

Tenterfield Urban Stormwater Quality Management Plan 2013



Prepared by: Dennis Gascoigne

Director Engineering Services

Tenterfield Shire Council

February 2013

Adopted: Council Resolution 41/13 – 27 February 2013

Contents

1. Executive summary	6
1.1 Aim of the stormwater quality management plan.....	6
1.2 Scope of the SWQMP	6
1.3 Community consultation and collecting existing data	6
1.4 Stormwater catchment values	6
1.5 The development of stormwater management objectives.....	7
1.6 Stormwater management issues.....	8
1.7 Stormwater management options	9
1.8 Stormwater implementation strategies	9
2. Introduction	11
2.1 Purpose of this plan.....	11
2.2 Scope of this plan	12
2.3 Background.....	13
2.4 Integration of this plan with other state government initiatives.....	13
2.4.1 Catchment Management Authorities.....	13
2.4.2 Landcare Groups.....	14
2.4.3 How does the Stormwater Quality Management Plan link to the CMA and Landcare?	15
3. Catchment Description	16
3.1 Waterways.....	16
3.2 Land use.....	16
3.3 Topography.....	17
3.4 Geology and soil	17
3.5 Climate.....	18
3.6 Hydrology	19
3.7 Fluvial geomorphology	19
3.8 Water quality	19
3.9 Aquatic habitat	20
3.10 Riparian and foreshore vegetation.....	21
4. Stormwater management values	22
Values raised by stakeholders	22
5. Stormwater management objectives	26
6. Stormwater management issues	32
6.1 Ranking of issues	38
6.1.1 Issues Matrix.....	38
7. Stormwater management options	44

7.1	Assessment of Options	44
7.2	Cost-benefit analysis.....	44
7.3	Options selection.....	44
7.3.1	Non-structural options	45
7.3.2	Structural options	45
8.	Implementation Strategies	58
8.1	Management strategy	60
8.1.1	Community Involvement and Education	60
8.1.2	Encourage public involvement in the stormwater management process	62
8.1.3	Promotion of Public Access to the Stormwater System.....	63
8.1.4	Continue to Hold Workshops Involving all Relevant Stakeholders to Discuss the Process and Issues of the Stormwater System.....	63
9.	Monitoring and reporting	64
	SWQMP preparation	64
9.1	Monitoring effectiveness/assessment performance indicators and benchmarks.....	64
9.1.1	Example of a water quality monitoring program	66
9.2	Mechanism for reporting.....	67
9.3	Program for revision.....	67
9.3.1	Revise/re-issue council implementation strategy	67
9.3.2	Review/Revise the SWQMP Document.....	68
9.4	CONCLUSION	68
10.	Appendix A: Tenterfield catchment audit protocol.....	70
11.	Appendix B: Environmental audits of Urbenville And Drake	74
11.1	Drake	74
	Catchment Audit Protocol.....	74
11.2	Urbenville	78
11.3	Drake summary	81
11.4	Urbenville summary	81
12.	Appendix D: Erosion control for new development sites	82

List of Tables

Table 1-1 - outcomes of the values ranking process 7

Table 1-2 Summary of objectives 8

Table 1-3 - Results for the issues ranking 8

Table 1-4- Stormwater action strategies 9

Table 3-1 Tenterfield Rainfall Statistics 18

Table 3-2 Tenterfield Creek Water Quality Measurements 20

Table 3-3 Water Quality Measurements upstream (Old Ballandean Rd) and downstream (Washpool Creek Road) of the Sewerage Treatment Plant 20

Table 3-4 Stream Quality Rating System 21

Table 4-1 Stakeholders individual score allocation to values..... 24

Table 4-2 Total score of values 25

Table 5-1 Stormwater management objectives 28

Table 5-2 Values and stormwater objectives linkages 30

Table 5-3 Scoring and ranking of objectives..... 31

Table 6-1 Stormwater management issues..... 34

Table 6-2 Issues - objectives linkage table 37

Table 6-3 Issues scores (impact)..... 38

Table 6-4 Issues ranking matrix 41

Table 6-5 Water quality sub-matrix 41

Table 6-6 Issues ranking scheme 42

Table 6-7 Issues rank & scores from table 6.2..... 43

Table 6-8 Water quality sub matrix rank & scores 43

Table 7-1 Issues & objectives and their link to options..... 46

Table 7-2 Cost-benefit analysis..... 49

Table 7-3 Cost Benefit Matrix..... 57

Table 8-1 Proposed actions 58

List of Figures

Figure 4-1 Stormwater scoring chart..... 25

Figure 9-1 Stormwater management loop. 64

Glossary

Aquatic Habitat - This includes rivers and their channels, wetlands adjacent to the river and the riparian zone.

Issues - Factors that may inhibit or enhance our ability to meet our stormwater objectives at present or in the future.

Matrix - Technically known as the frequency and impact study, a methodology that focuses on each issue and how it may impact on stormwater values and objectives in terms of probability and consequences.

Objectives - These are long and short term and describe how we intend to achieve our stormwater values and what we seek to achieve in our management of stormwater to protect and/or achieve the identified waterway and catchment values.

Options - Possible solutions to stormwater management issues. From these, actions are adopted and incorporated into an implementation strategy.

Stakeholders - Individuals or groups involved in the process of preparing a Stormwater Management Plan. Stakeholders include representatives from the Council, various Government agencies, landholders and representatives from the local community. Stakeholders are involved in stormwater workshops and in the process of the preparation of the Stormwater Management Plan.

Urban Stormwater Management Plan - A plan prepared by Council to address stormwater management issues within the catchment of the urban area, particularly issues affecting water quality and quantity.

Values - Things that we personally believe contribute to our quality of life (the anthropocentric view), or contribute to the wellbeing of the environment (the ecocentric view) and in this case involve aspects or components of the stormwater drainage system, or the environment, which interact with that system, which are valued by the community or other stakeholders.

.

1. Executive summary

The NSW Environmental Protection Authority (EPA) issued a notice under Section 12 of the Protection of the Environment Administration Act 1991 to all NSW councils early in 1998, requiring each council to develop an **Urban Stormwater Quality Management Plan**. In response, Tenterfield Shire Council (TSC) commenced plan preparation in November 1999 in accordance with the Stormwater Quality Management Plan (SWQMP) Guidelines (Managing Urban Stormwater Council Handbook, 1997) prepared by the EPA. This stormwater management plan has been updated in February 2013.

1.1 Aim of the stormwater quality management plan

The Urban Stormwater Quality Management Plan aims to address stormwater quality management problems within the catchment area, particularly environmental issues. The purpose of the Plan is to identify stormwater issues and achieve an overall improvement in the management of the stormwater system by recommending an action plan to the Council for implementing a stormwater improvement strategy.

1.2 Scope of the SWQMP

This Plan is focused on the urban area adjacent Tenterfield Creek.

1.3 Community consultation and collecting existing data

The identification of stormwater values, objectives and issues in order to develop practical stormwater management options is critical to the plan. To assist this process, community members and Government agency representatives were consulted on a number of occasions when the plan was initially prepared in 2000. This included a workshop session, which was held for the study areas. Council also advertised for submissions to identify locations within the stormwater network where localised periodic flooding occurred. Since the original data collection, significant flooding events have occurred in 2011. This plan will again be updated upon the receipt of an updated flood study scheduled for early 2013, and after consideration of the report by the recently established Section 355 Flood Study Committee.

This document has been prepared from the many useful comments provided to the facilitators by the original stakeholders during preliminary conversations and at the workshop session, subsequent audits (refer appendices) and subsequent environmental improvement projects including the Sunnyside Loop Road Closed Landfill review and Crown Street Drain remediation. This document thus benefits from the extensive local knowledge of the stakeholders who contributed.

1.4 Stormwater catchment values

Stormwater values are developed during workshops and community consultations and are incorporated into the stakeholder-briefing document.

The ranking of values is also accomplished during the workshops using a methodology of individual assessment and then consensus gathering. Each participant is given a total of 100 points to allocate to the stormwater values. Points from all stakeholders present are summed to produce Table 1-1. This document includes the result from the most recent community consultation, conducted in 2000. A new round of consultation is scheduled for late 2013.

The community considered **good water quality** to be most important and **habitat protection & restoration** ranked third. The ranking of water quality as the highest is usual for stormwater values, since water quality can be linked to most other values, whereas **reduction of maintenance cost/frequency** scored lowest.

Table 1-1 - outcomes of the values ranking process

Good water quality values	225
Health and Safety	217
Protection of habitats	150
Protection of Fauna	115
Community awareness	97
Local flooding	92
Good Aesthetics	90
Litter	85
Tourism value	80
Weeds	57
Reduction of maintenance costs	52
Recreation	40

The ranking of the values informs council of an 'order of priority' for considering management options for the Stormwater Management Plan. This process is ongoing and values will change over time.

1.5 The development of stormwater management objectives

The most recent workshop objectives are summarized in Table 1-2. A detailed version can be found in section 5.0 of the report. The objectives are linked to the key values to assist in demonstrating how each objective will help to address stormwater values (

Table 5-1).

Table 1-2 Summary of objectives

Improve water quality	827
Protection of aquatic and terrestrial habitats	627
Protection of community health and safety	627
Minimise erosion	375
Minimise localised flooding from stormwater	309
Optimal infrastructure, management & design	234
Improved community awareness	182
Improvement of aesthetics	170

These are broken down into short-term objectives, which provide means to achieve stormwater values in the short term and to support longer-term objectives. Over time, some short-term objectives have been achieved and will be replaced by other objectives as the need arises.

1.6 Stormwater management issues

From consultations with stakeholders and field observations, a number of stormwater issues within Tenterfield were identified. A detailed list of these issues and the procedure of the ranking assessment can be found in Section 6.0.

Table 1-3 - Results for the issues ranking

Issue	Score
Insufficient community awareness	1786
Decreased water quality	1446
Erosion	1202
Planning and infrastructure issues	670
Localised flooding from stormwater	526
Impact on aquatic & terrestrial habitats	402
Impact on Community health & safety	217

Impact on aesthetics	170
----------------------	-----

1.7 Stormwater management options

From the stormwater issues and objectives, a list of preferred options has been developed, the most recent results are listed in Table 7-1 of this plan. These options are further assessed in terms of efficiency in meeting the stormwater objectives and addressing key issues. This involves a cost-benefit analysis and evaluation of each option, taking into consideration the likely impact of the options on residents and the likely capital and operating costs. The Stormwater Management Plan is flexible in terms of the implementation strategies as environmental conditions may change over time and the plan is designed as an ongoing, dynamic document.

Also refer to section 9, which details future directions in terms of stormwater management to Council.

1.8 Stormwater implementation strategies

This component of the SWQMP outlines proposed expenditures. The strategy contains an action plan, which is derived from the management options described above and includes a budget, responsibility and timeframe. The implementation strategy also provides for evaluation and monitoring of the success of the Plan. The following table shows the outcomes and status of the cost/benefit analysis of options from the 2000 round of consultation. Refer to Section 8.0, Table 8.1 of this Plan for further detail. This table will be updated following the 2013 round of consultation.

Table 1-4- Stormwater action strategies

ACTIONS	ESTIMATED \$ COST		TIMEFRAME AND RESPONSIBILITY
	Capital	Operating	
COUNCIL ACTIONS			
Water quality monitoring in Tenterfield Creek	\$1000	\$1000	Completed. Water quality is monitored upstream and downstream as part of management of the sewer and water services.
Continue to support Streamwatch programs	\$5000	\$1000	The Streamwatch program has ended
Educate the community to collect dog droppings and correct use of fertilisers	\$1000	\$1000	Water quality reports indicate this is not currently a major issue
Install more rubbish bins in appropriate locations such as the park by Tenterfield Creek and the main street	\$2000	\$500	Completed

ACTIONS	ESTIMATED \$ COST Capital Operating		TIMEFRAME AND RESPONSIBILITY
COUNCIL ACTIONS			
Improve stormwater management at Sunnyside Loop Road Landfill	\$100,000+	\$10,000+	Part of the waste management strategy currently under development
Remediate issues with Crown Street contamination	\$50,000+	\$0	Completed.

2. Introduction

The township of Tenterfield is situated about 770km north of Sydney at the junction of the New England Highway and the Bruxner Highway and has a population of approximately 3300.

The NSW Environmental Protection Authority (EPA) issued a notice under Section 12 of the Protection of the Environment Administration Act 1991 to all NSW councils early in 1998 requiring each council with an urban population of greater than 1000 to develop an Urban Stormwater Management Plan, and the urban area of the Tenterfield Local Government Area (the town of Tenterfield) requires such a plan. Audits are also undertaken of the smaller urban areas in Tenterfield Shire of Urbenville and Drake (refer Appendix C).

This Stormwater Management Plan aims to improve the stormwater system of Tenterfield and address specific issues such as decreased water quality, erosion, impact on habitat and lack of community awareness, by identifying practical short- and long-term solutions to mitigate the environmental impacts of urban stormwater discharges. Although flooding is not a key issue addressed by this Plan, it does refer to localised flooding due to stormwater issues.

This Stormwater Management Plan has been prepared in accordance with the EPA Guidelines as outlined in the NSW EPA Guidelines on Managing Urban Stormwater - Council Handbook, May 2006 (<http://www.environment.nsw.gov.au/resources/stormwater/erosionsediment0642.pdf>).

All essential elements required by the EPA for a Stormwater Management Plan are contained within this document. It includes implementation strategies outlining responsibilities and their timeframes to be undertaken by the Council to address stormwater management issues that have been identified by the community, Government agencies and Council. The implementation strategy also outlines activities and expenditure for both long term and short term management and ensures that expenditures are compatible with the Council's proposed expenditures. In addition, the Plan identifies additional projects and potential funding for activities to be undertaken by external sources such as Landcare. The Plan also aims at a higher level of community involvement and education.

2.1 Purpose of this plan

The aim of the Urban Stormwater Management Plan is to achieve an overall improvement in the stormwater system and its associated environment, including;

- Increasing **community awareness**, education and interest of the importance of the stormwater catchment and the importance of a Stormwater Management Plan
- Improving stormwater quality
- Minimising the impact on aquatic and terrestrial **habitats** associated with the Tenterfield urban stormwater system;
- Reducing impacts of **erosion** on natural habitat and its impact on water quality
- Improving the overall **aesthetics** of the stormwater system;

- Minimising the impact of **health and safety** issues of the community in association with stormwater system;
- Addressing relevant **planning and flooding** issues within the urban catchment;
- Ensuring that stormwater management is at reasonable **cost and maintenance**

Council, in cooperation with local community have developed the Stormwater Management Plan. The following components will be included in the Plan:

- A description of the existing stormwater catchment (Section 3)
- The identification and ranking of stormwater values (Section 4)
- The development of stormwater objectives (Section 5)
- The identification and ranking of stormwater issues (Section 6)
- Potential management options for the stormwater, including a cost-benefit analysis (Section 7)
- Implementation strategies (Section 8)
- Monitoring and reporting (Section 9)

2.2 Scope of this plan

This Plan is focused on the urban area of the Tenterfield Creek catchment.

