BYRON SHIRE COUNCIL

MARSHALLS CREEK
FLOODPLAIN MANAGEMENT PLAN

REPORT

November 1997

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GLOSSARY - Terms and Abbreviations

Australian Height Datum (AHD): a common national plane of level corresponding approximately to mean sea level.

Reduced Level (RL): a measured height above Australian Height Datum.

Manual or *Floodplain Development Manual*: The New South Wales Government publication "Floodplain Development Manual", 1986.

Significant Wave Height: A parameter used to define the characteristics of ocean waves within a real sea. Normally defined as the average height (from crest to trough) of the one third highest waves.

Nearshore Zone: Inshore zone (extending through breaker zones) and including areas of nearshore currents.

Flood Probability

Annual Exceedence Probability (AEP): the probability of an event (say a flood) occurring or being exceeded in any one year.

Probable Maximum Precipitation (PMP): the rainfall calculated to be the maximum which is likely to occur.

Probable Maximum Flood (PMF): the flood resulting from the PMP storm.

Flood Damages

Direct Damage: damage caused by contact with floodwater eg. structural damage to building, water damage to furniture or house contents or damage caused by silt and debris.

Indirect Damage: damage caused by flooding though not directly eg. clean-up, loss of trade, cost of alternative accommodation or loss of wages.

Tangible Damage: damage that can be quantified in monetary terms, includes direct and indirect damages.

Intangible Damage: damage that occurs but is difficult to quantify eg. increased stress in the community or disruption to community life.

Potential Damages: an estimate of the flood damage that represents the maximum damage loss if no action is taken to reduce the damage.

Actual Damage: an estimate of the flood damage that makes allowance for any action taken to reduce the damage.

Mean Annual Damage: an estimate of the annual average damage from the full range of floods. It is obtained by summation of the product of damage and probability over the full range of flooding.

Economic Factors

Capital Cost: total construction cost of project, including land acquisition, survey, investigation and design.

Discount Rate: the nett interest rate, equal to the nominal interest rate minus the inflation rate.

Amortisation: annual interest and redemption payments over the economic life of the project.

Economic Life: period during which a works item remains in a satisfactory working condition before being replaced.

Recurrent Cost: annual cost for maintenance and operation eg. power, fuel.

Annual Cost: sum of amortisation, operation and maintenance cost for a year.

Nett Present Value: the sum of money which, if invested today at the adopted interest rate, would be sufficient to fund all annual costs of the project over the economic life.

Nett Present Value-Capital Cost Ratio: ratio of nett present value of annual costs of a project to the capital cost. This ratio reflects the relativities of capital and recurrent costs of a project.

Benefit-Cost Ratio: ratio of the monetary benefits of a project to the cost of a project. This ratio can be determined on an annual cost basis or nett present value basis.

Relative Cost Effectiveness: ratio of the relative benefit for a project to the relative cost of the project. This ratio enables a variety of projects which provide different benefits to be compared. It is also equal to the ratio of the benefit-cost ratio for a project to the benefit-cost ratio for the reference project.

SUMMARY

The Marshalls Creek Floodplain Management Plan is presented in two volumes. This volume, the Floodplain Management Plan Report, presents the available information and considerations leading to the components of the Floodplain Management Plan. The Floodplain Management Plan is presented in a companion volume and covers the provisions of the Plan.

This report and the Floodplain Management Plan have been prepared by Paterson Consultants in response to a Brief issued by Byron Council. The report and Plan have been prepared following the guidelines outlined in the NSW Governments "Floodplain Development Manual".

There have been numerous investigations into flooding behaviour along Marshalls Creek. There have been several examinations of floodplain management measures but these have not come to fruition through a Floodplain Management Plan.

Significant flooding is thought to have occurred along Marshalls Creek since first European settlement. Anecdotal evidence reports major flooding as occurring from 1921. Historical records are available at Billinudgel since 1972 and other locations (eg New Brighton). Unfortunately, there is no long term continuous record of floods along Marshalls Creek.

The largest historical flood occurred in May 1987, commonly referred to as "The Mothers Day Flood". The 1987 event approached the design 1% AEP flood at Billinudgel but only approached the 5% AEP event at New Brighton.

There is insufficient flood information available throughout the whole study area to confidently predict flood behaviour under either existing or future conditions for the range of likely events. Thus, computer based models of the catchment hydrology and floodplain hydraulics have been used in order to identify flood behaviour. This work was essentially undertaken in previous investigations.

Flood hazard analysis throughout the Marshalls Creek floodplain has been undertaken using combinations of flood depth and flow velocity (as outlined by the Floodplain Development Manual) and based on the results of computer modelling for the design 1% AEP flood. The bulk of the flood-liable area of Marshalls Creek is classified as "High Hazard - Flood Storage". The existing urban areas are generally outside the "High Hazard" areas. The exceptions are New Brighton and the western parts of the Billinudgel village zone.

Flooding in Marshalls Creek can be caused by:

- heavy rainfall over the catchment
- elevated ocean levels entering the Brunswick River system
- ocean waves spilling over the dune system
- combinations of the above

Much of the Marshalls Creek floodplain is prone to inundation by elevated ocean levels. The low lying nature of the Marshalls Creek floodplain implies the area will be susceptible to "Greenhouse" induced changes when they occur.

There is some uncertainty as to when "Greenhouse" changes will occur. It is thus recommended that any floodplain management strategies be tested against their ability to cope with Greenhouse induced changes and any works or measures be developed such that future change to cope with "Greenhouse" impacts can be facilitated.

The coastal processes near the Marshalls Creek floodplain have been reviewed. During the past 10 years there has been considerable debate regarding the presence (and otherwise) of permanent openings of Marshalls Creek to the Pacific Ocean through the dune system. Review of coastal process indicates any such openings would be ephemeral (ie non-permanent), being opened either through break-out of flood waters or "Break-in" of ocean waves and closed by coastal processes.

The review of coastal processes also indicates that any potential ocean outlets need to be located distant from the Brunswick River entrance so that a significant water level difference exists between Marshalls Creek flood levels and ocean water levels on the beaches to provide sufficient energy to create an opening through the dune system.

Ocean storms create large waves which break on and run up the beach faces. There are recorded instances of such events overtopping the dune system and eroding the dune system itself in the Marshalls Creek area.

A variety of statutory land use planning provisions apply through the study area namely:

- State and regional planning policies (eg State Environmental Planning Policies)
- Regional Plans and Strategies (eg North Coast Urban Planning Strategy)
- Local land use strategies (eg Byron Local Environmental Plan)
- Community specific control plans (eg Development Control Plans, "DCP's")

Byron Shirewide DCP No 1 applies to the area while DCP 14(a), 14(b) and 14(c) apply to Ocean Shores, New Brighton and Ocean Shores North and South Golden Beach respectively.

The socio-economic profile of the area indicates two groupings at Ocean Shores, Ocean Shores North and Billinudgel as compared to New Brighton and South Golden Beach. The first group has higher than average ages with fewer children while the second group has higher than average numbers in the 5 to 14 year group. Both groups are seen as having a high level of mobility.

The flora and fauna reviews indicate that the study area provides a diverse habitat with numerous species and habitats present. Endangered and threatened species of both flora and fauna have been identified in the study area.

Flood damages have been assessed throughout the study area using the ANUFLOOD computer package based on:

- a property database derived from survey of all buildings in the flood liable area;
- a water level versus flood damage relationship based on recent flooding at Nyngan, Inverell and other areas; and
- flood water level frequency for various locations derived from the computer based hydrology and hydraulic models.

The property database indicates there are some 71 residences and commercial premises in the study area that are flood liable in the 1% AEP flood. The total number of residences and commercial premises that have a less than desirable freeboard (0.5 m) above the design 1% AEP flood throughout the study area is 263.

Flood damages have been divided into "Tangible Damages" (which can be quantified) and "Intangible Damages" (which are difficult to quantify).

Tangible damages have been quantified in this study using "Direct" flood damages which accrue by direct contact by floodwaters (eg structural damage, damage to possessions) and "Indirect" flood damages which accrue but without direct floodwater contact (eg loss of earnings, clean-up costs). The estimation of flood damages is detailed in Chapter 6.

The average annual potential direct flood damage to residential areas is $ 55,800. The largest proportion of damages (some $ 35,080) occurs in New Brighton. The average annual potential direct flood damages to commercial/industrial properties in the study is $ 55,100. Ninety seven percent of the commercial/industrial damage occurs at Billinudgel. It is noted that value of commercial/industrial damage is similar to residential damage.

The total mean annual tangible damage for the Marshalls Creek floodplain has been assessed at $ 198,000 which includes direct and indirect damage. It is noted that in order to totally eliminate flood damage, while achieving a cost benefit ratio of 0.5, flood mitigation works cannot exceed $ 2.45 million in cost.

Community consultation through the development of the draft Floodplain Management Plan has been undertaken by:

- a Value Management workshop at commencement to reduce the 46 available options to four (4);
- informal community information/consultation through neighbourhood groups to assist in identifying issues;
- formal correspondence with government bodies and community groups; and
- community newsletters.

The current floodplain management measures in place are:

- adoption of the 1% AEP event as the Flood Standard;
- minimum habitable floor level controls;
- a levee system at South Golden Beach and Ocean Shores North; and
- development of a flood warning system.

There appears to be little benefit in reducing the adopted Flood Standard as a large proportion of the floodplain is susceptible to elevated ocean water levels.

The current minimum floor level controls, based on the 1986 flood study, provide a higher than minimum required freeboard above the 1% AEP design flood levels (refer Section 9.2).

The South Golden Beach - Ocean Shores North levee scheme is considered to provide protection in the 1% AEP design flood (refer Section 9.3).

Emergency response through the study area is the responsibility of the SES. Response to floods is detailed through the Byron Local Flood Plan. Review of the Flood Plan suggests that it is generally satisfactory given the nature of flooding in Marshalls Creek. A series of improvements are recommended, addressed chiefly at improvement to the distribution of flood warnings.

The Value Management workshop, held in June 1995, identified three works options and a single management option for possible inclusion in the floodplain management strategy. The options were:

Option A Dredging of Marshalls Creek and lowering of training walls.

Option B Lengthening of Orana Bridge.

Option C Construction of flood outlets at Wooyung, Ocean Shores North and "Holiday Village" with the Kallaroo Circuit bund and Capricornia Canal fully opened.

Option D Enforcement of a "quarantine" on future development of the floodplain.

The review of the effectiveness and practicality of the works options (options A, B and C above) indicates that none of the works is able to provide a significant reduction in flood levels or to significantly reduce the number of houses flooded. The "Quarantine" option (option D) is considered to be an appropriate measure to prevent significant increases in flood-liability for existing development but it does not reduce existing flood damage potential.

House-raising and flood-proofing were found to be measures which could significantly reduce the impact of flooding for individual properties.

The comparison of options assessed the relative performance of each option against relevant criteria, including:

- flood mitigation effectiveness;
- environmental impacts;
- social impacts; and
- economic performance.

This comparison found that flood-proofing, the "Quarantine" option and house-raising ranked ahead of the "do nothing" option, while the flood mitigation works options were all ranked below the "do nothing" option.

The preferred floodplain management strategy contains a number of non-structural management measures which are aimed at reducing the impact of flooding. These measures include:

- flood-proofing and house-raising;
- improvement of flood warning procedures and implementation of a recurrent community education programme;
- implementation of a "Quarantine" or prohibition on further development on the floodplain; and
- floor level controls for new construction, with preference for highset construction and limited site filling.

The preferred floodplain management strategies are detailed in the "Floodplain Management Plan", a companion volume to this report.

1. INTRODUCTION

This investigation presents the supporting information for the works and measures contained in the Marshalls Creek Floodplain Management Plan.

The investigation has been undertaken by Paterson Consultants Pty Ltd, Grafton, in response to a brief issued by Byron Shire Council, dated September 1995.

The Floodplain Management plan and report have been prepared in consultation with Byron Shire's Floodplain Management Committee and with the community through formal and informal processes.

The activities undertaken in the preparation of this Floodplain Management Plan have been in accordance with the general guidelines outlined with the NSW Floodplain Development Manual (Ref.1). Under the management process outlined in the Manual, councils are encouraged to create floodplain management committees covering specific geographical areas. The floodplain management committees, as envisaged in the Manual, are seen as comprising a balanced representation of elected members, council staff, technical specialists and local community representatives. Whilst the committee reports to council and provides a valuable community link, it does not have the powers and functions of a formal Local Government Committee, which is constituted of elected members of Council under the Local Government Act.

The objectives of this project are outlined by the Study Brief as comprising the production of a Floodplain Management Plan which:

- when implemented will reduce the impact of flooding and flood liability on individual land owners and occupiers and reduce the private and public losses from flooding; and

- will ensure that future development proposed on the floodplain is compatible with identified flood hazard.

The study has two forms of output comprising:

- Floodplain Management Plan report (this document) that outlines the background data, concepts and decision process leading to a Floodplain Management strategy

- Floodplain Management Plan (a companion document to this report) which simply outlines the adopted strategy.

The two-document approach has been taken so that general users of the Plan have a central reference for the Plan provisions while the Plan Report presents the background information for those seeking the reasoning used in preparation of the Plan.

Marshalls Creek is the north arm the Brunswick River on the northern New South Wales coast. Marshalls Creek currently joins the Brunswick River some 1200 metres upstream of the Brunswick's entrance to the Pacific Ocean and drains a catchment of some 50 square kilometres.

The Brunswick River entrance has a number of rock training walls which were constructed over the period 1962 to 1967 in order to improve navigation in the river mouth. The present Marshalls Creek confluence to the Brunswick River is controlled by the configuration of the training walls, which were modified following the 1974 ocean storm, which broke through the dune system at "Sheltering Palms".

There is extensive urban development on the lower parts of the floodplain comprising the villages of Billinudgel, Ocean Shores, South Golden Beach, Ocean Shores North and New Brighton.

The general features of the study area are illustrated on Figure 1.

Marshalls Creek has suffered numerous floods over recent years. The largest recent flood occurred on 10 May 1987 and is commonly identified as "The Mothers' Day Flood". This flood exceeded the estimated 1% AEP flood level at Billinudgel but was approximately equivalent to a 2% AEP flood at New Brighton due to the absence of a significant storm surge in the ocean.

Investigations into flooding along Marshalls Creek have been on-going since the early 1980's.

Council and the NSW Public Works Department completed a flood study of Marshalls Creek in 1986 which identified flood levels through the Marshalls Creek Floodplain.

After the 1986 Flood Study, Council adopted the one percent Annual Exceedence Probability flood (1% AEP) as its standard for floodplain management along the Marshalls Creek Floodplain. The standard represents a large flood that has a one percent chance of being equalled or exceeded **in any one year**. It is equivalent to the once in 100 year Average Recurrence Interval (ARI) flood. Floods are now referred to by Annual Exceedence Probability as this usage prevents the interpretation of return period in years (eg once in 100 years) as **implying** the average period **between** floods of this magnitude.

Over the period since 1989, a number of management investigations have been conducted but none of these has reached fruition through the proposal and adoption of a Floodplain Management Plan. The various investigations have produced some 46 structural management options.

Essentially, the options have revolved around:

- construction of new outlets from Marshalls Creek to the Pacific Ocean;
- works along the creek system (principally dredging) aimed at increasing the capacity of the creek system; and
- changes to existing bridges to reduce bridge affluxes.

Thus, many of the floodplain management options represent combinations of the three broad systems above or alternative sizing of works options.

A **Value Management Workshop** was conducted in June 1995 by Council and its Floodplain Management Committee with the objective to evaluate and rank the management options. The Value Management Workshop identified four options as being worthy of further investigation, namely:

- widening the Orana Bridge waterway (Option 16);
- dredging of Marshalls Creek and changes to the training wall (Options 43 & 27);
- construction and/or management of ocean outlets; and
- "quarantine", which has been interpreted in this study as prohibition of further development on the Marshalls Creek floodplain.

It will be noted that considerable work has been undertaken prior to the preparation of this Plan. Thus, this report draws on the fragmented data available through the previous studies and has supplemented this where necessary. Essentially, this study draws its information from the following sources:

- hydrology based on the 1986 Flood Study;
- existing flood behaviour based on the 1986 Flood Study, and as modified for the Value Management Workshop; and
- changes to flood behaviour following various floodplain management options as presented to the Value Management Workshop.

The following chapter of this report outlines the previous studies, while Chapter 3 outlines the existing flood attributes from both earlier reports and additional work for this study.

The Marshalls Creek floodplain can also be threatened by ocean and coastal processes. Chapter 4 outlines these issues as they relate to floodplain management.

The existing environment of the Marshalls Creek floodplain is relevant to the Floodplain Management Process, and likely environmental issues if envisaged floodplain management options were to proceed to adoption are outlined in Chapter 5 while Chapter 6 outlines the community consultation process undertaken and common outcomes of this process. Chapter 6 outlines an assessment of the flood damages potential within the Marshalls Creek area which has been based on collected data on the existing development and potential flood damages.

The existing flood emergency response provisions are outlined in Chapter 8 while Chapter 9 deals with existing floodplain management measures.

The preparation of this report and Floodplain Management Plan has been undertaken by Paterson Consultants, Grafton, and jointly funded by NSW Government (through the Department of Land and Water Conservation) and Byron Shire Council.

The report has been prepared by Paterson Consultants with specialist assistance in specific areas from:

- Lex Nielsen (Unisearch):	Coastal Engineering
- Peter Cuming and Jennifer Donovan (Sustainable Futures Planning and Design):	Community consultation and local planning
- Greg Clancy:	Flora and Fauna

2. BACKGROUND REPORTS

2.1 Overview

European settlement of the Brunswick Valley dates back to the 1840's when cedar-cutters camped along the river and worked in the surrounding forests. Some 20 years later, squatters moved in and cleared the land for cattle grazing. The squatters were followed by selectors who began farming in the district.

The township of Brunswick Heads was founded on the south bank of the river in the late 1860's. The first beachfront subdivision at New Brighton occurred in 1889, while farming in the Billinudgel area dates back to the 1880's.

Flooding in Marshalls Creek is a relatively frequent occurrence with anecdotal reports of flooding dating back to the 1880's. The first reported major flood occurred in 1921. This event has been exceeded several times since, with the 1987 flood being the highest recorded flood. Unfortunately, there is no comprehensive set of flood levels available for Marshalls Creek.

There have been a number of studies of flooding along Marshalls Creek since 1984. It would appear that additional information has also been provided to Council on an "as-requested" basis, and consequently this information appears as items of correspondence on Council's files.

The investigations of flooding since 1984 have relied on the use of computer modelling to determine flood behaviour. The studies have relied on a rainfall run-off routing model to establish flood hydrographs into the floodplain system while the riverine and floodplain hydraulics have been modelled using a variety of hydraulic models. This modelling arrangement is typical where insufficient flood data is available to define flood behaviour over the full range of flows. An overview of the models is provided here as they are frequently referenced in the previous studies.

The hydrology models to date have been based on the computer program WBNM (Watershed Bounded Network Model) which produces an estimate of flood hydrographs from rainfall after deduction of infiltration and other losses.

Two forms of hydraulic model have been used for the riverine modelling exercise. Initially, the river system was modelled via a program, identified generically as CELLS, while later systems were modelled using RUBICON. The CELLS and RUBICON models are fundamentally different.

CELLS divides the floodplain into a series of compartments where flood level in the cells is controlled by the flood volume in each compartment with flow between compartments controlled by friction.

RUBICON divides the river and flood system into a network of interlinked channels. Flow along each channel is controlled by the flood volume, flood momentum and friction in the channels.

RUBICON does not have a widespread use in Australia and so for identification of flood hazard and assessment of floodplain management options, the RUBICON system was converted to the more widely used Danish Hydraulics Institute system, MIKE-11. RUBICON and MIKE-11 are similar and can be considered equivalent for most uses.

2.2 Previous Studies

There have been a number of investigations of flooding in Marshalls Creek undertaken since 1984. A brief summary of each of these investigations is given below, while concentrating on those of most relevance to the current flood mitigation plan.

2.2.1 Brunswick Valley Floodplain Management Study Hydrology Report - Laurie Montgomerie & Pettit, July 1984 (*Reference 2*)

This report describes the hydrologic investigations undertaken for the subsequent flood studies for the Brunswick River and Marshalls Creek. Flood modelling was undertaken for floods recorded in October 1972, March 1974, February 1976 and March 1978. The report determined 5% and 1% design flood hydrographs for inputs to hydrological models.

The design rainfalls over the catchment were determined by analysis of local rainfall stations.

Design rainfall data determined in this study have been used in all subsequent investigations.

2.2.2 Marshalls Creek Flood Study - Webb McKeown & Associates, November 1986 (*Reference 3*)

The study was undertaken to determine flood behaviour under existing conditions (at that time) for Marshalls Creek.

The CELLS model developed for the Brunswick River was expanded to include Marshalls Creek and the Capricornia Canal. The model was calibrated against the July 1985 flood and tested against the March 1978 flood.

Design flood levels were estimated for 1% and 5% AEP events, assuming flood flows estimated from the hydrology model and coincidence of timing of the flood peak and ocean tide peak. The adopted ocean still water levels were 2.3 m Australian Height Datum (AHD) and 2.6 m AHD for the 5% AEP and 1% AEP ocean storm events respectively. The normal tidal variation was adopted as from RL -0.6 to RL 0.6 m AHD.

The design inflows from the hydrology model (Reference 2) were input to the hydraulic model to provide design flood levels for the 1% AEP and 5% AEP floods throughout the study area.

The report noted that the design flood events were significantly greater than any recorded events (to that time). The difference between the design flood levels and recorded levels was justified by the lack of elevated ocean levels during the earlier events.

2.2.3 Brunswick Valley Floodplain Management Study - Webb McKeown & Associates, April 1987 (*Reference 4*)

This study was undertaken to assess the impact on flood behaviour of 9 development proposals on the Brunswick River Floodplain. Three proposals involved works to mitigate existing flooding, while the balance allowed further development of the floodplain. Three of the 9 options had impact on Marshalls Creek.

The CELLS model established for the Marshalls Creek Flood Study was used to assess the potential flood mitigation benefits to be derived from lowering the bed level of the Brunswick River at the entrance and construction of an overflow weir to the ocean south of New Brighton as well as options for flood mitigation in Mullumbimby. The study also assessed the impact of filling land at Billinudgel.

The study indicated:

- a maximum reduction of 0.1 metres at the Marshalls Creek/Brunswick confluence and zero reduction at the Billinudgel for the lowering of the Brunswick River bed.

- a maximum reduction of 0.46 metres at Orana Bridge for the ocean outfall though this required a weir set at RL 1.5 m AHD over some 1000 metres. A more realistic overflow weir set at RL 2.0 m AHD over 200 metres reduced design flood levels by 0.12 metres at Orana Bridge.

- the filling of land at Billinudgel, east of Mogo Place and north of Wilfred Street would cause flood level increases of 0.08 m.

The study noted that a multi-disciplinary approach was required before proceeding with the weir option.

It is also noted that the weir levels adopted are lower than the elevated ocean water levels adopted earlier in Reference 3, and thus would create flooding from ocean water levels.

2.2.4 Brunswick River Floodplain Management Investigation - Webb McKeown & Associates, Nov 1989 (*Reference 5*)

The study was undertaken to draw on past investigations, to respond to community requests regarding flooding and to address development proposals at Ocean Shores North.

The impacts of proposed development by the Ocean Shores Development Corporation and on other lands within the Development Control Plan (DCP) area were investigated. The investigation was undertaken for a sub-committee of the Floodplain Development Committee comprising representatives of Public Works Department, Byron Shire Council, and Ocean Shores Development Corporation.

The CELLS model was extended to Wooyung and calibrated against the May 1987 flood records. Design flood levels were estimated for the 1%, 2% and 5% AEP events. The revised flood levels were significantly lower than the 1986 estimates.

A number of flood mitigation works options and schemes were also examined.

The proposals examined to protect existing development included:

- a levee around South Golden Beach;
- a levee or other means of protection for New Brighton;
- a levee at Billinudgel; and
- widening of road and railway bridges at Billinudgel.

Possible flood mitigation options evaluated were:

- flood outlets at three locations;
- dredging of Marshalls Creek;
- widening of Orana Bridge;
- floodway across South Ocean Shores Golf Course;
- separation of Yelgun and Marshalls Creeks by floodgates;
- widening of the Yelgun Creek - Marshalls Creek link; and
- floodway immediately downstream of Pacific Highway.

The maximum reduction in flood levels for the 1% AEP design event would appear to be 0.18 metres at New Brighton but involves a weir outlet at RL 1.9 m AHD, dredging of the channel to RL -2.0 m AHD, and widening of the Orana Bridge.

The study did not make firm recommendations towards an optimum floodplain management solution.

2.2.5 Draft LEP Amendments 13 and 14, Public Inquiry - Commissioner W Simpson, July 1990 (*Reference 6*)

This report addressed a wide range of issues relevant to the assessment of two proposed amendments to the Draft Local Environment Plan (LEP) for the Ocean Shores area. The assessment was completed by way of Public Inquiry in accordance with Section 86 of the Environmental Planning and Assessment Act (1979). The assessment of flooding issues was based on the 1989 report above.

Commissioner Simpson's report noted that the 1987 flood inundated the following numbers of properties:

- Ocean Shores: 4 properties
- New Brighton: 40 properties
- South Golden Beach: 11 properties

The Simpson Public Inquiry reached numerous findings. Those seen as relevant to the current study were:

- the modelling procedures adopted were considered to be appropriate;
- an appropriate allowance for sea level rises due to "Greenhouse" effects was considered to be 0.3 metres by the year 2030;
- an appropriate freeboard allowance was considered to be 0.5 metres. This did not include any allowance for increases in sea levels due to "Greenhouse" impacts; and
- identified an appropriate allowance for "Greenhouse" impacts of 0.3 metres.

2.2.6 Marshalls Creek Floodplain Management Study, Summary of Work Undertaken from September 1991 to March 1992 - Webb McKeown & Associates, June 1992 (*Reference 7*)

The study examined possible flood mitigation measures for South Golden Beach, New Brighton, Ocean Shores and Billinudgel, following the appointment of a new floodplain management committee in September 1991.

The report outlines the investigation of a range of flood management options including levees, ocean outlets, dredging, house raising, widening Orana Bridge and bunding of Capricornia Canal.

The report outlines the number of properties flooded in the 1987 flood event as:

- Ocean Shores: 4 to 6 properties
- New Brighton: 40 properties
- South Golden Beach: 22 properties
- Billinudgel: 15 properties

The report does not draw any firm conclusions or recommendations and appears to address a series of specific queries posed through a number of Council and Floodplain Management Committee meetings.

Flood-prone buildings in New Brighton, South Golden Beach and Ocean Shores were identified and flood damages estimated.

The study concluded with the recommendations that:

- a bund be constructed at the Kallaroo Circuit Bridge;
- earthworks on the dunes at Wooyung be examined to mitigate against local impacts;

- discussions be held with PWD, Council and Tweed Shire Council with the view to funding local drainage works to mitigate the low level drainage impacts of the bund;

- an EIS be undertaken into proposed dredging; and

- South Golden Beach levee to be constructed.

2.2.7 Report on Feasibility of an EIS for Ocean Shores North Flood Outlet - Webb McKeown & Associates, June 1992 (*Reference 14*)

The study examined the feasibility of a flood outlet through the dune system to protect existing development.

This report undertook a preliminary environmental assessment of a flood outlet through the dune system at South Golden Beach. The report concluded that:

- "It would appear inadvisable for the Council to undertake an EIS on the flood outlet at this stage...." (Reference 14, Section 5, page 14).

- More detailed work on coastal processes was required before proceeding with an EIS.

- The proposed outlet reduced flood levels in flood events greater than 5% AEP flood event. (see Reference 14, page 14)

- Possible adverse impacts included destruction of vegetation, lowering of water table and possible ocean wave "invasion" through the dune system.

- A continuing commitment of funds was required for the operation and maintenance of the outlet.

- The project had a low cost/benefit analysis.

- The completion of an EIS at that stage could not be justified.

2.2.8 Discussion Paper, Marshalls Creek Dredging Investigation, Stage I - Planning Workshop and Webb McKeown & Associates, October 1992 (*Reference 8*)

This investigation was commissioned to undertake an EIS for dredging of Marshalls Creek. The study approached the EIS in two stages. The first stage investigated the feasibility of dredging at no cost to Council while the second stage was to undertake the full EIS preparation. It appears that the study progressed no further than the presentation of a "Discussion Paper".

The Discussion Paper examined the impact of a number of dredging options on flood and tidal behaviour. A RUBICON hydraulic model was established and calibrated against the May 1987

flood records. The RUBICON model was used to predict the impact of various dredging proposals. Eight dredging options were examined with varying buffers to existing features set and yielding dredge sand volumes between 50 000 and 330 000 cu. metres.

It was concluded that the dredge material would only be suitable for "general filling sand" and that the local market for such material was met by the existing local sources and suppliers.

The report does not reach firm conclusions, however its "Discussion of Dredging Option" indicates:

- dredging of Marshalls Creek to a bed level of RL -2.5 m AHD could not be supported on environmental grounds;

- dredging of reduced quantities (indicated as Options 5A, 5B and 5C) could be acceptable on environmental grounds.

Options 5A, 5B and 5C removed between 110,000 and 50,000 cubic metres.

Flood level reductions for Options 5A, 5B and 5C were not quoted for the 1% AEP flood event but were quoted as between 0.170 and 0.10 m at New Brighton for the 1987 flood event. The flood level reductions from these options in the design 1% AEP flood event would be less than the quoted levels.

2.2.9 Marshalls Creek Dredging Investigation, Stage 1 Marine Ecological Studies - The Ecology Lab Pty Ltd, October 1992 (*Reference 9*)

This report outlined the investigation into the marine ecology of Marshalls Creek and identified significant mangrove stands and sea grass beds in the area proposed for dredging. The report was prepared as a sub-consultancy for Reference 8 above. The lower volume dredging options were identified as the least damaging options to the environment.

The study identified mangroves along Marshalls Creek, based on 1985 research and available aerial photography. It is interesting to note that the 1985 distribution of mangroves is little different from that identified by interpretation of the 1996 aerial photography.

2.2.10 Modelling of Flooding and Drainage Within the Marshalls Creek/Mooball Creek Area - Webb Mckeown & Associates, September 1994 (*Reference 10*)

This report outlines the various investigations undertaken to examine bund options for the Capricornia Canal during the period October 1992 to May 1994. The RUBICON model of Marshalls Creek was extended to the entrance of Mooball Creek at Pottsville and included the Mooball Creek and Crabbes Creek Floodplains.

The report also made a comparison between the design rainfall estimates given in Reference 2 (1982) above and a subsequent issue of Australian Rainfall and Runoff (1987), (*Reference 11*).

The report concluded that the local rainfall analysis of 1982 provided the better estimates of local design rainfalls and these were consequently adopted.

2.2.11 Summary of Options Report, Marshalls Creek - Webb McKeown & Associates, June 1995 (*Reference 12*)

The report summarises all the floodplain management works options which have been examined or considered since 1987. The report contains a general description of computer based hydraulic models. Results published in the report are derived from an expanded RUBICON hydraulic model of the creek and floodplain system which was verified against the February 1995 flood records.

2.2.12 Value Management Study Marshalls Creek - Value Management International, June 1995 (*Reference 13*)

A "Value Management Workshop" was held on 20 June 1995 using an independent facilitator with the Marshalls Creek Floodplain Management Committee. The Workshop evaluated 46 individual floodplain management options and refined the number of options for further investigation to four. The four final options, which form the basis of the Brief for this current Floodplain Management Plan were:

- widening of Orana Bridge waterway;
- dredging of Marshalls Creek and changes to the training walls;
- ocean outlets (three potential sites selected); and
- "quarantine" which has been interpreted as "No further development"

The selection of the final options was based on a matrix use of evaluation criteria and deletion of duplicated options. The evaluation criteria used were:

- benefit to cost ratio;
- environmental impact;
- community acceptance;
- flood mitigation effectiveness;
- external impact potential;
- internal impact potential;
- protection equity; and
- affordability.

The Floodplain Management Committee, following the Value Management Workshop, resolved to:

- concentrate on the three specific ranked options and a possible fourth option;

- not support the then current proposals for enlargement of the bund until further investigations were completed;

- encourage Byron Council to communicate with the Crabbes Creek/Mooball Drainage Union to resolve issues;

- request Council "re no further development until plan formulated".

2.2.13 Sedimentology Studies, North Coast Estuaries, Brunswick River - NSW Public Works Department, February 1995 (*Reference 15*)

This report assembled available data on the sediments present in the Brunswick River estuary including Marshalls Creek. The study identified (among other items) that the bed material in the lower reaches of Marshalls Creek was recent (Holocene) re-worked marine sands which shallowly overlay bedrock.

2.2.14 Notes to accompany Flood Outlet Runs, Marshalls Creek Floodplain Management Study - Webb McKeown & Associates, June 1995 (*Reference 16*)

This report details the review of a series of computer model runs to investigate the impact of various flood outlets through the ocean dune system. The flood levels detailed as "Existing Conditions" have been taken as the base case for appropriate levels as current in June 1995 and modified as outlined in the following section.

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3. EXISTING FLOODING ENVIRONMENT

3.1 Historical Flooding

Significant flooding along the lower parts of Marshalls Creek and its associated floodplains has been noted since early European settlement of the Brunswick Valley. Unfortunately, there are no comprehensive long term historical flood records available for Marshalls Creek. There have been significant floods in recent years with the largest being recorded in 1987.

Anecdotal historical evidence (provided by Mr Bruce Butt, personal communication) suggests that:

- Major floods were recorded at Billinudgel in 1921, 1931, 1954, 1962, 1974, 1985 and 1987.

- There were floods in the period 1880 to 1900 which were the same heights as the 1950's and 1970's.

Flood heights have been measured by the NSW Public Works Department at Billinudgel since the early 1970's and reproduced in various flood investigations outlined in Chapter 2.

A comparative list of recorded floods in Marshalls Creek at Billinudgel and New Brighton is provided in Table 1 and Table 2 respectively below. These tables are not purported to be comprehensive but are provided for indicative purposes.

There have been instances of breakthroughs of the beach dune system. The phenomena is not uncommon along the NSW North Coast.

Newspaper references of these events are included in Appendix F of this report.

Specific interest for this study was indicated by:

- Northern Star (7/1/1893)	- reports of elevated ocean levels
- Northern Star (1/2/1893)	- reports of waves overtopping the beach terrace at Wardell
- Northern Star (30/3/1936)	- reports overtopping of beach at Belongil
- Star Advocate (15/1/1954)	- reports of elevated ocean levels
- Star Advocate (23/2/1954)	- reports ocean breakthrough at New Brighton
- Star Advocate (6/8/1954)	- reports of ocean breakthrough at New Brighton
- Star Advocate (31/1/1956)	- reports waves over the beach terrace at New Brighton
- Star Advocate (23/1/1959)	- reports breakthrough north of New Brighton
- Advocate (9/2/1972)	- reports breakthrough at North Beach

Table 1

Comparative Historical Flood Heights
Marshalls Creek at Billinudgel

Year	Level (m AHD)	Source
1880 to 1990	About 3.3	Butt/Watterson (pers. comm.) "Floods equal to 1950's and 1970's"
1921	Above 3.4	Butt/O'Donnell "First flood to enter hotel (built 1907)"
1931	About 3.4	Butt/Flowers "Tied boat outside Post Office"
1954	3.4 to 4.1 About 3.5	Appendix A, Page A2, Ref.3 Butt/Maher "1954 and 1962 were similar"
1962	3.5	Appendix A, Page A2, Ref.3
29 Oct 1972	3.12	Appendix A, Ref.3
14 Feb 1973	3.06	Appendix A, Ref.3
11 Mar 1974	3.34	" "
29 Feb 1976	2.88	" "
3 Mar 1977	2.64	" "
18 Mar 1978	3.17	" "
9 May 1980	2.56	" "
22 May 1981	3.12	" "
9 Jul 1985	3.30	Appendix A, Ref.3
10 May 1987	4.20	Appendix A, Page A1, Ref.5
15/16 Feb 1995	3.30	Appendix B, Page B4, Ref.12

Table 2

Comparative Historical Flood Heights
Marshalls Creek at New Brighton
(identified at New Brighton Store at River St/Ocean Ave intersection)

Year	Level (m AHD)	Source
1954	2.25	Appendix A, Page A2, Ref.3, "Cason Street"
1967	2.25	Appendix A, Page A2, Ref.3, "Park Street"
1974	2.30	Appendix A, Page A2, Ref.3,"River Street"
1976	2.45 2.21	Appendix, A, Page A2, Ref.3, "River Street" New Brighton Shop
1978	1.75	Appendix A, Page A2, Ref.3, "Next to P.O."
9 July 1985	1.68	Appendix A, Page A4, Ref.3, "River Street south of Ocean St"
10 May 1987	2.49	Appendix A, Page A2, Ref.5
15/16 Feb 1995	1.6	Appendix B, Page B4, Ref.12

Review of the data in Tables 1 and 2 above indicates:

- The available record at Billinudgel is considerably longer than at New Brighton due to the longer period of permanent settlement at the former locality.

- Based on the assumption that no major floods have been missed, the data in Table 1 indicates that a flood level of RL 3.3 m AHD at Billinudgel has an estimated probability of being equalled or exceeded of 12.5% AEP (once in 8 year recurrence interval).

- Similar assumptions at New Brighton indicate that flood levels equalling or exceeding RL 2.2 m AHD have a probability of about 10 percent AEP.

3.2 Existing Flood Behaviour

There is insufficient historical flood data available throughout the study area to enable existing flood behaviour to be defined on the basis of the historical data alone. Thus, hydrologic and hydraulic modelling must be employed in order to provide information and to create a suitable base to test future floodplain management options. This work has been essentially undertaken and reported in References 2, 3, 5, and 13.

The adopted design flood levels through the study area for the 1% AEP event are illustrated on Figure 2 and in Table 3 below.

The data in Table 3 and on Figure 2 has been derived as follows:

- Data is primarily based on the flood data for "Existing Conditions" as in Reference 16, Table 1.

- Adjustment to the levels published in Reference 16 by use of a MIKE-11 model on the same layout as the RUBICON model and using the same calibration factors to account for:

    * Construction of a twin cell 3.3 m x 2.1 m box culvert at the Capricornia Canal as agreed by Byron Shire Council with adjacent upstream land owners in Tweed Shire.

    * Incorporation of the "El Dorado" estate which has involved filling between the Pacific Highway and the railway line at Billinudgel.

    * Incorporation of filling at a subdivisional development identified as "Fern Beach" near South Golden Beach.

- Rounding up of design flood levels to the nearest 0.05 metres (50 millimetres).

- Ocean water levels, acting as a tailwater for the Brunswick River system comprising of an elevated ocean level (with allowance for storm surge, wave set-up, barometric effects but not Greenhouse impacts) over a normal tidal range giving a peak ocean level of RL 2.6 m AHD. The flood hydrographs were assumed such that the flood peak arrived at Brunswick Heads 4 hours after the ocean peak level (Refer Figure 16 of Ref.3).

Testing of the model using rainfall inputs as 1% AEP design rainfall increased by twenty percent, indicates flood levels would be up to 0.3 metres higher than the design 1% AEP flood. This test is a measure of the sensitivity of the river system and needs to be noted when considering freeboard allocations.

It is emphasised that the flood levels quoted in Table 3 and on Figure 1 are suitable for fixing finite flood levels but that the impact between proposed floodplain management measures should be based on "Before measure" and "After measure" calculations.

Table 3

Design Flood Levels, Marshalls Creek and Associated Floodplains

Locality	1% AEP Flood (m AHD)	10% AEP Flood (m AHD)
Wooyung Road	3.10	2.55
Byron Shire Boundary	3.05	2.45
North of Kallaroo Circuit	3.05	2.45
Capricornia Canal	2.80	2.25
Billinudgel	3.95	3.30
Balemo Drive, northern end, near Gooloo Court	3.15	2.40
Ocean Shores Golf Course (Terrara Crescent)	2.80	2.05
New Brighton	2.70	1.95

Examination of the recorded flood level hydrographs at Billinudgel shows relatively rapid rise and fall of floods as:

- March 1978 (Ref.3): Rise of 0.2 metres/hour (m/hr) with a fall of 0.08 m/hr
- July 1985 (Ref.3): Rise of 0.6 m/hr with a fall of 0.15 m/hr.
- May 1987 (Ref.12): Rise of 0.75 m/hr with a fall of 0.25 m/hr.
- February 1995 (Ref.): Rise of 0.8 m/hr with fall of 0.1 m/hr

The response of the Marshalls Creek catchment to rainfall is rapid as indicated by the recorded rates of flood rise and fall and by the hydrologic modelling which indicates a "Critical" design storm duration of 12 hours (Ref.3) (for Brunswick River).

3.3 Existing Flood Hazard Assessment

The Floodplain Development Manual recognises three categories of flood-liable land, as defined below.

1. ***Floodways*** - those areas where a significant volume of water flows during floods which, even if only partially blocked, would cause a significant redistribution of flood flow.

2. ***Flood Storage*** - those areas which provide temporary storage of floodwaters and flow velocities are generally low.

3. ***Flood Fringes*** - those areas of the floodplain not included in floodways or flood storage areas.

The Manual also recognises two categories of flood hazard, identified as ***High***, and ***Low Hazard***, described as:

1. ***High Hazard*** - where floodwaters present a danger to life and limb, could cause structural damage to buildings, and where the resultant social disruption and financial losses could be high.

2. ***Low Hazard*** - where floodwaters do not present a danger to life and limb and flood damages would be low.

Flood hazard is a measure of the overall impact of flooding. The assessment of flood hazard includes consideration of the depth and velocity of floodwaters, effective warning and evacuation time and evacuation difficulties.

A preliminary assessment of hazard is generally determined on the basis of the depth and velocity of floodwaters. This preliminary assessment may be revised following a review of other relevant factors, including warning times, flood awareness, rate of rise of floodwaters and evacuation considerations.

The preliminary assessment of hazard has been determined for the Marshalls Creek floodplain using Figure 3 which shows the provisional flood hazard categories as defined in the Manual.

The extent of the 'High Hazard' and 'Low Hazard' areas, based on the depth and velocity of floodwaters in the 1% AEP design flood, is shown on Figure 4.

An assessment of the depth and velocity of floodwaters indicates that the bulk of the inundated area can be classified as "High Hazard - Flood Storage". The depth of floodwaters is generally greater than 1 metre, while the velocity is generally less than 0.3 m/sec.

In general, existing urban development is located outside the "High Hazard" areas. Exceptions are the western half of Billinudgel and the bulk of New Brighton which are located within the "High Hazard" area.

The western side of Billinudgel is located in a "High Hazard - Flood Storage" area. The depth of floodwaters exceeds 1 metre, while the velocity of floodwaters is less than 0.3 m/sec due to the flow restriction presented by the railway embankment and bridge openings.

The northern tip of New Brighton is also located in a "High Hazard - Flood Storage" area. However, the width of floodplain is reduced as Marshalls Creek approaches the Orana Bridge and remains relatively confined through to the Brunswick River some 3.5 km to the south.

The velocity of floodwaters through much of the New Brighton area is slightly greater than elsewhere on the floodplain, with a typical value of 0.6 m/sec. This area is classified as "High Hazard - Flood Fringe" in accordance with Figure 3.

The Yelgun Creek - Marshalls Creek floodplain is classified as "High Hazard - Flood Storage" with the floodwaters being generally greater than 1 m and depth and velocity of floodwaters being less than 0.3 m/sec.

There is a narrow strip around the periphery of the inundated area which is classified as "Low Hazard - Flood Storage". The depth of floodwaters is less than 1 metre and the velocity is less than 0.3 m/sec.

3.4 Causes of Flooding

Flooding in the Marshalls Creek floodplain is influenced by:

- heavy rainfall over the catchment;
- elevated ocean levels entering the Brunswick River and Marshalls Creek systems;
- ocean waves spilling over or through the dune system;
- catchment conditions; or
- combinations of the above.

Some members of the Floodplain Management Committee indicated their view that flooding was also caused by blocking of outlets through the dune system and by buildup of sediment in the lower reaches caused by the river training walls. Contemporary documentation to support this view has not been identified. In the consultant's view, the natural coastal processes rebuilding the dune system are more likely to influence the dune heights rather than the rarer, less continuous flood events. Review of aerial photography taken before and after construction of the river walls indicates little difference in the sandbanks in Readings Bay.

In general, the meteorological conditions which produce heavy rainfall can also produce elevated ocean water levels, storm surge and large waves. The level of the ocean at the entrance of the Brunswick River has a major influence on flood levels in the lower reaches of Marshalls Creek, particularly downstream of the Orana Bridge.

The estimated 1% AEP design ocean water level at RL 2.6 m AHD which was adopted in the previous flood studies is above the natural ground level for much of the Marshalls Creek floodplain, as shown in Table 4. The data presented in Table 4 has been extracted from the property database used to assess flood damages, as discussed in Chapter 6.

Table 4

Typical Ground Levels

Locality	Min. Level (m AHD)	"Typical Level in Flood Affected Areas" (m AHD)
Ocean Shores	2.0	2.75
New Brighton	1.0	2.25
South Golden Beach	1.5	2.50
Ocean Shores North	1.25	2.75
Billinudgel	2.25	3.50

Thus, much of the floodplain is prone to inundation by elevated ocean water levels entering the estuary through the Brunswick River entrance. The extreme ocean storm conditions which produce these elevated ocean water levels may be located out to sea and not be associated with very heavy rainfall over the catchment.

These conditions can create large waves which break through the frontal dunes. This occurred in May 1974 when ocean waves broke through the "Sheltering Palms" area adjacent to Readings Bay and at other locations at New Brighton and near South Golden Beach. These breakthroughs were initially blocked off by earthmoving equipment following the storm. Natural coastal processes continued the beach and dune build-up to pre-existing levels.

There have been several instances of waves breaking through the dune system reported in local newspapers. The references noted are listed in Section 3.1.

A copy of each of the above newspaper references appears in Appendix F.

It is also interesting to note the references call for earthmoving equipment to close the gaps in the dune system.

The May 1987 flood is the largest recorded flood in Marshalls Creek. This flood was produced by a thunderstorm over the upper catchment. The flood at Billinudgel was above the estimated 1% AEP flood level and approximated a 2% AEP event in Ocean Shores and along Capricornia Canal. However, at New Brighton, downstream of Orana Bridge, the flood was less than the 5% AEP flood level due to the ocean water level being in the normal tidal range in the absence of storm surge or large waves.

3.5 Channel Bed Conditions

The channel conditions of Marshalls Creek have been reviewed on a number of occasions. A brief summary of these investigations is presented below.

Warner (*Appendix D*, Ref.5) collected bed surface samples and indicated three sources of the materials namely:

- Fluvial (riverine) material upstream of Balemo Drive/Gooloo Close intersection
- Reworked coastal sand from Balemo Drive/Gooloo Close to Orana Bridge
- Marine sands downstream of the Orana Bridge that were considered as a flood tide delta.

The report notes that the marine sand is very mobile in its upper layers. The report opines that much of the marine sand has probably been introduced since the construction of the Brunswick River training walls. The view that siltation has occurred solely as a result of the training walls is contradicted by historical oblique photographs of the estuary (reproduced on Figure 14 of this report).

The Public Works Department (PWD, Ref.15) undertook some additional research and collation of data and reported:

- Boreholes by PWD along Marshalls Creek in 1978 indicated tidal deltaic (Holocene) sands and two holes indicated shallow bed rock between 2.2 and 2.4 metres depth. The ground level at the boreholes was not recorded. The location of these boreholes (Number 6 and 7) are shown on Figure 5.

- the western bank of Marshalls Creek, about 500 metres upstream of the Training Walls, comprises a "platform of fractured metamorphosed gravels" over a distance of some 500 metres (Ref.15, Figure 11).

The bore hole logs on the Orana Bridge design drawings (supplied by Byron Council) note "massive sandstone and argillite" (a sedimentary rock) at about RL -2.0 m AHD.

Soil samples were collected during this current study at 5 locations along Marshalls Creek as indicated in Table 5 and on Figure 5. The samples were taken from about one metre below bed level and tested for acid sulphate potential by Centre for Coastal Management at Southern Cross University. The abbreviated test results appear in Table 5 below and indicate a classification of "Marginal Potential Acid Sulphate Soil". The criterion for classification as potential acid sulphate

for sandy soils is an oxidisable sulphur content greater than 0.01% dry weight. The high pH of the sands (pH 7.5 to 8.5) reduces the acid sulphate potential.

Table 5

Acid Sulphate Soil Tests

Location (Refer Fig 5)	Material	Oxidisable Sulphur (%SO_x dry weight)	Total Sulphur (%S dry weight)
A	Sand	0.019	0.07
B	Sand	0.072	0.12
C	Sand	0.010	0.05
D	Sand	0.035	0.06
E	Sand	0.047	0.07

It was also noted that the bottom withdrawal tube could not be placed to full depth (over 2 metres) at 3 locations as:

Location	Refusal Depth
A	about RL -1.8 m AHD
B	about RL -1.4 m AHD
C	about RL -0.5 m AHD

Bed rock was also evident during the site sampling program across the Marshalls Creek channel at about RL 0.4 m AHD, some 500 metres downstream of the Orana Bridge.

The above data suggests that:

- Dredging material from Marshalls Creek downstream of the Orana bridge is unlikely to expose acid sulphate soils.

- The assumptions in earlier studies (Reference 8) of dredging to RL -2.5 m AHD in the channel would appear to be optimistic given the rock outcrops identified at a number of locations, namely:

    - Orana Bridge: RL -2.0 m (design drawings)
    - Paterson 1996 Survey, Points A, B and C: RL -0.5 to RL -1.8 m AHD
    - Rock outcrops at low tides:
    - PWD bore holes Number 6 & 7: approx RL -2.2 to RL -2.4 m AHD

3.6 Greenhouse Impacts

Scientific research is continuing into the "Greenhouse Effect" which postulates a general warming of the earth as a result of increased levels of "Greenhouse" gases (carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, and others) in the earth's atmosphere, which will cause major ocean level increases and changes to weather patterns.

It has been postulated that the "Greenhouse Effect" would cause increases both in mean ocean levels and total annual rainfall. It is less clear whether the increase in total rainfalls would similarly modify rainfall intensity-frequency behaviour for the rarer design events (viz. a one percent AEP flood).

It has been estimated that mean sea levels will rise by 0.24 to 0.38 metres over the next 50 years and possibly by between 0.5 and 1.5 metres over the next 100 years due to the "Greenhouse Effect" (outlined in Ref.26).

NSW Government "Coastline Management Manual", 1990 (Reference 26) illustrates best estimates of increases in mean sea level as 0.32 metres by the year 2050 and 0.68 metres by the year 2100.

It is noted that the Commissioner Simpson's Public Inquiry (Ref.6) adopted a value of 0.3 metres as an appropriate sea level increase by 2030.

The principal difficulty in development of a strategy to assess "Greenhouse Effects" relates to development of strategies acceptable at the present time. Whilst the exact impact of "Greenhouse" is uncertain, as are mitigating measures, the general community may take time to reverse current increasing trends in the "Greenhouse effect" (for example, reduction in "Greenhouse Gas" emissions).

The results of financial expenditure to fund works and measures to protect against effects that may or may not occur as a result of the "Greenhouse Effect" need to be reviewed as part of the Floodplain Management Plan.

A possible response to the uncertainty of "Greenhouse effects" should involve flexibility for future capital works and allowing space and size for works and measures such that changes can be made in the future in response to demonstrated "Greenhouse effects".

This response is demonstrated through typical strategies that could involve:

Flood Protection Works (Structural Options)

It is normal practice to construct structural flood protection works to a Design Flood level plus an appropriate freeboard. The nominal freeboard normally adopted on New South Wales coastal rivers is 0.5 metres.

However, such works could be designed and constructed such that a "Greenhouse" component can be added at a later date. For example, earth levees could be constructed with crest width of five metres with crest level at Designated Flood level plus 0.5 metres. This would enable the levee to be raised at a later date to achieve a three metre crest width at full height (say Designated Flood level plus 0.8 metres). Alternatively, easements could be acquired to provide sufficient space for the extra height to be added behind or in front of the embankment at some time after the initial construction.

Flood Management Policies (Non-Structural Options)

Non-structural measures in the Marshalls Creek situation chiefly involve development controls such as setting of minimum floor levels.

The more extensive current building practice of slab-on-ground construction restricts house raising at a later date. Whilst house raising of slab-on-ground construction is technically possible, such work is considerably more extensive than raising buildings with timber floors, timber frames and suitable exterior cladding.

An appropriate strategy for this building style could be setting flood mounds or fill sites to the Designated Flood level plus 0.3 metre freeboard, while setting floor levels at 0.5 metres above flood mound levels. Buildings on piered foundations (eg. timber framing with timber or similar cladding) can be raised at some later date. For this building type, an appropriate strategy could be setting flood mounds at the Designated Flood level with floor levels set at 0.5 metres freeboard above the flood level.

In new broadscale development areas, consideration should be given to provision of levee easements around the development areas. The object of such easements or land reservation is to ensure open space is available for future levee construction if the future impact of the "Greenhouse Effect" requires this approach.

It is suggested that this approach be taken for newer developments as it allows flexibility to change developments created under such controls at a later date, should predicted "Greenhouse Effect" changes to flood behaviour occur.

4. COASTAL PROCESS CONSIDERATIONS

Large areas of the Marshalls Creek floodplain have been affected by earlier (in geological time) coastal processes and are currently affected by ocean levels, ocean waves and dune overtopping.

A review of the existing coastal processes is included below as part of the existing flooding environment.

4.1 Nearshore Coastal Processes

Under normal tidal and low flow conditions, Marshalls Creek flows into the Brunswick River and, thence to the open sea. During periods of very heavy and prolonged rainfall, the floodwaters of Marshalls Creek may break through the dunes adjacent to the Brunswick River entrance, and thence flow to the sea.

The ocean entrance to the Brunswick River is located in the Byron Bay-Hastings Point coastal embayment. Studies undertaken by the NSW Geological Survey (Roy & Stephens, 1978, Ref. 25) have shown that this coastal embayment comprises a wide relict Pleistocene beach ridge barrier. It is a wide sand dune plain that was laid down, initially, some 120,000 years ago, prior to the last great Ice Age and during the Pleistocene Geological Epoch, when the sea level was at about the same level as it is today. The very white appearance of these coastal sands reflects the bleaching action of slightly acidic rainwater over the hundreds of millennia that they have been exposed to weathering and leaching. The white colour of the beach sands in this area contrasts with the golden sands of the Central Coast and South Coast of New South Wales which were laid down during the recent Holocene Geological Epoch; that is, over the past 10,000 years. The fact that these very white sands are forming the present-day beach in the Byron Bay-Hastings Point coastal embayment indicates that the coastline has undergone significant erosion and recession over the present Holocene Geological Epoch.

Studies undertaken by NSW Public Works (Gordon et al., 1978, Ref.20.) have shown that beach erosion and recession of the Byron Bay-Hastings Point coastline is occurring at present as a result of a differential in the rates of littoral drift (beach sand) transport along the surf zone to the north under the action of the predominant south-easterly swell. The sand that is moving to the north and out of the embayment is not being replaced at the same rate with sand entering the embayment around Cape Byron from Tallow Beach to the south. This occurs because the beach sand coming from the south is spilling out from off Cape Byron where the predominantly strong southerly currents transport it into deep water and out of the littoral drift transport system.

The annual average net northerly rate of littoral drift transport along the Byron Bay-Hastings Point coastal embayment varies from about several tens of thousands of cubic metres moving past Cape Byron to a very high value estimated to be in the order of several hundred thousand cubic metres past Hastings Point (Ref.20). These rates of net northerly littoral drift transport are very high when compared to those on the Central Coast and South Coast of New South Wales. Further, the total amount of littoral drift transport (gross transport) along the beach, that is the sum of the total northerly transport under south-easterly seas and the southerly transport occurring under north-easterly seas, would be an order of magnitude larger again.

Bruun (1977; 1978, Refs 18 & 19) demonstrated that, on such high littoral drift coastlines, only the entrances of those estuaries with very large tidal discharges would remain open. Bruun proposed a relationship between (gross) transport rates of littoral drift to an estuary entrance and the tidal prism of the estuary such that the stability of an inlet was defined in terms of the ability of the tidal discharge to flush out the sediments that are carried by wave and current action to the inlet gorge. The relationship proposed was the arithmetic result of tidal prism volume divided by the littoral drift. On this basis he proposed that inlet stability be classified in terms of "Ω/M ratio" where low ratios ($\Omega/M < 50$) indicate poor entrance conditions whereas high ratios ($\Omega/M > 150$) indicate good entrance conditions.

Even with the high rates of littoral drift transport occurring along the Byron Bay-Hastings Point embayment, the Brunswick River has a relatively high tidal prism which ensures that the ocean entrance remains open and, hence, navigable as well as competent to discharge flood waters. The greater outflow, or ebb tidal discharge, occurring during floods often resulting in scouring of the ocean inlet and improving navigation for some period. For a littoral drift transport rate at the Brunswick River entrance of some 50 000 cu. metres per annum for a calculated spring tidal discharge of 1.32 million cubic metres, the "Ω/M ratio" for the Brunswick is 26. Such openings were classified by Bruun as "Bar-bypassers" with waves breaking over the river entrance bar during storms and with the inlet remaining open due to the large storm flow discharge from the accompanying heavy rainfall.

Marshalls Creek has occasionally broken through the dunes to discharge flood waters across the beach. These break outs have always been ephemeral because the tidal discharge of the Marshalls Creek estuary has been relatively too small to ensure that the entrance would not become choked with littoral drift material. The calculated spring tide discharge of Marshalls Creek is some 447 thousand cubic metres indicating a "Ω/M ratio" of 9. Ratios of this magnitude typify inlets as unstable "overflow channels" rather than permanent inlets. Further, other works undertaken over the past few decades (Mangleson, personal communication) have reduced the nett potential tidal prism of Marshalls Creek and, hence, its competence to maintain an ocean entrance other than that at its confluence with the Brunswick River.

The tidal prism of Capricornia Canal itself is some 86,000 cubic metres, indicating a "Ω/M" ratio of 1.7, indicating less entrance stability than even Marshalls Creek itself if Marshalls Creek were opened to the sea.

In looking to improve the competence of the lower Marshalls Creek estuary to discharge flood waters, therefore, attention can be focussed on improving its conveyance capacity at its confluence with the Brunswick River and/or to providing weak locations along the frontal dune system where the creek can break through or be broken through during severe flood events.

Coastal processes relevant to these options are canvassed below.

4.2 Design Ocean Water Levels

The occurrences of heavy rainfalls and huge seas are not necessarily statistically independent. Both can be the result of the same weather system. Intense low pressure systems offshore that produce strong onshore winds and heavy seas are also the mechanism driving large amounts of moist air onto the coast, resulting in heavy rainfall. However, heavy rainfall can also occur without the occurrence of large seas. Further, flooding from large seas caused by wave overtopping of a beach berm and low foredune needs to be considered as well, as this phenomenon can occur with rainfall.

Nielsen and Wilson (1995, Ref.24) investigated the dependence or otherwise of severe rainfall and heavy seas in New South Wales. They found that 9 of the 13 heaviest rainfall recordings between 1934 and 1985 on the Central Coast were coincident with heavy seas (significant deep water wave height, $H_s > 3.5$ m) and 5 of these events were associated with very severe storms having significant wave heights exceeding 5 m (Refs 17 and 23). The most severe rainfall event recorded was coincident with an extreme storm event with peak significant wave heights, H_s, exceeding 6 m.

However, some of the most severe oceanic storms ever recorded have not been associated with the highest ranked rainfall events. Nevertheless, considerable rainfall has been associated with these extreme oceanic storm events. It is important to note that extreme rainfall and oceanic storm events will often be associated with elevated water levels due to the inverse barometer effect associated with the low pressure systems driving these weather conditions.

In view of the coincidence on the coast of severe storms with extreme precipitation and the possibility of flooding from wave overtopping of dunes associated with heavy rainfall, it is suggested that any floodplain management programs and/or works on estuaries be assessed and designed for the two separate scenarios:

- flooding caused by precipitation over the catchment
- flooding from dune breaching and wave overtopping

The deepwater offshore wave and tidal level design conditions for these scenarios need to be transferred to the nearshore and shoreface as appropriate for specific sites in the determination of the design tail water level conditions for flood management strategies.

The nearshore tail water control levels for various applications are developed below. The components of the ocean water level are illustrated on Figure 6.

Design Water Levels within the Brunswick River,
Flooding Caused by Precipitation

For flooding caused by precipitation, the controlling tailwater levels on floodwater discharge are determined for a severe storm with a significant offshore wave height, H_s, of 6 metres. Wave setup at the shoreline is determined on a site specific basis as appropriate.

Water levels within the Brunswick River at its confluence with Marshalls Creek will be determined by the prevailing tidal stage and storm surge. As the depth of water over the ocean bar would be in the order of some 5 m, wave setup at the river entrance would be negligible. This has been borne out by direct field measurements undertaken by New South Wales Public Works (Hanslow & Nielsen, 1992, Ref.21).

Thus, for design purposes, the maximum still water level as tail water control for the discharge of Marshalls Creek floodwaters into the Brunswick River would be RL 1.7 m AHD comprising:

- a maximum spring tidal stage (RL 1.1 m AHD);
- a storm surge (0.2 m);
- a coastal wind set-up allowance (0.2 m); plus
- a Greenhouse allowance (0.2 m).

For this condition, wave setup on the beach is included in the determination of the water level on the beach.

Design Level on the Beach,
Dune Discharge of Floodwaters

Given the extreme flood discharge through the dune and over the beach berm, the design condition for the determination of the tail water control would be RL 2.5 m AHD, comprising:

- a spring tidal stage (RL 1.1 m AHD);
- a storm surge allowance (0.2 m);
- a coastal wind set-up allowance (0.2 m)
- nearshore wave setup resulting from a 5 m significant offshore wave height (0.8 m); plus
- Greenhouse allowance (0.2 m)

Design Sill Level for Dune Weir Discharge Control Structure
Prevention of Oceanic Inundation

Any weir/sill control structure designed for dune discharge of floodwaters from Marshalls Creek across the beach berm would need to be at a level above that which could result in excessive oceanic inundation during times of very severe oceanic storms and wave uprush.

Design for this condition is based on an extreme storm with a significant offshore wave height, H_s, of 9 metres associated with a moderately heavy rainfall event. Wave setup at the shoreline is determined as appropriate. A Greenhouse allowance of 0.2 metres to be added for tail water control on berm levels.

The design still water level on the beach during a severe oceanic storm would be RL 3.2 m AHD, comprising:

- a maximum spring tidal level (1.1 m AHD);
- storm surge (0.2 m);
- coastal wind set-up allowance (0.2 m) resulting from a 9 m significant offshore wave height;
- wave set-up (1.5 m); plus
- a Greenhouse allowance (0.2 m).

