catchments it is considered that the ability of actions within the SMP study area to influence water quality at the mouth of the river would be negligible.

For the purpose of assessing the potential impacts of discharges from the Gawler and Surrounds SMP on receiving water quality, the receiving waters are considered to be the North Para, South Para and Gawler River immediately downstream of the study area.

3.5.1 Current condition of receiving waters

A 2013 study by the EPA rated the health of the aquatic ecosystems within the South Para River in Gawler as "poor", with extended dry conditions and "evidence of human disturbance and nutrient enrichment". There are widespread introduced weeds in the riparian zone. The study concluded that "the South Para River at Gawler provides no significant environmental value", other than providing a connection from its upper catchment to the discharge point at the junction with the North Para River.

A similar study undertaken in 2008 for the Gawler River at Gawler rated the condition of the river as "very poor". It was noted that the ecosystem was in a severely degraded condition with major changes to both the animal and plant life, and that there was a significant breakdown in the way the ecosystem functions because of human impact. The study concluded that the impacts of urban stormwater, runoff from agricultural areas and drought had contributed to the highly disturbed condition of the stream. It is not known what, if any, changes to river system health have occurred since the 2008 report.

The closest available water quality data for the Gawler River is at the Virginia monitoring station (A5050510). The data covered the period March 2012 to March 2017 and included 52 water quality readings over this period. Comparison of the recorded data with the ANZECC guidelines confirms the observations made by the EPA. Total Phosphorus (TP) readings ranged from 15 µg/L to 1,590 µg/L with 75% of the readings exceeding the ANZECC guideline value (100 µg/L) for 'slightly disturbed' ecosystems in lowland rivers in south-central Australia. Similarly, records of nitrates (NO_x) shows levels exceeding the ANZECC guideline value of 100 µg/L for 77% of the samples, with recorded values ranging from 3 µg/L to 8,380 µg. It should be noted that the contributions from the township of Gawler are likely to constitute only a small portion of the recorded nutrients.

3.5.2 Fish passage

In 2011 the Adelaide and Mount Lofty Ranges Natural Resources Management Board SARDI undertook a study (Schmarr et al., 2011) to identify threats to aquatic biota movements and recovery that may impact the success of the environmental flow trials proposed for the South Para, Torrens and Onkaparinga Rivers.

The study of the South Para River extended from the Barossa Diversion weir (upstream of the SMP study area) to Gawler and identified 34 'threats'. The threats included weirs, fords, culverts, sudden drops in the channel invert, erosion, exotic species of vegetation and stormwater discharges.

One of the main threats that was identified is the Woodlands Weir, which is a flow monitoring site (A5050503) located within the SMP area. The weir (pictured in Figure 3.10) has been classified as "a catastrophic barrier to fish" (Ward, 2011).

Figure 3.10 Woodlands Weir flow monitoring site on the South Para (Source: WaterConnect)

3.5.3 Environmental flows

The South Para River and Gawler Rivers are prescribed watercourses as part of the Western Mount Lofty Ranges Surface Water Area.

The natural flow regime in the South Para River has been heavily impacted by the construction of dams and other water supply infrastructure. Diversions from the river have reduced flows downstream of the South Para Reservoir by up to 90% and have extended the duration and frequency of periods of no flows.

The Western Mount Lofty Ranges (WMLR) Water Allocation Plan (WAP) includes formal arrangements for environmental water provisions in the South Para. Results of a three-year environmental flow trial concluded that the provision of environmental flows alone was not sufficient to change long-lived plant communities (Gatti and Muller, 2016). The South Para was identified as being at risk of converting to drier emergent and terrestrial habitats due to the relatively dry catchment. No information can be found regarding ongoing environmental flows in the South Para.

Strategies for the management of stormwater within the catchment need to consider the environmental flow requirements of the receiving water bodies. Strategies should aim to generate flow regimes that mimic pre-development patterns as closely as practicable.

3.6 Tributary assessment

A key conservation objective in Council's development plan is: "[The] conservation, preservation, enhancement or improvement of land adjoining riverine environments". In addition to the main water courses, there are a number of tributaries that flow through the study area. Eco Management Services (EMS) was commissioned to undertake an environmental assessment of selected tributaries within the SMP study area. The high level assessment looked at the terrestrial and aquatic habitats of the tributary watercourses of the North and South Para Rivers (refer Appendix A).

3.6.1 Habitat and erosion assessment

3.6.1.1 Habitat value

The assessment found that the tributaries within the study area are highly modified with little natural habitat remaining—mainly as a result of clearing, urban development and grazing. Small sections of habitat with high environmental value were identified in some tributaries near where they joined with the North Para River.

In the lower reaches of Tributary 1 (refer Figure 3.12 for location of tributaries), some mature *Eucalyptus camuldensis* were identified with some minor regeneration. EMS noted that some replanting had been undertaken and that there is "much scope for habitat enhancement". Some aquatic pool habitat was also noted in the upper sections of Tributary 1. This tributary drains into the North Para River.

Tributary 6, which is within the Gawler East growth area, has a spring fed permanent pool and drains into the South Para River.

Any strategies relating to the management of stormwater within the SMP study area must be cognisant of these areas of environmental value. It should also be noted that the assessment was undertaken at a high level and that some valuable areas of habitat may not have been picked up by the study.

3.6.1.2 Erosion potential

The assessment of soil erosion risk was based on a desktop analysis using published methods for South Australia. The modelled soil erosion risk was determined based on the two key factors that influence water induced erosion of soil – the slope of the land and the inherent erodibility of the soil, as defined and mapped by previous studies.

The resultant classifications for the tributaries within the SMP study area is shown in Figure 3.12 which is an extract from the EMS report.

It can be seen that a number of the tributaries are classified as having a 'moderate' or 'high' erosion potential. Stormwater management strategies must take into account the areas identified as having a high erosion potential. In these areas, peak flow rates and velocities should not be increased and works to protect streams (e.g. planting, regrading of batters and erosion protection) should be considered as part of future developments.

The erosion risk of tributaries within the urban areas has not been classified. Observations within the study area have identified existing erosion within the urban section of the study area (An example of this is shown in Figure 3.11). It is recommended that prior to setting the stormwater management requirements for areas of new development, the condition of tributaries and outfalls downstream of any proposed areas of development be inspected. Where erosion is of concern, measures should be put in place to limit volumes, peak flows and storm water velocities from the development and improve bank stability.

Figure 3.11 Erosion at a stormwater outfall along the South Para River (left) and on a tributary within the urban area of Gawler