2.4 Stakeholder consultation

The community consultation process involved one-to-one meetings with stakeholders, phone conversations and workshop sessions. Workshop sessions were facilitated by TSC and attended by representatives of the following:

- Landcare Group
- Border Rivers Gwydir Catchment Management Authority
- Councillors
- Other local residents with an interest in Stormwater Management
- Council representatives

The focus of the workshop was to undertake tasks 4 to 8 outlined in the EPA guidelines, which included:

- Identifying and prioritising stormwater values, issues and objectives for the Plan for Tenterfield,
- Identifying of hot spots within the catchment

The workshop commenced with a briefing on background information for the development of Stormwater Management Plans. Subsequently stakeholders identified, reviewed and then ranked the stormwater values and issues. A discussion on draft stormwater objectives (based on the values raised by stakeholders during and prior to the workshops) followed.

2.3 Background

Runoff from urban areas is referred to as urban stormwater, including major flows during and after rain, and dry weather flows. Various factors influence the amount of stormwater and its contaminants, including:

- Duration and intensity of flow;
- Topography;
- Type of land use and the proportion of impervious surfaces;
- The design and management of the stormwater system.

Other material in stormwater that is collected by rainfall includes litter, dust and soil, chemicals and pesticides, fertilisers and other nutrients, micro-organisms and grease and oils. The majority of the rainfall in rural areas infiltrates into the soil, some evaporates and the remaining stormwater runs into the streams. In highly urbanised areas, especially industrial areas with large sealed grounds, the majority (up to 90%) of the stormwater makes its way into the drainage system. Wet weather overflows from sewage systems may be part of the stormwater flows in some areas. Other features of the urban drainage include dry weather drainage flows from garden watering, wash down and discharges.

Stormwater can have varying degrees of impact on environmental values and the value of receiving water bodies. The Stormwater Quality Management Plan attempts to facilitate community participation, incorporate catchment wide implications in decision making, take into consideration the community's values and interests, and manage the catchment in a cost-effective manner. The Plan is responsive to social, environmental and economic concerns in a balanced manner.

2.4 Integration of this plan with other state government initiatives

2.4.1 Catchment Management Authorities

Tenterfield straddles Tenterfield Creek which belongs to the Border Rivers-Gwydir catchment area.

The Border Rivers-Gwydir CMA is one of 13 Catchment Management Authorities in NSW established under the Catchment Management Authorities Act, 2003 the Border Rivers-Gwydir CMA is responsible for engaging with its local communities in the management of the catchment's natural resources. This is achieved by implementing the Border Rivers-Gwydir CMA Catchment Action Plan, known as the "CAP".

The CAP is a 10-year plan, approved by the Minister for Natural Resources in 2006, that outlines clear and specific targets for the Border Rivers-Gwydir CMA to achieve in delivering improvements in the condition of our natural resources.

2.4.2 Landcare Groups

Landcare groups provide the community with opportunities to work together, address important Landcare problems and develop their skills. The aim is to help the community to become aware of land and water degradation issues in the local area.

The following description of landcare operations is sourced from <http://www.landcareonline.com.au>

Landcare is a national network of thousands of locally-based community groups who care for the natural resources of our country.

Australia is proud to boast more than 4000 community Landcare groups, 2000 Coastcare groups and many thousands of volunteers across the country.

Through Australia's people and communities, the Landcare movement is making a big difference in caring for our country.

All around Australia, Landcare volunteers are proving that together we can repair and viably manage our precious natural resources. This unique partnership between communities, government and organisations is achieving great things.

Improving our farmlands

Many primary producers are active participants in Landcare. They make significant contributions to combating soil salinity and erosion through sound land management practices and sustainable productivity. More than 40 per cent of farmers are involved in Landcare and many more practice Landcare farming.

Breathing new life into waterways

Groups work to conserve, rehabilitate and better manage our creeks, river systems and wetlands.

Around the coast

Coastcare groups are active in improving local coastal and marine environments.

Bringing back trees

Each year Landcarers plant many millions of native trees, shrubs and grasses for a range of benefits, including improved soil and water quality. They restore bushland and conserve sensitive areas on both public and private land.

Restoring wildlife habitats

Volunteers have provided protection for thousands of native species, including threatened and endangered flora and fauna.

Urban action – protecting our urban environment

Active Landcare groups in Australian towns and cities work thousands of hours each year to tackle local environmental issues of most concern to their communities.

2.4.3 How does the Stormwater Quality Management Plan link to the CMA and Landcare?

The Stormwater Quality Management Plan is not designed to stand alone. A crucial aspect of stormwater management is to work in close association and coordination with the above groups to achieve best practice management for the catchment area.

The Stormwater Quality Management Plan only focuses on a small part of the catchment, the urban catchment. The CMA covers the entire catchment and includes rivers, creeks, vegetation and landuse issues. Landcare is more site specific than CMA operations. Hence the SWQMP could be used in other documents for site specific studies and other management plans may expand on what has been established in the SWQMP.

3. Catchment Description

The purpose of the collection of existing catchment data is to determine stormwater values, prioritise areas of investigation and to identify constraints and opportunities for improving stormwater management.

The catchment description includes physical characteristics, social characteristics, waterways characteristics and ecological characteristics.

3.1 Waterways

Tenterfield is a town of approximately 2997 inhabitants (census 2011) within the New England Tablelands. It is located in the Border Rivers Region of New South Wales. Where specific data is not available for Tenterfield, general information referring to the New England Tablelands is used.

The Tenterfield Council area is drained by two major river systems. The northern and eastern parts lie within the catchment area of the Clarence River, the main tributaries are the Maryland, Cataract and Timbarra Rivers, and Beury and Tooloom Creeks.

West of the dividing range the Council area is drained by the Dumaresq River and its tributaries: the Mole, Bluff, Deepwater and Beardy Rivers, and Tenterfield, Curry's Gap, Back, and Reedy Creeks. Tenterfield Creek runs through the town of Tenterfield.

In Tenterfield itself the worst potential flooding would arise from the failure of Tenterfield Dam. In situations other than the dam failure, very severe flooding such as occurred in January 2011, low lying houses in Tenterfield may be inundated, as well as playing fields and the showground.

3.2 Land use

Most areas on the New England Tableland have been developed for agriculture (Morgan and Terrey, 1999).

Of the Border Rivers and Moonie Catchments, the major land use is grazing/pasture, which makes up 77.4%. The rest of the catchments are made up of cotton growing (0.8%), dryland cropping (15.5%), forests/reserves (6.2%) and horticulture (0.1%) (Border Rivers Catchment Management Association, 1998).

Typical enterprises within the Tenterfield Shire include pasture production for grazing and mixed cropping. Viticulture is also a large and expanding area. Grazing of pastures by cattle and sheep are the primary livestock activities. These tend to be dryland activities, which depend on natural rainfall or stored soil moisture from long fallows.

Within the town of Tenterfield, there is mostly low density residential area, as well as a small low density commercial area (the main street) and several small industrial areas containing industries including RTA, Council depot, Townes contracting (roadworks), SES and mechanics. There is also a large area of parkland through the centre of town along Tenterfield Creek.

Potential contaminants could therefore arise from the light industries (eg oils, petrol, solvents etc) and the commercial centre (litter, oil, other runoff).

3.3 Topography

The town of Tenterfield lies within 850-900m above sea level, the remainder of the shire is 500 - 1200m above sea level (Morgan and Terrey, 1999).

The landform throughout the Tenterfield shire is low hilly to hilly. The town itself has a significant slope down to the creek, thus the topography of the shire will have an effect on stormwater. Velocity of runoff is likely to be high.

3.4 Geology and soil

The geology and soils of the catchment need careful consideration in the development of the Stormwater Quality Management Plan. Erosion and soil drainage are directly affected by the nature of soil. For example, stony basalt soil has a poor soil drainage capacity and gravelly soils cause high erosion hazards. Generally, sandstones form a shallow, low fertile soil with low water-holding capacity and limited biological productivity. The finer grained siltstones, mudstones and shales tend to weather more rapidly and form moderately productive soils with good moisture and nutrient holding characteristics if managed properly.

The New England Tableland contains Palaeozoic rocks (older than 200 million years) including consolidated and deformed sediments and igneous and volcanic rocks (Morgan and Terrey, 1999).

Soil types are derived from parent material and are influenced by climate and time of weathering. There are 2 major geological sub-divisions in the Tenterfield region - granite and trap. Granite parent material gives rise to coarse sandy soils - these are yellow solodics. Soils derived from sediment or trap rock commonly include grey podzolics and stony lithosols (Thomas, 1996). In Tenterfield there are yellow solonetzic soils, with some podzolics. There is also fine to medium grained solodic soils (Morgan and Terrey, 1999).

Most commonly occurring is red-brown earths with a duplex profile. The topsoil is clay loam that changes to a light to medium clay in the sub soil. The topsoil is hard setting whilst the subsoil is moderately well structured. The profile is moderately well drained throughout. The soil has a neutral reaction trend, with pH values from 6-7.

There are some small gravel fragments in the lower part of the profile which may be derived from the parent material, or deposited by previous river activity. These soils are expected to have a moderate capacity to absorb excess phosphorous in effluent.

The water holding capacity of the soil at Tenterfield depends on the soil type and depth. Of a depth of 0-40cm the soil type is generally sandy clay loam with a water holding capacity of 1.5mm/cm. Of a depth of 40-100cm, the soil is generally medium clay, with a water holding capacity of 1.7mm/cm (Morgan and Terrey, 1999).

Gully erosion is widespread and of moderate intensity throughout the Tenterfield shire. Extensive clearing has taken place on the steep rocky hills in the west and south west of the Tenterfield province. The soils in this area are coarse infertile soils that have high catchment and habitat values but are prone to soil erosion and leaching when intensively developed (Morgan and Terrey, 1999).

The capability of a landscape to sustain a particular land use is a reflection of biological and physical features such as steepness, rockiness, soil depth, nutrient status and drainage. These features can be assessed to determine the capability of the land. Land capability has been mapped for the New England Tableland, using 8 capability classes. Most of the Tenterfield province has Class IV and VI lands. Class IV is not suitable for regular cultivation because of slope gradient, soil erosion, shallowness, rockiness or climate. It is suitable for grazing and can be cultivated for an occasional crop. Class VI are generally less productive grazing lands, not suitable for any cultivation. They usually carry a sparse to moderate timber cover and have been developed for grazing through the use of fertiliser and introduced legumes (Morgan and Terrey, 1999).

3.5 Climate

Climate is an important factor for appropriate Stormwater Management. Stormwater effluent in wet weather conditions may differ considerably to effluent in dry weather conditions.

Tenterfield lies in the summer dominant rainfall zone. Average annual rainfall is approximately 905mm. The Tenterfield shire is cool temperate climate with cold winters and mild summers. 47% of total rain falling occurs between November and February. Winter and Spring are normally dry. Spring is generally the fire season on the Northern Tablelands (Thomas, 1996).

Winter Climate is generally more reliable than summer. Heavy frosts and fog occur from June to August. The New England Region has a frost period which exceeds a median duration of 100 days per year. Light snow falls may occur on higher elevation peaks (Thomas, 1996).

Average temperatures vary from a maximum of 27 degrees in January to 1 degree in July. The lowest recorded temperature is -7.8 degrees and the highest 38.6 degrees (Thomas, 1996).

The following table indicates climatic averages for Tenterfield , the data has been verified with Bureau of Meteorology records.

Table 3-1 Tenterfield Rainfall Statistics

Month	J	F	M	A	M	J	J	A	S	O	N	D	Ann
Rainfall (mm)	116	95	80	47	49	50	54	44	51	77	85	105	852
Av max temp	27.1	26.1	24.6	21.8	18.0	15.0	14.4	16.0	19.5	22.3	24.8	26.6	21.4
Av min temp	14.4	14.3	12.4	8.5	4.9	2.4	1.0	1.8	4.7	8.0	10.8	13.0	8.0
mean evap (mm)	199	162	144	102	71	51	57	84	120	164	187	205	

3.6 Hydrology

Terrain and hydrology of the catchment are also important factors to be considered in Stormwater Management.

Previous hydrological studies have included the Dam Failure Risk Assessment (DPWS) and Tenterfield Water Supply Strategy Study (GHD).

The Tenterfield Creek is usually shallow with only low flow. It has been recommended that hydrological studies be carried out in Tenterfield, such as drainage systems, flood studies, flow length, slope and monthly flow rate. A flood study in response to the 2011 flood event has been commissioned and will be integrated into this plan when received.

3.7 Fluvial geomorphology

Fluvial geomorphology studies aim at identifying areas prone to erosion and sedimentation patterns.

No studies have been carried out on fluvial geomorphology characteristics such as channel erosion and sediment deposition for Tenterfield. There are areas noted to be prone to erosion however, such as unsealed road verges throughout Tenterfield. The sediment from this erosion is generally deposited at stormwater outlets into the creek. This sediment can cause problems such as blocking stormwater pipes and channels, and also has effects on the creek and water quality.

3.8 Water quality

Water quality is regularly carried out in Tenterfield dam, (see the following table) which is on Tenterfield Creek and upstream of the urban area of Tenterfield. The creek appears to be in good condition, with community members utilising the creek downstream for fishing. There have also been good results in surveys of the creek for macro invertebrate life, which are good indicators of stream health.

Table 3-2 Tenterfield Creek Water Quality Measurements

DATE	OLD POOL- PH-BOD-N,F,R			
	pH	Suspended Solids	Aluminium	BOD ₅
	units	mg/L	Mg/L	mg/L
Sep 12	8.2	3	0.62	2
Mar 12	7.6	7	0.16	4
Sep 11	8.1	2	0.22	<2
Mar 11	7.2	22	2.1	3

Water quality tests downstream immediately prior to, and after the discharge point for the sewer treatment plant were commenced in late 2012 and are shown in Table 3-3.

Table 3-3 Water Quality Measurements upstream (Old Ballandean Rd) and downstream (Washpool Creek Road) of the Sewerage Treatment Plant

DATE	Old Ballandean Rd				Washpool Creek Rd			
	pH	Suspended Solids	Turbidity	BOD ₅	pH	Suspended Solids	Turbidity	BOD ₅
	units	mg/L	Mg/L	mg/L	units	mg/L	Mg/L	mg/L
Dec-12	7.6	12	7.5	2	7.7	15	8.3	2

3.9 Aquatic habitat

Protection of habitats is a major component of environmental protection and stakeholders have expressed a need for the protection of endangered wildlife.

Macroinvertebrates make good stream health indicators because they live in the waterways for months or even years, and so can provide a long-term indication of the health of the system. They are also a major part of the aquatic food chain, cannot easily escape pollution and some species are sensitive to even mild pollution and changes in water quality.

Stream water quality rating is based on the Stream pollution index that is calculated from the number and range of macroinvertebrates found in a waterway, and the number classed as sensitive or tolerant. The index ranges from <4 (worst) to >6 (best).

Table 3-4 Stream Quality Rating System

<u>Stream pollution index</u>	<u>Stream Quality rating</u>
<4	poor
4-5	fair
5-6	good
>6	excellent

The range of water bugs found in the Tenterfield Creek include; Stonefly nymph, freshwater yabbie, mayfly nymph, freshwater mussel, caddisfly larvae, damselfly nymph, dragonfly nymph, freshwater shrimp, watermite, freshwater sandhopper, freshwater slater, nematodes, hydra, beetle larvae, true bugs (backswimmer, water scorpion, water boatman, lesser water strider, water strider/treader), dytiscid beetles, whirligig beetles, leech, freshwater snails, flatworm, mosquito larvae, midge larvae, fly larvae, aquatic earthworm and blood worm.

