# 35 Surface water and groundwater

## 35.1 Introduction

This section describes the existing flooding and drainage conditions within the study area relevant to the Port Wakefield Road Upgrade.

As mentioned in Section 20, whether surface or subsurface, water resources are precious within the Northern Adelaide Plains, an area which places a high importance on quality and quantity of water. Much of the region relies on the horticultural value of the land and the availability of suitable water resources to enable use of that land. Therefore the impacts of flooding and drainage on the land and any effects on the quality of water resources are important for the sustainability of the region, as well as the environment in general.

## 35.2 Assessment methodology

The same assessment methodology as outlined in Part D, Section 20 has been adopted for the Port Wakefield Road Upgrade.

## 35.3 Legislative and policy requirements

The relevant legislation and policies affecting South Australia's water resources are documented in Section 20.

## 35.4 Existing conditions

The existing conditions are summarised for flooding and drainage, groundwater and surface water quality.

### 35.4.1 Flooding and drainage conditions

The study area covers the catchments of three major watercourses; the Little Para River, Dry Creek and the Helps Road drain. Of these, the Little Para River is a natural watercourse while Dry Creek and Helps Road drain are man-made channels to the west of Main North Road. In addition to these major watercourses, Port Wakefield Road crosses a number of smaller sub-catchment drains along the proposed upgrade.

The location of the proposed road upgrade with respect to these catchments is shown on Figure 20.1.

#### Little Para River catchment

The Little Para River is an ephemeral river located between Dry Creek and the Gawler River, originating in the Mount Lofty Ranges. Downstream of Salisbury, the river is semi-perched with extensive meanders, typical of other rivers in the area.

Previous studies of the Little Para River drainage basin have identified limited hydraulic capacity of the Little Para River downstream of Waterloo Corner Road. Flood plain mapping indicated significant flooding would have occurred on average every 20 years, with flood flows flowing in a generally north-westerly direction towards the Helps Road drainage system. In response to this, an overflow channel has been

progressively constructed by the City of Salisbury to convey overflows which exceed the capacity of the main channel. The Little Para overflow channel passes underneath Port Wakefield Road to the north of the main river and discharges to the Helps Road drain just upstream of the 'Bolivar Flood Gap'.

The off-take to the Little Para overflow channel is designed to divert all flows in excess of the channel capacity of 30 $m^3/s$ downstream of that point to Port Wakefield Road. The estimated 100 year ARI peak flow at the off-take point is 56 $m^3/s$. Therefore the overflow channel is designed to convey the remaining 26 $m^3/s$ flow unable to be conveyed by the main river.

The Little Para River passes beneath Port Wakefield Road via bridge structures with a capacity in the order of 30 $m^3/s$.

### Helps Road catchment

The Helps Road drain is an artificially constructed channel of approximately 15 km, stretching across the Cities of Salisbury and Playford (BC Tonkin & Associates 1999). The catchment extends from the top of the Hills Face escarpment above Elizabeth in the east to Port Wakefield Road to the west. The southern boundary runs parallel to and just north of the Little Para River.

Flows from the greater catchment are intercepted by a series of man-made drains, with the Helps Road drain conveying stormwater west across the plains, underneath Port Wakefield Road and out into Barker Inlet. The catchment has a high degree of urbanisation, primarily residential with pockets of industrial and commercial in parts of Elizabeth and across the Edinburgh Defence Precinct (BC Tonkin & Associates 1999).

Due to the highly urbanised nature of the catchment, a number of flood detention facilities have been constructed within the drainage network to provide flood protection to the significant infrastructure within the catchment. The overall effect of these facilities has resulted in 100 year ARI standard of protection along most of these drains.

The estimated 100 year ARI peak flow within the Helps Road drain at the Port Wakefield Road crossing is 26 $m^3/s$. The Port Wakefield Road culvert is a box culvert which is estimated to have capacity in excess of the peak flow, and therefore it is not expected that flooding of the existing road will occur in the 100 year ARI event.

### Dry Creek catchment

The Dry Creek catchment is a drainage catchment bounded by the Little Para River catchment to the north and east, the River Torrens catchment and artificial drainage systems draining to the North Arm to the south and west. Land use within the catchment is predominantly urban, with a large residential component, but includes other land uses including recreational, extractive industries, commercial, industrial and partially developed low-density residential living areas (Brown & Root 2001).