4.3 Ocean Outlet Design Considerations

Dune discharge could result in the alleviation of extreme flooding in Marshalls Creek, provided that the outlet is located some distance upstream of the confluence with the Brunswick River. The difference in tailwater control for the design maximum flood event would be the allowance for wave set-up on the beach. While the coincidence of severe oceanic storms occurring with heavy rainfall is high, it would be unrealistic to combine the maximum probable oceanic storm event with the maximum flood discharge event. Therefore, the design condition makes an allowance for an offshore significant wave height, H_s for the maximum flood discharge. Under these conditions, the tailwater level for dune discharge on the beach would be some 0.8 m above that at the confluence of the Creek with the Brunswick River. For a water surface gradient in Marshalls Creek in the order of 0.1 to 0.2 m per km, the creek flood level would begin to exceed the ocean tailwater control level on the beach some 4 to 8 km upstream of the Brunswick River entrance.

While dune discharge may assist in alleviating flooding from the maximum flood event, there is a possibility of oceanic inundation resulting from extreme storm events if the crest level of the dune weir system is too low. Prevention of excessive inflow during an extreme storm event would need a weir sill level to be set at least above the maximum still water level occurring during the event, if not higher, to prevent wave overtopping. For a design offshore significant wave height, H_s, of 9 m with a wave period of 12 sec, the level of wave run up on a nearshore dune slope of 1:15 was computed to be RL 6 m AHD.

Discharges over a weir crest at various levels below the wave runup level were computed (as illustrated in Table 6 below), and indicated that a sand dune weir crest would need to be maintained at a level above about RL 4 m AHD to prevent significant severe oceanic storms.

The management of a dune discharge system, therefore, would need to be such that the weir level of the discharge structure could be varied according to the particular meteorological conditions pertaining at any one time. A fixed discharge weir level could not satisfy both requirements of alleviating the maximum probable flood discharge event while preventing oceanic inundation during extreme storm events. This, however, might be achieved if the weir was designed as a natural sand dune, maintained at a level to prevent oceanic inundation but with mechanical breakout being effected by the Local Government Authority during periods of extreme precipitation when the wave height is not excessive. Clearly, there may be occasions when a mechanical breakout might not be affected because of the dangers posed on the beach by the

severe wave action. Such a structure would need to be located in the order of some 4 to 8 km upstream of the Brunswick River entrance to be effective.

Table 6

Beach Weir Overtopping

Weir Level (m AHD)	Peak Inflow (cu. m/s per metre width)
3.0	14.0
3.5	6.7
4.0	3.0
4.5	1.2
5.0	0.5
5.5	0.2
6.0	0

5. COMMUNITY AND ENVIRONMENTAL ISSUES

5.1 Land Use and Statutory Planning

5.1.1 Introduction

This section considers the land use controls and policies relevant to the Marshall Creek Floodplain Management Plan area.

It identifies the different levels of land use planning from State and Regional planning policies, plans and reservations such as State Environmental Planning Policies (SEPP) areas, Nature Reserve/National Park reservations, to local planning polices and plans such as Local Environment Plan (LEP) and Development Control Plan (DCP) zonings. The purpose is to outline the land use planning approach being taken in managing broad land uses of the floodplain management study area.

Appendix D provides a summary of the relevant matters from the above planning controls and policies.

5.1.2 Broad Overview

Land use planning controls in the study area generally reflect the evolving location of urban settlement and rural industries within the coastal landscape. Protection of environmental values, such as the coastal dune system, estuaries and fauna habitat vegetation systems, initially an adjunct to these other uses, has increased in importance in recent years. There are now a number of important Nature Reserves, as well as riverine corridors, and remnant areas of representative vegetation such as wetlands and littoral/sub tropical rainforest and habitat (eg. for koalas), which are protected by planning policies and land use zonings.

Earlier proposals for further urban development outside of existing zoned areas, as well as on sensitive lands within planned urban expansion areas, have generally not proceeded, due to an increasing community awareness of environmental values, and hazards associated with aspects such as flooding and coastal erosion processes. Some of these sensitive areas such as the Billinudgel Nature Reserve have been acquired by government, with other areas being identified under State policies for protection and/or restrictions on inappropriate land uses.

There are a still a number of "Deferred" planning areas within the study area, considered as having some development potential and but also containing other constraints. In these "Deferred" areas, where broad policies and zonings apply, more detailed assessment is required. Thus, they remain contentious in the wider community in relation to their best overall future use, or how the lands should be developed, if at all. These areas are discussed in more detail in the following section.

5.1.3 Specific Planning Policies, Strategies and Controls

There are four main levels of land use planning controls:

1. State reservations, strategies and policies
2. Regional plans and strategies
3. Local land use strategy, and zonings under a Shirewide Local Environment Plan
4. Local policies and specific planning controls under Development Control Plans

State Reservations, Strategies and Policies

There are a number of land reservations of importance in the study area.

The dedicated Brunswick and Billinudgel Nature Reserves have been established specifically to protect important nature conservation values.

A number of dedicated and reserved coastline and riverside Crown Reserves established for conservation and public recreation provide corridors along Marshalls Creek, the North Arm of the Brunswick River, and the coastal beach and dune system.

These are identified on Figure 7.

The NSW Government's Draft Coastal Policy (Ref.30) applies to the study area. This policy includes specific policy statements in relation to protecting the coastline from inappropriate development, flood mitigation, and coastline hazards. The policy encourages compatible land uses with coastal hazards, in particular recognising and accommodating natural forces, and considering the Greenhouse Effect. Appropriate minimum floor levels for development affected by flooding, effective management, including warning systems, and community safety are also considered important.

There are four State Environmental Planning Policies (SEPPs) directly relevant to the study area in relation to floodplain management. These are:

- SEPP 14 - Coastal Wetlands
- SEPP 26 - Littoral Rainforest
- SEPP 44 - Koala Habitat
- SEPP 46 - Protection and Management of Native Vegetation

There are six designated SEPP 14 wetlands, (Numbers 57, 58, 59, 60, 61 and 63) located in the study area. These are associated with Marshalls and Billinudgel Creeks and the North Arm of the Brunswick River and are identified on Figure 7.

These wetland areas are protected by the policy and require management which retains their conservation values. Any works related to flood mitigation affecting these areas would be designated development under the Environmental Planning & Assessment Act (1979) and require an environmental impact statement (EIS) prior to any works.

There are three designated SEPP 26 areas, (Numbers 15, 16 and 18) located in the study area under this SEPP.

Two of the areas are associated with Marshalls Creek at the Orana Drive bridge between New Brighton and South Ocean Shores, and an area to the south of South Ocean Shores adjacent to the Brunswick Nature Reserve. (Refer Figure 7.) These areas are protected and management must retain environmental values including restricted uses in a buffer surrounding them.

There is identified koala habitat under SEPP 44 - Koala Habitat in the vicinity of the New Brighton village in close proximity to Marshalls Creek. This policy requires that such habitat values are protected in land use and management.

SEPP 46 - Protection and Management of Native Vegetation relates to controls on clearing of land, in the catchment, particularly on steep slopes.

The NSW Government's Floodplain Management Policy and Manual relates to the study area, in relation to preparation and implementation of a floodplain management plan and subsequent actions in relation to managing hazards related to flooding. The emphasis is to avoid hazards wherever possible and not to exacerbate problems through inappropriate development and land management practices. The manual also indicates that all feasible options should be considered and should take account of physical, social, economic or ecological factors.

This Floodplain Management Plan has been prepared based on the principles of this Policy and the manual.

State Government legislation such as the Environmental Planning & Assessment (EP&A) Act, the Local Government Act, the National Parks & Wildlife Act, and the Catchment Management Act, specify a range of matters related to nature conservation, Aboriginal and colonial heritage, social and economic impacts, and community values and perspectives, that need to be considered in relation to land use and management of the study area.

Regional Plans and Strategies

The North Coast Regional Environmental Plan (Ref.31) has a number of objectives which relate directly to the study area and floodplain management.

Objective 30(d), (e), and (f) relate to minimising risks to people, development and natural processes in the land use planning process. Objective 44 relates to encouraging the location of urban housing development on flood free land.

The North Coast Urban Planning Strategy (NCUPS), (Ref.32) emphasises the importance of complimenting urban areas with sensitive coastal locations and avoiding hazards such as floodprone lands.

The North Coast Crown Reserves Management Strategy (1994) (Ref.33) requires that conservation and habitat, cultural and recreational values of Crown Reserves are protected and enhanced by identifying and implementing appropriate land management approaches.

A Regional Planning Strategy for the Northern Rivers area currently being prepared by the Department of Urban Affairs and Planning is based on Ecologically Sustainable Development principles. Therefore any development and land management will need to consider the protection of natural systems and processes including biodiversity, and the precautionary principle ie. lack of scientific knowledge is not an excuse for creating an adverse impact on the environment, and caution should be taken if decisions would lead to uncertainty about the likely effects of subsequent actions.

Local Land Use Strategies and Policies

Byron Shire Local Environmental Plan (LEP) 1988, (Ref.34) establishes land use zoning and a range of policies that identify how lands should be developed and protected in the study area.

The land use zonings under this LEP are illustrated on Figure 8.

It should be noted that a permissible land use under a zone does not necessarily provide a legal right to develop the land on that basis. A range of planning factors are required to be considered in decision making as described in the plan.

Environmental zoning in the floodplain management plan study area is common with zonings such as "8(a) Nature Reserve", "7(a), Wetlands", "7(b) Coastal Habitat" and "7(f1) Coastal Lands".

Zoning "6(a) Open Space", prohibit or control development that would be detrimental to conservation, recreation and landscape values, and natural coastal processes including flooding.

The LEP includes a zoning identified as Zone 5(b), "High Flood Hazard". For simplicity, this zoning is indicated as with the Zone 5, "Special Uses" on Figure 8. The Zone 5(b) area is located in the management area adjacent to Marshalls Creek, east of the residential area at the northern end of Balemo Drive. This zoning specifically identifies a relatively low area affected by higher velocity floodwaters.

The land use zoning map illustrates the zoned areas indicated above and cover the coastal estuarine systems related to the Brunswick River and the adjacent coastline, including creeks, wetlands, riverside, urban areas prone to flooding used for recreation such as the Ocean Shores golf course, and coastal dune system.

A number of villages and urban areas such as New Brighton, Ocean Shores North, and South Golden Beach have been developed through the study area in relatively sensitive coastal locations, and which are directly affected by coastal processes of beach erosion. Ocean Shores and Billinudgel are also affected by flooding.

Development in "Rural 1(a)", "Urban 2(a)", "Business 3(a)", "Special Uses 5(a) and "Industrial 4(a) zones are required to consider flood impacts and mitigation through Clauses in the LEP Plan.

Part 3 of the LEP indicates that flood mitigation works are designated development and will require an EIS being prepared, and that development should only occur on flood liable land if no adverse effects on flooding regimes can be demonstrated.

There are a number of "Deferred" planning areas located in the management plan study area where final land use decisions in relation to the best use and management of these were not made at the time of preparing the Byron LEP. These are located both within existing urban and rural land use areas.

The "Deferred" areas in the rural area to the north of Marshalls Creek and south of Jones Road are now included in the Billinudgel Nature Reserve.

"Deferred" sites in Ocean Shores and New Brighton area have specific controls and matters under Development Control Plans (DCPs) for the urban areas to be addressed in any proposed development of the sites. These latter "Deferred" sites remain contentious in relation to a number of matters such as protection of conservation and scenic values, and coastal processes including flooding.

The Byron Shire Residential Development Strategy (1993) (Ref.35) identifies flooding as a major constraint and must be considered in relation to development in the management study area. No further release of urban development areas are identified in the Ocean Shores locality. At Billinudgel, the Strategy identifies land use in the short to medium term as a predominantly rural residential release area with limited serviced urban lots due to constraints including flooding.

Local Specific Planning Controls (Development Control Plans)

There are four Development Control Plans (DCPs) that are relevant to the management study area.

Byron Shire Council also has a an existing policy on development in flood prone areas (Policy No. 5.45 adopted on 24 June 1994. The objective of this policy - "Building and Development - Minimum Fill Levels on Flood Prone Land" is to determine a minimum fill level for residential development on flood prone land. It states that Council may consider a minimum fill level below the 1% flood level for rezoning and development on flood liable land where an applicant can demonstrate that seven (7) principles and development aspects can be achieved or met. These include the development being in accordance with the NSW Floodplain Development Manual, that it shall not increase flooding upstream or downstream from the site, that an appropriate building envelope classified "low hazard" can be provided, that vehicle access is satisfactory, and construction of buildings enables floor levels and sewer openings to be specific minimum heights above 1% flood levels.

Byron Shirewide DCP No.1 covers the whole of the management study area. Within this study three specific DCP apply namely:

- *DCP 14(a)* relates to Ocean Shores,
- *DCP 14(b)* to New Brighton village,
- *DCP 14(c)* to the South Golden Beach village and Ocean Shores North urban area.

DCP No. 1. establishes a range of detailed planning and design criteria for urban development which emphasise avoiding or mitigating effects of flooding and natural coastal processes on development. (Refer to specific clauses in Appendix D for further details).

DCP 14(a),(b), and *(c)* establish guidelines and criteria which emphasise the need to avoid problems associated with natural hazards, and the importance of managing riverside reserves for protection of fauna habitat and flora. In relation to flooding, specific clauses discourage inappropriate development, encourage innovative building requirements, and set minimum floor height levels for dwellings where flooding affects a site, but which is not of a nature to exclude development. Pole construction with minimal land fill rather than slab construction on a mounded filled site is an example of construction technique that the DCPs would encourage on this basis.

A number of clauses in *DCP 14(b) New Brighton*, and *DCP 14(c) South Golden Beach-Ocean Shores North* indicate the intention of Byron Shire Council to work with the local communities to provide suitable equipment and storage for flood rescue equipment.

"Deferred" planning areas in Ocean Shores and New Brighton are covered by their DCPs respectively. Clauses indicate that the lands are flood prone and that any urban development that may be possible subject to detailed study, will be required to follow guidelines related to minimum floor level heights for residences, as well as protect natural values of the sites.

5.1.4 Conclusions

Based on the planning policy and strategy documents that relate to the floodplain area, and the public consultation exercise undertaken for this study, potential flood management measures should be considered in light of their implications on the following factors:

- *Effectiveness* at mitigating some aspect of a flooding problem, such as social concern at the unpredictability of flooding, need for adequate warning and rescue services, water quality problems, damage to property, or risk to health.

- *Conformity* and *accordance* with the relevant planning policies for the area.

- *Retention of critical environmental resources* as these are the environmental resources that cannot realistically be replaced such as biodiversity and natural processes or the time and effort required would be unacceptable. Consequently all proposed measures ensure these are retained and where possible enhanced. These include the established landscape, natural appearance of riverbanks, integrity of the habitat value of wetlands and creekside environment.

- *Protection of other environmental resources* based on the identifiable environmental characteristics that the area already has, or potentially could have. In order to retain the stock of environmental resources in the area, it is necessary that any measures demonstrably ensure that these qualities are retained, or are adequately replaced and/or enhanced. Such existing resources include visual and physical access opportunities to river and creek bank, the contribution of vegetation systems and native fauna to the scenic quality of the area, the area of open space, and appropriate recreation opportunities related to the estuarine systems. Retention of critical environmental resources and the maintenance of other environmental resources also includes consideration of sites of cultural significance, including

  Aboriginal cultural values. These provisions may well restrict the ability of Council to undertake widespread clearing of waterways and normal "maintenance" procedures.

  The DCP's in the area do contain detailed provisions for reducing flood damage and meeting community expectations, however, the provisions of the DCP's do not appear to be widely understood or applied.

5.2 Social Profile

Key social profile indicators for the Marshalls Creek floodplain area have been sourced from the Byron Shire Community Profile (Ref.36).

The five communities that make up the floodplain population (North and South Ocean Shores, Billinudgel, New Brighton, Ocean Shores North and South Golden Beach) can be divided broadly into two distinct areas by their socio-economic characteristics. These area groupings are:

- the Ocean Shores area (including Ocean Shores North) and Billinudgel
- the New Brighton and South Golden Beach area.

Key features of these two areas have been summarised as:

Ocean Shores

* Higher than Shire average proportion of the population over 60.
* Relatively few children.
* Higher proportion than Shire average of households comprises couples without dependent children.
* Higher proportion than Shire average of households are owner occupiers (75% as opposed to 65% Shire wide).
* Highest levels of mobility in Shire.

South Golden Beach and New Brighton

* Area of rapid growth over the last few years.
* Highest percentage increase in 5-14 year group in the Shire.

* Lower than Shire average for persons aged over 60.
* Higher household incomes than Shire average.
* Higher than average home ownership level for South Golden Beach, however home ownership rates are lower than average for New Brighton.
* Very high levels of mobility (93 and 94% respectively).

Thus, the Ocean Shores community is older, comprising a high proportion of over 60 whereas New Brighton comprises a high proportion of children in the 5-14 year age group.

Both identified areas have a high level of car dependency because of the relative shortage of social infrastructure, such as shops, social and sports facilities (other than those associated with the beach) in the area.

Anecdotal evidence suggests that the communities are both articulate, well-informed and fairly settled.

The high levels of home ownership and the strength of feeling evident in the community suggest the floodplain communities have both a financial and an emotional commitment to the area. There is, in the communities, a strong sense of identification with their surroundings.

As the area consists of a number of neighbourhoods, the communities hold a diversity of interests and perspectives. The groups through which people articulated their feelings have tended to be small and pursue either localised or special interest agendas. All the groups identified have well developed and strongly felt views about the management of the floodplain.

The community generally value the qualities of their surroundings and have coalesced into a number of groups to articulate their concerns about their shared environments. This tends to indicate the community have a degree of social structure and can organise themselves effectively, as has been demonstrated by several meetings/demonstrations in the area.

5.3 Flora and Fauna Review

5.3.1 Overview

An overview flora and fauna investigation was undertaken through the Study Area. The full investigation report appears in Appendix C of this report. The purpose of the flora and fauna investigation is to review ecological factors (in particular the flora and fauna) of the study area and to identify the potential impacts of flood mitigation measures that may be implemented in the future.

The task aims of the flora and fauna review were to:

- undertake an overview of the flora and fauna attributes of the Marshalls Creek floodplain within the study area;

- identify flora and fauna of significance within the floodplain (essentially SEPP 44 considerations);

- identify the significance of Marshalls Creek with respect to fisheries and aquatic life; and

- outline issues for consideration in the Floodplain Management Plan works and measures such that the program can be implemented within the framework of the flora and fauna sustainability/enhancement.

A limited literature search was carried out to locate fauna species records for the study area and the Brunswick Heads area in general.

The specific references examined for relevant records were:

- annual 'NSW Bird Reports' from 1974 to 1993, published in the journal 'Australian Birds';

- the consultant's personal wildlife roadkill records; and

- National Parks & Wildlife Service Wildlife Atlas Records and ROTAP (Rare or Threatened Australian Plants) Database records for Threatened Species recorded within the study area.

A field inspection, involving a limited survey of fauna, was carried out during the period 22-23 April, 1996. This survey involved a total of two days observations during daylight hours. Walking spotlight surveys using two spotlights and three observers were carried out on the night of 22 April 1996.

5.3.2 Research Results

Fauna

Eighty-two bird species were recorded during the survey within the study area with an additional 27 identified from specified references above (National Parks & Wildlife Service, roadkill and Australian Birds records). Thus a total 109 bird species were identified.

Six mammal species were located during the survey with an additional 11 from the specified references.

Three reptile species and three amphibians were recorded during the field survey while an additional three reptiles and two amphibians were identified from the specified references.

The identified species list appears in Appendix C.

Threatened Fauna Species

Threatened fauna species are covered by the NSW Threatened Species Conservation Act, 1995. Schedule 1 of the Act lists species considered "Endangered" while Schedule 2 lists species considered "Vulnerable".

Twenty-nine "Threatened Species" of fauna (in the terms of the Act) have been recorded in the study area.

Three species of fauna listed on Schedule 2 of the Act (Vulnerable Species) were detected during the field survey. These were the Koala *Phascolarctos cinereus*, the Osprey *Pandion haliaetus* and the Pied Oystercatcher *Haematopus longirostris*.

Four Schedule 1 ("Endangered") species were recorded from the specified references. These are Bush Stone-curlew (Thick-knee) *Burhinus grallarius*, Beach Stone-curlew (Thick-knee) *Esacus neglectus*, Little Tern *Sterna albifrons* and Double-eyed Fig-Parrot *Cyclopsitta diophthalma coxeni*.

Twenty-two Schedule 2 ("Vulnerable") species were identified from the specified references. These are the Wallum Froglet *Crinia tinnula*, Wallum Tree Frog *Litoria olongburensis*, Black Bittern *Ixobrychus flavicollis*, Black-necked Stork *Ephippiorhynchus asiaticus*, Square-tailed Kite *Lophoictinia isura*, Bush-hen *Amaurornis olivaceus*, Brolga *Grus rubicunda*, Sooty Oystercatcher *Haematopus fuliginosus*, Wompoo Fruit-Dove *Ptilinopus magnificus*, Rose-crowned Fruit-Dove *Ptilinopus regina*, Glossy Black-Cockatoo *Calyptorhynchus lathami*, Swift Parrot *Lathamus discolor*, Masked Owl *Tyto novaehollandiae*, Grass Owl *Tyto capensis*, Collared Kingfisher *Todiramphus chloris*, Barred (Yellow-eyed) Cuckoo-shrike *Coracina lineata*, White-eared Monarch *Monarcha leucotis*, Black Flying-fox *Pteropus alecto*, Queensland Blossom-bat *Syconycteris australis*, Long-nosed Potoroo *Potorous tridactylus*, Little Bent-wing Bat *Miniopterus australis* and Northern Long-eared Bat *Nyctophilus bifax*.

A number of microchiropteran (small insectivorous) bats was observed during the spot-lighting survey and it is possible that some of them may have been Threatened Species other than those listed above.

Other Fauna of Interest

Migratory wading birds and terns have been observed utilising the mud and sand flats, rocky areas and mangroves of the estuary. These comprise the Whimbrel *Numenius phaeopus*, Common Sandpiper *Actitis hypoleucos*, Grey-tailed Tattler *Heteroscelus brevipes*, Ruddy Turnstone *Arenaria interpres*, Common Tern *Sterna hirundo* and Little Tern *Sterna albifrons*.

The Grassland Melomys *Melomys littoralis*, a species of native rat, recorded at the site by National Parks and Wildlife Service, is uncommon in New South Wales.

Aquatic fauna

No specific survey of aquatic fauna was carried out during this investigation. Anecdotal evidence suggests that Whiting, Bream, Flathead, Mullet, yabbies and soldier crabs are common.

However, in a previous investigation of dredging along Marshalls Creek, preliminary investigations were undertaken into aquatic life (see Reference). The investigations showed extensive areas of mangroves, sea grass beds and wide sand bar areas. The area was viewed likely to represent a significant aquatic resource.

Flora

The research approach used involved preparation of a generalised vegetation map from the available aerial photography and field checking of the vegetation communities. Individual specimen investigation of the site's flora was not carried out.

The vegetation map appears on Figure 9.

The vegetation communities identified are as follows:

- Coastal Dune Scrub
- Swamp Open Forest
- Open Eucalypt Forest
- Mangrove Forest
- Fern-sedge Swamp
- Heath
- Grasslands
- Littoral Rainforest

Threatened Flora

No species listed on Schedules 1 and 2 of the Threatened Species Conservation Act, 1995 were located during the fieldwork.

Eight Threatened species have been identified by other observers (National Parks & Wildlife Service ROTAP Data Base). These are *Davidsonia puriens var. jerseyana, Randia moorei* and *Acronychia littoralis* (Schedule 1 - Endangered species) and *Corokia whiteana, Cryptocarya foetida, Endiandra hayesii, Syzygium hodgkinsoniae* and *Syzygium moorei* (Schedule 2 - Vulnerable species).

In addition the rare species, *Thozetia racemosa, Trichosanthes subvelutina, Acacia bakeri, Archidendron muellerianum, Argophyllum nullumense, Endiandra globosa, Rhodamnia maideniana* and *Acronychia baeuerlenii* have been recorded (N.P.& W.S. Data Base).

5.3.3 Review of Results

Fauna

The study area at Marshalls Creek, Brunswick Heads, supports a variety of vegetation communities that provide habitat for numerous fauna species, in particular birds.

The number of threatened species of plants and animals is comparatively high.

This rich bio-diversity is acknowledged by the protection of a large part of the study area as the Brunswick Heads Nature Reserve and the recently dedicated Billinudgel Nature Reserve.

The short duration (2 days and 1 night), the limited survey techniques employed, and the season of survey (autumn) would all contribute to an underestimate of the faunal species present in the study area.

Common migratory birds such as the Dollarbird *Eurystomus orientalis*, Rufous Fantail *Rhipidura rufifrons*, Black-faced Monarch *Monarcha melanopsis* and Cicadabird *Coracina tenuirostris* were not recorded although they, and other species, would almost certainly be present during the spring and summer months.

The identification of microchiropteran bats requires that they be trapped or detected by ultra-sonic detectors. This was outside of the scope of this flora and fauna review.

Despite the above limitations this report provides a reasonable overview of fauna species present.

The sourcing of N.P.& W.S. Atlas Records and the consultants roadkill records has compensated to some degree for the other factors.

The twenty-nine Threatened Fauna species recorded for the study area indicate a high local bio-diversity and highlight the bio-geographical importance of the MacPherson-Macleay Overlap zone.

Fourteen of the Threatened species use wetlands (sand and mud flats, estuarine waters, mangroves, and freshwater wetlands). The integrity of these wetlands is closely linked to the health of Marshalls Creek and its estuary, as well as the surrounding catchment area.

The Koala has been recorded from a number of forested sites within the study area. The provisions of State Environmental Planning Policy (SEPP 44) relating to Koalas and their habitat, would have to be implemented in the event that a flood mitigation proposal would impact on forest communities.

The migratory wading birds and terns that visit the estuary are transequatorial migrants from the Arctic and sub-Arctic areas. They breed in places such as Siberia, Alaska, China and Japan and escape the harsh northern winter by migrating to southern latitudes. The Whimbrel, Common Sandpiper, Grey-tailed Tattler, Ruddy Turnstone, Common Tern and Little Tern are all subject

to two bi-lateral agreements to protect migratory birds and their environment. These agreements are generally known as the Japan-Australia Treaty and the China-Australia Treaty. The Australian Government therefore has obligations under these treaties to protect areas used by these species such as the Marshalls Creek and Brunswick estuaries.

The extensive areas of habitat for aquatic fauna, such as sand and mud flats, mangrove forests and rocky substrates, and the variety of avian predators of aquatic fauna (such as terns, gulls, kingfishers, herons, egrets, osprey etc) present at the site indicate a rich aquatic fauna.

Flora

Eight Threatened Species of plant are known from the study area with an additional eight rare species occurring. A number of these are at or near to their southern limit of distribution such as *Davidsonia pruriens var. jerseyana* and *Endiandra globosa*.

The existing status of much of the area as Nature Reserve should protect a high proportion of these threatened plant species, however populations outside of N.P.& W.S. estate may need special protective measures.

5.3.4 Impact of Proposed Development Works

The fieldwork carried out for this report was of a limited nature. The floodplain management options have not been developed to allow only site specific flora and fauna surveys which should be carried out prior to implementation of structural development works.

The potential impact of proposed, or potential, developments on flora and fauna varies depending upon the nature of the development and the type of ameliorative measures to be adopted.

The richness of the bio-diversity within the Marshalls Creek catchment means that there is a high potential for significant impact on natural ecosystems from works that will alter the natural hydrology and floodplain systems.

6. FLOOD DAMAGES ASSESSMENT

6.1 Overview

Damage caused by flooding has several components which are conventionally analysed separately and then combined to produce aggregate damage estimates for a particular flood (either historical or "Design").

Typically, flood damages are divided into **tangible damages**, which can be quantified in monetary terms, and **intangible damages** which cannot be quantified in monetary terms.

Tangible flood damages are generally subdivided as follows:

- **Direct Damages**
  Repair or replacement of buildings and contents damaged or destroyed by floodwaters; and

- **Indirect Damages**
  Costs incurred in-clean-up, evacuation, temporary accommodation and loss of income but not involving contact with flood waters.

Intangible damages reflect the effect of flooding on the health and psyche of the community and can be very real and significant. These damages typically take the form of anxiety, depression, trauma and general deterioration in well-being of those affected by flooding and are difficult to quantify in monetary terms. Assessment of intangible damages is beyond the scope of this study.

The direct flood damages have been assessed using the ANUFLOOD flood damages model which was developed at the Centre for Resource and Environmental Studies at the Australian National University (Ref.30). The model assesses the potential direct damage to property only and does not provide estimates of indirect damages. The intangible damages, which are also relevant in floodplain management, are not assessed by the model.

Potential direct damages represent the damages which would occur during a flood if no action is taken to reduce damages. In general, residents can be expected to take some action to reduce flood damages if adequate time is available. Such action would include the following:

- placing moveable items on tables;
- moving contents to upper floor levels;
- use of sandbags to seal doorways; and
- removal of vehicles to higher ground.

The above actions enable residents to reduce the actual damages suffered in a flood event. The savings in flood damages which can be achieved is dependent on a number of factors, including:

- flood warning lead times;
- flood awareness and preparedness;

- availability of upper level floors; and
- access conditions and evacuation considerations.

Considerable reduction in damages can be achieved with adequate warning and appropriate response.

The flood damages survey carried out following the Nyngan flood indicates that actual damages to buildings and contents may be 10% less than the potential damages. The Nyngan survey found that the major saving in external property damages is achieved by relocation of vehicles to higher ground.

Direct property damages for Marshalls Creek have been based on the potential direct damages to buildings, contents and vehicles. It has been assumed that a large majority of vehicles will not be relocated to higher ground prior to the floodwaters cutting the roads. This is seen as a function of the short response time of the catchment to rainfall and limited time available to move vehicles to flood free land.

6.2 Properties and Buildings at Risk

6.2.1 Assessment Approach

The ANUFLOOD damages model uses three sets of input data as follows:

- a property database;
- a stage-damages relationship which specifies the estimated potential direct damage sustained at differing depths of flooding for different categories of properties; and
- a design flood level probability distribution for the study area.

The property database is particularly valuable for assessment of the number of properties and buildings at risk. It might also be used to identify the flood risk of particular properties.

The information for the property database was obtained by ground survey for all properties which are located below Probable Maximum Flood (PMF) levels through the Marshalls Creek area. The data was partly collected in this study and partly developed from earlier surveys.

The data collected for residential properties included location, ground level, lowest habitable floor level, elevated or non-elevated construction, building materials and damage class required for estimation of flood damages and other data required for floodplain management considerations.

Similar data was collected for the commercial and light industrial properties with the inclusion of size of the property as damage estimates are based on floor area.

A full listing of the residential and commercial/light industrial property databases is provided in Appendix B.

The study area was divided into 5 neighbourhoods termed "precincts" for the purposes of this study, based on locality and/or source of flooding. A "Reference Location" was assigned to each precinct as shown on Table 7 below. The adopted precinct boundaries are shown on Figure 10.

Table 7

ANUFLOOD Precincts and Reference Locations

Precinct	Locality	Reference Location
1	Ocean Shores	Golf Course Gauge
2	New Brighton	New Brighton Gauge
3	South Golden Beach	Capricornia Canal
4	Ocean Shores North	Capricornia Canal
5	Billinudgel	Billinudgel Gauge

6.2.2 Residential Properties at risk

The distribution of habitable floor levels for the residential properties relative to the 1% AEP flood level in each Precinct is presented in Table 8. This data has been verified by comparison of the 1% AEP flood profile and the surveyed floor levels.

Testing of the floor level data base using the 1987 flood levels, indicates the following numbers of properties are predicted to be inundated:

- Ocean Shores: 4 properties
- New Brighton: 40 properties
- South Golden Beach: 16 properties
- Billinudgel: 15 properties (excluding developments since 1987)

The predicted numbers of properties inundated agree with the historical data given in earlier reports (see Section 2.2.5 and Section 2.2.6) with the exception of South Golden Beach. The historical information suggests between 11 and 22 properties as inundated in 1987 while the data base predicts 20 properties as inundated if the South Golden Beach levee were not constructed (the situation in 1987). The source of the discrepancy has not been investigated as South Golden Beach is protected by a levee to the 1% AEP flood event.

Table 8

Cumulative Number of Houses with Habitable Floors Below Given Flood Level

Flood Level	Precinct					
	1 Ocean Shores	2 New Brighton	3 South Golden Beach	4 Ocean Shores North	5 Billinudgel	Total
10% AEP	-	9	6 *	-	-	9
5% AEP	-	18	12 *	3 *	-	18
2% AEP	-	34	13 *	5 *	-	34
1% AEP	8	41	16 *	6 *	-	71
1% AEP + 0.3 m	50	47	53	11	1	162
1% AEP + 0.5 m	94	49	93	23	2	261
Extreme	149	55	133	43	3	383

* *Protected by levees, assuming 0.4 m minimum freeboard for levee crest*

The data presented in Table 8 shows that there are 71 houses with habitable floor levels below the 1% AEP flood level and there are 91 additional houses with habitable floors less than 0.3 metres above the 1% AEP flood level.

There are 22 houses in South Golden Beach and Ocean Shores North which are located below the 1% AEP flood level. These houses are protected by levees which have a nominal crest level 0.4 m above the 1% AEP flood level in Capricornia Canal. There are 49 houses in Ocean Shores and New Brighton which would be inundated in the 1% AEP flood event.

Normal practice is to set floor levels at an appropriate freeboard above the design flood level. If a freeboard of 0.5 metres is adopted, the data in Table 8 above indicates that some 263 houses in the Marshalls Creek are "at risk" in the 1% AEP flood.

The largest number of flood affected properties is located in New Brighton. This village is also the oldest of the residential areas on the Marshalls Creek floodplain.

The depth of floodwaters in the Ocean Shores houses would be approximately 0.1 m for the 8 affected houses. However, the depth of floodwaters in the New Brighton houses would be from 0.1 m to more than 0.7 m with a depth of 0.3 m being exceeded in 24 houses.

It should be noted that the floor levels for 4 houses in Ocean Shores and 41 houses in New Brighton are below the 1% AEP ocean water level of RL 2.6 m AHD and 24 houses in New Brighton are below the 5% AEP ocean water level of RL 2.3 m AHD.

Thus, reduction of creek flooding levels of 0.3 m if technically possible, would enable some 8 houses in Ocean Shores and 17 houses in New Brighton to avoid inundation in the 1% AEP flood, provided that the ocean water level was not significantly affected by storm surge and wave action.

Reductions of this magnitude would reduce the number of houses considered at risk by approximately 100.

It has been assumed that the Ocean Shores North and South Golden Beach levees are adequate to withstand the 1% AEP design flood without structural damage.

6.2.3 Commercial and Light Industrial Properties

The distribution of floor levels for commercial and light industrial properties relative to the 1% AEP flood level in each Precinct, is presented in Table 9.

The data presented in Table 9 shows that there are 26 commercial and light industrial premises which have floor levels below the estimated 1% AEP flood level.

The majority of the commercial and industrial premises are located in Billinudgel with the remaining commercial buildings comprising a shop in New Brighton and a former motel complex at South Golden Beach. More than half of the commercial/light industrial premises in Billinudgel are located below the 1% AEP design flood level.

There are 16 premises in Billinudgel which would be inundated by floodwaters in excess of 0. 3 m deep in the 1% AEP flood event. The Billinudgel commercial and light industrial properties represent the second largest group of flood affected property owners and occupants on the Marshalls Creek floodplain.

Table 9

Cumulative Number of Premises with Floors Below Given Flood Level

Flood Level	Precinct					
	1 Ocean Shores	2 New Brighton	3 South Golden Beach	4 Ocean Shores North	5 Billinudgel	Total
10% AEP	-	-	1 *	-	9	10
5% AEP	-	1	3 *	-	14	20
2% AEP	-	1	3 *	-	18	22
1% AEP	-	1	3 *	-	22	26
1% AEP + 0.3 m	-	1	3	-	25	29
1% AEP + 0.5 m	-	1	4	-	28	33
Extreme	-	1	4	-	34	39

* *Protected by levees, assuming 0.4 m minimum freeboard for levee crest*

6.3 Damages Assessment Data

6.3.1 Property Data

As noted earlier, the ANUFLOOD damages model uses three sets of input data comprising:

- a property database;
- stage-damages relationship
- a design flood level probability distribution.

The details of the property data base and properties at risk was detailed in the previous section.

The flood liable area was divided into precincts as indicated in Table 7. For damage assessment, each of the precincts was divided into sub-areas based on similar flood levels. Flood level adjustment factors equal to the difference in flood level at the centroid of the sub-area and at the reference location were then used to modify the ground level and floor level survey data to allow for the spatial variation in flood level throughout the precinct.

6.3.2 Stage-Damages Relationships

Direct Damages

Whilst major flooding has occurred in Marshalls Creek in recent years, there is no direct flood damage data available that was collected immediately after these events. Thus, it was considered appropriate to base damages estimates on the results of flood damages surveys from other towns rather than to undertake a fresh survey of residents in the Marshalls Creek area.

Detailed flood damages data was collected following the April 1990 flood in Nyngan and the February 1991 flood in Inverell (Refs 27 and 28). The data collected included potential direct damage to buildings and contents, external property damages (including vehicles) and indirect damage estimates for evacuation, temporary accommodation, clean-up and loss of income.

The stage-damages relationships for residential properties from the Nyngan and Inverell data, adjusted to 1997 dollar values, has been adopted for residential properties on the Marshalls Creek floodplain. The adopted stage-damages relationships for residential properties is summarised in Table 10 below.

The ANUFLOOD model assesses damages sustained by inundated houses and industrial/commercial buildings. The model does not assess damages sustained to the grounds of properties which may be inundated. Thus, the damages estimates are limited to structure and contents damages only.

Table 10

Potential Direct Damages For Residential Properties

Depth of Flooding (m)	Damages ($) per Property Structure and Contents
0	3,500
0.5	19,800
1.0	27,400
1.5	29,200
2.0	31,900

Flood damages data had been collected for commercial and light industrial premises following the Nyngan and Inverell floods. The damages data collected highlighted that flood damages to non-residential properties can be widely variable.

In an effort to 'standardise' the damages data, the damages were reduced to a 'per square metre' value and plotted against depth of floodwaters, as shown on Figure 10. The figure also illustrates the results of an interview process with 18 properties in the Tuggerah Industrial Area, Wyong. The data shows a high degree of variability.

The damages data adopted for commercial and light industrial properties is presented in Table 11.

Table 11

Potential Direct Damages Commercial and Light Industrial Properties

Depth of Flooding (m)	Value of Contents ($ per sq metre)		
	Low	Average	High
0	10	20	100
0.3	40	120	330
0.6	70	200	370
0.9	90	280	410
1.2	110	320	450
1.5	120	360	490
2.0	130	400	540

Indirect Damages

Analysis of the data collected at Nyngan and Inverell indicated that the indirect costs associated with flooding comprise:

- clean-up $2,400/property
- evacuation, temporary accommodation and loss of wages $ 500/household/day
- loss of trade $3,000/day

For short duration floods, the indirect damages above are equivalent to 20% of potential damages for residential and commercial/light industrial properties for a typical depth of flooding of 0.5 metres.

The indirect damages for Inverell were estimated to be 20% of potential direct damages for residential properties and 16 to 24% of potential direct damages for commercial and light industrial properties.

Indirect flood damages have been assessed as being 20% of the direct flood damages for residential and 20% for commercial/light industrial properties.

6.3.4 Design Flood Level Probability

The design flood level probability distributions adopted for each of ANUFLOOD Precincts were based on the design flood level probabilities listed in Table 3 and based on the earlier flood studies.

The design flood levels adopted for the reference locations for each ANUFLOOD precinct and used in the damages estimation, are presented on Table 12 below.

Table 12

Flood Level - Probabilities Adopted for Damages Assessment

Locality	Precinct	Adopted Flood Level (m) AHD				
		AEP %				
		10	5	2	1	Extreme
Ocean Shores	1	2.00	2.40	2.60	2.75	3.55
New Brighton	2	1.90	2.15	2.45	2.60	3.50
South Golden Beach	3	2.25	2.45	2.65	2.80	3.60
Ocean Shores North	4	2.25	2.45	2.65	2.80	3.60
Billinudgel	5	3.30	3.50	3.75	3.90	4.75

Table 12 includes an "Extreme" flood level which was based on earlier flood studies and extrapolated to a 0.01 percent AEP event (a once in 10,000 year event) and termed an "Extreme Flood".

6.4 Estimated Flood Damages

The estimated potential direct damages for a range of flood probabilities are summarised in Tables 13 and 14 for residential and commercial/light industrial properties, respectively.

The data presented in Tables 13 and 14 show that the mean annual damages sustained by residential properties and commercial/light industrial properties are very similar. However, the damages sustained by commercial/light industrial properties is significantly greater for the 1% AEP design flood and smaller events.

Table 13

Potential Direct Flood Damages to Residential Properties

Flood Level % AEP	Precinct					
	1 Ocean Shores $	2 New Brighton $	3 South Golden Beach $	4 Ocean Shores North $	5 Billinudgel $	Total $
10	-	61,900	- *	- *	-	61,900
5	10	173,000	- *	- *	-	173,010
2	21,270	433,700	- *	- *	-	454,970
1	59,000	597,000	- *	- *	40	656,040
Extreme	2,165,000	1,331,000	2,008,500	557,900	53,700	6,116,100
Mean Annual Damages	9,210	35,080	8,945	2,350	220	55,805
(Say)	9,300	35,100	9,000	2,400	300	55,900

* *Assumes levee prevents damages*

Table 14

Potential Direct Flood Damages to Commercial/Light Industrial Properties

Flood Level % AEP	Precinct					
	1 Ocean Shores $	2 New Brighton $	3 South Golden Beach $	4 Ocean Shores North $	5 Billinudgel $	Total $
10	-	-	- *	-	135,740	135,740
5	-	-	- *	-	348,320	348,320
2	-	20,300	- *	-	656,000	676,300
1	-	28,700	- *	-	890,760	919,460
Extreme	-	59,300	61,600	-	2,619,000	2,739,900
Mean Annual Damages	-	1,430	455	-	53,220	55,105
(Say)		1,500	500		53,300	55,200

* *Assumes levee prevents damages*

There are some 30 vacant lots in the Billinudgel industrial area. These lots are generally 0.5 m above the 1% AEP design flood level. Therefore, buildings constructed on these lots will be at a much lesser risk of flooding. As a result, the total flood damages for commercial/light industrial properties is expected to increase marginally with future building in the area.

Council's current building controls require that habitable floors of residential buildings be located a minimum of 0.5 m above the 1% AEP design flood level. Therefore, the future total damages sustained by residential properties is also expected to increase marginally as houses are constructed on the vacant lots.

6.5 Public Utilities Damages

Public utilities include roads, railways, parklands and underground water, sewerage, power and telephone services and installations.

The damages sustained by public utilities comprise the replacement or repair of assets damaged by floodwaters, the cost of clean-up of the installations as well as the collection and disposal of clean-up material from private property.

The assessment of public utility damages does not include damages sustained by the commercial/industrial buildings which are included in the assessment of commercial and industrial property damages. However damages sustained by pumping stations, amenities buildings, switchyards, etc, are included in the assessment.

Analysis of public utility damages for the Nyngan and Inverell floods in 1990 indicates that public utility damages are $5,500 to $6,500 per hectare of developed land inundated. The higher damages estimate was obtained for Nyngan and is possibly due to the longer duration of the flood, which lasted for several days.

Public utility damages for the Marshalls Creek floodplain has been assessed at $5,500 per hectare of inundated land, excluding wetlands, forests and undeveloped areas.

The extent of inundation in the 1% AEP design flood is shown on Figure 2. Some 500 hectares of land between Billinudgel, the northern limits of Ocean Shores North and South Golden Beach and the Brunswick River are covered by floodwaters in this event. There are extensive wetland areas within this inundated area, extending over some 260 hectares.

The estimated damages sustained by public utilities for a range of flood probabilities is presented in Table 15. The estimated mean annual damages to public utilities is $64,250. This is slightly less than 60% of the direct damages sustained by residential and commercial/light industrial properties.

Table 15

Estimated Public Utilities Damages

Flood % AEP	Damages $
10	300,000
5	400,000
2	700,000
1	800,000
Extreme	1,050,000

6.6 Total Tangible Flood Damages

The total mean annual tangible flood damages for the Marshalls Creek floodplain comprise:

-	direct damages to residential properties	$ 55,900
-	indirect damages to residential properties (20%)	$ 11,200
-	direct damages to commercial and light industrial properties	$ 55,200
-	indirect damages to commercial and light industrial properties (20%)	$ 11,100
-	public utilities damages	$ 64,300
	Total	$197,700
	Say	$198,000)

The estimated mean annual indirect damages to residential and commercial/light industrial properties has been assessed at 20% of the estimated direct damages.

The above damages assessment represents annual tangible costs that will be sustained by the community though, because flooding is an infrequent event, the damage is sustained as lump costs when each flood occurs.

The total tangible damage above indicates that economically viable structural works will need to cost no more than $ 2.45 million. This assertion is based on the assumptions of:

- Scheme **totally** eliminates flooding.
- The tangible damages saved are $ 198,000 per annum
- Total benefits are damages saved along a benefit stream of $ 198,000 per annum, capitalised over 30 years at a 7.0 percent discount rate.
- A benefit/cost ratio of 0.5 is acceptable, essentially identifying that social costs of flooding are accepted as equal to the tangible costs.

7. COMMUNITY CONSULTATION

7.1 Overview

Community consultation was undertaken during the Floodplain Management Study process via five mechanisms, namely:

- Value Management Workshop
- Formal correspondence with government and other bodies;
- Public requests for formal submission;
- Informal community information sessions and workshops; and
- Formal Public Exhibition of the Floodplain Management Plan.

Details of the above processes are outlined below.

7.2 Value Management Workshop

A Value Management Workshop was conducted by Byron Shire Council of 20 June 1995. The workshop has been outlined earlier in Chapter 2 and the proceedings detailed in Reference 13.

The participants at the Value Management Workshop comprised (by organisation):

- Byron Council	Mayor and one councillor
- Byron Council	Engineering and Works (2 representatives), Planning (1 representative)
- Public Works Department	One representative
- Progress Associations	Billinudgel Progress Association (2 representatives), New Brighton Progress Association (2 reps), South Golden Beach Progress Association (2 reps), Ocean Shores Urban Association (1 reps)
- Webb McKeown	Engineering consultants
- Byron Shire SES	One representative

The Workshop was primarily conducted to assist in culling the large number of options being canvassed at that time into a series of options for further review. The Workshop achieved this by focussing on the four options which have formed the basis for the current brief.

7.3 Dredging Poll

Byron Shire Council conducted a poll with the September 1995 Council election to gauge local support for dredging of the Brunswick River and its tributaries, Marshalls Creek and Simpson Creek.

The specific question asked was "Do you support the dredging of the Brunswick River and its tributaries, Marshalls Creek and Simpsons Creek?".

The result of the poll was:

-	Shirewide	"Yes" vote:	7,181
		"No" vote:	6,213
-	Ocean Shores	"Yes" vote:	1,509
		"No" vote:	521

A copy of the information provided with the poll appears in Appendix G.

Critics of the poll claim that the information provided is insufficient to make a reasonable judgement.

In the consultant's view, there is some merit in the criticism in that the poll information does not outline any negative impacts while the positive impacts noted are qualified by the text "Possible benefits of dredging may be:"

7.4 Formal Correspondence

Formal requests for input to the floodplain management study were forwarded to 26 government bodies and 56 community groups. A list of those contacted appears in Appendix E.1

A summarised list of the replies appears in Appendix E.2 while the actual submissions appear in Appendix E.3.

Eighteen submissions were received in response to 54 invitations to respond, representing a response rate of 33%. Many of the responses related to the effects of the suggested measures on water quality. The main issues related to silt, disturbance of acid sulphate soils, the effects on the habitat value of the waterways and pollution generally. Improving water quality was generally supported. Dredging will require the approval of the Fisheries Minister and any work which would effect the Nature Reserves will require a full assessment of its environmental implications.

Five submissions were received following the informal consultation process. The significant points from these submissions were that the area is an important and sensitive habitat, rich in biodiversity, and that serious concerns were expressed about the implications and practicality of undertaking several measures. In particular, dredging attracted a number of comments both for and against. Dredging was seen as assisting the floodplain to drain effectively in two submissions, but its practicality and effectiveness was also questioned.

There was a general feeling that community ownership of any measures is very important. The perception included allowing some consolidating development in the area, provided the development was appropriate for its setting and did not worsen flood impacts. This perception was expressed as "sensible development", rather than "no development".

7.5 Informal Community Contact

Informal community contact was established via a process of a public information evening followed by meetings with interested groupings of the floodplain communities.

The schedule of meetings completed was:

- Public Information Meeting	1 May 1996
- Community contact	
CONOS	16 May 1996
New Brighton	16 May 1996
Ocean Shores Association, South Golden Beach and Billinudgel	17 May 1996
Ocean Shores North	17 May 1996

Meeting reports have been produced on the above and appear in Appendix E.5

General public information has been maintained via a series of Public Newsletters (Two issues to February 1997).

A series of common views and areas of convergent as well as divergent views emerged from the informal consultation process. These areas of commonality and divergence are outlined below.

Common Ground

A number of themes recurred throughout the four meetings. These themes can be grouped into three categories as:

- Perceived qualities to be retained and/or enhanced
- Perceived problems to be consequently eliminated or amended
- Preferred outcomes

Shared Values

The participants greatly valued the residential amenity of the area, frequently stating it as the reason why people choose to live here. Significant elements of the residential amenity are seen as the peace and space the area offers, the proximity to the sea and the environmental qualities of the area, little pollution, and the perception of an attractive and vigorous landscape that offers rivers, wetlands, woodlands, dunes, beaches, access to attractive views and a range of natural habitats.

Shared Concerns

The community shared a general concern that development had worsened flooding problems. In particular the community felt that if development was allowed to carry on in a piecemeal, incremental way then the problems that the area faced with flooding were going to get worse.

The proposed upgrading of the highway from Brisbane was considered to increase development pressures in the area. It was believed that this problem would be compounded by fundamental environmental changes such as global warming and the associated rise in sea levels. The general focus of concern about flooding was that water became trapped within the floodplain.

There was a strong feeling that previous interventions, such as the perceived closing of the northern outlet, the construction of the training wall, and the amount of development and its associated fill and impermeable surfaces on the floodplain had compounded this problem. This was perceived as contributing to the complexity of the hydrology of the floodplain, which was seen as poorly understood and consequently the Council's computer model was an unreliable means of predicting the effects of flooding.

The Council was also seen as unresponsive to community feelings and made little attempt to foster a realistic understanding of the implications of living on a floodplain for either the existing community or the incoming residents.

Preferred Solutions

There was a general consensus that no one measure would offer a complete solution, and so the management plan should comprise of a number of complementary elements.

These elements were seen as comprising of two key strands, namely:

- a localised management and minor works regime that limits the implications of flooding; and

- "pulling the plug" structural measures that would release water more quickly from the floodplain.

Localised Mitigation and Management Measures

The participants' solutions for mitigating the effects of floods fell into three categories:

- empowering the community to handle the floods;
- making the environment less flood sensitive; and
- making individual dwellings less flood prone.

"Empowering the community" followed agreement that people should be better equipped to handle floods. It felt that people required better information about the implications of living in a floodplain. This was particularly important when people were making decisions affecting their quality of life. Educational material about development and landscaping in flood prone areas would also contribute, as well as recognition of local knowledge. The further element of achieving "Empowerment" was to facilitate the local community to complement existing services.

"Making the environment less flood sensitive" embodied a general agreement that further development should not compound the flood problems. An interim quarantine on development was seen as an important part of this objective. In the longer term, it was felt that development or redevelopment should be assessed primarily in light of its effect on flooding. Consequently (re)development should ensure it complies with adequately drainage, does not require fill, disturbance of acid sulphate soil or significant increases in impermeable surfaces. These measures should be reflected in the Council's Development Application assessment practice.

The second element of "Making the environment less flood sensitive" was making floods less damaging. This was seen as requiring commitment to adequate maintenance of drains and installation of silt and gross pollutant traps on the drains to minimise the pollution. This objective was thought to be assisted by a commitment to facilitate the lowering of the level of the golf course lake prior to the expected onset of flooding to increase the area's capacity to accommodate floodwater.

"Making individual dwellings less flood prone" was seen as required though the measures described above were expected to lower the impact of flooding. For those properties still considered to be at risk of substantial flood damage, there was support for raising these properties on poles where possible. An alternative was a "buy-back" system allowing the property to be purchased, the old buildings to be demolished, and new buildings to be constructed conforming to the principles outlined above.

The release measures through the beach dunes ("pulling the plug", "ocean outlets") received some general agreement though none of the options put before the community received universal support.

However an ocean outlet option was supported by two of the groups on the basis of suggested evidence that a natural outlet existed in this vicinity and could be reinstated as a low-key, "natural" outlet, without the major engineering works (assumed by the options put before the community). This measure will require detailed and careful exploration of its effectiveness, its on-going maintenance requirements and its ecological implications. Subject to the suitability of this option, the other possibilities would be either the reduction of the training wall to return the river to a more natural profile and consequently encourage a more vigorous scouring effect in the river channel or dredging the lower reaches of Marshalls Creek to achieve the same effect.

Dredging was thought to release useful material for repairing the beaches and dunes or for use in the construction of the proposed by-pass.

Areas of Strongest Feeling

An interim quarantine and a subsequent change to future DA assessment practice to reflect greater consideration of flooding was seen as the most broadly supported measure, with a greater education and commitment to consultation and community participation also strongly supported.

There was some disagreement about making individual properties less flood prone, which was seen as being of value to only those householders. The northern ocean outlet options were the

most contentious, attracting explicit disapproval from some participants. However it would appear that this disapproval was based on the environmental implications of the option. The suggestion of a "non-engineered" solution was seen to allay these environmental concerns.

Other areas of conflict largely relate to the relative importance placed on the different elements.

Technical Comment

The community concerns above raise a number of issues which can be addressed in a variety of ways.

It is noted that community concerns raised issues of water quality, blockage of local drainage and overland flow paths. These issues are seen as best addressed through Council's sub-division standards and for improvements and/or rectification via trunk drainage programs.

This approach is taken essentially as:

- This Study and Plan essentially are directed to flooding and reduction of flooding.

  Typically flood depths in the study area are 0.5 to 1 metre above ground level and effectively cover all the trunk drainage system.

- Water quality improvement requires attention to the long term duration flows in the river system whilst the flooding is comparatively rare and of short duration.

- Some reports of flooding appear to be a function of failure of the drainage system and lack of defined and engineered overland flow paths rather than flooding from Marshalls Creek.

Whilst the flood mitigation option of releasing flood waters through the beach dunes are attractive, this system may expose the community to additional coastal flooding. The lack of a significant water level difference between the peak flood levels prevailing in Marshalls Creek and the ocean implies that there is little energy available (through the water level difference) for scouring of an entrance and thus the flood reductions gained are small (as indicated by computer model results outlined in References 7, 10, 12 and 13).

The proposed system of changes to the Golf Course lake with the approach of floods is seen as unlikely to be effective given the storage available.

The issues of "community empowerment" and "Making dwellings less flood prone" can be addressed through the Floodplain Management Plan via sub-division and building standards and effective education programs.

8. EMERGENCY RESPONSE

8.1 Local Flood Plan

Emergency response to flooding in Marshalls Creek is primarily the responsibility of the State Emergency Service (SES). The SES is empowered by the State Emergency Rescue and Management Act 1989 and State Emergency Service Act 1989 as the primary "combat agency" for flood preparedness, response operations and immediate recovery measures within Byron Shire Council's administrative area.

The SES has published the Byron Local Flood Plan (Ref.29) which covers a response to flooding in Marshalls Creek.

The Flood Plan covers:

- Organisational structures and responsibilities
- Flood preparedness
- Flood warning
- Responses to flooding
- Outline of Flood threat

The Local Flood Plan is formulated along a standardised format with specific additions for the Brunswick River catchment (including Marshalls Creek).

Specific flood risk quoted in Local Flood Plan relates to the May 1987 flood and indicates the impacts of that flood as:

- Billinudgel	10 premises inundated
- South Ocean Shores	4 houses inundated, worst affected streets were Narooma Street and Balemo Drive
- South Golden Beach	11 houses inundated, area now protected to 1% AEP level by levee bank
- New Brighton	40 houses inundated though 1987 flood was below 5% AEP flood downstream of Orana Bridge

It was noted during the review of the Flood Plan that the number of buildings quoted in the Plan as affected by flooding differs from the data provided by the property data base. However, as noted earlier, the discrepancies appear to be at South Golden Beach which is now protected to the 1% AEP flood by a levee.

The Plan notes that the Local SES with Byron Shire Council was responsible for local flood education including awareness of flood threat, stages of inundation, evacuation routes and evacuation centres. During the investigation for this Floodplain Management Plan, there was no

evidence of the specific education programs being conducted. In the Consultant's opinion, the SES is under-funded and under-resourced to satisfactorily undertake the flood education program.

There is merit in the whole of this task being undertaken by Byron Shire Council.

Flood advice and flood warnings are not provided for Marshalls Creek and the Brunswick River by the Bureau of Meteorology, but are prepared by the Local SES. Preparation of Flood Warnings is not common practice in New South Wales but in this case is appropriate procedure because of the small size of the catchments and their rapid response to rainfall.

The evacuation centres for the Marshalls Creek communities are noted as:

-	Ocean Shores North	Seventh Day Adventist Centre, Shara Boulevard.
-	Ocean Shores	Ocean Shores Country Club, Orana Road.
-	Billinudgel	Old Public School, Billinudgel

It is noted that the evacuation centres for Ocean Shores North and Ocean Shores are above PMF flood level and are thus suitable locations. It is noted the Billinudgel School has been demolished.

It would be prudent to seek a flood free evacuation site at Billinudgel.

It is noted that South Golden Beach and New Brighton are not specifically mentioned above. These communities have only three access routes to flood free-land namely:

- Over Capricornia Canal via Kallaroo Circuit (The Bund)
- Over Capricornia Canal at New Brighton Road
- Over Marshalls Creek at the Orana Bridge

Access to Orana Bridge on the New Brighton side can be cut by floodwaters as can access via New Brighton Road. Thus, residents in New Brighton can be isolated in flood periods. The residents of South Golden Beach have access to the Pacific Highway via Kallaroo Crescent and Shara Boulevard.

As noted, the Local SES prepares the flood warning advices through area released to the media, government bodies and other Local SES controllers by the Richmond/Tweed SES Divisional Headquarters.

The Local Flood Plan indicates a series of flood heights through the area for the 1% AEP flood. The levels do not appear to correlate with the published flood levels given in the various Flood Studies nor the levels used for Council for building floor level control.

8.2 Flood Warning

The Local SES prepares flood warnings on the basis of ALERT rainfall data collection. A series of manual rainfall and water level gauge readers supplement and back-up the ALERT system.

The ALERT technology is essentially real time collection of data with continuous telemetric transfer of the data to a central station. The ALERT system is appropriate for the data collection.

Manual readers are principally located upstream of Billinudgel with only one reader downstream of Billinudgel.

8.3 Improvement Opportunities

There are a number of opportunities for improvement to the flood response in Marshalls Creek as follows.

The warning time available for flood warning in Marshalls Creek is short. Whilst the technology for collection of data is adequate, the weakness would appear to be dissemination of warnings.

The public consultation process has highlighted the community spirit in the study area and it is suggested that this be utilised to improve the dissemination of flood warnings.

It is recommended that:

- Clearly visible flood gauges be installed at Billinudgel, Capricornia Canal, New Brighton and Ocean Shores. These gauges should be tied to a common datum (Australian Height Datum) to reduce possible confusion over gauge readings and flood levels.

- A Warden be appointed at each location responsible for the reading of the gauges and for the dissemination of flood warnings in their locality. Each warden be supplied with fax and radio contact such that when Local Flood Warnings are released by the Divisional Headquarters, the Local Warnings are also directed to the individual area wardens.

- The SES develop a simple computer system with hand calculation back-up to enable the warnings issued at Billinudgel to be transferred to Capricornia Canal, New Brighton and South Ocean Shores. The computer models established by the various flood studies are seen as probably too reliant on specialist services to be able provide flood warnings reliably within the required time frame. They could however be used to develop a series of relationships between various flood heights to form the basis of a prediction method.

- There should be a clear commitment by Byron Shire Council and the SES for preparation of locally relevant flood information and flood response for distribution to the affected areas and other flood education programs. This should be undertaken independent of whatever structural floodplain management programs may be undertaken as part of the Floodplain Management Plan.

- A consistent set of flood levels be adopted as the 1% AEP flood levels throughout the Marshalls Creek Floodplain and the adopted levels used by all parties.

9. EXISTING FLOODPLAIN MANAGEMENT MEASURES

The Marshalls Creek Floodplain has been recognised as being flood liable for some time. It is noted that the land use around the Marshalls Creek floodplain is essentially urban development or nature reserve.

The current floodplain management measures in place are:

- Adoption of Flood Standard
- Floor level control
- A levee system at South Golden Beach
- Development of the flood warning system

The flood warning system is discussed in the previous chapter.

9.1 Flood Standard

The Floodplain Management Manual (Ref.1) recommends the adoption of a "Flood Standard" for land use planning purposes. The Brief for this study notes that, following the 1986 Flood Study (Ref.3), Council adopted the 1% AEP flood (as defined by Reference 3) as its standard for setting floor levels.

Council's policy is outlined in Policy No 5.45, adopted on 28 June 1994. The minimum floor levels adopted are based on Figure 18 of the 1986 Flood Study (Reference 3) which is reproduced in Appendix H of this report.

The adoption of 1% AEP flood as a "Standard" is consistent with the approach taken by many Councils in New South Wales.

It must be noted that land above the 1% AEP flood level only implies a degree of protection against flooding and that land needs to be above PMF levels to be considered truly "Flood Free".

There appears little benefit in reducing Council's adopted flood levels on the basis of the lowering flood level estimates between 1986 and 1996 because a large proportion still remains affected by ocean flooding events.

9.2 Floor Level Control

There is some confusion regarding the source of flood level information.

In his 1990 investigation, Commissioner Simpson (Ref.6, Page 11) noted that many of the floor levels in South Ocean Shores have been set at RL 2.5 m AHD, based an a standard adopted at that time equal to the 2% AEP flood event. His report also notes a proposal at that time to lower the floor level requirements below the 1986 assessment to be based on later (at that time) flood modelling.

Byron Council have advised (M Norris, personal comm., Feb 1997) that floor levels are fixed at a freeboard of 0.5 m above the 1% AEP flood level as defined by the 1986 Flood Study (Ref.3, Fig 18).

The 1986 Flood Study did not include a "Greenhouse" component in the ocean water levels but did apply conservative assumptions regarding co-incidence of rainfall and ocean surges and wave set-up. However, the current flood modelling for this study included a 0.2 m "Greenhouse" increase in ocean water levels and produces 1% AEP levels as indicated on Figure 3. The predicted levels are generally 0.2 m below the 1986 estimates.

