# Tweed Integrated Water Cycle Management (IWCM)

## Context Study & Strategy

1st Report

March 2006

Hunter Water Australia Pty. Limited
ABN 19 080 869 905

SUSTAINING THE TWEED

THE TWEED
TWEED SHIRE COUNCIL

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# EXECUTIVE SUMMARY

The following report, the Tweed Integrated Water Cycle Management - Context Study & Strategy, defines the catchment, water resource and urban water characteristics of the Tweed district, along with an outline of the broad IWCM strategy for the future.

Tweed Shire Council is the local government authority (LGA) responsible for the urban water cycle (including drinking water, stormwater and wastewater) in the Tweed district. Prior to the commencement of this study, Council identified several critical issues it faces, both now and in the future, in relation to the urban water cycle. They include:

- The ability of existing surface water sources to adequately service future populations.
- The impacts of urban stormwater and effluent on the Lower Tweed Estuary.
- The impacts of agricultural runoff on the Upper Tweed River and Bray Park Weir.

In order to plan for and manage the above critical issues, Council has committed to an Integrated Water Cycle Management (IWCM) process. IWCM is the integrated management of the water supply, sewerage and stormwater services within a whole of catchment strategic framework. An important component of the IWCM process is the preparation of an IWCM Strategy. The IWCM Strategy provides a framework and long term focus on the integrated delivery of water supply, sewerage and stormwater services. As part of this process, Council has decided to prepare a Context Study & Strategy Report in order to define the catchment, water resource and urban issues faced by Council and to outline the broad strategy for the future. This initial study also includes some short term actions, which will allow some solutions to be implemented while the IWCM process continues through the ongoing detailed strategy development and associated implementation.

The key *Catchment Characteristics* of the Tweed district are:

- There are mountain ranges to the north, west and south, a coastal plateau to the east, a major floodplain in the central catchment and coastal beaches to the east. Major urban centres are generally located on the coast (Tweed Heads, Kingscliff, Hastings Point and Pottsville) with the exception of Murwillumbah.
- Climate is generally subtropical, with relatively high rainfall.
- Much of the floodplain areas throughout the study area have potential or actual acid sulphate soils and around two-thirds of the study area is zoned for rural and agricultural purposes, with around half the catchment cleared of vegetation. The predominant agricultural pursuit is sugarcane.
- Population is expected to increase from an estimated 80,000 people in 2005 to over 100,000 in 10 to 15 years and to over 150,000 in 30 plus years. The majority of urban release areas are located within 5 to 10 km of the coast.

The key *Water Resource Characteristics* are:

- The study area includes one major dam (Clarrie Hall Dam), one major water supply weir (Bray Park Weir) and one minor water supply weir (Tyalgum Weir).
- The May 2002 estimate of secure yield based on "Historic No Failure Yield" methodology for the study area is 18.5 GL/a. This may reduce to as low as 14.7 GL/a, once environmental flows are set under a future water sharing plan.
- Surface water quality and health are generally fair to good across the catchment. Suspended solids and nutrient levels are generally elevated in the Upper Tweed catchment due to rural runoff, with algal blooms commonly occurring during the warmer months. Water quality and health are generally fair to good in the Lower Tweed estuary and broadwaters, which benefit from tidal flushing, but decline with distance from the river mouth, with poor health in the mid to upper estuary and the Rous River. Major pollutant sources for the Tweed Estuary include urban stormwater, effluent and rural runoff (via the Upper Tweed River). Rural runoff and urban stormwater appear to be the dominant influence on pollutant inputs to the other coastal estuaries.
- Water users in the catchment include extractions for town water (around 10GL/a) and rural irrigation (around 4.8 GL/a surface water and 1.7 GL/a groundwater), commercial enterprises (such as fishing, oyster farming, houseboats / cruises) and recreational activities (such as fishing, boating, swimming and skiing).

The key *Urban Water Characteristics* are:

- The urban water supply system includes one major water treatment plant (Bray Park WTP) and two minor plants. Bray Park WTP is soon to be upgraded from 60 ML/d to 100 ML/d to cater for expected population growth and improve treatment processes. A new WTP is required sometime in the future for Tyalgum to improve supply security during times of low water quality.
- Current town water consumption is around 10 GL/a, with around 60% attributed to residential. Future consumption is likely to increase to around 16 GL/a by 2019 and 22 GL/a by 2034 (assuming consumption levels remain unchanged).
- The urban wastewater system includes five major sewage treatment plants (Tweed Heads, Banora Point, Kingscliff, Hastings Point and Murwillumbah) and three minor plants. Tweed Heads, Banora Point and Kingscliff STPs require future augmentation in order to cater for predicted population increases, with Murwillumbah and Hastings Point STPs being recently upgraded.
- Around 7.5 GL/a of effluent is discharged to various receiving waters (the majority to the Tweed Estuary), with less than 5% of dry weather flows currently being reused. Future effluent volumes are likely to increase to around 13 GL/a by 2019 and 19 GL/a by 2034.
- Urban stormwater runoff contributes to nutrient and sediment loads in the study areas waterways (mainly the Lower Tweed Estuary), with only limited treatment of urban stormwater currently occurring.

A summary of the key issues along with some preliminary improvement objectives and potential options / solutions are shown below in Table A.

**Table A** *Summary of Tweed IWCM Issues, Objectives & Potential Solutions*

<table>
<tr><th colspan="5">IWCM Issues</th></tr>
<tr><th>Urban Town Water Issues</th><th>Urban Wastewater Issues</th><th>Urban Stormwater Issues</th><th>General Urban Issues</th><th>Rural / Catchment Issues</th></tr>
<tr><td>? High extractions for town water<br>? Town water security<br>? Poor raw water quality</td><td>? Sewerage system discharges<br>? Effluent discharges</td><td>? Urban stormwater runoff</td><td>? Residential development<br>? Renewals / augmentations of assets</td><td>? Rural residential development<br>? On-site sewage treatment system failures<br>? Contaminated rural stormwater runoff / riparian vegetation clearing<br>? Wastewater from intensive agriculture</td></tr>
<tr><th colspan="5">Preliminary Improvement Objectives</th></tr>
<tr><td>? Reduce hydrological stress on Tweed River<br>? Maintain high level of town water security<br>? Improve raw & treated water quality</td><td>? Minimise dry/wet weather system discharges<br>? Minimise discharge from Upper Tweed STP's<br>? Reduce point loadings of nutrients and bacteria to the Tweed Estuary<br>? Improve effluent quality to reuse standard</td><td>? Reduce pollutant loads on Upper Tweed River<br>? Reduce diffuse loadings of nutrients and sediments to Tweed and coastal estuaries<br>? Minimise impact of urban runoff on estuaries & groundwater</td><td>? Incorporate WSUD / ESD principles into urban development<br>? Adequately maintain assets</td><td>? Reduce rural nutrient and sediment loads to waterways<br>? Minimise vegetation removal<br>? Minimise septic system failures<br>? Restrict / minimise on-site disposal where not sustainable<br>? Reduce point source pollutant loads to Upper Tweed</td></tr>
<tr><th colspan="5">Potential Solutions</th></tr>
<tr><td>? Water Sharing Plan<br>? Demand management & substitution / effluent & stormwater reuse<br>? Community Education<br>? Environmental flow substitution<br>? Supply enhancement options<br>? Water supply catchment management plans<br>? Upgrade WTP's</td><td>? Increase dry/wet weather storage volumes<br>? Monitor I/I rates & I/I works<br>? Prepare effluent management plans<br>? Increase effluent reuse<br>? Augment STP's<br>? Decentralised sewerage / dual reticulation</td><td>? Targeted retrofit of detention / treatment systems in existing areas<br>? WSUD / rainwater tanks<br>? Ongoing tightening of planning requirements<br>? Stormwater treatment / detention<br>? Groundwater recharge<br>? Targeted community education</td><td>? Demand management / WSUD<br>? Subdivision based stormwater treatment<br>? Greywater reuse<br>? Decentralised sewerage / effluent reuse<br>? Implement Asset Management Plan</td><td>? Work with CMA to improve farm management practices, including eduction<br>? Identify / monitor 'hot spots'<br>? Work with CMA / land care groups on targeted riparian vegetation restoration<br>? Fencing of riparian zone to restrict stock access<br>? Upgrade failing septic systems / septic pump-outs / centralised collection & treatment</td></tr>
</table>

As Council continues with the preparation, refinement and implementation of IWCM, including annual reviews of strategy priorities, the following specific actions are recommended within the short term (< five years):

*Urban Town Water Actions*

1. Formalise a Demand Management Program and explore further demand management options – including targeted non-residential audit and education (eg motels, caravan parks, clubs, etc).

2. Target 12% for unaccounted for water by 2010.

3. Explore demand substitution options such as effluent and stormwater reuse.

4. Review and refine current estimates of system yields and supply security, (noting the "Historical No Failure Yield" methodology only affords a relatively low probabilistic risk against failure in this case, being approximately 1 in 120), including assessing the potential impacts of environmental flow rules being applied at Bray Park Weir and determining increased yields from supply enhancement options such as raising Clarrie Hall Dam and constructing Byrrill Creek Dam.

5. Determine the impacts on town water supplies of the proposed water sharing plans in association with DNR and the CMA, which will define environmental flow requirements for the Tweed River (including defining fish ladder and estuary fresh water requirements).

6. Investigate and implement improved treatment process at Tyalgum WTP and assess impact of water sharing plan on town water supply security.

7. Undertake detailed, long term town water demand forecasts.

8. Determine impact of new Australian Drinking Water Guidelines (ADWG) on Town Water Supplies and operations

*Urban Wastewater Actions*

9. Undertake sewerage system flow gauging and build a calibrated sewerage system model in association with monitoring of inflow / infiltration rates and sewerage system overflow locations.

10. Ongoing implementation of sewerage system optimisation (in association with a calibrated sewerage system model), including targeted inflow / infiltration works.

11. Prepare Effluent Reuse Opportunities Report.

12. Monitor wet weather performance of Upper Tweed treatment plants.

13. Assess short term options for increasing effluent quality and reuse.

14. Implement investigation and planning for dual reticulation and/or decentralised sewerage systems for future development areas, such as Cobaki and Kings Forest.

15. Undertake detailed, long term sewage loading forecasts.

*Urban Stormwater Actions*

16. Prepare a targeted retrofit program of stormwater detention and/or treatment devices for ‘hot spot’ pre 2000 development areas.

17. Ongoing review and development of Stormwater Management Plans.

*General Urban Actions*

18. Ongoing implementation of WSUD and ESD principles for new developments, including education of developers and the community and ongoing strengthening of local planning requirements.

19. Update existing local planning instruments to be in line with and to complement BASIX.

20. Undertake preliminary planning for alternatives to rainwater tanks for new development areas (eg grey water reuse, dual reticulation of treated effluent, stormwater reuse). Hold forums with local developers and the community to discuss the advantages and disadvantages of various options.

21. Prepare and implement Asset Management Plans.

22. Continued implementation of DEUS Best Practice Guidelines with a focus on IWCM outcomes.

*Rural / Catchment Actions (in association with DNR, CMA & local land care groups)*

23. Continue to identify and assess critical areas where on-site sewage disposal is ineffective and implement appropriate solutions.

24. Identify and monitor catchment ‘hot spots’ areas that adversely impact on water quality in the Upper Tweed River.

25. Support ongoing catchment management initiatives, including planning controls, education, vegetation restoration (by assisting land care groups and individual landholders) and engage with the CMA.

26. A detailed groundwater study needs to be undertaken in order to assess current quality issues and the potential for aquifer storage and recovery (may be undertaken by or in association with DNR).

Broad steps for the ongoing preparation of the IWCM are also included in the report.

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## APPENDICES



## EXHIBITS

# 1 INTRODUCTION

The Tweed district includes the catchments of the Tweed River and three adjacent coastal estuaries, which are the most north-eastern catchments in New South Wales. It is characterised by undisturbed, steep ranges to the west, disturbed rural land, including a large floodplain and coastal plateau in the central catchment, and a combination of estuaries and extensive urban development in the eastern, coastal parts. Water for urban and rural purposes is wholly sourced and disposed of within the catchment.

Tweed Shire Council is the local government authority responsible for the urban water cycle (including drinking water, stormwater and wastewater) in the Tweed district. Prior to the commencement of this study, Council identified several critical issues it faces, both now and in the future, in relation to the urban water cycle. They include:

- *The ability of existing surface water sources to adequately service future populations*. This issue is driven by a number of factors including ongoing high population growth rates, a recent reduction in the estimate of safe yield, and the possibility of a reduced entitlement to water in the future.

- *The impacts of urban stormwater on the Lower Tweed Estuary.* This issue is driven by high population growth, high urban runoff rates and the minimal use of stormwater quality improvement devices.

- *The impacts of effluent on the Lower Tweed Estuary*. This issue is driven by high population growth, low effluent reuse and effluent from the four major sewage treatment plants discharging directly into the Lower Tweed Estuary.

- *The impacts of agricultural runoff on the Upper Tweed River and Bray Park Weir*. This issue is driven by the high proportion of agricultural land in the catchment, past land management practices that have lead to loss of vegetation (including riparian) and past and existing agricultural practices.

In order to plan for and manage the above critical issues, Council has committed to an Integrated Water Cycle Management (IWCM) process. IWCM is the integrated management of the water supply, sewerage and stormwater services within a whole of catchment strategic framework. It is a framework to help identify water management problems, to address these problems, to determine the appropriate management responses and to manage the impacts of the problems so that social, environmental and economic objectives are met.

An important component of the IWCM process is the preparation of an IWCM Strategy. The IWCM Strategy provides a framework and long term focus on the integrated delivery of water supply, sewerage and stormwater services. As part of this process, Council has decided to prepare a Context Study & Strategy Report in order to define the catchment, water resource and urban issues faced by Council and to outline the broad strategy for the future. This initial study also includes some short term actions, which will allow some solutions to be implemented in while the IWCM process continues through the ongoing detailed strategy development and associated implementation.

The objectives of the overall IWCM Strategy are to:

- Develop guiding principles and objectives for urban water services that are consistent with the broader catchment and triple bottom line requirements.
- Evaluate and short-list IWCM options for water service delivery that address these objectives and requirements.
- Provide a forum for community and other stakeholder involvement in the ongoing development of an IWCM strategy for urban water services.
- Provide the strategic framework for the future development of the urban water services.
- Deliver sustainable urban water services within a sound business planning context.

The objectives of this Context Study & Strategy Report are to:

- Consider urban water cycle issues in the context of the total catchment and total water cycle.
- Identify the relationships between the various components of the urban water cycle.
- Identify the current and potential land management issues, water resource issues and urban water services issues and identify the impacts associated with them and the associated design and management gaps.
- Identify a range of options or strategies that could manage the identified urban water cycle issues.
- Prepare an initial broad strategy and short term implementation plan which focuses on achieving short term gains from integrated solutions.

The Context Study & Strategy Report comprises of the following sections:

*Sections 2, 3 and 4* contain background information to the study based on three broad components; the catchment context, the water resources context and the urban water context.

*Section 5* contains the urban water cycle issues identified in the review of background information, as well as potential solutions, the initial broad strategy for IWCM and a short term implementation plan.

*Section 6* contains the references to the study.

# 2 THE CATCHMENT CONTEXT

The background information contained within this section focuses on six general characteristics of the catchment; viz location, climate, geology / soils, land use, flooding and population.

*Location* includes information on catchment size and topography, as well as a general description of the catchment features. Location is important because it describes the main features of the catchment, it influences climate and runoff rates (and hence availability of water resources) and land use (and hence the extent and type of agricultural and urban development).

*Climate* includes information on rainfall, evaporation, humidity and temperature. Climate is important because it directly influences the availability of water resources, the extent and type of agricultural development, flooding and outdoor water usage.

*Geology & Soils* includes information on the geological features of the catchment, the soil types and their characteristics and the extent of acid sulphate soils. Geology & soils are important because they influence water quality, runoff rates and land use (and hence the extent and type of agricultural development).

*Land use* includes information on the extent and type of vegetation, land zonings and the extent, type and value of agricultural and urban industries. Land use is important because it directly influences runoff rates, runoff quality (including both diffuse and point sources of pollutants) and water demands / usage.

*Flooding* includes information on the extent, severity and frequency of flooding within the catchment, along with information on the associated flooding structures. Flooding is important because it influences land use and water quality.

*Population* includes information on the size and location of both rural and urban population centres, along with estimates of population growth rates, occupancy rates and demographics. Population is important because it directly influences water demands / usage, the extent of urban development and the extent of urban water, sewerage and stormwater services.

**Figure 2.1**

*Cudgera Creek Estuary [DIPNR (1999)]*

## 2.1 LOCATION

The key characteristics of *Location* are summarised in Table 2.1 below, with more detailed information following the table.

**Table 2.1** *Location – Key Characteristics*

| Characteristic | Details |
|---|---|
| Location | Far North Coast of NSW, Australia |
| Local Government Area (LGA) | Tweed Shire Council |
| Study Catchment Area | 1,340 $km^2$ |
| Study Catchment Boundary | Study boundary coincides with LGA boundary which encompasses the catchments of the Tweed River and three coastal estuaries (Cudgen, Cudgera and Mooball Creeks) |
| Major River Catchment | Tweed River (1,080 $km^2$) |
| Study Area Population | 74,380 (2001 Census) |
| Major Urban Areas | Tweed Heads (and surrounding suburbs), Murwillumbah, Kingscliff, Hastings Point and Pottsville |
| Major Rural Towns | Uki, Tyalgum, Tumbulgum, Mooball and Burringbar |
| Topography | Mountain ranges to the north, west and south, coastal plateau (to RL30-40m), floodplain below RL10m, coastal beaches to the east. |
| Major Catchment Features | Mount Warning (RL1156m), McPherson Range, Tweed Range & Nightcap Range, Tweed River floodplain, Cudgen Plateau, Tweed / coastal estuaries, Cobaki / Terranora broadwater and coastal beaches. |
| *Key references (see Section 6) are:* TSC (2000a), TSC (2003a) | |

The study area is located on the far north coast of NSW and is wholly contained within the Tweed Shire Council local government area (LGA). It adjoins the NSW LGA's of Byron, Kyogle and Lismore to the south and west and the NSW / Queensland border to the north. The study area and major catchment features are shown below on Figure 2.2**.**

The waterways of the study area comprise the Tweed River and its tributaries, including freshwater and estuarine sections, and the Tweed Coast estuaries of Cudgen, Cudgera and Mooball Creeks (refer to Table 2.2 below). The majority of urban development within the study area is adjacent to the estuarine waterways.

The Tweed River catchment covers an area of around 1,080 $km^2$. The terrain in the upper reaches of the Tweed River catchment is hilly to mountainous. An extensive floodplain forms the lower reaches of the catchment and is predominately covered by cane farms. The catchment has a fairly symmetrical drainage pattern, due to the valley's volcanic origins, with the main stream being fed by three major tributaries: the Tweed, Rous and Oxley Rivers. The Tweed River is tidal (estuarine) downstream of Murwillumbah, where the Bray Park Weir acts as a tidal barrage. Prior to discharging into the Pacific Ocean, the lower estuarine section of the Tweed River feeds into the Terranora and Cobaki Broadwaters, via the Terranora inlet.