Substantial works have been undertaken on Dry Creek to prevent flooding of adjacent developments, particularly through the Mawson Lakes development. Flood plain mapping of the Dry Creek catchment to Port Wakefield Road is currently being undertaken for the City of Salisbury. No results of this mapping exercise are currently available. For the majority of its length downstream of Main North Road, Dry Creek is an artificial channel to its tidal outlet at Swan Alley Creek.

The estimated 100 year ARI peak flow within Dry Creek at the Port Wakefield Road crossing is 205 $m^3/s$. The Port Wakefield Road crossing of Dry Creek is a bridge spanning the full width of the main channel, which has 100 year ARI capacity.

#### Local minor catchments

Port Wakefield Road crosses several local catchment drains, predominantly within the City of Salisbury local government area. Generally these drainage crossings have been designed and constructed to a 100 year ARI standard, or at least such that the road and adjacent properties are not affected during the 100 year ARI event.

Existing drainage infrastructure along Port Wakefield Road consists of a combination of swales, collector pits and small pipes draining into the larger sub-catchment drains indicated on Figure 20.1. The very flat nature of the area means that the drainage is in many areas inefficient but despite this, few existing drainage problems have been identified.

There is expected to be minimal effect on existing crossings and drainage infrastructure. Where necessary, existing crossings will be extended to accommodate any additional carriageway width.

### 35.4.2 Groundwater conditions

Port Wakefield Road is located in the area of groundwater management known as the Northern Adelaide Plains Prescribed Wells Area. The area contains relatively fertile soils underlain by a series of water-bearing beds of sand, gravels and limestone aquifers which have been heavily utilised by irrigators in the horticultural sectors of Virginia, Waterloo Corner and Angle Vale since the 1950s.

The groundwater conditions for Port Wakefield Road are described in Part D, Section 20.2.2.

### 35.4.3 Surface water quality

An overview of surface water quality is described in Section 20.2.3 and is not repeated in this section.

Little information is available on the surface watercourse quality immediately adjacent to Port Wakefield Road. Major stormwater detention basins such as the Greenfields and Kaurna Park wetlands together with numerous other small stormwater detention basins/wetlands also have the effect of reducing the load of stormwater pollutants reaching these watercourses and the Barker Inlet. However, water quality in other locations throughout the catchment gives an indication of the overall watercourse health and the load transported during run-off events. The generally variable nature of water quality is typical of the conditions at the downstream end of urban watercourses, as are the high turbidity levels and elevated nutrient and heavy metal concentrations recorded at some locations.

The proximity of Port Wakefield Road to the marine receiving environment (Barker Inlet) means that efforts should focus on preventing any increased stormwater pollution leaving the corridor. This will be particularly important during construction.

## 35.5 Effects of project upon existing conditions

### 35.5.1 General considerations

The proposed Port Wakefield Road Upgrade works intersect three major waterways; Dry Creek, Little Para River and the Helps Road drain, and several minor drainage systems. A construction project such as the one proposed has the potential to affect drainage and water quality during two distinct phases; the construction phase and the operational phase. The three primary impacts are physical changes to drainage infrastructure, changes in hydrological characteristics and additional pollution loads in local drainage systems and receiving waters.

This section considers all possible effects on the quantity and quality of local waters during the two phases of disturbance, while Section 35.66 proposes actions to prevent or mitigate identified effects.

## 35.5.2 Flooding and drainage

### Major watercourses

No works are proposed at the crossing of Dry Creek, the Little Para River or the Helps Road drain. There will therefore not be any effects on peak flows, flood levels or inundation periods within these watercourses. All three major watercourses currently have capacity for the 100 year ARI event, including the Port Wakefield Road crossings.

### Minor drains and watercourses

Minor drains and watercourses within the study area include the Whites Road drain, Lazurko drain, Little Para Overflow drain and the Greenfields wetland system. There are not anticipated to be any effects on these existing drainage systems as any additional impervious catchment resulting from the upgrade works will be small compared to the overall catchment size.

Where necessary, any existing pipes/culverts will be extended to accommodate any road widening.

### General flooding and drainage effects

Given the flat nature of the plains over which Port Wakefield Road traverses, even minimal modification to topography has the potential to cause the localised pooling of stormwater in undesirable locations. Waterlogged soils are more susceptible to damage by construction vehicles, and would necessitate treatment.