A survey of Tenterfield Creek of these waterbugs upstream and downstream indicated a stream pollution index (calculated by looking at the number of either sensitive or tolerant waterbugs) of 4.5 (possible range from 0 - >6) and the stream quality rating good (DLWC, 1999).

3.10 Riparian and foreshore vegetation

Riparian vegetation is referred to as vegetation on or near creeks or riverbanks. Riparian vegetation is important in terms of erosion control and maintaining good water quality of the waterways.

No riparian vegetation surveys have been undertaken in Tenterfield, but most indigenous vegetation has been cleared, this includes riparian vegetation. While historically most species presently along Tenterfield creek have been introduced, recent flood remediation works have included the reintroduction of native species and removal of invasive species including willows.

The following is a list of species found throughout the province of Tenterfield, no specific data for riparian vegetation could be found. Vegetation includes woodland to open forest of *E.caliginosa*, *E.blakelyi*, *E. melliodora*, *E. bridgesiana* and *A. floribunda* or *A. subvelutina*. Occasional *E. banksii*, *E. moluccana* and *E.conica*, *A. leuhmanii* in the west (Morgan and Terrey, 1999).

4. Stormwater management values

Prior to the stakeholder workshop, individual stakeholders are contacted to explain the process for the first phase of the Stormwater Quality Management Plan, to clarify definitions and to seek information on stormwater values and issues within the catchment area. This allows for the preparation of a preliminary list of values that stakeholders think may be of importance for stormwater management. During the workshop session the values are reviewed to produce Table 4-1. While the EPA suggests that values be placed into the categories of social, economic and ecological values, it was found to be more practical to combine all values into one stormwater values category.

Values can be defined as:

Things which we personally believe contribute to our quality of life (the anthropocentric view), or contribute to the wellbeing of the environment (the eco-centric view) and in this case involve aspects or components of the stormwater drainage system, or the environment which interacts with the system, which are valued by the community or the stakeholders.

During the consultation process the aim is to discover personal values and to compare them with those of other stakeholders. This process is ongoing and values will change over time. The ranking of values is accomplished during the workshop session with the aid of a methodology of individual assessment and consensus gathering as explained below. Some stakeholders may find it easier to see values in terms of 'visions' or 'likes'. These values are not presented in any particular order and no limit is set on the number of stormwater values.

Values raised by stakeholders

- Protection of community health/safety
- Good water quality
- Habitat protection/restoration
- Protection of ecosystems (platypus)
- Reduction of litter
- Community involvement/awareness
- Good aesthetics of the catchment
- Protection of the catchment for tourism value and recreation
- Reduction of maintenance cost/frequency
- Protection of properties from localised flooding

Note: the topic of water quality will be examined in detail in later sections of this report.

4.2 Ranking of values

The above values are summarised and ranked by the stakeholders in terms of importance. The challenge is to combine a wide range of values that are held by individuals in a way that allows the achievement of a useful ranking process with outcomes that are acceptable to all.

Consider, for example, a situation where one stakeholder may believe that there is only a single value of importance and so gives it a high ranking. Another stakeholder may have a multitude of values that they wish to include in the process and although including the single value held by the first participant, may rank it behind their own values. How are such divergent points of view combined? A two-fold approach that encourages individual participation is described below:

Step 1: Individual Assessment

A ranking table for all the values identified prior to the workshop session is handed to each stakeholder. A short period of approximately 10 minutes is allowed for each stakeholder to reflect on the stormwater values they personally considered relevant to the particular catchment. Each stakeholder is given a total of 100 points to allocate to the list of values and rank them in their personal priority, in a descending order of importance. As mentioned, some stakeholders might have multiple values that they considered worthy of inclusion but others may find that there are a limited number of relevant values that they were interested in.

Step 2: Consensus Gathering

The second stage involves jointly assembling a set of values for the stakeholder group. From the first step a complete list of all the values raised and the weighting given to them by individuals is compiled. Scores are added together to produce an overall weighting score for each value. This is then drawn up in rank order from highest to lowest.

The facilitator allows the group adequate time to debate the merits of their individual values as they appear in the list in order to ensure that the list is complete and agreement is reached about the ranking of priorities. This data is used later to establish not only what is ideal in the catchment but also what is practical and affordable.

This ranking method can be displayed in a bar graph rather than just ranking the values as high, medium and low. This allows for a comparison of the priorities put on each value. The EPA guideline suggests that the least important values can be eliminated at this stage, however, for Tenterfield all the values that have been identified were included. The method reduces potential conflict between stakeholders over personal values because none are excluded from the process.

Results:

The following section documents the results of a ranking process. Table 4-1 shows each stakeholder's score allocation for each of the values. The scores were then added up and Table 4-2 was produced showing the total score for each value.

Table 4-1 Stakeholders individual score allocation to values

Stakeholder "Number"->	1	2	3	4	5	6	7	8	9	10	11	12	13
Health and Safety	7	10	30	40	5	5	25	20	20	15	5	15	20
Good water quality values	10	30	10	10	30	10	15	20	15	15	25	15	20
Protection of habitats	10	10	10	10	10	25	5	10	10	15	20	5	10
Weeds	7	5	5	0	5	10	0	10	5	5	0	5	0
Protection of Fauna	10	5	5	10	5	20	5	10	10	15	5	5	10
Litter	10	5	5	5	5	0	10	5	10	10	5	10	5
Community awareness	7	0	10	0	10	5	10	5	15	10	5	10	10
Good Aesthetics	10	0	5	20	5	5	10	0	10	5	10	5	5
Tourism value	10	10	10	5	0	0	10	5	0	5	5	10	10
Reduction of maintenance costs	7	5	5	0	5	5	0	5	0	0	5	10	5
Recreation	5	5	0	0	0	5	5	5	0	0	10	5	0

The scores from Table 4.1 are added up during the workshop session and Table 4.2 is produced

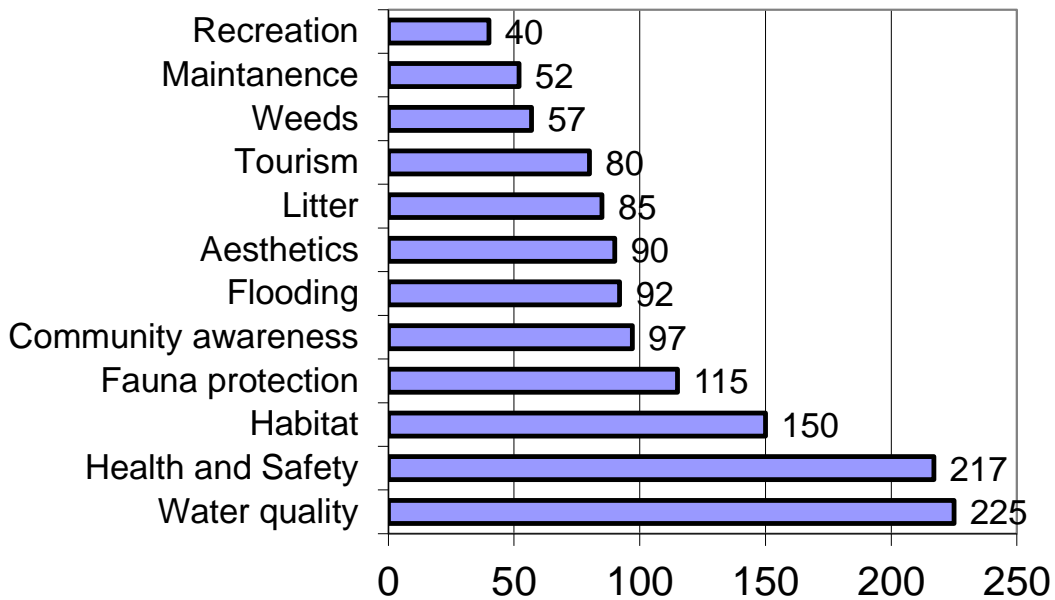
Table 4-2 Total score of values

Values	Score	Rank
Good water quality values	225	1
Health and Safety	217	2
Protection of habitats	150	3
Protection of Fauna	115	4
Community awareness	97	5
Local flooding	92	6
Good Aesthetics	90	7
Litter	85	8
Tourism value	80	9
Weeds	57	10
Reduction of maintenance costs	52	11
Recreation	40	12

In summary, the community considers good water quality to be most important and health and safety second. The ranking of water quality as the highest is usual for stormwater values, since water quality can be linked to most other values. Recreation is the lowest ranked value.

The scoring can also be represented in the following bar graph:

Figure 4-1 Stormwater scoring chart



5. Stormwater management objectives

Objectives can be defined as:

Objectives are long and short term and describe what we seek to achieve in terms of catchment protection and the stormwater values. They also state what we seek to achieve in our management of stormwater to protect and/or achieve the identified waterway and catchment values

The important thing to remember with assembling a list of objectives is to recognise that often a single objective will deliver to the community positive results on more than one of the identified values (see Table 5-2 for linkages between objectives and values). This means that as we assemble a list of objectives we will find that some of them will be capable of delivering more than others and in fact some of the objectives will be long term and some short term. Short term objectives should aim towards gaining a better understanding of the catchment from which long term objectives can evolve and establish strategies to reach the long-term objectives.

Stormwater management should aim to work within the framework of Ecological Sustainable Development (ESD), i.e. 'development that improves the total quality of life, both now and in the future, in a way that maintains the ecological process on which life depends'.

The main objectives of ESD are:

- Enhancing individual and community well-being and welfare by following the path of economic development that safeguards the welfare of future generations
- Provide equity within and between generations
- Protecting biological diversity and maintaining essential processes and life-support systems.

A list of potential stormwater management objectives is compiled, which is drawn from an understanding of the values and issues raised during the one-to-one interviews. These are further discussed with stakeholders and Council at the stakeholder workshop.

At the workshop session, stakeholders are welcome to make changes and additional objectives can be added until the stakeholders are satisfied that objectives would address all the stormwater values.

Table 5-1 includes both long term (overriding objectives) and short term (sub-objectives). **Error! Reference source not found.** details how values are linked to each of the objectives.

Table 5-1 Stormwater management objectives

LONG TERM (Overriding Objectives)	SHORT TERM (Sub-objectives)
IMPROVE WATER QUALITY	
<p>Improve and maintain water quality within ANZECC guidelines.</p>	<ul style="list-style-type: none"> • Reduce the amount of litter entering waterways, especially from the CBD and the High School • Reduce the amount of odour in Tenterfield Creek • Minimise the infiltration of stormwater into the sewage system • Continue to address grease and oil pollution caused by runoff from the highway, and illegal disposal of waste oils • Reduce the amount of siltation entering Tenterfield Creek from stormwater outlets • Reduce the number of unsealed roads feeding into the urban stormwater network
MINIMISE EROSION	
<p>Minimise the impact of erosion on property and the environment</p>	<ul style="list-style-type: none"> • Address the number of unsealed road verges susceptible to erosion • Reduce the incidence of river and stream bank erosion caused by stormwater outlets and removal of trees
IMPROVE AESTHETICS OF THE CATCHMENT	
<p>Improve the aesthetics of the stormwater system</p>	<ul style="list-style-type: none"> • Reduce odour, weed and litter problems in Tenterfield Creek
PROTECTION OF AQUATIC AND TERRESTRIAL HABITATS	
<p>Ensure that the stormwater system does not impact on aquatic and terrestrial habitats</p>	<ul style="list-style-type: none"> • Decrease sedimentation around stormwater outlets • Reduce the amount of exotic weeds in Tenterfield Creek at the showground and near the CBD • Improve water quality, especially regarding silt, oil and litter around stormwater outlets and cattle access to Creek

LONG TERM (Overriding Objectives)	SHORT TERM (Sub-objectives)
Ensure that public health and safety is not compromised by the stormwater system	<ul style="list-style-type: none"> • Reduce the risk of possible overflows from Septic tanks on Clive, Derby and Simpson Streets • Monitor and reduce the impact of infiltration of stormwater into the sewage system.
Improve community awareness, education and involvement in stormwater management	<ul style="list-style-type: none"> • Implement public education programs to increase public awareness of issues such as grass clippings in drains and litter

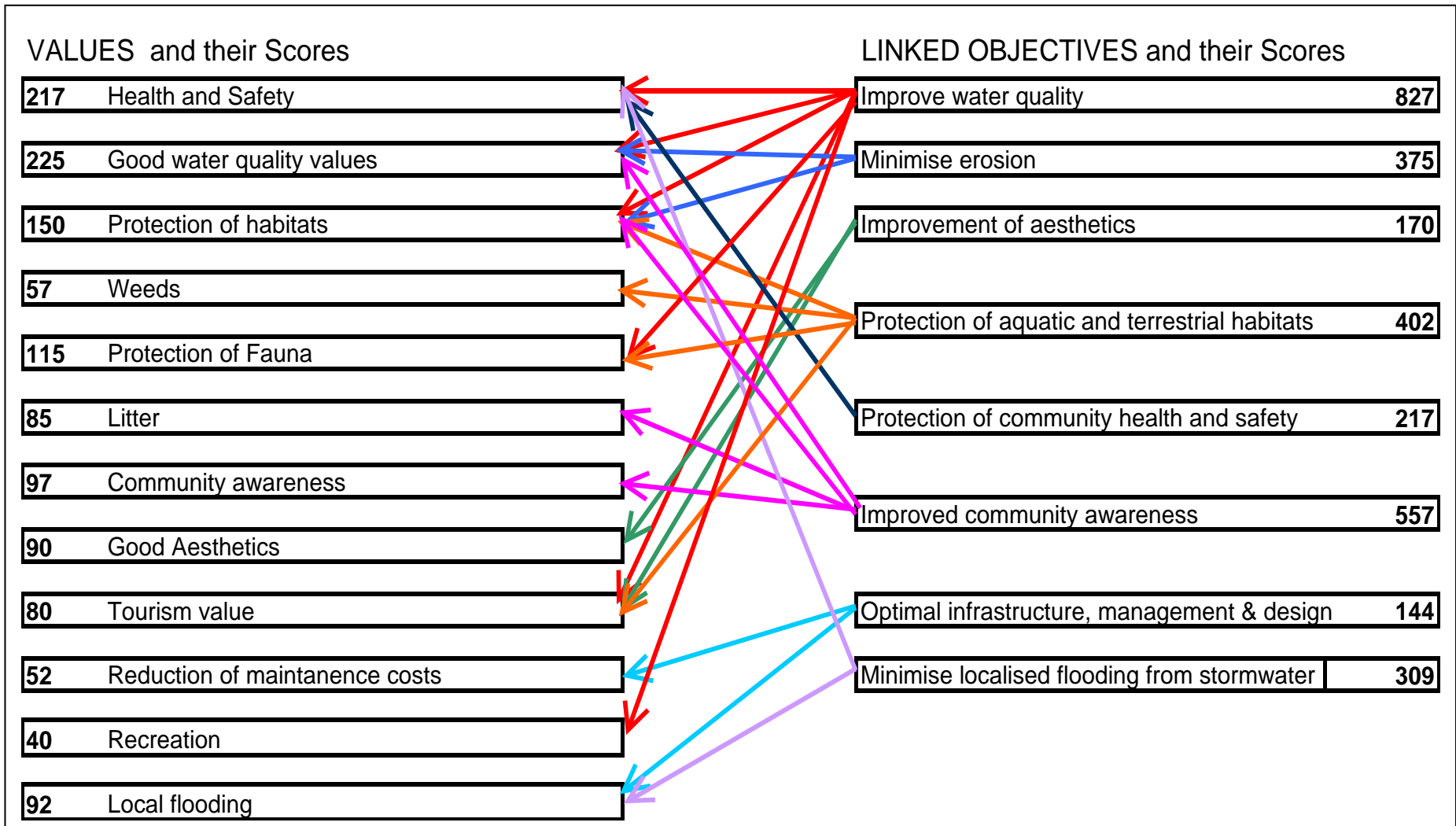
Stormwater management for new developments

Stormwater management plays a crucial role during construction work. Usually large areas of bare soil exist and erosion commonly occurs during rain if the soil is not properly captured.

