

Clare and Gilbert Valleys Council

Stage 2 SMPs for 7 Townships

STOCKPORT STORMWATER MANAGEMENT PLAN

APPROVED FINAL

July 2020



CLARE & GILBERT
VALLEYS COUNCIL



Government of South Australia
Stormwater Management Authority

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The report contains recommendations for stormwater management. Council will seek funding and resources for these recommendations from a range of sources. The availability and timing of funding and resources will determine the order and staging of the works.

Table of Contents

| | | |
|-----|-------------------------------------------------------------------------------|----|
| 1 | Introduction..... | 1 |
| 1.1 | Background..... | 1 |
| 1.2 | History and Nature of the Problem in the Region | 3 |
| 1.3 | Consultation and Development of the Plan..... | 3 |
| 1.4 | Legislative Context..... | 3 |
| 2 | Description of the Study Area | 5 |
| 2.1 | Study Area Boundary | 5 |
| 2.2 | Climate and Soils..... | 6 |
| 2.3 | Ecology..... | 6 |
| 2.4 | Hydrology of the Catchment..... | 7 |
| 2.5 | Township Population and Development Pressure..... | 7 |
| 2.6 | Existing Stormwater Assets..... | 8 |
| 3 | Identification of Problems and Opportunities..... | 10 |
| 3.1 | Economic, Social and Environmental Issues | 10 |
| 3.2 | Riverine and Local Flooding | 12 |
| 3.3 | Properties and People at Risk of Flooding | 14 |
| 3.4 | Impacts of Future Development on Flooding | 14 |
| 3.5 | Exploring Opportunities..... | 15 |
| 4 | Stormwater Management Objectives | 16 |
| 4.1 | Approach..... | 16 |
| 4.2 | Stormwater Management Objectives..... | 18 |
| 5 | Stormwater Management Plan Strategies | 23 |
| 5.1 | Approach..... | 23 |
| 5.2 | Non-Structural Flood Management Measures | 23 |
| 5.3 | Management of Flooding and Local Runoff..... | 26 |
| 5.4 | Effectiveness of Flood Mitigation Works | 28 |
| 5.5 | Regular Maintenance of Drainage Infrastructure and Watercourses..... | 29 |
| 5.6 | Water Quality and Reuse Assessment | 33 |
| 6 | Recommendations | 34 |
| 6.1 | Structural and Non-structural Measures | 34 |
| 6.2 | Environmental, Social and Economic Opportunities/Benefits..... | 36 |
| 7 | Implementation Issues and Funding Opportunities | 37 |
| 7.1 | Priorities and Timeframes for Implementation | 37 |
| 7.2 | Responsibilities for Implementation and Potential Funding Contributions | 37 |
| 7.3 | Responsibility for Maintenance | 38 |
| 7.4 | Potential Funding Contributions..... | 39 |
| 8 | Review of the Stormwater Management Plan | 41 |
| 9 | References..... | 42 |

List of Tables

| | |
|-----------------------------------------------------------------------------------------------------|----|
| Table 2-1: Projected Population | 8 |
| Table 3-1: Surface Watercourses Environmental Values..... | 12 |
| Table 3-2: Population and Properties at Risk in a 50 Year ARI event - Stockport..... | 14 |
| Table 5-1: Breakdown of Properties Protected in Different ARI events..... | 28 |
| Table 6-1: Recommendations..... | 35 |
| Table 7-1: Summary of Priorities | 37 |
| Table 7-2: Responsibility for Implementation and Potential Funding / Partnership Opportunities..... | 38 |

List of Figures

| | |
|------------------------------------------------------------------------------|----|
| Figure 1-1: Location | 2 |
| Figure 2-1: Study Area for Stockport | 5 |
| Figure 2-2: Monthly Rainfall and Evaporation..... | 6 |
| Figure 2-3: Existing Stormwater Assets | 9 |
| Figure 4-1: Issues and Opportunities Raised by the Community..... | 17 |
| Figure 5-1: Recommended Measures and Effectiveness on Flood Inundation | 30 |
| Figure 5-2: Flood Inundation Difference | 31 |
| Figure 5-3: Trafficability of Roads..... | 32 |

Appendices

- Appendix A : Flood Inundation Maps
- Appendix B : Community Feedback
- Appendix C : Assessment of Priorities
- Appendix D : Implementation Plan

1 Introduction

1.1 Background

The Clare and Gilbert Valleys Council (Council) engaged Australian Water Environments (AWE) to prepare a Stormwater Management Plan (SMP) for Stockport. The SMP builds upon the outcomes of the recently completed floodplain mapping for the town prepared by AWE (2013).

The purpose of SMPs is outlined by the Stormwater Management Authority (SMA), as follows - to manage stormwater on a total catchment basis with the relevant Natural Resources Management Board (NRMB), local government authorities and state government agencies. The aim is to work together to develop, implement and fund a coordinated and multi-objective approach to stormwater management in the area. This allows for consistent management that addresses existing problems and identifies opportunities for providing a range of benefits through multi-objective planning, including stormwater reuse where feasible.

This SMP investigates ways to alleviate existing stormwater and flooding problems and provides flood protection for public and private assets. It aims to assess flood mitigation options, investigate opportunities for stormwater reuse, including Managed Aquifer Recharge (MAR), without compromising flow management or flood mitigation infrastructure. The SMP also explores opportunities for environmental enhancement in the design of stormwater infrastructure. Environmental enhancement may be in the form of improved water quality and reduced roadside erosion, and increased biodiversity. The SMP will assess stormwater management options and rank their priority in accordance with the format recognised in the SMA SMP Guidelines with verification against Council wide assessment criteria.

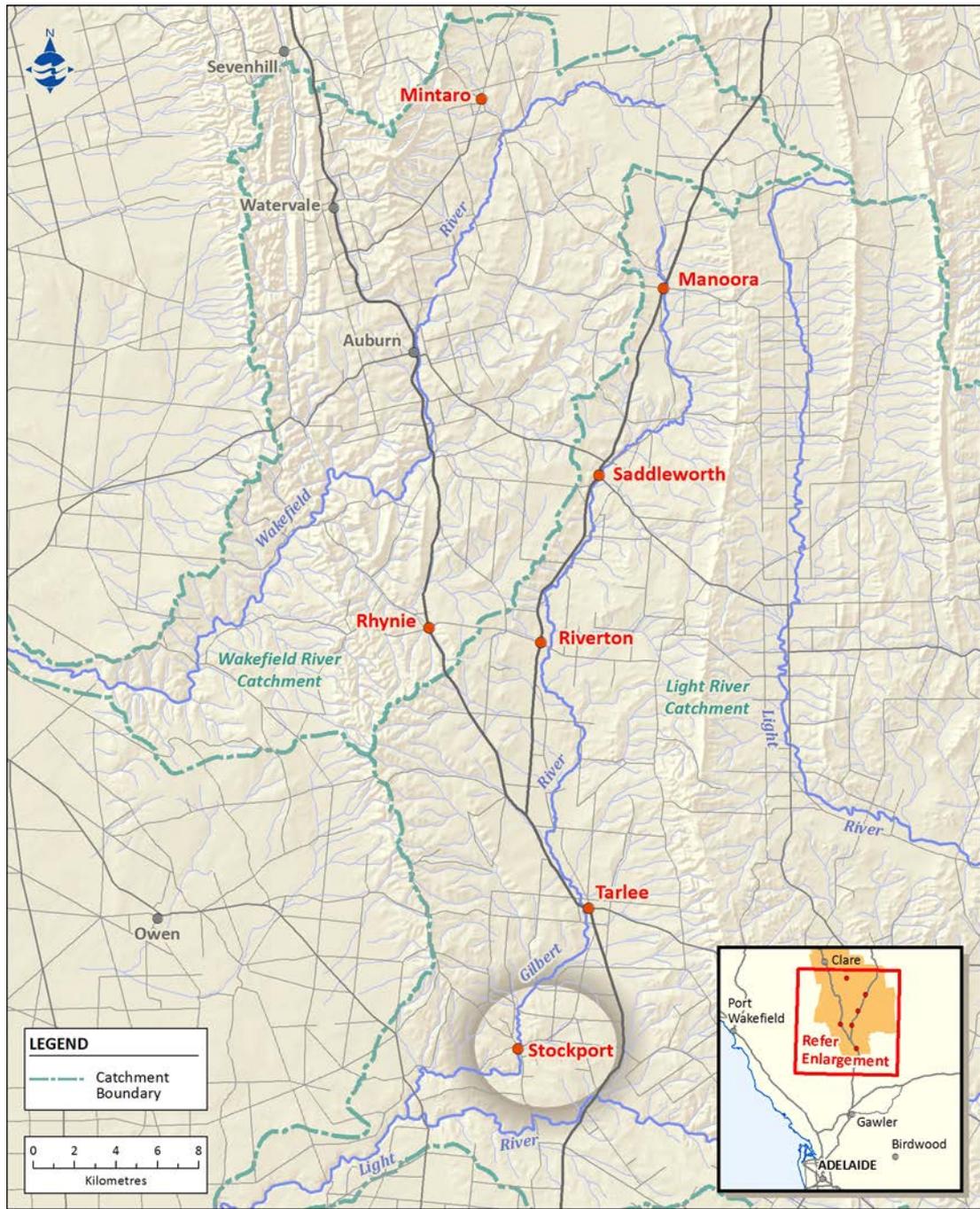
This SMP has been developed in conjunction with developing SMPs for six additional townships for the Council, including: Tarlee, Manoora, Saddleworth, Riverton, Mintaro, and Rhynie. These towns are located approximately 80 km – 130 km north of Adelaide. The location of these towns in relation to each other is shown on the following page in Figure 1-1.

Stockport, Manoora, Saddleworth, Riverton, and Tarlee are located along the Gilbert River, which is a major tributary of the Light River catchment, while Mintaro and Rhynie are within the Wakefield River catchment. Over time, the catchments have been cleared for farming and viticulture purposes, and dry land agriculture is the current dominant land use.

This report has been prepared on the basis of the best information, research and knowledge currently available to the Council. The report contains a range of recommended actions for consideration. The availability and timing of funding and resources will determine the order and staging of these actions.

Assistance in the form of funding and/or resources will be sought from the following:

- Australian Government - grants and subsidies
- State Government of South Australia - grants and subsidies
- Private sector – developer contributions
- Council – administration, implementation and funding
- Community



14009 D100 v5 Location Plan 140618
Last Updated: 18/06/2014

FIGURE 1-1: LOCATION

1.2 History and Nature of the Problem in the Region

The region has experienced flooding since its settlement, and this has become more apparent over recent years. Flooding in the townships has been caused by over bank flows from the rivers (e.g. Gilbert River and Wakefield River tributaries) and from runoff from adjacent hills and slopes. Inadequate stormwater systems/infrastructure within the towns is also contributing to flooding problems. Flooding events have been known to cause inundation and property damage, disruption to road and rail infrastructure. Council is also concerned over the quality of water in these river systems and the impacts the towns may be having on water quality.

1.3 Consultation and Development of the Plan

Council was successful in applying for funding from the SMA's Stormwater Management Fund to assist in preparing the floodplain mapping and this SMP.

The SMP was developed under the direction of a Steering Committee comprising representatives from Council, SMA/Department of Planning, Transport and Infrastructure, Northern and Yorke NRM and the Bureau of Meteorology (BoM).

The community has also provided input in developing the SMP by confirming the nature and extent of flood and stormwater issues and were given the opportunity to provide comment on the proposed management strategies through a series of community meetings.

1.4 Legislative Context

The Local Government (Stormwater Management Agreement) Amendment Act 2016 establishes the Stormwater Management Authority and new financing and governance arrangements for stormwater management and flood mitigation throughout South Australia.

The SMA implements the Stormwater Management Agreement and operates as the planning, prioritising and funding body in accordance with the Agreement. The SMA is charged with:

- Working with Councils to facilitate and coordinate catchment stormwater management planning;
- Allocation of State funding to projects in coordination with Council and other sources of financing; and
- Facilitating cooperative action by all relevant public authorities in the planning, construction and maintenance of stormwater management works.

The framework established by the Stormwater Management Act requires councils to prepare stormwater management plans on a catchment basis, and to implement infrastructure works in accordance with the catchment plans.

The process and content by which stormwater management plans are developed have been formalised by the State Government via the SMA in a guideline entitled *Stormwater Management Planning Guidelines*.

South Australia's legislative framework provides a number of other legislative tools and policy tools to address water management ranging from state-wide legislation to regional and local policy.

One of the key mechanisms for achieving the desired outcomes of integrated water management is to ensure that the objectives of the stormwater management plan meet and contribute to other State and National natural resource management policies and strategies. These strategies in turn assist in the implementation of the desired water management outcomes for townships.

This SMP has been developed in accordance to the requirements of the Stormwater Management Planning Guidelines.

2 Description of the Study Area

2.1 Study Area Boundary

Stockport is located approximately 80 km north from Adelaide in the Mid North region of South Australia and is on the southern boundary of the Clare & Gilbert Valleys Council area.

The town is situated at a bend on the Gilbert River, with development on both sides of the river. The town has small community as well as the Stockport Observatory (Strategic Directions Report 2012/13). Recently the community was affected by the floods that occurred in 2010.

The area for the stormwater management plan is shown in Figure 2-1.