**Table 2.2** *Catchment Areas*

| Major Catchment | Sub-catchment | Catchment Area (km$^2$) |
|---|---|---|
| Tweed River | Oxley River | 240 |
| | Tweed River u/s Bray Park Weir (including Oxley River) | 565 |
| | Rous River | 150 |
| | Cobaki / Terranora Broadwaters | 120 |
| | Residual (middle & lower Tweed River) | 245 |
| | Tweed River (total) | 1,080 |
| Tweed Coast Estuaries | Cudgen Creek | 75 |
| | Cudgera Creek | 60 |
| | Mooball Creek | 125 |
| | Coastal Estuaries (total) | 260 |
| TOTAL STUDY AREA | | 1,340 |


**Figure 2.2** *Locality Plan – Tweed Shire Council [TSC (2003a)]*

The major urban areas within the Tweed River catchment are: Murwillumbah on the upper estuary; Tweed Heads, Banora Point, Fingal, Chinderah and parts of Kingscliff on the lower estuary; and Terranora, Bilambil and Banora Point West around the Terranora Broadwater. There are substantial areas of undeveloped urban land in the Tweed River catchment, primarily located adjacent to the lower estuary and around the Terranora and Cobaki Broadwaters.

Cudgen Creek catchment is located to the south of the Tweed River catchment. Cudgen Creek feeds into and out of Cudgen Lake and has its mouth near Kingscliff. There is substantial urban development within the catchment, and a large amount of undeveloped urban land. Urban areas include Casuarina, Bogangar / Cabarita Beach and parts of Kingscliff.

Cudgera Creek catchment is located to the south of Cudgen Creek catchment. Cudgera Creek has its mouth at Hastings Point. There is some urban development within the catchment, with limited potential for further development. Urban areas include Hastings Point and Koala Beach.

Mooball Creek catchment is located to the south of Cudgera Creek catchment. Mooball Creek has its mouth at Potts Point. Within the catchment there is urban development in Pottsville, rural townships of Mooball and Burringbar and substantial cane farming activities at the southern end. There is limited potential for further urban development.

A major topographic feature of the study area is Mount Warning (see Figure 2.3), the remnant core of an extinct volcano. The surrounding McPherson, Tweed, Nightcap, Border, Springbrook and Burringbar ranges are the remaining rim of that volcano and home to several World Heritage-listed National Parks.

**Figure 2.3**

*Mount Warning*

## 2.2 CLIMATE

The key characteristics of *Climate* are summarised in Table 2.3 below, with more detailed information following the table.

**Table 2.3** *Climate – Key Characteristics*

| Characteristic | Details |
|---|---|
| Climate Type | Subtropical, Humid |
| Annual Mean Rainfall | 1,600mm |
| Annual Mean Evaporation | 1,100mm |
| Mean Temperatures | Daily Max 26°C / Daily Min 14°C |
| Mean Relative Humidity (3pm) | 60% |
| *Key references (see Section 6) are:* TSC (2003a), BOM (2004) | |

The study area experiences a subtropical climate, with warm humid summers and mild winters. The area generally experiences high rainfall, particularly on the elevated land close to the coast. Rainfall is generally highest during summer and autumn, with spring being the driest period (refer to Table 2.4). Rainfall is spread relatively evenly over the catchment. Very intense rainfall can be experienced as a result of occasional cyclonic disturbances.

Evaporation varies from around 1.5mm/day in June / July to around 5mm/day in December.

**Table 2.4** *Rainfall Statistics*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Median Rainfall (mm) | 156 | 185 | 192 | 104 | 99 | 55 | 48 | 35 | 22 | 77 | 125 | 147 | 1474 |
| 90%ile Rainfall (mm) | 303 | 514 | 441 | 443 | 428 | 219 | 153 | 122 | 98 | 161 | 213 | 308 | 2347 |
| 10%ile Rainfall (mm) | 53 | 66 | 49 | 41 | 16 | 10 | 4 | 3 | 2 | 27 | 25 | 55 | 1059 |

*Note: Climate averages for Station: 058158 MURWILLUMBAH (BRAY PARK) [BOM (2004)]*

## 2.3 GEOLOGY & SOILS

The key characteristics of *Geology & Soils* are summarised in Table 2.5 below, with more detailed information following the table.

**Table 2.5** *Geology & Soils – Key Characteristics*

| Characteristic | Details |
|---|---|
| Key Soil Types | Six main soil types:<br>1. Coastal sands<br>2. Krasnozems<br>3. Alluvial soils<br>4. Yellow earths<br>5. Red podzolics<br>6. Chocolate soils |
| Key Geological Features | The valley has volcanic origins and Mount Warning is the remnant core. The rim (caldera) of the ancient volcano has been broken by the Tweed River |
| Extent of Acid Sulphate Soils | Extensive, below 5 m AHD |
| *Key references (see Section 6) are:* TSC (2003a), DLWC (1996) | |

### 2.3.1 General

The geology of the region consists of a basalt plateau of the Lamington Range volcanics of the tertiary age with river gravels, alluvium, sand and clay of the Quaternary age along the Tweed River. Bedrock in the area consists of interbedded argillite and metagreywacke of the Neranleigh-Fernvale Beds of the Palaeozoic age. The erosion of the various geological layers has produced diverse geomorphology and soil types within the study area.

The general characteristics of each soil type are:

- Coastal sands are acidic and infertile, requiring large amounts of fertiliser to be productive and have high permeability, with the potential to carry leached contaminants through the soil profile down into groundwater
- Krasnozems are susceptible to erosion and are most suitable for agricultural activities
- Alluvial are generally mildly acidic and fertile
- Yellow earths are acid throughout and are susceptible to erosion
- Red podzolics are acid soils and have a low fertility
- Chocolate soils are mildly acidic with high levels of clay content

Many of the soils found in the study area are highly erodible, particularly in the sloping areas, and can lead to sedimentation and the introduction of nutrients, chemicals and organic material to waterways.

### 2.3.2 Acid Sulphate Soils

Due to their basaltic origin, many of the soils are also slightly acidic. Much of the floodplain areas throughout the study area have potential and actual Acid Sulphate Soils (ASS) close to the surface generally found where the surface elevation is less than 5 metres AHD (refer to **Exhibit 1** for ASS planning zones). In the study area, ASS are generally found on the river plains and coastal areas. It is estimated that approximately 13,714 Ha (approximately 10% of the total catchment) of the Tweed River floodplain and nearby coastal system are underlain with high risk ASS, and a further 6,118 Ha (approximately 5% of the total catchment) are underlain with low risk ASS (TSC 2003a). Hot spots have been identified as Cudgen Creek, Dulguigan Creek, McLeods Creek and Main Trust Canal. Land uses such as sugar cane growing and estuary development are the predominant disruptions in the catchment contributing to the ASS impacts.

ASS may also lead to impacts on structures, agriculture and aquatic systems:

- Impact on engineering – sulphuric acid can corrode concrete, iron and steel – weakening foundations and underground concrete water and sewerage pipes; leaves rust-coloured stain

- Impact on agriculture – loss of soil productivity due to acidity, aluminium toxicity and mobilisation of heavy metals; reduction in availability of plant nutrients resulting in low productivity and high vegetation dieback; alteration of soil chemistry; increase in soil erosion (due to lack of vegetation cover)

- Impacts on aquatic systems – acidic drainage into waterways can cause acidification and aluminium toxicity; alters chemical and physical properties of water this may result in fish diseases or in worse cases fish and other aquatic fauna deaths; reduces plant productivity

The Tweed Estuary experiences both long term and episodic ingress of acidic waters. Occasional major acid sulphate soil events occur in association with heavy rainfall events after a protracted dry period and more frequent minor entries of low pH into the estuary occurs in relatively minor quantities as a result of flushing by regular rainfall which has collected in isolated drains (WBM Oceanics 2000). Cudgen Lake has been subject to several major fish kills due to impacts from the presence of actual Acid Sulphate Soils within the catchment (TSC 2000a).

## 2.4 LAND USE

The key characteristics of *Land Use* are summarised in Table 2.6 below, with more detailed information following the table.

**Table 2.6** *Land Use – Key Characteristics*

| Land Use Category | Proportion Of Shire | Comments |
|---|---|---|
| Agriculture / Forestry | 65.5% | Main types include sugarcane (7%), bananas (2%) and cattle |
| National Park / Environmental Protection | 25% | NP's include: Mt Warning, the Nightcap Ranges, the Border Ranges and a portion of Lamington |
| Urban (Residential, open space) | 5.5% | Approximately half is undeveloped urban land |
| Industrial / Commercial | <0.5% | |
| Other | 4% | |
| Proportion of catchment subject to clearing | 52% | |
| *Key references (see Section 6) are:* TSC (2003a), TSC (2000b), TSC (2003c), Ecograph (2003) | | |

### 2.4.1 Agriculture

Agriculture is the dominant land use in the study area (refer to **Exhibit 2**), with approximately two thirds of the study area zoned for rural and agricultural purposes. It is the dominant land use in all areas of the catchment excluding the coastal strip and the urban centre surrounding Tweed Heads. It is a significant industry in the study area, contributing more than $40 million annually to the Tweed economy.

The major agriculture pursuit is sugarcane, which is primarily located on the alluvial flats (TSC 2003a). Grazing of cattle for both meat and milk production occurs primarily in the upper reaches of the catchment. Other types of agriculture include tropical fruit (eg bananas, mangoes), orchard trees, pigs, native pastures (eg eucalyptus and tea tree oil), sheep and other fruits and vegetables.

**Table 2.7** *Top Six Agricultural Industries*

| Agricultural Industry | Production Value |
|---|---|
| Sugar cane | $12.4M |
| Bananas | $9.7M |
| Cattle (meat) | $6.3M |
| Milk | $3.5M |
| Nurseries | $2.9M |
| Pigs (meat) | $1.6M |

*Source: Agricultural Census 2000-01*

### 2.4.2 Urban

Existing urban land use currently accounts for approximately 2-3% of the total land use, and there is sufficient undeveloped land zoned for urban expansion to double the amount of developed urban land within the next 25 years (TSC 2000a). These future urban release areas have a population capacity of over 50,000 people and are mostly located adjacent to existing urban development on the coastal strip and in the lower estuary area (refer to Section 2.6).

### 2.4.3 Industry

The key industries in the study area are shown in Table 2.8, below.

**Table 2.8** *Key Industries (2001 Census)*

| Key Industries | Proportion of Workforce | Details |
|---|---|---|
| Construction | 9% | |
| Agriculture | 6% | $40M pa to Tweed economy |
| Manufacturing | 7% | $127M pa |
| Retail | 19% | |
| Accommodation, Cafes & Restaurants | 9% | |
| Health & Community Services | 11% | |
| Tourism | Not classified, but captured in other categories such as Accommodation, Cafes & Restaurants and Retail. | Estimated $250M pa visitor spending |

The economy of the study area has three key economic drivers; tourism, agriculture and construction. While tourism and construction industries have seen growth in recent years, the agricultural industry is in decline.

By comparison, the wholesale trade category and manufacturing category are well below the State average. In the study area, these two categories mainly support the key economic drivers. For example a good proportion of the wholesale trade workforce supply economic input into the construction sector and the manufacturing sector derives considerable input from the agricultural sector.

There are currently 35 EPA licensed industries / commercial activities within the study area. They include sewage treatment plants, dredging operations (including Tweed River entrance sand bypassing), agricultural processing (Condong sugar mill), extractive industries, concrete batching and waste disposal facilities.

### 2.4.4 National Parks / Environmental Protection / Remnant Bushland

There are four National Parks within the study area; Mt Warning National Park, Nightcap Ranges National Park, Border Ranges National Park and a portion of Lamington National Park. All are located in the upper reaches of the catchment. There are also numerous Nature Reserves, State Forests and Environment Protection Zones. Almost half of the study area is under vegetation cover, and more than 80% of this vegetation cover is remnant bushland.

The study area also has five SEPP 14 zoned wetlands, comprising about 1.4% of the total land area. The largest is located at Ukerebagh Island. Other areas are at Dodds Island, Tweed Broadwater, Rawson Island, and Lower Rous. The wetlands support 17 species of migratory shorebirds (TSC 2003a).

There are four Environment Protection Zones on Tweed LEP (2000), covering the areas of Wetlands and Littoral Rainforest, Scenic Escarpment, Coastal Lands and Habitat.

The Tweed catchment lies within an overlap of biogeographic regions, the Toressian region of tropical northern and north eastern Australia, and the Bassian Region of temperate, south east Australia. Each biogeographic region has distinct vegetation and fauna species found within it. Therefore, overlap zones have a diverse mix of flora and fauna species and communities.

The most dominant type of vegetation community in the catchment is Sclerophyll Open Forest found on bedrock substrates with substantial areas of rainforest and riparian communities. The sclerophyll vegetation is characterised by eucalypt type vegetation and occurs predominately on metasediments associated with slopes, gullies and ridges throughout the study area (Ecograph 2003). Sclerophyll vegetation types are generally deep rooted species that can keep the watertable low and prevent sub-surface salt from being carried to the surface or surface waters.

Riparian vegetation (vegetation in or adjacent to waterways) acts as a filter for sediments, phosphorous and organic nitrogen which improves the quality of water entering watercourses, it stabilises banks, provides habitat and buffers water temperature. This promotes good water quality in creeks and rivers. Since European settlement, however in the study area much of the native riparian vegetation has been degraded or removed (TSC 2003a). Approximately 74% (in 1995) of the riparian vegetation is in a partly or highly degraded state or is nonexistent. Remnants of varying condition make up the other 26%.

There are at least 212 significant plant species and 58 species found only within the study area. The result of clearing for agricultural, commercial and residential land uses is an extensive list of rare, vulnerable, endangered or otherwise significant species (TSC 2003a). They include 89 species classified as rare or threatened (including one that is considered extinct), 16 that are endangered and 25 that are vulnerable to extinction.

There are at least 92 significant terrestrial vertebrate species that have been observed within the study area. They include 9 that are endangered and 83 that are vulnerable to extinction. On an Australia-wide basis the region contains a very high concentration of threatened vertebrates.

## 2.5 FLOODING

The key characteristics of *Flooding* are summarised in Table 2.9 below, with more detailed information following the table.

**Table 2.9** *Flooding – Key Characteristics*

| Characteristic | Details |
|---|---|
| Tweed River Floodplain | 120 to 130 $km^2$ |
| Tweed Coastal Creeks Floodplain | ~ 70 $km^2$ |
| Levees | Located throughout the catchment |
| Floodgates | ~250 |
| Design Flood Levels | 2.65m AHD at Tweed Heads, 7.15m AHD at Murwillumbah (based on 1 in 100 year flood levels). |
| *Key references (see Section 6) are:* Soros-Longworth & McKenzie (1980), NSW Fisheries (2001) | |

The Tweed River floodplain commences near Murwillumbah and includes the urban areas of Murwillumbah, South Murwillumbah, Tweed Heads and Chinderah, in addition to a number of small villages (refer to Exhibit 1). Low lying built up areas adjacent to the Terranora and Cobaki Broadwater's have experienced inundation as a result of both storm surges and freshwater flooding in the Tweed River (TSC 2000a).

In addition to the Tweed River floodplain, the coastal creeks floodplain occupies part of a 5 km side strip along the coastal strip. This area includes parts of Hastings Point, Pottsville and Bogangar.

Council are currently in the process of remodelling the Tweed River flood behaviour and are undertaking a Floodplain Risk Management Study, which will lead to the adoption of a Floodplain Risk Management Plan. Part of the implementation of this plan will be a comprehensive revision of Councils development control plan, *DCP5 – Development of Flood Liable Land.*

In general, Council's flood mitigation strategy is to minimise future potential flood damage both by structural protection and by planning controls (i.e. limiting development on flood liable land). It is expected that future mitigation works will be limited to possible modifications to existing flood levees.

Adopted design flood levels (based on the 1 in 100 year flood level) for the Tweed River range from 2.65m AHD at Tweed Heads, 3.30m AHD at Chinderah, 4.40m AHD at Tumbulgum, to 7.15m AHD at Murwillumbah. Adopted design flood levels for the coastal creeks range from 2.40m AHD at Hastings Point and Pottsville to 3.40m AHD at Bogangar.

All floodgates in the Tweed catchment are located in ASS areas. These floodgates regulate the tidal waters and flushing within the floodplain. The floodgates only open when the water level upstream of the floodgates is higher than the water level downstream. This means that there is a build up of acid sulphate soil runoff behind the floodgates which is released into the river. Flood gates prevent brackish water from neutralising acid drainage from soils, prevent fish passage and kill aquatic flora and fauna if acidic discharges exceed water acidity tolerance levels.

Active management of the floodgates (see Figure 2.4) increases flushing of drains with river water, improves water quality and reduces the build up of acid sulphate soil runoff behind previously closed gates. Currently 12 floodgates have been modified to allow tidal flow and ASS farm management plans developed by the sugar industry have been audited over the last 3 years (TSC 2003a).

**Figure 2.4**

*Floodgates – Terranora Drainage Union [NSW Fisheries (2001)]*

## 2.6 POPULATION

The key characteristics of *Population* are summarised in Table 2.10 below, with more detailed information following the table.

**Table 2.10** *Population – Key Characteristics*

| Locality | 2001 Census Population | 2005 Estimated Population | Projected Medium Term Population (+10 to 15 years) | Projected Long Term Population (>30 years) |
|---|---|---|---|---|
| Tweed Heads | 38,600 | - | 60,000 | 72,000 to 93,000 |
| Kingscliff | 9,150 | - | 10,400 to 20,000 | 34,000 to 40,000 |
| Coastal Villages | 8,000 | - | 13,300 | 23,400 |
| Murwillumbah | 9,360 | - | 9,900 | 12,000 to 16,000 |
| Rural | 9,270 | - | 13,500 | 15,500 |
| TOTAL STUDY AREA | 74,380 | 80,000 | 107,100 to 116,700 | 156,900 to 186,900 |
| *Key references (see Section 6) are:* TSC (2003a), TSC (2003c) | | | | |

The study area is currently experiencing high growth rates and this is expected to continue in the medium term, as there is a considerable amount of undeveloped urban land available to support this population growth. The population is projected to double in the next 30 to 40 years, largely as a result of retirees relocating to the area.

The average annual growth rate from 1996 to 2001 was around 2%. Anticipated annual growth rates over the next 30 years are expected to remain at around 2%, (around 2,000 people per annum).

The main population centres of the study area are the urban localities of Tweed Heads, which are home to approximately 48% of the population. The coastal urban villages are home to a further 18% of the population. Murwillumbah is the main urban non-coastal area, with around 11% of the Shire's population. The balance of the population live in the rural areas and small villages scattered throughout the study area. The vast majority of the study area's population growth is occurring within 5 to 10 km of the coast, within the Tweed River and Tweed Coast estuaries (refer to Table 2.11 and

Figure 2.5 below).

**Table 2.11** *Residential Release Areas*

| Urban Release Areas | Remaining Potential Population | Current Status |
|---|---|---|
| Casuarina | 2,500 | Under construction |
| Kings Forest | 10,000 | Zoning being reviewed |
| Salt (lot 490 & seaside city) | 2,500 | Under construction |
| Cobaki Lakes | 14,000 | Development approval granted |
| Banora Point / Sth Tweed | 6,150 | Nearing completion |
| West Kingscliff | 4,500 | Under construction |
| Bilambil Heights | 8,000 | Starting construction |
| West Murwillumbah | 2,330 | Under construction |
| Koala Beach, Pottsville | 2,750 | Under construction |
| Seabreeze, Pottsville | 2,000 | Under construction |
| Black Rocks, Pottsville | 750 | Under construction |
| Area E, Terranora | 2,000 | Zoning being reviewed |
| TOTAL STUDY AREA | 57,480 | |

The study area has a predominately older population with 55% of people being over the age of 40 and 23% over the age of 65, which is nearly twice the NSW state average. There is also a high proportion (25%) of young people (under 19) in the study area.