For each phase of development, stormwater management should focus on both quantitative and qualitative objectives for stormwater control. Any major construction work requires a Council approved sedimentation and erosion control plan.

More information on construction and development is at Appendix D: Erosion control for new development sites.

Table 5-2 Values and stormwater objectives linkages



After the workshop, the facilitators score the stormwater management objectives. The scores of the values (Table 4-2) are used to allocate scores to each objective. This is accomplished by adding up the scores of the values, which have been linked to the objectives (Table 5-3). For simplicity, only key linkages and long term objectives are used in Table 5-2.

Table 5-3 shows the objectives score allocations which are derived from Table 5-2. The objectives are also ranked in descending order. The higher an objective is ranked the more values it addresses.

Table 5-3 Scoring and ranking of objectives

Objective	Score	Rank
Improve water quality	827	1
Protection of aquatic and terrestrial habitats	627	2
Protection of community health and safety	627	3
Minimise erosion	375	4
Minimise localised flooding from stormwater	309	5
Optimal infrastructure, management & design	234	6
Improved community awareness	182	7
Improvement of aesthetics	170	8

6. Stormwater management issues

Issues can be defined as:

Factors that may inhibit or enhance our ability to meet our stormwater objectives at present or in the future.

The identification of stormwater management issues involves a review of existing information, field inspection and discussion with various State Government Agencies, community representatives and Council staff. Issues may be of social, economic, environmental and managerial origin.

Table 6-1 is a list of issues and possible causes that are raised by the stakeholders prior to the workshops. This table is further developed during the workshop session. Various issues may be taken out if they do not significantly relate to urban stormwater management. However, these issues may be considered in other management plans. These issues are then ranked with scores derived from the impact of issues on stormwater objectives.

The issue-ranking scheme is done with the aid of a matrix, technically known as a frequency and impact study. Techniques of this type are widely used in the water industry where managers and stakeholders are faced with considering the importance of events and issues. This methodology primarily focuses on each issue and how it may impact on stormwater values and objectives in terms of probability and consequences. The way to do that is to look at:-

- the frequency with which an event occurs;
- the impact of the event on the environment.

Refer to Section 6.1 for an illustration of the issues ranking methodology. The issues are put into broader topics in the matrix for simplicity, rather than considering each issue individually from Table 6-1. The outcomes of the issues ranking with the aid of the matrix are shown in

Table 6-4. It should be noted that most of the water quality issues cannot be dealt with in isolation and management should reflect their relationship to all aspects of water quality management. In the absence of data, issues are ranked by the use of judgement to point the Council in the right direction.

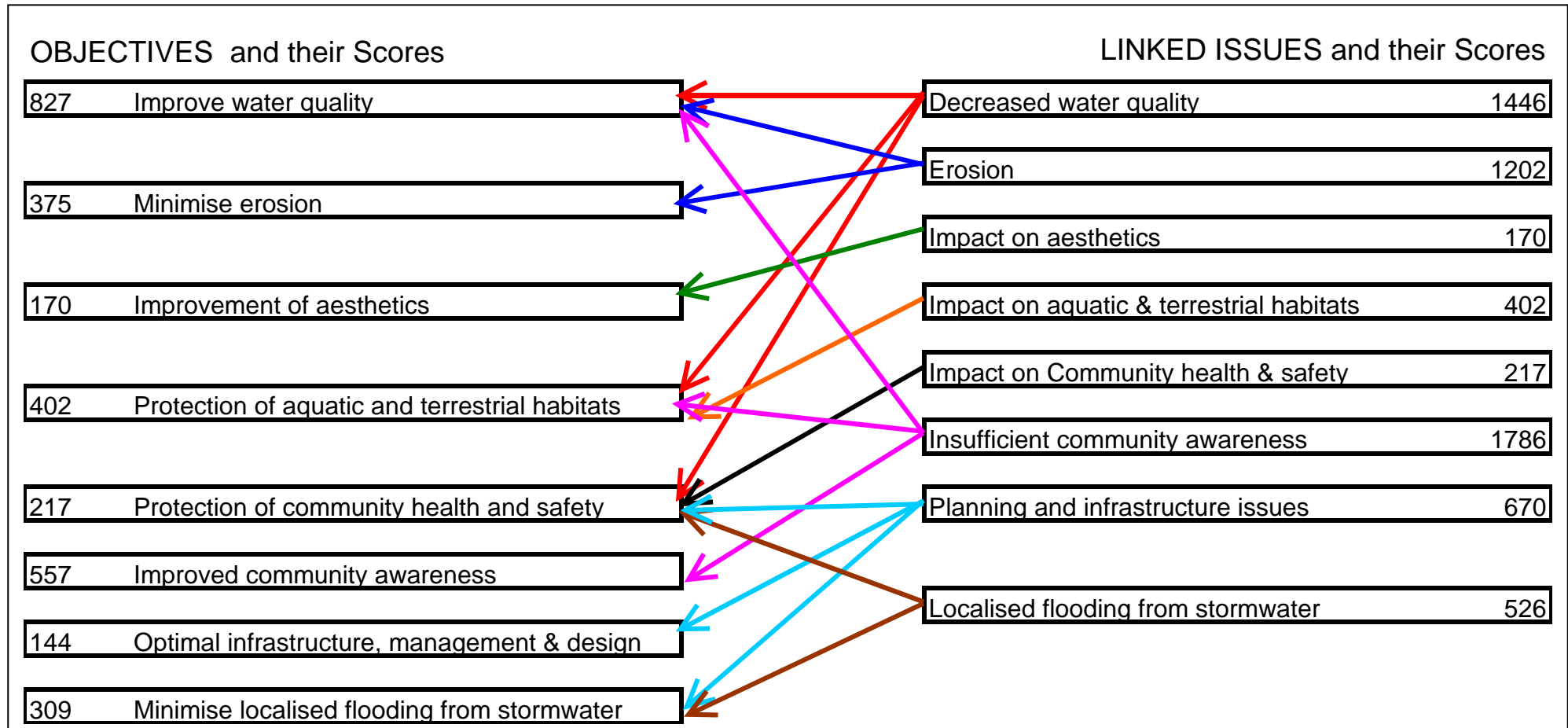
Table 6-1 Stormwater management issues

ISSUE	LOCATION AND CAUSE
Water Quality	
Litter in waterways (bottles, plastic bags, cigarette butts)	<ul style="list-style-type: none"> • There are several litter hotspots, including the stormwater outlets into Tenterfield Ck that originate from the commercial centre, where litter is generally more prominent • Another hotspot noted was the corner of East Street and the Bruxner Highway • The Stormwater outlet at Duncan St is another hotspot caused by the closeness of the commercial area • The stormwater outlet near the school on High St also contained a lot of litter, originating from the school, the cause could be lack of knowledge of schoolchildren. • Two stormwater outlets in Manners Street, washoff from carpark, stormwater outlet at the back of the school comes from Rouse Street onto Scott Street into the river • Most litter comes from Rouse Street
Odour	Parts of Tenterfield Ck had stagnant water causing an odour problem near the showground and the park in the centre of town, although this is now less of a problem
Increased levels of nutrients	Tenterfield Creek is thought to have high nutrient levels, caused by runoff from the urban area, or soil degradation (use of fertilisers – Council has data that indicates that this is not the case)
Infiltration of stormwater into the sewage system	Stormwater infiltrates into the sewage system causing overflows at the corner of Miles and Rouse St, the caravan park, High St, and the Corner of the highway and Petrie St. Overflows could also be caused by illegal connections or poorly sealed manholes
Grease and Oil pollution	<ul style="list-style-type: none"> • Grease and oil pollution is noted in Tenterfield creek, Manners St and the corner of Derby and Rouse Streets, possible causes include runoff from the highway and illegal disposal of waste oils. • Petrol and oil pollution from CBD
Erosion	
Erosion of road verges	Unsealed road verges have been seen to erode and cause siltation in the stormwater system. Hotspots include the corner of Douglas and Pelham streets, High Street, the corner of Scott and Clive Streets, and Clifton Street (twin bridge) which does add to turbidity problems

Erosion of riverbanks	The banks of Tenterfield creek were significantly eroded in the floods. This has been largely addressed by revegetation but areas remain which require attention.
Aquatic and terrestrial habitats	
Introduction of weeds	There are exotic weeds present in Tenterfield Creek near the showground and the commercial area, which impact upon the natural habitat
Siltation	Siltation was noted in Tenterfield creek at Duncan St and Clifton St, caused by stormwater outlets bringing stormwater from eroded sites, and also erosion of bare soil around the outlets.
Impact of bad water quality on natural habitats	Effluent from the town and sites where cattle are allowed access to the creek are causing the water quality to decrease and impacting on the natural habitat.
Health and safety	
Septic tanks	There are still septic tanks in the catchment area although there is an ongoing program to make the septic service available to all.
Health	Infiltration of stormwater into the sewage system and hence surcharges.
Safety	Stagnant water on showground from stormwater and mosquito breeding
Lack of community awareness	
Lack of awareness in terms of urban stormwater issues	The community lacks awareness of the impacts of litter (especially in the park) and grass clippings in the stormwater system.
Infrastructure/planning Issues	
Drainage	<ul style="list-style-type: none"> • There are a number of streets with poor stormwater drainage due mainly to geographic constraints. Affected streets include Railway and Logan streets • There is a lack of information on the drainage system within town (no drainage management plans) – option to assemble a drainage network model/plan
Flooding	
Localised	<ul style="list-style-type: none"> • Localised flooding occurs at many hotspots including the sporting ovals because of the proximity to the creek, other

Flooding	<p>hotspots to check;</p> <ul style="list-style-type: none">• The corner of Douglas and Pelham St• The Bridge at Manners St• Corner Naas and Highway• Culvert between Derby and Simpson Streets under the highway• High St near Railway Ave to Pelham Street• Corner of Douglas and Wood St• Jubilee Park• Logan St• Behind Commercial hotel• Pelham Street between Naas and Molesworth St• Flooding occurs at these hotspots for various reasons such as insufficient drainage, insufficient stormwater capacity and location of properties in relation to natural watercourses
----------	--

Table 6-2 Issues - objectives linkage table



6.1 Ranking of issues

6.1.1 Issues Matrix

The ranking is carried out with the aid of an issues matrix. The matrix is based on the potential impact of the issues to affect the values and objectives of the Stormwater Quality Management Plan in terms of consequences and frequency of impact. The following section describes the ranking of stormwater management issues using an issues matrix.

Step 1 - Deciding on Issues to be Ranked

At the workshop, stakeholders and Council representatives select a number of issues they consider important in terms of stormwater management in the study area. Issues identified by stakeholders are also supported by a field inspection of the urban stormwater catchment by Council representatives.

Step 2- Assigning an Impact and Frequency Score

This step involves assigning a score for each issue indicating its relative impact on stormwater objectives, and the likely frequency of that impact. The scores for the issues are derived by linking each issue to its related objectives. (Refer to Table 6-2). Scores of the objectives (previously obtained from a value-objective linkage table) are added up to determine the final score for each issue. See the following table for the issues score, hence their impact. The frequency is determined by examining the cause, location of each issue and by catchment inspections.

Table 6-3 Issues scores (impact)

Issue	Score	Impact	Frequency
Insufficient community awareness	1786	5	5
Decreased water quality	1446	5	5
Erosion	1202	4	3
Planning and infrastructure issues	670	2	4
Localised flooding from stormwater	526	2	4
Impact on aquatic & terrestrial habitats	402	2	5
Impact on Community health & safety	217	1	2
Impact on aesthetics	170	1	3

Issues which are considered to have an **insignificant** impact on objectives are allocated a **low score** and issues which are assessed as having a **high impact** on objectives are given the **highest**

impact score. Issues which have a very low occurrence within the catchment (or were unlikely to occur) are given a **low frequency score**, while issues that are very likely to occur within the catchment are given a **high frequency score**.

Step 3 - Using the Issues Matrix

The purpose of the matrix is to identify critical, intermediate and less critical issues for the Stormwater Quality Management Plan. After each issue is scored in accordance with Table 6-3, the issues are then included in the issues matrix for ranking. With reference to the issues matrix, it can be seen that the impact score increases as it goes up the vertical axis (from 1 to 5) which is based on the scores obtained from objectives. The frequency score increases as it goes from left to right on the horizontal axis (1 to 5). Therefore, issues that are scored as having a low impact and are assessed as having a low frequency would be found in the bottom left hand corner of the matrix. As issues increase in their relative impact and likely occurrence, they would move across the matrix to the top right hand corner, incurring a high ranking score. The highest score possible is 5x5, with the lowest score possible being 1x1.

With reference to the issues matrix, it can be seen that there are three rankings possible (from 1 to 3) with 1 being the highest ranking possible and 3 being the lowest ranking possible. The shading/cross hatching on the matrix indicates the range within the matrix for each ranking. For example, any issues that are included on the risk matrix within boxes 4x5, 5x4, and 5x5, all fall within the ranking area designated 1.

Step 4 - Recording the Ranking Results

The results of the ranking assessment are included in

Table 6-4. The issue of decreased water quality can have a number of causes. Causes may include erosion, litter, elevated levels of suspended solids, grease & oil pollution, etc. These causes are placed into a submatrix and will be useful when developing options.

Step 5 - Applying the Results of the Ranking Scheme

The ranking scheme aids in the development of management options for the highest priority issues in the catchment. Higher priority issues, particularly those ranked 1, should be given a higher priority than issues ranked 2 or 3 when management options were being developed.

