Mooney Mooney, Cheero Point & Little Wobby Sewerage

Options Report

for

Gosford City Council

and

Department of Land & Water Conservation

Document No:	EKA-097/03
Revision No:	0 (November 2002)

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ABBREVIATIONS

ADWF	Average Dry Weather Flow
AWTS	Aerated Wastewater Treatment System
BOD	Biological Oxygen Demand
CED	Common Effluent Drainage
DLWC	Department of Land and Water Conservation
DOCS	Department of Community Services
DOH	Department of Health
DOP	Department of Planning
DSR	Department of Sport & Recreation
EAT	Extended Aeration Tank
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EKA	Ellis Karm & Associates Pty Ltd, Project Managers
EP	Equivalent Person
EPA	Environment Protection Authority
ET	Equivalent Tenement
FC	Faecal Coliform
GP	Grinder Pump
HRC	Healthy Rivers Commission
IDEAT	Intermittently Decanted Extended Aeration Tank
MCG	Modified Conventional Gravity
MCPA	Mooney-Cheero Progress Association
N / TN	Nitrogen / Total Nitrogen
NFR	Non Filterable Residue
NPV	Net Present Value
O & M	Operation and Maintenance
OSM	On-site Sewage Management
OSMS	On-site Sewage Management Strategy
P / TP	Phosphorous / Total Phosphorous
POEO	Protection of Environment Operations
PS	Pump Station
RM	Rising Main
SEPP	State Environmental Planning Policy
SRC	Sport and Recreation Centre
STEP	Septic Tank Effluent Pumping
STP	Sewage Treatment Plant
STS	Small Town Sewerage
SWC	Sydney Water Corporation
WEPA	Wobby Environmental Protection Association

EXECUTIVE SUMMARY

S1 INTRODUCTION

Mooney Mooney, Cheero Point and Little Wobby, populations approximately 313, 107 and 65 respectively, are located on the Hawkesbury River estuary in Gosford City local government area.

Existing sewerage services comprise on-site systems, primarily septic tanks with transpiration trenches or beds. The towns are on the NSW Government's priority list under the Small Towns Sewerage (STS) program for improved sewerage services. Financial assistance (up to approximately 67%) is available under the program. In addition, Council has obtained financial support under the Government's Priority Sewerage Program.

This Options Report has been prepared to meet STS program requirements. The report examines low cost (affordable) sewerage options and compares feasible schemes options for consideration by community and other stakeholders so that a preferred scheme can be selected for implementation.

S2 DESCRIPTION OF TOWNS AND ENVIRONS

Mooney Mooney and Cheero Point

The urban areas are bounded by Mooney Mooney Creek, the Pacific Highway (and F3 freeway) and Brisbane Water National Park. Oyster farms are located in Mooney Mooney Creek in the vicinity of the urban areas and depuration depots lie south of Mooney Mooney township. The Department of Community Services (DOCS) owns the Peat Island hospital and associated facilities, including numerous residences, immediately south of the Mooney Mooney urban area.

The topography is hilly with slopes varying from moderate to very steep. All properties slope towards the waterfront. Rock is at shallow depth; surface outcrops are extensive.

The communities are serviced by sealed roads (no piped stormwater), electricity, phone and reticulated water supply. The DOCS facilities and residences are served by a reticulated sewerage scheme that also serves the oyster farmers depots, a public school and a licensed club.

Little Wobby

Little Wobby occupies a narrow 1.5km strip of land on the foreshore of the Hawkesbury River, approximately 1 km east of Dangar Island. Development comprises residential premises only, many of which are used for temporary holiday accommodation only.

Retaining walls protect the small and narrow urban lots from tides and wave action. A steep escarpment rises over 100m to the rear of the urban strip.

Boat access only is available – all properties have associated jetties; there are no roads. Phone and power are available; water is provided from privately owned rainwater tanks.

Environment

The Hawkesbury-Nepean River forms one of the largest coastal drainage basins in NSW with a catchment of 22,500 square kilometers. In the region of Mooney Mooney, Cheero Point and Little Wobby the river is estuarine.

The Healthy Rivers Commission in its recent inquiry (HRC, 1998) identified a number of water quality issues in the catchment, with on-site sewerage facilities adjacent waterways being a major source of excessive nutrients.

The EIS for Brooklyn-Dangar Island Priority Sewerage Program (Sydney Water, 2000) identified on-site sewerage systems as contributing to adverse impacts on water quality (nutrient levels and faecal coliforms). Water quality monitoring by Hornsby Shire Council near Mooney Mooney also shows presence of faecal coliforms, but at relatively low levels.

The nearby catchment area is characterised by dense sclerophyll forests that extend from the top of the ridges and escarpments to the river. Wetlands exist along foreshores of Mooney Mooney Creek at Mooney Mooney and Cheero Point. Except to the south of Mooney Mooney, clearing has been limited to the urban areas.

S3 SEWERAGE NEEDS AND CONSULTATIONS

Existing sewerage services comprise septic tank/absorption systems with a small number of aerated wastewater treatment systems (AWTS) and several pump-outs at Mooney Mooney. Problems with these systems in urban communities are well documented and result generally from increasing urbanisation, inadequate land areas and system deficiencies.

During the course of investigations the following consultations have been undertaken:

- Community consultations in accordance with a consultation Program adopted by Council at commencement of the Options study.

- A Planning Focus Meeting with stakeholders was held on 24 July 2002 at Mooney Mooney.

  Community representatives at the meeting emphasised the importance of minimising costs. River health is also a major consideration and there are concerns regarding impacts from on-site systems.

  Sydney Water is now considering siting a treatment plant for its Brooklyn-Dangar Island scheme at Mooney Mooney, adjacent the existing Peat Island plant owned by DOCS.

  The existing effluent discharge from the Peat Island plant was considered unsatisfactory.

  The oyster farming industry has no major objections or concerns with release of high quality effluent to the Hawkesbury River - the volumes of effluent released would be negligible in comparison with the tidal and catchment base flow.

- Direct consultation with stakeholders on specific issues. DOCS has advised that the Peat Island hospital facility will be closed although the timing is not known.

Based on consultations with stakeholders, the following objectives have been established for Mooney Mooney, Cheero Point and Little Wobby sewerage scheme(s):

- Affordable to the communities;
- Meet the governments STS program requirements to maximise financial assistance;
- Provide a long-term, environmentally acceptable and sustainable scheme;
- Service existing and future development;
- Satisfy regulatory requirements;
- Meet community expectations for levels of service and amenity.

S4 DEVELOPMENT & LOADING PROJECTIONS

Based on 2001 census and other data, existing and future development levels have been determined as follows.

Community	Year	ET	EP
Mooney Mooney	2002	149	313
	Future	192	400
Cheero Point	2002	51	107
	Future	85	180
Little Wobby	2002	63	63, peak 110
	Future	73	90, peak 130

S5 STRATEGIC SEWERAGE OPTIONS

Due to their close proximity (< 2 km by road) Mooney Mooney and Cheero Point can be more economically serviced by a common scheme rather than separate schemes. Little Wobby is comparatively remote and needs to be considered separately.

The broad options available for sewerage services are:

Mooney Mooney and Cheero Point

- Do Nothing ie. retain and manage on-site systems
- Independent scheme serving Mooney Mooney and Cheero Point only
- Combine treatment and effluent management with Peat Island Scheme
- Combine treatment and effluent management with both Peat Island and Brooklyn-Dangar Island schemes.

Little Wobby

- Do Nothing ie. retain and manage on-site systems
- Local scheme
- Connect to Gosford regional Sewerage Scheme at Patonga
- Connect to future Brooklyn-Dangar island scheme at Dangar Island

S6 RETENTION OF ON-SITE SYSTEMS

Legislative and performance standards affecting on-site sewerage systems have been significantly revised and upgraded in recent years. The NSW Government's health and environmental protection guidelines for "On-Site Sewage Management for Single Households" (1998) (OSM Guidelines) have been introduced to assist owners and regulators to effectively manage and improve performance of on-site systems.

Council has introduced its OSM Strategy (OSMS) to manage all on-site systems within the Gosford City area. Licensing under the OSMS reflects the risk profile of the property (high or low risk) and individual system concerned (low, medium or high risk).

All properties within the urban areas of Mooney Mooney, Cheero Point and Little Wobby under study are categorised as High risk (proximity to recreational water, within 250 m of an oyster lease etc). Of the 177 individual systems assessed to date, 34% are categorised as either Medium or High risk.

Given the small lot sizes, unfavourable ground conditions and other mitigating factors, it can be expected that an increasing number of systems will need to be upgraded over time to meet necessary performance standards. The only alternative available to property owners is a pump-out service at significantly increased cost.

S7 SEWERAGE SYSTEMS & OPTIONS

Collection System Options

In all cases, collection systems can collect either:

- Partly treated effluent (mostly septic tank effluent), in which case the existing on-site treatment unit (either septic tank or AWTS) has to be retained, or
- Untreated sewage, in which case all existing on-site facilities become redundant. Collection system options available are:

The collection system technologies available are:

- Pressure (or Low-Pressure) systems for all urban areas
- Gravity systems at Cheero Point and for approximately 33% (50 lots) at Mooney Mooney, primarily properties along the Pacific Highway. Gravity systems are nor feasible for the remainder of Mooney Mooney and at Little Wobby due to site constraints.

Effluent Management Options

The estimated future wastewater / effluent volume generated are:

- 122 kL/d (or 44 ML/a) at Mooney-Cheero
- 5.3 kL/d (1.9 ML/a) at Little Wobby if there is no water supply and 17 kL/d (6.3 ML/a) with a future potable supply.

The suitable options identified for management of treated effluent are:

- Discharge of high quality effluent to the Hawkesbury River;
- Non-potable reuse at Little Wobby.

At Little Wobby, urban reuse would double the wastewater load and account for approximately 50% of effluent produced. The remaining effluent would require an alternate management option ie. discharge to the Hawkesbury River.

The effluent quality assumed for river discharge is typical of that required for discharge in drinking water catchments (P class waters). Investigations will need to be undertaken to determine optimal effluent quality to meet the environmental values and objectives applicable.

Treatment Options

Wastewater will be derived almost exclusively from domestic sources. The treatment load will vary depending on whether partly treated effluent (with majority of solids removed) or raw sewage is collected - treatment costs are higher in the latter case.

Treatment plant capacities required are:

- Mooney-Cheero: 600 EP for independent scheme; 1800 EP approximately for facility combined with the Peat Island scheme; and 3350 EP approximately if combined with Peat Island and Brooklyn-Dangar Island schemes.
- Little Wobby: 130 EP

The following approximate land areas are required for treatment facilities:

- Mooney-Cheero: Up to 2000 m^2
- Little Wobby: Up to 500 m^2

Possible site options for Mooney-Cheero are adjacent the existing Peat Island STP, opposite the peat Island STP on vacant public reserve and adjacent the F3 freeway in Deerubbun Reserve.

At Little Wobby, site options are limited to Department of Sport and Recreation land at the south of the urban strip.

Various technologies are available to produce high quality effluent for discharge to the Hawkesbury River. Suitable package type facilities are available from a number of suppliers in Australia using proprietary equipment and designs.

Transfer Systems

Wastewater transfer systems, comprising pumping stations and transfer pipelines, are required under various scheme options.

Mooney-Cheero Schemes:

- Cheero Point to Mooney Mooney. The capacity of the transfer system depends on the type of collection system used (gravity or pressure) and varies from 1.8 L/s to 3.3 L/s with pipeline size 65 mm to 80 mm diameter; the lower capacity applies to a pressure collection system. Pipeline length also varies from 1.5 km to 2.1 km, depending on the type of collection systems used at both Cheero Point and Mooney Mooney.
- Mooney Mooney to the STP site. Transfer system capacity varies from 5.6 L/s to 8.3 L/s and pipeline size 80 mm to 100 mm diameter, also depending on the type of collection system used. The transfer length ranges from 1.2 km to 1.35 km but is dependent on the final location of the STP.

Little Wobby Scheme Options:

- Transfer to Patonga and connection to the Gosford Regional Sewerage Scheme; transfer distance 2.5 km. The pipeline needs to be constructed across the headland through native bushland.
- Transfer to Dangar Island for connection to future Brooklyn-Dangar Island Scheme; the transfer distance is 1.0 km across the Hawkesbury River.

In both cases, transfer capacity ranges from 0.3 L/s to 1.3 L/s for options without and with future water supply service. Pipeline size required is a minimum 50 mm irrespective of water supply.

S8 SEWERAGE SCHEME OPTIONS

Do Nothing

This Option represents the BASE case against which other options can be compared and assessed. Property owners are wholly responsible for the operation and maintenance of their on-site system in accordance with Council's OSMS and the relevant operating license. All costs are borne by the householder; no Government subsidy is available for the "Do Nothing" option.

Mooney-Cheero Scheme Options

Option M1: Independent local scheme, capacity 600 EP with high quality effluent discharge to the Hawkesbury River at the F3 road bridge.

Option M2: Combined scheme with 1800 EP treatment plant serving both Mooney-Cheero and Peat Island; high quality effluent discharge to the Hawkesbury River at the F3 road bridge.

Option M3: Combined scheme with 3350 EP treatment plant serving Mooney-Cheero, Peat Island and future Brooklyn-Dangar Island service area; high quality effluent discharge to the Hawkesbury River at the F3 road bridge.

Within these Scheme options, collection system alternatives are:

- A. Partly treated (septic) effluent, or B. Sewage collection
- Pressure collection systems throughout or part gravity (Cheero Point and part Mooney Mooney (33%).

Little Wobby Scheme Options

Option W1: Partly treated (septic) effluent collection system and barge-operated pump-out from a central collection tank.

Option W2: Local scheme with 130 EP treatment plant with effluent discharge to the Hawkesbury River.

Option W3: Connection to Gosford Regional Sewerage Scheme at Patonga.

Option W4: Connection to future Sydney Water scheme at Dangar Island.

Option W1 is viable only with septic effluent collection; Option W2, W3 and W4 can collect either septic effluent of untreated sewage.

There are impacts on the sewerage options if a potable water supply is provided in future:

- Option W1 is viable only without water supply (increased effluent volumes would increase operating costs significantly).
- Option W2 would require a treatment plant with significantly increased capacity.
- Options W3 and W4 are likely to incur increased operating costs only.

In addition, for Option W2 only, a non-potable supply of treated effluent can be provided in lieu of a potable water supply.

S9 SCHEME ESTIMATES

Cost estimates for all scheme options are summarised in the Tables S1 and S2 below.

Table S1 Mooney-Cheero Scheme Options – Cost Estimates ($M)

Sewerage Scheme Option	Option M1	Option M2	Option M3
A: Septic effluent collection (pressure type only)	3.46	5.38	7.15
Mooney-Cheero cost share	3.46 (100%)	3.09 (57%)	2.92 (41%)
NPV (Mooney-Cheero share)	*4.89*	*4.43*	*4.24*
B: Sewage collection (pressure type only)	3.89	5.74	7.46
Mooney-Cheero cost share	3.89 (100%)	3.45 (60%)	3.23 (43%)
NPV (Mooney-Cheero share)	*5.23*	*4.67*	*4.41*
Extra for gravity collection in lieu of pressure (where possible)* (all Options):			
A. Septic effluent collection	0.25 - 0.40		
NPV	*0.26 - 0.44*		
B. Sewage collection	0.27 - 0.47		
NPV	*0.23 - 0.32*		

Estimates include allowance for property connections

** At Cheero Point only or at Cheero Point and part Mooney Mooney where possible (approx 33% of lots)*

Table S2 Little Wobby Scheme Options – Cost Estimates ($M)

	Option W1	Option W2	Option W3	Option W4
Sewerage only:				
A: Septic effluent collection	0.64	0.81	1.23	1.63
NPV	*1.55*	*1.19*	*1.72*	*2.03*
B: Sewage collection	NA	0.96	1.33	1.72
NPV		*1.28*	*1.73*	*2.05*
Sewerage and non-potable reuse:				
A: Septic effluent collection		1.24		
NPV		*1.71*		
B: Sewage collection		1.39		
NPV		*1.80*		
Sewerage and potable water supply*:				
A: Septic effluent collection		1.87	1.83	2.50
NPV		*2.50*	*2.50*	*3.09*
B: Sewage collection		2.01	1.93	2.60
NPV		*2.57*	*2.52*	*3.12*

Estimates include allowance for property connections
** Indicative cost for water supply based on supply from Patonga in conjunction with sewerage scheme*

S9 COMPARISON OF SCHEME OPTIONS

It is generally acknowledged that improved sewerage services will provide health and environmental benefits to the towns and the region generally. The impacts of scheme development and operation, however, vary depending on the particular scheme features. A discussion of the more significant environmental impacts is included in Section 12 of the report.

All Options meet the scheme objectives but levels of service vary.

Mooney-Cheero Scheme Options

The key differentiating factors are (refer Table 13.1 for comparative summary):

a) Options M1A, M2A and M3A (effluent collection) require households to retain their on-site treatment unit (septic tank, AWTS). Under Options M1B, M2B and M3B (sewage collection) all on-site system are removed as they are no longer required.

   Under all Options, a pump unit is installed on each property to pump either septic effluent or sewage to a network of pressure collection mains located in roadways.

   There is improved householder and public amenity under the B. options (at additional cost) resulting from by the removal of on-site treatment units (primarily septic tanks).

b) A gravity collection system can be installed in lieu of pressure at Cheero Point and for approximately 50 lots (33%) at Mooney Mooney, at additional cost. The pumping units in pressure collection systems are not required in a gravity collection system.

Two additional catchment pumping station are required at Cheero Point under a gravity system. With a part gravity system at Mooney Mooney, the transfer pumping station will need to be located on private property on the foreshore of Mooney Mooney Bay rather than in public roadway.

c) Capital and operating costs for Mooney-Cheero are minimised by combining treatment and effluent management with either the Peat Island scheme or with both the Peat Island and Brooklyn-Dangar Island schemes.

However, agreement to the sharing arrangements, timing and funding (both capital costs and ongoing operations) with the participating parties will be required.

Little Wobby Scheme Options

The key differentiating factors are (refer Table 13.2 for comparative summary):

a) Options W1A to W4A (effluent collection) require households to retain their on-site treatment unit (septic tank, AWTS). Under Options W2B to W4B (sewage collection) all on-site systems are removed as they are no longer required.

Under all Options, a pump unit is installed on each property to pump either septic effluent or sewage to a collection mains located to the rear or front of each property.

There is improved householder and public amenity under the B. options resulting from by the removal of on-site treatment units (primarily septic tanks).

b) Future water supply service

The introduction of a potable supply is not compatible with Options W1A (centralised pump-out). Under Option W2 (local treatment) the treatment facility needs to be either capable of upgrading to cope with the increased hydraulic loads, or replaced with a higher capacity plant.

The transfer systems under Options W3 and W4 would be capable of handling the additional wastewater flows associated with a water supply service; operating costs will increase marginally.

c) Recycling of effluent for non-potable uses

A non-potable supply of effluent (for toilet flushing and external uses) could be provided under Option W2.

There are unique and significant risks associated with provision of sewerage services to Little Wobby, in particular:

- Construction risks under all Options related to ground and sub-surface conditions.
- Environmental risks and approvals associated with Option W3 – transfers to Patonga – with construction in native and essentially undisturbed bushland.

The former needs to be addressed as a first stage in the development of a preferred sewerage option at Little Wobby; the latter only applies if it is the preferred option.

1 INTRODUCTION

Mooney Mooney, Cheero Point and Little Wobby are small towns, total population approximately 485, located on the Hawkesbury River in Gosford City local government area.

Existing sewerage services comprise on-site systems. Problems associated with these existing systems have been evident for some time and include health risks; runoff and poor drainage; odours; pollution of ground and surface waters. Council has recently introduced its On-Site Sewage Management Strategy (OSMS) that is currently being implemented.

In 1997 the NSW Government announced the Small Towns Sewerage (STS) program, which provides increased subsidy for small towns (population less than 1000 persons). Mooney Mooney, Cheero Point and Little Wobby are on the government's priority list of 150 small towns eligible to receive subsidy under the program. The program is administered by the Department of Land & Water Conservation (DLWC) and is targeted at providing sewerage services to some 100,000 people in unsewered small communities throughout NSW. The need for sewerage services in these communities was identified by the increasing failure of existing on-site systems, public health risks linked to uncontrolled discharges of liquid wastes, and associated environmental impacts.

Subsidy under the STS program is subject to a number of conditions and requirements, including that Council investigate alternative low cost (affordable) options and implements the most cost effective and environmentally sound option. Low cost solutions rely on adopting standards, features and risks more appropriate to small towns. Capital cost savings of up to 30% have been estimated for low cost schemes in comparison to those adopting standards and features normally applied to large towns.

The availability of increased subsidy under the STS program (up to approximately 67%) has presented an opportunity for Council to proceed with project development. In addition, the NSW Government has extended its Priority Sewerage Program to several priority areas on the Central Coast, including Mooney Mooney, Cheero Point and Little Wobby, providing Council with additional financial support to improve sewerage services in these areas.

This report examines options for the provision of improved sewerage services to Mooney Mooney, Cheero Point and Little Wobby that would meet STS policy requirements.

The report presents the investigation work and findings to date, examines and defines feasible scheme options, and compares scheme options for consideration by community and other stakeholders. It is intended that this process will lead to identification and adoption of preferred sewerage scheme (or schemes) for Mooney Mooney, Cheero Point and Little Wobby that meet Government and stakeholder objectives and needs at an affordable price.

2 DESCRIPTION OF TOWNS & ENVIRONS

2.1 LOCATION

Mooney Mooney, Cheero Point and Little Wobby are small communities located on the southern boundary of Gosford City, on the northern side of the Hawkesbury River. A Locality Plan is at Figure 1.

Mooney Mooney is located on Mooney Mooney Creek, one kilometre north of its junction with the Hawkesbury River, adjacent the Sydney-Newcastle (F3) Freeway.

Cheero Point lies 1.5 kilometres north of Mooney Mooney, between the Pacific Highway and Mooney Mooney Creek.

Little Wobby is located on a narrow 1.5 km strip of land at the high tide mark of the Hawkesbury River, about one kilometre east of Dangar Island and west of the township of Patonga.

2.2 PHYSICAL ATTRIBUTES

2.2.1 Development

All three urban areas exhibit a mix of old style fibro cottages through to modern and substantial residences.

Mooney Mooney and Cheero Point

Mooney Mooney and Cheero Point are bounded by Mooney Mooney Creek, the Pacific Highway (including the F3 freeway) and Brisbane Water National Park.

The current populations at Mooney Mooney and Cheero Point are approximately 313 and 107 respectively (147 and 51 developed lots). The only industry in the area is oyster farming with a number of oyster leases located in the mouth of Mooney Mooney Creek and oyster depuration plants south of the Mooney Mooney township.

The Department of Community Services operates the Peat Island Hospital, which is close to Mooney Mooney. The Department is a significant landowner in the area and owns a number of residential properties as part of hospital infrastructure.

The communities are serviced by a primary school, a service station on the Pacific Highway, and a licensed club.

Little Wobby

The permanent population at Little Wobby is approximately 65 (63 dwellings), which increases by over 50% during weekends and holiday periods. The dwellings have been constructed along a 1.5 km strip along the Hawkesbury River foreshore, near to, and sometimes over, the mean high tide mark. All the residences have associated jetties (boat access only is available), some have boatsheds and a small number have swimming pools.

The land rises very steeply at the rear of the properties. Public access along the foreshore is provided by a meandering footway that runs either on crown land (the water side of the mean high tide), along the front or rear of private residences or, at times, underneath / through private residences. There are no retail outlets; Miss Piggy Crane Barges operates from a jetty at one of the residences. Public access is via a regular ferry service that links Little Wobby and other remote townships on the Hawkesbury River to Brooklyn.

The urban strip backs onto land owned by the Department of Sport and Recreation as part of its Broken Bay Sport and Recreation Centre. This land adjoins the Brisbane Water National Park and, in character, is indistinguishable from the Park.

2.2.2 Geography

The three urban areas are located within the Hawkesbury landscape that typically consists of rugged, rolling to very steep hills on Hawkesbury sandstone. The Hawkesbury sandstone consists of medium to course quartz sandstone with minor shale and laminate lenses that make up the distinctive escarpment landforms (Chapman & Murphy 1989).

The topography at Mooney Mooney and Cheero Point is hilly with slopes varying from moderate to very steep. Properties slope towards the waterfront. Soils generally consist of coarse, sandy loams of variable depth. Rock is at shallow depth and outcrops are numerous, particularly on the steeper slopes and rises. Mangrove swamps are evident along the foreshore of Mooney Mooney Bay and Sunshine Bay at Cheero Point.

At Little Wobby the land falls very steeply from the escarpment above the residences along the Hawkesbury River foreshore. Residences have been constructed along a rocky ledge with some excavation and filling behind retaining walls providing levelled areas for dwelling construction. Immediately beyond the jetties the river depth increases sharply, to in excess of 20 m.

2.2.3 Climate

The climate in the study area is temperate. Average annual rainfall is 1231 mm and evaporation 1198 mm (Bureau of Meteorology, Peats Ridge Station, 1981-2002).

Table 2.1: Average Rainfall and Evaporation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm)	127	143	150	137	106	81	74	92	73	114	89	89	1231
Evaporation (mm)	143	120	107	80	57	48	53	78	101	128	150	150	1198

Source: Bureau of Meteorology. Rainfall 1981-2002 at Peats Ridge Station;

Peats Ridge is located approximately 30 kms north and slightly inland of the study area. Consequently, it is likely that rainfall will be marginally higher and evaporation lower in the study area.

Rainfall averages 1231 mm per annum with the wetter months from January to May. The wettest year in the last 20 years (excluding 1988 due to incomplete data) was 1990 with 2186 mm and the driest 1991 with 846 mm (evaporation 1202 mm and 1447 mm respectively).

2.2.4 Utility Services

Roads in Mooney Mooney and Cheero Point are tar sealed mostly without kerb and gutter, there are no piped stormwater systems. There are no roads at Little Wobby; boat access only is available. All three areas are serviced by above-ground electricity and telephone. There is no reticulated gas service.

Mooney Mooney and Cheero Point have reticulated water supply provided by Gosford City Council using bulk potable water supplied by Sydney Water Corporation (SWC) via a pipeline over the Hawkesbury River road bridge. Water services to individual properties are metered.

Little Wobby does not have a potable water supply; property owners rely on rainwater tank(s) for their water needs.

Apart from the area serviced by the Peat Island Sewerage Scheme (refer Section 2.4), all urban areas have on-site sewerage systems.

