3. Further investigations

3.1 Community engagement

The community surrounding the proposed Southern Expressway Duplication and those with an interest in the project have been and will continue to be involved during the final design and throughout construction.

Before the initial concept was released, the opinion of the community was sought through a range of activities, including community information days and meetings, briefings and workshops with community groups, councils, government agencies and emergency services.

That information assisted with the formation of the initial concept design released in the Project Impact Report in May 2011. Numerous activities were undertaken to provide information and encourage submissions.

These activities included:

- the report placed online and displayed at libraries and council offices in the area
- two information days for residents, stakeholders and community organisations
- briefings, meetings and presentations with state and federal elected members, government agencies, emergency services, staff and elected members of Marion and Onkaparinga councils plus community groups
- responding to telephone and email enquiries and providing executive summaries on request.

The public was invited to make formal submissions to the concept design during the 20 business days following release of the Project Impact Report. In all, 320 people attended both community days and 53 formal submissions were received.

Key issues raised include:

- access to and from the proposed expressway, including a desire for southbound access to the expressway at the Reynella Interchange, a desire for a northbound exit at the Reynella Interchange and access onto the expressway at Majors Road
- noise, dust and vibration issues, particularly construction and post-construction noise affecting residents abutting the expressway corridor
- removal of rock by blasting on the Darlington escarpment and effects on nearby properties
- impacts on the local road network during construction
- vegetation and landscaping, particularly the impact on the Warriparinga Triangle and the Living Kaurna Cultural Centre vegetation areas, and the impact on Field River vegetation
- link with Darlington Transport Project
- land acquisition.

The active involvement of the community in the Southern Expressway Duplication will continue with the presentation of the final design and key construction activities towards the later part of this year, plus the program of works and traffic restrictions to come, and will continue during the project as construction evolves.
3.2 Employment and local industry

The project will support new investment and economic growth in the southern and Fleurieu regions by improving services, and to move goods and people.

Long term the expressway will form the southern-most part of the ultimate free flowing north-south corridor from Gawler to Old Noarlunga, removing the reversible operation of the existing expressway, making it permanently two-way. This project will open up access for business to markets and export facilities. In the short term, the construction project will create economic opportunities for local businesses and local employment opportunities.

3.2.1 Predicted employment and business opportunities

It is a state government requirement that all major infrastructure projects employ apprentices and trainees, Aboriginal people and local people with barriers to employment for at least 15 per cent of total labour hours.

This project will give people in the southern region the opportunity to gain new skills and trade qualifications and potentially begin a new career. Estimating employment opportunities is subject to various factors like skills availability, timing of required trades throughout delivery and the level of interest from unemployed people. However, using other projects as a guide, such as the Northern Expressway (completed in 2010), the following key points provide a good indication of how major infrastructure projects can address unemployment issues.

Pre-construction activities (relating to the department and its contractors):

- on average about one third of a typical contracted company’s labour force can be drawn from the local region during the course of the project
- about 80 per cent of businesses engaged can be classed as small and medium enterprises (SMEs) with up to 15 employees
- around 25 per cent of contractors involved in the Northern Expressway project took on additional employees that were in the main full time.

Construction phase (relating to the major contractor):

- on average about 40 per cent of a typical contracted company’s labour could be drawn from the local region to the project
- up to 60 per cent of companies engaged in the Northern Expressway project had up to 15 employees. These companies represented the largest sub-contractors
- a large percentage of jobs are expected to be full time
- a significant indirect flow-on effect is expected with approximately a third of companies hiring sub-contractors
- up to 45 per cent of surveyed contractors on the Northern Expressway project said that the project had led to increased investment in their businesses
- 25 per cent of companies on the Northern Expressway project employed Aboriginal employees.

The Department of Planning, Transport and Infrastructure (DPTI), in conjunction with the contractor, will establish a Local Industry Participation Plan and a Workforce Participation Plan as part of the project to achieve the targets set by the State Government.

In addition, the Member for Mawson, Leon Bignell is leading a taskforce to ensure that at least half of the workers employed on the project are from Adelaide’s southern region.
3.2.2 Areas of employment

Based on the experience of the Northern Expressway project, employment opportunities in the following areas are predicted for the Southern Expressway:

- irrigation
- noise attenuation
- fencing
- demolition
- earthworks
- bridge construction (steel fixing and concrete work)
- landscaping and wetlands
- vegetation removal and arboriculture
- electrical and lighting
- signs and line marking
- asphalt paving.

3.2.3 Business opportunities

There will be many opportunities for local businesses to supply materials and services during the project. These opportunities include directly supplying equipment and services for use by contractors or indirectly contributing to the project as part of the supply chain.

Local outlets, such as hardware suppliers, keen to get involved in the project could promote their products and services through avenues such as the Industry Capability Network (ICNSA), and their own websites. A broad range of local businesses also stand to benefit from the increased number of people being employed in the area through the project.

3.3 Non-Aboriginal Heritage

Distances between the expressway and registered heritage places (national, state and local) and non-registered heritage places as well as roadside significant sites have changed as a result of updates to the concept design.

The expressway will be further from Warriparinga than outlined in the Project Impact Report.

The location of the two non-registered places of heritage value at Warriparinga in relation to the current design are indicated in the table below. The historic water pump and shed are now located about four metres west of the current design. The historic Ford is now located around 35 metres west of the current design.

The following table details affected places and sites.
Table 3.1  Heritage places within proximity to the project corridor as listed in the South Australian Heritage Register and Council Development Plans, in addition to non registered heritage places

<table>
<thead>
<tr>
<th>SA Heritage Register ID</th>
<th>Heritage listing</th>
<th>Description</th>
<th>SA Heritage Register listed address</th>
<th>Approximate distance from nearest point on project area</th>
<th>LGA</th>
</tr>
</thead>
<tbody>
<tr>
<td>4375</td>
<td>State</td>
<td>Warrirapinga including Fairford House (sometimes referred to as Laffer Residence) Coach House (former Winery) and Grounds</td>
<td>Sturt Triangle, Sturt</td>
<td>±90 metres</td>
<td>City of Marion</td>
</tr>
<tr>
<td>5298</td>
<td>Local</td>
<td>Former Farmhouse</td>
<td>Main South Road, Hackham</td>
<td>±35 metres</td>
<td>City of Onkaparinga</td>
</tr>
<tr>
<td>-</td>
<td>Non registered</td>
<td>Historic water pump and shed located downstream of Sturt River Bridge</td>
<td>-</td>
<td>±4 metres</td>
<td>City of Marion</td>
</tr>
<tr>
<td>-</td>
<td>Non registered</td>
<td>Historic Ford located downstream of the Sturt River Bridge</td>
<td>-</td>
<td>±35 metres</td>
<td>City of Marion</td>
</tr>
</tbody>
</table>

Table 3.2  Roadside significant sites

<table>
<thead>
<tr>
<th>Road no.</th>
<th>Site no.</th>
<th>Road name</th>
<th>Side of road</th>
<th>Feature type</th>
<th>Approximate distance from nearest point on project area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Western alignment at Darlington Escarpment</td>
<td></td>
</tr>
<tr>
<td>10198</td>
<td></td>
<td>Main South Road, O’Halloran Hill (1.5 kilometres south of Seacombe Road)</td>
<td>East</td>
<td>Natural-Conservation reserve O’Halloran Hill Recreation Park, roadside width less than 8 metres, 700 metres in extent.</td>
<td>246 metres</td>
</tr>
<tr>
<td>68603</td>
<td>10271</td>
<td>Patapinda Road, Hackham (from the bridge over the Onkaparinga River to Paringa Parade)</td>
<td>East</td>
<td>Built/Cultural – Old Noarlunga Historic Township. 1.07 kilometres in extent.</td>
<td>60 metres</td>
</tr>
</tbody>
</table>

3.3.1  Management of impact

Potential impacts on the identified heritage places will be managed during construction through the implementation of a Contractor’s Environmental Management Plan (CEMP).
The CEMP will detail management and mitigation measures to protect non-Aboriginal heritage structures such as:

- delineated ‘no-go areas’ surrounding the registered and non-registered heritage places during construction with bunting or fencing along the construction interface
- vibration monitoring and management of construction activities as part of the Noise and Vibration Management Plan
- pre-construction property condition assessment surveys on buildings and structures of heritage value in proximity to the project area prior to the start of construction
- regular site audits.

