>600x600 (mm)</td>
<td>10</td>
<td>/</td>
</tr>
<tr>
<td>Petrol separator</td>
<td>2300x1200 (mm)</td>
<td>1</td>
<td>/</td>
</tr>
</tbody>
</table>
CAR PARK DRAINAGE SYSTEM DESIGN

Detail design – Oil Separator and Linear Drainage Channel
**CAR PARK DRAINAGE SYSTEM DESIGN**

### Check maximum flow can carry

<table>
<thead>
<tr>
<th></th>
<th>M200PP D depth channel</th>
<th>sub catchment area -5 year design life</th>
<th>sub catchment area -100 year design life</th>
<th>unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>maximum flow can carry</td>
<td>33.18</td>
<td>/</td>
<td>/</td>
<td>(l/s)</td>
</tr>
<tr>
<td>maximum flow</td>
<td>/</td>
<td>7.51</td>
<td>21.09</td>
<td>(l/s)</td>
</tr>
<tr>
<td>375 mm dia concrete pipe</td>
<td>1.28</td>
<td>/</td>
<td>/</td>
<td>(m/s)</td>
</tr>
<tr>
<td>maximum velocity can carry</td>
<td>/</td>
<td>0.34</td>
<td>0.96</td>
<td>(m/s)</td>
</tr>
</tbody>
</table>
DRAWING OF CAR PARK DRAINAGE SYSTEM DESIGN
### Connection between rail drainage and existing drainage system Design

**Detail design**

<table>
<thead>
<tr>
<th>Pipe Type</th>
<th>size</th>
<th>total length(m)</th>
<th>Notice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete pipe</td>
<td>375 mm(diameter)</td>
<td>664.26</td>
<td>1/300 hydraulic gradient &amp; 600mm pavement cover</td>
</tr>
<tr>
<td>other component required</td>
<td>size</td>
<td>total number</td>
<td></td>
</tr>
<tr>
<td>junction pit</td>
<td>600mmx600mm</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>
Check maximum flow can carry

<table>
<thead>
<tr>
<th>section of pipe</th>
<th>length(m)</th>
<th>velocity(m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>375 mm dia concrete pipe</td>
<td>/</td>
<td>1.28</td>
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<tr>
<td>Pipe AB to C</td>
<td>105</td>
<td>0.82</td>
</tr>
<tr>
<td>Pipe C to Queen Street</td>
<td>130.5</td>
<td>0.48</td>
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<tr>
<td>Pipe D to Queen Street</td>
<td>12.00</td>
<td>0.71</td>
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<tr>
<td>Pipe E to D</td>
<td>150.00</td>
<td>0.58</td>
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<tr>
<td>Pipe I&amp;H to G&amp;F</td>
<td>105.00</td>
<td>0.63</td>
</tr>
<tr>
<td>Pipe G&amp;F to South Road</td>
<td>161.76</td>
<td>0.87</td>
</tr>
</tbody>
</table>
CONNECTION BETWEEN RAIL DRAINAGE AND EXISTING DRAINAGE SYSTEM DESIGN
STORM WATER DRAINAGE SYSTEM DESIGN
EXCAVATION OF EARTH MATERIALS

- Service Relocations and Installation
- Car Park’s Pavement
- Pile installation
- Tree Removal
SERVICE RELOCATION AND INSTALLATION

• Communication cable
  - Total length to be excavated = 600m
  - Diameter of cable pipe = 150mm
  - Covering depth = 600mm
  - Total cut volume = 150 cubic meters (approximately)

• Electrification
  - Total length to be excavated = 740m
  - Diameter of cable pipe = 150mm
  - Covering depth = 1000mm
  - Total cut volume = 980 cubic meters (approximately)

• Water Mains
  - Total length to be excavated = 20m
  - Diameter of cable pipe = 80mm
  - Covering depth = 600mm
  - Total cut volume = 10 cubic meters (approximately)

• Storm Water
  - Total length to be excavated = 1220m
  - Diameter of cable pipe = 375mm
  - Covering depth = 600mm
  - Total cut volume = 564 cubic meters (approximately)
LOCATION OF EXCAVATION SITE

Relocation of Communication Cable
LOCATION OF EXCAVATION SITE

Location of new underground High Voltage power cable
LOCATION OF EXCAVATION SITE

Location of Storm water pipe
EXCAVATION

• Pile installation

- Excavation depth (depth of a pile + thickness of a pile cap) = 26.3m
- Dimensions of pile cap = 5.4m x 5.4m x 1.3m
- Clearance = 0.5m (both side)
- 56 piers
- Volume of excavation for a single pier = 1077.248 m³ (approximately)
- Total volume of excavation for 56 piers = 56 x 1077.248 m³ = 60,325.89 m³ (Approximate)
EXCAVATION