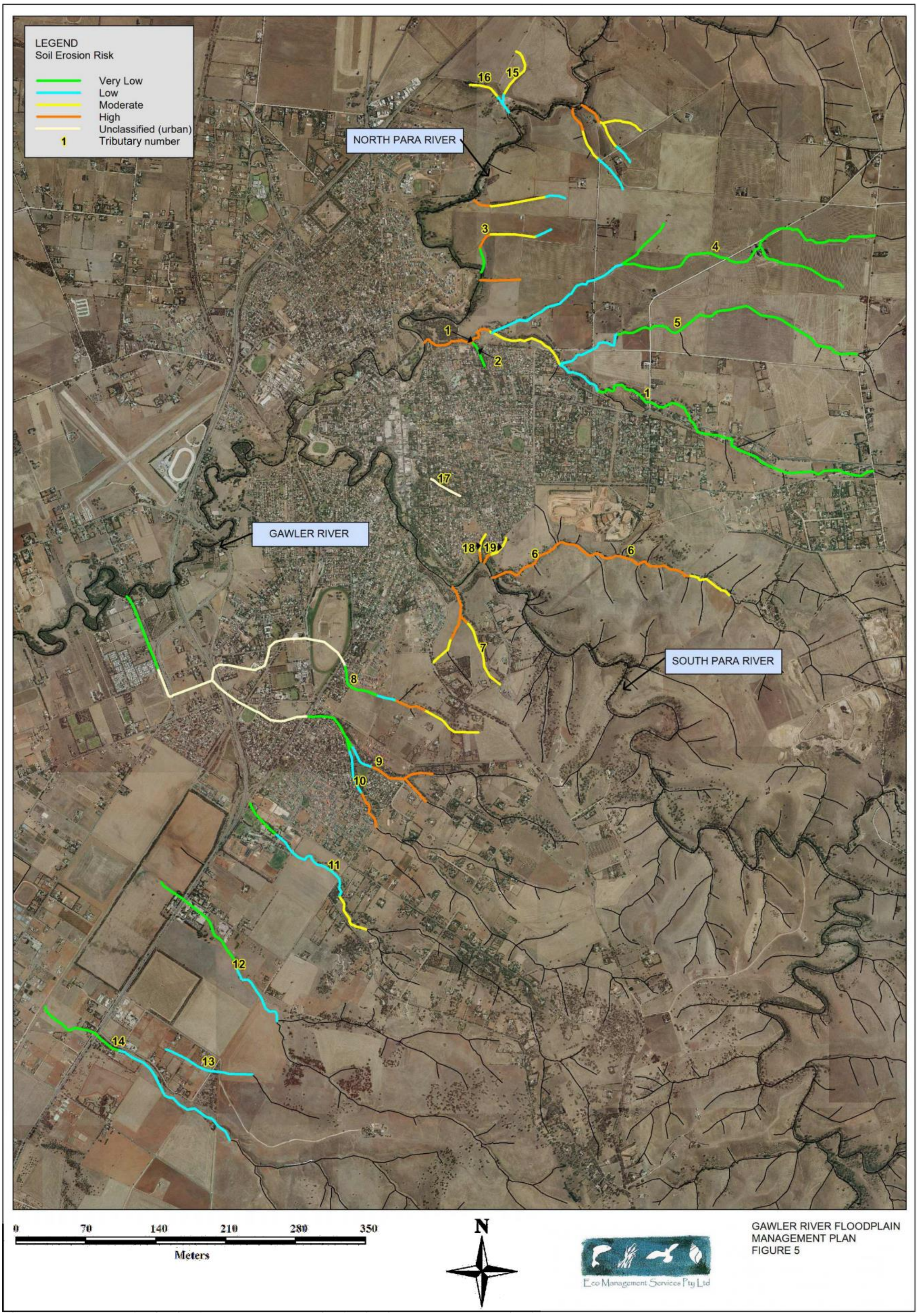


Figure 3.12 Erosion risk of tributaries within the SMP study area (extracted from EMS, 2017)

3.7 Water reuse

Consideration of reuse options needs to be in the context of the existing schemes, environmental water requirements and limitations imposed by the Western Mount Lofty Ranges Water Allocation Plan (WAP).

A summary of the existing water reuse schemes is provided in the following sections.

3.7.1 Gawler Water Reuse Scheme

The Gawler Water Reuse Scheme (GWRS) presented a concept for a broad-scale water harvesting and reuse scheme for the Gawler and Surrounds area. The original scheme aimed to supply up to 6 GL per year for irrigation and industrial purposes. The scheme incorporated water harvesting from within the Gawler township and the Gawler River, managed aquifer recharge and an extensive distribution network. The original GWRS did not eventuate due to insufficient demand for the non-potable water.

Bunyip Water Pty Ltd has been formed to build and operate a revised version of the GWRS. In 2016, the Bunyip Water harvesting and reuse scheme was completed. Bunyip Water scheme harvests water from the Gawler River and targets to deliver at least 800 ML/year to Seppeltsfield in the Barossa. It will also supply up to 50 ML/year for the irrigation of parks and schools in the Hewett region. It is understood that the annual supply volumes are limited by the flows available for diversion. Additional demand exists, should additional flows above the environmental flow threshold be available for harvest.

The scheme is currently in the process of acquiring authorisation to harvest up to 1,600 ML/year from the Gawler River for flows above the environmental water requirements. Water is currently stored in dams, but a managed aquifer recharge (MAR) trial has indicated that MAR is something that is likely to be viable but still requires additional risk assessments to be completed.

3.7.2 Gawler Urban Growth Areas

A harvesting and reuse scheme is proposed for the Gawler Southern Urban Growth Areas, which is located just outside the bounds of the SMP study area, but which may represent an opportunity for harvesting and reuse of water from the study area.

Process diagrams for the Devine subdivision (by Wallbridge and Gilbert) show that the recycled water network includes a number of wetlands and basins, new bores at Karbeethan a site adjacent to Coventry Road and pumps and storage tanks. Water is proposed to be used for irrigation of Karbeethan Reserve, to pump wetlands and as irrigation water for local schools including Trinity College. The scheme is generally consistent with that identified in the Evanston Stormwater Strategy (Ecological Engineering, 2007).

There is currently an injection and extraction bore at Karbeethan Reserve. Gawler Council commissioned a study into water supply options for the supply of additional non-potable water for the Gawler Southern Urban Growth Areas. The bore at Karbeethan was found to be low yielding and suitable for supply only.

The study (KBR, 2018) recommended that the growth area should be supplied with a 'climate independent' water supply with the preferred option being connection to the Water Reticulation Systems Virginia (WRSV) network.

The feasibility of securing additional groundwater resources was discussed in the study and it was identified that as it is a prescribed resource, additional entitlements would need to be sought on the market. This would likely take a number of years as the volume of water traded each year is low. Additionally, there are conditions set out in the Water Allocation Plan that must be satisfied for a transfer to be approved (KBR, 2018).

3.7.3 Regional harvesting schemes

Stormwater harvesting schemes require large areas of open space in close proximity to yields and demands. On this basis, two potential locations for additional regional harvesting schemes have been identified – the Gawler Racecourse and adjacent to the Clifford Road Drain at the downstream end of the study area.

Previous testing has confirmed the capability of managed aquifer recharge (MAR) in the Evanston area with bore yields of 15 to 20 L/s. Previous studies have determined that MAR at the racecourse was not viable due to high salinity levels associated with the shallow Quaternary aquifer in which the existing bore is completed. Similarly, the existing bore at Karbeethan Reserve has been deemed not suitable for managed aquifer injection due to poor yields (KBR, 2018).

Review of the Western Mount Lofty Ranges WAP determined that the contributing catchments and the racecourse are within surface water management zone (SWMZ) LC26 of the WAP. SMMZ LC26 has a catchment wide water allocation allowance of 95 ML/year. The Department for Environment and Water (DEW) has indicated that the surface water resources in the zone are fully allocated. Harvesting would therefore be limited to capture of flows from 'new urban land use development' (with a maximum volume equivalent to the difference between post and pre development runoff).

The Clifford Road Drain is outside of the managed water resource area, however as it is immediately downstream DEW advised that harvesting from this drain would be subject to review and approval from the NRM Board.

3.7.4 Impacts of climate change

Climate change is likely to impact the volumes, and quality, of water available for harvest and reuse. Reduced rainfall will result in lower runoff volumes, while higher evaporation rates will increase storage losses.

The MUSIC modelling of the long term development scenario shows that the end of the century climate projections results in a 27% reduction in runoff at the downstream end of the catchment. While increases in development will initially result in increased runoff, it is estimated that by the middle of the century, the impacts of reduced rainfall will more than offset this increased runoff. The MUSIC modelling is based on scaled rainfall and evaporation time series. The modelling does not capture the likely changes to rainfall patterns. With a trend towards higher rainfall intensities, it is likely that the reduction in harvestable volume will be less, with the higher flows exceeding the harvesting capacity of the facility.

Increased rainfall intensities, combined with higher temperatures, may also lead to greater concentrations of pollutants which may impact the suitability of water for the intended reuse purposes.

4 Stormwater Management Objectives

4.1 Stormwater management goals

The key issues to be addressed in the development of any plan for the management of stormwater runoff from an urban catchment include:

- Flooding
- Water Quality
- Water Use
- Environmental Protection and Enhancement
- Asset Management

Arising from these issues, broad goals for management of urban stormwater runoff can be developed and are commonly identified as follows:

Goal 1: Flood Management

- Provide and maintain an adequate degree of flood protection to existing and future development.

