Korogoro Creek Estuary Management Plan
Survey of Importance of Identified Estuary Values

PLEASE COMPLETE BOTH SIDES OF THIS SURVEY

PART 1 - VALUES OF KOROGORO CREEK

HOW TO COMPLETE PART 1 OF THE SURVEY:

19 VALUES of the Korogoro Creek estuary system have been identified, many as a result of community feeback during earlier phases of the Estuary Management Planning process. Each VALUE is defined by a short explanation or description to help respondents grade their personal opinion of its importance. These descriptions are important because they may reinforce what you consider important or cause you to rethink your priorities.

After reading through the whole of PART 1, please grade each VALUE according to it's importance to you. Insert '1' in the box alongside the VALUE you consider to be of most importance and then continue numbering through to a maximum of '19' (or '20' if you suggest a new value in the box provided). However, if you do not wish to number all the boxes simply stop numbering when you are satisfied that all the VALUES of importance to you have been numbered.

ECONOMIC VALUES

Value	Description	IMPORTANCE RANKING
Contribution to local village economy through tourism	Korogoro creek and the recreational opportunities it provides are a significant drawcard for visitors to Hat Head. As such, the creek plays an important role in the local economy, providing a focus for local tourism upon which many local businesses depend.	
Popular tourism & holiday locality	Hat Head and Korogoro Creek has been a favoured holiday destination for Macleay Valley residents and visitors from further afield for decades. Tourism contributes significantly to the local economy.	
Macleay Valley flood security	Korogoro Creek acts as an ocean outlet for the Macleay Valley Flood Mitigation Scheme which is designed to alleviate the effects of major flooding on the Macleay Floodplain.	

SOCIAL VALUES

Value	Description	IMPORTANCE RANKING
High scenic and aesthetic qualities	Korogoro Creek has high scenic and aesthetic qualities due to its low key/low development setting and its high degree of naturalness as a result of being surrounded by Hat Head National Park.	
Opportunities for recreational line fishing	Korogoro Creek is a popular recreational fishing location. Commercial fishing, spearfishing, netting (except landing nets) and the collection of aquarium fish in the creek are currently not permitted by DPI Fisheries. Recreational fishing is an important draw card for visitors and thus contributes to the local economy.	
Safe swimming location	The creek is renowned for its safe swimming opportunities particularly for families with young children. Some conflict between swimmers and boat users has been reported at the estuary mouth particularly in peak holiday seasons.	
Low impact multiple use recreational opportunities	Many visitors and residents alike enjoy a range of low impact recreational opportunities such as walking, canoeing/kayaking, picnicking, snorkeling, etc.	
Cultural heritage and history of the estuary	The estuary has an extensive pre-settlement indigenous use history. Several significant sites occur within the catchment. No post-settlement buildings are heritage listed however elements of the built environment may be considered to have cultural significance (eg. Footbridge).	
Easy vehicle access directly to the estuary banks	Currently, vehicular access is formalized at the boat ramp and in parts of the caravan park. Informal access occurs extensively on the southern and western creek banks both above and below the town bridge, and on the northern bank at points along Creek Street. Informal vehicle access is contributing to degradation of banks and vegetation on the southern creek bank.	
Easy disabled access directly to the estuary	There is currently no formalized disabled access to the creek. Informal access can be gained from the same locations as the informal vehicle accesses.	
Easy boating access directly to the estuary	Although motorised boating is permitted in the estuary upstream of the boat ramp, the major use of the boat ramp is for safe ocean access. The shallow nature of the creek and the entrance means that large, deep draft, single hulled vessels are often restricted.	

ENVIRONMENTAL VALUES

Value	Description	IMPORTANCE RANKING
Permanently open creek mouth	Korogoro Creek has not closed in living memory although at times the entrance has significantly contracted as a result of entrance shoaling. Any closure of the creek mouth would most likely result in reduced fish abundance and diversity and significantly reduced water quality depending upon the duration of closure. It is possible that changes anticipated under the various climate change scenarios could impact upon entrance conditions.	
Healthy water quality (within acceptable limits)	Water quality monitoring shows that estuary water quality is generally acceptable. Bacterial contamination levels rarely reach levels of concern for recreational users but at times could be considered to be a constraint to the collection of shellfish for human consumption. Low dissolved oxygen and pH are sometimes outside guidelines for environment protection. Healthy water quality is dependant upon the creek mouth remaining open.	
Stable estuary banks	Bank erosion was mapped as part of the 2007 Estuary Process Study. No severely eroding sections of river bank were identified however several moderately unstable reaches were identified.	
Healthy riparian (creek bank) vegetation	Riparian vegetation is essential for a healthy estuary environment. Currently, the riparian vegetation on the creek is impacted by weed infestation and vehicle access in some reaches.	
Healthy aquatic ecosystems and habitat	The estuary is generally considered to be a healthy aquatic ecosystem. It is known to support a wide variety of crustaceans and fish species (including juveniles of many species of commercial interest, seasonal populations of tropical fish, and at least one species listed as vulnerable, the Black Cod). The endangered loggerhead turtle has also been observed in the estuary.	
Healthy terrestrial ecosystem and wildlife habitat	The terrestrial ecosystems and wildlife habitat surrounding Korogoro Creek are generally considered to be in healthy condition. Almost 2/3rds of the catchment of the creek is protected within Hat Head National Park. The catchment supports several endangered ecological communities and several threatened bird and mammal species.	
High quality native vegetation communities	Several important vegetation communities exist within the Korogoro Creek catchment including freshwater wetlands, coastal saltmarsh, mangroves, littoral rainforest and coastal heaths. Many of these communities are considered to be of high conservation value. Whilst some are well represented in the National Park estate others such as coastal saltmarsh occur predominantly outside the NP estate.	
Healthily functioning Swan Pool wetland	Swan Pool is a major contributor of drainage water to Korogoro Creek during periods of operation of the flood mitigation scheme. Although Swan Pool has historically been a wetland of high ecological significance it has anecdotally been linked to poor water quality in the creek (pH and low dissolved oxygen) since the commencement of the flood mitigation scheme. Improving the health of Swan Pool may reduce impacts to the creek associated with the flood mitigation operation.	