• Car Park Pavement
  ➢ Removing of existing field surface
  ➢ Depth = 260mm
  ➢ Total surface area = 6,300 meter square (approximately)
  ➢ Cut Surface Volume = 1,638 cubic meters (approximately)

• Tree Removal
  ➢ 83 trees (mainly along Euston and Day Terrace)
  ➢ Area = 1 meter square and depth = 1m (approx.)
  ➢ Cut Volume = 1 cubic meters
  ➢ Total cut volume = 83 cubic meters
EMBANKMENT FOR RAIL TRACK

- Length of embankment = 180m
- Width of embankment = 15m
- Height of embankment = 3.4m

- Total surface area = 306 meter square
- Fill volume = 6120 cubic meters
- Total volume = 2 x 6120 = **12,240 cubic meters (approximately)**
Therefore, the total volume of earth materials that need to be filled on the both side of the section = 37.52 m³ (Approximately)

Note: The fill volume for the rail track as shown in figure is calculated along with the embankment.
# Cut and Fill Volume

<table>
<thead>
<tr>
<th>Types of excavation</th>
<th>Cut volume for removal and instillation (m³)</th>
<th>Back Fill volume (m³)</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embankment</td>
<td>-</td>
<td>12240</td>
<td>(Not Counted in remaining fill calculation as this will be bought)</td>
</tr>
<tr>
<td>Coglin Street</td>
<td>-</td>
<td>37.52</td>
<td>(Not Counted in remaining fill calculation as this will be bought)</td>
</tr>
<tr>
<td>Services</td>
<td>1325.4</td>
<td>1251.15</td>
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<tr>
<td>Rail Bridge Stormwater</td>
<td>178.65</td>
<td>121.2</td>
<td></td>
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<tr>
<td>Stormwater Upgrade (Queen Street)</td>
<td>99.945</td>
<td>88.505</td>
<td></td>
</tr>
<tr>
<td>Tree removal</td>
<td>83</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Car park</td>
<td>1923.32</td>
<td>57.777</td>
<td></td>
</tr>
<tr>
<td>Pile instillation(for 56 piers)</td>
<td>60,325.89</td>
<td>50,139.04</td>
<td></td>
</tr>
<tr>
<td>Total Volume</td>
<td>63936.205</td>
<td>51,795.192</td>
<td></td>
</tr>
<tr>
<td>Remaining Volume of soil</td>
<td></td>
<td></td>
<td>12,141.013m³</td>
</tr>
</tbody>
</table>
SOIL PROFILE
## SOIL PROFILE

### BH12

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Material description</th>
<th>Consistency density index</th>
<th>Friction coefficient ((\alpha))</th>
<th>Friction angle ((\phi))</th>
<th>Cohesion strength ((C)) KPa</th>
<th>Elastic modulus ((E)) Mpa</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 2</td>
<td>Sandy clay soil</td>
<td>stiff to hard</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>50</td>
</tr>
<tr>
<td>2 to 6</td>
<td>Silty clay</td>
<td>hard</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>60</td>
</tr>
<tr>
<td>6 to 8</td>
<td>Sandy clay soil</td>
<td>hard</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>60</td>
</tr>
<tr>
<td>8 to 13</td>
<td>Silty clay</td>
<td>very stiff</td>
<td>0.55</td>
<td>0</td>
<td>120</td>
<td>40</td>
</tr>
<tr>
<td>13 to 15</td>
<td>Sandy clay soil</td>
<td>very stiff</td>
<td>0.55</td>
<td>0</td>
<td>90</td>
<td>40</td>
</tr>
<tr>
<td>15 to 20</td>
<td>Silty clay</td>
<td>very stiff to hard</td>
<td>0.55</td>
<td>31</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>20 to 22</td>
<td>Clayey sand</td>
<td>very stiff to hard</td>
<td>1.00</td>
<td>31</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>22 to 29</td>
<td>Silty clay</td>
<td>very stiff</td>
<td>0.55</td>
<td>0</td>
<td>150</td>
<td>80</td>
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<tr>
<td>29 to 31</td>
<td>Sandy clay soil</td>
<td>hard</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>120</td>
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</tbody>
</table>

**Water table from 13.2 m**

### BH14

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Material description</th>
<th>Consistency density index</th>
<th>Friction coefficient ((\alpha))</th>
<th>Friction angle ((\phi))</th>
<th>Cohesion strength ((C)) KPa</th>
<th>Elastic modulus ((E)) Mpa</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1</td>
<td>Sandy clay</td>
<td>firm</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>60</td>
</tr>
<tr>
<td>1 to 2</td>
<td>Clayey Sand</td>
<td>firm</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>60</td>
</tr>
<tr>
<td>2 to 11</td>
<td>Silty Clay</td>
<td>hard to very stiff</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>40</td>
</tr>
<tr>
<td>11 to 13</td>
<td>Clayey Sand</td>
<td>very stiff</td>
<td>0.50</td>
<td>0</td>
<td>80</td>
<td>25</td>
</tr>
<tr>
<td>12 to 20</td>
<td>Silty Clay</td>
<td>stiff</td>
<td>0.55</td>
<td>0</td>
<td>180</td>
<td>50</td>
</tr>
<tr>
<td>20 to 24</td>
<td>Silty Sandy Clay</td>
<td>loose</td>
<td>1.00</td>
<td>31</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>24 to 26</td>
<td>Sandy gravel</td>
<td>loose</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>80</td>
</tr>
<tr>
<td>26 to 30</td>
<td>Clayey Silty Sand</td>
<td>medium dense</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>80</td>
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</tbody>
</table>

