PREPARED FOR
TAMWORTH REGIONAL COUNCIL

Urban Stormwater Management Plan

MANILLA

JULY 2023

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RevA	19/10/2021	Draft Urban Stormwater Management Plan	MG,MM,KS	SC, TH
RevB	19/04/2023	Final Draft Urban Stormwater Management Plan	HR MM, SS, SC, SHP	EL, SS
RevC	04/07/2023	Final Draft Urban Stormwater Management Plan	SS	MG

EXECUTIVE SUMMARY

Stantec (formerly Cardno) have been commissioned by Tamworth Regional Council to develop an Urban Stormwater Management Plan for Manilla. This update has been undertaken to define the existing stormwater management issues and to investigate possible management strategies for the Manilla Urban Stormwater Management Plan (USMP) in accordance with the requirements of the New South Wales Government (NSW) Office of Local Government (OLG).

Manilla is located in the Tamworth Regional Council (TRC) LGA in north-east New South Wales, approximately 45km north-west of Tamworth. The Study Area is approximately 23.5km^2 and is located at the confluence of Manilla and Namoi rivers which drain a combined upper catchment area of 5,150km^2.

All the available data, including studies and reports, for the Study Area was reviewed to help establish the existing catchment conditions and to identify the stormwater management issues within the catchment.

The key stormwater issues identified in the study included:

- Poor Water Quality (Elevated nutrients, heavy metals, toxicants, suspended solids, low dissolved oxygen and turbidity levels)
  - Unsealed road verges contribute to sediment within the stormwater system
  - The existing small retention basins require regular maintenance to maintain water quality;
  - Potential for septic tanks to leak into the stormwater system;
  - Contamination of stormwater as it passes through the showground
- High Salinity
- Degraded Waterway Conditions and Loss of Habitat including erosion impacts
- Loss of Environmental Flows
- Flooding
- Community Indifference to Stormwater Management
- Loss of Community Access and Recreation
- Risk to Community Health and Safety
- Ineffective stormwater management and adoption of best practices
- Lack of comprehensive database to assess the nature and magnitude of stormwater problems and identify suitable solutions

Consultation has been an integral part of this study. There are a large number of external agencies with stormwater related interests in the area. A letter of introduction to the study was sent to the key external stakeholder agencies along with an invitation to be involved in the project. In addition, internal engagement with relevant Council departments was undertaken to identify potential stormwater management measures (structural and non-structural) and recognise any opportunities for possible future collaboration.

A comprehensive list of potential structural and non-structural stormwater management measures was developed. The measures comprised of five main approaches:

- Asset Management;
- Education and Awareness;
- Maintenance and Monitoring;
- Planning and Development; and
- Stormwater Infrastructure.

A Multi-Criteria Assessment (MCA) approach was adopted for the comparative assessment of all options identified. This approach uses a subjective scoring system to assess the merits of various options against economic, social, and environmental criteria. The principal merits of such a system are that it allows comparisons to be made between alternatives using a common index. Each option is given a score according to how well the option meets specific considerations.

Capital and ongoing costs have been estimated based on previous experience, consultation with Council, and industry standards and are divided into indicative ranges or 'bins' to allow for a high-level comparison of options to be undertaken.

The following are the most highly ranked non-structural and structural options (up to and including rank 1-5) as an outcome of this assessment:

Non-Structural Options

- Rank 1: M3 – Weed control / management programs within the stormwater channels;
- Rank 1: M4 - Regularly maintain grassed areas within and adjacent to open urban stormwater channels;
- Rank 3: M2 - Investigate the feasibility of planting native vegetation along the existing stormwater channels;
- Rank 4: P15 - Investigate co-location benefits of integrating WSUD into detention systems; and
- Rank 5: P16 - Stormwater management levy to allow Council to raise stormwater management revenue.

Structural Options

- Rank 1: S8 – Reshaping and regrading of the connections from the culverts along Church St to the drainage channel;
- Rank 2: S7 – Water quality (WQ) treatment in the open space between Willows Pde, Kanangra Rd and Worooma Cres;
- Rank 3: S1 - Investigate stormwater harvesting and storage opportunity in the town of Manilla for distribution and reuse on main showground, sporting field, and public toilets;
- Rank 4: S3 – Install piped drainage network on Court St between Hill St and Arthur St;
- Rank 5: S4 – Bank stabilisation and scour protection at the end of Market Street stormwater outlet; and
- Rank 5: S5 - WQ device at the end of Market St stormwater outlet prior to discharge into Namoi River.

All the management options were compiled into an implementation program. This program provides a holistic view of the management options and allows for regular monitoring and reporting by Council.

GLOSSARY

Australian Height Datum (AHD)	**A standard national surface level datum approximately corresponding to mean sea level.**
Average Exceedance Probability (AEP)	Refers to the probability or risk of a flood of a given size occurring or being exceeded in any given year. A 90% AEP flood has a high probability of occurring or being exceeded each year; it would occur quite often and would be relatively small. A 1% AEP flood has a low probability of occurrence or being exceeded each year; it would be fairly rare but it would be relatively large. The 1% AEP event is equivalent to the 1 in 100 year Average Recurrence Interval event.
Average Recurrence Interval (ARI)	The average or expected value of the periods between exceedances of a given rainfall total accumulated over a given duration. It is implicit in this definition that periods between exceedances are generally random. That is, an event of a certain magnitude may occur several times within its estimated return period.
Cadastre, cadastral base	Information in map or digital form showing the extent and usage of land, including streets, lot boundaries, water courses etc.
Catchment	The area draining to a site. It always relates to a particular location and may include the catchments of tributary streams as well as the main stream.
Design flood	A significant event to be considered in the design process; various works within the floodplain may have different design events. E.g. some roads may be designed to be overtopped in the 1% AEP flood event.
Development	The erection of a building or the carrying out of work; or the use of land or of a building or work; or the subdivision of land.
Discharge	The rate of flow of water measured in terms of volume over time. It is to be distinguished from the speed or velocity of flow, which is a measure of how fast the water is moving rather than how much is moving.
Drainage	Any activity that intentionally alters the hydrological regime of any locality by facilitating the removal of surface or ground water. It may include the construction, deepening, extending, opening, installation or laying of any canal, drain or pipe, either on the land or in such a manner as to encourage drainage of adjoining land.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake, or dam, and/or overland runoff before entering a watercourse and/or coastal inundation resulting from super elevated sea levels and/or waves overtopping coastline defences.
Flood hazard	Potential risk to life and limb caused by flooding.

Floodplain	Area of land which is subject to inundation by floods up to the probable maximum flood event, i.e. flood prone land.
Floodplain management measures	The full range of techniques available to floodplain managers.
Management options/ strategies	The measures which might be feasible for the management of a particular area.
Geographical Information Systems (GIS)	A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data.
Hydraulics	The term given to the study of water flow in a river, channel, or pipe, in particular, the evaluation of flow parameters such as stage and velocity.
Hydrology	The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.
Mainstream flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of the principal watercourses in a catchment. Mainstream flooding generally excludes watercourses constructed with pipes or artificial channels considered as stormwater channels.
Management plan	A document including, as appropriate, both written and diagrammatic information describing how a particular area of land is to be used and managed to achieve defined objectives. It may also include description and discussion of various issues, special features and values of the area, the specific management measures which are to apply and the means and timing by which the plan will be implemented.
Overland Flow	The term overland flow is used interchangeably in this report with “flooding”.
Probable maximum flood (PMF)	The flood calculated to be the maximum that is likely to occur.
Probability	A statistical measure of the expected frequency or occurrence of flooding. For a more detailed explanation see Average Recurrence Interval.

ACRONYM AND ABBREVIATIONS

ABS	**Australian Bureau of Statistics**
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
ASS	Acid Sulphate Soils
CBD	Central Business District
CRM	Customer Request Management
CSP	Community Strategic Plan
DA	Development Application
DAWE	Department of Agriculture, Water and the Environment
DCP	Development Control Plan
DLWC	Department of Land and Water Conservation
DPE	NSW Department of Planning and Environment
EPBC	Environment Protection and Biodiversity Conservation
EPA	Environment Protection Authority
EP&A Act 1979	Environmental Planning and Assessment Act 1979
FPL	Flood Planning Level
FPM	Flood Planning Manual
FRMS&P	Floodplain Risk Management Study and Plan
FS	Flood Study
GIS	Geographic Information System
GMS	Growth Management Study
GPT	Gross Pollutant Trap
IWCM	Integrated Water Cycle Management
LEP	Local Environmental Plan

LGA	Local Government Area
LSPC	Local Strategic Planning Statement
NSW	New South Wales
OLG	Office of Local Government
OSD	On-Site Detention
PMF	Probable Maximum Flood
PMST	Protected Matters Search Tool
SES	State Emergency Services
SQID	Stormwater Quality Improvement Device
TEC	Threatened Ecological Communities
TRC	Tamworth Regional Council
TRDCP 2010	Tamworth Regional Development Control Plan 2010
TRLEP 2010	Tamworth Regional Local Environmental Plan 2010
USMP	Urban Stormwater Management Plan
WSUD	Water Sensitive Urban Design

TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

1 INTRODUCTION

Stantec have been commissioned by Tamworth Regional Council to develop an Urban Stormwater Management Plan for Manilla.

Tamworth Regional Council (Council) is responsible for providing public stormwater systems for effectively draining the urban catchments within its Local Government Area (LGA). Council now intends to develop the Manilla Urban Stormwater Management Plan (USMP) in accordance with the requirements of the New South Wales (NSW) Government Office of Local Government (OLG).

The USMP will facilitate a coordinated management of stormwater within the study area to achieve ecological sustainability, social, and economic benefits from sound stormwater management practices. This update has been undertaken to define the existing stormwater management issues within Manilla and to investigate possible management strategies to reduce the impact of these issues on the community and environment.

1.1 STUDY OBJECTIVES

The objectives of the study are to:

- To identify and describe the various potential urban stormwater (quality and quantity) management issues;
- To review the stormwater provisions in Council's existing environmental planning policies and instruments;
- To identify and assess potential management measures;
- To assess the benefits and cost of the potential management strategies; and
- To prioritise strategies and develop an implementation program.

The aim of the USMP is to integrate stormwater management objectives with Council's asset management framework, thus allowing a holistic and long-term approach to urban stormwater management.

1.2 REPORT STRUCTURE

This Report summarises the following:

Section 2 – Study Area: Provides relevant background on the Study Area;

Section 3 – Data Collection and Review: Presents a review of the previous related studies conducted in the area, the data reviewed as part of the study, and the various development controls and policies that are relevant to the Study Area;

Section 4 – Catchment Characteristics: Describes the topography, climate, waterways, geology, ecology, soils, demographics, water quality, and land use in the Study Area;

Section 5 – Baseline Water Quality Assessment: Summarises the baseline condition for water quality through recorded data and identifies current stormwater quality issues in the study area;

Section 6 – Consultation: Summarises the consultation process and the outcomes of stakeholder and community engagement;

Section 7 – Urban Stormwater Management Systems: Describes the current urban stormwater system characteristics, function of drainage infrastructure, and identifies the impacts of urbanisation on receiving waterways. Defines the goals and objectives to assist with prioritisation of issues and development of management measures;

Section 8 – Urban Stormwater Management Measures: Provides discussion on possible management strategies to improve stormwater management in the Study Area. Summarises the quadruple bottom line – social, economic, environmental and governance assessment of options and prioritisation of measures for inclusion in Council's schedule of works; and

Section 9 – Urban Stormwater Management Implementation Plan: Compiles the management measures into an implementation program.

2 STUDY AREA

Manilla is located in the Tamworth Regional Council (TRC) LGA in north-east New South Wales. Manilla is located approximately 45km north-west of Tamworth. The Study Area is approximately 23.5km^2 and is located at the confluence of Manilla and Namoi rivers which drain a combined upper catchment area of 5,150km^2. The two rivers flow through Manilla and drain south to Keepit Dam on the Namoi River. Split Rock Dam lies upstream of Manilla on the Manilla River.

The Study Area is shown in Figure 2-1 and **Map A1** in **Appendix A**.

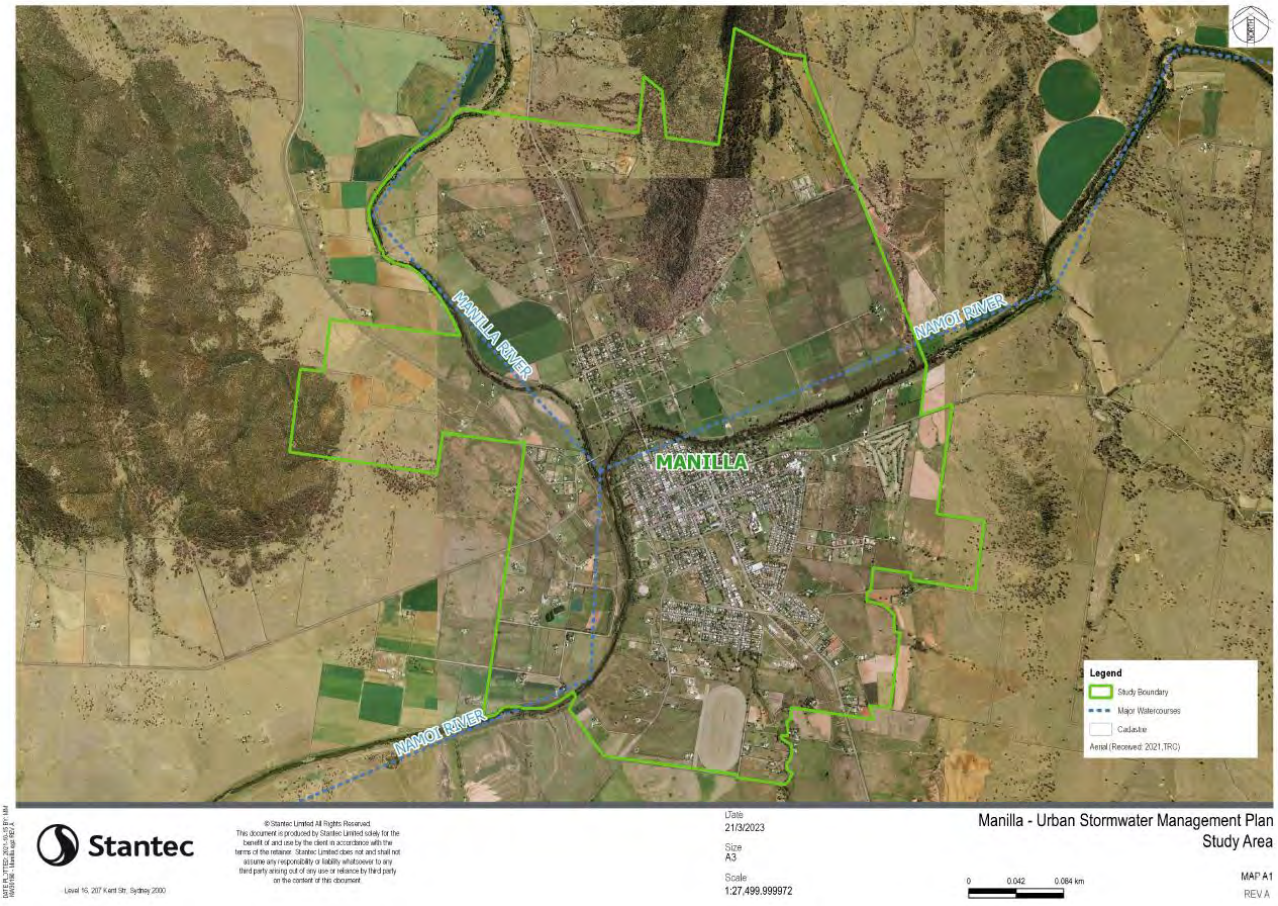

Figure 2-1 Manilla Study Area

3 DATA COLLECTION AND REVIEW

This section presents a review of available data, policies, plans, and previously prepared studies that are applicable for Manilla. The objective of the review was to identify stormwater management opportunities and constraints.

3.1 PREVIOUS STUDIES

3.1.1 Barraba Urban Stormwater Management Plan (Hunter Water Corporation, 2000)

In 2012 TRC commissioned the Integrated Water Cycle Management (IWCM) Evaluation Study Report (Hunter Water Australia, 2012). The study by Hunter Water Australia outlined the existing conditions, water resources and urban water services of the key TRC catchments, as well as identifying IWCM issues.

The key stormwater issues identified by the study for Manilla included:

- Unsealed road verges contribute to sediment within the stormwater system;
- The existing small retention basins require regular maintenance to maintain water quality;
- Potential for septic tanks to leak into the stormwater system;
- Contamination of stormwater as it passes through the showground; and
- Erosion in catchment creek beds and banks.

In February 2011, TRC received funding from the Federal Department of Sustainability, Environment, Water, Population and Communities, under its Water for the Future, Strengthening Basin Communities: Planning Component – Round 2, to investigate, plan and design a range of stormwater reuse opportunities. A summary of the option investigated for Manilla and the current status of the option is outlined in Section **1**.

Table 2-1 Summary of Options from 2011 Strengthening Basin Communities: Planning Component – Round 2 Project

ID	Options	Current Status
5	Stormwater harvesting and storage in the town of Manilla for distribution and reuse on main showground, sporting field, and public toilets.	Incomplete

3.1.2 Manilla Flood Study (GHD, 2012)

The Manilla Flood Study was commissioned by TRC and completed in 2012 by GHD. The primary objectives of this study were to define the mainstream flood behaviour under historical conditions and design flood behaviour under existing and future climate conditions in the Manilla Study Area. The investigation had several components including a review of available data and previous investigations, community consultation, hydrological and hydraulic assessment of design events including the Probable Maximum Flood (PMF) and the assessment of potential impacts of climate change and several other sensitivity analyses. The results from this study were intended to inform the subsequent Floodplain Risk Management Studies and Plans (FRMS&P) by TRC.

The community consultation activities included the engaging of the relevant government agencies, relevant local community group and the general public. The general public was contacted through a public notice placed in the local newspapers and an information sheet and survey sent to local residents. The surveys came to several conclusions including many residents had experienced flooding firsthand in Manilla and flood levels tend to rise and recede rapidly often in the space of one day.

The Manilla flood study produced information on flood levels, depths, velocities, flows, hydraulic categories, and provisional hazard categories for a full range of design and historical flood events, as well as estimates of flood damage. The following observations were drawn from the study:

- In a 20% Annual Exceedance Probability (AEP) event, flow is mostly contained to the river channels. Some spillage onto the floodplain could be expected in the area of Lloyd Street in North Manilla. In a 1% AEP event, flooding would be expected in North Manilla, north of the confluence. Wide spread flooding would also be expected at Lloyd, Charles and Manilla Streets. South and east of the confluence, areas of River Street would be inundated as would the Dewhurst and Rowan Street areas of town. Flood depths vary, from shallow depths along the edge of the floodplain to depths in excess of 5 to 10 m near the creek channel;
- West of the Namoi and Manilla Rivers, small areas of the floodplain would be inundated;
- Flow velocities associated with the river channel and immediately adjacent floodplain are high, around 2m/s and greater. There are a number of areas in the northern and western floodplains where flow velocities are in the order of 1m/s to 2m/s. Further away from the main channels the flow velocities are much lower at around 0.5m/s to 1m/s;
- Large areas of the floodplain can be designated as high hazard, on account of deep flow and/or rapid flow velocities. This includes areas of town in particular along River Street and areas of North Manilla;
- In larger events, several areas exist where flood runners could develop in the floodplain. This is particularly evident on the southern floodplain on the Namoi River and along River Street near the oval; and
- In a PMF event widespread flooding would be expected. Flood depths would be in excess of 10m, immediately adjacent to the creeks.

3.1.3 Assessment of Flood Risk in Various Towns and Villages

Bewsher Consulting Pty Ltd were commissioned by TRC in 2007 to conduct a preliminary assessment of the flood problem at eleven (11) towns and villages throughout the LGA (Bewsher Consulting Pty Ltd, 2007). The principle aim of the assessment was to identify flood problems, priorities towns and villages according to the general scope of the problem and to develop a strategic plan for the preparation of detailed flood studies and floodplain management studies and plans.

The investigation found Manilla had experienced 16 minor, 3 moderate and 2 major floods between 1941 when the Namoi River at Manilla Railway Bridge was gauged and the time of the assessment in 2007. Residents described the 1964 flood as the worst in 100 years which inundated 60 properties and an estimated 137 buildings where located within the flooding extents.

3.2 PLANNING GUIDELINES

3.2.1 Blueprint 100

The *Tamworth Regional Blueprint 100* was adopted by TRC on 26 May 2020. The Blueprint was intended to be prepared in three parts with other subsequent tasks proposed following these parts:

- *Tamworth Blueprint 100 Part 1: Overall Strategy (2020a)*: This plan brings together all the key elements of TRC's large number of plans, strategies, precinct plans and masterplans into a single document, hence the term 'Blueprint'. It guides and promotes the development of the Tamworth Region to 2041.
- *Tamworth Blueprint 100 Part 2: Local Strategic Planning Statement (LSPS) (2020b)*: This is a new statutory plan introduced by the NSW State Government. Unlike Part 1 it has a narrower focus on land use planning. It includes the land use vision, priorities, actions and approaches to monitor success. It takes its direction from Part 1 and distils the land use planning issues into a LSPS in accordance with Section 3.9 of the Environmental Planning and Assessment Act 1979 (EP&A Act 1979) and the Department of Planning Industry and Environment (DPIE) guidelines to underpin future land use planning relating to master planning, Development Control Plan (DCP) amendments and Local Environmental Plan (LEP) amendments including the potential comprehensive review of the Tamworth Regional Local Environmental Plan 2010 (TRLEP 2010).
- Other planned tasks within the Blueprint 100 framework include:
  - A review of the TRLEP 2010 to be aligned and directed by the Blueprint series of plans;
  - A review of the delivery plan included in Part 1 regarding how Council will deliver on the Community Strategic Plan (CSP) (Council's contract with the community) over a four-year period; and
  - Tamworth Integrated Transport Masterplan, which is currently underway and will pick up on the transport aspects from Blueprint including all modes; road, rail, cycle, walkway and public transport. It is integrated with the land use growth areas.

To date only Part 1 and 2 of the Blueprint 100 have been released, therefore these two documents have been reviewed and summarised in further detail in the following sections.

3.2.1.1 Tamworth Blueprint 100 Overview

The Blueprint 100 responds directly to the New South Wales Government's land use planning priorities and decisions to 2036. The overall planning framework for TRC and how the Blueprint fits within this framework is shown in the diagram in **Figure 3-1** (extracted from Figure 1 of TRC 2020a). As shown below there are a large number of planning guidelines and plans that fit within the framework and fall under the Blueprint 100 umbrella.

Responsible land use planning will be important in guiding future development to accommodate the expected population increase within the region. According to the Blueprint 100, as of 2019 the LGA had a population of 63,000, by 2041 that is expected to increase to 80,000, with targets of 100,000 by this time with stimulated growth programs. This represents an additional 17,000 - 37,000 residents within the LGA in the next 22 years, which will require an extensive amount of development in the region to facilitate this growth.

There are eight (8) priority themes of Blueprint 100 Part 1. Within each of the eight themes there are a series of priority initiatives that provide direction and within these priorities are specific actions identified as targets for the Blueprint. Some of these themes, priorities and actions are relevant to the Study Area of this USMP, as well as relevant to the fields of stormwater quantity, quality and flooding as discussed in the following sections.

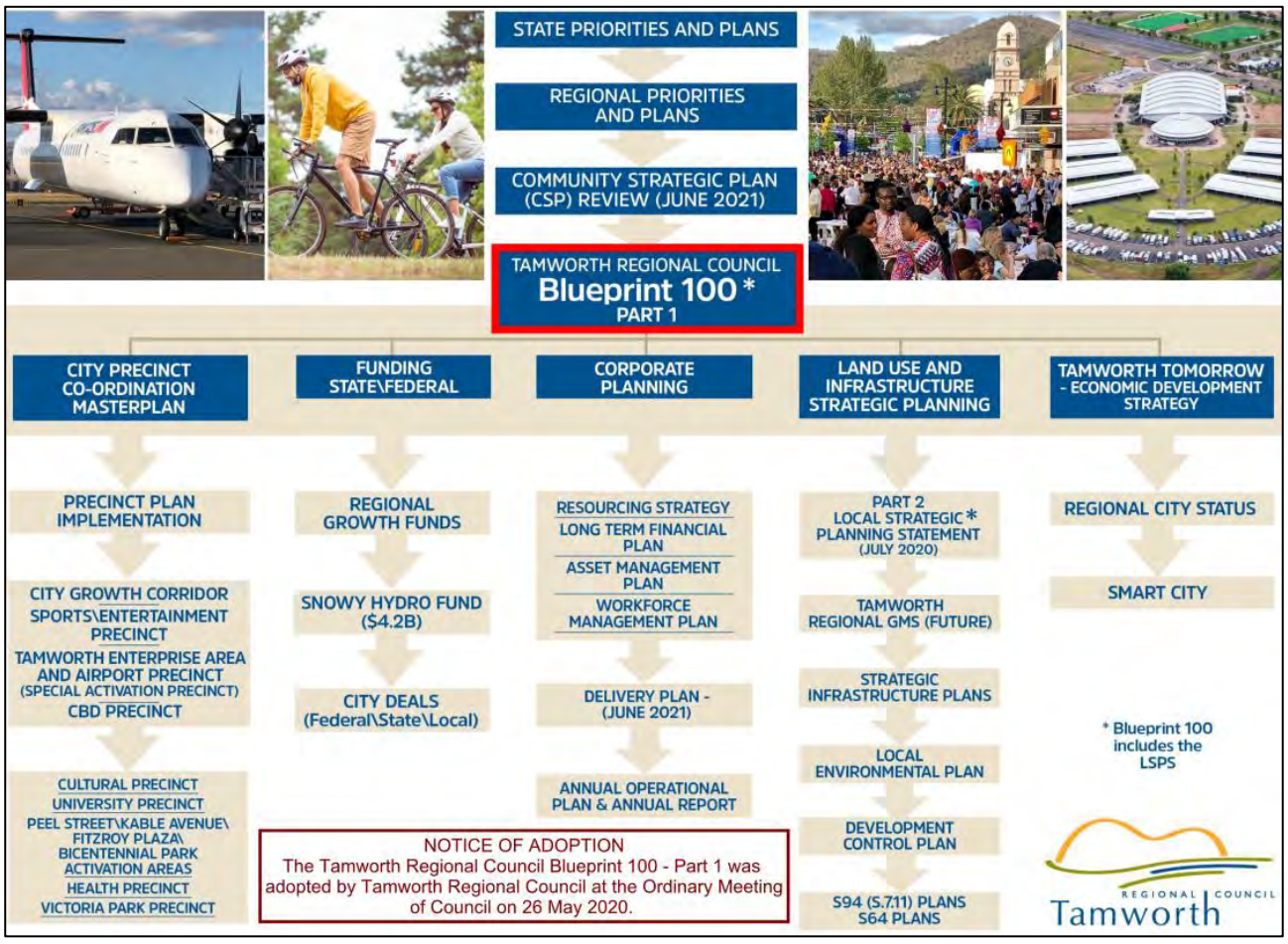

Figure 3-1 Tamworth Regional Council's plans and policies diagram (Source: TRC, 2020a)

The eight themes of Part 1 are carried over into the Local Strategic Planning Statement (LSPS) of Part 2. Using these themes as a basis, more detailed and narrower land use and planning specific priorities and actions are identified. Most of the actions for Part 2 are specific to land use planning, however some make specific reference to water sensitive urban design and flooding and are noted in the following sections.