Refer Figure 3.1 Non-Aboriginal heritage within Warriparinga.

For more information on environmental management during construction refer to Section 4.1 Environmental management.

3.4 Native title and Aboriginal cultural heritage

The project is located in the native title claim area of two native title applicants, the Kaurna and the Ramindjeri peoples.

The Department of Planning, Transport and Infrastructure (DPTI) has been advised by the Crown Solicitor’s Office that native title has been extinguished in all of the areas of land identified to be affected by the project.

The department has applied for a Section 23 exemption under the Aboriginal Heritage Act 1988 from the Minister for Aboriginal Affairs and Reconciliation. As a part of this application process, consultation with the Kaurna and Ramindjeri peoples has been facilitated by the Aboriginal Affairs and Reconciliation Division (AARD) of the Department of the Premier and Cabinet. An additional archaeological and anthropological survey has since been undertaken and the results are being considered by the Minister, together with the application.

The CEMP will include management measures and procedures to be followed in the event of the discovery of Aboriginal sites, objects or remains including any approval requirements.

For more information on environmental management during construction refer to Section 4.1 Environmental Management.

3.5 Flora

Approval will be obtained under the relevant legislation prior to any vegetation removals. The contractor will need to adhere to any conditions of these approvals and all vegetation impacts will be offset (refer Section 3.5.3).

In developing the final design, the department and the successful design and construct contractor will minimise vegetation impacts during construction by implementing a range of mitigation measures as detailed in the CEMP.

For more information on environmental management during construction refer Section 4.1 Environmental management.
Table 3.3  Potential clearance of native vegetation

<table>
<thead>
<tr>
<th>Description and Location</th>
<th>Total area of remnant vegetation (ha)</th>
<th>Current Potential area affected (ha)</th>
<th>Percentage impact in remnant area (%)</th>
<th>Current design incl. west at Darlington escarpment*</th>
<th>Current design incl. west at Darlington escarpment*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remnant group 1</td>
<td>Remnant Blue Gum patch adjacent the existing alignment within O’Halloran Hill Recreation Park</td>
<td>0.05 ha</td>
<td>0.05</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Remnant group 2</td>
<td>Kangaroo Thorn and planted vegetation west of project area, east of Adams Road</td>
<td>0.32 ha</td>
<td>0.061</td>
<td>19.1%</td>
<td>19.1%</td>
</tr>
<tr>
<td>Remnant group 3</td>
<td>Riparian vegetation along Field River north and south of Young Street</td>
<td>1.95 ha</td>
<td>0.085</td>
<td>4.4%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Remnant group 4</td>
<td>Remnant Grey Box patch at Beach Road</td>
<td>2.7ha</td>
<td>0.132</td>
<td>4.88%</td>
<td>4.88%</td>
</tr>
<tr>
<td>Vegetation Association 1</td>
<td>Native grassland north of Christies Creek, west of project area</td>
<td>0.04 ha</td>
<td>0.00035</td>
<td>0.88%</td>
<td>0.88%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>5.06 ha</strong></td>
<td><strong>0.246</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
</tr>
</tbody>
</table>

In total, at this stage of the design process, the area of native vegetation as defined in the Native Vegetation Act 1991 that is likely to be impacted is 0.222 hectares and two scattered native trees, which includes 0.132 hectares of the Grey Box Woodland (Remnant group 4), 0.04 hectares of Native grassland north of Christies Creek and 0.05 hectares of the Blue Gum patch (remnant group 1). The two native scattered trees are Eucalyptus Camaldulensis located within the O’Halloran Hill Recreation Park (refer Figures 3.2 to 3.7). At this stage it is likely that 77 significant trees (as defined by the Development Act 1993) will require removal during construction (refer Figures 3.2 to 3.7). For this project, the Act applies only to the City of Onkaparinga and the O’Halloran Hill Recreation Park.

In addition, there is native vegetation not covered by the Native Vegetation Act 1991 that is likely to be impacted. These are outlined in Table 3.3 above. Furthermore, 55 scattered native trees, not covered by the Native Vegetation Act 1991, are likely to be removed.

During the construction of the original Southern Expressway, vegetation was planted along the roadway to improve the amenity of the project. Approximately 14 hectares of amenity plantings and around 76,000 plants are likely to be removed during the construction.

Approval will need to be obtained under the relevant legislation prior to any vegetation removals. The contractor will need to adhere to any conditions of these approvals and all vegetation impacts will be offset (refer Section 3.5.3).

In developing the final design, vegetation removals will be optimised to minimise the impact.
Non-Aboriginal heritage within Warriparinga

Figure 3.1

- Property boundary
- Historic water pump and shed
- Historic Ford (indicative)
- Friends of Warriparinga revegetated area (indicative)
- State heritage listed place

Scale @ A4 1:2,000
Native trees to be removed
Significant trees impacted
Native vegetation removal

Impacted remnant native vegetation and significant trees

**Figure 3.2**
Map 1
Native trees to be removed
Significant trees impacted
Native vegetation removal

Impact remnant native vegetation and significant trees

Figure 3.3
Map 2
Native trees to be removed
Significant trees impacted
Native vegetation removal

Impacted remnant native vegetation and significant trees

Figure 3.4
Map 3
Impact remnant native vegetation and significant trees

Figure 3.5
Map 4
Southern Expressway Duplication Supplement Report

Figure 3.6
Map 5

Native trees to be removed
Significant trees impacted
Native vegetation removal

Impacted remnant native vegetation and significant trees
Figure 3.7

Map 6

- Native trees to be removed
- Significant trees impacted
- Native vegetation removal
- Impacted remnant native vegetation and significant trees
Only vegetation that cannot be avoided by construction activities will be allowed to be removed by the contractor. The contractor will implement a CEMP, which will manage and mitigate the impact on flora during construction.

For more information on environmental management during construction refer Section 4.1 Environmental management.

3.5.1 Additional surveys

Since the release of the Project Impact Report, two additional vegetation surveys have been conducted to better assess the potential impact of the current design and account for the construction footprint.

a. Western verge (mid blocks), including Seacombe Road south, eastern verge

This vegetation survey conducted in April and May 2011 primarily reinforced the findings of the initial survey, however two minor changes were noted:

- The project area is considered a high threat but low risk Phytophthora area. The actual amount of at risk or sensitive vegetation within the corridor is low, soils are not conducive to pathogen spread and there were no indications of the presence of Phytophthora noted. Controls may still be required in the low lying wetter areas such as the Field River and Christies Creek and their tributaries.

- Four additional significant trees were identified within the project corridor but not necessarily thought to be impacted by the project. As stated in the Project Impact Report, should any significant trees be identified as likely to be affected by the proposed project a Development Application will be submitted to the Development Assessment Commission for consideration and approval.

b. *Eucalyptus Microcarpa* (Grey Box) Woodland Environmental Protection and Biodiversity Conservation Act Investigations – Beach Road

A second survey was undertaken in July 2011 of the area west of the Beach Road Interchange potentially containing the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) listed *Eucalyptus Microcarpa* (Grey Box) Grassy Woodlands and Derived Native Grasslands of the South Australia ecological community.