Table 6-4 Issues ranking matrix

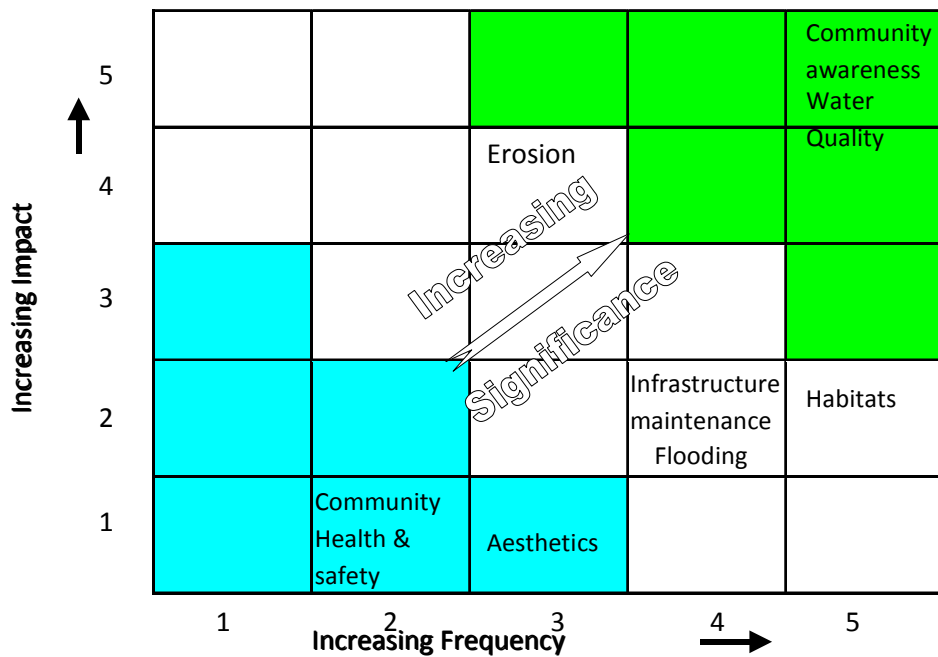


Table 6-5 Water quality sub-matrix

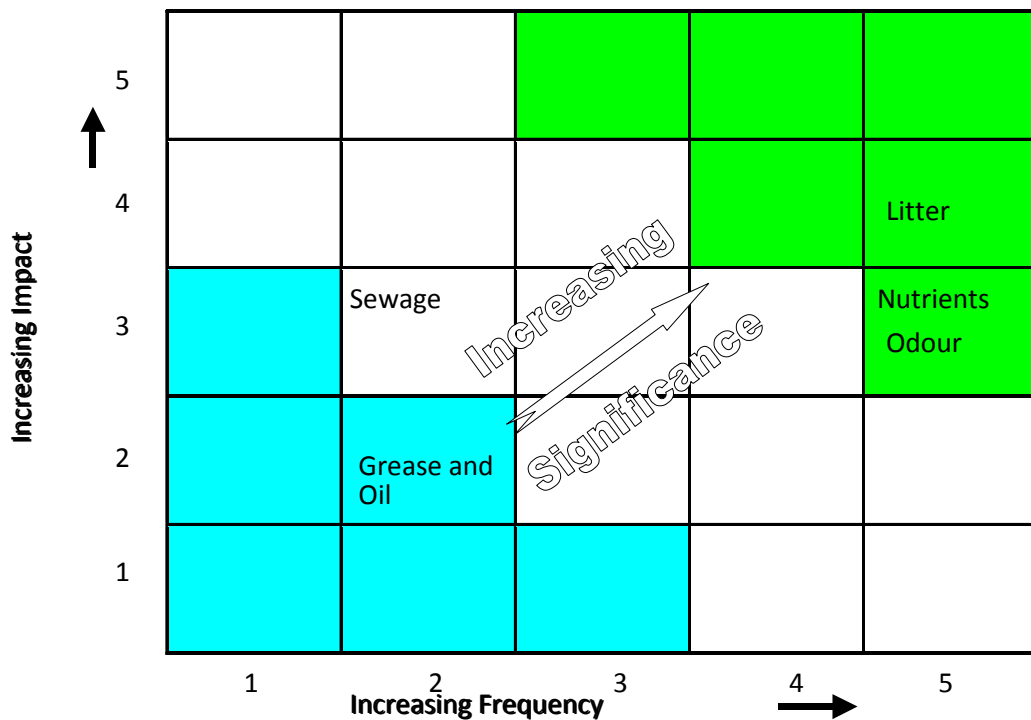


Table 6-6 Issues ranking scheme

Assigning an Impact and Frequency		
IMPACT ON VALUES AND OBJECTIVES (Vertical axis)		SCORE ALLOCATION OF ISSUES
1	Insignificant impact on values and objectives.	0 – 357.2
2	Low impact on majority of values and objectives	357.2 – 714.4
3	Moderate impact on most values and objectives	714.4 – 1071.6
4	Significant impact on most values and objectives.	1071.6 – 1428.8
5	High impact on all values and objectives (for significant time periods)	1428.8 - 1786
FREQUENCY OF IMPACT (Horizontal axis)		
1	Very rare (few reports)	
2	Occurs occasionally (event occurs once a year or less)	
3	Moderate frequency (occurs at least every 6 months or more)	
4	Occurs often (occurs in heavy rainfall or occurs every few months)	
5	High to very high occurrence (eg almost every time it rains or is ongoing)	

Table 6-7 Issues rank & scores from table 6.2

ISSUES	SCORE	RANK
Insufficient community awareness	5x5=25	1
Decreased water quality	5x5=25	1
Erosion	4x3=12	2
Planning and Infrastructure issues	2x4=8	4
Localised flooding from stormwater	2x4=8	4
Impact on habitats	2x5=10	3
Impact on health & safety	1x2=2	6
Impact on aesthetics	1x3=3	5

The above table indicates that insufficient community awareness ranked highest and thus has most impact on stormwater values and objectives.

Table 6-8 Water quality sub matrix rank & scores

WATER QUALITY SUB-ISSUES	SCORE	RANK
Litter in waterways	4x5=20	1
Odour	3x5=15	2
Increased nutrient levels	3x5=15	2
Sewage	3x2 = 6	3
Grease and oil	2x2=4	4

Having looked at water quality issues in detail, the above table indicates that litter in waterways has the highest impact.

7. Stormwater management options

Draft management options are identified by Council and stakeholders. Options are linked to stormwater issues and objectives (Table 7-1)

Options aim at addressing the stormwater issues

Options are further examined by the Engineering Department because they are in a position to put a cost and practicality judgement against each of them. For example, an option that is considered by the group to be of high priority and effectiveness may prove too expensive or impractical for the management group who have responsibility for the suggested activity. Equally, there may be many low cost options, which can be easily implemented by the community and deliver important improvements to the stormwater system.

The management strategy should incorporate flexibility into the stormwater system and encourage best management practices in stormwater management.

7.1 Assessment of Options

To evaluate stormwater management options, the following criteria are used:

- 1. An assessment of the efficiency of the option in meeting the stormwater objectives and addressing the key issues.**
- 2. The likely impact of the option on residents and the community.**
- 3. The estimated cost of the option (capital and operating, including maintenance).**

7.2 Cost-benefit analysis

The cost-benefit analysis is conducted by placing options on a cost-benefit matrix. The scoring for each option is taken from Table 7.2. The cost-benefit analysis aims at providing Council with a list of practical stormwater management options. This includes an outline of costs for each option, scores from issues and the likely impact on the community (Table 7.2). Both the scores and the cost are used to place options in the cost-benefit matrix as shown in Table 7.3. From this, the Engineering department can establish an order of priority when implementing stormwater management options to best satisfy community needs and to allow for a management plan that is feasible and effective.

7.3 Options selection

A number of options are listed in Table 7-1. These options are either structural or non-structural

7.3.1 Non-structural options

These include:

- Education programs (eg. workshops, CMA programs)
- Planning controls (eg. Council policies and strategies)
- Site auditing (eg. control of land use)
- Review of management practices (eg. Council maintenance activities)
- Studies & assessments (eg. water quality monitoring)

7.3.2 Structural options

These include:

- Litter traps (eg. litter baskets, litter booms, nets, litter socks, GPT, CDS units)
- Sediment traps
- Constructed stormwater wetland
- Bank/river stabilisation (eg. removal of exotics, replanting of riverbanks with native species, grass lining of roads, rock walls, reno mattresses, concrete lining)
- Sand filters

Table 7.1 lists a number of potential options for each stormwater issue and 'hotspots'. The option list is developed with a close focus on issues and hotspots. An option that addresses more than one issue is favoured over an option that only addresses a single issue.

Table 7-1 Issues & objectives and their link to options

ISSUE	CAUSES	LINK TO OBJECTIVES Table 5.1	SCORE Table 6.2	OPTIONS
DECREASED WATER QUALITY				
Litter Odour Nutrients Sewage Grease and oil	<ul style="list-style-type: none"> • Insufficient awareness • Stagnant water • Urban runoff, fertilisers • Infiltration of stormwater causing overflows • Highway runoff and illegal disposal of waste oils 	<ul style="list-style-type: none"> • Improve water quality • Protection of habitats • Protection of community health and safety 	1446	<ul style="list-style-type: none"> • Water quality monitoring at the top of the urban catchment and monitoring the quality of the water leaving the town. • Educate the community to collect their dog’s droppings and to use fertilisers correctly. • To address the litter issue on a wider scale such as installing more rubbish bins in appropriate locations • Install signs in the parks about not littering and protecting the creek • Council to review pollution control policy to prevent pollution from entering into waterways. • Continue to investigate and address sewage overflows
IMPACT ON AQUATIC AND TERRESTRIAL HABITATS				
<ul style="list-style-type: none"> • Weeds • Siltation • Bad water quality 	<ul style="list-style-type: none"> • Introduction of exotic species, including willows • Stormwater introducing eroded soil to the creek • Effluent from town and cattle access to the creek 	Protection of aquatic and terrestrial habitats	402	<ul style="list-style-type: none"> • Educate the community about pollinating species of willows • To encourage the community to join groups such as Landcare • Minimise sedimentation by minimising areas of bare soil • Discourage community members from housing cattle next to the creek

ISSUE	CAUSES	LINK TO OBJECTIVES Table 5.1	SCORE Table 6.2	OPTIONS
				<ul style="list-style-type: none"> Revegetate the creek banks with native species
EROSION				
<ul style="list-style-type: none"> Erosion of road verges Erosion of riverbanks 	<ul style="list-style-type: none"> Unsealed road verges Lack of vegetation, high velocity flows from stormwater outlets 	<ul style="list-style-type: none"> Improve water quality Minimise erosion 	1202	<ul style="list-style-type: none"> Investigate areas to Seal unsealed road verges. Minimise clearing of vegetation and where possible plant more native trees to stabilise riverbanks
IMPACT ON COMMUNITY HEALTH AND SAFETY				
<ul style="list-style-type: none"> Sewage Mosquito breeding 	<ul style="list-style-type: none"> Septic tanks and sewage surcharges Stagnant water 	Protection of community health and safety	217	<ul style="list-style-type: none"> Investigate areas of septic tank/sewage discharges into stormwater channels Minimise surcharges caused by stormwater infiltration into the sewage system. Improve drainage to discourage stagnant water
IMPACT ON AESTHETICS				
Litter	Highway through town, insufficient community awareness	Improvement of aesthetics	170	<ul style="list-style-type: none"> Install non-litter murals on stormwater channel walls Install signs in the park asking visitors to keep it clean Implement education programs.
INSUFFICIENT COMMUNITY AWARENESS				
Lack of awareness	Lack of awareness eg litter, grass clippings etc	Improve water quality Protection of habitats Improve community awareness	1786	<ul style="list-style-type: none"> Educate the community by installing stormwater stencils. Implement education programs in terms of stormwater pollution by over-fertilisation, lawn clippings etc.) Use local media to report on stormwater issues, including good news stories

ISSUE	CAUSES	LINK TO OBJECTIVES Table 5.1	SCORE Table 6.2	OPTIONS
				<ul style="list-style-type: none"> • Encourage/enforce correct car washing practices, and disposal of garden wastes • Install signs warning of dangers associated with stormwater system • Stakeholder meetings • Display at shopping centres, schools, council foyer • Consultative committees • Community surveys • Obtain brochures, posters etc for distribution
PLANNING/ INFRASTRUCTURE ISSUES				
Poor drainage Lack of underground drainage Blocked drains	Lack of infrastructure, Lack of maintenance	Protection of community health and safety Optimal infrastructure, management and design Minimise localised flooding	670	<ul style="list-style-type: none"> • Implement a cost-effective strategy to clean stormwater structures. • Investigate possibility of upgrading the capacity of stormwater channels • Map existing stormwater infrastructure • Increase maintenance
FLOODING				
Localised flooding	<ul style="list-style-type: none"> • Insufficient capacity, insufficient drainage 	Protection of community health and safety Minimise localised flooding	526	<ul style="list-style-type: none"> • Implement a cost-effective strategy to clean stormwater structures. • Investigate possibility of upgrading the capacity of stormwater channels • Map existing stormwater infrastructure

The benefit score is derived by multiplying the objectives scores with the issues scores. The score of the issues was identified with the aid of the Issues Impact/Frequency Matrix.

Table 7-2 Cost-benefit analysis

Option (table 7.1)	Link to objectives (table 5.3)	Link to issues (from table 7.1)	Impact on community	Estimated \$ cost		Status and / or Implementation timeframe	Option score (objectives x issues)
				Capital	Operating		
DECREASED WATER QUALITY							
1. Water quality monitoring at the top of the urban catchment and monitoring the quality of the water leaving the town.	<ul style="list-style-type: none"> Improve water quality-827. Protection of habitats – 402. Protection of health-217. 	<ul style="list-style-type: none"> Decreased water quality – 1446 Impact on habitats – 402 Impact on health - 217 	Positive - educational	\$1000	\$1000	Implemented Dec 2012	2 985 990
2. Educate the community to collect their dog’s droppings and to use fertilisers correctly.	<ul style="list-style-type: none"> Improve water quality-827. Protection of habitats – 402. Protection of health-217. 	<ul style="list-style-type: none"> Decreased water quality – 1446 Impact on habitats – 402 Impact on health - 217 	Positive - educational	\$1000	1000\$	Ongoing	2 895 990
3. Review options to address the litter issue on a wider scale such as installing more rubbish bins in	<ul style="list-style-type: none"> Improve water quality-827. Protection of habitats – 402. 	<ul style="list-style-type: none"> Decreased water quality – 1446 Impact on habitats – 402 	Positive	\$2000	\$500	Environmental Department to review suitability of bin placement	2 985 990

Option (table 7.1)	Link to objectives (table 5.3)	Link to issues (from table 7.1)	Impact on community	Estimated \$ cost		Status and / or Implementation timeframe	Option score (objectives x issues)
				Capital	Operating		
appropriate locations	<ul style="list-style-type: none"> • Protection of health-217. 	<ul style="list-style-type: none"> • Impact on health - 217 					
4. Council to review pollution control procedures to prevent pollution from entering into waterways.	<ul style="list-style-type: none"> • Improve water quality-827. • Protection of habitats – 402. • Protection of health-217. 	<ul style="list-style-type: none"> • Decreased water quality – 1446 • Impact on habitats – 402 • Impact on health - 217 	Positive	\$NA	\$NA	Environmental Department to review effectiveness of current development controls.	2 985 990
5. Install signs in the park asking visitors not to litter.	<ul style="list-style-type: none"> • Improve water quality-827. • Protection of habitats – 402. • Protection of health-217. 	<ul style="list-style-type: none"> • Decreased water quality – 1446 • Impact on habitats – 402 • Impact on health - 217 	Positive	\$1500	\$NA	Environmental Department to review suitability of signage	2 985 990
6. Continue to investigate and address sewage overflows	<ul style="list-style-type: none"> • Improve water quality-827. • Protection of habitats – 402. • Protection of health-217. 	<ul style="list-style-type: none"> • Decreased water quality – 1446 • Impact on habitats – 402 • Impact on health - 217 	Positive	\$15,000 per annum	\$NA	Sewer relining commenced in 2011	2 985 990
IMPACT ON AQUATIC AND TERRESTRIAL HABITATS							