SUGGEST A NEW VALUE

Your suggestion...	Description of value...	

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Korogoro Creek Estuary Management Plan
Survey of Importance of Identified Threats to Estuary Sustainability

PLEASE COMPLETE BOTH SIDES OF THIS SURVEY

PART 2 - THREATS TO KOROGORO CREEK

HOW TO COMPLETE PART 2 OF THE SURVEY:

18 THREATS to the health and sustainability of the Korogoro Creek estuary system have been identified. Many of these as a result of community feedback during earlier phases of the Estuary Management Planning process. Each THREAT is defined by its potential to negatively impact upon the VALUES listed in PART 1 of this survey (overleaf). The list of VALUES is important because it helps respondents to judge whether or not the threat is significant in terms of the way they value the estuary system.

After reading through the whole of PART 2, please grade each threat according to it's importance to you. Insert '1' in the box alongside the THREAT you consider to be of most importance and then continue numbering through to a maximum of '18' (or '19' if you suggest a new threat in the box provided). However, if you do not wish to number all the boxes simply stop numbering when you are satisfied that all the THREATS of importance to you have been numbered.

THREAT TO SUSTAINABLE ESTUARY MANAGEMENT	VALUES NEGATIVELY IMPACTED	IMPORTANCE RANKING
Lack of funding resources to address identified issues	• Healthy water quality • Stable estuary banks • High value native vegetation communities	
Operation of the Macleay Valley flood mitigation scheme	• Stable estuary banks • Healthy water quality • Healthy aquatic ecosystems and habitat • Macleay Valley flood security • Healthily functioning Swan Pool wetland • Permanently open creek mouth	
Potential effect of sea level rise and climate change #	• Permanently open creek mouth • Macleay Valley flood security	
Unmanaged vehicle access to the southern and western creek banks	• High scenic and aesthetic qualities • High value native vegetation communities • Healthy riparian vegetation • Stable estuary banks • Healthy terrestrial ecosystems and wildlife habitat	
Inadequate washdown facilities in the vacinity of the boat ramp	• Healthy water quality • Healthy aquatic ecosystems and habitat	
Conflict between swimmers and boaters at the estuary mouth	• Easy boating access • Safe swimming location • Low impact multiple-use recreational opportunities	
Oyster collection and burleighing downstream of the footbridge	• Healthy aquatic ecosystems and habitat • Safe swimming location	
Loss of recreational opportunity due to restrictions on fishing, boating, or vehicle access	• Popular tourism/holiday locality • Contribution to local economy through tourism	
Littering in the vicinity of the creek	• High scenic and aesthetic qualities • Healthy aquatic ecosystems and habitat	
Lack of community awareness of some issues impacting upon estuary health	• Healthy water quality • Healthy aquatic ecosystems and habitat	
Stormwater discharge into the creek	• Safe swimming location • Healthy water quality • Healthy aquatic ecosystems and habitat	
Sedimentation / shoaling at the boat ramp	• Easy boating access • Safe swimming location	

The full effects of sea level rise and climate change are not currently well understood. However, predicted impacts are likely to be very significant to the functioning of the creek system and barrier dune system which currently protects Hat Head Village.

THREAT TO SUSTAINABLE ESTUARY MANAGEMENT	VALUES NEGATIVELY IMPACTED	IMPORTANCE RANKING
Inadequate water quality testing program	• Safe swimming location • Healthy water quality • Healthy aquatic ecosystems and habitat	
Damage to high conservation value native vegetation communities	• High scenic and aesthetic qualities • High value native vegetation communities • Healthy terrestrial ecosystems and wildlife habitat	
Inappropriate development	• High scenic and aesthetic qualities • Popular tourism/holiday locality • Contribution to local economy through tourism • Cultural heritage and history	
Dumping of garden waste onto the creek bank	• High scenic and aesthetic qualities • Healthy riparian vegetation • Healthy terrestrial ecosystems and wildlife habitat	
Weed incursion into riparian vegetation	• High value native vegetation communities • Healthy riparian vegetation • Healthy terrestrial ecosystems and wildlife habitat	
Groundwater contamination	• Healthy water quality • Healthy aquatic ecosystems and habitat	

SUGGEST A NEW THREAT

Your suggestion...

Which values are affected by this threat (see overleaf)...

ADD A COMMENT ON THIS SURVEY

Your COMMENTS...