The assessment of this remnant patch of vegetation was undertaken to determine if the area:

- meets the key diagnostic characteristics set out in the *Eucalyptus Microcarpa* Grassy Woodlands EPBC Act Listing Advice; and
- exceeds the minimum patch size threshold.

The patch was assessed against further criteria to establish whether it actually qualifies as a nationally threatened ecological community. The total patch was measured to comprise approximately 2.7 hectares. A sample quadrate was established (as required by the EPBC Act Listing Advice) and surveyed. The remnant patch was found to meet the condition thresholds for listing as a nationally endangered ecological community.

An EPBC Act referral to the Australian Government Department for Environment, Sustainability, Water, Population and Communities has determined that the proposed impacts are not a ‘controlled action,’ that is, not significant.
However, to minimise the impacts on the Beach Road Grey Box woodland, the following key measures will be implemented:

- minimising the construction footprint by steepening batter slopes and construction of retaining walls where possible
- delineating ‘no-go areas’ during construction with bunting or fencing along the construction interface
- no lay-down areas will be permitted near the Grey Box woodland area
- hand-digging will be required directly around Grey Box trees in this area
- all construction activities will be undertaken from the road side of the site wherever possible

Additional vegetation surveys of areas that may be impacted by the construction works are being undertaken. These areas include sites identified for stockpiles, haul roads and construction compound and lay down areas.

### 3.5.2 Offset and revegetation plantings

Offset and revegetation planting will be undertaken in accordance with legislative requirements and the department’s *Vegetation Removal Policy*. DPTI is currently undertaking a seed collection program of local plant species to ensure enough seed is available to deliver offset plantings using locally native species. Refer to Section 3.11 Visual amenity for the landscape planting palette.

### 3.6 Fauna

The project’s potential impact on fauna has been assessed using field surveys, desktop surveys and consultation with key community groups as well as state government agencies and local government.

As a result of the revised concept design, the impact on fauna habitat is summarised in Table 3.3, which shows that no significant changes to impact on fauna are expected in addition to those discussed in the *Project Impact Report*.

For more information on environmental management during construction refer Section 4.1 Environmental management.

### 3.7 Surface water and groundwater

#### 3.7.1 Water quality objectives

The potential impacts to water quality as a result of the project have been identified and assessed for all water courses in the project area. Measures to mitigate these impacts will be implemented during design and construction.

An initial Water Quality Risk Assessment (WQRA) was undertaken as part of the concept design involving various government stakeholders including:

- Department of Environment and Natural Resources
- Environmental Protection Authority South Australia
- City of Marion
- City of Onkaparinga
- Adelaide and Mount Lofty Ranges Natural Resources Management Board.
This assessment was updated as the design evolved and water quality monitoring and management requirements were defined more specifically.

The WQRA process will be further updated as part of the final design involving external stakeholders to refine the construction and operation mitigation measures. As an example, these measures will include surface cut off drainage systems at the top and bottom of batter slopes to control and avoid potential erosion impacts.

### 3.7.2 Existing water quality

Existing water quality for Sturt River, Field River and Christie Creek is compared against the Environment Protection (Water Quality) Policy 2003 criteria in the updated tables below.

**Table 3.4 Water quality summary for Sturt River**

<table>
<thead>
<tr>
<th>Criterion</th>
<th>EPA Water Quality criteria*^~</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salinity (mg/L)</td>
<td>1881</td>
</tr>
<tr>
<td></td>
<td>10% variation</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>13</td>
</tr>
<tr>
<td>Nitrate/Nitrite (mg/L)</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
</tr>
<tr>
<td>Phosphorus (mg/L)</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>pH</td>
<td>7.67</td>
</tr>
<tr>
<td></td>
<td>6.5-9</td>
</tr>
</tbody>
</table>

* as per the Environment Protection (Water Quality) Policy 2003
^ values are maxima
~ in fresh aquatic ecosystems

**Table 3.5 Water quality summary for Field River**

<table>
<thead>
<tr>
<th>Criterion</th>
<th>EPA Water Quality criteria*^~</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salinity (mg/L)</td>
<td>522</td>
</tr>
<tr>
<td></td>
<td>10% variation</td>
</tr>
<tr>
<td>TKN as N</td>
<td>0.89</td>
</tr>
<tr>
<td>Nitrate/Nitrite (mg/L)</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
</tr>
<tr>
<td>Phosphorus (mg/L)</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>Suspended solids (mg/L)</td>
<td>19.49</td>
</tr>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Copper (mg/L)</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>0.01</td>
</tr>
<tr>
<td>Zinc (mg/L)</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>Lead (mg/L)</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>0.005</td>
</tr>
</tbody>
</table>

* as per the Environment Protection (Water Quality) Policy 2003
^ values are maxima
~ in fresh aquatic ecosystems
Table 3.6  Water quality summary for Christie Creek

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Level</th>
<th>EPA Water Quality criteria*^~</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salinity (mg/L)</td>
<td>2711</td>
<td>10% variation</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>52.53</td>
<td>20</td>
</tr>
<tr>
<td>TKN as N</td>
<td>0.86</td>
<td>5</td>
</tr>
<tr>
<td>Nitrate/Nitrite (mg/L)</td>
<td>0.58</td>
<td>0.5</td>
</tr>
<tr>
<td>Phosphorus (mg/L)</td>
<td>0.07</td>
<td>0.1</td>
</tr>
<tr>
<td>pH</td>
<td>8.36</td>
<td>6.5-9</td>
</tr>
<tr>
<td>Suspended solids (mg/L)</td>
<td>50.15</td>
<td>20</td>
</tr>
<tr>
<td>Copper (mg/L)</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Zinc (mg/L)</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>Lead (mg/L)</td>
<td>0.00</td>
<td>0.005</td>
</tr>
</tbody>
</table>

* as per the Environment Protection (Water Quality) Policy 2003
^ values are maxima
~ in fresh aquatic ecosystems

3.7.3  Impacts / Effects of the project

As the concept design has been refined, the effects of the project have been reassessed. Details of the project effects on Field River are:

- Construction of the Reynella Interchange, including fly over on-ramp and duplication, will require the extension of the existing culvert under the expressway and re-alignment of a section of the river channel for approximately 300 metres south of the existing culvert as indicated in the Updated concept design found in Part B.

- North of the Young Street Bridge, approximately a 200 metre section of Field River will need to be realigned due to the project footprint unavoidably encroaching into the river channel. This realignment will occur parallel to the existing river channel as indicated in the Updated concept design found in Part B.

The design and management of these activities will be carefully considered by the department together with the contractor during the detailed design phase including consideration of the timing and staging of these works to minimise the potential for downstream impacts and effects to fauna during construction.

DPTI has been working with the Adelaide and Mount Lofty Range Natural Resources Management Board (AMLR NRMB) to obtain a Water Affecting Activities permit for these works as required under the Natural Resources Management Act 2004.

The relevant licences required under the Environmental Protection Act 1993 will also need to be obtained by the contractor from the Environmental Protection Authority (EPA) for any relevant dewatering, earthworks and drainage activities prior to these activities starting.

All reasonable measures will be taken to ensure the management of the Field River realignment works are completed in an environmentally sensitive manner and in accordance with any licence and/or permit conditions.

The Project Impact Report outlines the effects on other watercourses within the project area.
3.7.4 Mitigation measures

DPTI, with the contractor, will ensure the appropriate licences and permits are obtained from the EPA and the AMLR NRMB ahead of construction.