For comparative purposes, flood levels at Narooma Avenue have been assessed as:

- 2% AEP at time of initial development — RL 2.5 m AHD
- 1% AEP, 1986 Study, Reference 3 — RL 3.1 m AHD
- 1% AEP, 1995, Reference 16, Table 1 — RL 2.73 m AHD
- 1% AEP, this study — RL 2.75 m AHD

Thus, the floor heights currently being applied by Byron Shire Council, if applied in accordance with the 1986 study, are conservative in that they are higher than required in order to provide protection in the 1% AEP design flood event.

It is thus recommended that:

- Council adopt Figure 2 as the 1997 estimated 1% AEP flood levels;
- Council maintain the existing minimum level floor levels for fixing of minimum habitable floor levels; and
- Council prepare a plan of the area indicating the minimum floor level requirements.

9.3 South Golden Beach Levee

Parts of South Golden Beach and Ocean Shores North are protected from Marshalls Creek floods by a small levee system.

The location of the levee is illustrated on Figure 12. The levee is earth with design parameters (derived from the design plans) as:

- Crest Width — 2 m
- Side slopes — 2:1 (H:V)
- Crest Level — RL 3.2 m AHD
- Design 1% AEP flood at site (1997) — RL 2.8 m AHD

Thus the levee can be considered as providing protection against the 1% AEP flood with an appropriate freeboard (0.4 m).

10. REVIEW OF FLOOD MITIGATION WORKS OPTIONS

10.1 Overview

The Value Management Study (Ref.13), which was held in June 1995, reviewed 46 options which had been identified and investigated in previous studies. The workshop resolved to concentrate on three specific works options with a fourth possibly evolving from further investigation. The options selected by evaluation matrix methods are listed below in order of ranking:

Option A Re-levelling of the north wall of the Brunswick River;

Option B Dredging of Marshalls Creek and removal of training walls;

Option C Lengthening the Orana Bridge; and

Option D Flood outlets at Wooyung, Ocean Shores North and "Holiday Village" with the Kallaroo Circuit bund and Capricornia Canal to be fully opened

Options A and B above have been combined into a single option, thus reducing the number of works options to be evaluated. The options are aimed at reducing the impact of flooding on the existing and future development on the floodplain. The locations of these works options are shown on Figure 13.

The Value Management Workshop also resolved to investigate one non-structural management option. This option, identified as the "Quarantine" option, seeks to reduce the impact of flooding on existing development by prohibition of future development on the floodplain. This option would prevent existing development from being adversely affected by extensive filling of the remaining undeveloped areas of the floodplain to provide "flood-free" building sites.

The three works options and the single management option have been investigated to assess their effectiveness and potential impacts as outlined below.

10.2 Dredging of Marshalls Creek and Lowering/Removal of Training Walls

Prior to the construction of the Brunswick River training walls in the early 1960's, the Marshalls Creek channel joined the Brunswick River channel at the eastern edge of Reading Bay. The initial river works retained this channel confluence.

Following the severe ocean storm which washed over the beach dune and destroyed part of the "Sheltering Palms" village in 1974, a new low level training wall was constructed in Reading Bay in order to prevent a break-through from Marshalls Creek to the ocean which could ultimately replace the Brunswick River entrance.

At this time, a section of the northern wall of the Brunswick River was removed at the western end and the confluence with Marshalls Creek diverted 500 m upstream.

The sequence of training wall construction is illustrated on Figure 14.

The channel of Marshalls Creek between Capricornia Canal and the Orana Bridge has a meandering alignment with a number of residual meander loops immediately downstream of the canal.

A number of options for dredging the channel of Marshalls Creek between the Capricornia Canal and Reading Bay have been investigated in previous studies (Ref.8 and Ref.12).

Lowering the training walls was found to reduce the flood levels by 0.11 m at Orana Bridge and 0.06 m at Capricornia Canal.

This would reduce the number of houses inundated in the 1% AEP flood in New Brighton by three with no alteration in the number of houses flooded elsewhere.

The early dredging investigations (Ref.5) assumed dredging to a bed level of RL -2.5 m AHD. The preliminary EIS investigations (Ref.8) indicated dredging of this magnitude would yield some 330,000 cubic metres of material but that recognition of environmental issues would reduce this volume by two thirds (that is a dredge yield of less than 100,000 cubic metres). Thus, it is concluded that the full reductions in flood levels quoted by dredging to RL -2.5 m AHD are unlikely to be achieved.

As discussed in Chapter 3, rock outcrops have been observed at a number of locations along Marshalls Creek within the proposed dredging limits. Therefore, it is considered unlikely that a significant increase in channel capacity can be achieved by dredging.

Notwithstanding the potential environmental impacts associated with the dredging option, the estimated reduction in flood levels which could be achieved is 0.10 m in Ocean Shores and New Brighton.

Thus, dredging of Marshalls Creek and lowering the training walls in Reading Bay would possibly save 4 houses in Ocean Shores and 4 houses in New Brighton from being inundated in the 1% AEP flood.

The channel of Marshalls Creek is a dynamic area with sediment transport being a continuous process. Material eroded from the catchment is transported along the creek during floods and discharged into the Brunswick River and carried out to the ocean. Some of this material settles to the bed of Marshalls Creek and does not reach the ocean. It is also likely that some of the bed material in Marshalls Creek is a relic of past ocean breaks through the dune system transferring dune material from the beach to the creek channel.

The normal tidal cycle transports sand up and down the creek channel. The limit of this active tidal sediment transport is considered to be located near the Marshalls Creek/Brunswick River confluence as reported in Reference 15 and shown on Figure 5.

Comparison of creek channel surveys in 1986 and 1991 indicates that there is a relatively slow build-up of sediment in Marshalls Creek, downstream of Capricornia Canal, under the current hydraulic regime.

It should be noted that the time interval between surveys was short, when compared to the time-scale of the sedimentary processes. The apparent nett sediment accumulation rate may well be distorted by the occurrence of a major flood (the 1987 event) in the period between surveys.

The natural hydraulic processes determine the channel geometry and alignment. These natural processes tend to respond to man-made changes in such a manner as to return the channel to a "natural" condition. Thus, it can be reasonably expected that sediment will build up in the dredged section of the channel over a period of time until the channel returns to the quasi-stable configuration existing at the present time.

The time-scale for the filling of the dredged channel is dependent on a number of factors, principally related to rainfall and oceanic factors. However, it is generally accepted that dredging of creek and river channels is not a permanently effective flood mitigation works option unless regular maintenance dredging is carried out to retain the improved hydraulic capacity of the channel.

The channel dredging and lowered training walls option is considered to be relatively ineffectual due to the small reduction in flood levels achievable and the small number of properties which would benefit from the works. The option also requires on-going commitment to the maintenance of the dredged channel in order that the benefits are not diminished as time goes by.

10.3 Orana Bridge

The Orana Bridge provides the principal road connection between New Brighton and the Pacific Highway via Ocean Shores. The bridge crosses Marshalls Creek approximately 2.5 km upstream of the confluence with the Brunswick River.

The bridge deck is above flood level, while the approach road on the New Brighton side is equivalent to the 2% AEP flood level. The local roads in New Brighton are approximately 0.6 m below the bridge approach. There is a flood-free high ground route through Ocean Shores to the Pacific Highway from the western side of the bridge.

The only alternative road connection between New Brighton and the Pacific Highway is along River Street and Shara Boulevard, via Ocean Shores North. This route follows the northern bank of Marshalls Creek between New Brighton and Ocean Shores North. This section of the route is prone to flooding.

The perceived objective of increasing the length of the Orana Bridge is to reduce the afflux caused by the bridge. Afflux is the term used to describe the increase in water level which is created upstream of a bridge in order to force the flow through the restricted waterway at the bridge. This afflux can be significant where the bridge waterway area is very much less than the channel and floodplain flow area both upstream and downstream of the bridge.

However, at locations where the bulk of the flood flow occurs within the creek channel with a relatively minor component over the floodplain, the possible afflux is generally small. Thus, it is possible to construct a bridge over the channel only, with the resultant afflux being relatively small.

The hydraulic modelling indicates that approximately 80% of the 1% AEP flood discharge in Marshalls Creek is contained within the creek channel section. The calculated afflux produced by the existing bridge is 0.1 m.

Therefore, the maximum reduction in flood levels which could be achieved by the addition of an extra span or spans to the Orana Bridge is less than 0.1 m.

The floor level survey data indicates that there are 15 houses upstream of the Orana Bridge which would be inundated in the 1% AEP flood. Only three of these houses would be flooded by less than 0.1 m.

The addition of one or more spans to the bridge is unlikely to prevent floodwaters entering any of these houses.

Therefore, it is considered that this option is ineffectual in achieving its perceived objective.

10.4 Ocean Outlets

Three sites have been identified for assessment for the construction of flood outlets through the frontal dune to the Pacific Ocean. The sites are located at:

- "Holiday Village" between New Brighton at South Golden Beach;
- Ocean Shores North, north of the "Fern Beach" subdivision; and
- Wooyung, some 3.5 km north of South Golden Beach.

The proposed outlets comprise the excavation of 75 m wide slots through the dune with variable bed levels. The outlets at "Holiday Village" and Ocean Shores North are to be some 1.7 m above high tide level, while the outlet at Wooyung is proposed to be tidal. The proposed combinations of flood outlets above was defined by the Floodplain Management Committee after the Value Management Workshop (Reference 13) was completed.

The coastal dynamic processes are discussed in detail in Chapter 4. The impact of these processes on the performance of the ocean outlets is outlined below.

As noted in Chapter 4, the ocean water levels can be seen as comprising of a series of components principally:

- tidal variations;
- storm surge;
- coastal wind set-up;

- nearshore wave set-up; and
- possible addition to the above by "Greenhouse" changes to ocean static levels .

The various components of the "Steady" ocean water levels are indicated on Figure 6.

It is estimated that wave setup on the open beaches at the identified outlet sites resulting from 5 m high offshore waves would effectively raise the ocean water level on the beach by 0.8 m. By comparison, these waves would pass through the Brunswick River entrance with minimal obstruction and dissipate as they travelled up the main river channel.

As a result, there would be a difference in water level of 0.8 m between the beach and the river. This means that any outlets must be located where the flood level in Marshalls Creek is at least 0.8 m higher than the ocean water level at the entrance to the Brunswick River in order that floodwaters can discharge to the ocean. If this condition is not satisfied, seawater from the ocean will flow through the opening and increase flooding along Marshalls Creek.

The identified outlet sites satisfy the water level differential constraint. However, the Wooyung outlet in the early stages of a flood event would tend to admit water from the ocean into the Marshalls Creek area. This would be the direct opposite of the proposed function of the outlet, ie to discharge floodwaters to the ocean.

The outlets at "Holiday Village" and Ocean Shores North would discharge floodwaters when the level of the floodwaters in Marshalls Creek exceeded the water level on the beach and exceeded the level of any constructed weirs at the outlets. This would depend on the magnitude of the creek flood, tidal phase and ocean storm conditions.

The ocean outlets would need to be located at a level which prevented ocean storm waves from passing through the outlets and discharging seawater into the Marshalls Creek system.

This occurred in May 1975 when the ocean waves broke through the frontal dune at "Sheltering Palms", the southern end of New Brighton and north of New Brighton.

The dune north of New Brighton had been overtopped in October 1972 and had not built up to an adequate height. Earthmoving machinery was used to repair the break in the dune following the 1974 event. The coastal processes have continued the replenishment of the dune. The location of the break-through is still evident in recent aerial photography, some 20 years after the event.

The analysis of ocean storm water levels outlined in Chapter 4 recommends a minimum crest level for the outlets at RL 4.0 m AHD. This level is 1.2 m above the 1% AEP flood level in Marshalls Creek at the "Holiday Village" site.

There are conflicting requirements for the dune heights. Prevention of ocean break through into the Marshalls Creek floodplain requires the dunes to be kept high. However, allowance for (or dependence on) a flood breakout through the dunes to reduce flood levels requires the dunes to be kept low such that a natural break can occur.

It would be possible to adjust the dune height by earthmoving machinery by:

- maintaining the dune height to prevent ocean inundation;
- maintaining a stockpile of material at the break-out point;
- on receipt of flood warning, cutting the beach dune such that a natural erosion process can begin; and
- refilling the low level break from the stock pile after the flood recession to accelerate the natural re-building of the dune.

It is not considered prudent to undertake the alternative procedure of keeping the dune low and building during ocean storms because of the dangers of operation of machinery near a surf zone.

The short time scale of Marshalls Creek flooding, the limited warning and the occurrence of ocean storms would require earthmoving equipment to be on virtually permanent standby to lower the outlet in advance of the creek flood and to rebuild the outlet to withstand ocean storm conditions immediately following the creek flood.

Large volumes of sand would have to be excavated, stored and returned within a short period of time. This is clearly not practical.

The estimated reduction in 1% AEP flood levels which may be achieved with the ocean outlets is 0.08 to 0.1 m at New Brighton and Ocean Shores (Ref.16). There are 4 houses in New Brighton and 4 houses in Ocean Shores which are inundated in floodwaters less than 0.1 m deep in the 1% AEP flood. This option may prevent floodwaters entering some these houses.

Therefore, construction of the ocean outlets is considered to be relatively ineffectual, due to the small number of houses protected, and impracticable due to the management and operational requirements.

10.5 Quarantine on Development

The Marshalls Creek floodplain downstream of the Pacific Highway has been extensively developed for residential purposes over the last 20 years. In the areas identified as Ocean Shores and New Brighton and South Golden Beach, (but excluding the area protected by the South Golden Beach levee) there are almost 200 houses at the present time on the floodplain and approximately 30 vacant, subdivided lots. The total number of vacant lots are dispersed throughout the floodplain as shown on Figure 15.

The Fern Beach subdivision at the northern end of South Golden Beach is currently being developed. This subdivision will provide 82 lots which have been filled to a ground level at RL 3.1 m AHD.

There is a large area of undeveloped land, extending over some 50 ha, between New Brighton and South Golden Beach. The southern edge of this area is the site of the 1972 dune overtopping. The land has a general surface level at RL 1.2 - 1.5 m AHD and is, thus, more than 1 m below the 1% AEP flood level.

The land is currently zoned "Rural Investigation 1(d)" and "Environmental Protection - Coastal Lands 7(f)" or noted as "Deferred". It is possible that the land within the Rural zone and the Deferred area may be developed some time in the future. Much of this land is Crown land which has been set aside for future public requirements. Some 13 ha of this land is privately owned and is sometimes referred to as the "Holiday Village" site. The location of the "Holiday Village" site is shown on Figure 16.

There is a general concern among the existing residents that any future development on the floodplain will have adverse impacts on the flood behaviour which could significantly increase the risk (or probability) of houses being flooded.

The objective of the proposed quarantine on development is to prevent an increase in the probability or severity of flooding in the future. It is a pro-active management measure to limit the future impacts of flooding.

The "Holiday Village" land could potentially provide up to some 120 additional lots. Hydraulic modelling indicates that if the "Holiday Village" site was filled to above the 1% AEP flood level, flood levels in Ocean Shores and along the Capricornia Canal would be increased by up to 0.25 m. As shown in Table 8, this represents an increase in the number of houses in Ocean Shores which would be inundated in the 1% AEP flood of approximately 40, or a five-fold increase.

The resultant increase in flood level along the Capricornia Canal would reduce the available freeboard to crest level of the levees to approximately 0.15 m. Freeboard of this magnitude is simply inadequate to allow reasonable confidence in the levee performing as intended during the design flood. The high flood level would significantly increase the risk of a failure of the levee, with disastrous consequences for the residents of South Golden Beach and Ocean Shores North.

The increase in flood levels would be reduced by limiting site filling to the 10% AEP flood level and constructing high set houses. This would provide building lots which have a degree of local drainage and wet weather accessibility.

The estimated increase in flood levels for this development scenario is 0.1 m, resulting in the inundation of 4 additional houses in Ocean Shores.

Due to the uncertainty as to the nature of any future development, it is considered that the above two scenarios represent upper and lower bounds to the expected impact of large-scale development on the floodplain. It is considered that the impact of such future development, if permitted to occur, would more likely approach the upper bound estimates, particularly if any of the Crown land was developed for residential purposes.

Therefore, it is considered that a quarantine or prohibition on further development on the floodplain is justifiable as a means of limiting future impacts of flooding on the existing residents.

There are approximately 30 vacant residential lots in Ocean Shores and New Brighton and 15 vacant industrial lots in Billinudgel which are located below the 1% AEP flood level. These lots represent less than 0.5% of the area inundated in the 1% AEP flood.

Therefore, filling of existing vacant lots to provide building sites above the 1% AEP flood level will have a negligible impact on flood behaviour, in general. There may be some localised impacts where a number of these potential fill sites are clustered together.

The northern limits of New Brighton represents the only cluster of a significant size. However, these lots are slightly larger than normal residential lots and should not cause adverse impacts on adjacent properties provided that site filling is restricted to the building site and access areas only.

The vacant lots in Ocean Shores are scattered throughout the area and filling of the whole lot should not produce a measurable adverse flood impact on adjacent properties.

Building controls which are considered to be appropriate for the existing vacant lots are as follows:

- habitable floor levels to the minimum 0.5 m above the 1% AEP flood level, as required by current Council policy;

- new house construction in New Brighton to be highset preferably, or site filling to be restricted to building area and access only;

- full site filling to minimum 0.3 m above 1% AEP flood level permitted in Ocean Shores and Billinudgel.

Infill development of existing vacant lots and re-development of older lots is anticipated to have a negligible impact on future flooding. The increase in flood levels for such development is estimated to be less than 0.01 m. This will not increase the number of houses inundated in the 1% AEP flood event.

Therefore, it is considered that the "quarantine" options should be applied to new development areas only and not to building on existing vacant lots or redevelopment of existing buildings.

10.6 Other Options

The review of the effectiveness and practicality of the structural flood mitigation works options above has indicated that none of the above works options is able to provide significant reduction in flood levels. As a result, the structural flood mitigation options do not create a significant reduction in the number of houses that would be inundated in the 1% AEP flood event.

The structural works outlined do not convert any "High Hazard" flood areas to "Low Hazard" flood areas.

Further, the flood level reductions after the structural works do not transfer properties from *"flood liable in a 1% AEP design event"* to *"flood protected in a 1% AEP design event with floor levels at an appropriate freeboard above the flood level"*.

There are major operational problems associated with the ocean outlets option which render this option to be impractical. Similarly, the requirement for on-going maintenance dredging reduces the long term practicality of the dredging option.

A "Quarantine" or prohibition on further development on the floodplain is considered to be an appropriate measure to prevent a significant increase in the flood-liability of the existing development in the future. Whilst the "Quarantine" option prevents the existing flooding from worsening, "Quarantine" has no impact in reducing existing flood liability and flood damages.

From the community consultation undertaken in this study, it is apparent that the community is committed to the area and to improving the amenity of the area.

It is perceived that the full scale removal of the communities and demolition of buildings would be unacceptable on social and economic grounds. Thus the Floodplain Management Plan needs to allow continued occupation of the floodplain by existing users whilst promoting methods to enhance safety and reduce flood damage.

Policies covering house raising and flood-proofing are seen as practical alternatives.

10.6.1 House Raising

The property survey shows some 23 of the 41 flood-liable houses in New Brighton are of timber frame construction and may be suitable for raising. There are 5 other potentially suitable houses in New Brighton and one (1) house in Ocean Shores with less than 0.5 m freeboard above the 1% AEP flood level. This option was rejected at the final stage of the Value Management Workshop.

Analysis of the flood damages data indicates that the mean annual direct flood damages can be reduced by $ 17,030 if all of the potentially suitable houses in New Brighton are raised by approximately 1 m to above Extreme flood level.

This reduction in mean annual flood damages is equivalent to 85% of the reduction in damages which may be achieved by dredging and lowering of the training walls and 2.5 times the reduction in damages for the ocean outlets option. The difference in reduction in damages between "House Raising" and dredging stems from the fact that the "House Raising" does not protect those houses that cannot be raised. However, houses that cannot be raised can be protected by flood-proofing.

The estimated cost of house raising is approximately $ 35,000 per dwelling or approximately $ 1,015,000 total cost. On this basis, raising of suitable houses to above flood level has a benefit-cost ratio of 0.25.

Further, examination of those properties located whose floor levels do not have sufficient freeboard (0.5 m) above the 1% AEP design flood shows that 28 of the 49 identified can be raised.

Thus, this option may be considered to be worthy of implementation given that the intangible benefits could be significant.

This option has minimal environmental impacts and is very effective in reducing the impact of flooding for individual landowners.

Major disadvantages of house raising include difficulty of access, particularly for aged or disabled persons, and changes in the general appearance of the houses. Not all owners would be in favour of raising their houses, for a variety of reasons.

There are two alternative means of funding the house raising option:

- through the Floodplain Management Programme; and
- privately.

Funding for projects under the Floodplain Management Programme is dependent on the moneys available and the state-wide priority ranking of floodplain management projects. Thus, funding may not be available for this option in the short-term or long-term.

The NSW Government's Flood Policy provides for full subsidy of the cost of voluntary house raising where this is found to be more cost-effective than other floodplain management measures. The Policy was amended in 1995 to provide for a $10,000 grant to owners of houses in areas of the floodplain where full subsidy of house raising is not available. It should be noted that the NSW Government expects two thirds of each grant to be funded from their monies and the balance from Council's funds.

This grant off to individual landowners would appear to be the best available funding scheme for the option.

Therefore, it is considered that owners of flood-liable houses should be encouraged to voluntarily raise their houses, where possible.

10.6.2 Flood-proofing

There are numbers of brick or slab-on-ground houses throughout Ocean Shores and New Brighton that are located at less than an appropriate freeboard (0.5 m) above the design 1% AEP flood and/or are below the 1% AEP design flood as in Table 16 below.

Table 16

Numbers of Houses for Raising and Flood-proofing

Locality	Floor Below Flood Level		Floor Below Required Freeboard	
	Raisable	Flood-proofing	Raisable	Flood-proofing
New Brighton	23	18	28	21
Ocean Shores	0	8	1	93

As noted earlier, slab-on-ground or brick construction cannot be raised at economical costs. However, the combination of house raising and flood-proofing can protect significant numbers of houses.

The object of flood-proofing would be to provide flood protection for the dwelling up to the design 1% AEP flood plus a 0.5 m freeboard.

Flood-proofing requires prevention of floodwaters entering the building. Thus, flood-proofing is seen as most applicable to brick houses which cannot be economically raised.

The entry points of water into buildings could be generically identified as:

- entry through openings in the external walls eg doorways and windows;
- entry through weep holes provided in walls;
- back-flow from the sewer system.

Each entry point needs to be closed. The mechanisms for flood-proofing are schematically illustrated on Figure 17.

Closure of door openings can be achieved by stop boards which are installed across door openings.

A variety of systems are seen as applicable for sealing of weep holes. The most promising is development of a gate system, as operates to drain small sailing dinghies, which can be opened and closed at will.

Sealing of sewer back-flow will require use of a gate valve at each house which can be screwed down to close off the sewer.

Whilst flood-proofing of the buildings will prevent flood damage, it does have some restrictions.

These restrictions are:

- the resident of the dwelling must be aware of the provisions and how to operate the provisions;
- regular maintenance of the provisions will be required to ensure their satisfactory operation when required;
- flood warning is required to give land owners sufficient time to close the flood-proofing measures;
- continued occupation of the building will be more difficult during flood time because of the requirement to close the sewers.

Whilst continued occupation of elevated buildings during floods does not apparently face the same immediate difficulties, long occupation of flood areas does create a public health risk.

Flood-proofing will need to be individually designed for each building. However during this process, it may become apparent that several standard systems may be suitable for application throughout the study area.

It is appreciated that widespread flood-proofing has not been undertaken in New South Wales. This follows because widespread use of slab-on-ground construction has only occurred in the past 25 years and over that period, State and Local Government has been more active in discouraging such housing development on flood prone lands.

It is anticipated that any voluntary house raising program would be extended over several years with the worst affected houses being raised first. Appendix I provides output of the property data base ranked from the most flood liable buildings.

The anticipated flood-proofing cost is $ 3,000 per property, leading to a total project cost of $ 342,000 if adopted for those houses in Ocean Shores and New Brighton which are unsuited to raising.

10.6.3 Special Measures, Billinudgel

The land use zoning for Billinudgel and its relevant features are illustrated on Figure 18.

The flood damage analysis shows that Billinudgel creates a significant proportion of the total flood damages in the Marshalls Creek floodplain. It would appear that previous studies have not addressed the issues of flood protection at Billinudgel.

Most of the buildings in the western section of Billinudgel are approximately 0.5 m below the 1% AEP flood levels as are many of the buildings in Mogo Place, between the railway and highway on the eastern side of the village.

It may be possible to construct a levee around the western section of the village. However, the existing trunk drainage and road levels on the eastern side of the village prevent the construction of a levee around the Mogo Place properties. The adjacent "Eldorado" industrial subdivision has been filled to 0.5 m above the 1% AEP flood level and could meet the demand for industrial land for the short to mid-term future.

Alternatively, vacant lots may be fitted to provide building sites above the 1% AEP flood level.

Construction of a levee or filling of lots on the western side of Billinudgel would cause a maximum increase in flood levels upstream of the railway of 0.01 m while flood levels downstream of the railway would be unchanged.

Thus, the impact of levee construction or site filling in the western section of Billinudgel will have a negligible impact on flood behaviour.

10.7 Economic Assessment of Options

10.7.1 Overview

The economic assessment process analyses the tangible costs and benefits associated with alternative options. The process provides information for decision making and for the formulation of capital works programs.

Intangible costs and benefits are difficult to quantify in monetary terms and are excluded from the economic assessment. Such intangible and social costs are often implicitly accounted by acceptance of strict benefit/cost ratios of less than 1.0 for projects.

The basic feature of the economic assessment is the systematic examination of all the costs incurred and the benefits derived from alternative means of satisfying an objective, ie improved flood protection. Benefit-cost analysis is the most widely used of the economic analysis techniques. However, the nature of benefits derived from alternative options can be widely variable, as can be the costs of the options. Therefore, it is often necessary to assess the relative cost-effectiveness of options which provide a range of flood mitigation benefits.

The tangible benefits derived from floodplain management are reductions in direct and indirect flood damages. The costs of options include survey, investigation, design and construction costs and recurrent operation and maintenance costs.

Total benefits are derived by totalling the present worth of annual benefits over future years. In this study, the benefit stream has been adopted as 30 years. It should be noted that, because of the present worth calculation, little monetary benefit is obtained by increasing the benefit stream beyond 30 years.

10.7.2 Reduction in Flood Damages

The estimated reduction in mean annual direct damages to existing development for the various flood mitigation works options investigated are summarised in Table 17.

Table 17

Reduction in Potential Direct Damages - Existing Development

Option	Properties Protected in 1% AEP Flood	Reduction in Mean Annual Damages ($)	Precincts Benefiting
1. Dredge Marshalls Creek and Lower Training Walls	< 8	20,180	1 - 4
2. Lengthen Orana Bridge	< 3	1,330	1, 2
3. Flood Outlets	< 8	6,820	1 - 4
4. House Raising	23	17,030	2
5. Flood-proofing (unraisable)	26	17,000	1, 2

The estimated reduction in potential direct flood damages which may be achieved by the structural flood mitigation works options represent 1% to 18% of the potential mean annual direct damages for the Marshalls Creek floodplain.

None of the structural works options was found to reduce the flood damages in Billinudgel. As discussed in Chapter 6, flood damages in Billinudgel exceed the flood damages for all the other villages for all but the very large and rare flood events.

10.7.3 Benefit-Cost Analysis

A traditional benefit-cost analysis requires the estimation of the monetary value of benefits and the total cost of works to be carried out. Projects which yield a benefit-cost ratio greater than unity are generally considered to be worthy of implementation.

However, in floodplain management, the intangible benefits and, in some cases, intangible cost associated with a particular project may be significant. For these situations, a benefit-cost ratio other than unity may be adopted as the economic criterion for evaluation of the project.

It may be argued that the intangible benefits to be derived from mitigation works are of equal value to the tangible benefits, ie the reduction in direct and indirect flood damages. The critical benefit-cost ratio for this situation would be 0.5.

The estimated construction costs of the flood mitigation works options has been determined on the basis of current rates. The survey, investigation and design costs have been assumed to be 25% of
the construction cost while annual operation and maintenance costs have been assessed at 2% of capital cost for structures.

It should be noted that the costs do not include any assessment of "environmental" costs. The consideration of environmental impacts has been addressed in a qualitative fashion in the following chapter.

It has been assumed that maintenance dredging of the Marshalls Creek channel would be required at least once every 15 years, and that ocean outlets would be affected by floods or ocean storm waves once every 10 years.

A standard discount rate of 7% pa has been adopted with all economic calculations based on a time-span of 30 years. The economic analysis is summarised in Table 18.

The estimated cost of dredging has been based on a nett cost of $8 per cu metre of sand removed and an estimated volume of sand of 100,000 cu m. The cost of lowering the training walls has been estimated at $ 200,000.

The benefit-cost analysis indicates that flood-proofing is the only option having a benefit-cost ratio greater than unity and this is considered to be worthy of implementation.

The ocean outlets and house-raising options have benefit-cost ratios which are marginal and may be considered worthy of implementation after allowance is made for the intangible benefits and costs associated with these options.

Dredging of Marshalls Creek and lowering of the training walls and lengthening of Orana Bridge were found to have benefit-cost ratios less than 0.2 and are thus considered to be not worthy of implementation.

Table 18

Economic Analysis of Options

	Option				
	Dredging & Lower Training Walls	**Lengthen Orana Bridge (15 m span)**	**Ocean Outlets (3 off)**	**House Raising**	**Flood-proofing**
Capital Cost	1,000,000	300,000	45,000	1,015,000	342,000
Loan Amortisation	80,600	24,200	3,600	81,800	27,550
Annual Operation & Maintenance	46,600	6,000	9,000	-	-
Annual Cost	127,200	30,200	12,600	81,800	27,550
Reduction in Direct Damages	20,180	1,330	6,820	17,030	17,000
Reduction in Indirect Damages	4,040	270	1,360	3,400	3,400
Total Reduction in Mean Annual Damages	24,220	1,600	8,180	20,430	20,400
Benefit/Cost Ratio	0.19	0.05	0.65	0.25	0.74

11. COMPARISON OF OPTIONS

There are several factors to be considered in the selection of a preferred management strategy. These factors can be grouped as follows:

- flood mitigation effectiveness;
- environmental impacts;
- social impacts; and
- economic performance.

One suitable technique to compare options is a matrix which enables the options to be assessed with reference to relevant criteria. This approach was adopted in the Value Management Workshop.

11.1 Identified Options

The Value Management Workshop also derived weighting factors to be applied to the various evaluation criteria. The workshop found that affordability, flood mitigation effectiveness, internal impacts and environmental impacts were of major importance with community acceptance being moderately important and all other issues having minor or negligible importance.

There was very little difference in the weightings attached to the factors of major importance with community acceptance receiving a weighting factor some 40% less than the major factors.

The options evaluation matrix presented in Table 19 draws on information presented in the Value Management Study workshop and additional information derived from the current study. The weighting factors adopted for the matrix are different in value but consistent with the trend determined in the workshop.

The "do nothing" option has been added to the matrix in order to provide a reference point for comparison purposes. This option is different from the "Quarantine" option in so far as this enables the possible impact of future development to be incorporated into the evaluation process.

The evaluation criteria in Table 19 have been defined as follows:

Affordability	Based on capital and recurrent costs (Table 18)
Effectiveness	Based on properties protected, reduction in flood damages and ability to cope with extreme flood events (Table 17)
Internal Impacts	Based on likelihood of adverse impacts being incurred at other locations due to implementation of option
Community Acceptance	Perceived acceptance of option by the floodplain community
Economic Assessment	Based on benefit-cost ratio of option (Table 18)

Each option has been "scored" in a similar fashion to the Value Management Workshop and as follows:

- each option was ranked against the other options for the individual criteria and identified as Rank 1 (best) to Rank 7 (worst);
- the rank of each option for a particular criteria was multiplied by the "Weighting Factor" for that criteria to create a "Weighted Ranking Score";
- the "Weighted Ranking Scores" for each option were summed over all the criteria to obtain a total score for that option; and
- the total scores were then ranked from lowest to highest and "Overall Rankings" applied from Rank 1 (best, lowest total score) to Rank 7 (worst, highest total score).

The options evaluation matrix (Table 19) shows that flood-proofing, the "Quarantine" option and house-raising were ranked ahead of the "do nothing" option. The flood mitigation works options were all ranked below the "do nothing" option.

The analysis confirms the general feeling in the community that increases in the frequency or depth of flooding is not acceptable and that some measures are required to reduce the impact of flooding on existing residents. The various flood mitigation works options are seen as being relatively ineffectual and having significant environmental impacts and high costs.

The house-raising and flood-proofing measures can be implemented for individual properties. These measures do not transfer flooding problems to adjacent properties or to other localities and have minor environmental impacts. These environmental impacts are primarily of an aesthetic nature and can generally be overcome with careful design.

11.2 Future Development

The "Quarantine" option has been found to be an appropriate and desirable means of preventing on-going increases in the flooding problems experienced by existing residents of the Marshalls Creek floodplain.

The "Quarantine" option has been interpreted as a prohibition on future development and filling on the floodplain.

Table 19

Comparison Matrix for Flood Management Options

Evaluation Criteria	Weighting Factor	Option						
		Dredging + Lower Training Walls	Lengthen Orana Bridge (15 m span)	Ocean Outlets (3 outlets)	Quarantine	Do Nothing	House Raising	Flood-proofing
Affordability	5	7/35	5/25	3/15	1/5	2/10	6/30	4/20
Effectiveness	5	3/15	5/25	4/20	6/30	7/35	2/10	1/5
Internal Impacts	5	7/35	5/25	6/30	3/15	4/20	2/10	1/5
Environmental Impacts	5	7/35	5/25	6/30	1/5	3/15	4/20	2/10
Community Acceptance	3	4/12	5/15	6/18	1/3	7/21	3/9	2/6
Economic Assessment	1	5/5	7/7	6/6	3/3	4/4	2/2	1/1
Total Score		137	122	119	61	105	81	47
Overall Ranking		7	6	5	2	4	3	1

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12. PREFERRED FLOODPLAIN MANAGEMENT STRATEGY

12.1 Existing Development

The detailed assessment and comparison of flood mitigation works options and floodplain management options revealed that none of the structural works options selected at the Value Management Workshop are considered to be worthy of construction.

Flood-proofing of houses which are unsuitable for raising was found to be a highly desirable and effective flood protection measure.

It is considered that minor flood-proofing works, such as the installation of brackets and stop-boards at doorways of flood-liable houses should be encouraged.

There are a significant number of flood-liable houses in New Brighton which are suitable for raising to above flood level. The NSW Government Flood Policy provides for a grant of $10,000 to owners who raise their houses above designated flood levels. The individual benefits to be derived from this action and the availability of partial funding via the grants scheme make this an attractive proposal for many landowners.

Therefore, it is considered that voluntary house-raising should also be encouraged.

12.2 Emergency Management

A number of improvements to the procedures used to prepare and disseminate flood warnings have been identified. It is considered that these improvements be developed in a co-operative manner with the State Emergency Service.

A public education campaign to inform the residents of the risks and hazards of flooding, suitable flood fighting activities and the services provided by the SES and how to access these services should be implemented.

12.3 Future Development

The setting of habitable floors with a minimum freeboard of 0.5 m above the 1% AEP flood level is considered to be an appropriate measure to limit the flood liability of houses to be constructed on existing vacant lots or as re-development of existing lots.

Highset forms of construction are to be preferred to site filling in order to achieve the required minimum floor level. Limited site filling to provide satisfactory wet weather site access is considered to be reasonable.

The floodplain management measure referred to as the "Quarantine" option, was found to be an appropriate measure to prevent future increases in the frequency and level of flooding and is thus considered to merit adoption in the Floodplain Management Plan for Marshalls Creek.

Site filling in Billinudgel has been found to produce minimal changes in flood behaviour. Thus, site filling is considered to be an appropriate flood protection measure for the Billinudgel village area.

The low areas of South Golden Beach and Ocean Shores North are protected by levees. However, the structural integrity of these levees under flood conditions has not been determined.

Therefore, it is considered advisable that all new houses constructed behind the levee be subject to the same minimum floor level controls as applied elsewhere on the floodplain.

The Yelgun-Wooyung rural area is classified as "High Hazard - Flood Storage" with the depth of floodwaters exceeding 1 metre. It is considered that the current land use zonings for this land should be retained.

The bulk of the Yelgun rural area is within the Billinudgel Nature Reserve and is expected to remain undeveloped. Any rural houses on the remainder of the rural area should be constructed on flood mounds with a minimum finished level at RL 3.9 m AHD and habitable floors should be at RL 4.1 m AHD or higher.

The Wooyung rural area is within Tweed Shire. It is recommended that a suitable strategy for this area be developed in consultation with Tweed Shire as any development activities carried out in the area may produce adverse impacts which cross the shire boundary.

For the safety of residents in this area, it is recommended that any rural houses which may be approved by Tweed Shire Council should be constructed on flood mounds with a minimum finished level at RL 3.3 m AHD. Habitable floors should be at RL 3.5 m AHD or higher.

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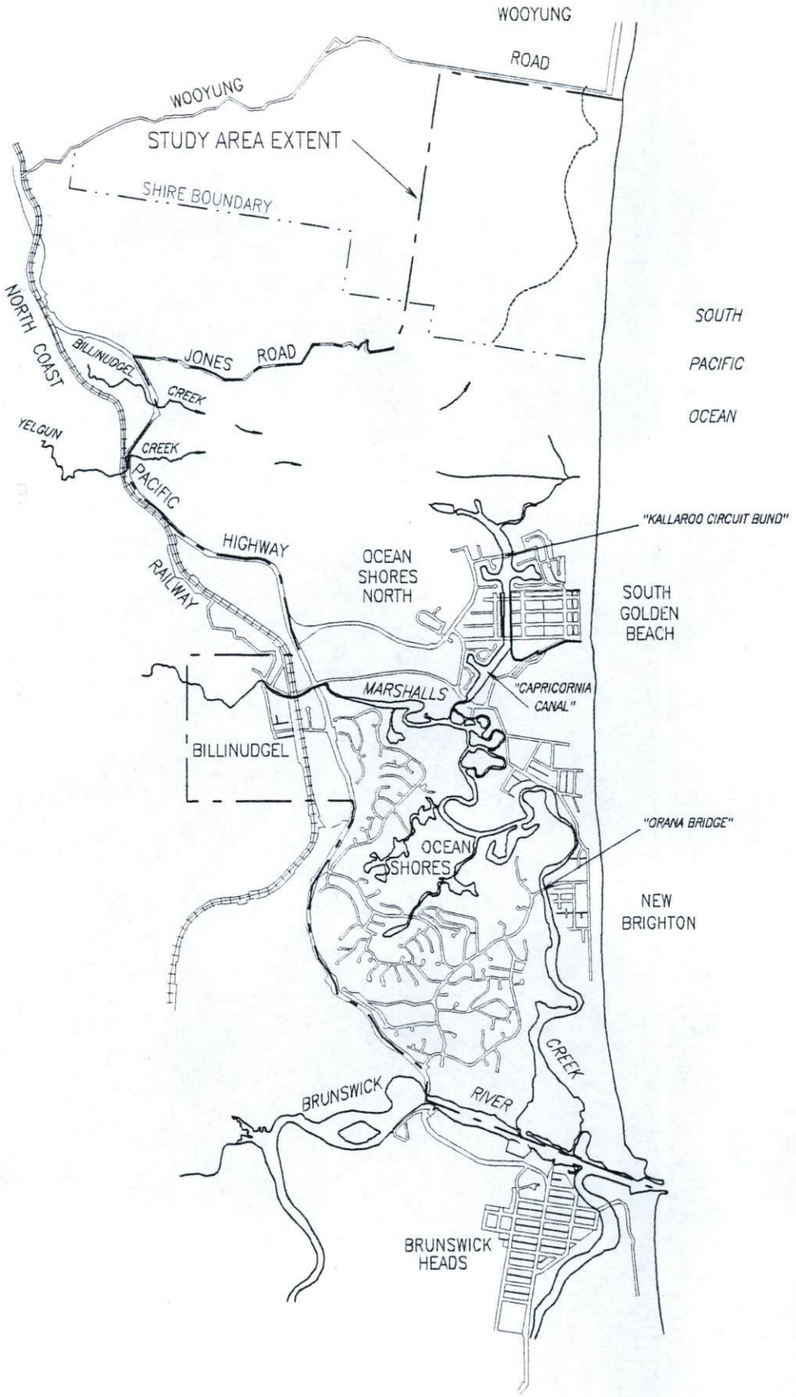
FIGURES



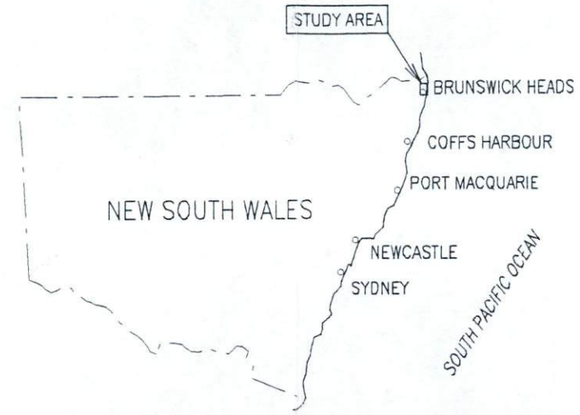


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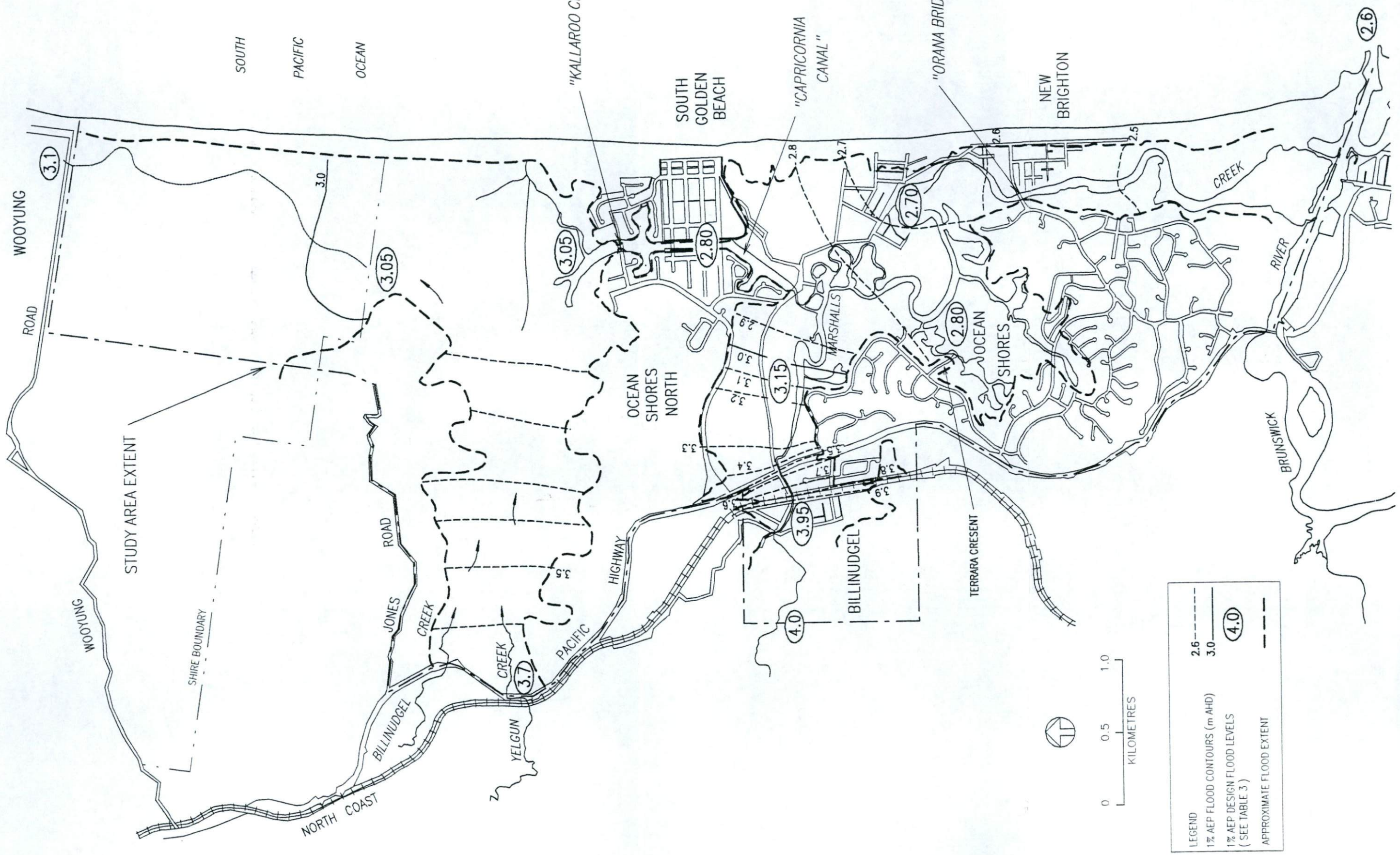
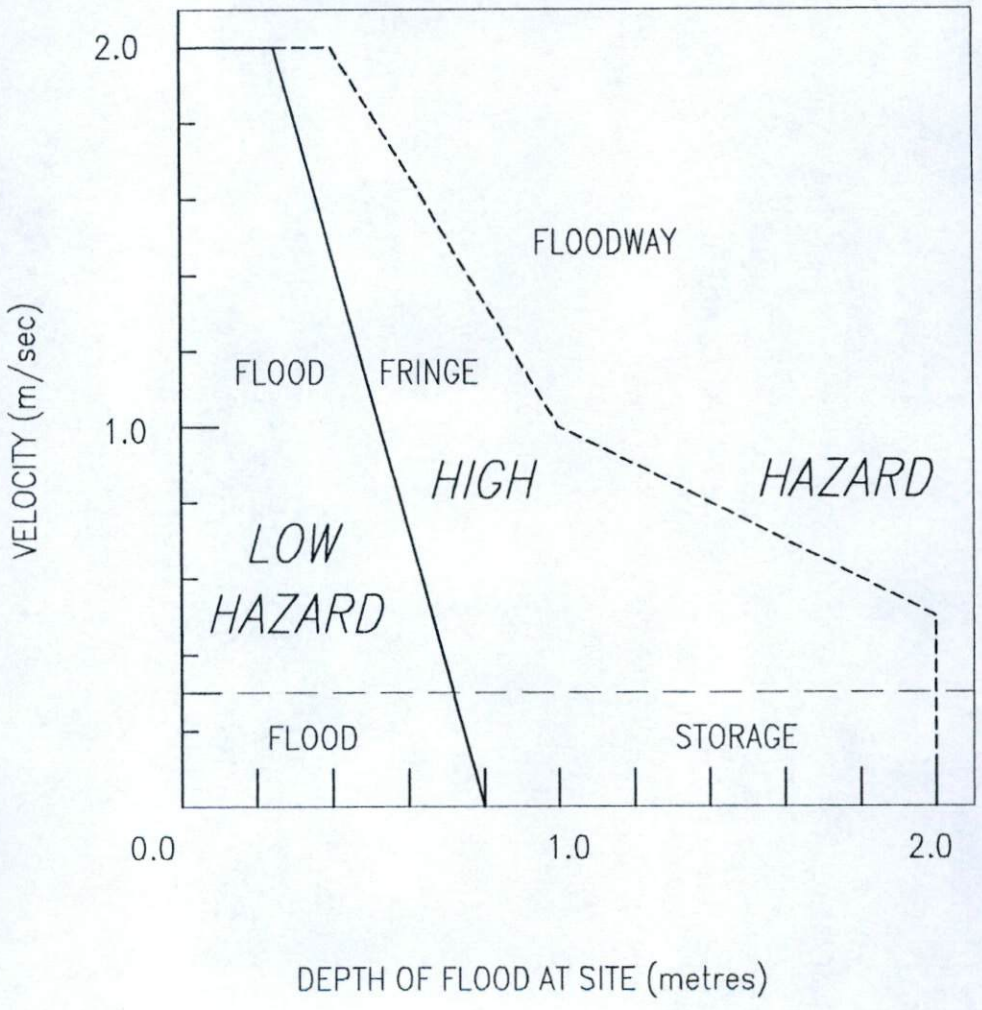
FIGURE 1
STUDY AREA



SK REF: DCAD 95049#6 25/11/97
GURE REF: 95049-2 (REV 2)

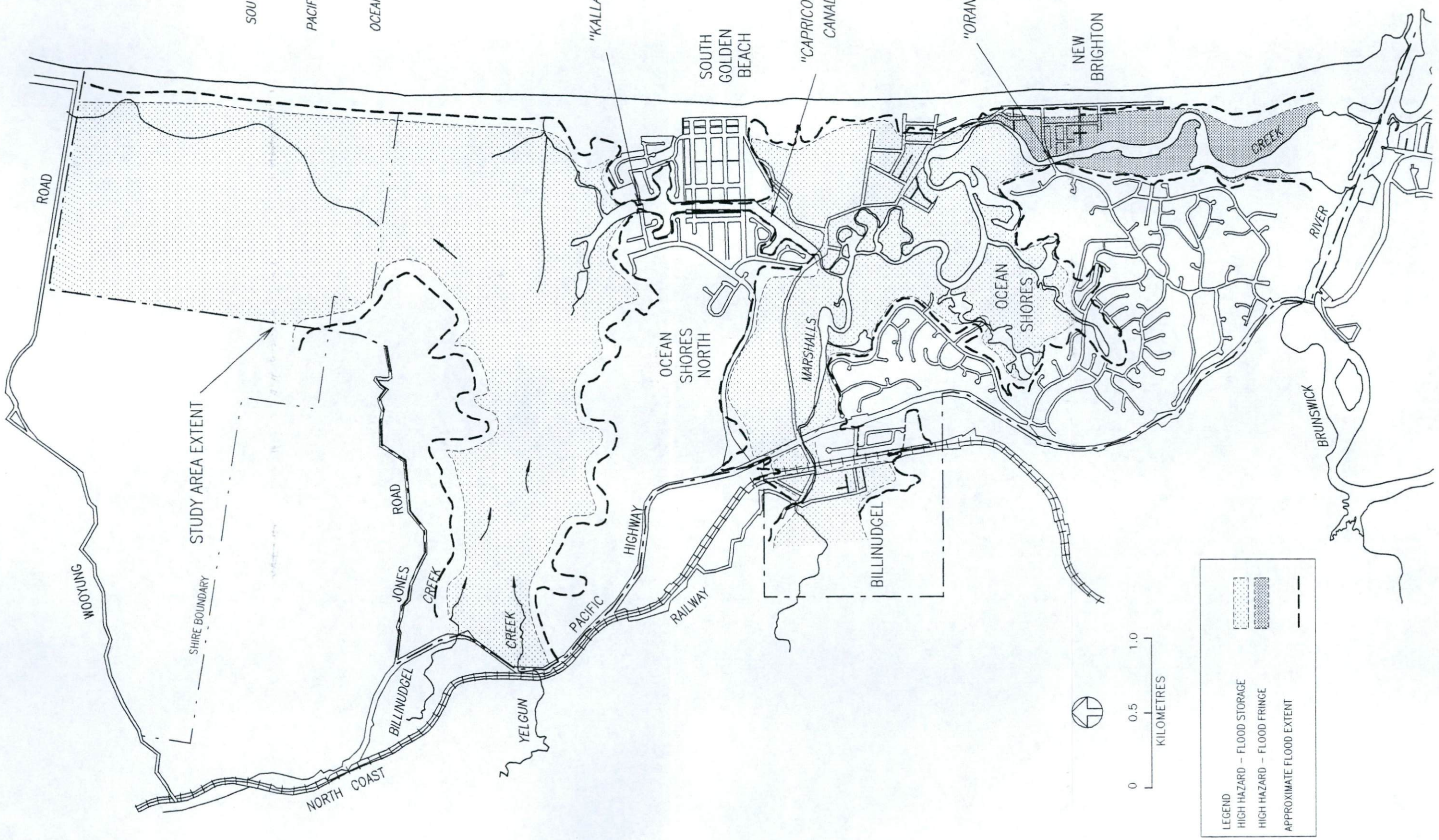
FIGURE 2
1% AEP FLOOD LEVELS



DISK REF: DCAD 95049#1 18/2/97]
FIGURE REF: 95049-3 (REV 1)

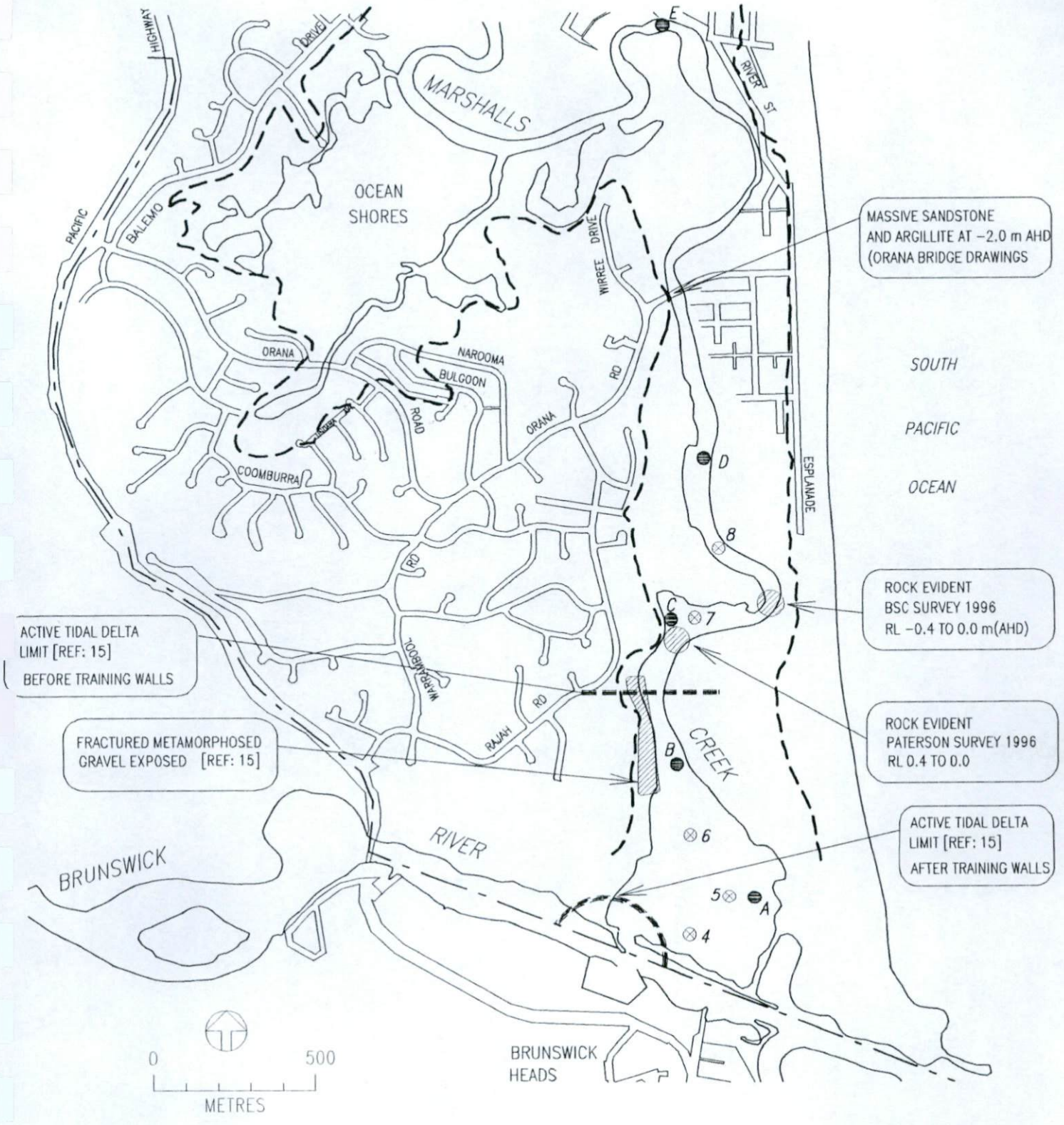
FIGURE 3
FLOOD HAZARD CRITERIA

MARSHALLS CREEK
FLOODPLAIN MANAGEMENT PLAN



DISK REF: DCAD 95049#1 25/11/97
FIGURE REF: 95049-4(rev 1)

FIGURE 4
HAZARD AREAS



LEGEND

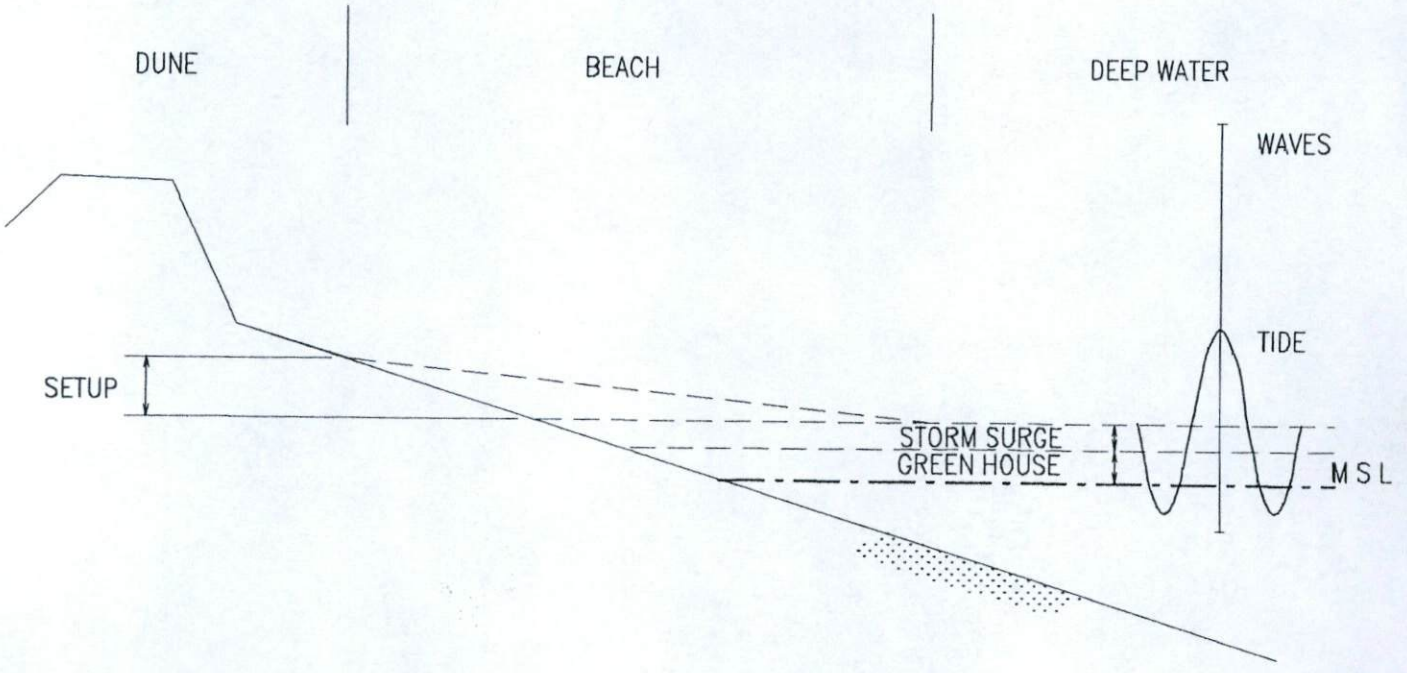
1978 BOREHOLES [REF:15] ⊗ 4

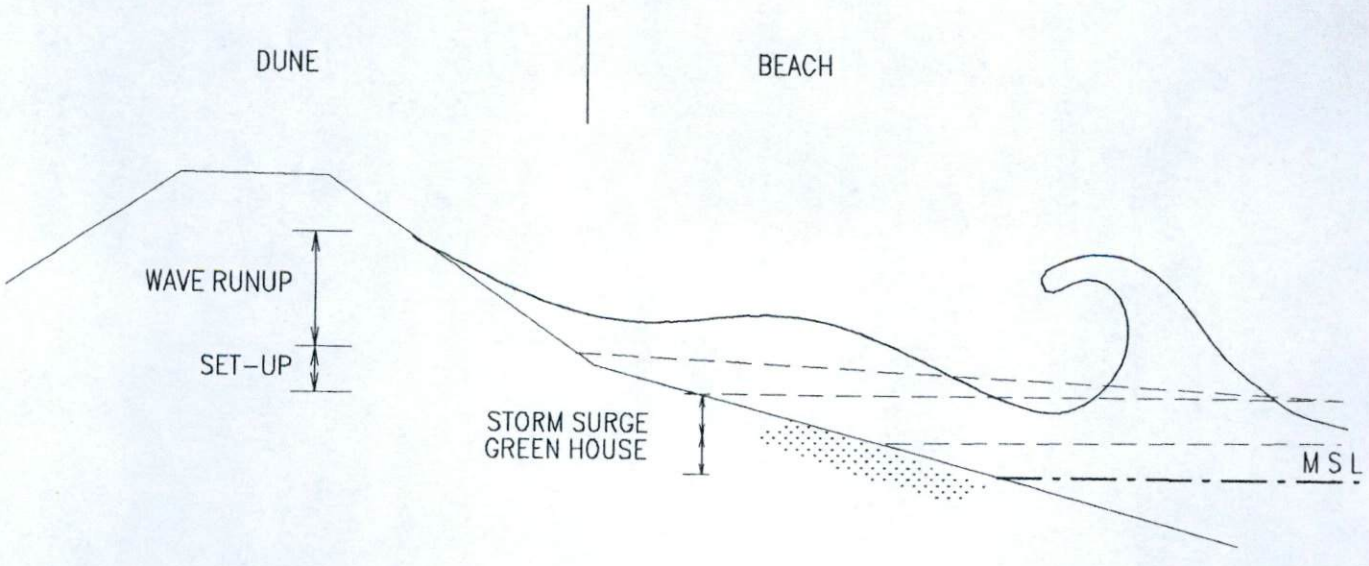
SAMPLING POINTS 1996 – PATERSON ●

APPROXIMATE FLOOD EXTENT — — —

DISK REF: DCAD 95049#1 18/2/97
FIGURE REF: 95049-5 (REV 1)