2.3 ENVIRONMENT

2.3.1 Hawkesbury River

The Hawkesbury-Nepean River forms one of the largest coastal drainage basins in NSW with a catchment area of 22,500 square kilometres. Mooney Mooney Creek discharges into the lower Hawkesbury River, immediately east of the Pacific Highway road bridge. In the region of the Mooney Mooney, Cheero Point and Little Wobby the river is estuarine and is controlled by the tidal regime and base flow from the catchment.

The “Independent Inquiry into the Hawkesbury Nepean River System” (Healthy Rivers Commission (HRC), 1998) provides a comprehensive examination of river health, water flows and water quality. Although the upper (western) section of the river has high levels of nutrients, high turbidity / suspended solids and varying bacterial levels, the lower (eastern) section is generally more healthy, with ecosystems and aquatic life less impacted by urban development.

The HRC report identifies a number of water quality issues in the catchment, with on-site sewerage facilities adjacent to waterways being one of the major sources of excessive nutrients.

The "Environmental Impact Statement for Brooklyn and Dangar Island: Priority Sewerage Program" (Sydney Water Corporation, March 2000) noted that water quality in the vicinity of Brooklyn and Dangar Island is being adversely affected by drainage from urbanised areas, in particular nutrient levels and faecal coliform concentrations. Investigations for the EIS identified existing on-site sewage management practices contributed to the decrease in water quality. Waterways downstream of urban areas were not suitable for secondary recreation and posed a health risk.

Similar impacts on water quality as identified in the Brooklyn - Dangar Island EIS can be expected at Mooney Mooney, Cheero Point and Little Wobby, albeit to a lesser degree due to the smaller urban areas.

Water quality monitoring of the Hawkesbury River in the vicinity of Mooney Mooney by Hornsby Shire Council (Annual Water Quality Report – 2000/01, Sites 70, 71) shows the presence of faecal coliforms, but generally at low levels.

2.3.2 Vegetation

The area is characterised by the dense dry sclerophyll forests that generally extend from the top of the escarpments to the river. Except for the southern end of Mooney Mooney, clearing of land has been confined to that required to accommodate residential development and associated services.

There are no designated (SEPP 14) wetlands within or near to the urban areas, although wetland areas exist along the foreshores at both Mooney Mooney and Cheero Point.

2.3.3 Land Uses

At Mooney Mooney and Cheero Point land uses are limited to the major roadways (F3 Freeway and Pacific Highway), Peat Island Hospital and residential development. Brisbane Water National Park occupies significant areas to the west and north of the urban areas.

Land use at Little Wobby is limited to residential development along the foreshore. Land associated with the Broken Bay Sport and Recreation Centre adjoins Little Wobby and extends east to Broken Bay / Patonga Creek, and north to Brisbane Water National Park.

Other than oyster farming there are no industries in the area.

2.4 PEAT ISLAND SEWERAGE SCHEME

The Department of Community Services (DOCS) owns and operates the Peat Island Sewerage Scheme, which dates from the mid-1960's. It serves development south of the Mooney Mooney urban area including DOCS facilities (hospital, laundry, depot etc), the licensed club, public school, oyster depuration depot, and approximately 30 residences owned by DOCS.

The collection system comprises gravity sewers and 5 pumping stations. A small trickling filter treatment plant, located on the western foreshore of the Hawkesbury River, comprises:

- Primary sedimentation tank
- Rotating biological filter
- Clarifier (humus tank)
- Chlorine dosing of effluent
- Digester and drying beds for biosolids treatment

Disinfected secondary quality effluent (no nutrient reduction) is discharged at Hawkesbury River foreshore at Deerubbun Reserve, west of the F3 road bridge.

Operating records show typical daily flow in the range 160 kL/d to 170 kL/d, equivalent to 760 – 810 EP at 210 L/EP/d. Wet weather impacts appear to be minimal.

The plant and discharge are licensed by the EPA. There is no current pollution reduction program or other plans to upgrade the treatment facility and/or improve effluent quality. SWC has discussed with DOCS the possible replacement of the treatment plant and effluent discharge with new facilities as part of a combined Peat Island-Brooklyn-Dangar Island scheme (refer also Section 3.2.5).

3 SEWERAGE NEEDS & CONSULTATIONS

3.1 EXISTING SEWERAGE SERVICES AND PROBLEMS

There are approximately 260 developed lots at Mooney Mooney, Cheero Point and Little Wobby. Existing sewerage services comprise on-site systems, the vast majority being septic tank–based systems mostly with transpiration trenches / beds and a few with a pump-out service (Mooney Mooney only). A small number of Aerated Wastewater Treatment Systems (AWTS) with associated irrigation areas exist in each community.

Problems with on-site systems in urban communities such as these are well-documented and include:

- Public health risks;
- Persistently wet and boggy ground conditions;
- Effluent runoff onto adjoining properties and watercourses, particularly during wet periods;
- Odours, particularly from septic tank based systems;
- Contamination of groundwaters;
- Contamination and pollution of waterways and the environment generally.

Problems generally result from:

- Increasing urbanisation;
- Insufficient land area to satisfactorily accommodate the volume of wastewater generated by households given the climate and ground conditions. Department of Health (DOH) guidelines advocate a minimum lot area of 4,000 m^2 for on-site systems for single households;
- Inappropriate and/or inadequate systems, many of which have exceeded their "use-by" date (particularly older absorption and transpiration areas) and/or have not been properly maintained.

Earlier studies such as the the HRC inquiry into the Hawkesbury Nepean River System (HRC, 1998) and the EIS for Brooklyn / Dangar Island (SWC, 2000) identified the need to correct deficiencies with existing systems (refer Section 2.3.1).

The priority listing of the towns on the NSW Government's STS program followed assessment of the existing situation by regulatory authorities, including the Environment Protection Authority (EPA), DOH, Department of Planning (DOP), DLWC and Council. The assessment concluded that Mooney Mooney, Cheero Point and Little Wobby were in priority need of assistance to deal with the deficiencies and problems caused by existing systems.

3.2 STAKEHOLDERS & COMMUNITY CONSULTATION

3.2.1 Consultation Generally

The following consultations have been undertaken during the course of investigations:

- Community consultations in accordance with a Community Consultation Program undertaken by Council at commencement of the Options Study (refer Section 3.2.3);
- Planning Focus Meeting held in July 2002 and attended by key government and other stakeholders (refer Section 3.2.4); and
- Direct consultation with stakeholders on specific issues.

3.2.2 Key Stakeholders

The stakeholders with significant interest and/or responsibility in the provision of sewerage services to Mooney Mooney, Cheero Point and Little Wobby are:

Stakeholder	Area of Interest / Responsibility
Gosford City Council	Funding partner; local government and water authority; owner and operator of community sewerage assets; responsible for ensuring performance of on-site sewerage systems.
Department of Land & Water Conservation	Funding partner; NSW government land and water resource manager.
Mooney Mooney, Cheero Point & Little Wobby Communities	Recipients of any improved sewerage services and benefits; ratepayers.
Oyster Farmers Association of NSW, Hawkesbury River Branch	Oyster industry representative
Hawkesbury River Shellfish Quality Assurance Program	Oyster and other shellfish quality monitoring
Environment Protection Authority	Government environment regulator; licensee for discharges to the environment.
Department of Health	Government regulator and health advisor
Department of Community Services	Owner / operator of Peat Island Sewerage Scheme; major landowner at Mooney Mooney.
Department of Sport & Recreation	Major land owner and manager Broken Bay Sport & Recreation Centre
Hornsby Shire Council	Local Government authority on southern side of Hawkesbury River
Sydney Water Corporation	Water authority south of the Hawkesbury River.
National Parks & Wildlife Service	Government agency managing National Parks; regulator for aboriginal heritage and flora / fauna.

3.2.3 Community Consultation

Council has implemented a Community Consultation Program (EKA, June 2002) that is running in parallel with the Options Study phase of the project. The Program includes:

- Consultation with local community groups, in particular the Mooney-Cheero Progress Association (MCPA) and the Wobby Environment Protection Association (WEPA), and community members as required;
- Preparation and distribution of Newsletters at key project milestones;
- Planning Focus Meeting with key stakeholders (refer Section 3.2.4);
- Preparation and distribution of a Scheme Options Brochure at the completion of this Options Report; and
- Holding of a community Open Day to disseminate information on scheme Options and facilitate community input and feedback.

Community consultations will continue through subsequent option selection, development and implementation phases of the project.

3.2.4 Planning Focus Meeting

A Planning Focus Meeting was held on 24 July 2002 at Mooney Mooney. The meeting assembled key stakeholders with the objective of identifying statutory, functional and other constraints and requirements that would need to be considered in the development of sewerage scheme options for Mooney Mooney, Cheero Point and Little Wobby.

Representatives from Council, DLWC, each community (MCPA, WEPA), Oyster Farmers Association, Hawkesbury River SQAP, EPA, SWC, Hornsby Shire Council and EKA participated; representatives from DOH and DOCS were unable to attend. A member of the Brooklyn Ratepayers Association attended as an observer.

The major outcomes from discussions at the Meeting were:

a) Community perspectives:

- Cost is important in all communities; affordability varies considerably within the communities.
- The effectiveness of existing systems varies; some are old and not working properly while some are new and represent a significant investment to the owners.
- Health of the river is a major consideration. There are concerns about the impacts of existing systems on the river.
- The Mooney Mooney and Cheero Point communities want a reticulated sewerage system.

b) On-site systems:

- Although there were some larger lots at Mooney Mooney, generally lot sizes were not suitable for on-site effluent disposal.
- Most lots at Mooney Mooney and Cheero Point and all lots at Little Wobby are classified as “high risk” by GCC under its OSMS policy. Council uses a number of factors in its “high risk” classification, including proximity to water used for recreational purposes (within 100m) and proximity to an oyster lease (within 250m).

- A septic pump out option is not acceptable to the Mooney Mooney and Cheero Point communities. This option was canvassed within the communities a few years ago.

c) Collection Systems:

- Features of pressure type collection systems were discussed as these are likely to be the only viable systems for Mooney Mooney and Little Wobby due to site and ground conditions.

d) SWC proposals for Brooklyn-Dangar Island:

- An EIS for a proposed scheme with a treatment plant at Brooklyn was put on public display (in 2000);
- Objections had been received from Hornsby Shire Council and sections of Dangar Island;
- SWC was now considering a pressure collection system for Dangar Island (gravity previously proposed);
- SWC was also investigating siting a new treatment plant adjacent the existing Peat Island facility - a treatment plant sited at Brooklyn was no longer an option. However, transfer to Hornsby Heights STP remains an option;
- There has been some consultation with the DOCS; DOCS has indicated it would be agreeable to SWC taking over the existing facility.

As far as Mooney Mooney and Cheero Point are concerned, options involving SWC (ie. Brooklyn and Dangar Island) are limited to a common treatment facility, located at Mooney Mooney, and effluent management.

For combined SWC – GCC treatment / effluent management, capital and operating costs would be subject to a share agreement. Regardless of which authority owns/operates the treatment plant, property owners will be rated by their respective water authority ie. Council in the case of Mooney Mooney and Cheero Point. Collection and transfer systems to the treatment plant would be owned and operated by each authority within its area of operation.

e) Effluent Management:

- Generally, on-site systems do not meet water quality standards for direct discharge to the river. Some aerated systems can reduce nitrogen levels but not phosphorous.
- For Options Study purposes, typical effluent quality adopted for 'P' class waters in NSW is proposed. EPA would require risk assessment supported by dispersion study.
- There has been no water quality monitoring carried out at Little Wobby. Some pre-discharge monitoring may be required.
- The existing effluent discharge for the Peat Island Scheme is considered to be unsatisfactory.
- Oyster farming is a major industry in the Hawkesbury River estuary. Oyster industry representatives noted that the volumes of proposed discharges to the Hawkesbury River were negligible in comparison to the large volume changes with each tide plus catchment base flow, even in Mooney Mooney Creek.

The SQAP monitors water quality at 17 sites; water quality is high. Oyster depuration ceases when freshes occur (rainfall > 50 mm over 2 days).

- The oyster farming industry has no major objections or concerns with release of a relatively small volume, high quality discharge into the main channel of the Hawkesbury River at the road bridge or at Little Wobby.

f) Sewage Treatment:

- Publicly owned land / reserve is preferred eg. adjacent existing plant at Mooney Mooney (DOCS land) or public / crown reserves nearby. Future development proposals by DOCS need to be identified and considered.
- At Little Wobby, the site of the old Sport & Recreation Centre at the south end of the urban strip is a potential site.
- NSW guidelines promote a minimum buffer of 400 metres. If the buffer zone is less then the plant design may need extra provisions for noise and odour control.
- Volumes of bio-solids do not justify on-site processing for small plants. Storage and periodic transfer to a larger processing plant (eg. Hornsby Heights or Kincumber) is the most economic option.
- Bio-solids are not suitable for disposal to the river.

Project funding, subsidies and Council rates were also discussed; these are matters for the relevant authorities and beyond the scope of this Report.

3.2.5 Consultation with DOCS re Peat Island Sewerage Scheme

Following the Planning Focus Meeting, discussions were held with DOCS regarding the Peat Island Sewerage Scheme and associated matters:

- NSW Government has earmarked Peat Island Hospital for closure as it is no longer considered suitable accommodation. There are 85 patients at the hospital currently. The timing of the closure is not known.
- DOCS would cooperate with any rationalisation of sewerage services in the area. It would prefer not to own / operate sewerage services.
- Development of a combined treatment facility for DOCS facilities and Mooney-Cheero would need to provide sufficient capacity to meet DOCS future (but currently undefined) needs.
- Capacity for DOCS in any common STP would need to at least provide for existing load plus hospital capacity no longer utilised. Original hospital capacity is not known, but was indicated at possibly 300-400 patients.

Details regarding the existing Peat Island Sewerage Scheme are provided in Section 2.4.

3.3 SEWERAGE SCHEME OBJECTIVES

Based on consultations to date and regulatory requirements, the objectives of sewerage schemes for Mooney Mooney, Cheero Point and Little Wobby can be summarised as follows:

- Affordable to the communities;

- Meet the governments STS program requirements to maximise financial assistance;
- Provide a long-term, environmentally acceptable and sustainable scheme;
- Service existing and future development;
- Satisfy regulatory requirements;
- Meet community expectations for levels of service including reduced health risks, boggy ground, odours, pollution and general amenity.

4 DEVELOPMENT & LOAD PROJECTIONS

4.1 GENERAL

Sewerage schemes for the three towns will need to serve existing and future populations and development. This Section of the report examines past, present and forecast populations and development at Mooney Mooney, Cheero Point and Little Wobby and the respective sewer loads that will need to be serviced.

The proposed service areas cover the zoned urban areas only – refer Figures 2, 4 and 6. No future expansion of the urban areas is expected and has not been allowed for in development forecasts.

4.2 MOONEY MOONEY

4.2.1 Census Data

The census data for the Mooney Mooney locality / Collector District (CD) includes the Peat Island facilities. Data for private dwellings is shown in Table 4.1.

Table 4.1 Census Data – Mooney Mooney CD

Year	Dwellings	Unoccupied	Population	Occupancy
1996	184	28	390	2.12
2001	190	23	398	2.10

Three flats attached to a house were recorded in the 2001 census.

Of the 190 dwellings in 2001, approximately 40 are located within the service area of the Peat Island Sewerage Scheme.

4.2.2 Existing Development

The land is zoned 2(a) Residential. Currently (June 2002) there are 147 developed lots within the proposed service (unsewered) area and one vacant ie. total 148 lots. The total number of dwellings is estimated at 150 (149 ET), including the three flats shown in the 2001 census.

4.2.3 Future Development

Future growth is limited to higher density development of existing residential lots. It is likely that some subdivision of larger lots and dual occupancy development will occur (minimum lot size is 550 m^2), particularly if reticulated sewerage becomes available.

Allowing subdivision of 25% of lots (148 x 1.25 = 185 lots) and dual occupancy on 20% of the remainder (111 x 0.2 = 22 lots), the total number of dwellings could reach 207 (163 + 2 x 22), or 192 ET (163 + 2 x 22 x 0.67).

Average occupancy may decrease with increased dual occupancy, however the proportion of vacant properties is likely to fall. Hence no significant change to overall occupancy is expected.

4.2.4 Summary for Service Area

The existing and future development at Mooney Mooney is shown in Table 4.2.

Table 4.2 Development Forecast – Mooney Mooney

Year	Lots	Dwellings	ET	Occupancy	EP
2002	148	150	149	2.10	313
Future	185	207	192	2.10	403 Say 400

4.3 CHEERO POINT

4.3.1 Census Data

Cheero Point is not separately listed by the census; the relevant Collector District covers a large area with Cheero Point representing only some 25% of the total dwellings in the District. Consequently, occupancy data for Mooney Mooney has been used in estimating populations at Cheero Point.

4.3.2 Existing Development

The land is zoned 7(c6) Scenic Protection – Residential. Currently (June 2002) there are 51 dwellings and 75 lots in the service area.

Note: The proposed service area excludes lots owned by RTA adjoining the Pacific Highway in Cheero Point Rd and lots owned by Council in Cararma Parkway and Cheero Point Rd, also adjoining the Pacific Highway. These lots are not expected to be developed due to severe slopes - a landslip has occurred over part of the RTA land and has been fenced-off.

4.3.3 Future Development

Although there is no minimum lot size, the potential for subdivision is limited by existing lot sizes (many are relatively small) and steep topography. Future growth has been assumed to be limited to infill and low level of subdivision and/or dual occupancy.

Allowing for development of all vacant lots, 10% subdivision (total 82 lots) and 10% dual occupancy, the total number of dwellings is estimated to reach 90 (= 82 + 8) ultimately, or 85 ET (82 x 0.9 + 82 x 0.1 x 2 x 0.67).

Occupancy as for Mooney Mooney (2.1 persons / ET) has been assumed.

4.3.4 Summary for Service Area

The existing and future development at Cheero Point is shown in Table 4.3.

Table 4.3 Development Forecast – Cheero Point

Year	Lots	Dwellings	ET	Occupancy	EP
2002	75	51	51	2.10	107
Future	83	90	85	2.10	179 Say 180

4.4 LITTLE WOBBY

4.4.1 Existing Population and Development

Little Wobby is not separately listed by the census. Approximate population estimates by WEPA indicate a permanent population of approximately 60 - 65, rising at weekends and holiday periods to 110 - 115.

The land is zoned 7(c6) Scenic Protection – Residential. As at June 2002 there were 63 dwellings occupying 64 lots. Vacant lots number 20, of which the former Sport and Recreation Centre at the southern end occupied 7.

The occupancy ratio at 1.0 is very low, representative of many dwellings used for holidays / weekends only.

4.4.2 Future Development

Most of the vacant lots have significant limitations for development – very steep slope, restricted area for development etc. For purposes of the Options study, it has been assumed that 50% of the 20 vacant lots will ultimately be developed. No dual occupancy or subdivision is expected due to severe site limitations.

Average weekday occupancy may rise gradually with increasing urbanisation generally.

4.4.3 Summary for Service Area

The existing and future development within the proposed service area at Little Wobby is shown in Table 4.4.

Table 4.4 Development Forecast – Little Wobby

Year	Lots	Dwellings	ET	Occupancy	EP	
					Permanent	Peak
2002	84	63	63	1.0 (1.75 peak)	63	110
Future	84	73	73	1.2 (1.75 peak)	88 Say 90	128 Say 130

4.5 SEWER SYSTEM LOADS

Mooney Mooney and Cheero Point have reticulated water supply; Little Wobby is serviced by rainwater tanks. For Little Wobby, sewer loads have been estimated both with and without reticulated water supply.

Per capita design loads adopted are as follows:

- With reticulated water supply: 210 L/EP/d
- Without reticulated water supply: 50 L/EP/d

Based on the population estimates above, the estimated sewage loads from each of the urban localities is shown in Table 4.5.

Table 4.5 Sewage Load Estimates

Service Area	Existing Development			Future Development		
	EP	ADWF (L/s)	ADWF (kL/d)	EP	ADWF (L/s)	ADWF (kL/d)
Mooney Mooney	313	0.76	66	400	0.97	84
Cheero Point	107	0.26	22	180	0.44	38
Little Wobby:						
a) Without potable water supply:						
Permanent	63	0.036	3.2	90	0.052	4.5
Peak	110	0.064	5.5	130	0.075	6.5
b) With potable water supply:						
Permanent	63	0.15	13	90	0.22	19
Peak	110	0.27	23	130	0.32	27

5 STRATEGIC SEWERAGE OPTIONS

5.1 REGIONAL CONTEXT

Existing sewerage services in the region comprise (refer Fig. 1):

- The Gosford Regional Sewerage Scheme, which extends south to Patonga.
- The existing Peat Island Sewerage Scheme (owned and operated by DOCS) which serves the Peat Island Hospital and associated facilities / staff housing, the Mooney Workers Club and the Mooney Public School.
- On-site systems elsewhere, including the Broken Bay Sport & Recreation Centre.

SWC is currently investigating options for serving Brooklyn and Dangar Island with a reticulated sewerage scheme.

5.2 COMBINED VS SEPARATE SCHEMES

Due to their close proximity (< 2 km by road) Mooney Mooney and Cheero Point can be serviced by a common scheme (ie. combined treatment and effluent management). This is more cost effective than separate schemes for these localities.

The distance, rugged topography and sensitive natural features that separate Little Wobby from Mooney Mooney and Cheero Point (Mooney Mooney Creek, Mullet Creek, Brisbane Water National Park) preclude development of a sewerage scheme with a central treatment facility and common effluent management serving all three communities.

5.3 RANGE OF OPTIONS

Within the above constraints and context, the broad options for sewerage services are:

Mooney Mooney and Cheero Point:

- Do Nothing ie. retain and manage on-site systems
- Local (independent) scheme
- Combine with Peat Island Scheme
- Combine with both Peat Island and Brooklyn / Dangar Island

Little Wobby:

- Do Nothing ie. retain and manage on-site systems
- Local (independent) scheme
- Connect to Gosford Regional Sewerage Scheme at Patonga
- Connect to future Brooklyn-Dangar Island sewerage scheme at Dangar Island

A further consideration for a local scheme for Little Wobby is the possible future provision of a reticulated water supply. Current wastewater volumes are estimated at 25% of those that would occur if a reticulated water supply were provided. Consequently, an opportunity exists to install a centralised (community) effluent pump-out service until a reticulated water supply becomes available.

This option is considered in conjunction with all others in subsequent Sections of this Report.

5.4 ON-SITE AND OFF-SITE TREATMENT OPTIONS

Within the range of options identified above (Section 5.3), opportunity exists to retain the use of existing on-site treatment units (septic tanks, AWTS). The intent of such schemes is to maximise the use of existing facilities and, if possible, reduce off-site treatment requirements.

The retention of on-site treatment units is of benefit where the cost of operation and maintenance of on-site units is compensated by savings in the off-site treatment costs (capital and operation). Maximum savings are achieved under the local scheme options (ie. those with a local treatment plant) identified in Section 5.3; lesser savings are available under options associated with the Gosford Regional Sewerage Scheme, Peat Island Sewerage Scheme or the future Brooklyn / Dangar Island scheme which provide, or will provide, for treatment of untreated (raw) sewage.

5.5 SCHEME COMPONENTS

The major components of all schemes are:

- Collection system: connects all properties via a network of pipes and fixtures and transports the collected wastewater to a single site.
- Transfer system: transfers wastewater to downstream catchment or treatment facility. A separate transfer system may or may not be required, depending on individual scheme arrangement.
- Treatment Plant: treats wastewater to required standard.
- Effluent Management System: returns treated effluent to water cycle.

The alternatives available within each of these scheme components are examined in detail in subsequent sections of this report. As the effluent quality needs to be determined before addressing treatment requirements, discussion of effluent management options precedes treatment.

6 RETENTION OF ON-SITE SYSTEMS

6.1 GENERAL

Typical systems currently in use in the study area are septic tanks with soil absorption and/or transpiration system and a relatively small number of AWTS with surface or sub-surface irrigation.

A small number of waterless systems (such as composting toilets) are understood to exist at Little Wobby.

Pump-out services are available at Mooney Mooney and Cheero Point and have been increasingly required for new developments.

However, the reliance on pump-out services is not considered a long-term solution for the Mooney Mooney and Cheero Point. The communities have previously rejected this as an option.

At Little Wobby, where boat access only is available, the cost of installing individual effluent storage tanks that rely on a regular pump out service is not considered a satisfactory long-term solution to current problems.

6.2 REGULATORY CONTEXT

6.2.1 Legislation

Key legislation affecting on-site sewage management systems includes:

Local Government Act (1993):

- Local councils have responsibility for performance standards, approval and operation of on-site sewage management systems. This includes site assessment and suitability of a particular site for on-site sewage management.

- The DOH has responsibility for “treatment devices” that can be used on-site (eg. AWTS, septic tanks). An accreditation system exists for manufacturers of treatment devices.

Protection of the Environment Operations (POEO) Act (1997):

The objective of the Act, inter alia, is to prevent pollution and protect, restore and enhance the quality of the environment. The local authority responsible for the performance and operation of on-site systems, in this case Council, can issue notices (eg. to clean-up, prevent pollution) and fines for pollution offences.

Under the Act, a person must not pollute or cause or permit pollution of waters unless that activity is regulated and/or licensed by the relevant authority. Heavy penalties (up to $120,000 for individuals; $60,000 for continuing offence) apply.

As the relevant regulatory authority, Council may also be subject to offences and penalties under the Act if it fails to carry out its responsibilities in the management and operation of on-site systems.

6.2.2 Performance Standards for On-Site Systems

The NSW Government has developed environmental and health protection guidelines for "On-Site Sewage Management for Single Households" (1998) (OSM Guidelines). The guidelines were developed to assist local councils, householders, developers and others in the assessment, regulation, selection, design, installation, operation and maintenance of on-site management systems.

The OSM Guidelines are referenced in the Local Government (Approvals) Amendment (Sewage Management) Regulation 1998 relating to Council's obligation to consider the Guidelines when approving the installation, alteration, construction and operation of on-site sewage management systems.

The performance objectives specified in the guidelines that need to be met are:

- Prevention of public health risk;
- Protection of the environment (lands, surface waters, groundwaters, conservation and reuse of resources); and
- Protection of community amenity (quality of life, aesthetics, odour, noise etc).

These objectives may be achieved by various means; the OSM Guidelines provide management and technical guidelines to this end.

6.3 ON-SITE SEWAGE MANAGEMENT STRATEGY (OSMS)

Council's draft OSMS provides the framework for implementation of the regulatory requirements including the risk assessment and management of on-site systems in the Gosford City Council local government area. Risk assessment is based on both area and individual systems; licences for operation reflect the risk profile for the property and system concerned.

a) Risk Assessment of Areas

Areas are categorised as either High or Low risk. High risk areas are those that lie:

- Within 100 m of water used for recreational purposes
- Within 1/20 year flood level
- Within 250 m of a domestic groundwater supply
- Within 250 m of an oyster lease
- Within 40 m of drainage channels, stormwater lines etc which discharge within 250 m of recreational water or oyster lease

All other areas are categorised as Low risk.