THANK YOU
Please return completed survey to:

Ron Kemsley
Kempsey Shire Council
PO Box 78, West Kempsey NSW 2441

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Stormwater Management Strategy for Hat Head

Prepared as part of the Korogoro Creek Estuary Management Plan

Prepared for: GECO Environmental
Project Manager: Tim Ruge
Ref: 1106618
Date: October 2008

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1

Background

1.1 Objective

This report has been prepared as part of the Korogoro Creek Estuary Management Plan (EMP). The aim of this report is to outline a stormwater management strategy for Hat Head which:

- identifies the need for stormwater treatment improvements; and
- develops appropriate stormwater treatment concepts and costs to guide future implementation works.

This report has been prepared with consideration of Kempsey Shire Council's (Council) Development Control Plan No. 37 (DCP 37) for Hat Head. One of the stated purposes of DCP 37 is to protect Korogoro Creek from any adverse effects due to stormwater runoff (KSC, 2003:5).

1.2 Urban Characteristics of Hat Head

The village of Hat Head is zoned 2(v) Village under Kempsey Local Environmental Plan 1987. The zoning allows for mainly residential development, with opportunities for minor commercial development to service the local population. The village is predominantly low density single storey residential development. The population of Hat Head is approximately 300 persons. Generally, the urban character consists of little hard paving other than the road surface as indicated in **Plate 1.1** which shows a typical portion of North Hat Head.

Plate 1.1 Aerial Photograph of North Hat Head

1.3 Existing Drainage System

The layout of the existing drainage system is shown in Illustration 1.1 and 1.2. The drainage system in North Hat Head comprises grassed swale drainage systems with a network of inlet pits and pipes. The North Hat Head drainage system comprises approximately ten pipe drainage networks which discharge stormwater into Korogoro Creek through separate pipe outlets. A number of smaller sub-catchments exist comprising only swale drains with one pit and a pipe outlet. A total of approximately 17 pipe outlets discharge to Korogoro Creek from the North Hat Head catchment.

Plate 1.2 Typical Street Grassed Swale in North Hat Head

Plate 1.3 Typical Pipe Outlet to Korogoro Creek

The South Hat Head drainage system comprises grassed swale drainage systems in the eastern portion of the residential area and standard kerb and gutter drainage in Marlin Grove and the connecting cul-de-sacs. The South Hat Head catchment discharges to Korogoro Creek at two pipe outlet locations. Drainage from Marlin Grove is directed to an open drain located behind the lots on the western side of the street. This open drain flows through a small pond section, shown in Plate 1.4 overleaf, before discharging to Korogoro Creek. The eastern portion of the catchment drains to larger swale drainage lines which converge before discharging to Korogoro Creek.

1.4 Rainfall Patterns

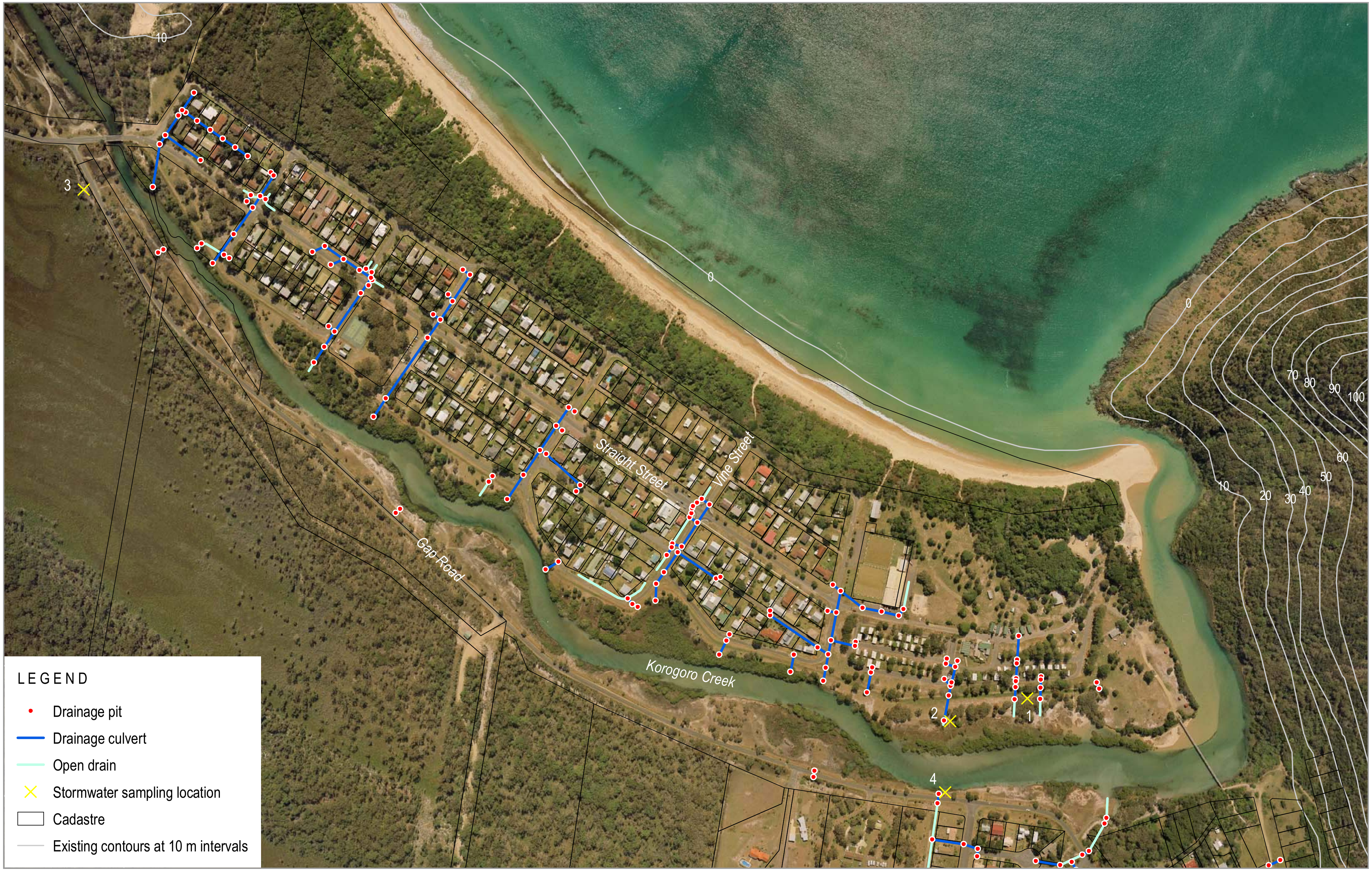
The climate at Hat Head is warm and temperate with maritime influences. Mean monthly rainfall data for the area show a strong seasonal pattern with generally wet late summers and early autumns, and dry winters and early springs. The annual rainfall for the area is approximately 1470mm based on records from Smoky Cape near South West Rocks (GECO Environmental, 2007).