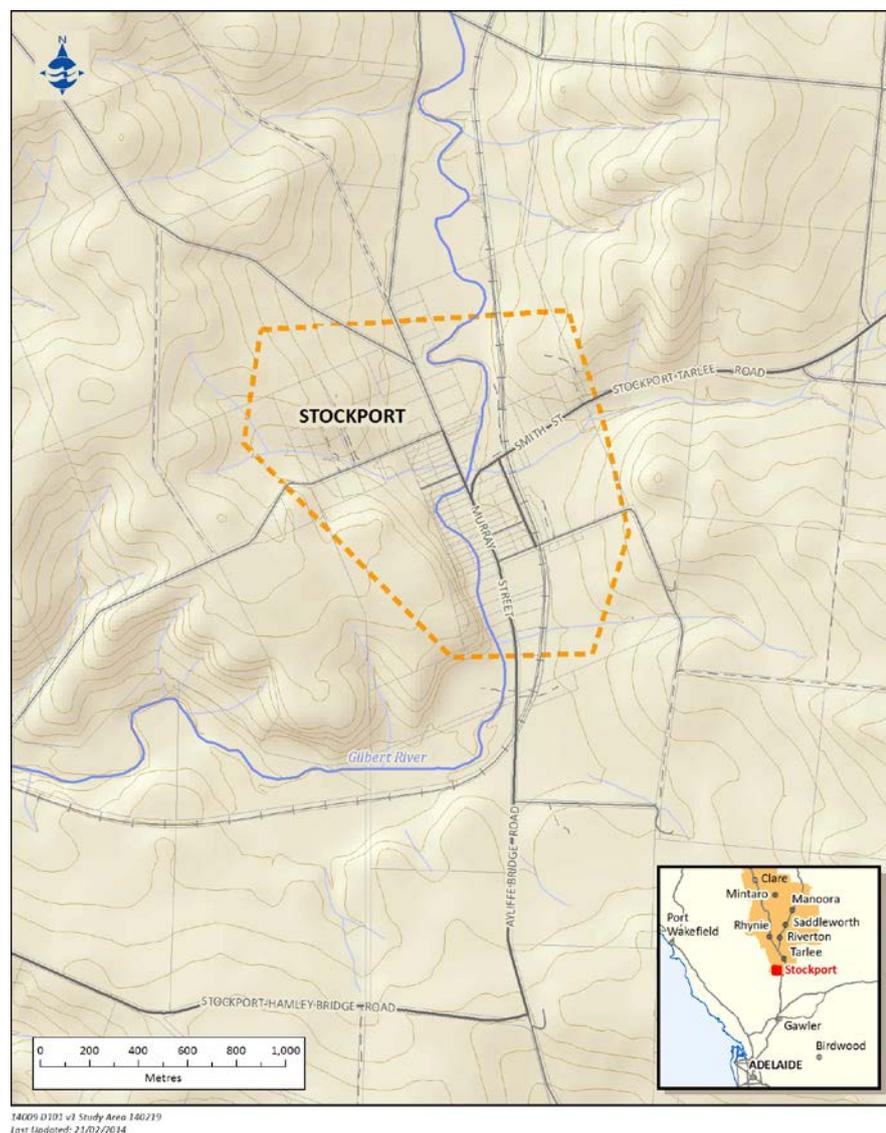


FIGURE 2-1: STUDY AREA FOR STOCKPORT

2.2 Climate and Soils

The soils in the region are predominantly red topsoil overlaying a limestone and tend to be free-draining but have an ability to hold water, particularly in the dryer months.

The climate associated with the study area is a temperate climate with dry summers (low rainfall), and rainfall generally occurs in the winter months.

The long term average rainfall information is based on information provided by BOM for the general region and is approximately 540 mm/yr. The average precipitation and evaporation for each month in the general region is shown in Figure 2-2.

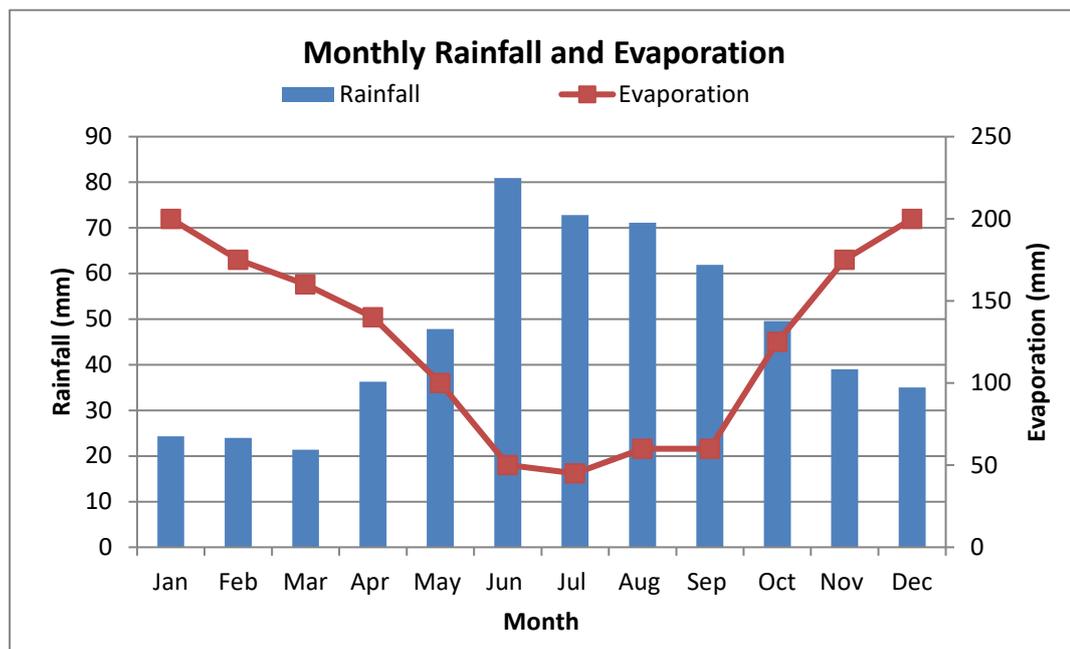


FIGURE 2-2: MONTHLY RAINFALL AND EVAPORATION

2.3 Ecology

The ecological diversity of the region has been significantly altered due to anthropogenic influences and is diminished to pockets of remnant habitats of high ecological value. Overall the ecological health of the systems is highly degraded. The systems have been dramatically modified by the impacts of European settlement and changes in land uses over time. Riverine habitats have been altered from the clearance of native riparian and floodplain vegetation; the loss of in-stream complexity due to channelisation, incision and deposition of sediment; stock grazing; and the introduction of exotic plants and animals (DWLBC, 2004). The original flow regime of the watercourses has been modified by vegetation clearance, agricultural development, farm dams and groundwater extraction. The structure and shape of watercourses have also changed over time, as well as the loss of connectivity with the floodplains.

Less than 3% of native vegetation remains in the Gilbert River catchment which provides habitats for a range of plant and animal species including orchids, native mammals, bird species and reptiles, as well as providing valuable seed reserves to re-establish vegetation (Rural Solutions, 2005).

Prior to European settlement, the in-stream vegetation of the Gilbert River comprised herbland/sedgeland consisting of common reed (*Phragmites australis*) and salt club rush (*Bolboschoenus cadwellii*), however due to land clearance, increased overland flow and sedimentation from past agricultural practices, the common reed now dominates (DWLBC, 2004). The reeds provide valuable food and shelter for fish, frogs, macroinvertebrates and birds and play an important role in preventing stream erosion by slowing the velocity of water.

The condition of riparian vegetation along the Gilbert River and tributaries is generally poor. However there are some areas of good sedgeland especially north of Saddleworth, north of Tarlee and between Tarlee and Stockport and these are under threat from rising salinity (Rural Solutions, 2005).

The receiving environment from Stockport runoff is the Gilbert River, which merges downstream with the Light River, which finally flows through the estuarine environment comprising samphire and mangrove vegetation as the river enters Gulf St Vincent.

2.4 Hydrology of the Catchment

Stockport is situated on the either side of the Gilbert River. The Gilbert River commences just north of Manoora and flows south through the towns of Manoora, Saddleworth, Riverton, Tarlee and Stockport where it joins the Light River just west of Hamley Bridge, before flowing out to the Gulf St Vincent between Dublin and Two Wells. There are a number of tributaries that enter the Gilbert River, including Macaw Creek, Salt Creek, Coghill Creek and other un-named Creeks (Rural Solutions, 2005).

The catchment area of the Gilbert River at Stockport is 416 km², and as rural land use dominates the catchment area it is considered to have a pervious landscape. There are no major storages along the Gilbert River and the channel types are considered to be 'natural'.

Topographic features of relevance within this SMP area include:

- A significant catchment from the east (6.6km²) flows to a dam, providing some stormwater detention;
- An unnamed tributary from the west that enters Stockport immediately north of the township near the Caravan Park, that is known to cause localised flooding issues in that area;
- Limited stormwater infrastructure and much of this is consider 'not standard';
- The railway line provides an embankment which partially blocks flows to the town from the eastern catchment;
- A single bridge over the Gilbert River; and
- There are multiple culverts under the railway line.

2.5 Township Population and Development Pressure

Council's Strategic Directions Report 2012/13 included information on population projections and stormwater management derived from its Water Security Plan (2011). According to that information the population growth in the Council region is expected to grow to 9,795 people by the year 2031 –

an average around 0.6 per cent per annum over the 25 years 2006 to 2031 or 15.5 percent in total. This is somewhat higher than projected growth at the state level over this period (11.0 percent).

The projected population growth for Stockport along with the other 6 townships in the project is shown in the following table.

TABLE 2-1: PROJECTED POPULATION

| Town | 2006 population | 2031 population | Projected annual growth |
|-------------|-----------------|-----------------|-------------------------|
| Stockport | 234 | 259 | 0.02% |
| Tarlee | 288 | 318 | 0.38% |
| Riverton | 723 | 1000 | 1.1% |
| Rhynie | 362 | 370 | 0.08% |
| Saddleworth | 425 | 450 | 0.22% |
| Manoora | 277 | 280 | 0.04% |
| Mintaro | 223 | 246 | 0.37% |

According to Council's Strategic Directions Report 2012/13, population growth in the region should primarily be channelled into Clare, Riverton and Saddleworth by utilising the benefit of existing community infrastructure and appropriately zoned land. No further expansion was recommended for Stockport due to lack of available land, consultation feedback, flooding issues, lack of services and to protect the observatory.

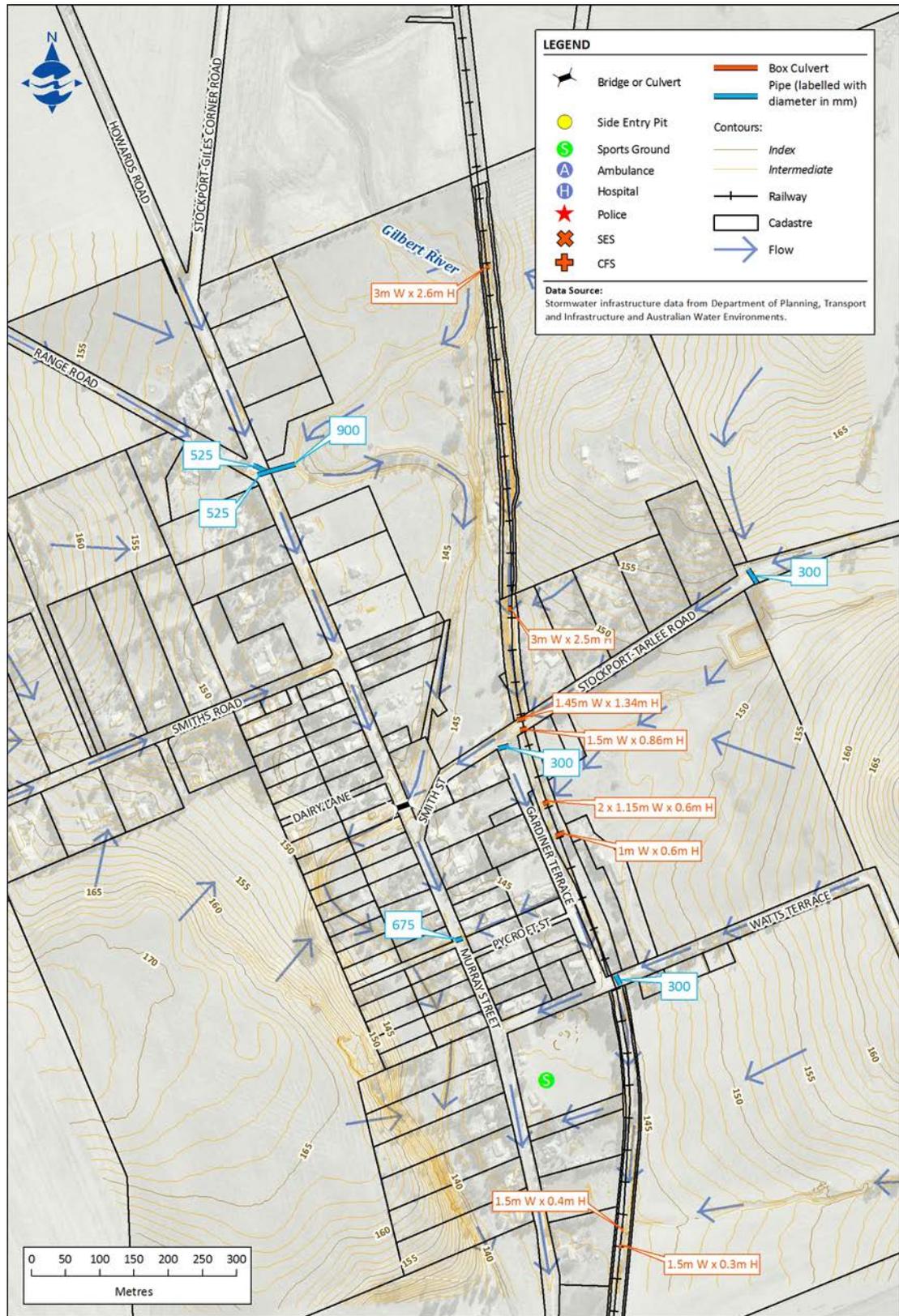
2.6 Existing Stormwater Assets

Stockport has limited stormwater infrastructure and much of this is 'not standard'. Some roadside swales have insufficient capacity to convey the flows. There are multiple culverts under the railway line however the railway line provides an embankment partially blocking flows from the eastern catchment. The flows that are actually conveyed by the culverts under the railway are either directly discharged into the Gilbert River, or are conveyed via a roadside swale along Stockport-Tarlee Road and/or Gardiner Terrace and into a channel with relatively limited capacity, running east to west towards Murray Street before discharging into the river. Flows from Watts Terrace are currently directed to Murray Street where flows run further south.