The service areas under study are categorised High risk.

b*) Risk Assessment of OSM Systems*

Individual systems are categorised as either Low, Medium or High risk. The categorisation is based on the following factors:

- Environmental sensitivity of the lot
- Type and capacity of the system

- Allotment size and available disposal area
- Soil features including depth of soil and its permeability
- Number of persons residing on the allotment
- Slope of irrigation and disposal area
- Aspect and duration of exposure to sunlight

Currently, Low risk OSM systems are issued with a 5-year operating approval, Medium risk 3-year and High risk 1-year.

The current status of systems for which risk assessment has been completed and operating approval granted is shown in Table 6.1.

Table 6.1 Current Risk Assessment of OSM Systems

	Mooney Mooney	Cheero Point	Little Wobby	Total
Area Risk Category	High	High	High	
Individual System Assessment:				
OSM approvals (no.)	116	17	44	177
High risk (no.)	9	1	1	11
Medium risk (no.)	37	5	8	50
Low risk (no.)	70	11	35	116

A pollution monitoring program in High risk areas also forms part of Councils OSMS. Given the findings of the SWC Study and HSC monitoring (refer Section 2.3.1) it is likely that an increasing number of on-site systems will be assessed in future as High risk.

6.4 CONCLUSIONS

The High risk categorisation of the urban areas combined with a significant proportion of on-site systems assessed as either High or Medium risk (34%) indicates that the cumulative impacts resulting from on-site disposal of effluent are unlikely to be sustainable in the longer term in the urban areas of Mooney Mooney, Cheero Point and Little Wobby.

In the absence of a collection system that removes the need for on-site effluent disposal, it is expected that properties will increasingly be required to install a pump-out service.

7 COLLECTION SYSTEM OPTIONS

7.1 GENERAL

For scheme options requiring the collection and transport of partly treated effluent or untreated sewage from individual properties, a number of lower cost options are available. These can be considered under the following categories:

- Gravity based
- Vacuum
- Pressure (or pumped) systems

This Section of the report examines the relative merits of these options for Mooney Mooney, Cheero Point and Little Wobby.

7.2 DESCRIPTION OF OPTIONS

Gravity based collection systems have been the most widely used in the past. This has been primarily due to the absence of alternate competitive technologies. Over the last 20 to 30 years, however, the appearance of vacuum and grinder pump (pressure) systems has provided greater opportunity to optimise systems and costs to suit particular localities.

a) Gravity Systems

These comprise sewer pipe networks graded with sufficient fall to allow untreated sewage or effluent to flow to low points in the catchment. From here the collected flow is pumped to an adjoining or downstream catchment or directly to a treatment facility. Sewer mains are typically 150 mm diameter and larger, depending on the number of properties connected.

A property connection comprises an 80 / 100 mm drain from the household plumbing (sewage collection) or septic tank/AWTS (for effluent collection system).

The standards and design criteria for gravity systems have been developed over many years, generally to suit larger towns and cities, where the economies of scale have made sewerage schemes affordable. The cost of providing sewerage schemes with these systems in smaller towns has, however been relatively high on a per property basis.

Modified Conventional Gravity (MCG) systems have been recently developed for use in smaller towns to reduce costs. The key features adopted in MCG systems include:

- Use of small lift type pump stations (single pump only) to reduce sewer depth;
- Replacement of concrete access chambers (or manholes) with small diameter maintenance access shafts which still allow use of cleaning and video inspection equipment;
- Increased separation between access points to suit modern inspection and cleaning equipment;

- Use of lower allowances for extraneous inflows reflecting the improved pipe materials and jointing systems available;
- To a lesser extent, use of flatter grades.

Although capital costs are reduced, MCG systems may incur higher operation and maintenance costs than conventional gravity systems due to additional pumping and potential for increased failures and blockages.

Only MCG type gravity systems have been considered in this Report.

Note: The STS guidelines specifically exclude conventional gravity based collection systems from consideration as a low cost option.

Systems collecting septic effluent, known as Common Effluent Drainage (CED), can utilise flatter graded pipes than MCG as the solids content in the effluent is far less than in sewage. However, other features are similar to MCG.

Note: For purposes of this Report, septic effluent refers to effluent collected from on-site treatment units, either septic tanks or AWTS. As septic tank systems are the dominant on-site treatment facility, most effluent collected would be primary treated septic effluent.

b) Vacuum Systems

An increasing number of these systems have been adopted in Australia since the 1970's. They comprise three key elements:

- A valve chamber into which the household sewer drain discharges. A vacuum valve in the chamber opens and closes depending on the water level in the chamber. Typically 2 to 4 house connections are made to each chamber.
- A pressure pipe network operating under vacuum and connecting all valve chambers to a vacuum pump station. Pipe diameters vary from about 65 mm to 200 mm depending on the number of premises connected. The network is constrained by vacuum pressure, limiting pipelines to a grade differential of approximately 5m. Hence these systems are suitable in flat areas where the vacuum mains can be kept at shallow depth.
- A vacuum pump station that provides the vacuum in the pipe network. A conventional pump station adjacent the vacuum station then pumps the collected sewage further downstream.

Vacuum systems are intended for collection of sewage only, not septic effluent. The vacuum valves are specifically designed to pass the solids in raw sewage. Hence there are no savings in collection system costs if septic effluent collection is proposed.

The operating cost of a vacuum system is relatively high due to energy requirements. The vacuum valves require periodic servicing, overhaul and replacement.

c) Pressure Systems

These rely on pumping either sewage or effluent from each property to a central facility (eg. transfer pump station, nearby treatment plant).

In the case of septic effluent, the collection system is known as a Septic Tank Effluent Pump (STEP) system. Where sewage is collected, grinder type pumps are used to macerate the solids into slurry that can be pumped through small diameter mains. These are also referred to as Grinder Pump (GP) systems.

In both cases the system comprises:

- A small pumping unit serving each household. The pump operates when water level in the pump well reaches a pre-determined level.
- A pressure pipe network connecting all pump units to the central facility. The pressure pipes range in size from about 40 mm diameter depending on the number of connections.

As for vacuum systems, the operating costs of pumped systems are relatively high due to the energy requirements. The pumps require periodic servicing, overhaul and eventual replacement.

The pump well size is variable, typical range 300 L to 1500 L, depending on consideration of a number of factors, including:

- Household water use;
- Response times for maintenance and repair;
- Reliability of power supply;
- Sensitivity of the environment to emergency discharges;
- Affordability

Typical per capita household wastewater volumes are in the range 150 L to 250 L per day where a reticulated water supply is available. At Mooney Mooney and Cheero Point, with occupancy at 2.1, average household wastewater load is estimated at 300 L to 500 L per day. At Little Wobby current water use is constrained by use of rainwater tanks.

For purposes of this Report, a standard 750 L pump well has been assumed in all cases. This would provide over a day's storage in the event of an extended power failure or similar problem. In the subsequent scheme development phase, more detailed consideration needs to be given to the pump well size that is acceptable to the community and regulators in the circumstances.

7.3 ASSESSMENT OF OPTIONS

7.3.1 General

There are many variables that affect the relative costs of the collection system options discussed above, the more crucial being:

- Topography including ground slopes, number of drainage catchments, groundwater levels, and depth to rock;
- Lot sizes and intensity of development.
- Construction difficulty and risks.

Additionally, comparative advantages and disadvantages apply in terms of operations, energy requirements, reliability and similar factors.

MCG systems are most cost effective in areas with gentle slopes (reduces sewer depth), a small number of catchments (reduces pumping), and with rock and groundwater below sewer levels. The shallower pressure and vacuum systems are competitive in areas with high water tables or with shallow rock.

Larger lot areas favour the vacuum and pressure systems since the pipe network required is usually less costly to construct on a per unit length basis than a graded gravity network. Equally, vacuum and pressure pipe networks can be accommodated more readily in highly developed areas eg. those with sealed roads, kerb and gutter, stormwater networks and well developed landscaping.

The options and merits of collection systems within each of the communities under study are discussed below.

7.3.2 Mooney Mooney

The urban area is located on the foreshores of Mooney Mooney Bay and on a rocky headland that extends into Mooney Mooney Creek. All lots face and fall to the waterways (refer Fig. 3).

- Lots along the Pacific Highway and opposite the school in Point Road have steep to very steep slopes with flatter areas bordering the wetland along the Mooney Mooney Bay shore.

- Lots in and adjacent to Mara Crescent have relatively gentle slope.
- The remaining lots, in Point Road north of Mara Crescent have steep to very steep slopes; the rocky headland rises over 20m from the waterfront.

Rock is extensively exposed on the steeper slopes and is visible at ground level along Point Road north of Mara Crescent.

The flatter area adjacent the Mooney Mooney Bay wetland remains heavily treed but many residents have cleared the undergrowth and established lawns.

Collection system options are limited by topography and site features:

- Gravity systems are not suitable for the Mara Crescent / Point Road headland area – construction of gravity sewers on the waterway (lower) side of existing residences is not possible. At Mara Crescent, gravity sewers could be constructed on the roadway side, but would have to be at substantial depth to permit property connection with consequent high costs, including property connection costs.

- A gravity sewer could be constructed adjacent the Mooney Mooney Bay foreshore to serve the properties fronting the Pacific Highway and nearby Point Road (approximately 50 properties). A pumping station would be required, located on the foreshore (private property) with access from Point Road – the necessary lands would need to be acquired.

  There are environmental considerations that need to be addressed – access to / from the foreshore for material deliveries and spoil disposal; disturbance to existing vegetation and landscaping; the likely presence of acid sulphate soils.

- A vacuum collection system is not suitable due to topographic constraints and site limitations.

- Pressure collection systems are suitable – all collection mains would be located in road reserves.

The collection system options for Mooney Mooney are thus:

(i) Pressure system, either GP or STEP (refer Fig. 2);

(ii) Part pressure (approximately 67%) and part gravity (approximately 33%) (refer Fig. 3).

7.3.3 Cheero Point

The urban area is located on the foreshores of Mooney Mooney Creek and Sunshine Bay. Apart from a few lots in Cararma Parkway all lots face and fall to the waterways (refer Figs. 4, 5).

Apart from 17 lots in Cheero Point Road between Milloo Parade and Cheero Point that have direct water frontage, all other lots have road reserves between the properties and the waterfront.

Most lots are steep to very steep, the exceptions being those in Cheero Point Road, between Cararma Parkway and Milloo Parade, and several at the Cheero Point Road end in Milloo Parade. The waterfront along Mooney Mooney Creek is very steep.

Rock is extensively exposed on the steeper slopes and is visible at ground level along Cheero Point Road to the rocky Cheero Point headland.

Mangroves line the foreshores of Sunshine Bay.

A vacuum system is not suited to the area due to grading constraints of the vacuum mains. Collection system options that are feasible are:

- Pressure collection systems are suitable – all collection mains would be located in road reserves (refer Figure 4).

- Gravity system comprising three catchments (refer Figure 5).

  Construction of a gravity sewer on the lower waterfront side of the properties that have waterfront access in Cheero Point Road is not feasible due to the steep rocky foreshore; a gravity sewer in Cheero Point Road should be able to serve most of the existing residences, however may restrict any future extensions and/or redevelopment. A few properties may require a pumped service to the sewer.

Both gravity and pressure collection systems have been assumed as suitable for Cheero Point.

7.3.4 Little Wobby

The urban area is located on a 1.5 km strip along the Hawkesbury River foreshore (refer Figs. 1 and 8). As described earlier, the land rises very steeply at the rear of the properties to over 100m above water level. Residences have been constructed on small excavated, reclaimed and/or filled areas behind retaining walls that serve to protect land and development from tidal and wave action.

The area is subject to slip; there is ample evidence of ground movements both at the rear of properties and along the waterfront.

The topography, ground conditions and nature of existing development present severe limitations and construction risks for collection systems. Access for machinery, material deliveries and working areas are significantly restricted. Insurance cover for public liability and construction risks is likely to attract a significant premium or may even be unavailable.

Assessment of the collection system options shows that:

- A gravity system would have to be constructed in the tidal zone by cut and cover excavation or by tunnelling. Several pumping stations would be required if sewers are to be kept at reasonable depth. The cost of such a collection system would be prohibitive and introduce significant problems for maintenance.
- Similarly, vacuum mains and valve chambers in a vacuum collection system would have to be located along the waterfront to permit the drainage of property connections.
- By contrast, a pressure collection system is not constrained by grading and property connections - the collection main can be located at the rear of properties and/or along the waterfront, below and/or above ground.

In the case of Little Wobby, access restrictions, ground conditions and construction risks dictate that most pipelines (40mm to 75mm diameter) would have to be located on or above-ground or at shallow (say 300 mm) depth. Excavations (mostly by hand) will need to be limited to essential items only eg. pump wells (approximately 1m diameter x 1.5m – 2m depth); in many cases these could also be installed above ground or partly inground.

A pressure collection system is considered the only feasible option for Little Wobby. The majority of pipelines (collection mains and property service connections) will have to be located at or above ground or at shallow depth. This introduces other unique problems that need to be considered and addressed in scheme development, designs and operations eg:

- Security of above-ground pipelines, given the susceptibility of the area to ground movements / slippage, damage from falling branches etc;
- Potential fire risks to above-ground mains;
- Responses and emergency procedures related to operational pipeline failures.

These and any other relevant issues will need to be satisfactorily resolved and risks minimised to an acceptable level if an affordable collection system is to be provided at Little Wobby.

7.3.5 Summary

Subject to detailed investigations the feasible collection system options for the communities are:

- Mooney Mooney: Pressure and part pressure / part gravity systems;
- Cheero Point: Pressure and gravity systems;
- Little Wobby: Pressure system provided construction and operating risks can be effectively managed.

Scheme options and cost estimates for the purposes of this Options Report have been prepared adopting these collection systems.

7.4 COLLECTION SYSTEM DETAILS

For estimating purposes, preliminary layouts and designs have been prepared for pressure collection systems at Mooney Mooney, Cheero Point and Little Wobby and also gravity collection at Cheero Point (Figures 2 to 6). Relevant details pertaining to each system are provided in Table 7.1.

Transfer systems connecting Cheero Point to Mooney Mooney and Mooney Mooney to the treatment plant, comprising a pumping station and associated pipeline, are not included; these are discussed in Section 10.

Table 7.1 Collection System Details

Collection System Type	Pressure			Gravity	Pressure & Gravity
Township	Mooney Mooney	Cheero Point	Little Wobby	Cheero Point	Mooney Mooney
Design Flows:					
ADWF (L/s)	0.97	0.44	0.32	0.44	0.97
Peak design flow (L/s)	3.9	1.8	1.3	3.3	5.0
Pressure collection mains:					
Length (m)	1,780	1,080	1,450		1200
Diameter (mm)	40 - 90	40 - 75	40 - 63		40 - 75
Gravity mains:					
Length (m)				1,100	530
Diameter (mm)				100 - 150	100 - 150
Catchment Pump Stations (no.)				2	
Rising Mains:					
Length (m)				360	
Diameter (mm)				50	

For the gravity system options, the hydraulic load includes a storm allowance of 0.025 L/s/lot to allow for loss in watertightness over time.

The gravity systems at Cheero Point require two catchment pump stations – at the northern end of Milloo Parade and the south-eastern end of Cheero Point Road (at Cheero Point). It is possible that some of the dwellings in Cheero Point Rd south of Milloo Parade may not be able to gravitate to a sewer in Cheero Point Road; these properties would have to pump to the sewer. It is not feasible to construct a lower level sewer along the waterfront due to the steep rocky terrain.

At Little Wobby, the pressure collection system size will be of similar capacity whether or not reticulated water supply is provided and under either STEP or GP options. Hydraulic designs are based on peak pumping rates and durations that remain similar under all options although wastewater volumes and thus total pump operating times, will increase if reticulated water supply is introduced.

8 EFFLUENT MANAGEMENT OPTIONS

8.1 MANAGEMENT OPTIONS

This Section of the report examines off-site effluent management options for Mooney Mooney, Cheero Point and Little Wobby. Treatment plant siting and performance requirements can then be matched to effluent management needs.

The broad options for effluent management include:

- Reuse ie. the application of effluent to beneficial use eg. non-potable urban reuse (for toilet flushing, external uses), watering of public areas etc;
- Land application eg. by soakage systems, irrigation and evaporation;
- Discharge to surface waters.

Effluent Reuse

Urban (non-potable) reuse is costly and therefore not appropriate for an affordable "low cost" sewerage scheme in towns with reticulated water supply ie. Mooney Mooney, Cheero Point. This does not preclude the future recycling of effluent through the towns.

There are no significant recreational or sporting facilities (eg. golf course) in or near Mooney Mooney, Cheero Point and Little Wobby that would benefit from reuse of treated effluent. The bowling club at Mooney Mooney may be able to reuse a relatively small volume (less than 2% of total effluent volume). No water-based industry exists in the vicinity.

At Little Wobby however, where there is presently no reticulated water supply, there may be an opportunity to recycle high quality effluent for non-potable uses (toilet flushing primarily). As such reuse could account for up to about 50% of total effluent available (without reticulated water supply), an additional management option is required to deal with the remainder.

Land Application

No suitable lands exist in close proximity to the communities to sustain land-based application of effluent. For Mooney-Cheero, an irrigation area of at least 10 Ha, and associated wet weather balancing storage, would be required for a reuse scheme based on irrigation of pasture.

Also, hilly topography, lack of suitable soils and unfavourable climate do not support the land application of effluent.

Discharge to Surface Waters

Discharge of high quality effluent to the Hawkesbury River estuary is considered the only feasible discharge option, subject to meeting various regulatory requirements and community expectations. Discharge to the Mooney Mooney Creek tributary, by comparison, affords no added benefits and is populated by numerous active oyster leases.

The EPA has a licensing role under the POEO Act for discharges to the environment. Licensing is mandatory for sewerage schemes with a discharge of more than 750 kL/d (or load greater than 2500 EP); water authorities may apply for a licence for smaller discharges / schemes. Discharges have to meet strict quality standards and controls.

Summary of Options

Subject to meeting environmental and regulatory requirements, discharge to the Hawkesbury River estuary offers the only practical, lowest cost effluent management option. No other local effluent management opportunities have been identified.

At Little Wobby, opportunity is available, subject to funding and community acceptance, to provide a reticulated supply of treated effluent for non-potable reuse in conjunction with a sewerage scheme – this is discussed in more detail in Section 8.6.

8.2 EFFLUENT VOLUMES

Estimated effluent volumes are shown in Table 8.1 and are based on the hydraulic loads shown in Table 4.5. The volume of effluent produced is only slightly less than the volume of sewage/effluent collected and treated - the difference is the (small) volume of biosolids (waste solids) removed during the treatment process. For investigation purposes sewage and effluent volumes are considered equal.

For the Peat Island Sewerage Scheme the existing load is estimated at 800 EP (refer Section 2.4) and future load at 1200 EP to allow for unused hospital capacity (refer Section 3.2.5).

For the Brooklyn-Dangar Island scheme, the existing load is estimated at 1350 EP based on data in the EIS (SWC, 2000); future load is 1542 (say 1550 EP).

Table 8.1 Estimated Effluent Volumes

	Mooney-Cheero			Little Wobby	
	Stand-alone Scheme	With Peat Is Scheme	With Brooklyn & Peat Is Schemes	Without Reticulated water supply	With reticulated water supply
ADWF (L/EP/d)	210	210	210	50	210
Existing Development					
Equivalent Population (EP)	420	1220	2570	82*	82*
Effluent volume (kL/d)^	88	256	540	4.1	17
Effluent volume (ML/a)^	32	94	197	1.5	6.3
Future Development					
Equivalent Population (EP)	580	1780	3330	106*	106*
Effluent volume (kL/d)^	122	374	699	5.3	22
Effluent volume (ML/a)^	44	136	255	1.9	8.1

** Average based on 150 peak load days; 215 non-peak days (refer Table 4.5)*
^ No allowance for extraneous inflows

8.3 EFFLUENT QUALITY FOR RIVER DISCHARGE

The HRC inquiry (final report 1998) sets water quality goals and strategies for delivering improvements to the Hawkesbury-Nepean River System. The regional values for the estuarine section of the river are:

- Healthy Waters: protection of aquatic ecosystems and human consumers of fish, crustaceans and shellfish;
- Recreation: protection of visual amenity, secondary contact recreation (eg. boating, fishing) and primary contact recreation (eg. swimming);

As the water is saline, it is not suitable for drinking or agricultural uses (eg. irrigation).

The HRC established Water Quality Objectives for nutrients (N, P), chlorophyll-a and faecal coliforms; other water quality parameters are as established in ANZECC guidelines for marine waters. The SQAP also has water quality requirements for oyster farming in the estuary.

The upper reaches of the Hawkesbury-Nepean River system serve as a drinking water catchment and are classified "P" (Protected) under the Clean Waters Regulations (1972). The Hawkesbury River estuary is not classified.

Water quality parameters relevant to sewerage systems and background water quality are shown in Table 8.2.

Table 8.2 Water Quality Parameters

Parameter	Unit	Discharge Effluent Quality[1]		Background Water Quality Guidelines		
		Typical 'P' Class water[2]	SWC - Brooklyn EIS	ANZECC	SQAP	HRC[3]
BOD_5	mg/L	10	10			
NFR	mg/L	15	10			
Total N	mg/L	10	10			0.4
Ammonia	mg/L	2	1			
Total P	mg/L	0.3 – 0.5	0.3			0.03
Faecal Coliforms	No. per 100 mL	200	150	150 / 1000 (primary / secondary contact recreation)	14 MPN[4]	

(1) 90 percentile except faecal coliforms which are absolute
(2) Protected waters - typical for drinking water catchments
(3) For Hawkesbury River estuary
(4) Most Probable Number; not more than 10% of samples > 43 MPN

A high quality effluent will be required for discharges to the Hawkesbury River in order to meet water quality objectives ie. to protect ecosystems and safeguard human health.

For purposes of this Report, effluent quality similar to that typically adopted for discharge to 'P' class waters has been assumed. Such an effluent quality may be more stringent than necessary for relatively low volume discharges, particularly at Little Wobby where discharge volumes are very small in comparison to river flows. Detailed investigations in subsequent stages of project development will be able to optimise effluent quality to ensure environmental values for river health are not adversely impacted whilst minimising scheme costs.

8.4 DISCHARGE LOCATION

Discharges will be need to be located to maximise dilution and dispersion of effluent into the river flow and sited clear of oyster beds. For the Brooklyn-Dangar Island Sewerage Scheme, SWC proposed a discharge location at the south bank of the Hawkesbury River near the F3 road bridge (refer Fig. 1). The River channel is at its narrowest here, with water depth 21m, and the necessary dilutions to protect environmental values could be achieved within the immediate vicinity of the discharge.

A discharge within this relatively narrow river channel is also considered the most suitable for Mooney-Cheero. To reduce costs however, a discharge closer to the northern bank would be more appropriate. The nearest oyster lease is 350 m to the west and river water depth 3m - 5m. Whilst dilutions may not be as high as at the south bank where stronger currents exist, they should remain within an acceptable range and not adversely affect environmental values. Discharge modelling may be required to determine the dilutions achievable and movement of the discharge plume.

It is assumed that a discharge near the northern bank would be suitable, particularly for the lower effluent volumes associated with an independent Mooney-Cheero scheme. For combined treatment options the higher effluent loads may require location of the discharge to the southern side of the River.

At Little Wobby, the discharge volumes are quite small; a discharge to the deepwater river channel near the foreshore can be expected to adequately provide necessary dilutions in close proximity to the discharge point.

8.5 INFRASTRUCTURE REQUIREMENTS

The general infrastructure requirements for a river discharge are:

- An effluent pumping station (EPS) to pump effluent to the discharge site. At Little Wobby, an EPS is unlikely to be required; the treatment plant can be at an elevation that will permit effluent to be discharged under gravity.
- An effluent pipeline from the treatment plant to the discharge site.
- An outlet structure that will ensure the necessary mixing and dilution occurs at the discharge. This may require high velocity nozzles or similar features at the outlet.

Pre- and post-discharge monitoring will be required to check and ensure that design assumptions and environmental impacts remain within defined levels.

8.6 EFFLUENT REUSE AT LITTLE WOBBY

As noted in Section 8.1, potential exists at Little Wobby, where existing water supply is from rainwater tanks, to recycle high quality effluent for non-potable uses in conjunction with a sewerage scheme.

As there is limited water demand for external uses (eg. garden watering, washing) the principal use of the effluent would be for toilet flushing.

A reuse scheme would incur significant additional costs and would only be feasible if there is no likelihood of provision of a reticulated water supply service in the foreseeable future.

A reuse scheme would require:

- A reticulated pipe network serving each property (similar to the pipework required for a pressure collection system for sewerage);
- Plumbing alterations at each property to separate tank water and reclaimed effluent;
- Additional treatment, primarily to achieve a higher standard of disinfection. Other effluent quality criteria as adopted for river discharge (Section 8.3) would apply;
- Increased testing and monitoring requirements.

The disinfection requirement as specified in the NSW Guidelines for Urban & Residential Use of Reclaimed Water (NSW Recycled Water Coordination Committee, 1993) is:

Faecal coliforms (fc)	< 1 / 100 mL
Coliforms	< 10 in 100 mL
Virus	< 2 in 50 L
Parasites	< 1 in 50 L

The Guidelines indicate that tertiary treated (filtered) effluent disinfected with chlorine (minimum 1 hr contact time) with a residual of < 0.5 mg/L should meet the standard required. The onus of “proof of process” rests, however, with the proponent.

The Guidelines also state that the minimum size of plant “producing reclaimed water for open access urban re-use reticulation system” should have an average design flow of more than 1 ML/d (over 4000 EP). Smaller plants may be considered if they also have “adequate staffing levels, automatic controls and quality assurance”.

Effluent discharge to the Hawkesbury River will be required whether or not there is urban reuse as not all effluent can be recycled – the volume of effluent recycled is less than the volume of wastewater generated.

The additional costs and benefits of an urban reuse scheme, satisfying a limited water demand at Little Wobby, need to be examined in detail and compared to provision of a reticulated water supply meeting all water needs.

The capacity of the sewerage scheme is impacted by the volume of wastewater generated and varies significantly from supply by rainwater tanks (limited supply) to a reticulated supply (effectively unlimited supply). Consequently, the possible provision of a reticulated potable water supply service to Little Wobby in the future needs to be addressed prior to, or in conjunction with, consideration of sewerage options.