Incomes in the North Coast Region are by far the lowest in NSW. The average income level in the study area in 1999/00 was $28,700 pa compared to the state average of $39,000 pa.

The most predominant family type within the study area is couple without children (43%) followed by couple with children (36%) and single parent families (18%).

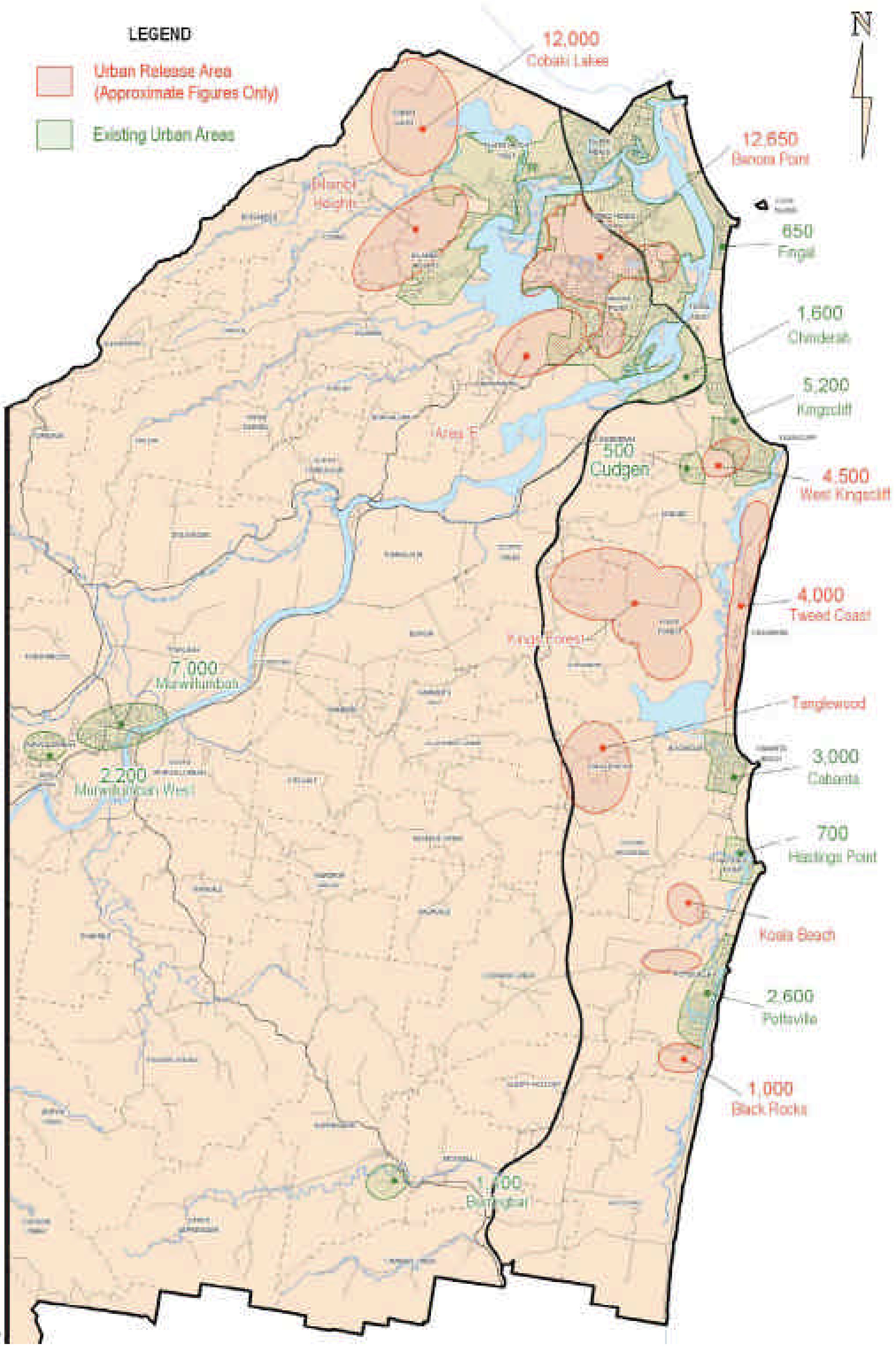



**Figure 2.5** *Future Urban Release Areas [TSC (2004b)]*

# 3 THE WATER RESOURCE CONTEXT

The background information contained within this section focuses on three water resource characteristics; viz surface waters, groundwater and water users.

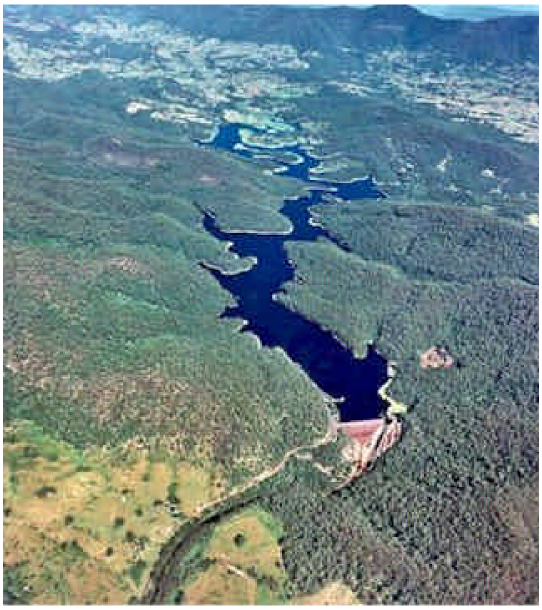
*Surface Waters* includes information on the quantity, quality and health of water sources as well as details on receiving waters within the catchment. Surface Waters are important because they are both the source point for the urban water cycle and the discharge point. They influence the development potential of the catchment from the source and discharge side as well as directly impact on how the demands from development are met. The source water quality impacts on the cost and type of water treatment process employed, while the receiving water quality and health influences the extent of wastewater treatment required.

*Groundwater* includes information on the quantity and quality of groundwater resources within the catchment. Similar to surface waters, groundwater in some rural areas of the catchment acts as both the source point for the urban water cycle and the discharge point.

*Water Users* includes information on the various direct and indirect water users within the catchment. Some water users directly consume water and discharge wastewater, others benefit in a commercial sense, while some benefit in a recreational sense. Consideration of all Water Users is important because it allows the total value of the water resource to be assessed by considering the total catchment water cycle, not just the urban water cycle.

**Figure 3.1**

*Clarrie Hall Dam [Tweed Shire Council – Engineering Services (2004c)]*



## 3.1 SURFACE WATER

Background information on surface waters includes discussion on the key surface water components, surface water quantity, surface water quality and river and estuary health.

### 3.1.1 Components

The key components of *Surface Waters* are shown below in Table 3.1 and Figure 3.2.

**Table 3.1** *Surface Water - Key Components*

| Component | Details |
|---|---|
| Bray Park Weir (Tweed River) | • The major water supply source for the catchment<br>• Catchment area of 565 km2<br>• Weir pool capacity of 839 ML<br>• Fixed weir crest level of 1.06m AHD<br>• Fish ladder capacity of 15 - 25 ML/d |
| Tweed River (Uki) | • The extraction point for Uki water supply (direct from river, ie no weir) |
| Oxley River (Tyalgum) | • The extraction point for Tyalgum water supply<br>• Small rock fill weir<br>• Catchment area of 38 $km^2$<br>• Weir pool capacity of 10 ML<br>• Fixed weir crest level of 52.2m AHD |
| Clarrie Hall Dam | • The major water supply storage for the catchment<br>• Located on Doon Doon Creek, approx. 20km upstream of Bray Park Weir<br>• Rock fill embankment with upstream reinforced concrete slab<br>• Catchment area of 60 $km^2$<br>• Total capacity of 16,000 ML (usable capacity of 15,000 ML)<br>• Full supply level of 61.5m AHD |
| Tweed Estuary | • The receiving environment for rural and urban stormwater runoff, as well as urban effluent, within the Tweed River catchment.<br>• Catchment area of 1,080 $km^2$ |
| Coastal Estuaries | • The receiving environment for rural and urban stormwater runoff within the Tweed Coast Estuaries catchments<br>• Combined catchment area of 260 $km^2$ |
| Coastal Beaches | • 37 km of coastline from Tweed Heads to Wooyoung<br>• 96% of coastline is sandy beaches |

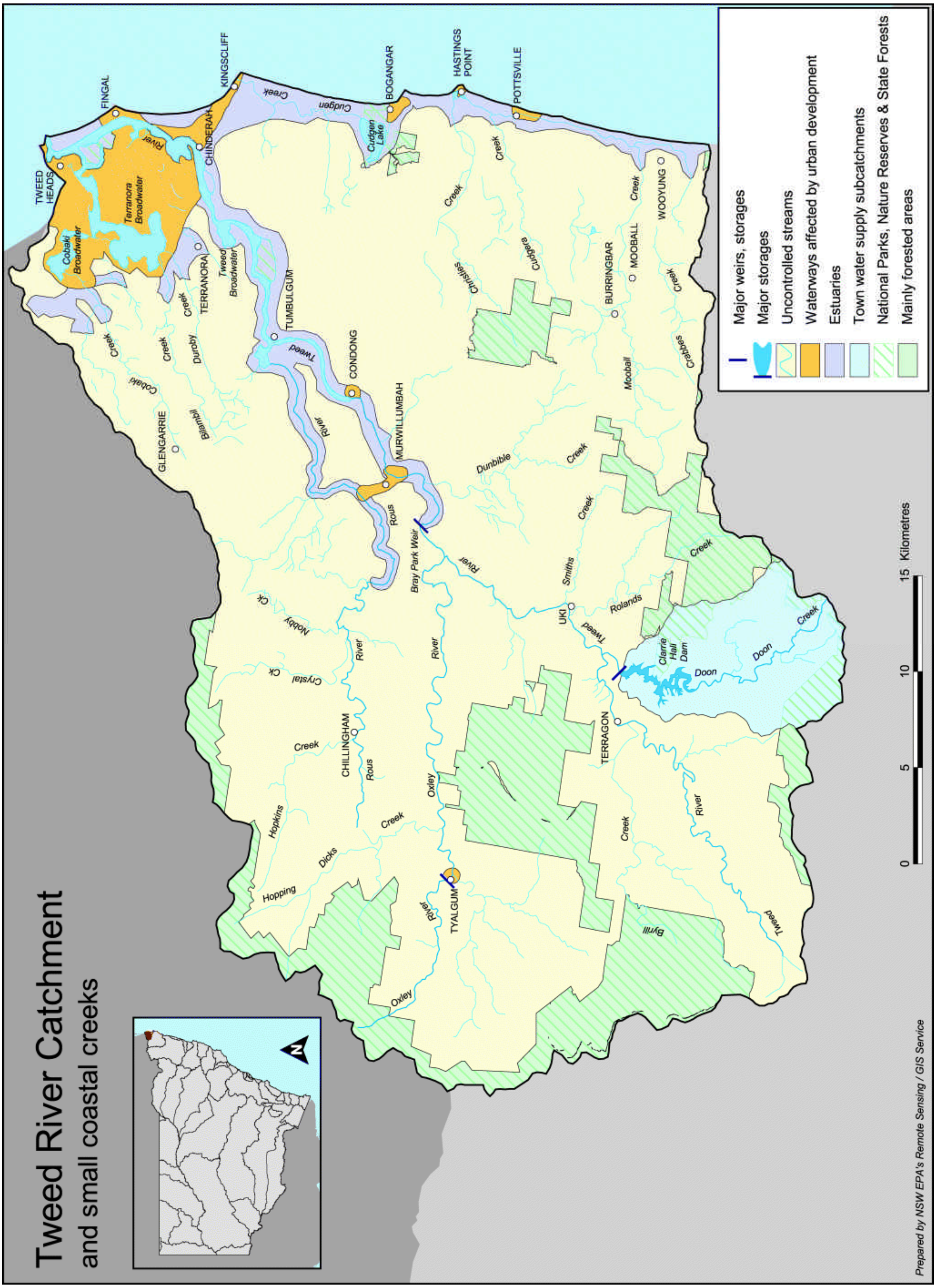



**Figure 3.2** *Water Resources of the Tweed District [EPA (2000)]*

### 3.1.2 Surface Water Quantity

The key characteristics of *Surface Water Quantity* are summarised in Table 3.2 below, with more detailed information following the table.

**Table 3.2** *Surface Water Quantity - Key Characteristics*

| Characteristic | Clarrie Hall Dam (Doon Doon Ck) | | Bray Park Weir (Tweed River) | |
|---|---|---|---|---|
| Average Flow | 120 ML/d | 43 GL/a | 1,000 ML/d | 365 GL/a |
| 50th percentile flow (median) | 95 ML/d | 34 GL/a | 810 ML/d | 296 GL/a |
| 80th percentile flow | 50 ML/d | 19 GL/a | 460 ML/d | 168 GL/a |
| 95th percentile flow | 25 ML/d | 9.1 GL/a | 220 ML/d | 80 GL/a |
| 99th percentile flow | 7.5 ML/d | 2.8 GL/a | 90 ML/d | 33 GL/a |
| Annual Ave Runoff Proportion | 45% | | 40% | |
| Secure Yield (Town Water) | 32 ML/d | 11.6 GL/a | 51 ML/d | 18.5 GL/a |
| Secure Yield (Irrigation from Bray Park Weir) | - | - | 2 ML/d | 0.7 GL/a |
| Environmental flows | Lesser of inflow to dam & • 1.1 ML/d (Sept to Apr) • 0.8 ML/d (May to Aug) | | Releases via fish ladder (up to 25 ML/d) | |
| Stressed Rivers Classification | High hydrological stress (overall rating of S3) | | | |
| *Key references (see Section 6) are:* DLWC (1998), Sunwater (2002a), Sunwater (2002b), Patterson Britton (2003), | | | | |

The Tweed River catchment is the bulk source for all town water supplies in the study area. Almost all of the town water supplies are sourced directly from Bray Park Weir (refer to Figure 3.3) and treated at Bray Park WTP. The exceptions to this are the township of Uki which uses the Tweed River at Uki as the source for the Uki WTP and the township of Tyalgum which uses the Oxley River (a tributary of Tweed River) at Tyalgum as the source for the Tyalgum treatment facility. Average runoff rates for the catchment are very high due to a combination of steep ranges in the upper catchment and relatively short stream lengths in the lower catchment.

**Figure 3.3**

*Bray Park Weir*

Bray Park Weir has a limited storage of around 840 ML, which is the equivalent of about one months average demand (at 2004). However, Clarrie Hall Dam (refer to Figure 3.4) is located within the Tweed River catchment on the Doon Doon Creek and has a usable storage capacity of 15,000 ML, which is the equivalent of around 20 months average demand (at 2004). The dam has a catchment area of 60 $km^2$, approximately 10% of the total catchment area of Bray Park Weir (565 $km^2$).

The current estimated secure yield for Bray Park Weir and Clarrie Hall Dam is 18,500 ML/a (Sunwater 2002a). This figure allows for releases down the fish ladder, but these releases are prevented during dry periods. The secure yield for Clarrie Hall Dam alone is 11,600 ML/a. A preliminary review of the secure yield was undertaken at the commencement of the Context Study and concluded that there were several components of the previous modelling that needed refining, with the likely outcome of the rework being a reduction in the previously stated secure yields (refer to Appendix B).

The storage volume in Bray Park Weir at any given time is a dynamic balance between:

- Direct inflows from 90% of the upstream catchment and releases (controlled and uncontrolled) from Clarrie Hall Dam, representing the remaining 10% of the catchment.
- Direct withdrawals for town water supply and irrigation of nearby farms.
- Discharges over the weir (including via the fish ladder) to the Upper Tweed Estuary.
- Direct rainfall and evaporation.

Current operating procedures allow for controlled releases from Clarrie Hall Dam when flows at either Bray Park Weir and/or Uki are insufficient to adequately supply town water demands. When releases from Clarrie Hall Dam are required to maintain sufficient flows at Bray Park Weir, the water level within the weir is usually maintained just below the fish ladder, which results in local irrigators having restricted or no access to irrigation water.

**Figure 3.4**

*Clarrie Hall Dam*

In an average year, annual extractions from Bray Park Weir to satisfy town water demands (around 10 GL) are around 3% of weir inflows. In a very dry year (say 95th percentile inflow), annual extractions for town water supplies increase to over 10% of weir inflows.

The 5 months period from August to December (one month either side of Spring) are the lowest inflow months in an average year. In a dry year (say 80th percentile inflow), the 5 months period from September to January (spring plus first two months of summer) are the lowest inflow months. In the late spring, early summer period of dry years (say 80th percentile inflow), extractions from Bray Park Weir to satisfy summer demands are around 50% of weir inflows.

This has led to the Upper Tweed catchment being given a 'hydrological stress rating' of high, as identified in the *Stressed Rivers Assessment Report* (DLWC 1998). When combined with an 'environmental stress rating' of medium, the catchment has been given an 'overall stress rating' of S3. Catchments with a stress rating of S3 or higher (S1, S2 or S3) generally have water extraction rates that are contributing to environmental stress and consequently, these catchments are the highest priority for the preparation of Water Sharing Plans. To date, however, Water sharing Plans have not been implemented for the Tweed River. In the absence of a Water Sharing Plans, there have been no fixed environmental flow objectives set for the Tweed River catchment.

The extraction point for the Uki town water supply is the Tweed River at Uki, downstream of Clarrie Hall Dam. Therefore, the security of the Uki town water supply is linked to the security of the combined Clarrie Hall Dam and Bray Park Weir supply system.

The secure yield of the town water supply for the township of Tyalgum, which uses the Oxley River at Tyalgum as its source (refer to Figure 3.5), is 37 ML/a based on a 99.9% security (Sunwater 2003). However, for 23 weeks in 2002/03 severe water restrictions had to be enforced, including a total ban on outdoor water use. Water carting from Murwillumbah was required for 3 months in late 2002 due to a combination of very low river flows and poor raw water quality in the weir. It is likely that water carting would have been avoided if better water treatment was available (refer to Section 3.1.3).

**Figure 3.5**

*Tyalgum Weir*

### 3.1.3 Surface Water Quality

The key characteristics of *Surface Water Quality* are summarised in Table 3.3 below, with more detailed information following the table and in Appendix C.

**Table 3.3** *Surface Water Quality – Key Characteristics*

| Component | Details |
|---|---|
| Upper Tweed River– Water Quality & Health | • Suspended solids and nutrient levels are generally elevated in the Upper Tweed catchment.<br>• Algal blooms commonly occur during the warmer months. |
| Upper Tweed River - Stressed Rivers Classification (EPA) | Medium Environmental Stress (overall rating of S3) |
| Tweed Estuary – Water Quality & Health | • Generally fair to good water quality and health in lower estuary and broadwaters, due to tidal flushing.<br>• Water quality and health declines with distance from river mouth, with poor health in the mid to upper estuary and the Rous River. |
| Coastal Estuaries – Water Quality & Health | • Agricultural and urban stormwater runoff appear to be the dominant influence on pollutant inputs to the estuary. |
| *Key references (see Section 6) are*: TSC (2003a), GHD (2002), UQ (2003), EPA (2000), Australian Wetlands (2004) | |

Monitoring and studies have shown that the water quality in the Tweed River System is generally a reflection of catchment activities and the management of these activities.

The Upper Tweed catchment generally experiences elevated levels of suspended solids and nutrient levels and several sites within the Oxley River and Tweed River sub-catchments have reached or exceeded bacterial thresholds for primary contact recreation on occasions. The upper catchment is significantly impacted by agricultural runoff, including soil erosion, and modified rural runoff containing fertilizers and animal waste.