1.5 Hydrology

For the purpose of this report Hat Head has been divided into two main catchments: north and south which are divided by Korogoro Creek.

The hydrology of North Hat Head is dominated by the predominantly sandy soils, the existing urban drainage system and the dune system located on the northern side of the town. The sandy soils and the grassed swale drainage system in North Hat Head allow for rapid infiltration of stormwater. Stormwater runoff from the village that does not infiltrate, flows to Korogoro Creek, discharging through a number of pipe outlets.

Source: Kempsey Shire Council Date: October 2008



North Hat Head Drainage System

Illustration 1.1

GeoLINK environmental management and design

Korogoro Creek EMP - Stormwater Strategy

1106834

Source: Kempsey Shire Council Date: October 2008

South Hat Head Drainage System

Illustration 1.2

The catchment area of South Hat Head is partly defined by the high ridgeline to the south. The upper portion of the catchment comprises bushland which is located in Hat Head National Park. Drainage from the catchment discharges to Korogoro Creek at two defined locations.

Plate 1.4 Open Drain and Small Pond

Plate 1.5 Swale Drainage beside Gap Road

1.6 Soils

North Hat Head is located on a beach soil landscape unit defined as the North Shore group (Atkinson, 1999a) which comprise sandy soils with a very high permeability.

The soils of the upper portion of the South Hat Head catchment are an erosional soil landscape unit defined as the Crescent Head group (Atkinson, 1999a) which comprise sandy loam topsoil and sandy clay subsoils.

The lower portion of South Hat Head catchment where the majority of the urban area is located is on an aeolian and barrier soil landscape unit defined as the Korogoro group (Atkinson, 1999a) which comprise sandy soils with a very high permeability.

2

Existing Stormwater Quality

2.1 Water Quality in Korogoro Creek

The Korogoro Creek Estuary Data Compilation and Processes Study Report (GECO Environmental, 2007) analysed previous data collection conducted for the area from a period of 1994 to 2007. The study concluded that the water quality of the Korogoro Creek is generally within an acceptable range as specified by the relevant ANZECC guidelines. The Creek is a tidal estuary, and so regular tidal flushing reduces the potential for poor water quality from point and diffuse sources within the creek catchment.

Water quality parameters reported in the processes study for Korogoro Creek in the section adjacent to the village include:

- pH levels in the range of 6.0 to 8.0;
- dissolved oxygen levels in the range of 2 to 8 mg/L;
- total suspended solids in the range of 1 to 20 mg/L;
- total phosphorus in the range of 0.01 to 0.3 mg/L;
- total nitrogen in the range of 0 to 4 mg/L; and
- faecal coliforms in the range of 0 to 100 cfu/100mL.

2.2 Stormwater Quality Sampling

To help define existing stormwater quality issues at Hat Head stormwater quality was sampled and analysed. Sampling was undertaken at four stormwater outlets during a rain event on 25 July 2008. Approximately 25 mm of rainfall was recorded at Smoky Cape Lighthouse for the 25 July 2008 with 17 mm on the preceding day. Three of the locations are associated with runoff from Hat Head village and the other sampled runoff from the National Park area to the south as shown in **Illustration 1.1**. The results are summarised in the table below.

Table 2.1 Stormwater Quality Sampling Results for 25 July 2008

Sampling Location[1] / Identification	*Faecal Coliforms (cfu/100mL)*	*Total Phosphorus (mg/L)*	*Total Nitrogen (mg/L)*	*Total Oil and Grease (mg/L)*
1. Sump at North Hat Head (ID: H08 0372:1664)	2,300	0.10	0.36	3
2. Outlet at North Hat Head (ID: H08 0372:1665)	2,800	0.06	0.19	2
3. Outlet from Nat. Park (ID: H08 0372:1666)	1,500	<0.01	0.80	2
4. Outlet at South Hat Head (ID: H08 0372:1667)	18,000[2]	0.09	0.26	<2

Note: 1. refer to **Illustration 1.1** for location
2. estimated count

The levels for faecal coliforms are in the lower range of values typically expected for residential areas. The value of 18,000 at location No.4 is not considered significantly high in comparison to typical values for residential areas which range from 2,000 to 200,000 cfu/100mL (Fletcher, *et al*. 2004).