Goal 2: Water Quality Improvement

- Improve water quality to meet the requirements for protection of the receiving environment and downstream water users.

Goal 3: Water Use

- Maximise the economic use of stormwater runoff for beneficial purposes while ensuring sufficient water is maintained in creeks and rivers for environmental purposes.

Goal 4: Environmental Protection and Enhancement

- Manage stormwater runoff in a manner that protects and enhances biodiversity and the natural environment. In association with this goal, land used for stormwater management purposes should be developed, where possible, to facilitate recreation use and to enhance amenity.

Goal 5: Asset Management

- That stormwater assets are managed in a sustainable manner and are provided with adequate maintenance such that they are able to operate as originally intended.

The development of a Stormwater Management Plan for the Gawler and surrounds area has required that these broad goals be further refined to identify catchment specific management objectives. These specific objectives have enabled targeted management strategies to be identified and assessed.

4.2 Guidelines for urban stormwater management

Development of catchment specific objectives for management of runoff from the Gawler and surrounds area have been carried out with reference to the principles contained in the document 'Stormwater Management Planning Guidelines' prepared by the Stormwater Management Authority (2007).

The catchment specific objectives that have been developed are consistent with the directions for management of stormwater promoted by the guidelines and based on consultation with the Steering Committee in the initial consultation phase.

4.3 Catchment specific objectives

4.3.1 Flood management

Drainage within the study area comprises of three main systems.

The urbanised areas of the catchment predominantly contain inlet pits that are interconnected via an underground drainage network. This underground drainage system is there to prevent nuisance flooding of roadways resulting from relatively frequent storm events, while surface flow paths such as roads and reserves are there to carry excess runoff during more substantial storm events. The combined capacity of the underground and surface drainage system should be sufficient to carry the peak flow produced by a 1% AEP event. A design standard of between 2 and 5 years is generally adopted for the underground system.

The underground systems predominantly outlet into natural watercourses which form the second main system in the study area. Based on the flood modelling results these are typically able to carry significant flows and should be able to safely convey 1% AEP flows.

The final systems are shallow surface sheet flows that are predominantly located within the western portion of the study area. In this area there is little formal drainage infrastructure and the depth and direction of flows is governed by the existing topography and the build up by the road network.

Based on the background outlined above the following objectives have been set.

Objective 1.1

- Where economically and practically viable, protect all properties from inundation in a 1% AEP event. A lower standard of flood protection may be adopted where physical and economic constraints limit the ability to achieve a 1% AEP level of protection.

Objective 1.2

- Provide an underground drainage system with a minimum capacity sufficient to convey a 39.35% AEP (equivalent to 2 year ARI) flow, but where possible provide a 20% AEP standard.

Objective 1.3

- Provide a trunk drainage system (typically open channels) with a minimum capacity sufficient to carry a 1% AEP flow.

Objective 1.4

- Ensure that new development does not increase the degree of flood risk to other properties for all events up to a 1% AEP.

Objective 1.5

- Increase the public awareness of flood risk so that they are better able to respond to flood events and reduce flood damages.

Objective 1.6

- Include consideration of possible future climates in all future works.

4.3.2 Water quality improvement

The North Para and South Para Rivers flow through the Gawler and Surrounds SMP study area, merging within the township of Gawler to form the Gawler River. Stormwater from the SMP study area discharges into the North Para River, South Para River and Gawler River, either directly or via tributaries.

The catchment specific objectives for water quality improvement within the receiving waters are listed below. They are based on best practice, understanding of the catchments, the current health of the receiving waters and known key pressures within the study area.

Objective 2.1

- Manage the quantity of gross pollutants discharging into the South Para, North Para and Gawler rivers such that they meet the 90% recommended reduction in average annual load as specified by the SA Government water sensitive urban design policy (Government of South Australia, 2013).

Objective 2.2

- Minimise the quantity of sediment exported from the catchment such that it meets the 80% recommended reduction in average annual load as specified by the SA Government water sensitive urban design policy.

Objective 2.3

- Minimise the quantity of nutrients (total phosphorus) exported from the catchment such that runoff meets the recommended 60% reduction in average annual load as specified by the SA Government water sensitive urban design policy.

Objective 2.4

- Minimise the quantity of nutrients (total nitrogen) exported from the catchment such that runoff meets the recommended 45% reduction in average annual load as specified by the SA Government water sensitive urban design policy.

Objective 2.5

- Minimise the increase in average annual runoff from redevelopment such that patterns runoff more closely mimics pre-development conditions.

4.3.3 Water reuse

The Gawler Water Reuse Scheme (GWRS) presented a concept for a wide-scale water harvesting and reuse scheme for the Gawler and Surrounds area. The original scheme aimed to supply up to 6 GL per year for irrigation and industrial purposes. The scheme incorporated water harvesting from within the Gawler township and the Gawler River, managed aquifer recharge and an extensive distribution network. The original GWRS did not eventuate due to insufficient demand for the non-potable water.

In 2016, the Bunyip Water harvesting and reuse scheme was completed. Bunyip Water scheme harvests water from the Gawler River and will deliver at least 800 ML/year to Seppeltsfield in the Barossa. It will also supply up to 50 ML/year for the irrigation of parks and schools in the Hewett region. It is understood that the annual supply volumes are limited by the flows available for diversion. Additional demand exists, should additional flows above the environmental flow threshold be available for harvest.

Testing has confirmed the capability of managed aquifer recharge in the Evanston area with bore yields of 15 to 20 L/s. A bore on the Gawler horse racing track just to the N has a yield of 10 L/s and will be tested to assess its capacity as an ASR facility.

There is currently an injection and extraction bore at Karbeethan Reserve and Gawler Council have commissioned a study into water supply options for the supply of additional non-potable water for the Gawler Southern Urban Growth Areas.

The catchment specific objectives for water reuse are listed below. Consideration of reuse options will be in the context of the existing schemes and limitations imposed by the requirements of the Western Mount Lofty Ranges Water Allocation Plan (WAP).

Objective 3.1

- Encourage on-site use of stormwater runoff to minimise discharges to the downstream stormwater system.

Objective 3.2

- Within the limitations imposed by the Western Mount Lofty Ranges WAP maximise the capture and re-use of stormwater runoff.

4.3.4 Environmental protection and enhancement

The environmental condition of the existing watercourses within the catchment have been assessed by Eco Management Services (refer Appendix A). The report concluded that "the tributaries have been highly modified, with little of the natural habitat remaining, mainly as a result of clearing, urban development and grazing". Most of the watercourses are pasture areas with introduced understory species. Some scattered tall native shrubs and trees still exist. The watercourses currently provide minimal habitat for native species, other than hollows in older native trees.

It is acknowledged that this study was very focussed and considered a relatively small area and the importance of environmental protection and enhancement should not be downplayed. Over the last ten years a range of works which are aimed at improving the environmental values of the watercourses within the study area have been undertaken by various agencies and stakeholder groups. These works include environmental flow trials in the South Para River, improving the biodiversity of the terrestrial and aquatic habitats by exotic species removal and planting of native species and review of fish barriers along the South Para River.

The objectives described in the following sections are cognisant of the environmental values of the receiving waters and are consistent with the works that have been undertaken. They are aimed at realising the opportunities for environmental and biodiversity enhancements

Objective 4.1

- Where new stormwater management facilities are constructed on existing open space maximise the community use and benefit derived from the facility and ensure that opportunities for biodiversity, water quality, amenity and environmental enhancement are realised.

Objective 4.2

- Retain and enhance the habitat quality of the existing natural watercourses in the study area.

Objective 4.3

- Attempt to mimic the pre-development hydrological regime of the watercourses in the study area.

Objective 4.4

- Maximise fish passage throughout the watercourse; by both minimising the creation of new fish barriers and to facilitate fish passage in any newly proposed barriers.

4.3.5 Asset management

Stormwater drainage forms a considerable financial asset for the three Councils within the study area, particularly for the Town of Gawler. Considering that a large portion of the existing drainage infrastructure was constructed over 30 years ago, some degree of structural degradation is likely. Degraded infrastructure will reduce the ability of the drainage system to act as per its original design intent.