Similarly, the majority of flows generated at the north western catchments drain via Murray Street and into the Gilbert near the bridge crossing, while catchments to the south west of the town drain directly into the river.

A catchment immediately to the north of Stockport drains south towards a low point near the intersection of Range Road and Howards/Murray Street, where flows are diverted into the river via twin 525mm diameter pipes, followed by a 900mm diameter pipe.

Existing stormwater assets are shown on the following page in Figure 2-3.



14009 D107 v5 Stockport Stormwater Assets 150123
Last Updated: 23/01/2015

FIGURE 2-3: EXISTING STORMWATER ASSETS

3 Identification of Problems and Opportunities

3.1 Economic, Social and Environmental Issues

3.1.1 Economic

In December 2010, flooding (water inundation) occurred in Stockport as well as other towns in the region. The floods affected houses, sheds, fences, traffic disruption and accessibility, as well as causing significant damage to Council infrastructure, such as bridges and roads, which all involve significant economic costs.

3.1.2 Social

The social impacts of flooding and poor stormwater management are often difficult to quantify in monetary terms. These impacts are related to the physical and mental health of individuals, environmental impacts and disruption to essential community services and operations. They can include aspects such as the following:

- Loss of life, personal injury and associated losses and expenses;
- Destruction of memorabilia (e.g. family photos);
- Loss of heritage and cultural features;
- Loss of amenity, recreational value and aesthetics;
- Increased medical costs and reduced life expectancy associated with increases in levels of sickness in a community following a disaster;
- Emotional stress and mental illness associated with experiencing damage to family homes and businesses, including:
 - Replacement of damaged property, particularly if there is no flood insurance or it is insufficient;
 - Living in temporary accommodation;
 - Children attending a different school;
 - Death of pets; and
 - Loss of business goodwill.

3.1.3 Environmental Values

The condition of watercourses in the catchment and downstream has been described earlier in this report in chapter 2. In summary, the downstream (receiving) environment is the Gilbert River, which merges downstream with the Light River, which finally flows through the estuarine environment comprising samphire and mangrove vegetation as the river enters Gulf St Vincent. Erosion and sedimentation caused by stormwater and flooding in Stockport can result in a decline in water quality and ecological health of downstream environments. Therefore measures to control erosion and sedimentation arising from stormwater and flooding in Stockport can help protect water quality and ecological health of these downstream environments.

There is not much water quality data available, however this SMP includes water quality principles to protect downstream environments. The water quality targets for both new and existing developments in the region are designed to reduce the impact on the receiving environments whilst preserving environmental values.

Although there is no available water quality data at present, visual assessment suggests the watercourses in the area of the SMP are in a moderate condition, despite the region as a whole being dramatically modified since European settlement.

Environmental values are those that the community place on the environmental services. The strategy underpinning the determination of the environmental values for the SMP is the National Water Quality Management Strategy (NWQMS). The NWQMS aims to enable Council and community groups to protect the health of water bodies and waterways. Environmental values for this SMP can be guided by the objectives of this Strategy which include the following (but not limited to):

- To ensure the water quality monitoring of waterways and regulation for the discharging of pollutants into waterways adheres to the agreed water quality objectives;
- Provide a strategic direction for the management of all watercourses as well as protecting ecosystems and not compromising the economical well being of the community; and
- Prioritise funding for environmental management which will ultimately lead to improved water quality.

As part of developing this SMP, environmental values were ascribed for the region, as shown in the table on the following page. These values reflect the community's value of the watercourses. Management actions need to safeguard these values.

Whilst the system downstream of the town is highly disturbed, there are areas within the SMP which may respond well to efforts to improve the system. Other stakeholders, such as the NRMB, are also working towards achieving an improved system and therefore it is recommended that such efforts be undertaken in a coordinated manner.

This SMP provides opportunities to control erosion and sedimentation arising from stormwater and flooding in Stockport which can help protect water quality and ecological health of the downstream environments.

TABLE 3-1: SURFACE WATERCOURSES ENVIRONMENTAL VALUES

| Environmental Values | Supporting Details | |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Aquatic Ecosystems |  | Supporting highly disturbed systems (HD) (see below) |
| | Highly disturbed systems (HD). These are degraded systems likely to have lower levels of naturalness. These systems may still retain some ecological or conservation values that require protecting. Targets for these systems are likely to be less stringent and may be aimed at remediation and recovery or retaining a functional but highly modified ecosystem that supports other environmental values also assigned to it (e.g. primary industries). | |
| Primary Industries |  | Irrigating crops such as vines, crops, etc |
| |  | Water for farm use such as in fruit packing or milking sheds, etc |
| |  | Stock watering |
| |  | Human consumption of wild or stocked fish or crustaceans |
| Recreation & Aesthetics |  | Visual appreciation with no contact with water such as picnicking, bushwalking, sightseeing |
| Cultural & Spiritual |  | Cultural and spiritual values including the cultural values of traditional owners |

3.2 Riverine and Local Flooding

3.2.1 Floodplain Mapping

AWE (2013) undertook floodplain mapping for the town, including riverine and local flooding. This is summarised below and also shown in flood inundation maps for the 100 year ARI event which are provided in Appendix A.

3.2.2 Riverine Flooding

A description of the riverine flooding is provided below.

20 year ARI event

The Gilbert River runs close to properties on the western side of Murray Street (the main road). During a 20 year ARI flood event much of the land on Murray Street is inundated. Much of the land located between Smiths Road, Murray Street and the Gilbert River is lower than the river bank level and therefore once the banks are overtopped water ponds here, with a depth up to 0.5m.

The tributary from the east is a significant contributor to flooding in the township. It flows primarily along road verges and through the central channel. Most of the inundation in residential areas is less

than 100mm. In one flow path approximately 30m north of the tributary channel which has depths greater than 200mm. Other areas include the western side of the oval where there is a low point and water ponds, to either flow northwest over the roadway or south along the road verge.

The Gilbert River is confined by the railway line on the left bank upstream of the bridge and by the sharp rise on the right bank downstream of the bridge.

100 year ARI event

During the 100 year ARI event, the Gilbert River inundates areas of the floodplain on the eastern side of the riverbank upstream of the bridge near the river bend. The area of flooding extends to the north of Smith Street by approximate 130m. Inundation is approximately 900mm greater than inundation of a 20 year ARI event.

A breakout on the western side of the bank downstream of the bridge extends over Murray Street, with much of the area inundated over 100mm.

Flow from the tributary contributes to the town's inundation, with most of this area inundated less than 100mm in depth. Water is held back behind the railway line and the depth is over 0.5m in some areas.

500 year ARI event

During the 500 year ARI event the extent of flooding in the northern area extends almost to Range Road on the western side of the river. The depth of inundation in this area is over 1.5m.

South of the bridge (i.e. western side of river) the township is inundated between Murray Street and the railway line. Some areas closer to the railway line are only marginally inundated to 50mm.

3.2.3 Local Flooding Assessment¹

Local flooding issues in Stockport are predominantly dominated by external catchment flow. Particularly, flows on Smiths Road are the result of the confluence of runoff generated from two relatively steep sub catchments to the north west and south west of this road, the hard standing areas of the properties located either side of Smiths Road and the road surface itself. Although a roadside swale exist at some locations along Smiths Roads, the flow path is not continuous (i.e. there are no culvert crossings at several property entrances) and its capacity is quite limited. Due to the lack of an adequate drainage path along this road, the majority of the flows pond at a low lying location on the southern corner of the intersection of Smiths Road and Murray Street, where several private properties are located.

Similarly, flows from Range Road and Murray Street in the northern portion of the town pond in a low lying area located at the intersection of these two roads. Although there is a pipe here to discharge flows into the Gilbert River, its capacity is limited and the infrastructure is surcharged during storm events equal to or greater than the 20 year ARI event.

¹ Runoff causing local flooding issues was assumed to be caused by rainfall falling directly on the townships and the immediate surrounding slopes. This whole area was typically contained within the Digital Elevation Model (DEM) contained within the TuFlow model for each town. In some cases inflows from small catchment areas that lay outside the DEM could also cause local flooding issues, and in these cases the external catchment inputs were modelled in RORB and hydrographs included as boundary conditions to the TuFlow Model.

Flooding at locations on the south west of Stockport are mainly driven by overflows from a dam situated to the west of the town. There are two culverts through the railway line that feed flow into Gardiner Terrace and then into a channel with limited capacity running towards Murray Street and the Gilbert River.

3.3 Properties and People at Risk of Flooding

Flood maps (based on riverine flooding) and aerial photography were used to identify properties/dwellings at risk of flooding. The number of people at risk of flooding in a 100 year ARI event was determined by analysing the number of properties at risk of flooding and the average number of people per property.

In the 100 year ARI flood event there are 57 properties at risk of flooding in Stockport, however due to the extensive works (and costs) that would be required to protect those properties in this flood event, it was determined that the SMP focus on protecting properties in the 50 year ARI event. The cost of works for a 50 year ARI event would therefore be in a better position to be funded and implemented, compared to the very high costs of works aimed at the 100 year ARI event.

In the 50 year ARI flood event there are 53 properties at risk of flooding, with 47 of these involving flooding of built assets. The population and number of properties in Stockport at risk of flooding in a 50 year ARI event, with a breakdown of the number in each hazard zones, are shown in the table below. There are no properties at risk from direct rainfall that are not also at risk from riverine flooding. In all cases, flooding by riverine sources is significantly worse, noting that the tributaries from the east and west have catchments of several square kilometres and hence are regarded as causing riverine flooding.

TABLE 3-2: POPULATION AND PROPERTIES AT RISK IN A 50 YEAR ARI EVENT - STOCKPORT

| Population at risk of flooding | No. of properties at risk of flooding in each flood hazard zone (Riverine and Local flooding) | | | |
|--------------------------------|--------------------------------------------------------------------------------------------------|-----|------|-------|
| | Low | Med | High | Total |
| 151 | 9 | 10 | 28 | 47 |

3.4 Impacts of Future Development on Flooding

It is important to understand if future development is planned in the area and what impacts this may have on flooding. Any redevelopment of these will need to take into account of the flood extent and depth maps prepared for this SMP to reduce the risk of being flooded, as well as to reduce any impact they may have on flood paths and flood behaviour.

As outlined previously in chapter 2.5 of this SMP, Stockport is not anticipated to expand in the immediate to medium term. It is to retain its small scale village character, but still to allow for modest growth.

The township is zoned as 'Township' and is surrounded by land zoned 'Primary Production'. There is no 'Deferred Urban' zone and therefore future development is likely to be limited to infill development.

3.5 Exploring Opportunities

This SMP explores opportunities for better managing the risk of flood, including structural and non-structural flood mitigation measures. Non-structural measures include aspects such as flood warning and preparedness and better integration between stormwater management and Council's Development Plans.

Harvesting of stormwater as an alternative source of water is a desirable option for many towns, for purposes such as greening of public open space, irrigating sports ovals and other recreational areas. The SMP describes options for water harvesting including aquifer storage.

Whilst harvesting of stormwater is to be promoted, any scheme should also have regard to water dependent ecosystems downstream.

In addition, the design of stormwater infrastructure has consideration of potential environmental enhancement and benefits to watercourses and receiving environments, such as detaining flows from storm events which will reduce downstream scouring.

4 Stormwater Management Objectives

4.1 Approach

The development of stormwater management objectives has had consideration of the earlier floodplain mapping and technical assessments, consultation activities and the requirements of the SMA Guidelines.

The project has been overseen by a steering committee including representatives from Council, DPTI/SMA, the Northern and Yorke NRMB, and more recently from BOM. Regular meetings have been held throughout the project to discuss progress, issues arising, and to confirm the approach to technical investigations and community consultation.

Consultation with the Stockport community was undertaken in August 2013 to identify issues and opportunities for stormwater and flood management. This information helped to determine the objectives of the SMP. A summary of the issues raised by the community is shown on the following page in Figure 4-1, and in Appendix B.



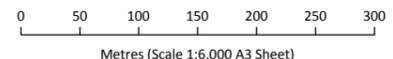
LEGEND

Contours:
 — Index
 — Intermediate

— Railway
 — Road Edge
 — Cadastre

● Flood control/management
 ● General comment
 ● Water reuse
 ● Water quality/biodiversity/erosion control

Data Source:
 Aerial Imagery, Road Edge and Contours from Aerometrex; Road Names and Cadastre from Clare & Gilbert Valleys Council; Railway Alignment from DTEI.