9 TREATMENT OPTIONS

9.1 GENERAL

This Section of the Report examines requirements and options for treatment facilities for those schemes based on a local treatment plant ie:

- All Mooney-Cheero schemes, including development in conjunction with Peat Island Sewerage Scheme and the future Brooklyn-Dangar Island Sewerage Scheme.
- Little Wobby schemes excluding those involving remote treatment ie. connection to Gosford Regional Sewerage Scheme at Patonga or future Brooklyn-Dangar Island Sewerage Scheme.

The existing Peat Island STP is not considered suitable for expansion or incorporation into any new STP facility. Hence it is assumed that this plant will be decommissioned and additional treatment capacity provided in a new facility under options accepting loads from the Peat Island Sewerage Scheme.

9.2 SITE OPTIONS

The site requirements for a treatment plant for Mooney-Cheero and Little Wobby are:

a) Proximity to the urban areas and/or effluent discharge sites to keep sewage / effluent transfer distances to a minimum;

b) Availability of access and services (power, phone).

c) Adequacy of buffer zones around the treatment plant. The EPA's guideline buffer distance is 400m to the nearest residence to avoid nuisance problems with odours in particular, but also from noise and aesthetic impacts. Where adequate buffers cannot be provided, suitable other measures, (such as enclosing the facility, odour controls etc) are likely to be required.

d) Environmental impacts resulting from the development and any mitigation measures that may be required.

Approximate site area requirements, based on production of effluent to meet river discharge quality as discussed in Section 8.3 and without on-site biosolids treatment are:

- Mooney-Cheero: up to 2000 m^2;
- Little Wobby: up to 500 m^2.

The above areas do not include buffers to nearby residences; such will need to be considered in site selection.

Although no particular site(s) have been identified for any particular scheme at this time, possible options are discussed below.

A. Treatment Sites for Mooney-Cheero

The STP site needs to be located between the Mooney Mooney township and location of the effluent discharge to minimise costs. Several potential sites could accommodate an STP exist in this area (refer Fig 7):

- Adjacent existing Peat Island STP: Land owned by DOCS, zoned 5(a) Special Uses (Mental Hospital) and fronting the Hawkesbury River. The available buffer to nearby DOCS facilities the ambulance station on the F3 is approximately 250 m.

- Public Reserve fronting Peats Ferry Road opposite the Peat Island STP. The Reserve is vested in Gosford City Council and is zoned 6(a) Open Space (Recreation). The site is undeveloped and partly cleared. Buffer distance to DOCS facilities is approximately 350 m and to the ambulance station 200 m.

- Deerubbun Reserve (crown land; 1.93 Ha) adjoining the F3 freeway to the east and fronting the Hawkesbury River. The site has been developed for public access to the waterway and includes a boat ramp, large parking area and public amenities.

All of the above are considered suitable for the siting of a treatment plant. Power, phone, access and other services are in close proximity. If odour controls are necessary due to reduced buffer distances, such can comprise covered tanks with air extracted and treated in a soil bed. Noise levels are unlikely to be of concern given the background noise from the nearby F3 freeway.

B. Treatment Sites for Little Wobby

The only site identified is the location of the former Sport & Recreation Centre (SRC) at the southern end of the urban area.

Although several unformed road reservations transect the urban strip, these locations are very steep and not suitable for development of a STP. Council also owns several lots north of the urban area, however these fall into the same category.

The former SRC occupied several of the southern-most lots (zoned 7(c6) Conservation and Scenic Protection (Scenic Protection – Residential)) and included some reclaimed land, extending up to 25 m beyond the original high water mark. All buildings have been demolished and removed; only ground-level concrete pavements and the wharf remain. The levelled area of the site exceeds 2000 m^2 in area. A buffer distance to the nearest residence of about 50 m can be obtained.

A gravel road along the foreshore of the headland connects this site with the Broken Bay SRC on the western foreshores of Broken Bay (Fig. 8). Supplies to the Centre are ferried to the wharf at Little Wobby and trucked to the Broken Bay Centre.

If part of this former SRC site cannot be secured for a STP, then a small area further south along the access road to the Broken Bay SRC could be utilised. The land is zoned 7(a) Conservation and Scenic Protection (Conservation). Some minor clearing and levelling would be required.

9.3 WASTEWATER & EFFLUENT QUALITY

Wastewater from Mooney Mooney, Cheero Point and Little Wobby will be derived from domestic sources only. No industries are present (nor planned in future) and consequently the discharge of harmful wastes such as heavy metals, pesticides etc is not of concern.

Final effluent quality requirements are discussed in detail in Section 8.3. Typical wastewater quality for raw sewage and effluent from septic tanks as well as effluent quality assumed for Mooney-Cheero and Little Wobby river discharges are shown in Table 9.2.

Table 9.2: Wastewater and Effluent Quality

Parameter	Unit	Typical Wastewater Quality		Effluent Quality*
		Raw Sewage	Septic Tank Effluent	
BOD_5	mg/L	200 - 300	150	10
NFR	mg/L	200 - 300	50	15
Total N	mg/L	40 - 60	40 – 60	10
Ammonia	mg/L	30 - 40		2
Total P	mg/L	10 - 15	10 – 15	0.3 – 0.5
Faecal Coliforms	No. per 100 mL	10^6 - 10^{10}	10^5- 10^7	< 200

** 90 percentiles except faecal coliforms which is absolute*

As noted in Section 8.3, effluent quality similar to that typically adopted for discharge to 'P' class waters (drinking water catchment) has been assumed but may be more stringent than necessary – subsequent investigations will need to determine optimal effluent quality for the environmental values applicable and thus optimise treatment costs.

9.4 TREATMENT TECHNOLOGIES

There are various technologies available for the treatment of domestic sewage and wastewaters. These are almost exclusively based on biological processes with physical and chemical processes added to meet particular requirements. The quality of effluent required is a key factor, along with site considerations and any other constraints that may be applicable.

The most common technologies used for small towns are:

- Oxidation Ponds
- Aerated Lagoons
- Fixed Media Biological Filters
- Activated Sludge

Additional facilities for disinfection, biosolids handling and higher effluent quality are provided when necessary.

Of the above, oxidation ponds and aerated lagoons are not suitable for the high quality effluent required for Mooney-Cheero and Little Wobby. Technologies based on biological filters and activated sludge processes are well-proven and suitable with the latter being the most commonly used.

Many proprietary applications of these technologies exist and can be designed and modified to suit particular effluent quality requirements and applications.

a) Fixed Media Filtration

This type of process uses fixed-growth media to support microbial growths over which wastewater is passed. The microbial growths feed on the organic material in the wastewater. There are several variations to the process using stone or synthetic media and with the wastewater sprayed onto the media or with the media rotating through the wastewater.

The plants have low operating costs (low energy requirement) but capital costs are relatively high due to the number of processes involved (sedimentation, filtration, clarification). Add-on processes/equipment are required for high quality effluent and to reduce nutrient levels.

b) Activated Sludge Process

Activated sludge is the most commonly used technology to treat biodegradable wastes. Biological organisms (the "activated sludge") is circulated and mixed with incoming wastewater in an aerobic environment. The "mixed liquor" is then allowed to settle, resulting in separation of the biological solids from the treated effluent. Most of the biological solids are recirculated to provide an active mass of organisms that feeds on the incoming wastewater; excess solids are wasted.

There are many variations on the process including number and configuration of process tanks. The most common for small plants is the Extended Aeration Tank (EAT) type where only one tank is used to treat the wastewater, settle the solids and draw off effluent.

The process is well proven, reliable, can accommodate temporary overload and produces high quality effluent at reasonable cost, although power requirements are relatively high. Nitrogen reduction can be achieved as part of the biological processes, however phosphorous reduction requires additional processes, particularly for small plants such as those under consideration.

Filters are added where very low organic, solids or nutrient levels are required.

A more recent development is the use of membranes (microfiltration) to achieve high effluent quality. The membranes are submerged in the bioreactor and remove the need for a clarification stage (separation of solids). In addition, the membranes provide very high pathogen removal, thereby eliminating the need for other disinfection processes such as chlorination (unless a residual chlorine level is required) or UV.

The site areas required for the above technologies are relatively small and the process unit(s) can be designed to optimise site constraints eg. minimise tank depth to reduce rock excavation.

Suitable standard “package type” (standardised) facilities for small plants are available from a number of suppliers in Australia using various proprietary equipment and designs.

9.5 OTHER CONSIDERATIONS

9.5.1 Treatment of Septic Effluent vs Raw Sewage

Whilst the biological and physical treatment requirements for septic effluent are less than for raw sewage due to the reduced BOD and solids loads, the hydraulic loads are equivalent. Consequently, the size and hydraulic capacity of treatment units and systems will be identical in both cases. However, aeration and other process systems, including use of chemicals, will be reduced in the case of septic effluent treatment.

9.5.2 Effluent Disinfection

Disinfection by UV irradiation has been assumed as this has proven to be the most economic in recent times. If chlorination is used, then the EPA also requires dechlorination to avoid possible long-term impacts from chlorination by-products entering watercourses.

If a membrane bioreactor is adopted for treatment then separate disinfection facilities will not be required (refer Section 9.4(b)) except where the effluent is recycled for non-potable reuse (refer Section 8.6).

9.5.3 Phosphorous Reduction

For river discharges, it is likely that phosphorous will need to be reduced to low levels (possibly to 0.3 mg/L). The most common method of achieving the low concentrations required, particularly in small plants, is two stage dosing with alum or ferric salts followed by filtration (eg. sand or similar media filters).

Although results for activated sludge plants using 2-stage dosing have indicated that filtration may not be necessary to achieve the 0.3 mg/L level, for a small plant, such as that required at Mooney-Cheero, it may not be possible to consistently achieve this level of performance. Consequently, it has been assumed that filtration will be required for effluent meeting the assumed river discharge quality criteria.

9.5.4 Biosolids Management

The volume of biosolids removed from domestic sewage in treatment plants of the size required at Mooney-Cheero and Little Wobby is shown in Table 9.3. For septic effluent treatment, the volumes are considerably lower as most of the solids are removed in the septic tank (from where they are also need to removed periodically).

The annual volume of biosolids produced is relatively small, at approximately 1% of the effluent volume (based on raw sewage treatment, biosolids at 3% solids concentration).

Table 9.3 Estimated Biosolids Quantities

	Mooney-Cheero STP				Little Wobby STP	
	Septic Effluent	Raw Sewage			Septic Effluent	Raw Sewage
Load (future EP)	600	600	1800	3300	106	106
Biosolids removed (g/EP/d)	25	75	75	75	25	75
Biosolids (kL/d @ 3% solids)	0.5	1.5	4.5	8.3	0.09	0.27
Biosolids (kL/a @ 3% solids)	183	548	1643	3030	32	97

Includes chemical P reduction for river discharge; biosolids density 1000 kg/m^3

The solids by-products from treatment plants are usually stabilised and settled in lagoons or tanks and dewatered prior to reuse or disposal, usually to land. For small plants, however, it is usually uneconomic to provide stabilisation and drying facilities, particularly where biosolids treatment and disposal facilities are available nearby at larger, regional plants (eg. Kincumber STP, Woy Woy STP, Hornsby Heights STP)

On-site stabilisation and dewatering facilities may be economic for a 3300 EP plant at Mooney Mooney. For estimating purposes however, all options assume biosolids are tankered off-site for processing and disposal at larger regional treatment facilities.

10 TRANSFER SYSTEMS

10.1 GENERAL

The following section discusses the transfer of collected sewage or septic effluent to treatment plants.

Transfer systems are required for the following schemes / options:

a) Mooney-Cheero Sewerage Scheme:

- Transfers from Cheero Point to Mooney Mooney;
- Transfers from Mooney Mooney to the Mooney-Cheero STP

b) Little Wobby

- Transfers from Little Wobby to Patonga for connection to the Gosford Regional Sewerage Scheme;
- Transfers from Little Wobby to Dangar Island for connection to the future Brooklyn-Dangar Island Sewerage Scheme.

No separate transfer system is required for the local treatment options. The pressure collection system can discharge directly to a nearby STP.

The requirements for a transfer system are:

- A pumping station where all discharged wastewater from the town has been collected; and
- A pipeline (rising main and possibly part gravity main if sufficient elevation is available) from the pump station to the treatment plant.

The capacity and size of the transfer system is governed by the peak flow rate, transfer distance and elevations along the pipeline route.

10.2 TRANSFER SYSTEM DETAILS

Routes for the transfer pipelines have been adopted as follows:

a) Cheero-Mooney Schemes

- Cheero Point to Mooney Mooney: Along Pacific Highway road verges.
- Mooney Mooney to STP: Along Pacific Highway and Peats Ferry Road verges.

The capacity and length of the transfer systems at Cheero Point and Mooney Mooney vary depending on which collection system (gravity or pressure) is used - refer Figs 2-6 and Appendix C for details.

b) Little Wobby Schemes

i. Little Wobby to Patonga

The most direct route generally follows the aerial transmission line to Patonga Creek an approximate distance of 2.5 km. The transfer main can connect into reticulation at Patonga near the Caravan Park (refer Fig. 8).

An alternative route following the foreshore access road to the Broken Bay SRC and then via the existing walking trail to Patonga Creek is considerably longer (over 5 km) and not economic.

The pipeline route to Patonga climbs very steeply from Little Wobby (to an elevation of over 100m) and, after crossing the headland, falls very steeply to Patonga Creek. The steep sections may have to be constructed above-ground – below ground construction may not be feasible due to the ruggedness of the ground, access difficulties for equipment and materials due to steep slopes and the associated risks.

Across the headland, the pipeline is proposed to be below-ground. An above-ground pipeline could be provided, however this would introduce increased risks of damage or failure (due to fire, physical damage by falling trees/branches, vandalism etc) that may not be readily managed in such a remote and largely inaccessible area.

There are significant environmental risks associated with this transfer option. The threats and impacts from construction to threatened species, native vegetation and aboriginal heritage have not been assessed; other environmental risks (eg. clearing, spoil disposal) also need to be addressed. The technical issues and operational risks associated with above-ground sections of main in the steep areas (high-pressure sections) and the Patonga Creek crossing will also need detailed investigation.

ii. Little Wobby to Dangar Island

A submarine pipeline is required to connect to future reticulation on the Island. Construction of the pipeline would be by directional drilling (as is proposed by SWC for the transfer system between Dangar Island and Brooklyn), a relatively expensive operation for small diameter mains.

A pipeline laid along the river-bed may reduce costs but risks of damage also increase and are unlikely to be acceptable.

Transfer system design loads, flow rates and pipeline details are shown in Table 10.1.

Detention times in the longer transfer systems are excessive, increasing problems with septicity and odours. A 4-hour detention time is regarded as the limit before problems are likely, although there are other contributing factors and variables that need to be considered. Where detention time exceeds 4 hrs a septicity control system, such as alum dosing, has been included in estimates.

For pressure collection systems, the cumulative detention time in the collector mains and transfer systems needs to be considered. A septicity control system is likely to be required for the Mooney-Cheero systems due to cumulative detentions.

Table 10.1 Transfer System Details

	Mooney-Cheero*		Little Wobby	
From	Cheero Point	Mooney Mooney	Little Wobby	Little Wobby
To	Mooney Mooney	STP	Patonga	Dangar Island
PS capacity (L/s):				
Pressure collection systems	1.8	5.6	0.3 - 1.3^	0.3 - 1.3^
Gravity at Cheero only	3.3	7.2		
Gravity at Cheero / part Mooney	3.3	8.3		
Pipe diameter (mm)	65 / 80*	80 / 100*	50	50
Pipeline length (m):				
Pressure collection systems	1800	1200	2500	1000
Gravity at Cheero only	2100	1200		
Gravity at Cheero / part Mooney	1500	1350		
Septicity control	No	Yes	Yes	Yes

** Former is for pressure collection system and latter for gravity systems*

^ Higher flow applies if potable water supply is provided

Safeguards to prevent or reduce emergency overflows and discharges need to be incorporated in sewerage systems. Standby pumping equipment, alarms, emergency response and management systems are provided to deal with unforeseen circumstances and events.

Additionally, emergency storage of wastewater collected at pump stations can provide a further safeguard. In sensitive environments up to 8 hrs emergency storage (at average flow) is usually provided. This generally allows sufficient time for restoration/repair of pumping equipment/system in the event of a failure (eg. loss of power, blocked pumps etc). Transfer pump station estimates include an allowance for the additional storage required.

11 SCHEME OPTIONS & ESTIMATES

11.1 GENERAL

Based on discussions in earlier Sections, the following Section of this Report examines scheme options and provides a description and summary of cost estimates prepared for those schemes.

11.2 SCHEME OPTIONS

11.2.1 The "Do Nothing" Option

The "Do Nothing" option represents the BASE case against which all other options can be compared and assessed.

The legislative and regulatory requirements now in place (refer Section 6.2) require Council to put into effect strategies and procedures to manage and control the performance of on-site systems to reduce health risks and pollution. Council's OSMS addresses risks, performance levels and monitoring requirements for on-site systems in the Gosford City area. As a consequence, improvements to existing on-site systems will need to be undertaken where possible, or alternate systems implemented with the aim of providing long-term sustainable sewage management in Mooney Mooney, Cheero Point and Little Wobby.

Those property owners with systems that do not meet Council OSMS requirements will be required to fix defective systems or adopt alternatives eg. pump-out for septic system; on-site storage for AWTS.

No Government subsidy is available for the "Do Nothing" option. All costs will need to be met by individual property owners.

11.2.2 Scheme Options for Mooney-Cheero

The options for the Mooney-Cheero Sewerage Scheme are:

Option M1 Independent local Scheme with 600 EP treatment plant.

Option M2 Combined scheme with 1800 EP treatment plant serving both Mooney-Cheero and Peat Island scheme.

Option M3 Combined scheme with 3300 EP treatment plant serving Mooney-Cheero, Peat Island and Brooklyn-Dangar Island schemes.

Under all Options, effluent suitable for discharge to the Hawkesbury River (at the F3 road bridge) has been assumed.

Within these three broad Options, the collection system options are:

- Collection of septic effluent or untreated sewage; and

- Gravity (MCG / CED) or pressure (STEP / GP) type systems at Cheero Point and approximately 33% of Mooney Mooney (primarily along Pacific Highway). The remaining 67% of properties at Mooney Mooney will require a pressure collection system.

11.2.3 Scheme Options for Little Wobby

Option W1: STEP collection system to central (common) collection tank with barge-operated pump-out service to a nearby STP (eg. future Mooney-Cheero STP).

Option W2: Local Scheme with 130 EP treatment plant and effluent discharge to Hawkesbury River;

Option W3: Connection to Gosford Regional Sewerage Scheme at Patonga;

Option W4: Connection to future Brooklyn-Dangar Island Sewerage Scheme at Dangar Island.

For Options W2, W3 and W4, either septic effluent (STEP system) or untreated sewage (GP system) can be collected. Sewage collection is not suitable under Option W1.

The introduction of a potable water supply has the following impacts:

- Option W1 would not be viable; the increased wastewater volumes would increase the pump-out costs significantly and eliminate such option from consideration.
- Option W2 would require a significantly increased capacity treatment plant.
- Options W3 and W4 are unlikely to be affected to any significant degree, but operating costs would increase due to the increase in wastewater loads.

In addition, effluent reuse for non-potable uses (toilet flushing, external uses) is available under Option W2 (local treatment) as an alternative to reticulated water supply.

11.3 COST ESTIMATES

11.3.1 General

Capital cost and Net Present Value (NPV) estimates have been prepared for the various collection system options, treatment and effluent management facilities.

Scheme components have been sized for future loads; there is no significant future load component that provides scope for construction staging except for the larger treatment plants under Mooney-Cheero Options M2 and M3. Some modular, staged development of the plant could be considered if necessary to suit timing requirements of the authorities involved.

For collection systems at Cheero Point, minor extension of the collection system to serve vacant lots on at the extremity of existing development has been included as a “future” cost in estimates.

Unit rates and costs have been based where applicable on DLWC NSW Reference Rates (1999) for valuation of existing sewerage assets. Additions and variations have been made to suit particular circumstances and conditions for each locality, allow for cost movements since 1999 and to reflect lower cost alternatives. Budget prices from suppliers of treatment plants and pressure collection systems have also been obtained. The septic effluent pump-out cost for Little Wobby scheme Option W1 was obtained from a local operator.

Operation and maintenance costs have been based on typical rates and charges.

Emphasis has been directed at ensuring comparative estimates between options are realistic.

Estimate details are located in the Appendices:

- Appendix A: Pressure collection systems (GP and STEP)
- Appendix B: Gravity collection systems (Cheero Point and part Mooney Mooney only)
- Appendix C: Transfer systems
- Appendix D: Treatment and Effluent Management
- Appendix E: Water Supply and Effluent Reuse at Little Wobby
- Appendix F: Summaries

11.3.2 Estimate Details

a) Collection Mains and Sewers

Pipeline lengths and sizes have been determined from preliminary designs, collection system layouts and topography. Quantities have been estimated for external dewatering of trenches where high water tables are known to exist (gravity systems only) and for rock excavation.

Marginal impact on collection system size and cost is likely if reticulated water supply service is extended to Little Wobby. Hence capital cost estimates for collection systems are identical under the various scheme options.

b) Pumping Stations

All pump stations have been assumed as conventional 2-pump (duty + standby) submersible type except for the transfer station for Little Wobby scheme Option W4 (transfer to Patonga) where a high head (approximately 150m) will be required. This station has been assumed to comprise positive displacement type pumps in series.

For transfer systems to treatment plants, 8 hours emergency storage at ADWF has been included in estimates. For the gravity collection options at Cheero Point, sufficient storage is expected to be available in the reticulation sewers and catchment pump wells.

c) Transfer Pipelines at Little Wobby

Pipeline sizes for the transfer mains to Patonga and Dangar Island have been assumed the same whether or not reticulated water supply is provided. The pipe sizes are a minimum that would be required for hydraulic efficiency.

d) Septicity Control

Septicity control estimates are nominal allowances typical for chemical dosing by metal salts.

e) Remote Treatment Options for Little Wobby

In the case of scheme Options W3 and W4, the cost of remote treatment and effluent management (either by Gosford regional Sewerage Scheme or the future SWC Brooklyn-Dangar Island scheme) has been estimated on the basis of current headworks charge applicable to new connections ($1,543 per ET).

A nominal $60 / EP / annum has been used for estimating operating costs for these options.

f) Water Supply and Reuse Options at Little Wobby

Water supply estimates are indicative only, based on extending supply from Patonga - no investigations have been undertaken to confirm the feasibility of such a supply option. Other options may be possible at lower cost.

Estimates include reticulation and household connection costs and allow for current headworks and distribution charges levied by Council for connection of new developments ($1,474 and $495 per ET respectively). The works are assumed to be undertaken concurrently with sewerage. Operating costs have been based on a supply cost of $1.00 per kL.

For recycling of treated effluent for non-potable uses, estimates allow for additional treatment, reticulation and household plumbing modifications.

g) Non-Construction and Contingencies

A fixed percentage of capital cost has been applied for:

- Non-construction costs. A 20% margin has been applied to cover project management, investigations, environmental impact assessments, approvals, survey, design, construction management and similar activities.

- Contingencies. At this stage of investigations there are many unknowns and uncertainties. Subsurface conditions, environmental risks, regulatory authority requirements and similar unknowns can only be defined and cost impacts determined when detailed studies and designs are completed. A 20% allowance has been applied to all construction activities to allow for unpriced items, cost variations and uncertainty.

h) Property Connection Costs

These allow for connection of individual properties to the collection system and include, as applicable:

- Decommissioning of existing on-site systems where not forming part of new works;
- Installation of pumping units (with 750 L emergency storage) for GP and STEP systems, including power supply;
- Plumbing connections to pumping units;

- Connection of pumping units to the collection system at the property boundary (32mm pressure pipe);
- Gravity connections to MCG and CED collection system options at Cheero Point / Mooney Mooney.

For future development, provision of a septic tank is included for STEP and CED systems.

The on-site costs can vary significantly from property to property depending on ground conditions (eg presence of rock), existing development, location of existing sewerage facilities and so on. Estimates are based on typical costs that can be expected.

i) Land Acquisitions

Most scheme components should be able to be located within road reserves and open space reserves with little impact on costs. Allowances have been included in estimates for the following:

- Treatment plant at Mooney Mooney, either on DOCS land or the adjacent public reserve ($50,000);
- Treatment plant at Little Wobby on land under management by DSR ($50,000);
- Acquisition of private property for the transfer pump station site and access on the foreshore of Mooney Mooney Bay ($250,000). This applies only to those options where a part gravity collection system is adopted at Mooney Mooney.

j) Operation and Maintenance

Asset maintenance costs have been estimated as a percentage of capital cost using typical industry rates with adjustments to account for higher costs at Little Wobby due to remote and restricted access.

Operation costs (power, chemicals, attendance) have been estimated either as a percentage of capital cost (where relevant and applicable) or on a typical cost per unit basis (eg. cost per EP, cost per ML).

For pumping units in pressure systems, a fixed cost per annum has been adopted to cover electricity costs (up to $30 pa), maintenance, repairs, overhauls and replacement over a 20-year time frame. As pressure collection systems are a relatively new technology in Australia, operation and maintenance costs are considered indicative.

A fixed rate of $120 pa at Mooney-Cheero and $150 pa at Little Wobby has been adopted for maintenance of privately owned septic tanks and associated connections under CED (Cheero Point) and STEP systems. This allows for inspections by Council, periodic desludging and repairs that may be necessary.

k) Net Present Value

All NPV estimates have adopted a 7% interest rate over 20 years. Future extensions and services to vacant lots assume costs are spread evenly over the 20-year period.

The NPV of operation and maintenance costs has been estimated on average loads over 20 years for collections systems and on future (design) loads for transfer, treatment and effluent management components.

11.4 SUMMARY OF ESTIMATES

11.4.1 Mooney-Cheero Scheme Options

Table 11.1 summarises the estimates for the Mooney-Cheero Scheme Options.

For the combined treatment options, cost sharing by Mooney-Cheero, Peat Island and Brooklyn-Dangar Island has been determined on pro-rated EP load basis.

The key factors affecting scheme costs are:

i) Untreated Sewage vs Septic Effluent Collection

Under all Options, septic effluent collection (Options M1A, M2A and M3A) has a lower cost than collection of untreated sewage (Options M1B, M2B and M3B) – capital cost savings range from $0.31M to $0.46M or 10.0% to 12.4% (NPV's $0.17M to $0.34M or 4.0% to 6.9%). The higher savings apply under Option M1 (independent scheme) and the lowest under Option M3 (combined scheme) as the unit costs of treatment and effluent management reduce with increasing loads.