Without careful planning, structural failure of existing infrastructure may necessitate immediate and expensive rectification. Careful asset management will allow for future planning to determine the timeline for replacement of assets.

An increased implementation of water sensitive urban design necessitates a higher degree of maintenance, compared to traditional pits and pipes, to ensure that optimum water quality improvement performance is obtained from WSUD assets. However, WSUD assets offset this by providing a more wholistic range of benefits.

Based on the above, the following general objectives have therefore been set:

Objective 5.1

- Have up to date information on the age and condition of existing drainage infrastructure

Objective 5.2

- Plan for the strategic replacement of infrastructure nearing the end of its design life, with a particular focus on major assets such as trunk drainage systems.

Objective 5.3

- All stormwater infrastructure including WSUD schemes are to be maintained in accordance with maintenance management plans.

5 Management Strategies

5.1 Flood management

Flood models were developed for three scenarios:

- existing levels of development,
- estimated long-term development within the catchment; and
- estimated long-term development within the catchment with selected structural flood management strategies included.

These flood models were used to identify opportunities for structural flood management strategies. The identified flood management strategies were investigated to assess their impact on the extent and severity of flood inundation. Figure 5.1 shows the location of the investigated management strategies.

Figure 5.13, Figure 5.14 and Figure 5.15 (pages 68, 69 and 70 respectively) each show the modelled flood inundation for the 1% AEP event (based on the long-term development scenario) with and without structural flood management strategies. The difference in flood inundation depth as a result of the various management strategies is also shown.

Flood inundation and hazard maps of all scenarios are presented in Appendix F.

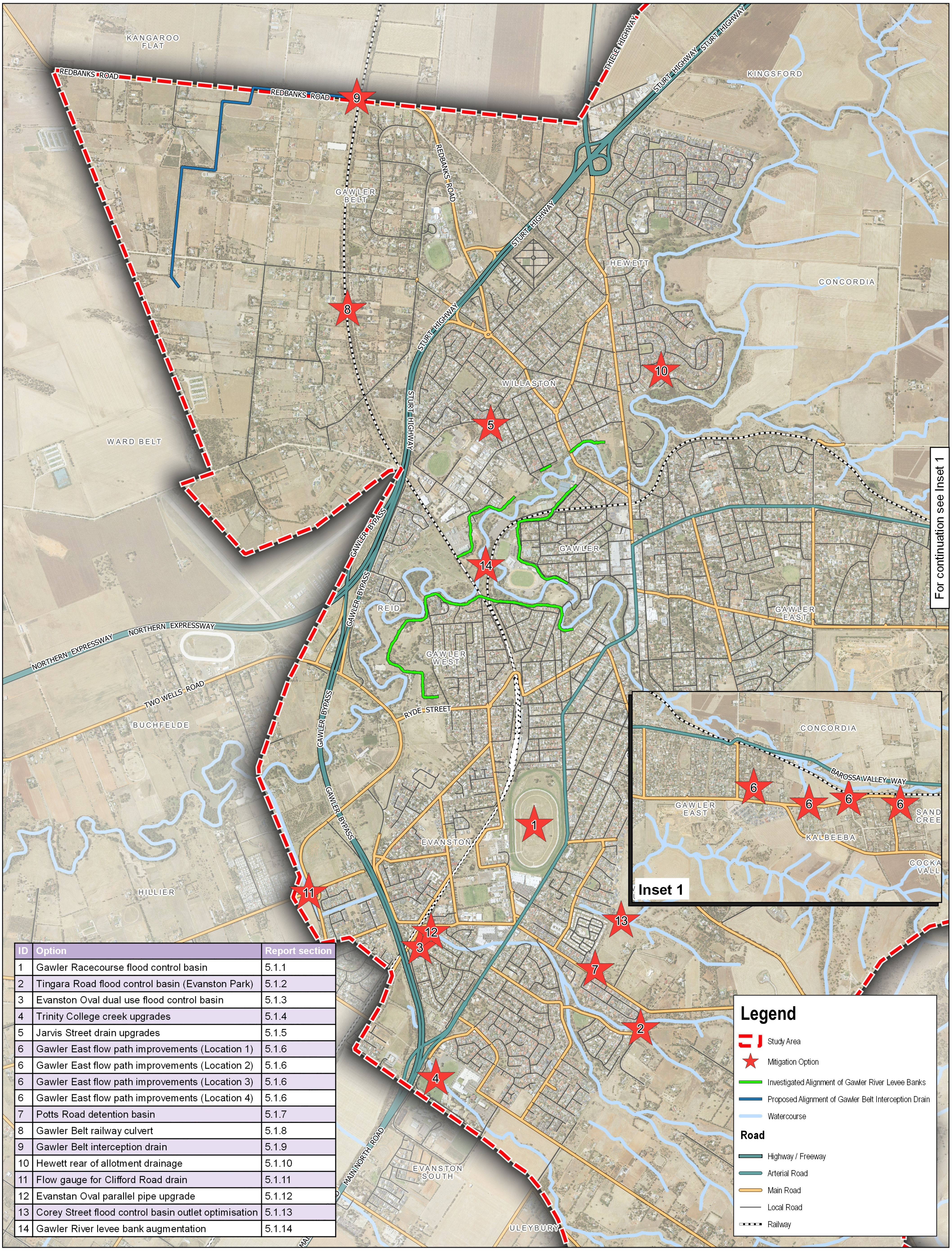
5.1.1 Gawler Racecourse flood control basin

There is considerable open space within the centre of the racecourse. If this open space can be utilised to provide effective flood storage it may be possible to reduce the flooding of First Street and surrounding areas.

The proposed solution involves diverting the Adelaide Road and Main North Road drainage systems directly into a flood basin within the racecourse. The footprint of the proposed basin and the sections of upgraded pipe networks associated with this option are shown in Figure 5.2. The First Street drainage network would be upgraded with approximately 200 m of DN1200 reinforced concrete pipe (RCP) to increase outflow capacity from the low-spot to the racecourse basin. The Sheriff Street system would continue to discharge via the existing DN1500 RCP.

It is estimated that a 35,000 m^3 basin would be sufficient to adequately detain the flows that are directed into it without exceeding the capacity of the downstream drainage system. Ideally the basin would be split into a flood control portion for large flood events and a water quality portion to provide treatment to smaller frequent storm flows. If more than 35,000 m^3 of storage can be provided it may be possible to reduce outflows and further relieve flooded areas downstream in Evanston.

Figure 5.13 illustrates the impact of the racecourse basin. It can be seen that some properties between Mount Terrace and First Street still suffer flooding in the 1% AEP event due to stormwater that cannot be conveyed by the local stormwater system. The primary cause appears to be the drains in Sheriff Street. The standards mapping of the existing catchment and drainage infrastructure estimated that the Sheriff Street drains lack the capacity to convey the 20% AEP event (refer Figure 2.5). It may be possible to address residual flooding through upgrade of the Sherriff Street drainage system. However, given that flooding in the 20% AEP is not severe, Council will need to consider whether upgrades of the minor drainage system to accommodate 1% AEP flows is merited.