2.1.1.2 Relevance to Study Area

Within the fourth theme of the Blueprint (Build resilient communities) a summary of the LGA's largest urban areas is provided with the initiatives that are relevant to each as shown in **Figure 3-2**. For Manilla, all initiatives are relevant; social and communications, affordable housing, public transport, and special employment.

With respect to relevant priorities and actions identified within the Blueprint for Manilla:

- Priority 4.1: Establish local strategies for towns and villages. Relevant actions for Manilla include:
- Build on affordable housing opportunities;
- Public transport: bus services to Tamworth;
- Promote tourism that relates to heritage and natural assets such as vintage machinery, Mt Borah, Warrabah NP;
- Investigate a Poultry precinct; and
- Support the mining industry.

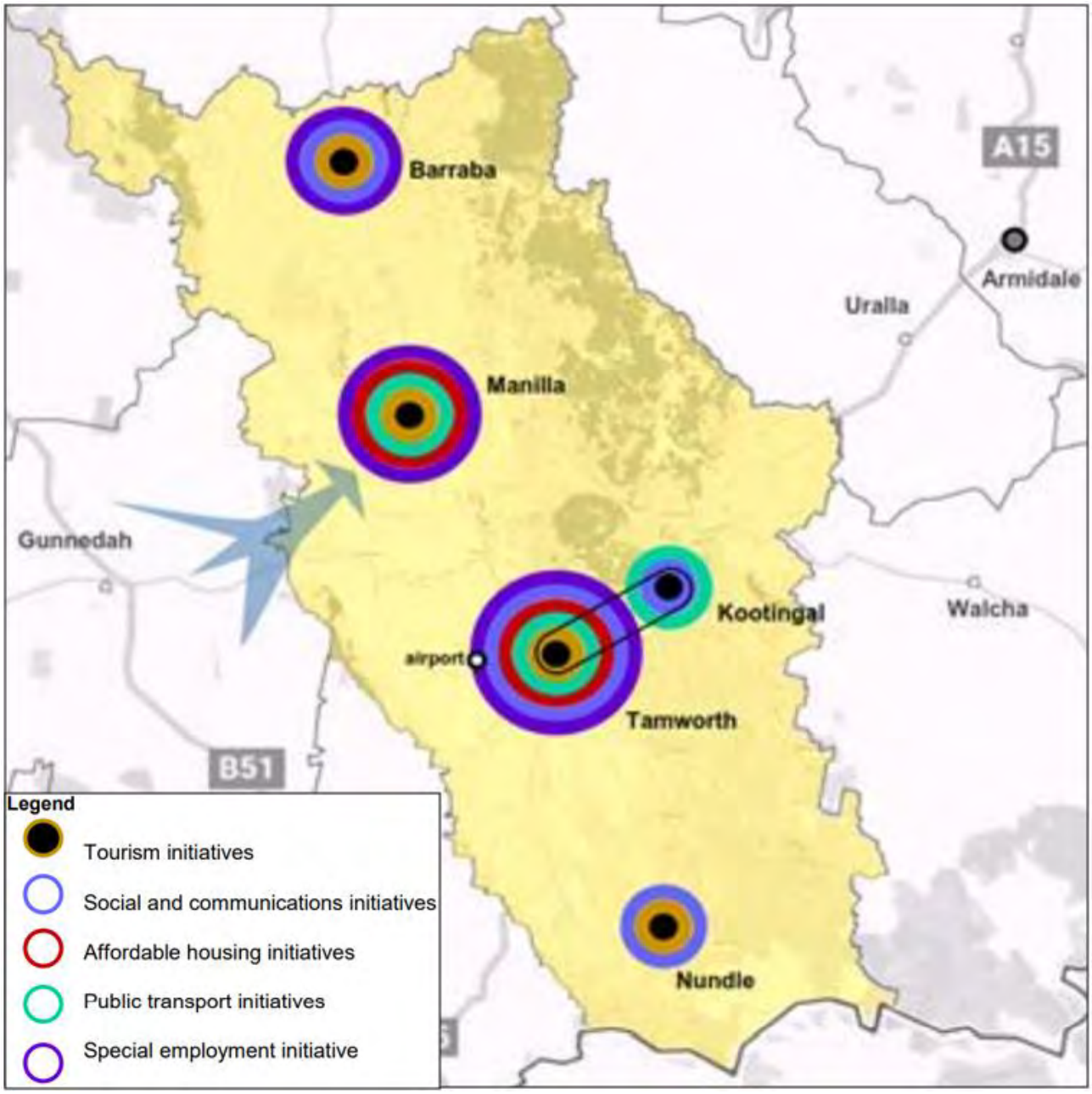

Figure 3-2 TRC Community Network (Source: TRC, 2020a)

2.1.1.3 *Relevance to Water Sensitive Urban Design*

The Blueprint 100 has set the following regionally focused goals:

- A strong and dynamic regional economy;
- A healthy environment with pristine waterways;
- Strong infrastructure and transport networks for a connected future; and
- Attractive and thriving communities.

It can be seen that of the core goals of the regional plan, maintaining a healthy environment and pristine waterways is seen as a critical outcome in the region, which is also a key goal of this USMP. Of the eight themes of the Blueprint, the relevant priorities and actions for stormwater quality and quantity and water re-use are listed below:

- Priority 1.2: Encourage water conservation across the region. Relevant actions include:
  - Providing clear instructions for the installation of BASIX tanks so that tanks will pass inspection and not require auditing (this will allow tank water to be used on gardens during water restrictions);
  - Exceeding BASIX requirements via incentives / rebates. Require or incentivise larger rainwater tanks, artificial turf, groundcover. Extend this to existing buildings / dwellings;
  - Investigate greater incentives for the use of mulch to enhance water efficiency; and
  - Capturing all available water from Council buildings for re-use.
- Priority 1.4: Promote sustainable water and wastewater urban planning and design approaches, relevant actions include:
  - Formulate guidelines, policies in the DCP, and apply pre-application procedures to ensure new developments are master planned to achieve the most sustainable water, wastewater and waste outcomes;
  - Incorporate water-wise design in the public realm and sports areas. Consider:
    - Alternatives for active open space – tactile / sensory garden, synthetic courts, multidisciplinary, bush food garden, sand / compacted gravels, BMX track;
    - Detention basins – drought tolerant design, below ground tanks, use of infiltration cells; and
    - Building effective public open spaces that are not expanses of lawn.
- Priority 2.2: Better managed rural-residential development, relevant actions include:
  - Identify the blue / green networks (drainage reserves that combine as parks with cycleway / walkways) in new greenfield areas to reduce drainage cost for greenfield development.
- Priority 6.2: Improve practices related to low impact stormwater management:
  - Collate existing low impact stormwater guidelines and link them to Tamworth Regional Council policies. Include urban design measures that control and manage stormwater;
  - Promote these stormwater guidelines through Tamworth Regional Council's communications; and
  - Influence developers and designers at the early stages of their master planning.
- Priority 6.3: Improve practices related to low impact stormwater management, relevant actions include:
  - Incorporate energy efficiency design in all current and new facilities. Considering roof capture, ground water usage, recycled water and LED lighting;
  - Achieve efficiencies and sustainability for whole of life maintenance of facilities, including site selection based on water security / rationalisation of parks and sports precincts;
  - Require the quality of development designs submitted to the Council to be improved, including their sustainability aspects; and
  - Require the quality of infrastructure built, and accepted by, the Council to be robust, durable, sustainable, and low maintenance.

With respect to the more detailed land use planning priorities and actions identified in Part 2 of the Blueprint (TRC, 2020b), under the fifth theme [Design with Nature (DN)] several actions relate to Water Sensitive Urban Design (WSUD):

- DN1: Require the quality of development designs submitted to the Council to be improved, including their sustainability aspects supported by urban design guidelines;

- DN2: Require the quality of infrastructure built, and accepted by the Council to be robust, durable, sustainable, and low maintenance aided by inclusion of low impact stormwater guidelines to link to TRC policies to control and manage stormwater; and
- DN5: Identify the blue/green networks in new greenfield areas to reduce drainage cost for greenfield development considering water sensitive urban design while still requiring superior open space outcomes.

2.1.1.4 Relevance to Floodplain Management

The Blueprint 100 notes that environmental hazards, such as drought, flooding, bushfire, severe storms, salinity, contaminated land and land degradation can occur within the region and cause major loss or harm to the community and the environment. The plan also notes land use planning is an effective management tool in minimising the impact of these hazards at both the strategic and detailed level. Any land prone to environmental hazards should not be developed and risks should be avoided.

No priority themes or actions in Part 1 make specific mention of flood risk management, however several actions make reference to promoting safe and sustainable development practices that inherently includes accounting for flood risk within future developments.

With respect to the more detailed land use planning priorities and actions identified in Part 2 of the Blueprint (TRC, 2020b), under the fifth theme (Design with Nature) note the following action relating to flooding:

- DN6: Complete and utilise mapping for flooding, bushfire hazards, vegetation and biodiversity and support renewable energy initiatives.

3.2.2 Tamworth Regional Local Environmental Plan 2010

The NSW Planning Reforms require all local governments to prepare their planning instruments in accordance with a new standard instrument LEP. The key features of these reforms are:

- An objective of reducing the number and layers of planning instruments;
- Provision of a standard LEP template for Councils to conform to;
- All mandatory controls to be included in the LEP;
- Mandatory timeframe for Council to prepare a new LEP (3-5 years);
- Rationalise and clarify the DCP relationship to LEP; and
- Replace Master Plans with DCPs and staged Development Applications (DA).

Under this process, TRC developed an LEP which was gazetted in 2010, referred to as TRLEP 2010.

There are no sections of the TRLEP 2010 that specifically deal with stormwater quantity and quality treatment.

Section 5.21 Flood Planning of the LEP (updated 14/07/2021) outlines controls and objectives for land considered to be in a flood planning area which is defined by the *Floodplain Development Manual* (NSW Gov, 2005) as the area of land below the Flood Planning Level (FPL) equal to the 1% AEP flood level plus a 0.5 m freeboard. The objectives of this section are:

- To minimise the flood risk to life and property associated with the use of land;
- to allow development on land that is compatible with the flood function and behaviour on the land, taking into account projected changes as a result of climate change; and
- to avoid adverse or cumulative impacts on flood behaviour and the environment; and
- to enable the safe occupation and efficient evacuation of people in the event of a flood.

The LEP states that development consent must not be granted for development on land to which this clause applies unless the consent authority is satisfied that the development:

- is compatible with the flood function and behaviour on the land;
- will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and
- will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood; and
- incorporates appropriate measures to manage risk to life in the event of a flood; and

- will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.

As of mid-2021, NSW DPIE also released a new Flood Prone Land Policy Update. Included within this policy is draft flood LEP text which provides some updates to the current TRLEP 2010 language:

- Several new objectives have been added to the updated text including a reference to cumulative impacts, enabling safe and appropriate uses of land, and enabling safe evacuation from the land;
- The requirements for development consent have been updated with reference to cumulative impacts, no significant alteration of flow distributions and velocities, safe and efficient evacuation, no unsustainable social and economic costs to the community, no potential for hazardous material, and to be consistent with any relevant floodplain risk management plan adopted by the Council;
- A new clause has been added specifically for consideration of climate change in development consent for the design life of the development;
- A new flood clause has been added to the update called the “Special Flood Considerations” clause. The clause relates to; a) sensitive, vulnerable and critical uses, b) hazardous industry or hazardous material storage establishments, and c) any other land uses requiring controls in relation to risk to life considerations. Unlike the previous flood clause that was below for the FPL, the Special Flood Considerations clause relates to land located between the FPL and up to the Probable Maximum Flood (PMF); and
- A new flood clause has been added to the update called the “Regional Evacuation Consideration Area”. The objective is to protect the capacity of regional evacuation routes during extreme flood events, and to support vehicular connectivity of development to regional evacuation routes. Regional Evacuation Consideration Area is the area that is identified in a relevant regional flood evacuation strategy or flood related state emergency sub-plan by NSW State Emergency Service (SES).

3.2.3 Tamworth Regional Development Control Plan 2010

Tamworth Regional Development Control Plan 2010 (TRDCP 2010) outlines development controls for six development categories, which include stormwater drainage related development controls. In addition, specific development controls are defined for all flood affected land, as well as specific controls for each area. Discussion of stormwater and flood related development controls from the TRDCP 2010 are included in the following sections.

3.2.1.1 Stormwater Related Controls

TRDCP 2010 under Step 2 has development controls related to stormwater drainage for subdivision development types as follows:

- The servicing strategy, including preliminary engineering designs shall include consideration of flows up to the 1 in 100 year Average Recurrence Interval (ARI) for existing natural flow, existing developed flow and post developed flow;
- Minor flows are to be designed to a 1 in 5 year ARI;
- Location of major flows are to be defined to a designated overland flow path up to a 1 in 100 year ARI. Where the path traverses private property, it shall be dedicated as a drainage reserve unless a natural drainage line (as indicated by blue line on the topographic map);
- Detention basins are not a preferred solution; and
- Where drainage is required to the rear of the lot, inter-allotment drainage shall be located in easements in favour of the upstream properties benefitted by the easement.

In addition for site / location specific development controls, stormwater drainage related controls are also applied in Step 4. There are no site-specific controls for Manilla.

Finally, under Step 5 discretionary standards for proposals not subject to "Type of Development" and where deemed to satisfy criteria are not achieved. For subdivisions these discretionary standards for stormwater drainage are as follows:

- Stormwater drainage systems must be designed to prevent stormwater damage to the built and natural environment and ensure acceptable levels of health, safety and amenity;
- The stormwater drainage system must reduce nuisance flows to a level which is acceptable to the community;

- The stormwater drainage system should be easily accessed and economically maintained;
- The stormwater drainage system should utilise open space in a manner compatible with other uses;
- The stormwater drainage system must control flooding and provide escape routes for overland flows for high frequency storm occurrences; and
- Council will only consider alternative forms of drainage including methods of on-site disposal such as retention and/or detention basins where it can be demonstrated that there is no other practical solution available. In assessing the suitability of such systems, Council will take into account ease of maintenance, public safety risk, proven functionality and cost liability for Council.

3.2.1.2 Flood Related Controls

TRDCP 2010 under Step 4 has development controls related to flood affected properties. The flood affected maps for the LGA are included within Appendix C of the TRDCP 2010, but flood affected land also includes site specific flood mapping. Other sites that have applicable flood controls are properties protected by levees which must include consideration of inundation resulting from a levee breach (failure of overtopping) or stormwater ponding when the river system is in flood.

The general flood related controls from the TRDCP 2010 include:

- Flood free vehicle access is required for all lots created by subdivision;
- For development of existing lots, where flood free vehicle access is not possible, the development must be able to achieve safe wading criteria as specified in Figure L1 of the Flood Planning Manual (FPM);
- No building or work (including land filling, fencing, excavation) shall be permitted on flood affected land where in the opinion of Council, such building or work will obstruct the movement of floodwater or cause concentration or diversion of floodwaters;
- DA must demonstrate the building or structure can withstand the force of flowing floodwaters, including debris and buoyancy forces as appropriate;
- A survey plan prepared by a registered surveyor showing existing ground levels, finished ground levels, finished floor levels, flood levels and location of existing/proposed buildings and safe evacuation path on the site relative to Australian Height Datum (AHD);
- All materials used in construction shall be flood compatible; and
- Development must be designed in accordance with the Flood Proofing Guidelines (refer Discretionary Development Standards).

For residential developments the following flood related controls apply:

- Floor levels of all habitable rooms, or rooms with connection to sewer infrastructure shall not be less than 500mm (freeboard) above the 1% AEP flood level, except for those properties between the Ogunbil Bridge and Dungowan Dam where the applicable flood height is 500mm above the Sunny Day Failure of Dungowan Dam;
- Upon completion and prior to the occupation (where relevant), a certificate by a registered surveyor showing the finished ground and floor levels conform to approved design levels shall be submitted to Council;
- Additions to existing buildings will be only be permitted, with limitations, as follows:
- where the floor level of the proposed addition is located below the standard 1% AEP or the Sunny Day Failure of Dungowan Dam for properties between the Ogunbil Bridge and Dungowan Dam, the maximum increase in floor area is not to exceed 10% of the floor area of the existing dwelling; or
- where the floor level of the proposed addition is located above the standard 1% AEP or the Sunny Day Failure of Dungowan Dam for properties between the Ogunbil Bridge and Dungowan Dam, the maximum increase in habitable floor space shall not exceed 100m^2;
- Rebuilding part of a dwelling may be permitted provided the building maintains the same dimensions which result in the same impact on flood behaviour; and
- For subdivision developments, residential subdivision will not be permitted where any lot to be created will be fully inundated by a 1% AEP event and the creation of such lot will create the potential for increased intensity of development on flood liable land.

Commercial / retail / industrial developments shall incorporate measures to seal or flood proof buildings, to avoid activities or fittings susceptible to flood damage, or to store the contents of buildings above the 1% AEP level.

For land filling developments the following flood related controls apply:

- Land filling proposals are to demonstrate consideration of AS3798;
- Survey plan prepared by a registered surveyor is required, showing the contour levels of natural surface, any existing fill and the designed contour levels for the finished work;
- A report certified by a consulting engineer is required to detail the impact of the proposed fill on adjoining properties and, where levee banks are proposed, and the methods of internal drainage;
- Applications shall be accompanied by a construction management plan to show:
- Source of fill, including contamination assessment;
- An assessment of the impact of haulage vehicles on roads;
- precondition report of all haulage routes;
- Details of method of compaction of fill and associated impacts: control of dust, sedimentation, water quality impacts, noise and vibration; and
- Contingency for containment of fill in the event of a flood during placement.

For non-residential rural buildings the following flood related controls apply:

- Not permitted in “floodways”.

Finally, under Step 5 discretionary standards for proposals not subject to "Type of Development" and where deemed to satisfy criteria are not achieved. For subdivisions these discretionary standards for flood related controls are as follows:

- Development should be consistent with the principles and standards of the Flood Plain Management Manual (NSW Government);
- Development must ensure safety to life and property;
- Development on flood affected land must be structurally capable of withstanding the effects of flowing floodwaters including debris and buoyancy forces;
- Development must not increase the risk or implications of flooding to existing areas;
- Development on flood affected land must incorporate the Flood Proofing Guidelines in Appendix B;
- If flood free access is not possible, the development must be able to achieve safe wading criteria as specified in Figure L1 of the FPM;
- For industrial development:
  - Variation to the design flood planning level may be approved where Council considers strict adherence to the designed floor level to be unreasonable or unnecessary;
  - Council may require that all electrical installations and wiring be above the flood standard and that building materials and services are in accordance with the Flood Proofing Guidelines; and
- For non-residential rural buildings where it is not practical to locate floor levels above the 1% flood level, materials used in construction must be capable of withstanding inundation by floodwaters.

3.2.4 Strategic Plans

There are two open space strategic plans for Tamworth Regional Council:

- Tamworth Regional Council Sport and Recreation Strategic Plan - Summary Report (TRC, 2020c); and
- Tamworth Regional Council Sport and Recreation Strategic Plan (TRC, 2020d).

In Figure 11 of TRC, 2020d it is noted that there are 8 facilities for sport and recreation within Manilla.

Of the two strategic plans, the nominated challenges included water security with many sport and recreation facilities across the Tamworth region are heavily reliant on the availability of water, particularly for irrigation of playing fields. Included within the actions of the plan is continuing to reduce reliance on potable water to irrigate sports grounds and increase alternative water sources (e.g. increasing stormwater capture and re-use and improvements to irrigation).

3.2.5 Masterplans

TRC have prepared several local masterplans for the LGA. The masterplans within the Study Area are:

- Chaffey Park Manilla Master Plan (TRC, 2020e).

The Chaffey Park master plan assigns areas as shown in **Figure 3-3**. It shows that there are riverbank improvements along the extent of Namoi River. For field irrigation, with appropriate irrigation systems the fields are irrigated with ground water. The site also includes tanks to store water. The eastern field will be fenced to allow the option of gate takings.

Figure 3-3 Chaffey Park Manilla Areas Diagram (TRC, 2020e)

3.2.6 Construction Specifications

3.2.1.3 TRC Engineering Design Standards for Subdivisions & Developments

The TRC Engineering Design Standards for Subdivisions & Developments Version 1 were published and adopted by TRC in March 2019. Sections of the standards relevant to urban stormwater management in Manilla include the following:

- 2. Minimum Standards for Roads:
- 2.7.4 Batters – Specify grade requirements and location of catch drains to be incorporates into stormwater drainage design;
- 2.7.7 Vehicular Crossing and Accesses – Specify culvert or drain requirements (including hydraulic capacity) for crossings that cross open channel drains;
- 3. Minimum Standards for Stormwater Drainage Design:
- 3.5.6 – Specify recurrence intervals for different designs (residential, commercial, rural areas, major systems and more;
- 3.6 Hydrology – Specifications for hydrological calculations;
- 3.7 Design of piped Drainage Systems – Design specifications for aspects of drainage systems (pit inlets, drainage pits, pipeline);
- 3.8 Design of Overland Drainage Systems – Design specifications for hydraulic design and open channel designs;
- 3.9 Inter-Allotment Drainage – Design specifications for inter-allotment drainage where roof water and surface water cannot be discharged directly to the street gutter system;
- 3.10 Stormwater Detention and Retention – Specifications of design considerations, requirements and objectives for detention and retention systems including On-site Detention Design (OSD) design; and
- 3.11 Drainage Corridor Tenure – Specifications for stormwater discharge when designed to discharge onto land other than existing drainage easements, drainage reserve, public road or other legal point of discharge

3.2.1.4 TRC Construction Specifications for Civil Works

The TRC Construction Specifications for Civil Works describes specifications to be addressed and included in applications for Developer Infrastructure Works within the TRC local government area. The following sections are relevant to urbans stormwater management.

- C101 Development Construction-General;
- C220 Stormwater Drainage;
- C221 Pipe Drainage; and
- C222 Precast Box Culverts.

3.2.1.5 TRC Standard Drawings

TRC's latest standard drawings were published in March 2019 and include the following relevant to urban stormwater management:

- Road
  - G001: Service allocations – urban residential;
  - G002: Service allocations – rural residential;
  - G004: Kerb drainage connections and adaptors;
  - RD001: Typical rural cross section;
  - RD002: Typical urban cross section;
  - RD003: Kerb profiles;
  - RD004: Kerb ramps;
  - RD008: Driveways urban residential;
  - RD009: Driveways industrial;
  - RD010: Driveways rural access across table drains;
- Stormwater
  - SW001: Sag pit with lintel and grate – pipe under kerb;
  - SW002: Drop pit with lintel and grate – pit under kerb;

- SW003: On grade kerb inlet pit with lintel and grate – pipe under kerb;
- SW004: On grade kerb inlet pit with lintel and grate – pipe behind kerb;
- SW005: On grade kerb inlet pit with lintel and grate – pipe under carriageway;
- SW006: On grade kerb inlet pit with lintel and grate – roll type kerb;
- SW007: Junction pit and grated inlet pit;
- SW008: Surface inlet pit and surcharge pit;
- SW009: Inter allotment drainage pit;
- SW010: Subsoil drainage;
- SW011: Access chamber roof slab reinforcement details;
- SW012: Stormwater pipe bedding;
- SW013: Pipe to box culver connection;
- SW014: Stormwater pipe bulkhead and concrete pipe extension; and
- SW015: Stormwater pit step iron ladder details.

3.3 GEO-SPATIAL DATA

3.3.1 Stormwater Network

The Manilla stormwater network has been provided in geo-spatial format and includes end structures, pipes, pits and culverts. The location of the assets within the Manilla stormwater network are depicted in **Map A2** in **Appendix A** and the data provided includes the following details:

- Object ID;
- Asset Number;
- TRC Acquisition Date;
- Description;
- Diameter;
- Invert Values; and
- Length.

3.3.2 Aerial Imagery

The aerial imagery provided by TRC covers the entire Manilla Study Area. It is considered to be of a resolution suitable for this investigation.

3.3.3 Topographic Data

At the time of this investigation, 5m grid size topographic data from 2019 which covers the entire Manilla Study Area and a 1m grid size topographic data from 2019 which covers most of the Manilla Study Area with an exception of 0.07km^2 of missing data at the northern end of the Study Area, was made available. The combination of the two data sets is considered suitable for this investigation.

3.4 STORMWATER INFRASTRUCTURE

3.4.1 Stormwater Priorities

Council has a list of the stormwater priority projects for 2021. The list has ranked all projects across the TRC based on priority. The projects relevant to the Manilla Study Area are listed in **Table 3-1** in priority order, along with their cost estimate and current status.

These priorities involve the upgrading of existing or construction of new stormwater infrastructure and includes but is not limited to the following activities:

- Pipe and Culvert Upgrades; and
- Road and Drainage Reshape.

Table 3-1 2021 Manilla Stormwater Priorities

Priority	Site	Project	Cost	Status
11	South Street Major Drainage	Reshape road and drains to convey major flows	$500,000.00	Design
34	Hill Street @ Court Street	450 Court Street Hill to Arthur	$60,000.00	Planning

Map A3 in **Appendix A** highlights the location of the 2021 Stormwater priorities for the Manilla Study Area.

3.4.2 Stormwater Resolutions

TRC Customer Request Management (CRM) Resolutions log recorded several enquiries regarding drainage or flood and storm damage in the Manilla Study Area. The enquiries are recorded and resolved where possible. The enquiries within the Manilla Study Area are summarised in the **Table 3-2**. **Map A3** in **Appendix A** highlights the location of these enquiries.