Stormwater Management Plan
 For Seven Townships In The
 Clare And Gilbert Valleys Council
 Stockport

Issues and Opportunities Raised by the Community

4.2 Stormwater Management Objectives

With consideration of the above technical information, consultation feedback and SMA Guidelines, the following stormwater management objectives have been developed:

- Provide an acceptable level of protection of assets from local and regional flooding (from Gilbert River and from drainage from the east and west of the town);
- Develop an appropriate, and sustainable, stormwater management system which has consideration of operational and maintenance requirements and costs;
- Continue to improve maintenance processes to optimise the water quality and water quantity management services performed by the stormwater network;
- Improve drainage along Observatory Rd (Smiths Rd) and along Gardiner Terrace and West Lane;
- Explore opportunities to maximise the use of the existing dams for flood control purposes;
- Seek ways to enable people to be better prepared for floods, such as preparedness and a flood warning system;
- Explore issues and opportunities to improve water quality and downstream ecological health, local amenity and options for future reuse.

A brief description of these objectives follows.

4.2.1 Local Flooding

The following criteria were adopted:

Formal Infrastructure to Remain Effective

Formal infrastructure should be functional and able to cope with their design flows.

Informal Infrastructure to Remain Effective

The informal infrastructure (such as the roadways) should remain effective with only standard maintenance activities.

Stormwater Flows should be Contained in the Road Reserve

Stormwater flows should not inundate and cause damage to areas outside of the road easement. If significant flows leave the road reserve there is potential for damage to private property.

All Built Roads are Required to be Trafficable

Council's built roads are required to be trafficable against the following ARI events:

- 5 year ARI event for local arterial and collector roads; and
- 2 year ARI event for the remaining roads.

The road was assumed to be trafficable when small conventional vehicles can safely traverse the sections of deepest flowing water. The deepest water is expected to occur in the road side swales. A small vehicle is expected to be able to safely traverse flows that are less than or equal to 0.3m deep.

The velocity of the flowing water is also important in determining whether the flow can be safely traversed. The combination of depth and velocity (i.e. DxV) reflects the hazard of the flows. To provide safe access for small conventional vehicles the hazard must be low (SCARM, 2000). Low hazard has previously been defined for floodplain mapping projects in South Australia as flows with a depth less than 0.3m and a velocity less than 0.3m/s i.e. a maximum DxV of 0.09 m^2/s . This value of the DxV relationship is also supported by the data in SCARM (2000) which specifies low hazard flows to have a DxV value of less than or equal to 0.09 m^2/s .

New Developments to not Increase Peak Flow Rates

The SMP is to seek ways to support Council's Development Plan which specifies that water discharged from a development site should:

- (a) be of a physical, chemical and biological condition equivalent to or better than its pre-developed state; and
- (b) not exceed the rate of discharge from the site as it existed in pre-development conditions.

4.2.2 Regional Flooding

Stockport experiences flooding from the Gilbert River during the 20 year ARI event, 100 year ARI event and the 500 year ARI event, and flows tend to inundate Murray Street and streets adjacent the river, e.g. Observatory Road (Smith St) and Gardiner Tce. Objectives include providing protection to properties from flooding within the identified township boundary. The SMP can assist with achieving this by providing guidance on:

- Formulating drainage paths to limit flooding of properties in the township;
- Ensuring drainage infrastructure is appropriate for conveying flows, eg culvert capacities;
- Appropriate finished floor levels to prevent over bank flooding from the Gilbert River and from other flow paths entering buildings;
- Reducing any restriction to flows caused by inefficient drainage system; and
- Options for mitigating flooding.

The SMP is to seek ways to support Council's Development Plan relating to flood hazards. It specifies the following principles of development control:

- *Principle 4 - Development should not occur on land where the risk of flooding is likely to be harmful to safety or damage property.*
- *Principle 5 - Development should not be undertaken in areas liable to inundation by tidal, drainage or flood waters unless the development can achieve all of the following:*
 - (a) it is developed with a public stormwater system capable of catering for a 1 in 100 year average return interval flood event; and*
 - (b) buildings are designed and constructed to prevent the entry of floodwaters in a 1 in 100 year average return interval flood event.*

In terms of flooding and mitigating peak flows, Council's Development Plan also includes information on stormwater and includes the following principles of development control:

- *Principle 31 - Development should include stormwater management systems to protect it from damage during a minimum of a 1 in 100 year average return interval flood.*
- *Principle 33 - Development should have adequate provision to control any stormwater over-flow run-off from the site and should be sited and designed to improve the quality of stormwater and minimise pollutant transfer to receiving waters.*
- *Principle 34 - Development should include stormwater management systems to mitigate peak flows and manage the rate and duration of stormwater discharges from the site to ensure downstream systems are not overloaded.*
- *Principle 38 - Where not detained or disposed on site, stormwater should be drained to a public stormwater disposal system.*

The SMP is to seek ways to support the above principles of development control.

4.2.3 Water Quality and Ecological Protection

Stormwater runoff should not impair the health of receiving environments, such as the Gilbert River and downstream environments such as the saltmarsh coastal environment of Gulf St Vincent. The SMP can assist this by estimating the quality of runoff and developing mitigation strategies aimed at protecting water quality.

Desirable end-state values for watercourses and riparian ecosystems have been identified earlier in this SMP in section 3.1.3. This also included objectives aimed at protecting the health of waterbodies and waterways. This issue is expanded below.

The SMP aims to reduce the pollutant load of stormwater and will be guided by the State Government's targets for stormwater quality (pollutant reduction), as outlined below:

- 80% reduction in Total Suspended Solids
- 60% reduction in Total Phosphorus
- 45% reduction in Total Nitrogen
- 90% reduction in litter/gross pollutants

(Water Sensitive Urban Design, 2013)

In addition, the SMP will help support the following Council objectives:

Council's Development Plan provides objectives to protect natural resources, such as:

Objective 2 - Protection of the quality and quantity of South Australia's surface waters, including inland and underground waters.

The Development Plan also includes principles of development controls that aim to manage the quality of stormwater runoff, such as:

Water Sensitive Design

Principle 11 - Development should have adequate provision to control any stormwater over-flow runoff from the site and should be sited and designed to improve the quality of stormwater and minimise pollutant transfer to receiving waters.

Water Catchment Areas and Water Quality

Principle 24 - The quality of water leaving the site of a development should be of a physical, chemical and biological condition equivalent to or better than pre-development conditions, and the rate of water discharged from the site should not exceed the rate of discharge from the site in pre-development conditions.

Stormwater

Principle 35 - Development should include stormwater management systems to minimise the discharge of sediment, suspended solids, organic matter, nutrients, bacteria, litter and other contaminants to the stormwater system.

Principle 36 - Stormwater management systems should preserve natural drainage systems, including the associated environmental flows.

The SMP aims to support the Northern and Yorke NRM's resource condition targets for a range of NRM issues - the most relevant issues and their targets are outlined below:

- Integrity of native vegetation communities:
 - By 2030, maintain the condition of the region's 1,200,000 ha of remnant native vegetation, and improve the condition of 15% from 2008 levels.
- Integrity of inland aquatic ecosystems (rivers and other wetlands):
 - By 2030, inland and estuarine water-dependent ecosystems are maintained or improved in condition from 2008 levels.
 - By 2030, core refuge areas are protected by a 20% reduction in the extent of priority degrading watercourse management issues.
- Integrity of estuarine, coastal and marine habitats:
 - By 2030, there is no reduction in the extent and a steady improvement in the condition of coastal, estuarine and marine ecosystems, compared to 2008.
 - By 2030, the extent and diversity of coastal landscapes is maintained and their condition improved, compared with 2008.
- Nutrients in aquatic environments, Turbidity/suspended particulate matter in aquatic environments, Surface water salinity in freshwater aquatic environments:
 - By 2030, water quality is maintained, within climatic limitations and natural conditions, below levels set for aquatic ecosystems in the Environment Protection (Water Quality) Policy.
- Significant native species and ecological communities:
 - By 2030, there has been no loss of species or ecological communities and their viability and conservation status has improved from 2008 levels.

The Northern and Yorke NRM's Regional Plan (Volume D) also contains information and requirements relating to managing works around watercourses, known as Water Affecting Activities (WAA's). A permit is required to undertake any of the WAAs listed in Section 5 of the NRM Plan either in the not prescribed areas, or in relation to prescribed water resources where no water allocation plan exists. The purpose of this permit is to ensure activities support the NRM's aims of protecting water resources. However, Council may decide to develop Best Operating Practices that

have been approved by the Board which will replace the need for a WAA permit, such as for the construction of a culvert or managing vegetation along a watercourse.

4.2.4 Stormwater Reuse

The reuse of stormwater was discussed with the community however it was not regarded as a high priority as they wanted the SMP to focus more on flooding control measures. For this reason the options for potential reuse was not explored further.

4.2.5 Desirable Planning Outcomes

New Development

As outlined earlier in this SMP, there is no 'Deferred Urban' zone and therefore future development is likely to be limited to infill development.

Any future development needs to have consideration of the land's flood risk. Flood maps produced in this SMP provide information on flood extents and heights. This information is useful in Council setting minimum finished floor levels to adequately provide protection from floods.

Some allotments in the township are currently affected by flooding, such as those adjacent to the main watercourse channels and those situated to the east of the town which experience sheet flow coming down the eastern slopes towards the town.

Future development also needs to have consideration of how it may affect flood paths. To ensure adequate drainage is achieved, it may be necessary to provide detention onsite for a single allotment, or a detention basin placed within a larger subdivision, so not to exacerbate the town's drainage system.

Open Space, Recreation and Amenity

Areas of open space, recreation and amenity are important to the community and options to safeguard and enhance these values are explored in this SMP, such as investigating watercourse rehabilitation works, water quality improvements, and stormwater reuse options.

5 Stormwater Management Plan Strategies

5.1 Approach

The development of stormwater management strategies has been based on the stormwater management plan objectives, modelling and technical investigations, and feedback received from the Steering Committee, Elected Members and the local community. A summary of the community feedback on draft strategies is provided in Appendix B.

Strategies for managing flooding and stormwater runoff are outlined as follows.

The recommended strategies in this report are assigned a unique label and number, such as:

Flood management: F1, F2, etc

Water Quality: WQ1, WQ2, etc

Reuse: R1, R2, etc

Preparedness and planning: P1, P2, etc

Combined strategies (not predominantly one of the above): C1, C2, etc.

In addition to the proposed measures outlined below, the road network's function of conveying high flows will continue.

It is noted that the availability and timing of funding and resources will determine the order and staging of the recommended works.

5.2 Non-Structural Flood Management Measures

In addition to structural measures aimed at controlling flooding, there is a range of non-structural measures that can assist in achieving this outcome and minimise the impacts of flooding in the future. Non-structural measures are typically highly cost effective and can be implemented over much shorter timeframes. Both structural and non-structural approaches should be incorporated within an overarching management plan for Stockport.

Examples of non-structural measures are described below.

5.2.1 Flood Preparedness

Flood preparedness is a cost effective non-structural means of reducing damages as a result of a flood. Flood preparedness is basically about helping people to be aware of the flood risk and how best to respond to it. Flood preparedness programs in this context are considered in four phases: flood awareness, flood warning, response and recovery. They form the key elements of a total flood warning system (Commonwealth of Australia, 2009).

Flood Awareness

A flood awareness program for people in Stockport is an important aspect of reducing the risk of flood damage. A community awareness program, similar to the Clare township's 'Floodsafe' program which assists the community in being better prepared and able to respond to flood risks and events is recommended. This program is based on the SA State Emergency Service's (SES) highly successful community education and awareness raising 'Floodsafe' program. A program such as this

may include awareness activities such as informing the community through discussions with individual households, the Council's newsletters, public presentations, articles in local media, information included on Council's website, and information about a flood emergency kit.

A coordinated education program is one means of ensuring this information is effectively disseminated. The development of such programs is essential for ensuring that landholders can take full advantage of flood warnings.

Flood Warning

Research has demonstrated that flood warning can substantially reduce the damage costs associated with flooding. Generally, the greater the warning time, and the more prepared the community are then the greater the savings may be. A well informed community can reduce the costs associated with a flood by around 20% with only 2 hours warning whilst with 12 hours warning costs can be reduced by around 60% (BTE, 2001). At Stockport, there is approximately 18 hours from the onset of rainfall higher upstream in the catchment to the time of peak flooding in the town from the Gilbert River. This provides time for the community to prepare for an impending flood.

Flooding from the local catchments is likely to occur over much shorter timeframes (less than two hours). Nevertheless, warnings based on forecast and recorded rainfalls can be provided to help alert towns people of a potential impending flooding issue from the local catchment.

A flood warning service would be useful for the Gilbert River, such as the system currently provided by BOM for other areas e.g. the Gawler River. This may require more flow information, additional river and rain gauging stations in the Gilbert River catchment to significantly improve the ability to warn the people of Stockport of impending high flows or intense rainfall.

Flood Response

The flood response phase (and to a lesser extent the recovery phase) is highly influenced by the experience or knowledge of people of the likely behaviour and nature of a flood event. There are a range of actions people can do with their property before and during a flood that can substantially reduce the damage costs. Many of these measures are very simple and easily implemented. To be effective landholders potentially affected by flooding need to be aware of their options and response strategies.

The response of emergency services during a flood is obviously also a key factor in reducing flood damages and threats to public safety. Integrated disaster response plans are an important means for helping to ensure emergency services can effectively respond. Whilst not wishing to suggest that current response services are deficient (because they are not), the regular review of these plans and the conduct of "dry run" flood response exercises can be effective ways of ensuring emergency response staff and volunteers are aware of the issues, hazards, and opportunities that might be presented to them during a real flood event. Such initiatives should be effectively supported.

Flood Recovery

The recovery phase post flood is critical to reducing social disruption and long lasting health issues associated with trauma (and in extreme cases disease) as well as ensuring communities can get back to "normal" as soon as possible and thereby contain the overall damage costs.