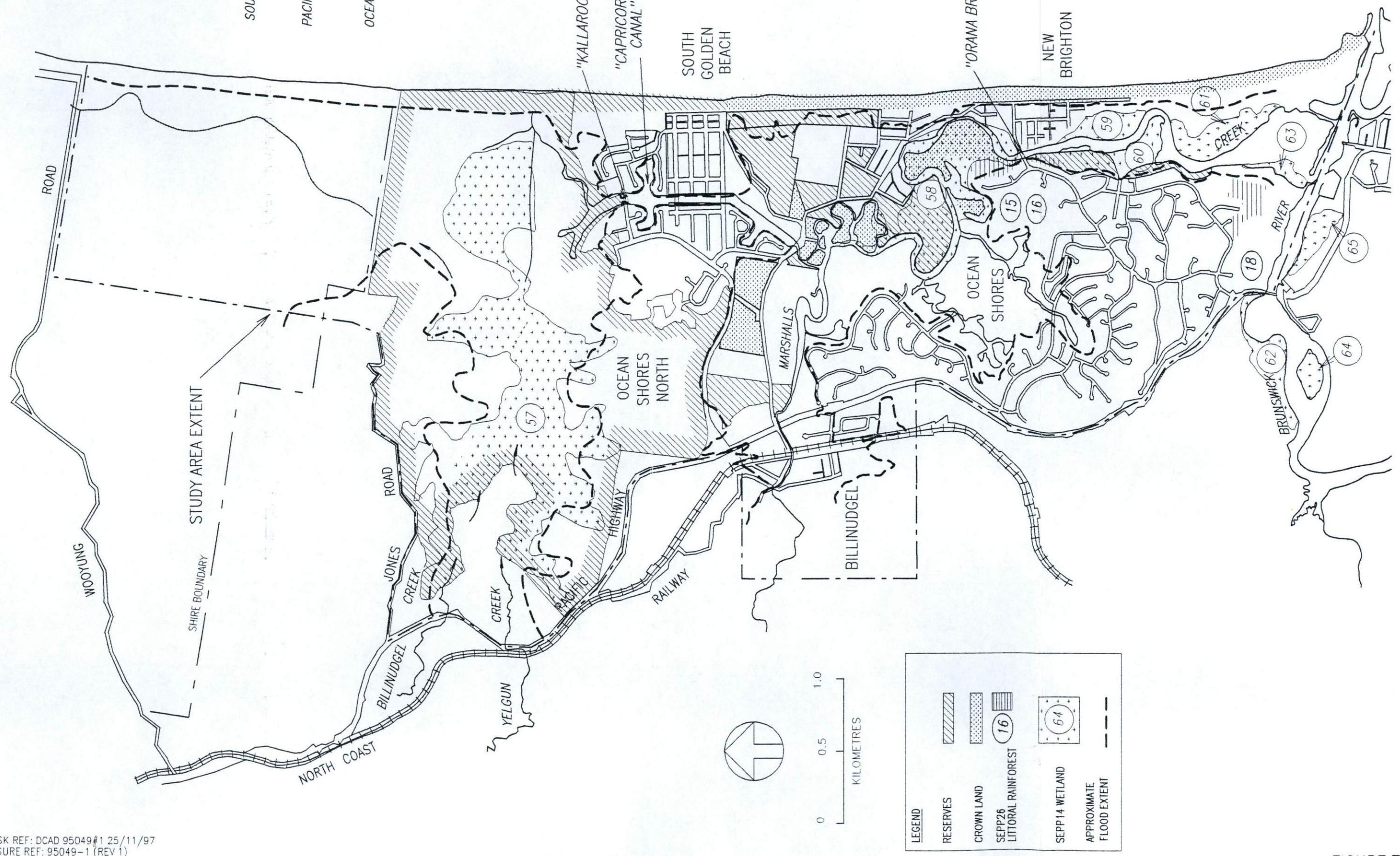
FIGURE 5
GEOLOGICAL INFORMATION





DISK REF: DCAD 95049#1 18/2/97
IGURE REF: 95049-6

FIGURE 6
OCEAN WATER LEVEL COMPONENTS

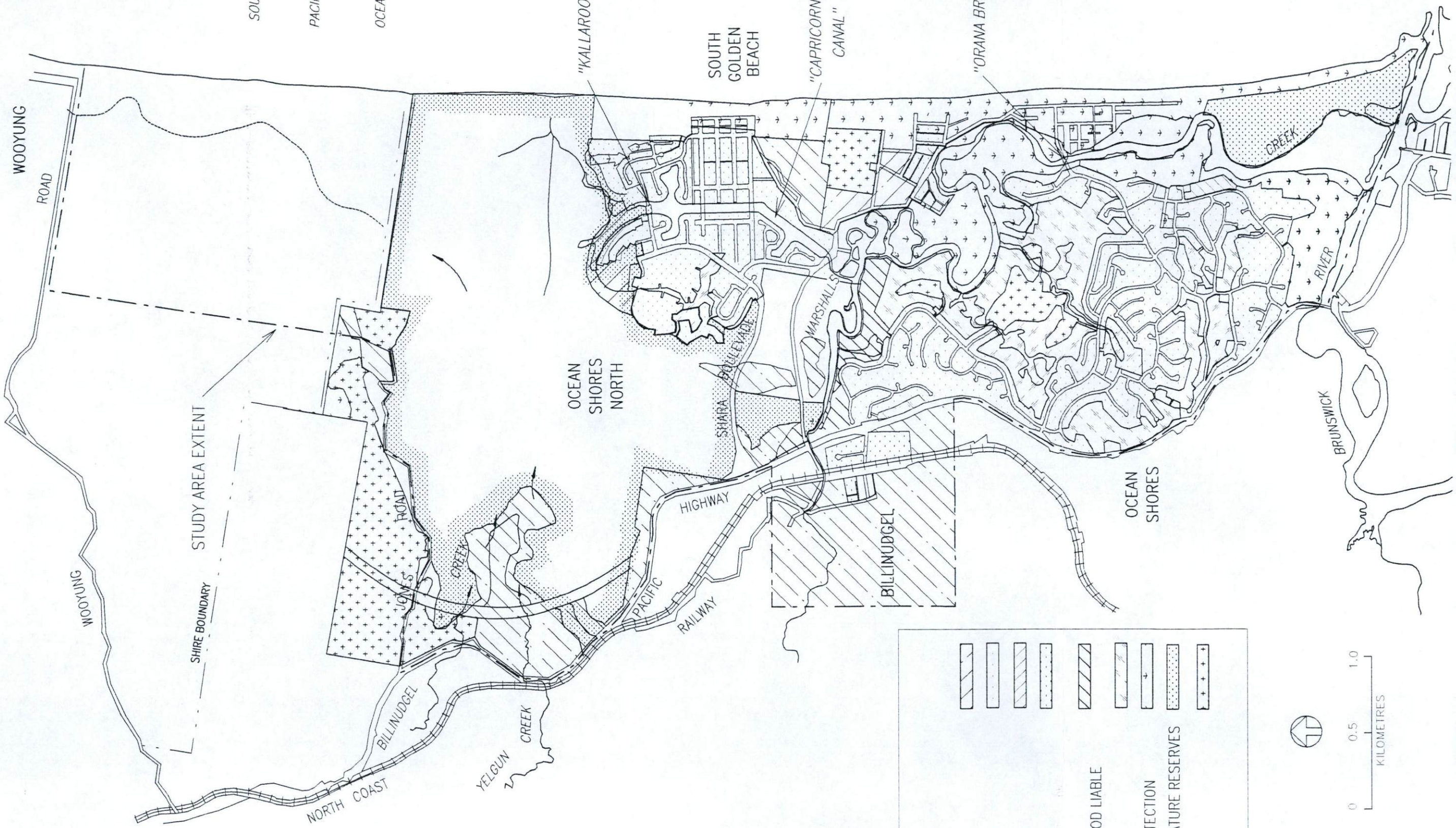


DISK REF: DCAD 95049#1 25/11/97
FIGURE REF: 95049-1 (REV 1)

FIGURE 7

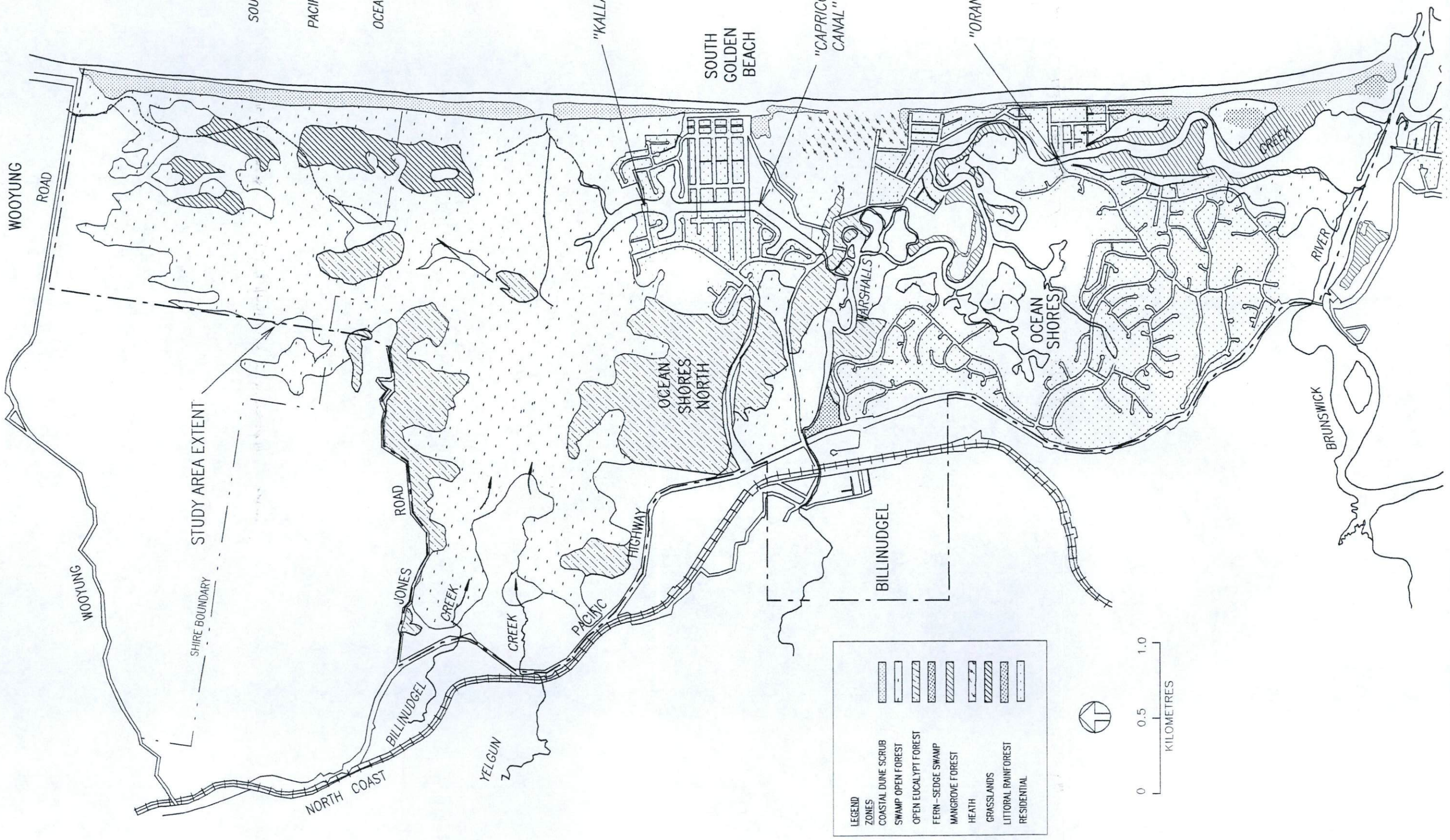
CROWN LAND. RESERVES. AND SEPP AREA

MARSHALLS CREEK
FLOODPLAIN MANAGEMENT PLAN



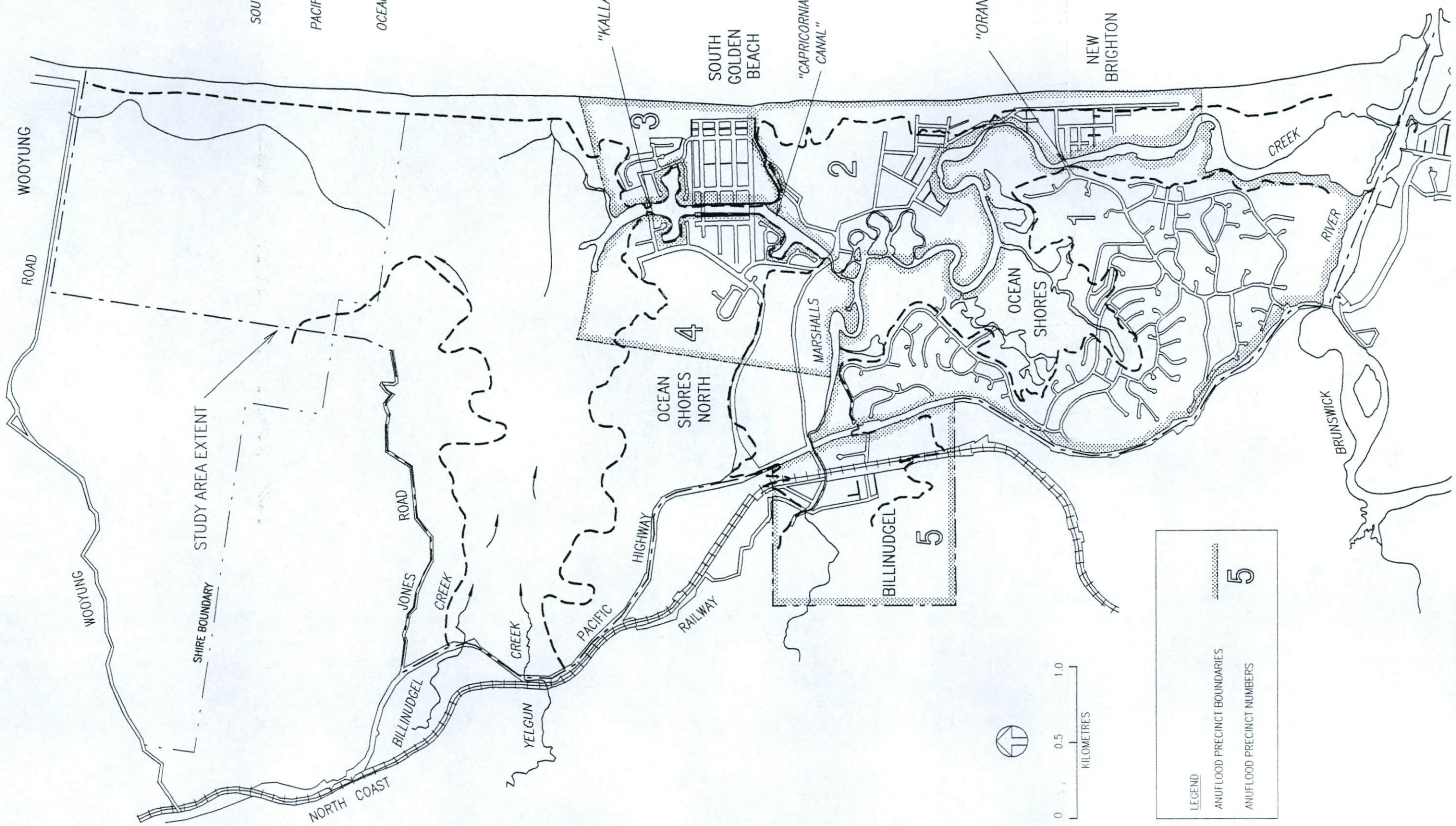
DISK REF: DCAD 95049#1 25/11/97
FIGURE REF: 95049-8 (REV 2)

FIGURE 8
LANDUSE ZONINGS



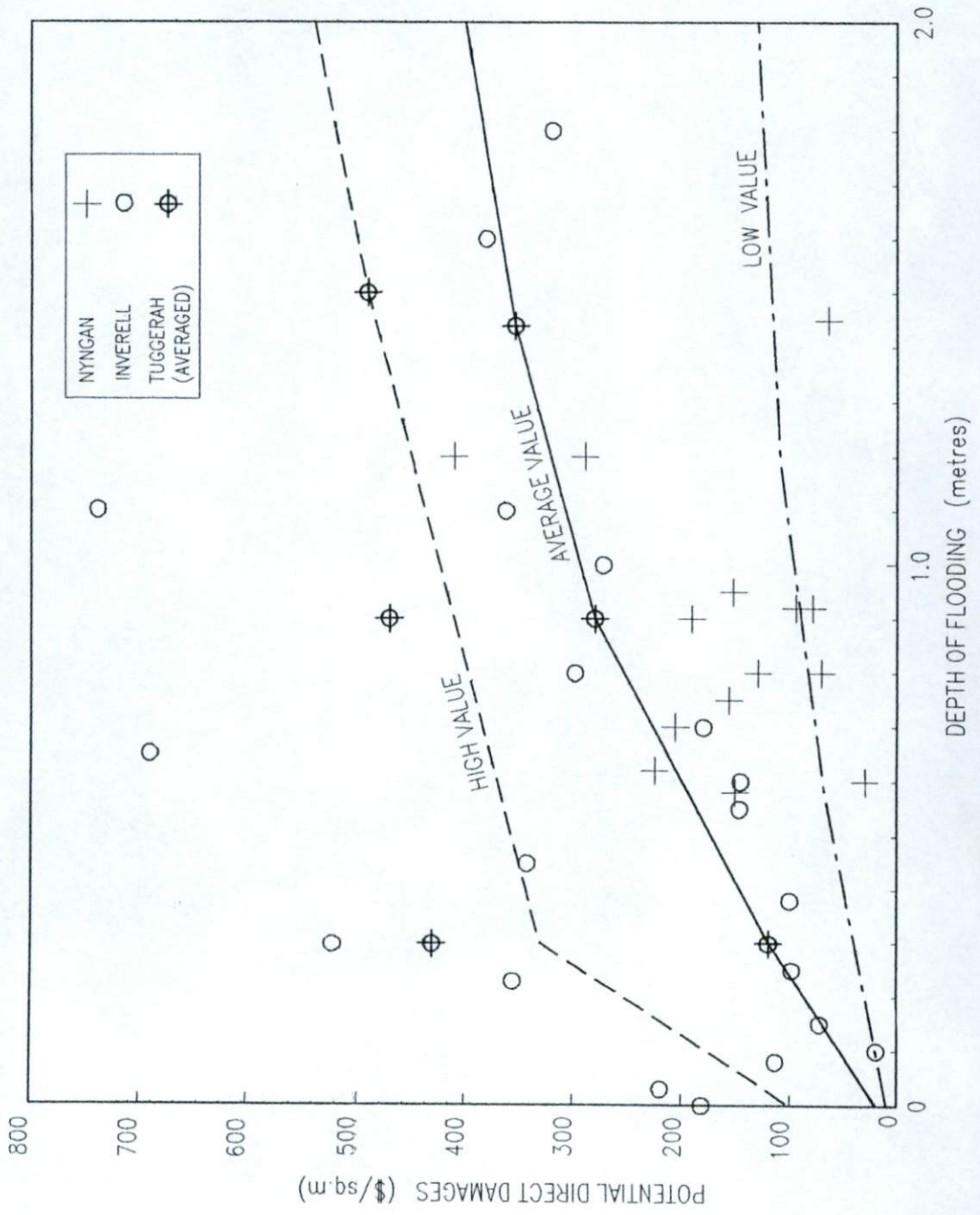
DISK REF: DCAD 95049#1 25/11/97
FIGURE REF: 95049-9 (REV-2)

FIGURE 9
VEGETATION MAP



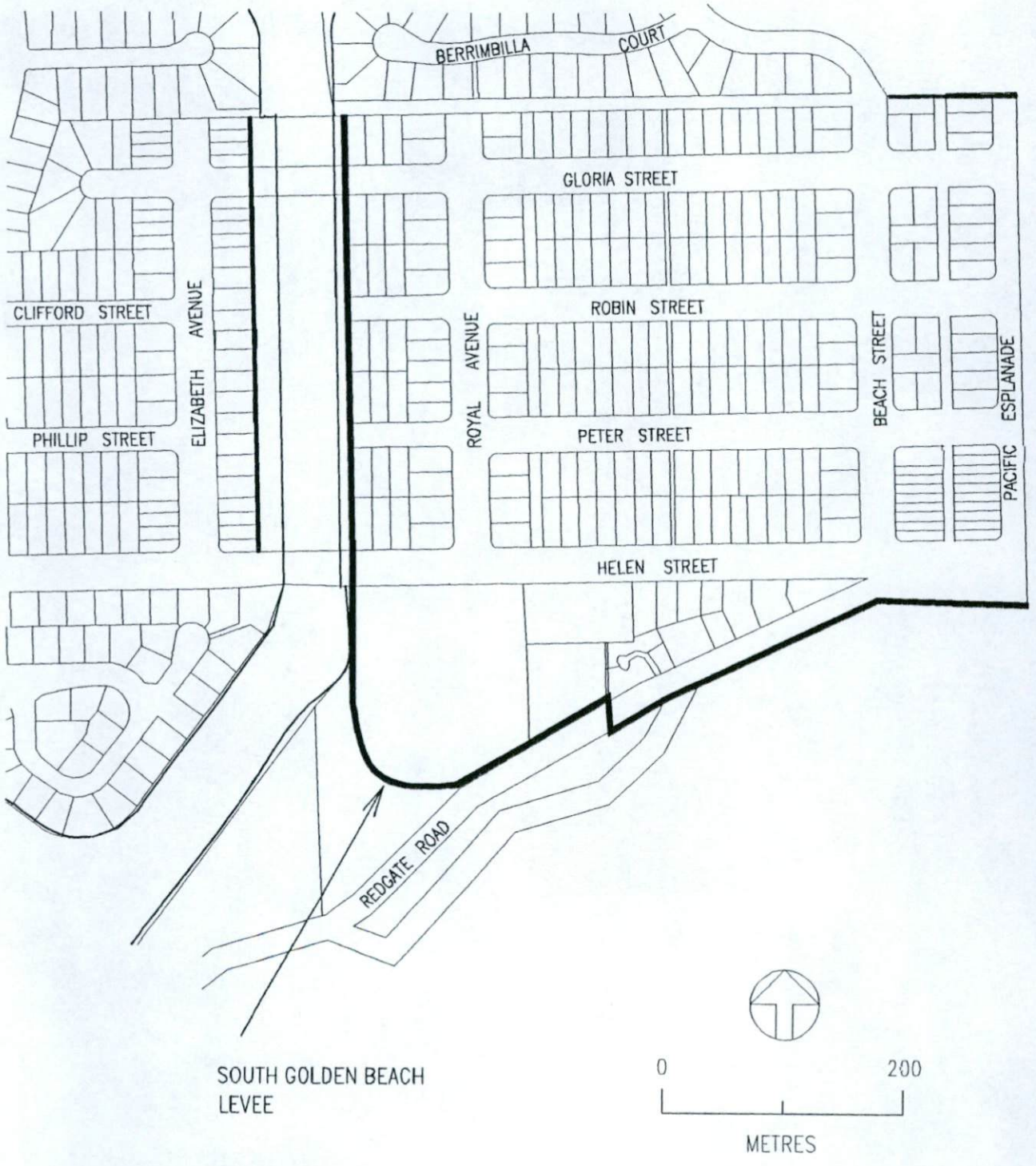
DISK REF: DCAD 95049#1 25/2/97
FIGURE REF: 95049-10 (REV 2)

FIGURE 10
ANUFLOOD PRECINCTS



SK REF: DCAD 95049#1 25/11/97
GURE REF: 95049-11 (REV 1)

FIGURE 11
COMMERCIAL AND LIGHT INDUSTRIAL DAMAGES DATA



DISK REF: DCAD 95049#1 25/11/97
FIGURE REF: 95049-12 (REV 1)

FIGURE 12
SOUTH GOLDEN BEACH LEVEE

DISK REF: DCAD 95049#1 25/11/97
FIGURE REF: 95049-13 (REV 2)

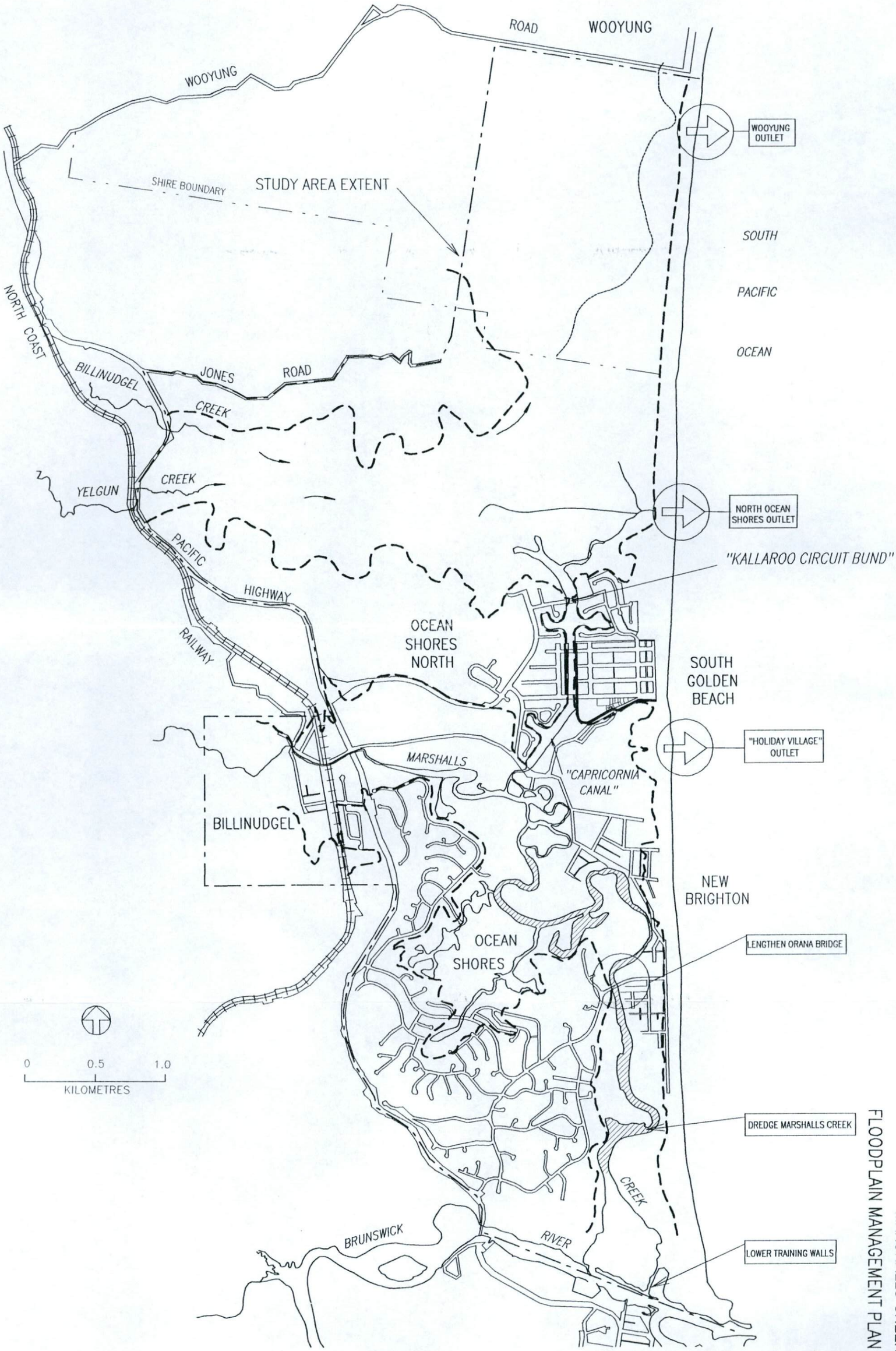
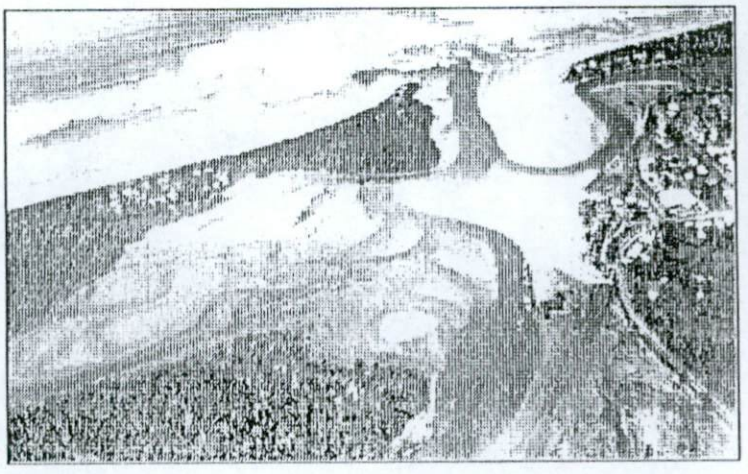


FIGURE 13
FLOOD MITIGATION OPTIONS

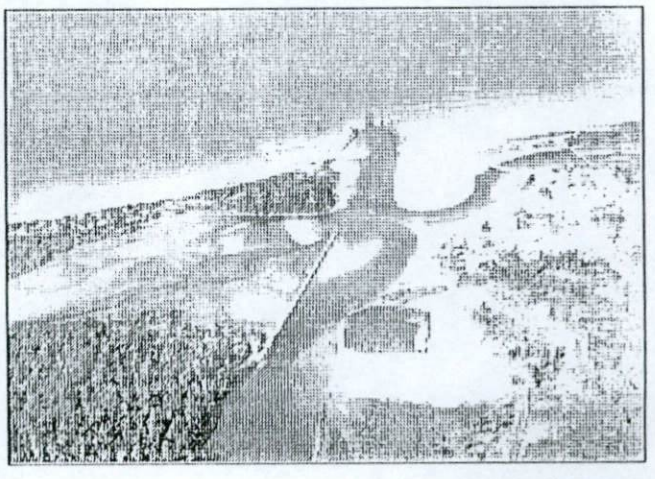
MARSHALLS CREEK
FLOODPLAIN MANAGEMENT PLAN

"Sheltering Palms" Village

Marshalls Creek



1961 - Before Construction of River Walls



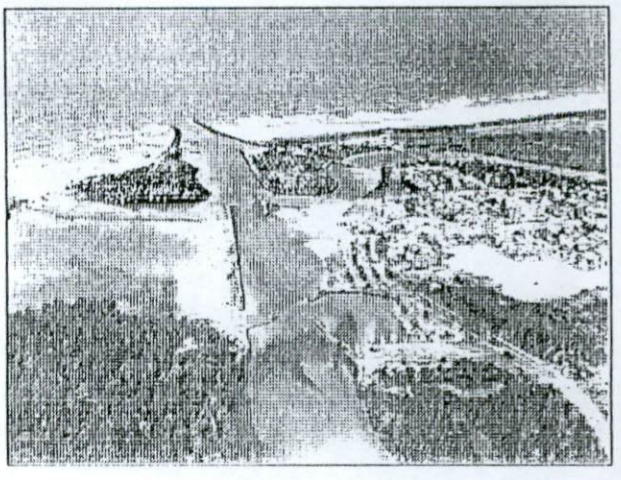
1967 - After Construction of River Walls

"Sheltering Palms"

Ruins after Ocean Breakthrough 1974

New Training Wall

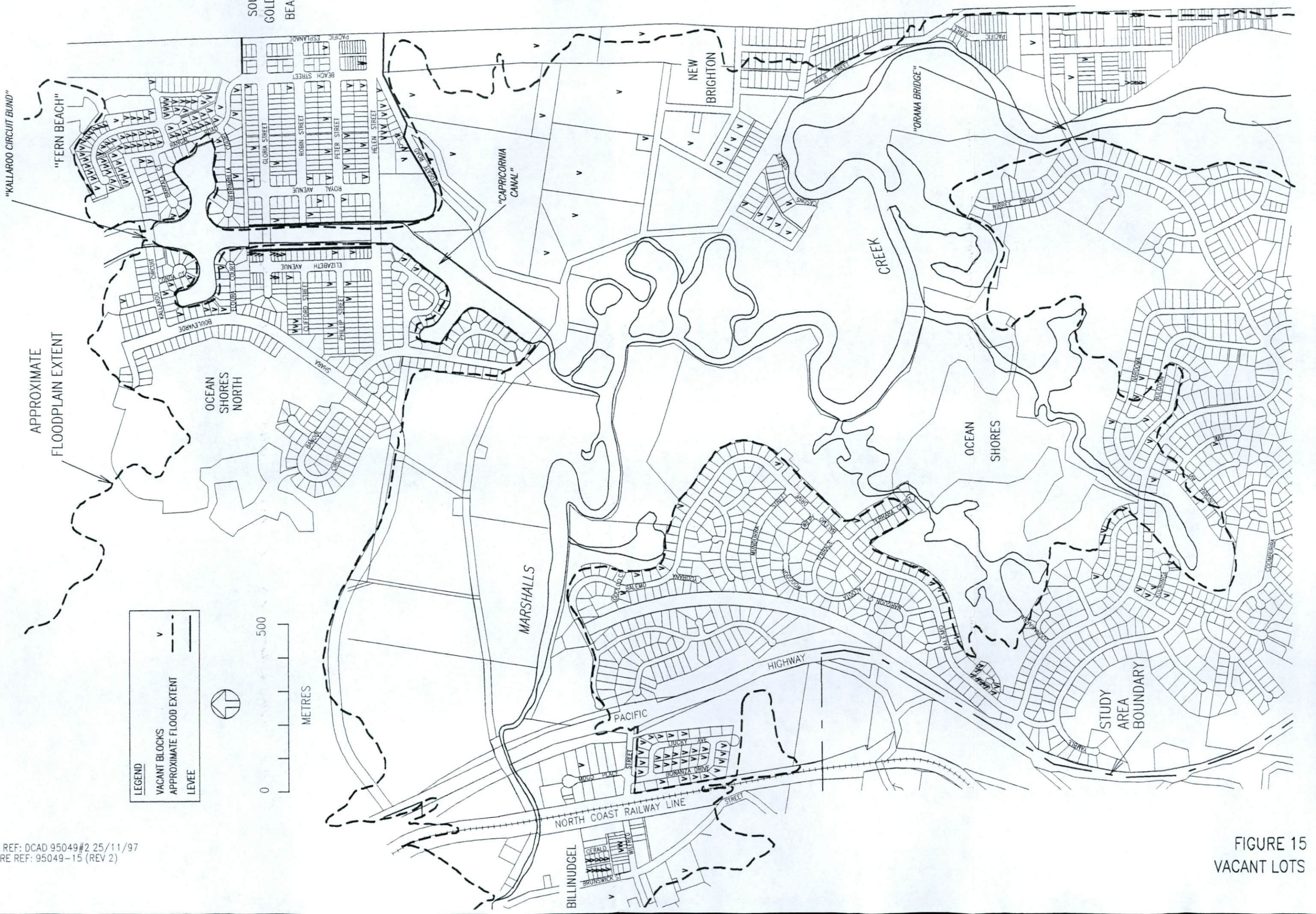
Relocated Outlet



DISK REF: DCAD 95049#7 18/2/97
FIGURE REF: 95049-14

1978 - Modified Training Walls in Marshalls Creek

FIGURE 14
MARSHALLS CREEK TRAINING WALLS

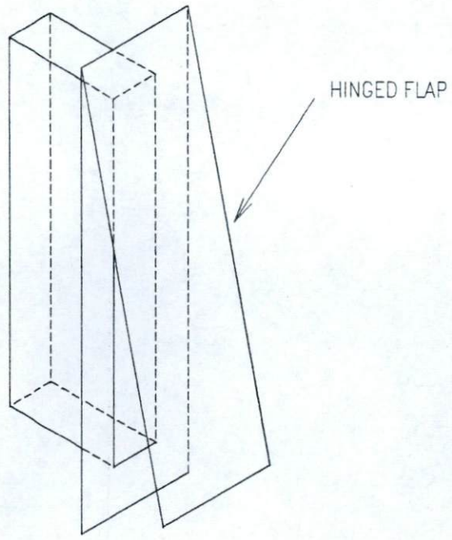


DISK REF: DCAD 95049#2 25/11/97
FIGURE REF: 95049-15 (REV 2)

FIGURE 15
VACANT LOTS

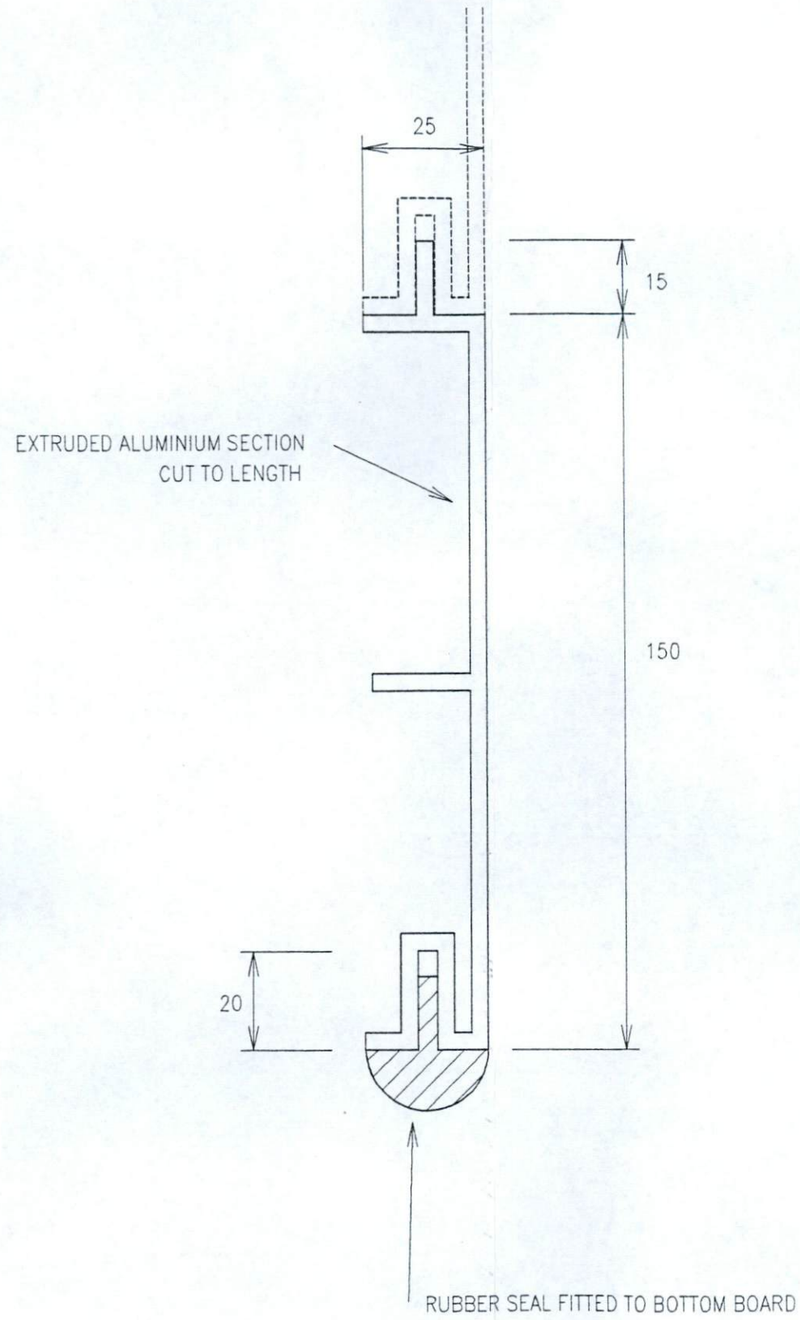
DSK REF: DCAD 95049#7 25/11/97
FIGURE REF: 95049-16 (REV 1)

FIGURE 16
LOCATION OF "HOLIDAY VILLAGE"



WEEP HOLE MINI FLAP GATE

TYPICAL FLOODPROOFING MEASURES



DETAIL OF STOPBOARDS

DISK REF: DCAD 95049#2 25/11/97
FIGURE REF: 95049-17((REV 2)

FIGURE 17
TYPICAL FLOOD PROOFING MEASURES

LEGEND

LEP ZONINGS (1988 AS AMENDED)

RURAL – GENERAL RURAL	1(a)
RURAL – AGRICULTURAL PROTECTION	1(d)
RESIDENTIAL	2(a)
RESIDENTIAL – VILLAGE	2(v)
INDUSTRIAL	4(a)
OPEN SPACES	6(a)
OPEN SPACES – PRIVATE	6(b)
ENVIROMENTAL PROTECTION	
– WETLANDS	7(a)
– COASTAL HABITAT	7(b)
– COASTAL LAND	7(f1)
– URBAN COASTAL LANDS	7(f2)
– HABITAT	7(k)
RESERVATIONS – PROPOSED ROAD	9(a)
VACANT LOTS	V

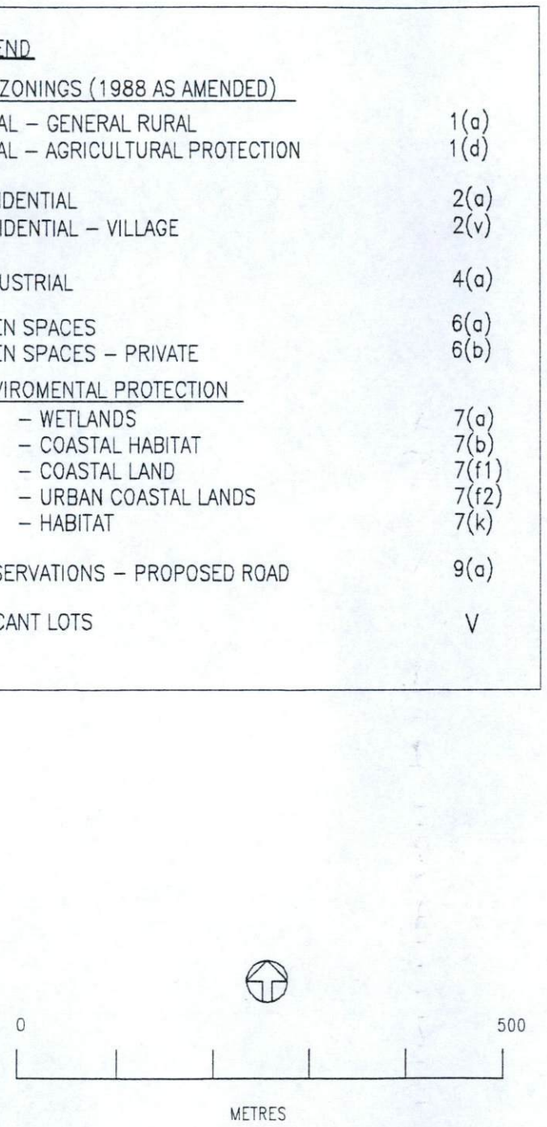


FIGURE 18
BILLINUDGEL VILLAGE

REF: DCAD 95049#2 25/11/97
RE REF: 95049#18

APPENDICES

APPENDIX A

DOCUMENTS RECEIVED

FLOOD REPORT

PREPARED BY
BRUCE BUTT

NOVEMBER, 1995

FEBRUARY, 1995

Date	Rainfall Gauge	Flood Gauge
15.02.95	Daily total - 332 mm (this figure cannot be confirmed as I away) Mrs. Baggaley, The Pocket - 150 mm	Broughton Creek gauge:- 12.30 p.m. 1.5 m 1.30 p.m. over 2 m Walsh gauge:- 3.00 p.m. .9 m 4.15 p.m. .7 m Mill Farm gauge:- 5.00 p.m. .75 m 6.45 p.m. .58 m
16.02.95	9.00 a.m. to 10.00 a.m. 48mm 10.45 a.m. 15mm 11.30 a.m. 17mm 12.30 p.m. 3mm 2.30 p.m. 13mm	

15th February, 1995

Larry O'Donnell said the flood rose very quickly and much faster than previously.

The peak height (from debris) .78 metres at approximately 2.00 p.m.

MARCH, 1994

Date	Rainfall Gauge	Creek Gauge
01.03.94	42 mm	6.00 a.m. .5 m 9.00 a.m. .58 m 1.00 p.m. .78 m 4.00 p.m. .8 m
02.03.94	19 mm	7.00 a.m. .72 m
03.03.94	6.30 a.m. - 7.30 a.m. - 12 mm 7.30 a.m. - 8.30 a.m. - 18 mm 8.30 a.m. - 11.30 a.m. - 5 mm 11.30 a.m. - 3.15 p.m. - 3 mm 3.15 p.m. - 5.30 p.m. - 7 mm 5.30 p.m. - 7.00 a.m. - 20 mm TOTAL - 65 mm	6.30 a.m. 1.2 m 7.30 a.m. 1.4 m 8.30 a.m. 1.8 m 5.30 p.m. 1.7 m
04.03.94	7.00 a.m. - 65 mm (total rain)	1.1 m
	Flood Gauge	
03.03.94	8.30 a.m. - ½ " below gauge 10.00 a.m. - .3 m 11.30 a.m. - .41 m 1.00 p.m. - .3 m 1.45 p.m. - .22 m 3.15 p.m. - .1 m 5.30 p.m. - .1 m below gauge	8 mm (at 7.00 a.m.) .6 mm (at 10.00 a.m.) .5 mm (at 5.00 p.m.)

1st March, 1994

At 4.00 p.m. the water was about 4 inches over O'Donnells' cattle crossing.

2nd March, 1994

7.00 a.m. - the water was about 2 inches over cattle crossing.

4.00 p.m. - the crossing was just clear of water. Mill Farm gauge - .7 m.

4th March, 1994

The water was up to the third wire on O'Donnells' fence (opposite old gauge) and over most of cricket ground and up to the main road entrance.

FEBRUARY, 1994

Date	Rainfall Gauge	Creek Gauge
20.02.94	74 mm (24 hour total)	1.5 m (at 7.00 a.m.)

20th February, 1994

Water was over the first wire on O'Donnells' boundary (opposite gauge site). Water was running down to the cricket pitch and over the flat from the creek in Holm's property.

DECEMBER, 1994

Date	Rainfall Gauge	Creek Gauge
01.12.94	43 mm	.2 mm (below gauge)
02.12.94	103 mm	.2 mm (on gauge at 7.00 a.m.)
03.12.94	3 mm	.8 mm (at 7.00 a.m.) .6 mm (at 10.00 a.m.) .5 mm (at 5.00 p.m.)

2nd December, 1994

On the evening of the above date, the gauge reached 1 metre.

3rd December, 1994

7.00 a.m. - 6 inches of water over O'Donnells' bridge. The water in their paddock was nearly up to the location of the old gauge.

5th December, 1994

Approximately 8inches under O'Donnells' bridge.

8th December, 1994

My bridge gauge reading was .19 m - this reading shows the absence of underground water.

DECEMBER, 1993

Date	Rainfall Gauge	Creek Gauge
07.12.93	6.00 a.m. - 100 mm (24 hours) 11.00 a.m. - 20 mm 2.00 p.m. - 33 mm	7.00 a.m. 1.27 m 1.00p.m. 1.25 m 5.30 p.m. 1.42 m
08.12.93	53 mm (24 hours)	
09.12.93		6.30 a.m. 1.4 m 12.30 a.m. .9 m
10.12.93	2 mm	.6 m

7th December, 1993

Judging by the marks on my big bridge, water probably reached 1.6 m on the above night. Water was approximately 1 foot below the surface of the new crossing on Moffatts Road.

APRIL, 1992

Date	Rainfall Gauge	Creek Gauge
05.04.92	5 mm	6.30 a.m. .2 m
06.04.92	22 mm	7.00 a.m. .81 m
07.04.92	2 mm	7.00 a.m. .6 m

MARCH, 1992

Date	Rainfall Gauge	Creek Gauge
16.03.92	6.00 a.m. - 2.30 p.m. - 42 mm 2.30 p.m. - 3.50 p.m. - 10 mm 3.50 p.m. - 5.45 p.m. - 12 mm 5.45 p.m. - 6.00 a.m. - 45 mm TOTAL 109 mm Billinudgel Road - up to second top wire	1.30 p.m. .5 m 2.30 p.m. .55 m 3.30 p.m. .61 m 5.30 p.m. .8 m 6.00 a.m. 1.6 m * Probably reached 1.68 m
17.03.92	6.00 a.m. - 100.00 a.m. - 10 mm	6.00 a.m. 1.6 m 9.30 a.m. 1.7 m 1.30 p.m. 1.52 m

DECEMBER, 1991

Date	Rainfall Gauge	Creek Gauge
12.12.91	6.00 a.m. - 11.30 a.m. - 35 mm 1.30 p.m. - 55 mm 3.00 p.m. - 65 mm 4.00 p.m. - 88 mm 5.30 p.m. - 90 mm 6.45 p.m. - 109 mm 8.00 p.m. - 112 mm	8.00 a.m. .19 m 10.00 a.m. .29 m 2.40 p.m. .8 m 3.40 p.m. 1.4 m 4.30 p.m. 1.6 m 5.30 p.m. 1.7 m
	Flood Gauge	
	6.45 p.m. - .3 m 8.00 p.m. - .2 m	
	Rainfall Gauge	
13.12.91	5.30 p.m. - 136 mm	

13th December, 1991

Water marks at the flood gauge show an approximate height of .5 metres to .6 metres (sometime during the early hours of the morning of the above date).

The flood gauge at the Butcher's Shop registered .287 metres at approximately 2.30 a.m. (Walter Walsh Jnr. gauge reader).

JUNE, 1990

Date	Rainfall Gauge	Creek Gauge	
07.06.90	45 mm - mostly fell between 4.00 a.m. and 6.00 a.m. 25 mm - fell between 6.00 a.m. and 12.00 p.m.	7.15 a.m. 7.30 a.m. 10.30 a.m. 4.30 p.m.	.52 m .9 m 1.5 m 1.3 m

7th June, 1990

Water on Pocket Road, Billinudgel and just above house paddock and low lying areas of my farm.

8th June, 1990

Water gone from creek on my farm. Water over O'Donnells' flats. Water running over creek banks and coming from Walter Holm's farm.

APRIL, 1990

Date	Rainfall Gauge	Creek Gauge
05.04.90	7.30 a.m. - 82 mm 9.00 a.m. - 17 mm 10.00 a.m. - 24 mm 11.00 a.m. - 28 mm 1.00 p.m. - 32 mm 2.00 p.m. - 32 mm 3.00 p.m. - 36 mm 4.00 p.m. - 37 mm 5.00 p.m. - 37 mm 6.00 a.m. - 70 mm TOTAL - 107 mm	7.30 a.m. 1.5 m 9.00 a.m. 1.58 m 10.00 a.m. 1.6 m 11.00 a.m. 1.7 m 1.00 p.m. 1.8 m - water over gauge
06.04.90		7.45 a.m. - 1.7 m 8.15 a.m. - 1.6 m 10.15 a.m. - 1.5 m 1.15 p.m. - 1.3 m
Date	**Flood Gauge**	
05.04.90	1.00 p.m. - water touching bottom of gauge 2.00 p.m. - .05 m 3.00 p.m. - .07 m 4.00 p.m. - .01 m 5.00 p.m. - .02 m	
06.04.90	6.00 a.m. - .08 m	

5th April, 1990

Water on Billinudgel flat up to the second fence wire (opposite the flood gauge site) at 7.30 a.m.

6th April, 1990

Water was approximately .23 metres deep on Wilfred Street and Moggo Place entrance. It was on Billinudgel flat, approximately .2 metres deep on the Pocket Road and on the third fence wire of O'Donnells' boundary (opposite the flood gauge).

Water in the creek was flowing well despite the fact that the tide was on the turn. At high tide at 6.26 p.m. - 1.4 metres. Morning high tide at 5.43 a.m. - 1.6 metres. Water was 6 inches deep under the Walsh house inWilfred Street.

Date	Rainfall Gauge	Creek Gauge
08.04.90	6.45 a.m. - 85 mm 8.00 a.m. - 7 mm 9.00 a.m. - 8 mm 10.00 a.m. - 8 mm	6.00 a.m. 1.7 m 3.00 p.m. 1.65 m
	Flood Gauge	
	6.45 a.m. - .02 m 8.00 a.m. - .31 m 9.00 a.m. - .37 m 10.00 a.m. - .368 m 11.00 a.m. - .32 m 12.00 p.m. - .28 m 1.00 p.m. - .12 m 2.00 p.m. - 0 m	

8th April, 1990

At 6.00 a.m. water was just over the bridge at the flood gauge. At 8.00 a.m. water was .31 metres on gauge - the rate of rise slowed by 9.00 a.m.

Rain had stopped falling by 8.15 a.m. At 10.00 a.m. the flood had started falling and the rain had stopped. The flood dropped very slowly and by 2.00 p.m. most of the water was back in the confines of the creek.

Date	Rainfall Gauge	Creek Gauge
21.04.90	5.00 p.m. - 24 mm Gauge fell down 2.00a.m. - 3.00 a.m. - 8 mm 7.30 a.m. - 1 ml	2.00 a.m. 1.3 m 2.30 a.m. 1.5 m 3.00 a.m. 1.55 m 8.00 a.m. 1.55 m Probable maximum height - 1.7 m at approximately 4.00 a.m.

21st April, 1990

Water on Billinudgel flat was up to the third fence wire (opposite gauge site) - this height gives about .4 metres on roadway. No water on Wilfred Street.

22nd April, 1990

Creek height - .67 metre - this height had water flowing over O'Donnells' calvert near the cricket ground and water lying on the ground west of the flood gauge. Marshalls Creek and attached drain were flowing swiftly, however the middle drain was stagnant.

FEBRUARY, 1990

Date	Rainfall Gauge	Creek Gauge
02.02.90	8.00 a.m. - 3.00 p.m. - 10 mm 3.00 p.m. - 5.00 p.m. - 35 mm 5.00 p.m. - 6.30 p.m. - 30 mm 6.30 p.m. - 8.30 p.m. - 22 mm 8.30 p.m. - 10.00 p.m. - 6 mm 10.00 p.m. - 11.00 p.m. - 3 mm 11.00 p.m. - 6.00 a.m. - 24 mm	9.30 a.m. .38 m 5.00 p.m. .6 m 6.30 p.m. 1.2 m
03.02.90	6.00 a.m. - 11.30 a.m. - 8 mm 11.30 a.m. - 1.30 p.m. - 12 mm 1.30 p.m. - 8.00 a.m. - 0 mm TOTAL 20 mm	8.30 a.m. 1.6 m 2.00 p.m. 1.55 m * Creek gauge probably reached 1.8m
04.02.90	.8 mm	
05.02.90	.5 mm	
	Flood Gauge	
	8.30 p.m. - .05 m 10.00 p.m. - .3 m 11.00 p.m. - .38 m * Flood gone at 6.00 a.m. on 3.2.90	

3rd February, 1990

The Pocket had 22 mm to 4.00 p.m.

Water was on Pocket Road, Billinudgel flat at 8.30 a.m. (opposite old flood gauge) and covered three wires on O'Donnells' fence as well as the west side of the road. The round post nearest Marshalls Creek bridge had 6 inches of water.

At Moggo Place entrance and Wilfred Street the water peaked at the fire hydrant late at night (probably at 1.30 a.m.). At 9.30 a.m. water was approximately 15 inches deep on Wilfred Street - the water was running swiftly and was only passable by truck. Water was running very slowly as pipes and drains located at Humble Pie were totally inadequate

5th February, 1990

Water in the cricket pitch drain just reached O'Donnells' bridge.

Depressions west of O'Donnells' property (next to Marshalls Creek) were all full. The middle drain on the roadway was full but moving very slowly.

JANUARY, 1990

Date	Rainfall Gauge	Creek Gauge
15.01.90	4.00 a.m. - 5.00 a.m. - 35 mm 9.40 a.m. - 11.00 a.m. - 50 mm	7.30 a.m. .1 m
16.01.90	5.30 a.m. - 85 mm	5.30 a.m. 1.2 m 8.30 a.m. 1.19 m 3.00 p.m. .7 m
17.01..90	9.00 a.m. - 3.00 p.m. - 25 mm	10.00 a.m. .45 m 11.00 a.m. .48 m 3.00 p.m. .55 m 5.30 p.m. .6 M

16th January, 1990

Water was 6 to 8 inches deep on Billinudgel flat and needed to rise approximately foot' to cover the road. It was also running from the Holm's property into the depressions on the O'Donnell property and on the cricket ground back to the tea trees.

17th January, 1990

Rainfall registrations suggested a rise of 1 foot however the water only rose to 8 inches, taking approximately 8 ½ hours to do so.

At the height of the storm, the drain beside Humble Pie to the Highway was full and totally inadequate for the amount of water is was required to carry.

DECEMBER, 1989

Date	Rainfall Gauge	Flood Gauge
05.12.89	6.00 a.m. 45 mm 10.30 a.m. 10 mm 8.00 p.m. 24 mm	
06.12.89	8.00 a.m. 1 mm	
	Creek Gauge	
05.12.89	10.30 a.m. .3 m 4.30 p.m. .5 m	

5th December, 1989

Mrs. Baggaley recorded 65 mm in this storm.

Date	Rainfall Gauge	Flood Gauge
09.12.89	8.00 p.m. 45 mm	
	Creek Gauge	
08.12.89	.3 m 4.30 p.m. .5 m	
10.12.89	8.00 a.m. .85m Probably reached 1 metre through the night	

9th December, 1989

Mrs. Baggaley recorded 66 mm in this storm.

Date	Rainfall Gauge	Flood Gauge
24.12.89	50 mm	
	Creek Gauge	
24.12.89	8.30 a.m. .2 m 4.00 p.m. .35 m 6.00 p.m. .63 m	

25th December, 1989

Judging by the muddy water marks left on Mill Farm's bridge, the flood probably reached from between .85 to 1 metre.

SEPTEMBER, 1989

Date	Rainfall Gauge	Flood Gauge
15.09.89	6.00 a.m. 5mm 6.35 a.m. 70 mm 7.30 a.m. 13 mm 8.00 a.m. 13 mm	6.00 a.m. .19 m 6.35 a.m. .29 m 7.00 a.m. .33 m 8.00 a.m. .34 m 9.00 a.m. .25 m 11.00 a.m. Below gauge
16.09.89	8.00 a.m. 3 mm	
	Creek Gauge	
15.09.89	11.00 a.m. 1.8 m 4.00 p.m. 1.1 m	
16.09.89	8.00 a.m. .6 m	

15th September, 1989

At 1.30 p.m. on 15th September, 1989 the water on Billinudgel flat was approximately 18 inches deep

APRIL, 1989

Date	Rainfall Gauge	Flood Gauge
01.04.89	To 3.00 p.m. 5 mm 3.00 p.m. - 5.00 p.m. 36 mm	7.00 a.m. .12 m
	Creek Gauge	
01.04.89	8.00 a.m. .4 m 11.00 a.m. .59m 5.00 p.m. 1.0 m	
02.04.89	6.30 a.m. 1.7 m 10.00 a.m. 1.4 m	
03.04.89	4.30 p.m. .84 m	

1st April, 1989

Water on Billinudgel flat was just over the second top wire of the fence (opposite the flood gauge) and was about 6 inches deep at the end of Wilfred Street. Water 2 inches deep was running over the road at the foot of the hill on the South Stock Route.

Water was over O'Donnell's stock bridge at 4.30 p.m.

3rd April, 1989

Reading at Mill Farm's bridge gauge - .84 m

4th April, 1989

High tide of 1.8 m at Woodburn - this produced approximately 1 inch on flood height according to Bill McCormack, SES Controller. This high tide at Woodburn steadied rate fall by about three to four hours.

Date	Rainfall Gauge		Flood Gauge	
26.04.89	Mill Farm		6.00 a.m.	.46 m
	6.00 a.m.	- 120 mm (24 hours)	6.30 a.m.	.55 m
			7.30 a.m.	.50 m
	6.30 a.m.	- 20 mm	8.00 a.m.	.52 m
	7.30 a.m.	- 25 mm	8.30 a.m.	.50 m
			9.30 a.m.	.45 m
	The Pocket	- 186 mm	3.00 p.m.	.30 m
	Yelgun	- 200 mm	4.00 p.m.	.20 m
	Creek Gauge			
27.04.89	2.00 p.m.	.82 m		
	4.00 p.m.	.82 m		

26th - 27th April, 1989

Water reached the top step of the P.O. store and the hotel and halfway to the gateway of Y&N Caryard at Moggo Place and backed up nearly to the gate at the rear of Nick Bird's shop. There was 4" on water in Monteiths Garage. Billinudgel flat was 6 to 8 inches deep and was within 18inches of the bitumen. This flood was approximately 1 foot lower than the 1985 mark.

The water peaked as predicted at 9.15 a.m.

28th April, 1989

Water gone from under the fence on the west side of the Pocket Road - the first drain and crossing was full with water still running strongly from the west. This would suggest that water was still running over this land but was not visible due to long grass. It was obvious that the drainage works were not working as expected - the raod again broke up as it did the previous year.

JANUARY, 1989

23rd January, 1989

The flood water rose to the back steps of the butcher shop. The Pocket - 9 inches of rain, Billinudgel - 5 inches.

Information supplied by Mr. E. O'Donnell (I was away at this time).

Date	Rainfall Gauge	Flood Gauge
23.01.89	9.00 a.m. 13.9.88 to 6.00 a.m. 14.9.88 - 140 mm	
15.09.88		6.00 a.m. .190 m 6.35 a.m. .290 m 7.00 a.m. .33 m 8.00 a.m. .34 m 9.00 a.m. .25 m 11.00 a.m. .25 below gauge
	Creek Gauge	
27.04.89	2.00 p.m. .82 m 4.00 p.m. .82 m	

Date	Rainfall Gauge	Flood Gauge
28.01.89	.77 mm	
	Creek Gauge	
28.01.89	9.00 a.m. 1.6 m 4.00 p.m. .82 m	

28th January, 1989

The water on Billinudgel flat up to the third wire on the fence (opposite council flood gauge)

The level on the Mill Farm gauge was .45 metre.

Reported levels at Billinudgel were conflicting - I believe the water reached to the top step of the butchers shop.

Mrs. Baggaley recorded 254 mm. No Mill Ffarm readings recorded.

DECEMBER, 1988

Date	Rainfall Gauge		Flood Gauge
13.12.88		5 mm	
14.12.88	8.00 a.m.	8mm	
15.12.88	7.00 a.m.	7 mm	
16.12.88	8.00 a.m.	18 mm	
17.12.88	7.00 a.m.	5 mm	
18.12.88	6.30 a.m. 12.30 p.m. 1.30 p.m 3.30 p.m. 9.00 a.m.	45 mm 25 mm 10 mm 5 mm 83 mm (recorded by Mrs Baggaley)	
19.12.88	7.00 a.m.	60 mm	
20.12.88	7.00 a.m.	10 mm	
21.12.88		1 mm	
	Creek Gauge		
13.12.88	8.00 p.m.	.15m	
16.12.88	8.00 a.m.	.3 m	
17.12.88	2.00 p.m.	.25m	
18.12.88	6.30 a.m. 11.30 a.m. 12.30 p.m. 3.30 p.m. 4.30 p.m.	1.25m 1.5 m 1.6 m 1.8 m Stationary	
19.12.88	7.00 a.m. 1.30 p.m.	1.12m 1.30m	
20.12.88	8.00 a.m.	.8 m	
21.12.88	1.30 p.m.	.51m	
22.12.88	6.00 .a.m.	.37m	

Date	Rainfall Gauge	Flood Gauge
25.12.88	6.30 a.m. to 12.30 p.m. 37mm	
	Creek Gauge	
25.12.88	12.30 p.m. .55 m 7.30 p.m. .72 m	

25th December, 1988

At 12.30 p.m. the drain in O'Donnell's property (cricket pitch) was 6 inches off the top of the bank.