Option (table 7.1)	Link to objectives (table 5.3)	Link to issues (from table 7.1)	Impact on community	Estimated \$ cost		Status and / or Implementation timeframe	Option score (objectives x issues)
				Capital	Operating		
7. Educate the community about pollinating species of willows	<ul style="list-style-type: none"> • Improve water quality-827. • Protection of habitats-402. • Improve community awareness - 557 	<ul style="list-style-type: none"> • Decreased water quality –1446 • Impact on habitats – 402 • Insufficient community awareness - 1786 	Positive	\$NA	\$NA	Ongoing willow removal program in place	6 490 324
8. Encourage the community to join groups such as Landcare.	<ul style="list-style-type: none"> • Improve water quality-827. • Protection of habitats-402. • Improve community awareness - 557 	<ul style="list-style-type: none"> • Decreased water quality –1446 • Impact on habitats – 402 • Insufficient community awareness - 1786 	Positive	\$250	\$250	Ongoing	6 490 324
9. Minimise areas of sedimentation by minimising areas of bare soil	<ul style="list-style-type: none"> • Improve water quality – 827 • Minimise erosion – 375 • Protection of habitats - 402 	<ul style="list-style-type: none"> • Decreased water quality – 1446 • Erosion – 1202 • Impact on habitats - 402 	Neutral	\$2000	\$1000	Subdivision code and LEP review in 2013 to address	4 892 220
10. Discourage community members from housing	<ul style="list-style-type: none"> • Improve water quality – 827 	<ul style="list-style-type: none"> • Decreased water quality – 1446 	Negative	\$500	\$250	Ongoing	4 892 220

Option (table 7.1)	Link to objectives (table 5.3)	Link to issues (from table 7.1)	Impact on community	Estimated \$ cost		Status and / or Implementation timeframe	Option score (objectives x issues)
				Capital	Operating		
cattle next to the creek	<ul style="list-style-type: none"> Minimise erosion – 375 Protection of habitats - 402 	<ul style="list-style-type: none"> Erosion – 1202 Impact on habitats - 402 					
EROSION							
11. Investigate areas to seal unsealed road verges	<ul style="list-style-type: none"> Improve water quality-827. Minimise erosion-375. 	<ul style="list-style-type: none"> Decreased water quality – 1446 Erosion - 1202 	Neutral	\$2000	NA	Ongoing	3 182 896
IMPACT ON COMMUNITY HEALTH AND SAFETY							
12. Investigate areas of septic tank/sewage discharges into stormwater channels	<ul style="list-style-type: none"> Improve water quality – 827 Protection of health - 217 	<ul style="list-style-type: none"> Decreased water quality – 1446 Impact on health - 217 	Neutral	\$1000	NA	Not thought to be a significant problem	1 736 172
13. Minimise sewage surcharges caused by stormwater infiltration into the sewage system	<ul style="list-style-type: none"> Improve water quality – 827 Protection of health - 217 	<ul style="list-style-type: none"> Decreased water quality – 1446 Impact on health - 217 	Neutral	See Sewage overflows		Sewer relining commenced in 2011	1 736 172
IMPACT ON AESTHETICS							
14. Install signs in the park asking visitors to keep it	<ul style="list-style-type: none"> Improvement of aesthetics-170. 	<ul style="list-style-type: none"> Impact on aesthetics – 170 	Positive	\$1000	NA	Environmental department to review	1 611 152

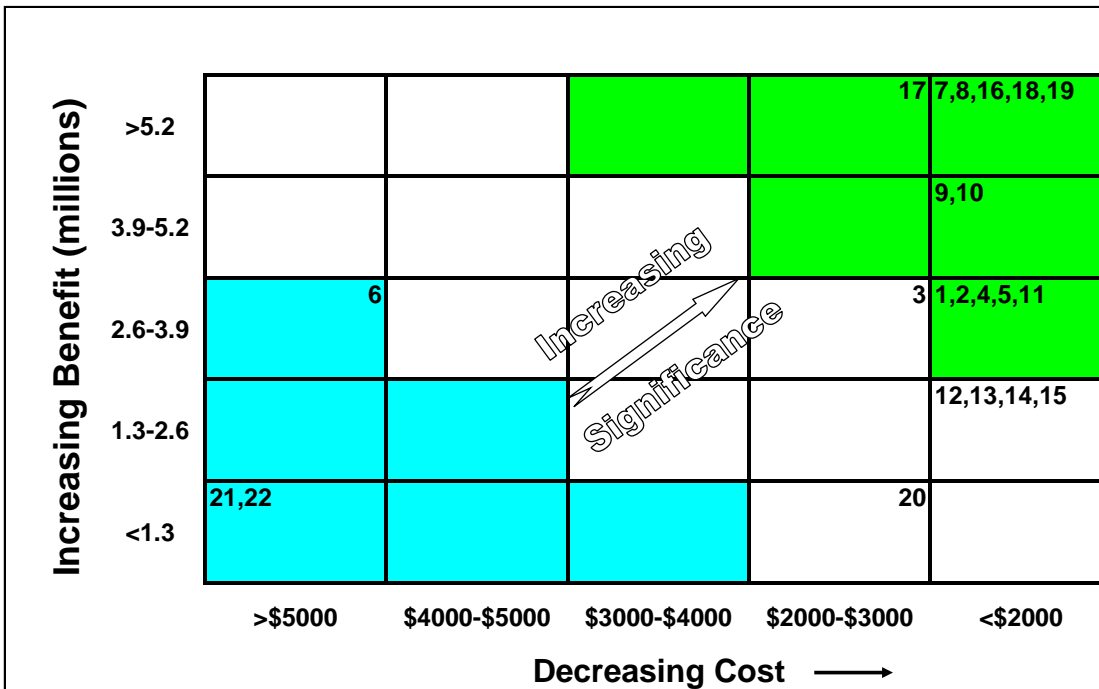
Option (table 7.1)	Link to objectives (table 5.3)	Link to issues (from table 7.1)	Impact on community	Estimated \$ cost		Status and / or Implementation timeframe	Option score (objectives x issues)
				Capital	Operating		
clean	<ul style="list-style-type: none"> Improve water quality - 827 	<ul style="list-style-type: none"> Decreased water quality - 1446 				suitability of signage	
15. Implement education programs.	<ul style="list-style-type: none"> Improvement of aesthetics-170. Improve water quality - 827 	<ul style="list-style-type: none"> Impact on aesthetics – 170 Decreased water quality - 1446 	Positive - educational	\$1000	\$1000	Ongoing	1 611 152
INSUFFICIENT COMMUNITY AWARENESS							
16. Educate the community by installing stormwater stencils.	<ul style="list-style-type: none"> Improve water quality-827. Protection of habitats-402. Improve community awareness-557. 	<ul style="list-style-type: none"> Decreased water quality – 1446 Impact on habitats – 402 Insufficient community awareness - 1786 	Positive - educational	\$500	\$NA	Implement stencilling of gully pits – 12 month program 2013	6 490 324
17. Implement education program in terms of stormwater pollution by over-fertilisation, lawn clippings etc.	<ul style="list-style-type: none"> Improve water quality-827. Protection of habitats-402. Improve community awareness-557. 	<ul style="list-style-type: none"> Decreased water quality – 1446 Impact on habitats – 402 Insufficient community awareness - 1786 	Positive - educational	\$1000	\$1000	Include with Council newsletter	6 490 324

Option (table 7.1)	Link to objectives (table 5.3)	Link to issues (from table 7.1)	Impact on community	Estimated \$ cost		Status and / or Implementation timeframe	Option score (objectives x issues)
				Capital	Operating		
18. Use local media to report on stormwater issues, including good news stories	<ul style="list-style-type: none"> • Improve water quality-827. • Protection of habitats-402. • Improve community awareness-557. 	<ul style="list-style-type: none"> • Decreased water quality – 1446 • Impact on habitats – 402 • Insufficient community awareness - 1786 	Positive	\$500	\$500	Ongoing	6 490 324
19. Encourage/enforce correct car washing practices, and disposal of garden wastes	<ul style="list-style-type: none"> • Improve water quality-827. • Protection of habitats-402. • Improve community awareness-557. 	<ul style="list-style-type: none"> • Decreased water quality – 1446 • Impact on habitats – 402 • Insufficient community awareness - 1786 	Negative	\$500	\$500	Currently implemented and ongoing.	6 490 324
20. Stakeholder meetings to discuss current stormwater issues	<ul style="list-style-type: none"> • Improve water quality-827. • Protection of habitats-402. • Improve community awareness-557. 	<ul style="list-style-type: none"> • Decreased water quality – 1446 • Impact on habitats – 402 • Insufficient community awareness - 1786 	Positive	NA	NA	As Required	6 490 324
PLANNING, INFRASTRUCTURE, FLOODING							

Option (table 7.1)	Link to objectives (table 5.3)	Link to issues (from table 7.1)	Impact on community	Estimated \$ cost		Status and / or Implementation timeframe	Option score (objectives x issues)
				Capital	Operating		
21. Implement a cost-effective strategy to clean stormwater structures	<ul style="list-style-type: none"> • Protection of health and safety – 217 • Optimal infrastructure management and design – 144 • Minimise localised flooding - 309 	<ul style="list-style-type: none"> • Impact on health and safety – 217 • Planning and maintenance issues – 670 • Localised flooding - 526 	Neutral	NA	\$500	Maintenance program for stormwater structures commenced November 2012	946 710
22. Investigate upgrading stormwater channels	<ul style="list-style-type: none"> • Protection of health and safety – 217 • Optimal infrastructure management and design – 144 • Minimise localised flooding - 309 	<ul style="list-style-type: none"> • Impact on health and safety – 217 • Planning and maintenance issues – 670 • Localised flooding - 526 	Neutral	\$2000	NA	Stormwater asset management plan developed February 2013	946 710
23. Map existing stormwater infrastructure	<ul style="list-style-type: none"> • Protection of health and safety – 217 • Optimal infrastructure management and design – 144 	<ul style="list-style-type: none"> • Impact on health and safety – 217 • Planning and maintenance issues – 670 • Localised flooding - 	Neutral	\$ 30,000	\$500	Stormwater assets mapped and created as layer in MapInfo Jan 2013	946 710

Option (table 7.1)	Link to objectives (table 5.3)	Link to issues (from table 7.1)	Impact on community	Estimated \$ cost		Status and / or Implementation timeframe	Option score (objectives x issues)
				Capital	Operating		
	<ul style="list-style-type: none"> Minimise localised flooding - 309 	526					
24. Increase maintenance and asset renewal.	<ul style="list-style-type: none"> Protection of health and safety – 217 Optimal infrastructure management and design – 144 Minimise localised flooding - 309 	<ul style="list-style-type: none"> Impact on health and safety – 217 Planning and maintenance issues – 670 Localised flooding - 526 	Neutral	\$ 20,000 per annum	\$ 15,000 per annum	Ongoing	946 710

Table 7-3 Cost Benefit Matrix



KEY: The option to the matching numbers can be found in Table 7.2. The benefit score comes from the last column in Table 7.2.

Notes from the cost benefit matrix;

Many of the options may come up as the highest priority, of these most are the educational options, which are the cheapest and of the most benefit because they address several issues, and community awareness is something that always can be improved.

Options with high priority include education programs such as those offered by CMAs, and involvement in Landcare groups and water quality monitoring.

The matrix does not set these options in stone, options in the matrix that came up as a lower priority may still be options that Council wishes to pursue, for example option 21: mapping of stormwater infrastructure. It is high in cost, but may be of more long term benefit.

8. Implementation Strategies

Strategies are developed from the management options in section 7.0 and focus on source control, practicality and cost-effectiveness. The strategies take into account stormwater values and objectives described in Sections 4.0 and 5.0. After evaluation of options (Section 7.0), they are translated into actions with accordance to budget, responsibility and timeframe, as outlined below.

The list of actions also includes an additional 'wishlist' of actions that Council would like to undertake if funding is available.

Table 8-1 Proposed actions

Actions	Estimated \$ cost		Timeframe and responsibility
	capital	operating	
Proposed Actions			
COUNCIL ACTIONS			
Water quality monitoring in Tenterfield Creek	\$1,000	\$1,000	Completed
Educate the community to collect dog droppings and correct use of fertilisers	\$1,000	\$1,000	Ongoing, council
Appropriate placement of rubbish bins in appropriate locations such as the park by Tenterfield Creek and the main street	\$2,000	\$500	Ongoing, council
Install signs in the park asking visitors not to litter	\$1,500	0	Ongoing, council
Investigate and address sewage overflows and surcharges	\$5,000 – investigation, \$25,000-implementation	\$5,000	Underway - \$15,000 pa commitment
Educate the community about the negative effects of introducing pollinating species of willows	\$500	\$250	Underway, willow removal programme in place
Encourage the community to join groups such as Landcare	\$250	\$250	Ongoing, council
Revegetate bare areas of soil	\$2,000	\$1,000	Ongoing, council

Actions	Estimated \$ cost capital operating		Timeframe and responsibility
Proposed Actions			
COUNCIL ACTIONS			
Discourage the community from housing cattle next to the creek	\$500	\$250	Ongoing, council
Investigate areas to seal unsealed road verges	\$2,000	0	Ongoing, council
Investigate areas of septic tank/sewage discharges into stormwater channels	\$1,000	0	Ongoing, council – unlikely to be an issue
Implement general stormwater education programs	\$1,000	\$1,000	Ongoing, council
Publicise landcare activities and results	0	\$500	Ongoing, council
Use local media to report on stormwater issues	\$500	\$500	Ongoing, council
Continue to enforce/encourage correct car washing procedures and disposal of garden wastes	\$500	\$500	Ongoing, council
Install signs warning of the dangers associated with the stormwater system	\$1,500	0	2013, Council
Hold stakeholder meetings to discuss current stormwater issues	0	0	2013, council
Implement a cost effective strategy to clean stormwater structures	0	\$500	Commenced 2012. Ongoing
Investigate upgrading stormwater channels	\$2,000	0	Commenced 2013 with Stormwater asset management plan
Map existing stormwater infrastructure	\$30,000	0	Completed
Increase maintenance	\$20,000	\$15,000	2013, council

Effective stormwater management should aim to be innovative and site-specific. An integrated approach is required to ensure effective implementation to maximise pollutant removal, minimise cost and reduce maintenance burdens.

Both deficiencies in current stormwater management practices and a guideline for future management and improvement of the stormwater system will be addressed in the implementation strategy.

The focus of the actions should be in the following hierarchy: to retain/restore valuable features of the water environment, to control pollution at its source and to implement “end of pipe” solutions. This should also include both structural and non-structural solutions.

