MIDCOAST WATER

Small Communities Wastewater Risk Assessment

February 2000

Small Communities Wastewater Risk Assessment

Summary

Two previous investigations have been undertaken in order to identify unserviced communities that have a potential to impact on the downstream activities from wastewater generated from those communities. These assessments undertook a basic risk assessment of issues involved. The assessments also were fragmented along general purpose Council areas and used different methods of assessment. This assessment aims to consolidate the communities under review and use a more comprehensive needs analysis, and assessment methodology over both general purpose Council areas. With data connected into the Capital Expenditure program for the entire MidCoast Water operating area.

The components of the needs analysis are as follows:

- Risk assessment
- Stakeholder needs including community and regulators
- Servicing options available.

The risk assessment is the first step and will be used to highlight areas to initially concentrate.

The risk assessment methodology to be used in this assessment uses a dimensional matrix system based on ‘likelihood’ versus ‘severity’.

The likelihood of a wastewater problem with existing development was assessed on the basis of the number of blocks. The larger the number of existing developed lots the greater the likelihood of an onsite wastewater problem.

Severity was broken down into the following issues:

- Distance of existing development to downstream activity of:
    - Town water supply
    - Shellfish food production
    - Aquatic ecosystem
    - Recreational use
    - Agricultural use
- Size of lots
- Site soil conditions, and
- If development had town water supplied

Using the matrix methodology, the ranking of those small communities with a high risk, in order of ranking highest to lowest is as follows:

Small community	*No. of lots*
Greater Taree	
Bungay	73
Cedar Party	145
Crowdy Head	80
Forrest Downs	80
Great Lakes	
Coomba Park	497
North Arm Cove	493
Stroud Road	85
Allworth	123
Shearwater	120
North Pindimar	113
South Pindimar	155
Bundabah	115
Nerong	153

In the Greater Taree area there are significant 'fringe' areas. As stand alone schemes they are small but on the out skirts of towns currently serviced. The assessment system used does not have capacity to identify small urban lots as a need for servicing adjacent to existing sewerage services and on community expectations as being adjacent to 'town' provided with the same services. It is for this reason that these 'fringe' areas should be included in any servicing program in the following ranking:

Minor Fringe Area	*No. of lots*
Greater Taree	
Glenthorne	26
North east Wingham	25
East Wingham	24
Wingham Industrial	24
Ritchie Cr	10
Kookaburra Dr	18
Harrington Industrial	11
Great Lakes	
Tea Gardens industrial	35

Order of costs for servicing program:

Total centralised sewerage capital costs are as follows:
Small Communities $46,060,000
Fringe Areas $3,110,000

Total onsite sewerage capital costs are as follows:
Small Communities $15,630,000
Fringe Areas $1,230,000

It would be intended to concurrently investigate the supply of town water with the sewerage investigation for those small communities without town water, from the ranked priority list.

Small community	*No. of lots*
Great Lakes	
Coomba Park	497
North Arm Cove	493
Allworth	123
North Pindimar	113
South Pindimar	155
Bundabah	115
Nerong	153

Order of costs for serving program:

Total centralised water capital costs are as follows:
Small Communities $6,250,000
Fringe Area Nil

Total onsite water capital costs are as follows:
Small Communities $8,880,000
Fringe Areas Nil

Any scheme proceeding would need community as well as other stakeholder acceptance. It is intended to circulate this document to other stakeholders as well as issuing to the small communities a questionnaire for input into the process.

Without stakeholder or community support for a centralised scheme, other onsite systems will need to be developed to minimse risk to downstream uses from the small communities.

1 Introduction

Two previous investigations have been undertaken in order to identify unserviced communities that have a potential to impact on the downstream activities from wastewater generated from those communities. These assessments undertook a basic risk assessment of issues involved. The assessments also were fragmented along general purpose Council areas and used different methods of assessment. This assessment aims to consolidate the communities under review and use a more comprehensive risk assessment methodology over both general purpose Council areas.

This investigation aims to objectively as possible undertake a risk assessment of the small communities on a uniform basis for the Great Lakes and Greater Taree areas. The risk assessment will be a recognised methodology. The outcome will be a ranking system for all small communities on their risks to downstream activities. From this ranking a list of priorities can be developed further and provide a starting point for community and other stakeholder consultation and needs assessment for wastewater and water services.

A broad estimate of preliminary capital costs for conventional centralised sewerage system and upgraded onsite wastewater systems will be provided. It should be noted that centralised sewerage systems are not the only solution and that other alternative sewerage systems may also be viable, if any further investigation work proceeds alternatives will be considered.