Consequently, Bray Park Weir has experienced increasing apparent levels of algal activity over the last 5 years.

The greatest increases in nutrient and faecal coliform concentrations occur at monitoring sites located downstream from high density animal husbandry. Increased nutrient and faecal coliform concentrations also occur downstream of townships and in areas where stock have ready access to waterways.

Suspended solids generally increase with rainfall, with soil erosion considered the primary source.

The Tweed Estuary generally has poor water quality, including high levels of nutrients, suspended sediments and faecal coliforms. Water quality at the mouth of the Tweed estuary is good as it is relatively well flushed with oceanic water. Water quality in the remainder of the estuary is generally poor. Terranora Inlet is well flushed by tidal movement but is subject to a high level of pollutant inputs from the adjacent heavily urbanised area including several canal estates (TSC 2000a). Terranora and Cobaki Broadwaters are both shallow water bodies with reasonable water quality. They are subject to nutrient and sediment accumulation from the catchment. Terranora Broadwater catchment has substantial existing and future urban development and Cobaki Broadwater catchment will be developed within the next five to ten years (TSC 2000a).

Concentrations of faecal coliforms, total nitrogen and total phosphorous generally exceed water quality objectives in the lower, mid and upper Tweed Estuary (GHD 2002). The Rous River has been identified as a major hotspot, as it experiences eutrophication and is a likely source of pollution to the mid estuary.

There is a strong seasonal variation, with higher turbidity and nutrients and lower pH during wet seasons (Costanzo 2001; SKM 1998). Estuary health generally improves in dry seasons due to reduced run-off, lower temperature and light levels (during winter). In the flood events the lower estuary, which generally has fair to good health in the other seasons, experiences high levels of nutrients (transported from upstream), reducing estuary health. Stormwater has a significant impact on estuarine water quality, accounting for 70-90% of the variation.

Water quality processes are dominated by point source loadings during dry months, while diffuse loads from the whole catchment dominate during wet periods. The upper estuary is impacted by nutrients derived from agricultural fertilisers, the mid to upper estuary and Rous River are impacted by wastewater discharges and agricultural fertiliser runoff and the mid estuary is impacted by wastewater discharges. The lower to mid estuary is also heavily impacted by urban runoff processes.

Cudgen, Cudgera and Mooball Creeks are three small estuaries located between Kingscliff and Wooyung. They have high conservation and recreational value to Tweed residents and visitors. Estuaries at Bogangar, Hastings Point and Pottsville are affected by urban development. Poor agricultural and urban development practices can increase pollution runoff, siltation and exposure of acid sulphate soils.

Based on the four year monthly monitoring program of the three smaller estuaries:

- Water quality in the estuaries is within a range where focused improvements in catchment management are likely to produce a measurable effect in meeting water quality objectives

- Agricultural and urban stormwater appear to be the dominant influence on pollutant inputs to the estuaries.

While each of the estuaries are affected by similar influences, the issues specific to each of the estuaries are outlined below:

*Cudgen Estuary*

- Monthly monitoring appears to be insufficient to distinguish particular pollutants in wet weather events, such as the widely reported erosion of topsoil from Cudgen vegetable growing areas

- SEPP 14 wetland area

- Draft Management Plan for Cudgen Lake Reserve (DIPNR, 2005) received submissions concerning flooding, siltation, water quality decline, nutrient flux, acid sulphate runoff and increased recreational activity in Lake Cudgen.

*Cudgera Estuary*

- The old bridge crossing at Hastings Point which restricted both tidal and flood flows was removed in August 2005.

- The relatively small size of the estuary may be an important factor in the impact of wet season pollution events on the lower estuary, as there appear to be relatively high levels of some pollutants entering the lower estuary more frequently than in the Cudgen and Mooball estuaries

*Mooball Estuary*

- Acid flows from acid sulfate soils disturbance. Drainage channels associated with these agricultural activities are connected to Mooball Creek and rely on the creek to effectively convey drainage waters.

- Residential development is expanding adjacent to Mooball Creek as part of Pottsville Waters and Black Rocks estates increasing impacts of stormwater and increasing recreational use of the creek

NSW EPA has developed water quality objectives (WQO) as part of the Catchment Management Blueprints. The interim water quality and river flow objectives have been developed to guide plans and actions to achieve healthy waterways. Up to eleven interim water quality objectives apply with objectives based on measurable environmental values for protecting aquatic ecosystems, recreation, visual amenity, drinking water and agricultural water.

An interim water quality management plan for the Tweed Shire was developed by WBM Oceanics in 1999 and adopted by Council in 2000. The plan assessed the water quality in the catchment in accordance with the *NSW EPA Interim Environmental Objectives for NSW Waters* and identified the water quality problems in the catchment (refer to Appendix C for details). The plan also assessed the water quality in terms of meeting environmental values. The NSW EPA has defined the water quality objectives that must be met to satisfy each of the environmental values. The environmental values are classified as:

- Aquatic Ecosystems

- Edible Molluscs (raw)

- Potable Water

- Primary Contact Recreation
- Secondary Contact Recreation
- Agricultural Irrigation Water
- Livestock Drinking Water
- Farmstead Supply (Non potable)

The Management Plan for the Tweed River and catchment identifies the issues which need to be addressed and outlines a series of key actions. These key actions while addressing a specific issue are general and broad facilitating further investigation and modelling, additional studies and reviews of existing practices.

### 3.1.4 River & Estuary Health

River & estuary health is considered an indicator of the sustainability of the entire catchment water cycle. Catchments with waterways that are not subject to hydrological and/or environmental stress, have good water quality and are overall in good condition are generally sustainable. Conversely, catchments with waterways that are stressed, have poor water quality and are overall in poor condition are generally unsustainable.

The river & estuary health in the study area is considered to be generally fair to poor at present. The Healthy Rivers Commission in its *Independent Inquiry into the North Coast Rivers* (HRC 2003), has identified the overall health of the Tweed River as worse than average condition, compared to other NSW coastal river catchments.

The Healthy Rivers Commission inquiry found that:

- The overall health of the Tweed River is in worse than average condition.
- The river is highly stressed because of extraction of water.
- The Tweed River, along with Brunswick and Richmond Rivers, has the poorest water quality on the North Coast.
- Macro invertebrate communities are in relatively poor condition.

In addition, the *Stressed Rivers Assessment Report* (DLWC 1998) has identified the Upper Tweed River as having an 'environmental stress rating' of Medium, while the Lower Tweed River / Estuary and Tweed Coast Estuaries have been given an 'environmental stress rating' of High.

Current management measures include Estuary Management Plans and Stormwater Management Plan, the setting of interim water quality objectives, monitoring and reporting and planned STP augmentations.

It has been recognised in the various studies / reports that have considered the health of the Tweed River and Estuary, that the catchment is highly urbanised and as such it is no longer feasible to return the system to its pre-development state. The Healthy Rivers Commission recommended that three categories of goals / objectives be defined for north coast rivers.

The three categories and their goals are:

- Streams to be conserved: The key goal for waterways that have high ecological value and still retain and support important ecological processes and functions is *CONSERVATION*. Ecosystem structure and functioning should be protected and improved for near-natural areas.

- Streams for sustainable use: The key goal for waterways in areas of agriculture, forestry and rural residential use is *SUSTAINABLE USE*. These waterways have both productive value and modified ecological values and have the potential for restoration of both.

- Streams for which selected values are to be protected or enhanced: The key goal for waterways in highly urbanised areas is *PROTECTION OF SELECTED VALUES*. These areas must be managed for specific environmental outcomes and to protect or enhance selected and/or significant values.

For the Upper Tweed River, where the appropriate HRC river health goal is 'sustainable use', the management responses that have been suggested (HRC 2003) include:

- Restore riparian and instream vegetation as practical (i.e. targeted).

- Employ river sensitive methods for any bank stabilisation.

The objectives for water quality should be the maintenance of quality suitable for agricultural use and primary / secondary contact recreation, and to minimise treatment for town water use.

## 3.2 GROUNDWATER

The key *Groundwater components* are summarised in Table 3.4 below, with more detailed information following the table.

**Table 3.4** *Groundwater Availability - Key Components*

| Aquifer | Area | Depth to G'water | Groundwater Quality | Yield | Groundwater Vulnerability | Managed |
|---|---|---|---|---|---|---|
| Tweed Coastal Dunes | Extensive along coast | 1-3 m | Fresh with brackish regions assocciated with tidal creeks | up to 40 L/s | High | NO - licenced bores |
| Tweed River Alluvium d/s Murwillumbah | Variable along river channels | 1 - 3 m | Marginal - stock watering | 1 - 5 L/s | Moderately High | NO |
| Tweed River Alluvium u/s Murwillumbah | Variable along river channels | 7 -10 m | Fresh | 2.5 - 20 L/s | Moderately high to low-moderate. | |
| Oxley River Alluvium u/s Murwillumbah | Variable along river channels | 7 -10 m | Fresh | 2.5 - 20 L/s | Moderately High | NO - licenced bores |
| Clarence Morton Basin | Around Mt Warning | approx 30 m | Fresh | 1 - 2 L/s | Low | NO |
| Tweed Valley Fractured Basement Rock | most of catchment | Variable | Fresh | <1.5 L/s | Low-moderate | NO |
| *Key references (see Section 6) are:* DLWC (1995) | | | | | | |

There are more than 650 licensed bores within the catchment at the present time. The dominant extraction purpose is for stock and domestic use. Other bores are utilised for the purposes of irrigation, horticulture, industry, and testing and monitoring (TSC 2003a).

It is estimated that around 750 ML/yr is utilised for stock, farming and domestic purposes, with around 900 ML/yr utilised for other purposes. The concentration of bores occurs near Murwillumbah but the best resources are considered to be on the Tweed coastal dunes.

### 3.2.1 Tweed Coastal Dunes

The beach and dune sand system extends from Point Danger to Pottsville and comprises high permeability aeolian sands with thin discontinuous low permeability layers of clay, silt and peat. The depth to water table is low, often less than a few metres with numerous freshwater lagoons and wetland habitats.

Beach and dune sands are considered to be principally recharged from direct infiltration of rainwater and runoff from Cudgen Ridge. Yields of up to 40 L/s have been recorded however careful management of extraction is required to prevent saline intrusion and up-coning. Groundwater vulnerability for this system is rated as *High* due to the low depth to groundwater and high hydraulic connection with the surface.

Groundwater salinity within the beach and dune sands is variable with records showing low (<500 mg/L) salinity along the beaches grading to higher salinity (1500 – 5000 mg/L) within the dunes, probably due to the effect of numerous tidal creeks running parallel to the coast. Water quality problems in some areas have been reported as a result of iron or hydrogen sulphide in extracted water.

Little agricultural use is made of the resource, however numerous spear points are used for domestic and tourist facility use.

*Tweed River Alluvium downstream of Murwillumbah*

Alluvium in the Tweed Rivers thickens from approximately 7 to 10 metres in the upper reaches of the catchment to 23 to 35 metres at the lower extremities of the river system where a more estuarine environment prevails.

Groundwater investigations undertaken by DLWC indicate that there are no significant fresh groundwater sources on the alluvial flats downstream of Murwillumbah. In general, shallow groundwaters associated with the floodplain are brackish and overlie increasingly saline groundwaters.

Groundwater sourced from the top 5 to 6 metres of this formation is suitable for stock watering with yields of 1 to 5 L/s from main alluvial flats. Salinity increases with depth due to the marine origin on the sediments. Fresher water is available along the northern edge of the Tweed River alluvium due to recharge from basement rocks.

To date, groundwater use has been very limited and restricted to stock and domestic supplies, with only supplementary irrigation documented in the estuarine area. Limited flow and poor water quality can also be attributed to the limited use of the resource.

*Tweed and Oxley River Alluvium upstream of Murwillumbah*

DLWC bore records show that the groundwater potential upstream of Murwillumbah is reasonable with alluvium ranging up to 20 metres deep on the Tweed River.

Yields over 2.5 L/s (up to 20 L/s in coarse gravels) and salinity <500 mg/L have been achieved along the Oxley River.

Due to the relatively low yields, this resource has been utilised primarily for agricultural use.

*Tertiary Basalts and Volcanics*

Tertiary basalts are widespread throughout the catchment comprising the remnants of the Mt Warning shield volcano. Acidic plugs, dikes and sills are one of the most important aquifer systems in the area as they are a reliable source of low salinity groundwater (<500mg/L) suitable for urban and agricultural use, although the water is typically hard. Yields vary from 0.5 L/s to 1.5 L/s although yields of up to 15 L/s have been recorded. Average depth to groundwater is 30 metres.

High permeability of the rocks is generally high due to secondary porosity associated with fracturing and jointing. Groundwater discharging from the basalt formations feeds numerous springs and wetlands and forms a major component of river baseflow in the catchment.

*Porous Sedimentary Rocks*

Sandstones, siltstones and pebble conglomerates of the Bundamah Group to the north and south of Mt Warning are reported as low yielding formations with variable salinity. The extent of the resource is yet to be fully established.

Shale, sandstone, coal and ironstone of the Walloon Coal Measures to the west of Mt Warning yield moderate salinity (500 to 1500 mg/L) groundwater at a depth of approximately 30 metres. Yields, however are generally low at less than 1 L/s and rarely exceed 2 L/s.

*Fractured Basement Rocks*

Basement metamorphosed sedimentary rocks of the Neranleigh-Fernvale Group generally have yields less than 1.5 L/s with low salinity (<500 mg/L).

## 3.3 WATER USERS

The key characteristics of *Water Users* are summarised in Table 3.5 below, with more detailed information following the table.

**Table 3.5** *Water Users - Key Characteristics*

| Characteristic | Details |
|---|---|
| Surface Water Extractions | • Approx. 10 GL/a (town water)<br>• Approx. 4.8 GL/a (around 213 licensed irrigators) |
| Groundwater Extractions | • Approx. 1.7 GL/a (around 655 licensed bores) |
| Commercial Activities | • Fishing, houseboats, boating, cruises |
| Recreational Activities | • Fishing, boating, swimming, skiing, windsurfing, regattas |
| *Key references (see Section 6) are:* TSC (2003a), PWD (1991), DLWC (1992) | |

Town water extractions currently amount to about 10 GL/a. The majority of town water (60%) is used for residential purposes. Rural extractions total around 6.5 GL/a from combined surface water and groundwater sources.

In addition to the town water supply, the water bodies of the Tweed have recreational value, and are used for various purposes including recreational fishing, swimming, boating and tourism.

Commercial fishing activities are undertaken in the Tweed River Estuary with approximately 26 local commercial fishers operating in the estuary, targeting a wide range of finfish (including whiting, mullet, flathead, and bream), prawns and mud crabs. There are no prawn or fish farms adjacent to the Tweed River (GHD, 2002).

NSW Fisheries recently gazetted a new “Recreational Fishing Haven” in the Tweed River. This area is closed to commercial fishing as of the May 2002. The Haven includes Terranora Creek downstream of Boyd’s Bay Bridge, and the Tweed River from Rocky Point to the mouth. Wommin Lake and Lagoon, and six canal estates are also included (GHD, 2002).

Substantial areas of the Tweed River Estuary remain open to commercial fishing. Based on catch statistics from 1993 – 1999, the Tweed Estuary produces a total annual catch of between 119 – 197 tonne (of all finfish, crustacean, and molluscs) with a value of between $452,000 – $721,000 (GHD, 2002).

There are approximately twenty operational oyster leases in the Terranora Broadwater and a non operational lease in the Tweed River, near Rocky Point. Following reports in September 1996 of food poisoning alleged to be associated with oyster consumption, the oyster growers in the Tweed area voluntarily closed the estuary for commercial oyster production. A Tweed River Oyster Quality Assurance Program was then developed which set out the responsibilities of stakeholders and minimum required monitoring and reporting. No further reports of food poisoning associated with oyster consumption have been recorded (GHD, 2002).

The Upper and Lower Tweed Estuary provide a base for recreational and commercial water uses. Recreational activities are both organised and informal. Some informal activities include: bait gathering, canoeing, fishing, houseboating, jet skiing, pleasure boating, rowing, sailing, swimming, water skiing and windsurfing. There are approximately twenty six recreation clubs that use the river. Events such as Dragon Boat racing, Rowing and Sailing Regattas and carnivals are also held in or on the banks of the waterways.

Dredging has been undertaken on the Upper Tweed Estuary for many years. The extraction material is classified as filling sand (Barneys Point to Tumbulgum) and concreting sand (Tumbulgum to Murwillumbah) (DLWC 1992).

# 4 THE URBAN WATER CONTEXT

The background information contained within this section focuses on the three urban water characteristics; viz town water, wastewater and stormwater.

*Town Water* includes information on the treatment, distribution and consumption of town water. Town Water is important because it describes the urban water supply system, the demands that are placed on the system and consequently the demand on the water resource. The Town Water system influences the location of development, the demand on the water resource and the loading on the wastewater system.

*Wastewater* includes information on the loading, transportation, treatment and reuse of wastewater. Wastewater is important because it describes the urban wastewater transportation system, the loadings that are placed on the system, the discharges from the system to the environment (typically receiving waters) and the extent of effluent reuse. The Wastewater system influences the location of development, the nature of controlled and uncontrolled discharge of sewage and effluent to the environment and their impact on the receiving waters.

*Stormwater* includes information on the collection, transportation, treatment, reuse and discharge of urban stormwater. Stormwater is important because it describes the urban stormwater system, the loading on the system, the discharge from the system to the receiving waters and the extent of stormwater reuse. The Stormwater system influences the nature of stormwater runoff and its impact on the receiving waters.

**Figure 4.1**
*Banora Pt STP*

## 4.1 TOWN WATER

The key characteristics of *Town Water* are summarised in Table 4.1 below, with more detailed information following the table (also refer to Appendix D).