Table 3-2 Manilla CRM Resolutions

ID	Date	Details	Resolution	Status
TRC2021-10223	7/06/2021	Drainage - Stormwater/gutter	-	No record
TRC2021-05247	7/01/2021	Drainage - Stormwater/gutter	Works complete. Detailed response provided to customer by email.	Issue Resolved
TRC2020-06022	20/02/2020	Drainage - Stormwater/gutter	Works have recently been undertaken in Grantham Lane to divert water to table drains in Burrell Street.	Issue Resolved
TRC2020-05840	17/02/2020	Drainage - Stormwater/gutter	Fix the drainage up clean it all out with the excavator	Issue Resolved
ROAD2017/0944	8/12/2016	Manilla and Attunga Area - Flooding	-	No record
ROAD0804/2012	17/01/2012	Manilla and Attunga Area - Flooding	-	No record

4 CATCHMENT CHARACTERISTCS

4.1 TOPOGRAPHY AND DRAINAGE

The Manilla Study Area is relatively flat and split into three defined areas by the Manilla and Namoi Rivers. The Manilla River enters the Study Area at the north-west corner and merges with the Namoi River in the centre of town. The Namoi River enters on the eastern side of the Study Area and leaves at the southern end. A ridge line defines the northern section of the study area and splits it into two catchments one draining into the Manilla River and the Second into the Namoi River. The ridge line has an elevation of approximately 588mAHD and has a steep drop with a grade of approximately 27% before it flattens out the ground level continues with a grade of approximately 6% to each of the rivers. The confluence of the two rivers is at an elevation of 340mAHD. The remainder of the catchment maintains the flat ground with the southern portion of the study area having an approximate grade of 2% towards the Namoi River.

4.2 CLIMATE

The climate characteristics for Manilla sourced from the Bureau of Meteorology website is provided in Table 4-1 below. The climate characteristics are sourced from the closest Tamworth Airport AWS Station (Site Number 055325), which is located approximately 38km from Manilla.

Manilla experience an average maximum temperature of 31.8°C in summer and 17.4°C in winter. The highest rainfall was recorded in November 2008 with a precipitation of 283.6mm, followed by February 2012 with a precipitation of 257.6mm.

Table 4-1 Monthly Climate Data (year 1992 – 2021)

Month	Mean Maximum Temperature (°C)	Mean Minimum Temperature (°C)	Mean Monthly Rainfall (mm)	Lowest Recorded Rainfall (mm)	Highest Recorded Rainfall (mm)
January	33	17.7	60.2	0.2	227.6
February	31.6	17	74.4	0.8	257.6
March	29.3	14.5	54.9	0	162
April	25.5	10	25.1	0	123
May	20.7	6	29.7	0.2	80.2
June	17.1	3.7	54.4	1.2	169
July	16.5	2.3	41	1.8	154.3
August	18.5	2.7	38.1	0	100
September	22.1	5.8	42.9	0.8	132.6
October	25.7	9.7	55.3	10.6	121.6
November	28.7	13.3	78.4	3	283.6
December	30.8	15.7	80.7	0	223.6

4.3 LAND USE AND ZONING

Based on the TRLEP 2010 land use zone mapping for the Study Area has been shown in **Map A4** in Appendix A. Land use in Manilla is predominantly Primary Production Small Lots (sheep and cattle grazing) with some areas of General Residential, Large Lot Residential, Local Centre, and Public Recreation. Flood Behaviour

Several significant floods have been recorded to have occurred in Manilla prior to the installation of gauges, these are listed below:

- 1840;
- February 1864; and
- 1910.

Gauges were installed in 1941 and since then 16 minor, 3 moderate and 2 major floods have occurred. The most significant are noted below:

- February 1955 major flood event, noted as highest event since 1910; and
- January 1964 major flood event, noted as worst in 100 years.

More recent flood events have been recorded in 1971, 1984, 1998 and 2004. The nature of the floodwaters from both river systems tend to rise quickly and isolate communities and properties for several days. Many properties are inundated during flood events and require evacuations of residents.

As per the Assessment of Flood Risk in Various Towns and Villages (Bewsher Consulting Pty Ltd, 2007) study, there were many community members requiring evacuations in flood events in Manilla, as well as the rapid rate of rising floodwaters and inundation of entire homes. These findings were also confirmed by the community consultation conducted as part of the 2012 Manilla Flood Study, finding many residents had experienced flooding first had and confirm the rapid rising and receding of floodwaters.

4.4 FLOOD BEHAVIOUR

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As per the Assessment of Flood Risk in Various Towns and Villages (Bewsher Consulting Pty Ltd, 2007) study, there were a large number of community members requiring evacuations in flood events in Manilla, as well as the rapid rate of rising floodwaters and inundation of entire homes. These findings were also confirmed by the community consultation conducted as part of the 2012 Manilla Flood Study, finding many residents had experienced flooding first had and confirm the rapid rising and receding of floodwaters.

4.5 CATCHMENT WATERWAYS

The Manilla River is 138km long and has a catchment of 2,075km^2. Upstream of Manilla the Manilla River originates in the Nandewar Range and travels through several areas before discharging into the Split Rock Dam before continuing on for approximately 25km and entering Manilla. The Manilla River and Namoi River meet in the centre of Manilla and the Namoi River continues downstream. The Namoi River has a length of 708km, a catchment of 3,075km^2 and is a part of the Barwon catchment of the Murray-Darling basin. The Namoi River merges with Lake Keepit 15km downstream of Manilla before continuing to its confluence with Barwon River near Walgett via Keepit Dam.

There is a water level and discharge gauge on Namoi River at Manilla Railway Bridge (419022). Historical water levels and discharge rates from 1970 to 2023 are illustrated in Figure 4-1.

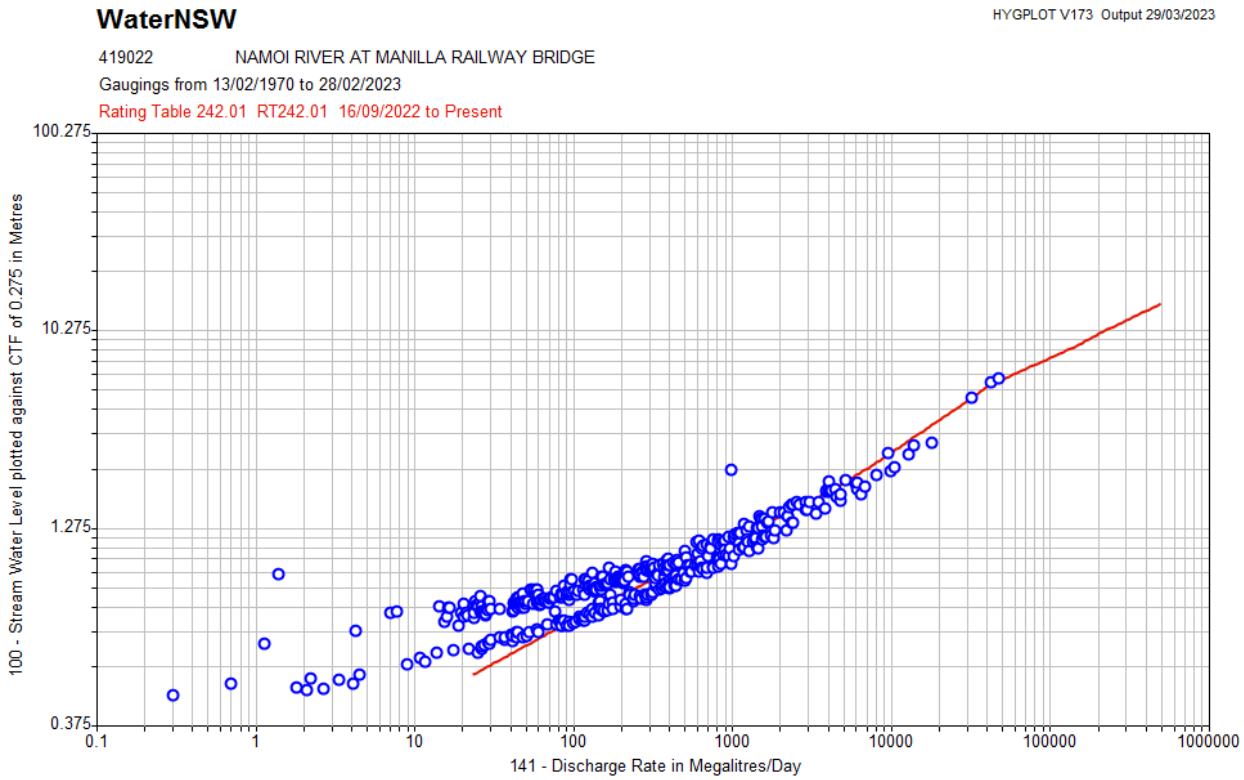

Figure 4-1 Discharge Rate vs. Stream Level for Namoi River at Manilla Railway Bridge (419022)

4.6 SOIL AND GEOLOGY

4.6.1 Soil Landscape

The soils within the Study Area include alluvial, transferal, residual, erosional and colluvial (refer to **Map A5** in **Appendix A**). Under the Australian Soil Classification, they are classified as Sodosols, Ferrosols and Dermosols, with chromosols soils in the area surrounding the Study Area. The landforms within the Study Area include hillcrest and footslope with some sections where the landform has not been defined.

Lithology is classified as siltstone/mudstone, alluvium, andesite.

The soil landscape is summarized in Table 4-2**.**

Table 4-2 Soil and Landscape Summary

Landscape	Description
Wongo	Landform not defined. Lithology classified as Residual
Upper Namoi Plains	Landform not defined. Lithology classified as Colluvium
Lower Manilla River	Landform not defined. Lithology classified as Alluvium

4.6.2 Surface Geology

The geology of Manilla is made up of a number of different geological formation including:

- Noumea beds of the Devonian. Part of Parry group (Interbedded massive and andesitic lithic wacke, pebbly wacke, laminated siltstone and mudstone;
- Lowana Formation of the Devonian. Part of the Parry group (Green-black, thinly bedded siltstone and mudstone with thin white tuffaceous beds);
- Keepit Conglomerate of the Devonian. Part of the Parry group (boulder to pebble conglomerate, mudstone and thinly bedded sandstone; and
- Mandowa Mudstone from the Famennian. Mandowa Mudstone is part of the Parry Group (grey, thinly bedded, laminated and massive mudstone with subordinate, thin siltstone and fine sandstone).

4.6.3 Acid Sulphate Soils

The TRCLEP 2010 defines Acid Sulphate Soils (ASS) as “naturally occurring sediments and soils containing iron sulphides (principally pyrite) or their precursors or oxidation products, whose exposure to oxygen leads to the generation of sulphuric acid (for example, by drainage or excavation)”. These soils are more likely to occur in low-lying areas of coastal floodplains, and are also locally associated with saline sulphate-rich groundwater in some agricultural areas or with freshwater wetlands. In an undisturbed and waterlogged state, ASS generally pose no or low risk. However, the sulphuric acid produced from the oxidation of ASS when exposed can negatively impact on the surrounding environment in a number of ways including a reduction in water quality, fish kill and plant death. Sulphuric acid produced by the soils can also corrode and weaken certain structures and building foundations.

The CSIRO Australian Soil Resource Information System has mapped the land in and around Manilla as having a Low Probability of Occurrence of ASS.

4.6.4 Contaminated Land

Contaminated land refers to any land which contains a substance at such concentrations as to present a risk of harm to human or environmental health, as defined in the *Contaminated Land Management Act 1997*. Contamination issues need to be considered at the flood management options development and design stage.

The NSW DPIE regulates contaminated land sites and maintains a record of written notices issued by the NSW EPA in relation to the investigation or remediation of site contamination.

The EPA Contaminated Land Record was searched on 30 September 2021 to determine whether any notices had been issued under the *Contaminated Land Management Act 1997* within Tamworth Regional Council LGA. A total of eleven notices relating to five sites was found within the Tamworth LGA. None of these sites listed were located in Manilla.

The List of NSW Contaminated Sites notified to the NSW EPA was searched on 30 September 2021. The search was conducted for Manilla and returned one result which is listed in Table 4-3.

Table 4-3 Sites in Manilla listed on the EPA list of NSW contaminated sites notified to EPA

Site	Address	Activity	EPA Management Class	Coordinates
Tamworth Regional Council Works Depot - Manilla	73 River Street, Manilla	Other Petroleum	Regulation under CLM Act not required	-30.74879943, 150.7181011

4.7 FLORA AND FAUNA

A search of the Australian Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) for matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was undertaken on 1 October 2021 adopting a 10km buffer from the Study Area (DAWE 2021). A copy of the PMST search tool results is included in **Appendix B**.

The search indicated that thirty threatened species and twelve migratory species have the potential to occur within 10km of Manilla. Of the listed threatened species, eleven are known to occur (three birds, one fish, three mammals and four plants) and of the migratory species two species are known to occur.

A search of the DPIE BioNet Atlas was undertaken on 1 October 2021 to assess the potential for threatened species to occur within the area that are listed under the *Biodiversity Conservation Act 2016* (BC Act) and/or he EPBC Act (DPIE 2021). A total of twenty-three threatened fauna and flora species were recorded within 10km of Manilla. The sightings consisted of seven bird species, eight mammal species and eight flora species. These species are:

- Spotted Harrier (*Circus assimilis*) listed as vulnerable under the BC Act;
- Little Eagle (*Hieraaetus morphnoides*) listed as vulnerable under the BC Act;
- Little Lorikeet (*Glossopsitta pusilla)* listed as vulnerable under the BC Act;
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae)* listed as vulnerable under the BC Act;
- Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis)*
- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*) listed as vulnerable under the BC Act;
- Diamond Firetail (*Stagonopleura guttata*) listed as vulnerable under the BC Act;
- Spotted-tailed Quoll (*Dasyurus maculatus*) listed as vulnerable under the BC Act;
- Koala (*Phascolarctos cinerus*) listed as vulnerable under the BC Act;
- Squirrel Glider (*Petaurus norfolcensis*) listed as vulnerable under the BC Act;
- Grey-headed Flying-Fox (*Pteropus poliocephalus*) listed as vulnerable under the BC Act;
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis)* listed as vulnerable under the BC Act;
- Greater Broad-nosed Bat (Scoteanx *rueppelli)* listed as vulnerable under the BC Act;
- Eastern Cave Bat (*Vespadelus troughtoni)* listed as vulnerable under the BC Act;
- Large Bent-winged Bat *(Miniopterus orianae oceanensis)* listed as vulnerable under the BC Act;
- Narrow-leaved Black Peppermint (*Eucalyptus nicholii)* listed as vulnerable under BC Act;
- Tarengo Leek Orchid (*Prasophyllum petilum)* listed as endangered under the BC Act;
- *Euphrasia arguta* listed as critically endangered under the BC Act;
- Bluegrass (*Dichanthium setosum)* listed as vulnerable under BC Act;
- Finger Panic Grass (*Digitaria porrecta*) listed as endangered under the BC Act;
- Belson's Panic (*Homopholis belsonii)* listed as endangered under the BC Act;
- Austral Toadflax (*Thesium australe)* listed as vulnerable under the BC Act; and
- Ooline (*Cadellia pentastylis)* listed as vulnerable under the BC Act.

The distribution of the records for these species is shown on **Appendix B**.

4.8 VEGETATION

The PMST indicated that four threatened ecological communities (TECs) are likely to or may occur in the search area, namely:

- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered under the EPBC Act);
- New England Peppermint (*Eucalyptus nova-anglica*) Grassy Woodlands (Critically Endangered under the EPBC Act);
- Weeping Myall Woodlands (Endangered under the EPBC Act); and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered under the EPBC Act).

A review of DPIE's vegetation mapping for the Border Rivers Gwydir – Namoi Region (NSW OEH, 2016) shows that the vegetation in and around Manilla is characterised predominately dry sclerophyll forests, grassy woodlands, and dry rainforest. The following Plant Community Types (PCTs) were identified and are shown in **Map A6** in **Appendix A**.

- PCT 1: Candidate Native Grasslands;
- PCT 78: River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion;
- PCT 84: River Oak-Rough-barked Apple -red gum-box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregions;
- PCT 435: White Box-White Cypress Pine shrub grass hills woodland in the Brigalow Belt South Bioregion and Nandewar Bioregion;
- PCT 516: Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion;
- PCT 547: Wild Quince-Mock Olive-Rusty Fig-Iamboto-Sweet Pittosporum dry rainforest of rocky and scree areas of the Nandewar Bioregion and New England Tableland Bioregion;
- PCT 588: White Box – White Cypress Pine shrubby hills open forest mainly in the Nandewar Bioregion; and
- PCT 589: White Box – White Cypress Pine – Silver-leaved Ironbark grassy woodland on mainly clay loam soils on hills mainly in the Nandewar Bioregion.

4.9 DEMOGRAPHICS

The demographic characteristics of Manilla (State Suburbs) was sourced from the Australian Bureau of Statistics (ABS) 2016 Census Data and aggregated to produce an overall synopsis for the area. A summary of the demographic data collected is listed below (ABS, 2021):

- The population of Manilla (State Suburbs) from the 2016 Census data was 2,550;
- The median age of people living in Manilla is 47 with children aged 0-14 making up 17.7% of the population and people aged over 65 making up 27.3% of the population;
- Of the population in Manilla 84.3% were born in Australia. The most common countries of birth outside of Australia were England (1.4%), New Zealand (0.6%), Germany (0.4%), United States of America (0.4%) and China (0.3%);
- English was the only language spoken in approximately 89.2% of homes in Manilla. The most common languages spoken at home other than English included German, Greek, Hindi, Cantonese and Dutch;
- The most common occupations in Manilla included Labourers (15.5%), Technicians and Trades Workers (14.5%), Community and Personal Service Workers (13.9%), Machinery Operators and Drivers (12.2%), and Clerical and Administrative Workers (11.7%);
- The median weekly income for individuals aged 15 years and over was $456, compared to the NSW median of $664. This trend of below average income for Manilla compared to the NSW average was also evident for family ($1,095 compared to $1,780 for NSW) and household incomes ($837 compared to $1,486 for NSW); and
- In Manilla, on the day of the Census, the most common methods of travel to work for employed people was by car (69.3% as the driver and 6.1% as passengers) and by walking (6.7%) Other common responses were 4.8% who worked at home and 1.4% who travelled by truck.

4.10 WATER QUALITY

The NSW Government have previously undertaken a State of the Catchments assessment for the Namoi region in 2010, to determine the riverine ecosystem condition using water quality, macroinvertebrate, fish, and hydrology indicators. The 2010 outcome of the water quality assessment is illustrated in **Figure 4-2**, highlighting three water quality sites relevant for Manilla along the Namoi and Manilla Rivers.

The water quality condition based on turbidity and phosphorous show the Namoi River at Manilla Railway Bridge (419022) as exceeding ANZECC guidelines for a greater proportion of samples than at Manilla River downstream of Split Rock Dam (419043) and Namoi River at the Manilla Weir. This is likely due to runoff directly correlated to the Manilla urban area and showgrounds.

The trend for electrical conductivity from data between 2005-2008 was found to be decreasing in the Namoi River at the Manilla Railway Bridge, with an increasing trend in turbidity.

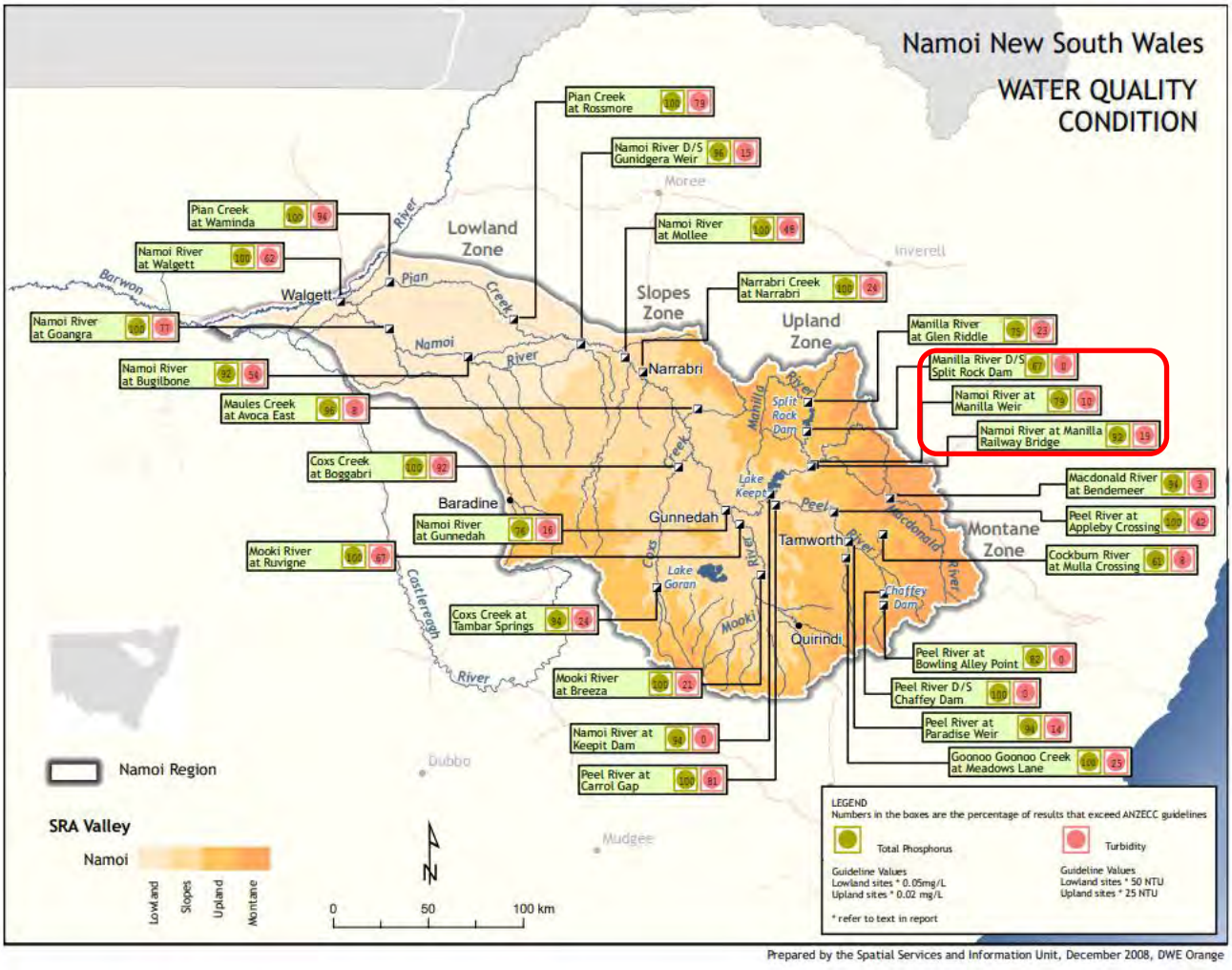

Figure 4-2 Riverine Water Quality Condition (NSW Government, 2010)

The water quality index score for the Namoi River at the Manilla Railway Bridge as per the DPIE *Water quality technical report for the Namoi surface water resource plan area (SW14) (2020)* illustrated in Figure 4-3 was deemed good as per the extracted summary table shown in Table 4-4.

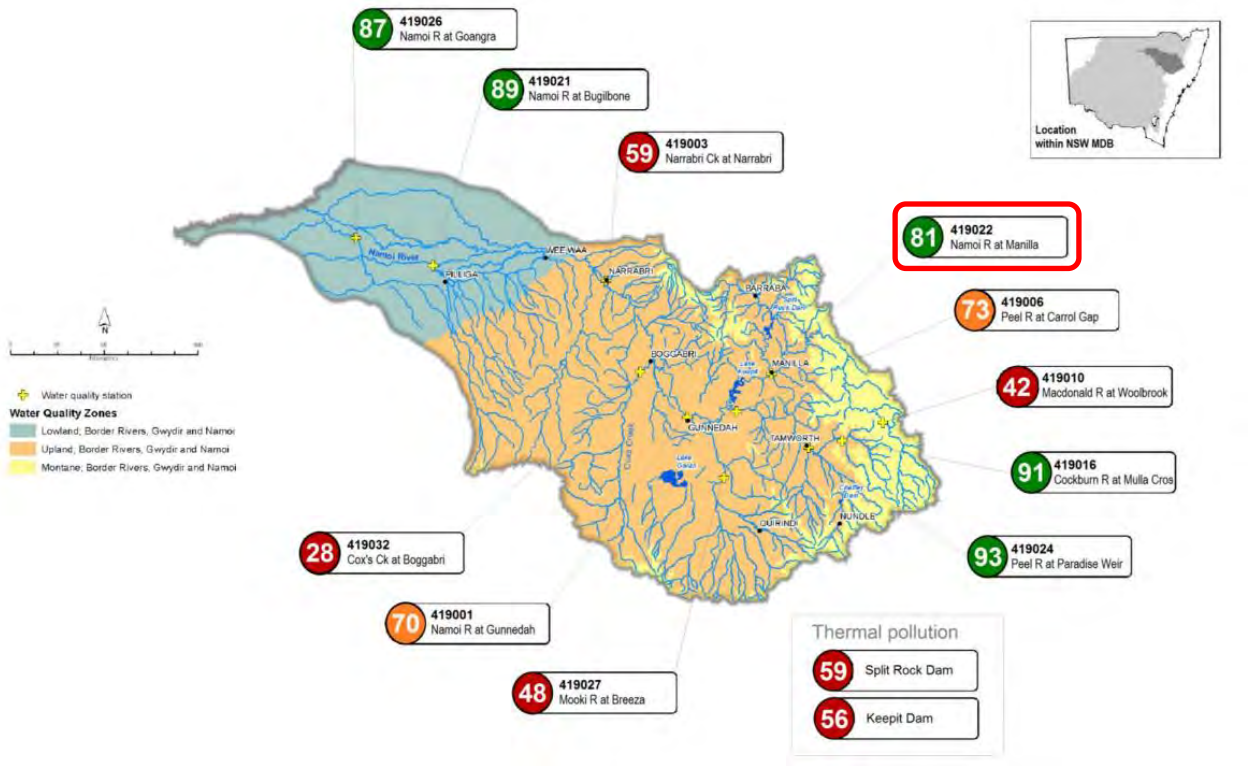

Figure 4-3 Water quality technical report for the Namoi resource plan area (SW14) (DPIE, 2020)

Table 4-4 Water quality index for the Namoi WRPA 2010-2015 (Table 10) (DPIE, 2020

Site Name	Rating	WaQI	Total N	Total P	Turbidity	pH	DO
Macdonald River at Woolbrook	Poor	42	20	14	92	70	33
Namoi River at Manilla Railway Bridge	**Good**	**81**	**83**	**86**	**83**	**55**	**98**
Cockburn River at Mulla Crossing	Good	91	87	89	96	94	83
Peel River at Paradise Weir	Good	93	95	96	95	86	90
Peel River at Carroll Gap	Fair	73	61	68	54	96	95
Mooki River at Breeza	Poor	48	58	16	44	69	84
Coxs Creek at Boggabri	Poor	28	25	10	15	63	66
Namoi River at Gunnedah	Fair	70	67	55	56	98	90
Narrabri Creek at Narrabri	Poor	59	71	27	41	95	91
Namoi River at Bugilbone	Good	89	87	82	87	94	92
Namoi River at Goangra	Good	87	81	83	83	93	100

The median total nitrogen, total phosphorus, and turbidity results from the 2020 DPIE study for **Namoi River at the Manilla Railway Bridge** were less than the Basin Plan target values (see Table 5-2) every year, with the highest results occurring during the high flows in 2010/2011. The majority of dissolved oxygen results were within the upper and lower ranges. The median pH was within the desired range from 2007 to 2011, only dropping below the lower limit from 2011 to 2014 but at medium risk of impacting water dependent ecosystems. The median electrical conductivity increased in 2009/2010, possibly in response to a concentration of salts during very low flows. The median electrical conductivity increased following the heavy rainfall in 2010/2011 and subsequent shallow groundwater recharge, and then decreased again in 2014/2015 as the catchment dried.