Flood preparedness is included in the list of recommendations as option P1 in Table 6-1. This includes a total flood warning system and a community awareness/education program (to be implemented every 5 years).

5.2.2 Development/Planning controls

The Development Plan is a statutory document that controls and manages all forms of development within the Clare and Gilbert Valleys area. It sets out a range of development zones, maps and rules (Objectives and Principles) to help ensure that development occurs in a well managed way and takes account of relevant environmental, infrastructure, urban design, heritage and community requirements (Strategic Directions Report 2012/13).

Planning controls within Council's Development Plan provide a framework to plan and build in a manner that incorporates stormwater management. Council already has information in its Development Plan to help guide development in terms of stormwater runoff volumes, water quality and reuse aspirations. To improve the effectiveness of the Development Plan Council may consider including specific water quality targets identified in the State Government's targets and the NRM Board's resource condition targets as described earlier in this SMP.

It is recommended that Council includes flood maps in its Development Plan to demonstrate land at risk of flooding and to guide appropriate development.

In relation to stormwater reuse, the Development Plan may be improved by including the reuse targets outlined in the State Government's Stormwater Strategy and "Water for Good" plan and also support the region's "Water Security Plan" (2011).

It is also recommended that Council enforces its current flood hazard requirements in its Development Plan, such as not allowing development on land where the risk of flooding is likely to be harmful to safety or damage property. In addition, to avoid buildings being constructed too low and thus potentially at risk of flooding, it is recommended that finished floor levels of new developments are 300mm above the 100 year ARI flood level or if the develop lies outside a floodplain area then 300 mm above surrounding land levels.

There are a variety of planning and legislative controls available to minimise the various risks to the receiving environments, with the fundamental requirement that stakeholders have a duty of care to not adversely impact on the environment. For example, the Development Plan has a section on Water Sensitive Design which, amongst other provisions, requires:

Water discharged from a development site should:

(a) be of a physical, chemical and biological condition equivalent to or better than its pre-developed state

(b) not exceed the rate of discharge from the site as it existed in pre-development conditions.

Improvements to water quality, stream management, and actions to reduce the risk of flooding are outlined below. These also have the potential to achieve better planning outcomes associated with open space, recreation and amenity.

Development / planning controls are included in the list of recommendations as option P2 in Table 6-1.

5.3 Management of Flooding and Local Runoff

Management strategies have been developed that focus on improving the ability of the river to convey flows, managing runoff/flows from the east and west of the town, improving the capacity of existing drainage infrastructure and proposing additional infrastructure to help facilitate flows.

Mitigation measures aimed at protecting properties from inundation in the 100 year ARI event were extensive and considered cost prohibitive and therefore the suggested measures are based on a level of protection from the 50 year ARI event.

In addition to the proposed measures outlined below, the road network's function of conveying high flows will continue.

The recommended measures are described below and shown in Figure 5-1. This figure also shows the effectiveness of these recommendations on flood inundation.

The difference in flood inundation pre and post measures is shown in Figure 5-2.

Further information on the properties protected in different ARI events is provided in section 5.4 of this plan.

Some of the proposed works are on private land and in these cases, agreements will need to be reached with landholders with respect to access and arrangements for maintaining infrastructure.

5.3.1 Modification to Gilbert River, Bridge Deck Height and a Proposed Levee

It is recommended that a levee be established along the western bank of the Gilbert River upstream from the bridge on Murray Street (minimum 1m high). The deck of the Murray Street bridge would need to be raised by approximately 750 mm, and the river widened by 8m to achieve a channel bottom width of 12m. (these works may involve works on privately owned land)

An alternative option to raising the bridge has been explored and this involves providing a levee along the southern bank adjacent Smith Street to prevent overflow down Murray Street South. However, this alternative option is not recommended at this time as it is considered not to be as effective or reliable in managing floods as raising the bridge.

These works are included in the list of recommendations as F1 in Table 6.1.

5.3.2 Modifications and Proposed Infrastructure on Eastern Side of Town

It is recommended that the existing detention basin situated to the east of the township is modified to increase its capacity to store more water (approximately an additional 2 – 3 ML). (this would involve works on privately owned land).

A levee is proposed along Smith Street and the eastern side of the railway line (0.5 – 1.5m high), as well as a levee (up to 0.8m high) around a property situated to the south west of the basin (this would involve works on privately owned land).

The capacity of the culverts under railway line is to be reduced (provide orifice) to limit inflow and redirect flow to a proposed drainage swale along the railway line. The northern culverts need to be fitted with a single 600 mm diameter orifice; the southern culvert fitted with a 400 mm orifice.

A swale is recommended along the eastern side of the railway line (1.95m deep x 4m wide (bottom) x 8.6m wide (top)).

A swale is recommended along the eastern side of the railway line (1.95m deep x 4m wide (bottom) x 8.6m wide (top)).

Culverts are to be upgraded on Watts Terrace and Murray Street (2 x 1.2m diameter RCP).

It is recommended that the roadside swale along Gardiner Terrace is formalised (3.5m wide (top), 0.5m wide (bottom), 0.5m high, 1:3 side slopes), with a capacity of 0.93 m³/s. Also, culverts/road crossing are to be placed on Gardiner Terrace (2 x 0.7m diameter culverts).

These works are included in the list of recommendations as F2 in Table 6.1.

5.3.3 Measures to Address Local Runoff

The following recommended measures provide better protection from local stormwater runoff:

- Provision of a roadside swale on Smiths Road (capacity 1.7 m³/s) and Murray Street (capacity of 2.6 m³/s) (4.3m wide (top), 1.6m wide (bottom), 0.6m high, 1:2 side slopes) (this may involve works on privately owned land), as well as corresponding culvert crossings at road intersections (2 x 0.675m diameter RCP).
- Provision of driveway crossovers on Murray Street and Smiths Road to the entrance of properties where the swale has been proposed. (this would involve works on privately owned land)
- Provision of a set of culverts (including backflow flaps or equivalent) under the proposed levee near the bridge on Murray Street. (this may involve works on privately owned land)
- An additional culvert (0.525m diameter RCP) and headwall on the western side of Murray Street, at the low lying area near the intersection of Murray Street and Range Road.

These works are included in the list of recommendations as F3 in Table 6.1.

5.3.4 Other Options

During the Council and community consultation meetings there were a number of people indicating that farm dams upstream of the towns should be assessed for their potential to reduce peak flow rates.

Aerial photography was used to identify potential dams and to estimate their approximate size. In most cases it was found that existing dams were either too small or not located in an area of the catchment that would allow them to be effective with respect to flood mitigation.

Opportunities were also considered for the construction of new flood control dams upstream of the townships. This assessment process revealed that the volumes of storage required were large and the rounded topography made it impractical to size a dam that would be effective for major floods.

Landholders also identified that land management practices have improved and are continuing to improve further with respect to minimum tillage / direct drilling / contour bank techniques that are all effective in retaining more water on farm. These techniques along with farm dams all contribute to reducing peak flows but the effectiveness of these systems diminishes with the larger, less frequent floods. The volumes of water associated with the 20 year ARI flood are simply too great for these measures to be effective. Their effectiveness is usually limited to floods up to the 5 year or occasionally 10 year ARI event.

5.4 Effectiveness of Flood Mitigation Works

5.4.1 Difference in Flood Inundation Pre And Post Mitigation Measures

The flows of a 50 year ARI event were modelled with the recommended management measures in place. The difference of flood inundation is shown in Figure 5-2. This figure shows areas that were once inundated are either now shallower or dry. As a result of changing the flow paths, some areas that were once dry are now seen to be wet or flooded in the 50 year ARI event but these are located outside of areas where this could cause harm.

There are 57 properties at risk of flooding in the 100 year ARI event, however due to the extensive works (and costs) that would be required to protect those properties in this flood event, it was determined that recommendations would aim at protecting properties in the 50 year ARI event, in conjunction with non-structural measures. There are 53 properties at risk in the 50 year ARI event and the recommended works are expected to protect all of these.

The proposed works would provide better protection than currently exists for the remaining dwellings/properties, which are situated at the southern end of the town. The expected depth of water would be less than 0.10m. This depth of water would not cause over floor flooding of the dwellings.

A breakdown of the number of properties protected in a range of ARI events (with the recommendations in place), is provided below in Table 5-1.

TABLE 5-1: BREAKDOWN OF PROPERTIES PROTECTED IN DIFFERENT ARI EVENTS

| ARI event | 20 year | 50 year | 100 year |
|---------------------------------------|---------|---------|----------|
| Number of properties protected | 32 | 53 | <53 |

5.4.2 Trafficability of Road Network

Objectives of this SMP include Council's built roads to be trafficable under the following scenarios:

- 5 year ARI event for local arterial and collector roads; and
- 2 year ARI event for the remaining roads.

The 5 year ARI event (based on local flooding/direct rainfall) was modelled to assess the trafficability of roads following the implementation of recommended works. This showed that the recommended measures would improve the trafficability of the road network and no roads would be overtopped.

The trafficability of the roads is shown in Figure 5-3.

5.4.3 Impact of Mitigation Measures on Downstream Stream Stability

It is important to understand the impact of the proposed mitigation measures on downstream environments, such as higher flow velocities that may cause erosion issues.

In a 50 year ARI event, the proposed channel widening, and works are expected to reduce the peak velocity of flows leaving the town by a significant amount (up to 40% in places) compared to the existing situation. This will help protect downstream environments by reducing the risk of stream instability and mobilisation of sediment from the section of river through the township.

5.5 Regular Maintenance of Drainage Infrastructure and Watercourses

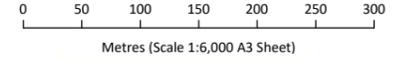
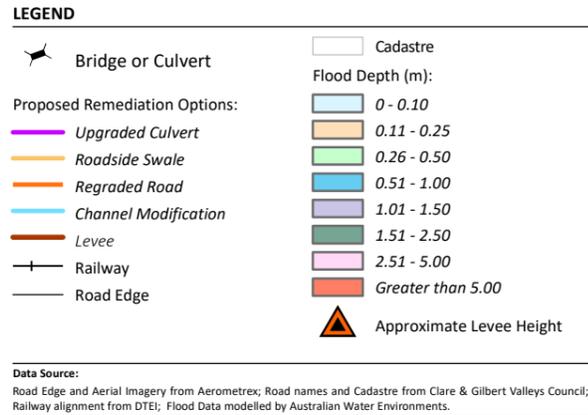
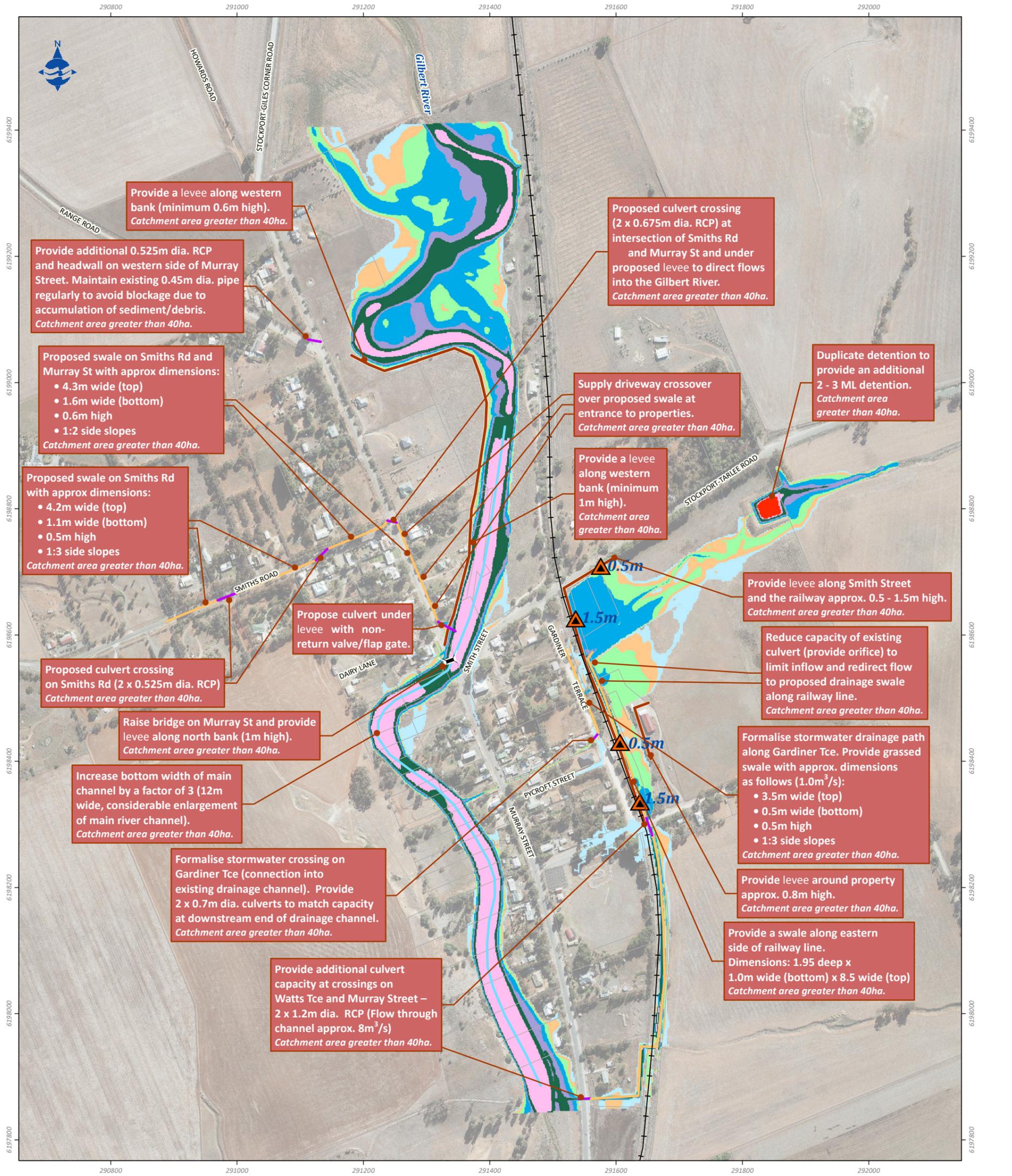
The effectiveness of stormwater drainage infrastructure and watercourses is influenced by whether or not they are maintained and free of blockages. It is recommended that Council maintain the drainage paths and infrastructure in a manner to ensure they perform as designed, i.e. to enable efficient flow of water.