However, estimates do not take into account or price the value of the increased community amenity afforded under the B Options by the removal of septic tanks and their associated maintenance requirements (including periodic desludging), odours, space utilisation and other impacts. The improved amenity provided under the B (sewage collection) options needs to be considered in comparative assessments between these scheme Options.

ii) Independent vs Combined Schemes

Cost benefits accrue under the combined schemes, Options M2 and M3, from reduced unit costs for treatment and effluent management resulting from economies of scale. Savings of over 15% in capital costs (over 13% NPV) are estimated between the Option M1 and Option M3 schemes.

However, the adoption of a combined scheme relies on suitable arrangements and agreements between the parties involved ie. GCC, SWC and DOCS.

11.4.2 Little Wobby Scheme Options

Table 11.2 summarises the estimates for the Little Wobby Scheme Options.

Transfer systems are only required under the remote treatment Options W3 and W4; the pressure collection systems can discharge directly to downstream effluent collection or treatment facilities under the other options.

Table 11.1 Mooney-Cheero Sewerage Schemes - Cost Estimate Summary

Estimates $1,000 unless otherwise shown

OPTION	M1 Independent Scheme (600 EP)		M2 Combine with Peat Island		M3 Combine with Peat Island and Brooklyn-Dangar Is.	
Wastewater collected	**A. Septic Effluent**	**B. Sewage**	**A. Septic Effluent**	**B. Sewage**	**A. Septic Effluent**	**B. Sewage**
Collection systems (all pressure)	1,279	1,479	1,279	1,479	1,279	1,479
Transfer systems	663	663	663	663	663	663
Treatment	1,310	1,480	3,160	3,260	4,850	4,900
Effluent Management	112	112	180	180	260	260
Sub-total	3,364	3,734	5,282	5,582	7,052	7,302
Property connections (existing 200 ET)	100	160	100	160	100	160
Total	**3,464**	**3,894**	**5,382**	**5,742**	**7,152**	**7,462**
(NPV)	*(4,890)*	*(5,226)*	*(7,201)*	*(7,438)*	*(9,396)*	*(9,566)*
Cost sharing^						
Peat Island Scheme (DOCS)			2,293	2,293	1,848	1,848
Brooklyn-Dangar Is Scheme (SWC)					2,387	2,387
Mooney-Cheero: Scheme capital cost	3,364	3,734	2,989	3,289	2,817	3,067
Cost ($) per ET (277 ET)	$12,146	$13,482	$10,791	$11,874	$10,168	$11,071
Property connections	100	160	100	160	100	160
Total capital cost Mooney-Cheero	**3,464**	**3,894**	**3,089**	**3,449**	**2,917**	**3,227**
(NPV)	*(4,890)*	*(5,226)*	*(4,433)*	*(4,670)*	*(4,241)*	*(4,411)*
Extra for gravity collection at Cheero Point only						
Extra to scheme capital cost	157	158	157	158	157	158
Extra cost ($) per design ET served (85 ET)	$1,848	$1,856	$1,848	$1,856	$1,848	$1,856
Extra for property connections (existing 51 ET)	92	107	92	107	92	107
Total extra capital cost	249	265	249	265	249	265
(NPV)	*(261)*	*(226)*	*(261)*	*(226)*	*(261)*	*(226)*
Extra for gravity collection at Cheero Point and part Mooney Mooney (33%)						
Extra to scheme capital cost	220	255	220	255	220	255
Extra cost ($) per design ET served (148 ET)	$1,483	$1,725	$1,483	$1,725	$1,483	$1,725
Extra for property connections (existing 100 ET)	180	210	180	210	180	210
Total extra capital cost	400	465	400	465	400	465
(NPV)	*(440)*	*(323)*	*(440)*	*(323)*	*(440)*	*(323)*

NPV estimates based on 7% interest rate over 20 years and include property connections

^ Cost sharing relates to treatment and effluent management only for Peat Island (1200 EP) and Brooklyn-Dangar Is (1550 EP)

Table 11.2 Little Wobby Sewerage Schemes - Cost Estimate Summary

Estimates $1,000 unless otherwise shown

OPTION	W1 Centralised Pump-Out	W2 Local Treatment		W3 Transfer to Patonga		W4 Transfer to Dangar Is.	
Wastewater collected	**A. Septic Effluent**	**A. Septic Effluent**	**B. Sewage**	**A. Septic Effluent**	**B. Sewage**	**A. Septic Effluent**	**B. Sewage**
Sewerage Scheme							
Collection system	507	507	570	507	570	507	570
Transfers				583	583	975	975
Treatment & Effluent Management	100	273	331	113	113	113	113
Total for Scheme	607	780	901	1,203	1,266	1,595	1,658
Cost ($) per ET (73 ET)	$8,313	$10,682	$12,340	$16,477	$17,340	$21,847	$22,710
Property connections (existing 63 ET)	32	32	63	32	63	32	63
Total capital cost	**638**	**811**	**964**	**1,234**	**1,329**	**1,626**	**1,721**
(NPV)	*(1,547)*	*(1,194)*	*(1,283)*	*(1,718)*	*(1,734)*	*(2,034)*	*(2,050)*
Sewerage with non-potable reuse							
Scheme Capital cost		1,157	1,278				
Cost ($) per ET (73 ET)		$15,855	$17,513				
Property connections (existing 63 ET)		82	113				
Total capital cost		**1,239**	**1,392**				
(NPV)		*(1,712)*	*(1,801)*				
Sewerage with potable water supply							
Sewerage scheme		966	1,068	1,203	1,266	1,595	1,658
Water supply		827	827	549	549	827	827
		1,792	1,894	1,751	1,814	2,421	2,484
Cost ($) per ET (73 ET)		$24,554	$25,951	$23,992	$24,855	$33,170	$34,033
Property connections (existing 63 ET)		82	113	82	113	82	113
Total capital cost		**1,874**	**2,008**	**1,833**	**1,928**	**2,503**	**2,598**
(NPV)		*(2,497)*	*(2,572)*	*(2499)*	*(2522)*	*(3,093)*	*(3,116)*

NPV estimates) based on 7% interest rate over 20 years and include property connections
Water supply estimates based on supply from Patonga
Reuse and water supply options based on concurrent construction with sewerage scheme

The key factors affecting scheme costs are:

i) Untreated Sewage vs Septic Effluent Collection

As in the case of the Mooney-Cheero schemes, the septic effluent collection (STEP) options have lower capital costs and NPV's than comparable sewage collection (GP) options.

There is an estimated $153,000 (18.9%) increase in capital cost (and $89,000 in NPV or 7.5%) under Option W2 for sewage collection in lieu of septic effluent. The margin reduces to an estimated $95,000 (NPV $16,000) under the remote treatment Options W3 and W4 as there are no, or at best minimal, savings in treatment costs.

However, as noted above in the case of the Mooney-Cheero scheme, the community amenity benefits associated with the removal of septic tanks has not been priced under any of the Options and needs to be considered in comparative assessments.

It should also be noted that Option W1 (common pump-out) is not compatible with sewage collection – there are significant problems with odours and septicity associated with storage of untreated sewage.

Option W1 is also not compatible with a future GP collection system (eg. if a potable water supply is introduced) unless the STEP system is designed for later operation as a GP system ie. using grinder pumps.

ii) Water Supply Issues

The future provision of a reticulated water supply service to Little Wobby has a significant impact on sewerage scheme options. Issues related to water supply are:

- Option W1 is not compatible with a reticulated water supply.
- Local treatment Option W2 is also not compatible unless the treatment plant can be readily upgraded to cope with the increased wastewater volumes. It is doubtful such can be economically undertaken, in which case the plant would need to be replaced.
- The remote treatment Options W3 (transfer to Patonga) and W4 (transfer to Dangar Island) are compatible with a future water supply - the collection and transfer systems would be capable of handling the additional flows generated.

The net increase in cost for provision of water supply varies from about $0.8M (Option W3) to over $1.0M (Option W2).

iii) Non-potable Effluent Reuse

In the case of Option W2 only, opportunity is available to recycle treated effluent for non-potable uses. The additional cost is estimated at $0.43M (NPV $0.52M).

iv) Transfer to Patonga – Option W3

In addition to serving Little Wobby, Option W3 would readily permit connection of the Patonga Creek urban community, stretching along the southern foreshore of the Creek, by a connection to the Little Wobby transfer system near Patonga. Opportunity would also exist for the Broken Bay Sport & Recreation Centre to connect to the transfer system and dispose of any of the Centre's surplus effluent (effluent is currently reused on-site). The cost savings that would accrue due to additional loads from these areas and economies of scale, however, are minimal as far as Little Wobby is concerned and have not been considered.

As noted earlier, there are significant environmental and technical risks associated with the transfer system (refer Section 10.2 (i)).

v) Transfer to Future Brooklyn-Dangar Island Scheme – Option W4

There are significant technical and financial risks associated with this Option. The effectiveness and costs associated with directional drilling depend on the reliability of information on sub-surface conditions and their consistency. Varying ground conditions (eg. sand, rock) have significant impacts on drilling and costs. Ground conditions are usually assessed by test drilling during the early stages of project development to prove the feasibility of the proposal, however these costs are also relatively high for submarine pipelines and thus usually considered only for much larger pipelines or where few, if any, economic alternatives are available.

12 ENVIRONMENTAL ISSUES

12.1 GENERAL

It is generally acknowledged that provision of improved sewerage services to small towns such as Mooney Mooney, Cheero Point and Little Wobby will result in environmental and health benefits in these communities and the region generally.

The impacts associated with development and operation of a scheme, however, vary depending on the particular scheme chosen and its features. This applies primarily to longer-term consequences and impacts following commissioning of the scheme rather than from shorter-term construction effects.

The following discussion is intended to provide a precis of the more significant issues and risks associated with various schemes and their components to allow comparative review and assessment. It is not intended to be exhaustive, but to provide decision makers some background on issues and concerns. Specific environmental studies and impact assessment will need to be undertaken as part of the environmental assessment process for development of a preferred sewerage scheme or schemes.

Potential environmental values and risks need to be assessed to in conjunction with the features and cost differentials between schemes and scheme components. Cost differentials can be weighed against significant environmental impacts, advantages/disadvantages and inherent risks that apply to each scheme and/or component. Safeguards normally provided or required by regulators for similar schemes have been assumed.

12.2 ENVIRONMENTAL BENEFITS

Benefits gained by implementation of a sewerage scheme at Mooney Mooney, Cheero Point and Little Wobby include:

- Improved environmental outcomes by reduction in pollution of surface and groundwaters caused by existing on-site sewerage systems. There would be a significant reduction in quantity and concentrations of pathogens and nutrients entering the waterways.
- Reduced public health risks due to inappropriate and/or poorly maintained on-site systems and deliberate (illegal) discharges.
- Improved public amenity from the removal of on-site effluent disposal (all options) and on-site treatment (under some options). Odours, boggy ground, mosquito infestations, alienation of land and other impacts of on-site systems would be removed.

12.3 ENVIRONMENTAL IMPACTS

12.3.1 Development and Growth

The implementation of a sewerage scheme to replace existing on-site treatment and effluent management could provide impetus to growth and development in the towns.

The levels of future development at Mooney-Cheero and Little Wobby are limited to infill within urban areas and low-density residential redevelopment. Expansion of the urban areas is constrained by existing land uses and zonings.

Consequently, potential impacts on future development are considered to be minimal.

12.3.2 Effluent Discharges and Water Quality

Currently, the uncontrolled disposal and discharge of partly or inadequately treated effluent from individual properties is causing adverse environmental impacts, including contamination and pollution of ground and surface waters.

Implementation of a sewerage scheme and removing reliance on on-site disposal of effluent is widely acknowledged as a desirable step to improving local water quality.

The quality of effluent, reliability of treatment processes and impacts on the environment are all key issues for a discharge scheme. Higher effluent quality (ie less contamination) reduces impacts and risks to the environment. However, treatment costs increase significantly with the need to adopt more sophisticated technologies to improve effluent quality. These technologies also require a high degree of operational control to continuously meet performance criteria.

Water quality objectives based on the Healthy Rivers Commission recommendations have been assumed. Effluent quality and discharge criteria/conditions remain to be defined and agreed with EPA for any proposed discharges to the Hawkesbury River. These would be based on ensuring that risks to water quality, river ecology and the oyster industry are within acceptable limits.

Any scheme that improves the level of treatment and/or the manner in which effluent is returned to the watercycle will reduce adverse impacts and improve local water quality.

12.3.3 Pipelines and Routes

Whilst most pipelines can be located within road reserves and disturbed areas, the transfer pipeline route across the headland to Patonga under Option W3 at Little Wobby, poses significant environmental issues and risks (refer Section 10.2(b)). The headland adjoins Brisbane Water National Park to the north. Detailed environmental assessment and measures to minimise impacts will need to be effected under this Option.

12.3.4 Sewage Treatment Plant

The main concerns relating to the treatment plant, apart from operational security and reliability (refer Section 12.3.5), are potential impacts of odours, noise and aesthetics.

Unpleasant odours from treatment plants are usually associated with abnormal operations, such as prolonged overloading or septic sewage arriving at the plant. Minor odours may occur from time to time under normal operating conditions.

Background noise from operations is usually limited to aeration systems (eg. splashing where surface aerators are used) and other equipment operation. These can be managed by selecting equipment that has low noise levels or is covered or otherwise treated to limit noise.

The provision of a reasonable buffer zone to the plant serves a number of purposes including visual screening and as a natural dispersion area for any possible odours and background noise. If a natural buffer zone is not available then it may be necessary to provide measures to deal with these impacts eg. alternative treatment technology, enclosure of treatment units, use of submerged air diffusers for aeration.

12.3.5 Operational Reliability and Overflows

All schemes will require built-in safeguards to prevent or minimise uncontrolled overflows of sewage or discharge of effluent that does not meet specified standards. Standby electrical and mechanical equipment, effective maintenance programs, responsive operation and control procedures, early warning and failure notification (eg by telemetry) all contribute to security of operations and controlled management of emergency situations. These issues will need to be dealt with in designs and in collaboration with regulatory authorities and other stakeholders.

As far as scheme options are concerned, all schemes are essentially similar and can provide equivalent levels of performance. Use of proven technologies and designs will increase reliability of scheme components and their operation.

Ownership and operational responsibilities of property services, particularly pumping units in pressure collection systems, will need to be addressed and resolved between Council and the communities. Emergency and maintenance response plans need to be developed. Educating householders regarding pressure pumping systems and their operation will be necessary.

Occasional overflows may occur even though safeguards have been incorporated. Loss of power supply for an extended period represents a major threat to operations. The provision of in-system storage within collection systems (individual household pump wells in pressure systems) and transfer systems, standby pumping equipment and effective monitoring and alarms provide safeguards against overflows in the event of operational problems. Standby power (dual supplies or portable generators) should be considered if extended power outages are likely.

12.3.6 Construction Impacts

There will be construction impacts under all schemes. Pipeline networks will need to be constructed within the urban areas together with transfer systems, treatment plants and effluent management facilities in surrounding areas.

Noise, dust and other construction related impacts would have to be managed in accordance with regulations and standards applying in the industry and with any specific requirements that may be imposed as part of any planning approval after environmental assessment.

Construction impacts and risks at Little Wobby may be significant (due to site and ground conditions) and need to be examined in detail. Environmental issues need to be addressed and managed under Option W3 at Little Wobby (transfer pipeline to Patonga) – refer 12.3.3 above.

12.3.7 Operational and Long-term Impacts

Odours

The major threat of odours is from the treatment plants (refer 12.3.4). Occasional odours may occur at pumping stations, usually after commissioning when insufficient flows or load is available. This would be of greater concern at Little Wobby where low flows currently exist due to the reliance on rainwater tanks for water needs. Flushing is adopted in most cases to clean and provide adequate water for operations.

Where buffer distances are considered to be inadequate, treatment process units can be covered and air extracted and treated in low-cost soil beds.

Noise

Operational noise is not expected to be of concern under any scheme. Suitable choice of equipment and designs would ensure noise impacts would not exceed regulatory requirements. Noise impacts from a treatment plant are discussed in section 12.3.4.

Aesthetics

At Mooney-Cheero, most works will buried with the only above-ground works being at pumping stations (electrical switchboard) and the treatment plant. These facilities are usually landscaped or otherwise located to minimise visual impact.

At Little Wobby, due to site and ground conditions and construction risks from excavations, most works will need to be located at shallow depth or at/above ground.

Pressure collection system pipelines and household pump units will mostly be located at the rear of properties; locations would be agreed with property owners. No significant adverse visual impacts are likely.

A treatment plant at Little Wobby will be a small facility (container size) and can be effectively screened by landscaping.

12.3.8 Flora and Fauna

Most works and facilities can be located on developed and cleared areas with minimal impact on vegetation and fauna.

The exception is the transfer pipeline from Little Wobby to Patonga under Option W3, which is located within the Broken Bay SRC area (zoned 6(b) Open Space (Special Purposes)). This area comprises natural bushland and although some clearing would have occurred for installation of the power transmission line, any disturbed areas have since recovered and revegetated.

Installation of a pipeline across the headland will involve clearing the line, transport of materials and equipment along the pipeline route and spoil disposal. A small depot is likely to be required; all materials and equipment may have to be delivered by helicopter – no suitable vehicle access is currently available.

The environmental impacts need to be assessed and measures implemented to mitigate and minimise impacts.

12.3.9 Heritage

Except for Option W3 at Little Wobby, all works can be located in previously disturbed areas and no significant heritage impacts are expected.

The transfer pipeline route to Patonga under Option W3 will need to be inspected and assessed for aboriginal heritage.

12.3.10 Land Acquisitions

The major land requirements for sewerage schemes at Mooney-Cheero and Little Wobby are sites for the STP's. The sites identified in Section 9.2 are located on public lands. Pipelines and pumping stations will generally be located in road reserves; easements may need to be acquired for some transfer pipelines if not located in road reserves.

The site for the treatment plant (once it has been decided) will need to be acquired and appropriately zoned. Planning controls may need to be incorporated to provide and maintain adequate buffer zones.

For the option incorporating a part gravity collection system at Mooney Mooney, a site for the transfer pumping station (including access) will need to be acquired on the foreshore of Mooney Mooney Bay (refer Fig. 3).

12.4 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

In the context of the Mooney-Cheero and Little Wobby Sewerage Schemes, the principles of Ecologically Sustainable Development (ESD) need to be met as far as is possible within the criteria and objectives established for scheme development in Section 3.

The four key ESD principles are:

1. The precautionary principle
2. Inter-generational equity
3. Conservation of biological diversity and ecological integrity
4. Improved valuation and pricing of environmental resources

Environmental issues discussed above will need to have regard to ESD principles. As mentioned earlier, a more rigorous examination will be required as part of the environmental impact assessment process to be undertaken for the preferred schemes.

12.5 ENVIRONMENTAL IMPACT ASSESSMENT

The preferred scheme option(s) will be subject to Environmental Impact Assessment (EIA) in accordance with the Environmental Planning and Assessment (EP&A) Act, 1979. Parts 4 and 5 define the legal requirements for the EIA process, including public participation.

The form and process for EIA of a proposal is dependent on a number of factors. Generally, an Environmental Impact Statement (EIS) is required for proposals that have the potential to significantly affect the environment. Depending on land zonings and uses, development consent and other environmental planning requirements, a Review of Environmental Factors (REF) may suffice for schemes that are unlikely to have a significant impact on the environment.

The form and extent of EIAs will need to be determined during subsequent project stages.

13 COMPARISON OF SCHEME OPTIONS

13.1 GENERAL

This Section of the Report provides a summary and comparison of the feasible scheme options. This will assist stakeholders to consider the relative merits of the alternatives and decide on a preferred scheme option for subsequent development and implementation.

Evaluation and comparison of the scheme Options identified in Section 11.2 has been undertaken on the following bases:

- Whether or not each scheme meets the objectives identified in Section 3.3;
- Comparative features, advantages and disadvantages;
- Estimated costs.

13.2 MOONEY-CHEERO SCHEME OPTIONS

Apart from the "Do Nothing" Option, all Options satisfy the scheme objectives defined in Section 3.3. The principal differentiating factors and variations in levels of service can be summarised as follows.

a) Options M1A, M2A and M3A (effluent collection) require households to retain their on-site treatment units (septic tanks, AWTS). Under Options M1B, M2B and M3B (sewage collection) the on-site treatment units are redundant and can be removed, providing improved householder and public amenity, but at additional cost. Under all options, a pump unit is installed on each property to pump the wastewater into a common pressure pipeline.

b) A gravity collection system in lieu of pressure can be provided for Cheero Point and also to approximately 33% of lots at Mooney Mooney (principally those along the Pacific Highway) at additional cost. A gravity collection system removes the need for household pumping units.

   At Cheero Point two additional catchment pumping station would be required for a gravity collection system, one located in Milloo Parade and the other at the Cheero Point headland (refer Fig. 5).

   At Mooney Mooney, the transfer pumping station will be required to be relocated from road reserve to private property on the foreshore of Mooney Mooney Bay (refer Fig. 3).

c) Capital and operating cost can be minimised for the Mooney-Cheero community by combining treatment and effluent management with the existing Peat Island and future Brooklyn-Dangar Island schemes (Options M2 and M3). The combined schemes provide cost savings to all participating parties through economies of scale.

   The adoption of either Option M2 or Option M3 requires the relevant operating authorities to negotiate and agree on scheme development, operation and administration. Staged development of the treatment plant may be required to suit each party's priorities.

Table 13.1 provides a consolidated presentation of the scheme Options showing cost estimates, main features, advantages and disadvantages with respect to the these criteria. The "Do Nothing" option has been included to provide a reference point.

13.3 LITTLE WOBBY SCHEME OPTIONS

Apart from the "Do Nothing" Option, all Options satisfy the scheme objectives defined in Section 3.3. The principal differentiating factors and variations in levels of service can be summarised as follows.

a) Under Options W1A to W4A (effluent collection) households need to retain their on-site treatment units (septic tanks, AWTS). Under Options W2B to W4B (sewage collection) the on-site treatment units are redundant and can be removed, providing improved householder and public amenity, but at additional cost. Under all options, a pump unit is installed on each property to pump the wastewater into a common pressure pipeline.

b) Future water supply service.

   If the reliance on rainwater tanks is retained, relatively low wastewater volumes will continue to be generated. If a reticulated supply is provided, then significantly higher wastewater volumes will require management.

   The provision of a reticulated water supply service, in conjunction with sewerage services or at a later date, is not compatible with Option W1A (centralised pump-out). Under Option W2 (local treatment) the treatment plant would be required to handle substantially increased wastewater flows – this may not be possible for a small package type plant and it may require replacement.

   Options W3 and W4 (transfer to either Patonga or Dangar Island) are, however compatible with reticulated water supply service.

   Option W1A could serve as an interim solution until a reticulated water supply is provided. However, the pump-out operation cost, estimated at $60,000 pa, is relatively high; the capital cost difference between Options W1A and W2A would be paid for in less than 4 years (and slightly longer under Option W2B) by the increased operating cost of Option W1A.

   The treatment facility under Option W2 would be hydraulically limited if Little Wobby was provided with a water supply service. Hence this Option should only be adopted if the treatment plant can be economically upgraded to accept the significantly higher hydraulic loads applicable if a water supply service is provided in future.

   The transfer systems under Options W3 and W4 would have capability to handle the additional wastewater flows generated with a future water supply service.

   The provision of a reticulated water supply service to Little Wobby in conjunction with sewerage services is estimated to cost an additional $0.8M to $1M – refer 11.4.2 and Table 11.2.

c) Recycling of effluent for non-potable uses.

A non-potable supply of treated effluent could be provided in lieu of a potable supply under the local treatment Option W2; the estimated additional cost is $0.43M. The non-potable supply could be used for toilet flushing and external (non-personal) uses.

There are unique risks associated with the sewerage Options for Little Wobby that need to be addressed as part of the next phase of work on a sewerage scheme for Little Wobby.

- Construction risks – all Options. The nature of ground and sub-surface conditions along the urban strip indicate the need for rigorous risk assessment to be undertaken to determine the conditions and requirements for construction and maintenance of public utility services of the type proposed. Cost estimates provided herein should be reviewed in the light of the outcomes from the risk assessment.

- Environmental risks associated with Option W3 – Transfer to Patonga. A preliminary assessment is required to confirm the environmental acceptability of construction of a pipeline across the headland from Little Wobby to Patonga if this Option is to be given further consideration.

Table 13.2 provides a consolidated presentation of the feasible scheme Options showing cost estimates, features, advantages and disadvantages of each. The "Do Nothing" option has been included to provide a reference point.

Option W4 (transfer to Dangar Island) has not been included in Table 13.2. Option W4 is similar to Option W3 in that both schemes transfer collected wastewater to nearby schemes for treatment and effluent management. However, Option W4 provides no substantive advantage over Option W3 but has significantly higher costs (refer Table 11.2).