Some minor existing road drainage will be affected during construction as a result of the abandonment and/or relocation of some existing drainage infrastructure. If managed during construction, localised flooding during the construction phase can be avoided.

Long-term effects due to the road construction are expected to be minimal due to the negligible additional flows generated by the works. Where significant additional pavement widths are proposed within minor catchments, the stormwater design will make allowance for any minor additional flows and potential scour in individual sub-catchments.

Existing drainage infrastructure will be retained and utilised wherever possible.

## 35.5.3 Groundwater

### Effects due to general road construction

Potential effects on groundwater resulting from general road construction are considered to be low, due to lack of excavation at significant depth and the minor nature of the upgrade works. No changes to groundwater levels are expected. All other effects will be minimised by ensuring site practices follow the requirements of the Construction Environmental Management Plan. Shallow groundwater can be expected along some portions of the alignment, and therefore precautions to avoid accidental spills during construction will be required.

### Potential for contamination

Road run-off can contain pollutants resulting from normal use of the road, as well as from leaks, spills, and accidents. Pollutants can include hydrocarbons (petrol, diesel, oils), metals, nutrients and other compounds.

Port Wakefield Road has been in operation for many years, and therefore the risks are ones which already exist. There is not expected to be any significant increase to the risks of groundwater contamination due to the minor nature of the upgrade works.

## 35.5.4 Surface water quality

The potential effects on surface water quality during the construction phase and the operational phase are summarised below.

### Effects during construction

The highest potential risk to surface water quality in the watercourses and receiving environment would be during the construction phase, and would be related to the following:

- export of sediment and associated pollutants such as heavy metals and nutrients via wind and water erosion
- heavy metals, toxic organics and surfactants used by machinery and other vehicles in the road building process itself.

While the upgrade works proposed are relatively minor, the existing drainage systems and the proximity of the road to their outfalls mean that the risk of pollutants discharging to the gulf are relatively high during the construction phase unless effectively managed. The existing drainage systems have the potential to act as ready-made conveyance paths to Gulf St Vincent, with potentially significant effects on the marine environment potentially significant.

Bituminous materials used to surface roads emit a range of volatile organic compounds, the characteristics of which will vary depending on the solvents and surfacing materials selected for each job. A different range of chemicals are used to pre-treat the gravel surface prior to coating with bitumen. Pollution risk is high during the transport, storage and application of materials, and will be greater in the event of an on-site accident.

In addition to fuel combustion by-products, construction and other general vehicles will provide a range of potential pollutants including leaked fuels, battery acid, car-care products, coolants and lubricants, tyre, clutch and brake lining parts, larger pieces of metal, glass and plastic, and bulk materials spilled from open trays (e.g. soils, chemicals). Oils and grease typically adsorb (i.e. gather on a surface in a condensed layer) to suspended solids and may persist in sediment deposits for prolonged periods, affecting bottom-dwelling organisms. If present as a surface film, the hydrocarbons can disrupt the transfer of oxygen into the water body.

### Effects during operation

During normal operation, Port Wakefield Road has the potential to affect the water quality of Dry Creek and the Little Para River, and particularly Gulf St Vincent by introducing pollutants associated with the use of the road. These pollutants are normally associated with roads such as Port Wakefield Road and include:

- stormwater related pollutants

  - suspended solids from the road surface, embankments and open channel drains
  - pollutants, for example, heavy metals (such as zinc, cadmium, and to a lesser extent, lead) attached to sediment particles washed off the road surface
  - oil, grease and other hydrocarbon products
  - gross litter
  - organic material (grass clippings, leaves, etc.)
- accidental spillage of contaminants such as petrol, oil or other toxic compounds as a result of a collision or some other incident.

These pollutants have the potential to affect the environment in the following ways:

- suspended sediments reduce the clarity of water, thereby reducing light penetration, and cause siltation of downstream drainage systems and waterways
- heavy metals are toxic to aquatic organisms
- excess nutrients can encourage eutrophication of and algal growth within surface waters, particularly in slow flowing systems common across the Adelaide plains
- oils and grease are unsightly and can smother organisms in extreme cases
- accidental spills of hydrocarbons or chemicals can cause severe ecosystem damage and have the potential to leach into the shallow groundwater system, particularly within the Gawler River
- litter is unsightly, can create bad odours and can damage fragile ecosystems
- organic material can reduce dissolved oxygen levels when it breaks down and can create bad odours and discolouration of the water.