The **Namoi River at Buglibone** results from the 2020 DPIE study revealed the total nitrogen, total phosphorus and turbidity annual medians were below the Basin Plan (2012) targets in all years, as well as dissolved oxygen and pH annual medians being within the desired range, highlighting the positive impact of freshes in the lowland areas comparative to upstream at Manilla.

The electrical conductivity results for the Namoi River at Buglibone site suggested limited connectivity between surface water and shallow saline groundwater, in contrast to the Manilla River which runs along the western boundary of the study area and is a major contributor of salinity to the downstream Keepit Dam. The salinity impacts from the Manilla River are likely due to high salt stores that interact with recharge, gully and sheet erosion from land clearing and shallow grazing and cropping. Water releases from the upstream Split Rock Dam could also contribute to channel erosion and increased turbidity in the Manilla River, however discharges are typically small and cold-water pollution impacts are minimal.

Algal blooms within the Namoi region were identified as a possible risk in the Murray-Darling Basin Plan.

Additional water quality analysis to establish the baseline condition for the study area based on current available information is summarised in Section 5.

4.11 SITE VISIT

Detailed site inspection was undertaken on 16 November 2021 with Council staff. The site visit provided the opportunity to familiarise with the Study Area and inspect key features and major stormwater infrastructure. The locations visited included:

- Rock lined stormwater outlet channel from Manilla Street to Namoi River;
- Stormwater infrastructure near and underneath the Manilla Street Highway Bridge;
- Stormwater drainage near the old bridge including outlets to Namoi River;
- Stormwater outlet from Market Street to Namoi River;
- Drainage channel from Rowan Street, traversing along Church St, and discharging into Namoi River;
- Stormwater outlet at Willows Parade discharging into the open space between Willows Parade and Worooma Crescent;
- Confluence of Manilla and Namoi Rivers.

Some photos from the site inspection are provided in **Appendix C**.

5 BASELINE WATER QUALITY ASSESSMENT

5.1 WATER QUALITY DATA MONITORING

Local water quality varies naturally due to various factors, including the nature of landforms and land use the waters are draining from (such as soils, slope), or rainfall and runoff patterns (ephemeral or permanent streams). Water quality monitoring in conjunction with flow monitoring across long-term timeframes and inclusive of wet and dry periods are therefore highly valuable for understanding the catchment condition.

This study additionally incorporates a summary of the findings for the historical water quality monitoring that has been undertaken in addition to the existing water quality analysis undertaken by DPIE as outlined in Section 4.10.

5.1.1 Streamwatch Monitoring

It is known that six high schools in the Tamworth Area historically monitored water quality at one site each, however these do not appear relevant to the Manilla study area.

It is recommended that sampling is undertaken as part of the proposed educational programs (Section 8.2) to incorporate community ownership and deeper understanding of the need for catchment management practices.

5.1.1 River Monitoring

Water quality testing data managed by WaterNSW on the Namoi River at Buglibone (Riverview) (419021) and downstream of Keepit Dam (419007) was provided for the study but lies substantially outside of the Manilla study area with little to no correlation being able to be speculated. There was no WaterNSW data supplied for the Namoi River at Manilla Railway Bridge (419022) or Manilla Weir or Manilla River downstream of Split Rock Dam (419043) testing sites.

Council sampling results include data recorded since 2007 to 2021 that were reported at inconsistent intervals with significant data gaps. These are:

1. Council Monitoring
    - Manilla River at Manilla (R302) - assumed to be upstream of the Namoi River convergence as opposed to downstream for the WaterNSW testing site;
    - Namoi River at Manilla Weir (R301); and
    - Manilla River at Split Rock Dam (R401)

Details of the water quality samples collected at each testing site near the Manilla study area over the specified timeframes are included in **Appendix D**. The location of the monitoring sites are illustrated in **Map A8 in Appendix A** and Figure 5-1**.**

Nutrient values (phosphorous and nitrogen) comparative to the limited pollutant processing of MUSIC conceptual water quality modelling were not available from the Council data. Additional testing or sourcing of WaterNSW data is recommended in future studies for validation of conceptual modelling and water quality options assessment.

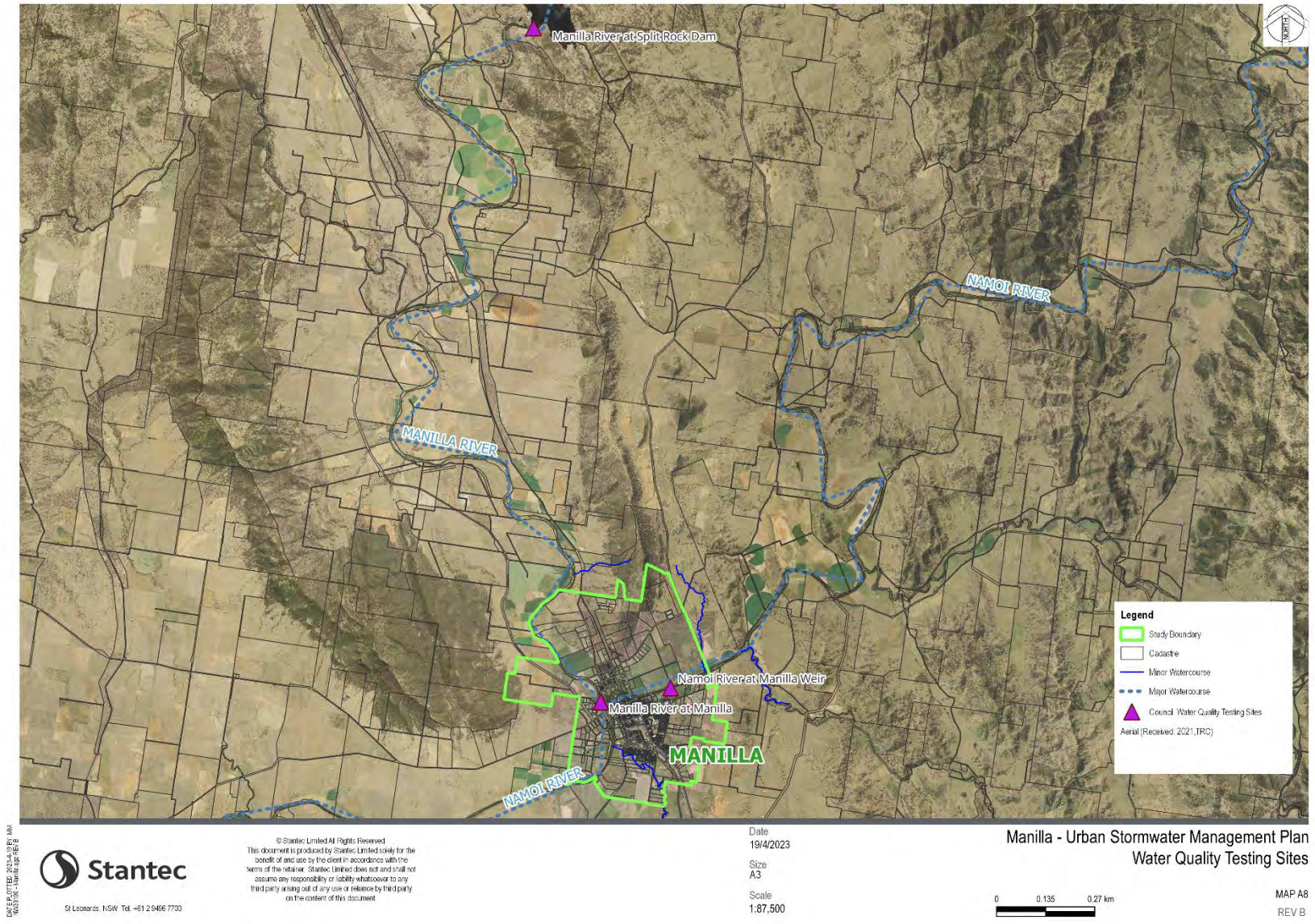

Figure 5-1 Location of Water Quality Monitoring Sites

5.2 RECORDED WATER QUALITY ASSESSMENT

5.2.1 Catchment Water Quality Objectives

At present, there are no local standards for water quality provided by TRLEP 2010. Hence the water quality assessment was carried out against:

- NSW Water Quality and River Flow Objectives (https://www.environment.nsw.gov.au/ieo/);
- Guidelines for Managing Risks in Recreation Water (Australian Government, 2008);
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000); and
- Murray-Darling Basin Plan (2012) Objectives (Chapter 9.16 – 9.18 and Schedule 11)

As the local and regional waterways of Manilla are within the upland zone of the Namoi River region, the trigger values referenced in the guideline were indicators that apply to a highly disturbed freshwater waterway or inland river ecosystem across South-East Australia and developed for the objective of maintenance or improvement of water quality for a long term (50 year) period.

The Department of Environment NSW have developed eleven Water Quality Objectives (WQOs) for NSW rivers and estuaries and provide guideline levels to assist water quality planning and management:

1. Aquatic ecosystems
    a. Maintaining or improving the ecological condition of waterbodies and their riparian zones over the long term
2. Visual amenity
3. Secondary contact recreation
4. Primary contact recreation
5. Livestock water supply
6. Irrigation water supply
7. Homestead water supply
8. Drinking water - Disinfection only, or
9. Drinking water - Clarification and disinfection
10. Drinking water - Groundwater
11. Aquatic foods (cooked)

For the purposes of this study, the water quality objective for the protection of Aquatic Ecosystems (1) has been assessed where limited data is available for comparison to key indicators. Primary and secondary contact recreation objectives have also been identified as valuable for the specific and have been reported on where appropriate.

5.2.2 Water Quality Benchmarking

Water quality condition is described as the percentage of samples exceeding the selected trigger. There are two methods of benchmarking recorded water quality values as per Section 7.4.4 of the ANZECC standard and defined below:

1. Comparison against default trigger values (either as per ANZECC or Basin Plan which is less conservative)
2. Comparison against site-specific trigger values representative of the 80th percentile value for the recorded performance indicators (statistical analysis outside current scope)

Trigger values are defined as the concentration (or load) of the key performance indicators measured for the ecosystem, below which there exists a low risk that adverse biological (ecological) effects will occur. They indicate a risk of impact if exceeded and should 'trigger' some action, either further ecosystem specific investigations or implementation of management/remedial actions.

Assessing whether the exceedance means a risk of impact to the NSW Water Quality Objective requires site-specific investigation for some parameters. For the Protection of Aquatic Ecosystems Objective in NSW, the ANZECC 2000 Guidelines provide default trigger values for major physio-chemical stressors in Tables 3.3.2 and 3.3.3 and for Toxicants in Table 3.4.1. These are not adjusted for site-specific trigger values as any exceedance of the values will result in ecological degradation.

The **default ANZECC trigger values have been adopted for this study as per Table 5-1** as specified in the NSW Water Quality Objectives for the Namoi region as opposed to the less conservative target values in the current Basin Plan (Table 5-2). This approach has been adopted for this study as local level assessments should not be skewed by Basin-level approaches that would apply if they were of a magnitude requiring coordinated action (e.g. river operations) and so where more than one target applies at a given location, the expectation is that achieving the most stringent target (ANZECC, 2000) would ensure all environmental values are met.

Table 5-1 Water Quality Benchmark Trigger Values for Upland River (ANZECC 2000)

Parameter	Units	Trigger Values	Clause
Algae	cells/mL	>15,000	Table 5.2.2
Aluminium	mg/L	pH>6.5: 0.055	Table 3.4.1
Ammonia	mg/L	0.9	Table 3.4.1
Arsenic	mg/L	0.013-0.024	Table 3.4.1
Boron	mg/L	0.37	Table 3.4.1
Cadmium	mg/L	0.0002	Table 3.4.1
Chloride	mg/L	25-40	Table 3.4.1
Chlorine	mg/L	0.003	Table 3.4.1
Chlorophyll-a	mg/L	NA to upland rivers	Table 3.4.1
Chromium (total)	mg/L	0.001	Table 3.4.1
Copper	mg/L	0.0014	Table 3.4.1
Dissolved Oxygen	% Saturation	90-110	Table 3.3.2
Dissolved Oxygen	mg/L	9.4-10.6	Conversion
Faecal coliforms	cfu/100mL	< 150 faecal coliforms per 100 mL primary recreation < 1000 faecal coliforms per 100 mL secondary recreation	Table 5.2.2
Radioactivity	Bq/L	Gross Alpha/Beta < 0.1 (recreational)	Table 5.2.3
Lead	mg/L	0.0034	Table 3.4.1

Parameter	Units	Trigger Values	Clause
Manganese	mg/L	1.9	Table 3.4.1
Mercury	mg/L	0.00006	Table 3.4.1
Nickel	mg/L	0.011	Table 3.4.1
Nitrate	mg/L	0.7	Table 3.4.1
Nitric Oxide	mg/L	0.015	Table 3.4.1
pH	pH	6.5-8 *Changes of more than 0.5 pH units from the natural seasonal maximum or minimum should be investigated.*	Table 3.3.2
Phenol	mg/L	0.32	Table 3.4.1
Salinity/EC	µS/cm	30-350 *Note that salinity levels vary widely, both within and between systems. Locally applicable salinity concentration and load targets are given in catchment plans, within the frameworks of the NSW Salinity Strategy*	Table 3.3.3
Selenium (Total)	mg/L	0.005	Table 3.4.1
Silver	mg/L	0.00005	Table 3.4.1
Sulphate	mg/L	<1000	Section 4.3.3.4
Temperature	°C	> 80%ile, < 20%ile (15–35°C for recreation)	Table 3.3.1, Table 5.2.2
Total Nitrogen	mg/L	0.25	Table 3.3.2
Total Phosphorus	mg/L	0.02 *Note that total phosphorus levels above 100 micrograms/litre have been consistently recorded in the areas of the Peel and Namoi Rivers. Development of local guideline trigger values for these areas may be necessary. See "Tailoring Water Quality Objectives to local conditions"*	Table 3.3.2
Turbidity	NTU	25 *In general values in the lower part of the range will be found in rivers and streams during low flows and/or in more vegetated catchments. Values in the higher part of the range will be found in rivers and streams in high flows and lower in the catchment (particularly inland catchments). For lakes and reservoirs, in general the higher values will be found in waterbodies that are shallow or in areas with dispersive soils.*	Table 3.3.3
Zinc	mg/L	0.008	Table 3.4.1

Table 5-2 Water Quality Benchmark Values for Zone B2 Streams Namoi Valley Upland Zone (Murray River Basin Plan 2012)

Benchmark	Annual Median Value
Turbidity (NTU)	30
Total Phosphorus (mg/L)	0.08
Total Nitrogen (mg/L)	0.75
Dissolved oxygen (mg/L; or saturation (%)	60–110%
pH	7.5-8.5
Salinity	NA
Temperature	Monthly median between the 20%ile and 80%ile of natural monthly water temperature
Pesticides, heavy metals, and other toxic contaminants	the protection of 95% of species ((values in table 3.4.1 of the ANZECC Guidelines not to be exceeded) All as per triggers above other than: Selenium < 0.011mg/L Mercury < 0.0006

5.2.3 Water Quality Data Results

Details showing the key water quality datasets against the ANZECC default trigger values as per the NSW Water Quality Objectives for the Namoi region is included in **Table 5-3**. These results show that all the testing sites are susceptible to environmental and recreational degradation for several parameters.

The overall water quality condition of the Manilla River at Manilla site appears to be more impacted by extensive land clearing resulting in agricultural runoff high in sediment and salts in comparison to the Namoi River Weir at Manilla site which appears to be most impacted by nutrients leading to higher algal bloom and lower dissolved oxygen, despite the lower temperatures. Total Coliforms, heavy metals and toxicants show minimal safe recreational opportunities.

Table 5-3 Water Quality Testing Site Observations

Testing Site		Manilla River at Manilla	Namoi River Weir at Manilla	Split Rock Dam	
Observations		Highest comparative Total Coliforms, Turbidity, ECC, pH, TDS, Aluminium and Chloride. Risk of low DO.	Highest comparative Algae, Chromium, Mercury and Arsenic. Highest peak in pH and TDS. Risk of low DO, high aluminium, copper, nitric oxide, and lowest temperatures.	Highest comparative Chlorine, Lead and Manganese. Highest risk of low DO. Risk of moderately high aluminium and high copper and nitric oxide.	Trigger
Key Pollutants Observed (% of samples exceeding trigger)	Algae	21%	44%	39%	15,000 cells/mL
	Aluminium	100%	86%	56%	55 mg/L
	Ammonia	NA	0%	0%	0.9 mg/L
	Arsenic	2%	13%	0%	0.013 mg/L
	Boron	0%	0%	0%	0.37 mg/L
	Chloride	79%	12%	6%	25 mg/L
	Chlorine	NA	11%	22%	0.003 mg/L
	Chromium	0%	42%	33%	0.001 mg/L
	Copper	NA	100%	100%	0.0014 mg/L
	Dissolved Oxygen	81%<90%	73%<90%	100%<90%	90-110%
		10%>110%	11%>110%		9.4-10.6 mg/L
	Gross Alpha	0%	0%	0%	0.1 Bq/L
	Gross Beta	0%	0%	0%	0.1 Bq/L
	Lead	NA	Inconclusive	33%	0.0034 mg/L
	Manganese	0%	0%	5%	1.9 mg/L
	Mercury	1%	2%	0%	0.00006 mg/L
	Nickel	NA	0%	0%	0.011 mg/L
	Nitrate	NA	0%	0%	0.7 mg/L
	Nitric Oxide	NA	100%	100%	0.015 mg/L
	pH	59%>8	25%>8	45%>8	6.5-8
		max = 8.9	max = 13	max = 8.3	
	EC	88%	30%	0%	30-350 µS/cm

Testing Site		Manilla River at Manilla	Namoi River Weir at Manilla	Split Rock Dam	Trigger
Observations		Highest comparative Total Coliforms, Turbidity, ECC, pH, TDS, Aluminium and Chloride. Risk of low DO.	Highest comparative Algae, Chromium, Mercury and Arsenic. Highest peak in pH and TDS. Risk of low DO, high aluminium, copper, nitric oxide, and lowest temperatures.	Highest comparative Chlorine, Lead and Manganese. Highest risk of low DO. Risk of moderately high aluminium and high copper and nitric oxide.	
	Selenium	Inconclusive	Inconclusive	Inconclusive	0.005 mg/L
	Silver	Inconclusive	Inconclusive	Inconclusive	0.00005 mg/L
	Sulphate	0%	0%	0%	400-1000 mg/L
	TDS	max = 600 ave = 402	max = 1497 ave = 189	max = 398 ave = 263	mg/L
	Temp	max = 30 ave = 18.4 min = 10	max = 22.4 ave = 13.1 min = 9.3	max = 23.7 ave = 17.2 min = 14.2	15–35°C
	Total Coliforms	86%>primary rec 59%>primary rec	NA	38%>primary rec 14%>primary rec	150-1000 cfu/100mL
	Turbidity	21%	15%	14%	25 NTU
	Zinc	NA	0%	0%	0.008 mg/L

It is recommended that nutrient testing not included in the provided data be assessed for validation of future conceptual modelling options assessments. Water quality improvement measures, development and construction controls, agricultural practice management, scour protection and industry discharge enforcement measures are recommended to be investigated in future studies.

The limitations of catchment-scale water quality improvement on riverine systems is noted, however, a combination of the above recommendations and improved understanding and acknowledgement of water quality issues in NSW governance is highly advised.

Sedimentation solutions in combination with low-cost sorbents could offer WSUD-related opportunities for removal of heavy metals and toxicants. Additional investigation of engineered treatment measures to address heavy metal and toxicant pollution is further supported for future consideration.

5.3 CONCEPTUAL WATER QUALITY MODELLING

There was no conceptual water quality modelling undertaken for this catchment at this stage. It is recommended that future opportunities for water quality improvement measures including Water Sensitive Urban Design (WSUD) assets and stormwater harvesting and reuse be considered as per Section 8.5.

6 CONSULTATION

Consultation with the community and stakeholders is an important component in the development of an Urban Stormwater Management Plan. Consultation provides an opportunity to collect feedback and observations from the community and stakeholders on problem areas and potential stormwater management measures.

The main consultation elements for this study are:

- A call for information from all affected external stakeholders within the catchment;
- Internal stakeholder interviews;
- Public Exhibition of Urban Stormwater Management Plan; and
- Collation and acknowledgement of written submissions during the public exhibition.

This process ensures that community / stakeholder participation is maximised during the development of the USMP.

6.1 AGENCY CONSULTATION

There are a large number of agencies with stormwater related interests in the LGA. Key stakeholders were identified in consultation with Council. To best approach them, a letter of introduction to the study was sent to the key stakeholder agencies and an invitation to be involved in the project. It also included requests for any relevant data or information that they may have. An example of the letter is provided in **Appendix E**. These stakeholders were contacted by letter to identify whether the stakeholders might be able to provide input to the project.

Table 6-1 provides a summary of the stakeholders contacted and any responses provided.

Table 6-1 Stakeholder Contact Summary

Company	Contact Name and Position	Response Summary
Department of Planning, Industry and Environment	Director of the Local Tamworth DPIE office	The study be mindful of the New England North West Regional Plan 2036 and ensure consistency with any relevant sections such as Direction 10 – Sustainably manage and conserve water resources
Department of Primary Industry	Water Regulation Officer	No response received
North West Local Land Services	Communications Officer	No response received
WaterNSW	Water System Operations Manager, North	WaterNSW doesn't have any operational issues to be included in the Management Plan
Transport for NSW	Senior Manager, Community and Place (New England)	No response received
John Holland	Structures Superintendent	Walmar Road, Kootingal – periodic flooding / community complaints occur frequently at this location. Urban runoff appears to be directed towards the railway corridor from the new developments in Garden Street / Kootingal bowling club. Powerhouse on New England Highway, Tamworth – new developments on steep catchments direct urban runoff toward the railway corridor just east of the Powerhouse motel on the New England Highway. Development approval appears reliant on a swale drain within the railway corridor which has proven to be inadequate for generated flows. There also appears to be a missing drainage infrastructure to convey urban flows to the Peel river.
NSW Environment Protection Agency	Regional Operations Officer	EPA does not have any specific comments or areas of concerns at this point in time

6.2 COUNCIL STAFF INTERVIEWS

Meetings were held with relevant Council departments during the morning of 17 November 2021 at the TRC office. Input was sought to inform the development of the Urban Stormwater Management Plan. The purpose of the interviews were to present the Council staff from various departments an opportunity to inform their priorities, raise any concerns, identify any potential stormwater management measures (structural and non-structural) and recognise any opportunities for possible future collaboration.

Staff from the following departments were interviewed:

- Water and Waste - Water and Environmental Operations;
- Water and Waste - Sustainability (Water and Waste);
- Water and Waste - Projects, Strategy and Infrastructure;
- Planning & Compliance - Development Engineering;
- Planning & Compliance - Development Engineering;
- Planning & Compliance - Integrated Planning;
- Planning & Compliance – Development;
- Regional Services – Transport;
- Regional Services – Asset and GIS;
- Regional Services – Design; and
- Regional Services – Project Planning and Delivery.

7 URBAN STORMWATER MANAGEMENT SYSTEMS

7.1 EXISTING STORMWATER MANAGEMENT SYSTEM

Urban stormwater infrastructure includes both drainage infrastructure and stormwater quality treatment infrastructure.

Stormwater drainage infrastructure within Manilla includes stormwater pipes, pits, kerb and gutters, open drains such as concrete channels, vegetated channels, and natural drains such as gullies and creeks.

Table 7-1 provides a summary of the drainage infrastructure within Manilla.

Table 7-1 Stormwater Drainage Infrastructure within Manilla

Drainage Type	Description	Example
Pit and Pipe	Major or minor drainage system that receives stormwater runoff from buildings and hard surfaces such as roads and pavements; and diverts it to the underground stormwater system.	Due to the underground nature these are generally only viewed by CCTV or manhole access.
Culverts	Structure at the outlet of the underground stormwater system, typically featuring a headwall	

Open Concrete Channel	Traditional engineered concrete lined major drainage systems used to convey stormwater flows	
Kerb and Gutter	Receives stormwater runoff from road surfaces and directs it to underground stormwater system	
Inlet pits	Directs kerb and gutter stormwater runoff to underground stormwater system	

Box inlets	Directs large stormwater runoff to underground stormwater system	
Open drains	Traditional engineered concrete or rock lined minor drainage systems used to convey stormwater flow	
Vegetated Channels	Natural vegetated open channels that convey stormwater and also provide some treatment	

Natural channels, natural drains	Ephemeral streams and creeks that receive and convey stormwater runoff from the urban environment.	

There is currently no stormwater quality treatment infrastructure in Manilla.

7.2 STORMWATER MANAGEMENT ISSUES

To prepare a sound stormwater management plan it is important to identify and understand the stormwater related issues and concerns, and their causes. Stormwater management issues were identified through a process involving discussion with key stakeholders, review of existing information (including existing customer request management), site inspection and water quality monitoring. The issues have been grouped into three different categories and described in Table 7-2.

- Environmental;
- Social; and
- Governance.