This Stormwater Quality Management Plan is designed to be implemented in conjunction with other plans such as local Landcare projects and to work closely with other existing local projects.

It is advised that this SWQMP is reviewed and revised on an on-going basis to ensure that actions are implemented and that actions do indeed improve stormwater management to the satisfaction of both the Council and the community.

8.1 Management strategy

The implementation plan aims at identifying areas of approval and the establishment of a monitoring and review phase. It will enable the Council to outline a financial program, identifying major capital investment time and cost. From the cost-benefit analysis it will become evident that the management strategy should focus on the mitigation of identified high priority issues.

Council may also gain increased community support and participation through the establishment of a public information framework relating to stormwater issues and concerns within Tenterfield’s urban stormwater catchment.

The following section is an expansion or explanation of some of the options mentioned earlier and will outline details of some of the possible options for Council to follow.

8.1.1 Community Involvement and Education

8.1.1.1 Community Involvement

Community education programs are implementation strategies to prevent, control and treat stormwater by observing substantial environmental improvements, realising economic advantages and enjoying various associated quality-of-life benefits. Community benefits may include aesthetics or recreational enhancement, overcoming administrative hurdles or institutional barriers, or improving community relations.

While many day-to-day activities impact on stormwater runoff, there are control strategies that work.

Urban runoff can be prevented in a cost-effective response that comes from preventative, enforceable efforts that integrate all levels of government, design professionals from multiple disciplines, private organisations, and the local community. The following strategies have been proven effective in many stormwater cases:

- **Preserving and utilising natural features and processes** have many benefits. Undeveloped landscapes absorb large quantities of rainfall and vegetation helps to filter out pollutants from stormwater. Buffer zones, conservation design development, sensitive area protection, or encouragement of infill development all try to enhance natural processes and are among the most effective stormwater programs.
- **Strong incentives, routine monitoring and consistent enforcement to establish accountability** are the key element in improving water quality. Programs with high accountability can reduce pollutant loading by 50% or greater.
- **Establishing a dedicated source of funding ensures long term viability of programs and public support.** Dedicated funding sources, such as stormwater utilities or dedicated grants, help ensure that stormwater programs are stable over time and help gain public support.
- **Strong leadership is often a catalyst for success.** An individual is needed to champion the project and make it happen.
- **Effective administration is critical.** This allows implementation of broad-based, multi-faceted programs.

In summary, together the following summary key points build a strong framework for effective, efficient, and successful stormwater management over the long term.

- Plan in advance and set clear goals.
- Encourage and facilitate broad participation.
- Work to prevent pollution first, rely on structural treatment only when necessary.
- Establish and maintain accountability.
- Create a dedicated funding source.
- Tailor strategies to the region and setting.
- Build broad-based programs.
- Evaluate and allow for evolution of programs.
- Recognise the importance of associated community benefits.

8.1.1.2 Implement a Public Education Program

Public education is an important part in stormwater management. This action provides ownership to the community by informing the community about values of a healthy, well-maintained stormwater system. Public interest will be encouraged through education and ensured community involvement in the stormwater process. For example, leaves, grass clippings and organic matter from yards increase oxygen demands and may contribute nutrients to algae blooms that may result in fish kills. A significant source of nutrient input to water bodies is from grass clippings and leaves washed into drainage systems during storms.

The following are issues that should be addressed;

Appropriate car washing:

- washing cars on lawns and not on roadsides or driveways
- prevent excess waste water from entering stormwater drains

Appropriate litter disposal

- educate community about effects and consequences of inappropriate litter disposal
- outline correct litter disposal behaviour

Appropriate waste oil and other chemical disposal

- ensure the community is aware of correct disposal for waste such as oil and other chemicals such as herbicides
- provide oil disposal facilities at service stations

Appropriate disposal of domestic animal droppings

- encourage dog walkers to implement correct disposal of dog droppings
- encourage appropriate disposal methods for households (compost bins, garbage bins, sewer)

Appropriate garden and lawn maintenance

- correct levels of fertiliser use in gardens
- encourage use of low maintenance, native plant species
- discourage hosing lawn clippings from entering the stormwater gutters

Safety awareness

- prevent contact with high velocity stormwater flows

8.1.2 Encourage public involvement in the stormwater management process

Community involvement will provide a sense of ownership to the community and will aid the management of the urban stormwater system. The value of the stormwater system will be increased with the community's desire to maintain a healthy stormwater system. Public involvement should be encouraged during all stages of the stormwater process, including planning, implementation and review stages.

Various programs such as Landcare groups, school syllabus and community groups can be used to promote awareness and involvement of the community in managing and monitoring particular sections of the stormwater system.

8.1.2.1 Labelling of stormwater pits with slogans

*Stencilling labels near the stormwater pits with slogans such as
“Only rain down this drain”*

The introduction of similar programs may encourage public awareness and decrease impacts of gross pollutants, grease and oils, nutrients and bacterial contamination. Local school, scouts and community groups may carry out the labelling with Tenterfield Shire Council supplying the road marking spray paint.

8.1.2.2 Storm drain marking program

The installation of storm drain plaques has proven to be an effective means of providing a pollution prevention message to citizens.

8.1.2.3 Posters/brochures

These could be developed by council or sourced from other organisations such as the CMA or Landcare.

8.1.3 Promotion of Public Access to the Stormwater System

Promoting public access to the stormwater system may develop a sense of ownership and an increased concern. If the community is involved in the process of stormwater management, they will feel responsible for the identification of potential problems and concerns.

8.1.4 Continue to Hold Workshops Involving all Relevant Stakeholders to Discuss the Process and Issues of the Stormwater System.

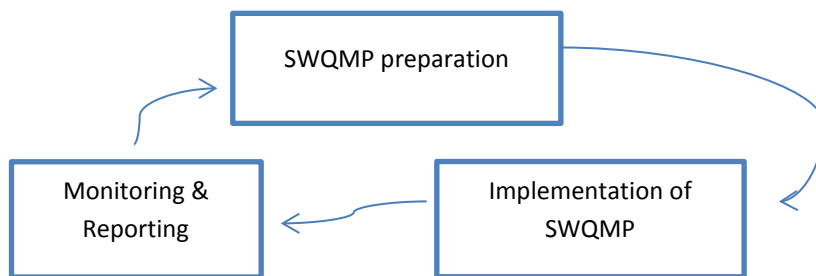
The ongoing consultation will ensure that all stakeholders are aware of their responsibilities and an active approach to ongoing stormwater management will be encouraged.

9. Monitoring and reporting

Revision of the Stormwater Quality Management Plan is a crucial part in the Stormwater Quality Management Plan to ensure its effectiveness in years to come. Environmental conditions and uses of the catchment will change over time and this SWQMP should be flexible to evolve with these changes. Council may also wish to link this plan to their Management Plan, which is being reviewed every 5 years. This plan usually only identifies options if funding is available to Council.

A typical stormwater management loop is illustrated in Figure 9.1.

Figure 9-1 Stormwater management loop.



The stormwater management loop shows how the preparation of the SWQMP, the implementation as per implementation strategy and the monitoring and review of the implementation measures all form part of stormwater management. This loop is continuous and needs to be updated on a regular basis

9.1 Monitoring effectiveness/assessment performance indicators and benchmarks

Monitoring is an important tool in assessing the success of the Stormwater Quality Management Plan. In constructing the catchment descriptions, it has been found that quite a few data gaps exist. Monitoring can also help to fill these gaps and provide a base line data set. Monitoring should include water quality monitoring and should generally be undertaken in accordance with the principles outlined in the EPA's *Managing Urban Stormwater: Council Handbook* document.

Monitoring is a part of the urban stormwater management responsibility to determine if actions and strategies are effective. The overall objectives should include minimisation of environmental impacts in accordance with the principles of Ecologically Sustainable Development and Total Catchment Management.

Lack of monitoring and maintenance results in overgrown vegetation, accumulated sediment and debris, and deteriorated stormwater structures can greatly reduce effectiveness. Without maintenance on a regular basis, stormwater structures may not store, treat or convey stormwater according to design and purpose, and may require frequent repair or even replacement. Regular maintenance will allow structures to operate as designed for their maximum lifetime, enabling optimum flood control and water quality treatment as well as demonstrating to the community

that stormwater capital investments are being protected in a systematic, responsible and cost-effective way.

The catchment health should be assessed and reviewed with the assistance of relevant community groups and Government agencies. For example, Landcare groups could be involved in observational water quality assessment, which is an effective tool in establishing the success of the Stormwater Quality Management Plan. It is necessary to establish base line data and information on stormwater issues in Tenterfield including photographic and water quality information.

The performance evaluation and reporting of the performance of the Urban Stormwater Quality Management Plan provides a review of recommendations and stormwater strategies so they remain valid and effective over time.

The review process should be conducted on a regular basis against available base line data and against each objective.

Other catchment management responsibilities include:

- 1)** Carrying out audits as per Appendices B and C every two years to assess the health of the catchment, pollution sources and to identify problems (erosion, weeds, litter, etc)
- 2)** Monitoring and reporting publicly on the performance of this Stormwater Quality Management Plan every two years.
- 3)** Provision of regular briefing to Council on progress against the Plan and developing more comprehensive objectives and targets for the Plan when significant monitoring has been completed.

Monitoring can be achieved through the following:

- observation based monitoring,
- ambient water quality monitoring,
- biological monitoring and recording progress of plan implementation.

Some of these do not require special training and the community/schools could be part of this. Reporting on the following may be achieved in this way:

- Litter, oil, algae, odour, water clarity, organic matter, aquatic plants, condition of riparian vegetation, fish abundance, bank erosion and sedimentation.

The survey form should include the following information:

- Location
- Date
- Time

- Weather Conditions
- Flow Conditions/Depth

9.1.1 Example of a water quality monitoring program

The more water samples collected, the better chance we have of understanding the status of the water quality, and thus leading to better ways to manage the water at a high quality level for residents.

9.1.1.1 Why do we monitor water quality?

Water-monitoring programs provide valuable data on the water quality of the catchment, establishes a bank of knowledge and understanding on the natural quality of water. By increasing the amount of reliable data, more accurate assumptions on the natural water quality can be made. In addition, the community will show that they are proactive in the management of the catchment and its natural resources. It also provides the community with an understanding of how different soils, or management practices can influence the quality of water.

A water quality sampling recording sheet might look like the following table.

Location	Colour	Turbidity (NTU)	pH	Total Phosphorus (mg/l)	Nitrogen (mg/l)
Upstream of the urban catchment (Tenterfield Dam)					
Near major outlets (Crown Street)					
Downstream of the urban area (before Sewer Treatment Outlet)					
Downstream of the urban area (after Sewer Treatment Outlet)					

Note: Downstream of one town is upstream of another town and impacts on water quality in one town may therefore effect towns further downstream.

Addition sampling may be done for:

- Faecal Coliforms
- Chlorophyll-a
- Conductivity
- Dissolved oxygen
- Temperature

Before commencing water quality sampling, the following need to be established:

- Baseline water quality conditions (eg. ANZECC Guidelines)
- Determine how to link monitoring and looking at the performance of the existing stormwater management practices (ie. Does the education program improve water quality?)

With time, Council should consider whether there are catchment wide changes in water quality as a result of structural and non-structural measures implemented as part of the SWQMP.

9.1.1.2 Biological monitoring

Biological monitoring will help in the understanding of the health of waterbodies and involves the collection of marine and freshwater biota from the waterbodies. The aim is to build a picture of the waterbodies over time so that when changes occur, the type, magnitude and frequency of that change can be easily monitored and possibly linked to a specific cause or causes.

9.2 Mechanism for reporting

Reporting of stormwater quality will be included in Council's environment report and should be used as a valuable input into future improvements of stormwater management. The effectiveness of pollution control devices need to be highlighted to pinpoint any weaknesses of these and aid in improving its effectiveness as stormwater management is a long term process and requires a process of continuous improvement. Hence, the preparation of this SWQMP is only the first phase in the stormwater management process.

9.3 Program for revision

This Plan should be updated following the Flood Study and reviewed in four years (2017). The revision process will involve the assessment of the effectiveness of stormwater management options (i.e. Do options satisfy the stormwater management objectives?). The implementation strategy will aid Council in future management planning processes. Programs should also account for linking the stormwater implementation strategies to Council's management planning process (LG Act).

Revision will be through renewed community consultation and updating of the SWQMP document

9.3.1 Revise/re-issue council implementation strategy

The implementation strategy is the basis for Council's and the RMS's stormwater management program and addresses each stormwater issue within the catchment in a cost-effective and community-beneficial manner.

The implementation strategy is dynamic and should evolve as stormwater works have been completed (and as issues have been addressed). New issues may arise and new strategies may need to be developed. The implementation strategies should be reviewed on an annual basis to identify progress and gaps in the program.

The review of the implementation strategy should consider:

- Results of any monitoring programs, i.e. water quality monitoring
- Any additional stormwater management option to be included in the plan

9.3.2 Review/Revise the SWQMP Document

Just as the implementation strategy is dynamic, objectives and issues are dynamic as well. The revision of the SWQMP is important to ensure that these are relevant and provide the necessary information for the Council's works program.

The revision/reviewing should take place as required with the exception of the implementation strategy which should be revised more frequently. The review of the plan should involve:

- Results from any monitoring programs e.g. water quality monitoring
- The effectiveness and efficiency of options implementation
- Document what objectives and issues have been addressed
- The effectiveness of satisfying the community's values
- Newly arising issues and objectives
- Improve the local understanding of issues within the catchment
- Identify if additional options need to be developed or if present options need to be modified

The preparation of this SWQMP is achieved through catchment inspections with Council, consultation of the community and agencies and the Council. This plan could not have been developed without the valuable local input from the stakeholders. Effort has been put into this plan to ensure that community values and concerns have been included and supported by stormwater managers.

9.4 CONCLUSION

There are no universal fixes for stormwater pollution control. Each outfall and drainage basin must be analysed to determine types of pollution loadings, size of drainage basin, type of conveyance system, and pollutants targeted for removal. Then the appropriate Best Management Practise strategy or strategies should be selected.

This Stormwater Quality Management Plan for the Tenterfield Local Government Area provides an integrated scheme for the ecologically sustainable and cost-effective BMP of stormwater within

the area. The Plan will satisfy the community's expectations and address environmental issues. The major part of this plan is the implementation strategy, which defined actions to be implemented by Tenterfield Shire Council to address stormwater issues and objectives. The implementation strategy also prioritises work in terms of its cost and benefit to the community.

Addressing stormwater within the catchment requires a long-term commitment by Council and cooperation of the community. It should be noted that stormwater management is an integral part of catchment management, as the activities of one town directly impact on (for example) water quality of the town downstream.