**Table 4.1** *Town Water – Key Characteristics*

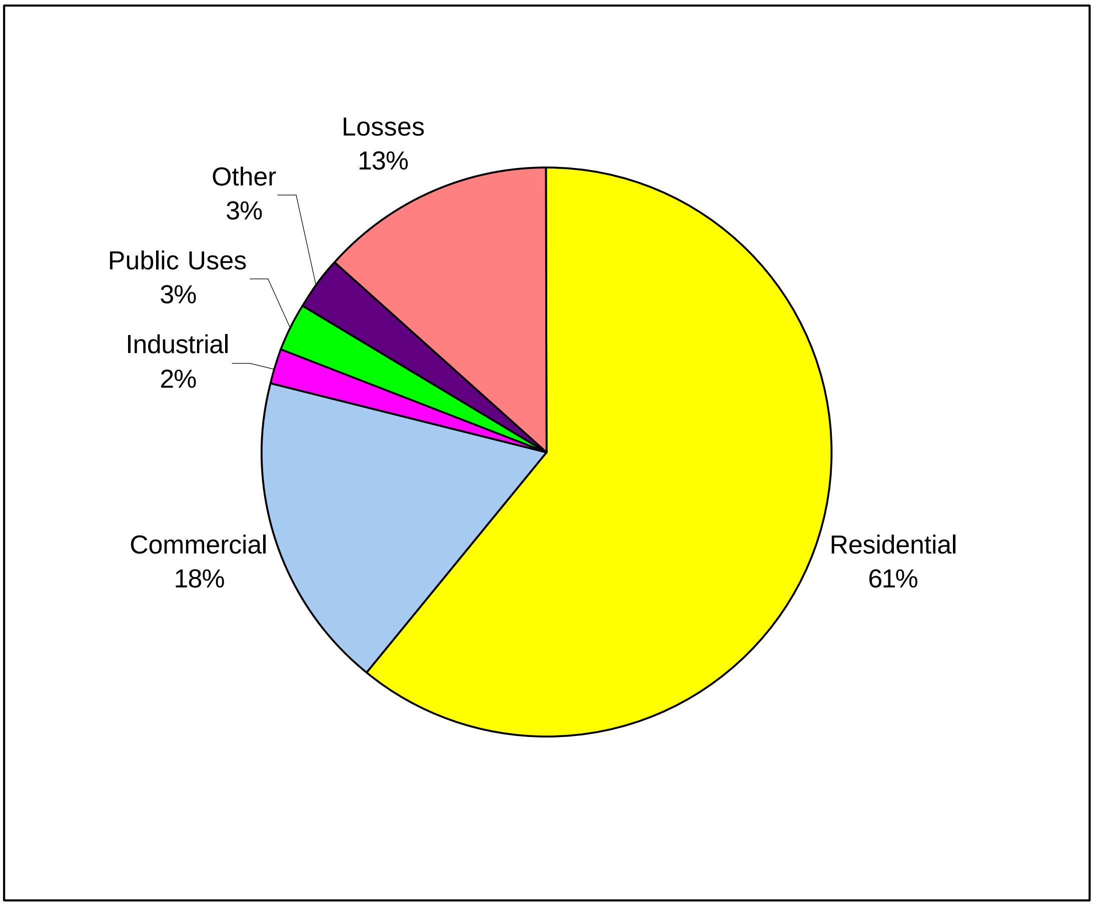
| Characteristic | Data @ 2003 | Details |
|---|---|---|
| Water Treatment Plants (WTP) | 3 | • Bray Park WTP (55 ML/d)<br>• Uki WTP (0.4 ML/d)<br>• Tyalgum WTP (0.4 ML/d) |
| Water Pump Stations (WPS) | 20 | Combined capacity of 176 ML/d |
| Reservoirs | 34 | Combined capacity of 82 ML |
| Length of Watermains | 612 km | 451 km retic / 161 km trunk |
| Population Served | 69,360 | 87% total population (100% of urban) |
| Connections – Residential | 19,347 | |
| Connections - Non-Residential | 871 | |
| Consumption – Residential | 5,550 ML/a | 5 year average (61%) |
| Consumption – Non-Residential | 2,340 ML/a | 5 year average (26%) |
| Consumption - Total | 9,110 ML/a<br>(25.0 ML/d) | 5 year average (including 13% losses) |
| Peak Day Demand | 42 ML/d | 5 year average |
| Ave Residential Consumption | 225 kL/a/dwelling | 5 year average |
| '02/03 Residential Consumption | 213 kL/a/dwelling | 2002/03 |
| *Key references (see Section 6) are:* DEUS (2004b), GHD (1999) | | |

The study area is serviced by three separate town water supply systems. The major system is the Bray Park water supply system that services all of the urban areas within the study area, including Murwillumbah and some rural localities. Two smaller systems are located at Uki and Tyalgum. The details for the three water supply systems are included in Sections 4.1.1 to 4.1.3.

Typically, residential usage accounts for around 60% of total consumption. Figure 4.2 shows the typical breakdown of town water consumption. There are only a few industries within the study area to which town water is supplied, with the Condong Sugar Mill being the largest non-residential water user. The majority of the largest non-residential water users are clubs, caravan parks and motels.

The average annual residential consumption for 2002/03 was 213 kL/a/dwelling. This figure is relatively consistent with the State average of 220 kL/a/dwelling for the same period. It should be noted that during this period outdoor water use was banned for 22 weeks.

**Figure 4.2** *Typical Breakdown of Town Water Consumption*




A two-part tariff charging system was implemented in 2002/03, with a fixed service charge and a volumetric change. The previous pricing structure had a higher fixed charge and a free water allowance of 250kL/a. Details of the current two-part tariff are shown in Table 4.2 below, along with a summary of other key financial characteristics.

**Table 4.2** *Town Water – Financial Characteristics*

| Characteristic | Details @ 2003/04 |
|---|---|
| Water Tariff | • Residential Assessments Service Charge - $106/a<br>• Business Assessment Service Charge - $106/a x meter size multiplier<br>• Volumetric Charge – $0.62 /kL |
| Typical Developer Charge | $4,110 /ET |
| Average Residential Bill | $239 /property |
| Revenue from Usage Charges - Residential | 62% of Access + Usage Charges |
| Revenue from Usage Charges – Non-Residential | 81% of Access + Usage Charges |

Council is currently preparing revised developer charges according to the latest guidelines prepared by the Department of Energy, Utilities & Sustainability (DEUS). The revised charges are expected to apply from July 2005. In preparing the revised developer charges, Council has also prepared revised growth projections, including low, medium and high growth scenarios. The revised growth projections for the study area are shown below in Table 4.3, expressed as ET's. The table also includes approximate annual consumptions based on usage levels per ET remaining constant over the projection period.

**Table 4.3** *Town Water Demand Projections*

| Growth Scenario | 2004 | | 2019 | | 2034 | |
|---|---|---|---|---|---|---|
| | ET | ML/a | ET | ML/a | ET | ML/a |
| Low | 26,660 | 9,820 | 36,880 | 13,590 | 47,440 | 17,480 |
| Medium | 27,470 | 10,120 | 42,930 | 15,820 | 60,250 | 22,200 |
| High | 28,290 | 10,420 | 49,910 | 18,390 | 67,970 | 25,040 |

It should be noted that the above growth protections expressed as ET's are not entirely consistent with the population projections shown in Table 2.10. Population projections in Section 2.6 have been estimated in association with the Tweed Futures planning documents and as such are based on planned or ideal future population levels. The above ET growth projections are based on projected historical growth rates.

### 4.1.1 Bray Park Water Supply System

The Bray Park water supply system serves the urban areas of Murwillumbah, Tweed Heads and the coastal strip from Kingscliff to Pottsville, in addition to the villages of Mooball and Burringbar (refer to Exhibit 3).

The Bray Park water supply system is supplied from the Bray Park WTP, near Murwillumbah.

Raw water is pumped from Bray Park Weir to the WTP through dual 1.4 km rising mains. If present, organic contaminants such as blue green algal toxins or pesticides can be removed using powdered activated carbon dosing of the raw water. The conventional treatment process (coagulation with aluminium sulphate, clarification, rapid sand filtration, and disinfection) has the capacity to produce approximately 55 ML/d of potable water.

Bray Park WTP is scheduled for augmentation in 2006 to a capacity of 75 to 100 ML/d to cater for population growth as well as increasing the reliability of the treatment process when challenged by dirty water conditions following storms in the catchment or during cyanobacterial blooms in the weir.

Potable water produced by the WTP complies with the requirements of the Australian Drinking Water Guidelines. Typically, treated water turbidity is <0.3 NTU and true colour <5 HU.

As shown on Exhibit 3, potable water is pumped from the WTP to two reservoirs located at Hospital Hill in Murwillumbah. Downstream of the Hospital Hill reservoir's, there are three main trunk mains that supply water to the northern, central and southern parts of the water supply system. The northern and central trunk mains are approximately DN600 and follow the Tweed River to supply Tweed Heads in the north to Kingscliff in the south and Bilambil in the west. The southern trunk main is also DN600 and crosses the Cudgen Plateau (where it supplies Duranbah Reservoir) to supply the southern coast areas, from Kings Beach in the north to Pottsville in the south, as well as the inland towns of Burringbar and Mooball.

### 4.1.2 Uki Water Supply System

The village of Uki is located two kilometres east of Clarrie Hall Dam. The Uki WTP is located adjacent to the Tweed River, upstream of the village (refer to Exhibit 3). Raw water is pumped from the Tweed River to the WTP, where it undergoes treatment via coagulation with aluminium sulphate, clarification, Dynasand filtration and disinfection. Total annual production is around 55 ML/a, supplying approximately 350 EP, and the plant capacity is 0.4 ML/day.

Potable water produced by the WTP complies with the requirements of the Australian Drinking Water Guidelines. Typically, treated water turbidity is 0.5 NTU and true colour <5 HU. One significant challenge at Uki is manganese in the raw water following storm events in the catchment or discharges from Clarrie Hall Dam. While treated water is well below the health guideline value of 0.5 mg/L, low levels of manganese (>0.02 mg/L) can result in taste and odour and dirty water complaints for consumers.

### 4.1.3 Tyalgum Water Supply System

The village of Tyalgum is located 24 km west of Murwillumbah on Tyalgum Creek. The Tyalgum WTP is located adjacent to the Tyalgum weir pool, which is located on the Tyalgum Creek (refer to Exhibit 3). Raw water is extracted from the creek via an in-creek coarse sand filter. Chlorination is provided via a hypochlorite dosing system but no other treatment is provided. Total annual usage is around 32 ML/a, supplying approximately 250 EP, and the plant capacity is 0.4 ML/day.

Typically, treated water turbidity is 2.0 NTU and true colour 5 –7 HU. Due to the unfiltered nature of the supply, mains turbidity is determined by the raw water turbidity and the filtering efficiency of the in-creek coarse sand filter as no coagulation is employed. Disinfection of water is inhibited when turbidity is >1 NTU. Free chlorine residual in the supply has been variable with a typical residual of 0.6 mg/L (1999 to 2003). Loss of disinfection residual and excursions up to 4-5 mg/L have been experienced in the past. In response, Council completed an upgrade of the disinfection system in 2003 to include feedback control and remote alarming.

The water quality in the Tyalgum Weir pool during low flow events is a concern at Tyalgum. During the 2002/03 drought, water restrictions were introduced as a result of poor raw water quality in the weir pool. High levels of algae, faecal coliforms and colour and turbidity were present in the weir. Water carting was introduced from August 2002 to February 2003 and a total ban on outdoor usage was imposed. Council is currently investigating the provision of a new WTP to the village, as it is the quality rather than the quantity of available water that appears to be the limiting factor.

## 4.2 WASTEWATER

The key characteristics of *Wastewater* are summarised in Table 4.4 below, with more detailed information following the table (also refer to Appendix D).

**Table 4.4** *Wastewater – Key Characteristics*

| Characteristic | Data @ 2003 | Details |
|---|---|---|
| Sewage Treatment Plants (STP) | 8 | • Tweed Heads STP (12,000 EP)<br>• Banora Point STP (62,500 EP)<br>• Kingscliff STP (14,000 EP)<br>• Hastings Point STP (16,000 EP)<br>• Murwillumbah STP (16,000 EP)<br>• Tumbulgum STP (700 EP)<br>• Tyalgum STP (500 EP)<br>• Uki STP (600 EP) |
| Sewage Pump Stations (SPS) | 161 | Combined ADWF capacity of 50 ML/d |
| Length of Gravity Mains | 447 km | |
| Length of Rising Mains | 122 km | |
| Population Served | 64,600 | 80% total population (98% of urban) |
| Connections – Residential | 17,517 | |
| Connections - Non-Residential | 839 | |
| Average Dry Weather Flow | 18.9 ML/d | ADWF |
| Total Volume Treated | 7,810 ML/a<br>(21.4 ML/d) | Includes wet weather |
| Total Volume Recycled | 235 ML/a | Approx. 4% of ADWF |
| Estimated % Volume of Inflow / Infiltration (I/I) | 13.5% | 5 year average |
| Trade Waste Licences | 397 | |
| Trade Waste Volume | 810 ML/a | |
| Total Annual Loading of Nutrients (primarily to Tweed Estuary) | Approx. 44 T/a TN<br>Approx. 30 T/a TP | 2003 mean |
| *Key references (see Section 6) are:* DEUS (2004b) | | |

The study area is serviced by eight wastewater systems within the study area. The major systems are located within the urban and coastal areas of Tweed Heads (i.e. Banora Point, Kingscliff, Tweed Heads, Hastings Point) and in Murwillumbah. Smaller systems are located at Tyalgum, Tumbulgum and Uki (commissioned in 2004). The details for the eight sewage treatment plants (STP) are included in Appendix E and their locations are shown on Exhibit 4.

Banora Point STP and Tweed Heads STP service the major urban area of Tweed Heads and surrounding suburbs. Both plants will require future augmentation in order to cater for predicted population increases. Council has also adopted an effluent disposal strategy for the plants, which will involve enhanced effluent treatment via improved nutrient removal and disinfections processes in order to reduce bacterial and nutrient levels in effluent discharged to the Terranora Inlet.

Kingscliff STP is to be replaced in the near future in order to cater for predicted population increases in the catchment. In addition, effluent quality will be significantly improved in order to more consistently achieve the EPA's effluent quality criteria for the plant and in conjunction with augmentations proposed for Tweed Heads STP and Banora Point STP, will help to improve water quality in the lower estuary.

Hastings Point STP is currently being augmented, with improved quality effluent being discharged into the coastal dune system. Opportunities for providing effluent to a nearby turf farm and/or for irrigation of local sporting fields are also being investigated.

Murwillumbah STP was upgraded in 2001, with improved quality effluent being discharged into Rous River. The new plant has dramatically reduced nutrient and bacteria loadings on the Rous River and downstream estuary. However, nutrient accumulation still occurs downstream of the STP during dry periods due to poor flushing of the river. Reuse opportunities are currently being investigated in order to reduce nutrient loadings on the Rous River. Reuse opportunities include a cogeneration project at a nearby sugar mill, golf course and race course irrigation and irrigation of open spaces in new development areas.

Tumbulgum STP was commissioned in 1996 and generally has a reliable effluent quality. Some effluent is currently used to irrigate Taro crops on an adjacent farm.

Tyalgum STP performance is at times unreliable. Tertiary ponds are used for disinfection of secondary treated effluent, with the effluent from tertiary ponds being used to irrigate adjacent pastures. Pastures are not currently used for grazing. Investigations have identified that the reuse area could potentially be expanded with the planting of woodlots adjacent to the existing irrigation area.

During extended wet periods, the irrigation ponds overflow to Brays Creek, upstream of the Oxley River confluence.

Uki STP was commissioned in 2004, with effluent being used to irrigate nearby koala feed trees. Any overflows, resulting from extended wet periods, from the irrigation ponds would discharge into Smiths Creek and eventually the Upper Tweed River.

There are several smaller villages, including Burringbar and Mooball, which are currently not serviced. There are approximately 4,000 onsite wastewater systems throughout the catchment, located in these villages and in rural areas. Council adopted an Onsite Sewage Management Policy in February 2003. The study area has been rated in terms of high, medium and low risk, and an auditing and inspection system has been developed for each of the risk categories. The provision of reticulated sewerage services to Burringbar and/or Mooball is currently being investigated.

Over 7,500 ML of treated effluent is currently discharged to various receiving waters (the majority to the Tweed Estuary) on an annual basis. In addition, there is a limited amount of reuse for irrigation purposes. The current reuse schemes are outlined in Table 4.5. A summary of historical effluent reuse projects is also included in Appendix I.

**Table 4.5** *Wastewater – Effluent Reuse*

| STP | Proportion Reused | Average Volume Reused | Purpose |
|---|---|---|---|
| Uki | 100% ADWF | Approx. 20 ML/a | Irrigation of koala feed trees |
| Tyalgum | 100% ADWF | 18 ML/a | Irrigation of pasture |
| Banora Point | 5% ADWF | 175 ML/a | Irrigation of Tweed Heads/ Coolangatta Golf Course |
| Tumbulgum | Up to 100% ADWF | Up to 25 ML/a | Irrigation of crops |

Potential future reuse schemes include a proposed regeneration scheme at Condong Sugar Mill, which would result in reuse of 100% of dry weather flows from the Murwillumbah STP. It has also been proposed to reuse effluent from the Hastings Point STP for the irrigation of nearby sports fields and turf farm.

Council have implemented a two-part tariff charging system for wastewater, with a fixed service charge and a volumetric change applying for discharge volumes greater than 400kL (predominately non-residential properties). Details of the tariff are shown in Table 4.6 below, along with a summary of other key financial characteristics.

**Table 4.6** *Wastewater – Financial Characteristics*

| Characteristic | Details @ 2003/04 |
|---|---|
| Wastewater Tariff | • Access Charge - $430/a<br>• Volumetric Charge – $0.65 /kL (for volumes greater than 400kL/a)<br>• Plus Trade Waste Fees |
| Typical Developer Charge | $3,290 /ET |
| Average Residential Bill | $ 430 /property |

Council has recently prepared revised growth projections (based on projected historical growth rates) for input into their revised developer charges. The projections include low, medium and high growth scenarios. The revised growth projections for the study area are shown below in Table 4.7, expressed as ET's. The table also includes approximate annual discharge volumes based on loading levels per ET remaining constant over the projection period.

**Table 4.7** *Wastewater Loading Projections*

| Growth Scenario | 2004 | | 2019 | | 2034 | |
|---|---|---|---|---|---|---|
| | ET | ML/a | ET | ML/a | ET | ML/a |
| Low | 24,840 | 7,850 | 35,060 | 11,080 | 45,620 | 14,410 |
| Medium | 25,650 | 8,100 | 41,110 | 12,990 | 58,430 | 18,460 |
| High | 26,470 | 8,360 | 48,090 | 15,200 | 66,150 | 20,900 |

## 4.3 STORMWATER

The key characteristics of *Stormwater* are summarised in Table 4.8 below, with more detailed information following the table.

**Table 4.8** *Stormwater – Key Characteristics*

| Characteristic | Data @ 2000 | Details |
|---|---|---|
| Estimated Stormwater Loads for Urban Tweed without stormwater treatment | 1200 kg/ha/yr SS<br>18 kg/ha/yr TP<br>3 kg/ha/yr TN | Based on average rainfall figures |
| Estimated Stormwater Loads for Undeveloped Tweed without stormwater treatment | 125 kg/ha/yr SS<br>0.4 kg/ha/yr TP<br>1.5 kg/ha/yr TN | Based on average rainfall figures |
| *Key references (see Section 8) are:* TSC (2000a), TSC (2003a) | | |

The quality of stormwater is influenced by the condition and practices of the urban environment through the direct link between the stormwater system and local rivers and creeks. Waterways in the study area that have the potential to be influenced by urban stormwater include the Tweed Estuary (particularly the lower estuary) and the Coastal Estuaries.

Typical pollutants contained in stormwater that influence water quality include: sediment (reduces light, affects photosynthesis); nutrients (stimulate plant growth, disrupt DO levels); oxygen demanding substances (decrease oxygen levels); micro-organisms (introduce potentially toxic bacteria and viruses); toxic organics and heavy metals (poisonous to living organisms); oils/grease/detergents (poisonous to living organisms); water temperature alterations (stimulate plant growth, decrease dissolved oxygen) (EPA Vic, 2005). Many of these pollutants have been identified in the Tweed Estuaries. Stormwater monitoring has been undertaken in high priority drains since January 1997. This sampling has indicated very high levels of pollutants within the drains with a significant impact on receiving waters (TSC 2000a).

The stormwater entering into waterways can cause scouring and sedimentation. This is caused by the increased volume and velocity of water leaving urban areas which contain large areas of impervious and hard smooth surfaces.

There has been a range of stormwater treatment devices installed throughout the Tweed catchment to address hotspot areas within the existing urban areas. These include:

- Gross Pollution Trap – eg Ukerebagh Passage
- Gross Pollution Interceptor, Sediment basin and Artificial Wetland – eg Duffy St Drain
- Constructed Wetland – eg Knox Park
- Trade Waste Facility – eg Murwillumbah Sale Yards
- CDS Unit – eg Kingscliff East (refer to Figure 4.3)

- Stormwater Treatment Device – eg Cabarita Beach outfall
- Sediment Pond – eg Koala Beach Estate

**Figure 4.3**
*CDS Unit – Kingscliff East*

Future urban development (particularly the high density of buildings and infrastructure) will increase the stormwater loads and potentially the pollution levels entering the local waterways. The *Stormwater Management Plan* (TSC 2000a) has identified areas such as Cudgen Creek, Cobaki Lakes and Cudgera Creek to be under increasing pressure from future development.