**Water table from 12.5 m**

### BH15

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Material description</th>
<th>Consistency density index</th>
<th>Friction coefficient ((\alpha))</th>
<th>Friction angle ((\phi))</th>
<th>Cohesion strength ((C)) KPa</th>
<th>Elastic modulus ((E)) Mpa</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 4</td>
<td>Silty clay</td>
<td>hard</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>60</td>
</tr>
<tr>
<td>4 to 8</td>
<td>Sandy clay</td>
<td>hard to very stiff</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>60</td>
</tr>
<tr>
<td>8 to 11</td>
<td>Silty clay</td>
<td>very stiff to stiff</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>60</td>
</tr>
<tr>
<td>11 to 12</td>
<td>Clay sand</td>
<td>loose</td>
<td>0.50</td>
<td>0</td>
<td>120</td>
<td>40</td>
</tr>
<tr>
<td>12 to 15</td>
<td>Silty clay</td>
<td>loose to stiff</td>
<td>0.55</td>
<td>0</td>
<td>80</td>
<td>25</td>
</tr>
<tr>
<td>15 to 19</td>
<td>Clay</td>
<td>stiff to very stiff</td>
<td>0.55</td>
<td>0</td>
<td>80</td>
<td>50</td>
</tr>
<tr>
<td>18 to 20.5</td>
<td>Clayey sand</td>
<td>stiff to very stiff</td>
<td>0.55</td>
<td>0</td>
<td>80</td>
<td>50</td>
</tr>
<tr>
<td>20.5 to 24</td>
<td>Silty clay</td>
<td>stiff</td>
<td>0.55</td>
<td>31</td>
<td>80</td>
<td>25</td>
</tr>
<tr>
<td>24 to 26.5</td>
<td>Sandy clay</td>
<td>medium dense</td>
<td>1.00</td>
<td>31</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>26.5 to 27</td>
<td>Silty clay</td>
<td>very stiff to hard</td>
<td>0.55</td>
<td>0</td>
<td>200</td>
<td>80</td>
</tr>
<tr>
<td>27 to 30</td>
<td>Clayey Sand</td>
<td>medium dense</td>
<td>0.55</td>
<td>0</td>
<td>200</td>
<td>80</td>
</tr>
</tbody>
</table>

**Water table from 12.5 m**

### BH16

<table>
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<tr>
<th>Depth (m)</th>
<th>Material description</th>
<th>Consistency density index</th>
<th>Friction coefficient ((\alpha))</th>
<th>Friction angle ((\phi))</th>
<th>Cohesion strength ((C)) KPa</th>
<th>Elastic modulus ((E)) Mpa</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1</td>
<td>Sandy Silty Clay</td>
<td>friable</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>60</td>
</tr>
<tr>
<td>1 to 11.5</td>
<td>Sandy clay</td>
<td>friable</td>
<td>0.50</td>
<td>0</td>
<td>200</td>
<td>60</td>
</tr>
<tr>
<td>11.5 to 12</td>
<td>Clayey Silty clay</td>
<td>very stiff</td>
<td>0.55</td>
<td>0</td>
<td>120</td>
<td>40</td>
</tr>
<tr>
<td>12 to 13</td>
<td>Sandy Clay</td>
<td>firm</td>
<td>0.50</td>
<td>0</td>
<td>80</td>
<td>25</td>
</tr>
<tr>
<td>13 to 15</td>
<td>Clayey Sand</td>
<td>firm to loose</td>
<td>0.55</td>
<td>0</td>
<td>80</td>
<td>25</td>
</tr>
<tr>
<td>15 to 17</td>
<td>Silty clay</td>
<td>very stiff to hard</td>
<td>0.55</td>
<td>0</td>
<td>150</td>
<td>50</td>
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<tr>
<td>17 to 19</td>
<td>Clayey Silty clay</td>
<td>very stiff</td>
<td>0.55</td>
<td>0</td>
<td>150</td>
<td>50</td>
</tr>
<tr>
<td>19 to 22.5</td>
<td>Clay</td>
<td>very stiff</td>
<td>0.55</td>
<td>0</td>
<td>150</td>
<td>50</td>
</tr>
<tr>
<td>22.5 to 25</td>
<td>Clayey Sand</td>
<td>hard</td>
<td>1.00</td>
<td>31</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>23 to 24</td>
<td>Clay</td>
<td>hard</td>
<td>0.50</td>
<td>31</td>
<td>120</td>
<td>40</td>
</tr>
<tr>
<td>24 to 28</td>
<td>Sandy clay</td>
<td>stiff</td>
<td>0.55</td>
<td>0</td>
<td>200</td>
<td>80</td>
</tr>
<tr>
<td>28 to 30</td>
<td>Sandy clay</td>
<td>stiff to hard</td>
<td>0.55</td>
<td>0</td>
<td>200</td>
<td>80</td>
</tr>
</tbody>
</table>