Council will continue to improve maintenance processes to optimise the water quality and water quantity management services performed by the stormwater network.

In relation to fences across watercourses, it is also recommended that Council, in conjunction with the NRM Board, assesses the suitability of stream fencing that may be in place, and identifies the need for any upgrade/modification to existing fences as appropriate. It is anticipated that this work would be done in partnership with landholders and the NRM Board.

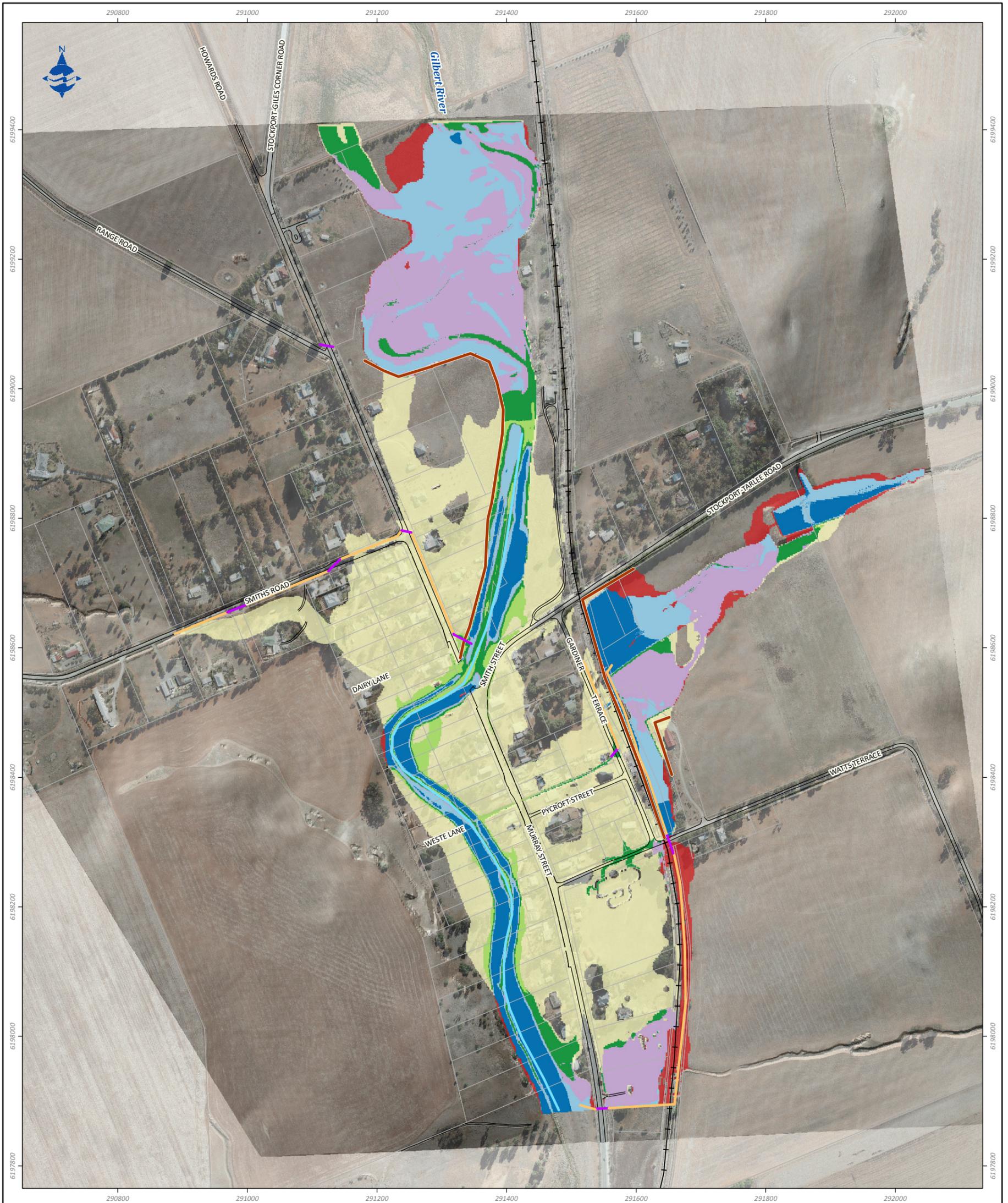
These actions are included in the list of recommendations as option F4 in Table 6-1.

Further information and recommendations on the maintenance of watercourses and stormwater infrastructure located in private and public land is provided in section 7.3 of this report.



Stormwater Management Plan
For Seven Townships In The
Clare And Gilbert Valleys Council
Stockport 50 Year ARI Event

Recommended Measures and Effectiveness on Flood Inundation



LEGEND

Proposed Remediation Options:

- Upgraded Culvert
- Roadside Swale
- Regraded Road
- Channel Modification
- Levee
- Railway
- Road Edge
- Cadastre

Wet Previously Wet:

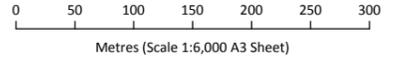
- Significant increase in flood depth (over 0.5m)
- Moderate Increase in flood depth (up to 0.5m)
- No significant change in flood depth
- Moderate decrease in flood depth (up to 0.5m)
- Significant decrease in flood depth (over 0.5m)

Wet Previously Dry: ■

Dry Previously Wet: ■

Note: Flood difference was determined by subtracting mitigation data from the current scenario therefore negative values represent a greater depth in mitigation data.

Data Source: Road Edge and Aerial Imagery from Aerometrex; Road names and Cadastre from Clare & Gilbert Valleys Council; Railway alignment from DTEI; Flood Data modelled by Australian Water Environments.



Stormwater Management Plan
For Seven Townships In The
Clare And Gilbert Valleys Council

**Stockport
50 Year ARI Event Inundation Difference**



LEGEND

Road Trafficability Standard

Post Mitigation Works:

- 5 year ARI event
- 2 year ARI event

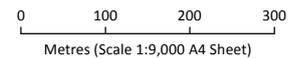
— Road (outside dtm extent)

—+— Railway

□ Cadastre

Data Source:

Railway alignment from Department of Planning, Transport and Infrastructure; Cadastre and Roads from Clare & Gilbert Valleys Council; Aerial Imagery from Aerometrex.



Stormwater Management Plan
For Seven Townships In The
Clare And Gilbert Valleys Council

**Stockport
Trafficability of Roads**

5.6 Water Quality and Reuse Assessment

The community wanted to prioritise Council funds in Stockport to reduce flood risk, rather than water quality measures or reuse opportunities. However, the proposed measures for flood and stormwater management are expected to also improve water quality, as described below:

- Formalisation of drainage paths and better managed flows will help to reduce sedimentation and erosion in the River and main drainage lines; and
- Maintenance of watercourses and drainage lines will help to control weeds and other vegetation that would otherwise have a detrimental impact on biodiversity values and potential case obstructions to flows. The protection of vegetation that is more suited to the local environment and stabilises the river banks will reduce the risk of erosion.

These works will reduce the risk of erosion and therefore will benefit the health of downstream receiving environments. The formalising drainage paths, better managing flows and watercourses, eg weed control, will also help to achieve better planning outcomes associated with open space, recreation and amenity.

Additional opportunities to those listed above were identified during development of this SMP and preliminary assessments were undertaken, however they were not considered to be practical or desirable by the Stockport community. Their main priority for this SMP was to manage flood waters, Council undertake more frequent maintenance of drainage paths, and development of a flood warning system.

6 Recommendations

6.1 Structural and Non-structural Measures

Recommendations include structural measures aimed at improving stormwater and flood management, as well as several non-structural measures. Opportunities for stormwater harvesting and reuse have not been recommended in this SMP due to the community's greater focus on flood control at this present time. Recommendations with their associated costs and benefits are summarised below in Table 6-1 on the following page. This table also identifies if the catchment area of the proposed works is greater than 40ha.

TABLE 6-1: RECOMMENDATIONS

| Recommended measures | Preliminary construction cost estimate (program contribution) | Benefits | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | No. of properties protected | Other |
| F1: Modification to Gilbert River, bridge height and a proposed levee (catchment area is greater than 40ha) | \$2,600,000 (Breakdown of costs: channel widening \$1,480,000; bridge height \$1,000,000; 1 m levee \$120,000) | 25 | Improved road trafficability. |
| F2: Modifications and proposed infrastructure on eastern side of town (catchment area is greater than 40ha) | \$400,000 (Breakdown of costs: Grassed swales and orifice plate \$190,000; culverts at road crossings \$90,000; levees \$80,000; works on dam enlargement \$40,000) | 11 | The formalising drainage paths, better managing flows and watercourses, eg weed control, will also help to achieve better planning outcomes associated with open space, recreation and amenity. There will also benefits to watercourses and receiving waters as a result of detaining flows and reducing runoff rates. Improved road trafficability. |
| F3: Measures to address local runoff (catchment area is greater than 40ha) | \$260,000 | 11 | The formalising drainage paths, better managing flows and watercourses, eg weed control, will also help to achieve better planning outcomes associated with open space, recreation and amenity. There will also benefits to watercourses and receiving waters as a result of detaining flows and reducing runoff rates. Improved road trafficability. |
| F4: Regular maintenance of stormwater drainage infrastructure and watercourses | \$5000 (ongoing cost) | | An effective drainage system. |
| P1 – Flood preparedness program: <ul style="list-style-type: none"> • Establishment of a flood warning system for the Gilbert River • Community education program - e.g. Floodsafe (Community/education officer role, materials) | \$30,000 \$10,000 | - - | Provides a warning for flood events, provides time for preparation and thus reduces risk and impact of flooding. Build the capacity of the community to prepare for floods as well as reduce risk of flooding. Gain community support for stormwater management measures. Improve the community's sense of worth and feeling of security. |
| P2 – Development/ Planning Controls: Enforce and include flood maps in Council's Development Plan and ensure siting of developments 300mm above surrounding land level. | - | - | Reduced risk and cost of flooding to properties and people. |

6.2 Environmental, Social and Economic Opportunities/Benefits

Environmental enhancement opportunities resulting from the recommended actions in this SMP are predominantly based on the improvements to managing stormwater flows. There will also be benefits to watercourses and receiving waters as a result of detaining flows and reducing runoff rates. Channel improvements, eg weed control, will benefit riparian environments to support native vegetation and wildlife, which would also improve the amenity of the town. These actions will help to protect the receiving environments of the Gilbert River, Light River as well as the estuarine and marine environment associated with Gulf St Vincent.

The improved infrastructure aimed at flood control recommended in this SMP will provide social benefits, including improved road trafficability, public safety, protection of property and continuity of community services. The increased standard of drainage and regular infrastructure maintenance will help to prevent nuisance flooding, particularly at the main township intersections and behind the railway line. This will alleviate community frustration and help maintain business trade in the town.

Non-structural measures, such as flood preparedness programs, flood warning systems and education will improve the community's capacity to prepare for and manage stormwater issues, as well as create a stronger sense of security within the community. Planning controls (e.g. Council's Development Plan) provide a framework to plan and build in a manner that incorporates stormwater management.

Although the Stockport community was more interested in improving flood control rather than reusing stormwater or creating wetlands, etc, the recommended actions of formalising drainage paths, better managing flows and watercourses, eg weed control, will also help to achieve better planning outcomes associated with open space, recreation and amenity.

There are also economic benefits as there won't be the same damage costs as there would be without the stormwater infrastructure. The measures help to prevent flooding which will result in less disruption to business trade and transport routes, and also avoid economic losses arising from stormwater issues. The improvements to stormwater management may have a positive impact on business confidence and attract future economic investment in the area.

7 Implementation Issues and Funding Opportunities

7.1 Priorities and Timeframes for Implementation

The SMA Guidelines recommend that the highest priorities are for works and measures that reduce flood hazard and protect life and property. In accordance to the multi-objective approach to stormwater management, greater weighting should be placed on strategies that also provide opportunities for stormwater reuse, and improvement to water quality, open space/local amenity, biodiversity and recreation.

A subjective assessment of the recommended strategies has been undertaken to determine their ranking and priorities. This assessment is shown Appendix C.

A detailed 10 year program for implementing the recommended strategies as been developed for Council, refer to the Implementation Plan in Appendix D. It provides information on the priorities, timeframes, costs, benefits and potential funding partners.

Notwithstanding this preferred list of actions and timing, the availability and timing of funding and resources will determine the order and staging of the works. A summary of the priorities is provided below in Table 7-1.