2 Background

Great Lakes Council Area

The Council area is 3,373 square kilometers in area, comprising both coastal and forested rural hinterland. It is 85 kilometers at its widest point, 62 kilometers north to south , and has a total coastline of 145 kilometers. One third of the area is made up of national parks and state forests. These natural features have turned the Great Lakes into a major recreational area.

Because of these geographic features, distinct communities have developed in the Council area. (Ref 1)

Population growth has been strong in the area placing demand on existing infrastructure and the need for services.

It is those distinct communities which are currently unserviced that will be examined in this risk assessment. There is limited rural residential development with most of the existing rural residential development being serviced by centralised sewerage services.

Greater Taree Council Area

The Council area is 3732 square kilometers in area. The area is rich in agriculture such as dairy and beef production and timber. The Taree area is a center for manufacturing with a number of light industries. (Ref 2)

Greater Taree therefore has a different community structure than the Great Lakes. Greater Taree is based on fringe small communities originating from a rural agricultural base serviced by the larger centers of Taree and Wingham. The rural climate has provided greater demand for rural residential development with strong growth being experienced in this style of development. (Ref 3)

Existing Development

All major urban areas have been serviced with centralised sewerage services in both Council areas. Currently, the management of wastewater from remaining unserviced small communities is the responsibility of the General Purposes Councils. The issue is whether to provide reticulated water supply and sewerage to all, some or none of these small communities and if so, in which order of priority. This is one of the major challenges facing MidCoast Water to balance the health, environmental, social and economic aspects. (Ref 4)

3 Current levels of Service

The current service provision of centralised sewerage to urban areas is:

- 93.6% in the Greater Taree area, and
- 95.4% in the Great Lakes area

After completion of the current schemes at Nabiac, Lansdowne, Coopernook and Manning Point the service provision for the combined MidCoast Water area will rise to 97.4%.

This compares with:

- NSW Country median (50 % of Councils) at 90.4%
- NSW Country top (20 % of Councils) at 96.8%
- NSW Country bottom (80 % of Councils) at 80.2%

These high levels of service availability across MidCoast Water have been achieved at a price. The annual sewerage bill for sewerage residential properties in both general purpose Council areas' is in the highest 20 % of NSW Country Council's. (Ref 4)

4 Communities to be assessed

A list of rural villages and rural residential areas were compiled for Greater Taree and Great Lakes Council areas and is detailed in Table 1.

Populations covered by this assessment amount to:

- Greater Taree villages 1,000 people
- Greater Taree rural residential 2,600 people
- Great Lakes villages 2,600 people

No growth has been considered outside existing 'village' boundaries. Total lots shown in Table 1 are existing lots including those currently not built on. It should also be noted that the assessed lots is preliminary and will need to be more accurately detailed in later investigations.

5 Risk Assessment Methodology

The risk assessment methodology uses a dimensional matrix system based on 'likelihood' versus 'severity' as presented in Appendix A. A hyperbolic ranking system is to be used to obtain a better scatter of risks.

Likelihood

The likelihood of a wastewater problem with existing development was assessed on the basis of the number of blocks. The larger the number of existing developed lots the greater the likelihood of an onsite wastewater problem. The range was set at 150 lots for high likelihood of problem based on existing experience, such as Nabiac, Coopernook and Lansdowne where a decision to provide a centralised sewerage system on the basis of onsite systems causing significant effluent problems, with that size development down to less than 24 lots for low likelihood of a problem.

Severity

Severity was broken down into the following issues:

- Distance of existing development to downstream activity of:
    - Town water supply
    - Shellfish food production
    - Aquatic ecosystem
    - Recreational use
    - Agricultural use
- Size of lots
- Site soil conditions, and
- If development had town water supplied

Downstream water usages were identified for known or likely to occur uses. These downstream usages were identified in the main classifications for water quality and in order of quality standards as detailed in ANZECC guidelines (Ref 2) as:-

- Town water Supply
- Shellfish food provision
- Aquatic Ecosystems
- Recreation and aesthetics
- Agriculture

The relative severity was moderated between the five parameters by reducing the distance of impact as one went down the list. For example highest risk was downstream water supply at upto 9.9 km, shellfish upto 4.9 km, aquatic ecosystem upto 0.9 km, recreational use upto 0.4 km, and agricultural use upto 0.1 km. The actual distances may not be technically correct and no one may know the technically correct number, this system merely provides a relativity between the five parameters. To some extent the distances are based on experience with monitoring of the Manning River.