ID	Option	Report section
1	Gawler Racecourse flood control basin	5.1.1
2	Tingara Road flood control basin (Evanston Park)	5.1.2
3	Evanston Oval dual use flood control basin	5.1.3
4	Trinity College creek upgrades	5.1.4
5	Jarvis Street drain upgrades	5.1.5
6	Gawler East flow path improvements (Location 1)	5.1.6
6	Gawler East flow path improvements (Location 2)	5.1.6
6	Gawler East flow path improvements (Location 3)	5.1.6
6	Gawler East flow path improvements (Location 4)	5.1.6
7	Potts Road detention basin	5.1.7
8	Gawler Belt railway culvert	5.1.8
9	Gawler Belt interception drain	5.1.9
10	Hewett rear of allotment drainage	5.1.10
11	Flow gauge for Clifford Road drain	5.1.11
12	Evanstan Oval parallel pipe upgrade	5.1.12
13	Corey Street flood control basin outlet optimisation	5.1.13
14	Gawler River levee bank augmentation	5.1.14

tonkin

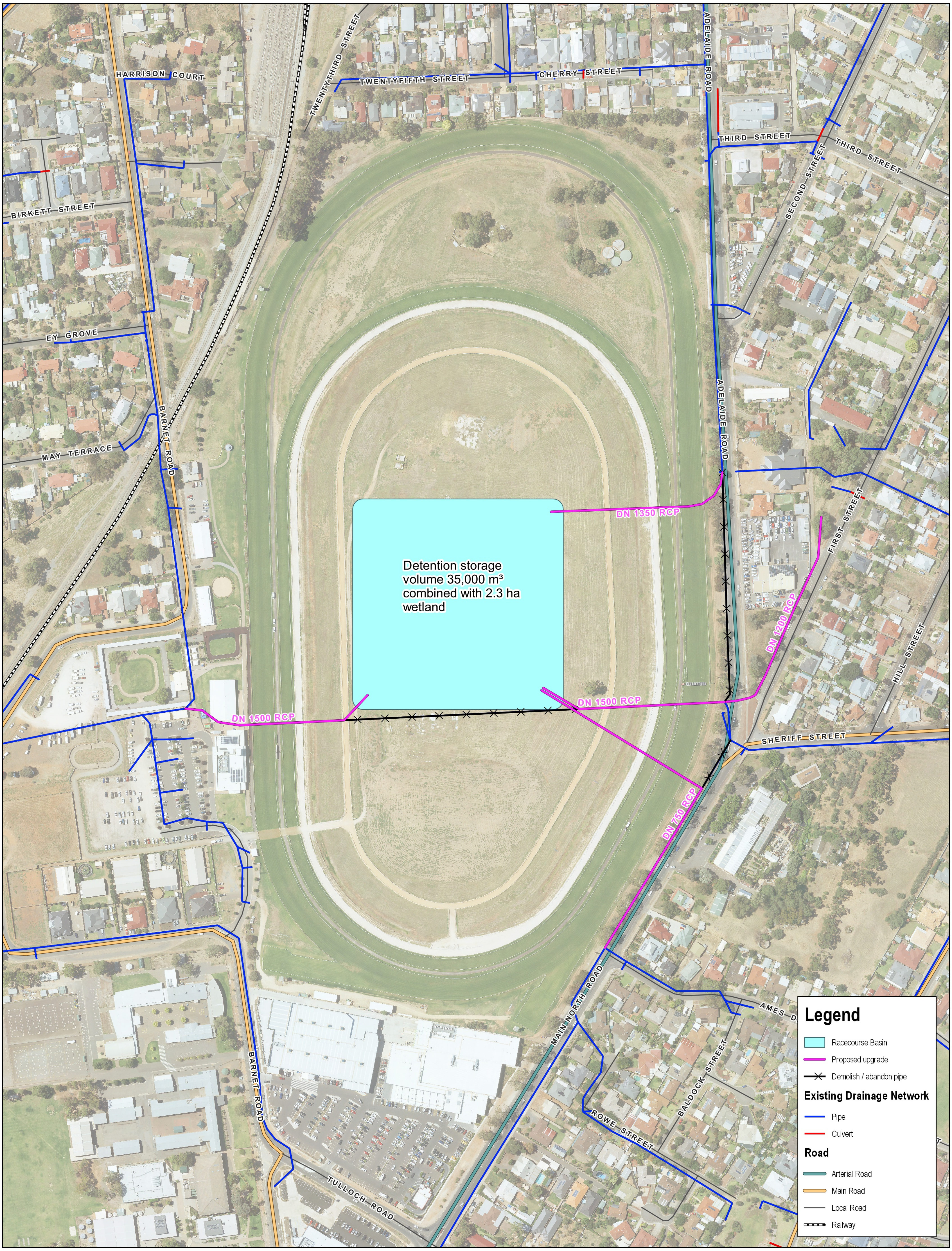
Job Number: 20141387
Filename: 20141387GQ004A
Revision: REV B
Date: 2019-03-22
Drawn: Dylan Bone

Data Acknowledgement:
Aerial Imagery from Metromap, 2017
Roads and Railways from DataSA, 2017

Town of Gawler, Light Regional Council and The Barossa Council

LOCATION OF INVESTIGATED STRUCTURAL FLOOD MANAGEMENT STRATEGIES

Figure 5.1



50 0 50 100 150 m

N

Town of Gawler, Light Regional Council and The Barossa Council

GAWLER RACECOURSE FLOOD CONTROL BASIN

Job Number:	20141387	Data Acknowledgement:	
Filename:	20141387GQ001	Aerial Imagery from Metromap, 2017	
Revision:	REV B	Roads and Railways from DataSA, 2017	
Date:	2019-03-25	Cadastre from PBI, 2015	
Drawn:	Dylan Bone		

Figure 5.2

5.1.2 Tingara Road flood control basin (Evanston Park)

A basin at Tingara Road would act to detain flow in the same manner as the existing basins in the area. A review of the digital elevation model suggests that an 8 metre deep basin is likely the maximum possible volume that could be achieved at this site. A concept design for the flood control basin is shown in Figure 5.4.

Modelling was undertaken to determine the minimum possible outflow from the basin in the 1% AEP event without engaging the basin spillway. The modelling demonstrated that a peak 1% AEP inflow of 7 m^3/s could be reduced to 3 m^3/s. Further optimisation of the basin outlet could provide some additional reduction of the peak outflows during more frequent events. Not only does the basin reduce the peak flows, but the timing of the peak outflow from the basin is delayed by about an hour which reduces the coincidence of peak flows within the urban catchments. Consequently, the downstream peak flows are reduced and more flows are contained within the main channel. This provides a noticeable reduction in the flooding around the Evanston Oval and Railway Crescent areas.

A high level assessment of the potential environmental impacts of the flood control basin was undertaken. It was determined that construction of the dam will not result in a significant loss of habitat upstream of the dam wall as the riparian habitat is already very degraded. The downstream channel is small and highly modified with virtually no aquatic habitat. The proposed flow regime will not negatively impact the downstream habitat. During design development consideration should be given to allowing some storm event water to pass, as this will benefit riparian species. Based on the EMS study (Appendix A), there is no aquatic habitat that would be impacted by the basin.

5.1.3 Evanston Oval dual use flood control basin

A dual-use flood control basin was considered at Evanston Oval adjacent Dawson Road. This basin was proposed to use the Evanston Oval to detain floodwater spilling from the drainage channel east of the oval. The basin is proposed to activate only during rare flood events (1% AEP or greater) whilst remaining in active use as an oval when not required for flood control. The basin would act to temporarily store floodwater during the flood events, slowly releasing water back into the drainage system at a controlled rate. This would act to prevent runoff from spilling over the railway line and causing inundation of buildings along Dyson Street and Railway Crescent.

A concept design of the basin was developed considering the existing surface elevation of the oval and surrounding areas. Modelling found that the basin provided only a minimal benefit to flood mitigation during the 1% AEP event. The timing of runoff within the upstream catchments is such that the limited storage capacity of the basin is full by the time the main flood peak, which is generated by the large rural catchments upstream of the urban areas, arrives. The basin is therefore unable to significantly attenuate the peak flow rate, with little to no reduction in the downstream flooding. It has therefore not been given further consideration as a mitigation option as a part of this SMP.

5.1.4 Trinity College creek upgrades

The large culvert beneath the Gawler Bypass is estimated to have the capacity to convey flows of over 8 m^3/s. The DRAINS modelling suggests that the culvert should have ample capacity to convey the flows arriving from the upstream catchment. The modelled flooding is a result of insufficient capacity within the channel through Trinity College. The proposed solution therefore involves containing the flood waters within the channel and directing it via the existing culvert into the existing large detention basins on the western side of the Gawler Bypass. This will require works along the channel between the school chapel and the culvert entrance; marked as A and B respectively in Figure 5.5.