TABLE 7-1: SUMMARY OF PRIORITIES

| Priority | Timeframe | Recommendations | | Capital Cost (\$) | Recurrent Cost (\$ pa) |
|----------|-------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------|-------------------|------------------------|
| | 0 - 1 yr 1 - 5 yrs 5 - 10 yrs | | | | |
| 1 | 0 - 1 | F4 | Regular maintenance of stormwater drainage infrastructure and watercourses | \$5,000 | \$1,000 |
| 1 | 0 - 1 | P2 | Development / planning controls | - | - |
| 2 | 0 - 1 | P1 | Flood preparedness program - | \$30,000 | \$5,000 |
| | | | <ul style="list-style-type: none"> • Flood warning system for Gilbert River • Community education program | \$10,000 | \$1,000 |
| 3 | 1 - 5 | F2 | Modifications and proposed infrastructure on eastern side of town | \$400,000 | \$2,000 |
| 3 | 1 - 5 | F3 | Measures to address local runoff | \$260,000 | \$2,000 |
| 3 | 5 - 10 | F1 | Modification to Gilbert River, bridge height and a proposed levee | \$2,600,000 | \$5,000 |

7.2 Responsibilities for Implementation and Potential Funding Contributions

Council will incorporate stormwater management strategies in its Infrastructure and Asset Management Plan; however it will need to seek funding contributions from other sources, as described below. The availability and timing of funding and resources will determine the order and staging of the works.

A stormwater management plan that has been approved by the SMA and gazetted is in a good position to attract funding contribution from the SMA to implement the recommendations. The

SMA has the discretion to contribute more or less than 50% of the cost of certain works and may elect to contribute to the cost of works in a catchment of less than 40 ha, provided that those works form part of an approved Stormwater Management Plan. To assist in identifying funding opportunities with the SMA, the catchment sizes for the structural measures are provided in Table 6-1.

Council may also be able to secure some funding from the NRM Board, particularly in relation to watercourse rehabilitation and water quality improvement works. The Commonwealth government also offers grants at various times for the purpose of flood disaster planning and relief.

The Yorke and Mid North Regional Development Board may also be another source of funding for implementing some of the recommended actions in this SMP. For example, the Regional Development Fund (RDF) is an annual grant fund administered by South Australia (Regions SA). This funding is to drive economic growth and productivity by investing in regional infrastructure, creating jobs and new opportunities for regional South Australia.

Responsibilities for implementation of recommendations and potential funding opportunities are presented in Table 7.2, with further details in the Implementation Plan (refer Appendix D).

TABLE 7-2: RESPONSIBILITY FOR IMPLEMENTATION AND POTENTIAL FUNDING / PARTNERSHIP OPPORTUNITIES

| Recommendations | | Responsibilities for Implementation and Potential Funding |
|-----------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| F4 | Regular maintenance of stormwater drainage infrastructure and watercourses | Council, and in partnership with landholders and the NRM Board as appropriate |
| P2 | Development / planning controls | Council |
| P1 | Flood preparedness program | Council, with potential partnership and/or funding from BoM and SMA (flood warning system); and SES (community education program) |
| F2 | Modifications and proposed infrastructure on eastern side of town | Council to lead design, consultation and construction processes, with potential funding from SMA |
| F3 | Measures to address local runoff | Council to lead design, consultation and construction processes, with potential funding from SMA |
| F1 | Modification to Gilbert River, bridge height and a proposed levee | Council to lead design, consultation and construction processes, with potential funding from SMA |

7.3 Responsibility for Maintenance

The maintenance of watercourses and stormwater infrastructure that is located in **road reserves and council owned land** is normally the responsibility of the council concerned. For **other land** however, there is no legislation specifically identifying this as council's responsibility. Instead, it is the landowners responsibility under the *Natural Resources Management Act* to maintain their land and watercourses in good condition in line with natural resource management practices. Any stormwater infrastructure constructed on **other land** is not the responsibility of the council to maintain unless the council has an interest in the land through an easement etc.

Maintenance of watercourses in good condition may include actions such as removal of weeds and removing any obstacles to flow (e.g. fallen branches, poorly constructed / inappropriate fencing). The NRM Board could also assist landowners by providing information on appropriate natural resource management practices including information on best practice for the maintenance

of watercourses. Information on watercourse management can be found on the following page of the Northern and Yorke NRM's website:

http://www.naturalresources.sa.gov.au/northernandyorke/water/managing-water-resources/watercourses/Managing_watercourses

Councils may also acquire, through an approved and gazetted stormwater management plan, the legislative responsibility to maintain watercourses in other land, including the power to enter such land (with reasonable notice) and to carry out works and infrastructure in accordance with the approved stormwater management plan. The legislative provision for this is contained in the Local Government (Stormwater Management Agreement) Amendment Act 2016.

It is important that the council puts in place the appropriate administrative arrangements to facilitate ongoing maintenance of any permanent infrastructure established on other land as part of this stormwater management plan. Unless otherwise agreed with the landowner, council must take on responsibility for permanent stormwater infrastructure that is to be placed on other land by taking an interest in the land. Examples of such an interest include an easement, a Land Management Agreement (under the Development Act) with the landowner (which would go on the title of the land), or land acquisition.

Examples of recommended stormwater infrastructure works in private land that may benefit from a formal arrangement with the landowner, such as creating an easement, land acquisition or a Land Management Agreement, are provided below:

- A new levee along the western bank of Gilbert River
- New swales on Smiths Road and Murray Street
- A culvert under levee
- Widening of river channel
- Provision of property driveway crossovers
- A levee along the western bank of the river
- Duplication of the detention basin
- A levee around a property

7.4 Potential Funding Contributions

Council will incorporate stormwater management strategies in its Infrastructure and Asset Management Plan; however it will need to seek funding contributions from other sources, as described below. The availability and timing of funding and resources will determine the order and staging of the works.

A stormwater management plan that has been approved by the SMA and gazetted is in a good position to attract funding contribution from the SMA to implement the recommendations. The SMA has the discretion to contribute more or less than 50% of the cost of certain works and may elect to contribute to the cost of works in a catchment of less than 40 ha, provided that those works form part of an approved Stormwater Management Plan. To assist in identifying funding opportunities with the SMA, the catchment sizes for the structural measures are provided in Table 6-1.

Council may also be able to secure some funding from the NRM Board, particularly in relation to watercourse rehabilitation and water quality improvement works. The Commonwealth government also offers grants at various times for the purpose of flood disaster planning and relief.

The Yorke and Mid North Regional Development Board may also be another source of funding for implementing some of the recommended actions in this SMP. For example, the Regional Development Fund (RDF) is an annual grant fund administered by South Australia (Regions SA). This funding is to drive economic growth and productivity by investing in regional infrastructure, creating jobs and new opportunities for regional South Australia.

Potential funding partners for each recommendation is provided in the detailed Implementation Plan in Appendix D.

8 Review of the Stormwater Management Plan

It is anticipated that this Stormwater Management Plan will be a 'living document' that is periodically reviewed to take account of current knowledge, changing conditions within the catchment and changing community attitudes to the management of stormwater and other water resources making up the urban water cycle.

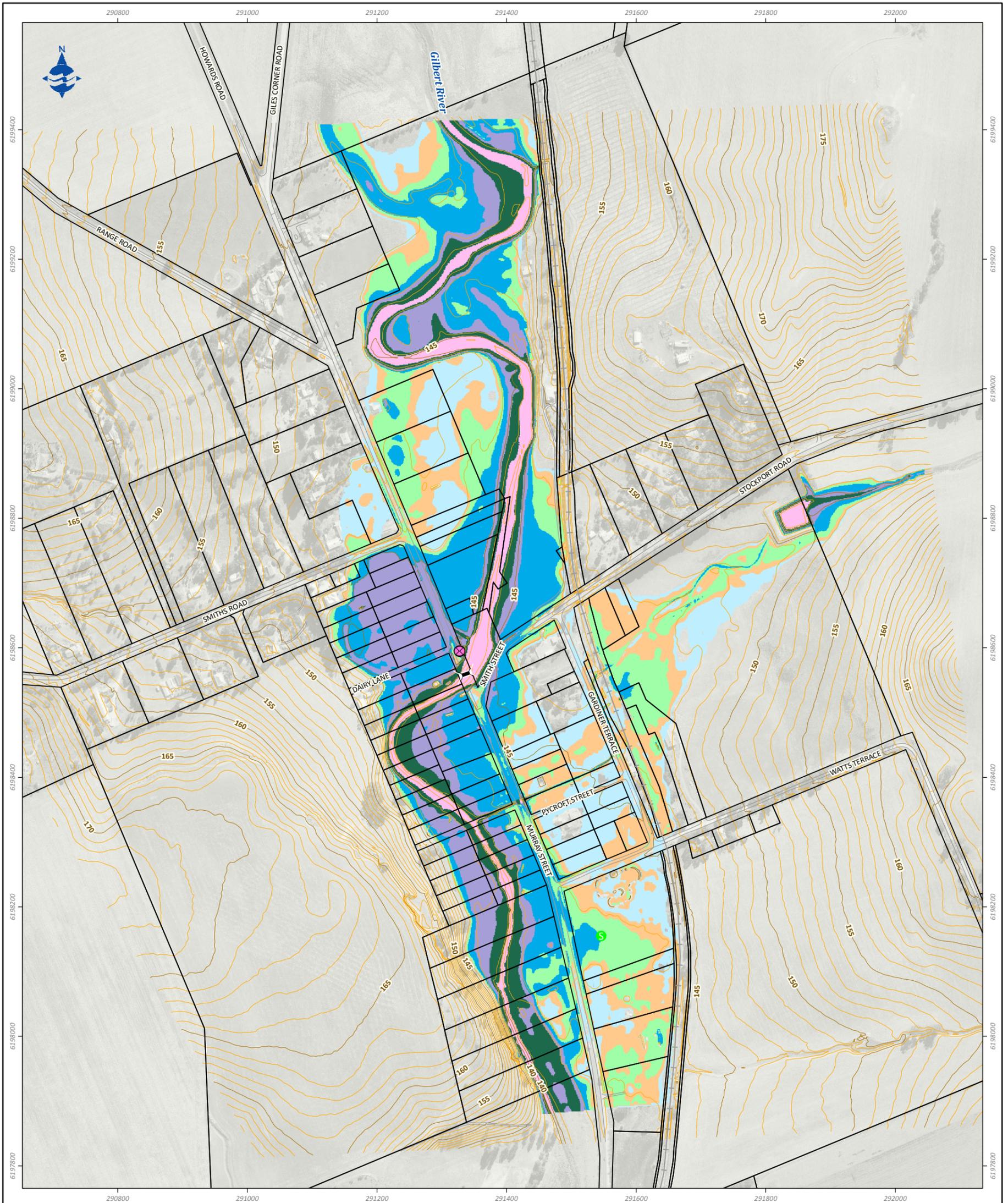
To ensure that this occurs, it is expected that Council initiates a review of this Plan at least every 5 years and that the proposed works and strategies to be adopted for the subsequent 10 year period will be identified.

The SMA recognises that the Plan may need to be amended to account for modifying or elevating the priority of the recommended actions as a result of unforeseen circumstances, provided that the proposed changes are consistent with the overall strategy and properly integrate with any existing or proposed infrastructure, including any Stormwater Management Plan for an adjoining catchment.

9 References

- Australian Water Environments (2013) Floodplain Mapping for Seven Townships, prepared for the Clare and Gilbert Valleys Council
- Bureau of Transport Economics (2001) Economic Costs of Natural Disasters in Australia
- Clare and Gilbert Valleys Council - Strategic Directions Report 2012/13
- Clare and Gilbert Valleys Council (2011) Water Security Plan
- Commonwealth of Australia (2009) Flood Preparedness, Manual 20 Australian Emergency Manual Series
- Department for Water (2011) Stormwater Strategy - The Future of Stormwater Management, Government of South Australia
- Department of Environment, Water and Natural Resources (2013) Water Sensitive Urban Design – Creating more liveable and water sensitive cities in South Australia, Government of South Australia
- Department of Water, Land and Biodiversity Conservation (2004) *A River Management Plan for the Light Catchment*. Report, DWLBC 2004/17
- Northern and Yorke Natural Resources Management Board (2009) Northern and Yorke Regional NRM Plan – Volume B: Strategic Plan 2009 – 2018, Government of South Australia
- Northern and Yorke Natural Resources Management Board (2009) Northern and Yorke Regional NRM Plan – Volume D: Regulatory and Policy Framework, Government of South Australia
- Rural Solutions SA (2005) Gilbert River Salinity Management Plan
- SCARM (2000) Floodplain Management in Australia: Best Practice Principles and Guidelines. SCARM Report 73, CSIRO Publishing, Australia.
- Water for Good (2009) Government of South Australia