The levels for total phosphorus and total nitrogen are generally significantly less than mean stormflow values for residential areas which are expected to be approximately 0.25mg/L and 2.0mg/L respectively (Fletcher, *et al*. 2004). The values in Table 2.1 are more representative of typical values from bushland areas. These low pollutant values are thought to be due to the low density of development and the treatment provided by the grassed swales. This is discussed in more detail in Section 3.

Similar to above, the levels for total oil and grease are also generally significantly less than typical values for residential areas which range from 3mg/L to 20mg/L (Fletcher, *et al*. 2004).

Samples were also analysed for metals. No significant readings were recorded.

The analysis results for the sampling are contained in Appendix A.

2.3 Stormwater Issues

2.3.1 Community Concerns

Community members raised a number of issues at a consultation meeting in August 2006. The issues include the lack of gross pollutant traps on stormwater pipes discharging directly to the creek and pollution caused by the washing of vehicles and caravans in the caravan park (GECO Environmental, 2007).

2.3.2 Site Observations

Potential sources of stormwater pollutants observed during a site inspection on 9 September 2008 include leaf litter and lawn clippings as indicated in the photographs below, and some minor incidences of litter such as plastic bags and drink cans. However the latter may be the result of littering directly along the creek bank.

Plate 2.1 Leaf Litter in Caravan Park Drains

Plate 2.2 Lawn Clippings

There were no significant erosion issues observed at the various stormwater outlets.

2.3.3 Interpretation of Sampling Results

The stormwater sampling described in Section 2.2 indicates no major issues in regard to the quality of the stormwater from Hat Head village. The results are generally in the lower range of values typically expected for residential areas.

2.3.4 Future Development

South Hat Head currently contains undeveloped residential lots. There are also areas of adjoining land zoned 'Rural 1D Investigation' which may be rezoned and developed into residential allotments in the future. Development of these allotments will increase the stormwater pollutant load and runoff rate from the South Hat Head catchment.

The amount of impervious area within residential allotment in both North and South Hat Head may also increase with redevelopment / house renovations. This will increase the stormwater pollutant load and runoff rate from the allotments.

2.3.5 Summary of Stormwater Issues

The above indicates that current stormwater quality issues for Hat Head are relatively minor in comparison to typical residential areas. The types of pollutants are typical of residential areas: litter, sediments, oils from cars, and nutrients from different sources such as grass clippings, attached to sediment and potentially from fertilisers used on lawns.

The low pollutant values are thought to be due to the low density of development and treatment and infiltration provided by the grassed buffer strips and swales.

The main issues that may impact on stormwater quality are:

- future development in South Hat Head without appropriate detention and treatment measures;
- increased roof areas and paved areas from redevelopment throughout Hat Head without appropriate detention and treatment measures; and
- replacement of the existing grassed swales and buffer strips with standard kerb and gutter street drainage.

The following section outlines and assesses a number of stormwater management strategies that address the above issues.

3

Stormwater Management Strategies

The following stormwater issues and strategies are investigated in this section to determine the impact on Korogoro Creek:

1. future development in South Hat Head (refer to Section 3.2);
2. redevelopment throughout Hat Head (refer to Section 3.3); and
3. retain grassed swales as opposed to replacing the swales with standard kerb and gutter street drainage (refer to Section 3.4);

Gross pollutant traps and educational strategies are also discussed in Section 3.5 and Section 3.6 respectively. Educational strategies are discussed in regard to addressing issues such as litter, grass clippings and car washing detergents.

3.1 MUSIC Modelling

Assessment of the issues and strategies has included water quality modelling using the MUSIC program (Model for Urban Stormwater Improvement Conceptualisation - Version 3.01). The objective of the water quality modelling is to establish a model of existing conditions to help assess the impact of future works on stormwater quality.

The MUSIC model requires recorded rainfall data at six minute time steps to more accurately model the impact of small treatment units such as grassed swales. Coffs Harbour pluviograph rainfall data (6-minute interval data) has been used in the model as this was the nearest pluviograph data that provided a reasonable continuous record over a period of ten years.

The land use types used in the MUSIC model were separated into the following categories:

- urban residential – roads (30% impervious): comprising the bitumen area and the adjoining grassed road reserve area;
- urban residential – roofs (100% impervious): modelling of the roofs separate from the remaining portions of the lots enabled assessment of the impacts of installing rainwater tanks;
- urban residential – other areas (5% impervious): the area of each lot excluding the dwellings. An allowance of 5% impervious area accounts for paved areas within each lot;
- rural residential (20% impervious): the larger lots in South Hat Head; and
- forest: the vegetated dune area in North Hat Head and the bushland on the upper slopes of South Hat Head.

The impervious percentages listed above are based on estimates obtained from aerial photography of Hat Head. The rainfall-runoff parameters and stormwater quality parameters used in the MUSIC model are based on parameter values recommended in *MUSIC Modelling Guidelines* produced by Gold Coast City Council (2006).

3.2 Future Development in South Hat Head

3.2.1 Existing Conditions

To establish a MUSIC model of existing conditions South Hat Head was separated into two main sub-catchments, S1 and S2 shown in Illustration 3.1, which approximate the main drainage networks. The areas within each sub-catchment were grouped into the respective land use types listed in Section 3.1. The swales were modelled with a seepage loss of 180 mm/hour. This figure is based on the lower end of MUSIC default seepage values for sandy soils. The layouts of the MUSIC models are shown in Appendix B.