The WQRA identified that Earthworks and Drainage Licence will be required from the EPA and a Water Affecting Activities Permit will be required from the AMLR NRMB for the proposed realignment of Field River and Christie Creek as well as ‘Water Affecting Activities’ that will occur adjacent water courses within the project area:

The contractor will need to incorporate any permit and licence conditions into their CEMP.

For further details on construction environmental management measures, refer to Section 4.1 Environmental management and the Project Impact Report.

3.7.5 Stormwater drainage design

Since the release of the Project Impact Report in May 2011, the 1 in 100 Year flow rates for each watercourse crossing the expressway have been attained to confirm the capacity of culverts and associated structures, including erosion control measures at outlets. The predicted flows and required structures are listed in the table below.

<table>
<thead>
<tr>
<th>Watercourse</th>
<th>100 year ARI flow</th>
<th>Type of crossing</th>
<th>Location of nominated flow</th>
<th>Data Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sturt River</td>
<td>74 m³/s</td>
<td>Bridge</td>
<td>At bridge crossing</td>
<td>1997 BC Tonkin and Associates</td>
</tr>
<tr>
<td>Field River* (at Young Street)</td>
<td>48 m³/s</td>
<td>Pipe culvert</td>
<td>At upstream side culvert inlet</td>
<td>1998 BC Tonkin and Associates</td>
</tr>
<tr>
<td>Panalatinga Creek</td>
<td>72.5 m³/s</td>
<td>Box culvert</td>
<td>At Main South Rd crossing</td>
<td>2011 Tonkin Consulting</td>
</tr>
<tr>
<td>Grant Creek</td>
<td>21.7 m³/s</td>
<td>Bridge</td>
<td>At confluence with Field River</td>
<td>1998 BC Tonkin and Associates</td>
</tr>
<tr>
<td>Christie Creek</td>
<td>109 m³/s</td>
<td>Bridge</td>
<td>At Brodie Rd</td>
<td>2005 SKM</td>
</tr>
<tr>
<td>Hackham Creek</td>
<td>59.1 m³/s</td>
<td>Pipe culvert</td>
<td>At upstream side of culvert inlet</td>
<td>2011 Tonkin Consulting and consultation with City of Onkaparinga</td>
</tr>
</tbody>
</table>

*Field River catchment may have undergone further development since the 1998 study and the flow rates may have increased within the range of confidence.

In discussion with City of Marion, the hydrology for Hackham Creek has been updated. This flow rate has been revised down compared with the design flow rate used. Therefore there is considered to be excess capacity available within the existing culvert.

The contractor is required to undertake a headwater level check for the Field River and Panalatinga Creek culverts using the listed flow rates plus 10 per cent. This will be undertaken as a check to ensure that there are no flooding impacts on upstream levels.
3.7.6 Detention Basins

Stormwater runoff from both the existing and duplicated Southern Expressway carriageways will be treated using a series of both existing and new detention basins along the alignment.

In all, the changes to detention basins will include:

- construction of eight new basins
- upgrading 11 existing basins (including reshaping, relocation, re-vegetation and increasing capacity where required)
- retention of three existing basins that do not require modification
- removal of two existing basins (the replacement of which can be found in the Updated concept design in Part B.

3.7.7 Groundwater

No further investigations into groundwater depth or quality have been completed since the release of the Project Impact Report as these factors are highly dependent on rainfall and seasonal flow regime. Mitigation measures have also been discussed in the Project Impact Report.

3.8 Transport

3.8.1 Predicted level of service until 2031

Traffic flow performance of proposed interchanges and intersections has been forecast until 2031, including the additional northbound lane from the Reynella Interchange to Marion Road.

Overall traffic flow performance at intersections is reported as an indicative measure of the ratio of traffic demand to available capacity, or degree of saturation. A degree of saturation of one (1) is representative of an intersection that is at capacity. A result of not exceeding 0.90 is desirable. The expressway interchanges and intersections are forecast to operate under capacity, with a degree of saturation of less than one (1). The exception to this is the signalised junction at Darlington which is expected to have been replaced by 2031 as part of the Darlington Transport Project.

Table 3.8 Interchange / intersection performance during morning and afternoon peaks for forecast 2031 traffic volumes

<table>
<thead>
<tr>
<th>Section of road</th>
<th>Degree of Saturation (DOS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Morning peak</td>
</tr>
<tr>
<td>Southern Expressway / Main South Road signalised junction at Darlington</td>
<td>&gt; 1</td>
</tr>
<tr>
<td>Southern Expressway / Marion Road signalised interchange</td>
<td>0.86</td>
</tr>
<tr>
<td>Panalatinga Road/Southern Expressway / Main South Road signalised interchange</td>
<td>0.86</td>
</tr>
<tr>
<td>Kenihans Road / Panalatinga Road/Old South Road signalised intersection</td>
<td>0.78</td>
</tr>
<tr>
<td>Sherriffs Road / Southern Expressway diamond interchange</td>
<td>0.85</td>
</tr>
<tr>
<td>Beach Road / Southern Expressway diamond interchange</td>
<td>0.80</td>
</tr>
<tr>
<td>Southern Expressway / Main South Road signalised interchange at Old Noarlunga</td>
<td>0.79</td>
</tr>
</tbody>
</table>
The design of interchanges has been undertaken so that peak traffic queues are accommodated within the lanes provided and not extend to adjacent intersections or onto the expressway.

Traffic conditions along the mid block sections of the expressway (between interchanges) is assessed using a Level of Service (LOS) rating from ‘A’ through to ‘F’. The Austroads Guide to Traffic Management defines six ratings:

- LOS A – free flowing conditions
- LOS B – unrestricted stable conditions
- LOS C – restricted stable conditions
- LOS D – restricted conditions approaching capacity
- LOS E – close to capacity – unstable traffic flow
- LOS F – worst conditions – capacity exceeded, forced flow conditions.

Table 3.9 summarises the forecast performance of the mid block sections of the expressway in 2031. All sections are forecast to operate at LOS D or better in 2031 with the exception of the southbound direction from Main South Rd at Darlington to the Reynella Interchange.

The traffic analysis indicates that between Main South Road at Darlington to the Reynella Interchange, afternoon southbound traffic is not as concentrated as the morning northbound traffic, but rather spread across the afternoon period. This is because commuters generally leave work at different times in the afternoon, to collect children from school or to other after-work obligations. In addition, truck and van movements tend to be more concentrated in the morning peak compared to the afternoon. Therefore, the existing expressway can adequately cater for the afternoon northbound peak traffic until at least the mid-2020’s at which time an additional southbound lane may be required to meet the forecast traffic volumes.

Table 3.9  Mid block expressway performance during morning and afternoon peaks for forecast 2031 traffic volumes

<table>
<thead>
<tr>
<th>Expressway section</th>
<th>Peak</th>
<th>Direction</th>
<th>Total vehicles per hour</th>
<th>No of lanes</th>
<th>LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main South Road (Darlington) to Marion Road</td>
<td>AM</td>
<td>Northbound</td>
<td>4,571</td>
<td>3</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>AM</td>
<td>Southbound</td>
<td>2,056</td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>Northbound</td>
<td>2,510</td>
<td>3</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>Southbound</td>
<td>3,650</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Marion Road to Reynella interchange (grade of &gt; 6% for 1.6 km)</td>
<td>AM</td>
<td>Northbound</td>
<td>6,541</td>
<td>4</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>AM</td>
<td>Southbound</td>
<td>2,604</td>
<td>3</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>Northbound</td>
<td>3,380</td>
<td>4</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>Southbound</td>
<td>5,590</td>
<td>3</td>
<td>E</td>
</tr>
<tr>
<td>Reynella interchange to Sherriffs Road</td>
<td>AM</td>
<td>Northbound</td>
<td>3,823</td>
<td>2</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>AM</td>
<td>Southbound</td>
<td>1,614</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>Northbound</td>
<td>1,975</td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>Southbound</td>
<td>3,440</td>
<td>2</td>
<td>D</td>
</tr>
<tr>
<td>Sherriffs Road to Beach Road</td>
<td>AM</td>
<td>Northbound</td>
<td>3,728</td>
<td>2</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>AM</td>
<td>Southbound</td>
<td>2,003</td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>Northbound</td>
<td>1,949</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>Southbound</td>
<td>3,460</td>
<td>2</td>
<td>D</td>
</tr>
</tbody>
</table>
### Noise and vibration

#### 3.9.1 Noise modelling

Noise modelling has been completed on the updated concept design to determine the impact of the project on the surrounding area. The department’s *Road Traffic Noise Guidelines* have been used to establish the operational noise criteria that are applicable: 65 decibels during the day and 60 decibels at night. Developed residential areas as well as educational institutions, childcare centres, kindergartens and nursing homes are considered to be noise sensitive land users.