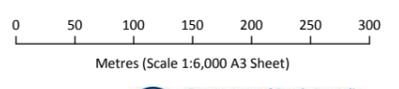
Appendix A : Flood Inundation Maps



LEGEND

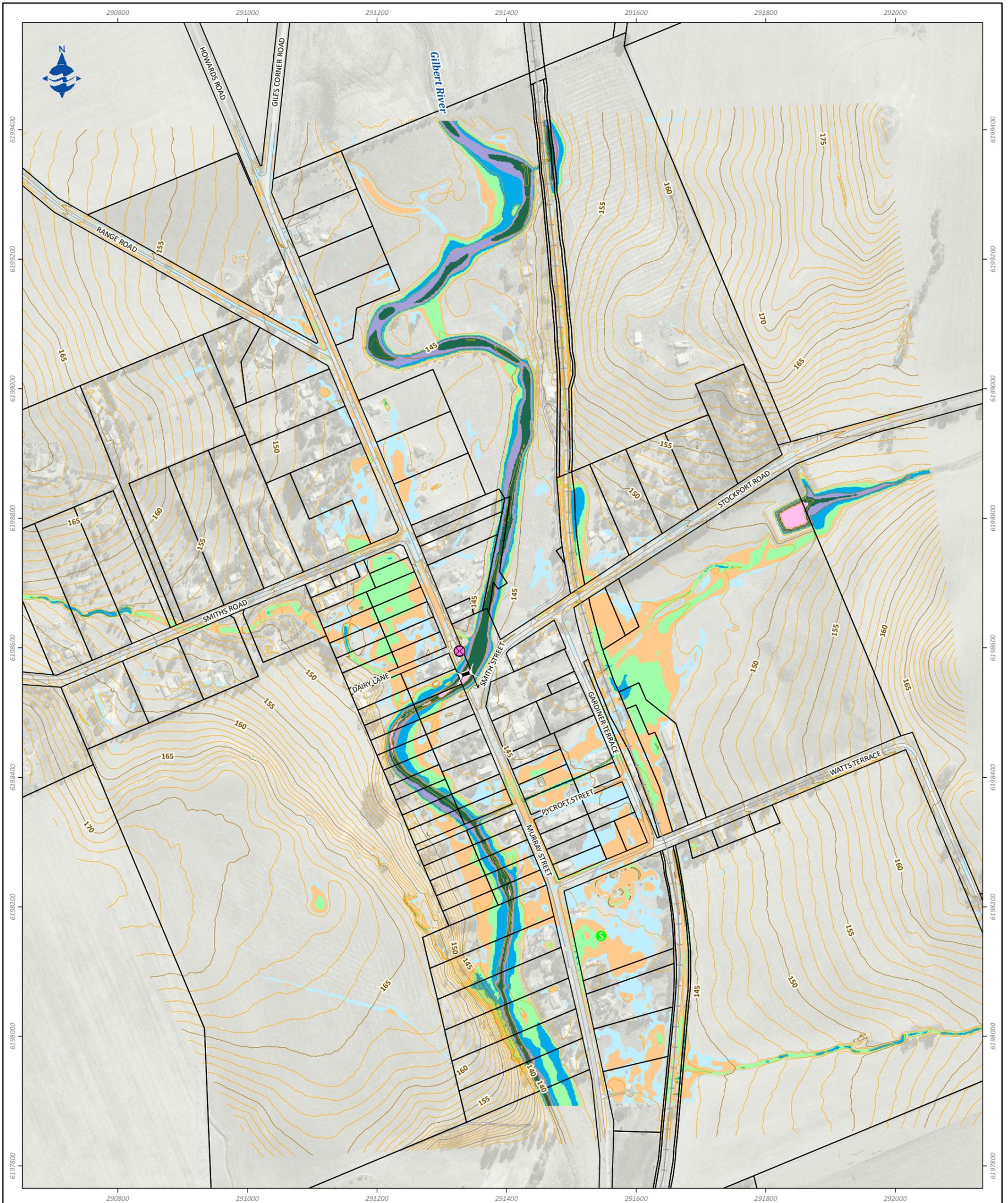
| | | | | | |
|--|-------------------|--|---------------------|--|-------------|
| | Bridge or Culvert | | Water Main Crossing | | Road Edge |
| | Sports Ground | | 63; 80; 100; 150 | | 0 - 0.10 |
| | Ambulance | | 200; 250; 375 | | 0.11 - 0.25 |
| | Hospital | | 600; 750 | | 0.26 - 0.50 |
| | Police | | Index | | 0.51 - 1.00 |
| | SES | | Intermediate | | 1.01 - 1.50 |
| | CFS | | Greater than 5.00 | | 1.51 - 2.50 |
| | Cadastral | | Railway | | 2.51 - 5.00 |

Data Source:
 Flood Data, Sports Ground and Railway Extent from AWE; Road Edge, Aerial Imagery and Contours from Aerometrix; Water Mains from SAWater; Bridges from DPTI; Roadnames, Bridges and Cadastre from Clare & Gilbert Valleys Council; CFS from South Australian Country Fire Service; SES from South Australian State Emergency Service; Police Stations from South Australia Police; Hospital from Australian Institute of Health and Welfare; Ambulance from SA Ambulance Service; Watercourses from Geoscience Australia.



Floodplain Mapping for Seven Townships
 Clare and Gilbert Valleys Council

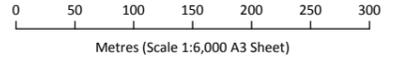
**Stockport (Riverine)
 100 Year ARI Event Inundation**



LEGEND

| | | | | | |
|--|-------------------|--|------------------------------------|--|---------------------------------|
| | Bridge or Culvert | | Water Main Crossing | | Road Edge |
| | Sports Ground | | Diameter (mm): 63; 80; 100; 150 | | Flood Depth (m): 0.05 - 0.10 |
| | Ambulance | | 200; 250; 375 | | 0.11 - 0.25 |
| | Hospital | | 600; 750 | | 0.26 - 0.50 |
| | Police | | Contours: Index | | 0.51 - 1.00 |
| | SES | | Intermediate | | 1.01 - 1.50 |
| | CFS | | Railway | | 1.51 - 2.50 |
| | Cadastral | | | | 2.51 - 5.00 |
| | | | | | Greater than 5.00 |

Data Source:
Flood Data, Sports Ground and Railway Extent from AWE; Road Edge, Aerial Imagery and Contours from Aerometrex; Water Mains from SAWater; Bridges from DPTI; Roadnames, Bridges and Cadastral from Clare & Gilbert Valleys Council; CFS from South Australian Country Fire Service; SES from South Australian State Emergency Service; Police Stations from South Australia Police; Hospital from Australian Institute of Health and Welfare; Ambulance from SA Ambulance Service; Watercourses from Geoscience Australia.



Floodplain Mapping for Seven Townships
Clare and Gilbert Valleys Council

Stockport (Direct Rainfall)
100 Year ARI Flood Inundation

Appendix B : Community Feedback



Stockport Stormwater Management Plan

Community Consultation

Identification of Issues

Consultation with the Stockport local community was undertaken early in the project (August 2012) to identify their issues and opportunities for stormwater and flood management. The community meeting also provided the opportunity to confirm the accuracy of the modelled flow paths with the community.

A summary of the main issues raised by the community is provided below.

Stormwater and flooding issues:

- Limited stormwater infrastructure;
- Blocked drains, culverts;
- Stormwater pooling – Observatory Road;
- Main flow paths and problems -
 - Gilbert River;
 - Observatory Road;
 - From the east towards railway line, along Gardner Tce, along Weste Lane drain
- Possibly an easement has been established rear of Caravan Park to direct flow down to River (check modeling);
- Reeds in river has resulted in increased siltation in the river;
- Siltation of river and drainage paths during flows;
- Pepper trees blocking drainage;
- Lack of easements has limited access and space for Council to install management works;
- Currently no stormwater reuse;
- There are large flows and rapid flows during storm events.

Aspirations and Opportunities:

- Address stormwater management along main drainage paths;
- Control the growth of reeds and pepper trees in drainage lines;
- Explore stormwater mitigation upstream and east of railway line to capture and slow down flows, and upstream of the town;
- Clean out infrastructure, e.g. culverts (silt, pepper tree, other vegetation);

- Improve management of Weste Lane drain and Gardner Tce and Observatory Road;
- Explore opportunities to improve use of dam to the east of the town for flood control purposes;
- Look into using railway reserve to implement stormwater management measures;
- Better prepare houses for flood protection;
- Explore stormwater reuse for watering street trees – mixed opinions from the community;
- Explore groundwater water quality/ bores;
- Explore development of a flood warning system.

Consultation on Draft Strategies

Feedback on the draft strategies was provided by the Project Steering Committee and the Elected Members. A meeting was held in Stockport (May 2014) to gain feedback from the local community on the draft strategies. This feedback helped to finalise the recommendations of the SMP.

A summary of the community consultation is provided below.

A meeting was held in Stockport on 8th May 2014 and approximately 8 members of the community attended. Feedback forms were made available to the wider community to provide the opportunity for others to comment.

During the meeting AWE presented the key issues and draft suggested measures, including the impact to controlling flood. The feedback is summarised below.

Discussion:

- Concerned that some landowners haven't improved their practices since the 2010 floods, e.g. bringing in tires for bike tracks which end up in the river in a flood.

Do you think the measures address stormwater and flooding issues?

- Yes, they seem reasonable however there are a few areas to check – (as per below):
- Check that stormwater runoff from the west can reach the River through the proposed levee
- Check the culvert at Range Rd has sufficient capacity.
- Check alignment of proposed swale so it avoids the property to the south of town.
- Flood warning system needs to be accurate for it to be useful.

Do you think the measures address water quality, local amenity and reuse options?

- These measures are a low priority – just want the water to flow out of the town without causing flooding.

Are there any issues that Council should be aware of in implementing the suggested measures?

- Land in private ownership – need to liaise with landowners where works are proposed.
- What happens to the properties that are not protected?

- Caravan park should have an evacuation plan. There are more people using the park since the 2010 floods and they probably are not aware of the flood risk in the area.

What are the most important measures?

The community members present at the meeting were asked to indicate what they thought were the most important suggested measures, as shown in the table below:

Table - Community Feedback - Most Important Measures

| Recommended measures | Which suggested measures do you think are most important? (percentage of people's preference) |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| Stormwater and flooding measures: <ul style="list-style-type: none"> • Create levee along western bank of river upstream from bridge on Murray Street. Raise deck of bridge and widen river channel by 8m to achieve a channel width of 12m. Ensure local runoff can pass through levee without backflow with the use of one way pipes. (Cost \$2,000,000; protection to 31 properties) | 38% |
| <ul style="list-style-type: none"> • Modify detention basin to the east of the township, provide levee along Smith St and eastern side of the railway line, as well as around property to the south west of the basin, provide orifice at culverts under railway line, create swale along eastern side of the railway line, and upgrade culverts on Watts Terrace and Murray Street. Formalise roadside swale and provide culverts/road crossing on Gardiner Terrace. (Cost \$400,000; protection to 11 properties) | 29% |
| Regular maintenance of stormwater drainage infrastructure (Cost \$5,000) | 29% |
| Establishment of a flood warning system for the Gilbert River (Cost \$30,000) | 0% |
| Enforcement and inclusion of flood maps in Council's Development Plan | 0% |
| Community education program - e.g. Floodsafe (Cost \$10,000) | 4% |

Feedback forms

Feedback forms were also available for people to provide comment on the draft strategies. A total of 2 forms were received by Council. Key issues raised:

- Instead of excavating under Murray St bridge, suggest a levee bank is created on southern side of bank adjacent to Smith St to prevent overflow down Murray St south.
- Inappropriate land management by some residents (eg tyres) in flood prone area.
- Important to create the proposed levees, increase culvert capacity and add swale, and increase width of river.

Appendix C : Assessment of Priorities

Appendix D : Implementation Plan

Stockport – Implementation Plan

| Priority | Timeframe 0 - 1 yr 1 - 5 yrs 5 - 10 yrs | Project/ Activity and Location | Capital Cost (\$) | Recurrent Cost (\$ pa) | Flood Mitigation Benefit <i>Measures:</i> <i>(P) – Properties Affected</i> <i>(properties protected by measures in the 1 in 50 ARI event)</i> | Water Harvesting Benefit <i>Measures:</i> <i>(V) – Volumetric</i> <i>(Q) – Qualitative</i> | Water Quality Benefit | | | Other Benefits <i>Rating:</i> <i>(H) - High</i> <i>(M) - Medium</i> <i>(L) – Low</i> Qualitative description of benefit | Potential funding partners with Council |
|----------|--------------------------------------------------|--------------------------------------------------------------------------------------------|----------------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| | | | | | | | <i>Rating:</i> <i>(H) - High</i> <i>(M) - Medium</i> <i>(L) – Low</i> | Benefit to whole of catchment | Benefit to township only | | |
| 1 | 0 - 1 | F4 - Regular maintenance of stormwater drainage infrastructure and watercourses | \$5,000 | \$1,000 | Effective drainage and therefore reducing risk of flooding. | - | - | - | - | Improved sense of security and wellbeing amongst the community. | - |
| 1 | 1 - 5 | F2 - Modifications and proposed infrastructure on eastern side of town | \$400,000 | \$2,000 | 11 properties protected | - | - | - | - | Improved road trafficability | SMA |
| 3 | 1 - 5 | F3 - Measures to address local runoff | \$260,000 | \$2,000 | 11 properties protected | - | - | - | - | Improved road trafficability | SMA |
| 1 | 0 - 1 | P2 - Development / planning controls | - | - | Reduced risk and cost of flooding to properties and people. | - | - | - | - | Better planning and development outcomes. Improved sense of security and wellbeing amongst the community. | - |
| 3 | 5 - 10 | F1 - Modification to Gilbert River, bridge height and a proposed levee | \$2,600,000 | \$5,000 | 25 properties protected | - | - | - | - | Improved road trafficability | SMA |
| 2 | 0 - 1 | P1 - Flood preparedness program – Establish a total flood warning system for Gilbert River | \$30,000 | \$5,000 | | - | - | - | - | Provides a warning for flood events which provides time for preparation and therefore reduces the risk and impact of flooding. Community awareness raised and people are empowered to protect their properties and response – thereby significantly reducing flood damages. Improved sense of security and wellbeing amongst the community. | BoM, SMA |
| 2 | 0 - 1 | P1 - Flood preparedness program – Community education program - e.g. Floodsafe | \$10,000 | \$1,000 | Reduce the risk of flooding and impacts of flooding. | - | - | - | - | Gain community support for implementation and ongoing management of the stormwater management measures. Build the capacity of the community to prepare for floods as well as reduce risk of flooding. Improve the community's sense of worth and feeling of security. | SES |