The mean value of pollutant concentrations flowing to Korogoro Creek from sub-catchment S2 are shown in Table 3.1 together with the sampling results for the outlet from the sub-catchment (Outlet No.4). The mean values and standard deviations obtained from the MUSIC model are generally in agreement with the sampling results. The mean values plus the standard deviation appear to generally reflect the sampled values. Therefore it is considered that the MUSIC model provides an acceptable representation of the existing conditions at South Hat Head.

Table 3.1 Stormwater Pollutant Concentrations for South Hat Head – Comparison of Modelled and Sampled Values

	Total Suspended Solids (mg/L)		*Total Phosphorus (mg/L)*		*Total Nitrogen (mg/L)*	
	Modelled	*Sampled*	*Modelled*	*Sampled*	*Modelled*	*Sampled*
Maximum Value	180	-	0.37	0.09	1.86	0.26
Mean Value and Std Dev.	0.48± 4.55		0.01± 0.02		0.03 ± 0.21	

3.2.2 Future Development

Future development has been assessed separately for each sub-catchment shown in Illustration 3.1. The impact of future / infill development has been assessed by comparison of the mean annual pollutant load for existing conditions and future development conditions. This is discussed for each sub-catchment below.

Sub-Catchment S1

Future development for this sub-catchment comprises infill development of eight standard residential lots. These lots were modelled as either a 'forest' or 'rural residential' node for existing conditions. The future development scenario modelled the additional lots by increasing the area of the 'urban residential – roofs' node by 250 m^2 per additional lot and increasing the area of the 'urban residential – other areas' node by the remaining area of these lots. The impact of the infill development on pollutant increases is relatively small due to the effectiveness of the existing swale system. The effectiveness of the swale system is still considered very high in treating the future development of the sub-catchment. Therefore no additional works are considered necessary to treat the small amount of infill development.

Table 3.2 Sub-Catchment S1 – Changes in Annual Pollutant Loads for Infill Development

Parameter	*Units*	*Existing Conditions*	*Future – Infill Development*	*Percentage Increase in Load*
Flow	ML/year	31.2	31.9	2%
Total Suspended Solids	kg/year	2,780	2,860	3%
Total Phosphorus	kg/year	6.4	6.7	5%
Total Nitrogen	kg/year	45.5	47.3	4%

Source: Kempsey Shire Council and GeoLINK Date: October 2008

Development Scenarios in South Hat Head

Korogoro Creek EMP - Stormwater Strategy

1106866

Illustration 3.1

Sub-Catchment S2

Future development for this sub-catchment comprises infill development of four standard residential lots and nine rural residential lots. The future standard residential lots were modelled as 'rural residential' for existing conditions. The model for future development accounts for these lots with an increased area of the 'urban residential – roofs' node and the 'urban residential – other areas' node as described previously.

The additional rural residential lots were modelled as 'forest' for existing conditions and converted to 'rural residential' nodes for the future scenario.

The increase in pollutant load from the infill development is relatively large in regard to the MUSIC results. However, this is considered an overestimate due to the way in which it was modelled. Changing the status of the additional rural residential lots from 'forest' to 'rural residential' nodes will overestimate the increase in pollutant load. The overall effectiveness of the existing swale system in treating the future pollutant loads remains in the order of 70% removal efficiency which is still considered relatively high removal efficiency. To increase this removal rate it is recommended that a swale drainage system is constructed along the length of Marlin Grove where the future rural residential development will occur.

Table 3.3 Sub-Catchment S2 – Changes in Annual Pollutant Loads for Infill Development

Parameter	*Units*	*Existing Conditions*	*Future – Infill Development*	*Percentage Increase in Load*
Flow	ML/year	38.6	40.1	4%
Total Suspended Solids	kg/year	3,010	3,980	32%
Total Phosphorus	kg/year	5.88	9.29	58%
Total Nitrogen	kg/year	49.1	76.5	56%

Sub-Catchment S3

Sub-catchment S3 has been modelled as comprising 'forest' and 'rural residential' nodes. Future development comprises reducing the 'forest' node and the 'rural residential' node by 4.4ha to account for approximately four new rural residential lots.

The increase in pollutant load is similar to Sub-catchment S2. Similarly the increase is considered an overestimate and the overall effectiveness of the existing swale system in treating the future pollutant loads remains in the order of 65% removal efficiency which is still considered relatively high removal efficiency. The previously recommended swale drainage system in Marlin Grove will assist in reducing the impact of the development.

Table 3.4 Sub-Catchment S3 – Changes in Annual Pollutant Loads for Rural Residential Development

Parameter	*Units*	*Existing Conditions*	*Future – Infill Development*	*Percentage Increase in Load*
Flow	ML/year	39.3	39.5	1%
Total Suspended Solids	kg/year	3,250	3,740	15%
Total Phosphorus	kg/year	6.64	8.34	26%
Total Nitrogen	kg/year	59.3	72.4	22%

Sub-Catchment S4

This sub-catchment is currently zoned 1(d) 'rural investigation' in the areas highlighted in Illustration 3.1. Potential development of this area in has been modelled by converting 19ha (the shaded area in Illustration 3.1) from a 'forest' node to a 'rural residential' node. The existing scenario was modelled without any treatment system such as swales. The developed scenario was modelled with and without treatment to assess the impact of a swale system. The treated development scenario shown in Table3.5 assumes a total length of 800 m of swales for the development area which approximates a length of swale along the frontage and depth of this area as shown in Illustration 3.1. This length of swale is considered adequate to treat the developed area.