Table 7-2 Stormwater Management Issues

Type	Issue	Cause
Environmental	Poor Water Quality (Elevated nutrients, suspended solids and turbidity levels)	> Agriculture > Peak weather overflows from wastewater system > Untreated road and paved surface runoff > Detergent used in car washing > Pet excrement > Domestic Littering > Lack of planning controls such as water quality requirements for new developments > Poor erosion and sediment control measures on construction sites > New urban development
	High Salinity	> Land clearing > Decrease in groundwater flows due to increased impervious areas > Discharge of treated effluent
	Degraded Waterway Conditions and Loss of Habitat	> Modified hydrology resulting in changes in natural flow paths > Stream banks and channel erosion due to high flow velocities around the stormwater discharge outlets > Clearing of vegetation > Noxious weeds > Inadequate maintenance of creek vegetation including removal of weeds > Illegal dumping of litter and rubbish
	Loss of Environmental Flows	> Increase in impervious surfaces > Stormwater detention basins > Stormwater diversion schemes
Social	Flooding	> Increase in impervious surfaces > Inadequate and/or non-existent drainage in problem areas > Inadequate maintenance of existing drainage infrastructure > Minor drainage system not meeting best practice level of service
	Community Indifference to Stormwater Management	Lack of education and awareness of: > Importance of urban waterways > Impact of stormwater on waterway health > Land use and practices that contribute to degradation of urban waterways

Type	Issue	Cause
	Loss of Community Access and Recreation	> Loss of visual amenity > Poor water quality including odours and litter in waterways > Degraded access to waterways > Degraded nature of the waterways
	Risk to Community Health and Safety	> Hazardous flood depths and velocities during major rain events > Safety concerns with open stormwater channels > Mosquitoes breeding around ponded water at outlets and within channels > Stormwater discharge point is immediately upstream of the Manilla River intake for water supply at Manilla
Governance	Ineffective stormwater management and adoption of best practices	> Lack of an integrated stormwater management plan > Inadequate communication internally between Council teams > No stormwater management committee within Council
	Lack of comprehensive database to assess the nature and magnitude of stormwater problems and identify suitable solutions	> Lack of sufficient data on Council stormwater drainage assets > Insufficient maintenance of existing stormwater drainage assets > No water quality monitoring programs > Insufficient funding available

7.3 STORMWATER MANAGEMENT OBJECTIVES

Based on the issues identified, stormwater management values and objectives have been developed. The Barraba Urban Stormwater Management Plan (2000), Council's strategic document *Tamworth Regional Blueprint 100* (2020) and internal stakeholder feedback also form the basis for the development of the stormwater management objectives. These are document in Table 7-3.

Table 7-3 Stormwater Management Values and Objectives Issues

Values	Objectives
Water Quantity	To minimise the occurrence of localised flooding associated with urban stormwater drainage. To minimise adverse impacts of stormwater runoff downstream of the urban drainage network. Appropriately manage stormwater as an integral part of the total water cycle balance within the urban catchment
Water Quality	To adopt and promote WSUD principle to maintain and / or improve the surface and groundwater quality within the Barraba urban catchment. To consider community concerns and values in relation to water quality.
Water Conservation	To maximise the storage and reuse of stormwater as a secondary source of water.
Ecosystem Health	To retain natural drainage systems and appropriately integrate stormwater systems into the natural and built environments. To restore, rehabilitate, and enhance existing vegetation within the stormwater drainage channels.
Community Involvement	To ensure that social, aesthetic, and cultural values are recognised and maintained when managing stormwater. To encourage continuous community involvement with the urban stormwater management.
Public Health	To minimise the public risk, including risk of injury or loss of life, to the community. To ensure stormwater drainage systems are planned, designed, and managed with consideration and protection of community health and safety standards.
Economic Viability	To implement stormwater management systems that are sustainable and economically viable in the long term. To ensure stormwater is managed at a cost that is acceptable to the community as a whole, and that the levels of service and the contributions to costs are equitable.
Planning and Development	To minimise the impact of new urban development on the urban stormwater system. To ensure the delivery of best practice stormwater management through strategic planning and development.

8 URBAN STORMWATER MANAGEMENT MEASURES

A broad range of structural and non-structural options are available to address the stormwater issues identified in **Section 7.2**. The stormwater management options identified and assessed as part of this study comprises of five main approaches:

- Asset Management;
- Education and Awareness;
- Maintenance and Monitoring;
- Planning and Development; and
- Stormwater Infrastructure.

Appendix F provides a detailed list of options that have been considered to address the stormwater management issues. Many of these have been identified in previous studies and some of them have already been implemented by Council. Of the list of options identified, a shortlist of options was selected to be included in the USMP based on expected effectiveness, viability, and in liaison with Council. These are described further in the following sections.

8.1 ASSET MANAGEMENT

The current stormwater assets within Manilla provide valuable services to the area enabling a safe and reliable stormwater collection & discharge network to provide flood protection and prevention. In order to provide adequate service and benefits to community, these assets must be properly maintained and developed.

Council has been documenting details of the stormwater management assets within the study area. However, the information available is limited and have not been ground-truthed at most locations. Asset condition data is also not currently available resulting in lack of easily accessible information for maintenance planning. In addition, due to limited internal resources and funding, and a focus on capital works such as road rehabilitation, the maintenance requirements for stormwater drainage assets have been a lower priority. Limited improvement of poorly performing or ageing assets has occurred due to limited funding and renewals planning.

To address these issues, feasible asset management options were identified for implementation, and these are documented in Table 8-1.

Table 8-1 Stormwater Asset Management Measures

Option ID	Option Description	Stormwater Management Objective Met
A1	**Utilise a maintenance management system for planning, scheduling, and recording maintenance and inspections. Maintenance records will help identify issues and develop solutions.** Council currently uses Reflect, which is an inspection and maintenance software, to maintain the roads and pavements within Manilla. During the Council staff interviews, it was identified that extending the use of this software for stormwater management assets will allow the maintenance crews to accurately assess asset conditions and plan for rehabilitation and renewal.	Water Quality Water Quantity Public Health Economic Viability
A2	**Survey the existing stormwater network to improve the completeness of Council's dataset.** Much of the existing dataset lacks invert level information that could be improved through survey and recordkeeping, starting with areas of increased flood risk.	Economic Viability
A3	**Condition Assessment of Council's current stormwater infrastructure through field inspection starting with areas where failure has high-risk or consequence.** The current condition of assets have been determined through theoretical degradation. This option will verify the stormwater management asset data base with field inspection and/or CCTV condition assessments to inform appropriate actions for those assets requiring maintenance, renewal or upgrade to improve performance including associated costs and priority. Option A2 and A3 are recommended to be undertaken in parallel to reduce labour efforts.	Water Quantity Public Health Economic Viability

Option ID	Option Description	Stormwater Management Objective Met
A4	**Council to develop a stormwater asset renewal program.** Council currently has a pavement renewal program which allows regular maintenance and upgrades of the sealed road network. During the Council staff interviews, it was identified that a similar program be developed for stormwater asset renewal. This however will be subject to availability of suitable asset condition data (Option A3) and maintenance records (Option A1).	Water Quantity Public Health Economic Viability
A5	**Investigate the stormwater benefits of capturing stormwater runoff from Council buildings for re-use.** The *Tamworth Regional Blueprint 100* Priority 1.2 encourages water conservation through capture of stormwater runoff from Council buildings for reuse.	Water Quantity Public Health Water Conservation
A6	**Investigate the stormwater benefits of roof runoff capture, ground water usage, and recycled water for reuse. Achieve efficiencies and sustainability for whole of life maintenance of facilities, including site selection based on water security / rationalisation of parks and sports precincts.** The *Tamworth Regional Blueprint 100* Priority 6.3 identifies practices related to low impact stormwater management including consideration of roof capture, ground water usage, and recycled water for reuse for facilities across parks and sports precincts.	Water Quantity Public Health Water Conservation

8.2 EDUCATION AND AWARENESS

Community education and awareness can play a significant role in the best practice management of stormwater within a catchment. People are often unaware that their activities (at work, while travelling or at home) can have an impact on stormwater and result in environmental degradation. Suitable education and awareness programs for various sectors of the community can provide a catalyst for a change in behaviour that contributes to stormwater pollution and volume.

Education and awareness are one of the non-structural methods that can be used in an integrated approach to best practice stormwater management, Education and awareness measures are described in Table 8-2.

Table 8-2 Stormwater Education and Awareness Measures

Option ID	Option Description	Stormwater Management Objective Met
E1	**Develop a drain stencilling education program.** Drain stencilling is a program designed to raise awareness and reduce the impacts of stormwater pollution in rivers, creeks, and local waterways. The program involves various community groups stencilling stormwater drain lids with environmental messages. As many people are not aware that stormwater drain pipes carry water to the nearest creek or river without any form of treatment, the messages stencilled will remind the community that actions such as washing the car on the road or driveway, littering, sweeping or hosing leaves and dirt into gutters, and not picking up after their dog can directly affect the health of the local waterways. **Involve community groups and school students with stormwater programs.** Programs may include stencilling slogans over drain inlets and the installation of appropriate signs in strategic locations, promoting some early drainage awareness. **Engaging External Environmental group** Actively involve existing environmental groups such as Landcare, Rivercare and Catchment Management Committee (CMC) process and discuss relating to stormwater issues.	Water Quality Ecosystem Health Community Involvement

Option ID	Option Description	Stormwater Management Objective Met
E2	**Public education and awareness campaign on excessive watering, companion animal waste, car washing, Stormwater friendly gardens and recycling.** This option was identified in the Tamworth 2000 Urban Stormwater Management Plan. This is yet to be implemented and as part of this study it was identified that there is benefited to include this option and extend it to Manilla. Campaigns such as these will help raise knowledge and awareness within the community on stormwater management issues and the role, they can play by changing behaviours to reduce the impact to downstream environment.	Water Quality Ecosystem Health Community Involvement
E3	**Education campaign targeted at Building and Construction industry on the implementation of soil and water management controls during construction.** This option was identified in the Tamworth 2000 Urban Stormwater Management Plan. This is yet to be implemented and as part of this study it was identified that there is benefitted to include this option and extend it to Manilla. When land is cleared of vegetation for construction, the soil is exposed and is vulnerable to erosion from rainfall events. Eroded soils lead to blocked drains and contribute to stormwater turbidity and waterways pollution. Engaging with the building and construction industry and increasing their knowledge and awareness on soil and water management controls during construction will helps reduce the impact to downstream environment.	Water Quality Ecosystem Health Community Involvement Planning and Development
E4	**Investigate current industrial / commercial stormwater management practices and develop industry / commercial stormwater awareness programs.** This option was identified in the Barraba 2000 Urban Stormwater Management Plan. This is yet to be implemented and as part of this study it was identified that there is benefitted to include this option and extend it to Manilla. Industrial and commercial areas are a major contributor to stormwater pollution and degrading waterways health. Careful site management by businesses in commercial and industrial areas is therefore critical to avoid damage to receiving waterways.	Water Quality Ecosystem Health Community Involvement

Option ID	Option Description	Stormwater Management Objective Met
E5	**Expand the current litter education program to incorporate stormwater and river health.** Council currently has a litter education program which is run by the sustainability team and involves sharing information about waste management and sustainability practices with residents, students, and teachers. This program can be extended to incorporate stormwater management and waterways health.	Water Quality Ecosystem Health Community Involvement
E6	**Incorporate WSUD in the current water efficiency education programs.** Council currently has various water efficiency education programs which is run by the sustainability team. The programs aim at achieving water efficiencies in business, home, and garden use. These programs can be extended to incorporating WSUD in homes and businesses.	Water Quantity Water Quality Water Conservation Ecosystem Health Community Involvement
E7	**Develop a stormwater pollution and management education program for local schools and community organisations.** This option was identified in the 2000 Urban Stormwater Management Plan. This is yet to be implemented and as part of this study it was identified that there is benefit to include this option and extend it to Manilla. Local schools and community organisation can be a valuable resource to educate the wider local community. Partnerships can be formed, and education programs can be delivered through them to raise knowledge and awareness within the community on stormwater management issues and the role they can play to reduce the impact to the downstream receiving environment.	Water Quality Ecosystem Health Community Involvement

Option ID	Option Description	Stormwater Management Objective Met
E8	**Undertake community/environmental group led water quality monitoring (macroinvertebrate sampling) as part of other Council/community led events that enables community and school kids to monitor the quality and health of local waterways (e.g., Streamwatch).** This option was identified in the 2000 Urban Stormwater Management Plan. As part of this study, it was identified that there is benefitted to extend this option to Manilla. Waterways are home for many small animals called macroinvertebrates. These animals generally include insects, crustaceans, molluscs, arachnids, and annelids. They are sensitive to different chemical and physical conditions of the waterway and if there is a change in the water quality then the macroinvertebrate community may also change. Therefore, the richness of macroinvertebrate community composition in a waterway can be used to provide an estimate of waterway health. Council has undertaken community/school led water quality monitoring (macroinvertebrate sampling) as part of stormwater education in Tamworth. This could be extended to Manilla.	Water Quality Ecosystem Health Community Involvement
E9	**Publish regular stormwater information on Council's website and social media accounts.** This option was identified in the Tamworth 2000 Urban Stormwater Management Plan. This is yet to be implemented and as part of this study it was identified that there is benefit to include this option and extend it to Manilla. This is the traditional engagement approach wherein Council disseminates regular stormwater management information through its website, social media, and newsletters.	Water Quality Ecosystem Health Community Involvement

8.3 MAINTENANCE AND MONITORING

Stormwater management assets have a long life. The life cycle costs to provide stormwater management services includes operation, maintenance, renewal, acquisition, upgrade of existing and construction of new assets. Regular maintenance and monitoring of these assets will ensure that the asset functions effectively and for its intended lifespan. Suitable maintenance and monitoring options were identified for implementation, and these are documented in Table 8-3.

Table 8-3 Stormwater Maintenance and Monitoring Measures

Option ID	Option Description	Stormwater Management Objective Met
M1	**Compliance and monitoring program for private OSD systems (in combination with P6).** The purpose of OSD is to control peak flow rates and peak time by temporality storing some of the rainfall runoff from a site and releasing the stored runoff at a controlled rate. To ensure the OSD functions effectively, it is essential that these systems are maintained regularly. A compliance and monitoring program for the private lot OSDs will allow Council to regularly inspect the OSD systems and ensure they are clean and functioning as per requirement.	Water Quantity Public Health Planning and Development
M2	**Investigate the feasibility of planting native vegetation along the existing stormwater channels.** This option was identified in the Barraba 2000 Urban Stormwater Management Plan. As part of this study it was identified that there is benefit to extend this option to Manilla. There are many benefits to be gained from planting native vegetation in urban waterways such as stream banks and stormwater channels. They create habitat for native wildlife, improve water quality, and improve the local aesthetics and natural heritage. It is also often the cheapest form of revegetation.	Water Quantity Water Quality Ecosystem Health Community Involvement Economic Viability

Option ID	Option Description	Stormwater Management Objective Met
M3	**Weed control / management programs within the stormwater channels.** This option was identified in the 2000 Barraba Urban Stormwater Management Plan. As part of this study it was identified that there is benefit to extend this option to Manilla. The existing vegetation within the stormwater channels have been impacted by invasion of weeds. Urban stormwater typically contains elevated levels of plant nutrients phosphorus and nitrogen. This increases the nutrient levels in local vegetation. Weeds flourish in high nutrient environments and compete with indigenous species. When high nutrients are combined with the presence of weeds and the changed hydrological regime of urban areas, damaging ecological stress can be created to the downstream waterways where the stormwater discharges into.	Water Quality Ecosystem Health Community Involvement Economic Viability
M4	**Regularly maintain grassed areas within and adjacent to open urban stormwater channels.** This option was identified in the Barraba 2000 Urban Stormwater Management Plan. As part of this study it was identified that there is benefit to extend this option to Manilla. Regularly maintaining the grassed areas within and adjacent to open urban channels will enhance pollutant removal, provide some groundwater recharge, and reduce stormwater runoff volume.	Water Quality Ecosystem Health Community Involvement Economic Viability
M5	**Implement a cost-effective strategy to improve proactive cleaning of stormwater structures.** This option was identified in the Tamworth 2000 Urban Stormwater Management Plan. As part of this study it was identified that there is benefit to extend this option to Manilla. Regular cleaning of stormwater structures such as pits and pipes will reduce the potential for blockages and subsequently reduce localised flooding issues.	Water Quantity Ecosystem Health Public Health Economic Viability

8.4 PLANNING AND DEVELOPMENT

Good land use planning controls and stormwater management practices can improve the stormwater runoff quantity and quality without the need of hard engineering practices. Growth of urban areas increased urban density, commercial / industrial development, and lack / failure of stormwater infrastructure can lead to increased urban pollution of local ecosystems and localised flooding problems.

To help Council address the stormwater management issues feasible planning and development options were identified for implementation, and these are documented in Table 8-4**.** The Tamworth Regional Blueprint 100 has guided the development of these options. These options are more cost-effective in comparison to hard engineering options with a focus on minimisation and / or prevention of the issues related to stormwater management.

Table 8-4 Stormwater Planning and Development Measures

Option ID	Option Description	Stormwater Management Objective Met
P1	**Improve Council's Integrated Management System (IMS) to control the use of chemicals near waterways.** This option was identified in the Barraba 2000 Urban Stormwater Management Plan. This is yet to be implemented and as part of this study it was identified that there is benefit to include this option and extend it to Manilla. The use of chemicals such as herbicides and pesticides near waterways can affect the aquatic flora and fauna. Improving the IMS to allow safe and effective practices will allow for responsible use of chemicals and reduce the impact on waterway health.	Water Quality Ecosystem Health
P2	**Review erosion control procedures on new developments. Provide relevant Council staff with training to enable this.** This option was identified in the Moonbi 2000 Urban Stormwater Management Plan. This is yet to be implemented and as part of this study it was identified that there is benefit to include this option and extend it to Manilla. When land is cleared of vegetation for construction, the soil is exposed and is vulnerable to erosion from rainfall events. Eroded soils lead to blocked drains and contribute to stormwater turbidity and waterways pollution. Inspection and auditing of construction sites is typically conducted by Council and hence having suitable procedures in place with trained Council staff undertaking inspections, will ensure improved implementation of erosion control procedures.	Water Quality Ecosystem Health Planning and Development

Option ID	Option Description	Stormwater Management Objective Met
P3	**Stormwater management requirements for new subdivisions needs to be reviewed and updated including consideration of Water Quality targets.** As is becoming increasingly common in Council's across NSW, specification of stormwater management and water quality targets in the DCP will provide developers and their consultants guidance for development applications to Council. These requirements can be high level relating to overall outcomes such as post-pre stormwater quantity requirements and nutrient and pollutant removal targets (TP, TN, TSS). Or these requirements can be very prescriptive relating not only to the desired outcomes but also Council's preferences with respect to acceptable treatment types, methods of analysis and modelling parameters and reporting. The best practice stormwater pollution reduction targets (adopted by most Councils in NSW) are: TP – 65% TN – 45% TSS – 85% Gross Pollutants – 90%	Water Quality Water Conservation Ecosystem Health Public Health Economic Viability Planning and Development
P4	**Council to develop a WSUD policy.** A WSUD policy will provide an overarching documentation of Council's water quality objectives and reduce the negative impact of development on the natural environment. The policy will provide a framework for new developments to improve stormwater quality and reduce potable water consumption. This policy will guide Council staff in development of short to medium term planning and will assist external stakeholders in interpreting Council's WSUD desired outcomes through documentation.	Water Quantity Water Quality Water Conservation Ecosystem Health Public Health Economic Viability Planning and Development

Option ID	Option Description	Stormwater Management Objective Met
P5	**Council to adopt WSUD requirements as part of the DCP.** Similar to option P3, the inclusion of WSUD requirements within the DCP will provide developers and their consultants guidance for development applications to Council. Inclusion within the DCP will provide these requirements the backing of the planning control framework, providing Council greater legislative support to be able to enforce these requirements. It will also account for WSUD as a consideration in a consolidated set of development controls, simplifying the development application through limiting the number of policies and plans that need to be referenced.	Water Quantity Water Quality Water Conservation Ecosystem Health Public Health Economic Viability Planning and Development
P6	**Develop an OSD policy and pilot program that specifies OSD sizing and orifice requirements at subcatchment scale (especially for smaller developments).** OSD provides temporary storage of stormwater runoff to reduce the rate of runoff flowing onto other properties or into Council's drainage system. This is particularly important to reduce the chance of nuisance flooding downstream for the short, intense storm events. An OSD policy will define when OSD system is required and the basic sizing requirements of these systems.	Water Quantity Public Health Planning and Development
P7	**Review OSD requirements for subdivision of 5 or more lots. Allow private OSD for smaller subdivisions and public detention basins for larger subdivisions.** As per the current TRC DCP, for residential (multi-dwelling) type of development, the developer must demonstrate no detrimental downstream flood impacts. Options include increasing downstream infrastructure, detention basins (less preferred) or underground detention. The ongoing maintenance of these assets is then transferred to Council. Due to the maintenance burden on Council, it is recommended that public detention basins be utilised for larger catchments. Lot scale individual detention systems may be acceptable for the smaller subdivisions.	Water Quantity Public Health Planning and Development

Option ID	Option Description	Stormwater Management Objective Met
P8	**Staged approach to WQ targets in DCP. Short term – Gross pollutant targets. Medium to long term - TSS/TP/TP targets.** This option stages the approach to achieve option P3. In the immediate short term, gross pollutant reduction target can be adopted for the detention basins required as part of the DCP. In the medium term, TP, TN and TSS reduction targets can be adopted for the detention basins required as part of the DCP.	Water Quality Ecosystem Health Planning and Development
P9	**Stream Erosion Index (SEI) target in DCP.** Stream erosion is assessed using a measure of the increase in the relative frequency in flows from the site greater than the identified 'stream forming flow' resulting from the urbanisation of the catchment. The Stream Erosion Index (SEI) is defined by DPE as the post development duration of flows greater than the 'stream forming flow' divided by natural duration of flows greater than the 'stream forming flow'. This provides an appropriate means of assessing and addressing the impacts of urbanisation on the frequency of regular flows to the waterways. SEI will provide a means of waterway erosion assessment for new developments that will set easily reviewable outcomes based on simplified hydrologic and geomorphologic principles. This will help to ensure that waterway stability is considered for future developments as a requirement of development controls in the DCP. The DPE guidelines recommend a SEI of between 3.5-5.	Water Quality Ecosystem Health Planning and Development
P10	**Incorporate waterway health as part of Council's sustainability strategy focus areas.** Incorporating waterway health as a focus area within Council's sustainability strategy will ensure that the importance of waterways is continually considered in the future. As a strategic focus area, waterway health will have priority responses identified and promoted.	Water Quality Ecosystem Health Economic Viability Planning and Development

Option ID	Option Description	Stormwater Management Objective Met
P11	**Identify the blue/green networks (drainage reserves that combine as parks with cycleway / walkways) in new greenfield areas to reduce drainage cost for greenfield development.** In accordance with Priority 2.2 of Blueprint 100, an up-to-date database of existing blue / green areas will simplify the initial WSUD assessment for Council. Identifying these existing networks around greenfield development sites will help to understand the baseline condition for water quality and ecosystem of the catchment and may offer opportunities to reduce drainage costs by encouraging use of existing networks rather than the design and construction of new networks of treatment.	Water Quantity Water Quality Community Involvement Ecosystem Health Economic Viability Planning and Development
P12	**Collate existing low impact stormwater guidelines and link them to Tamworth Regional Council policies. Include urban design measures that control and manage stormwater. Promote these stormwater guidelines through Tamworth Regional Council's communications.** In accordance with Priority 6.2 of Blueprint 100, this strategy looks to simplify the process for developers and other stakeholders in understanding Council's stormwater management requirements. This simplification through consolidation and through emphasis in communications improves the likelihood of positive stormwater management outcomes through stakeholders engaging in good faith with Council's requirements.	Economic Viability Planning and Development
P13	**Empower developers and designers to consider urban stormwater management at the early stages of their master planning.** In accordance with Priority 6.2 of Blueprint 100, this strategy looks to promote consideration of urban stormwater management from the beginning of planning for developers. By emphasising stormwater management considerations in discussions with developers, it will encourage development layouts that prioritise stormwater and water quality outcomes rather than tailoring non-best practice stormwater solutions to developments at the end of the planning and designing process.	Water Quantity Water Quality Water Conservation Ecosystem Health Economic Viability Planning and Development

Option ID	Option Description	Stormwater Management Objective Met
P14	**Complete and utilise mapping for flooding.** A comprehensive flood mapping database will aid Council in reviewing and advising stakeholders such as developers of flood risk for sites throughout the LGA. This flood mapping could also be made publicly available on Council's website. While the information is already available through Flood Study reports on Council's website, the use of a consolidated flood mapping platform will assist in improving public flood awareness in the community and provide developers a better understanding of flood risk in the LGA.	Water Quantity Public Health Planning and Development
P15	**Council to continue to promote site WSUD treatments such as OSD and rainwater tanks as opposed to regional treatment and detention basins. Swales and treatments in the public domain are preferred over regional basins.** Regional treatment basins can produce ongoing maintenance issues and as they are typically located in the lower reaches of the catchment, these have in the past been shown to have lesser benefit in some instances. Alternatively, for localised and site-based treatments in the upper reaches of the catchment, treatment for an entire development is not consolidated and reliant upon one single site, and if designed appropriately the maintenance requirements can be less. Treatments within the streetscape are important as they allow for treatment closer to the source of highly polluted road runoff and reduces the need for dedication of public lands specifically for stormwater management.	Water Quantity Water Quality Ecosystem Health Economic Viability Planning and Development

Option ID	Option Description	Stormwater Management Objective Met
P16	**Stormwater management levy to allow Council to raise stormwater management revenue in addition to that already provided through Council's general income.** In regional NSW, responsibility for stormwater management is shared between State Government, water corporations, local government, and private owners / developers. Funding for stormwater management is provided through a variety of mechanisms including: > Council general revenue; > Stormwater management service charge; > Special rate variation (which excludes the ability to levy the service charge); and > Developer contributions and special development levies. Council currently charges a stormwater management service for Tamworth. Extending this to Manilla will allow Council to raise additional revenue to cover some of the costs of providing stormwater management services including the management measures developed as part of this USMP.	Economic Viability Planning and Development

8.5 STORMWATER INFRASTRUCTURE

Structural on-ground stormwater infrastructure measures were identified through discussion with Council staff, data collection, and site inspections. These measures are aimed at preventing / avoiding / reducing the likelihood of flood risks, improving stormwater runoff quality, and enabling water conservation through hard engineering. These options are discussed in Table 8-5 and **Appendix F**. The locations of these options are shown in **Map A7** in **Appendix A**.