The Stormwater Management Plan sets out objectives for stormwater from new development areas during and following construction. These objectives also include stormwater treatment objectives which provide a qualitative maximum load of pollutants as shown in Table 4.9. These targets and objectives have applied to new development since 2000.

**Table 4.9** *Stormwater Treatment Objectives for New Development (Post Construction or Occupational phase)*

| Pollutant | Maximum permissible load that may be discharged kg/ha/year for an average year |
|---|---|
| Suspended solids (SS) | 300 |
| Total Phosphorous (TP) | 0.8 |
| Total Nitrogen (TN) | 4.5 |
| Litter | Retention of 70% of annual litter load greater than 5mm |
| Coarse sediment | Retention of 90% of annual load of sediment coarser than 0.125mm |
| Oil and grease (hydrocarbons) | <10 mg/ litre in flows up to 40% of Q1 peak |
| *Key references (see Section 8) are:* TSC (2000a) | |

Development Design Specification D7 and DCP No.16 – Subdivision Manual have been adopted to ensure adequate planning is incorporated into new development and the objectives for new development are meet. These controls adopt erosion and sediment control and water sensitive urban design principles to minimise runoff, delay its passage and mimic natural runoff where possible from new development areas.

# 5 THE IWCM PROCESS

Based on the background information for the catchment water cycle, a range of water cycle issues / problems have been identified. Water cycle issues have been identified based on the total catchment water cycle and therefore include some issues that are outside of Councils control in terms of the cause of the issues and the associated impacts. These issues have been categorised as 'external issues' and are outside of the scope of the IWCM process, which focuses on the urban water cycle. This is discussed further in Section 5.1, which lists the total catchment water cycle issues.

Having identified the total catchment water cycle issues, the focus of the remainder of the report and the IWCM process becomes the urban water cycle issues. In order to address the three fundamental questions underpinning the IWCM process (i.e. What is the problem? How do we fix the problem? How do we know the problem is fixed?), a staged approach has been adopted.

The key steps of the process for achieving integrated management are:

1. Identify the urban water cycle issues, the impacts associated with them and the associated design and management gaps (refer to Section 5.1).

2. Consider improvement options for each of the urban water cycle issues by setting broad improvement objectives and identifying potential solutions that are sustainable (economically, environmentally & socially) and therefore more integrated solutions (refer to Section 5.2).

3. Based on the range of improvement options identified, prepare an initial broad strategy and short term implementation plan which focuses on achieving short term gains from integrated solutions (refer to Section 5.3). The short term solutions should be consistent with the solutions and detailed strategies that are likely to come out of a more detailed implementation plan (see below).

4. Ongoing strategy development that details the approach for achieving integration and sustainability (refer to Section 5.4).

5. An ongoing process of monitoring (against measurable outcomes) and review / update (refer to Section 5.4).

The first three steps above have been addressed by this study / report, with Council taking full ownership over these initial steps in the IWCM process. Step 4 will be undertaken in association with various stakeholders, including the community and various government authorities, and is likely to take 3 to 5 years to complete. The final step will be a mixture of regular (eg weekly / monthly) monitoring of various performance indicators, as well as minor annual and major 5 yearly reviews and updates of the IWCM Strategy.

## 5.1 TOTAL CATCHMENT WATER CYCLE ISSUES

The catchment water cycle issues identified in the Tweed IWCM are shown on the following tables. Table 5.1 includes the list of issues for the Upper Catchment (i.e. upstream of Bray Park Weir), while Table 5.2 includes the list of issues for the Lower Catchments (i.e. the remainder of the IWCM study area). The tables include: the catchment water cycle issues and current control measures associated with the issues; existing / actual impacts and future / potential impacts associated with the issues including economic (both Council & community costs), environmental and social impacts; and current design and/or management gaps (i.e. inadequate control measures).

A number of issues have been identified as ‘external issues’, as they are outside of the scope of the IWCM. These issues are not generally within Council’s control and don’t significantly impact on the urban water cycle. The remaining issues are considered to be urban water cycle issues that will need to be considered and addressed in the IWCM process.

Sections 5.1.1 to 5.1.4, following the tables, includes a discussion on the water cycle issues under the five broad headings:

1. Urban Town Water Issues
2. Urban Wastewater Issues
3. Urban Stormwater Issues
4. Other Urban Issues
5. Rural / Catchment Issues

An assessment of the adequacy of data used to identify the urban water cycle issues is included in Appendix A. The assessment includes a list of data gaps identified during the Context Study phase.

**Table 5.1:** *Tweed IWCM: Existing & Potential / Future Issues [Upper Tweed Catchment]*

| ISSUE | CURRENT CONTROL MEASURES | IMPACTS [$C, $S, S, E] | | DESIGN / MANAGEMENT GAPS |
|---|---|---|---|---|
| | | EXISTING (ACTUAL) | POTENTIAL / FUTURE | |
| **High Extractions for Town Water** | • Fish ladder flows are maintained at Bray Park Weir, except during low flow periods<br>• Some environmental flows are released from Clarrie Hall Dam<br>• Informal demand management program<br>• BASIX | • Reduced / altered downstream river flows reduce river health and have undefined estuary health impacts due to reduced fresh water inflows [E]<br>• Reduced social amenity of downstream watercourses [S] | • Increased extractions from Bray Park Weir in the future will further increase hydrological stress on river and potentially reduce estuary health [E]<br>• Further reductions in social amenity and potential impacts on tourism based activities [S] | • Extractions from weirs are not subject to environmental flow rules (no water sharing plan)<br>• A comprehensive demand management program has not been adopted<br>• Other water sources (eg recycled water) are not presently utilised<br>• Pumping from Bray Park Weir for irrigation is not properly managed by DNR |
| **Poor Raw Water Quality (for Town Water)** | • Full treatment provided at Bray Park & Uki WTP's<br>• Coarse screening & chlorination only provided at Tyalgum WTP<br>• Releases are made from Clarrie Hall Dam to flush Bray Park Weir during poor water quality / algal bloom events | • Reduced treated water quality [S] and/or increased treatment costs [$C] during poor water quality events (algal blooms / post storm runoff / low flows)<br>• Water carting to Tyalgum during drought [$C] in association with severe restrictions [$S/S]<br>• Generally poor to average water quality to consumers from Tyalgum WTP [S] | • Increased extractions in the future will increase the need to extract water from Bray Park Weir during poor water quality events [$C/S] | • Insufficient capacity and treatment standard (for varying raw water qualities) at Bray Park WTP for future growth<br>• Inadequate level of treatment at Tyalgum WTP<br>• No water supply catchment management plan for Bray Park Weir |
| **Sewerage System Discharges** | • Tyalgum & Uki systems, treated effluent only discharges to adjacent water ways after prolong periods of wet weather<br>• STP's have limited stormwater overflow storage | • Minimal impacts noted to date from overflows from Tyalgum and Uki sewerage systems | • Potential for dry & wet weather overflows to discharge into downstream waterways, adversely impacting on river health [E] and raw water quality [$C, S] | • Risk assessment required to determine dry & wet weather overflow storage requirements<br>• Monitoring of inflow/infiltration rates is needed at Tyalgum |
| **Effluent Discharges** | • Nominally 100% dry weather reuse of effluent at Tyalgum and Uki STP's<br>• Uki system is new and is below design load<br>• Limited wet weather storage of excess effluent | • Minimal impacts noted to date from overflows from Tyalgum and Uki effluent reuse systems | • Potential for effluent from Uki and Tyalgum reuse schemes to discharge into downstream waterways, with likely minor impacts on river health [E] and raw water quality [$C, S] | • Effluent management plans have not been prepared<br>• Risk assessment is required to determine wet weather overflow storage requirements |
| **Urban Stormwater Runoff Flows & Quality** | • Post 2000 development is subject to WSUD requirements<br>• Current stormwater management plan<br>• DCP's covering stormwater & WSUD<br>• Limited use of stormwater treatment and/or detention systems in pre 2000 development areas | • Runoff from pre 2000 development increases sediment and nutrient loads on Tweed River [E], impacts on raw water quality (including contributing to algal blooms) in Bray Park Weir [$C, S] and increases erosion of local watercourses [E] | • Future impacts are likely to be similar to existing impacts due to limited growth & more stringent DCP's | • Developments prior to 2000 discharge stormwater without treatment or detention |

| ISSUE | CURRENT CONTROL MEASURES | IMPACTS [$C, $S, S, E] | | DESIGN / MANAGEMENT GAPS |
|---|---|---|---|---|
| | | EXISTING (ACTUAL) | POTENTIAL / FUTURE | |
| **Rural Residential Development** | • Existing DCP's<br>• BASIX<br>• Extent of recent development | • Servicing with water and/or sewer is more expensive than standard residential [$C]<br>• Clearing of vegetation for development [E] | • Demand for rural residential land may require extension of existing water and wastewater systems to more remote areas [$C/E]<br>• Runoff from rural residential land may impact on raw water supply quality & river health [$C/E] | • DCP's for rural residential lots need to include WSUD components including rainwater tanks & stormwater detention / treatment |
| **On-site Sewage Treatment System Failures** | • Septic systems constructed post 2002 are licensed & subject to annual inspections<br>• Ongoing program of inspections & upgrades to systems built prior to 2002<br>• Township of Uki sewered in 2004 | • Overflows from poorly performing or failed septic systems impact on health of downstream surface waters and groundwater [E] | • Potential for septic system overflows / failures to impact on raw water quality in Bray Park Weir and Tyalgum Weir [$C, S] | • Backlog of pre 2002 septic systems still requiring upgrades<br>• Not all lots in the township of Uki have connected to new sewerage system |
| **Contaminated Rural Stormwater Runoff** | • Draft Vegetation Management Strategy<br>• CMA initiatives and programs, including catchment management plan<br>• Interim Water Quality Management Plan | • Increased runoff rates due to vegetation clearing and earthworks increases nutrient & sediment loads on Tweed River [E], adversely impacts on raw water quality (including contributing to algal blooms in Bray Park Weir) [$C, S] and increases erosion of local waterways [E] | • Further clearing of vegetation & earthworks would increase impacts & potentially increase frequency of algal blooms | • Little Monitoring of 'hot spots<br>• An overall coordinated Government approach not yet in place |
| **Riparian Vegetation Clearing** | • See above<br>• Limited targeted riparian remediation by Council | • Lose of riparian vegetation reduces filtering of rural runoff with impacts similar to above | • Further lose of riparian vegetation would increase impacts & potentially increase frequency of algal blooms | • Further targeted riparian remediation is required |
| **Wastewater from Intensive Agriculture** | • EPA licensing | • Wastewater from intensive agriculture increases nutrient & pathogen loadings on Tweed River [E], adversely impacting on raw water quality (including contributing to algal blooms in Bray Park Weir) [$C, S] | • Further establishment of intensive agricultural farms would increase impacts & potentially increase frequency of algal blooms | • Little Monitoring of 'hot spots<br>• An overall coordinated Government approach not yet in place |
| ***Surface Water Diversions for Irrigation [ext]*** | • DNR licensing of irrigators | • Increases hydrological stress on river, adversely impacting on river health [E]<br>• Reduced raw water availability for town water during low flow periods [S] | • Any increase in surface water diversions would further increase hydrological stress [E] & reduce raw water availability [S] | • A water sharing plan has not been prepared for the Upper Tweed River (DNR) |
| ***Groundwater Extractions [ext]*** | • DNR licensing of bores | • Unknown | • Extraction of groundwater above sustainable yields will deplete resource availability in future years, adversely impacts groundwater dependent ecosystems & may impact on river flows [E] | • A water sharing plan has not been prepared for the Upper Tweed River (DNR)<br>• Sustainable yield of groundwater sources is not known (DNR) |

*Note: Impact codes: Council cost [$C], social cost [$S], general social impact [S], environmental impact [E]*

**Table 5.2**: *Tweed IWCM: Existing & Potential / Future Issues [Lower Tweed Catchment]*

| ISSUES | CURRENT CONTROL MEASURES | IMPACTS [$C, $S, S, E] | | DESIGN / MANAGEMENT GAPS |
|---|---|---|---|---|
| | | EXISTING (ACTUAL) | POTENTIAL / FUTURE | |
| **Town Water Security (Supply from Upper Catchment** | • Informal demand management program<br>• Drought contingency measures / restrictions | • There have been extended periods of restrictions during drought periods [$C/$S/S] | • Increased frequency & duration of restrictions due to system yield being exceeded [$C/$S/S]<br>• Potential for severe restrictions & high cost drought contingencies measures being required if system yield is exceeded [$C/$S/S] | • Town water demands are likely to exceed system yield in the medium term (10 to 15 years)<br>• Comprehensive demand management program has not been adopted<br>• Other water sources (eg recycled water) are not presently utilised<br>• HNFY Methodology for Town Water Supply Security is now considered low |
| **Sewerage System Discharges** | • Capital works program for future augmentations<br>• Investigation & modelling (Static theoretical models) studies to assess existing system overflows<br>• Dry weather detentions times at pumping stations<br>• Constructed overflow locations | • Dry & wet weather overflows increase nutrient and pathogen loads on local waterways and downstream estuaries [E/S] | • Increasing loadings & aging infrastructure may lead to more dry & wet weather overflows [E/S] | • No formal inflow / Infiltration reduction program<br>• EPA licensing of system overflows will be required in the future<br>• No time series / calibrated modelling studies to assess existing system overflows |
| **Effluent Discharged to Estuaries & Sand Dunes** | • Interim Water Quality Management Plan<br>• Monitoring & reporting on estuarine water & groundwater quality<br>• Nominal effluent reuse at Tumbulgum STP<br>• Currently upgrading Hastings Point STP | • Pathogen & nutrient loads impact health of estuaries & groundwater [E] and reduce social amenity of estuaries [S] | • Reductions in estuary health may potentially impact on water quality at downstream beaches [E] and reduce social amenity [S]<br>• Reduction in GW quality may impact on its suitability as a source water [$C]<br>• Increased loadings may lead to further reductions in estuary / g'water health [E/S] | • Full tertiary treatment is not currently available at all STP's<br>• Effluent discharged to estuary is not available / utilised for reuse<br>• Banora Point, Tweed Heads & Kingscliff STP's all require augmentation to cater for future growth |
| **Urban Stormwater Runoff Flows & Quality** | • Post 2000 development is subject to WSUD requirements<br>• Current stormwater management plan<br>• DCP's covering stormwater & WSUD<br>• Limited use of stormwater treatment and/or detention systems in pre 2000 development areas | • Runoff from pre 2000 development increases nutrients, sediments, oxygen demanding substances, heavy metals, oils and grease loads on local waterways, estuaries and groundwater, reducing health [E/S]<br>• Runoff volumes and velocities increase erosion of local waterways [E] | • Reductions in estuary health may potentially impact on water quality at downstream beaches [E] and reduce social amenity [S]<br>• Reduction in GW quality may impact on its suitability as a source water [$C]<br>• Increased stormwater discharges may lead to further reductions in estuary and groundwater health [E/S] | • Developments prior to 2000 discharge stormwater without treatment or detention<br>• Ongoing development of Stormwater Management Plan is required |

| ISSUES | CURRENT CONTROL MEASURES | IMPACTS [$C, $S, S, E] | | DESIGN / MANAGEMENT GAPS |
|---|---|---|---|---|
| | | EXISTING (ACTUAL) | POTENTIAL / FUTURE | |
| **Urban Residential Development / Growth** | • Existing DCP's (including WSUD requirements)<br>• BASIX<br>• Partial compliance with DEUS Best Practice Guidelines for Water and Sewer<br>• Council's Tweed Futures Draft Strategic Plan | • Growth in recent years has placed increasing pressure on urban water cycle components, resulting in the need for significant augmentations of assets [$C, E] and increasing extractions, effluent discharges & stormwater runoff (see below)<br>• Clearing of vegetation for new urban development areas [E]<br>• Ever increasing burden of management / operation of expanding systems [$C] | • There will be an increasing need to provide services to areas that are remote from existing infrastructure [$C]<br>• Further increases in extractions, effluent discharges & stormwater runoff (see below) | • Ongoing updating of DCP's<br>• Requirements that development master plans consider urban water cycle impacts & WSUD / ESD principles<br>• Full compliance with DEUS Best Practice Guidelines for Water and Sewer<br>• Developer / community eduction & training in WSUD / ESD principles |
| **Renewals & Augmentations of Assets** | • Assets are generally replaced when ongoing repair / maintenance costs become excessive | • Failure of assets reduces levels of service [S], impacts on the environmental [E] & generally requires urgent & costly replacement [$C] | • Inadequate replacement program now may lead to more frequent failures of assets [S/E] and an excessive cost burden [$C] in the future | • No formal Asset Management Plan is in place |
| **On-site Sewage Treatment System Failures** | • Septic systems constructed post 2002 are licensed & subject to annual inspections<br>• Ongoing program of inspections & upgrades to systems built prior to 2002 | • Overflows from poorly performing or failed septic systems impact on health of downstream waterways, including local creeks, estuaries and groundwater [E] | • Future impacts are likely to be similar to existing impacts due to limited potential for new on-site systems | • Backlog of pre 2002 septic systems still requiring upgrades<br>• Townships of Mooball & Burringbar are not sewered |
| ***Contaminated Rural Stormwater Runoff [ext]*** | • Draft Vegetation Management Strategy<br>• CMA Initiatives and programs, including catchment management plan<br>• Interim Water Quality Management Plan<br>• Floodgate policy | • Increased runoff rates due to vegetation clearing (including riparian) and earthworks increases nutrients and sediment loads on local waterways and downstream estuaries [E/S] and increases erosion of local waterways [E] | • Further clearing of vegetation and earthworks would increase impacts | • Little Monitoring of 'hot spots' |
| ***Uncontrolled Earthworks Disturbing Acid Sulphate Soils [ext]*** | • DCP's requiring ASS management plans<br>• ASS Management Advisory Committee guidelines<br>• ASS risk maps | • Increased construction costs due to ASS management [$C/$S]<br>• Increased asset replacement costs [$C]<br>• Uncontrolled disturbance of ASS has an adverse impact on estuary health [E]<br>• Concentrated acidic flushes during storm events adversely impacts on estuary health [E] | • The impacts associated with ASS may increase in the future with increasing pressure to develop in areas affected by ASS | • An overall coordinated Government approach not yet in place |
| ***Groundwater Extractions [ext]*** | • DNR licensing of bores | • Unknown | • Extraction of groundwater above sustainable yields will deplete resource availability for future years [E] | • A water sharing plan has not been prepared (DNR)<br>• Sustainable yield of coastal aquifers is not known (DNR) |

*Note: Impact codes: Council cost [$C], social cost [$S], general social impact [S], environmental impact [E]*

### 5.1.1 Urban Town Water Issues

The three key urban town water issues that have been identified are:

- High extractions for town water
- Town water security
- Poor raw water quality

***High Extractions for Town Water / Town Water Security***

It is projected that the town water demand in the study area will exceed the current secure yield estimate from the existing system within the next 30 years, as a result of the high population growth occurring in the area. The extent and timing of this exceedence is not at all clear, as environmental flow requirements for the Tweed River and the risk level for Town Water Supply security have not yet been defined.

The current extraction rates from the Upper Tweed River have led to the catchment being given a 'hydrological stress rating' of high, as identified in the *Stressed Rivers Assessment Report* (DLWC 1998). The high extraction rates are likely to be contributing to environmental stress, currently rated as medium for the Upper Tweed River.