Table 13.1 Mooney-Cheero Sewerage Schemes – Comparison of Options

SCHEME OPTION	Do Nothing	M1 Independent Scheme		M2 Combine with Peat Island		M3 Combine with Peat Island & Brooklyn	
Wastewater collected: A = Septic Effluent; B = Untreated sewage		**A**	**B**	**A**	**B**	**A**	**B**
Capital cost (pressure collection system, Mooney-Cheero share only, $1000)		3,464	3,894	3,089	3,449	2,917	3,227
NPV ($1,000)		*4,890*	*5,226*	*4,433*	*4,670*	*4,241*	*4,411*
Features							
▪ Existing on-site systems and practices retained	✓						
▪ Septic tank / AWTS retained for part treatment on-site		✓		✓		✓	
▪ No on-site systems retained			✓		✓		✓
▪ Gravity collection system available at Cheero Point & part Mooney Mooney (33% of lots)		At Extra cost	At Extra cost	At Extra cost	At Extra cost	At Extra cost	At Extra cost
▪ Treatment plant with high quality effluent discharge to Hawkesbury River		✓ (600 EP)	✓ (600 EP)	✓ (1800 EP)	✓ (1800 EP)	✓ (3350 EP)	✓ (3350 EP)
Advantages							
▪ Maximises use of existing infrastructure (septic tanks, AWTS)	✓	✓		✓		✓	
▪ Reduced health risks and improved environmental outcomes		✓		✓		✓	
▪ Maximum health and environmental benefits			✓		✓		✓
▪ Improved public amenity* with removal of on-site effluent disposal systems		✓		✓		✓	
▪ Maximum public amenity* realized with removal of all on-site systems			✓		✓		✓
▪ No single point effluent discharge from Mooney-Cheero to Hawkesbury River	✓						
▪ New treatment plant replaces ageing Peat Island STP removing odour source and relatively low effluent quality discharge to River				✓	✓	✓	✓
▪ Combined (regional) facility removes need for separate treatment facility for Brooklyn-Dangar Island						✓	✓
▪ Reduced cost to Mooney-Cheero community				✓	✓	✓	✓
Disadvantages							
▪ Limited improvement to current health, environmental and other problems	✓						
▪ Householder responsible for operation of on-site treatment (incl. desludging), effluent disposal system & meets costs of any upgrading required under OSMS	✓						
▪ Householder responsible for maintenance of septic tank (incl. desludging)		✓		✓		✓	
▪ Location of treatment plant and discharge site require community and regulatory authority acceptance		✓	✓	✓	✓	✓	✓
▪ Effluent quality / impacts require detailed assessment		✓	✓	✓	✓	✓	✓
▪ Agreement with DOCS required				✓	✓	✓	✓
▪ Agreement with DOCS and Sydney Water required						✓	✓

** Amenity issues include odours, boggy ground, alienation of lands for sewerage purposes etc*

Table 13.2 Little Wobby Sewerage Schemes – Comparison of Options

SCHEME OPTION	Do Nothing	W1 Centralised Pump-Out	W2 Local Treatment		W3 Transfer to Patonga	
Wastewater collected: A = Septic Effluent; B = Untreated sewage		**A**	**A**	**B**	**A**	**B**
Capital cost (without water supply; $1000)		638	811	964	1,234	1,329
NPV ($1,000)		*1,547*	*1,194*	*1,283*	*1,718*	*1,734*
Features						
▪ Existing on-site systems and practices retained	✓					
▪ Septic tank / AWTS only retained for part treatment on-site		✓	✓		✓	
▪ No on-site systems retained				✓		✓
▪ Centralised pump-out service by licensed operator		✓				
▪ Local treatment plant (130 EP capacity) with high quality effluent discharge to Hawkesbury River			✓	✓		
▪ Remote treatment & effluent management					✓	✓
▪ Compatible with reticulated water supply	Unlikely	At extra $	At extra $	At extra $	Yes	Yes
▪ Compatible with non-potable effluent reuse (in lieu of water supply)	No	No	Yes	Yes	No	No
Advantages						
▪ Maximises use of existing infrastructure (septic tanks, AWTS)	✓	✓	✓		✓	
▪ Reduced health risks and improved environmental outcomes		✓	✓		✓	
▪ Maximum health and environmental benefits				✓		✓
▪ Improved public amenity* with removal of on-site effluent disposal systems		✓	✓		✓	
▪ Maximum public amenity* realized with removal of all on-site systems				✓		✓
▪ No direct local effluent discharge to Hawkesbury River	✓	✓			✓	✓
▪ Opportunity to connect Patonga Creek community and Broken Bay SRC					✓	✓
Disadvantages						
▪ Limited improvement to current health, environmental and other problems	✓					
▪ Householder responsible for operation of on-site treatment (incl. desludging), effluent disposal system and costs of any upgrading required under OSMS	✓					
▪ Householder responsible for maintenance of septic tank (incl. desludging)		✓	✓		✓	
▪ Collection system (and Scheme) subject to detailed risk assessment due to ground/site conditions		✓	✓	✓	✓	✓
▪ Location of treatment plant and discharge site require community and regulatory authority acceptance			✓	✓		
▪ Effluent quality / impacts require detailed assessment			✓	✓		
▪ Transfer pipeline located in sensitive native bushland/terrain subject to environmental assessment and approvals					✓	✓

** Amenity issues include odours, boggy ground, alienation of lands for sewerage purposes etc*

14 REFERENCES

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2. Annual Water Quality Report – 2000/01 (Hornsby Shire Council)
3. Australian Guidelines for Sewerage Systems – Effluent Management (ANZECC, 1997)
4. Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC, November 1992)
5. Environment and Health Protection Guidelines: On-Site Sewage Management for Single Households (NSW EPA / DLG / DOH / DLWC / DUAP, Feb 1998)
6. Environmental Impact Statement for Brooklyn & Dangar Island: Priority Sewerage Program (Sydney Water, March 2000)
7. Independent Inquiry into the Hawkesbury Nepean River System: Final Report (Healthy Rivers Commission, August 1998)
8. NSW Guidelines for Urban & Residential Use of Reclaimed Water (NSW Recycled Water Coordination Committee, 1st Edition, May 1993)
9. NSW Reference Rates for Valuation of Existing Water Supply, Sewerage and Stormwater Assets (NSW Department of Land and Water Conservation, Sept 1999)
10. Small Town Sewerage: Guidelines on Financial Assistance and Implementation of Affordable Systems (DLWC, Oct 1997)

Mooney Mooney: Cost Estimates for Pressure Collection System

Design Load: All pressure system: Existing dwellings (2002): 149 Future dwellings: 192
Part pressure system: Existing dwellings (2002): 100 Future dwellings: 129

Capital Costs			**All Pressure System**						**Part Pressure System***					
Item		Unit	**GP System**			**STEP System**			**GP System**			**STEP System**		
			Qty	Rate	Amount ($1000)	Qty	Rate	Amount ($1000)	Qty	Rate	Amount ($1000)	Qty	Rate	Amount ($1000)
Pressure collection mains														
Service lines to property		m	300	$35	11	300	$35	11	200	$35	7	200	$35	7
40mm		m	500	$42	21	500	$42	21	250	$42	11	250	$42	11
50mm		m	420	$50	21	420	$50	21	210	$50	11	210	$50	11
63mm		m	600	$60	36	600	$60	36	440	$60	26	440	$60	26
75mm		m	240	$70	17	240	$70	17	300	$70	21	300	$70	21
90mm		m	20	$80	2	20	$80	2	0	$80	0	0	$80	0
			2,080			2,080			1,400			1,400		
Rock	Total excavation (m3)		392			392			272			272		
	Rock	%	30%			30%			35%			35%		
	Volume	m3	118	$110	13	118	$110	13	95	$110	10	95	$110	10
	Sub-total				120			120			86			86
Non-construction		Item		20%	24		20%	24		20%	17		20%	17
Contingencies		Item		20%	24		20%	24		20%	17		20%	17
Total collection mains					**$168**			**$168**			**$120**			**$120**
Property Service														
Property audit / design		ea	149	$300	45	149	$300	45	100	$300	30	100	$300	30
Supply / install pump unit (750L)		ea	149	$5,000	745	149	$4,000	596	100	$5,000	500	100	$4,000	400
Connect to collection system at property boundary		ea	149	$800	119	149	$800	119	100	$800	80	100	$800	80
Property Connection														
Decommission septic system		ea	149	$400	60				100	$400	40			
Decommission effluent diposal		ea				149	$100	15				100	$100	10
Plumbing to pump unit		ea	149	$400	60	149	$400	60	100	$400	40	100	$400	40
Total property services / connections					**$1,028**			**$834**			**$690**			**$560**
Total					**$1,196**			**$1,002**			**$810**			**$680**
Future Costs														
Extensions to vacant lots		m												
Pumping units (750L)		ea	43	$4,500	194	43	$3,500	151	29	$4,500	131	29	$3,500	102
Instal septic tank		ea				43	$2,500	108				29	$2,500	73
Connection to property boundary		ea	43	$600	26	43	$600	26	29	$600	17	29	$600	17
Total Future Costs					**$219**			**$284**			**$148**			**$191**
Total for collection system					**$1,415**			**$1,286**			**$958**			**$872**

O & M														
Item	Unit	Qty	Rate (pa)	Amount ($ pa)	Qty	Rate (pa)	Amount ($ pa)	Qty	Rate (pa)	Amount ($ pa)	Qty	Rate (pa)	Amount ($ pa)
Operations and maintenance													
Pressure mains	$Capital	$168K	1.0%	1,678	$168K	1.0%	1,678	$120K	1.0%	1,202	$120K	1.0%	1,202
Septic tank (avg no.)	ea				170	$120	20,400				114	$120	13,680
Pumping units (avg no.)	ea	170	$170	28,900	170	$95	16,150	114	$170	19,380	114	$95	10,830
Electricity to pump units	ea	170	$30	5,100	170	$25	4,250	114	$30	3,420	114	$25	2,850
Total O&M				**$35,678**			**$42,478**			**$24,002**			**$28,562**
Cost per ET (average no.)				$210			$250			$211			$251

NPV	Interest rate 7%	over 20 years						over 20 years					
Item	Unit	Qty	Rate (pa)	Amount ($1000)	Qty	Rate (pa)	Amount ($1000)	Qty	Rate (pa)	Amount ($1000)	Qty	Rate (pa)	Amount ($1000)
NPV O&M				$378			$450			$254			$303
NPV Capital costs													
Capital (initial)				$1,196			$1,002			$810			$680
Future				$116			$150			$78			$101
Total NPV				**$1,690**			**$1,603**			**$1,143**			**$1,084**

Cheero Point: Cost Estimates for Pressure Collection System

Design Load: Existing dwellings (2002): 51 Future dwellings: 90

Capital Costs			**GP System**			**STEP System**		
Item		Unit	Qty	Rate	Amount ($1000)	Qty	Rate	Amount ($1000)
Pressure collection mains								
Service lines to property		m	100	$35	4	100	$35	4
40mm		m	300	$42	13	300	$42	13
50mm		m	160	$50	8	160	$50	8
63mm		m	110	$60	7	110	$60	7
75mm		m	410	$70	29	410	$70	29
			1,080			1,080		
Rock	Total excavation (m3)		221			221		
	Rock	%	25%			25%		
	Volume	m3	55	$110	6	55	$110	6
		Sub-total			65			65
Non-construction		Item		20%	13		20%	13
Contingencies		Item		20%	13		20%	13
		Total collection mains			**$92**			**$92**
Property Service								
Property audit / design			51	$300	15	51	$300	15
Supply / install pump unit (750L)		ea	51	$5,000	255	51	$4,000	204
Connect to collection system at property boundary		ea	51	$800	41	51	$800	41
Propert Connection								
Decommission septic system		ea	51	$400	20			
Decommission effluent diposal system						51	$100	5
Plumbing to pump unit		ea	51	$400	20	51	$400	20
		Total property services / connections			**$352**			**$286**
		Total			**$444**			**$377**
Future Costs								
Extensions to vacant lots		m	200	$40	8	200	$40	8
Pumping units		ea	39	$4,500	176	39	$3,500	137
Instal septic tank						39	$2,500	98
Connect to property boundary		ea	39	$600	23	39	$600	23
		Total Future Costs			**$207**			**$265**
Total for collection system					**$650**			**$643**

O & M							
Item	Unit	Qty	Rate (pa)	Amount ($ pa)	Qty	Rate (pa)	Amount ($ pa)
Operations and maintenance							
Pressure mains	$Capital	$92K	1.0%	917	$92K	1.0%	917
Septic tank (avg no.)	ea				70	$120	8,400
Pumping units (avg no.)		70	$170	11,900	70	$95	6,650
Electricity to pump units	ea	70	$30	2,100	70	$25	1,750
	Total O&M			**$14,917**			**$17,717**
	Cost per ET (average no.)			$213			$253

NPV	Interest rate	7%	over 20 years				
Item	Unit	Qty	Rate (pa)	Amount ($1000)	Qty	Rate (pa)	Amount ($1000)
NPV O&M				$158			$188
NPV Capital costs							
Capital (initial)				$444			$377
Future				$110			$141
	Total NPV			**$711**			**$706**

Little Wobby: Cost Estimates for Pressure Collection System

Design Load: Existing dwellings (2002): 63 Future dwellings: 73

Capital Costs		**GP System**			**STEP System**		
Item	Unit	Qty	Rate	Amount ($1000)	Qty	Rate	Amount ($1000)
Pressure collection mains							
Service lines to property	m						
40mm	m	150	$42	6	150	$42	6
50mm	m	400	$50	20	400	$50	20
63mm	m	900	$60	54	900	$60	54
		1,450			1,450		
Extra for difficulty, access	m		$20	29		$20	29
Sub-total				80			80
Non-construction	Item		20%	16		20%	16
Contingencies	Item		20%	16		20%	16
Total collection mains				**$141**			**$141**
Property Service							
Property audit / design		63	$400	25	63	$400	25
Supply / install pump unit (750L)	ea	63	$6,000	378	63	$5,000	315
Plumbing to pump unit	ea	63	$400	25	63	$400	25
Property Connection							
Decommission septic system	ea	63	$600	38			
Decommission effluent diposal system					63	$100	6
Connect to collection main	ea	63	$400	25	63	$400	25
Total property services / connections				**491**			**397**
Total				**633**			**538**
Future Costs							
Pumping units	ea	10	$5,000	50	10	$4,000	40
Instal septic tank					10	$3,500	35
Connect to collection main	ea	10	$300	3	10	$300	3
Total Future Costs				**53**			**78**
Total for collection system				**686**			**616**

O & M							
Item	Unit	Qty	Rate (pa)	Amount ($ pa)	Qty	Rate (pa)	Amount ($ pa)
Operations and maintenance							
Pressure mains	$Capital	$141K	1.5%	2,121	$141K	1.5%	2,121
Septic tank (avg no.)	ea				68	$150	10,200
Without water supply:							
Pump units (avg no.)	ea	68	$187	12,716	68	$130	8,840
Electricity for pumps	ea	68	$13	884	68	$10	680
Total O&M				**15,721**			**21,841**
With water supply:							
Pump units (avg no.)		68	$220	14,960	68	$155	10,540
Electricity for pumps	ea	68	$30	2,040	68	$25	1,700
Total O&M				**19,121**			**24,561**
Cost per ET (average no.)				$281			$361

NPV Interest rate 7% over 20 years							
Item	Unit	Qty	Rate (pa)	Amount ($1000)	Qty	Rate (pa)	Amount ($1000)
NPV Capital costs							
Capital (initial)				633			538
Future				28			41
				661			580
NPV O&M - without water supply				167			231
NPV O&M - with water supply				203			260
Total NPV - without water supply				**827**			**811**
Total NPV - with water supply				**863**			**840**

Cost Estimates for Gravity Collection Systems

Design load:

Cheero Point: Existing dwellings (2002): 51 Future dwellings: 90

Part Mooney Mooney: Existing dwellings (2002): 49 Future dwellings: 63

Item			Cheero Point						Part Mooney Mooney*					
			Modified Conv. Gravity			Common Eff. Drainage			Modified Conv. Gravity			Common Eff. Drainage		
		Unit	Qty	Rate	Amount ($1000)	Qty	Rate	Amount ($1000)	Qty	Rate	Amount ($1000)	Qty	Rate	Amount ($1000)
Gravity mains:														
100mm	Sidelines to property		200	$45	9	200	$45	9		$45	0		$45	0
	< 1.5m	m		$73	0	250	$73	18		$73	0	50	$73	4
	1.5-3.0m	m		$109	0		$109	0		$109	0		$109	0
	3.0-4.5m	m		$144	0		$144	0		$144	0		$144	0
150mm	< 1.5m	m	480	$87	42	450	$87	39	280	$87	24	300	$87	26
	1.5-3.0m	m	420	$126	53	200	$126	25	150	$126	19	160	$126	20
	3.0-4.5m	m		$162	0		$162	0	100	$162	16	20	$162	3
			1,100			1,100			530			530		
External dewatering		m	100	$60	6	100	$60	6	250	$80	15	180	$80	14
Rock	Total excavation (m3)		1,074			897			647			529		
	Rock	%	25%			25%			30%			25%		
	Volume	m3	269	$110	30	224	$110	25	194	$110	21	132	$110	15
Extra for difficulty, access etc									530	$80	42	530	$80	42
Pump stations:														
Catchment PStns		no.	2	$100,000	200	2	$90,000	180	Incl. In transfer system			Incl. In transfer system		
Rising mains:														
	50 mm	m	360	$39	14	360	$39	14	Incl. In transfer system			Incl. In transfer system		
		Sub-total			353			316			138			82
Non-construction		Item		20%	71		20%	63		20%	28		20%	16
Contingency		Item		20%	71		20%	63		20%	33		20%	16
		Total collection			$495			$443			$199			$115
Property connection:														
Decommission septic system		ea	51	$400	20				49	$400	20	49		
Decommission effluent disposal		ea				51	$100	5				49	$100	5
Connect to gravity sewer		ea	51	$2,500	128	51	$2,200	112	49	$2,500	123	49	$2,200	108
	Total property connections				$148			$117			$142			$113
	Total				**$642**			**$560**			**$341**			**$228**
Future Costs														
Extensions to vacant lots	100mm	m	100	$45	5	100	$45	5		$45	0		$45	0
	150mm	m	200	$73	15	200	$73	15		$73	0		$73	0
Future sewer connections		ea	39	$1,500	59	39	$1,300	51	14	$1,500	21	14	$1,300	18
Future septic tanks		ea				39	$2,500	98				14	$2,500	35
	Total Future Costs				**$78**			**$167**			**$21**			**$53**
Total for collection system					**$720**			**$727**			**$362**			**$280**

Operation & Maintenance														
Item	**Unit**	Qty	Rate	Amount ($ pa)	Qty	Rate	Amount ($ pa)	Qty	Rate (pa)	Amount ($ pa)	Qty	Rate	Amount ($ pa)
Operations and maintenance													
Gravity mains	$Capital	$195K	1.5%	$2,924	$171K	1.2%	$2,054	$134K	2.0%	$2,683	$115K	1.2%	$1,379
Rising mains	$Capital	$20K	0.5%	$98	$20K	0.5%	$98	$0K	0.5%	$0	$0K	0.5%	$0
Pump stations	$Capital	$280K	5.0%	$14,000	$252K	5.0%	$12,600	$0K			$0K	0.0%	$0
Septic tank (avg no.)	ea				70	$120	$8,400				56	$120	$6,720
	Total O&M			**$17,022**			**$23,152**			**$2,683**			**$8,099**
	Cost per ET (average no.)	70		$243	70		$331	56		$48	56		$145

NPV	Interest rate 7%	over 20 years											
Item		Qty	Rate (pa)	Amount ($1000)	Qty	Rate (pa)	Amount ($1000)	Qty	Rate (pa)	Amount ($1000)	Qty	Rate (pa)	Amount ($1000)
NPV O&M				180			245			28			162
NPV Capital costs													
	Initial stage			642			560			341			228
	Future			41			89			21			53
	Total NPV			**864**			**894**			**391**			**443**

Cost Estimates: Transfer Systems

Capital Cost Estimate	**Mooney-Cheero**						**Little Wobby**	
Collection System Type	All Pressure		Pressure at Mooney; Gravity at Cheero Point		Gravity at Cheero Pt & part Mooney; pressure remainder Mooney		Pressure	
Transfer from:	Mooney	Cheero Point	Mooney	Cheero Point	Mooney	Cheero Point	Little Wobby	Little Wobby
Transfer to:	STP	Mooney	STP	Mooney	STP	Mooney	Patonga	Dangar Is
Design criteria								
Future EP	580	180	580	180	580	180	130	130
ADWF (L/s)	1.41	0.44	1.4	0.44	1.41	0.44	0.08	0.08
With future water supply							0.32	0.32
r				3.34	3.05	3.34		
PDWF (L/s) (grav only)				1.46	2.31	1.46		
Storm Allowance - grav systems (L/s)			1.88	1.88	3.10	1.88		
Peak Design Flow (L/s)	5.6	1.8	7.2	3.3	8.3	3.3	0.3	0.3
With future water supply							1.3	1.3
Rising main:								
Diameter (mm)	80	65	80	80	100	80	50	50
Length (m)	1200	1800	1200	2100	1350	1500	2500	1000
Detention time (hrs)	1.2	3.8	1.2	6.7	2.1	4.8	18.1	7.2
With future water supply							4.3	1.7
Cost Estimate								
Pump station	$120,000	$107,000	$125,000	$110,000	$140,000	$110,000	$135,000	$80,000
Emergency storage	41 kL	13 kL	41 kL	13 kL	41 kL	13 kL	2 kL	2 kL
Amount @ $500/kL	$20,300	$6,300	$20,300	$6,300	$20,300	$6,300	$1,083	$1,083
Rising Main:								
Base rate	$60/m	$50/m	$60/m	$60/m	$70/m	$60/m	$40/m	
Directional drill								$600/m
Amount	$72,000	$90,000	$72,000	$126,000	$94,500	$90,000	$100,000	$600,000
Extra for roadworks	$6,000	$18,000	$6,000	$21,000	$6,750	$15,000		
Extra for rock	$6,000	$8,000	$6,000	$8,000	$6,000	$8,000	$20,000	
High pressure/steep pipelines							$30,000	
Extra for clearing and access							$30,000	
Extra for env. protection							$35,000	
Extra for Patonga Ck crossing							$50,000	
Septicity/odour control	$20,000		$20,000	At Mooney	$20,000	At Mooney	$15,000	$15,000
Sub-total	$244,300	$229,300	$249,300	$271,300	$287,550	$229,300	$416,083	$696,083
Non-construction 20%	$48,860	$45,860	$49,860	$54,260	$57,510	$45,860	$83,217	$139,217
Land acquisition					$250,000			
Contingencies 20%	$48,860	$45,860	$49,860	$54,260	$57,510	$45,860	$83,217	$139,217
Total	$342,020	$321,020	$349,020	$379,820	$652,570	$321,020	$582,517	$974,517
Say	**$342,000**	**$321,000**	**$349,000**	**$380,000**	**$653,000**	**$321,000**	**$583,000**	**$975,000**

OPERATION & MAINTENANCE									
PS	6.0%	of $Capital	$7,200	$6,420	$7,500	$6,600	$8,400	$6,600	$8,100	$4,800
RM	0.5%	of $Capital	$420	$1,147	$420	$1,357	$536	$1,147		
RM	1.0%	of $Capital							$4,161	
RM (drill)	0.05%	of $Capital								$300
Septicity Control		$10 /EP	$5,800		$5,800		$5,800		$1,300	$1,300
Total O&M ($pa)			$13,420	$7,567	$13,720	$7,957	$14,736	$7,747	$13,561	$6,400
With water supply @ L Wobby									$16,161	$9,000

NPV								
@ 7% over 20 yrs								
Capital cost	$342,000	$321,000	$349,000	$380,000	$653,000	$321,000	$583,000	$975,000
O&M	$142,172	$80,160	$145,350	$84,291	$156,116	$82,067	$143,664	$67,802
Total	$484,172	$401,160	$494,350	$464,291	$809,116	$403,067	$726,664	$1,042,802
NPV (say)	**$484,000**	**$401,000**	**$494,000**	**$464,000**	**$809,000**	**$403,000**	**$727,000**	**$1,043,000**
O&M with water supply at L Wobby							$171,208	$95,346
NPV							**$754,000**	**$1,070,000**

Mooney-Cheero - Cost Estimates: Treatment

Item	Option 1A		Option 1B		Option 2A		Option 2B		Option 3A		Option 3B	
	Independent local STP				Including Peat Island				Including Peat Is, Brooklyn-Dangar			
Design load	600 EP				1800 EP				3350 EP			
Effluent volume	46 ML/a				137 ML/a				256 ML/a			
Collection system (Mooney-Cheero)	STEP collection		GP collection		STEP collection		GP collection		STEP collection		GP collection	
Capital Cost ($1000)		Amount		Amount		Amount		Amount		Amount		Amount
Siteworks and services		80		80		120		120		200		200
Treatment plant	$1300 /EP	780	$1500 /EP	900	$1060 /EP	1,908	$1100 /EP	1,980	$890 /EP	2,982	$900 /EP	3,015
Extra for noise/odour management		40		40		90		90		150		150
Decommission Peat Is plant						100		100		100		100
Sub-total		900		1,020		2,218		2,290		3,432		3,465
Non-construction & contingencies	40%	360	40%	408	40%	887	40%	916	40%	1,373	40%	1,386
Land matters		50		50		50		50		50		50
Total		1,310		1,478		3,155		3,256		4,854		4,901
Say		**1,310**		**1,480**		**3,160**		**3,260**		**4,850**		**4,900**
Operation & Maintenance (pa)												
Operations	$0.25 / kL	$11,500	$0.40 / kL	$18,400	$0.32 / kL	$43,840	$0.35 / kL	$47,950	$0.30 / kL	$76,800	$0.31 / kL	$79,360
Maintenance (% of capital cost)	2%	$26	2%	$30	2%	$63	2%	$65	2%	$97	2%	$98
Total (pa)		$11,526		$18,430		$43,903		$48,015		$76,897		$79,458
NPV @ 7% over 20 years ($1000)		122		195		465		509		815		842
Total NPV ($1000)		**1,432**		**1,675**		**3,625**		**3,769**		**5,665**		**5,742**
Cost sharing (Options 2 and 3):												
a) Capital Cost ($1000)												
Mooney-Cheero						1,050		1,090		870		880
Peat Island						2,110		2,170		1,740		1,760
Brooklyn-Dangar Is										2,240		2,260
b) O&M ($ pa)												
Mooney-Cheero						$14,630		$16,010		$25,630		$26,490
Peat Island						$29,273		$32,005		$27,550		$28,460
Brooklyn-Dangar Is										$23,717		$24,508
c) NPV ($1000)												
Mooney-Cheero						1,210		1,260		1,010		1,030
Peat Island						2,415		2,509		2,030		2,060
Brooklyn-Dangar Is										2,625		2,652

Mooney-Cheero - Cost Estimates: Effluent Management

Item	Option 1		Option 2		Option 3	
	Independent local STP		Incl. Peat Island		Incl. Peat Is, Brooklyn-Dangar	
Capacity	600 EP		1800 EP		3350 EP	
Effluent volume	46 ML/a		138 ML/a		257 ML/a	
Capital Cost						
Transfer capacity	5.8 L/s		17.5 L/s		33 L/s	
Effluent Pump Station		$30,000		$60,000		$90,000
Effluent main:						
Diameter	100 mm		150 mm		200 mm	
Length	500 m		500 m		500 m	
Cost	$60 / m	$30,000	$75 / m	$37,500	$90 / m	$45,000
Discharge / diffuser		$20,000		$30,000		$50,000
Sub-total		$80,000		$127,500		$185,000
Non-construction & contingencies	40%	$32,000	40%	$51,000	40%	$74,000
Total		$112,000		$178,500		$259,000
Say		**$112,000**		**$180,000**		**$260,000**
Operation & Maintenance (pa)						
Pump operations	$5 / ML	$230	$4 / ML	$552	$4 / ML	$1,028
Monitoring		$12,000		$15,000		$20,000
Maintenance (% of capital cost)	2%	$2,240	2%	$3,600	2%	$5,200
Total		$14,470		$19,152		$26,228
Say		**$14,500**		**$19,200**		**$26,200**
NPV @ 7% over 20 years		$153,000		$203,000		$278,000
Total NPV		**$265,000**		**$383,000**		**$538,000**
Cost sharing (Options 2 and 3):						
a) Capital Cost						
Mooney-Cheero				$60,000		$47,000
Peat Island				$120,000		$93,000
Brooklyn-Dangar Is						$120,000
b) O&M						
Mooney-Cheero				$6,400		$4,700
Peat Island				$12,800		$9,400
Brooklyn-Dangar Is						$12,100
c) NPV						
Mooney-Cheero				$128,000		$96,000
Peat Island				$255,000		$193,000
Brooklyn-Dangar Is						$249,000