SEPTEMBER, 1988

Date	Rainfall Gauge	Flood Gauge
14.09.88	9.00 a.m. 13.9.88 to 6.00 a.m. 14.9.88 - 140 mm	
15.09.88	6.00 p.m. to 7.00 a.m. - 125 mm (same amount recorded by Mrs. Baggaley, The Pocket)	6.00 a.m. .19 m 6.35 a.m. .290 m 7.00 a.m. .33 m 8.00 a.m. .34 m 9.00 a.m. .25 m 11.00 a.m. .25 below gauge

15th September, 1988

For the period 6.00 p.m. to 7.00 a.m. (15.09.88) Mrs. Baggaley, The Pocket, recorded 125 mm and Bruce Broughton, Middle Pocket recorded 140 mm for the same period.

The flood peaked at Mill Farm at 8.00 a.m. at .34 metre. In Billinudgel, the water reached the end of the footpath on the eastern end at the fron ot the butchers shop. Water was also halfway up the first step on Wally Walsh's house.

16th September, 1988

The flood was gone from Mill Farm by 8.00 a.m.. There does not appear to have been much water on Billindugel flat. At 8.30 a.m. I walked over the land on the west side of the road, where water was 4 to 8 inches deep and was running along the fence into the first drain. As usual, both drains were full, however water in the first drain was moving very slowly - a leaf on the water at the fence took 2 ½ minutes to travel 2 metres. Past the figtree the flow rate was the same.

The river was full and flowing fairly slowly where the first drain enters. It was banked up on to the second level of the bank, with water on the western side overflowing at O'Donnell's boundary and spreading over their land.

JUNE, 1988

Date	Rainfall Gauge	Flood Gauge
05.06.88	9.00 a.m. 4.6.88 to 9.00 a.m. 5.6.88 - 83 mm (recorded by Mrs. Baggaley, The Pocket) Broughtons Creek - 75 mm	

5th June, 1988

The above rain gave a rise of approximately 3 feet in the creek at Mill Farm by 9.00 a.m.

Date	Rainfall Gauge	Flood Gauge
16.0.6.88	5.00 a.m. 16.06.88 to 9.00 a.m. 17.06.88 - 24 mm (recorded by Mrs. Baggaley, The Pocket)	
17.06.88	9.00 a.m. - Broughtons Creek - 25.5 mm	
	Creek Gauge	
18.06.88	Mill Farm .3 m	
19.06.88	Mill Farm .25 m	

7th April, 1988

The water peaked at Mill Farm at 2.00 p.m. and at Billinudgel at 4.00 p.m.

The flood water was up to Eddy O'Donnell's knees in his butchers shop and reached the top step of the hotel.

Wally Walsh Snr. said the water seemed to be higher at the school than normal.

Water dropped 1 inch in 45 minutes.

6th April, 1988

The flood peaked at approximately 2.30 a.m.

Water was 4 inches deep in the butchers shop and 15" deep under the Walsh house. Water was lying on the O'Donnell property from 1st April, 1988 to 17th April, 1988.

On the eastern end of Wilfred Street, water was over the road for approximately 9 days - this had never occurred before and must have been caused by the filling.

BILLINUDGEL FLOOD NOTES

The road from the Highway was built at a lower level so that it would not impede the flow of water from the south of the village; the railway was built with three viaducts to take the flow in the positions of the three main flood flows.

When a flood reaches 0.9 metres the water leaves the creek and flows in a straight line towards the corner of the Pocket Raod and Wilfied Street, then south to the viaduct, over swamp land and then on to Humble Pie.

The filling at Humble Pie and Moggo Place has reduced the flow by approximately 50% to 70%, which has caused the road to flood for much longer periods - this will be confirmed by a long term resident. Mr. Lloyd Poynting will confirm that the road was not closed as often as it currently is prior to the filling being carried out.

The Stock Route Road now becomes submerged in water with the smallest of floods.

The flood of 12th July, 1988 was very small on my property, however at the gauge, water was halfway across the Pocket Road - at the bottom of the hill south of the school, water was three inches deep and approximately two feet deep at the Moggo Place intersection. This, I might add, was after extensive drain and creek clearing carried out by the Council.

There must be a free flow of water bewteen the railway line and the Highway - the present drain beside Humble Pie is approximately 18 inches wide and is totally inadequate.

I have noted that when the creeks are fairly full, 75 mm of rain in The Pocket will produce a rise of 1 foot in these same creeks.

From 1892 to 1986, Billinudgel School did not miss a day of schooling due to flooding.

Flood Study - 11th November, 1990

In the above flood study, no mention was made of the water levels in creeks before the rain and floods had occurred.

There was also no mention of the 23 inches of rain recorded at "Mill Farm" in January, 1955, which fell between 3.00 p.m. and 11.00 p.m. This was the same amount of rain that fell over an 18 hour period that produced the Mothers Day flood.

The reason that the 1955 downpour didn't result in a flood as big as the Mothers Day flood was because there had been little rain for about three months and the creeks were very low and there wasn't as much rain recorded in The Pocket.

The flood study also comments on work done on the Brunswick river mouth. I have never heard of this nor have any of the older residents or children of the first settlers. Perhaps it was a misprint or just wishful thinking!

Article in The Echo - Vol, 4 (7.1.90)

Jim Manglesson was reported as saying that the breakwater was responsible for the siltation of Readings Bay - I remember walking on dry sand on practically all of this bay at low tide in 1940.

A Mr. Brown also stated that Marshalls Creek's problems are caused by man. Anyone who has lived here will tell hime that this creek was always shallow.

Article in Byron News (September, 1995)

Gordon Campbell wrote in an article that Marshalls Creek was being dredged, but re-claimed. After all the information I have given him, he still seems to believe that the creek was once deep!

Summary

Because Marshalls Creek has very low banks, the floods always run across country and therefore the creek has very little influence on flooding.

Residents of Billinudgel believe that the tide has a big effect on flood heights and dropping speed, however I do not think that this is the case.

With a short valley in The Pocket, the greatest effect on rise and fall in rainfall - as soon as it stops raining in The Pocket, one hour later there is a dramatic drop in the flood level in Billinudgel.

From "Mill Farm" to Billinudgel (as the water runs) is approximately one mile. It takes two hours from the flood peak at "Mill Farm" for the peak to occur in Billinudgel.

FLOOD SUMMARY

January, 1955

On 22nd January, 1995, light rain was falling at 2.30 p.m. with very heavy rain falling at 3.30 p.m. Rain stopped falling at 11.00 p.m.. Rain registration for the period - 23 inches.

Mothers Day Flood - May, 1987

On Saturday at 9.00 a.m., water was just over the Pocket Road at Billinudgel. The day was fine, but during the night 11 inches of rain fell. By 6.00 a.m. on Mothers Day there was a major flood, which dropped by about 1 foot by 10.00 a.m. Rain started falling again at about 10.00 a.m. Len Walker recorded 12 inches of rain in the period 8.00 a.m. to 1.00 p.m. - this downpour caused the biggest flood in the 106 years of settlement at Billinudgel. With the creeks full and the ground saturated, all the rain water ran off. (In 1955 when 23 inches fell, the ground was very dry as there had been little rain in the previous three months - all small streams were dry and Marshalls Creek had stopped running in many places.)

Also, The Pocket and Middle Pocket did not register as much rain as Billinudgel - Mt. Chillingham, approximately 12 miles north west of Billinudgel, recorded record rainfall and flooding, therefore I think we can assume that the Billinudgel flooding was caused by rainfall and not silted creeks.

Once the flood water had gone over the railway line and the Pacific Highway, the flood dropped. This would suggest that this is the maximum height that floods can reach in Billinudgel.

15th September, 1988

This flood was the result of 15 mm of rain from 9.00 a.m. to 6.00 p.m. on 14th September, 1988 and 125 mm from 6.00 p.m. to 8.00 a.m. on 15th September, 1988 at The Pocket and 140 mm in the Middle Pocket.

At my gauge, 125 mm was recorded from 6.00 p.m. to 8.00 a.m. The water reached 3/4 of a metre on my flood gauge at 8.00 a.m. The water at Billinudgel reached the eastern end of the footpath at the butcher's shop.

At 1.30 p.m. on 15th September, 1988, the water had left the Mill Farm gauges. On the Pocket Road at Billinudgel flat, the water was approximately .55 of a metre.

Wilfred Street, from the railway line to the Highway, was still closed. West of the railway line the village was dry, with water lying either side of Wilfred Street and in the north east corner of the school ground. This water only receded when the flow of the water from The Pocket dropped.

At 8.15 a.m. on 16th September, 1988 water was still halfway across Wilfied Street and the swamp on the southern side still full of water. Twelve months prior to this, the road would have been free of water.

At 9.00 a.m. on 16th September, 1988 the creek at Mill Farm dropped by 1.1 metres. Depressions and drains had dried out by 22nd September, 1988. I think that this quick drying was helped by the lower level of the underground water.

There does not appear to have been as much water on Billinudgel flat as in previous floods. I walked over the land on the western side of the road and found water six to eight inches deep, which was running beside the road into the first drain. Both these drains were full (as normal) and water in the first (northern) drain was moving very slowly.

I placed a leaf in the water on the eastern side at the fence, which took two and a half minutes to travel five metres. Further along, past the figtree, the water speed was the same. The water in the river was moving fairly slowly and was banked up on to the second level of the bank. On the Holm's/O'Donnell boundary water was flowing from the main creek onto the O'Donnell property.

The cleaning of the drains and main creek did not seem to make any difference to the water flow or the water level on either side of the road.

Four flood heights at Mill Farm and four corresponding ones at Billinudgel were put in place at this time, which may it easier to predict heights in Billinudgel.

23rd January, 1989

Mrs. Baggaley recorded 254 mm for the 24 hours ending 23 January, 1989:-

From 9.00 a.m. 22.1.89 to 9.00 a.m. 23.1.89 -	179 mm
From 2.00 p.m. to 4.00 p.m. 23.1.89 -	75 mm

Light rain fell in Billinudgel, Ocean Shores and Mullumbimby. Roads were cut in Main Arm, The Pocket and Middle Pocket.

According to Mrs. Baggaley, the water was as high or higher in The Pocket and Middle Pocket as during the "Mothers Day" flood of 1987. Stephanie Baggaley had to spend the night in Billinudgel and told her mother that there was water between the hotel and the general store, with water up to the first step of the butcher's shop.

I was told that the gauge at Mill Farm recorded .6 metre, which would correspond with the water height in Billinudgel.. On 27th January, 1989, I asked Mr. E. O'Donnell about the flood in Billinudgel - he replied that there was little or no water and that the flood had only reached the back step of the butcher's shop; he attributed the low water to the cleaning at the back of Billinudgel.

December, 1989

At 7.30 a.m. on 18th December, 1989 Marshalls Creek at the crossroads was up to the top of the bank on the bottom side of the bridge and running very swiftly, which is normal in flood conditions.

The water at the Holm's/O'Donnell boundary was running on to O'Donnell's flats to the west of the Pocket Road. At the crossing at the cricket ground, water was running over the bridge in O'Donnells and breaking out onto the cricket ground.

February, 1995

I arrived at Billinudgel from Brisbane at about 2.50 p.m. on 15th February, 1995.

There was no water on the flat on the western side of the Highway at Shara Boulevarde, however water on the south side of Wilfred Street was running west to the railway line and was about one foot deep on the roadway opposite J&N Car Yard. When we reached the general store there was three inches of water on the footpath.

We went home to Mill Farm via the Northern Stock Route. Water at Willows Road was approximately 18 inches deep and one foot deep at Mill Farm's gateway. Water entered Barry Williams house, making it the same depth as the record Mothers Day flood of 1987. If I had been at home I would not have telephoned Mr. Williams as the gauge level would have suggested that the water level would be nowhere near his house.

The water level reached in Billinudgel was the same height as the 1989 flood.

The level on my flood gauge was about one foot below the Mothers Day flood - this would suggest that something caused the high level on the Pocket Road at the Williams' residence, possibly the blocking of the crossing at Moffatt's Road.

The water started to drop about six inches per hour from 4.30 p.m.

Flood - 6th May, 1996 - Millfarm

Date	Rainfall Gauge	Flood Gauge	
06.05.96	137 mm	6.00 p.m. 7.30 p.m. 8.30 p.m. 9.30 p.m.	.25 mm .04 mm .48 mm .48 mm

Flood - 7th May, 1996 - Millfarm

6.00 a.m. - water gone from Millfarm. On Billinudgel Flat - Pocket Road. Water to the top wire of the fence on the west side.

This is the first time in history that my farm was free of water and Billinudgel Flat had 2 feet or more of water on it.

We always knew when our farm was dry that Billinudgel Flat would have about 6 inches of water over it.

This large amount of cover must be caused by the filling at the Eldorado Estate.

The area west of the Pocket Road at Billinudgel was originally a swamp and was owned by Gerald O'Connor.

Sometime between 1900 and 1910, O'Connor dug a drain from the Pocket Creek through the swamp to meet the waters of the North Arm of the Brunswick River, known today as Marshalls Creek.

The flow in the creek from the Pocket is very slow and only speeds up in flood time. This being so, the only movement in the North Arm is tidal and this would not have enough volume to force a track through the terrace to the sea.

Pottsville, with a tidal entrance and strong flow from Crabbes Creek, always had silting problems at the entrance.

The late Jack Watterson told me how he and other farmers around Mooball Beach would go with their horses and scoops to clear the sand build up so that the water would run off their farms.

A map drawn in 1871 shows an outlet to the sea at Wooyung. Jack Watterson told me he ran cattle along the beach front in the early 1900's and had never seen any signs of an outlet to the sea, so I suppose it is filled in by sand and vegetation and has never re-appeared.

The area now know as Golden Beach was, until 1956, used for farming purposes. It was owned by W.H. Flowers, with the largest portion owned by Maurice McCartie. Flood waters used to get up the 6 to 8 feet - this water always ran down to New Brighton.

In previous pages, men have stated how they had never seen any outlets to the sea. The first outlet Mangleson shows on his map was on land that I had cattle running on from 1942 to 1945 and there wasn't an opening to the sea in that time.

I also went by car in 1940 about halfway to Wooyung without being stopped by outlets. Mr.Ron Hopf at Rous Street, Murwillumbah used to bring large herds of cattle down from Mooball to New Brighton and then on to A.W. Andersons Meat Works at Byron Bay. He says he never crossed any creeks running out to the sea - this was in the late 40's to the middle 1950's.

It is important that the following men are consulted about sea outlets at New Brighton:-

Mr. Ted Boyle, Minyon Street, Brunswick Heads
Mr. Jack Chawner, Feros Village, Byron Bay
Mr. W.H. Flowers, 4 Tallowood Crescent, Byron Bay.

16 Bryce Street,
SUFFOLK PARK NSW

18th January, 1992.

Dear Bruce,

Regarding your enquiry of this morning:-

As far as I can see from my records we walked from Brunswick Heads to Pottsville, the latter end of 1932 or 1933, we dug pits every 200 yards or so for the whole length to get tests of the minerals in the sand. At no place was there any sign of water running into the sea. If there had been any breach in the dunes we would certainly have noticed it and I can say quite definitely there was none.

A mining engineer, a Mr. Johnson (an American) was in charge of the party. Mr. John Flood, who lived at New Brighton and the late Syd Flowers were with me. I believe two others as well, but I cannot recollect their names.

I hope this will be os some use to you.

P.S. I had forgotten Tom Groom. Also, another who lived at New Brighton, an elderly man with the christian name of Tom, always wore a long sleeve shirt because of sunburn. Pat McCarthy might remember him.

Yours sincerely,

J.E. CHAWNER

Information from Bruce Butt by Hand from Pete Cumming

FLOOD REPORT

PREPARED BY BRUCE BUTT - MAY, 1988

MR. J.A. WATTERSON, 1880 - 1974

Mr. Watterson lived with his parents on the farm now owned by Mr. John Ludlow in 1890.

He said floods from then and up to 1900 were of the same heights as floods of later years and the same as floods in the 1950's and 1970's.

He also told me that in about 1890 the sea washed through to the river on the track to North Head, where one of the teachers lived that taught school at Billinudgel.

MR. MICHAEL MOFFATT, 1896 - 1978

Mr. Moffatt told me in 1972 that the floods of 1954 and 1962 were record floods - they were only about 6 inches higher than the floods that occurred when he was very young.

Even though the district had been cleared of vegetation, the floods rose and fell just the same as before the land was cleared.

MRS. EVA MAHER - INTERVIEWED 6TH SEPTEMBER, 1985

Mrs. Maher came to live on the Old New Brighton Road on the west side of the northern end of the railway bridge in 1939. Her house was about 3 foot 6 inches off the ground and in the 1954 and 1962 floods the floor was covered by about 6 inches.

MR. W.H. FLOWERS JNR., BYRON BAY - TELEPHONE CONVERSATION 28TH JULY, 1984

Mr. Flowers stated that there was a house 2 - 3 chains from the entrance of Golden Beach on the eastern side that never flooded.

He said that there was never a natural outlet to the sea on the northern side of Golden Beach.

MR. SPENCER JONES - SCHOOL TEACHER AT BILLINUDGEL 1958 - 1985

Mr. Jones said that the 1962 and 1985 floods both lapped the school verandah floor, but did not go inside. Both floods occurred at night after about 14 hours of heavy rain.

MR. LLOYD POYNTING - GOLDEN BEACH

The 1962 flood was the highest the Poynting family ever experienced - heavy rain started at about 9.00 p.m. and by 12.30 a.m. the water was over the seats of their Holden car. The water seeped through the shop floor and was about 1 inch deep in the R.S.L. Clubrooms.

Mrs. Poynting's father, Mr. Herbert Williams, one of the first settlers, told Mrs. Poynting that the water once went through the windows of the Methodist Church on Billinudgel flat, on the Pocket Road - the year that this occurred is unknown. The church was approximately 3 foot 6 inches off the ground.

MR. PATRICK MCCARTHY - TELEPHONE CONVERSATION 2ND JUNE, 1987

The 1931 flood came into Mr. McCarthy's mothers house at New Brighton - it was about 30 inches of the ground.

The house was about 100 metres off the river bank, approximately a quarter of a mile south of the present New Brighton Store. He remembers the water halfway up the posts of the picnic ground, i.e. present day soccer field.

In the 1931 flood, as in other big floods, water always came down from Yelgun and spread over the farms, back to the hills. This spreading of water is now greatly restricted after the extensive filling done on Golden Beach, at the foot of the hills.

In 1936 the sea poured through at New Brighton where the public dressing sheds were, destroying the sandworks and a small shed up on the terrace used by the fledgling surf club. There was never an outlet to sea north of Golden Beach.

MR. LEN WALKER, THE POCKET - 6TH SEPTEMBER, 1985

The Walker family arrived at The Pocket in 1900. After their arrival, they had many floods, the highest one mentioned by his father being in 1921.

The recent flood of June 1985 was the highest he has ever recorded on his property- at the foot of the Chincogan Range.

2nd June 1987 - the "Mothers Day Flood" exceeded the 1985 flood as it did all along the valley. Mr. Walker recorded 9 inches of rain on the Saturday night and 10 inches on the Sunday morning.

MR. LLOYD POYNTING - 28TH APRIL, 1988

In years gone by the road from the highway to Billinudgel always closed before the road past the school. Mr. Poynting thought that the railway via duct south of Billinudgel seemed to be clogged up.

Even if this was so, the filling of the industrial estate would slow the flow of water.

MR. WALLY WALSH SNR. - 28TH APRIL, 1988

Mr. Walsh also agrees that more water is getting on the road past the school than it used to. He also thinks that the old residents of Billinudgel know enough about floods never to have any loss.

MR. CHARLES O'DONNELL, TYAGARAH STREET, MULLUMBIMBY

Mr. O'Donnell lived in Billinudgel from 1920 - for many years he lived on the extreme north side of Billinudgel, right in the path of all floods. His house was about 8 feet off the ground and has since been demolished.

All the big floods varied from about 1 to 6 inches - the peak only held for about 15 to 30 minutes.

The first flood he remembers that went into the hotel was in 1921 with many more having since gone in.

He vividly remembers being in his house pushing logs away with a broom as they came floating past.

MR. REX SAXON, BILLINUDGEL - SEPTEMBER, 1985

Mr. Saxon and his wife manage his father-in-law's (Mr. Walter Holmes) farm at Billinudgel.

He noticed that after the filling of Mogo Place, the water rose over the Stock Route Road near where Budd's Palm Nursery is now located.

MR. WALTER HOLM - 30TH ARPIL, 1988

Mr. Holm stated that the water on the flat at the Stock Route past his house was the highest he has ever seen it.

MR. EDDIE O'DONNELL - BUTCHER

Mr. O'Donnell has lived in Billinudgel all his life and has a thorough knowledge of the floods. He believes the water only peaks for 15 to 30 minutes. Mr. O'Donnell said that the last couple of floods have come down quicker and seem slower in going.

The O'Donnells have always had to lift the machinery in their shop in flood time and have had very litte loss. They have developed a good system of knowing the floods and taking the correct measures to protect their cattle and property.

The Poynting family were also quite good at flood protection - I think the 1962 flood was the only one that caught them out.

MR. J. FORD, STOCK ROUTE ROAD, BILLINUDGEL - SEPTEMBER, 1985

Mr. Ford lived in a house on the east side of the Stock Route Road at the junction with the Pocket Road for approximately 40 years.

He showed me flood marks under his house - the marks rose about 1 foot after the land was filled in Mogo Place. This was the first filling near railway station

MR. W.H. FLOWERS, BALLINA - TELEPHONE CONVERSATION 23RD AUGUST, 1985

Mr. Flowers came with his parents to their New Brighton farm in 1908 - this farm is now part of Ocean Shores North and Golden Beach. He lived there until 1941 then moved to Murwillumbah, returning in 1962 and leaving again in 1984.

He remembers the 1931 flood, when his brother Sid rowed a boat up the Billinudgel/New Brighton Road and tied the boat up at the Billinudgel Post Office.

The posts along the roadside had about 3 inches of wood showing. He said if heavy rain fell on the hills of Middle Pocket and Yelgun, Golden Beach and New Brighton experienced severe flooding.

MR. MIKE WILSON, GODOO COURT, OCEAN SHORES - 24TH APRIL, 1988

Mr. Wilson said that a lot of townspeople claim the tide has a big influence on the floods, but he doesn't agree. From his observations at Ocean Shores he thinks a high tide makes a difference of about 1 inch in height. He also said at about 3.00 p.m. on the 11th the flood water at the industrial estate was flowing south instead of north.

FLOOD NOTES

The record floods, since settlement started at Billinudgel, have all been much the same, with a variation of 1 inch to 3 inches.

The first flood I heard of that was considered a record was in 1921; all the long time residents only ever mention this as the first record flood they knew of. This was the first flood that went into the New Brighton Hotel - since then I think this has happened about 8 times.

The other big floods were 1931, 1938, 1941, 1945, 1948, 1949, 1954, 1955, 1962, 1970, 1974, 1975, 1979, 1981, 1985, 1987.

The 1948 and 1981 floods were caused by a cloud burst in the ranges of The Pocket and Main Arm - other district centres did not record rain as heavy. Both these floods came down The Pocket in a wave and reached my property in about 3 and a half hours - it generally takes about 4 to 5 hours for water to reach my farm.

The 1981 flood left marks on my property higher than any flood ever recorded - I think some of this was caused by the wave effect.

In Billinudgel, Mr. Walter Walsh's fence was about 3 inches lower than the previous highest mark.

The flood of 1985 was claimed to be the highest ever, but this flood was about 1 inch lower than 1962. In 1962, the water was about 1 inch deep in the R.S.L. Club, whereas 1985 flood only levelled with the floor - it also lapped the floor of the school. Mr. Walsh also agrees that all the big floods vary from 1 inch to 3 inches.

1987 FLOOD

There have been many reasons given as to why this was the greatest of all floods, but the simple fact was that we had two lots of rain and two floods within about 5 hours of each other.

At 6.00 a.m. there was a major flood on my property with little rain falling. At about 8.00 a.m. heavy rain again started falling and continued until about 12.00 p.m..

Mr. Len Walker recorded 9 inches on the Saturday and a further 10 inches on Sunday. At the head of The Pocket, Bill Sorsby claimed 24 inches and the man opposite him recorded 17 inches.

Martin Wallwork said the flood was about 2 foot 6 inches higher at the head of The Pocket than he had ever seen. When the fall from my place to Billinudgel is considered it is not surprising that the height at Billinudgel was so high.

One thing that has been learned from this flood is that there can never be a higher one. Once the water ran over the railway line the level dropped.

Settlers have been in Billinudgel for 107 years and this is the first time a flood of this size was ever recorded.

Chillingham on the Tweed experienced a flood of the same proportions caused solely by swollen creeks and a down pour of about 30 inches.

1988 FLOODS

The prolonged rain and floods have new people looking for reasons for the duration of the floods. This situation has happened before in 1941 and there have been others that I cannot date, where we would have a small flood in the morning and down in the afternoon.

The only difference this time was that the southern flow of water was nearly completely blocked by the new filling west of the highway at Billinudgel.

Many people are saying that the rivers are silted up and that tree growth on the riverbank is slowing up the water. I do not agree with this as the river and undergrowth have little effect on the running water.

There are posts on my property that have been there for between 70 and 80 years and there is no build-up of soil around them. Most of the water moving down to Billinudgel moves very slowly - this would allow the silt to drop and settle on the way.

At 2.00 p.m. on Monday, 11th April I rang the Hotel at Billinudgel to say water had peaked - I was surprised to learn from Barry O'Donnell that the water had peaked at the hotel at 4.00 p.m. This shows the slow movement of water and the spread of it, as in a straight line my farm would be about 1 mile from Billinudgel.

The width of the flood is also very wide from Moffatt's Road to Billinudgel - the width would be from three quarters to about one and a half miles wide, with an average depth of around 3 feet.

Considering these dimensions I do not think it will matter how deep the river is, as it cannot take this volume of water.

Since the new arch bridge was built over Marshalls Creek on the Pocket Road three years ago, people in Billinudgel claim the water comes down quicker. They fail to realise that when the water breaks over Moffatt's Road it flows in a straight line to Billinudgel, carrying most of the water with it.

When the water breaks its banks at the arch bridge, it mostly runs in a south easterly direction. Even if the water is faster at the bridge, the turning of water will take just as long as it always did.

There has been a lot of claims about river depths but where I, and the rest of the Billinudgel school children, learnt to swim in New Brighton it is still the same, as I have measured it over the last 3 years - it is 55 years since I learnt to swim.

If one refers to the conversations I have had with Messrs. Watterson and Moffatt, who were in Billinudgel in 1890 and 1900, one will see that the theory of undergrowth is not very strong. Photographs in Billinudgel of around 1900 - 1905 show the place still heavily timbered, yet the floods of that time, and later, were much the same as the ones of the last 30 years.

SUMMARY

In 1985 I supplied most of the information I have here to the Public Works Department, and went on a tour with some of their officers in October (approx.) of that year.

I pointed out that from ~~1981~~ 1984 to 1985 there were not any records to show there had been floods bigger than those I had listed and that I believed we could not get bigger ones.

The 1987 flood proved I was wrong, but this was a one off flood which could only occur if we receive about 20 inches of rain in 24 hours, with the creeks in flood when the rain falls - this flood was one in 107 years.

From the Mother's Day flood we have learnt the maximum height of the floods, because once it breaks over the railway line the water in Billinudgel drops.

With two people reporting flood heights and rainfall in The Pocket/Middle Pocket and my flood levels, I don't think people in Billinudgel will again be unprepared for floods. There is a difference of two hours between the peak at "Millfarm" and the New Brighton Hotel and I have also noticed that the higher the flood rises, the slower the last few inches take.

There have only been losses in Billinudgel in the 1987 flood as no-one had ever experienced such a large flood.

The flood study claims the first 10 decades of this century were drier than the rainfall since 1950, and that from 1950 we are getting bigger floods and more rain.

While the rainfall figures since 1950 are showing a higher trend, if we had more information the amount of flooding would probably be much higher. Any monthly recording of 150m or more would have produced some sort of a flood.

I am taking these figures from the Tweed recordings as I couldn't get any local ones going back so far, and I have found Tweed rainfall is very close to our own district.

If the wet season went for 2 to 4 months, 50m of rain will produce a flood of about the size we have geen getting this year, and so far we have had 3.

I have found since putting a gauge on my creek, 25m of rain in the Pocket will produce a rise on the gauge of .3 of a metre.

The following are floods I know of:

FLOODS & HEIGHT

The following floods ahve all been of major height. The ones underlined are thw so-called recorded ones. These vary from 1-3 inches.

1921, 1930, 31, 38, 39, 41 42 43 44 45 48 49 50 51 52 53 54 55 56 58 61 62 64 66 67 69 70 72 73 74 75 76 77 78 78 81 85 87 (88,89) there has been one fairly large one and about 6 small ones. The 1921 flood was the first to go into the Billinudgel Hotel - it was built in 1907

The floods of 48, 55, & 81 were caused by severe rains, like a cloud burst, the creeks were either dry or very low, this prevented the floods from being higher.

In January 1955 on my property 23 inches of rain was recorded from 4p.m. to 11p.m. This was roughly the same amount as the falls which created the Mothers' Day flood, it fell in 7 hrs., whereas the rain for Mothers' Day fell over a period of 12 to 14 hrs. There was minor flooding when rain started to fall because the creeks were low in 1955 and the ground dry - the flood was much lower than 1987.

In 1952 I had two sections of the creek cleaned and widened to try and stop the water running over one of my cultivation paddocks. This exercise proved a waste of time.

Creek cleaning from 1972 - 1988.

1972

Marshalls Creek was cleared of willow trees and logs for a distance of about 120 metres east and west of the present arched crossing.

The water never altered in depth on the crossing, the water didn't drop any quicker opposite the crossing and the creek still broke its banks opposite my farm in the same place. The only difference was that the crossing was turned into a raging torrent.

June, 1985.

When the arch crossing was completed, the creek west of it was cleaned out to a distance of about 70 metres and on the east side about 20 metres, to clear the creek of the old level crossing. This work together with the much bigger opening of the arch crossing has made no difference to the flooding on my property or the place where the creek breaks its bank in F. & N. Irving's farm.

1985.

The creek at Moffatts Road was opened up for about 300 metres below the crossing and 1986 Mr. R. Taylor did more cleaning on his property. All this work did nothing to the level of water on the crossing at Moffatts Road intersection.

1988, September.

Marshalls Creek cleaned from east of Pocket Road to Railway bridge and the two tidal drains on Hudgel flat cleaned from the road to Marshalls Creek.

At 8.30 a.m. 16/9/88 I inspected this work and the level of water in Marshalls Creek. The creek was still up to the top of its banks with the water slowly flowing out of the middle drain on Pocket Road.

The flow of water in the middle drain was hardly moving. I put a leaf on the water and it took 2½ minutes to travel 5 yards.

Water was still lying on O'Donnell's farm, west of the road, it was about 6" deep and it was flowing over the banks on the Holm property down on to O'Donnell's flats.

1975.

Mr. Geo. Bangnall had about half the length of Marshall's Creek on his property cleared of willows and logs and Kevin Wilkes had about 200 metres cleared on his adjoining property. All this

cleaning didn't alter the flood levels or the three places where water breaks over the creeks.

It is interesting to note that around 1972 the Tweed River at Euengella, all the river oak in the river bed were cut down, but the next flood water still behaved the same and no more work of this nature has been done.

The rise and fall of water on the crossings and the flood plain seems to me to be governed by the following -

1. The amount of water coming down the valley.
2. The underground water level.
3. The filling of the flood plain around Billinudgel.
4. Tidal influence - this seems to be minimal.

Marshalls Creek is a very slow running, winding creek with very low banks. In the last 500 - 700 metres before it reaches the tidal influences at the Pocket road, it is nothing more than a winding shallow drain.

It has a large catchment area and requires very little rain to make a flood. In the wet season 50 mm. of rain in the Pocket will produce a flood.

On 9/10/88 I recorded 19 mm. and this gave a rise of 8 cm. on the creek gauge at Mill Farm at 2 p.m.

1988-1990.

The 1988 September cleaning and dredging of the 2 drains and portion of Marshall's Creek on Pocket Rd., Nudgel flat, now seem to be reverting back to their previous condition.

With the prolonged rain we are now having, the water is again lying on the land west of the Pocket road, the water in the drains nearly to the top of the banks. Everything looks much like it was in 1988. To me the whole exercise seems to have been a waste of time and money.

From early photos the river bank and adjoining lands were as heavily timbered as they are today.

DREDGING

I have doubts about the benefits of dredging for the following reason. From the highway west for a distance of about 3 miles and a width of ½mile to 1¼miles is covered with water at a depth from 1ft. to 8ft. At peak flood, I fail to see how this water can be dropped by any useful amount by deepening a channel that is only 10 to 40 yds. wide.

With the water running over the lowlands the river would not have much influence on the flood, when the water gets back to the confines of the banks the flood problems would have mainly gone.

INGS BAY

People talk of the setting up of Readings Bay at Brunswick Heads.

On 29th September, 1988 I spoke to Mr. Clive Wraight, who has lived in Brunswick Heads for the last 70 years. For as long as he can rememeber Readings Bay was a shallow sandbank that was dry at low tide.

He stated that the Ferry Reserve had never been coovered with flood water until the breakwaters were built at Brunswick Heads.

In 1939 I can remember walking on most of Readings Bay at low tide, with only ~~shallow~~ DEEP water near Harries Hill and on towards the west bank.

TELEPHONE CONVERSATION WITH LES COROWA, CHINDERAH (23.2.89)

Mr. Corowa lived with his parents at New Brighton in what is now known as Red Gate Road, Golden Beach, from 1926 to 1938. At this time there was no outlet to the sea on the farm owned by Mr. Jack Fitzpatrick - this is now an artificial lake. There was a swampy depression running towards the terrace from the river under the road and through Fitzpatrick's farm; this depression did not reach the terrace nor the sea.

In 1931 the flood where the Corowa family lived was about 18 inches in their house, which was appoximately 2 foot 6 inches off the ground.

TELEPHONE CONVERSATION WITH MR. SYD FLOWERS (23.2.89)

Mr. Flowers stated that there was no outlet to the sea from the swamp only an inlet from the river that ran towards the sea, with the terrace always being high in this area. He also stated that there was definitely no outlet to the sea north of Golden Beach. The area of North Ocean Shores, which was at the foot of his brother's farm, was swampy and used to be covered with about 6 FT ~~feet~~ of water during flood time. This area has now been filled and is pushing flood water towards the terrace, hence high flooding in New Brighton.

QUOTATON FROM LETTER OF MR SYD FLOWERS:

44Aruma Avenue
Burleigh Heads 21.4.88

"The river from Nudgel to Brunswick is known as the North Arm of the Brunswick River. It has at times become brackish at Nudgel when tides are high, but mostly fresh water until you get a fair way down. It has never ran out to the sea except at the mouth at Brunswick. The river was never deep, only in places as you say, and until getting near Brighton was full of logs, snags, etc.

Only small row boats were used if required, but very rarely used from Brighton to Nudgel, but more often from Brighton to Brunswick."

Mr. Flowers was born at Billinudgel 1912 and left there in 1936 to join the Police Force. He was a very strong swimmer, and knew all the deep holes in the river.

River Depths + Ocean outlets

MR. W.H. FLOWERS, BALLINA - TELEPHONE CONVERSATION 23RD AUGUST, 1985

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He remembers the 1931 flood, when his brother Sid rowed a boat up the Billinudgel/New Brighton Road and tied the boat up at the Billinudgel Post Office.

The posts along the roadside had about 3 inches of wood showing. He said if heavy rain fell on the hills of Middle Pocket and Yelgun, Golden Beach and New Brighton experienced severe flooding.

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EXTRACT FROM A LETTER OF MR P McCARTHY 27-11-88

I lived at New Brighton from 1931 - 1935 and on an off till 1940. During a lot of that time I worked for sugar growers Borketts at Crabbes Creek and for Geoff Steele along Wills Road.

I walked from New Brighton each Monday morning and back again each Saturday at Midday and never crossed a creek or outlet to the sea.

The Brunswich entrance at the "tin shed" was rocky and deep the southern side was sandy and shallow - maybe 30 yards wide.

The North Arm was a matter of a few feet deep, we used to walk practically all over it at night, with a spear, kerosene tin and a torch spearing crabs. The only deep part was about halfway between N.B. and Brunswick known as the "black hole" where there often black fish.

Around New Brighton the river deepens on the North East and South banks grading to mangroves on the other side. The mangroves seem to have encroached a little from the coast, but all in all it seems much the same.

APPENDIX B

FLOOR LEVEL DATA

Non-residential Properties

Survey Data

Variable	Description
1	Precinct
2	Business name and description
3	Street number
4	Street name
5	Code: 4 = commercial 5 = tourist accommodation 6 = industrial 7 = other
6	Number of storeys
7	Building raised indicator
8	Height raised (m) (if indicator = 1)
9, 10	Precinct, sub-area
11	Construction material: 1 = N/A 2 = timber 3 = fibro 4 = brick 5 = steel 6 = stone 7 = other
12	Building size: 1 = <80 sq metres 2 = 80 to 140 sq metres 3 = >140 sq metres (or number of units if Code = 5)
13	Ground level (m AHD)
14	Floor level (m AHD)
15	Damage class: 1 = low 2 = medium 3 = high

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	SHOP	L 19	RIVER	4	1	0	0.00	2	2	2	1	1.6	2.2	2
3	SHOP	17	BEACH	4				3	1	4	0	2.67	3.27	2
3	MOTEL	42	HELEN	5	1	0	0.00	3	1	3	6	1.96	2.05	1
3	MOTEL	46	HELEN	5	1	0	0.00	3	1	3	6	1.96	3.11	1
3	MOTEL	50	HELEN	5	1	0	0.00	3	1	3	4	1.96	2.21	1
3	MOTEL	54	HELEN	5	1	0	0.00	3	1	3	4	1.96	2.26	1
5	SMASH REPAIRS	1	MOGO PL	6				5	1	3	2	3.18	3.32	2
5	WASHER REPAIR	3	MOGO PL	6				5	1	1	2	3.08	3.16	2
5	MARINE REPAIR	7	MOGO PL	6				5	1	1	2	3.18	3.18	2
5	BRICK SALES	9	MOGO PL	6				5	1	1	2	3.03	3.18	2
5	KITCHEN MAKER	11	MOGO PL	6				5	1	1	2	3.23	3.60	2
5	BUS DEPOT	13	MOGO PL	6				5	1	3	2	3.03	3.23	2
5	READYMIX	17	MOGO PL	6				5	1	4	1	3.13	4.32	2
5	GAS CONVERT	18	MOGO PL	6				5	1	3	2	3.78	3.96	2
5	FUNERAL HOME	16	MOGO PL	7				5	1	3	2	3.63	4.07	2
5	CHURCH	14	MOGO PL	7				5	1	3	2	3.63	4.51	2
5	TYRE SERVICE	12	MOGO PL	6				5	1	1	2	3.73	4.21	2
5	VACANT	10	MOGO PL					5	1		0	3.53	99.9	1
5	MINI STORAGE	8	MOGO PL	7				5	1	3	2	3.90	4.12	2
5	BATCH PLANT	6	MOGO PL	6				5	1	3	1	3.40	3.50	2
5	HUMBLE PIES	2	MOGO PL&No4	7				5	1	3	2	3.42	4.12	2
5	WINDOW MAKER	1	BONANZA DR	6				5	1	3	2	4.19	4.47	2
5	UNKNOWN	2	BONANZA DR					5	1	3	2	4.19	4.47	2
5	VACANT	3	BONANZA DR					5	1		0	4.17	99.9	1
5	MINI STORAGE	4	BONANZA DR	7				5	1	3	2	4.14	4.45	2
5	VACANT	5	BONANZA DR					5	1		0	4.20	99.9	1
5	VACANT	6	BONANZA DR					5	1		0	4.25	99.9	1
5	VACANT	7	BONANZA DR					5	1		0	4.30	99.9	1
5	VACANT	8	BONANZA DR					5	1		0	4.34	99.9	1
5	VACANT	9	BONANZA DR					5	1		0	4.32	99.9	1
5	VACANT	10	BONANZA DR					5	1		0	4.30	99.9	1
5	VACANT	11	BONANZA DR					5	1		0	4.29	99.9	1
5	VACANT	12	LUCKY LA					5	1		0	4.14	99.9	1
5	VACANT	13	LUCKY LA					5	1		0	4.18	99.9	1
5	MINI STORAGE	14	LUCKY LA	7				5	1	3	2	4.20	4.47	2
5	VACANT	15	LUCKY LA					5	1		0	4.25	99.9	1
5	VACANT	16	LUCKY LA					5	1		0	4.29	99.9	1
5	VACANT	17	LUCKY LA					5	1		0	4.26	99.9	1
5	VACANT	18	LUCKY LA					5	1		0	4.23	99.9	1
5	VACANT	19	LUCKY LA					5	1		0	4.19	99.9	1
5	VACANT	20	LUCKY LA					5	1		0	4.04	99.9	1
5	VACANT	21	LUCKY LA					5	1		0	4.09	99.9	1
5	VACANT	22	LUCKY LA					5	1		0	4.15	99.9	1
5	VACANT	23	BONANZA DR					5	1		0	4.24	99.9	1
5	VACANT	24	BONANZA DR					5	1		0	4.19	99.9	1
5	VACANT	25	BONANZA DR					5	1		0	4.22	99.9	1
5	VACANT	26	BONANZA DR					5	1		0	4.24	99.9	1
5	VACANT	27	BONANZA DR					5	1		0	4.26	99.9	1
5	VACANT	28	BONANZA DR					5	1		0	4.28	99.9	1
5	VACANT	29	BONANZA DR					5	1		0	4.29	99.9	1
5	VACANT	30	BONANZA DR					5	1		0	4.29	99.9	1
5	VACANT	31	LUCKY LA					5	1		0	4.28	99.9	1
5	VACANT	32	LUCKY LA					5	1		0	4.27	99.9	1
5	VACANT	33	LUCKY LA					5	1		0	4.26	99.9	1
5	VACANT	34	LUCKY LA					5	1		0	4.25	99.9	1
5	VACANT	35	LUCKY LA					5	1		0	4.24	99.9	1

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
5	FIRE STATION		WILFRED ST	7				5	2	4	1	2.83	3.28	2
5	GENERAL STORE	2	WILFRED ST	4	2			5	2	2	3	2.68	3.49	2
5	HALL	4	WILFRED ST	7				5	2	2	1	2.93	3.43	2
5	HOTEL	1	WILFRED ST	7	2			5	2	2	2	2.58	3.38	2
5	HOTEL STORAGE	3	WILFRED ST	7				5	2	2	1	2.58	3.23	2
5	REALTY	5	WILFRED ST	4				5	2	2	1	2.58	3.06	2
5	GIFT SHOP	7	WILFRED ST	4				5	2	2	1	2.38	2.88	2
5	VACANT	11	WILFRED ST					5	2		0	2.17	99.9	1
5	VET CLINIC	8	WILFRED ST	7				5	2	2	1	2.62	3.38	2
5	RESTAURANT	10	WILFRED ST	7				5	2	3	3	3.32	3.87	2
5	FACTORIES	22	WILFRED ST	6				5	2		0	3.32	3.87	2
5	VACANT	13	WILFRED ST					5	2		0	1.62	99.9	1
5	VACANT	15	WILFRED ST					5	2		0	1.52	99.9	1
5	AUTO SERVICE	17	WILFRED ST	6				5	2	1	2	2.76	2.98	2
5	TYRE SERVICE	19	WILFRED ST	6				5	2	3	2	2.71	3.05	2
5	AUTO REPAIRS	1	BRUNSWICK ST	6				5	2	3	2	3.36	3.88	2
5	PRE SCHOOL	2	BRUNSWICK ST	7				5	3	2	2	2.22	3.49	2
5	VACANT	15	BRUNSWICK ST					5	2		0	2.82	99.9	1
5	VACANT	13	BRUNSWICK ST					5	2		0	3.07	99.9	1
5	VACANT	11	BRUNSWICK ST					5	2		0	3.12	99.9	1
5	VACANT	9	BRUNSWICK ST					5	2		0	2.92	99.9	1
5	VACANT	7	BRUNSWICK ST					5	2		0	2.67	99.9	1
5	VACANT	5	BRUNSWICK ST					5	2		0	2.37	99.9	1
5	VACANT	3	BRUNSWICK ST					5	2		0	2.27	99.9	1
5	DUNG OVAL	8	BRUNSWICK ST					5	3		0	1.47	99.9	1
5	VACANT	L12	BRUNSWICK ST					5	2		0	1.15	99.9	1
5	VACANT	L8	BRUNSWICK ST					5	2		0	1.25	99.9	1
5	VACANT	L12	BRUNSWICK ST					5	3		0	1.25	99.9	1
5	CHURCH	4	BRUNSWICK ST	7				5	3	2	1	2.24	4.19	2
5	VACANT	L7	BRUNSWICK ST					5	3		0	2.64	99.9	1
5	VACANT	L2	BRUNSWICK ST					5	3	1	2	2.49	3.93	2
5	VACANT	2	GERALD ST					5	2		0	1.37	99.9	1
5	VACANT	4	GERALD ST					5	2		0	1.37	99.9	1
5	VACANT	6	GERALD ST					5	2		0	1.37	99.9	1
5	VACANT	8	GERALD ST					5	2		0	1.37	99.9	1
5	VACANT	10	GERALD ST					5	2		0	1.37	99.9	1

Residential Properties

Survey Data

Variable	Description
1	Precinct
2	Street number
3	Street name
4	Code: 1 = detached 2 = semi-detached 3 = flats/units
5	Number of storeys
6	House raised indicator
7	Height raised (m) (if indicator = 1)
8, 9	Precinct, sub-area
10	Construction material: 1 = N/A 2 = timber 3 = fibro 4 = brick 5 = steel 6 = stone 7 = other
11	House size: 1 = <80 sq metres 2 = 80 to 140 sq metres 3 = >140 sq metres
12	Property size (not used): 1 = small 2 = medium 3 = large
13	House condition (not used): 1 = poor 2 = medium/good
14	Building age (not used): 1 = pre-1940 2 = post-1940
15	Ground level (m AHD)
16	Lowest Habitable floor level (m AHD)
17	Damage class: 1 = low 2 = medium 3 = high

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1	GOOLOO					1	1	4	2	0	0	0	3.79	4.74	2
1	1	YOORANA					1	1	4	2	0	0	0	3.38	3.81	2
1	8	YOORANA					1	1	4	2	0	0	0	3.68	4.01	2
1	99	BALEMO					1	1	0	0	0	0	0	3.24	99.9	2
1	97	BALEMO	1	1	0	0.00	1	1	4					3.20	3.49	2
1	95	BALEMO	1	1	0	0.00	1	1	4					3.16	3.28	2
1	93	BALEMO	1	1	0	0.00	1	1	4					2.82	2.96	2
1	91	BALEMO					1	1	4	2	0	0	0	3.29	3.90	2
1	89	BALEMO					1	1	4	2	0	0	0	3.34	3.93	2
1	87	BALEMO					1	1	4	2	0	0	0	3.48	3.86	2
1	85	BALEMO					1	1	3	2	0	0	0	3.23	3.53	2
1	83	BALEMO					1	1	4	2	0	0	0	3.09	3.66	2
1	146	BALEMO					1	1	2	2	0	0	0	2.91	3.74	2
1	144	BALEMO	1	1	0	0.00	1	1	4					3.61	3.84	2
1	142	BALEMO	1	1	0	0.00	1	1	4					3.45	3.70	2
1	140	BALEMO	1	1	0	0.00	1	1	4					3.45	3.74	2
1	138	BALEMO	1	1	0	0.00	1	1	4					3.35	3.40	2
1	136	BALEMO	1	1	0	0.00	1	1	4					3.07	3.70	2
1	134	BALEMO					1	1	0	0	0	0	0	2.59	99.9	2
1	132	BALEMO					1	1	2	2	0	0	0	2.64	4.54	2
1	130	BALEMO	1	1	0	0.00	1	1	4					2.76	3.30	2
1	128	BALEMO					1	1	0	0	0	0	0	2.88	99.9	2
1	126	BALEMO	1	1	0	0.00	1	1	4					2.85	3.08	2
1	124	BALEMO					1	1	4	2	0	0	0	2.83	3.75	2
1	122	BALEMO	1	1	0	0.00	1	1	4					2.74	3.03	2
1	120	BALEMO	1	1	0	0.00	1	1	4					2.76	2.96	2
1	118	BALEMO					1	1	4	2	0	0	0	2.73	3.21	2
1	116	BALEMO	1	1	0	0.00	1	1	4					2.74	3.03	2
1	114	BALEMO					1	1	0	0	0	0	0	2.76	99.9	2
1	112	BALEMO					1	1	0	0	0	0	0	2.70	99.9	2
1	110	BALEMO					1	1	4	2	0	0	0	2.90	3.73	2
1	108	BALEMO	1	1	0	0.00	1	1	4					2.92	3.32	2
1	106	BALEMO					1	1	4	2	0	0	0	2.95	3.56	2
1	104	BALEMO					1	1	0	0	0	0	0	2.64	99.9	2
1	102	BALEMO	1	1	0	0.00	1	1	4					2.79	3.09	2
1	100	BALEMO	1	1	0	0.00	1	1	4					2.94	3.26	2
1	98	BALEMO					1	1	4	2	0	0	0	3.09	3.74	2
1	96	BALEMO	1	1	0	0.00	1	1	4					2.96	3.06	2
1	94	BALEMO	1	1	0	0.00	1	1	4					3.12	3.69	2
1	92	BALEMO	1	1	0	0.00	1	1	4					3.14	3.30	2
1	90	BALEMO	1	1	0	0.00	1	1	4					3.15	3.33	2
1	88	BALEMO					1	1	4	2	0	0	0	3.17	3.72	2
1	86	BALEMO					1	1	4	2	0	0	0	3.27	3.75	2
1	84	BALEMO					1	1	4	2	0	0	0	3.27	3.85	2
1	82	BALEMO					1	1	0	0	0	0	0	2.86	99.9	2
1	80	BALEMO					1	2	0	0	0	0	0	2.83	99.9	2
1	78	BALEMO					1	2	4	2	0	0	0	2.86	3.67	2
1	76	BALEMO	1	1	0	0.00	1	2	4					3.07	3.52	2
1	74	BALEMO					1	2	4					2.96	3.51	2
1	72	BALEMO	1	1	0	0.00	1	2	4					2.96	3.16	2
1	70	BALEMO	1	1	0	0.00	1	2	4					2.86	2.98	2
1	68	BALEMO	1	1	0	0.00	1	2	4					2.83	3.11	2
1	66	BALEMO	1	1	0	0.00	1	2	4					2.91	3.13	2
1	64	BALEMO					1	2	4	2	0	0	0	3.31	3.84	2
1	62	BALEMO					1	2	4	2	0	0	0	3.20	3.37	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	60	BALEMO					1	2	4	2	0	0	0	3.20	3.55	2
1	58	BALEMO	1	1	0	0.00	1	2	4					3.00	3.12	2
1	56	BALEMO	1	1	0	0.00	1	2	4					2.93	3.19	2
1	54	BALEMO					1	2	4	2	0	0	0	2.49	3.62	2
1	52	BALEMO					1	2	4	2	0	0	0	2.60	3.64	2
1	50	BALEMO	1	1	0	0.00	1	2	4					2.77	2.97	2
1	48	BALEMO					1	2	4	2	0	0	0	2.97	3.41	2
1	46	BALEMO					1	2	4	2	0	0	0	3.57	3.67	2
1	44	BALEMO					1	2	0	0	0	0	0	3.02	99.9	2
1	42	BALEMO					1	2	0	0	0	0	0	2.72	99.9	2
1	40	BALEMO	1	1	0	0.00	1	2	4					2.68	3.54	2
1	38	BALEMO					1	2	0	0	0	0	0	2.64	99.9	2
1	36	BALEMO					1	2	0	0	0	0	0	2.64	99.9	2
1	34	BALEMO	1	1	0	0.00	1	2	4					2.73	3.10	2
1	32	BALEMO	1	1	0	0.00	1	2	4					2.82	3.38	2
1	30	BALEMO	1	1	0	0.00	1	2	4					2.91	3.44	2
1	28	BALEMO	1	1	0	0.00	1	2	4					3.01	3.65	2
1	26	BALEMO					1	2	4	2	0	0	0	3.20	3.69	2
1	24	BALEMO					1	2	0	0	0	0	0	2.95	99.9	2
1	22	BALEMO					1	2	4	2	0	0	0	3.02	3.63	2
1	20	BALEMO	1	1	0	0.00	1	2	4					3.48	3.58	2
1	16	BALEMO	3				1	2	4	3	0	0	0	3.72	3.95	2
1	16	BALEMO	3				1	2	4	3	0	0	0	3.72	3.95	2
1	16	BALEMO	3				1	2	4	3	0	0	0	3.72	3.95	2
1	16	BALEMO	3				1	2	4	3	0	0	0	3.72	3.95	2
1	16	BALEMO	3				1	2	4	3	0	0	0	3.72	3.95	2
1	14A	BALEMO					1	2	0	0	0	0	0	3.93	99.9	2
1	14B	BALEMO					1	2	0	0	0	0	0	3.85	99.9	2
1	14C	BALEMO					1	2	0	0	0	0	0	3.77	99.9	2
1	12D	BALEMO					1	2	4	2	0	0	0	4.02	4.34	2
1	12E	BALEMO					1	2	4	2	0	0	0	4.11	4.49	2
1	12J	BALEMO					1	2	0	0	0	0	0	4.42	99.9	2
1	12K	BALEMO					1	2	4	2	0	0	0	4.22	4.57	2
1	10F	BALEMO					1	2	4	2	0	0	0	4.17	4.63	2
1	10G	BALEMO					1	2	0	0	0	0	0	4.32	99.9	2
1	10H	BALEMO					1	2	0	0	0	0	0	4.62	99.9	2
1	10I	BALEMO					1	2	0	0	0	0	0	4.52	99.9	2
1	10L	BALEMO					1	2	4	2	0	0	0	4.27	4.63	2
1	53	BALEMO	1	1	0	0.00	1	2	4					3.08	3.35	2
1	51	BALEMO	1	1	0	0.00	1	2	4					2.96	3.41	2
1	51A	BALEMO	1	1	0	0.00	1	2	4					2.83	3.10	2
1	49	BALEMO					1	2	4	2	0	0	0	3.06	3.88	2
1	47	BALEMO					1	2	4	2	0	0	0	4.18	4.67	2
1	43	BALEMO					1	2	4	2	0	0	0	2.85	3.45	2
1	41	BALEMO					1	2	4	2	0	0	0	2.64	3.29	2
1	39	BALEMO					1	2	4	2	0	0	0	2.89	3.44	2
1	1	MUNDURRA	1	1	0	0.00	1	2	4					3.02	3.23	2
1	2	MUNDURRA	1	1	0	0.00	1	2	4					2.84	3.24	2
1	3	MUNDURRA	1	1	0	0.00	1	2	4					3.19	3.69	2
1	4	MUNDURRA	1	1	0	0.00	1	2	4					3.08	3.29	2
1	5	MUNDURRA					1	2	4	2	0	0	0	3.30	4.05	2
1	6	MUNDURRA					1	2	4	2	0	0	0	3.00	3.67	2
1	8	MUNDURRA					1	2	4	2	0	0	0	3.40	3.79	2
1	10	MUNDURRA					1	2	4	2	0	0	0	3.44	4.40	2
1	12	MUNDURRA					1	2	4	2	0	0	0	3.54	4.41	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
1	14	MUNDURRA					1	2	4	2	0	0	0	4.09	4.53	2	
1	1	WILPY					1	2	4	2	0	0	0	3.29	3.91	2	
1	6	WILPY					1	2	4	2	0	0	0	2.94	3.28	2	
1	14	TERRARA					1	2	0	0	0	0	0	2.46	99.9	2	
1	1	TERRARA	1	1	0	0.00	1	2	4					2.90	3.29	2	
1	2	TERRARA	1	1	0	0.00	1	2	4					2.88	3.29	2	
1	3	TERRARA					1	2	0	0	0	0	0	2.52	99.9	2	
1	4	TERRARA	1	1	0	0.00	1	2	4					2.92	3.13	2	
1	5	TERRARA	1	1	0	0.00	1	2	4					2.94	3.24	2	
1	6	TERRARA	1	1	0	0.00	1	2	4					2.87	3.05	2	
1	7	TERRARA					1	2	4	2	0	0	0	2.67	3.62	2	
1	8	TERRARA	1	1	0	0.00	1	2	4					2.94	3.22	2	
1	9	TERRARA					1	2	4	2	0	0	0	2.85	3.69	2	
1	10	TERRARA	1	1	0	0.00	1	2	4					2.91	3.42	2	
1	11	TERRARA	1	1	0	0.00	1	2	4					2.89	3.08	2	
1	12	TERRARA	1	1	0	0.00	1	2	4					3.19	3.30	2	
1	1	ALOOTA					1	2	4	2	0	0	0	2.74	3.64	2	
1	2	ALOOTA	1	1	0	0.00	1	2	4					2.86	3.23	2	
1	4	ALOOTA					1	2	4	2	0	0	0	3.13	3.62	2	
1	5	ALOOTA	1	1	0	0.00	1	2	4					3.14	3.25	2	
1	20	ALOOTA	1	1	0	0.00	1	2	4					4.56	99.9	2	VACANT
1	29	ALOOTA	1	1	0	0.00	1	2	4					4.06	4.70	2	
1	5	ULPIRRA					1	2	4	2	0	0	0	3.15	3.66	2	
1	1	NARGOON					1	2	4	2	0	0	0	2.98	3.61	2	
1	3	NARGOON					1	2	4	2	0	0	0	3.16	3.76	2	
1	8	COONAWARRA	1	1	0	0.00	1	2	4					3.56	3.93	2	
1	6	COONAWARRA	1	1	0	0.00	1	2	4					3.19	3.77	2	
1	4	COONAWARRA	1	1	0	0.00	1	2	4					3.21	3.33	2	
1	3	COONAWARRA	1	1	0	0.00	1	2	4					3.49	3.77	2	
1	45	NAROOMA					1	3	4	2	0	0	0	2.54	2.84	2	
1	43	NAROOMA					1	3	4	2	0	0	0	2.48	3.05	2	
1	41	NAROOMA	1	1	0	0.00	1	3	4					2.48	2.53	2	
1	39	NAROOMA	1	1	0	0.00	1	3	4					2.49	2.92	2	
1	37	NAROOMA	1	1	0	0.00	1	3	4					2.74	3.25	2	
1	31	NAROOMA					1	3	0	0	0	0	0	3.55	99.9	2	
1	29	NAROOMA					1	3	4	2	0	0	0	5.84	6.61	2	
1	35	NAROOMA					1	3	0	0	0	0	0	2.93	99.9	2	
1	33	NAROOMA					1	3	4	2	0	0	0	3.23	3.54	2	
1	56	NAROOMA	1	1	0	0.00	1	3	4					2.42	2.69	2	
1	54	NAROOMA	1	1	0	0.00	1	3	4					2.39	2.55	2	
1	52	NAROOMA	1	1	0	0.00	1	3	4					2.35	2.71	2	
1	50	NAROOMA	1	1	0	0.00	1	3	4					2.30	2.55	2	
1	48	NAROOMA	1	1	0	0.00	1	3	4					2.67	2.90	2	
1	46	NAROOMA	1	1	0	0.00	1	3	4					2.24	2.51	2	
1	44	NAROOMA					1	3	0	0	0	0	0	2.39	99.9	2	
1	42	NAROOMA	1	1	0	0.00	1	3	4					2.60	2.86	2	
1	40	NAROOMA	1	1	0	0.00	1	3	4					2.80	3.14	2	
1	38	NAROOMA					1	3	4	2	0	0	0	3.04	3.35	2	
1	36	NAROOMA					1	3	4	2	0	0	0	3.43	3.88	2	
1	34	NAROOMA					1	3	4	2	0	0	0	4.14	4.49	2	
1	32	NAROOMA					1	3	4	2	0	0	0	5.45	5.80	2	
1	47	BULGOON	1	1	0	0.00	1	3	4					2.49	2.68	2	
1	45	BULGOON	1	1	0	0.00	1	3	4					2.50	3.33	2	
1	43	BULGOON	1	1	0	0.00	1	3	4					2.50	3.04	2	
1	41	BULGOON					1	3	0	0	0	0	0	2.49	99.9	2	