10. Appendix A: Tenterfield catchment audit protocol

Catchment Audit Report

Town/Village Inspected: Tenterfield

Date: 8/10/2012

Inspection By: G Chorley

Signature:

<p>Obtain map of SW catchment including outfalls, channels and drainage lines.</p> <p>Obtain catchment map showing all creeks and rivers (associated with SW system)</p> <p>Obtain Landuse map (zoning) – residential, density of development, industrial, future residential, rural, nature reserves, national parks, soil landscape, etc.</p> <p>Map major sewer overflow locations, slopes, erosion, reserve areas</p> <p>EPA licensed premises/discharge points</p> <p>Read relevant background information on waterways, eg. TCM reports, SOE reports, Council reports, DLWC water quality reports, Landcare reports/articles etc.</p>	
<u>Things to do in field:</u>	
Check SW outfalls	<input type="checkbox"/>
Is litter visible? Yes No describe	Corner of East & High St.
Is there evidence of erosion?	Douglas St, west of Francis St. Logan St. north of Molesworth St.
Are weeds a problem?	No
Check existing pollution devises (GPT's etc)	
Is the trap maintained on a regular basis?	Yes as needed after inspections.
How often are traps cleaned?	As above.
What quantity of rubbish is removed annually?	2 cubic metres.
Is the trap a potential mosquito breeding area?	No
How does the trap cope with 1 in 5 year storms?	Can lead to overflow and sometimes loss of rope baskets on litter traps
Have there been any complaints regarding traps from the	No

community?	
Are there plans to upgrade/replace/remove trap?	No
Is council happy with the traps?	Yes
Are there any animal scats near SW channels?	No
<u>Sewage Overflows & Discharge Points.</u>	
Check location of major points	Pump Station: Saddler Estate, Drummond St & Petrie St. Discharge of treated sewerage: Old Ballandean Rd
Is the overflow visible?	No
Is there evidence of recent overflows?	No
Have there been complaints about major overflows?	No
How often do overflows occur from major overflow outlets?	Only after major flood incidents.
Do overflows enter sensitive waterways?	Tenterfield Creek
Has the overflow affected residents?	No
Is the EPA concerned about any overflow points?	No
Have there been any environmental studies on the overflow's impact?	No
<u>Riparian Vegetation and Bushland</u>	
Are there any significant areas of riparian vegetation in the SW catchment?	All along Tenterfield creek.
Is riparian vegetation affected by stormwater?	Only in flood events. Replanted after flood
Map riparian vegetation (approx. location) and weed infestation?	Refer maps
Does Council or any other group intend to restore any riparian vegetation?	Council has been restoring banks along Tenterfield Ck after 2011 floods and willow removal program
Are there any areas of natural bushland within the urban	No

catchment?	
Have any areas of bushland been protected in a nature reserve/park etc.?	No
Map bushland (approx. location only)	N/A
Does council (or other groups) intend to restore bushland?	No
<u>Industrial Areas</u>	
Are there any industrial areas in the urban catchment/what types of industries?	Mainly the Council Industrial Estate at the northern end of Riley St.
Are there any proposals to expand existing areas?	No
Has Council or other agencies carried out surveys of industrial areas?	No
Are there any water quality problems associated with the industrial areas?	No
Is there any evidence of industrial pollution in the SW system eg. discolouration/staining, dead flora and fauna downstream etc.?	No
Have there been any industrial waste incidents, how was it cleaned up, was contaminated waste removed?	Yes. Drain remediation along Crown Street revealed contamination. Rectified. Sunnyside Loop Landfill remediation ongoing
Where are trucks and other vehicles washed?	Council vehicles in wash bay at depot.
What threats may be in the industrial area, e.g. acid, oils, metals, petrol, solvents	Mainly fuels & oils.
<u>Commercial Centre</u>	
Is there evidence of pollution from commercial centres eg. litter, oil, etc.	No. Waste trap program recently implemented. Inspections 9-11 Oct 2012.
Are there any GPT's or silt traps in the SW system?	Molesworth St, High St, Whereat Lane & Scott St into Tenterfield

	Creek. 3 GPT's from industrial estate into Ghost Gully.
Are there any GPT's fitted to any commercial premises?	Liquid Trade Waste program implemented in 2011 to 2013
Are there any detention basins in the commercial area?	No
Is there a need for GPT's, silt traps, additional rubbish bins or detention basins?	Only with regards to current projects for Sunnyside Loop landfill.
Have there been complaints regarding litter from the commercial area?	No
Are there any suitable locations for bins, traps, basins?	As above.
What are the threats from the commercial area? eg. litter, oil, flooding etc.	Litter, food waste, fuels & oils.
<u>Hotspots</u>	
Are there any obvious erosion and siltation problems?	At newly planted regions, sediment fence needs repairs.
What condition is the SW system in?	Fair
Are there any litter hotspots in the SW system?	No
Are there any weed hot spots in the SW system?	No
Are there any odour problem hot spots in the SW system?	No
Are there any algae problems in the SW system?	No
Are there any mosquito breeding areas in the SW system?	No
Are there any areas prone to animal waste problems e.g. horses, cattle, dogs etc.?	No
Is there any localised flooding?	Yes. Flood study recently completed.

11. Appendix B: Environmental audits of Urbenville And Drake

As part of the preparation of the Tenterfield Stormwater Quality Management Plan , Audits were also undertaken of Drake and Urbenville, two towns in Tenterfield Shire with populations of less than 1000.

The following shows the catchment audit protocols for Drake and Urbenville.

11.1 Drake

Catchment Audit Protocol	
Obtain map of SW catchment	
Council to nominate all outfalls, SW channels on map	
Council to nominate hotspots on map	
Obtain catchment map showing all creeks and rivers (associated with SW system)	
Obtain Landuse map (zoning) – residential, density of development, industrial, future residential, rural, nature reserves, national parks, soil landscape, etc.	
Map major sewer overflow locations, slopes, erosion, reserve areas	
EPA licensed premises/discharge points	
Read relevant background information on waterways, eg. TCM reports, SOE reports, Council reports, DLWC water quality reports, Streamwatch reports, Landcare reports/articles etc.	
<u>Things to do in field:</u>	
Check SW outfalls	<input type="checkbox"/>
Is litter visible? <input type="checkbox"/> <input type="checkbox"/> Yes No describe	Yes, corner of Allison and Fairfield
Is there evidence of erosion?	Yes, main ST crossing Plumbago Ck (erosion control fences in place), Cnr Allison and Fairfield
Are weeds a problem?	No
Check existing pollution devises (GPT's etc)	N/A
Is the trap maintained on a regular basis?	N/A
How often are traps cleaned?	N/A
What quantity of rubbish is removed annually?	N/A

Is the trap a potential mosquito breeding area?	N/A
How does the trap cope with 1 in 5 year storms?	N/A
Have there been any complaints regarding traps from the community?	N/A
Are there plans to upgrade/replace/remove trap?	N/A
Is council happy with the traps?	N/A
Are there any animal scats near SW channels?	No
<u>Sewage Overflows</u>	
Check location of major points	N/A – town on Septic tanks. Milky water in waterways possibly due to septic tank overflows
Is the overflow visible?	N/A
Is there evidence of recent overflows?	N/A
Have there been complaints about major overflows?	N/A
How often do overflows occur from major overflow outlets?	N/A
Do overflows enter sensitive waterways?	N/A
Has the overflow affected residents?	N/A
Is the EPA concerned about any overflow points?	N/A
Have there been any environmental studies on the overflow's impact?	N/A
<u>Riparian Vegetation and Bushland</u>	
Are there any significant areas of riparian vegetation in the SW catchment?	Dense riparian vegetation along creeks, both native and introduced
Is riparian vegetation affected by stormwater?	No
Map riparian vegetation (approx. location) and weed infestation?	<input type="checkbox"/>
Does Council or any other group intend to restore any riparian vegetation?	No
Are there any areas of natural bushland within the urban	Yes, to the northern side of town

catchment?	
Have any areas of bushland been protected in a nature reserve/park etc.?	No
Map bushland (approx. location only)	<input type="checkbox"/>
Does council (or other groups) intend to restore bushland?	No
<u>Industrial Areas</u>	
Are there any industrial areas in the urban catchment/what types of industries?	No
Are there any proposals to expand existing areas?	N/A
Has Council or other agencies carried out surveys of industrial areas?	N/A
Are there any water quality problems associated with the industrial areas?	N/A
Is there any evidence of industrial pollution in the SW system eg. discolouration/staining, dead flora and fauna downstream etc.?	No
Have there been any industrial waste incidents, how was it cleaned up, was contaminated waste removed?	N/A
Where are trucks and other vehicles washed?	Most likely in the street
What threats may be in the industrial area, e.g. acid, oils, metals, petrol, solvents	N/A
<u>Commercial Centre</u>	1 shop, 1 petrol pump, tank and hardware shop
Is there evidence of pollution from commercial centres eg. litter, oil, etc.	No
Are there any GPT's or silt traps in the SW system?	No
Are there any GPT's fitted to any commercial premises?	No
Are there any detention basins in the commercial area?	No
Is there a need for GPT's, silt traps, additional rubbish bins or detention basins?	No

Have there been complaints regarding litter from the commercial area?	No
Are there any suitable locations for bins, traps, basins?	No
What are the threats from the commercial area? eg. litter, oil, flooding etc.	Petrol from petrol pump?
<u>Hotspots</u>	
Are there any obvious erosion and siltation problems?	Yes, cnr Allison and Fairfield, plus Fairfield near Stuart St
What condition is the SW system in?	Open table drains – no underground stormwater piping system
Are there any litter hotspots in the SW system?	Cnr Allison and Fairfield
Are there any weed hot spots in the SW system?	No
Are there any odour problem hot spots in the SW system?	No
Are there any algae problems in the SW system?	Cnr Allison and Fairfield
Are there any mosquito breeding areas in the SW system?	No
Are there any areas prone to animal waste problems e.g. horses, cattle, dogs etc?.	Cheviot Hills Rd crossing Fairfield Ck – cattle access to Ck
Is there any localised flooding?	No

Milky water in waterways due to either septic tank runoff or mining practices in the past. Council is planning to inspect the catchment and will look at septic tank runoff.

11.2 Urbenville**Catchment Audit Report****Town/Village Inspected:** Urbenville**Date:** 17/10/2012**Inspection By:** G Chorley**Signature:**

Obtain map of SW catchment including outfalls, channels and drainage lines.	
Obtain catchment map showing all creeks and rivers (associated with SW system)	
Obtain Landuse map (zoning) – residential, density of development, industrial, future residential, rural, nature reserves, national parks, soil landscape, etc.	
Map major sewer overflow locations, slopes, erosion, reserve areas	
EPA licensed premises/discharge points	
Read relevant background information on waterways, eg. TCM reports, SOE reports, Council reports, DLWC water quality reports, Landcare reports/articles etc.	
<u>Things to do in field:</u>	
Check SW outfalls	<input type="checkbox"/>
Is litter visible? Yes No describe	No
Is there evidence of erosion?	No
Are weeds a problem?	Yes along Tooloom & no name creeks.
Check existing pollution devises (GPT's etc)	N/A
Is the trap maintained on a regular basis?	N/A
How often are traps cleaned?	N/A
What quantity of rubbish is removed annually?	N/A
Is the trap a potential mosquito breeding area?	N/A
How does the trap cope with 1 in 5 year storms?	N/A
Have there been any complaints regarding traps from the community?	N/A
Are there plans to upgrade/replace/remove trap?	N/A

Is council happy with the traps?	N/A
Are there any animal scats near SW channels?	No
<u>Sewage Overflows & Discharge Points</u>	
Check location of major points	Pump stations: Urben St, MR 361 Discharge of treated sewerage: Urbenville Rd
Is the overflow visible?	No
Is there evidence of recent overflows?	No
Have there been complaints about major overflows?	No
How often do overflows occur from major overflow outlets?	System monitored 24hr.
Do overflows/discharge enter sensitive waterways?	Tooloom Creek
Has the overflow affected residents?	No
Is the EPA concerned about any overflow points?	No
Have there been any environmental studies on the overflow/discharge impact?	No
<u>Riparian Vegetation and Bushland</u>	
Are there any significant areas of riparian vegetation in the SW catchment?	Along Tooloom & no name creeks.
Is riparian vegetation affected by stormwater?	Only in flood events.
Map riparian vegetation (approx. location) and weed infestation?	<input type="checkbox"/>
Does Council or any other group intend to restore any riparian vegetation?	No
Are there any areas of natural bushland within the urban catchment?	No
Have any areas of bushland been protected in a nature reserve/park etc.?	No
Map bushland (approx. location only)	<input type="checkbox"/>
Does council (or other groups) intend to restore	No

bushland?	
<u>Industrial Areas</u>	
Are there any industrial areas in the urban catchment/what types of industries?	Shire yard, MR 361 livestock transport Stephen St
Are there any proposals to expand existing areas?	No
Has Council or other agencies carried out surveys of industrial areas?	N/A
Are there any water quality problems associated with the industrial areas?	No
Is there any evidence of industrial pollution in the SW system eg. discolouration/staining, dead flora and fauna downstream etc.?	No
Have there been any industrial waste incidents, how was it cleaned up, was contaminated waste removed?	No
Where are trucks and other vehicles washed?	On grassed areas
What threats may be in the industrial area, e.g. acid, oils, metals, petrol, solvents	Fuels & oils.
<u>Commercial Centre</u>	
Is there evidence of pollution from commercial centres eg. litter, oil, etc.	No
Are there any GPT's or silt traps in the SW system?	No
Are there any GPT's fitted to any commercial premises?	Shop in process of fitting grease arrestor, as per waste trap program.
Are there any detention basins in the commercial area?	No
Is there a need for GPT's, silt traps, additional rubbish bins or detention basins?	No
Have there been complaints regarding litter from the commercial area?	No
Are there any suitable locations for bins, traps, basins?	No
What are the threats from the commercial area? eg.	Litter ,food waste, fuels & oils.

litter, oil, flooding etc.	
<u>Hotspots</u>	
Are there any obvious erosion and siltation problems?	No
What condition is the SW system in?	Fair
Are there any litter hotspots in the SW system?	No
Are there any weed hot spots in the SW system?	Along both creeks.
Are there any odour problem hot spots in the SW system?	No
Are there any algae problems in the SW system?	No
Are there any mosquito breeding areas in the SW system?	No
Are there any areas prone to animal waste problems e.g. horses, cattle, dogs etc?.	No
Is there any localised flooding?	

11.3 Drake summary

No major issues were noted in Drake. Minor issues in the town include occurrence of milky coloured water in all drains and creeks throughout town, which was concluded to be a result of septic tank seepage or mining practices of the past. Some erosion and litter was also noted at some sites.

11.4 Urbenville summary

The timber mill in Urbenville is of the most concern, as black liquid is coming from the mill, draining through the open stormwater drains to the creek. The exact content of the pollution is not known.

There was also some litter, algae and erosion hotspots noted.

12. Appendix D: Erosion control for new development sites

Tenterfield Shire Council requires developers to operate in accordance with *Managing urban stormwater: soils and construction* published by the Department of Environment and Conservation. These documents provide guidelines for the installation of roads, services, buildings, developments and waste landfills.

Larger developments (>2,500 square metres) developments require SWMPs that outline strategies for protecting downslope areas from other pollutants. These strategies may require the design of water control ponds and/or wetlands. Show in the Plan the way that works will be modify the landscape and drainage patterns, adding new or modified existing constraints.

If possible, prepare the Plan at the design concept stage, taking consideration of design goals and based on an assessment of the physical constraints of the site.

For more detailed information refer to;

<http://www.environment.nsw.gov.au/stormwater/publications.htm>