Physical site conditions such as lot size, site soil conditions and if town water is available all contribute to the capability of the onsite system to work and minimise risk. Thus the physical site condition issues amounted to a weighting of three parameters out of eight. With downstream use contributing a weighting of five possible parameters.

The score for each of the eight parameters are added together to produce a total score. The maximum score possible is 190. The lowest level of high risk is considered to be a likelihood of 2, with severity of 5, which will produce a total score of 76. A total score of round 66 will be used as the cut off point, with scores below this level not considered further for a centralised sewerage system at this stage. For likelihood of 1, low, or less than 19 lots under this system it is not possible to pose a high risk due to the scale of development.

This system looks at each development individually and does not take into account the combined or accumulated risk of development within the catchment.

6 Risk Assessment

Table 2 details actual parameter data for each village. Table 3 provides the score for each parameter and total score. Figure 1 shows the graph of scores sorted from lowest to highest. Figure 1 indicates the top ranking communities can be further divided into three groups if required and that the score of 66 is an appropriate ‘cut off point’. The ranking of those small communities with a score greater than 66 in order of ranking highest to lowest is as follows:

Greater Taree

- Group 1 Bungay
- Group 2 Cedar Party
  - Crowdy Head
- Group 3 Forrest Downs

Great Lakes

- Group 1 Coomba Park
  - North Arm Cove
  - Stroud Road
- Group 2 Allworth
  - Shearwater
- Group 3 North Pindimar
  - South Pindimar
  - Bundabah
  - Nerong

In the Greater Taree area there are significant ‘fringe’ areas as east Wingham, North east Wingham, Wingham industrial, Kookaburra Dr, Ritchie Cr, Glenthorne, and Harrington Industrial area. As stand alone schemes they are small but on the out skirts of towns currently serviced. The assessment system used does not have capacity to identify small urban lots as a need for servicing adjacent to existing sewerage services and on community expectations as being adjacent to ‘town’ provided with the same services. It is for this reason that these ‘fringe’ areas should be included in any servicing program in the following ranking:

- Glenthorne
- North east Wingham
- East Wingham
- Wingham industrial
- Ritchie Cr
- Kookaburra Dr
- Harrington Industrial

In the Great Lakes area the fringe area of Tea Gardens Industrial area should also be considered in the category of adjacent to town.

7 Options for Wastewater Management

Options for the management of Wastewaters from small communities can be categorised broadly into what is known as:-

- ‘on site’ system
- ‘off site’ system, and
- combinations of both.

The need to properly manage ‘on site’ systems has been recognised by Government with recent regulatory controls covering these systems. This control is currently the responsibility of General purpose Councils.

The need to provide more affordable reticulated (or 'off site' systems) water supply and sewerage to small communities has produced a wider range of options.

In planning decisions on which system(s) to implement, the most crucial part is the effluent management. What are we going to do with the final effluent from the system. Then work back through treatments then to collection and transport options. (Ref 4)

8 Costs of Wastewater Management

If conventional technologies from larger water supply and sewerage systems are applied to small communities, then economics of scale can work against the small community.

Data shows the cost of treatment per person for small populations can be 2 to 3 times the cost for large populations. While the cost of trunk mains for small populations can be up to 8 times the cost of large populations. (Ref 4)

Costs of Centralised Wastewater Collection
The cost of completed sewerage schemes in the MidCoast area were analysed for collection cost components and adjusted to current dollars.

As a basis for preliminary estimates per lot, a low range of $11,500 and a high range of $14,500 are indicated for centralised wastewater collection systems. These ranges are based on similar technologies being applied to the smaller communities, ie centralised collection using gravity or modified gravity systems for urban size lots of approximately 20 m by 30 m, costing from $11,500 to $14,500 per lot for collection only. (Ref 4)

For rural residential development where the average lot size is 80 m by 100 m the cost would be expected to be greater. There will be approximately three times the length of pipe compared with an urban size lot. This will not necessarily translate to a tripling in the costs and will also depend on transfer system to existing sewerage system. For the purposes of this simplistic analysis a cost figure of double the urban size lots will be used. Thus the upper cost will be expected to be approximately $29,000 per lot.

The economics of sewering rural residential lots is marginal, particularly were no financial assistance from the NSW Government as is the case with urban size lots.

Costs of Centralised Wastewater Treatment and Effluent Management
Treatment costs have been allowed for each small community, this may include options of connecting into an existing system ie buy into the existing treatment system, or a stand alone treatment/effluent system or a grouped treatment/effluent system.

The treatment costs of sewerage schemes in the MidCoast area were also identified, adjusted to current dollars, sized by equivalent persons (ep) and cost per ep calculated.