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	39	BULGOON	1	1	0	0.00	1	3	4					2.56	2.79	2
1	37	BULGOON	1	1	0	0.00	1	3	4					2.73	3.14	2
1	35	BULGOON	1	1	0	0.00	1	3	4					2.56	2.83	2
1	33	BULGOON	1	1	0	0.00	1	3	4					2.59	2.88	2
1	31	BULGOON					1	3	4	1	0	0	0	2.61	2.90	2
1	29	BULGOON					1	3	4	2				2.77	3.55	2
1	27	BULGOON	1	1	0	0.00	1	3	4					2.80	3.35	2
1	34	BULGOON					1	3	4	2	0	0	0	2.56	3.08	2
1	32	BULGOON	1	1	0	0.00	1	3	4					2.82	3.17	2
1	30	BULGOON	1	1	0	0.00	1	3	4					2.76	3.06	2
1	28	BULGOON	1	1	0	0.00	1	3	4					2.87	3.12	2
1	26	BULGOON					1	3	4	2	0	0	0	4.30	4.78	2
1	6	TINBIN					1	3	4	2	0	0	0	4.36	4.74	2
1	7A	TINBIN					1	3	4	2	0	0	0	3.71	3.91	2
1	7	TINBIN					1	3	4	2	0	0	0	3.66	3.85	2
1	8	TINBIN					1	3	4	2	0	0	0	3.32	3.41	2
1	9	TINBIN	1	1	0	0.00	1	3	4					3.02	3.04	2
1	1	KIAH	1	1	0	0.00	1	3	4					2.68	2.80	2
1	2	KIAH					1	3	0	0	0	0	0	2.15	99.9	2
1	3	KIAH					1	3	4	2	0	0	0	2.70	3.51	2
1	4	KIAH	1	1	0	0.00	1	3	4					2.32	3.12	2
1	6	KIAH	1	1	0	0.00	1	3	4					2.37	3.23	2
1	5	KIAH	1	1	0	0.00	1	3	4					2.72	3.02	2
1	7	KIAH	1	1	0	0.00	1	3	4					2.73	3.14	2
1	8	KIAH	1	1	0	0.00	1	3	4					2.43	2.76	2
1	9	KIAH	1	1	0	0.00	1	3	4					2.75	3.07	2
1	10	KIAH					1	3	0	0	0	0	0	2.49	99.9	2
1	11	KIAH	1	1	0	0.00	1	3	4					2.77	3.00	2
1	12	KIAH	1	1	0	0.00	1	3	4					2.56	2.93	2
1	13	KIAH	1	1	0	0.00	1	3	4					2.79	3.55	2
1	14	KIAH	1	1	0	0.00	1	3	4					2.61	3.11	2
1	15	KIAH	1	1	0	0.00	1	3	4					2.80	2.97	2
1	16	KIAH	1	1	0	0.00	1	3	4					2.69	3.00	2
1	17	KIAH					1	3	4	2	0	0	0	2.82	3.63	2
1	18	KIAH	1	1	0	0.00	1	3	4					2.76	3.45	2
1	19	KIAH	1	1	0	0.00	1	3	4					2.85	3.37	2
1	20	KIAH	1	1	0	0.00	1	3	4					2.82	3.01	2
1	22	KIAH					1	3	0	0	0	0	0	2.88	99.9	2
1	1	WAHLOOGA					1	3	0	0	0	0	0	3.01	99.9	2
1	2	WAHLOOGA					1	3	4	1	0	0	0	3.91	5.42	2
1	3	WAHLOOGA					1	3	0	0	0	0	0	3.11	99.9	2
1	4	WAHLOOGA					1	3	4	2	0	0	0	3.82	4.65	2
1	5	WAHLOOGA					1	3	4	2	0	0	0	3.77	3.99	2
1	1	KOORINGA					1	3	0	0	0	0	0	2.98	99.9	2
1	2	KOORINGA	1	1	0	0.00	1	3	4					2.92	3.35	2
1	3	KOORINGA	1	1	0	0.00	1	3	4					2.87	3.17	2
1	4	KOORINGA	1	1	0	0.00	1	3	4					2.81	3.45	2
1	5	KOORINGA		2			1	3	4	2	0	0	0	2.77	3.57	2
1	6	KOORINGA					1	3	0	0	0	0	0	2.45	99.9	2
1	7	KOORINGA	1	1	0	0.00	1	3	4					2.79	3.38	2
1	8	KOORINGA	1	1	0	0.00	1	3	4					2.87	3.31	2
1	9	KOORINGA	1	1	0	0.00	1	3	4					2.96	3.62	2
1	10	KOORINGA					1	3	0	0	0	0	0	3.05	99.9	2
1	1	YAMBLE					1	3	4	2	0	0	0	3.29	3.73	2
1	2	YAMBLE					1	3	4	2	0	0	0	3.39	3.96	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	58	ORANA	1	1	0	0.00	1	3	4					2.68	2.83	2
1	56	ORANA	1	1	0	0.00	1	3	4					2.60	2.94	2
1	54	ORANA	1	1	0	0.00	1	3	4					2.71	3.11	2
1	52	ORANA	1	1	0	0.00	1	3	4					3.01	3.35	2
1	50	ORANA					1	3	4	2	0	0	0	3.27	3.56	2
1	48	ORANA					1	3	4	2	0	0	0	3.40	3.77	2
1	46	ORANA					1	3	4	2	0	0	0	3.37	3.73	2
1	44	ORANA	1	1	0	0.00	1	3	4					3.32	3.31	2
1	42	ORANA	1	1	0	0.00	1	3	4					3.26	3.54	2
1	40	ORANA					1	3	4	2	0	0	0	3.24	3.67	2
2L	100	REDGATE			1	1.60	2	4	2	3	0	0	0	2.02	3.62	2
2L	465	REDGATE					2	4	0	0	0	0	0	5.00	99.9	2
2L	219	REDGATE					2	4	0	0	0	0	0	2.50	99.9	2
2P	409	REDGATE					2	4	0	0	0	0	0	1.50	99.9	2
2L	459	REDGATE					2	4	0	0	0	0	0	1.00	99.9	2
2L	428	NEW BRIGHTON					2	4	0	0	0	0	0	1.52	99.9	2
2	L2	UN-NAMED					2	4	0	0	0	0	0	1.68	99.9	2
2	L1	UN-NAMED					2	4	0	0	0	0	0	2.30	99.9	2
2L	401	UN-NAMED					2	4	0	0	0	0	0	1.75	99.9	2
2L	411	UN-NAMED					2	4	0	0	0	0	0	1.80	99.9	2
2L	461	UN-NAMED					2	4	0	0	0	0	0	2.20	99.9	2
2L	349	RIVER	1	1	0	0.00	2	1	4					2.2	99.0	2
2L	350	RIVER	1	1	0	0.00	2	1	2					2.2	2.46	2
2L	351	RIVER	1	1	0	0.00	2	1	2					2.2	3.73	2
2L	352	RIVER	1	1	0	0.00	2	1	2					2.2	3.11	2
2L	353	RIVER	1	1	0	0.00	2	1	2					2.2	2.72	2
2L	367	CASONS	1	1	0	0.00	2	1	2					2.2	2.55	2
2L	366	CASONS	1	1	0	0.00	2	1	2					2.2	2.71	2
2L	365	CASONS	1	1	0	0.00	2	1	2					2.2	2.82	2
2L	364	CASONS	1	1	0	0.00	2	1	2					2.2	2.54	2
2L	363	CASONS	1	1	0	0.00	2	1	2					2.2	2.49	2
2L	362	CASONS	1	1	0	0.00	2	1	2					2.2	2.39	2
2L	361	CASONS	1	1	0	0.00	2	1	2					2.2	2.38	2
2L	360	CASONS	1	1	0	0.00	2	1	2					2.2	99.0	2
2L	359	CASONS	1	1	0	0.00	2	1	2					2.2	2.70	2
2L	4	BYRON	1	1	1	2.60	2	1	4					2.2	4.87	2
2L	301	BYRON	1	1	1	0.80	2	1	2					1.7	2.53	2
2L	422	BYRON	1	1	1	1.20	2	1	2					2.2	3.47	2
2L	303	RIVER	1	1	0	0.00	2	1	2					2.2	2.81	2
2L	356	CASONS	1	1	1	0.70	2	1	2					2.2	2.89	2
2L	1	RIVER	1	2	0	0.00	2	1	2					2.2	2.43	2
2L	1	PARK	1	1	1	0.70	2	1	2					2.0	2.50	2
2L	2	PARK	1	1	1	2.30	2	1	2					1.8	4.35	2
2L	311	PARK	1	1	1	0.90	2	1	2					2.0	2.75	2
2L	312	PARK	1	2	1	0.70	2	1	2					2.0	2.45	2
2L	313	PARK	1	1	0	0.00	2	1	2					1.8	2.00	2
2L	314	PARK	1	1	1	2.60	2	1	2					2.0	4.57	2
2L	315	PARK	1	1	1	2.70	2	1	2					2.0	4.73	2
2L	2	GAGGIN	1	1	1	1.80	2	1	2					2.8	4.53	2
2L	317	GAGGIN	1	1	1	2.10	2	1	2					3.3	5.40	2
2L	318	GAGGIN	1	1	1	2.60	2	1	4					2.8	5.48	2
2L	319	GAGGIN	1	1	1	0.90	2	1	2					3.4	4.27	2
2L	320	GAGGIN	1	1	0	0.00	2	1	4					4.2	4.15	2
2L	321	GAGGIN	1	1	0	0.00	2	1	4					4.0	4.03	2
2L	322	GAGGIN	1	1	1	2.10	2	1	2					3.0	5.07	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
2L	1	GAGGIN	1	1	1	1.40	2	1	7					3.0	4.38	2
2	0	GAGGIN	1	1	1	1.10	2	1	7					4.8	5.93	2
2L	2	OCEAN	1	2	0	0.00	2	1	7					2.0	3.02	2
2L325		GAGGIN	1	1	0	0.00	2	1	7					3.8	4.41	2
2L326		GAGGIN	1	1	1	2.80	2	1	4					3.7	6.70	2
2L327		GAGGIN	1	1	1	2.80	2	1	4					2.7	5.53	2
2L328		GAGGIN	1	2	0	0.00	2	1	2					2.8	2.85	2
2L329		GAGGIN	1	1	1	3.50	2	1	2					2.8	6.38	2
2L330		GAGGIN	1	1	1	1.90	2	1	2					3.4	5.33	2
2L331		GAGGIN	1	1	0	0.00	2	1	2					4.4	4.70	2
2L331		GAGGIN	1	1	1	1.30	2	1	2					4.7	5.97	2
2L333		GAGGIN	1	2	1	0.80	2	1	2					4.2	4.99	2
2L	2	GAGGIN	1	1	0	0.00	2	1	2					4.0	4.13	2
2L	1	OCEAN	1	2	0	0.00	2	1	2					3.8	4.19	2
2L	25	OCEAN	1	1	1	2.40	2	2	2					3.4	5.76	2
2L	1	OCEAN	1	1	1	2.60	2	2	4					3.2	5.70	2
2L	20	OCEAN	1	1	0	0.00	2	2	4					1.6	2.26	2
2L	12	RIVER	1	1	1	2.60	2	2	2					2.0	5.20	2
2L	22	TERRACE	1	1	1	2.60	2	2	2					3.2	5.80	2
2L	4	TERRACE	1	1	1	2.80	2	2	2					4.8	7.60	2
2L	5	TERRACE	1	2	0	0.00	2	2	4					5.1	5.19	2
2L	6	TERRACE	1	1	1	1.00	2	2	2					5.9	7.65	2
2L	7	TERRACE	1	2	0	0.00	2	2	4					5.3	5.76	2
2L	8	TERRACE	1	1	1	2.00	2	2	2					4.9	7.00	2
2L	9	TERRACE	1	1	1	1.20	2	2	2					5.6	6.84	2
2L	10	TERRACE	1	1	0	0.00	2	2	2					5.2	6.01	2
2L	1	RIVER	1	1	0	0.00	2	2	2					5.7	6.43	2
2L	2	RIVER	1	1	1	3.00	2	2	4					2.7	6.70	2
2L	3	RIVER	1	1	1	2.80	2	2	4					3.2	6.10	2
2L	D	RIVER	1	1	1	2.00	2	2	2					4.9	6.94	2
2L	4	RIVER	1	1	1	2.60	2	2	2					5.5	8.16	2
2L	5	RIVER	1	1	1	2.00	2	2	2					6.1	8.34	2
2L	6	RIVER	1	1	1	2.60	2	2	2					1.5	5.70	2
2L	A	RIVER	1	1	1	2.50	2	2	4					1.6	4.50	2
2L	B	RIVER	1	1	1	2.20	2	2	2					4.2	6.48	2
2L	C	RIVER	1	1	1	2.60	2	2	4					3.3	6.10	2
2L	8	RIVER	1	2	0	0.60	2	2	2					2.9	3.50	2
2L	12	RIVER	1	2	0	0.00	2	2	4					6.4	6.73	2
2L	8	RIVER	1	1	1	2.00	2	2	4					4.0	5.97	2
2L	B	RIVER	1	1	1	1.90	2	2	2					3.6	5.55	2
2L	A	RIVER	1	1	1	2.20	2	2	2					3.7	5.90	2
2L	6	TERRACE	1	2	0	0.00	2	2	4					5.9	6.07	2
2L	5	TERRACE	1	2	0	0.00	2	2	2					5.5	5.59	2
2L	11	TERRACE	1	1	0	0.00	2	2	2					4.4	4.65	2
2L	12	TERRACE	1	2	0	0.00	2	2	2					4.0	4.75	2
2L	13	TERRACE	1	1	1	2.00	2	2	2					3.6	5.58	2
2L	8	TERRACE	1	1	1	2.10	2	2	2					3.4	5.50	2
2L	A	TERRACE	1	1	0	0.00	2	2	2					3.0	3.33	2
2L	1	TERRACE	1	1	1	0.60	2	2	2					2.8	3.44	2
2L	6	PACIFIC	1	1	1	0.80	2	2	2					1.5	2.32	2
2L	16	PACIFIC	1	1	1	2.30	2	2	4					1.4	3.60	2
2L	14	PACIFIC	1	1	1	0.70	2	2	2					1.6	1.8	2
2L	18	PACIFIC	1	2	0	0.00	2	2	4					1.8	2.19	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
2L	19	PACIFIC	1	1	0	0.00	2	2	2					1.6	1.84	2
2L	5	ESPLANADE	1	1	1	2.80	2	2	2					2.0	5.00	2
2L	24	ESPLANADE	1	1	1	2.00	2	2	2					2.4	4.44	2
2L	23	ESPLANADE	1	1	1	2.20	2	2	2					2.4	4.54	2
2L	22	ESPLANADE	1	1	1	2.70	2	2	2					2.1	4.80	2
2L	15	ESPLANADE	1	1	1	2.60	2	2	2					2.2	5.00	2
2L	13	ESPLANADE	1	1	1	0.50	2	2	2					2.8	3.28	2
2L	8	ESPLANADE	1	1	1	3.00	2	2	2					1.9	5.01	2
2L	9	ESPLANADE	1	1	1	2.80	2	2	2					2.1	5.26	2
2L	10	ESPLANADE	1	2	0	0.00	2	2	4					2.4	2.68	2
2	0	ROAD 'A'	1	2	1	0.20	2	3	2					1.6	1.79	2
2L	1	BRUNSWICK	1	1	1	2.60	2	3	4					2.0	4.80	2
2L	2	BRUNSWICK	1	2	0	0.00	2	3	2					1.5	1.71	2
2L	3	BRUNSWICK	1	1	1	2.50	2	3	2					1.5	4.20	2
2L	10	BRUNSWICK	1	2	0	0.00	2	3	2					2.0	2.38	2
2L	5	BRUNSWICK	1	2	0	0.00	2	3	2					1.8	1.95	2
2L	9	SHORT	1	1	1	2.20	2	3	2					1.8	4.03	2
2L	8	SHORT	1	2	0	0.00	2	3	2					1.8	1.97	2
2L	7	SHORT	1	2	0	0.00	2	3	2					1.8	1.96	2
2L	6	SHORT	1	1	1	3.00	2	3	4					2.0	2.28	2
2L	1	NORTH HEAD	1	1	0	0.00	2	3	2					1.6	2.21	2
2L	5	NORTH HEAD	1	1	1	2.40	2	3	2					2.0	4.60	2
2L	7	NORTH HEAD	1	1	1	2.60	2	3	2					1.8	4.70	2
2L	3	NORTH HEAD	1	1	0	0.00	2	3	2					1.8	2.04	2
2L	4	NORTH HEAD	1	1	0	0.00	2	3	2					1.7	2.32	2
2L	12	NORTH HEAD	1	2	0	0.00	2	3	2					1.5	1.73	2
2L	11	NORTH HEAD	1	2	0	0.00	2	3	2					1.5	1.74	2
2L	10	NORTH HEAD	1	1	1	2.90	2	3	2					1.8	4.84	2
2L	9	NORTH HEAD	1	1	1	1.30	2	3	7					1.7	3.00	2
2L	1	NORTH HEAD	1	1	1	2.60	2	3	4					1.9	4.60	2
2L	2	NORTH HEAD	1	2	0	0.00	2	3	7					1.7	1.86	2
2L	3	NORTH HEAD	1	1	1	2.30	2	3	7					1.5	3.76	2
2L	4	NORTH HEAD	1	1	1	3.00	2	3	2					1.7	4.80	2
2L	6	NORTH HEAD	1	1	0	0.00	2	3	2					1.4	1.45	2
2L	1	ESPLANADE	1	1	0	0.00	2	3	2					1.5	1.65	2
2L	5	NORTH HEAD	1	2	0	0.00	2	3	2					1.9	1.99	2
2L	2	ESPLANADE	1	1	1	2.60	2	3	4					2.3	4.90	2
2L	1	ESPLANADE	1	1	0	0.00	2	3	2					2.0	2.32	2
2L	2	ESPLANADE	1	1	1	2.40	2	3	2					2.2	4.80	2
2L	1	ESPLANADE	1	1	0	0.00	2	3	2					2.1	2.37	2
2L	B	ESPLANADE	1	1	0	0.00	2	3	2					2.3	2.43	2
2L	10	STRAND	1	1	1	1.80	2	3	2					2.1	2.04	2
2L	2	STRAND	1	1	1	2.50	2	3	7					1.9	4.90	2
2L	2	ROAD 'A	1	1	197	.00	2	3	2					2.0	99.9	2
2L	2	ESPLANADE	1	1	0	0.00	2	3	2					1.9	2.04	2
3	8	REDGATE			1	2.80	3	1	2	2	0	0	0	2.31	5.11	2
3	10	REDGATE			1	2.80	3	1	2	2	0	0	0	2.59	5.39	2
3	12	REDGATE			1	2.70	3	1	2	2	0	0	0	2.61	5.31	2
3	14	REDGATE		2			3	1	2	2	0	0	0	2.80	3.66	2
3	16	REDGATE					3	1	0	0	0	0	0	2.80	99.9	2
3	18	REDGATE					3	1	2	2	0	0	0	2.85	3.60	2
3	20	REDGATE					3	1	0	0	0	0	0	2.85	99.9	2
3	22	REDGATE					3	1	0	0	0	0	0	2.85	99.9	2
3	23	PACIFIC ESP		2			3	1	2	2	0	0	0	2.52	2.92	2
3	22	PACIFIC "	1	2	1	2.68	3	1	2					2.52	5.20	2
3	21	PACIFIC "			1	2.90	3	1	2	2	0	0	0	2.50	5.40	2
3	20	PACIFIC "	1	1	1	2.6	3	1	2					2.72	5.40	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
3	19	PACIFIC "	1	2	0	0.00	3	1	4					2.95	3.05	2
3	18	PACIFIC "					3	1	2	3	0	0	0	2.76	3.97	2
3	17	PACIFIC "	1	1	0	0.00	3	1	4					3.02	3.32	2
3	16	PACIFIC "	1	1	1	1.0	3	1	2					2.96	4.06	2
3	15	PACIFIC "	1	1	1	2.4	3	1	2					3.15	3.38	2
3	14	PACIFIC "	1	2	0	0.00	3	1	4					3.09	3.34	2
3	13	PACIFIC "	1	2	0	0.00	3	1	4					3.19	3.38	3
3	12	PACIFIC "	1	1	1	2.4	3	1	2					3.43	3.34	3
3	11	PACIFIC "	1	1	1	2.8	3	1	2					3.09	5.92	2
3	9	PACIFIC "	1	2	1	0.9	3	1	2					2.60	3.55	2
3	8	PACIFIC "	1	2	1	0.9	3	1	2					2.56	3.66	2
3	7	PACIFIC "	1	2	0	0.00	3	1	2					2.53	3.34	2
3	6	PACIFIC "					3	1	2	3	0	0	0	2.50	4.40	2
3	5	PACIFIC "					3	1	2	3	0	0	0	2.40	3.43	2
3	4	PACIFIC "					3	1	2	3	0	0	0	2.40	3.79	2
3	2	PACIFIC "	1	2	1	1.2	3	1	7					2.48	3.51	2
3	0	PACIFIC "	1	2	0	0.00	3	1	4					2.52	2.59	2
3	1	BEACH					3	1	0	0	0	0	0	2.50	99.9	2
3	3	BEACH					3	1	0	0	0	0	0	2.50	99.9	2
3	5	BEACH					3	1	2	2	0	0	0	2.57	3.72	2
3	7	BEACH					3	1	2	2	0	0	0	2.71	3.71	2
3	9	BEACH					3	1	2	2	0	0	0	2.70	3.62	2
3	11	BEACH					3	1	2	2	0	0	0	2.68	3.63	2
3	13	BEACH					3	1	2	2	0	0	0	2.68	3.62	2
3	15	BEACH					3	1	2	2	0	0	0	2.70	3.63	2
3	21	BEACH					3	1	2	2	0	0	0	2.74	3.94	2
3	25	BEACH	1	2	0	0.00	3	1	2					2.96	3.05	2
3	31	BEACH	1	2	1	2.4	3	1	4					2.93	3.08	2
3	35	BEACH					3	1	2	2	0	0	0	2.65	3.68	2
3	2	BEACH					3	1	0	0	0	0	0	2.00	99.9	2
3	4	BEACH					3	1	4	2	0	0	0	2.25	3.68	2
3	6	BEACH					3	1	0	0	0	0	0	2.26	99.9	2
3	8	BEACH					3	1	2	3	0	0	0	2.44	3.62	2
3	10	BEACH					3	1	4	2	0	0	0	2.24	4.00	2
3	12	BEACH					3	1	0	0	0	0	0	2.04	99.9	2
3	14	BEACH					3	1	4	2	0	0	0	2.94	3.18	2
3	18	BEACH					3	1	0	0	0	0	0	2.22	99.9	2
3	20	BEACH	1	1	0	0.00	3	1	4					2.76	2.91	2
3	22	BEACH			1	2.90	3	1	2	2	0	0	0	2.57	5.47	2
3	24	BEACH					3	1	2	2	0	0	0	2.63	3.99	2
3	26	BEACH					3	1	2	2	0	0	0	3.08	3.96	2
3	28	BEACH					3	1	0	0	0	0	0	2.50	99.9	2
3	29	BEACH	1	1	0	0.00	3	1	4					2.93	3.55	2
3	16	BEACH	1	1	1	1.0	3	1	2					2.35	3.20	2
3	23	BEACH	1	2	1	0.5	3	1	2					2.85	3.25	2
3	19	BEACH	1	1	1	0.6	3	1	2					2.82	3.32	2
3	1	ROYAL					3	1	0	0	0	0	0	2.06	99.9	2
3	2	ROYAL			1	2.30	3	1	2	2	0	0	0	2.07	4.37	2
3	3	ROYAL					3	1	2	1	0	0	0	2.01	3.27	2
3	4	ROYAL					3	1	2	2	0	0	0	2.01	3.60	2
3	5	ROYAL					3	1	2	2	0	0	0	2.01	3.18	2
3	6	ROYAL			1	2.50	3	1	2	2	0	0	0	2.06	4.56	2
3	7	ROYAL					3	1	2	2	0	0	0	1.84	3.04	2
3	8	ROYAL					3	1	0	0	0	0	0	1.66	99.9	2
3	9	ROYAL					3	1	0	0	0	0	0	1.74	99.9	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
3	10	ROYAL					3	1	2	2	0	0	0	2.09	3.10	2
3	11	ROYAL					3	1	0	0	0	0	0	1.74	99.9	2
3	12	ROYAL			1	2.90	3	1	2	2	0	0	0	2.21	5.11	2
3	13	ROYAL	2				3	1	4	2	0	0	0	2.74	3.06	2
3	14	ROYAL					3	1	0	0	0	0	0	2.09	99.9	2
3	15	ROYAL					3	1	0	0	0	0	0	1.73	99.9	2
3	16	ROYAL			1	2.80	3	1	2	2	0	0	0	2.14	4.94	2
3	17	ROYAL	1	1	0	0.00	3	1	4					2.14	3.08	2
3	18	ROYAL	1	2	0	0.00	3	1	4					2.17	2.31	2
3	19	ROYAL					3	1	2	2	0	0	0	2.01	3.11	2
3	20	ROYAL			1	2.60	3	1	2	2	0	0	0	1.98	4.58	2
3	21	ROYAL			1	2.40	3	1	2	2	0	0	0	1.91	4.31	2
3	22	ROYAL					3	1	2	2	0	0	0	2.01	3.72	2
3	23	ROYAL	3				3	1	4	3	0	0	0	2.17	3.11	2
3	23	ROYAL	3				3	1	4	3	0	0	0	2.17	3.11	2
3	24	ROYAL					3	1	2	4	0	0	0	2.86	3.16	2
3	25	ROYAL					3	1	4	2	0	0	0	2.30	3.21	2
3	27	ROYAL					3	1	0	0	0	0	0	1.95	99.9	2
3	28	ROYAL	1	2	0	0.00	3	1	4					2.08	2.23	2
3	30	ROYAL	1	1	0	0.00	3	1	4					2.21	2.33	2
3	3	HELEN	1	2	1	0.90	3	1	2					1.93	2.92	2
3	5	HELEN					3	1	2	2	0	0	0	2.08	3.21	2
3	7	HELEN			1	2.70	3	1	2	3	0	0	0	2.03	4.73	2
3	9	HELEN	2				3	1	4	2	0	0	0	2.48	2.88	2
3	11	HELEN	2				3	1	2	2	0	0	0	2.03	3.12	2
3	13	HELEN					3	1	4	3	0	0	0	2.33	3.61	2
3	15	HELEN	1	1	0	0.00	3	1	4					2.19	2.79	2
3	17	HELEN	1	1	1	1.30	3	1	2					2.23	3.97	2
3	19	HELEN			1	2.50	3	1	2	2	0	0	0	2.21	4.71	2
3	21	HELEN	3				3	1	4	2	0	0	0	2.11	3.13	2
3	21	HELEN	3				3	1	4	2	0	0	0	2.11	3.13	2
3	23	HELEN					3	1	0	0	0	0	0	1.91	99.9	2
3	25	HELEN			1	2.70	3	1	2	2	0	0	0	2.16	4.76	2
3	27	HELEN					3	1	2	2	0	0	0	2.44	3.80	2
3	29	HELEN	1	1	1	0.90	3	1	2					2.18	3.08	2
3	31	HELEN	1	1	0	0.00	3	1	4					2.21	2.87	2
3	33	HELEN					3	1	0	0	0	0	0	2.00	99.9	2
3	35	HELEN	1	1	0	0.00	3	1	4					2.33	2.40	2
3	2	HELEN					3	1	2	3	0	0	0	2.30	3.53	2
3	14	HELEN					3	1	0	0	0	0	0	2.37	99.9	2
3	16	HELEN					3	1	0	0	0	0	0	2.40	99.9	2
3	18	HELEN					3	1	0	0	0	0	0	2.52	99.9	2
3	20	HELEN			1	2.70	3	1	2	2	0	0	0	2.47	5.17	2
3	22	HELEN					3	1	0	0	0	0	0	2.52	99.9	2
3	24	HELEN					3	1	0	0	0	0	0	2.61	99.9	2
3	26	HELEN					3	1	0	0	0	0	0	2.61	99.9	2
3	1	PETER	1	1	0	0.00	3	1	7					2.98	3.10	2
3	3	PETER	1	2	0	0.00	3	1	2					2.30	3.54	2
3	4	PETER					3	1	2	2	0	0	0	2.09	3.64	2
3	5	PETER	1	1	1	1.30	3	1	2					2.18	3.62	2
3	6	PETER					3	1	4	2	0	0	0	2.54	3.44	2
3	7	PETER					3	1	4	1	0	0	0	2.14	2.97	2
3	8	PETER	1	2	0	0.00	3	1	4					2.32	2.45	2
3	9	PETER	1	1	0	0.00	3	1	2					2.14	2.24	2
3	10	PETER	3	2	0	0.00	3	1	4					2.33	3.03	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
3	10	PETER	3	2	0	0.00	3	1	4					2.33	3.03	2
3	10	PETER	3	2	0	0.00	3	1	4					2.33	3.03	2
3	10	PETER	3	2	0	0.00	3	1	4					2.33	3.03	2
3	11	PETER					3	1	0	0	0	0	0	2.02	99.9	2
3	12	PETER	2	2	0	0.00	3	1	4					2.15	3.01	2
3	12	PETER	2	2	0	0.00	3	1	4					2.15	3.01	2
3	13	PETER					3	1	0	0	0	0	0	2.12	99.9	2
3	14	PETER	2	2	0	0.00	3	1	4					2.15	3.01	2
3	14	PETER	2	2	0	0.00	3	1	4					2.15	3.01	2
3	15	PETER					3	1	4	2	0	0	0	2.32	3.20	2
3	16	PETER	2	2	0	0.00	3	1	4					2.07	2.97	2
3	16	PETER	2	2	0	0.00	3	1	4					2.07	2.97	2
3	17	PETER	1	1	1	1.10	3	1	4					2.40	3.34	2
3	18	PETER			1	2.50	3	1	2	2	0	0	0	1.87	4.37	2
3	19	PETER		2			3	1	2	2	0	0	0	1.77	3.30	2
3	20	PETER					3	1	0	0	0	0	0	1.87	99.9	2
3	21	PETER					3	1	4	2	0	0	0	1.80	3.04	2
3	22	PETER			1	2.30	3	1	2	2	0	0	0	1.85	4.15	2
3	23	PETER			1	1.80	3	1	2	2	0	0	0	2.04	3.84	2
3	24	PETER					3	1	2	2	0	0	0	1.99	3.19	2
3	25	PETER		2			3	1	2	2	0	0	0	2.04	1.99	2
3	26	PETER			1	2.50	3	1	2	2	0	0	0	1.89	4.39	2
3	27	PETER					3	1	2	2	0	0	0	1.82	2.84	2
3	28	PETER					3	1	2	2	0	0	0	1.74	3.34	2
3	29	PETER					3	1	2	2	0	0	0	1.82	3.14	2
3	30	PETER			1	2.70	3	1	2	2	0	0	0	1.83	4.53	2
3	31	PETER			1	2.40	3	1	1	1	0	0	0	1.82	4.22	2
3	32	PETER					3	1	0	0	0	0	0	1.62	99.9	2
3	33	PETER					3	1	2	2	0	0	0	2.13	3.24	2
3	34	PETER			1	2.60	3	1	2	2	0	0	0	1.98	4.58	2
3	35	PETER			1	2.90	3	1	2	2	0	0	0	1.93	4.83	2
3	36	PETER					3	1	2	2	0	0	0	2.58	3.58	2
3	37	PETER					3	1	2	2	0	0	0	2.51	3.35	2
3	38	PETER					3	1	2	2	0	0	0	2.46	3.59	2
3	27	BEACH	1	1	0	0.00	3	1	4					2.97	3.27	2
3	1	ROBIN	1	2	1	0.7	3	1	2					2.95	3.58	2
3	2	ROBIN					3	1	2	2	0	0	0	2.91	3.70	2
3	3	ROBIN	1	2	0	0.00	3	1	7					2.20	3.18	2
3	4	ROBIN					3	1	3	2	0	0	0	2.22	3.71	2
3	5	ROBIN			1	2.90	3	1	2	2	0	0	0	2.59	5.49	2
3	6	ROBIN	1	2	0	0.00	3	1	4					2.25	2.35	2
3	7	ROBIN					3	1	2	2	0	0	0	2.24	3.24	2
3	8	ROBIN	1	1	1	2.40	3	1	4					2.18	4.60	2
3	9	ROBIN					3	1	0	0	0	0	0	2.01	99.9	2
3	10	ROBIN	1	2	0	0.00	3	1	4					2.34	2.68	2
3	12	ROBIN	1	1	1	2.90	3	1	4					2.16	5.00	2
3	11	ROBIN					3	1	4	2	0	0	0	2.06	3.09	2
3	13	ROBIN					3	1	0	0	0	0	0	1.96	99.9	2
3	14	ROBIN					3	1	4	1	0	0	0	2.16	3.09	2
3	15	ROBIN					3	1	0	0	0	0	0	1.86	99.9	2
3	16	ROBIN		2			3	1	2	2	0	0	0	2.26	3.36	2
3	17	ROBIN		2			3	1	2	2	0	0	0	1.91	3.86	2
3	18	ROBIN					3	1	2	2	0	0	0	2.41	3.56	2
3	19	ROBIN					3	1	4	3	0	0	0	2.21	3.71	2
3	20	ROBIN					3	1	0	0	0	0	0	1.86	99.9	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
3	21	ROBIN			1	2.70	3	1	2	2	0	0	0	2.54	5.24	2
3	22	ROBIN			1	2.20	3	1	2	2	0	0	0	2.01	4.21	2
3	23	ROBIN					3	1	4	2	0	0	0	2.49	3.11	2
3	24	ROBIN			1	2.60	3	1	2	2	0	0	0	2.19	4.79	2
3	25	ROBIN					3	1	0	0	0	0	0	1.94	99.9	2
3	26	ROBIN					3	1	0	0	0	0	0	1.99	99.9	2
3	27	ROBIN			1	2.80	3	1	2	2	0	0	0	2.24	5.04	2
3	28	ROBIN					3	1	4	2	0	0	0	2.00	3.20	2
3	29	ROBIN	1	1	0	0.00	3	1	4					2.36	2.97	2
3	30	ROBIN			1	2.60	3	1	4	2	0	0	0	1.95	4.55	2
3	31	ROBIN	1	1	0	0.00	3	1	4					2.40	2.95	2
3	32	ROBIN	2				3	1	4	3	0	0	0	1.97	2.05	2
3	33	ROBIN			1	2.40	3	1	2	2	0	0	0	2.11	4.51	2
3	34	ROBIN			1	2.80	3	1	2	2	0	0	0	1.81	4.61	2
3	35	ROBIN			1	2.60	3	1	2	2	0	0	0	1.91	4.51	2
3	36	ROBIN					3	1	0	0	0	0	0	1.26	99.9	2
3	37	ROBIN			1	2.50	3	1	2	2	0	0	0	1.90	4.40	2
3	2	GLORIA	1	1	1	0.9	3	1	2					2.85	3.65	2
3	1	GLORIA	1	1	1	0.9	3	1	2					2.50	3.28	2
3	33	BEACH	1	2	1	1.3	3	1	2					2.61	3.91	2
3	3	GLORIA			1	2.60	3	1	2	2	0	0	0	3.23	5.83	2
3	4	GLORIA	1	2	0	0.00	3	1	4					2.73	2.81	2
3	5	GLORIA	1	1	0	0.00	3	1	4					2.65	2.73	2
3	6	GLORIA	1	2	0	0.00	3	1	4					2.55	3.00	2
3	7	GLORIA					3	1	4	2	0	0	0	2.78	3.57	2
3	8	GLORIA			1	2.30	3	1	2	2	0	0	0	2.43	4.73	2
3	9	GLORIA	1	2	1	1.0	3	1	4					2.32	3.32	2
3	10	GLORIA					3	1	0	0	0	0	0	2.08	99.9	2
3	11	GLORIA					3	1	0	0	0	0	0	2.23	99.9	2
3	12	GLORIA	2				3	1	4	3	0	0	0	2.33	2.42	2
3	13	GLORIA	1	2	0	0.00	3	1	4					2.38	2.42	2
3	14	GLORIA					3	1	2	2	0	0	0	3.03	4.03	2
3	15	GLORIA					3	1	4	2	0	0	0	2.11	3.76	2
3	16	GLORIA	1	2	0	0.00	3	1	2					2.58	2.68	2
3	17	GLORIA					3	1	2	2	0	0	0	2.16	3.60	2
3	18	GLORIA					3	1	4	2	0	0	0	2.71	2.86	2
3	19	GLORIA			1	2.50	3	1	2	2	0	0	0	2.61	5.11	2
3	20	GLORIA					3	1	4	2	0	0	0	2.56	3.51	2
3	21	GLORIA	1	2	0	0.00	3	1	2					2.56	2.86	2
3	22	GLORIA					3	1	2	2	0	0	0	2.59	3.09	2
3	23	GLORIA					3	1	0	0	0	0	0	2.44	99.9	2
3	24	GLORIA					3	1	4	2	0	0	0	2.57	3.33	2
3	25	GLORIA					3	1	4	2	0	0	0	2.84	3.22	2
3	26	GLORIA					3	1	2	2	0	0	0	2.22	3.60	2
3	27	GLORIA	1	2	0	0.00	3	1	4					2.53	3.03	2
3	28	GLORIA					3	1	2	2	0	0	0	2.22	3.65	2
3	29	GLORIA					3	1	2	2	0	0	0	2.02	3.93	2
3	30	GLORIA					3	1	0	0	0	0	0	2.27	99.9	2
3	31	GLORIA					3	1	2	2	0	0	0	2.32	3.92	2
3	32	GLORIA	1	1	0	0.00	3	1	4					2.85	3.09	2
3	33	GLORIA					3	1	3	2	0	0	0	1.99	3.74	2
3	34	GLORIA	1	1	0	0.00	3	1	2					2.24	2.39	2
3	35	GLORIA			1	2.70	3	1	2	2	0	0	0	2.70	5.40	2
3	36	GLORIA					3	1	2	2	0	0	0	2.15	3.55	2
3	37	GLORIA					3	1	4	2	0	0	0	2.65	3.43	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
3	38	GLORIA					3	1	0	0	0	0	0	2.10	99.9	2
3	2	RANGAL					3	1	0	0	0	0	0	3.26	99.9	2
3	4	RANGAL					3	1	3	2	0	0	0	3.21	3.69	2
3	6	RANGAL		2			3	1	2	2	0	0	0	3.06	3.26	2
3	8	RANGAL					3	1	0	0	0	0	0	3.06	99.9	2
3	10	RANGAL					3	1	4	2	0	0	0	2.91	3.63	2
3	12	RANGAL					3	1	4	2	0	0	0	2.91	3.57	2
3	14	RANGAL					3	1	0	0	0	0	0	2.77	99.9	2
3	30	RANGAL					3	1	0	0	0	0	0	3.09	99.9	2
3	32	RANGAL					3	1	4	2	0	0	0	3.04	3.41	2
3	1	BERRIMBILLA					3	1	0	0	0	0	0	2.72	99.9	2
3	2	BERRIMBILLA					3	1	4	2	0	0	0	2.82	3.10	2
3	3	BERRIMBILLA		2			3	1	4	2	0	0	0	2.92	3.27	2
3	4	BERRIMBILLA					3	1	4	2	0	0	0	2.87	3.18	2
3	5	BERRIMBILLA					3	1	4	2	0	0	0	2.96	3.60	2
3	6	BERRIMBILLA					3	1	4	2	0	0	0	2.77	2.95	2
3	7	BERRIMBILLA					3	1	4	2	0	0	0	3.05	3.71	2
3	8	BERRIMBILLA					3	1	4	2	0	0	0	2.91	3.63	2
3	9	BERRIMBILLA					3	1	4	2	0	0	0	3.10	3.42	2
3	10	BERRIMBILLA					3	1	4	2	0	0	0	2.91	3.11	2
3	11	BERRIMBILLA					3	1	4	2	0	0	0	3.00	3.63	2
3	12	BERRIMBILLA					3	1	4	2	0	0	0	2.95	3.48	2
3	13	BERRIMBILLA					3	1	4	2	0	0	0	2.87	3.30	2
3	14	BERRIMBILLA					3	1	0	0	0	0	0	2.65	99.9	2
3	15	BERRIMBILLA					3	1	4	2	0	0	0	2.77	3.63	2
3	16	BERRIMBILLA					3	1	3	2	0	0	0	2.90	3.10	2
3	17	BERRIMBILLA					3	1	4	2	0	0	0	2.96	3.37	2
3	18	BERRIMBILLA					3	1	2	2	0	0	0	2.67	3.37	2
3	19	BERRIMBILLA					3	1	4	2	0	0	0	3.16	3.65	2
3	20	BERRIMBILLA					3	1	4	2	0	0	0	2.87	3.57	2
3	21	BERRIMBILLA					3	1	4	2	0	0	0	3.16	3.65	2
3	22	BERRIMBILLA					3	1	4	2	0	0	0	2.91	3.28	2
3	23	BERRIMBILLA					3	1	4	2	0	0	0	3.16	3.98	2
3	24	BERRIMBILLA					3	1	4	2	0	0	0	3.16	3.62	2
3	26	BERRIMBILLA					3	1	4	2	0	0	0	3.01	3.56	2
3	4	BARKALA					3	1	4	2	0	0	0	2.95	3.58	2
3	6	BARKALA					3	1	4	2	0	0	0	3.05	3.53	2
3	8	BARKALA					3	1	4	2	0	0	0	3.07	3.95	2
3	10	BARKALA					3	1	4	2	0	0	0	3.12	3.44	2
3	11	BARKALA					3	1	4	2	0	0	0	3.32	3.75	2
3	12	BARKALA					3	1	4	2	0	0	0	3.12	3.64	2
3	13	BARKALA					3	1	4	2	0	0	0	3.42	3.89	2
3	14	BARKALA					3	1	4	2	0	0	0	3.27	3.86	2
3	15	BARKALA					3	1	0	0	0	0	0	3.27	99.9	2
3	2	KALLAROO					3	1	4	2	0	0	0	3.11	3.68	2
3	4	KALLAROO					3	1	4	2	0	0	0	3.06	3.65	2
3	6	KALLAROO					3	1	4	2	0	0	0	2.91	3.43	2
3	8	KALLAROO					3	1	4	2	0	0	0	3.00	3.68	2
3	10	KALLAROO					3	1	4	2	0	0	0	3.25	3.84	2
3	12	KALLAROO					3	1	0	0	0	0	0	3.75	99.9	2
3	14	KALLAROO					3	1	0	0	0	0	0	4.45	99.9	2
3	16	KALLAROO					3	1	4	2	0	0	0	4.29	5.61	2
4	26	LARELAR					4	3	4	2	0	0	0	3.17	3.88	2
4	24	LARELAR					4	3	4	2	0	0	0	2.77	3.75	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
4	22	LARELAR					4	3	4	2	0	0	0	2.88	3.44	2
4	20	LARELAR					4	3	0	0	0	0	0	2.83	99.9	2
4	18	LARELAR					4	3	4	2	0	0	0	3.03	3.59	2
4	16	LARELAR					4	3	4	2	0	0	0	3.14	3.69	2
4	14	LARELAR					4	3	4	2	0	0	0	3.09	3.85	2
4	12	LARELAR					4	3	4	2	0	0	0	3.24	3.92	2
4	10	LARELAR					4	3	4	2	0	0	0	3.09	3.52	2
4	13	NATAN		2			4	3	4	2	0	0	0	3.56	3.89	2
4	14	NATAN					4	3	4	2	0	0	0	3.46	3.87	2
4	15	NATAN					4	3	0	0	0	0	0	3.21	99.9	2
4	16	NATAN					4	3	4	2	0	0	0	3.16	3.42	2
4	17	NATAN					4	3	0	0	0	0	0	3.06	99.9	2
4	18	NATAN					4	3	4	2	0	0	0	2.86	3.60	2
4	19	NATAN					4	3	4	2	0	0	0	2.98	3.40	2
4	20	NATAN					4	3	4	2	0	0	0	2.98	3.37	2
4	21	NATAN					4	3	4	2	0	0	0	3.05	3.67	2
4	22	NATAN					4	3	4	3	0	0	0	3.01	3.90	2
4	23	NATAN					4	3	4	2	0	0	0	3.01	3.81	2
4	65	HELEN					4	1	4	2	0	0	0	3.04	3.49	2
4	63	HELEN					4	1	4	2	0	0	0	2.98	3.54	2
4	61	HELEN					4	1	4	2	0	0	0	2.89	3.54	2
4	59	HELEN					4	1	3	2	0	0	0	3.11	3.55	2
4	57	HELEN					4	1	4	2	0	0	0	3.01	3.13	2
4	55	HELEN					4	1	5	2	0	0	0	2.43	3.97	2
4	53	HELEN					4	1	2	2	0	0	0	2.68	3.78	2
4	51	HELEN					4	1	4	2	0	0	0	2.93	3.34	2
4	49	HELEN					4	1	2	2	0	0	0	3.17	3.62	2
4	47	HELEN					4	1	4	2	0	0	0	3.02	3.67	2
4	45	HELEN					4	1	4	2	0	0	0	2.92	3.69	2
4	43	HELEN					4	1	2	2	0	0	0	2.77	3.85	2
4	41	HELEN					4	1	2	2	0	0	0	2.62	3.67	2
4	39	HELEN					4	1	4	2	0	0	0	2.57	2.53	2
4	1	ELIZABETH					4	1	2	2	0	0	0	3.47	3.86	2
4	2	ELIZABETH					4	1	2	2	0	0	0	2.32	3.13	2
4	3	ELIZABETH			1	2.40	4	1	2	2	0	0	0	2.42	4.82	2
4	4	ELIZABETH	1	1	0	0.00	4	1	2					2.30	3.09	2
4	5	ELIZABETH		2			4	1	4	2	0	0	0	2.37	2.53	2
4	6	ELIZABETH					4	1	2	2	0	0	0	2.27	3.46	2
4	7	ELIZABETH					4	1	2	2	0	0	0	2.52	3.63	2
4	8	ELIZABETH					4	1	2	2	0	0	0	2.19	3.58	2
4	9	ELIZABETH					4	1	0	0	0	0	0	2.39	99.9	2
4	10	ELIZABETH	2				4	1	2	2	0	0	0	2.39	3.68	2
4	10	ELIZABETH	2				4	1	2	2	0	0	0	2.39	3.68	2
4	11	ELIZABETH		2			4	1	2	3	0	0	0	2.69	3.16	2
4	12	ELIZABETH					4	1	0	0	0	0	0	1.74	99.9	2
4	13	ELIZABETH					4	1	4	2	0	0	0	2.14	3.17	2
4	14	ELIZABETH	2				4	1	4	3	0	0	0	2.75	3.28	2
4	14	ELIZABETH	2				4	1	4	3	0	0	0	2.75	3.28	2
4	15	ELIZABETH					4	1	0	0	0	0	0	1.99	99.9	2
4	16	ELIZABETH	2				4	1	4	3	0	0	0	2.88	3.16	2
4	16	ELIZABETH	2				4	1	4	3	0	0	0	2.88	3.16	2
4	17	ELIZABETH					4	1	0	0	0	0	0	1.99	99.9	2
4	18	ELIZABETH					4	1	2	2	0	0	0	2.13	3.60	2
4	19	ELIZABETH			1	2.70	4	1	4	2	0	0	0	2.23	4.93	2
4	20	ELIZABETH			1	2.80	4	1	2	2	0	0	0	2.45	5.26	2
4	21	ELIZABETH					4	1	4	2	0	0	0	3.13	3.68	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
4	22	ELIZABETH			1	2.80	4	1	2	2	0	0	0	2.18	4.98	2
4	23	ELIZABETH					4	1	2	2	0	0	0	2.70	3.74	2
4	24	ELIZABETH					4	1	0	0	0	0	0	2.03	99.9	2
4	25	ELIZABETH		2			4	1	4	3	0	0	0	2.86	3.04	2
4	26	ELIZABETH		2			4	1	4	2	0	0	0	2.63	3.56	2
4	27	ELIZABETH					4	1	2	2	0	0	0	2.86	3.55	2
4	28	ELIZABETH	1	2	0	0.00	4	1	2					2.61	2.87	2
4	29	ELIZABETH					4	1	2	2	0	0	0	2.90	3.63	2
4	30	ELIZABETH					4	1	0	0	0	0	0	2.02	99.9	2
4	31	ELIZABETH		2			4	1	2	3	0	0	0	2.76	3.64	2
4	32	ELIZABETH					4	1	0	0	0	0	0	1.97	99.9	2
4	33	ELIZABETH					4	1	0	0	0	0	0	1.93	99.9	2
4	34	ELIZABETH	1	2	0	0.00	4	1	4					2.28	2.39	2
4	35	ELIZABETH					4	1	0	0	0	0	0	1.83	99.9	2
4	36	ELIZABETH					4	1	2	2	0	0	0	2.37	3.68	2
4	37	ELIZABETH					4	1	0	0	0	0	0	1.98	99.9	2
4	38	ELIZABETH	1	2	0	0.00	4	1	7					2.48	2.82	2
4	39	ELIZABETH					4	1	0	0	0	0	0	2.08	99.9	2
4	40	ELIZABETH	1	2	0	0.00	4	1	4					2.37	2.47	2
4	41	ELIZABETH					4	1	0	0	0	0	0	1.12	99.9	2
4	43	ELIZABETH					4	1	0	0	0	0	0	1.27	99.9	2
4	45	ELIZABETH					4	1	0	0	0	0	0	1.22	99.9	2
4	47	ELIZABETH					4	1	0	0	0	0	0	1.62	99.9	2
4	1	PHILLIP					4	1	2	2	0	0	0	2.40	3.85	2
4	2	PHILLIP					4	1	0	0	0	0	0	2.05	99.9	2
4	3	PHILLIP					4	1	0	0	0	0	0	2.40	99.9	2
4	4	PHILLIP					4	1	2	2	0	0	0	2.55	3.87	2
4	5	PHILLIP					4	1	2	2	0	0	0	2.26	3.81	2
4	6	PHILLIP			1	2.90	4	1	2	2	0	0	0	2.36	5.26	2
4	8	PHILLIP					4	1	0	0	0	0	0	2.41	99.9	2
4	9	PHILLIP					4	1	2	3	0	0	0	2.36	3.87	2
4	10	PHILLIP					4	1	2	2	0	0	0	2.56	3.99	2
4	11	PHILLIP					4	1	0	0	0	0	0	2.42	99.9	2
4	12	PHILLIP					4	1	2	2	0	0	0	2.32	4.06	2
4	13	PHILLIP					4	1	4	2	0	0	0	2.62	3.30	2
4	14	PHILLIP					4	1	2	2	0	0	0	2.52	3.67	2
4	15	PHILLIP					4	1	0	0	0	0	0	1.77	99.9	2
4	16	PHILLIP					4	1	2	2	0	0	0	2.47	3.67	2
4	17	PHILLIP					4	1	0	0	0	0	0	1.77	99.9	2
4	18	PHILLIP		2			4	1	3	2	0	0	0	3.08	3.49	2
4	19	PHILLIP					4	1	0	0	0	0	0	1.98	99.9	2
4	20	PHILLIP					4	1	2	2	0	0	0	2.63	4.29	2
4	21	PHILLIP					4	1	0	0	0	0	0	1.98	99.9	2
4	22	PHILLIP					4	1	2	2	0	0	0	2.98	3.68	2
4	23	PHILLIP					4	1	0	0	0	0	0	1.98	99.9	2
4	24	PHILLIP					4	1	2	2	0	0	0	2.33	3.59	2
4	25	PHILLIP			1	2.60	4	1	2	3	0	0	0	2.27	5.22	2
4	26	PHILLIP					4	1	4	2	0	0	0	2.28	3.14	2
4	27	PHILLIP					4	1	2	1	0	0	0	2.88	3.85	2
4	28	PHILLIP					4	1	2	3	0	0	0	2.47	3.22	2
4	1	CLIFFORD					4	1	2	2	0	0	0	2.54	3.63	2
4	2	CLIFFORD			1	2.60	4	1	2	2	0	0	0	2.63	5.23	2
4	3	CLIFFORD					4	1	2	2	0	0	0	2.49	3.67	2
4	4	CLIFFORD					4	1	0	0	0	0	0	2.19	99.9	2
4	5	CLIFFORD			1	2.70	4	1	2	2	0	0	0	2.64	5.34	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
4	6	CLIFFORD					4	1	2	2	0	0	0	2.44	3.87	2
4	7	CLIFFORD					4	1	4	2	0	0	0	2.82	3.97	2
4	8	CLIFFORD			1	2.80	4	1	2	2	0	0	0	2.47	5.27	2
4	9	CLIFFORD			1	2.70	4	1	4	2	0	0	0	2.68	5.38	2
4	10	CLIFFORD					4	1	2	2	0	0	0	2.73	4.03	2
4	11	CLIFFORD		2			4	1	3	2	0	0	0	2.78	3.07	2
4	12	CLIFFORD					4	1	2	2	0	0	0	2.33	3.83	2
4	14	CLIFFORD					4	1	4	2	0	0	0	2.34	3.25	2
4	15	CLIFFORD					4	1	0	0	0	0	0	2.68	99.9	2
4	16	CLIFFORD			1	2.70	4	1	2	2	0	0	0	2.57	5.27	2
4	17	CLIFFORD					4	1	0	0	0	0	0	3.03	99.9	2
4	18	CLIFFORD					4	1	2	2	0	0	0	2.62	3.58	2
4	19	CLIFFORD					4	1	0	0	0	0	0	3.43	99.9	2
4	20	CLIFFORD					4	1	2	2	0	0	0	2.38	2.96	2
4	4	ELOURA					4	1	4	2	0	0	0	3.91	4.66	2
4	6	ELOURA					4	1	4	2	0	0	0	3.71	4.40	2
4	8	ELOURA					4	1	4	2	0	0	0	3.70	4.07	2
4	10	ELOURA					4	1	4	2	0	0	0	3.65	4.08	2
4	12	ELOURA					4	1	4	2	0	0	0	3.68	4.13	2
4	14	ELOURA					4	1	0	0	0	0	0	3.68	99.9	2
4	15	ELOURA					4	1	4	2	0	0	0	4.05	4.26	2
4	16	ELOURA					4	1	4	2	0	0	0	4.00	4.25	2
4	17	ELOURA					4	1	4	2	0	0	0	4.02	4.42	2
4	18	ELOURA					4	1	4	2	0	0	0	4.10	4.43	2
4	149	SHARA					4	1	0	0	0	0	0	4.16	99.9	2
4	151	SHARA					4	1	0	0	0	0	0	3.91	99.9	2
4	153	SHARA					4	1	0	0	0	0	0	3.66	99.9	2
4	155	SHARA					4	1	4	2	0	0	0	3.66	4.18	2
4	157	SHARA					4	1	4	2	0	0	0	3.62	4.25	2
4	159	SHARA					4	1	4	2	0	0	0	3.67	3.87	2
4	161	SHARA					4	1	4	2	0	0	0	3.67	99.9	2
4	2	KONDA					4	1	4	2	0	0	0	3.92	4.35	2
4	4	KONDA					4	1	4	2	0	0	0	3.64	4.08	2
4	3	KONDA					4	1	0	0	0	0	0	3.59	99.9	2
4	5	KONDA					4	1	4	2	0	0	0	3.74	4.31	2
4	7	KONDA					4	1	0	0	0	0	0	3.74	99.9	2
4	9	KONDA					4	1	4	2	0	0	0	3.84	4.19	2
4	11	KONDA					4	1	0	0	0	0	0	3.84	99.9	2
4	13	KONDA					4	1	4	2	0	0	0	4.08	4.31	2
4	14	KONDA					4	1	4	2	0	0	0	3.98	4.17	2
4	12	KONDA					4	1	4	2	0	0	0	4.01	4.43	2
4	10	KONDA					4	1	4	2	0	0	0	4.11	4.48	2
4	8	KONDA					4	1	4	2	0	0	0	3.96	4.69	2
4	26	KALLAROO					4	1	4	2	0	0	0	4.29	5.24	2
4	28	KALLAROO					4	1	4	2	0	0	0	4.27	4.85	2
4	27	KALLAROO					4	2	2	2	0	0	0	4.45	4.87	2
4	29	KALLAROO					4	2	4	2	0	0	0	4.22	4.65	2
4	31	KALLAROO					4	2	4	2	0	0	0	4.17	4.42	2
4	33	KALLAROO					4	2	4	2	0	0	0	4.07	4.28	2
4	35	KALLAROO					4	2	4	2	0	0	0	3.96	4.26	2
4	36	KALLAROO					4	2	4	2	0	0	0	3.86	4.12	2
4	38	KALLAROO					4	2	0	0	0	0	0	3.81	99.9	2
4	40	KALLAROO					4	2	4	2	0	0	0	3.73	4.11	2
4	44	KALLAROO					4	2	4	2	0	0	0	3.53	4.05	2
4	42	KALLAROO					4	2	0	0	0	0	0	3.63	99.9	2

VARIABLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
4	46	KALLAROO					4	2	4	2	0	0	0	3.48	3.99	2
4	1	HARDEY					4	2	4	2	0	0	0	3.75	4.18	2
4	5	HARDEY					4	2	4	2	0	0	0	3.92	4.27	2
4	7	HARDEY					4	2	4	2	0	0	0	3.87	4.65	2
4	9	HARDEY					4	2	4	2	0	0	0	3.82	99.9	2
5	6	WILFRED			1	2.77	5	2	2	2	0	0	0	2.78	5.55	2
5	9	WILFRED			1	2.12	5	2	2	2	0	0	0	2.17	4.29	2
5	261	UNNAMED LANE			1	3.00	5	2	2	2	0	0	0	1.42	4.41	2
5	L1	DP121397			1	2.50	5	2	2	2	0	0	0	1.47	3.99	2

APPENDIX C

FLORA AND FAUNA REPORT

MARSHALLS CREEK FLOODPLAIN MANAGEMENT STUDY AND PLAN

FLORA AND FAUNA REVIEW

APRIL - MAY 1996

MARSHALLS CREEK FLOODPLAIN MANAGEMENT STUDY AND PLAN
FLORA AND FAUNA REVIEW

1. INTRODUCTION

This report was prepared by Mr Greg P Clancy B. Sc. with the assistance of Phil Austin and Russell Jagoa. It was commissioned by Paterson Consultants Pty Limited, of Grafton, for the Marshalls Creek Floodplain Management Study. Its purpose is to review ecological factors (in particular the flora and fauna) of the study area and the potential impacts of flood mitigation measures that may be implemented in the future.

The aims of the review were to:

- Undertake an overview of the flora and fauna attributes of the Marshalls Creek floodplain within the study area.
- Identify flora and fauna of significance within the floodplain (essentially SEPP 44 considerations).
- Identify the significance of Marshalls Creek with respect to fisheries and aquatic life.
- Advise how the Floodplain Management Plan works and measures can be implemented within the framework of the flora and fauna sustainability/enhancement.

2. RESEARCH METHODS

A limited literature search was carried out to locate fauna species records for the study area and the Brunswick Heads area in general.

The specific references examined for relevant records were:

- Annual 'NSW Bird Reports' from 1974 to 1993, published in the journal 'Australian Birds'.
- The consultant's personal wildlife roadkill records
- National Parks & Wildlife Service Wildlife Atlas Records and ROTAP (Rare or Threatened Australian Plants) Database records for Threatened Species recorded within the study area.

A field inspection, involving a limited survey of fauna, was carried out during the period 22-23 April, 1996. This survey involved a total of two days observations during daylight hours. Walking spotlight surveys using two spotlights and three observers were carried out on the night of 22 April. These surveys sampled habitats along Jones Road, New Brighton Road and within the Brunswick Heads Nature Reserve.

Owl "playback surveys" were conducted at two points along Jones Road. The pre-recorded calls of the Powerful, Barking, Masked and Sooty Owls and the Marbled Frogmouth were broadcast from a "ghetto-blaster".

All fauna species observed were noted with some limited searching for reptiles under logs and rocks and under the bark of standing trees. Frogs were recorded at night from their calls.

3. RESEARCH RESULTS

3.1 Fauna

Eighty-two (82) bird species were recorded during the survey within the study area with an additional 27 identified from specified references above (National Parks & Wildlife Service, roadkill and Australian Birds records). Thus the total bird species is 109.

Six mammal species were located during the survey with an additional 11 from the specified references.

Three reptile species and three amphibians were recorded during the field survey while additional species (an additional three reptiles and an additional two amphibians) were identified from the specified references.

The identified species list appears in Attachment A.

3.1.1 Threatened Fauna Species

Threatened fauna species are covered by the NSW Threatened Species Conservation Act, 1995. Schedule 1 of the Act lists species considered "Endangered" while Schedule 2 lists species considered "Vulnerable".

Twenty-nine "Threatened Species" of fauna (in the terms of the Act) have been recorded in the study area.

Three species of fauna listed on Schedule 2 of the Act (vulnerable species) were detected during the field survey. These were the Koala *Phascolarctos cinereus*, the Osprey *Pandion haliaetus* and the Pied Oystercatcher *Haematopus longirostris*. The Koala was located only from its distinctive scats found at the base of food trees.

Four Schedule 1 (Endangered) species were recorded from the specified references. These are Bush Stone-curlew (Thick-knee) *Burhinus grallarius*, Beach Stone-curlew (Thick-knee) *Esacus neglectus*, Little Tern *Sterna albifrons* and Double-eyed Fig-Parrot *Cyclopsitta diophthalma coxeni*.

Twenty-two Schedule 2 species were defined from the specified references. These are the Wallum Froglet *Crinia tinnula*, Wallum Tree Frog *Litoria olongburensis*, Black Bittern *Ixobrychus flavicollis*, Black-necked Stork *Ephippiorhynchus asiaticus*, Square-tailed Kite *Lophoictinia isura*, Bush-hen *Amaurornis olivaceus*, Brolga *Grus rubicunda*, Sooty Oystercatcher *Haematopus fuliginosus*, Wompoo Fruit-Dove *Ptilinopus magnificus*, Rose-crowned Fruit-Dove *Ptilinopus regina*, Glossy Black-Cockatoo *Calyptorhynchus lathami*, Swift Parrot *Lathamus*

discolor, Masked Owl *Tyto novaehollandiae*, Grass Owl *Tyto capensis*, Collared Kingfisher *Todiramphus chloris*, Barred (Yellow-eyed) Cuckoo-shrike *Coracina lineata*, White-eared Monarch *Monarcha leucotis*, Black Flying-fox *Pteropus alecto*, Queensland Blossom-bat *Syconycteris australis*, Long-nosed Potoroo *Potorous tridactylus*, Little Bent-wing Bat *Miniopterus australis* and Northern Long-eared Bat *Nyctophilus bifax*.

A number of microchiropteran (small insectivorous) bats was observed during the spot-lighting survey and it is possible that some of them may have been Threatened Species other than those listed above.

3.1.2 Other Fauna of Interest

Migratory wading birds and terns have been observed utilising the mud and sand flats, rocky areas and mangroves of the estuary. These comprise the Whimbrel *Numenius phaeopus*, Common Sandpiper *Actitis hypoleucos*, Grey-tailed Tattler *Heteroscelus brevipes*, Ruddy Turnstone *Arenaria interpres*, Common Tern *Sterna hirundo* and Little Tern *Sterna albifrons*.

The Grassland Melomys *Melomys littoralis*, a species of native rat, recorded at the site by National Parks and Wildlife Service, is uncommon in New South Wales.

3.1.3 Aquatic fauna

No specific survey of aquatic fauna was carried out however the remains of a large Flathead *Platycephalus sp.* and a Long-finned Eel *Anguilla reinhardti* were observed. Numerous Ghost Crabs *Ocypode sp.* were observed during the spotlight walk through the Brunswick Nature Reserve on 22 April.

3.2 Flora

No detailed survey of the site's flora was carried out. However a generalised vegetation map has been prepared by use of the available aerial photography and field checking of the vegetation communities.

The vegetation communities identified are as follows:

- Coastal Dune Scrub
- Swamp Open Forest
- Open Eucalypt Forest
- Mangrove Forest
- Fern-sedge Swamp
- Heath
- Grasslands
- Littoral Rainforest

The vegetation map appears on Figure 9.

3.2.1 Threatened Flora

No species listed on Schedules 1 and 2 of the Threatened Species Conservation Act, 1995 were located during the fieldwork.

Eight Threatened species have been recorded by other observers (National Parks & Wildlife Service ROTAP Data Base). *These are Davidsonia puriens var. jerseyana, Randia moorei* and *Acronychia littoralis* (Schedule 1 - Endangered species) and *Corokia whiteana, Cryptocarya foetida, Endiandra hayesii, Syzygium hodgkinsoniae* and *Syzygium moorei* (Schedule 2 - Vulnerable species).

In addition the rare species, *Thozetia racemosa, Trichosanthes subvelutina, Acacia bakeri, Archidendron muellerianum, Argophyllum nullumense, Endiandra globosa, Rhodamnia maideniana* and *Acronychia baeuerlenii* have been recorded (N.P.& W.S. Data Base).

4. REVIEW OF RESEARCH RESULTS

4.1 Overview

The study area at Marshalls Creek, Brunswick Heads, supports a variety of vegetation communities that provide habitat for numerous fauna species, in particular birds.

The number of Threatened Species of plants and animals is comparatively high.

This rich bio-diversity is acknowledged by the protection of a large part of the study area as the Brunswick Heads Nature Reserve and the recently dedicated Billinudgel Nature Reserve.

There is also a proposal to add the riparian areas of Marshalls Creek to the existing Brunswick Heads Nature Reserve (B. McLaughlan, N.P. & W.S. pers. comm.).

4.2 Limitations of Survey

The short duration (2 days and 1 night), the limited survey techniques employed and the season of survey (autumn) would all contribute to an underestimate of the faunal species present in the study area.

Common migratory birds such as the Dollarbird *Eurystomus orientalis*, Rufous Fantail *Rhipidura rufifrons*, Black-faced Monarch *Monarcha melanopsis* and Cicadabird *Coracina tenuirostris* were not recorded although they, and other species, would almost certainly be present during the spring and summer months.