The noise modelling considers the existing topography, current and future traffic volumes, existing barriers (and impacts to existing barriers), the design and sensitive receivers. Existing noise levels were measured over a period of ten days and incorporated into the model.

#### 3.9.1.1 Noise modelling boundary

The duplication of the Southern Expressway will result in traffic using the road continuously in both directions. Therefore, noise for the surrounding community along the expressway corridor will generally increase. Where the noise modelling indicates that noise levels will exceed the *Road Traffic Noise Guidelines* noise criteria, reasonable measures to reduce the impact of the noise, are required. Treatment options are outlined in Section 3.9.2 *Noise treatment options*.

Only noise generated from the Southern Expressway will be treated as part of this project.

#### 3.9.1.2 Influences on Noise

Topography of the surrounding land and distance between the expressway and sensitive receivers can influence noise experienced by surrounding receivers. For example a road in a cut section has the potential to reduce noise as the batters can shield adjoining properties. The amount of noise reduction will depend on the topography of the area and the dimensions of the cut.

Barriers for noise are natural or constructed impediments placed in a location to block the direction of noise between the source and the receiver. Roadside barriers located in the road corridor between the road and sensitive receivers are able to reduce traffic noise by interrupting the path of the noise from source to receiver.

Barriers range in height from one to five metres with lengths dependent on the noise mitigation required.

When traffic noise reaches a barrier it will be:

- absorbed or muffled by the barrier; or
- reflected back towards the road; or
- diffracted by passing over the top of the barrier.

---

<table>
<thead>
<tr>
<th>Expressway section</th>
<th>Peak</th>
<th>Direction</th>
<th>Total vehicles per hour</th>
<th>No of lanes</th>
<th>LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beach Road to Main South Road (Old Noarlunga)</td>
<td>AM</td>
<td>Northbound</td>
<td>2,741</td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Southbound</td>
<td>2,032</td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>Northbound</td>
<td>1,321</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Southbound</td>
<td>2,850</td>
<td>2</td>
<td>C</td>
</tr>
</tbody>
</table>
The interaction of sound with a barrier is shown in Figure 3.8.

The noise reduction will improve as a receiver moves further into the shadow zone.

Noise modelling and noise attenuation requirements will be updated using new information during the detailed design phase. The department will continue to liaise with residents on proposed noise mitigation measures to reduce the impact of the expressway noise as new information becomes available. Verification noise modelling and monitoring will be conducted to ensure that installed noise treatments achieve the Road Traffic Noise Guidelines criteria.

### 3.9.2 Noise treatment options

There are a number of treatments that may be used to mitigate noise with attenuation requirements identified through the modelling of the updated concept design. These will be finalised in conjunction with the final design for the expressway duplication.

The proposed noise wall locations are shown in the Updated concept design in Part B where noise levels for the surrounding sensitive receivers exceed the Road Traffic Noise Guidelines criteria.

No noise walls are indicated where:

- the noise modelling indicates that the surrounding sensitive receivers will not experience noise levels exceeding the Road Traffic Noise Guidelines
- the surrounding topography acts as natural noise attenuation for surrounding sensitive receivers
- existing treatments like barriers, walls or fences may be retained if they are effective in meeting the noise criteria indicated for that location
- treatments of individual properties have been recommended to achieve the Road Traffic Noise Guidelines.

Locations that may require other treatments, like individual houses, have not been finalised and will be determined during the detailed design phase. The final project design will determine the treatments most appropriate for each property or area where noise attenuation may be required.
Overall, the noise treatment options will include:

- Traffic management and road design such as consideration of road gradient and surrounding topography
- Pavement treatments such as Open Graded Asphalt (OGA) or Stone Mastic Asphalt (SMA)
- Noise barriers such as earth mounds, fences or walls
- House treatments to doors or windows.

3.9.2.1 Traffic management and road design

At interchanges, traffic management and road design improvements such as co-ordination of traffic signals and provision of roundabouts, which smooth or reduce the traffic flow, can reduce traffic noise particularly from braking and accelerating vehicles.

Reducing the gradient of the road has the potential to reduce the noise of traffic accelerating uphill and using exhaust brakes when travelling downhill. However, the effect of changing the gradient is generally minor and not considered to be a cost effective measure for the reduction of traffic noise alone.

The existing surrounding topography has been considered in the noise modelling with any changes to the topography, including areas of new cut and fill, to be a key consideration in the design of noise mitigation measures. The location of cut and fill areas are indicated in the *Updated concept design* in Part B.
Photo 3.1 Cut section along the Southern Expressway
3.9.2.2 Pavement treatments

The type of road surface can have a considerable effect on the overall traffic noise level from a new or upgraded road and the noise mitigation measures that will be required. Reduction of noise generated from tyres rolling on pavement can dramatically reduce the overall noise from the roadway.

Two pavement treatments that can be used to decrease the traffic noise level are Open Graded Asphalt (OGA) and Stone Mastic Asphalt (SMA).

3.9.2.3 Earth mounds

Earth mounds can be effective road traffic noise barriers if the highest point of the mound is located close to the road. The extensive earthworks involved in the project will generate a large quantity of low-cost, excavated soil that could be reused to form mounds if the space permits.

As the height of an earth mound increases, so does the width (footprint) of the mound to ensure it is stable and that the batter slopes are not too steep for maintenance activities such as mowing and slashing grass.

Photo 3.2 An earth mound along the Southern Expressway

Where existing noise mounds may be disturbed by the new road footprint, noise attenuation will be reinstated where it is required. In some cases, where the new road is moving closer to property boundaries, there may not be the space to replace the noise mound. Instead other noise barriers may be required.
3.9.2.4 Noise Walls

Noise walls can be constructed from different materials, such as wood, steel and concrete. Various fittings are available, including precast concrete barriers, modular walls, and composite noise barriers.

Noise walls can be placed adjacent to the roadway itself or anywhere up to and including property boundaries, depending on the most appropriate location. The walls must at least break the direction of noise between the road and noise receiver to be effective.

Precast concrete walls are often used for roadside noise barriers as they are:

- effective in reducing noise impacts
- highly durable
- not easily vandalised

Photo 3.3 Southern Expressway
3.9.2.5 Safety barriers

Solid safety barriers, such as New Jersey precast concrete barriers, are common features on road corridors and often assist in reducing road traffic noise.
3.9.2.6 Modular walls

Modular walls consisting of compressed fibre cement skins around foam cores can be used as road traffic noise barriers in certain situations.

Photo 3.6 A modular wall

3.9.2.7 Fences

Colorbond steel, often used for property fences, can be an effective roadside barrier at heights of up to 2.4 metres.
3.9.2.8  House treatments

Treating houses is not the preferred method of noise attenuation as many are not suited to the upgrades. In some cases treatments may still be the most effective and practical solution, such as where property density is low or where there are isolated noise threshold exceedences.