Table 8-5 Stormwater Infrastructure Measures

Option ID	Option Description	Stormwater Management Objective Met
S1	**Investigate stormwater harvesting and storage opportunity in the town of Manilla for distribution and reuse on main showground, sporting field, and public toilets.** This option was identified through the 2011 Strengthening Basin Communities: Planning Component – Round 2. This is yet to be undertaken and as part of this study it was identified that there is benefitted to include this option as part of the stormwater management plan as this option meets the requirements of the Blueprint 100.	Water Quantity Water Quality Ecosystem Health Water Conservation Public Health Economic Viability
S2	**Reshape South Street and install drainage network to convey major flows** A major drainage system to direct water down south street without impacting properties on the southern side of South Street. Flows are likely to be directed overland. This option was identified through the 2021 Manilla Stormwater Priorities.	Water Quantity Water Conservation Public Health
S3	**Install piped drainage network on Court St between Hill St and Arthur St.** This option was identified through the 2021 Manilla Stormwater Priorities. Drainage exists in Arthur Street but larger flows skip the kerb and run through private property. An extension of the existing drainage would improve capture.	Water Quantity Public Health
S4	**Bank stabilisation and scour protection at the end of Market Street stormwater outlet.** This option was identified through site visit.	Water Quality Ecosystem Health Public Health

Option ID	Option Description	Stormwater Management Objective Met
S5	**WQ Device at the end of Market St stormwater outlet prior to discharge into Namoi River.** This option was identified through site visit. During site visit, large stormwater inlets were observed at the intersection of Alice St and Queen St. A Gross Pollutant traps (GPT) / grate at the end of Market St stormwater outlet prior to discharge into Namoi River will prevent gross pollutants such as litter and debris discharging into Namoi River.	Water Quality Ecosystem Health Community Involvement
S6	**WQ Device at the outlet underneath old bridge prior to discharge into Namoi River** During the site visit, a stormwater outlet was observed underneath the old bridge at the Namoi River. It was observed that the outlet provides an opportunity to install a Gross Pollutant Trap (GPT) that will prevent gross pollutants such as litter and debris prior to discharging the stormwater runoff into the river.	Water Quality Ecosystem Health Community Involvement
S7	**WQ treatment in the open space between Willows Pde, Kanangra Rd and Worooma Cres.** There is an open space currently located between Willows Pde, Kanangra Rd and Worooma Cres. The open space was identified to be suitable for WQ treatment device such a bioretention system or possibly wetland. Manilla currently does not have any water quality treatment infrastructure and this site provides a suitable location for a pilot study to gather community support for future bioretention systems.	Water Quality Ecosystem Health Community Involvement
S8	**Reshaping and regrading of the connections from the culverts along Church St to the drainage channel.** During the site visit it was observed that connections from the culverts along Church St to the drainage channel can be upgraded by reshaping and regrading.	Water Quantity Public Health Economic Viability

9 URBAN STORMWATER MANAGEMENT IMPLEMENTATION PLAN

9.1 MULTI CRITERIA ASSESSMENT

A Multi Criteria Assessment (MCA) approach was adopted for the comparative assessment of all options identified. This approach to assess the merits of various options is based on:

- Social costs and benefits;
- Economic costs and benefits;
- Environmental costs and benefits; and
- The decision making process (governance).

9.1.1 Scoring System

A scoring system was devised to subjectively rank each option against a range of criteria given the background information on the nature of the catchment. The scoring is based on the MCA approach, incorporating economic, social, environmental, and governance criterion. The criterion and scoring system adopted includes:

- Economic
  - Capital costs
  - Ongoing costs
  - Feasibility
  - Staging of works
- Social
  - Reduction in frequency of flooding
  - Visual Impact
- Environmental
  - Number of pollutants removed
  - Improved water quality
  - Fauna / Flora impacts
- Governance
  - Community support and executive commitment
  - Compatible with existing policies and plans

The scoring system summary is provided in Table 9-1.

Table 9-1 MCA Assessment – Scoring System

Category	Criterion	Description	Score				
			-2	-1	0	1	2
Economic	Capital Costs	Initial construction costs to Council	>$1 million	$500,000 - $1 million	$200,000 - $500,000	$100,000 - $200,000	<$100,000
	Ongoing Costs	Annual maintenance costs to Council	>$50,000	$20,000 - $50,000	$10,000 - $20,000	$1000 - $10,000	<$1000
	Feasibility	Establishes the feasibility of options based on constructability, and bureaucratic difficulties such as land acquisition and agreements with external agencies	There are a number of factors that pose a significant impact on the feasibility of the project	There are few factors that pose a potential impact on the feasibility of the project	May or may not be feasible	Likely to be feasible	Very likely to be feasible
	Staging of Works	Ability to stage proposed works	NA	NA	Works cannot be staged	Some minor components of the works may be staged	Significant components of the works can be staged
Social	Reduction in Frequency of Flooding	The impact of option on flooding for roads and other public and private areas	Increases the flooding risk for a significant area	Increases the flooding risk for a minor area	No change to flood risk	Reduces the flood risk for a minor area	Reduces the flood risk for a significant area
	Visual Impact	Impact of completed works on visual amenity or function of public domain	Significant loss of existing visual amenity or public domain	Minor loss of existing valued visual amenity or public domain	No change	Some improvement to visual amenity or public domain	Significant improvement to visual amenity or public domain

Category	Criterion	Description	Score				
			-2	-1	0	1	2
Environmental	Number of Pollutants Removed	This has been based on the types and number of pollutants removed	Significant loss of water quality	Minor loss of water quality	No improvement	Primary Treatment Only (Litter, large Sediments)	Secondary Treatment (Litter, Nutrients, Sediments, indeterminant Metals and Hydrocarbons)
	Improved Water Quality	The impact of option on pollution reduction. This has been based on the annual removal of Total Nitrogen (TN)	NA	NA	No improvement or indeterminant	<150kg/year	>150kg/year
	Flora/Fauna Impact	Likely impacts on biodiversity	High negative impact	Slight negative impact	No Impact	Some Benefit	Considerable Benefit
Governance	Community support and executive commitment	Potential support from the local community and internal stakeholders	Very unlikely to be supported	Unlikely to be supported	Neutral	Likely to be supported	Very likely to be supported
	Compatibility with policies and plans	Compliance with the planning policies requirements, and government regulations	Amendment required to either Council's current policies or plans	Slightly incompatible with Council's current policies or plans	Slightly incompatible with Council's current policies or plans, but could be grounds for reviewing policies or plans	Compatible with both Council's policies and plans	In line with and supported by Council's current policies or plans

The assignment of a score for each criterion for each option is shown in the completed matrix in **Appendix G**. The total score of each option was calculated by equally weighting criteria and summing the total. Each of the options was then ranked against each other based on the total scores, allowing identification of the referred options, namely those that provide the greatest benefit to the community. These total scores and rankings are also shown in **Appendix G**.

The rankings are proposed as the basis for selecting management options for prioritising their implementation. It is noted that both structural and non-structural options have been considered separately since it is difficult to directly compare these two types of measures.

Table 9-2 provides a ranked list of non-structural management options for consideration and Table 9-3 provides a ranked list of structural management options for consideration.

Table 9-2 Summary of MCA of Non-Structural Options

Option Type	Option ID	Description	Total Score	Rank
Asset Management	A1	Utilise a maintenance management system for planning, scheduling, and recording maintenance and inspections. Maintenance records will help identify issues and develop solutions.	3.00	25
	A2	Survey the existing stormwater network to improve the completeness of Council's dataset.	3.00	25
	A3	Condition Assessment of Council's current stormwater infrastructure through field inspection starting with areas where failure has high-risk or consequence.	3.50	6
	A4	Council to develop a stormwater asset renewal program.	3.50	6
	A5	Investigate the benefits of capturing stormwater runoff from Council buildings for re-use	3.50	6
	A6	Investigate the benefits of roof runoff capture, ground water usage, and recycled water for reuse. Achieve efficiencies and sustainability for whole of life maintenance of facilities, including site selection based on water security / rationalisation of parks and sports precincts.	3.50	6
Education and Awareness	E1	Develop a drain stencilling education program	3.50	6
	E2	Public education and awareness campaign on excessive watering, companion animal waste, car washing, Stormwater friendly gardens and recycling	3.50	6
	E3	Education campaign targeted at Building and Construction industry on the implementation of soil and water management controls during construction	3.50	6
	E4	Investigate current industrial / commercial stormwater management practices and develop industry / commercial stormwater awareness programs	3.50	6

Option Type	Option ID	Description	Total Score	Rank
	E5	Expand the current litter education program to incorporate stormwater and river health	3.50	6
	E6	Incorporate WSUD in the current water efficiency education programs	3.50	6
	E7	Develop a stormwater pollution and management education program for local schools and community organisations	3.50	6
	E8	Undertake community/environmental group led water quality monitoring (macroinvertebrate sampling) as part of other Council/community led events that enables community and school kids to monitor the quality and health of local waterways (e.g. Streamwatch)	3.50	6
	E9	Publish regular stormwater information on Council's website and, social media accounts.	3.50	6
Maintenance and Monitoring	M1	Compliance and monitoring program for private OSD systems (in combination with P6)	3.00	25
	M2	Investigate the feasibility of planting native vegetation along the existing stormwater channels	4.50	3
	M3	Weed control / management programs within the stormwater channels	5.00	1
	M4	Regularly maintain grassed areas within and adjacent to open urban stormwater channels	5.00	1
	M5	Implement a cost-effective strategy to improve proactive cleaning of stormwater structures	3.50	6
Planning and Development	P1	Improve Council's Integrated management system (IMS) to control the use of chemicals near waterways	2.50	36
	P2	Review erosion control procedures on new developments. Provide relevant Council staff with training to enable this.	3.00	25
	P3	Stormwater Management requirements for new subdivisions needs to be reviewed and updated including consideration of Water Quality targets	3.50	6
	P4	Council to develop a WSUD policy	3.50	6
	P5	Council to adopt WSUD requirements as part of the DCP	3.50	6
	P6	Develop an OSD policy and pilot program that specifies OSD sizing and orifice requirements at subcatchment scale (especially for smaller developments).	3.00	25

Option Type	Option ID	Description	Total Score	Rank
	P7	Review OSD requirements for subdivision of 5 or more lots. Allow private OSD for smaller subdivisions and public detention basins for larger subdivisions.	3.00	25
	P8	Staged approach to WQ targets in DCP. Short term – Gross pollutant targets. Medium to long term - TSS/TP/TP targets	3.50	6
	P9	Stream Erosion Index (SEI) target in DCP	3.00	25
	P10	Incorporate waterway health as part of Council's sustainability strategy focus areas	3.00	25
	P11	Identify the blue/green networks (drainage reserves that combine as parks with cycleway / walkways) in new greenfield areas to reduce drainage cost for greenfield development	3.00	25
	P12	Collate existing low impact stormwater guidelines and link them to Tamworth Regional Council policies. Include urban design measures that control and manage stormwater. Promote these stormwater guidelines through Tamworth Regional Council's communications.	3.00	25
	P13	Empower developers and designers to consider urban stormwater management at the early stages of their master planning	3.00	25
	P14	Complete and utilise mapping for flooding	3.25	24
	P15	Investigate co-location benefits of integrating WSUD into detention systems.	4.25	4
	P16	Stormwater management levy to allow Council to raise stormwater management revenue in addition to that already provided through Council's general income.	4.00	5

Table 9-3 Summary of MCA of Structural Options

Option Type	Option ID	Description	Total Score	Rank
Stormwater Infrastructure	S1	Investigate stormwater harvesting and storage opportunity in the town of Manilla for distribution and reuse on main showground, sporting field, and public toilets.	3.50	3
	S2	Reshape South Street and install drainage network to convey major flows	1.92	7
	S3	Install piped drainage network on Court St between Hill St and Arthur St	2.42	4
	S4	Bank stabilisation and scour protection at the end of Market Street stormwater outlet	2.17	5
	S5	WQ Device at the end of Market St stormwater outlet prior to discharge into Namoi River	2.17	5
	S6	WQ Device at the outlet underneath old bridge prior to discharge into Namoi River	1.92	8
	S7	WQ treatment asset in the open space between Willows Pde, Kanangra Rd and Worooma Cres	3.83	2
	S8	Reshaping and regrading of the connections from the culverts along Church St to the drainage channel	4.00	1

9.2 IMPLEMENTATION PLAN

The implementation plan for the measures is provided in Table 9-4. The plan includes:

- Description of each option;
- Estimated capital costs (design and construction) and operational costs (annual maintenance) – Capital and ongoing cost estimates provided for options in this report are preliminary only and more detailed cost estimates will be required during the concept and detailed design phase;
- Ranking based on MCA as described in **Section 9**; and
- Timeframe to complete (short, medium, long-term) – Short term (5 to 10 years) measures are relatively low in capital expenditure. Medium to long term (10 to 20 years) should be implemented as funding and opportunities arise including land availability.

Table 9-4 Implementation Plan of Options

Option Type	Option ID	Description	Cost		Ranking	Timeframe
			Capital	Ongoing		
NON-STRUCTURAL OPTIONS						
Maintenance and Monitoring	M3	Weed control / management programs within the stormwater channels	$100,000 - $200,000	$1000 - $10,000	1	Short term
Maintenance and Monitoring	M4	Regularly maintain grassed areas within and adjacent to open urban stormwater channels	<$100,000	<$1000	1	Short term
Maintenance and Monitoring	M2	Investigate the feasibility of planting native vegetation along the existing stormwater channels	<$100,000	<$1000	3	Short term
Planning and Development	P15	Investigate co-location benefits of integrating WSUD into detention systems.	<$100,000	<$1000	4	Short term
Planning and Development	P16	Stormwater management levy to allow Council to raise stormwater management revenue	<$100,000	<$1000	5	Medium to long term
Asset Management	A3	Condition Assessment of Council's current stormwater infrastructure through field inspection starting with areas where failure has high-risk or consequence.	$200,000 - $500,000	<$1000	6	Short term
Asset Management	A4	Council to develop a stormwater asset renewal program.	<$100,000	<$1000	6	Short term
Asset Management	A5	Investigate the benefits of capturing stormwater runoff from Council buildings for re-use	<$100,000	<$1000	6	Short term
Asset Management	A6	Investigate the benefits of roof runoff capture, ground water usage, and recycled water for reuse. Achieve efficiencies and sustainability for whole of life maintenance of facilities, including site selection based on water security / rationalisation of parks and sports precincts.	<$100,000	<$1000	6	Short term
Education and Awareness	E1	Develop a drain stencilling education program	<$100,000	<$1000	6	Short term
Education and Awareness	E2	Public education and awareness campaign on excessive watering, companion animal waste, car washing, Stormwater friendly gardens and recycling	<$100,000	<$1000	6	Short term
Education and Awareness	E3	Education campaign targeted at Building and Construction industry on the implementation of soil and water management controls during construction	<$100,000	<$1000	6	Short term

Option Type	Option ID	Description	Cost		Ranking	Timeframe
			Capital	Ongoing		
Education and Awareness	E4	Investigate current industrial / commercial stormwater management practices and develop industry / commercial stormwater awareness programs	<$100,000	<$1000	6	Short term
Education and Awareness	E5	Expand the current litter education program to incorporate stormwater and river health	<$100,000	<$1000	6	Short term
Education and Awareness	E6	Incorporate WSUD in the current water efficiency education programs	<$100,000	<$1000	6	Short term
Education and Awareness	E7	Develop a stormwater pollution and management education program for local schools and community organisations	<$100,000	<$1000	6	Short term
Education and Awareness	E8	Undertake community/environmental group led water quality monitoring (macroinvertebrate sampling) as part of other Council/community led events that enables community and school kids to monitor the quality and health of local waterways (e.g. Streamwatch)	<$100,000	<$1000	6	Short term
Education and Awareness	E9	Publish regular stormwater information on Council's website and, social media accounts.	<$100,000	<$1000	6	Short term
Maintenance and Monitoring	M5	Implement a cost-effective strategy to improve proactive cleaning of stormwater structures	<$100,000	<$1000	6	Short term
Planning and Development	P3	Stormwater Management requirements for new subdivisions needs to be reviewed and updated including consideration of Water Quality targets	<$100,000	<$1000	6	Short term
Planning and Development	P4	Council to develop a WSUD policy	<$100,000	<$1000	6	Short term
Planning and Development	P5	Council to adopt WSUD requirements as part of the DCP	<$100,000	<$1000	6	Short term
Planning and Development	P8	Staged approach to WQ targets in DCP. Short term – Gross pollutant targets. Medium to long term - TSS/TP/TP targets	<$100,000	<$1000	6	Medium to Long term
Planning and Development	P14	Complete and utilise mapping for flooding	<$100,000	<$1000	24	Short term
Asset Management	A1	Utilise a maintenance management system for planning, scheduling, and recording maintenance and inspections.	$100,000 - $200,000	$1000 - $10,000	25	Short term

Option Type	Option ID	Description	Cost		Ranking	Timeframe
			Capital	Ongoing		
		Maintenance records will help identify issues and develop solutions.				
Asset Management	A2	Survey the existing stormwater network to improve the completeness of Council's dataset.	$200,000 - $500,000	<$1000	25	
Maintenance and Monitoring	M1	Compliance and monitoring program for private OSD systems (in combination with P6)	<$100,000	<$1000	25	Short term
Planning and Development	P2	Review erosion control procedures on new developments. Provide relevant Council staff with training to enable this.	<$100,000	<$1000	25	Short term
Planning and Development	P6	Develop an OSD policy and pilot program that specifies OSD sizing and orifice requirements at subcatchment scale (especially for smaller developments).	<$100,000	<$1000	25	Short term
Planning and Development	P7	Review OSD requirements for subdivision of 5 or more lots. Allow private OSD for smaller subdivisions and public detention basins for larger subdivisions.	<$100,000	<$1000	25	Medium to Long term
Planning and Development	P9	Stream Erosion Index (SEI) target in DCP	<$100,000	<$1000	25	Medium to Long term
Planning and Development	P10	Incorporate waterway health as part of Council's sustainability strategy focus areas	<$100,000	<$1000	25	Short term
Planning and Development	P11	Identify the blue/green networks (drainage reserves that combine as parks with cycleway / walkways) in new greenfield areas to reduce drainage cost for greenfield development	<$100,000	<$1000	25	Short term
Planning and Development	P12	Collate existing low impact stormwater guidelines and link them to Tamworth Regional Council policies. Include urban design measures that control and manage stormwater. Promote these stormwater guidelines through Tamworth Regional Council's communications.	<$100,000	<$1000	25	Short term
Planning and Development	P13	Empower developers and designers to consider urban stormwater management at the early stages of their master planning	<$100,000	<$1000	25	Short term
Planning and Development	P1	Improve Council's Integrated management system (IMS) to control the use of chemicals near waterways	<$100,000	<$1000	36	Medium to Long term
STRUCTURAL OPTIONS						

Option Type	Option ID	Description	Cost		Ranking	Timeframe
			Capital	Ongoing		
Stormwater Infrastructure	S8	Reshaping and regrading of the connections from the culverts along Church St to the drainage channel	$200,000 - $500,000	$1000 - $10,000	1	Medium to long term
	S7	WQ treatment asset in the open space between Willows Pde, Kanangra Rd and Worooma Cres	$500,000 - $1 million	$1000 - $10,000	2	Medium to long term
	S1	Investigate stormwater harvesting and storage opportunity in the town of Manilla for distribution and reuse on main showground, sporting field, and public toilets.	$500,000 - $1 million	$20,000 - $50,000	3	Medium to long term
	S3	Install piped drainage network on Court St between Hill St and Arthur St	<$100,000	$1000 - $10,000	4	Short term
	S4	Bank stabilisation and scour protection at the end of Market Street stormwater outlet	$200,000 - $500,000	$1000 - $10,000	5	Medium to long term
	S5	WQ Device at the end of Market St stormwater outlet prior to discharge into Namoi River	$100,000 - $200,000	$1000 - $10,000	5	Medium to long term
	S2	Reshape South Street and install drainage network to convey major flows	$200,000 - $500,000	$1000 - $10,000	7	Medium to long term
	S6	WQ Device at the outlet underneath old bridge prior to discharge into Namoi River	$100,000 - $200,000	$1000 - $10,000	8	Medium to long term

9.3 MONITORING, REPORTING AND EVALUATION

An effective monitoring and reporting system is a key component to track progress of the management measures. It will assist Council in directing funds / effort where it is most needed and in future decision making. Obtaining feedback on the success of the management options is also a critical aspect of effective management.

This study should be regarded as a dynamic document requiring review and modification over time. Catalysts for change may include availability of new data, new flood events and experiences, legislative changes, and the availability of funding.

While management options are prioritised in this study, it is envisaged that these priorities will change over time due to changing circumstances. Accordingly, Council will have to regularly monitor and update priority actions on an annual basis in accordance with budget planning activities. Furthermore, a review of the study every five (5) to seven (7) years is warranted to ensure continuing relevance.

10 REFERENCES

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9. Tamworth Regional Council (2020a) *Tamworth Regional Blueprint 100 – Part 1*, May 26
10. Tamworth Regional Council (2020b) *Tamworth Regional Blueprint 100 – Part 2*, May 26
11. Tamworth Regional Council (2020c) Tamworth Regional Council Sport and Recreation Strategic Plan - Summary Report, August 18
12. Tamworth Regional Council (2020d) Tamworth Regional Council Sport and Recreation Strategic Plan, August 18
13. Tamworth Regional Council (2020e) *Chaffey Park Manilla Master Plan*

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APPENDIX A
MAPS

DATE PLOTTED: 2021-10-15 BY: MM
NW30190 - Manilla.qgz REV A

Stantec

Level 16, 207 Kent Str, Sydney 2000

Date
21/3/2023

Size
A3

Scale
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0 0.042 0.084 km

Manilla - Urban Stormwater Management Plan
Study Area

MAP A1
REV A

NORTH

Legend

- Study Boundary
- Stormwater Pipes
- Stormwater Pits
- Stormwater End Structures
- Culverts

Aerial (Received: TRC,2021)

DATE PLOTTED: 2021-10-17 BY: MM
NW30190 - Manilla.ggz REV A

Stantec

Level 16, 207 Kent Str, Sydney 2000

Date
21/3/2023

Size
A3

Scale
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Manilla - Urban Stormwater Management Plan
Stormwater Network

MAP A2
REV A

DATE PLOTTED: 2021-10-18 BY: MM
MW30190 - Manilla.qgz REV A

Stantec

Level 16, 207 Kent Str, Sydney 2000

Date
21/3/2023

Size
A3

Scale
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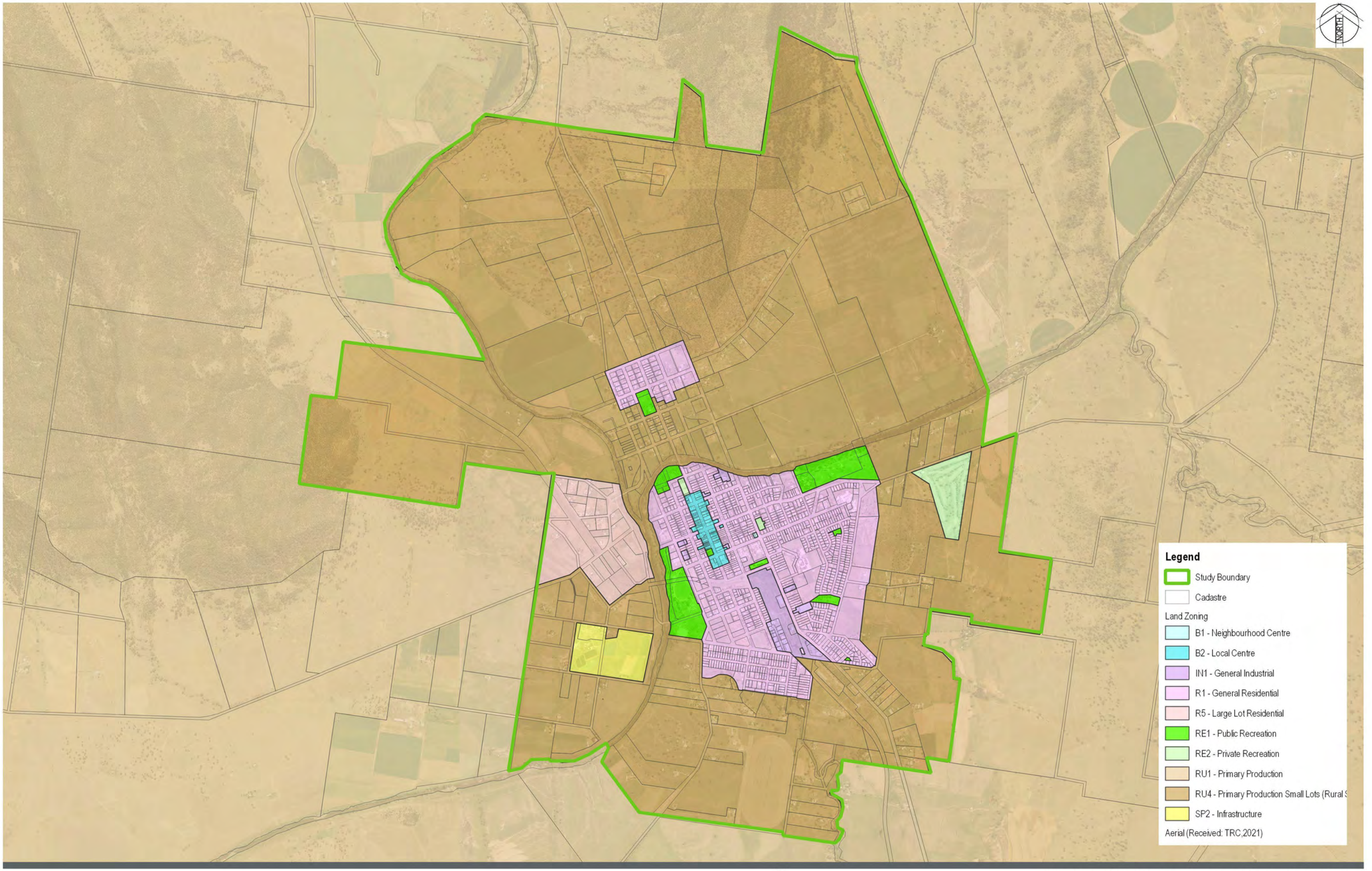
Manilla - Urban Stormwater Management Plan
Stormwater Priorities and CRM