The identification of microchiropteran bats requires that they be trapped or detected by ultra-sonic detectors. This was outside of the scope of this flora and fauna review.

Despite the above limitations this report provides a reasonable overview of fauna species present. The sourcing of N.P.& W.S. Atlas Records and the consultants roadkill records has compensated to some degree for the other factors.

4.3 Endangered Fauna

The twenty-nine Threatened Fauna species recorded for the study area indicate a high local bio-diversity and highlight the biogeographical importance of the MacPherson-Macleay Overlap zone.

Fourteen of the Threatened species use wetlands (sand and mud flats, estuarine waters, mangroves, and freshwater wetlands). The integrity of these wetlands is closely linked to the health of Marshalls Creek and its estuary, as well as the surrounding catchment area.

The Koala has been recorded from a number of forested sites within the study area (see map). The provisions of State Environmental Planning Policy (SEPP) 44, relating to Koalas and their habitat, would have to be implemented in the event that a flood mitigation proposal would impact on forest communities. Under the SEPP an assessment has to be made as to whether there is greater than 15% of Koala food trees (as listed on Schedule 2 of the SEPP) in the canopy of the forest of the proposed development site. If there is greater than 15% the site would be considered as "Potential Koala Habitat". Further study would then be required to determine if the site was 'Critical Habitat'. An assessment under SEPP 44 is out of the scope of this study.

4.4 Other Fauna of Interest

The migratory wading birds and terns that visit the estuary are transequatorial migrants from the Arctic and sub-Arctic areas. They breed in places such as Siberia, Alaska, China and Japan and escape the harsh northern winter by migrating to southern latitudes. The Whimbrel, Common Sandpiper, Grey-tailed Tattler, Ruddy Turnstone, Common Tern and Little Tern are all subject to two bilateral agreements to protect migratory birds and their environment. These agreements are generally known as the Japan- Australia Treaty and the China-Australia Treaty. The Australian Government therefore has obligations under these treaties to protect areas used by these species such as the Marshalls Creek and Brunswick estuaries.

4.5 Aquatic Fauna

The extensive areas of habitat for aquatic fauna, such as sand and mud flats, mangrove forests and rocky substrates, and the variety of avian predators of aquatic fauna (such as terns, gulls, kingfishers, herons, egrets, osprey etc.) present at the site indicate a rich aquatic fauna.

NSW Fisheries (Craig Copeland pers. comm. to K.W. Paterson) states "Marshalls Creek contains a variety of fish habitats and as a result a potentially diverse fish community."

4.6 Flora

Eight Threatened Species of plant are known from the study area with an additional eight rare species occurring. A number of these are at or near to their southern limit of distribution such as *Davidsonia pruriens var. jerseyana* and *Endiandra globosa*.

The existing status of much of the area as Nature Reserve should protect a high proportion of these Threatened plant species, however populations outside of Service estate may need special protective measures.

4.7 Impact of Proposed Development Works

The fieldwork carried out for this report was of a limited nature only and therefore site specific flora and fauna surveys should be carried out prior to any development proposals being approved.

The potential impact of proposed, or potential, developments on flora and fauna varies depending upon the nature of the development and the type of ameliorative measures to be adopted.

The richness of the bio-diversity within the Marshalls Creek catchment means that there is a high potential for significant impact on natural ecosystems from works that will alter the natural hydrology.

5. CONCLUSIONS

The study area provides habitat for a variety of flora and fauna species, including numerous Threatened Species.

Proposals for the construction of flood mitigation works would need to fully address the flora and fauna values of the area. This should involve detailed site specific flora and fauna surveys as discussed above.

The development of strategies that would not involve changing the natural flow and flooding regime of the Creek would be preferable as there is likely to be a significant impact on flora and fauna species, including those covered by International Treaties and state legislation.

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ATTACHMENT A

FAUNA SPECIES LIST MARSHALLS CREEK FLOODPLAIN STUDY

FAMILY	COMMON NAME	SCIENTIFIC NAME
MAMMALS		
TACHYGLOSSIDAE	Short-beaked Echidna	Tachyglossus aculeatus R
PERAMELIDAE	Northern Brown Bandicoot	Isoodon macrourus R
	Long-nosed Bandicoot	Perameles nasuta #
PHASCOLARCTIDAE	Koala	Phascolarctos cinereus #, N, T
PHALANGERIDAE	Mountain Brushtail Possum	Trichosurus caninus R
POTOROIDAE	Long-nosed Potoroo	Potorous tridactylus N, T
MACROPODIDAE	Swamp Wallaby	Wallabia bicolor #, R
PTEROPODIDAE	Grey-headed Flying-fox	Pteropus poliocephalus #
	Black Flying-fox	Pteropus alecto N, T
	Queensland Blossom-bat	Syconycteris australis N, T
VESPERTILIONIDAE	Northern Long-eared Bat	Nyctophilus bifax N, T
	Little Bent-wing Bat	Miniopterus australis N, T
?	micro bat (possibly one of above)	Species not determined #
MURIDAE	Water-rat	Hydromys chrysogaster R
	Grassland Melomys	Melomys burtoni N
	Black Rat	*Rattus rattus #
CANIDAE	Fox	*Vulpes vulpes R
BIRDS		
ANATIDAE	Pacific Black Duck	Anas superciliosa #
PHAETHONTIDAE	White-tailed Tropicbird	Phaethon lepturus A
PHALACROCORACIDAE	Little Pied Cormorant	Phalacrocorax melanoleucos #
	Pied Cormorant	Phalacrocorax varius #
ARDEIDAE	White-faced Heron	Egretta novaehollandiae #
	Little Egret	Egretta garzetta #
	Great Egret	Ardea alba #
	Intermediate Egret	Ardea intermedia #
	Cattle Egret	Ardea ibis #, A
	Black Bittern	Ixobrychus flavicollis N, T
THRESKIORNITHIDAE	Australian White Ibis	Threskiornis molucca #
	Straw-necked Ibis	Threskiornis spinicollis #
CICONIIDAE	Black-necked Stork	Ephippiorhynchus asiaticus A (GPC), T

FAMILY	COMMON NAME	SCIENTIFIC NAME
ACCIPITRIDAE	Osprey	Pandion haliaetus #, N, T
	Pacific Baza	Aviceda subcristata #, A (GPC)
	Square-tailed Kite	Lophoictinia isura N, T
	Whistling Kite	Haliastur sphenurus #
	White-bellied Sea-Eagle	Haliaeetus leucogaster #
	Swamp Harrier	Circus approximans A
	Collared Sparrowhawk	Accipiter cirrhocephalus #, A
	Wedge-tailed Eagle	Aquila audax #
FALCONIDAE	Peregrine Falcon	Falco peregrinus #
GRUIDAE	Brolga	Grus rubicunda N, T
RALLIDAE	Bush-hen	Amaurornis olivaceus N, A, T
	Purple Swamphen	Porphyrio porphyrio #
SCOLOPACIDAE	Whimbrel	Numenius phaeopus #
	Common Sandpiper	Actitis hypoleucos A
	Grey-tailed Tattler	Heteroscelus brevipes #, A
	Ruddy Turnstone	Arenaria interpres #
BURHINIDAE	Bush Stone-curlew	Burhinus grallarius A, T
	Beach Stone-curlew	Esacus neglectus N, A, T
HAEMATOPODIDAE	Pied Oystercatcher	Haematopus longirostris #, N, A, T
	Sooty Oystercatcher	Haematopus fuliginosus N,A,T
CHARADRIIDAE	Masked Lapwing	Vanellus miles #
LARIDAE	Silver Gull	Larus novaehollandiae #
	Crested Tern	Sterna bergii #
	Common Tern	Sterna hirundo A
	Little Tern	Sterna albifrons A (GPC), T
	Black Noddy	Anous minutus A
COLUMBIDAE	Rock Dove	*Columba livia #
	White-headed Pigeon	Columba leucomela #
	Spotted Turtle-Dove	*Streptopelia chinensis #
	Brown Cuckoo-Dove	Macropygia amboinensis #
	Emerald Dove	Chalcophaps indica #, A
	Crested Pigeon	Ocyphaps lophotes #
	Bar-shouldered Dove	Geopelia humeralis #
	Wompoo Fruit-Dove	Ptilinopus magnificus N, T
	Rose-crowned Fruit-Dove	Ptilinopus regina N, T
CACATUIDAE	Glossy Black-Cockatoo	Calyptorhynchus lathami N, T
	Galah	Cacatua roseicapilla #
PSITTACIDAE	Rainbow Lorikeet	Trichoglossus haematodus #
	Scaly-breasted Lorikeet	Trichoglossuschlorolepidotus#
	Double-eyed Fig-Parrot	Cyclopsitta diophthalma A, T
	Eastern Rosella	Platycercus eximius #
	Swift Parrot	Lathamus discolor N, T
CUCULIDAE	Fan-tailed Cuckoo	Cacomantis flabelliformis #
CENTROPODIDAE	Pheasant Coucal	Centropus phasianinus R

FAMILY	COMMON NAME	SCIENTIFIC NAME
TYTONIDAE	Masked Owl	Tyto novaehollandiae R, N, A,T
	Barn Owl	Tyto alba R
	Grass Owl	Tyto capensis N, T
PODARGIDAE	Tawny Frogmouth	Podargus strigoides #, R
AEGOTHELIDAE	Australian Owlet-nightjar	Aegotheles cristatus #
ALCEDINIDAE	Azure Kingfisher	Alcedo azurea #
HALCYONIDAE	Laughing Kookaburra	Dacelo novaeguineae #, R
	Sacred Kingfisher	Todiramphus sanctus #
	Collared Kingfisher	Todiramphus chloris A, T
MEROPIDAE	Rainbow Bee-eater	Merops ornatus #
MALURIDAE	Superb Fairy-wren	Malurus cyaneus #
	Variegated Fairy-wren	Malurus lamberti #
PARDALOTIDAE	Spotted Pardalote	Pardalotus punctatus #
	Striated Pardalote	Pardalotus striatus #
	White-browed Scrubwren	Sericornis frontalis #
	Mangrove Gerygone	Gerygone levigaster #
	Brown Thornbill	Acanthiza pusilla #
MELIPHAGIDAE	Little Wattlebird	Anthochaera chrysoptera #
	Noisy Friarbird	Philemon corniculatus #
	Blue-faced Honeyeater	Entomyzon cyanotis #
	Noisy Miner	Manorina melanocephala #, R
	Lewin's Honeyeater	Meliphaga lewinii #
	Brown Honeyeater	Lichmera indistincta #
	White-cheeked Honeyeater	Phylidonyris nigra #
	Scarlet Honeyeater	Myzomela sanguinolenta #
PETROICIDAE	Eastern Yellow Robin	Eopsaltria australis #
CINCLOSOMATIDAE	Eastern Whipbird	Psophodes olivaceus #
PACHYCEPHALIDAE	Golden Whistler	Pachycephala pectoralis #
	Rufous Whistler	Pachycephala rufiventris #
	Little Shrike-thrush	Colluricincla megarhyncha #
	Grey Shrike-thrush	Colluricincla harmonica #
DICRURIDAE	White-eared Monarch	Monarcha leucotis N, A, T
	Magpie-lark	Grallina cyanoleuca #
	Grey Fantail	Rhipidura fuliginosa #
	Willie Wagtail	Rhipidura leucophrys #
	Spangled Drongo	Dicrurus bracteatus #
CAMPEPHAGIDAE	Black-faced Cuckoo-shrike	Coracina novaehollandiae #
	Barred Cuckoo-shrike	Coracina lineata N, T
ORIOLIDAE	Figbird	Sphecotheres viridis #
ARTAMIDAE	White-breasted Woodswallow	Artamus leucorynchus #
	Grey Butcherbird	Cracticus torquatus #
	Pied Butcherbird	Cracticus nigrogularis #
	Australian Magpie	Gymnorhina tibicen #, R
	Pied Currawong	Strepera graculina #
CORVIDAE	Torresian Crow	Corvus orru #, R

FAMILY	COMMON NAME	SCIENTIFIC NAME
PTILONORHYNCHIDAE	Regent Bowerbird	Sericulus chrysocephalus N
PASSERIDAE	House Sparrow	*Passer domesticus #
	Red-browed Finch	Neochmia temporalis #
DICAEIDAE	Mistletoebird	Dicaeum hirundinaceum #
HIRUNDINIDAE	Welcome Swallow	Hirundo neoxena #
	Tree Martin	Hirundo nigricans #
ZOSTEROPIDAE	Silvereye	Zosterops lateralis #
REPTILES		
CHELIDAE	Eastern Long-necked Tortoise	Chelodina longicollis R
AGAMIDAE	Eastern Water Dragon	Physignathus lesueurii #
	Eastern Bearded Dragon	Pogona barbata R
SCINCIDAE	Fence Lizard	Cryptoblepharus virgatus #
	Major Skink	Egernia frerei N
BOIDAE	Carpet/Diamond Python	Morelia spilota #, R
AMPHIBIANS		
MYOBATRACHIDAE	Common Eastern Froglet	Crinia signifera #
	Wallum Froglet	Crinia tinnula N, T
	Red-backed Toadlet	Pseudophryne coriacea #
HYLIDAE	Wallum Tree Frog	Litoria olongburensis N, T
BUFONIDAE	Cane Toad	*Bufo marinus #
FISH		
ANGUILLIDAE	Long-finned Eel	Anguilla reinhardti #
PLATYCEPHALIDAE	Flathead	Platycephalus sp. #
INVERTEBRATES		
PAPILIONIDAE	Orchard Butterfly	Papilio aegeus aegeus #
PIERIDAE	Common Grass Yellow	Eurema hecabe phoebus #
	Monarch	Danaus plexippus plexippus #
	White	Delias sp. #
NYMPHALIDAE	Common Australian Crow	Euploea core corinna #
	Evening Brown	Melanitis leda bankia #
	Tailed Emperor	Polyura pyrrhus sempronius #
	Glasswing	Acraea andromacha andromacha #
LYCAENIDAE	Genoveva Azure	Ogyris genoveva ssp. genoveva #
CURCULIONOIDEA	Diamond Weevil	Chrysolophus spectabilis #
HEPIALIDAE	moth	Abantiades magnificus #
OCYPODIDAE	Ghost Crab	Ocypode sp.

KEY

# =	Recorded during this survey
N =	National Parks & Wildlife Service Report on Billinudgel Nature Reserve (1996) and/or Wildlife Atlas Database
A =	Record published in NSW bird Report in Australian Birds journal
A (GPC) =	Record of G.P. Clancy published in Australian Birds journal
R =	Roadkill record collected by G.P. Clancy
* =	Introduced species
T =	Threatened Species listed under Threatened Species Conservation Act, 1995

APPENDIX D

PLANNING CONTROLS SUMMARY

APPENDIX 1, Relevant Plans and policies

DCP 1	Observation on potential relevance to floodplain management plan
B3.3 Road Hierarchy	Road heirachy with cul de sacs more likely to isolate flooded areas
	but, emphasis on lower order roads reduces area of impermeable surfaces
B3.6 Public open space	Quality of open space should not be compromised
B3. 7 Lot size	Suitability of house raising option will depend on size of lot
B3.9 Storm water drainage	Recognises value of road reserve as floodway
B6.7 Grass drainage swales	Accepts grass drainage swales
C3.7 Building height plane	Suitability of house raising option related to building height plane
G4.1 Car parking	Suggesting brick/paver for drives minimises impervious surfaces
H1.2 Landscaping objectives	Emphasises landscaping to be low impact and mitigate local climatic conditions
H4.5 Run-off control	Emphasises retarding basins complemented with planting
H5.2 Drainage retardation basins	Emphasises role of mounds/basins as landscaping features
J2.2 Coastal erosion land	Precinct 2 (inc. part Ocean Shores) residential (re)development to be relocatable
J3.1 Coastal erosion land	Restrictions on works that might restrict demounting buildings
DCP 14c	
6.9 Building setbacks	House raising may require greater setbacks
DCP 14a	
untitled page	Emphasises visual amenity, views of Brunswick river, discourages development which will increase problems associated with natural hazards
A2.12 Landscaping	Appropriate planting "native endemic planting"
A2.17 Open Space/ recreation areas	Riverside reserves managed for protection of flora and habitat*
A2.19 Flood liable land	Habitable rooms required to be above 1% flood level
Byron Bay LEP 1988	
schedule 1, aims, objectives	Discourages development of land adversely affected by flooding/soil erosion
7a Wetlands zone	Environmental protection area subject to SEPP14, Coastal wetlands
7b Coastal habitat zone	Prohibits development detrimental to landscape qualities/ flood mitigation
7f1 Coastal land zone	Development only if no detrimental affect on/by coastal processes
8a Nature Reserve	Conservation and recreation value should be protected by plan
Part 3, div.3(2) Certain development	Devt. of permanent flood overflow/ocean entry is designated development
Part 3, div.3(3) Certain development	flood mitigation works are designated development
" " "	Development on flood liable land only if no adverse affect on flooding is demonstrated

* Importance cannot be ascertained with information available

APPENDIX 1, Relevant Plans and policies

Development adjoining wetland	Fill, clear, excavation only after consideration of effect on flora/fauna and water table
Residential development strategy	*
North Coast Planning Strategy	
Residential development	Emphasises importance of complementing areas sensitive coastal location
North Coast R.E.P 1988	
SEPP 14 Coastal wetland applies	
SEPP 26 Littoral Rain forest	
SEPP 44 Koala Habitat	
SEPP46 Protection and management of	
native vegetation	

* Importance cannot be ascertained with information available

APPENDIX E

COMMUNITY CONSULTATION

APPENDIX E.1

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33 Byron Street
Byron Bay NSW 2481
Attention: **Mr M Looyan**

The Secretary
Tweed-Byron Greens LETTER RETURNED
P O Box 685
Brunswick Heads NSW 2483
Attention: **Mr T Talbot**

The Secretary
Brunswick River Protection Committee
P O Box 925
Mullumbimby NSW 2482
Attention: **Mr D Dey**

The Manager
Bunswick-Byron Fishermans Co-operative Ltd
Pacific Highway
Brunswick Heads NSW 2483

The Editor
Byron Shire News
Bangalow Road
Byron Bay NSW 2481

The Co-ordinator
Brunswick Catchment Management Committee
P O Box 796
Murwillumbah NSW 2484
Attention: **Ms Suzanne Byrne**

Aboriginal Land Council
2 Orion Street
Lismore NSW 2480

Tweed Byron Local Aboriginal Land Council
9 Morton Street
Chinderah NSW 2487

Koori Mail
1/73 Magellan Street
Lismore NSW 2480

The Secretary
Billinudgel Progress Association
C/- Billinudgel Hotel
P O Box 312
Billinudgel NSW 2483

The Secretary
New Brighton Progress Association
C/- New Brighton Shop
New Brighton NSW 2483

The Secretary
Brunswick Valley Historical Society
2 Jubilee Avenue
Mullumbimby NSW 2482

The Secretary
Ocean Shores & District Garden Club Inc.
Ocean Shores NSW 2483
Attention: **Ms Joan Mills**

Byron Environment and Conservation Networ
(BEACON)
P O Box 445
Byron Bay NSW 2481

Byron Environment Centre
33 Byron Street
Byron Bay NSW 2481

Conservation of North Ocean Shores (CONOS)
P O Box 343
Brunswick Heads NSW 2483

North Coast Environment Council Inc.
C/- Environment Centre
33 Byron Street
Byron Bay NSW 2481

Streamwatch
P O Box 371
Grafton NSW 2460

Surfrider Association
P O Box 444
Mermaid Beach Qld 4218

Tidy Towns
28 Seaview Street
Byron Bay NSW 2481

New Brighton Dune Care Group
27 The Esplanade
New Brighton NSW 2483

Ms Liliana Corriedor
Brunswick Total Catchment Management
C/- McAuley
Mill Road
Huonbrook NSW 2482

APPENDIX E.2

SUMMARY OF RESPONSES

APPENDIX E.2

SUMMARY OF RESPONSES

Jim Mangleson	26 March 1996
Brunswick River Protection Committee	23 April 1996
New Brighton Progress Association	28 April 1996
Telstra	29 April 1996
Department of School Education	30 April 1996
Roger Buck	30 April 1996
Landcom	30 April 1996
Matthew Lambourne	1 May 1996
Brunswick Valley Historical Society	3 May 1996
Department of Housing	3 May 1996
L Lowe	5 May 1996
TAFE	7 May 1996
Transgrid	10 May 1996
NSW Department of Agriculture	13 May 1996
NorthPower	13 May 1996
NSW Fisheries	15 May 1996
RTA	15 May 1996
Jim Mangleson	16 May 1996
Department of Urban Affairs & Planning	20 May 1996
Environmental Protection Authority NSW	23 May 1996
MSB Waterways Authority	23 May 1996
State Emergency Service	29 May 1996
NSW National Parks and Wildlife Service	30 May 1996
Railway Services Group	31 May 1996
Matthew Lambourne	4 August 1996
Rail Access Corporation	17 September 1996

APPENDIX E.3

RESPONSES

Job 95-049

Fax to Bill Patterson 26th March 1996.
from
Jim Mangleson.

Dear Bill,

Enclosed recent newspaper article that may be of assistance.

I have spent the past 25 years researching the man made changes to the coastal area in the vicinity of the Marshalls Creek Floodplain and have written a book on the subject.

The map with this article is made from a compilation of old aerial photographs and Surveyor Generals maps.

I have received since this article, original colour photos and negatives of the closing of the flood outlet at North Ocean Shores by the American developers under Council instructions.

I also have copies of a series of aerial photographs showing dramatic changes to the dunal system in the vicinity of this closed outlet in the early 40's that coincide with major rainfall events recorded in the annual rainfall charts.

I would be happy to provide Lex Neilsen with any information I have (Photos. maps, Cranston Report, Council Minutes etc.) but the book I have written on the subject has not been published yet and I would prefer to keep it's content confidential.

Regards

Jim Mangleson
066 843300
Fax 066 843302

IN THE DRINK?

In your last edition you published comments attributed to Larry Anthony which stated that he had "vivid memories of travelling along the dirt road from South Golden Beach to Wooyung one night in the 80's to find myself almost in the drink because Alan Bond had made an illegal canal cutting right through to the ocean".

The only problem with that statement is that the only cut of the dirt road (the road incidentally is illegal) was made by the American developers of the Ocean Shores estate, Princess Properties, as a condition of development consent for the construction of the canal in the early 70's.

Having followed that development condition the canal was open to the ocean until late 1976 when it was ordered closed by the council in July 1976.

This was done only after the developers, Princess Properties, had council accept liability for the increased flood heights caused by the closure.

This acceptance by Council of liability for consequent flooding caused by this closure is clearly documented in Council minute 631 dated 27th July 1976.

There were several warnings to Council of their liability caused by this closure and their non compliance with the development conditions by the Public Works Department, including a warning from the Minister for Public Works who in 1982 in part told Council it "is likely to be in an invidious position in the event of flooding and damage to property".

Council lost their planning powers in the early eighties and a planning administrator Jim Waugh appointed an acting manager to Council Ray Rawson, who in turn appointed a retired engineering acquaintance, Mr Frank Cranston, to examine the deed of agreement between the development company and the government of the day to investigate if there were any bonding issues still outstanding on the development.

The original development was covered by a deed of agreement between the government and the development company which bonded various issues including the flood outlet before the land was allowed to be developed or sold.

Frank Cranston on 2nd December 1986 issued a confidential report to Councillors which "contained potentially damaging material" that confirmed he had found both the council minute of 1976 and subsequent government warnings of council's liability for flooding caused by the closure. He went further and warned the flooding now not only affected Ocean Shores but Golden Beach as well.

In his report Cranston also acknowledged Council had held a bond for the outlet since the early 70's.

This report by Cranston was censored before release to the public and reference the liability of council was covered over by a thick black line.

Original Councillor copies contain the uncensored clauses and of course the Council Minutes are still intact because they cannot be censored.

I have been informed that Cranston has since denied that he wrote the report in the uncensored version, which is a ridiculous claim.

On Mothers' Day 1987 there was a heavy rain event in the Shire and property flooding occurred in the area as the floodwaters could no longer escape to the ocean because of the outlet closure. Properties were inundated in areas that had not been flooded before in 1974.

In fact in 1974, in a much worse rain event, which was also coupled with the highest recorded tidal surge on the east coast of Australia (caused by heavy cyclonic activity) there were no properties flooded at Ocean Shores.

Readers may recall the flooding in Brisbane and the destruction of a village called Sheltering Palms immediately north of the north break wall at Brunswick Heads during the 1974 event, when 22 houses were destroyed.

During the flooding of Mothers' Day 1987, there were repeated calls from the flooded residents and from the State Emergency Services (confirmed by SES log books) to reopen the closed outlet to relieve the flooding but these calls were ignored by Council engineer of the day, Greg Alderson.

A couple of days after the Mothers' Day flood, I chaired a meeting at our Ocean Shores Roundhouse sales office (there being no community halls in the area at the time) where aggrieved residents and SES officers confirmed those calls to open up the blocked outlet.

Prior to and after the flood of 1987, the development company (which was sold to a Bond company in 1981 by my real estate firm) offered to reopen and maintain the closed outlet. Council steadfastly refused this offer.

Early aerial photos clearly show several flood outlets to the ocean between New Brighton and Wooyung and a Lands Department map dated October 1887 show a major outlet at Wooyung to the ocean from Billinudgel Creek.

This major natural outlet is also now closed.

The bund erected across the canal in the early 90's at North Ocean Shores is also in breach of the development consent conditions given to Bond's company for the release of the canal blocks as that consent was conditional upon the construction of a bridge.

This bund was constructed by a later development company, MBOWN, who bought that part of land previously owned by the Bond company and this bund is also a major cause of further flooding in the area.

The myth of the size of Billinudgel Wetland and claims of illegal openings to the ocean has been created by a local environmental lobby BEACON and was started in 1983 when BEACON had a major input into the Draft Plan for the area in 1983.

You will find acknowledgements in the Council Planning papers supporting the Draft Plan, produced by planning consultants for Council in 1983 of that BEACON input and also their misleading statements in relation to the "history" of the natural outlets to the ocean in this area.

I suspect it was created by BEACON to try and block development in the area without them being aware that the process of actually creating this large artificial wetland has caused considerable harm to existing residential development built to safe flood levels prior to these blockages occurring.

It is unfortunate that the myth has been repeated by both newspapers and politicians alike in their haste to align themselves with green votes in our area.

It is easy to produce predevelopment photographic evidence of the area now called Billinudgel Wetland that shows no areas of permanent water and defined dry flood path channels to the ocean, now blocked by man made obstructions.

One classic is that of the actual construction of Golden Beach showing the bulldozing of a large area of ground into a major outlet channel to the ocean in the vicinity of Helen Street."

The surveyor for that Golden Beach project is still alive and is happy to confirm that he warned the Council of the day that the area would flood if blocked and should never have been filled.

After the 1987 Mothers' Day flood, Byron Council reinforced the closed outlets in the area by bulldozing sand up from the beach to create a large frontal dune to replace sand lost to beach erosion caused by the retaining walls built by PWD.

PWD have acknowledged in their own reports that these walls at the mouth of the Brunswick River have accelerated beach erosion significantly.

This action of blocking outlets by Council is in distinct contrast to actions taken in Byron Bay where periodically the sand is removed from the Belongil to allow floodwaters to escape in that area.

Strangely Council had no similar reservations about cutting a channel through an area in Byron Bay at Pacific Vista estate (which was clearly identified as being of significant aboriginal importance in the same 1983 planning papers) when that area also flooded badly in 1987.

The rock wall erected across the mouth of Marshalls Creek in the early 60's has been identified as a major source of blockage by Robin Warner for Webb McKeown and Associates, Council's current flood consultants.

These same flood consultants have now computer modelled conclusively that if these outlets were open to the ocean and the accumulation of sand caused by these blockages were removed from the river, no flooding would occur in the Ocean Shores area as planned by the original developers of the estate.

There would be massive reductions in flood levels elsewhere.

The other benefit to dredging and removing these accumulated blockages is that the water quality within the canal and the river would dramatically improve if there was an efficient tidal flushing throughout the system. Something that has been self evident to most long term residents for years.

This of course doesn't mean you should automatically develop these areas behind these natural outlets as these flood paths, while not containing any water 99% of the time, should remain available to reduce flood levels when flood rains do occur.

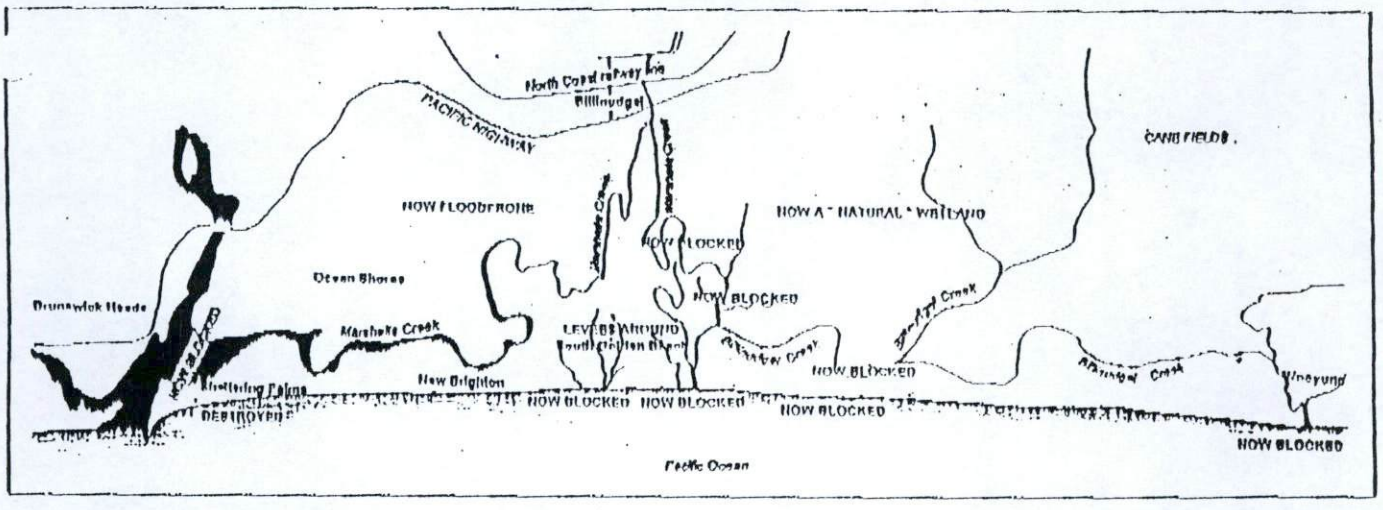
I find it amusing when we have people calling the water in the existing North Ocean Shores area "natural" when these water areas were created by bulldozers by the original American developers less than 25 years ago."

In order to fully appreciate the man made changes that have recently created the wetland behind Golden Beach, I provide a copy of a map drawn accurately from historical photographs and surveyed early Lands Department maps of the natural drainage pattern for the area to the ocean, with the subsequent man made changes to that historical drainage.

While never having been a fan of Alan Bond, I don't think Larry can blame him for something he never did. Either the drink Larry vividly remembers almost going into one night was pre 1976 when the canal was legally open to the ocean, or more likely, it was indeed the early 80's as claimed by him, and it was one of the huge water filled holes that appears regularly on the old mining road between Wooyung and Golden Beach every time it rains, that he nearly went into.

From the easily documented facts, it is also very evident that Alan Bond never legally or illegally cut the canal into the ocean and I hope that if Larry is indeed "aiming to provide Richmond with a strong and effective voice" he has a better " vivid" memory recall than that attributed to him on this issue.A

-Jim Mangleson



This map has been drawn from historical aerial photographs which clearly show the natural drainage pattern for the catchment area.

It is evident that the central natural system of Marshalls Creek and Billinudgel Creek has been totally removed in the vicinity of South Golden Beach, and that village has now been surrounded by levee banks to protect it from the consequential rise in floodwaters.

The mouth of Marshalls Creek has been blocked by a rock wall configuration built in Reedings Bay by the Public Works Department in the 1960's.

The major natural outlet of Billinudgel Creek to the north of South Golden Beach has also been closed by man made obstructions.

The loss of a small village called Sheltering Palms, immediately north of Brunswick Heads, occured in 1974 and was a direct result of the erection of sea walls by the Public Works Department during the 1960's.

As a consequence of these major alterations to the natural drainage system, an area to the north west of South Golden Beach has now become a swamp and all areas to the south of the blockages in the South Golden Beach area have now become floodprone.

Brunswick River Protection Committee

the Secretary
B R P C
PO Box 925
Mullumbimby 2482

The Manager
Paterson Consultants
60a Prince Street
GRAFTON 2460

23 April, 1996

MARSHALLS CREEK FLOODPLAIN MANAGEMENT PLAN

Dear Bill

The Committee has been informed that you have been engaged to prepare the above plan for Byron Shire Council. We wish to introduce ourselves as a group of local residents concerned with the state of the waterways in the Brunswick Valley, including Marshalls Creek. A copy of a brochure outlining our philosophies is enclosed for your information.

Like many others our observation of the timeframe of the degradation of our river system leads us to conclude that human activity both in the catchment and in the waterways is the basic cause of the degradation. We are therefore extremely concerned about activities which interfere with the behaviour of the natural water system. We would like to see Marshalls Creek return to its former beauty, one of the main reasons why people reside here.

We wish to make contact with you, to be put on any mailing list you may have and to offer our services as a group including residents of the floodplain and long-term residents of the area. Please keep us informed of public meetings and consider consulting us, especially on environmental issues which we understand are one area of concern nominated in your brief.

Yours faithfully

Duncan Dey

(Duncan Dey)
for the Committee

Paterson Consultants
26 APR 1996
DOCUMENT RECEIVED
JOB NO: 95-049
ITEM NO:
ACTION: .....
.....

WHAT CAN YOU DO?

Look at the list above and see where you fit in.

If you are farming the land (and keeping the rest of us fed) ask your local department (NSW Agriculture 842100) about the techniques that minimise erosion, or that reduce the need for chemicals. Large proportions of these wind up in the river either killing aquatic life or growing the wrong ones. Can you farm with less chemicals than you have done? 1% of produce is now organically grown in Australia.

Ask the water people (Land and Water Conservation 427799) about the significance of the "Riparian Zone", that part of the valley right beside the river.

Talk to your older generation about the shape of the river in the old days. Was it deeper or shallower, faster or slower, saltier or fresher, more waves or less, etc.? Are there fewer fish than then, fewer birds, different species? How do they feel about the river?

Find out through the Council notices or your local Progress Association about developments in your area and ask the Council to modify or refuse ones that fill or drain the land. Each development of this kind is considered by Byron Shire Council following a Development Application that you may read and write in about. The Council needs your help to understand the issues. The environment needs you to speak up for it. If you live here, you are a custodian of the environment, and deserve a healthy place to live.

DON'T POO POO THE BRUNSWICK

If you live in town, you're probably connected to the sewerage system. A sewer is a large pipe running along under the ground past your house. It transports liquids away from your place by flowing downhill. The liquids carry solids with them. Everything you put in the toilet, the sink, the washing machine, the bath, and the shower goes down the sewer. It only works when everything is flowing - it requires water as the transport medium. The sewer also collects rainwater by mistake, and some factories and shops put things down the sewer different from what you do at home.

This is great for getting rid of things you don't want, but they all finish up in the river! The sewer takes them ever downwards to a sump from which they are pumped over to the treatment works. They get "treated" which is an attempt to separate the water back out from the rest. The water gets dumped, along with whatever couldn't be retrieved from it. The amounts retrieved are quite small. What gets dumped includes most of what you put down the sewer. In the Brunswick Valley, all three Sewage Treatment Works (STWs) dump into arms of the Brunswick River.

Everyone in town is forced to connect to sewerage and must have a flushing "water closet". Ask Council and State politicians to change legislation to allow and encourage people to have "dry" composting toilets in town. They keep human excreta out of the sewer in the first place, and provide compost for your garden. They are cheap and are not a health hazard. They don't even smell.

If there is no toilet connected, the rest of that house's sewage is called "Grey Water". Ask Council and State politicians to change legislation to allow and encourage people to re-use grey water on the garden.

Think about the chemicals you use at home, like cleaning agents for your teeth, body, clothes, wash-up, household, pet, car, etc. Can you use less? (you don't have to use as much toothpaste as the models on TV do, try it). Use brands of cleaning agents that are environmentally friendly, but use less of them too. Buy detergent with "No Phosphates", phosphates can't be treated. They pass straight to the river and grow algae there, and the wrong kinds of fish.

Basically, the more things you keep the out of the sewer, the healthier a river you'll have. Would you rather be squeaky clean, or have a river you can swim in.

WHAT THE COUNCIL IS DOING

Byron Shire Council has acknowledged that there are water quality problems in the river and it has various roles in solving them. In its May 95 "Council Promotion" the Council says "Our rivers are polluted from deteriorating sewerage structures, rural runoff and urban drainage." Council's responsibilities to the river stem from its activities including:

a. controlling all forms of development in the Shire
b. ensuring that those developments are carried out as approved in the paperwork;
c. construction and repair of infrastructure like public roads, sewerage, parks, etc.;
d. weed control in public spaces;
e. management of stormwater from urban areas;
f. operation of three sewage treatment works.

Unfortunately past practices have meant that none of these roles has respected the river. There is a huge deficit of care. Council is aware that it will not be able to clean up the river single-handed. "Solutions require community-wide action, both in measures to reduce pollutants and coming up with the necessary finances to address infrastructure shortfalls."

Of course the Council has final say on its activities (like a to f above) and may still need convincing of the importance of orienting them towards a clean river. You can help by telling them this, especially at election time.

WHAT STATE GOVERNMENT IS DOING

Various authorities are involved and each is aware of public concern for the state of the Brunswick River. The Environment Protection Authority licences all discharges to the river and requires a Pollution Reduction Program for any discharge it believes is polluting. One has recently been required for the STW at Mullumbimby. Any new works that include a discharge to the environment must get Pollution Control Approval from the EPA before building.

Land & Water Conservation study the normal behaviour of our waterways. NSW Public Works help design and finance major public works, like the new sewage treatment works at Ocean Shores.

5.

WHAT THIS COMMITTEE IS DOING

BRPC is a community group concerned about water quality in our beautiful valley. Its activities to date have included a general community meeting in February and a Clean River Rally which demonstrated public support for its aims of cleaning up the river. A series of motions put by the Rally has been passed on to Byron Shire Council and will again be submitted in June as a petition. The motions read:

1. that we censure Council for allowing the Brunswick River to become polluted,
2. that new sewage treatment works be built to replace the obsolete ones draining to the Brunswick. No more bandaids! A Council who can find $7.7million for a new headquarters can find a few million for that,
3. that Council be more open and consult with and inform the community on all aspects of sewerage, starting immediately with the repair proposal for the Mullumbimby plant and with the publication of test results,
4. that Council undertake adequate monitoring to ensure our health and erect notices in prominent places when limits are exceeded,
5. considering the state of sewage treatment on the Brunswick and the lack of testing for viruses, that we hold Council liable for the public health of river users,
6. that there be no further development until the sewage treatment problems are resolved.

BRPC plans to establish and operate a long-term water quality monitoring network in the valley under the state government's Streamwatch program. The Council supports the Committee's monitoring plans and has recently expanded its own river testing.

BRPC is liaising with local and state government to see that each is aware of the poor state of the river. By raising their attention to the problem, it hopes to get action and have each authority fulfil its legislative function. If the legislation falls short, it will lobby politicians to change the legislation. We appeal to residents of the Brunswick Valley to understand the nature of the problem, to do what they can to help and not to accept anything less than a clean river.

Brunswick River Protection Committee

the Secretary
B R P C
PO Box 925
Mullumbimby 2482

WHAT HAPPENED TO THE BRUNSWICK?

Once upon a time there was a beautiful little valley through which the most easterly river on the mainland of Australia flowed. The water in the river was clean and the environment was shared amongst all the life-forms that lived in the valley. There was a general balance with a coming and going of natural events like flooding, drought, tides, seasons, ice ages, and species.

The area was so beautiful that Europeans even settled here, with their funny values. We enjoyed the river and most old people can still recall their connections to the Brunswick River for food, transport, recreation, peace. But we changed the balance with our large scale activities like:

- removing vegetation from the catchment, and even from the banks;
- opening the soils to erosion;
- adding chemicals like fertilisers, herbicides, and pesticides to the catchment;
- reshaping the mouth river to suit our transport;
- draining the wetlands that are part of the river's biology;
- blocking and filling the lowlands where flood and tide used to spread;
- even adding chemicals and nutrients straight into the river itself.

Some members of the community think that a beautiful river is worth the effort. You can swim in it, or watch the other aquatic life in it, or eat the fish out of it, or just think what a good thing it is to have around. Others think that it's a place to get rid of anything you don't want, because the river will carry it away cheaper than any other means of transport. Many people are still learning about the relationships between the river and sources of pollution like the ones above.

WHAT CAN YOU DO? see page 2.

NEW BRIGHTON PROGRESS ASSOCIATION INC

P.O. New Brighton 2483 tel 066 801 055

April 28, 1996

Mr K. W. Paterson
Paterson Consultants
60A Prince St
Grafton NSW 2460
Fax 066 42 7566

Dear Sir

In reply to your letter 21.4.96 your ref. 95-049 concerning flooding on the Marshall's Creek Flood Plain.

We particularly draw your attention to two issues.

Firstly we want a ban on fill on the floodplain. There are a number of other solutions to building and every bit of fill incrementally increases the flood risk in already flood prone areas.

Secondly, we feel partial or total quarantine of development on the floodplain is essential. There are already enough building blocks available, too many people and Brunswick River and Marshall's Creek are heavily polluted.

While it may be suggested that the other options would negate the need for No Fill and Quarantine, we would like to point out that the other options, Outlets, dredging etc, are way down the track and unproven while the No Fill and Quarantine options can be activated by the stroke of a buearocratic pen, and AT NO COST.

We also have grave concerns at the speed of the water level rise in the 1995 flood, with relatively little rainfall (12 "). The most obvious cause of this rapid rise compared to other floods was the massive earthworks used to fill the Eldorado Estate at Billinudgel in 1994, demonstrating starkly how fill affects flooding downstream and upstream.

Finally we would like to raise the issue of acid-sulphate soils in the area, we have had two classic occurrences of this phenomena recently, both of which caused fish-kills in the Capricornia Canal but extended the full length of Marshall's Creek. The cause was disturbance of soils in the catchment upstream of the Canal in the preparation of a cane farm.

It appears to this Association, that this fragile ecosystem is at saturation point. We are now well into the process of polluting our own nest. Our children can no longer swim in the River System and residents are at serious health risk when weather conditions produce algal blooms and disturbance of soils causes fish-kills. We experience much worse flooding with less rain than we did some years back and we are angry that our repeated warnings to Council have been ignored to date.
Owing to the shortness of time, we are sending only this abbreviated submission, we have plenty of documentation on file if this is of interest to you. Please feel free to contact us at any time.

We are relying on you as authorities in the field to bring some sanity to the future of our area.

Sincerely Yours,

Andrew Hall
VICE PRESIDENT
802027

Ruth Ashton
SECRETARY
801055

Telephone (066) 230321
Facsimile (066) 230310

Telstra
26 Bounty Street,
Postal Address
PO Box 1000
LISMORE 2480

Paterson Consultants
Engineering, Planning and Environmental Services.
PO Box 596
GRAFTON NSW 2460

Dear Sir,

Re: Marshalls Creek Floodplain Management Plan.
(Reference 95:049)

With Reference to the above study Telstra has a number of cables that traverse through this area. These cables were installed under the Telecommunications Act 1991 Part 7 section 128,129 and 131 taking into consideration the access to and flood effects on this network.

Should there be a need for Telstra to relocate or repair any network due to the excavation of any drains, channels or the daming of certain sectors then these costs are to be borne by your client .

The amount of resources and funding should we be required to relocate Telstra's network cannot be supplied until a working plan is prepared.

Trusting this will assist with your study.

.....
Barry Fisher
Northern Sector CAN Planner
NSW Country and ACT Region
29 April, 1996

Paterson Consultants
3 MAY 1996
DOCUMENT RECEIVED
JOB NO: 95-049
ITEM NO:
ACTION: .....
.....

FAX MESSAGE

Department of School Education
North Coast Region
PO Box 422
LISMORE NSW 2480
Telephone : 066 211761

TO: *Paterson Consultants Pty Limited*

Attention: *K.W.Paterson*

From: *Margaret Campton-Jones*

Subject: *MARSHALLS CREEK FLOODPLAIN MANAGEMENT PLAN*

Regarding your correspondence of the 22 April, 1996 concerning the above matter I would like to thank you for the opportunity to comment but must inform you that the Department of School Education is presently restructuring and the North Coast Regional office is winding down its operations, with all functions being transferred to the Department's office in Newcastle.

Accordingly, I have forwarded your letter to the Newcastle office and advise you of their address and possible contact person :

Mr Barry Wheeler
Department of School Education
NSW Government Offices
Level 1 Bull Street
Newcastle NSW 2330

I trust this is satisfactory.

Regards,

M Campton-Jones

Margaret Campton-Jones

30th April, 1996

ATTENTION; BILL PATERSON
FAX NO 066-427566

RE: MARSHALLS CREEK FLOODPLAIN MANAGEMENT PLAN
COMMUNITY NEWSLETTER APRIL 1996

I would like to have the opportunity to have input into the plan to ensure that existing and future development can proceed whilst minimising flood impact.

My interest is as a local resident and land owner of some twenty years.

I have commissioned (1994/1995) many thousands of dollars of current Engineering research keyed in with the Webb McKeown computer flood models for sites within the flood plan area.

2nd May, 1996

I attended segment of your Community Contact meeting at the Ocean Shores Public School yesterday evening. I can only say I don't envy you the task of satisfying all the divergent needs and opinions expressed. I don't think its possible.

I would appreciate the opportunity to have further imput without monopolising your valuable time. Please phone me at your earliest convenience.

My position is that development that doesn't exacerbate existing flooding conditions should be considered on its merits and that the flood plain management plan NOT be used as a tool to alienate future potential landuse options. After all the flood plain Management Plan is about managing floods NOT stopping development.

Best Regards,

Roger Buck

Ph. 066 851754 W
018 660240 M
Fax 066 851966

Enterprise House
1 Fitzwilliam Street
Parramatta NSW 2150
Australia
DX 28448 Parramatta
Phone (02) 841 8600
Fax (02) 841 8688
International Access (61 2)

The Director
Paterson Conssultants Pty Ltd
P.O. Box 596
GRAFTON NSW 2460

HD/DEDDEN/002/PH

30 April, 1996

Attention K W Paterson

Dear Sir,

Re: Marshall Creek Flood Plain Management Plan

I refer to your letter of 22 April 1996, in which you request a submission regarding the subject matter

As Landcom has no land holdings nor any other interests on the New South Wales North Coast, it is not appropriate for Landcom to make a submission towards the subject study.

Yours faithfully,

Keith Dedden
General Manager, Operations
LANDCOM

7 Konara Dr,
Loganholme
Qld 4127
1/5/96

Bill Paterson
Paterson Consultants P/L
PO Box 596
Grafton NSW 2460

Paterson Consultants
3 MAY 1996
DOCUMENT RECEIVED
JOB NO: 95-049
ITEM NO:
ACTION: ....
....

Dear Bill,
I enclose a copy of my submission on the Marshalls Creek Flood Study, and also a separate copy of the summary. There is also a summary at the beginning of several of the sections. Sections 2 & 3 are probably the most important, but I hope you will have time to read it all, I think you will find it interesting.

Yours,
Matthew Lambourne.

SUMMARY

The Brunswick River Floodplain Management Investigation (BSC, 1989)(the Study) fails in a number of important respects to adequately address the questions of flood behaviour and flood mitigation options in the Marshalls Creek floodplain and the Billinudgel Swamp area.

The way in which the Study has been conducted fails to comply with the principles set out in the NSW Government's Floodplain Development Manual (PWD, 1986)(FDM) in a number of substantial areas, relating to both the procedures and the content of the Study.

The Study does not follow the procedures set out in the FDM relating to the existence, role and composition of the Floodplain Management Committee; does not consider the possible impacts of ocean overtopping of the dunes and of floods of less than 1% probability; does not select the flood standard as part of the investigation; does not take account of social, economic and ecological issues in selecting the flood standard or assessing flood mitigation options; and does not consider all feasible options for flood mitigation measures.

The Study does not take account of a range of scenarios of possible greenhouse effect impacts. The reasons given in the Study for not doing so are either irrelevant or wrong. A range of scenarios of probable and possible greenhouse effect impacts should have been modelled, covering sea level rise, increases in rainfall, and increases in storm surge height due to changes in cyclone frequency and intensity.

Failure to properly consider the possible impacts of the greenhouse effect could lead to new development that might within decades be subject to frequent flooding, and mitigation works for existing settlements that do not stop flooding. The economic costs to both Council and the community could be enormous, and a significant risk to life could also occur.

The design rainfalls used in the Study are open to serious question, as they are not based on all the available information relating to both intensity and spatial distribution, and they may lead to an under-estimation of 1% design flood flows by 15-25%.

The 1% peak ocean level used in the Study (2.6m AHD) is based on a false assumption, and the 1% peak ocean level should be 3.35m AHD. The modelled assumption that peak storm surge and high tide would occur at the same time is wrong, and the effects of different relative timings of peak storm surge and high tide on flood levels in the New Brighton - South Golden Beach - Ocean Shores area should have been investigated.

The assessment of flood mitigation options in the Study is totally inadequate. Some options have not been considered at all, others have been dismissed without reason, and the assessments of most options are inadequate and in some cases contain serious errors. In particular, the performance of the proposed North Ocean Shores flood outlet in relation to flood mitigation, ocean inflow, beach recession, and possible greenhouse effect impacts is not adequately assessed, and it cannot be concluded that the outlet would have any benefit even under present conditions.

The considerable differences between the 1% design flood levels found in this Study and those found in the earlier Marshalls Creek Flood Study (PWD, 1986a) have not been explained, and may indicate that the order of accuracy of the modelling of flood flows is equal to the benefit offered by the suggested flood mitigation options.

The failure to clearly define the aims of the Study has lead to considerable public confusion over the Study's results, and the lack of information and explanation of many details of the Study make it very difficult to adequately comment on some aspects of the Study.

The Study contains many faults, some of which are of sufficient magnitude to make it of no practical use in its present form either for the purpose of rezoning land or putting conditions on the development of land, or for the planning of any flood mitigation measures.

Brunswick Valley Historical Society
Founded in Mullumbimby 1983

Paterson Consultants

6 MAY 1996
DOCUMENT RECEIVED
JOB NO: 95-049
ITEM NO:
ACTION: .....
.....

President: Mr. Jim Rose 843 139
Secretary: Mrs. Robyn Gray 884 356
P.O. Box 378, Mullumbimby, 2482

3 May 1996
Your reference: 95-049

Paterson Consultants Pty. Limited
60A Prince Street
Grafton 2460

Dear Sir,

Thank you for your invitation to participate in the consultations about the Marshalls Creek Floodplain Management Plan. It is timely that as I write, there is flooding in that area of the Brunswick Valley, so the opportunity is there to look at the real life situation once again.

We considered the subject at our last meeting, and it was agreed that there is very little that we are able to add to what you already will have collected from Byron Shire and other records. There is some anecdotal information however, which may be of interest to you.

This came to us when we gathered information about Brunswick Heads as a holiday place. Owners of holiday cabins on the north beach told of the marine wonders of Readings Bay before surplus rock supplies were dumped there at the end of the river works in the early 1960s. It seems that the water movement in that area was greatly impeded when leftovers from the training wall project became "fill" in the Bay. Since that time, it has been noticed that marine flora and fauna are not nearly so plentiful and this has been put down to the change to water flow patterns.

If this information is useful to you and you need to know more about it, please feel free to call me.

Yours faithfully,

Robyn Gray

Robyn Gray

New South Wales

DEPARTMENT OF HOUSING

NORTHERN REGION

Director
Paterson Consultants Pty Ltd
PO Box 596
Grafton NSW 2460

Our reference

Your reference

- 3 MAY 1996

Dear Sir

Marshalls Creek Floodplain Management Plan

Thank you for your invitation offering the Department of Housing to participate in the above project.

The Department has little involvement in this area and therefore will have to decline your offer.

Thanking you again.

Yours sincerely

JIM ALLEN
for The Regional Manager

51 Moonee Street, COFFS HARBOUR
P. O. Box 524 COFFS HARBOUR N S W 2450

Administration: Telephone (066)50 1300 Fax: (066)50 1388
Client Service: Telephone (066)50 1333 Fax: (066)50 1350

L Lowe
10 LAKELAR Court
OCEAN SHORES NTH.
NSW 2483

5.5.96

Dear Sir

I have received your newsletter No1 & am writing to you about 1 item in particular that concerns me namely the retaining wall erected to stop the uninterrupted flow into the MAIN BRUNSWICK River (I believe it was erected to stop the SILTING of the Main River to ALLOW the FISHING fleet etc. to navigate the River) While this situation is allowed to continue it is only transferring the problem from 1 side of the Wall to the other side, & has probably been one of the causing things in the SILTING of MARSHALLS Creek, I feel the retaining wall has to go & dredging introduced SINCE I BUILT here 8 years ago the minimum building level has been raised from the level I had to build to, & THIS concerns me especially if new MOC BARRIERS have any bearing on the RAISING of Building levels

FINALLY it would be good to see BLUE WATER along the NORTH ARM of the BRUNSWICK River once again as it used to be.

Yours Sincerely

L Lowe

Your ref: 95-049

North Coast Institute of TAFE
Directorate Office - Wollongbar
P O Box 638
ALSTONVILLE NSW 2477
Phone: (066) 28 5169
Fax: (066) 28 5288

7 May, 1996

The Director
Paterson Consultants Pty Limited
PO Box 596
Grafton NSW 2460

Dear Sir

Re: Marshalls Creek Floodplain Management Plan

Please be advised that the North Coast Institute of TAFE do not have properly interests in the study area nominated for the Marshalls Creek Floodplain Management Plan.

Consequently, unless you determine a specific need for our involvement in the plan we will remain as community observers and trust that the outcomes will not adversely affect our clients and staff who may travel to and from the subject area.

Yours faithfully

Ross Christian
Property Manager
North Coast Institute of TAFE

rc jw
File: winword/letter/marshall

TransGrid

NETWORK/TAMWORTH AREA

Northern Region - Tamworth Area
Goonoo Goonoo Road
PO Box 526 Tamworth
New South Wales 2340 Australia
Facsimile (067) 651 683
Telephone (067) 651 666

10 May 1996

Mr Bill Paterson
Paterson Consultants Pty Limited
PO Box 596
GRAFTON NSW 2460

Dear Sir

MARSHALLS CREEK FLOODPLAIN MANAGEMENT PLAN

Thank you for your request for a submission from TransGrid on this Management Plan.

TransGrid, at the present time, has no assets or planned assets in the area.

Yours faithfully

D.J. Turner
10/5/1996

D TURNER
MAINS & ENVIRONMENT ENGINEER/TAMWORTH

Wollongbar
Agricultural
Institute

NSW Agriculture

Bruxner Highway
Wollongbar NSW 2477
Australia

Telephone (066) 24 0200
Facsimile (066) 28 1744

Your Ref: 95-049
Our Ref: MB:ct

13 May 1996

Paterson Consultants Pty Ltd
PO Box 596
GRAFTON 2460

Dear Sir

MARSHALLS CREEK FLOODPLAIN MANAGEMENT PLAN

Thank you for your letter of 22nd April seeking the comments of NSW Agriculture with respect to the proposed study.

There are significant issues NSW Agriculture would like embodied in the study. These are:

- **Acid Sulfate Soil** - There is a high probability that the maps study area may contain acid sulfate soil or potential acid sulfate soil. Whilst risk have been published by Department of Land and Water Resources. I believe that a more detailed study of the area is justified in order to understand water quality in that area. There are a number of firms which have expertise in that area R.J. Smith and Associates phone 283 472 at Alstonville and Neil Sutherland, Soil and Water Control Murwillumbah phone 726 644.

- **Agricultural Land Classification** - It would appear from your map that there could well be significant agricultural land particularly in the western sector of the study area. Some of these lands are used for sugar cane production or have the potential in sugar cane production. It will be necessary for a detailed study to be carried out to identify these lands. NSW Agriculture could provide this information by way of a consultancy.

- **Prime Agricultural Land** in the Byron Shire is a limited resource. Prime agricultural land consists of land classified of Class 1, 2 or 3 or specialists lands. However, every effort should be made to preserve these land classes for future feed and fodder products. These lands should be identified in the agricultural land classification study, and any management option proposed should ensure that these lands are protected or managed in a way to provide this resource in the future.

Yours faithfully

M R BELLERT
Agricultural Environment Officer

C:\WPDATA\BELLERT\MARSHALL.LET

NorthPower

PO BOX 110
21 CARRINGTON STREET
LISMORE NSW 2480
TELEPHONE (066) 23 0666
FACSIMILE (066) 23 0651

YOUR REF: 95/049
OUR REF:
GG

13 May 1996

The Director
Paterson Consultants Pty Ltd
PO Box 596
GRAFTON NSW 2460

Dear Sir

Marshalls Creek Floodplain Management Plan

Reference is drawn to your letter dated 22 April 1996 concerning the above.

NorthPower has the following duties, obligations and powers in the study area which may be affected by management options outlined in the Newsletter:

1 To provide electricity supply to customers requesting connection in the study area.

2 To construct and maintain any overhead powerlines, underground cables and other assets necessary to provide electricity supply in the study area.

3 Ensure any earthworks or changes to the physical environment do not adversely effect NorthPower assets in the study area.

As is the normal practice associated with such works, NorthPower would expect that all costs associated with the modification, moving, lowering, raising or protection of NorthPower assets brought about by Floodplain Management would be met by Byron Shire Council.

I thank you for the opportunity to make comment on the Plan and hope that the above information is of assistance to you. Please contact me on telephone 066 23 0666 should you require any further information.

Yours faithfully

VINCE KELLY
NETWORK MANAGER
NORTH REGION

FOR FURTHER INFORMATION CONTACT: Mr Vince Kelly - Phone 066 23 0666

NSW FISHERIES

CC:gh
15 May, 1996

Mr K W Paterson
Director
Paterson Consultants Pty Ltd
PO Box 596
GRAFTON NSW 2460

Dear Sir

Re: **MARSHALLS CREEK FLOODPLAIN MANAGEMENT PLAN**

Thank you for your letter of 22 April 1996 requesting input from NSW Fisheries in regard to the above plan.

I have attached for your use Habitat Protection Plan No.1 which sets out in clear language the responsibilities for environmental protection under the Fisheries Management Act 1994.

In regard to the options outlined NSW Fisheries is particularly concerned about the proposal to dredge Marshalls Creek.

As has been previously pointed out to Byron Council and other committees and consultants who have examined this issue, Marshalls Creek contains a variety of fish habitats and as a result a potentially diverse fish community. To ascertain what values there are and to be able to accurately predict any impacts the following actions are suggested:

Address significant issues such as:

1. The value of the existing combination of habitats, in particularly shallow and deep sandy areas.

2. The impacts of removing certain habitats, e.g. shallow shoals, on fish populations in the creek.

3. Possible changes in physical characteristics of the environment that may result from dredging, and their impacts on fish.

4. The short and medium term effects of the dredging process.

To address these issues a research program is broadly described:

1. A mapping exercise to accurately locate fish habitats in the creek.

2. An assessment of benthic invertebrates located in the areas to be affected by dredging.

...2/

3. An assessment of the distribution, population structure and feeding ecology of the fish fauna of the area.

4. A compilation of environmental parameters such as temperature, salinity, oxygen, pH and sediment composition.

In order to obtain meaningful answers the following study criteria need to be adhered to:

1. Sampling should be conducted over four seasons so as to account for natural variability.

2. There needs to be control sites to guage experimental against natural variations.

3. Adequate replication is needed so as to document natural variability in the parameters studied.

4. If the dredging project is to proceed a monitoring period of about two years is needed to document parameters which may take longer than 12 months to recover from dredging effects.

Should you wish to discuss the matter any further please contact me on (066) 261 394.

Yours sincerely

Craig Copeland
Regional Biologist
Fish Conservation Management Branch

Our reference: M2190. GC:RD
Glenn Charleston (066) 401339
Your reference: 95-049

Roads and Traffic Authority
Grafton Zone

RTA

Better Roads. Safer Roads. Saving Lives.

31 Victoria Street
Grafton NSW 2460
Telephone (066) 40 1300
Facsimile (066) 40 1301
PO Box 576
Grafton NSW 2460
DX 7610

The Director
Paterson Consultants Pty Limited
Engineering, Planning and Environmental Services
60A Prince Street
GRAFTON NSW 2460

ATTENTION : K W Patterson

MARSHALLS CREEK FLOODPLAIN MANAGEMENT PLAN

Dear Sir/Madam

I refer to your letter dated 22 April 1996 concerning the above and advise that the Study Area for this Plan will be affected by the Authority's future route between Brunswick Heads and the Queensland Border.

This investigation is currently being undertaken in conjunction with the Department of Urban Affairs and Planning and the Department of Transport.

The proposed road will be required to be constructed across the floodplain above the 1 in 100 year (1% AEP) flood level.

Yours faithfully

P.J. Collins

15.MAY1996

P J Collins
Zone Manager

C:\Users\Typing\Glenn\M2190

Received
By Hand 16/5/96
95-049

Mr Bill Patterson

Dear Bill,

I have assembled some relevant documentation that should be of assistance in your presentation of background and understanding of the option preferences given by the community over now a decade and the Marshalls Creek Floodplain Committee during the past 5 years.

Firstly, I have given to Lex Nielsen copies of photographs and a Lands Department map showing major natural outlets to the ocean in the vicinity of Wooyung and Golden Beach.

All of these outlets are closed and have been closed manually.

The construction of the canal at North Ocean Shores was conditional upon the construction of a permanent outlet to the ocean.

To assess this operation, a temporary outlet was constructed and was functioning over a 4 year trial period (1972-1976).

This period coincided with the worst rainfall recorded this century and the highest ocean elevation which resulted in severe flood damage from Brisbane to Sydney.

There was no environmental damage to the area now known as Billinudgel Swamp because the floodwaters escaped through this outlet.

There was also no damage to the canefields to the north because the floodwaters in that area also escaped through this outlet.

As stated earlier there were several natural outlets prior to this canal outlet but these natural outlets were apparently blocked by sandmining in the 50's and 60's.

The construction of Golden Beach also blocked a major outlet point and this is clearly shown on Lands Department photos.

For very dubious reasons Council ordered the developers to close this outlet after 4 years of successful trialling under extreme conditions and at the same time accepted the consequences of increased flooding caused by this closure. (see annexures)

On Mothers Day in May 1987 another severe rain event occurred in the area (no elevated ocean event this time) and because this last remaining canal outlet was

blocked, floodwaters from the cane fields, instead of escaping to the ocean via the outlet flowed south through the canal and caused severe flooding in the area under investigation.

There have been several spurious attempts to prove that these outlets either do not work, never existed or are expensive or environmentally damaging.