In the absence of a Water Sharing Plan, environmental flow objectives for the Tweed River have not been set. However, the EPA has set *Interim Environmental Objectives* (EPA 2000) for the Tweed River catchment which includes an objective to 'protect natural low flows' in town water supply sub-catchments and uncontrolled streams. Measures required to meet this objective include:

- Share low flows between the environment and water users (i.e. flows below the level naturally exceeded on 80% of all days with flow). Environmental share to be 50-70% of low flows.

- Fully protect all very low flow natural flows (i.e. flows below the level naturally exceeded on 95% of all days with flow). Environmental share to be 100% of very low flows.

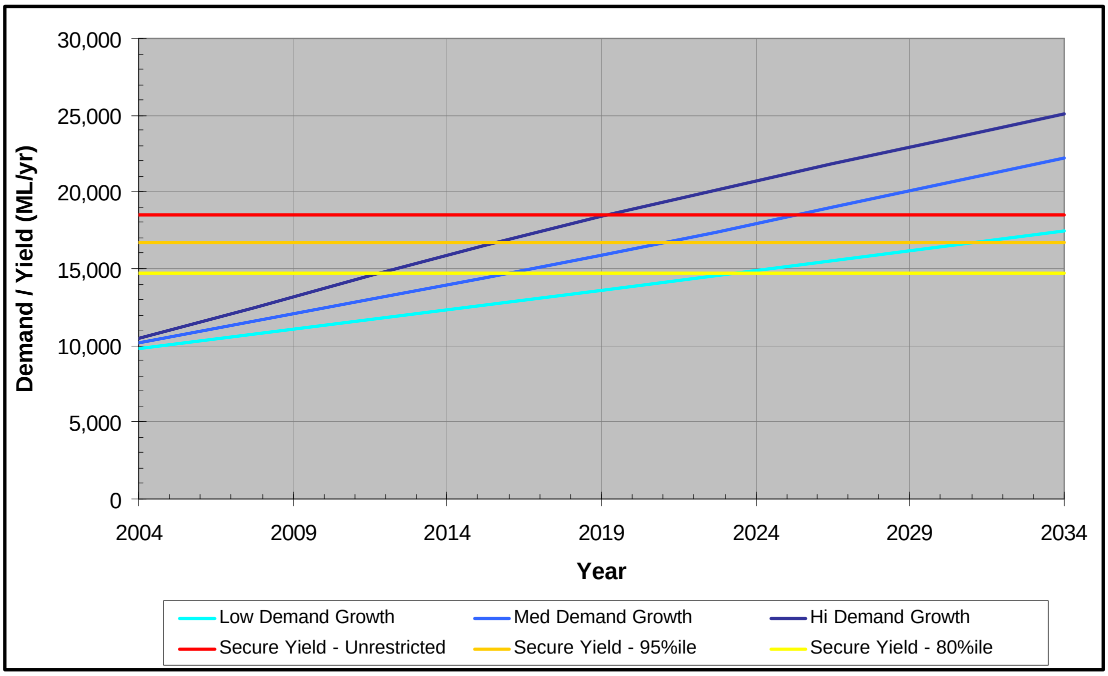
While the above measures are not yet mandated by a Water Sharing Plan, when the plan is prepared in the future, the *Interim Environmental Objectives* suggest that consideration will need to be given to whether it is feasible to achieve the above objectives without significantly affecting reliability.

There is some uncertainty as to the accuracy of the current estimate of the secure yield of the existing surface water storages. However, what is certain is the impact of future environmental flow requirements on the secure yield of the storages is likely to be significant. In a recent review of the secure yield of the combined Bray Park Weir and Clarrie Hall Dam (Sunwater 2002a), it was determined that the current secure yield, in the absence of any environmental flow objectives, is 18,500 ML/a. If the $95^{th}$ percentile flow was imposed as the environmental flow requirement, then the secure yield would reduce to 16,700 ML/a. If the $80^{th}$ percentile flow was imposed as the environmental flow requirement, then the secure yield would reduce to 14,700 ML/a.

Additionally, the "Historical No Failure Yield" methodology used in all previous estimates of secure yield only affords a relatively low probabilistic risk against failure, in this case being approximately 1 in 120), which is now considered low. A buffer storage over and above this yield is now recommended to allow time for the provision of an emergency supply, likely to be a small desalination facility in Tweed Shires case.

Figure 5.1 shows the May 2002 estimate of the secure yield of Bray Park Weir and Clarrie Hall Dam and the reduced secure yield for, based on the 95th percentile and the 80th percentile environmental flow objectives. Existing and projected demands (low, medium and high growth scenarios) are also included, based on current consumption levels. Regardless of future environmental flow objectives, if current consumption levels continue, town water demand in the study area is likely to exceed the secure yield from the existing system within the next 30 years and as early as 2012.

**Figure 5.1** *Town Water Demand Growth Scenarios versus Secure Yield Scenarios*




The key management measures currently employed to minimise the adverse effects of high water extractions are the maintenance of a fish ladder at Bray Park Weir and the release of environmental flushing flows from Clarrie Hall Dam during periods of very poor water quality in the weir.

### *Poor Raw Water Quality*

Poor water quality in Bray Park Weir is caused by a combination of poor land use practices in rural areas, wastewater from intensive agriculture and urban runoff from villages such as Uki and Tyalgum. Impacts associated with poor raw water quality include increased treatment costs and reduced treated water quality.

A combination of poor water quality during low flow periods and only partial treatment of raw water at Tyalgum has also resulted in prolonged periods of water carting in association with severe restrictions.

Key management measures currently employed include the provision of full treatment at Bray Park and Uki WTP's and the use of flushing releases from Clarrie Hall Dam to improve water quality in Bray Park Weir.

Poor water quality will have a reduced impact on Bray Park WTP in the next couple of years (2006/07), as the plant is being upgraded to include advanced membrane technology, which will make the treatment process more robust. Council are also investigating options for improved (full) treatment at Tyalgum WTP.

### 5.1.2 Urban Wastewater Issues

The two key urban wastewater issues that have been identified are:

- Sewerage system discharges
- Effluent discharges

***Sewerage System Discharges***

Dry and wet weather overflows from sewerage systems are inevitable, particularly for older systems. In recent years Council has assessed the capacity of its existing sewerage systems using hydraulic modelling combined with theoretical loadings for both existing and future loadings. While these studies have identified some areas that are under capacity during wet weather events, the extent and frequency of overflows from the sewerage systems during storm events is largely unknown. Any overflows from the sewerage systems will place point loads of pathogens and nutrients on downstream waterways, impacting on waterway health and social amenity.

In order to assess the existing extent and potential future extent of sewerage system overflows, flow gauging of the system and subsequent calibration of a dynamic hydrological / hydraulic model is needed. The calibrated model can then be used to assess the performance of the system during a long term sequence of rainfall, providing outputs such as locations of overflows, monthly / annual overflow volumes and frequencies of overflows. In the next couple of years Council will also be required to seek licensing approval from the NSW EPA for their sewerage system overflows. This process will also require more detailed information on sewerage system overflows, including location, volumes and frequencies.

***Effluent Discharges***

Large volumes of effluent are currently discharged to the waterways of the study area and there is currently little reuse occurring. The majority of effluent in the study area is discharged to the Tweed Estuary, with effluent volumes to increase in the future with increasing population, resulting in further increases in the nutrient / bacteria loading on the estuary.

The Northern Rivers Catchment Management Authority (CMA) has set a target that all treated effluent discharged from treatment plants is to have either 50% reuse of dry weather flow, or be of reuse standard, by 2011.

Pathogen and nutrient loads from STP's in the lower catchments adversely impact estuary and groundwater health. Council has previously recognised this and is presently upgrading one major plant (Hastings Point) and has plans to upgrade another three major plants (Banora Point, Tweed Heads & Kingscliff) in the next 2 to 3 years. These upgrades will result in significant improvements in effluent quality and will therefore reduce the loadings of pathogens and nutrients on the Tweed Estuary and coastal aquifers.

Murwillumbah STP was upgraded in 2001, which resulted in a large reduction in pathogen and nutrient loadings on the Rous River / Upper Tweed Estuary. Current impacts associated with the plant are difficult to assess as there is an accumulation of nutrients in the waterways downstream of the plant as a result of high nutrient loadings from the previous plant and poor flushing of the Rous River. Additional monitoring is due to occur over 2006/07 to verify the condition of the Rous River.

The upper catchment STP's (Uki & Tyalgum) currently have 100% reuse of dry weather effluent via irrigation of woodlots and pasture. Historically, there have been minimal impacts noted downstream associated with discharging of effluent from these plants during prolonged wet periods.

### 5.1.3 Urban Stormwater Issues

The key urban stormwater issue that was identified was urban stormwater runoff.

The majority of existing and future urban development areas in the IWCM study area are located on the coastal estuaries, leading to high urban stormwater loadings (diffuse) of nutrients and sediments. Urban stormwater volumes will potentially increase substantially in the future due to high population growth if suitable treatment is not provided.

In 2000 the Tweed Urban Stormwater Quality Management Plan was adopted by Council which requires a demonstration to comply with stormwater treatment objectives by new development applications. These objectives contain maximum loads for pollutants such as suspended solids, total phosphorous, total nitrogen, litter, course sediment and oil and grease. The loads in the objectives represent a large reduction in the typical stormwater pollutant loadings from pre 2000 development. Several planning documents also require stormwater treatment to reduce volumes and velocity of runoff from new development and include the Development Design Specification - D7 (2003) and Development Control Plan No. 16 – Subdivision Manual (2003).

In the absence of actual measured data, a desktop environmental assessment was undertaken to determine the impact of urban areas on the water resource. The focus was on determining the relative inputs of nutrients due to stormwater runoff from various land uses (urban, agriculture and undisturbed) and the nutrient inputs from point sources such as STPs.

*Development Design Specification-D7 (TSC 2003b)*, uses modelling to determine stormwater pollutant loads for comparison with the maximum pollutant loads in the *Tweed Urban Stormwater Quality Management Plan.* Data for this model are based on the Brisbane City Council, *Guidelines for Pollutant Export Modelling in Brisbane*, and typical pollutant loads for each land use category outlined in the *Tweed Urban Stormwater Quality Management Plan* as shown in Table 5.3. The pollutant loads from STP discharges were estimated from 2003 monitoring data (quality and quantity) for the Kingscliff, West Tweed, Murwillumbah and Banora Point STPs (refer to Appendix E). The Hastings Point STP discharges to a dune disposal system. The smaller STPs (Tyalgum, Tumbulgum and Uki) have 70- 100% reuse of dry weather flows so their contribution to the nutrient loads in the river system is small.

**Table 5.3** *Landuse and Typical Stormwater Pollutant Loadings*

| Pollutant Loadings (kg/ha/yr) | Urban Tweed | Rural Tweed | Undeveloped Tweed |
|---|---|---|---|
| Total Suspended Solids | 1200 | 410 | 125 |
| Total Phosphorus | 18 | 6 | 1.5 |
| Total Nitrogen | 3 | 1 | 0.4 |
| *Key references:* TSC (2000a) | | | |

The results of the assessment of the relative contributions of pollutant loadings to the total study area waterways (primarily the Tweed Estuary) are shown below on Figure 5.2 to Figure 5.4.

Note that 'undeveloped' represents 29% of the catchment area, 'rural' represents 69%, 'urban' represents 2% and 'STP' represents <1%. While loading rates from 'undeveloped' and 'rural' are unlikely to increase significantly in the future, loading rates from 'urban' and 'STP' may potentially double in the next 30 to 40 years.

**Figure 5.2** *Estimated Total Suspended Solids Loads – Study Area (tonnes/yr)*

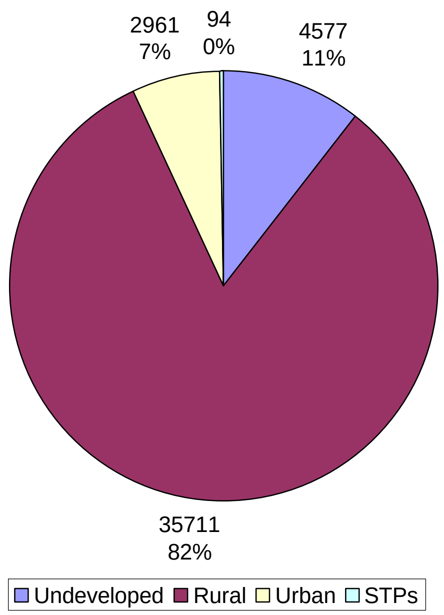


**Figure 5.3** *Estimated Total Phosphorus Loads – Study Area (tonnes/yr)*

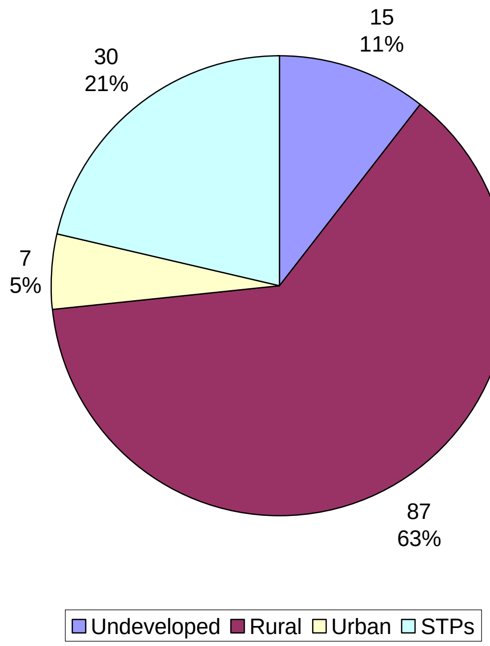
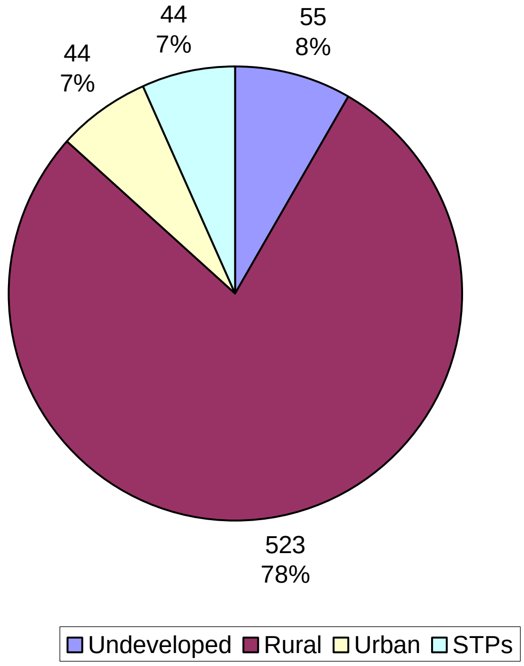



**Figure 5.4** *Estimated Total Nitrogen Loads – Study Area (tonnes/yr)*



### 5.1.4 General Urban Issues

The two key general urban issues that have been identified are:

- Residential development
- Renewals / augmentations of assets

***Residential Development***

The residential development that accompanies high population growth rates has the potential for multiple adverse impacts on the urban water cycle. Potential impacts include vegetation clearing, modified / contaminated stormwater runoff and increased pressure on the water supply system and sewerage systems (ultimately resulting in increased extractions for town water and increased effluent discharges). When this is considered in the context of an urban water cycle system that is already under significant pressures, there is an imperative to ensure that residential development occurs in a sustainable manner, in order to minimise these potential impacts.

There are a number of control measures already in place to encourage or enforce sustainable development. These control measures typically come under the banners of environmentally sustainable development (ESD) and water sensitive urban design (WSUD). Existing control measures generally take the form of planning controls, both at a State level (BASIX) and at a Council level (the inclusion of ESD and WSUD requirements in existing DCP's).

These control measures need to be subject to constant review and revision in order to ensure that they are achieving the desired objective of sustainable development and are consistent with State planning instruments such as BASIX. Monitoring of urban water cycle impacts associated with new development areas is an essential component of the review and revision process.

Developers and the community in general also need to be educated and trained in ESD and WSUD principles along with the importance of sustainable development in the Tweed catchment.

***Renewals / Augmentations of Assets***

Council does not have a formal Asset Management Plans and subsequently, assets are generally replaced when they fail or the ongoing cost of repairs and maintenance become excessive. The key impacts of this on the urban water cycle is a reduction in the levels of service provided to customers due to unplanned disruptions in water, wastewater and stormwater services and the shifting of the cost burden of augmentations and renewals onto future generations. Other impacts include the social and environmental impacts associated with systems failures (eg sewage pump station overflows and localised flooding).

In the next 2 to 3 years, Council is planning to prepare and implement Asset Management Plans for the water, wastewater systems.

### 5.1.5 Rural / Catchment Issues

The eight key rural / catchment issues that have been identified are:

- Rural residential development
- Surface water diversions for irrigation
- Groundwater extractions
- On-site sewage treatment system failures
- Contaminated rural stormwater runoff
- Riparian vegetation clearing
- Wastewater from intensive agriculture
- Uncontrolled earthworks disturbing acid sulphate soils (ASS)

***Rural Residential Development***

The impacts associated with rural residential development are similar to the impacts from standard residential developments, with the potential for slightly higher stormwater runoff rates and higher town water usage (refer to Section 5.1.4).

***Surface Water Diversions for Irrigation / Groundwater Extractions***

The existing impacts associated with surface water diversions and groundwater extractions are considered to be primarily external to the urban water cycle and have not been considered in detail. A water sharing plan for the Tweed River is required in order to ensure that potential future impacts associated with irrigation usage of surface water and groundwater are minimised.

***On-site Sewage Treatment System Failures***

Since 2002, on-site systems have been subject to licensing and regular inspections and the type of systems installed have been chosen with due consideration of site specific constraints such as soil profiles and available land areas. Historically, systems installed prior to 2002 have been prone to high incidences of failure due to the adoption of inappropriate systems for the site specific constraints and the failure of owners to maintain the systems. For these systems, Council has embarked on a program of licensing, inspection and upgrading where required, in order to improve the performance of pre 2002 on-site systems. In addition, Council has historically identified critical areas and with the assistance of the State Government and owners, has provided reticulated sewage and treatment to the villages of Tyalgum (late 1980's), Tumbulgum (mid 1990's) and Uki (2004). Some critical areas such as Mooball and Burringbar are yet to be addressed.

The impacts associated with on-site sewage system failures include pollution of downstream waterways and groundwater, adversely affecting waterway health and social amenity. With the existence of on-site systems within the Upper Tweed catchment, there is the potential for system failures / overflows to impact on raw water quality. However, to-date there has been no measured impacts.

***Contaminated Rural Stormwater Runoff / Riparian Vegetation Clearing***

Contaminated rural stormwater runoff is essentially the result of agricultural and earthwork practices in the past and is the key pollution source (point & diffuse) for the upper Tweed River.

More than half of the vegetation cover in the study area has been cleared for agricultural and urban purposes, resulting in increased and modified stormwater runoff. A large proportion of riparian vegetation along the upper (freshwater) and lower (estuary) Tweed River has been cleared for agriculture and damaged by stock. Less than 60% of the stream and estuary length are vegetated (HRC 2003).

Modified runoff due to soil erosion is causing turbidity, nutrient export and sedimentation. Due to a lack of riparian vegetation, the runoff in these cleared areas is unfiltered before it enters the river and stock can also gain direct access to the river. This has an adverse impact on water quality and overall waterway health.