At the upstream end of the channel section, near Site A, the existing culvert does not have the capacity to convey the 1% AEP peak flow. Works would need to upgrade the culvert or alternatively earthworks could create a defined flow path to ensure bypass flows are contained within the channel. This would prevent floodwater escaping the channel and flowing over the oval to the north.

Midway between Site A and Site B, a number of crossings would need to be given a similar treatment, such that low flows flow through a culvert and high flows are contained within the channel.

Channel works would be required for roughly 175 m of channel upstream of Site B to increase the channel capacity and contain the 1% AEP flow. It is estimated that a 1.0 m deep trapezoidal channel with 1V:4H side slopes and 2.1 m base width would provide the required capacity.

Modelling demonstrated that flow through the main culvert could be increased to approximately 6 m^3/s in the 1% AEP event. Although inundation of Greening Drive still occurs, floodwater does not flow along Main North Road. Consequently, there is less floodwater directed towards the flood prone areas in Evanston, such as Railway Crescent and Evanston Oval.

Environmental and amenity impacts

The shallow grassed channel that runs through Trinity College is currently lined with mostly planted red gums, some within the channel (refer Figure 5.3) and one which would be regulated. These trees are considered an important amenity feature and provide shade for students in the summer. The proposed channel works would probably require the removal of trees, subject to getting the necessary approvals. It is likely that as a part of the works riparian vegetation is established and that the channel is landscaped to provide long term benefits such as habitation creation, erosion protection, shade and some water quality treatment.

Figure 5.3 Red gums along and within existing creek line

tonkin

Job Number: 20141387
Filename: 20141387GQ001
Revision: REV B
Date: 2019-03-22
Drawn: Dylan Bone

Data Acknowledgement:
Aerial Imagery from Metromap, 2017
Roads and Railways from DataSA, 2017

Town of Gawler, Light Regional Council and The Barossa Council

TINGARA ROAD FLOOD CONTROL BASIN

Figure 5.4

10 0 10 20 30 m

N

tonkin

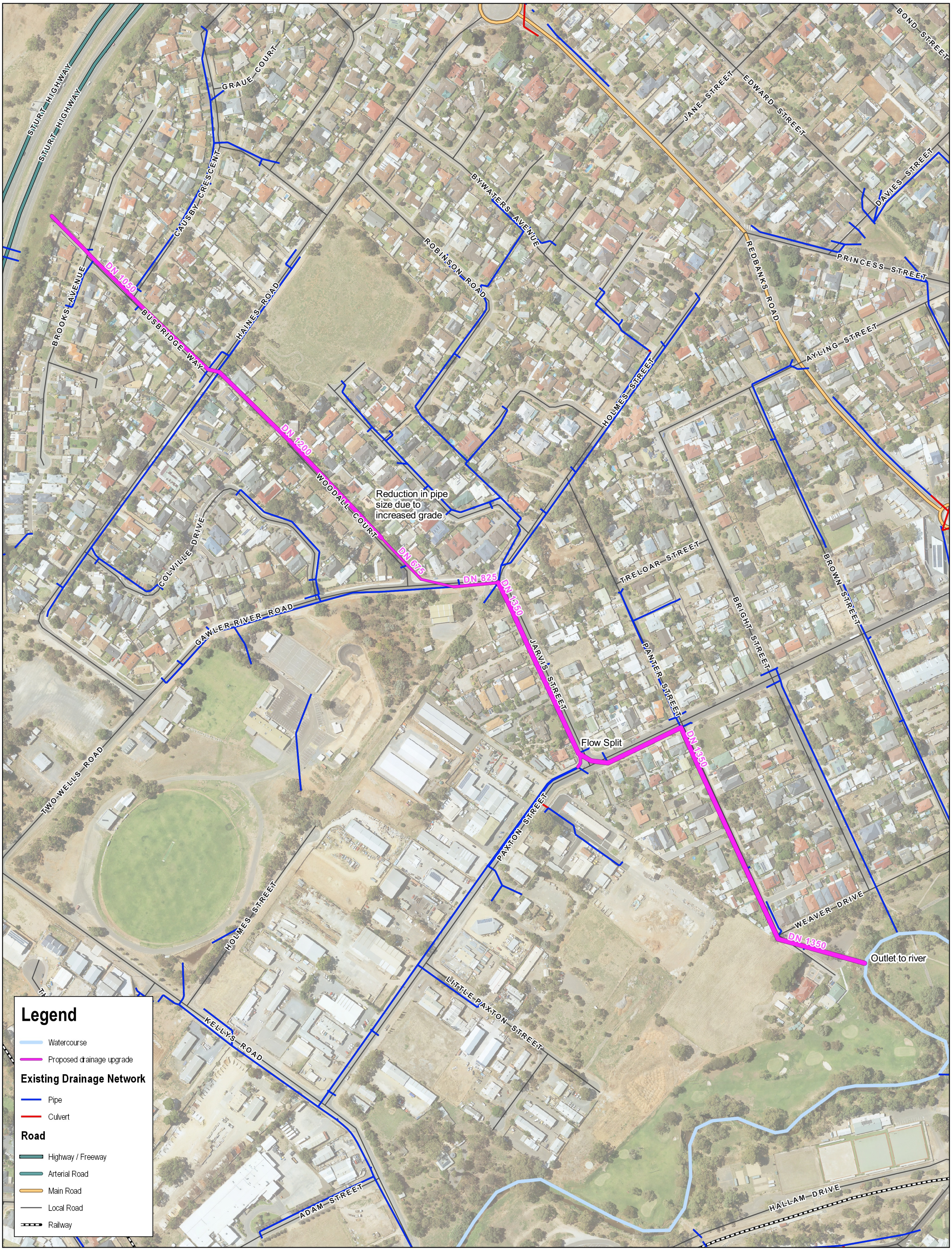
Job Number:	20141387
Filename:	20141387GQ001
Revision:	REV B
Date:	2019-03-22
Drawn:	Dylan Bone

Data Acknowledgement:
Aerial Imagery from Metromap, 2017
Roads and Railways from DataSA, 2017

Town of Gawler, Light Regional Council and The Barossa Council

PROPOSED TRINITY COLLEGE CREEK UPGRADES

Figure 5.5



Town of Gawler, Light Regional Council and The Barossa Council

JARVIS STREET UPGRADES

tonkin

Job Number:	20141387	Data Acknowledgement:
Filename:	20141387GQ001	Aerial Imagery from Metromap, 2017
Revision:	REV B	Roads and Railways from DataSA, 2017
Date:	2019-03-22	
Drawn:	Dylan Bone	

Figure 5.6

5.1.5 Jarvis Street drain upgrades

Significant flooding occurs along Jarvis Street and at Brooks Avenue in the 1% AEP event (refer Section 3.2.4). There are no opportunities to detain the floodwaters in the local catchment that drains towards Jarvis Street and Brooks Avenue. Further, due to the topography of the catchment—with a number of trapped low spots—it is not possible to convey excess floodwater using overland flow paths. Therefore, the only possible structural flood control strategy is upgrade of the underground drainage network. Given the significant capital costs of upgrades, it is not proposed that the underground drainage network be upgraded to provide a 1% AEP standard. Instead, a reduced level of protection targeting a 5% AEP level of protection is recommended for the main trunk drain. This would alleviate flooding of the trapped low spots where no other flow path is available. For lateral feeder systems a 20% AEP standard is recommended in line with Objective 1.2.

Two possible upgrade options were considered. The first option replaces the existing trunk network and follows the existing alignment. The second option involves a flow split at the intersection of Jarvis Street and Paxton Road. The second upgrade option allows a shorter distance of replacement for new pipes and at a lower cost. Figure 5.6 shows the layout of the shorter option.

Both options would mitigate flooding within the 5% AEP event for the dwellings in Brooks Avenue and Jarvis Street. Flooding in the 1% AEP event is reduced but not eliminated.

When undertaking preliminary and detailed design of these works, Council should also consider whether the drain system from McGonigal Drive should be upgraded. The drain standards assessment (refer Figure 2.5) indicates this system is particularly limited in capacity near the intersection with Holmes Street.