Treatments can include treating or upgrading windows and glazing, window and door seals and sealing wall vents.

3.9.2.9  Vegetation

Vegetation has a negligible effect on noise reduction.

3.9.3  Construction noise

Construction noise emanates from the operation of heavy machinery. The department requires construction noise and vibration to be managed to achieve the outdoor noise targets for noise sensitive receivers of 55–65 decibels during the day and 50–60 decibels at night.

Potential noise impacts of construction activities must be identified by the contractor and appropriate mitigation measures implemented in accordance with the department’s operational requirements. All reasonable measures will be included in the Construction Noise and Vibration Management Plan (CNVMP).

Where possible, installation of permanent and temporary noise barriers will also occur early in the construction program to assist in mitigating noise effectively.
The majority of works for the project will be undertaken during daylight hours. However, to minimise disruption on the expressway during construction, it is likely that some construction activity will take place during the night (i.e. between 7pm and 7am Monday to Saturday and between 7pm and 9am on Sunday and public holidays).

Night works, when required, should be limited by the number of consecutive nights receivers are impacted to give respite from sleep disturbance. A Night Works Management Plan will be prepared which will include details for managing noise at night.

Residents that are likely to experience construction noise at night will be consulted prior to works commencing.

### 3.9.4 Vibration

The surrounding community immediately adjacent the expressway corridor is likely to experience some impact from construction activities such as minor blasting and compaction works.

Vibration activities that may impact on the surrounding community will be investigated and measures to mitigate impacts implemented. These will be detailed in the Construction Noise and Vibration Management Plan.

All blasting activities must be undertaken in accordance with Australian Standard 2187.2-2006 ‘Explosives – Storage, Transport and Use – Use of Explosives’ which contains guidelines for ground vibration levels for human comfort and control of damage to structures. A Blast Management Plan will be developed by appropriate experts to manage noise, vibration, dust and any other impacts associated with blasting activities.

Prior to the project commencing Property Condition Assessment (PCA) surveys will be undertaken for selected properties that may be subject to vibration from construction activities, including blasting and heavy machinery works.

PCA surveys are engineering assessments of properties undertaken by qualified inspectors to capture the condition of a property at that time. They include a site inspection and a report, which details the building type and condition.

PCA surveys are likely to be carried out for:

- heritage properties
- properties adjacent to areas of blasting
- properties immediately adjacent to construction activities.

The PCA survey reports will be retained as a baseline record of the condition of buildings and structures prior to construction. This will allow an accurate assessment of whether any impacts have occurred as a result of construction activities after works are complete.

The department will continue to liaise with the community and targeted property owners as more information becomes available.

### 3.10 Air quality

Since the release of the Project Impact Report, additional air quality modelling has been completed. The assessment reflected the latest traffic volume predictions and the updated concept design. This
updated assessment included a number of additional parameters, including the measurement of PM$_{2.5}$ (particle matter less than 2.5 microns) and air toxins (benzene, Polycyclic Aromatic Hydrocarbons [PAH], formaldehyde, toluene and xylene). All pollutants and toxins were evaluated against the Ambient Air National Environment Protection Measure (NEPM) and the Air Toxics NEPM (see Tables 3.10 and 3.11).

Air quality predictions were made for 2011 and 2021 using background air quality and wind direction information for a number of locations sourced from the EPA.

### 3.10.1 Results

The assessment showed there is no potential adverse impact from the majority of pollutants measured. The NEPM noted the following exceptions:

- Predicted concentrations of particles of 10 micrometers or less (PM$_{10}$) were marginally above the NEPM limit in the northern area at peak times three to five days each year due to winds in the area and the proximity of some houses to the expressway. Detailed consideration of PM$_{10}$ levels will be explored during the detailed design of the project.

- Predicted concentrations of annual average particles of 2.5 micrometres or less (PM$_{2.5}$) are above the NEPM limit due to high existing background concentrations of PM$_{2.5}$ in the region. However, the PM$_{2.5}$ levels are predicted to decline quickly with distance from the expressway. Also, the 24-hour NEPM limit for PM$_{2.5}$ is 25 µg/m$^3$ and present and future concentrations of PM$_{2.5}$ are expected to remain below this limit.

- The peak concentration of PAH is twice the NEPM limit of 0.0003 µg/m$^3$ at the centre-line of the expressway. However, the concentration drops to the NEPM limit approximately 25 metres to the west and 20 metres to the east of the centre-line.

The NEPM notes that if the limits are exceeded in the short term, adverse health effects do not automatically occur.

### 3.10.1.1 Comparison with the National Environment Protection Measure (NEPM) for Ambient Air

Table 3.10 Maximum expected project pollutant levels and comparison with the NEPM for Ambient Air

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>NEPM Standard</th>
<th>Allowable exceedances (NEPM Goal)</th>
<th>Approximate maximum expected project levels in 2021</th>
<th>Meets NEPM standards (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Monoxide</td>
<td>8 hour limit of 10.4 mg/m$^3$</td>
<td>1 day per year</td>
<td>Northern section: &lt;2.5 mg/m$^3$</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Southern section: &lt;1.5 mg/m$^3$</td>
<td>Y</td>
</tr>
<tr>
<td>Nitrogen Dioxide</td>
<td>1 hour peak 220 µg/m$^3$</td>
<td>1 day per year</td>
<td>Northern section: &lt;135 µg/m$^3$</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Southern section: &lt;100 µg/m$^3$</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Annual average 55 µg/m$^3$</td>
<td>None</td>
<td>Northern section: &lt;24 µg/m$^3$</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Southern section: &lt;20 µg/m$^3$</td>
<td>Y</td>
</tr>
<tr>
<td>Particles as PM$_{10}$</td>
<td>24 hour limit 50µg/m$^3$</td>
<td>5 days per year</td>
<td>Northern section: &lt;20.6 µg/m$^3$</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Southern section: &lt;35 µg/m$^3$</td>
<td>Y</td>
</tr>
</tbody>
</table>
3.10.1.2 Particles of 10 micrometers or less (PM$_{10}$)

In the southern section of the project area (where traffic volumes are lower) present and future concentrations of PM$_{10}$ are within the 24-hour NEPM limit of 50 µg/m$^3$. In the northern section of the project area (where traffic volumes are generally higher), future peak concentrations of PM$_{10}$ are marginally above the NEPM limit of 50 µg/m$^3$ at a few properties for 3 to 5 days each year, particularly during the morning traffic peak.

This seems to result from the high proportion of light winds from the north-east which align with the orientation of the expressway at the northern end as well as the narrow separation (less than 25 metres) between the expressway and some residential properties. Detailed consideration of PM$_{10}$ concentrations in the northern part of the project area is required during detailed design.

3.10.1.3 Particles with a diameter of 2.5 micrometers or less (PM$_{2.5}$)

The 24-hour NEPM limit for PM$_{2.5}$ is 25 µg/m$^3$ and present and future concentrations of PM$_{2.5}$ are expected to remain below this limit.

The annual average NEPM limit for PM$_{2.5}$ is 8 µg/m$^3$ and predicted future concentrations of PM$_{2.5}$ are expected to be above the NEPM limit due to high existing background concentrations of PM$_{2.5}$ in the region. However, the PM$_{2.5}$ levels are predicted to decline quickly with distance from the expressway.

3.10.1.4 Comparison with National Environment Protection Measure (NEPM) for Air Toxics

Table 3.11 compares the project pollutant levels to the NEPM for Air Toxics to assess the significance of predicted air toxic levels and the impact on health.