The cost of treatment for preliminary estimates at the small end of the graph would be from $640 to $920 per person. Allowing 2.5 ep per lot, this is a range from $1,600 to $2,300 per lot. (Ref 4)

An allowance of a further 50% will be included for effluent management, this may include effluent reuse or discharge infrastructure.

In the case of centralised systems the total system ranges for collection and treatment would be from $13,900 to $17,950 per lot. ***The collection component at 80-90% of the total, has the greatest potential to improve the affordability of small community systems. (Ref 4)***

Life cycle costing of operational costs is calculated on the basis of a 20 period, using a discount rate of 7%, reticulation operational costs of 1.8% of the reticulation capital cost, and treatment operational costs of 9% of the capital treatment cost. The life cycle cost of the operational component is $2,765 per lot for reticulation on urban size lots and $8,820 per lot for rural residential size lots, and $3,290 per lot for treatment. The total NPV of operational costs is $6,055 per lot for urban size lots and $12,110 per lot for rural residential size lots.

Cost of Onsite Systems

The costs of individual "on site" systems for preliminary estimates was assumed as $7,000 per lot. This was based on typical installation costs of domestic type systems.

With adequate lot size and affordable site conditions, these 'on-site' systems can provide a satisfactory level of service. However a high frequency of failure of 'on-site' systems has been reported (Ref 6).

It was concluded that the capital cost ranges from $7,000 for individual on site systems through to $16,800 per urban size lot for centralised systems using conventional technology.

Currently 'on-site' systems are much lower in both capital and operating costs than conventional centralised systems. *In the future it can be expected that the operating and management of 'on-site' systems will increase while the costs of centralised systems may reduce through newer technologies (Ref 4).*

Life cycle costing of operational costs is calculated on the same basis as in Section 8 above, with $250 per lot per year for 4 routine operational inspections, $200 per lot per year for power and replacement of consumables, and the NPV of $4,770 per lot for operational costs.

Estimated Preliminary Costs on Priority Small Communities

The estimated preliminary costs based on upper range for priority small communities identified in section 6 is as follows:

Small community	*No. of lots*	*Centralised system capital cost*	*Centralised system NPV*	*On site system capital cost*	*On site system NPV*	*Government funding available*
Greater Taree						
Bungay	73	$2,370,000	$3,013,000	$510,000	$858,000	No
Cedar Party	145	$4,690,000	$5,969,000	$1,020,000	$1,712,000	No
Crowdy Head	80	$1,420,000	$1,904,000	$560,000	$942,000	Yes
Forrest Downs	80	$2,590,000	$3,296,000	$560,000	$942,000	No
Great Lakes						
Coomba Park	497	$8,910,000	$11,919,000	$3,480,000	$5,851,000	Yes
North Arm Cove	493	$8,840,000	$11,825,000	$3,450,000	$5,802,000	Yes
Stroud Road	85	$1,530,000	$2,045,000	$600,000	$1,005,000	Yes
Allworth	123	$2,200,000	$2,945,000	$860,000	$1,447,000	Yes
Shearwater	120	$3,890,000	$4,617,000	$840,000	$1,412,000	No
North Pindimar	113	$2,030,000	$2,714,000	$790,000	$1,329,000	Yes
South Pindimar	155	$2,790,000	$3,728,000	$1,090,000	$1,829,000	Yes
Bundabah	115	$2,060,000	$2,756,000	$800,000	$1,349,000	Yes
Nerong	153	$2,740,000	$3,666,000	$1,070,000	$1,800,000	Yes

The estimated preliminary costs based on upper range for priority minor fringe areas in the Greater Taree area identified in section 6 is as follows:

Minor Fringe Area	*No. of lots*	*Centralised system capital cost*	*Centralised system NPV*	*On site system capital cost*	*On site system NPV*	*Government funding available*
Greater Taree						
Glenthorne	26	$470,000	$620,000	$180,000	$300,000	possibly
North east Wingham	25	$450,000	$600,000	$180,000	$290,000	possibly
East Wingham	24	$430,000	$580,000	$170,000	$280,000	possibly
Wingham Industrial	24	$430,000	$580,000	$170,000	$280,000	No
Ritchie Cr	10	$180,000	$240,000	$70,000	$120,000	possibly
Kookaburra Dr	18	$320,000	$430,000	$130,000	$210,000	possibly
Harrington Industrial	11	$200,000	$260,000	$80,000	$130,000	No
Great Lakes						
Tea Gardens industrial	35	$630,000	$840,000	$250,000	$410,000	No

Total centralised sewerage capital costs are as follows:
Greater Taree Small Communities $11,070,000
Greater Taree Fringe Areas $2,480,000

Great Lakes Small Communities $34,990,000
Great Lakes Fringe Area $630,000

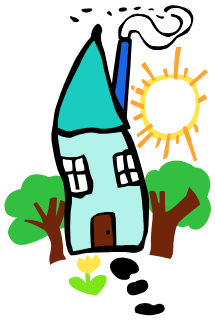
Obviously all these small communities cannot be connected to a centralised sewerage service at once, it would be expected that over the next 10 years as funding permits work could be undertaken.