5.1.6 Gawler East flow path improvements

Formal drainage corridors within the rural residential area bounded by Sunnydale Avenue and Kalbeeba Road have not been established and as a result nuisance flooding occurs within private properties. Flow paths within this area are therefore unpredictable and pose regular nuisance flooding to local properties, particularly under long term conditions where runoff is expected to increase due to future development.

There are four main locations of concern; these include:

1. downstream of the Easton Drive wetlands
2. downstream of John Schultz Court
3. downstream of Lucks Road
4. downstream of Bischoff Road.

These four locations are shown in Figure 5.7.

At some locations along these flow paths a review of aerial imagery identified drainage infrastructure that was included within the Council GIS databases and has not been included in the modelling. As the size of the infrastructure is relatively small the resultant impacts on the results of the flood mapping will be minimal. Subject to further design development, additional WSUD features could be incorporated into the works that are proposed below.

Location 1

Discharge from the Easton Drive wetlands moves in a northerly direction towards Hameister Court via a natural channel that passes through downstream properties which have some capacity for detention. Review of the modelled results shows that this channel has the capacity to contain the 1% AEP flows and therefore requires no upgrades.

Flows conveyed by Hameister Court then overtop Lawson Road and disperse and encroach on downstream properties. While there is a channel that runs through these properties and another that runs along the eastern side of Sunnydale Road, the modelling suggests that both of these channels do not have sufficient capacity to contain 1% AEP flows.

It is estimated that channel upgrade works would be required over a distance of approximately 275 m along channel that runs through private property downstream of Lawson Road. It is estimated that a grass lined trapezoidal channel profile with 1V:3H side slopes, 1.5 m base width and 0.7 m depth would provide a sufficient capacity to convey the 1% AEP flows.

In order to prevent frequent floods from passing through properties downstream of Lawson Road, works would be required to connect pits on Hameister Court and Lawson Road to a pipe that has sufficient capacity to convey the 20% AEP flow underground, in a westerly direction along Lawson Road (approximately 150 m), to the swale that runs along the eastern side of Sunnydale Road. It is estimated that a DN375 pipe would suffice.

Channel works would also be required for a length of approximately 285 m along the eastern side of Sunnydale Road to increase the channel capacity to contain the 20% AEP flow. It is estimated that a grass lined trapezoidal channel profile with 1V:3H side slopes, 0.5 m base width and 0.5 m depth would suffice. As part of these works, short lengths of culverts would be required to convey flows under driveway crossings.

Location 2

Flows filling the sag point within John Schultz Court eventually spill to a downstream property and move in a northerly direction towards Calton Road. The flow width across this path is approximately 50 m. Works would be required to contain the 1% AEP flow within a drainage easement that runs for roughly 230 m along property boundaries. It is estimated that a grass lined trapezoidal channel profile with 1V:3H side slopes, 1.0 m base width and 0.5 m depth would suffice.

Once flows reach Calton Road there appears to be a culvert passing flows under the road. The culvert would need to be upgraded, or an additional culvert provided in parallel, to provide a 1% AEP capacity to prevent flows from ponding within upstream properties.

There is a channel downstream of Calton Road which conveys flows in a northerly direction towards the railway line. Review of the modelled results indicated that this channel has sufficient capacity to contain the 1% AEP flow. It is therefore likely that no channel works are required along this path.

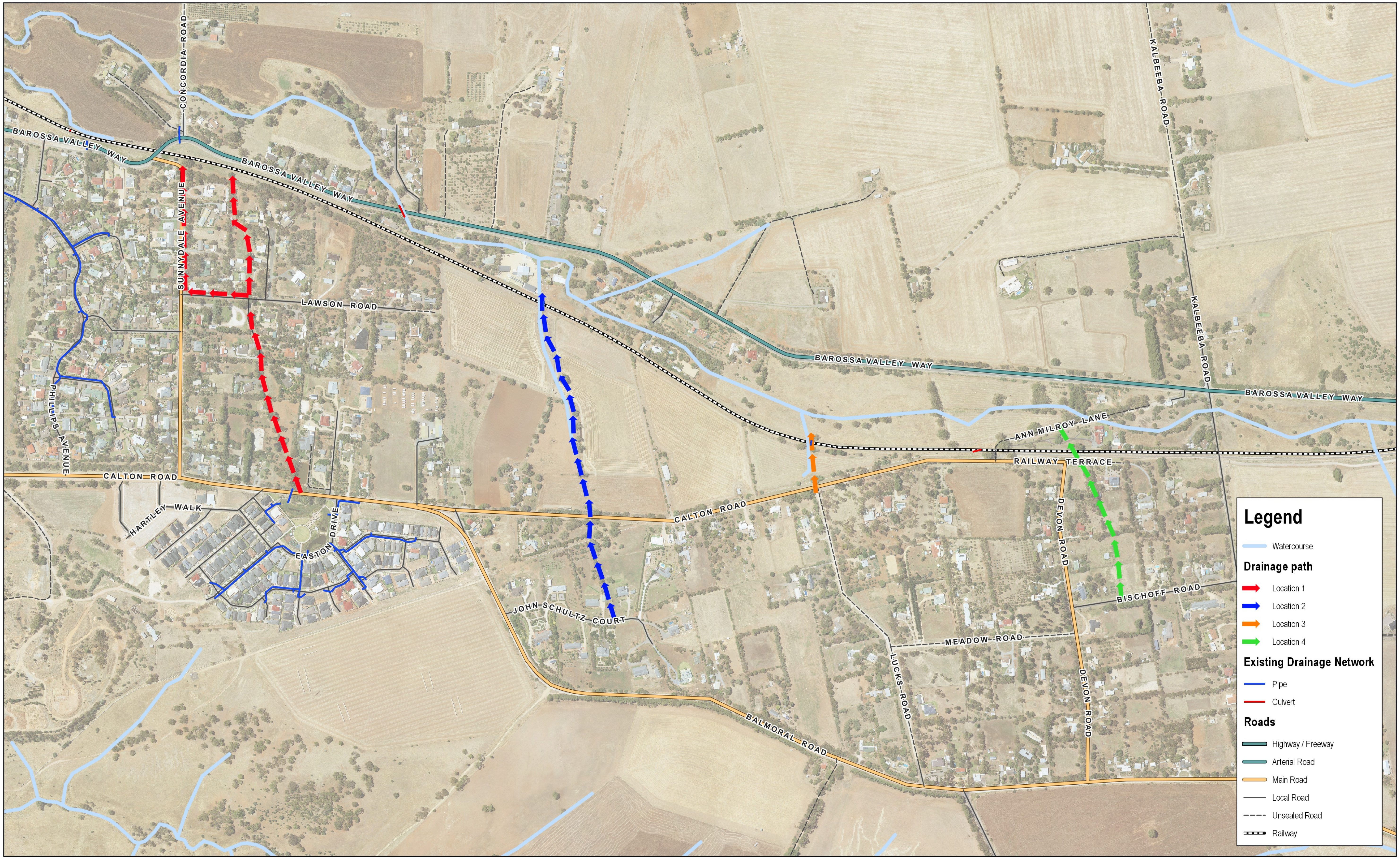
Review of the modelled results shows that the existing DN450 pipe that conveys flows under the railway line does not have sufficient capacity to convey the 1% AEP flow, causing flows to spill along the southern side of the railway line. Works would be required to upgrade this pipe to provide a 1% AEP capacity.

Location 3

Based on surface contours it is predicted that overland flows upstream (south) of Calton Road would flow alongside Lucks Road towards small pipes that convey flows in a northerly direction under Calton Road. Flows then move in a northerly direction via a natural low point until reaching the railway line where a DN375 pipe conveys flows under the railway line.

Channel works would be required in order to contain the 1% AEP flow within a formalised channel between Calton Road and the railway line. It is estimated that a 0.5 m deep grass lined trapezoidal channel profile with 1V:3H side slopes and a 2.5 m base width would have sufficient capacity.