**Water table from 12 m**
COMPACTION

• Road and Car park pavement Compaction
  - Soil comprises of Sandy Silty Clay with low strength
  - Compacted with Sheep Foot roller before the pavement installation
  - Helps to increase the strength and removes the void space between granular materials

• Embankment Compaction
  - Consist of backfill layers of granular soil separated by the reinforcement to support the retaining wall
  - Compacted using Reversible Vibratory plate
  - Helps to produce uniformly compacted layers
COMPACTION

Sheep foot roller (Left) and Reversible vibratory plates(Right)
TRAFFIC MANAGEMENT

Traffic/Transport Activities

- Road users
- Delivery Trucks
- Slow moving vehicles/equipment
- Long/huge materials (turning circle)
- Additional traffic
- On site parking
- Public Transport detour
TRAFFIC MANAGEMENT

Signage (During Construction)

- CHANGED TRAFFIC CONDITIONS AHEAD
- TRAFFIC HAZARD AHEAD
- DETOUR FOR HEAVY VEHICLES
- REDUCE SPEED
- END ROADWORK
- ROADWORK AHEAD

AS 1742.4 – 2008
TRAFFIC MANAGEMENT

Signage (During Construction Map)

- Road Work Ahead
- Prepare to Stop
- Speed limit 40km/hrs
- End Speed limit 40km/hrs
- Speed limit 25km/hrs
- Road Work on Side Street
- Detour Ahead
- Heavy Vehicle Detour
- Reduce Speed
- Workers
- Traffic Hazard Ahead
- Changed Traffic Conditions Ahead
- Trucks Entering and Exiting
- VSM Sign Board
TRAFFIC MANAGEMENT

Lane Makings List

• Single Broken Lane (White)
• Edge Lane (White)
• Turn lanes (white)
• Single Continuous Lane (White)
• Give Way Line (White)
• Stop Line (White)
• Platform Edge Line (Yellow)
TRAFFIC MANAGEMENT

Lane Makings Samples

- **Single broken lane** will be used as Separation line between the traffic flowing in same direction.

- **Single continuous lane are** used for separating the opposing traffic flow and stoping the traffic from one side turning into side streets (Width is in (mm))

- **Give Way Line** is normally a white coloured broken line as shown below.
TRAFFIC MANAGEMENT

Pedestrians and Cyclists

- **South Road** will not require any Pedestrian & Cyclist
- **South Road** Pedestrian & Cyclists will be designed for the future development
- **Queen/ Elizabeth Street** will be designed to accommodate Pedestrians and cyclists as it’s major community focal area during and after construction
  - 1.5 to 2m width
  - Levelled, smooth surface, free of debris
  - Appropriate lines markings
  - Connectivity (Ramps and kerb heights)
Public Transport

Buses will run from West Croydon Station to Queen Street before traveling down Port Road to the Central Business District.

Key Aspects

- **Buses** will be provide a substitute for the train service from West Croydon to the Central Business District

Traffic management provision to made to ensure safe and effective operation of this service:

- Criteria that needs to be met:
  - Minimum delays
  - The service level for the Community surrounding
- The site is maintained
- Does not interfere with the other heavy vehicle movements
TRAFFIC MANAGEMENT

Truck Access To The construction Site

- **South Road** will be the main access for truck and other heavy vehicles
  - Access the construction site
  - Sufficient turning circles for trucks
  - Rail line
    - Rail line width 17.08 m
    - Rail line length is 983 m
  - Rail line will be used as storage
TRAFFIC MANAGEMENT

Detours

- Detours will be required for raising of girders (During Night)
- Detours are designed to provide safe alternative routes for road users

Stage One (Queen/Elizabeth Street closed) Stage Two (South Road is closed)
TRAFFIC MANAGEMENT

Detours

Stage Three (Coglin street closed)

Truck Detours
TRAFFIC MANAGEMENT

Fill Haulage Management

- Fill Source, 132 Frederick St
- Earthworks Storage Site
- Continues via south/Pt Wakefield Rd to lower light
- Earthworks Storage Site
- Casting Yard
- Fill Disposal Route
- Fill Supply Vehicle Routes
- Girder Transport Route
- Rail Easement
TRAFFIC MANAGEMENT