Port Wakefield Road has been in operation for many years and a stormwater pollution load already exists and is released to the gulf. The additional stormwater pollutants generated as a result of the upgrade works are expected to be negligible.

#### Accidental spills

Port Wakefield Road currently acts as a heavy vehicle transport route, which carries a variety of trucks carrying a range of hazardous substances. While the traffic volumes along this section of Port Wakefield Road are expected to increase, the proposed upgrades are also aimed at improving the safety of the road thereby reducing the potential for accidents. Nevertheless the risk of accidental spillage of hazardous materials will remain.

The management of these issues is addressed in the next section.

## 35.6 Environmental management

### 35.6.1 Principles adopted to minimise effects

Long-term operational effects associated with the Port Wakefield Road Upgrade are expected to be minimal due to the small changes proposed to the road in terms of run-off potential and stormwater

pollution loads. The principles to be adopted to minimise effects will focus on the construction phase, during which there is the potential for drainage and water quality effects.

From a water quality perspective, during construction, it will be important to treat stormwater run-off where drainage is directed to natural watercourses, urban drainage systems or environmentally significant areas. In addition, areas considered at a high risk in terms of spill potential should be considered for spill containment.

## 35.6.2 Measures to minimise effects during planning and design

### Flooding and drainage

The minor drainage system for the new road will be designed for a 5 year ARI capacity, consistent with the existing design standard. No upgrading of existing major waterway crossings is proposed.

All stormwater design will be undertaken in accordance with recommended principles in *Australian Rainfall and Runoff: A Guide to Flood Estimation* (Pilgrim [ed.] 1987) and consistent with DTEI standards.

### Water quality

Further evaluation of the effect on water quality within receiving environments will be undertaken during the planning and design phase, which will involve conducting a water quality risk assessment to gauge the likelihood and consequence of changes in water quality in specific areas. This will be done in line with DTEI's *Protecting Waterways Manual* (Transport SA 2002). Specific areas identified during the risk assessment process will be managed through the implementation of the management principles introduced throughout this section. Monitoring requirements during construction will also be determined through the risk assessment.

Key to the management of potential water quality effects will be the management of suspended sediment transported by stormwater. A Soil Erosion and Drainage Management Plan (SEDMP) will be developed prior to the commencement of construction. While soil erosion and the generation of sediment during construction cannot be entirely prevented, sound project planning and appropriate design of control measures will reduce the effect on water quality both on site and off site.

The SEDMP will be prepared in accordance with EPA guidelines, such as those contained in the *Stormwater Pollution Prevention Code of Practice for Local, State and Federal Government* (EPA 1998).

The design of sediment control facilities will be undertaken during the planning and design phase.

## 35.6.3 Measures to minimise effects during construction

Provided appropriate environmental planning has been undertaken in the initial design phase, the construction phase should simply represent the implementation of this plan.

### Flooding and drainage

Key to managing flooding and drainage issues during construction will be the maintenance of an adequate standard of drainage for the duration of construction works.

The upgrade works are relatively minor and are not expected to affect flow capacity within the existing drainage systems discharging west of Port Wakefield Road.

Some minor drainage systems may be affected during the construction, with abandonment and relocation of some existing drainage infrastructure. Temporary drainage outfalls will be constructed where necessary

and care taken to ensure flow paths are not blocked by the placement of temporary structures, such as dams, bunds or stockpiles. Drainage function will be maintained at all times.

### Surface water quality

#### *Erosion and sediment control*

Erosion and sediment control will be managed in a variety of ways during construction including:

- sedimentation basins and minor sediment traps
- hay bales and sandbags
- sediment fences.

A sedimentation basin is a dam designed to intercept run-off and hold it for a sufficient period to allow suspended sediment to settle before release. These basins reduce the release of sediments into creeks and receiving waters, and minimise damage to downstream ecosystems. They also reduce potential siltation of stormwater pipes, culverts and swales. Hay bales, sandbags and sediment fences act as a physical filter of the stormwater and are useful around headwalls and in swale drains. Existing roadside swales will be used as detention facilities where possible as space is limited for the construction of new basins.