9 Town Water Supply

It would be intended to concurrently investigate the supply of town water with the sewerage investigation for those small communities without town water, from the ranked priority list.

This will involve the following small communities:

- Coomba Park
- North Arm Cove
- Allworth
- North Pindimar
- South Pindimar
- Bundabah
- Nerong



Costs of Centralised Water System
Reticulation is estimated at $1,500 per lot for urban size lots and $4,800 per lot for rural residential size lots.

Based on Manning District headworks expenditure in the 1980's on reservoirs, delivery mains and pump stations, as well as the forecast expenditure on treatment expected in 2002, an estimated headworks component of $59,000,000 will have been expended on the water system. It is estimated there will be 25,850 lots, this provides an average capital cost of $2,282 per lot.

Life cycle costing of operational costs is calculated on the same basis as in Section 8, with the treatment component at $15,000,000 and reservoirs, delivery mains and pump stations component at $44,000,000, and the NPV of $878 per lot for operational costs.

Cost of Onsite Water System
For a 20 kL storage and pump the cost is $5,014 per lot (Ref 7) and life cycle costing of operational costs calculated on the same basis as in section 8 and the NPV of $710 per lot for operational costs.

The estimated preliminary costs based on upper range for priority small communities identified in section 6 is as follows:

Small community	*No. of lots*	*Centralised system capital cost*	*Centralised system NPV*	*On site system capital cost*	*On site system NPV*	*Government funding available*
Great Lakes						
Coomba Park	497	$1,880,000	$2,320,000	$2,490,000	$2,840,000	Yes
North Arm Cove	493	$1,860,000	$2,290,000	$2,470,000	$2,820,000	Yes
Allworth	123	$470,000	$580,000	$620,000	$700,000	Yes
North Pindimar	113	$430,000	$530,000	$570,000	$650,000	Yes
South Pindimar	155	$590,000	$730,000	$780,000	$890,000	Yes
Bundabah	115	$440,000	$540,000	$580,000	$660,000	Yes
Nerong	153	$580,000	$710,000	$770,000	$880,000	Yes

Total centralised water capital costs are as follows:
Greater Taree Small Communities Nil
Greater Taree Fringe Areas Nil
Great Lakes Small Communities $6,250,000
Great Lakes Fringe Area Nil

10 Stakeholder Consultation

Any scheme proceeding would need community as well as other stakeholder acceptance. It is intended to circulate this document to other stakeholders as well as issuing to the small communities the questionnaires contained in Appendix B for input into the process.

Without stakeholder or community support for a centralised scheme, other onsite systems will need to be developed to minimse risk to downstream uses from the small communities.

References

Ref 1 Great Lakes Community Profile 1999, Great Lakes Council

Ref 2 Facts & Figures 1996, Greater Taree City Council

Ref 3 Rural Villages Study 1996, Greater Taree City Council

Ref 4 Small Communities Wastewater Risk Assessment 1999, MidCoast Water

Ref 5 Australian Water Quality Guidelines for Fresh and Marine Waters 1992, ANZECC

Ref 6 Water Service Association of Aust., Agriculture and Resource Management Council of Aust. And New Zealand 1999, Affordable Water Supply and Sewerage for Small Communities.

Ref 7 Manning District Water Supply Augmentation, Stratgey Review Report Dept of Public Works & Services May 1999.