Emergency Management Route
TRAFFIC MANAGEMENT

Signage (After Construction)

- NO ENTRY (R2-4)
- CLEARANCE 4.6 m
- GIVE WAY
- Way Out
- 60 AREA
- 40 AREA
- END 40 AREA

AS 1742.4 – 2008
TRAFFIC MANAGEMENT

Signage (After Construction Map)

- Speed limit 60km/hrs
- Speed limit 50km/hrs
- No Entry
- No Left Turn
- No Right Turn
- Give Way
- Clear Way
- Clearance
- Park and Ride
- Way Out
- Parking with User Limitations
The Environmental Management Plan Objective

• Minimise environmental impacts and issues

• Ensure proper correction and prevention environmental measure are in place

• Define all environmental roles and responsible for all company personnel and visitors

• Environmental induction and training for all employees

• Manage and maintain environmental records and complaints
Environmental Aspects Considered

- Air Quality and Emissions
- Noise and Vibration
- Water Quality, Erosion and Sedimentation
- Clearing/Disturbance of Native Vegetation
- Fauna
- Waste Management and Soil Contamination
- Fire
The Environmental Management Plan

Each environmental aspect included the following:

- Action and Control Measures (mitigation strategies)
- Monitoring and Inspections
- Contingencies and Corrective Actions

They all also include a brief summary of the issues, Performance Objectives and Benchmark Criteria
Clearing/Disturbance Of Native Vegetation

The Issues

- According to the Department of Environment, Water and Natural Resources (DEWNR), the native vegetation is at low levels across South Australia’s remaining agricultural areas. Some places averaging less than 30% remaining with others regions containing less than 10%.
URBAN AND ENVIRONMENTAL

South-West Side of the Station
URBAN AND ENVIRONMENTAL

North-East Side of the Station
URBAN AND ENVIRONMENTAL

North-East Side of the Station

27 Day Terrace, Adelaide, South Australia, Australia
Address is approximate
Clearing/Disturbance Of Native Vegetation

Performance Objectives

• Aim to minimise the impact on native vegetation.

• Aim for no damage to endangered native vegetation on site.

• Aim to minimise the potential for the introduction and spread of weeds.
Clearing/Disturbance Of Native Vegetation

Benchmark Criteria

- Native vegetation areas outside of the work site will remain in a healthy undisturbed state.

- Native vegetation that is removed is stored for reuse.

- After completion of works, disturbed areas are to be rehabilitated.

- Ensure successful revegetation.
Clearing/Disturbance Of Native Vegetation

Action and Control Measures

- No clearing and disturbance of the vegetation beyond the design drawing.

- Ensure that all mulch and other native vegetation that is cleared are removed to stored facilities where it can later be re-used during the rehabilitation and revegetation phase.
Urban Planning
The Plan for Improved Urbanisation Includes:

- A connected transport system which will form the backbone of the urban environment;
- Walkable neighbourhoods;
- People living in the best places, near parklands, waterways and vibrant centres;
- A design that compliments the surrounding neighbourhoods;
- The ability to encourage future growth within the area.
Bridge and Platform Design

• It has been decided that the train station will be elevated above ground level and moved to the eastern side of Queen Street.

• The relocation of the train station was employed so that the bridge could start declining straight after Queen Street.

• A newly created station will be designed to encompassed a track crossing, stair well, and lift.

• These features are designed with the intention of pedestrian and cycling integration with the train facilities.
URBAN AND ENVIRONMENTAL

Bridge and Platform Design

- 2.0m Wide Walkway
- 1.5m Wide Bicycle Lane
URBAN AND ENVIRONMENTAL

Bridge and Platform Design
URBAN AND ENVIRONMENTAL

Bridge and Platform Design

- Existing Train Station Catchment (Red)
- New Train Station Catchment (Blue)
Aesthetics

- The rail bridge can be quite an intrusive object to the visuals for the area. This is why certain measures have been taken to mask the structure from the residents (barrier etc). This will also aid to keep the privacy of the neighbourhood.

- The entire area along Euston and Days Tce will be revegetated with a hedge.

- A noise barrier will also be implemented to account for the many households living along the area.
Selling to the Community

- Flyers
- Advertising
- Community meetings prior to the start of the project, during and afterwards.

Focus on the highlights of the projects

- Creating a better community, allowing for a more vibrant and aesthetically pleasing area.
- Increase Overall Land Value
- Lower Greenhouse Emissions per capita due to the upgrade Railway
- Local Business will most likely improve as well due to the increased activity of the area.
CONSTRUCTION

DETAILED DESIGN
SITE DESCRIPTION

Located at Croydon, at the intersection of South Road and the Outer Harbor Railway Line
SITE AMENITIES AND TEMPORARY SERVICES

• Temporary buildings including sanitary facilities and safety equipment will be provided.