MAP A3
REV A



DATE PLOTTED: 2021-10-18 BY: MM
NW30190 - Manilla.qgz REV A

Stantec

Level 16, 207 Kent Str, Sydney 2000

Date
21/3/2023

Size
A3

Scale
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Manilla - Urban Stormwater Management Plan
Land Zoning

MAP A4
REV A

NORTH

Legend

- Study Boundary
- Cadastre

Soil Landscape

- Alluvial
- Colluvial
- Erosional
- Residual
- Transferral

Aerial (Received: TRC,2021)

DATE PLOTTED: 2021-10-18 BY: MM
NW30190 - Manilla qgz REV A

Stantec

Level 16, 207 Kent Str, Sydney 2000

Date
21/3/2023

Size
A3

Scale
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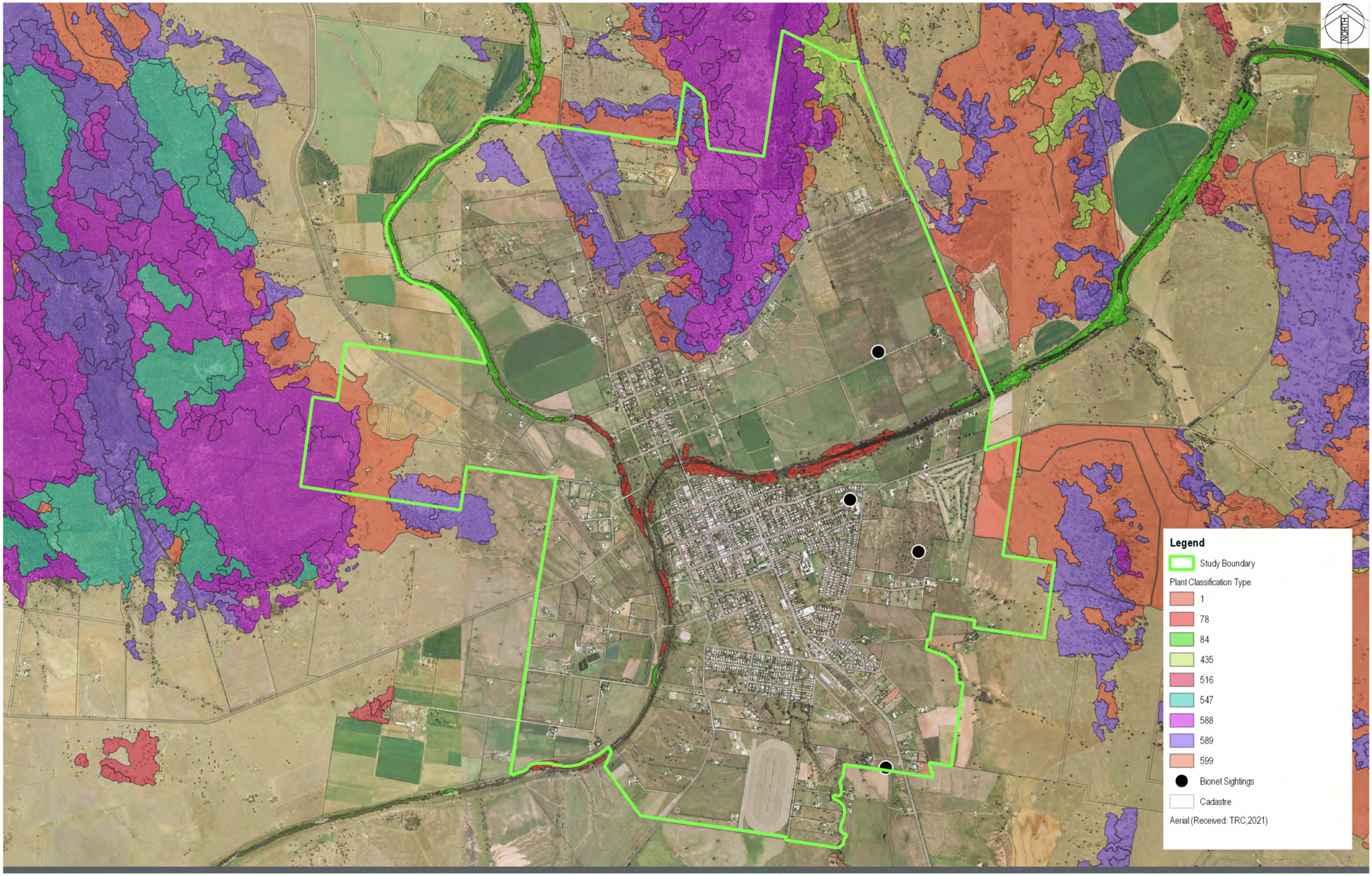
Manilla - Urban Stormwater Management Plan
Soil Landscape

MAP A5
REV A



DATE PLOTTED: 2023-3-21 BY: MM
IW30190 - Manilla.aprx REV B

Stantec

Level 16, 207 Kent Str, Sydney 2000

Date
21/3/2023

Size
A3

Scale
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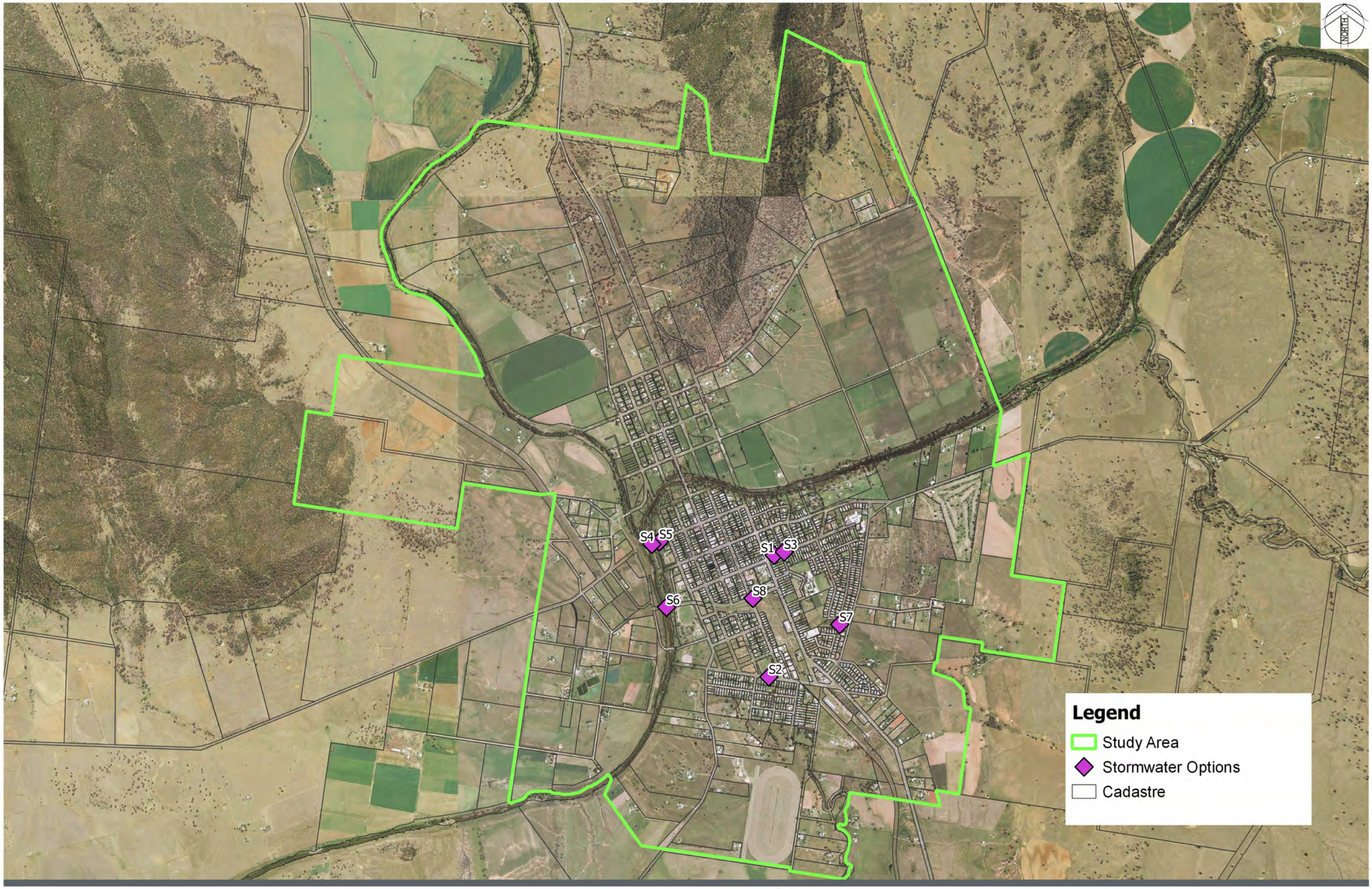
Manilla - Urban Stormwater Management Plan
Biodiversity

MAP A6
REV B



DATE PLOTTED: 2023-3-28 BY: MM
NV30190 - Manilla.qgz REV B

Stantec

Level 16, 207 Kent Str, Sydney 2000

Date
28/3/2023

Size
A3

Scale
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Manilla-Urban Stormwater Management Plan
Structural Stormwater Management Options

0 0.041 0.082 km

MAP A7
REV A

APPENDIX B
PROTECTED MATTER REPORT

Australian Government

Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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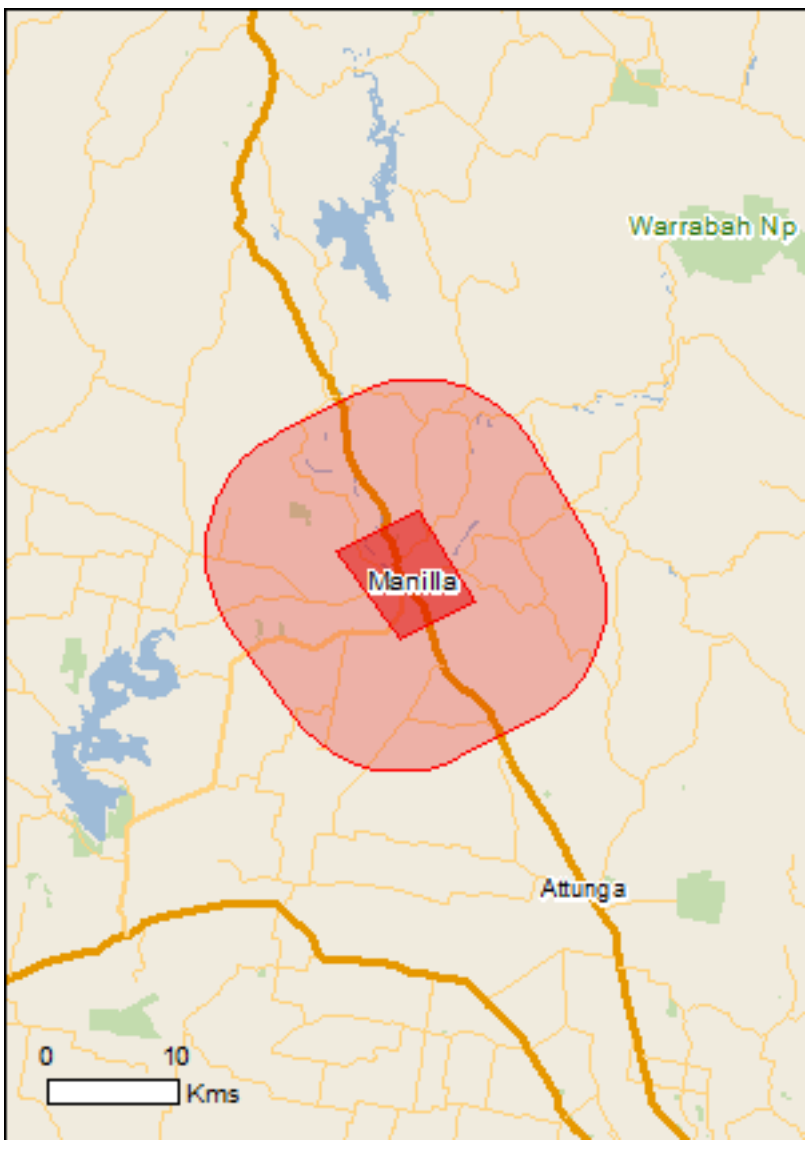

Coordinates

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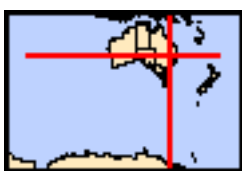

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	30
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	27
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Banrock station wetland complex	1000 - 1100km
Riverland	900 - 1000km upstream
The coorong, and lakes alexandrina and albert wetland	1100 - 1200km

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community may occur within area
New England Peppermint (Eucalyptus nova-anglica) Grassy Woodlands	Critically Endangered	Community may occur within area
Weeping Myall Woodlands	Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Polytelis swainsonii Superb Parrot [738]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Fish		
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
Androcalva procumbens [87153]	Vulnerable	Species or species habitat may occur within area
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat known to occur within area
Callistemon pungens [55581]	Vulnerable	Species or species habitat may occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat known to occur within area
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat known to occur within area
Homopholis belsonii Belson's Panic [2406]	Vulnerable	Species or species habitat may occur within area
Lepidium monoplocoides Winged Pepper-cress [9190]	Endangered	Species or species habitat may occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
[Thesium australe](#) Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
[Tylophora linearis](#) [55231]	Endangered	Species or species habitat likely to occur within area
Reptiles		
[Aprasia parapulchella](#) Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat may occur within area
[Uvidicolus sphyrurus](#) Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko [84578]	Vulnerable	Species or species habitat likely to occur within area
[Wollumbinia belli](#) Bell's Turtle, Western Sawshelled Turtle, Namoi River Turtle, Bell's Saw-shelled Turtle [86071]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
[Hirundapus caudacutus](#) White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area
[Myiagra cyanoleuca](#) Satin Flycatcher [612]		Species or species habitat known to occur within area
[Rhipidura rufifrons](#) Rufous Fantail [592]		Species or species habitat may occur within area
Migratory Wetlands Species		
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat may occur within area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area
[Charadrius leschenaultii](#) Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pandion haliaetus		
Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Telecommunications Commission

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius leschenaultii		
Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area
Chrysococcyx osculans		
Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Extra Information

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Cylindropuntia spp. Prickly Pears [85131]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-30.730269 150.674978,-30.706066 150.729909,-30.759775 150.768018,-30.78131 150.718236,-30.730269 150.674978,-30.730269 150.674978

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX C
SITE PHOTOS

Figure 2 Manilla St kerb outlet to Namoi River near the new highway

Figure 1 Rock lined outlet to Namoi River

Figure 3 Towards Namoi River

Figure 4 Headwall underneath the highway bridge

Figure 5 Headwall underneath the Highway bridge

Figure 6 Litter

Figure 8 Water channel towards Manilla River

Figure 7 Water traversing through private land towards the River

Figure 10 Old bridge

Figure 9 Culverts

Figure 12 Culvert underneath old bridge

Figure 11 Water ponding downstream of channel

Figure 13 Confluence of Manilla and Namoi Rivers

Figure 15 Other side of old bridge

Figure 14 Outlets to Namoi River

Figure 17 Outlets to Namoi rivers with water pipe within pumping water out of river

Figure 16 Water ponding in drainage channels

APPENDIX D
BASELINE WATER QUALITY

D.1 MONITORED WATER QUALITY DATA AVAILABILITY

The water quality samples collected at each testing site near the Manilla study area over the specified timeframes are listed in **Table 1-1**.

Table 1-1 Samples Collected at Tamworth Sites

Site	Manilla River at Manilla (R302)	Namoi River at Manilla (R301)	Manilla River at Split Rock Dam (R401)
Algae	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (3) 2019 (17) 2020 (8) 2021 (7)	2010 (2) 2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (3) 2019 (48) 2020 (36) 2021 (32)	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (9)
Alkalinity	2007 (14) 2008 (22) 2009 (24) 2010 (25) 2011 (22) 2012 (20) 2013 (23) 2014 (13) 2016 (20) 2017 (2) 2018 (2) 2019 (17) 2020 (7) 2021 (6)	2007 (24) 2008 (49) 2009 (51) 2010 (50) 2011 (51) 2012 (50) 2013 (51) 2014 (26) 2015 (3) 2016 (3) 2017 (27) 2018 (26) 2019 (31) 2020 (30) 2021 (32)	2021 (7)
Aluminium (Al)	2015 (1) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2015 (1) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)
Ammonia (NH_3)	N/A	2021 (2)	2021 (3)
Arsenic	2007 (8) 2008 (11) 2009 (12) 2010 (13) 2011 (11) 2012 (10) 2013 (11) 2014 (7) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2007 (11) 2008 (24) 2009 (27) 2010 (24) 2011 (25) 2012 (22) 2013 (23) 2014 (14) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Barium	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2009 (1) 2010 (2) 2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Boron	2014 (1) 2015 (2) 2016 (2) 2017 (1)	2009 (1) 2010 (2) 2014 (1) 2015 (2) 2016 (2) 2017 (1)	2014 (1) 2015 (2) 2016 (2) 2017 (1)

Site	Manilla River at Manilla (R302)	Namoi River at Manilla (R301)	Manilla River at Split Rock Dam (R401)
Calcium	N/A	2021 (2)	2021 (3)
Chloride	2007 (8) 2008 (12) 2009 (12) 2010 (12) 2011 (11) 2012 (10) 2013 (11) 2014 (7) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2007 (12) 2008 (25) 2009 (28) 2010 (27) 2011 (25) 2012 (23) 2013 (25) 2014 (14) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Chlorine	N/A	2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (1)	2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (1)
Chlorophyll. a	2021 (5)	2021 (25)	2021 (7)
Chromium	2021 (5)	2021 (19)	2021 (3)
Colour Apparent	2021 (5)	2021 (25)	2021 (7)
Colour True	2007 (8) 2008 (12) 2009 (12) 2010 (14) 2011 (11) 2012 (10) 2013 (11) 2014 (7) 2015 (2) 2016 (21) 2017 (2) 2018 (2) 2019 (17) 2020 (7) 2021 (6)	2007 (14) 2008 (25) 2009 (28) 2010 (28) 2011 (25) 2012 (23) 2013 (25) 2014 (14) 2015 (4) 2016 (4) 2017 (27) 2018 (26) 2019 (31) 2020 (30) 2021 (32)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (8)
Copper	N/A	2021 (2)	2021 (3)
Dissolved Iron	N/A	2021 (2)	2021 (3)
Dissolved Oxygen	2014 (1) 2015 (2) 2016 (21) 2017 (2) 2018 (2) 2019 (17) 2020 (7) 2021 (6)	2009 (1) 2010 (2) 2014 (1) 2015 (2) 2016 (4) 2017 (27) 2018 (26) 2019 (31) 2020 (30) 2021 (32)	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (8)
Electrical Conductivity (Salinity)	2007 (8) 2008 (12) 2009 (11) 2010 (14) 2011 (11) 2012 (10) 2013 (11) 2014 (6) 2016 (20) 2017 (2) 2018 (2) 2019 (17) 2020 (7) 2021 (6)	2007 (12) 2008 (25) 2009 (26) 2010 (28) 2011 (25) 2012 (23) 2013 (25) 2014 (13) 2015 (3) 2016 (3) 2017 (27) 2018 (26) 2019 (31) 2020 (30) 2021 (32)	2021 (7)

Site	Manilla River at Manilla (R302)	Namoi River at Manilla (R301)	Manilla River at Split Rock Dam (R401)
E-Coli	2014 (1) 2015 (2) 2016 (21) 2017 (2) 2018 (2) 2019 (17) 2020 (7) 2021 (6)	2009 (1) 2010 (2) 2014 (1) 2015 (2) 2016 (4) 2017 (27) 2018 (26) 2019 (31) 2020 (30) 2021 (32)	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (8)
Fluoride	2007 (8) 2008 (12) 2009 (12) 2010 (14) 2011 (11) 2012 (10) 2013 (11) 2014 (7) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2007 (12) 2008 (25) 2009 (29) 2010 (28) 2011 (25) 2012 (23) 2013 (25) 2014 (14) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Gross Alpha	2014 (1)	2014 (1)	2014 (1)
Gross Beta	2014 (1)	2014 (1)	2014 (1)
Geosmin	2021 (1)	2021 (1)	2021 (2)
Hardness (total)	2007 (8) 2008 (11) 2009 (12) 2010 (14) 2011 (11) 2012 (10) 2013 (11) 2014 (7) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2007 (13) 2008 (25) 2009 (28) 2010 (28) 2011 (25) 2012 (23) 2013 (25) 2014 (14) 2015 (5) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Iodide	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2009 (1) 2010 (5) 2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Iron	2007 (14) 2008 (21) 2009 (24) 2010 (25) 2011 (22) 2012 (20) 2013 (23) 2014 (14) 2015 (2) 2016 (20) 2017 (2) 2018 (2) 2019 (17) 2020 (7) 2021 (6)	2007 (21) 2008 (48) 2009 (50) 2010 (48) 2011 (51) 2012 (50) 2013 (51) 2014 (26) 2015 (5) 2016 (4) 2017 (26) 2018 (26) 2019 (31) 2020 (30) 2021 (32)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (8)
Lead	N/A	2021 (2)	2021 (3)
Magnesium	N/A	2021 (2)	2021 (3)

Site	Manilla River at Manilla (R302)	Namoi River at Manilla (R301)	Manilla River at Split Rock Dam (R401)
Manganese	2007 (14) 2008 (22) 2009 (24) 2010 (25) 2011 (22) 2012 (20) 2013 (23) 2014 (14) 2015 (2) 2016 (21) 2017 (2) 2018 (2) 2019 (17) 2020 (7) 2021 (6)	2007 (23) 2008 (48) 2009 (53) 2010 (48) 2011 (51) 2012 (50) 2013 (51) 2014 (26) 2015 (5) 2016 (4) 2017 (26) 2018 (26) 2019 (31) 2020 (30) 2021 (32)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (8)
Mercury	2007 (8) 2008 (11) 2009 (12) 2010 (13) 2011 (11) 2012 (10) 2013 (11) 2014 (7) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2007 (12) 2008 (25) 2009 (28) 2010 (28) 2011 (24) 2012 (23) 2013 (25) 2014 (14) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Methyl-Isoborneol (MIB)	2021 (1)	2021 (1)	2021 (2)
Molybdenum	N/A	2009 (1) 2010 (2) 2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Nickel	N/A	2021 (2)	2021 (3)
Nitrate NO3	N/A	2021 (2)	2021 (3)
Nitrite NO2	N/A	2021 (2)	2021 (3)
Nitric Oxide NOX	N/A	2021 (2)	2021 (3)
Pesticides	N/A	2009 (1) 2010 (2) 2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (1)	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)
pH	2007 (14) 2008 (22) 2009 (24) 2010 (26) 2011 (22) 2012 (20) 2013 (23) 2014 (14) 2015 (2) 2016 (21) 2017 (2) 2018 (2) 2019 (17) 2020 (7) 2021 (6)	2007 (24) 2008 (48) 2009 (53) 2010 (50) 2011 (51) 2012 (50) 2013 (51) 2014 (27) 2015 (5) 2016 (4) 2017 (27) 2018 (26) 2019 (31) 2020 (30) 2021 (32)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (8)

Site	Manilla River at Manilla (R302)	Namoi River at Manilla (R301)	Manilla River at Split Rock Dam (R401)
Selenium	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2009 (1) 2010 (2) 2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Silver	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2009 (1) 2010 (1) 2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Sulphate	2007 (7) 2008 (11) 2009 (12) 2010 (12) 2011 (11) 2012 (10) 2013 (11) 2014 (7) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2007 (10) 2008 (25) 2009 (28) 2010 (27) 2011 (24) 2012 (23) 2013 (25) 2014 (14) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Sodium	2007 (6) 2008 (9) 2009 (9) 2010 (11) 2011 (11) 2012 (8) 2013 (11) 2014 (7) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2007 (10) 2008 (18) 2009 (20) 2010 (24) 2011 (25) 2012 (22) 2013 (25) 2014 (14) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Total Dissolved Solids	2007 (8) 2008 (11) 2009 (12) 2010 (14) 2011 (11) 2012 (10) 2013 (11) 2014 (7) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2007 (12) 2008 (25) 2009 (28) 2010 (28) 2011 (25) 2012 (23) 2013 (25) 2014 (14) 2015 (5) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Temperature	2007 (2) 2021 (5)	2021 (25)	2021 (7)

Site	Manilla River at Manilla (R302)	Namoi River at Manilla (R301)	Manilla River at Split Rock Dam (R401)
Tin	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2009 (1) 2010 (1) 2011 (0) 2012 (0) 2013 (0) 2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Total Organic Carbon (TOC)	2007 (8) 2008 (11) 2009 (12) 2010 (14) 2011 (11) 2012 (10) 2013 (11) 2014 (7) 2015 (2) 2016 (17) 2017 (2) 2018 (2) 2019 (16) 2020 (7) 2021 (6)	2007 (12) 2008 (25) 2009 (29) 2010 (30) 2011 (25) 2012 (23) 2013 (25) 2014 (14) 2015 (5) 2016 (4) 2017 (24) 2018 (26) 2019 (30) 2020 (30) 2021 (31)	2014 (1) 2015 (2) 2016 (2) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (3)
Total Coliforms	2014 (1) 2015 (2) 2016 (19) 2017 (2) 2018 (2) 2019 (17) 2020 (7) 2021 (6)	N/A	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (7)
Turbidity	2007 (14) 2008 (21) 2009 (24) 2010 (26) 2011 (22) 2012 (20) 2013 (23) 2014 (14) 2015 (2) 2016 (21) 2017 (2) 2018 (2) 2019 (17) 2020 (7) 2021 (6)	2007 (21) 2008 (48) 2009 (53) 2010 (49) 2011 (51) 2012 (50) 2013 (51) 2014 (27) 2015 (5) 2016 (4) 2017 (27) 2018 (26) 2019 (31) 2020 (30) 2021 (32)	2014 (1) 2015 (2) 2016 (3) 2017 (2) 2018 (2) 2019 (2) 2020 (2) 2021 (8)
Uranium	2017 (1) 2018 (2) 2019 (2) 2020 (2) 2021 (2)	2017 (1) 2018 (2) 2019 (2) 2020 (2) 2021 (3)	2017 (1) 2018 (2) 2019 (2) 2020 (2) 2021 (4)
Zinc	N/A	2021 (2)	2021 (3)

APPENDIX E
STAKEHOLDER LETTER

Stantec Australia Pty Ltd
Street Address 16/207 Kent St
City STATE Zip Sydney, NSW, 2000
AUSTRALIA
ABN 17 007 820 322

Our Ref: NW30190:SC
Contact: Eric Lin

10 March 2023

Name of Agency
Address of Agency

Attention: Name of Contact

To Whom It May Concern,

URBAN STORMWATER MANAGEMENT PLANS FOR TAMWORTH, MANILLA, BARRABA, AND KOOTINGAL & MOONBI

We are writing to inform you that Stantec has been engaged by Tamworth Regional Council (Council) to undertake the Urban Stormwater Management Plans (USMPs) for the townships of Tamworth, Manilla, Barraba, and Kootingal & Moonbi.