Table 3.5 Sub-Catchment S4 – Changes in Annual Pollutant Loads for Rural Residential Development

Parameter	*Units*	*Existing Conditions*	*Future Development – No Treatment*	*Future Development – With Treatment*	*Percentage Increase in Load*
Flow	ML/year	142	155	31.5	-78%
Total Suspended Solids	kg/year	6,230	14,500	3,310	-47%
Total Phosphorus	kg/year	7.09	37.4	7.99	13%
Total Nitrogen	kg/year	80.7	331	67.4	-16%

3.2.3 Costs

Construction cost estimates associated with the above works are:

- Sub-Catchment S1 – no additional works therefore no costs;
- *Sub-Catchment S2 and S3* - recommended swale drainage system on both sides of Marlin Grove where the future rural residential development will occur. Construction cost estimate for total length of swale of 600m with top width of 5m is approximately $200,000;
- *Sub-Catchment S4* - recommended swale drainage system with a total length of swale of 800m for the development area. Construction cost estimate assuming top width of 5m is approximately $250,000.

3.3 Redevelopment throughout Hat Head

Redevelopment of existing residential lots associated with house renovations / demolition and rebuilding will generally result in increased roof areas and paved areas. The impact on stormwater quality has been assessed with consideration of the following scenarios:

- redevelopment without any additional detention and treatment measures; and
- redevelopment with rainwater tanks and reuse requirements for each redeveloped allotment.

This issue has been assessed by modelling a typical drainage catchment in North Hat Head. North Hat Head has been selected because it is considered that more redevelopment is likely to occur in this area.

3.3.1 Existing Conditions

North Hat Head was separated into ten sub-catchments which approximate the main drainage networks in the village. One typical sub-catchment has been modelled to assess this issue. The areas within each sub-catchment were grouped into one of the respective land use types listed in Section 3.1. An example of the model layout for three sub-catchments is shown in Appendix B.

Buffer areas were modelled for the runoff from the roads, roofs and other portions of the lots to simulate overland flow across the grassed areas before the flows enter the swales. A seepage loss of 180 mm/hour was modelled over the buffer areas and in the swales based on the lower end of default values for sandy soils.

The mean value of pollutant concentrations flowing to Korogoro Creek are shown in Table 3.2 together with the sampling results from Section 2.2. The mean values obtained from the MUSIC model are generally in agreement with the sampling results. The mean values less the standard deviation appear to generally reflect the sampled values. Therefore it is considered that the MUSIC model provides an acceptable representation of the existing conditions at Hat Head.

Table 3.6 Stormwater Pollutant Concentrations for North Hat Head – Comparison of Modelled and Sampled Values

	Total Suspended Solids (mg/L)		*Total Phosphorus (mg/L)*		*Total Nitrogen (mg/L)*	
	Modelled	*Sampled*	*Modelled*	*Sampled*	*Modelled*	*Sampled*
Maximum Value	10 - 100	-	0.13 – 0.16	0.06 – 0.10	1.4 – 1.6	0.19 – 0.36
Mean Value and Std Dev.	15 ± 1.1		0.13 ± 1.0		1.4 ± 1.1	

3.3.2 Future Redevelopment

Future redevelopment has been assessed by comparison of the mean annual pollutant load for existing and future redevelopment conditions. The following assumptions have been used in the MUSIC modelling:

- redevelopment will involve an increase in roof area from approximately 300m² to 350m² per lot;
- redevelopment will involve an increase in impervious paved area from 5% to 20% for the remaining area of each lot (the total lot area less the roof area);
- modelling of rainwater tanks has assumes installation of a 4,000 L rainwater tank for each redeveloped lot with 50% of the capacity dedicated to stormwater detention and remainder used for reuse purposes including toilet flushing.

The above stormwater detention allowance provided by the rainwater tank is considered sufficient in respect to the DCP 37 requirement of no increase in pre-development flow rates during a 1 in 5 year storm event (Section 4.13c in DCP 37).

Initially the impact of redevelopment was assessed without the inclusion of rainwater tanks. The impact of the increased roof and paved areas increases the pollutant load reaching Korogoro Creek by approximately 10 to 15% as shown overleaf in Table 3.7. This increase at the outlet to Korogoro Creek is not very large due to the effectiveness of the existing swale system.

Modelling of redevelopment with the inclusion of rainwater tanks is shown overleaf in Table 3.8. The impact of rainwater tanks is not very significant when comparing the quality at the outlet to Korogoro Creek. Comparing the results in Table 3.7 and Table 3.8 indicates that the annual pollutant load to Korogoro Creek from the redeveloped scenario is only reduced by approximately 3% with the requirement of rainwater tanks. This seemingly small impact is due to the masking effect of the high treatment efficiency of the existing swale system which can adequately treat the additional loadings from redevelopment without the need for rainwater tanks. However, the direct impact of rainwater tanks in reducing annual pollutant loads is in the range of 5% to 15% prior to treatment by the swale system.