• Facilities will comply with statutory and local requirements.

• The contractor will provide all installation and payments for any temporary services.
PRESERVATION OF SURROUNDING AREAS

• The contractor will make the best effort to minimise the area of the land affected by the works

• Damage to the surrounding allotment areas shall be repaired immediately at the contractors expense
SITE MEETINGS

• Site meetings will be held weekly. The time of the meeting shall be organised by the project superintendent.

• The contractor shall provide office accommodation for on site for meetings and make appropriate senior staff available for all meetings.
EXISTING SERVICES

• The contractor shall protect and maintain all existing services such as drains and public utilities.

• Any damage to these services will be repaired at the contractors expense
NUISANCE

• The contractor shall make all possible effort to minimise noise, dust, mud, vibration and any other nuisance.

• All machinery shall be fitted with effective silencing equipment.

• Work on site on Sundays shall not be scheduled on a regular basis, except in an emergency.
PROTECTION OF EXISTING VEGETATION

• The contractor shall not remove, disturb or modify any existing vegetation unless indicated by the contract document.

• The contractor may apply for the removal of vegetation to the superintendent if it is an impediment to carrying out the works.

• The contractor shall be liable for any damage caused to vegetation.
WORK IN EXISTING ROADWAYS

• Contractors shall give at least two days warning to local councils and the superintendent before commencing work on existing roadways.

• The contractor shall not unnecessarily obstruct any road, and must undertake all necessary steps to maintain the satisfaction of the local council, police and superintendent.
FOREMAN AND SUPERVISORY STAFF

• Adequate supervisory personnel must be assigned to the project to ensure that works are constructed in accordance with this specification and the construction program.

• Additional personnel may be assigned to the project if the supervisor is not satisfied this is being achieved.
TECHNICAL SPECIFICATIONS

Technical Specifications have been assembled for all contracts, including:

1. The Overpass
2. The Car Park
3. Traffic Management
4. Earthworks and Civil Works
OVERPASS

Specifies all requirements of the overpass construction.

Concrete

- Precast
- In-Situ
- Formwork

Bridge Super-Structure
CAR PARK

Outlines specifications of the car park construction
Earthworks
Pavement construction
Concrete works
Storm water drainage
TRAFFIC MANAGEMENT

Outlines requirements for traffic management
Placement of temporary signage
All signage to comply with standards outlined by the Department of Planning, Transport and Infrastructure
Lighting Placement
EARTHWORKS AND CIVIL WORKS

Outlines the requirements for earthworks and civil works

Procedures for excavation and removal of top soil

Storm water drainage

Pavements
TRAFFIC MANAGEMENT

Prepare traffic detours
GROUND ELECTRICITY

• Ground electricity in the immediate area and current rail line is used to nullify any potential hazard.
EARTH EXCAVATION

• The earth excavation and digging trenches are done prior to the installation of footings and abutment walls.

• Bore holes are drilled for reinforced concrete piles.

• Install reinforcement into bore holes.
PILES

• Concrete piles are poured filled using standard concrete trucks.

• Reinforcement of pile caps are then installed. Reinforcement is to be assembled on site.

• Concrete pile caps are poured.

• Excavation for pile caps to support the piers of the overpass are then begun.
Bore holes are then drilled for reinforced concrete piles at the bottom of the pile caps.

Reinforcement is installed into bore holes. Reinforcement is to be assembled off site and trucked onto site.

Fill bore holes with concrete.
PILE CAPS

• Reinforcement of pile caps are installed on site.

Pour the pile caps.
PRECAST WORK

Install reinforcement and formwork of piers.

Cast the piers in-situ.

Precast headstocks are to be trucked on site.

T5 girders are to be precast and trucked on site.
FINAL STAGE FOR RAIL BRIDGE

- Excavate earth, in preparation of abutment installation
- Laying of formwork for bridge slab deck.
- Reinforcement of bridge slab to be installed on site.
- Slab deck to be cast in-situ using boom pump
- Preparation of deck to lay new tracks down.
- Install rail lines on overpass.
- Landscape pedestrian path
- Prepare access areas for users and mark cycle path.
CAR PARK

Construction to commence once bridge super structure is in place and it’s safe to commence work beneath it.
EXCAVATION AND SERVICES

Trench’s excavated for storm water, sewerage, water and common services.

Any unsuitable material in the excavated trench will be replaced

Services to be placed in trench and there required tolerances

Services to be connect to existing networks and run to their required positions.

The location of their entry’s to be marked and raised above the level of the pavement.
CONSTRUCTION

After placing the services in the excavated trench the trench will be back filled and compacted with care taken not to damage any of the newly installed services.

Any existing utility covers to be raised and or marked to the new level of the pavement in the car park.

Construct curbs and spoon drains and other concrete works and then backfill, compact and fill to these works.