Council currently has existing USMPs for Tamworth (2000), Barraba (2000) and Kootingal (2000). Council now intends to update these USMPs and also develop new USMPs for the townships of Manilla and Moonbi, in accordance with the requirements of the NSW Government Office of Local Government (OLG). This will facilitate a co-ordinated management of stormwater within the individual townships to achieve ecological sustainability, social, and economic benefits from sound stormwater management practices.

As part of the development of the USMPs, Council regard stakeholder views in terms of both improved awareness on urban stormwater management and for obtaining valuable input to the project. The aim is to deliver the greatest benefit to the community at least cost.

The study area for each of these townships is provided in the attached figures.

We would welcome any information and input you may be able to provide into the development of the plans including any issues or areas for improvement you are aware of in relation to stormwater.

For further information please do not hesitate to contact either myself on 02 9495 8131, or at Eric.lin@stantec.com or Aidan Pugh on 02 6767 5018 or at a.pugh@tamworth.nsw.gov.au.

Yours sincerely,

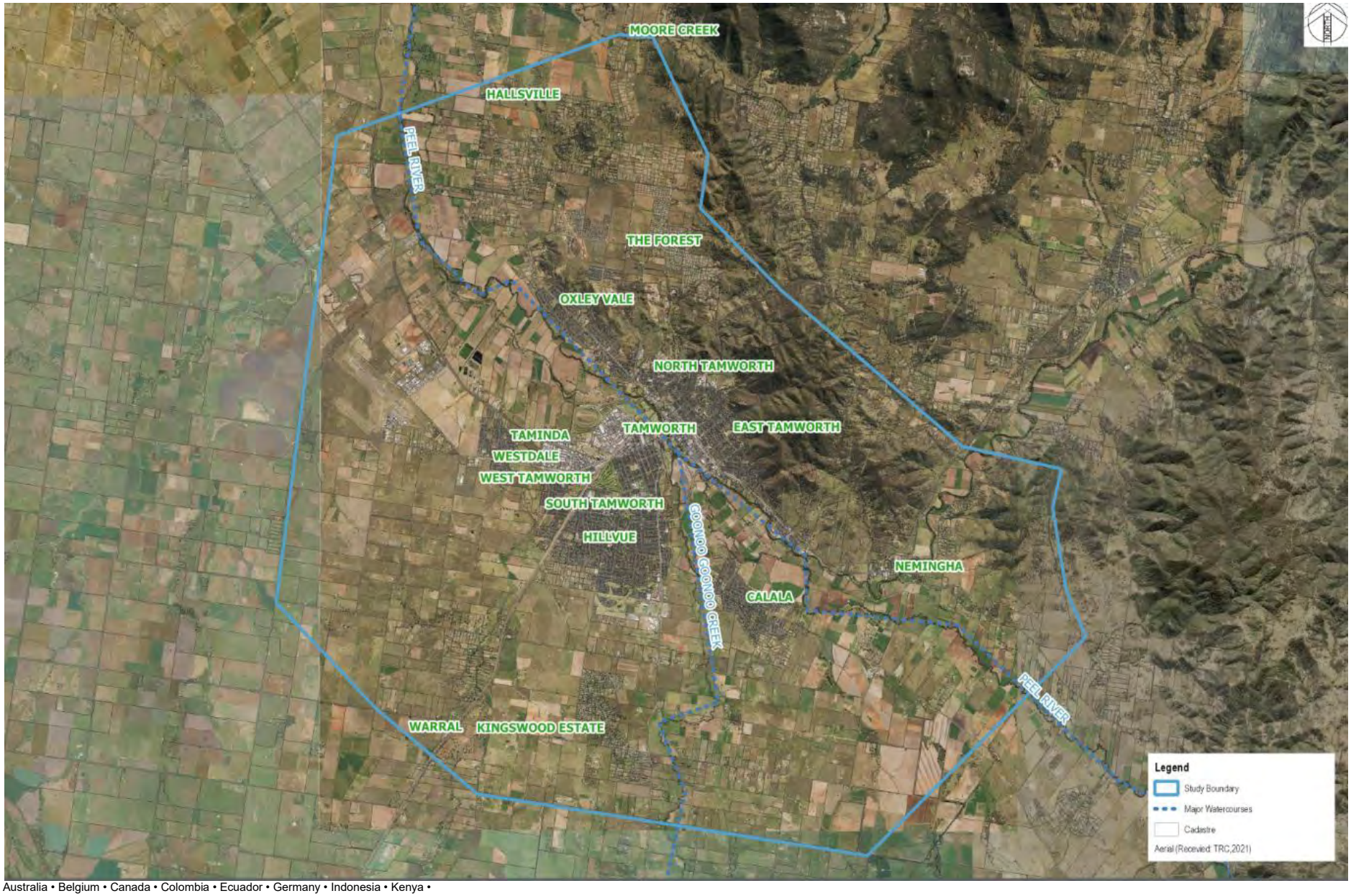
Eric Lin

Eric Lin
Principal Stormwater & Flooding Engineer
for Stantec
Direct Line: +61 2 9495 8131
Email: eric.lin@stantec.com

Enc: Tamworth Study Area
Manilla Study Area
Barraba Study Area
Kootingal & Moonbi Study Area

Stantec Australia Pty Ltd
Street Address 16/207 Kent St
City STATE Zip Sydney, NSW, 2000
AUSTRALIA
ABN 17 007 820 322

Tamworth Study Area



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Manilla Study Area

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Barraba Study Area

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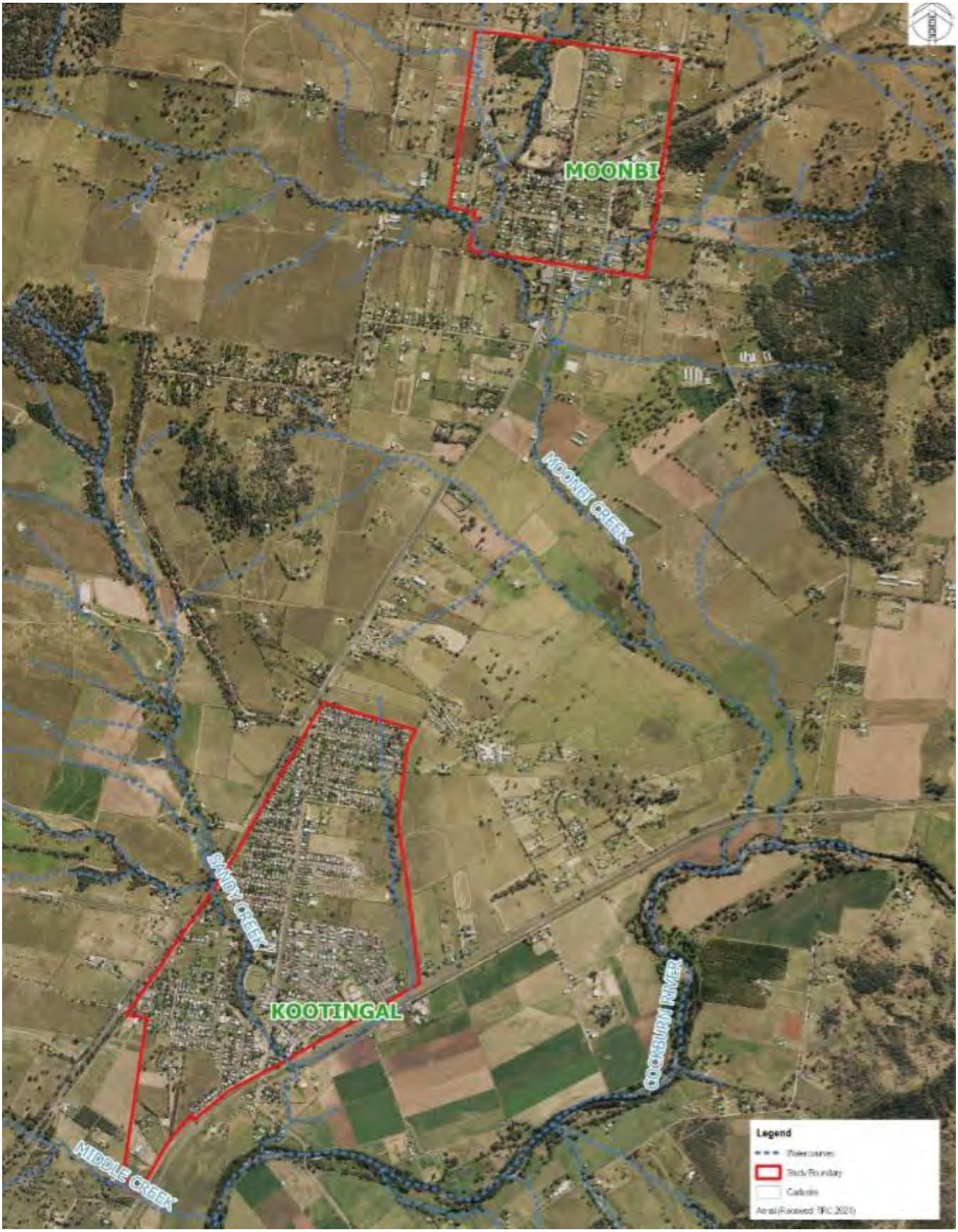
Kootingal and Moonbi Study Area



APPENDIX F
STORMWATER MANAGEMENT MEASURES

Option Type	Option ID	Initial option description	Source
Asset Management	A1 - LGA wide	Utilise a maintenance management system for planning, scheduling, and recording maintenance and inspections. Maintenance records will help identify issues and develop solutions.	Identified through internal stakeholder engagement
Asset Management	A2 - LGA wide	Survey the existing stormwater network to improve the completeness of Council's dataset.	Identified through internal stakeholder engagement
Asset Management	A3 - LGA wide	Condition Assessment of Council's current stormwater infrastructure through field inspection starting with areas where failure has high-risk or consequence.	Identified through internal stakeholder engagement
Asset Management	A4 - LGA wide	Council to develop a stormwater asset renewal program.	Identified through internal stakeholder engagement
Asset Management	A5 - LGA wide	Investigate the benefits of capturing stormwater runoff from Council buildings for re-use	Identified through review of Blueprint planning document
Asset Management	A6 - LGA wide	Investigate the benefits of roof runoff capture, ground water usage, and recycled water for reuse. Achieve efficiencies and sustainability for whole of life maintenance of facilities, including site selection based on water security / rationalisation of parks and sports precincts.	Identified through review of Blueprint planning document
Education and Awareness	E1 - LGA wide	Develop a drain stencilling education program	Identified through internal stakeholder engagement
Education and Awareness	E2 - LGA wide	Public education and awareness campaign on excessive watering, companion animal waste, car washing, Stormwater friendly gardens and recycling	Incomplete item from Tamworth 2000 USMP
Education and Awareness	E3 - LGA wide	Education campaign targeted at Building and Construction industry on the implementation of soil and water management controls during construction	Incomplete item from Tamworth 2000 USMP
Education and Awareness	E4 - LGA wide	Investigate current industrial / commercial stormwater management practices and develop industry / commercial stormwater awareness programs	Incomplete item from Tamworth and Barraba 2000 USMP
Education and Awareness	E5 - LGA wide	Expand the current litter education program to incorporate stormwater and river health	Identified through internal stakeholder engagement
Education and Awareness	E6 - LGA wide	Incorporate WSUD in the current water efficiency education programs	Identified through internal stakeholder engagement
Education and Awareness	E7 - LGA wide	Develop a stormwater pollution and management education program for local schools and community organisations	Incomplete item from 2000 USMP
Education and Awareness	E8 - LGA wide	Undertake community/environmental group led water quality monitoring (macroinvertebrate sampling) as part of other Council/community led events that enables community and school kids to monitor the quality and health of local waterways (e.g. Streamwatch)	Incomplete item from 2000 USMP
Education and Awareness	E9 - LGA wide	Publish regular stormwater information on Council's website and, social media accounts.	Incomplete item from 2000 USMP
Maintenance and Monitoring	M1 - LGA wide	Compliance and monitoring program for private OSD systems (in combination with P6)	Identified through internal stakeholder engagement
Maintenance and Monitoring	M2 - LGA wide	Investigate the feasibility of planting native vegetation along the existing stormwater channels	Incomplete item from Barraba 2000 USMP
Maintenance and Monitoring	M3 - LGA wide	Weed control / management programs within the stormwater channels	Incomplete item from Barraba 2000 USMP
Maintenance and Monitoring	M4 - LGA wide	Regularly maintain grassed areas within and adjacent to open urban stormwater channels	Incomplete item from Barraba 2000 USMP
Maintenance and Monitoring	M5 - LGA wide	Implement a cost-effective strategy to improve proactive cleaning of stormwater structures	Incomplete item from Moonbi 2000 USMP
Planning and Development	P1 - LGA wide	Improve Council's Integrated management system (IMS) to control the use of chemicals near waterways	Incomplete item from Barraba 2000 USMP
Planning and Development	P2 - LGA wide	Review erosion control procedures on new developments. Provide relevant Council staff with training to enable this.	Incomplete item from 2000 Moonbi USMP
Planning and Development	P3 - LGA wide	Stormwater Management requirements for new subdivisions needs to be reviewed and updated including consideration of Water Quality targets	Identified through internal stakeholder engagement
Planning and Development	P4 - LGA wide	Council to develop a WSUD policy	Identified through internal stakeholder engagement
Planning and Development	P5 - LGA wide	Council to adopt WSUD requirements as part of the DCP	Identified through internal stakeholder engagement
Planning and Development	P6 - LGA wide	Develop an OSD policy and pilot program that specifies OSD sizing and orifice requirements at subcatchment scale (especially for smaller developments).	Identified through internal stakeholder engagement
Planning and Development	P7 - LGA wide	Review OSD requirements for subdivision of 5 or more lots. Allow private OSD for smaller subdivisions and public detention basins for larger subdivisions.	Identified through internal stakeholder engagement
Planning and Development	P8 - LGA wide	Staged approach to WQ targets in DCP Short term - GP targets - GPT requirements for detentions basins Medium to long term - TSS/TP/TP targets	Identified through internal stakeholder engagement
Planning and Development	P9 - LGA wide	Stream Erosion Index (SEI) target in DCP	Identified through internal stakeholder engagement
Planning and Development	P10- LGA wide	Incorporate waterway health as part of Council's sustainability strategy focus areas	Identified through internal stakeholder engagement
Planning and Development	P11 - LGA wide	Identify the blue/green networks (drainage reserves that combine as parks with cycleway / walkways) in new greenfield areas to reduce drainage cost for greenfield development	Identified through review of Blueprint planning document
Planning and Development	P12 - LGA wide	Collate existing low impact stormwater guidelines and link them to Tamworth Regional Council policies. Include urban design measures that control and manage stormwater. Promote these stormwater guidelines through Tamworth Regional Council's communications.	Identified through review of Blueprint planning document
Planning and Development	P13 - LGA wide	Empower developers and designers to consider urban stormwater management at the early stages of their master planning	Identified through review of Blueprint planning document
Planning and Development	P14 - LGA wide	Complete and utilise mapping for flooding	Identified through review of Blueprint planning document
Planning and Development	P15 - LGA wide	Investigate co-location benefits of integrating WSUD into detention systems.	Identified through review of planning documents
Planning and Development	P16	Stormwater management levy to allow Council to raise stormwater management revenue in addition to that already provided through Council's general income.	Identified through internal stakeholder engagement
Stormwater Infrastructure	S1	Investigate stormwater harvesting and storage opportunity in the town of Manilla for distribution and reuse on main showground, sporting field, and public toilets.	Incomplete item from 2011 Strengthening Basin Communities
Stormwater Infrastructure	S2	Reshape South Street and install drainage network to convey major flows	From 2021 Manilla Stormwater Priorities
Stormwater Infrastructure	S3	Install piped drainage network on Court St between Hill St and Arthur St	From 2021 Manilla Stormwater Priorities
Stormwater Infrastructure	S4	Bank stabilisation and scour protection at the end of Market Street stormwater outlet	Identified through site visit
Stormwater Infrastructure	S5	WQ device at the end of Market St stormwater outlet prior to discharge into Namoi River	Identified through site visit
Stormwater Infrastructure	S6	WQ device at the outlet underneath old bridge prior to discharge into Namoi River	Identified through site visit
Stormwater Infrastructure	S7	WQ treatment in the open space between Willows Pde, Kanangra Rd and Worooma Cres	Identified through site visit
Stormwater Infrastructure	S8	Reshaping and regrading of the connections from the culverts along Church St to the drainage channel	Identified through site visit

APPENDIX G
MULTI-CRITERIA ASSESSMENT

Option Type	Option ID	Description	Economic				Social		Environment			Governance		Score	Rank	Overall Rank
			Capital Costs	Ongoing Costs	Feasibility	Staging of Works	Reduction in Frequency of Flooding	Visual Impact	Number of Pollutnats removed	Improved Water Quality	Flora/Fauna Impacts	Community support and executive commitment	Compatibility with Policies and Plans			
NON STRUCTURAL																
Asset Management	A1	Utilise a maintenance management system for planning, scheduling, and recording maintenance and inspections. Maintenance records will help identify issues and develop solutions.	1	1	2	0	NA	NA	NA	NA	NA	2	2	3.00	25	28
Asset Management	A2	Survey the existing stormwater network to improve the completeness of Council's dataset.	0	2	2	2	0	0	NA	NA	NA	2	1	3.00	25	28
Asset Management	A3	Condition Assessment of Council's current stormwater infrastructure through field inspection starting with areas where failure has high-risk or consequence.	0	2	2	2	0	0	NA	NA	NA	2	2	3.50	6	8
Asset Management	A4	Council to develop a stormwater asset renewal program.	2	2	2	2	0	0	NA	NA	NA	2	1	3.50	6	8
Asset Management	A5	Investigate the benefits of capturing stormwater runoff from Council buildings for re-use	2	2	2	0	NA	NA	0	NA	0	2	2	3.50	6	8
Asset Management	A6	Investigate the benefits of roof runoff capture, ground water usage, and recycled water for reuse. Achieve efficiencies and sustainability for whole of life maintenance of facilities, including site selection based on water security / rationalisation of parks and sports precincts.	2	2	2	0	NA	NA	NA	NA	NA	2	2	3.50	6	8
Education and Awareness	E1	Develop a drain stencilling education program	2	2	2	0	NA	NA	NA	NA	NA	2	2	3.50	6	8
Education and Awareness	E2	Public education and awareness campaign on excessive watering, companion animal waste, car washing, Stormwater friendly gardens and recycling	2	2	2	0	NA	NA	NA	NA	NA	2	2	3.50	6	8
Education and Awareness	E3	Education campaign targeted at Building and Construction industry on the implementation of soil and water management controls during construction	2	2	2	0	NA	NA	NA	NA	NA	2	2	3.50	6	8
Education and Awareness	E4	Investigate current industrial / commercial stormwater management practices and develop industry / commercial stormwater awareness programs	2	2	2	0	NA	NA	NA	NA	NA	2	2	3.50	6	8
Education and Awareness	E5	Expand the current litter education program to incorporate stormwater and river health	2	2	2	0	NA	NA	NA	NA	NA	2	2	3.50	6	8
Education and Awareness	E6	Incorporate WSUD in the current water efficiency education programs	2	2	2	0	NA	NA	NA	NA	NA	2	2	3.50	6	8
Education and Awareness	E7	Develop a stormwater pollution and management education program for local schools and community organisations	2	2	2	0	NA	NA	NA	NA	NA	2	2	3.50	6	8
Education and Awareness	E8	Undertake community/environmental group led water quality monitoring (macroinvertebrate sampling) as part of other Council/community led events that enables community and school kids to monitor the quality and health of local waterways (e.g. Streamwatch)	2	2	2	0	NA	NA	NA	NA	NA	2	2	3.50	6	8
Education and Awareness	E9	Publish regular stormwater information on Council's website and, social media accounts.	2	2	2	0	NA	NA	NA	NA	NA	2	2	3.50	6	8
Maintenance and Monitoring	M1	Compliance and monitoring program for private OSD systems (in combination with P6)	2	2	2	0	NA	NA	NA	NA	NA	2	1	3.00	25	28
Maintenance and Monitoring	M2	Investigate the feasibility of planting native vegetation along the existing stormwater channels	2	2	2	0	-1	2	NA	NA	1	2	1	4.50	3	3
Maintenance and Monitoring	M3	Weed control / management programs within the stormwater channels	1	1	2	2	0	2	NA	NA	1	2	1	5.00	1	1
Maintenance and Monitoring	M4	Regularly maintain grassed areas within and adjacent to open urban stormwater channels	2	2	2	2	0	1	NA	NA	1	2	1	5.00	1	1
Maintenance and Monitoring	M5	Implement a cost-effective strategy to improve proactive cleaning of stormwater structures	2	2	2	0	0	0	NA	NA	NA	2	2	3.50	6	8
Planning and Development	P1	Improve Council's Integrated management system (IMS) to control the use of chemicals near waterways	2	2	2	0	NA	NA	NA	NA	NA	1	1	2.50	36	39
Planning and Development	P2	Review erosion control procedures on new developments. Provide relevant Council staff with training to enable this.	2	2	2	0	NA	NA	NA	NA	NA	2	1	3.00	25	28
Planning and Development	P3	Stormwater Management requirements for new subdivisions needs to be reviewed and updated including consideration of Water Quality targets	2	2	2	0	NA	NA	NA	NA	NA	2	2	3.50	6	8
Planning and Development	P4	Council to develop a WSUD policy	2	2	2	0	NA	NA	NA	NA	NA	2	2	3.50	6	8
Planning and Development	P5	Council to adopt WSUD requirements as part of the DCP	2	2	2	0	NA	NA	NA	NA	NA	2	2	3.50	6	8
Planning and Development	P6	Develop an OSD policy and pilot program that specifies OSD sizing and orifice requirements at subcatchment scale (especially for smaller developments).	2	2	2	0	NA	NA	NA	NA	NA	2	1	3.00	25	28
Planning and Development	P7	Review OSD requirements for subdivision of 5 or more lots. Allow private OSD for smaller subdivisions and public detention basins for larger subdivisions.	2	2	2	0	NA	NA	NA	NA	NA	2	1	3.00	25	28

Option Type	Option ID	Description	Economic				Social		Environment			Governance		Score	Rank	Overall Rank
			Capital Costs	Ongoing Costs	Feasibility	Staging of Works	Reduction in Frequency of Flooding	Visual Impact	Number of Pollutnats removed	Improved Water Quality	Flora/Fauna Impacts	Community support and executive commitment	Compatibility with Policies and Plans			
NON STRUCTURAL																
Planning and Development	P8	Staged approach to WQ targets in DCP Short term - GP targets - GPT requirements for detentions basins Medium to long term - TSS/TP/TP targets	2	2	2	2	NA	NA	NA	NA	NA	2	1	3.50	6	8
Planning and Development	P9	Stream Erosion Index (SEI) target in DCP	2	2	2	0	NA	NA	NA	NA	NA	2	1	3.00	25	28
Planning and Development	P10	Incorporate waterway health as part of Council's sustainability strategy focus areas	2	2	2	0	NA	NA	NA	NA	NA	2	1	3.00	25	28
Planning and Development	P11	Identify the blue/green networks (drainage reserves that combine as parks with cycleway / walkways) in new greenfield areas to reduce drainage cost for greenfield development	2	2	2	0	NA	NA	NA	NA	NA	2	1	3.00	25	28
Planning and Development	P12	Collate existing low impact stormwater guidelines and link them to Tamworth Regional Council policies. Include urban design measures that control and manage stormwater. Promote these stormwater guidelines through Tamworth Regional Council's communications.	2	2	2	0	NA	NA	NA	NA	NA	2	1	3.00	25	28
Planning and Development	P13	Empower developers and designers to consider urban stormwater management at the early stages of their master planning	2	2	2	0	NA	NA	NA	NA	NA	2	1	3.00	25	28
Planning and Development	P14	Complete and utilise mapping for flooding	2	2	2	1	NA	NA	NA	NA	NA	2	1	3.25	24	27
Planning and Development	P15	Investigate co-location benefits of integrating WSUD into detention systems.	2	2	1	0	NA	NA	2	NA	1	2	1	4.25	4	4
Planning and Development	P16	Stormwater management levy to allow Council to raise stormwater management revenue in addition to that already provided through Council's general income.	2	2	2	2	NA	NA	NA	NA	NA	2	2	4.00	5	5
STRUCTURAL																
Stormwater Infrastructure	S1	Investigate stormwater harvesting and storage opportunity in the town of Manilla for distribution and reuse on main showground, sporting field, and public toilets.	1	1	0	0	1	1	2	0	1	1	1	3.50	3	8
Stormwater Infrastructure	S2	Reshape South Street and install drainage network to convey major flows	0	1	-1	1	1	1	0	0	-1	1	1	1.92	7	43
Stormwater Infrastructure	S3	Install piped drainage network on Court St between Hill St and Arthur St	2	1	0	0	1	0	0	0	-1	1	2	2.42	4	40
Stormwater Infrastructure	S4	Bank stabilisation and scour protection at the end of Market Street stormwater outlet	0	1	2	1	0	0	1	0	1	0	1	2.17	5	41
Stormwater Infrastructure	S5	WQ device at the end of Market St stormwater outlet prior to discharge into Namoi River	1	1	2	0	0	0	1	1	0	0	1	2.17	5	41
Stormwater Infrastructure	S6	WQ device at the outlet underneath old bridge prior to discharge into Namoi River	1	1	1	0	0	0	1	1	0	0	1	1.92	8	44
Stormwater Infrastructure	S7	WQ treatment in the open space between Willows Pde, Kanangra Rd and Worooma Cres	-1	1	-1	1	1	2	2	0	2	1	1	3.83	2	7
Stormwater Infrastructure	S8	Reshaping and regrading of the connections from the culverts along Church St to the drainage channel	0	1	2	1	1	2	0	0	0	2	1	4.00	1	5