Little Wobby - Cost Estimates: Treatment and Effluent Management

Item	**Little Wobby**										
Option	**Without reticulated water supply**						**With reticulated water supply**				**Remote Treatment***
	Option 1		**Option 2A**		**Option 2B**		**Option 2A**		**Option 2B**		
	Centralised Pump-out		Local STP		Local STP		Local STP		Local STP		
Collection system type	STEP collection		STEP collection		GP collection		STEP collection		GP collection		
Capacity	106 (average)		130 EP		130 EP		130 EP		130 EP		130 EP
Effluent volume	1.9 ML/a	(=5.3 kL/d)	1.9 ML/a		1.9 ML/a		8.1 ML/a	(=22 kL/d)	8.1 ML/a		8.1 ML/a
Capital Cost		Amount		Amount		Amount		Amount		Amount	Amount
Siteworks and services		$5,000		$20,000		$20,000		$20,000		$20,000	
Effluent collection facilities	50 kL	$30,000									
Treatment plant			$900 / EP	$117,000	$1200 / EP	$156,000	$1800 / EP	$234,000	$2000 / EP	$260,000	
Effluent discharge / diffuser				$8,000		$8,000		$10,000		$10,000	
Extra for noise/odour management		$5,000		$10,000		$10,000		$15,000		$15,000	
Sub-total		$40,000		$155,000		$194,000		$279,000		$305,000	
Non-construction & contingencies	40%	$16,000	40%	$62,000	40%	$77,600	40%	$111,600	40%	$122,000	
Land matters		$40,000		$40,000		$40,000		$40,000		$40,000	
Extra for remote access	10%	$4,000	10%	$15,500	10%	$19,400	10%	$27,900	10%	$30,500	
Total		$100,000		$272,500		$331,000		$458,500		$497,500	$112,639
Say		**$100,000**		**$273,000**		**$331,000**		**$459,000**		**$498,000**	**$113,000**
Operation & Maintenance (pa)											
Pump-out service	$30 / kL	$57,000									
Operations			$0.50 / kL	$950	$0.60 / kL	$1,140	$0.40 / kL	$3,240	$0.45 / kL	$3,645	
Monitoring		$1,000		$4,000		$4,000		$6,000		$6,000	$6,360
Maintenance (% of capital cost)	2%	$2,000	2%	$5,460	2%	$6,620	2%	$9,180	2%	$9,960	
Total		$60,000		$10,410		$11,760		$18,420		$19,605	$6,360
NPV @ 7% over 20 years		$636,000		$110,000		$125,000		$195,000		$208,000	$67,000
Totals											
Capital Cost		**$100,000**		**$273,000**		**$331,000**		**$459,000**		**$498,000**	**$113,000**
NPV (@ 7% over 20 years)		**$736,000**		**$383,000**		**$456,000**		**$654,000**		**$706,000**	**$180,000**

* For Remote Treatment (Patonga, Brooklyn), capital cost based on GCC developer headworks charge of $1543/ET (future 73ET)
O&M based on $60/EP (average load 106EP)

Cost Estimates: Water Supply to Little Wobby
Connect to Water Supply at Patonga

Capital Cost Estimate		**In conjunction with Sewerage Option 3 (transfers to Patonga)**		**Under Sewerage Options 2 (Local Treatment) and 4 (Transfer to Dangar Is)**	
Service zone	73 ET				
Peak load	130 EP				
Avg day demand	250 L/EP				
	33 kL/d				
Peak day demand	65 kL/d				
Peak flow rate (22 hrs)	0.8 L/s				
Cost Estimate			Amount		Amount
Pipeline: Patonga to Little Wobby					
Diameter (mm)		50		50	
Length (m)		2500		2500	
Cut and cover base cost		$40/m	$100,000	$40/m	$100,000
Extra for roadworks					
Extra for rock			$15,000		$20,000
High pressure/steep pipelines			$15,000		$30,000
Extra for clearing and access					$30,000
Extra for env. protection					$35,000
Extra for Patonga Ck crossing			$10,000		$50,000
Sub-total			$140,000		$265,000
Booster Pump Station			$10,000		$10,000
Break tank / reservoir			$30,000		$30,000
Reticulation		$1500 / ET	$109,500	$2500 / ET	$182,500
Sub-total			$289,500		$487,500
Non-construction	20%		$57,900		$97,500
Contingencies	20%		$57,900		$97,500
			$405,300		$682,500
Property connections and meters		$800 / ET	$50,400	$800 / ET	$50,400
Allow for headworks and distribution*		$1969 / ET	$143,737		$143,737
Total			$599,437		$876,637
Say			**$599,000**		**$877,000**
Cost per ET			**$8,205**		**$12,014**
Operation and maintenance (pa)					
Estimate at $1 / kL			$11,863		$11,863
NPV at 7% over 20 years			$125,671		$125,671
Total NPV			$724,671		$1,002,671
		Say	**$725,000**	**Say**	**$1,003,000**

* Current headworks charge for new developments: $1474 for headworks, $495 for distribution

Little Wobby - Cost Estimate: Recycled (Non-Potable) Supply

Item			Amount
Applicable to Option 2 only (local treatment)			
Treatment capacity		130 EP	
Service area		73 ET	
Effluent volume (tank water + recycled effluent)		3.8 ML/a	
Volume of recycled effluent (30% of effluent vol under Options with reticulated water supply)		2.4 ML/a	
Capital Cost (additional)			
Treatment			
Additional hydraulic capacity		$250 / EP	$32,500
Additional treatment units (chlorination, controls)			$40,000
Distribution			
Pump station			$10,000
Header tank			$20,000
Reticulation		$2000 / ET	$146,000
Household plumbing alterations		$500 / ET	$36,500
	Sub-total		$285,000
Non-construction & contingencies		40%	$114,000
Extra for remote access		10%	$28,500
	Total		$427,500
		Say	**$428,000**
Operation & Maintenance (additional pa)			
Operations		$0.50 / kL	$1,215
Monitoring			$3,000
Maintenance (% of capital cost)		1%	$4,280
	Total		$8,495
NPV @ 7% over 20 years			$90,000
Total additional cost:			
Capital Cost			**$428,000**
NPV (@ 7% over 20 years)			**$518,000**

Mooney-Cheero Schemes: Estimate Summary

Scheme / Component	**Option 1** Independent Scheme		**Option 2** Combine with Peat Is		**Option 3** Combine with Peat Is and Brooklyn	
Wastewater collected	Septic Eff	Sewage	Septic Eff	Sewage	Septic Eff	Sewage
Treatment & Effluent Management						
Capacity	600 EP		1800 EP		3350 EP	
Mooney-Cheero share	600 EP		600 EP		600 EP	
Peat Is share			1200 EP		1200 EP	
Brooklyn share					1550 EP	
Capital cost ($1000)						
Treatment	1,310	1,480	3,160	3,260	4,850	4,900
Effluent management	112	112	180	180	260	260
Total	**1,422**	**1,592**	**3,340**	**3,440**	**5,110**	**5,160**
Mooney-Cheero share	1,422	1,592	1,047	1,147	874	924
Peat Is share			2,293	2,293	1,848	1,848
Brooklyn share					2,387	2,387
O&M ($pa)						
Treatment	11,526	18,430	43,903	48,015	76,897	79,458
Effluent management	14,500	14,500	19,200	19,200	26,200	26,200
Total	**26,026**	**32,930**	**63,103**	**67,215**	**103,097**	**105,658**
Mooney-Cheero share	26,026	32,930	18,293	22,405	16,363	18,924
Cost per ET (avg 240 ET)	$108	$137	$76	$93	$68	$79
Peat Is share			44,810	44,810	37,848	37,848
Brooklyn share					48,887	48,887
NPV ($1000)						
Treatment	1,432	1,675	3,625	3,769	5,665	5,742
Effluent management	265	265	383	383	538	538
Total	**1,697**	**1,940**	**4,008**	**4,152**	**6,203**	**6,280**
Mooney-Cheero share	1,697	1,940	1,240	1,384	1,048	1,125
Peat Is share			2,768	2,768	2,250	2,250
Brooklyn share					2,906	2,906
Collection & Transfer System			**As for Option 1**			
Total capacity (= future ET)	277 ET					
1. Pressure collection systems						
Capital cost ($1000)						
Cheero Point collection	352	403				
Mooney Mooney collection	928	1,077				
Transfer Cheero to Mooney	321	321				
Transfer Mooney to STP	342	342				
Total	**1,942**	**2,142**				
Cost per ET	$7,012	$7,734				
Property connections	100	160				
Cost per ET (200 ET existing)	$500	$800				
Total capital cost	**2,042**	**2,302**				
O&M ($pa)						
Cheero Point collection	7,567	12,817				
Mooney Mooney collection	17,828	30,578				
Transfer Cheero to Mooney	7,567	7,567				
Transfer Mooney to STP	13,420	13,420				
Total scheme	**46,381**	**64,381**				
Cost per ET (avg 240 ET)	$193	$268				
Householder:						
- Septic tanks	28,800					
- Electricity for pump units	6,000	7,200				
Total Householders	**34,800**	**7,200**				
Cost per ET (avg 240 ET)	$145	$30				
Total O&M ($pa)	**81,181**	**71,581**				
NPV ($1000)						
Cheero Point collection	706	711				
Mooney Mooney collection	1,603	1,690				
Transfer Cheero to Mooney	401	401				
Transfer Mooney to STP	484	484				
Total	**3,193**	**3,286**				
Cost per future ET	$11,527	$11,864				

Mooney-Cheero Schemes: Estimate Summary

Scheme / Component	**Option 1** Independent Scheme		**Option 2** Combine with Peat Is		**Option 3** Combine with Peat Is and Brooklyn	
Wastewater collected	Septic Eff	Sewage	Septic Eff	Sewage	Septic Eff	Sewage
B. Gravity at Cheero; Pressure at Mooney						
Capital cost ($1000)						
Cheero Point collection	443	495				
Mooney Mooney collection	928	1,077				
Transfer Cheero to Mooney	380	380				
Transfer Mooney to STP	349	349				
Total scheme	**2,100**	**2,300**				
Cost per ET	$7,579	$8,304				
Property connections	192	267				
Cost per ET (200 ET existing)	$959	$1,336				
Total capital cost	**2,291**	**2,567**				
O&M ($pa)						
Cheero Point collection	14,752	17,022				
Mooney Mooney collection	17,828	30,578				
Transfer Cheero to Mooney	7,957	7,957				
Transfer Mooney to STP	13,720	13,720				
Total scheme	**54,257**	**69,276**				
Cost per ET (avg 240 ET)	$226	$289				
Householder:						
- Septic tanks	24,550					
- Electricity for pump units	4,250	5,100				
Total Householders	**28,800**	**5,100**				
Cost per ET (avg 240 ET)	$120	$21				
Total O&M ($pa)	**83,057**	**74,376**				
NPV ($1000)						
Cheero Point collection	894	864				
Mooney Mooney collection	1,603	1,690				
Transfer Cheero to Mooney	464	464				
Transfer Mooney to STP	494	494				
Total	**3,455**	**3,512**				
Cost per future ET	$12,471	$12,678				
C. Gravity at Cheero and part Mooney; remainder pressure at Mooney						
Capital cost ($1000)						
Cheero Point collection	443	495				
Mooney Mooney collection	745	929				
Transfer Cheero to Mooney	321	321				
Transfer Mooney to STP	653	653				
Total scheme	**2,162**	**2,398**				
Cost per ET	$7,805	$8,656				
Property connections	280	370				
Cost per ET (200 ET existing)	$1,400	$1,850				
Total capital cost	**2,442**	**2,768**				
O&M ($pa)						
Cheero Point collection	14,752	17,022				
Mooney Mooney collection	11,731	23,265				
Transfer Cheero to Mooney	7,747	7,747				
Transfer Mooney to STP	14,736	14,736				
Total scheme	**48,966**	**62,770**				
Cost per ET (avg 240 ET)	204	262				
Householder:						
- Septic tanks	28,800					
- Electricity for pump units	2,850	3,420				
Total householders	**31,650**	**3,420**				
Cost per ET (avg 240 ET)	$132	$14				
Total O&M ($pa)	**80,616**	**66,190**				
NPV ($1000)						
Cheero Point collection	894	864				
Mooney Mooney collection	1,527	1,533				
Transfer Cheero to Mooney	403	403				
Transfer Mooney to STP	809	809				
Total	**3,633**	**3,609**				

Mooney-Cheero Schemes: Estimate Summary

Scheme / Component	**Option 1** Independent Scheme		**Option 2** Combine with Peat Is		**Option 3** Combine with Peat Is and Brooklyn	
Wastewater collected	Septic Eff	Sewage	Septic Eff	Sewage	Septic Eff	Sewage
Cost per future ET	$13,116	$13,030				
Scheme Summary - Cheero-Mooney share only						
A. Pressure collection only						
Capital cost ($1000)						
Scheme capital cost	3,364	3,734	2,989	3,289	2,817	3,067
Cost per future ET	$12,146	$13,482	$10,791	$11,874	$10,168	$11,071
Property connections	100	160	100	160	100	160
Cost per existing ET (200)	$500	$800	$500	$800	$500	$800
Total capital cost	**3,464**	**3,894**	**3,089**	**3,449**	**2,917**	**3,227**
O&M ($pa)						
Scheme O&M per ET (240 ET)	$302	$405	$269	$362	$261	$347
Household direct cost per ET	$145	$30	$145	$30	$145	$30
O&M per ET ($pa)	$447	$435	$414	$392	$406	$377
NPV ($1000)	4,890	5,226	4,433	4,670	4,241	4,411
NPV per future ET ($)	$17,654	$18,867	$16,004	$16,860	$15,310	$15,924
B. With gravity collection at Cheero						
Capital cost ($1000)						
Extra to scheme over A.	157	158	157	158	157	158
Cost per future ET (85)	$1,848	$1,856	$1,848	$1,856	$1,848	$1,856
Extra to A. for property connections	92	107	92	107	92	107
Cost per existing ET (51)	$1,800	$2,100	$1,800	$2,100	$1,800	$2,100
Total extra	**249**	**265**	**249**	**265**	**249**	**265**
Total scheme capital cost	3,522	3,892	3,146	3,447	2,974	3,224
Total property connections	192	267	192	267	192	267
Total capital cost	**3,713**	**4,159**	**3,338**	**3,714**	**3,165**	**3,492**
O&M ($pa)						
Extra to scheme over A.	7,876	4,895	7,876	4,895	7,876	4,895
Extra to householder over A.	-6,000	-2,100	-6,000	-2,100	-6,000	-2,100
Net extra	1,876	2,795	1,876	2,795	1,876	2,795
Extra per ET served (avg 70 ET)	$27	$40	$27	$40	$27	$40
NPV ($1000)	5,152	5,452	4,695	4,896	4,502	4,637
NPV per future ET ($)	18,598	19,682	16,948	17,675	16,254	16,739
C. Grav at Cheero, part Mooney; remainder pressure at Mooney						
Capital cost ($1000)						
Extra to scheme over A.	220	255	220	255	220	255
Cost per future ET (148)	$1,483	$1,725	$1,483	$1,725	$1,483	$1,725
Extra to A. for property connections	180	210	180	210	180	210
Cost per existing ET (100)	$1,800	$2,100	$1,800	$2,100	$1,800	$2,100
Total extra	**400**	**465**	**400**	**465**	**400**	**465**
Total scheme capital cost	3,584	3,990	3,209	3,544	3,036	3,322
Total property connections	280	370	280	370	280	370
Total capital cost	**3,864**	**4,360**	**3,489**	**3,914**	**3,316**	**3,692**
O&M ($pa)						
Extra to scheme over A.	2,585	-1,611	2,585	-1,611	2,585	-1,611
Extra to householder over A.	-3,150	-3,780	-3,150	-3,780	-3,150	-3,780
Net extra	-565	-5,391	-565	-5,391	-565	-5,391
Extra per ET served (avg 126 ET)	-$4	-$43	-$4	-$43	-$4	-$43
NPV ($1000)	5,330	5,549	4,873	4,993	4,681	4,734
NPV per future ET ($)	19,242	20,033	17,592	18,026	16,898	17,090

Little Wobby Schemes: Estimate Summary

Scheme Option	**Option 1** Central pump-out	**Option 2** Local treatment		**Option 3** Transfer to Patonga		**Option 4** Transfer to Dangar Is	
Collection system	STEP	STEP	GP	STEP	GP	STEP	GP
Capital Costs							
Collection	507	507	570	507	570	507	570
Transfers	NA	NA	NA	583	583	975	975
Treatment & EM	100	273	331	113	113	113	113
Scheme ($1000)	**607**	**780**	**901**	**1,203**	**1,266**	**1,595**	**1,658**
Cost per ET ($) 73 ET	$8,313	$10,682	$12,340	$16,477	$17,340	$21,847	$22,710
Property connections ($1000):	32	32	63	32	63	32	63
Cost ($) per connection (63 ET)	$500	$500	$1,000	$500	$1,000	$500	$1,000
Total capital cost ($1000)	**638**	**811**	**964**	**1,234**	**1,329**	**1,626**	**1,721**
Operation & Maintenance ($ pa)							
Collection	10,757	10,757	14,837	10,757	14,837	10,757	14,837
Transfers	NA	NA	NA	13,561	13,561	6,400	6,400
Treatment & EM	60,000	10,410	11,760	6,360	6,360	6,360	6,360
Scheme O&M	**70,757**	**21,167**	**26,597**	**30,678**	**34,758**	**23,517**	**27,597**
Householder costs	11,084	11,084	884	11,084	884	11,084	884
Total O&M	**81,841**	**32,251**	**27,481**	**41,762**	**35,642**	**34,601**	**28,481**
Cost ($) per ET (average 68 ET):							
- Scheme	$1,041	$311	$391	$451	$511	$346	$406
- Householder	$163	$163	$13	$163	$13	$163	$13
Total cost per ET ($pa)	$1,204	$474	$404	$614	$524	$509	$419
NPV ($1000 at 7% over 20 years)							
Collection	811	811	827	811	827	811	827
Transfers	NA	NA	NA	727	727	1,043	1,043
Treatment & EM	736	383	456	180	180	180	180
Total NPV	**1,547**	**1,194**	**1,283**	**1,718**	**1,734**	**2,034**	**2,050**
Sewerage with reticulated water supply							
Capital Costs							
Collection		507	570	507	570	507	570
Transfers		NA	NA	583	583	975	975
Treatment & EM		459	498	113	113	113	113
Scheme ($1000)		**966**	**1,068**	**1,203**	**1,266**	**1,595**	**1,658**
Cost per ET ($) 73 ET		$13,230	$14,628	$16,477	$17,340	$21,847	$22,710
Property connections ($1000):		32	63	32	63	32	63
Cost ($) per connection (63 ET)		$500	$1,000	$500	$1,000	$500	$1,000
Total capital cost ($1000)		**997**	**1,131**	**1,234**	**1,329**	**1,626**	**1,721**
Operation & Maintenance ($ pa)							
Collection		12,661	17,081	12,661	17,081	12,661	17,081
Transfers		NA	NA	16,161	16,161	9,000	9,000
Treatment & EM		18,420	19,605	6,360	6,360	6,360	6,360
Scheme O&M		**31,081**	**36,686**	**35,182**	**39,602**	**28,021**	**32,441**
Householder costs		11,900	2,040	11,900	2,040	11,900	2,040
Total O&M		**42,981**	**38,726**	**47,082**	**41,642**	**39,921**	**34,481**
Cost ($) per ET (average 68 ET):							
- Scheme		$457	$540	$517	$582	$412	$477
- Householder		$175	$30	$175	$30	$175	$30
Total cost per ET ($pa)		$632	$570	$692	$612	$587	$507
NPV ($1000 at 7% over 20 years)							
Collection		840	863	840	863	840	863
Transfers		NA	NA	754	754	1,070	1,070
Treatment & EM		654	706	180	180	180	180
Total NPV		**1,494**	**1,569**	**1,774**	**1,797**	**2,090**	**2,113**
Estimate for water supply ($1000)							
Reticulated supply		683	683	405	405	683	683
Headworks / distribution charge(#)		144	144	144	144	144	144
Scheme		**827**	**827**	**549**	**549**	**827**	**827**
Cost per ET ($) 73 ET		$11,323	$11,323	$7,515	$7,515	$11,323	$11,323
Property connections ($1000):		50	50	50	50	50	50
Cost per connection (63 ET)		$800	$800	$800	$800	$800	$800
Total capital cost ($1000)		**877**	**877**	**599**	**599**	**877**	**877**
Operation & Maintenance ($ pa)							
Estimate at $1.00/kL (250L/EP/d)		11,863	11,863	11,863	11,863	11,863	11,863
Cost per ET ($) 68 ET		$174	$174	$174	$174	$174	$174
NPV (at 7% over 20 years)		**1,003**	**1,003**	**725**	**725**	**1,003**	**1,003**

Little Wobby Schemes: Estimate Summary

Scheme Option	**Option 1** Central pump-out	**Option 2** Local treatment		**Option 3** Transfer to Patonga		**Option 4** Transfer to Dangar Is	
Collection system	STEP	STEP	GP	STEP	GP	STEP	GP
Total sewerage and water supply							
Capital cost ($1,000)							
Scheme		**1,792**	**1,894**	**1,751**	**1,814**	**2,421**	**2,484**
Property connections		82	113	82	113	82	113
		1,874	**2,008**	**1,833**	**1,928**	**2,503**	**2,598**
Cost ($) per ET (73 ET)		$24,554	$25,951	$23,992	$24,855	$33,170	$34,033
Property connection ($) per ET (63 ET)		$1,300	$1,800	$1,300	$1,800	$1,300	$1,800
NPV ($1,000)		**2,497**	**2,572**	**2,499**	**2,522**	**3,093**	**3,116**
Sewerage with non-potable reuse ($1,000)							
Sewerage scheme incl. reuse		1,157	1,278				
Cost per ET ($) 73 ET		$15,855	$17,513				
Property connections:							
- sewerage scheme		32	63				
- reuse scheme		50	50				
		82	113				
Cost ($) per connection (63 ET)		$1,300	$1,800				
Total capital cost ($1000)		**1,239**	**1,392**				
Operation & Maintenance ($ pa)							
Scheme O&M		28,982	34,412				
Householder		11,764	1,564				
Total O&M		40,746	35,976				
Cost ($) per ET (average 68 ET):							
- Scheme		$426	$506				
- Householder		$173	$23				
Total		$599	$529				
NPV ($1000)		**1,712**	**1,801**				

Headworks $1474 + distribution $495

Householder O&M costs include septic tank maintenance and electricity for STEP and GP pump units