Vegetation clearing and agriculture have caused excess amounts of nutrients to be discharged to the waterways. Consequently, algal blooms commonly occur in the waterways of the study area during the warmer months. Phosphorus is the most important factor for an algal bloom to develop, with phosphorus sources being natural, existing sediment, sewage and wastewater, human and animal waste, and superphosphate fertiliser. Algal blooms have been noted in Bray Park Weir (as well as Clarrie Hall Dam, Tyalgum Weir and reaches of the Oxley and Rous rivers). These blooms can have an economic impact, resulting in significant increases in water supply treatment costs or need to use alternate supplies. These blooms have caused treatment problems and have recently prompted the planned upgrade of treatment processes at the Bray Park WTP.

Salvinia molesta outbreaks have also occurred, on the still and slow flowing dam, river systems and drainage schemes in the Tweed. Prolific growth of this aquatic weed is a good indicator of the nutrient status of the water. Salvinia depletes oxygen levels in the water, pollutes drinking water, chokes waterways, prevents birds and wildlife from using them, can reduce fish stock and restricts recreational activities. This plant is also a Weed of National Significance, declared noxious in all states and territories.

Existing management measures have included chemical weed spraying of infested areas and the release of a weevil from its native region to control its spread.

***Wastewater from Intensive Agriculture***

The other key pollutant source in the Upper Tweed catchment is wastewater from intensive agricultural enterprises such as dairies and piggeries. Farms that do not have appropriate pre-treatment of wastewater prior to discharging to local waterways, contribute concentrated point loadings of nutrients and pathogens. Wastewater from intensive agriculture contributes to the water quality problems in Tyalgum Weir and Bray Park Weir, particularly during dry periods.

*Uncontrolled Earthworks Disturbing ASS*

Acid Sulphate Soils (ASS) primarily impacts on water quality and health of local waterways and estuaries in the lower catchments. Urban water cycle impacts are less significant and include increased construction costs for assets due to ASS management and increased asset replacement costs due to corrosion.

## 5.2 URBAN WATER CYCLE IMPROVEMENT OPTIONS

For each of the urban water cycle issues identified in Section 5.1, broad improvement objectives have been nominated, along with potential solutions (refer to Tables 5.4 & 5.5 below). Potential solutions include both design and management solutions. In identifying potential solutions and ultimately in adopting and implementing improvement strategies for the urban water cycle issues, emphasis needs to be placed on sustainable solutions (economically, environmentally & socially) and also integrated solutions. Options for integrated solutions are discussed below (refer to Section 5.2.1).

A preliminary assessment of a variety of potential solutions has been included in Appendix H. An assessment of current compliance with the DEUS *Best Practice Management Guidelines* and suggested options for improvement is included in Appendix G.

**Table 5.4:** *Tweed IWCM: Preliminary Objectives & Potential Solutions [Upper Tweed Catchment]*

| ISSUES | DESIGN / MANAGEMENT GAPS | IMPROVEMENT OBJECTIVES | POTENTIAL SOLUTIONS (DESIGN, MGT) |
|---|---|---|---|
| **High Extractions for Town Water** | • Extractions from weirs are not subject to environmental flow rules (no water sharing plan)<br>• A comprehensive demand management program has not been adopted<br>• Other water sources (eg recycled water) are not presently utilised<br>• Pumping from Bray Park Weir for irrigation is not properly managed by DNR | • Reduce hydrological stress on Tweed River<br>• Improve efficiencies in delivery and promote conservation of town water<br>• Maximise use of alternatives sources of water, where economically viable & sustainable | • Define environmental flow requirements (including fish ladder & estuary fresh water requirements) in the context of a water sharing plan for dam / weirs<br>• Comprehensive demand management program<br>• Explore demand substitution options (eg effluent / stormwater reuse)<br>• Environmental flow substitution (eg with effluent) |
| **Poor Raw Water Quality (for Town Water)** | • Insufficient capacity and treatment standard (for varying raw water qualities) at Bray Park WTP for future growth<br>• Inadequate level of treatment at Tyalgum WTP<br>• No water supply catchment management plan for Bray Park Weir | • Provide all customers with a consistent, high quality town water supply<br>• Minimise impacts associated with poor raw water quality events<br>• Improve raw water quality | • Prepare water supply catchment management plan in order to identify catchment based solutions<br>• Currently investigating options for improved treatment processes at Tyalgum WTP<br>• Bray Park WTP to be augmented in 2006/07 |
| **Sewerage System Discharges** | • Risk assessment required to determine dry & wet weather overflow storage requirements<br>• Monitoring of inflow/infiltration rates is needed at Tyalgum & Uki | • Minimise dry & wet weather sewerage system overflows | • Increase dry & wet weather system storage volumes<br>• Monitor inflow/infiltration rates<br>• I/I reduction works if required |
| **Effluent Discharges** | • Effluent management plans have not been prepared<br>• Risk assessment is required to determine wet weather overflow storage requirements | • Minimise effluent discharged from Upper Tweed STP's to downstream waterways | • Prepare effluent management plans<br>• Monitor wet weather performance of reuse schemes<br>• Review wet weather storage requirements |
| **Urban Stormwater Runoff Flows & Quality** | • Developments prior to 2000 discharge stormwater without treatment or detention | • Reduce pollutant loadings on Upper Tweed River from urban stormwater runoff | • Targeted retrofit program of stormwater detention and/or treatment for pre 2000 development areas<br>• WSUD / rainwater tank retrofit<br>• Groundwater recharge with stormwater |
| **Rural Residential Development** | • DCP's for rural residential lots need to include WSUD components including rainwater tanks & stormwater detention / treatment | • Incorporate WSUD & ESD principles into rural residential development<br>• Improve raw water quality by minimising pollutant loads on Tweed River | • Investigate options for decentralised sewerage infrastructure combined with effluent reuse<br>• Demand management / WSUD<br>• Subdivision based stormwater treatment schemes |

| ISSUES | DESIGN / MANAGEMENT GAPS | IMPROVEMENT OBJECTIVES | POTENTIAL SOLUTIONS (DESIGN, MGT) |
|---|---|---|---|
| **On-site Sewage Treatment System Failures** | • Backlog of pre 2002 septic systems still requiring upgrades<br>• Not all lots in the township of Uki have connected to new sewerage system | • Minimise septic system failures & impacts associated with failures<br>• Restrict / minimise on-site disposal in areas where it is not sustainable | • Continue to investigate & upgrade backlog of pre 2002 septic systems that are inadequate<br>• Identify areas where on-site treatment & disposal is not sustainable & consider alternative options such as septic pumping or centralised collection / treatment |
| **Contaminated Rural Stormwater Runoff** | • Little Monitoring of 'hot spots' | • Reduce rural nutrient & sediment loadings to Upper Tweed River<br>• Minimise the removal of & restore vegetation | • Work with CMA to encourage the use of Farm Best Management Practices, including restricting stock access to rivers<br>• Identify & monitor 'hot spots' areas that adversely impact on river water quality |
| **Riparian Vegetation Clearing** | • Further targeted riparian remediation is required | • Reduce rural nutrient & sediment loadings to Upper Tweed River<br>• Minimise the removal of & restore riparian vegetation | • Work with CMA & local land care groups on targeted riparian vegetation restoration projects |
| **Wastewater from Intensive Agriculture** | • Little Monitoring of 'hot spots' | • Reduce point source pollutant loads to Upper Tweed River | • Work with CMA to encourage the use of Farm Best Management Practices, including pre-treatment of wastewater<br>• Identify & monitor 'hot spots' areas that adversely impact on river water quality |

**Table 5.5:** *Tweed IWCM: Preliminary Objectives & Potential Solutions [Lower Tweed Catchment]*

| ISSUES | DESIGN / MANAGEMENT GAPS | IMPROVEMENT OBJECTIVES | POTENTIAL SOLUTIONS (DESIGN, MGT) |
|---|---|---|---|
| **Town Water Security (Supply from Upper Catchment** | • Town water demands are likely to exceed system yield in the medium term (10 to 15 years)<br>• Comprehensive demand management program has not been adopted<br>• Other water sources (eg recycled water) are not presently utilised<br>• HNFY Methodology for Town Water Supply Security is now considered low | • Maintain a high level of town water supply security<br>• Provide water for residential / economic development | • Comprehensive demand management program<br>• Demand substitution options (effluent / stormwater reuse)<br>• Supply enhancement options including augmentation of Clarrie Hall Dam, Byrrill Ck Dam, groundwater resource development<br>• Review Methodology for determination of Secure yield |
| **On-site Sewage Treatment System Failures** | • Backlog of pre 2002 septic systems still requiring upgrades<br>• Townships of Mooball & Burringbar are not sewered | • Minimise septic system failures & impacts associated with failures<br>• Restrict / minimise on-site disposal in areas where it is not sustainable | • Continue to investigate & upgrade backlog of pre 2002 septic systems that are inadequate<br>• Identify areas where on-site treatment & disposal is not sustainable & consider alternative options such as septic pumping or centralised collection / treatment (eg Burringbar / Mooball) |
| **Sewerage System Discharges** | • No formal inflow / Infiltration reduction program<br>• EPA licensing of system overflows will be required in the future<br>• No time series / calibrated modelling studies to assess existing system overflows | • Minimise dry & wet weather sewerage system overflows<br>• Minimise inflow/infiltration & maintain sufficient system capacity for loadings | • Monitor inflow/infiltration rates<br>• Carry out time series / calibrated modelling studies to assess existing system overflows<br>• Augmentations of transportation system components<br>• I/I reduction works |
| **Effluent Discharged to Estuaries & Sand Dunes** | • Full tertiary treatment is not currently available at all STP's<br>• Effluent discharged to estuary is not available / utilised for reuse<br>• Banora Point, Tweed Heads & Kingscliff STP's all require augmentation to cater for future growth | • Reduce point loading of effluent (including pathogens & nutrients) to estuaries / groundwater<br>• Improve effluent quality to a standard that increases the potential for reuse | • Augment Banora Point, Tweed Heads & Kingscliff STP's in the short term as planned)<br>• Investigate opportunities for effluent reuse (eg town water substitution, groundwater recharge & environmental flow substitution)<br>• For new developments, investigate options such as decentralised treatment / reuse and dual reticulation |
| **Urban Stormwater Runoff Flows & Quality** | • Developments prior to 2000 discharge stormwater without treatment or detention<br>• Ongoing revision of Stormwater Management Plan is required | • Reduce diffuse loadings and point sources of nutrients and sediments on estuaries<br>• Minimise impact of stormwater runoff from urban development on estuaries & groundwater | • Targeted retrofit program of stormwater detention and/or treatment for pre 2000 development areas<br>• WSUD / rainwater tank retrofit<br>• Stormwater treatment / detention in all new development areas<br>• Groundwater recharge with stormwater<br>• Continue tightening DCP requirements |
| **Urban Residential Development / Growth** | • Ongoing updating of DCP's<br>• Requirements that development master plans consider urban water cycle impacts & WSUD / ESD principles<br>• Full compliance with DEUS Best Practice Guidelines for Water and Sewer | • Incorporate WSUD & ESD principles into urban residential development | • Demand management / WSUD<br>• Investigate options for decentralised sewerage infrastructure combined with effluent reuse<br>• Subdivision based stormwater treatment schemes<br>• Greywater reuse |

| ISSUES | DESIGN / MANAGEMENT GAPS | IMPROVEMENT OBJECTIVES | POTENTIAL SOLUTIONS (DESIGN, MGT) |
|---|---|---|---|
| **Renewals & Augment. of Assets** | • No formal Asset Management Plan is in place | • Adequately maintain assets | • Implement Asset Management Plan |

### 5.2.1 Options for Integration

A key objective of the IWCM process is to identify and implement integrated and sustainable solutions / strategies. Historically, the emphasis has been on identifying issues associated with single urban water cycle components (i.e. either the water system, wastewater system or stormwater system) and formulating independent solutions to address these issues. Increasingly, integrated solutions that address issues across the various urban water cycle system components are proving to be more sustainable.

Options for integration in the Tweed study area include:

1. High Quality Effluent & Reuse: Improving effluent quality to be of reuse standard would reduce the impacts on receiving waters and encourage reuse – thereby reducing surface water extractions. This would have a dual benefit on the Tweed Estuary, with reduced pollutant loadings on the estuary and increased fresh water flushing flows.

2. Demand Management: Implementation of demand management measures that result in conservation of water has the dual impact of reducing town water usage and reducing sewage volumes. Reductions in town water usage improve supply security and reduce surface water extractions.

3. Rainwater Tanks: Rainwater tanks enable the collection, storage and reuse of rainwater from the roofs of buildings, thereby reducing town water usage and stormwater flows / volumes.

4. Decentralised Sewerage: Community based treatment of sewerage or greywater for new developments can result in lower cost transportation and treatment solutions and lower cost dual reticulation of treated effluent, thereby reducing sewage loadings on existing STP's and reducing town water usage levels.

5. Stormwater Reuse: Community based stormwater detention, treatment and reuse systems for new developments can result in improved stormwater quality discharged to downstream waterways and reductions in town water usage levels.

6. WSUD: The adoption of WSUD principles in new developments has multiple benefits, including demand management, rainwater / stormwater reuse, stormwater treatment and stormwater attenuation / detention.

It is important to note that some integrated solutions are not feasible or less feasible than other solutions in some areas or catchments. In selecting integrated solutions, consideration needs to be given to the local urban water cycle characteristics and issues. For example, if there is a primary objective to reduce town water usage in a new development area by recycling either stormwater or effluent, rainwater tanks or stormwater reuse may be more feasible than effluent reuse where downstream wetlands, that may be sensitive to urban stormwater loadings, are present.

It is likely that a range of integrated solutions will need to be adopted across the catchment in order to achieve a sustainable urban water cycle. Sustainability is unlikely to be achieved through the adoption of just one or two key integrated solutions or strategies.

## 5.3 PRELIMINARY STRATEGY & IMPLEMENTATION

Having identified the urban water cycle issues for Tweed catchment and having considered a range of potential solutions for improvement, a preliminary strategy that focuses on short term gains from integrated solutions has been determined. The intent of the preliminary strategy is to encourage solutions to be implemented in the short term, while the ongoing IWCM process continues through the detailed strategy development and implementation phases. With population growth rates expected to continue to remain high and approvals for future large development areas being considered by Council within the next couple of years, Council cannot afford to wait until the IWCM Strategy is finalised before implementing solutions.

It is considered that the short term solutions identified will be consistent with the ongoing strategy development

### 5.3.1 Preliminary Strategy (Short Term Actions)

As Council continues with the preparation, refinement and implementation of the IWCM Strategy (see Section 5.3.2), including annual reviews of priorities, the following specific actions are recommended within the short term (< five years):

*Urban Town Water Actions*

1. Formalise a Demand Management Program and explore further demand management options – including targeted non-residential audit and education (eg motels, caravan parks, clubs, etc).

2. Target 12% for unaccounted for water by 2010.

3. Explore demand substitution options such as effluent and stormwater reuse.

4. Review and refine current estimates of system yields and supply security, (noting the "Historical No Failure Yield" methodology, only affords a relatively low probabilistic risk against failure in this case, being approximately 1 in 120), including assessing the potential impacts of environmental flow rules being applied at Bray Park Weir and determining increased yields from supply enhancement options such as raising Clarrie Hall Dam and constructing Byrrill Creek Dam.

5. Determine the impacts on town water supplies of the proposed water sharing plan for the Tweed River, in association with DNR and the CMA, which will define environmental flow requirements for the Tweed River (including defining fish ladder and estuary fresh water requirements).

6. Investigate and implement improved treatment process at Tyalgum WTP and assess impact of water sharing plan on town water supply security.

7. Undertake detailed, long term town water demand forecasts.

8. Determine impact of new Australian Drinking Water Guidelines (ADWG) on Town Water Supplies and operations

*Urban Wastewater Actions*

9. Undertake sewerage system flow gauging and build a calibrated sewerage system model in association with monitoring of inflow / infiltration rates and sewerage system overflow locations.

10. Ongoing implementation of sewerage system optimisation (in association with a calibrated sewerage system model), including targeted inflow / infiltration works.

11. Prepare Effluent Reuse Opportunities Report.

12. Monitor wet weather performance of Upper Tweed treatment plants.

13. Assess short term options for increasing effluent quality and reuse.

14. Implement investigation and planning for dual reticulation and/or decentralised sewerage systems for future development areas, such as Cobaki and Kings Forest.

15. Undertake detailed, long term sewage loading forecasts.

*Urban Stormwater Actions*

16. Prepare a targeted retrofit program of stormwater detention and/or treatment devices for 'hot spot' pre 2000 development areas.

17. Ongoing review and development of Stormwater Management Plans.

*General Urban Actions*

18. Ongoing implementation of WSUD and ESD principles for new developments, including education of developers and the community and ongoing strengthening of local planning requirements.

19. Update existing local planning instruments to be in line with and to complement BASIX.

20. Undertake preliminary planning for alternatives to rainwater tanks for new development areas (eg grey water reuse, dual reticulation of treated effluent, stormwater reuse). Hold forums with local developers and the community to discuss the advantages and disadvantages of various options.

21. Prepare and implement Asset Management Plans.

22. Continued implementation of DEUS Best Practice Guidelines with a focus on IWCM outcomes.

*Rural / Catchment Actions (in association with DNR, CMA & local land care groups)*

23. Continue to identify and assess critical areas where on-site sewage disposal is ineffective and implement appropriate solutions.

24. Identify and monitor catchment ‘hot spots’ areas that adversely impact on water quality in the Upper Tweed River.

25. Support ongoing catchment management initiatives, including planning controls, education, vegetation restoration (by assisting land care groups and individual landholders) and engage with the CMA.

26. A detailed groundwater study needs to be undertaken in order to assess current quality issues and the potential for aquifer storage and recovery (may be undertaken by or in association with DNR).

### 5.3.2 Ongoing IWCM Process

The following broad steps are suggested for ongoing strategy development and associated implementation of IWCM:

1. Assemble and setup a steering committee with representation from key stakeholders.

2. Initiate an ongoing community consultation process.

3. Prioritise issues and set firm objectives and incorporate into Councils Management Plan and all relevant subsidiary plans.

4. Undertake detailed studies of solutions and impacts, including: effluent / stormwater reuse options, supply enhancement options, water quality improvement options.

5. Detailed options formulation and assessment, including TBL assessment.

6. Preparation and adoption of preferred options.

7. Implementation of the preferred options.

8. Annual review of priorities and updates and major five yearly reviews of the IWCM Strategy.

## 5.4 DETAILED STRATEGY DEVELOMENT, IMPLEMENTATION, MONITORING & REVIEW

The IWCM process requires ongoing strategy development, (which details the approach for achieving integration and sustainability), implementation of the preferred options and the ongoing process of monitoring and review.

In order to prepare a detailed strategy, stakeholder involvement is required. Stakeholders include the community, various government authorities and the catchment management authority. It is important that the various stakeholders have input into the process of prioritising urban water cycle issues, setting measurable urban water cycle objectives and setting triple bottom line (TBL) assessment criteria to be used in the assessment and comparison of solution strategies. Stakeholder consultation and involvement should begin as soon as possible after the completion of the Context Study & Strategy Report.

It is important that measurable urban water cycle objectives are set in order to clearly define the scope and extent of the preferred options to allow for ongoing monitoring of objectives in order to assess system performance.

TBL assessment criteria are also required to enable ranking of solution strategies against how well they achieve the community's objectives in terms of economic, environmental and social impacts. The TBL assessment methodology is discussed further in Appendix F.

Ongoing monitoring of system performance (against measurable objectives) is an essential input into the process of regular review and update of the IWCM Strategy. Reviews of the IWCM priorities and updates should be undertaken annually and major reviews of the IWCM strategy should be undertaken every five years.

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