Review of the modelled results indicated that the DN375 pipe under the railway line does not have sufficient capacity to convey the 1% AEP flow, with flows ponding on the southern side of the railway line until the railway is overtopped. Works would be required to upgrade this pipe, or to provide another in parallel, to achieve a 1% AEP capacity.



0 100 200 300 400 m

N

tonkin

Job Number: 20141387
Filename: 20141387GQ001
Revision: REV B
Date: 2019-03-22
Drawn: Dylan Bone

Data Acknowledgement:
Aerial Imagery from Metromap, 2017
Roads and Railways from DataSA, 2017
Cadastre from PBI, 2015

Town of Gawler, Light Regional Council and The Barossa Council

GAWLER EAST FLOW PATH IMPROVEMENTS

Figure 5.7

LOCATION 4

Flows moving towards the low point along Bischoff Road appear to pass under the road via an existing culvert. This culvert requires a 1% AEP capacity to to prevent significant ponding on the upstream (southern) side of the road in a 1% AEP event.

Flows then continue to flow in a northerly direction through downstream properties towards a low point on Railway Terrace where flows pond on the southern side before overtopping the road and spilling to culverts that pass under the adjacent walkway and railway line. The flow width through these properties ranges from 20 to 50 m.

Channel works would be required for a length of approximately 280 m along the flow path between Bischoff Road and Railway Terrace to provide a channel with sufficient capacity to contain the 1% AEP flows. It is estimated that a 0.5 m deep grass lined trapezoidal channel with 1V:3H side slopes and a 2.0 m base width would be sufficient. This channel would need to be extended downstream of Railway Terrace in order to confine the 1% AEP flow to a smaller flow width. Works would also need to provide a culvert under Railway Terrace to convey the 1% AEP flow thereby preventing ponding within upstream properties.

5.1.7 Potts Road detention basin

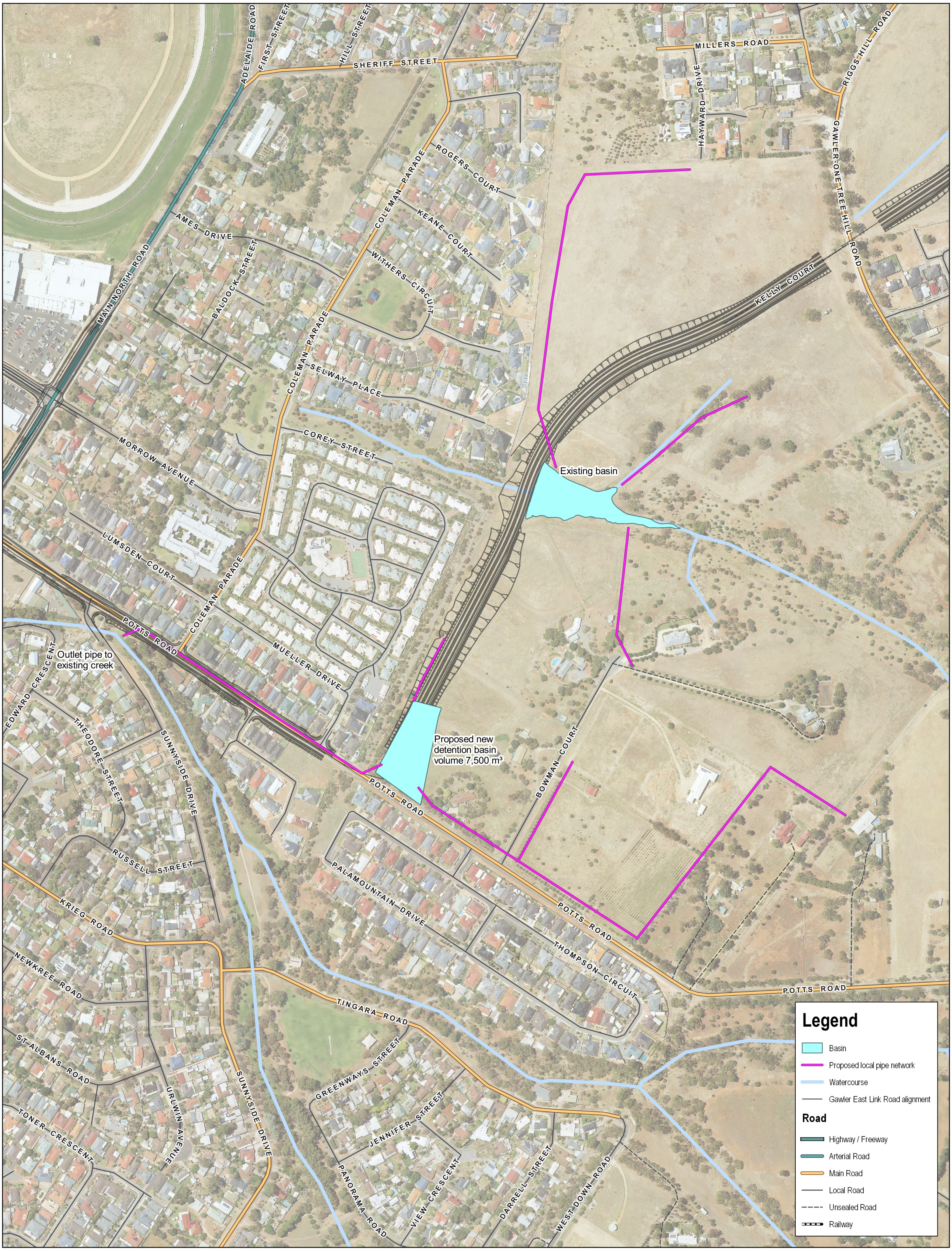
The area bounded by Potts Road and the Gawler One–Tree Hill Road is currently used for semi-rural living, but has recently been zoned for future medium to high density residential development. The Gawler East Stormwater Infrastructure Study (Tonkin Consulting, 2016) examined the management of water quality and quantity impacts resulting from the transition in land use. The Gawler East Stormwater Infrastructure Study identified that increased runoff from catchments along Potts Road would cause an increased likelihood of flooding downstream of Mueller Drive. Consequently, it was recommended that a detention basin of 7,500 m^3 be implemented to control runoff from future development.

It was recommended that the detention basin be located near the southwest corner of the developable land, however, since the release of the Gawler East Stormwater Infrastructure Study, Council and DPTI have undertaken to construct the Gawler East Link Road (GELR) (refer Figure 5.8).

The preferred alignment of the GELR conflicts with the proposed location of the Potts Road detention basin. Potential options to resolve the conflict could include: relocation of the basin further upslope (this may not be practical due to the gradient of the terrain) or division of the required storage into smaller basins spread throughout the developable area. As the design of the GELR is yet to be finalised it is unclear how best to resolve this conflict. For the purposes of the Gawler and Surrounds SMP, the basin was modelled with the same configuration as was originally recommended by the Gawler East Stormwater Infrastructure Study.

The Potts Road detention basin was designed to provide 7,500 m^3 of storage in order to limit outflow to the pre-development 1% AEP flowrate (0.3 m^3/s). The proposed configuration also requires 380 m of DN375 pipe along Potts Road to the creek adjacent Sunnyside Drive. The basin would be reliant on the road network and drainage system of the developed land delivering runoff to the basin during a 1% AEP event.

Modelling of this option has shown that the construction of the basin would prevent significant sheet flow cascading through properties along Mueller Drive and would reduce the volume of flow reaching detention basins along Coleman Parade. Additionally, the Potts Road basin reduces flow along the gutter of Potts Road which helps to reduce the volume of runoff causing flooding in First Avenue. Figure 5.13 illustrates the reduction in flooding that results from the Potts Road basin.



Town of Gawler, Light Regional Council and The Barossa Council

POTTS ROAD DETENTION BASIN

tonkin

Job Number:	20141387
Filename:	20141387GQ001
Revision:	REV B
Date:	2019-03-22
Drawn:	Dylan Bone

Data Acknowledgement:
Aerial Imagery from Metromap, 2017
Roads and Railways from DataSA, 2017

Figure 5.8