Appendix A Risk Assessment Methodology

Appendix A Risk Assessment Methodology

Likelihood	**Severity**
For Existing Development: • >150 lots **high** • 95 – 149 lots • 50 – 94 lots **medium** • 20 – 49lots • <19 lots **low**	Existing development distance from downstream activity ranked in order of highest severity to lowest by moderating distance downstream 1.1 Town water supply downstream of development: • <9.9 km **high** • 10 – 19.9 km • 20 – 29.9 km **medium** • 30 – 49.9 km • > 50 km **low**
	1.2 Shellfish food production downstream • <4.9 km **high** • 5 – 14.9 km • 15 – 29.9 km **medium** • 30 – 49.9 km • > 50 km **low**
	1.3 Aquatic ecosystem downstream • <0.9 km **high** • 1 – 1.9 km • 2 – 3.9 km **medium** • 4 – 5.9 km • >6 km **high**
	1.4 Recreational use downstream • <0.4 km **high** • 0.5 – 0.9 km • 1 – 1.9 km **medium** • 2 – 2.9 km • >3 km **low**
	1.5 Agricultural use downstream • <0.1 km **high** • 0.2 – 0.5 km • 0.6 – 0.9 km **medium** • 1 – 1.9 km • > 2 km **low**
	2.0 Size of lot • <700 m^2 **high** • 701 – 1500 m^2 • 1501 – 4000 m^2 **medium** • 4001 – 8000 m^2 • >8001 m^2 **low**
	3.0 Site soil conditions • clay/rock **high** • shale • clay/loam **medium** • loam • sand **low**
	4.0 Town water supply available • NA **high** • Yes **medium** • No **low**

Appendix B Proposed Community Questionnaire

Type 1 Villages

Type 2 Rural Residential

Table 1 Greater Taree and Great Lakes Council Small Communities

Greater Taree Area[2]					
Village/Location	**Current Population**[1]	**Growth Trend**	**Existing houses**[3]	**Total Lots**	**Catchment**
Moorland	150	Low	63	70	Pipeclay canal/Manning River
Johns River	100	Low	40	110	Stewarts River/Camden Haven
Mount George	120	Low	42	54	Manning River
Crowdy Head	170	Low	73	80	Pacific Ocean
Krambach	120	Low	49	64	Wallamba River/Wallis Lake
Croki	48	Low	20	27	Manning River
Elands	70	Low	30	48	Dingo Creek/Manning River
Oxley Is	30	Low	12	16	Manning River
East Wingham	60	Low	24	33	Manning River
North East Wingham	60	Low	25	25	Manning River
Wingham Industrial	NA	Low	24	24	Manning River
Kookaburra Dr	45	Low	18	18	Manning River
Ritchie Cr	26	Low	10	10	Manning River
Glenthorne	65	Low	26	26	Manning River
Harrington Industrial	NA	Low	11	11	Manning River
Colonial Leisure Village	60	Low	24	30	Manning River
Rural Residential					
Homestead/heritage Estate	195	Low	73	88	Wallamba River/Wallis Lake
Rainbow Flat	200	Low	69	83	Khappinghat Creek/ Saltwater Lagoon
Nabiac Rural	80	Low	32	50	Wallamba River/Wallis Lake
Sorrento Pl	110	Low	40	45	Manning River
Cedar Party	390	Low	120	145	Dawson River/Manning River
Clovernook	160	Low	56	70	Ghinny Ghinny Creek/Manning River
Kolinda	95	Low	35	40	Manning River
Warwiba	150	Low	53	66	Manning River
Helmich Cl	160	Low	58	65	Manning River
Bungay	240	Medium	67	73	Manning River
Idlewoods	95	Low	45	55	Wallamba River/Wallis Lake
Diamond Beach	310	Medium	86	116	Saltwater Lagoon
Forrest Downs	210	Medium	70	80	Manning River
Manning Waters	120	Low	25	43	Manning River
Malcolms Rd	10	Medium	3	33	Manning River
Riverview Dr	60	Low	23	25	Manning River
Abbott Rd	25	Low	10	10	Manning River

Great Lakes Area					
Allworth	180	Medium	83	123	Karuah River
Limeburners Creek	90	Medium	42	62	Karuah River
Booral	80	Low	39	58	Karuah River
Stroud Road	110	Low	57	85	Karuah River
Wards River	90	Low	45	67	Karuah River
Coomba Park	520	Medium	227	497	Wallis Lake
Coolongolook	120	Low	49	96	Coolongolook River/Wallis Lake
Wooton	40	Low	17	25	Coolongolook River/Wallis Lake
North Pindimar	120	Medium	57	113	Port Stephens
South Pindimar	170	Medium	78	155	Port Stephens
Bundabah	130	Medium	58	115	Port Stephens
North Arm Cove	550	High	248	493	Port Stephens
Tahlee	90	Low	41	82	Port Stephens
Carrington	30	Low	14	28	Port Stephens
Nerong	150	Medium	70	153	Myall Lake
Seal Rocks	180	Medium	81	120	Pacific Ocean
Tea Gardens Industrial	NA	Medium	35	50	Port Stephens
Rural Residential					
Racecourse Estate	140	Low	65	75	Wallis Lake
Shearwater Estate	180	Medium	80	120	Port Stephens

Notes

1 Current populations is based on average Council area occupancy rates for existing houses
2 The villages or localities of Wherrol Flat, Killabakh, Burrell Creek, Waitu, Bobin, Hannam Vale, Dyers Crossing identified in Greater Taree City Council's Rural Villages Study 1996 have been omitted from this assessment due to the size of development being in most cases less than 10 urban size blocks.
3 Lot numbers include allowance for existing non domestic development such as caravan parks and other commercial.