Table 3.7 Redevelopment – Changes in Annual Pollutant Loads Without Additional Treatment Measures

Parameter	*Units*	*Existing Conditions*	*Future Redevelopment (No Rainwater Tanks)*	*Percentage Increase in Load*
Flow	ML/year	0.341	0.384	13%
Total Suspended Solids	kg/year	5.03	5.65	12%
Total Phosphorus	kg/year	0.045	0.051	12%
Total Nitrogen	kg/year	0.478	0.541	13%

Table 3.8 Redevelopment – Changes in Annual Pollutant Loads With Rainwater Tanks

Parameter	*Units*	*Existing Conditions*	*Future Redevelopment (With Rainwater Tanks)*	*Percentage Increase in Load*
Flow	ML/year	0.341	0.374	10%
Total Suspended Solids	kg/year	5.03	5.49	9%
Total Phosphorus	kg/year	0.045	0.049	9%
Total Nitrogen	kg/year	0.478	0.525	10%

Regardless of the relatively small impact of rainwater tanks in comparison to the existing swale system the requirement of rainwater tanks or some other form of on-site detention and treatment is recommended. This will still have some impact in reducing the overall load to Korogoro Creek and also significantly reduce the reliance on the existing swale system to provide all necessary treatment.

3.3.3 Costs

Construction cost estimates associated with the rainwater tanks are approximately $2,000 per lot.

3.4 Retaining Grassed Swales

Council's Development Control Plan for Hat Head (DCP 37) states that Council does not intend providing or requiring the construction of any kerb and guttering (KSC, 2003:13) and lists the lack of kerb and guttering as an important landscape feature that requires protection by "maintaining a stormwater system of grassed swales" (KSC, 2003:11).

The previous assessment in Section 3.3 shows the high treatment effectiveness of the existing swale system in buffering any increases in stormwater pollutant generation associated with redevelopment. The purpose of the following modelling is to provide a more focussed assessment of the benefit of the existing swale system in comparison to a kerb and gutter system in regard to stormwater pollution.

The impact of kerbs and guttering is very significant when comparing to existing conditions. The results in Table 3.9 indicate that the annual pollutant load to Korogoro Creek from the redeveloped scenario is increased in the order of 100 times. In order to mitigate this effect, a significant area would be required for treatment on each residential lot and at the outlets. This is not considered feasible due to the location of the outlets in mangroves. The significant impact of kerbs and guttering highlights the high level of effectiveness of the existing swale system.

Table 3.9 Redevelopment – Changes in Annual Pollutant Loads With Kerbs and Guttering

Parameter	*Units*	*Existing Conditions*	*Future Redevelopment (With Kerbs and Guttering)*
Flow	ML/year	0.522	52.2
Total Suspended Solids	kg/year	19.3	8,400
Total Phosphorus	kg/year	0.0804	16.6
Total Nitrogen	kg/year	0.685	77.7

3.5 Gross Pollutant Traps

Community concerns in regard to stormwater pollution include the lack of gross pollutant traps (GPT's) on stormwater pipes discharging directly to the creek. Gross pollutants are large pieces of debris including litter. The use of gross pollutants can be an expensive option.

The most appropriate type of GPT for Hat Head would be in the form of an end-of-pipe litter net as that indicated in Plate 3.1. These types of nets have a reported 50-75% pollution reduction efficiency.

Maintenance of the nets involves Council manually removing the nets from the pipes, emptying the nets into a truck and reattaching the nets to the pipe. This could be undertaken by manually lifting the nets due to the relatively small size required for each pipe outlet at North Hat Head.

Source: http://www.stormwater.com.au/end_pipe.htm

Plate 3.1 End of Pipe Litter Net

The effectiveness of using a litter net at Hat Head is not considered high due to the following reasons:

- the relatively low litter generation from Hat Head;
- a significant portion of the litter present in the creek may be due to individuals dropping the litter near the creek edge during recreational activities such as walking, canoeing, swimming and fishing. This litter will not be captured by the nets; and
- litter originating in the drainage system will often be 'caught' in the grassed swale systems or grated drainage inlet pits.

3.5.1 Costs

Cost estimates for supply and installation of litter nets are approximately $2,500 per net with one net required per outlet pipe. If this option was pursued it is assumed that up to eight nets may be required at a cost of approximately $20,000. This does not include maintenance costs.

3.6 Educational Strategies

Education can form a key source control tool for dealing community concerns regarding washing of vehicles and caravans in the caravan park and gross pollutants in the form of litter. Education can be an appropriate and effective strategy for minimising these forms of stormwater pollution because it:

- targets the individual: the behaviour of individuals associated with littering, washing vehicles and caravans, and collecting lawn clippings;
- targets diffuse sources: the 'diffuse source' nature of stormwater pollution such as littering means that structural solutions are often less effective than education;
- impacts on the whole community: education has the capacity to mobilise the whole community which can assist in further targeting of individuals by the community;
- is a major motivator: simple messages such as 'stormwater flows untreated into Korogoro Creek' can be a motivator for appropriate behaviour.

Educational strategies targeting the issue of littering at Hat head may include a stage approach involving:

- initially targeting education of people about the impacts of littering on the local environment and promoting the concept of individuals taking responsibility for their own litter (minimising the amount of litter they produce and taking what they produce home). This phase may involve signage works; and
- depending on the success of the initial education, installation of strategically located litter bins maintained by Council.

3.6.1 Costs

The cost of an educational strategy similar to that described above is estimated at approximately $50,000 which includes fees for development of a strategy, community and stakeholder consultation, and development, manufacture and installation of signage and litter bins.