Measures may be required to limit sediment tracking from the construction site onto adjacent roads, particularly and in close proximity to sensitive areas and watercourses. Treatments such as shaker ranks, wash-down bays or street sweeping will be used as required in accordance with appropriate guidelines.

The Soil Erosion and Drainage Management Plan (SEDMP) prepared during the design phase will be incorporated into the Construction Environmental Management Plan (CEMP) and implemented during construction. Erosion and sediment controls would also be designed during the detailed design phase. Many of the water quality control devices required during construction will form part of the final surface water quality treatment process.

#### *Management of toxic substances*

Pollution of ground and surface waters with toxic organics, oils, surfactants and heavy metals will be managed by following basic site management principles including the limited use of herbicides and pesticides (selecting a low toxicity compound suitable for aquatic environments); isolation of vehicle maintenance and refuelling to designated areas away from drainage lines, shallow aquifers and other sensitive features; and the appropriate storage of all hazardous liquids and solids.

A rapid response plan developed for spills and accidents will ensure minimal pollution risk away from centralised storage and maintenance sites.

### Groundwater

With recharge of Northern Adelaide Plains aquifers occurring primarily in the Mount Lofty Ranges, groundwater resources will be most vulnerable to contamination where shallow aquifers or natural recharge and/or leakage points exist. Key to limiting potential effects will be the containment and treatment of all site water and the diversion of natural surface flows away from the construction site. Where containment/treatment structures cannot be sited away from sensitive areas, alternative off-site locations or the use of impervious linings and isolation valves will be considered.

The greatest threat to groundwater quality is likely to be posed by spills and accidents, where there is the potential for large quantities of liquids to seep into subsurface systems once spilt on an unsealed surface. As discussed, spill containment and isolation structures should be installed in high risk locations, adjacent to central storage and servicing locations, and coupled with site risk management and induction for all construction workers. The implementation of a spill plan will be critical to facilitating a faster response and thus limiting potential effects.

### 35.6.4 Measures to minimise effects during ongoing operations

#### Flooding, drainage and surface water quality

As the upgrade works are relatively minor in terms of their long-term effects on flooding, drainage and water quality, no specific treatments are proposed for ongoing operations. The drainage and water quality situation will remain largely unchanged from the current situation; management of stormwater will continue in the same manner.

#### *Ongoing maintenance*

It will be important to ensure that drainage features are periodically monitored and maintained. This would include cleaning and mowing of swales and buffer strips, desilting of sedimentation facilities and replacement of damaged erosion protection.

#### *Accidental spill containment*

Port Wakefield Road currently acts as a heavy vehicle transport route, which carries a variety of trucks carrying a range of hazardous substances. While the traffic volumes along this section of Port Wakefield Road are expected to increase, the Port Wakefield Road Upgrade is aimed at improving the safety of the road thereby reducing the potential for accidents. Nevertheless the risk of accidental spillage of hazardous materials will remain.

Any new stormwater drainage swales along the road corridor will be designed to allow the use of temporary bunding and containment of run-off to mitigate potential effects of accidental spills.

A quick response to spills will be facilitated by a spill response plan (i.e. modified from the construction stage) identifying isolation points, vulnerabilities and an efficient chain of events to enable clean-up.

#### Groundwater

Groundwater across the Northern Adelaide Plains is monitored heavily to satisfy prescription requirements under State legislation. A regular appraisal of these results will enable the early identification of effects, but with an exhaustive planning and design phase, these are expected to be minimal.

## 35.7 Conclusion

The Port Wakefield Road Upgrade has the potential to affect local drainage systems and water quality during the construction phase, but not so much during the operational phase. The proposed works are anticipated to have negligible effects on the long-term drainage and water quality characteristics of the area.

Effects during construction will relate mainly to the export of sediment from the construction area, and the creation of short-term drainage problems if not properly managed. Sediment, and associated pollutants such as heavy metals, may enter existing drainage systems and be transported downstream which is of

particular concern due to the proximity of the works to the gulf. Siltation may also create flooding and drainage issues, as will the temporary blockage or abandonment of existing drainage infrastructure.

All potential effects are manageable through the implementation of a Soil Erosion and Drainage Management Plan (SEDMP) during the construction phase which will form part of the CEMP. This will address stormwater management during construction, and document erosion control measures such as hay bales and silt fences which will be utilised during construction.