Table 2 Severity data used in Assessment

Greater Taree Area								
	Severity							
	Distance to downstream activity in km:					**Physical attributes:**		
Village/Location	**Water supply**	**Shellfish product**	**Aquatic system**	**Recreation use**	**Agriculture use**	**Size of lots m^2**	**Soil type**	**Town water provided**
Moorland	NA	14	8	8	0.2	600	Loam	No
Johns River	NA	10	1.5	1.5	2	1000	Clay loam	No
Mount George	20	52	0.6	0.6	0.2	1000	Clay loam	No
Crowdy Head	NA	NA	0.6	0.6	2	600	Rock	Yes
Krambach	NA	40	1.7	1.7	0.2	1000	Shale	Yes
Croki	NA	0.1	0.1	0.1	0.2	600	Clay loam	Yes
Elands	30	50	3	3	2	700	Loam	No
Oxley Is	NA	6.5	1.5	1.5	0.2	4000	Clay loam	Yes
East Wingham	NA	32	0.2	0.2	1	800	Clay loam	Yes
North East Wingham	NA	34	0.3	0.3	0.2	900	Shale	Yes
Wingham Industrial	NA	38	4	4	2	2500	Shale	Yes
Kookaburra Dr	NA	13	2.6	2.6	2	700	Shale	Yes
Ritchie Cr	NA	25	0.1	0.1	2	700	Shale	Yes
Glenthorne	NA	13	0.2	0.2	1	700	Clay loam	Yes
Harrington Industrial	NA	1	0.9	0.9	2	2000	Sand	Yes
Colonial Leisure Village	NA	0.7	0.7	0.7	2	<700	Sand	Yes
Rural Residential								
Homestead/Heritage Estate	NA	11	0.5	3.2	2	14,000	Shale	Yes
Rainbow Flat	NA	NA	4	4	2	11,000	Shale	Yes
Nabiac Rural	NA	26	2.2	2.2	0.2	20,000	Shale	Yes
Sorrento Pl	NA	25	1.6	1.6	1	11,000	Shale	Yes
Cedar Party	NA	20	1.5	1.5	2	14,000	Shale	Yes
Clovernook	NA	8	5	5	2	13,000	Shale	Yes
Kolinda	NA	7.5	2.5	2.5	2	11,000	Clay	Yes
Warwiba	NA	7	1.7	1.7	1	13,000	Shale	Yes
Helmich Cl	NA	34	3	3	2	5,000	Shale	Yes
Bungay	0.8	39	0.8	0.8	0.2	13,000	Shale	Yes
Idlewoods	NA	13	4.5	4.5	2	9,000	Shale	Yes
Diamond Beach	NA	NA	2	2	2	12,000	Clay loam	Yes
Forrest Downs	NA	18	0.9	0.9	2	8,000	Clay	Yes
Manning Waters	NA	0.5	0.5	0.5	0.2	13,000	Clay loam	Yes
Malcolms Rd	NA	8	2	2	0.2	10,000	Shale	Yes

Riverview Dr	NA	34	0.4	0.4	1	4,000	Shale	Yes
Abbott Rd	NA	36	4	4	2	5000	Shale	Yes
Great Lakes Area								
Allworth	NA	12	0.1	0.1	0.2	900	Clay loam	No
Limeburners Creek	NA	9	1.1	1.1	0.2	900	Shale	No
Booral	NA	22	0.5	0.5	0.2	2400	Shale	No
Stroud Road	7	38	0.4	0.4	0.2	800	Shale	Yes
Wards River	22	43	0.2	0.2	0.2	1000	Shale	No
Coomba Park	NA	3	0.1	0.1	2	600	Clay	No
Coolongolook	NA	10	0.5	0.5	1	2000	Clay loam	No
Wooton	NA	20	10	10	1	1000	Clay loam	No
North Pindimar	NA	0.1	0.1	0.1	2	800	Sand	No
South Pindimar	NA	0.1	0.1	0.1	2	800	Sand	No
Bundabah	NA	0.1	0.1	0.1	2	800	Sand	No
North Arm Cove	NA	0.1	0.1	0.1	2	800	Rock	No
Tahlee	NA	0.1	0.1	0.1	2	2000	Shale	No
Carrington	NA	0.1	0.1	0.1	2	1000	Shale	No
Nerong	NA	NA	0.1	0.1	2	700	Shale	No
Seal Rocks	NA	NA	0.2	0.2	2	600	Sand	No
Tea Gardens Industrial	NA	4.3	1.6	1.6	2	1300	Sand	Yes
Rural Residential								
Racecourse Est	NA	4.5	0.8	0.8	2	6000	Sand	Yes
Shearwater Est	NA	4.3	0.8	0.8	2	5000	Shale	Yes