All air toxics are expected to meet the NEPM guidelines with the exception of Polycyclic Aromatic Hydrocarbons (PAH). The peak concentration of PAH is twice the NEPM limit of 0.0003 µg/m$^3$ at the centre-line of the expressway. However, the concentration drops to the NEPM limit approximately 25 metres to the west and 20 metres to the east of the centre-line. The NEPM notes that if these limits are exceeded in the short term, it does not mean that adverse health effects automatically occur.

Table 3.11 Maximum project pollutant levels and comparison with NEPM for Air Toxics

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>NEPM Standard</th>
<th>Approximate maximum expected project levels (at centre-line of expressway) in 2021*</th>
<th>Meets NEPM standards (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene</td>
<td>Annual average 9.35 µg/m$^3$</td>
<td>&lt;3.1 µg/m$^3$</td>
<td>Y</td>
</tr>
<tr>
<td>Polycyclic Aromatic Hydrocarbons (PAH)</td>
<td>Annual average 0.0003 µg/m$^3$</td>
<td>&lt;0.0006 µg/m$^3$</td>
<td>N</td>
</tr>
</tbody>
</table>
### Pollutant NEPM Standard Approximate maximum expected project levels (at centre-line of expressway) in 2021* Meets NEPM standards (Y/N)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>NEPM Standard</th>
<th>Approximate maximum expected project levels (at centre-line of expressway) in 2021*</th>
<th>Meets NEPM standards (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>Annual average 382 µg/m³</td>
<td>&lt;3.1 µg/m³</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>24-hour average 3,823 µg/m³</td>
<td>&lt;7.9 µg/m³</td>
<td>Y</td>
</tr>
<tr>
<td>Xylene</td>
<td>Annual average 912 µg/m³</td>
<td>&lt;8.9 µg/m³</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>24 hour average 1,140 µg/m³</td>
<td>&lt;7.9 µg/m³</td>
<td>Y</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>24-hour average 48 µg/m³</td>
<td>&lt;0.8 µg/m³</td>
<td>Y</td>
</tr>
<tr>
<td>Carbon monoxide (CO)</td>
<td>NEPM 8-hour limit of 10.4 mg/m³</td>
<td>&lt;2.3 10.4 mg/m³</td>
<td>Y</td>
</tr>
<tr>
<td>Nitrogen Dioxide (NO₂)</td>
<td>NEPM limits of 220 µg/m³ peak and 55 µg/m³ annual average.</td>
<td>&lt; 150 µg/m³ peak, &lt; 25 µg/m³ annual average.</td>
<td>Y</td>
</tr>
</tbody>
</table>

*levels decrease with greater distances from the centre-line of the expressway

### 3.10.1.5 Further assessment

At this stage, the materials and methods of road construction are still to be defined as part of the detailed design and construction method. The location and operation of any mobile asphalt plant will be the subject of a separate air quality assessment, once detailed design is underway and the location of the asphalt plant has been determined.

### 3.11 Visual amenity

The Southern Expressway Duplication provides an opportunity to enhance the landscape along the length of the route. Design elements will be included in the project to improve the appearance and visual amenity of the carriageway for roadway users and the surrounding community.

The final design will define the height and width of the duplication, new structural forms and their relationship to existing landform and vegetation.

The department is currently defining the scope of visual amenity opportunities which will include landscaping, noise barriers, bridges, walking trails, bike paths and opportunities for public art.

#### 3.11.1 Landscaping

A significant element of the landscape design will be the use of vegetation planting, especially at major interchanges and pedestrian walkways. Native plants will be used for replanting which have been collected from local seed sources wherever possible.

Refer Figure 3.9 Landscape planting palette

All vegetation removed as a result of the duplication will be offset in accordance with the department’s Vegetation Removal Policy as well as any legislative conditions of approval which include replanting.
### Landscape planting palette

#### Trees
- **Acacia melanoxylon**  
  Blackwood
- **Allocasuarina verticillata**  
  Drooping Sheoak
- **Allocasuarina muelleriana**  
  Slaty Sheoak
- **Callitris gracilis**  
  Southern Cypress
- **Eucalyptus porosa**  
  Mallee Box
- **Eucalyptus camaldulensis**  
  River Red Gum
- **Eucalyptus leucoxylon**  
  South Australian Blue Gum
- **Eucalyptus microcarpa**  
  Grey Box

#### Shrubs
- **Acacia acinacea**  
  Wreath Wattle
- **Acacia dodonaeifolia**  
  Hop Bush Wattle
- **Acacia ligulata**  
  Umbrella Bush
- **Acacia paradoxa**  
  Kangaroo Thorn
- **Acacia pycnantha**  
  Golden Wattle
- **Acacia retinodes**  
  Wirilda
- **Acacia victoriae**  
  Elegant Wattle
- **Atriplex suberecta**  
  Lagoon saltbush
- **Banksia marginata**  
  Silver Banskia
- **Bursaria spinosa**  
  Sweet Bursaria
- **Callistemon sieberi**  
  River Bottlebrush
- **Calytrix tetragona**  
  Common Fringe Myrtle
- **Dodonea viscosa ssp. spatulata**  
  Sticky Hop-bush
- **Goodenia ovata**  
  Hop Goodenia
- **Leptospermum lanigerum**  
  Silky Tea Tree
- **Melaleuca decussata**  
  Totem Poles
- **Melaleuca lanceolata**  
  Dryland Tea Tree
- **Myoporum montanum**  
  Native Myrtle
- **Myoporum viscosum**  
  Sticky Boobialla
- **Nitraria billardierei**  
  Nitre bush
- **Olearia ramulosa**  
  Twiggy Daisy Bush
- **Rhabodia parabolica**  
  Mealy Saltbush

#### Groundcovers
- **Astroloma humifusum**  
  Native cranberry
- **Atriplex semibaccata**  
  Creeping Saltbush
- **Billardiera cymosa**  
  Sweet Apple Berry
- **Carphobrotus rossii**  
  Pigface
- **Enchytraea tomentosa**  
  Ruby Saltbush
- **Hardenbergia violacea**  
  Native Lilac
- **Kennedia prostrata**  
  Running Postman
- **Kunzea pomifera**  
  Muntries
- **Myoporum parvifolium**  
  Creeping Boobialla

#### Clumping Plants
- **Austrodanthonia spp**  
  Wallaby Grass
- **Austrostipa spp**  
  Spear Grass
- **Bolboschoenus caldwellii**  
  Sea Club-rush
- **Carex bichenoviana**  
  Notched Sedge
- **Carex tereticaulis**  
  Tall Sedge
- **Chrysocephalum apiculatum**  
  Yellow Buttons
- **Cyperus gymnocaules**  
  Spiny Flat Sedge
- **Cyperus vaginatus**  
  Stiff Flat Sedge
- **Dianella revoluta**  
  Black Anther Flax Lily
- **Enneapogon nigricans**  
  Black Heads
- **Ficinia nodosa**  
  Knobby Club Rush
- **Juncus kraussii**  
  Sea Rush
- **Juncus pallidus**  
  Pale Rush
- **Lomandra densiflora**  
  Soft Tussock Mat Rush
- **Lomandra longifolia**  
  Spiny Headed Mat Rush
- **Scaveola albida**  
  Pale Fan Flower
- **Themeda triandra**  
  Common Kangaroo Grass

Note: Plant species selection is indicative only and is subject to confirmation in the detail design stage of the project.
within the road corridor. All plants removed will be offset on at least a one-for-one basis either through on-site plantings or investment into other local revegetation programs.

Screening plantings will be incorporated into the landscape design where space allows and where road safety requirements and Crime Prevention Through Environmental Design (CPTED) principals can be achieved.

3.11.2 Noise Barriers

As discussed in Section 3.9 Noise and vibration, noise barriers are proposed where the noise criteria will be exceeded at sensitive receivers.