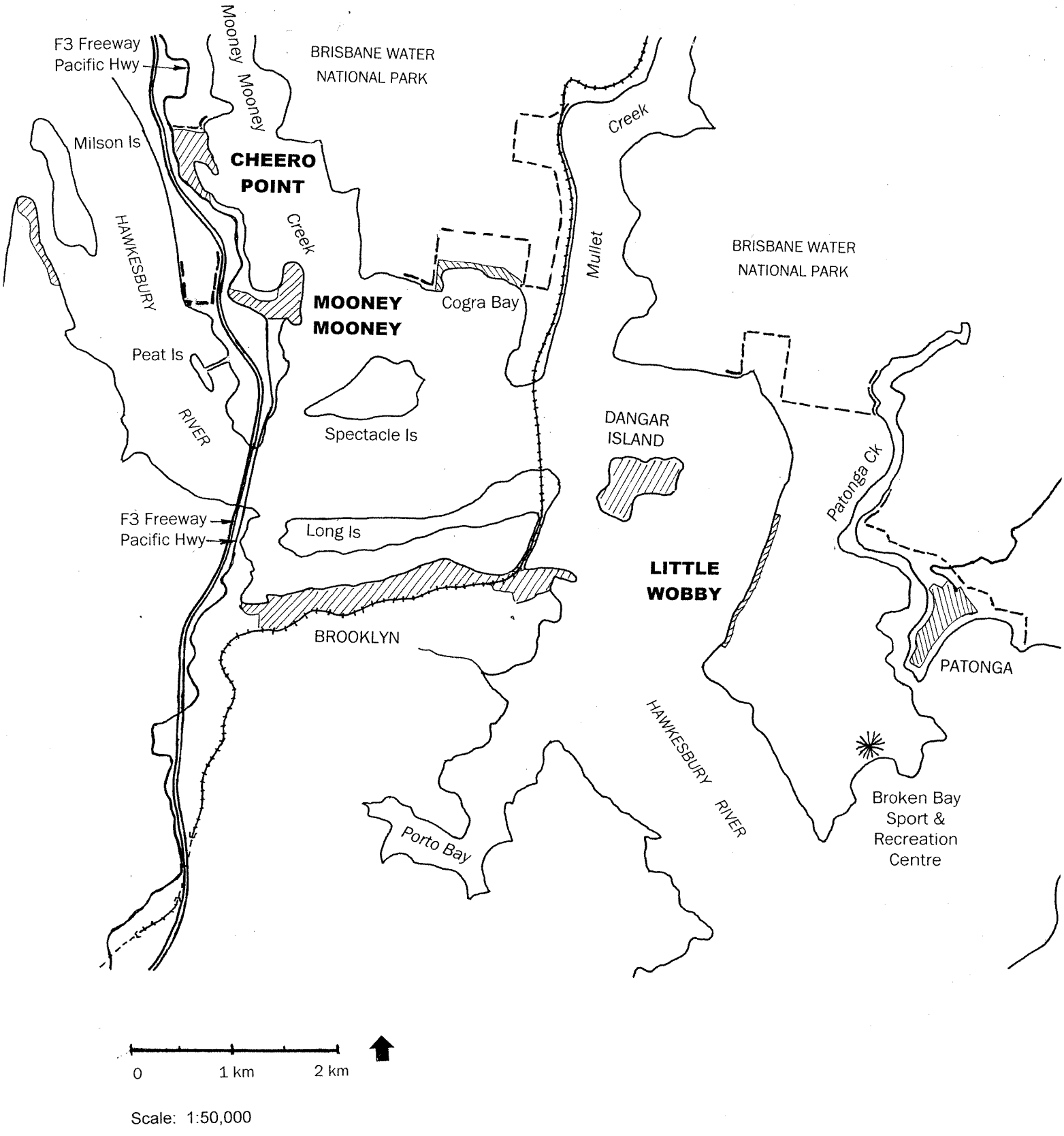

Figure 1
Locality Plan

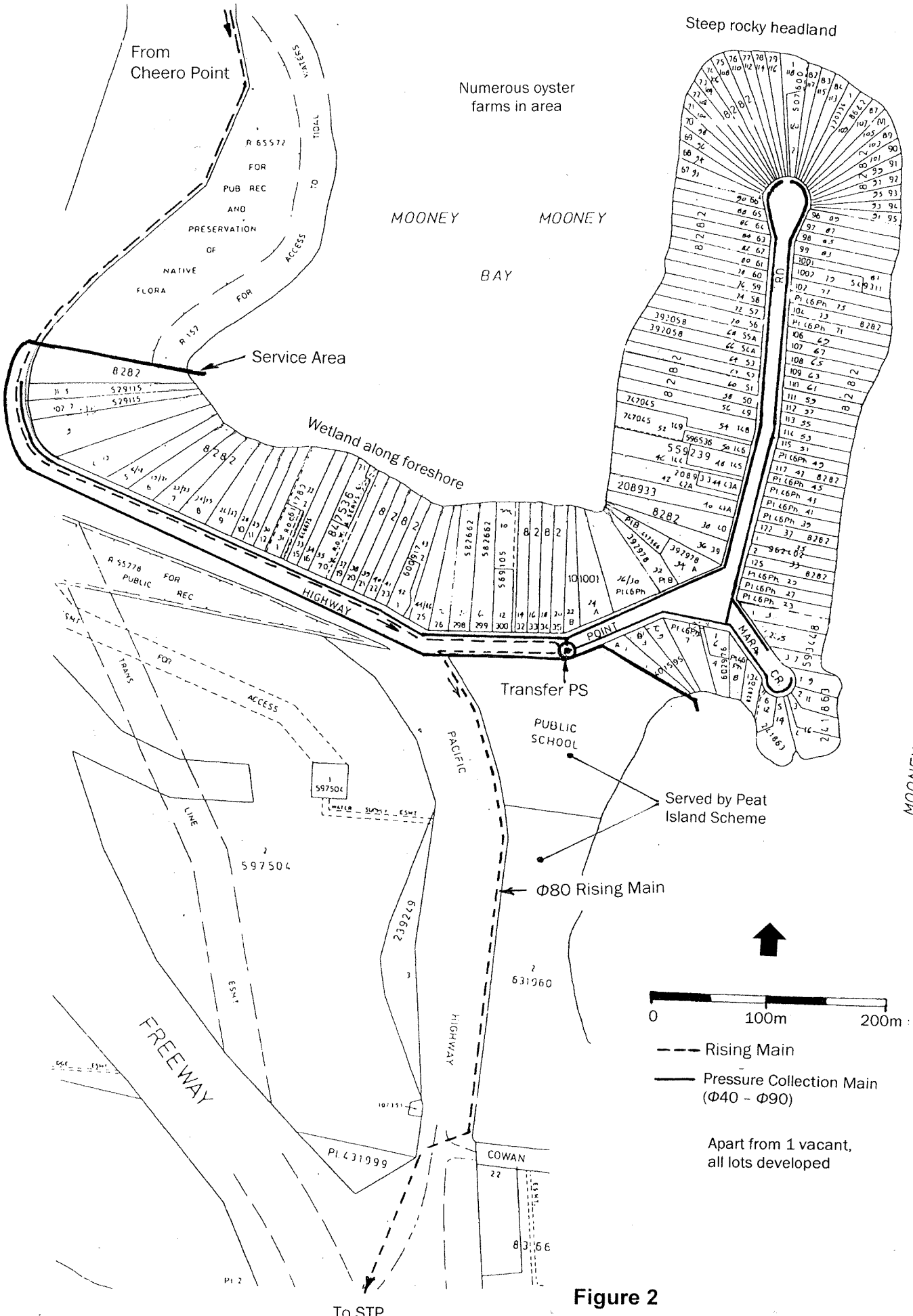

Figure 2
Mooney Mooney
Pressure Collection System

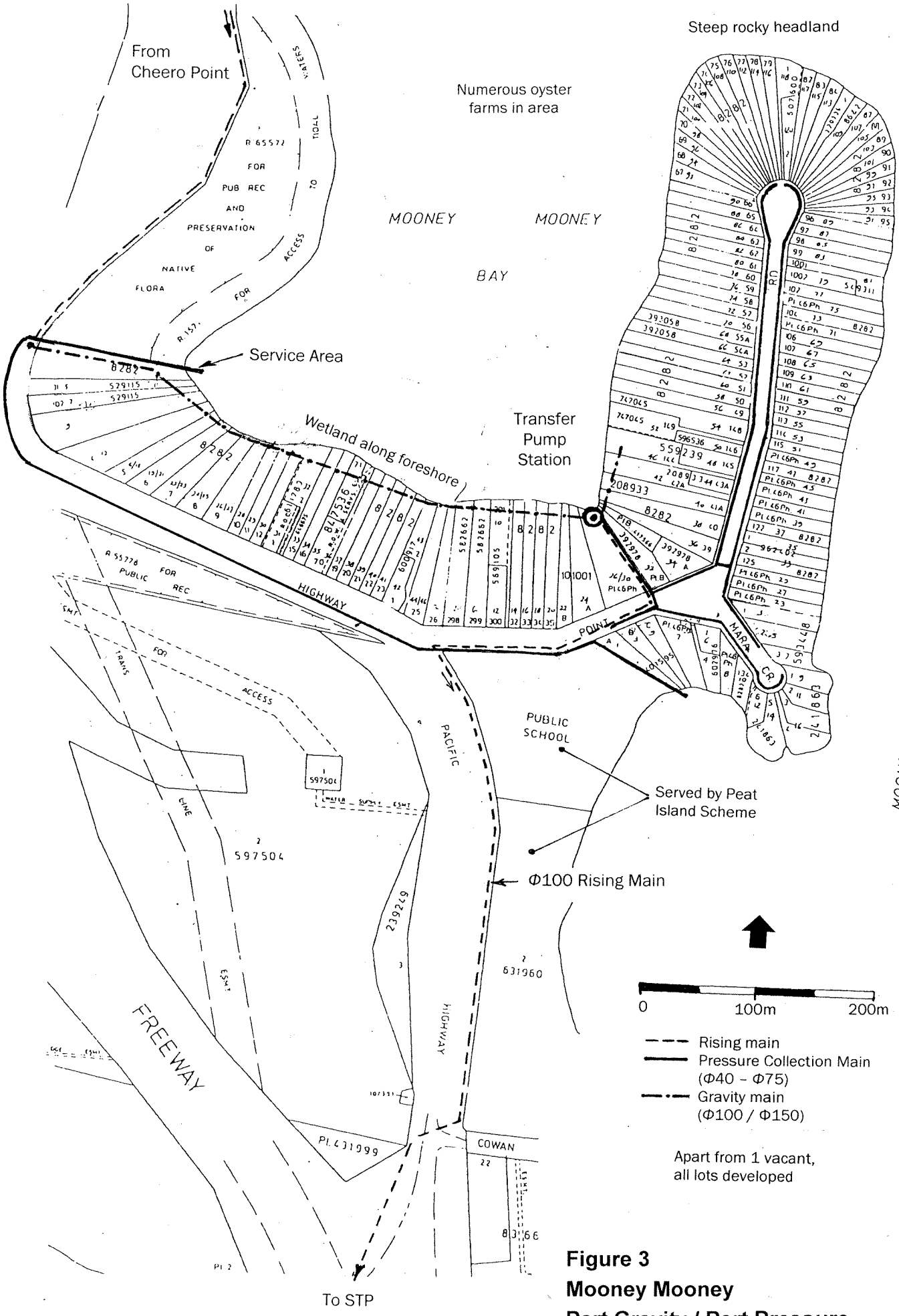

Figure 3
Mooney Mooney
Part Gravity / Part Pressure Collection System

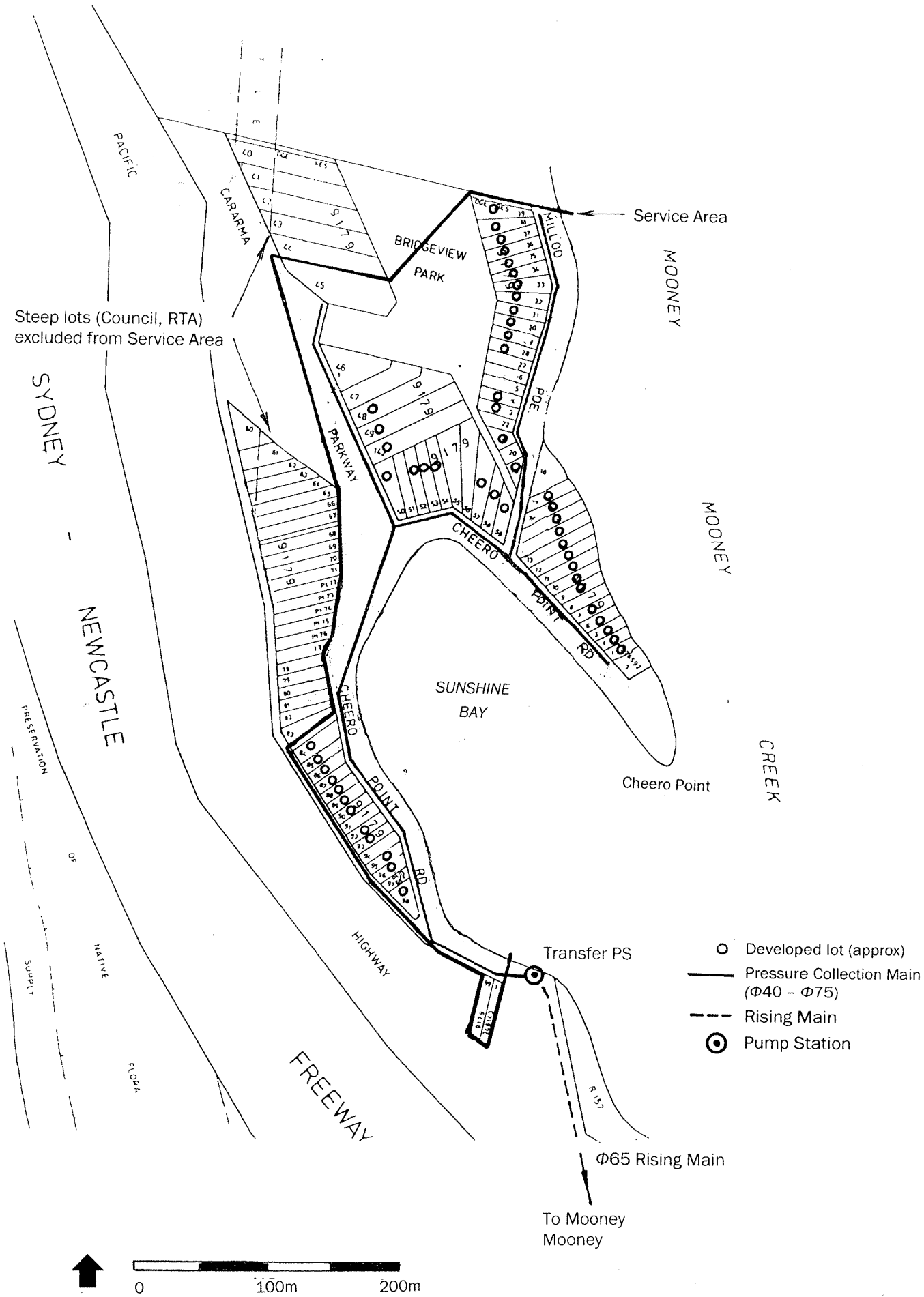

Figure 4
Cheero Point
Pressure Collection System

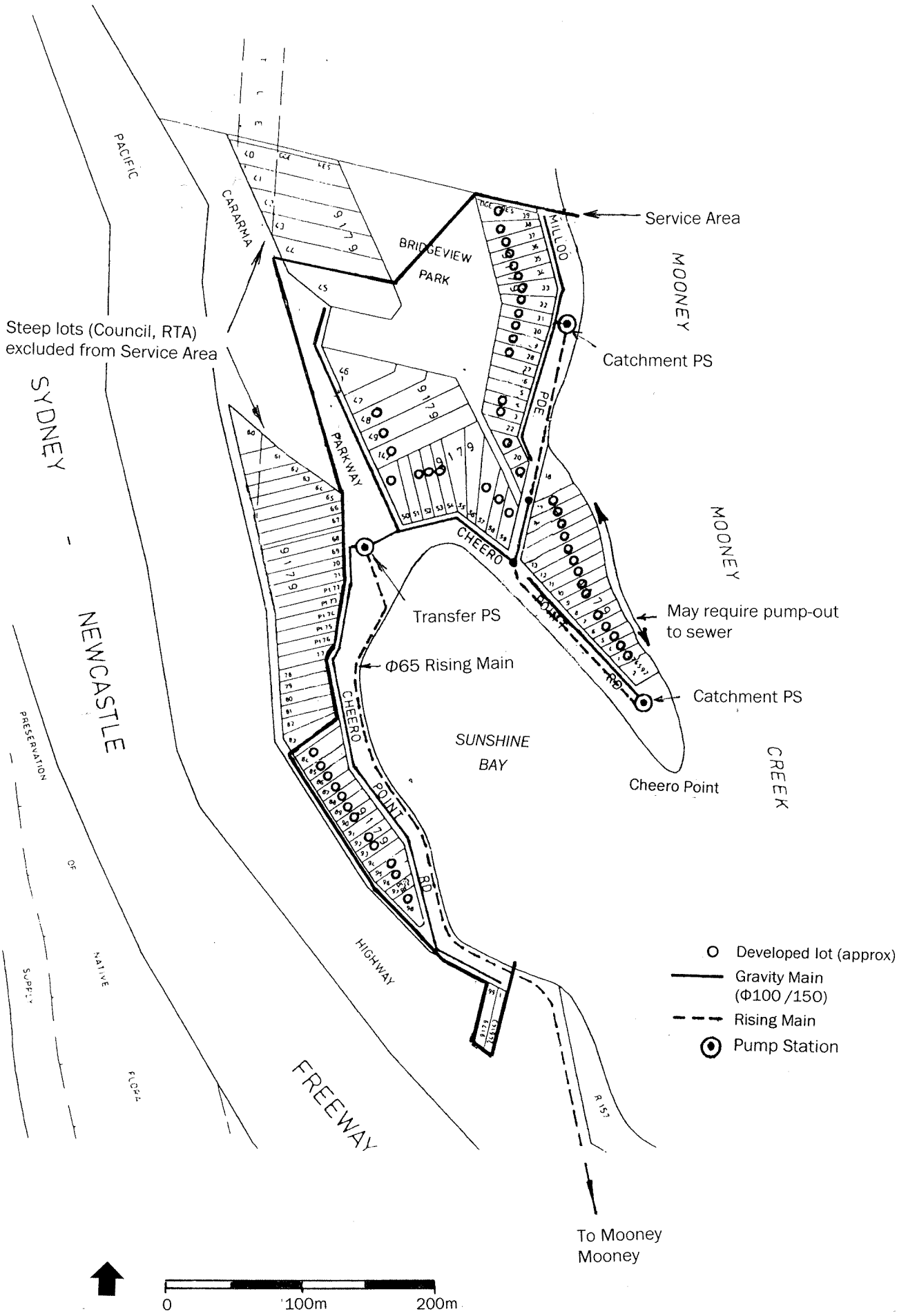

Figure 5
Cheero Point
Gravity Collection System

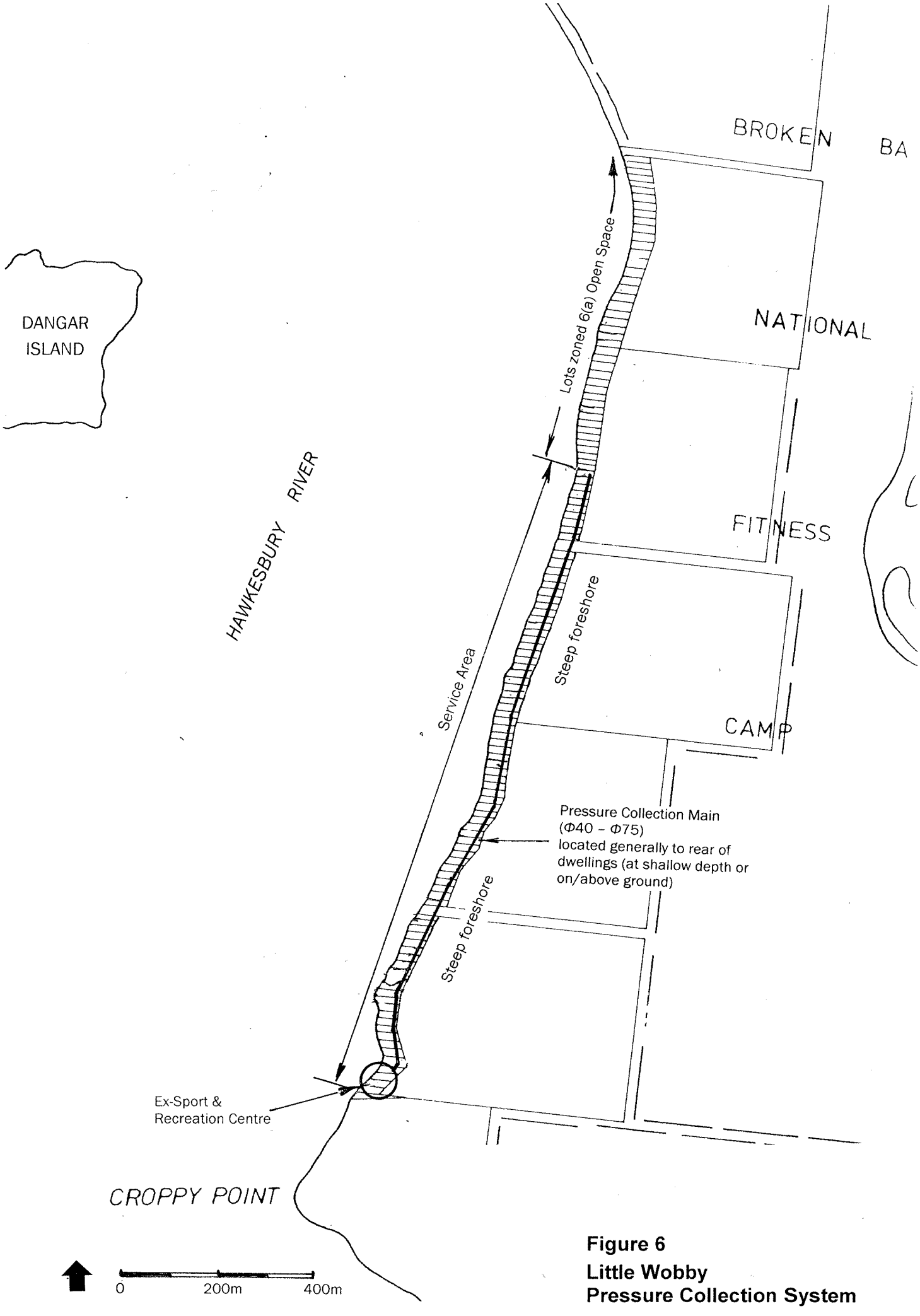

Figure 6
Little Wobby
Pressure Collection System

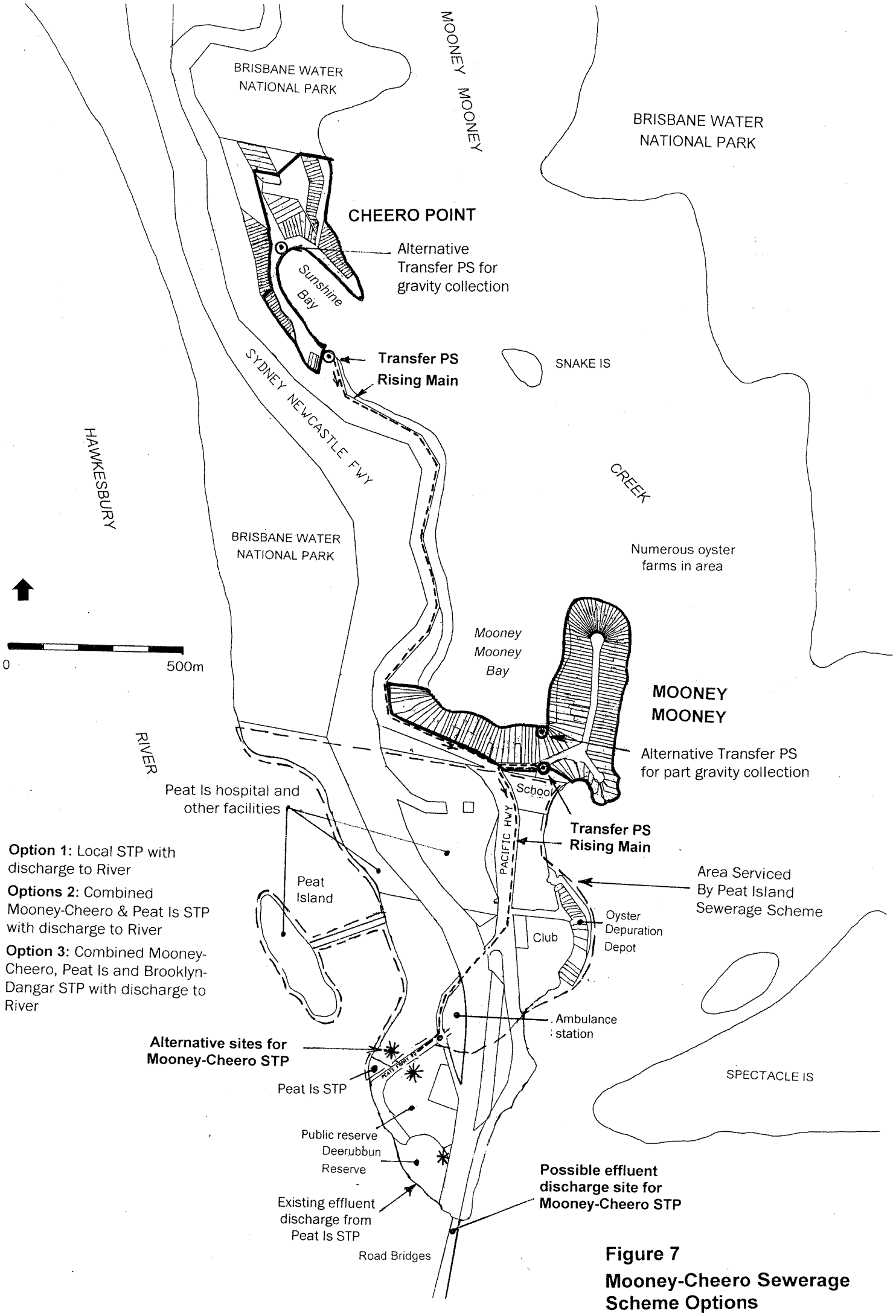

Figure 7

Mooney-Cheero Sewerage Scheme Options

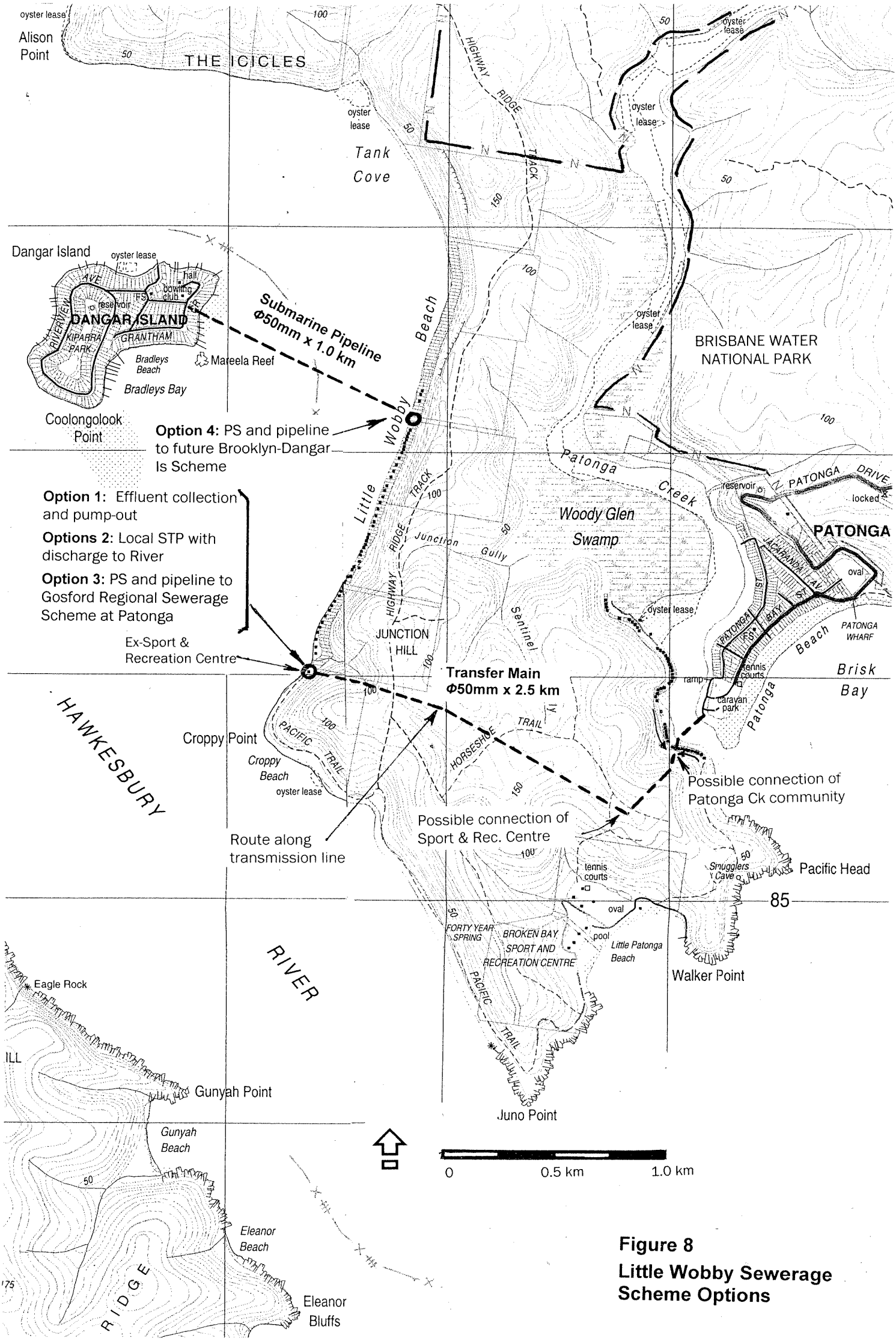

Figure 8
Little Wobby Sewerage Scheme Options