Table 3 Risk Assessment Scores

Greater Taree Area									
	Severity Parameter								
	1.1	**1.2**	**1.3**	**1.4**	**1.5**	**2**	**3**	**4**	**Total**
Village/Location									
Moorland	NA	12	3	3	12	15	6	3	54
Johns River	NA	8	8	6	2	8	6	2	40
Mount George	6	2	10	8	8	8	6	2	44
Crowdy Head	NA	NA	15	12	3	15	15	9	69
Krambach	NA	4	8	6	8	8	8	6	48
Croki	NA	10	10	10	8	10	6	6	60
Elands	8	2	6	2	2	10	4	6	40
Oxley Is	NA	4	4	3	4	3	3	3	24
East Wingham	NA	4	10	10	4	8	6	6	48
North East Wingham	NA	4	10	10	8	8	8	6	54
Wingham Industrial	NA	4	4	2	2	6	8	6	32
Kookaburra Dr	NA	4	3	2	1	5	4	3	22
Ritchie Cr	NA	3	5	5	2	5	4	3	27
Glenthorne	NA	8	10	10	4	10	6	6	54
Harrington Industrial	NA	5	5	4	1	3	1	3	22
Colonial Leisure Village	NA	10	10	8	2	10	2	6	48
Rural Residential									
Homestead/Heritage Estate	NA	12	15	3	3	3	12	9	57
Rainbow Flat	NA	NA	6	3	3	3	12	9	36
Nabiac Rural	NA	6	6	4	8	2	8	6	40
Sorrento Pl	NA	6	8	6	4	2	8	6	40
Cedar Party	NA	12	16	12	4	4	16	12	76
Clovernook	NA	12	6	3	3	3	12	9	48
Kolinda	NA	8	6	4	2	2	10	6	38
Warwiba	NA	12	12	9	6	3	12	9	63
Helmich Cl	NA	6	9	3	3	3	6	9	39
Bungay	15	6	15	12	12	3	12	9	84
Idlewoods	NA	8	4	2	2	2	8	6	32
Diamond Beach	NA	NA	9	6	3	3	9	9	39
Forrest Downs	NA	9	15	12	3	3	15	9	66
Manning Waters	NA	10	10	8	8	2	6	6	50
Malcolms Rd	NA	4	3	2	4	1	4	3	21
Riverview Dr	NA	4	10	10	6	2	8	6	46
Abbott Rd	NA	2	2	1	1	1	4	3	14
Great Lakes Area									
Allworth	NA	12	15	15	12	12	9	3	78
Limeburners Creek	NA	8	8	6	8	8	8	2	48

Booral	NA	6	10	8	8	6	8	2	48
Stroud Road	15	6	15	15	12	12	12	9	96
Wards River	6	4	10	10	8	8	8	2	56
Coomba Park	NA	25	25	25	5	25	25	5	135
Coolongolook	NA	8	10	8	4	6	6	2	44
Wooton	NA	3	1	1	2	4	3	1	15
North Pindimar	NA	15	15	15	3	12	3	3	66
South Pindimar	NA	15	15	15	3	12	3	3	66
Bundabah	NA	15	15	15	3	12	3	3	66
North Arm Cove	NA	25	25	25	5	20	25	5	130
Tahlee	NA	10	10	10	2	6	8	2	48
Carrington	NA	5	5	5	1	4	4	1	25
Nerong	NA	NA	15	15	3	15	15	3	66
Seal Rocks	NA	NA	15	15	3	15	3	3	63
Tea Gardens Industrial	NA	10	8	6	2	8	2	6	42
Rural Residential									
Racecourse Est	NA	15	15	12	3	6	3	9	63
Shearwater Est	NA	15	15	12	3	6	12	9	72

Risk Assessment