As seen along the existing expressway, earth mounds can provide a landscaping opportunity to provide both acoustic and aesthetic benefits to residents directly adjacent. Earth mounds will be constructed for noise attenuation where space allows.

Noise walls, ranging from one to five metres in height, in locations shown in Part B, may be constructed where sufficient space for earth mounds is not available. Precast concrete walls will be preferred for roadside noise barriers as they are:

- effective in reducing noise impacts
- highly durable
- not easily vandalised.

It is possible to texture, pattern, colour and paint precast concrete to assist with the urban design objectives of a project to achieve an aesthetically pleasing result.

3.11.3 Bridges

All existing bridges along the expressway, except the Young Street Bridge, will be extended as part of this project. Any new bridges will be designed with the philosophy of retaining the character of the existing landscape and consideration will be given to achieving a visually balanced outcome.

3.11.4 Walking trails and bike paths

Priority will be given to retaining walking trails and bicycle paths wherever possible and retaining or creating open and recreational space throughout the project area. Where walking trails and bicycle paths may be impacted by the road design, these paths will be realigned and matched to existing paths to maintain pedestrian and cyclist safety and convenience as effectively as possible.

3.11.5 Community opportunities

The project presents an exciting opportunity to work with the community on the development of public art. The extent of public art requires further investigation and engagement with the community.
3.12 Geology, soils and site contamination

3.12.1 Geology and soils

Geotechnical investigations have been undertaken to confirm the soil and groundwater conditions along the length of the project to provide data for the design of the road pavements, bridge structures and earthworks.

Laboratory testing was done on varying soil types to determine suitability for reuse in earthworks fills, possible disposal requirements and the susceptibility to erosion.

Rock coring was undertaken to provide information for possible excavation or minor blasting methods. Drilling was completed along the proposed alignment with targeted boreholes adjacent to residential properties to gain an understanding of the possible noise and vibration issues.

Groundwater was generally not encountered within the proposed excavation depths to the road pavements. Groundwater can be expected to occur at shallower depths nearer the creek and rivers bordering the expressway.

3.12.2 Site contamination

Site contamination assessment in the field was undertaken, following desktop analysis. The assessment included sampling in the following areas:

- sites identified as low and medium risks during the desktop site history assessment
- soil mounds containing excess material stockpiled from the original expressway construction
- material located within overpasses and adjacent existing underpasses.

Results from the soil sampling of low and medium risk sites, soil mounds, overpasses and underpasses indicate only minor concentrations of chemical substances detected in several locations. In most instances the minor concentrations are likely to be caused by elevated natural concentrations in local soils. A few isolated occurrences of minor concentrations may be a result of introduced materials utilised in the construction of the existing expressway or as a result of activities conducted historically at these locations.

Concentrations of these chemical substances detected were above Environmental Protection Authority South Australia waste fill criteria but did not exceed intermediate landfill cover or intermediate waste soil criteria and are suitable for non sensitive uses such as road construction.

3.13 Greenhouse gases

A preliminary assessment of the greenhouse gas estimated to be generated from the project indicates that over 134,000 tonnes of emissions will be created and 71,649 tonnes, more than 50 per cent, of these emissions will be from the manufacture of construction materials.

3.13.1 Assessment tools

The department’s Greenhouse Gas Assessment Tool (GGAT) v3.1 (adapted by Parsons Brinckerhoff) and the Greenhouse Gas Assessment Workbook for Road Projects (developed by the Transport Authorities’ Greenhouse Group) were used to make this assessment.

The assessment was conducted on the current design.
The emissions were estimated from the following components of the project:

- land use change through vegetation clearing and ecosystem change
- earthworks
- vehicle transport at site and mobilisation
- fuel use by plant equipment
- emissions from manufacture of construction materials (e.g. concrete, steel, bitumen)
- construction of other infrastructure along the corridor for services, including:
  - electricity
  - water (potable)
  - water (recycled)
  - sewerage
  - gas
  - waste management.

Emissions that may be offset by landscape revegetation have not been considered as part of this assessment.

### 3.13.2 Results

Total estimated greenhouse gas emissions associated with construction of the project are shown in the table and graph below.

#### Table 3.12 Greenhouse gas emissions from the project's construction phase

<table>
<thead>
<tr>
<th>Summary of Emissions</th>
<th>Greenhouse gas emissions (t CO₂-e)</th>
<th>Percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stationary Energy</td>
<td>239</td>
<td>0.2%</td>
</tr>
<tr>
<td>Transport – Fuel Combustion</td>
<td>52,155</td>
<td>38.67%</td>
</tr>
<tr>
<td>Materials</td>
<td>71,649</td>
<td>53.1%</td>
</tr>
<tr>
<td>Vegetation Clearance</td>
<td>3,670</td>
<td>2.7%</td>
</tr>
<tr>
<td>Waste</td>
<td>7,115</td>
<td>5.3%</td>
</tr>
<tr>
<td>Other</td>
<td>42</td>
<td>0.03%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>134,870</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

![Graph showing greenhouse gas emissions](Figure 3.10 Greenhouse gas emissions from the project’s construction phase)
### Table 3.13 Breakdown of most significant material emissions

<table>
<thead>
<tr>
<th>Summary of material emissions (Scope 3)</th>
<th>Greenhouse gas emissions (t CO₂-e)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>35,661</td>
<td>49.7%</td>
</tr>
<tr>
<td>Steel</td>
<td>32,137</td>
<td>44.9%</td>
</tr>
<tr>
<td>Bitumen</td>
<td>3,360</td>
<td>4.7%</td>
</tr>
<tr>
<td>Other</td>
<td>491</td>
<td>0.7%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>71,649</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

### Figure 3.11 Breakdown of most significant material emissions

#### 3.13.3 Mitigation measures to minimise effects

Measures will be taken during the construction phase to minimise emissions, including improving energy efficiency, minimising vegetation clearing and replanting, using local materials to reduce transport and recycling and reusing materials.

#### 3.13.4 Final assessment

A more accurate assessment of the estimated greenhouse gas and mitigation measures will be completed by the successful contractor.

#### 3.14 Sustainability

Sustainability initiatives have been given further consideration since the release of the *Project Impact Report*. 
A Sustainability Management Plan (SMP) has been developed which includes measures to minimise impacts and identifies sustainability opportunities such as:

- minimise waste and increase use of recycled materials
- minimise energy consumption and greenhouse emissions
- protect water quality and implement water conservation and reuse
- protect and enhance biodiversity
- recycle cut and fill material for use in landscaping and road construction
- reuse rock and topsoil, reducing the need for quarried material
- utilise local stockpile sites to minimise haul distances
- use removed vegetation as mulch
- develop and implement a Soil Erosion and Drainage Management Plan to reduce erosion and runoff during construction and to maintain water quality
- implement noise mitigation measures for the community
- incorporate water sensitive urban design, including creation of wetlands to treat operational road runoff and create habitat
- revegetate using local native species to offset removals and improve amenity.

The SMP has been developed by the department and reviewed by the Sustainability and Climate Change Division of the Department of the Premier and Cabinet, which will continue to monitor progress.

Further initiatives will be included in the selected contractor’s final design, which may include:

- use of green power over and above the 20 per cent state government mandate for government operations
- substitution of hot mix asphalt with warm mix asphalt
- use of up to 20 per cent recycled asphalt pavement
- use energy efficient intelligent transport systems (e.g. electronic signage) and lighting
- use of alternative water sources (e.g. use recycled water rather than mains water)
- use of a mobile (temporary) asphalt plant on site to reduce material transport distances.

For more information on environmental management during construction refer Section 4.1 Environmental management.