Sub grade to be swept of all loose material such as, dust, dirt and foreign matter.

Sub base course to be spread, watered and rolled. This process is repeated for base course.
ENTRIES

The car park entries with existing roads are “cut” to allow entry to car park. Existing curbing and water tables to be connected with new curbs and water tables.
CONSTRUCTION METHODOLOGY

Apply concrete formwork in slab sections

Reinforcement mesh in concrete to be placed in the supper half of the pavement base

Reinforcement to be handled to insure the sheets are free from undue distortions or kinks

Bar chairs to be placed at rectangular grid
FINAL STAGE

Concrete to be poured to a thickness of 80mm

Control joints to be placed at 3m intervals whilst the concrete is wet.

Concrete to be continuously wetted till it has cured to reduce cracking and to increase concrete strength

Once concrete has cured formwork is to be removed.

Sample of concrete to be taken from both curb and pavement to be tested to check conformity to design.

Concrete finishing to be applied at services and covers so as to evenly bring the services and covers to the pavement level to ensure no jagged outcrops.

Line markings for parking spaces, directional arrows, and handicapped parking to be applied as per design.

All services to be connected and final finishes applied.
GANTT CHART

• Refer to the construction methodology report
Occupational Health and Safety

• All Contractors shall comply in full with all applicable regulations of the Act.

• The Developer will have to erect and maintain suitable signs and fencing at all times during the day and night on and around working areas to protect the public.
OCCUPATIONAL HEALTH AND SAFETY AND RISK MANAGEMENT

DANGER
CONSTRUCTION SITE
NO UNAUTHORISED ENTRY

HARD HATS
EYE PROTECTION
EAR PROTECTION
FOOT PROTECTION
HIGH VISIBILITY VEST

The Required PPE above MUST BE WORN IN THIS AREA
Risk Management

• Very important to identify and coming up with prevention, to:
  
  ➢ Improve the safety of construction site.
  
  ➢ Prevent delays hazard to the construction

• Financial penalties will be apply to help deter delays to construction.
## Common Risk Activity

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hazard</th>
<th>Precaution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working at heights</td>
<td>Risk of falling</td>
<td>Work with harnesses</td>
</tr>
<tr>
<td>Fire</td>
<td>Fire</td>
<td>Fire alarm, fire wardens, Easily accessible Firefighting equipment (e.g. fire extinguishers)</td>
</tr>
<tr>
<td>Electrical equipment</td>
<td>Electricity</td>
<td>Electrical Appliance Inspection, Testing and Tagging Program</td>
</tr>
</tbody>
</table>
### Activity

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hazard</th>
<th>Precaution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working with machinery</td>
<td>Pinch points</td>
<td>Only authorized personnel to use machinery</td>
</tr>
<tr>
<td>Emergency procedures/Excavation</td>
<td>Unable to escape during an emergency</td>
<td>Detailed evacuation process, evacuation assembly points</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Chemical contact with skin/ eyes</td>
<td>Always wearing protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No eating, drinking or smoking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wash hands/self with soap</td>
</tr>
</tbody>
</table>
Common Delay Risk

<table>
<thead>
<tr>
<th>Description</th>
<th>Probable Consequences</th>
<th>Risk prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material delays</td>
<td>Delay in works, additional cost</td>
<td>Financial penalties</td>
</tr>
<tr>
<td>Inadequate materials</td>
<td>Delay in works, additional cost</td>
<td>Financial penalties Regular checks of material</td>
</tr>
<tr>
<td>Incorrect geotechnical</td>
<td>Delay in works, additional cost</td>
<td>Financial penalties</td>
</tr>
<tr>
<td>reports</td>
<td></td>
<td>Secure funding</td>
</tr>
<tr>
<td>Funding</td>
<td>Delay in works</td>
<td></td>
</tr>
</tbody>
</table>
Risk Forms

- Need to be filled out Work Safe Statement (WSS) and Risk Prevention form (RPF) for each task of construction process.

- Prevent accidents from happening by letting involved people in that job the risks involved and how to prevent them from happening.

- Hazard Materials Form (HMF) needs to be filled out to make sure all the required steps are undertaken to prevent a spill.
## Work Safe Statement

<table>
<thead>
<tr>
<th><strong>Work Safe Statement (WSS)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name of Organisation:</strong></td>
<td><strong>Person Responsible:</strong></td>
</tr>
<tr>
<td><strong>ABN:</strong></td>
<td><strong>Contact Name:</strong></td>
</tr>
<tr>
<td><strong>Address:</strong></td>
<td><strong>Contact number:</strong></td>
</tr>
</tbody>
</table>

### Project Details

<table>
<thead>
<tr>
<th><strong>Name of Project:</strong></th>
<th><strong>This WSS has been developed with:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Date:</strong></td>
<td><strong>Reviewed by:</strong></td>
</tr>
<tr>
<td><strong>Location:</strong></td>
<td><strong>Position:</strong></td>
</tr>
<tr>
<td><strong>Date:</strong></td>
<td><strong>Date:</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Work Activity:</strong></th>
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<table>
<thead>
<tr>
<th><strong>Trade/Resources used:</strong></th>
</tr>
</thead>
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<table>
<thead>
<tr>
<th><strong>Equipment used:</strong></th>
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<table>
<thead>
<tr>
<th><strong>Maintenance Checks:</strong></th>
</tr>
</thead>
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<table>
<thead>
<tr>
<th><strong>Materials involved:</strong></th>
<th><strong>Hazardous (check)</strong></th>
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<table>
<thead>
<tr>
<th><strong>Occupational health and Safety Legislation:</strong></th>
</tr>
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<table>
<thead>
<tr>
<th><strong>Codes/Standard related with works:</strong></th>
<th><strong>Australian Standard AS</strong></th>
</tr>
</thead>
</table>
## Risk Prevention Form

<table>
<thead>
<tr>
<th>Task</th>
<th>Activity</th>
<th>risk value</th>
<th>Hazard</th>
<th>Risk Control</th>
<th>Date</th>
<th>Check</th>
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</thead>
<tbody>
<tr>
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</table>

Checked by

Signature

Date
<table>
<thead>
<tr>
<th>Hazardous Materials Form</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Company Name</strong></td>
</tr>
<tr>
<td><strong>Contractors Name</strong></td>
</tr>
<tr>
<td><strong>Material Name</strong></td>
</tr>
<tr>
<td><strong>Chemical Name</strong></td>
</tr>
<tr>
<td><strong>Common Name</strong></td>
</tr>
<tr>
<td><strong>Manufacturer</strong></td>
</tr>
<tr>
<td><strong>Material Type (tick One)</strong></td>
</tr>
<tr>
<td><strong>Physical State (tick One)</strong></td>
</tr>
<tr>
<td><strong>Storage (circle)</strong></td>
</tr>
<tr>
<td><strong>If ticked other. Name storage Container</strong></td>
</tr>
<tr>
<td><strong>Storage Temperature (°C)</strong></td>
</tr>
<tr>
<td><strong>Potential Hazards</strong></td>
</tr>
<tr>
<td><strong>Protective clothing to be worn</strong></td>
</tr>
<tr>
<td><strong>Steps to prevent spillage, fire or Accident</strong></td>
</tr>
<tr>
<td><strong>First Aid Requirements</strong></td>
</tr>
<tr>
<td><strong>Emergency Procedures</strong></td>
</tr>
<tr>
<td><strong>Check Interval</strong></td>
</tr>
<tr>
<td><strong>To be Checked By</strong></td>
</tr>
<tr>
<td><strong>Additional Information</strong></td>
</tr>
<tr>
<td><strong>Checked by</strong></td>
</tr>
<tr>
<td><strong>Signed</strong></td>
</tr>
<tr>
<td><strong>Date</strong></td>
</tr>
</tbody>
</table>

Amount (Kg or L)  
Radioactive (Tick and Highlight)  
Tank on Truck  
Other  
Storage Pressure (Kpa)
General Site Safety Rules

- Personal Protection
  - Wear personal protective equipment where signage requires.

- Alcohol and Drugs
  - No alcohol or illegal drugs consumed before or during working hours.
  - Persons affected by alcohol or drugs have to leave work sites and will be assisted in seeking treatment.
• Equipment
  
  o Only be used for purpose it is intended and accordance with the manufacture’s instruction.
  
  o Only truck drivers with correct licenses are to be used to drive trucks.
  
  o Any defect identified shall be reported to the site supervisor and be fixed before.
OCCUPATIONAL HEALTH AND SAFETY AND RISK MANAGEMENT

Cont.

• Loading and unloading plant
  o Loading/unloading on level ground using an observer.
  o In wet conditions, check surface conditions to be driven on before loading.

• Safety Awareness
  o Follow safety rules as safe work methods, safety signs and instruction
  o Report all hazards to site supervisors
COSTING

In total, the costing is $41.6 millions (Including tax and 5% of contingency)

<table>
<thead>
<tr>
<th>Description</th>
<th>Total Amount ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthworks</td>
<td>642,600</td>
</tr>
<tr>
<td>Pavement</td>
<td>263,470</td>
</tr>
<tr>
<td>Station</td>
<td>634,989</td>
</tr>
<tr>
<td>Bridge</td>
<td>4,650,482</td>
</tr>
<tr>
<td>Drainage</td>
<td>155,035</td>
</tr>
<tr>
<td>Transport</td>
<td>26,618</td>
</tr>
<tr>
<td>Labour (3 years)</td>
<td>35,238,000</td>
</tr>
</tbody>
</table>
THANK YOU FOR LISTENING
ANY QUESTIONS?