One of these lies was quoted at the first public meeting and was obtained when the outlet was not even connected to the drainage system and modelled to the ridiculous width of 200 metres.

You will find that by examining the documentation of increase in flood heights because of these closures that the floodwaters are raised from .5 metre (Council Town Planner 15/11/83) to 178 mm 7/8/95.

Not the 25 mm given by yourself in the presentation (se annexures)

In between these figures are variations on these figures with the acknowledgement by the Shire engineer that the flood outlet made a "*significant difference*" contrary to the previous figures given earlier and quoted in your initial presentation.

The further blockage of the canal by the construction of the bund (instead of a bridge the DA consent condition) caused major damage to the canefields because the canefields floodwaters were no longer able to escape to the ocean by the natural outlets and were also now prevented from flowing south through residential properties as happened in 1987.

There is a huge amount of scepticism among residents at the studies carried out to date to prove that dredging of the river and the construction of these outlets are either environmentally damaging or prohibitively expensive because the residents know from experience that neither claim can be proven from their actual experience **under the natural conditions they are asking to be restored.**

The claim that the outlets would cost $1m is ridiculous in view of the fact that the one closed would cost the charge of the hire of a good bulldozer for one day approx $1,000.

There is a plus to the bund being constructed in that it would now be possible to trial the outlet again with no risk to the population because it acts as a barrier to inundation from the north and would solve the problem of the canefarmers.

If successful, the bund could be removed and the southern floodwaters could escape to the north as detailed on the Notes on Flood outlets 7/8/95 further reducing the levels south of this illegal obstruction.

If you removed the internal training walls (identified by Robin Warner as the major source of siltation in (Brunswick River FMI June 1989) and dredged the accumulation of sand behind these walls **without dredging further**, the river would naturally scour to it's original depth and with the outlets back in operation you would achieve the optimum benefit with the least environmental damage.

This optimum benefit would be in the vicinty of .5 metre as originally indicated by the Council Town Planner 13 years ago.

Incidentally when the developers (at that stage an Alan Bond company) illegally blocked the canal in 1984 with a low bund to allow truck access to the area now known as Fern Beach, the State Pollution Commission **(acting on a complaint by myself)** ordered the blockage to be removed because of the damage occuring to the area caused by acid sulphate runoff of the elevated water level.

There were no objections from the environmental lobby to the raising of the water level because they thought if the area became artificially flooded they could successfully stop Bond from developing further.

In fairness, I don't think they realised the consequences of increased flooding on either the canefarmers or residents in the area, nor the increased risk from acid sulphate soils runoff caused by the elevated water levels.

The Government has now been convinced to purchase this tract of land to protect it from development but this also is a plus as to reconstruct the outlet would not involve further compensation to any private owners.

I am happy to expand on any or all of these points if required at short notice.

Yours sincerely

Jim Mangleson.
16th May 1996.

Department of Urban Affairs and Planning

NORTHERN REGIONS OFFICE

Mr K Paterson
Paterson Consultants
PO Box 596
GRAFTON NSW 2460

Paterson Consultants
22 MAY 1996
DOCUMENT RECEIVED
JOB NO: 95-049
ITEM NO:
ACTION: .....
.....

49 Victoria Street, Grafton 2460
PO Box 6 Grafton 2460
Telephone : (066) 42 0622
Fax No. : (066) 42 0640
Contact : Jim Clark

Our Reference : G96/00104 JC:LW
Your Reference : 95-049

20 MAY 1996

Dear Mr Paterson

MARSHALLS CREEK FLOODPLAIN MANAGEMENT PLAN

Thank you for your letter of 22 April 1996 concerning the proposed floodplain management plan.

2. The Department's responsibilities in floodplain management are confined to the processing of draft local environmental plans (LEPs) prepared by councils, which affect flood liable land. In this regard, there are provisions in the North Coast Regional Environmental Plan, 1988 (clause 45A) which require LEPs to restrict any increase in development intensity of such land. The Department has no involvement in consideration of flood behaviour on land which is already zoned for a particular purpose. In such matters the local council has sole responsibility.

3. While the Department would like to contribute to floodplain management issues, limited staff resources make this option impractical. The Department would, however, appreciate being kept informed - perhaps by receiving copies of the minutes of meetings of the proposed community consultations.

4. I trust you will understand the Department's position in the matter. Please contact Jim Clark in the event of any enquiry.

Yours sincerely

Trevor Prior
Manager
(Northern Regions)

EPA

Environment Protection Authority
New South Wales

NSW Government Offices
49 Victoria Street
PO Box 498
Grafton
N S W 2460

Telephone .066. 42 0535
Facsimile .066. 42 7743

Mr K Paterson
Paterson Consultants Pty Ltd
PO Box 596
Grafton NSW 2460

Our Reference:
GR 1457
Your Reference:

2 3 MAY 1996

Contact: Bruce Blunden

Dear Mr Paterson

MARSHALLS CREEK FLOODPLAIN MANAGEMENT STUDY

Thank you for your letter of 22 April 1996 inviting the Environment Protection Authority (EPA) to provide a submission outlining issues we consider important to incorporate in the abovementioned study.

We offer the following comments for your consideration.

General comments
It is important that the planning for future flood mitigation fully addresses the relevant environmental issues so that the management of flood prone land is undertaken in a sustainable manner. The floodplain should not be viewed in isolation but as a component of a fully functional river and catchment system. In particular, we strongly recommend that you consider the management of the floodplain to achieve the discharge of high quality water, not only the capacity of floodways to safely discharge in large flood events.

Stormwater management
The development and implementation of the floodplain management plan should be integrated into the urban and rural stormwater management system. Stormwater should be managed in an environmentally, socially and economically responsible manner. We recommend that an integrated stormwater/floodplain management plan be developed that incorporates all land management, planning, education and engineering aspects to minimise the adverse impact on water quality in this catchment.

Performance criteria should be developed with respect to water quality and quantity management protocols acceptable to the community.

Detention basins
We recommend that any detention basins planned for reducing flood peaks be designed so that they have multiple uses in the management of flood and storm water in the floodplain. We encourage the

provision of primary detention basins and engineered wetlands to retard flow and to facilitate the discharge of high quality water. These structures should be designed so that they facilitate the removal of suspended sediment from the water column. If feasible, these management systems may be able to be incorporated into multi objective, open space reserves for public use during "normal" flow periods.

Secondary vegetated filter strips, detention basins, trash racks and other systems that remove suspended and other material from the water column near its source should be integrated into the floodplain management plan to promote the discharge of high quality water.

Structures and management techniques associated with the control of stormwater should be designed in accordance with the EPA's Draft Urban Stormwater Pollution Control Part C Construction Guidelines.

Creek clearing and widening
Creek clearing and widening may give rise to considerable streambank erosion and/or instability. Streambank ersoion will promote downstream sedimentation, possibly causing unforseen streamflow problems, in addition to the discharge of poor quality water. A strategy should be developed to prevent streambank erosion or water quality impacts resulting from any creek clearing or widening works undertaken.

Development constrains
Development within the floodplain and its immediate catchment should only occur if appropriate pollution control measures and land use management practices can be successfully implemented.

Acid sulfate soils
The disturbance of acid sulfate soils must be managed in a manner that prevents the discharge of acidic leachate . The Department of Land and Water Conservation has released maps describing areas where acid sulfate soils are likely to exist. It is noted from these maps that much of the area under consideration has a high probability of containing acid sulfate soils. The area at risk comprises not only the floodplain but also the bottom sediments of Marshalls Creek. Construction activities that may form part of the flood mitigation proposals associated with the management plan may have a high risk of disturbing these soils. Given the severe constraints to construction activity posed by acid sulfate soils, flood and floodplain management for the Marshalls Creek system may need to be orientated towards management rather than structural options. The EPA has released the Assessment and Management of Acid Sulfate Soils Guidelines for Land Management in Coastal Areas. These guidelines should be used as a basis for the development of a strategy to manage acid sulfate soils.

Use of herbicides
The EPA requires that any herbicide used on or near waters be registered for this use and be used in accordance with the label directions. We encourage the adoption of management systems that do not rely upon the regular application of herbicides to control weeds in sensitive catchments. If regular weed and vegetation management is considered necessary in the floodplain management plan, we encourage the investigation of methods of integrated vegetation control that do not rely upon the application of herbicides.

If the EPA can offer further advice on this issue please contact Bruce Blunden at our Grafton office.

Yours faithfully

GRAEME BUDD
Regional Manager (North Coast)
for Director-General

Waterways

We're with you on the water

23 May, 1996

Mr. K.W. Paterson
Director
Paterson Consultants Pty. Ltd.
Post Office Box 596
GRAFTON NSW 2460

Subject: Marshall Creek Floodplain Management Plan

Dear Mr. Paterson,

Thank you for your letter dated 22 April 1996 regarding the above matter.

The Waterways Authority has responsibility for navigation and safe boating in NSW and therefore has no particular comment on the issue of flood plain management.

The only matter of particular interest would be the entry of silt to the system which over time tends to restrict boating activity in the area. Any action taken to reduce silt entering the system is viewed positively.

Should you or your staff require any further information regarding navigation or dredging of the system please contact me at the address or telephone number shown below.

Yours sincerely,

Lawrie McEnally
A/Regional Manager North

MSB WATERWAYS AUTHORITY REGIONAL OFFICE NORTH COFFS HARBOUR SERVICE CENTRE JORDAN ESPLANADE
P.O. BOX J23 COFFS HARBOUR JETTY NSW 2450
TELEPHONE: 066 51 3400 008 04 3620 FACSIMILE: 066 51 1352

State Emergency Service

LOCAL HEADQUARTERS

Shire Offices,
Dalley Street,
MULLUMBIMBY.2482.

29th May, 1996.

Telephone: 066- 843444

Our reference

Your reference

Mr.K.W.Paterson,
Director,
Paterson Consultants P/L.,
P.O.Box 596,
GRAFTON . 2460

Dear Sir,

Re: Marshalls Creek Floodplain Management Plan

In response to your recent request for information concerning the duties, obligations and powers of the Byron Shire SES relevant to the Marshalls Creek Floodplain I have enclosed herewith information considered to meet your requirements.If any further information is required it could be obtained from Gordon Campbell who is the SES representative in the Marshalls Creek Floodplain Management Committee.

Yours faithfully,
Brian Pilcher.
Local Controller,
Byron Shire SES.
per.....

State Emergency Service

LOCAL HEADQUARTERS

Shire Offices,
Dalley Street,
Mullumbimby. 2482.

Telephone:
Our reference
Your reference

Re: Marshalls Creek Floodplain Management Plan

Subject: The Duties,Obligations and Powers of Byron Shire State Emergency Service with Specific Reference to Marshalls Creek Floodplain.

1.The Byron Shire SES is the Combat Agency for floods in Marshalls Creek, Lacks Creek and Yelgun Creek catchment area and their floodplain which encompasses the area under consideration.

2.As such the SES has the duty of providing to the people of the Floodplain

a.up-to-the-minute information on the likely development of a flood situation.This is achieved through information gathered through the resources listed under 4,below and disseminated through media outlets and to specific at risk persons through the Warden Service.

b.organisational assistance through the Warden Service to those people affected by the flood situation.

c.with the assistance of Byron Shire Council and other resources available to it practical assistance to affected people.

e.g.c.1. sandbags to keep out rising floodwaters

c.2. removal of fallen trees affecteing homes,streets and driveways

c.3. rescue and relief of people affected by rising floodwaters and needing urgent medical attention.This is achieved by the use of high level vehicles and helicopters

c.4. in extreme and prolonged situations with the assistance of D.O.C.S. food supplies to those in need

c.5. organisation and registration facilities for people needing to leave their homes.This is done with the assistance of Police and D.O.C.S.

3.The powers of Byron Shire SES exercised by the Local Controller include powers

a.to call upon other Emergency Services to assist operations

e.g.Police V.R.A. D.O.C.S.

b.to order evacuations where people are perceived to be in great danger by remaining in their present situation or rescue personnel would be in danger if called upon to attempt rescue in an extreme situation.

4.Facilities available to Byron Shire SES in meeting its responsibilities are

4.a. a fully manned and equipped H.Q. in the Shire Offices in Mullumbimby which receives,collates and disseminates information relevant to flooding on the Floodplain

4.b. an ALERT system for acquiring rainfall and river level recordings as they are occurring. (See Annex A)

4.c. advice from the Bureau of Meteorology either from forecasts received via Division H.Q. or by direct phone contact.

4.d. a team of manual rainfall and R.L.readers to supplement the ALERT system or replace it in the event of physical or radio failure. (See Annex B)

4.e. floodboat and Storm Rescue crews to render assistance where needed

4.f. lists of other resources available to enable the organisation to discharge its responsibilities

4.g. a Warden Service keeping watch on the situation "on the ground" and providingorganisational and practical assistance to people on the Floodplain.

Brian Pilcher.
Local Controller,
Byron Shire SES.

ANNEX B

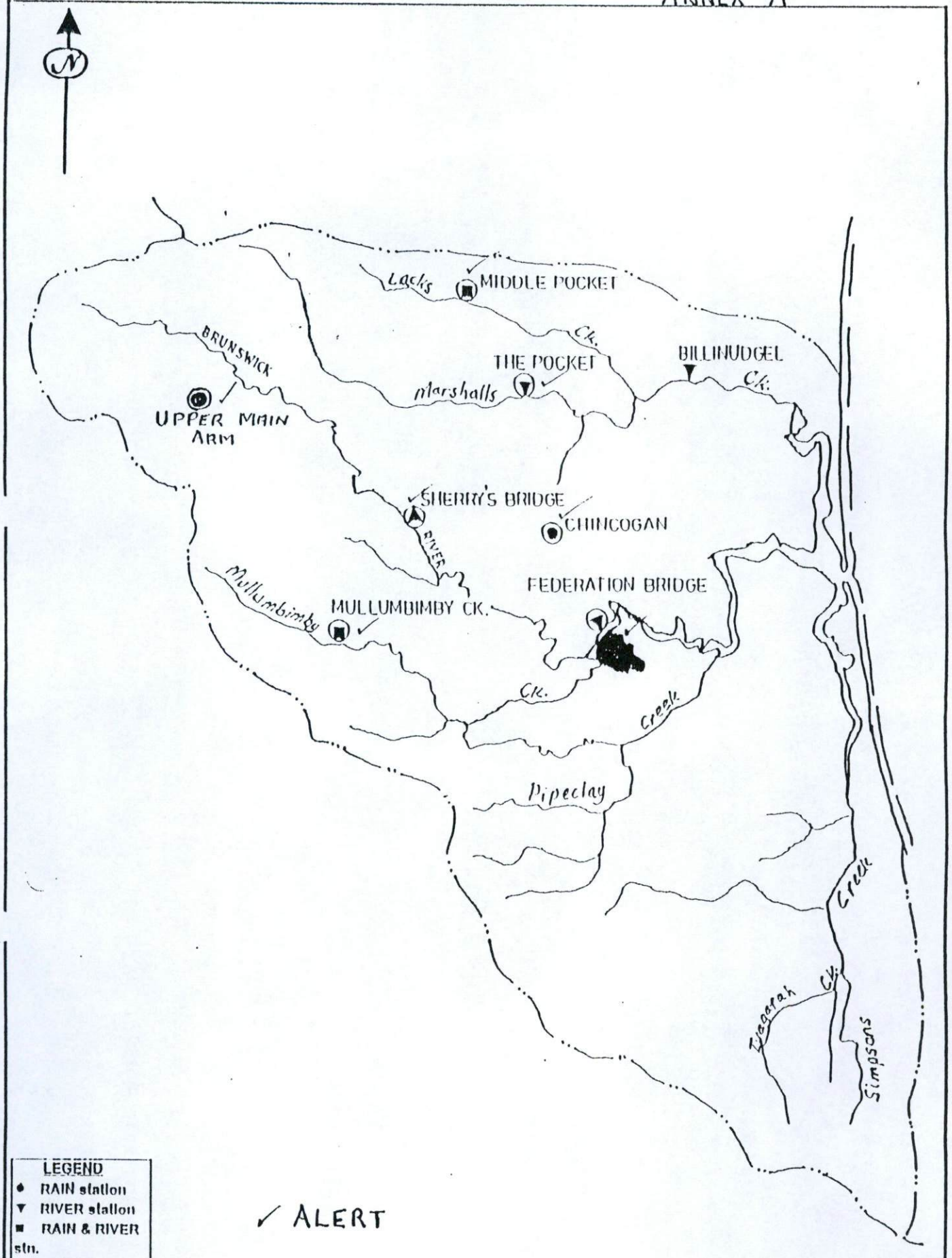
CHAPTER 4 - ANNEX B

BYRON SHIRE S.E.S.

RIVER LEVEL GAUGE READERS

Gauge No.	Stream	Map Ref.	Gauge Reader	Phone No.
R.L.1	Wilsons Ck	Huonbrook 390406	~~Stan Cieplicki~~	066 840032
R.L. 2	Byron Creek	Byron Bay 515265	To be arranged	
R.L.3	Mullumbimby Creek	Huonbrook 425414	Ron Butler	066 842449
R.L.4	Coopers Ck	Huonbrook 360414	Pierre Giraud	066 840163
R.L. 5	Main Arm Brunswick R.	Burringbar 389478	Peter Passfield	066 845554
R.L. 6	Main Arm Brunswick R.	Huonbrook 412468	~~Alan Riches~~	066 845259
R.L.7	Main Arm Brunswick R.	Huonbrook 447436	Mike Rosee	066 841354
R.L.8	Main Arm Brunswick R.	Huonbrook 473417	Reconn. Squad S.E.S.	066 842222
R.L.9	Brunswick R.	Huonbrook 485415	Reconn. Squad S.E.S.	066 842222
R.L.10 *	Marshall's Creek	Huonbrook 448467	Jason Mangleson	066 845399
R.L.11 *	Marshall's Creek	Huonbrook 483463	John Ludlow	066 845271

ANNEX A



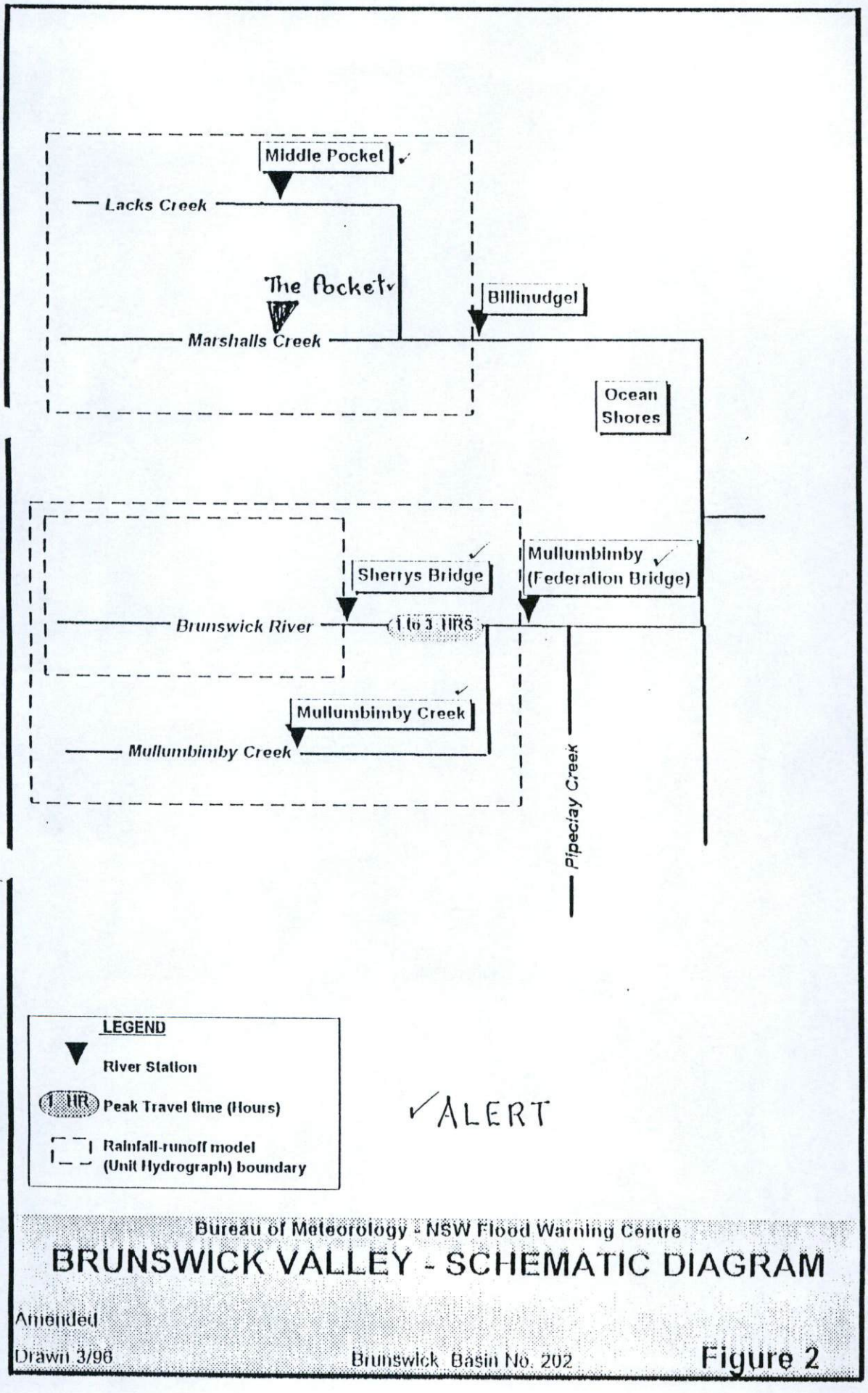
BRUNSWICK RIVER CATCHMENT MAP

Amended: Nov 05

Drawn: IRP

Brunswick River Basin No. 202

Figure 1


Middle Pocket
Lacks Creek
The Pocket
Billinudgel
Marshalls Creek
Ocean Shores
Sherrys Bridge
Mullumbimby (Federation Bridge)
Brunswick River
1 to 3 HRS
Mullumbimby Creek
Mullumbimby Creek
Pipeclay Creek
LEGEND
River Station
1 HR Peak Travel time (Hours)
Rainfall-runoff model (Unit Hydrograph) boundary
ALERT
Bureau of Meteorology - NSW Flood Warning Centre
BRUNSWICK VALLEY - SCHEMATIC DIAGRAM
Amended
Drawn 3/96
Brunswick Basin No. 202
Figure 2

(cont'd)

Gauge No.	Stream	Map Ref.	Gauge Reader	Phone No.
R.L.12 *	Marshall's Creek	Bruns. Hds 500464	Bruce Butt	066 801046
R.L.13 *	Lack's Creek	Burringbar 478476	Bruce Broughton + ALERT	066 802532
R.L.14 *	Lack's Creek	Bruns. Hds 494467	David Grant	066 801209
R.L.15 *	Ocean Shores North Canal	Pottsville 532479	Debbie Cooper	066 802022
R.L.16 *	Billinudgel Village	Bruns. Hds 514467	Wally Walsh	066 801140
* RL17	YELGUN Crk.	Pottsville 497487	DICK MEPPEM (BACM)	066 801214

* Relevant to Marshalls Creek Floodplain

CHAPTER 4 - ANNEX C

BYRON SHIRE STATE EMERGENCY SERVICES

RAINFALL RECORDERS

Map Ref.	Name	Location	Phone No.	
R1	~~Phil Hayman~~	Wilsons Creek	~~884319~~	
R2	Stan Sigley	Wilsons Creek	840122	
R3	Ron Butler	Mullumbimby Creek	842499	
R4	Wayne Hyland	Main Arm	845335	
R5	Lance Frost	Upper Main Arm	845212	
R6	Doug Henry	Palmwoods	845204	
R7	~~Bill Boyd~~	Blindmouth Creek	~~845468~~	
R8 *	Marlene Baggeley	The Pocket	845341	
R9 *	John Ludlow	The Pocket	845271	
R10 *	Bruce Broughton	Middle Pocket	802532	+ ALERT
R11	Mandy Paron	Yelgun	801483	
R12	Ron Hulbert	St. Helena	847214	

* Relevant to Marshalls Creek Floodplain

30 May, 1996

Paterson Consultants Pty Ltd
P.O. Box 596
Grafton, NSW, 2460

Our reference: 96/469 MC:CM
Your reference: 95-049

Dear Sir

Re: Marshalls Creek Floodplain Management Plan

I refer to your letter of 22 April 1996 requesting a submission from the National Parks and Wildlife Service (NPWS) on the above proposal.

NPWS has duties, obligations and powers under the National Parks and Wildlife Act 1974 the Environmental Planning and Assessment Act 1979, and the Threatened Species Conservation Act 1995.

NPWS's areas of interest include management of lands reserved under the NPW Act, flora and fauna, and cultural heritage. NPWS has a statutory role in relation to environmental impact assessment, particularly where this relates to impacts on threatened flora and fauna, threatened populations, habitats and ecological communities.

With respect to the Marshalls Creek area, NPWS has recently acquired the majority of the lands which lie to the north of your study area for the Billinudgel Nature Reserve. The final boundaries of this reserve have yet to be determined, but could include parts of the study area. Brunswick Heads Nature Reserve lies immediately to the south of your study area, and the area contains wetlands protected under State Environmental Planning Policy 14. In addition the general area is known to contain a number of sites of significance to the local Aboriginal community.

In view of the proximity of sensitive and reserved lands, NPWS considers it essential that any of the works proposed in the management plan receive an appropriate level of environmental assessment. Attached is a list of environmental issues which the NPWS considers should be addressed, although it is recognised that some will be more applicable than others. would need to be closely consulted regarding any management decisions which may affect the hydrology or other attributes of these reserved lands.

In addition, any management actions which are likely to affect threatened plants or animals, or their habitat, may need to obtain the Concurrence of the Director-General, NPWS, before they may be carried out.

NSW NATIONAL PARKS AND WILDLIFE SERVICE

Northern Zone
GIO House
24 Moonee Street
Coffs Harbour NSW
Australia
PO Box 914
Coffs Harbour 2450
Fax: (066) 516 187
Tel: (066) 515 946

Head Office
43 Bridge Street
Hurstville NSW
Australia
PO Box 1967
Hurstville 2220
Fax: (02) 585 6555
Tel: (02) 585 6444

Please contact John Turbill at this office if you would like to discuss this matter further.

Yours faithfully

Matt Cameron
Manager, Environmental Planning

for DIRECTOR-GENERAL

NSW NATIONAL PARKS AND WILDLIFE SERVICE, NORTHERN ZONE

ENVIRONMENTAL ISSUES TO BE ADDRESSED

INTRODUCTION

The following list is provided to assist preparation of Development Applications. The list details the minimum information that is required by the New South Wales National Parks and Wildlife Service (NPWS) in their assessment of such applications.

Please note that the provision of information in accordance with this list does not negate the applicant's obligations under any legislative or planning instruments. NPWS suggests that the applicant contact the relevant local council, and the Department of Urban Affairs and Planning, to ascertain these obligations.

GENERAL

1. Map(s) showing the locality of the proposed development in a regional and local context. Local context maps should be based on 1:25 000 topographic plans. Photographs of the site's key attributes may provide useful documentation.

2. A description of the existing environment on the subject land and surrounding land, the proposed development and ancillary works, and the manner in which the environment will be modified by the proposal (particularly with regard to the clearing of native vegetation and impacts on fauna habitat).

3. ıe area subject to development should be clearly identified on an appropriately scaled plan. This includes all ancillary works such as buildings and other structures, parking areas, loading/processing/treatment areas, access roads, and material stockpiling areas.

4. The applicability or otherwise of Local Environment Plans (LEP), Regional Environment Plans (REP) and State Environmental Planning Policies (SEPP) to the site should be determined and detailed. In particular, your attention is drawn to SEPP No. 14 - Coastal Wetlands, SEPP No. 26 - Littoral Rainforest, SEPP No. 44 - Koala Habitat Protection, and SEPP No. 46 - Protection and Management of Native Vegetation.

FLORA

1. A comprehensive description of the vegetation on the site. This will include an assessment of the condition of the plant communities present, including the designation of conservation significance at a local, regional and State level, and the identification of the presence of any threatened species, populations or ecological communities listed under Schedules 1 or 2 of the *Threatened Species Conservation Act 1995* and any Rare or Threatened Australian Plant (ROTAP) species

2. A plan showing the distribution of the Threatened and ROTAP species and the vegetation communities on the site, and the extent of vegetation proposed to be cleared. This plan should be at the same scale as the plan of the area subject to development in order to assist in the assessment of the impact of the proposal on the existing vegetation.

3. . . here the assessment concludes that threatened species, populations or ecological communities, or their habitats, exist on or in proximity to the subject land, the effect of the proposed development should be determined in accordance with the eight point test described in Section 5A of the *Environmental Planning and Assessment Act* 1979. An assessment of the impact of the development on the plant communities and/or ROTAP species should also be provided.

4. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on the plant communities and/or Threatened and ROTAP species.

FAUNA

1. A fauna survey to identify the distribution and abundance of fauna species known or likely to utilise the site, including a description of available fauna habitats and an assessment of the conservation status of each of the faunal components at a local, regional and State level.

2. A plan showing the results of the above survey. This plan should be at the same scale as the plan of the area subject to development to assist in the assessment of the impact of the proposal on the identified faunal components.

3. An assessment of the impact of the development on the identified faunal components.

4. An assessment of the existence or likely occurrence of threatened species, populations or ecological communities, or their habitats on the subject land. Where the assessment concludes that threatened species, populations or ecological communities,

or their habitats exist on or in proximity to the subject land, the effect of the proposed development should be determined in accordance with the eight point test described in Section 5A of the *Environmental Planning and Assessment Act* 1979.

5. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on the identified faunal components.

CULTURAL

1. The presence or absence of Aboriginal sites should be identified and the significance of the area to the local Aboriginal population must be determined. Accordingly, a search of the NPWS Aboriginal sites register should be made and the Local Aboriginal Land Council should also be consulted with regard to any Aboriginal heritage issues associated with the proposed development.

2. Aboriginal sites and places of significance to the Aboriginal community are to be detailed on a plan. This plan should be at the same scale as the plan of the area subject to development to assist in the assessment of the impact of the proposal on the identified cultural components.

3. An assessment of the impact of the development on the identified cultural sites.

4. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on the identified cultural sites.

5. A contingency plan that details the measures to be taken in the event that archaeological sites are discovered during the course of operations must be prepared.

NOTES

Surveys and Assessments

1. Conclusions drawn in surveys and assessments must be substantiated by evidence resulting from those surveys and assessments. Those conclusions must be directly translated into the document being supported by the surveys and assessments.

2. All surveys and assessments should refer to the NPWS databases and Schedules 1 and 2 to the *Threatened Species Conservation Act* 1995.

3. Fauna, flora and cultural surveys and assessments should be undertaken by suitably qualified persons and the qualifications and experience of the persons undertaking the work detailed.

4. Dates, site locations, design, methodology, analysis techniques, and weather conditions at the time of the assessments and surveys must be described.

NPWS Databases

5. The NPWS can provide records of flora and fauna held in the Wildlife Atlas and / or Rare or Threatened Australian Plants (ROTAP) databases. In addition NPWS has an Aboriginal Sites Register of which searches can be made. These services generally attract a fee. Enquires should be made to NPWS Hurstville office, telephone (02) 585 6444.

6. It should be noted that the above databases are not comprehensive and should only be used as a guide. They do not negate the need for specific site investigations.

RAILWAY SERVICES GROUP

Paterson Consultants

4 JUN 1996
DOCUMENT RECEIVED

JOB NO: 95-049
ITEM NO:

ACTION: .....
.....

North Coast Infrastructure Management Centre
29 Bent Street
SOUTH GRAFTON N.S.W. 2460
Tel: (066) 42 3144
Fax: (066) 42 9409

Our Ref: 5942 GS:JFM:CMB
Contact No: (066) 429456
Mr M. Corfe

Your Ref: 95-049

May 31, 1996

Paterson Consultants Pty Ltd
Engineering, Planning & Environmental Services
P. O. Box 596
GRAFTON NSW 2460

Dear Sir

Re: **Marshalls Creek Floodplain Management Plan**
Billinudgel 905.276km – Rehabilitation of Timber Underbridge

Reference is made to your letter of 22 April 1996.

The Railway Services Group is responsible to maintain the track, bridges and railway right of way.

Changes to track, bridges and right of way that come outside normal maintenance are not the responsibility of the Railway Services Group and any costs incurred will have to be the responsibility of Byron Shire Council. Information on proposed changes to the corridor should be addressed through the Chief Executive Officer, Rail Access Corporation, 11-31 York Street, Sydney.

The main timber underbridge at Billinudgel 905.276km will undergo repairs in 1995/96 financial year.

The repairs to the timber underbridge include the replacement of timber components, the replacement or underpinning of two concrete piers incorporating minimum lift of the track (0-40mm).

Yours faithfully

G. Sutherland
A/DIVISION ENGINEER

Bill Paterson

Matthew Lambourne
PO Box 536
Mullumbimby NSW 2482

4 August 1996

Peter Cuming
Sustainable Futures
209 River St
Maclean NSW 2463

Dear Peter,

Re: Marshalls Creek Floodplain Management Plan

The following comments and attachments are in response to your "Common Ground ..." report on public consultation meetings during May 1996, and constitute my submission on the preparation of a draft floodplain management plan for the area.

Your report is in some respects very encouraging, indicating widespread appreciation of the natural attractions and environmental values of the area, and a commitment to community involvement and empowerment in finding solutions. Less encouraging is the continuing lack of appreciation of the natural hazards of the area, and the continuing misunderstanding, fuelled by mis-information being spread by some people, of some aspects of the present and past drainage patterns of the area.

It seems from your report that there is a general acceptance that the area is a natural floodplain (something that some people have denied in the past) and that floods are a part of life there, and some valid concern at the implications of global warming and associated sea level rise.

However, there seems to be little awareness of the risk of the ocean overtopping the dunes and possibly washing through to Marshalls Creek/Capricornia Canal, perhaps because this has not happened on any significant scale since 1974. Yet the possibility of this happening was clearly warned of in the Byron Bay - Hastings Point Erosion Study of 1978 (extract attached), and such events have occurred on a number of occaisions on the North Coast and in this area in the past. The implications of such an event should be taken into consideration in the development of the floodplain management plan.

There is clearly continuing confusion over the issue of flood outlets to the ocean in the area. I have seen maps of the area going back to the 1880s, aerial photos belonging to Byron Shire Council back to 1947, and aerial photos in the possession of a local real estate agent back to 1942, and none of them contain any evidence of any permanent natural outlet or associated creeks.

In early 1973, a temporary outlet was constructed by the developers of Ocean Shores about 1km north of South Golden Beach, but aerial photos, topographic maps and Lands Department maps going back to 1893 show that there was no natural outlet there before 1973 (see maps 2,3,4,5).

Some people have claimed that there was a natural outlet in the vicinity of what is now Helen St, South Golden Beach, or between there and New Brighton, before sand mining took place in the area in the late 1950s, although others say there was never a natural outlet in this area. Lands Department and topographic maps from 1885 to 1942 show no outlet, waterways or lagoons in this area (see maps 2,3,4), but one person who ran cattle in the area after WWII says that there was a lagoon there, but that it didn't run out to sea.

An explanation of these conflicting claims may be that the ocean breached the dune system, perhaps in the 1942 or 1945 storms, and flooded a low-lying area, killing the wetland vegetation and forming an area of open water. The frequent storms and floods between 1945 and 1955 might have maintained such a breach in the dunes during that period.

Lands Department maps of the late 1880s show a flood outlet near Wooyung, about 4km north of South Golden Beach, which appears to have formed in this way (see map 1). This outlet is shown to be linked to a wide but short waterway, draining only a small local area, and not connected to the main drainage patterns of the Crabbes Creek - Burringbar Creek - Mooball Creek area. It appears to have been formed by the flooding of wetlands which have formed in an older drainage channel. This outlet may have formed during the period of frequent floods in the 1860s and 1870s, and is said to have closed up naturally before 1900. In the early years of this century, a drain was constructed to drain the area north to Mooball Creek.

The waterway associated with this outlet is named on the maps as Billinudgel Creek, but it is not connected to the creek which has that name now, which flows from west of the highway into the Billinudgel wetlands adjacent to Yelgun Creek. Some recent topographic maps show the present-day Billinudgel Creek flowing north to Wooyung (see map 5), but Lands Department and earlier topographic maps show no creek in that area (see maps 2,3,4), and there is no evidence of such a creek on the ground.

A permanent natural outlet is not possible in the New Brighton - Wooyung area while Marshalls Creek joins up with the Brunswick River, as it has done for hundreds of years, as there is not enough catchment area to provide the water flow that would be needed to maintain an outlet against the wave and wind forces which tend to build up the sand dunes. This is why Simpsons and Marshalls creeks join up with the Brunswick River, rather than maintain their own outlets to the ocean, and why Crabbes and Burringbar creeks flow 6 km north as Mooball Creek before flowing into the ocean at Pottsville.

It is quite possible that hundreds or thousands of years ago Marshalls Creek, and possibly the whole Brunswick River, may have flowed north behind the dune system, which might have been further seaward than it is now. There is evidence of this in vegetation patterns which show up on the aerial photos, and which some people have wrongly claimed to be waterways and flood outlets.

These patterns are in fact wetland vegetation in old drainage channels which are a little lower, and therefore wetter, than the surrounding areas. The size of these old channels shows that they must have been made by a creek at least as large as Marshalls Creek, and possibly as large as the Brunswick River. None of these old channels, except for those near the Wooyung outlet, are shown as creeks or waterways on the Lands Department maps, which date back as far as 1885.

If people wish to propose an artificial outlet, whether engineered or "organic", they should argue for it on the merits of their proposal, and not use the false argument that it is helping to restore some supposed natural state of the floodplain.

Similar misleading and in some cases false arguments have been put forward in relation to the dredging of Marshalls Creek and the altering of the training walls in Readings Bay, and there is clearly widespread misunderstanding of the dynamics of such tidal estuaries. I am not aware of any evidence that there has been any significant siltation of Marshalls Creek, or that the training walls in Readings Bay have caused a build-up of sand on their upstream sides. Any proposal for dredging or similar works must be based on factual evidence and rational arguments, not urban myths.

I have been argueing for nine years that there is no engineering solution to flooding problems in this area, and nothing that has been done in that time has challenged my arguments. "Pulling the plug" is an urban myth - while it may be physically possible in the short term, it is economically, socially and environmentally absurd as a long-term solution.

The management plan should include house-raising, flood proofing, purchase and demolition, and possibly levees in some cases, as appropriate for individual dwellings and local areas, together with a community-based scheme to manage and limit the adverse effects of flooding. Such a scheme might well be based on the existing progress associations in the various communities, and might help encourage and empower them to take co-operative action to improve their communities in other ways as well.

Attachments:

Map 1 : Wooyung area, Lands Department plans of portions 43 (1886), 58 (1888) and 71 (1889).

Map 2 : South Golden Beach - New Brighton area, Lands Department, Parish of Billinudgel, 1893.

Map 3 : South Golden Beach area, Lands Department plans of portions 286 and 358 (1909).

Map 4 : New Brighton - Wooyung, Lands Department and 2nd Field Survey Coy., R.A.E., 1942.

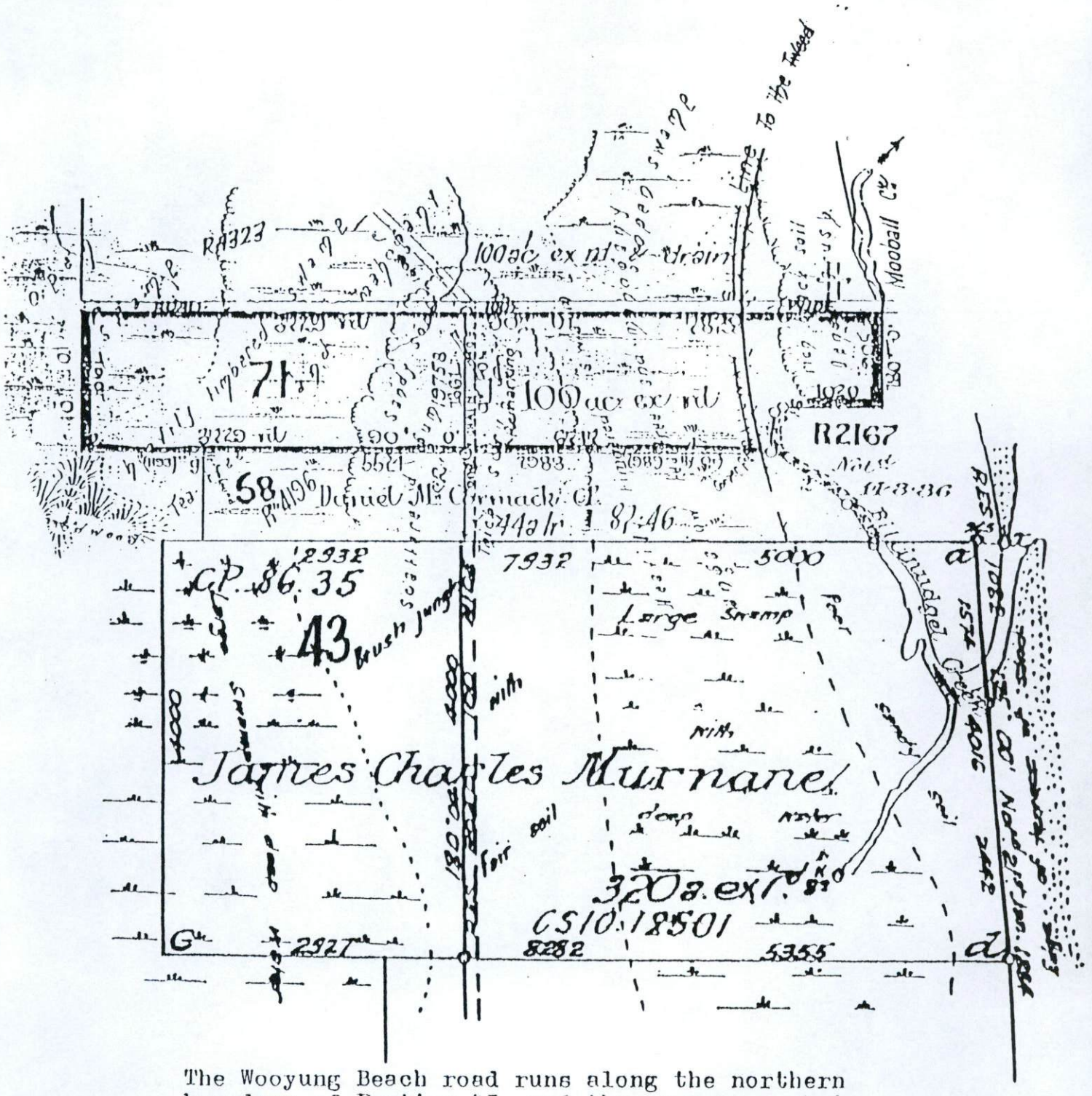
Map 5 : South Golden Beach - Wooyung, Royal Australian Survey Corps., 1966.

Northern Star,: editorial, 15 February 1893.

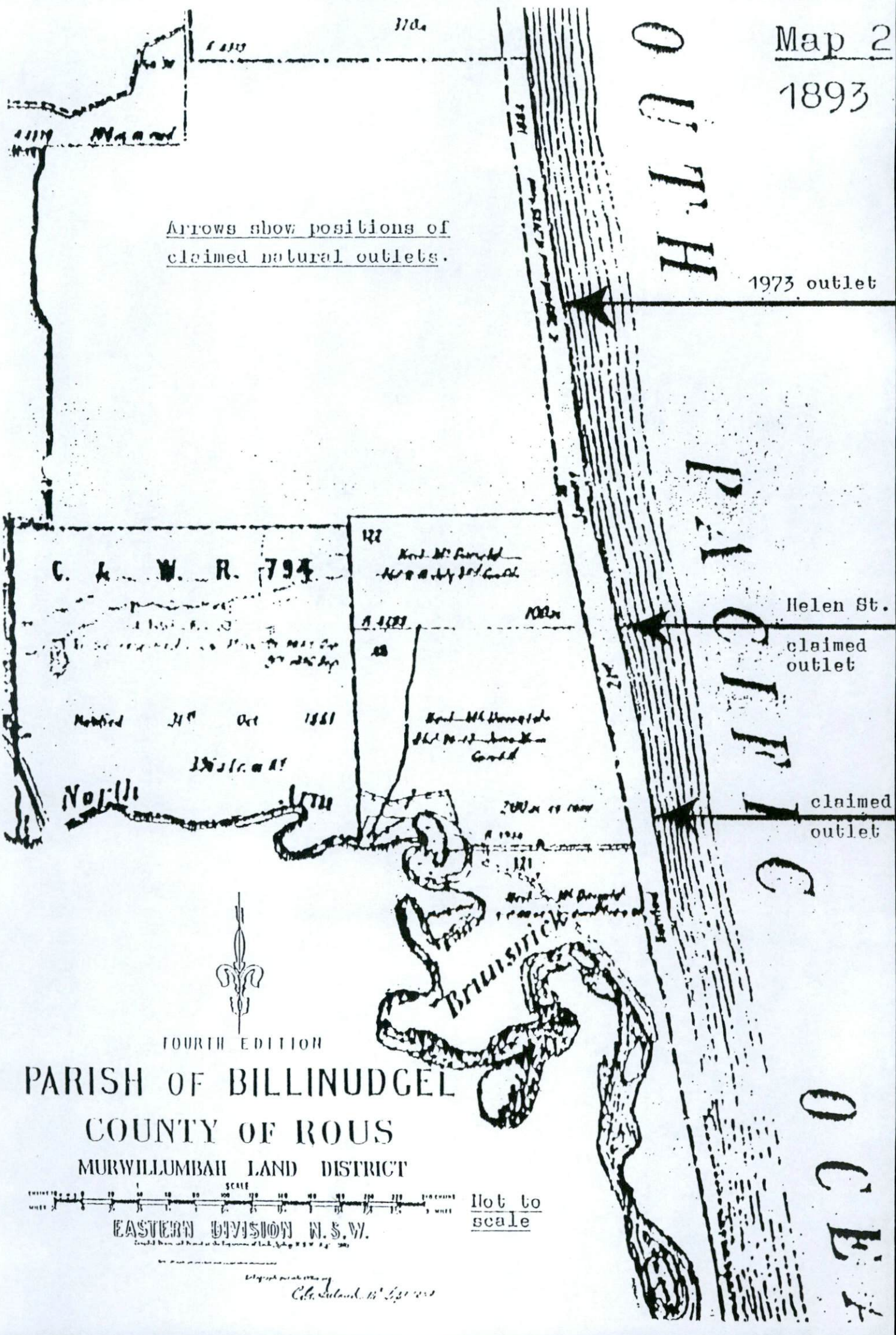
Byron Bay - Hastings Point Erosion Study : Report no. IWD 78025, 1978, p. 110.

Map 1

1886-89

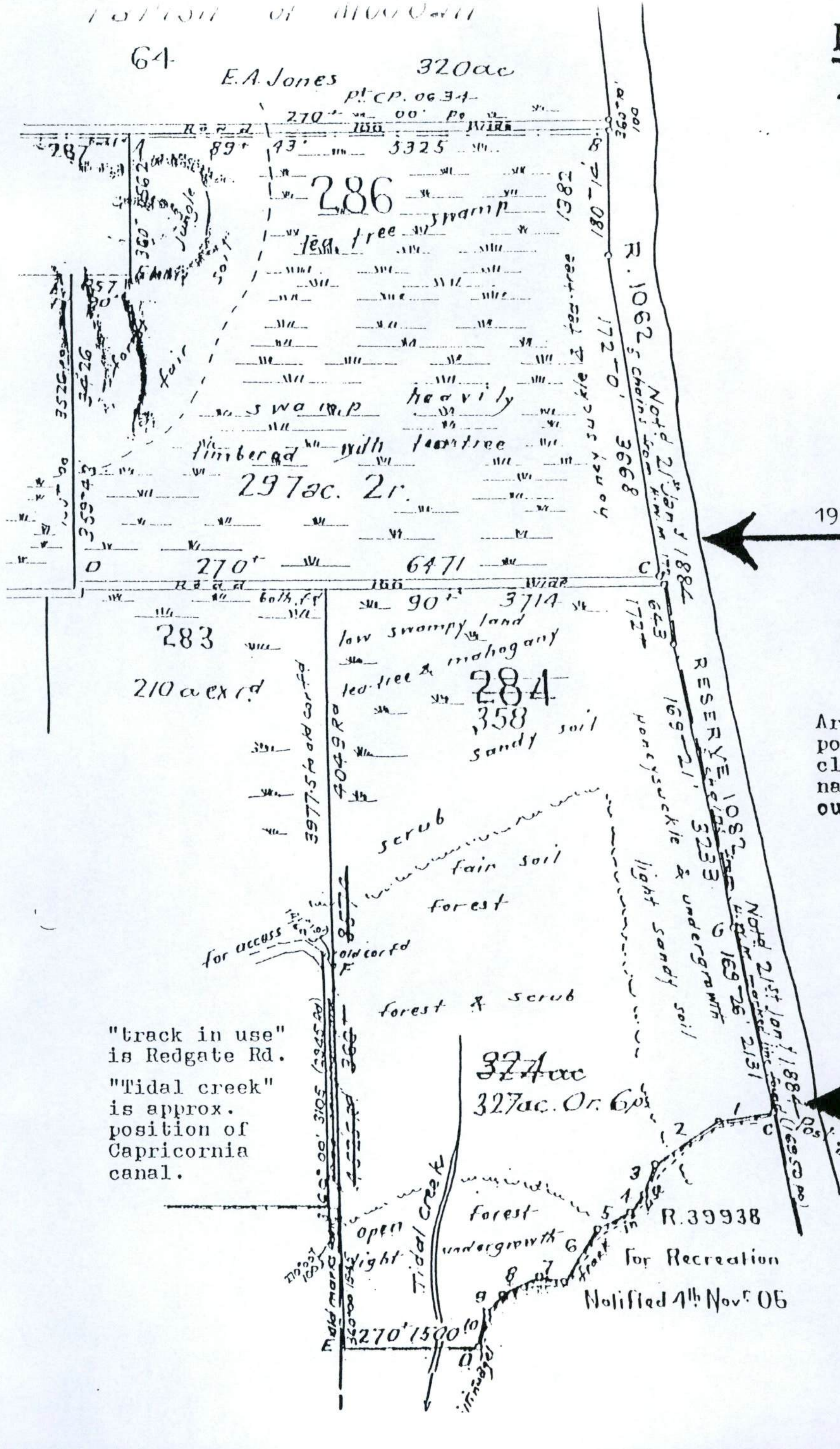


The Wooyung Beach road runs along the northern boundary of Portion 43, and the caravan park is east of "Billinudgel Creek", near "8.86".


Map 2
1893
SOUTH PACIFIC OCEAN
Arrows show positions of claimed natural outlets.
1973 outlet
Helen St.
claimed outlet
claimed outlet
C. & W. R. 794
Brunswick
FOURTH EDITION
PARISH OF BILLINUDGEL
COUNTY OF ROUS
MURWILLUMBAH LAND DISTRICT
SCALE
Not to scale
EASTERN DIVISION N.S.W.

Map 3

1909



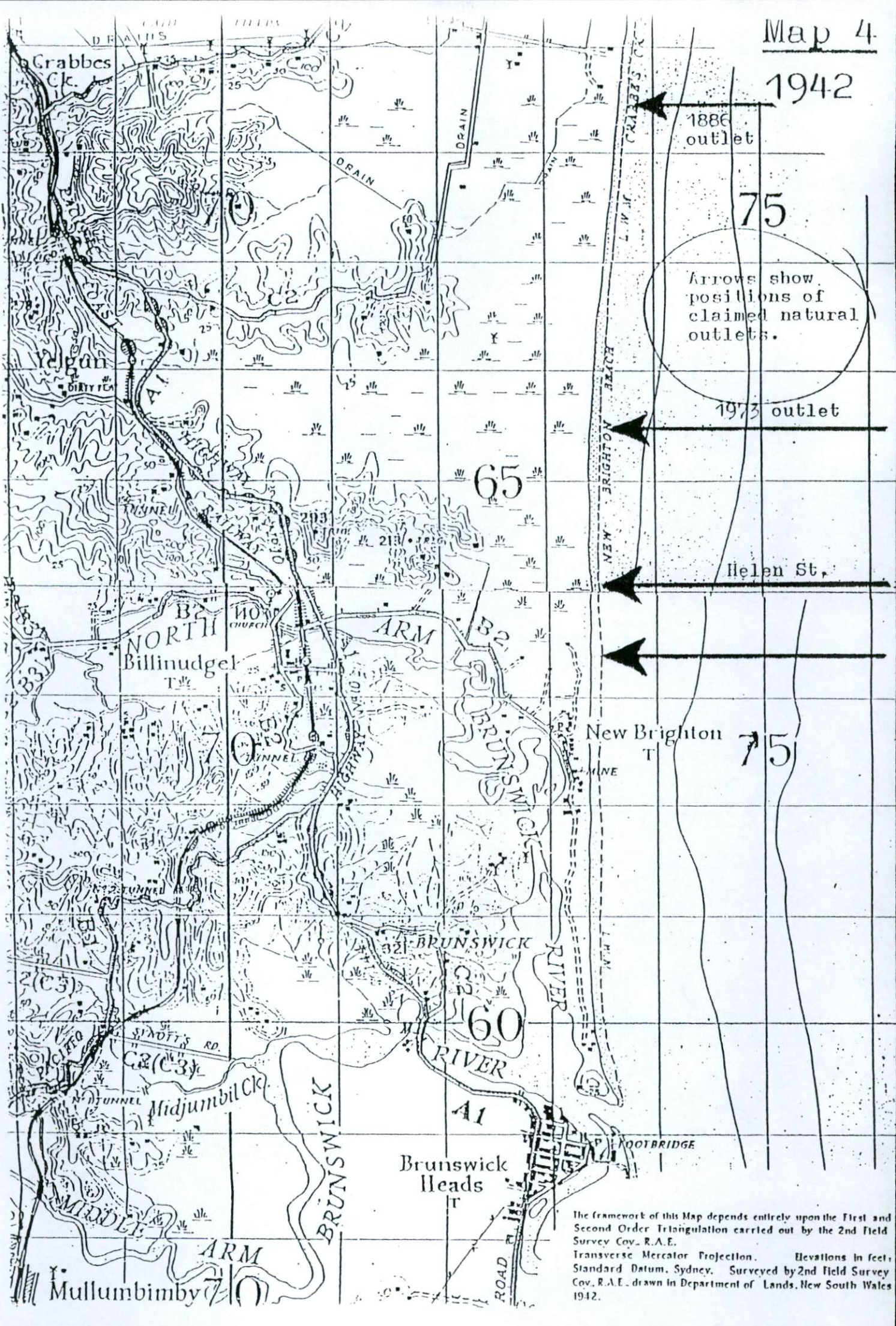
1973 outlet

Helen St

Arrows show positions of claimed natural outlets.

"track in use" is Redgate Rd.

"Tidal creek" is approx. position of Capricornia canal.



The framework of this Map depends entirely upon the First and Second Order Triangulation carried out by the 2nd Field Survey Coy. R.A.E.
Transverse Mercator Projection. Elevations in feet. Standard Datum, Sydney. Surveyed by 2nd Field Survey Coy. R.A.E. drawn in Department of Lands, New South Wales 1942.

Map 5

1966

EDITION 1 - AAS
SERIES R 753

Prepared under the direction of the Chief of the General Staff, Australian Military Forces, by the Royal Australian Survey Corps as part of the national mapping programme. Survey control established by the Royal Australian Survey Corps. Compiled in 1968 from 1966 aerial photography. Distributed to the Defence Services by the Royal Australian Survey Corps and to all other map users by the Department of National Development.

The Northern Star.

WEDNESDAY MORNING, 15th FEBRUARY, 1860.

FLOOD LESSONS.

THE eastern rivers of Australia have been settled for periods ranging from 50 to 70 years, and it is a remarkable fact that the people who inhabit these valleys, and particularly those who reside on the banks of the rivers, are so slow to profit by observation, and withal so ready to forget the lessons of experience. Although by settlement they are changing the natural features of the country, in fact quite altering the condition which existed in the early years of occupation, people will persist in believing that other things must remain as they were. By heavily stocking the country and the tramping of the soil, by ringbarking timber and clearing the land, by the gradual formation of other water channels, all tending to drain off surface water more quickly, the tendency has been to accelerate year by year the flow of water into the main streams, and this to produce high floods. That has been the experience on the Hunter, Hawkesbury, Macleay, Clarence, and more recently in the case of the Brisbane River. A careful examination of the features of the country will also afford many indications of flood traces far beyond any modern records, and this added to the other fact should warn people of flood possibilities of which no former experience affords a guide. Still people will congregate on the brink of the drainage arteries of the country, and build their towns, dwellings, and warehouses on the alluvial banks of these streams. For the greater convenience of being near the ground, too, they will not even take the precaution to raise the floor more than a few inches above the soil. The history of these districts tells, as a result of this, that property to the value of thousands of pounds is sacrificed in this way, and still towns are laid out in flooded positions, and the same risks hazarded year after year; while experience is reminding the inhabitants that the floods are becoming more and more disastrous. Ordinary prudence demands that if people have a choice they should reside beyond the possible reach of floods, failing this that they should build to provide accommodation considerably above the rise of any known flood. Here in our own town we should not be satisfied to be guided by previous records. That we shall have higher floods is a certainty. We have already been very near it, another twelve hours rainfall would bring it about, and we have only to contemplate a further rise like that experienced at Brisbane to realise what it would mean. Forewarned is to be forearmed, and we would strongly recommend all having business premises, and storing valuable stocks, to be provided with lofts or second stories, which will provide room to stow away their goods until the rush of water is past.

Department of Public Works N.S.W.
Coastal Engineering Branch

Byron Bay - Hastings Point Erosion Study

Report No. PWD 78025

November 1978

A. D. Gordon
D. B. Lord
M. W. Nolan

This is in agreement with the approximation that wave set up is between 10% to 15% of the offshore wave height (U.S. Army C.E.R.C., 1977). Therefore, for the design situation the wave set up was taken as 1.4 metres.

9.3.3 Implications

In a severe storm or cyclone, the total super elevation of water level on the beach due to storm surge and wave set up can be in the order of 2.6 metres (1.2 m of storm surge and 1.4 m of wave set up). This combined with maximum spring tides of up to 2 metres, can result in mean water surface elevations of up to 4.6 metres above tidal datum (Indian Springs Low Water) at the peak of the tide.

Examination of topographical information obtained during the mapping work (Sec. 7) and survey cross sections showed that at this level (+4.6 m I.S.L.W.), the beach berm throughout the embayment would be submerged. Further, in some locations, particularly in the New Brighton region, the dune at the back of the beach would be overtopped (Figure 9.3.1).

Hence, a combination of high tides and storms can lead to direct wave attack of dune areas. Wave run up overtopping would also occur in certain locations over several kilometres in the New Brighton region (Figure 9.3.1), with resulting salt water inundation of the back beach region.

9.4 Winds

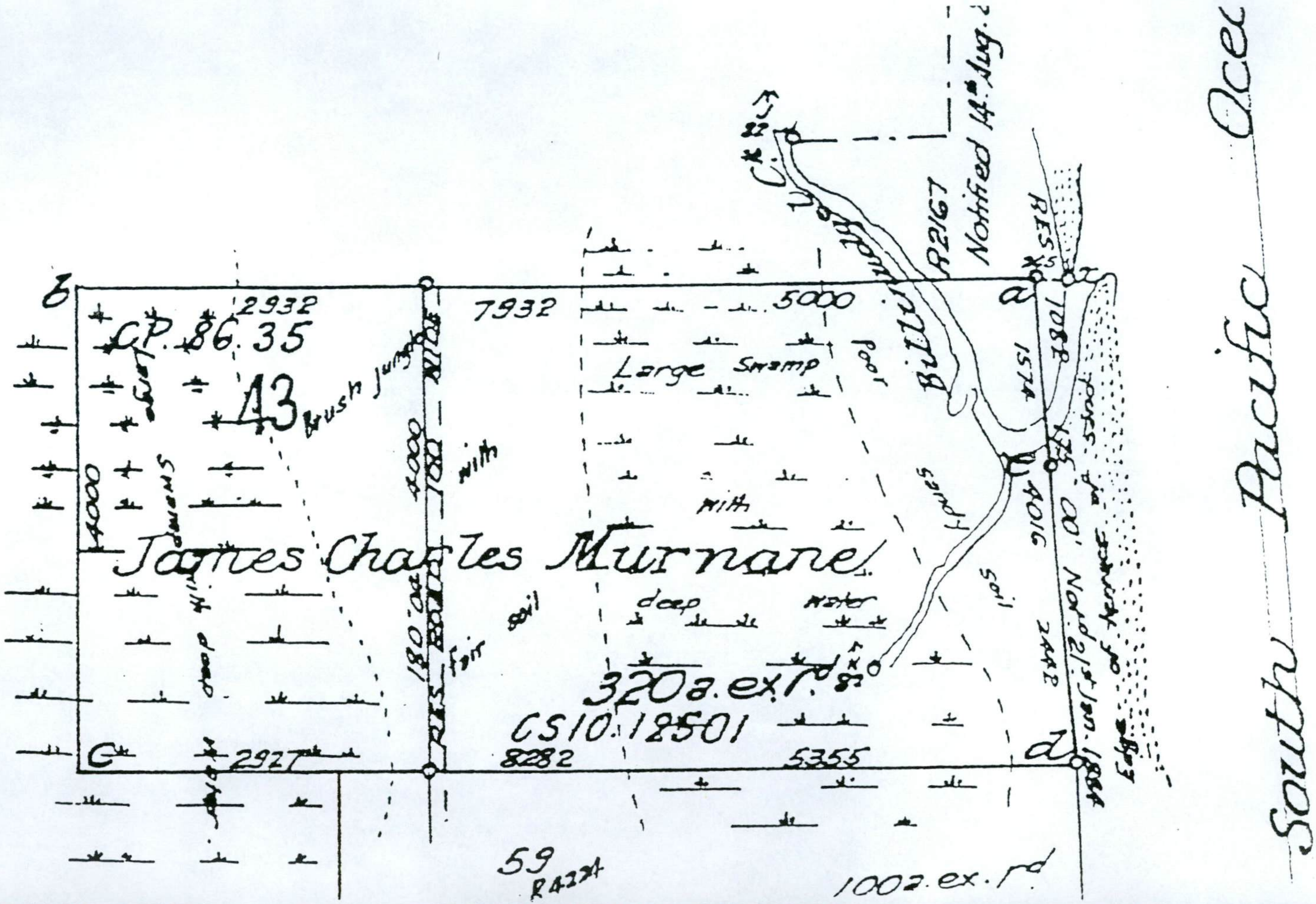
Wind action can affect the sediment budget of a region in a number of ways. Winds may cause aeolian (wind borne) losses of sand from the beach system (Sec. 12.2.2), or may generate local "sea" conditions which act in conjunction with the swell waves to increase the magnitude of sediment movement in the nearshore zone.

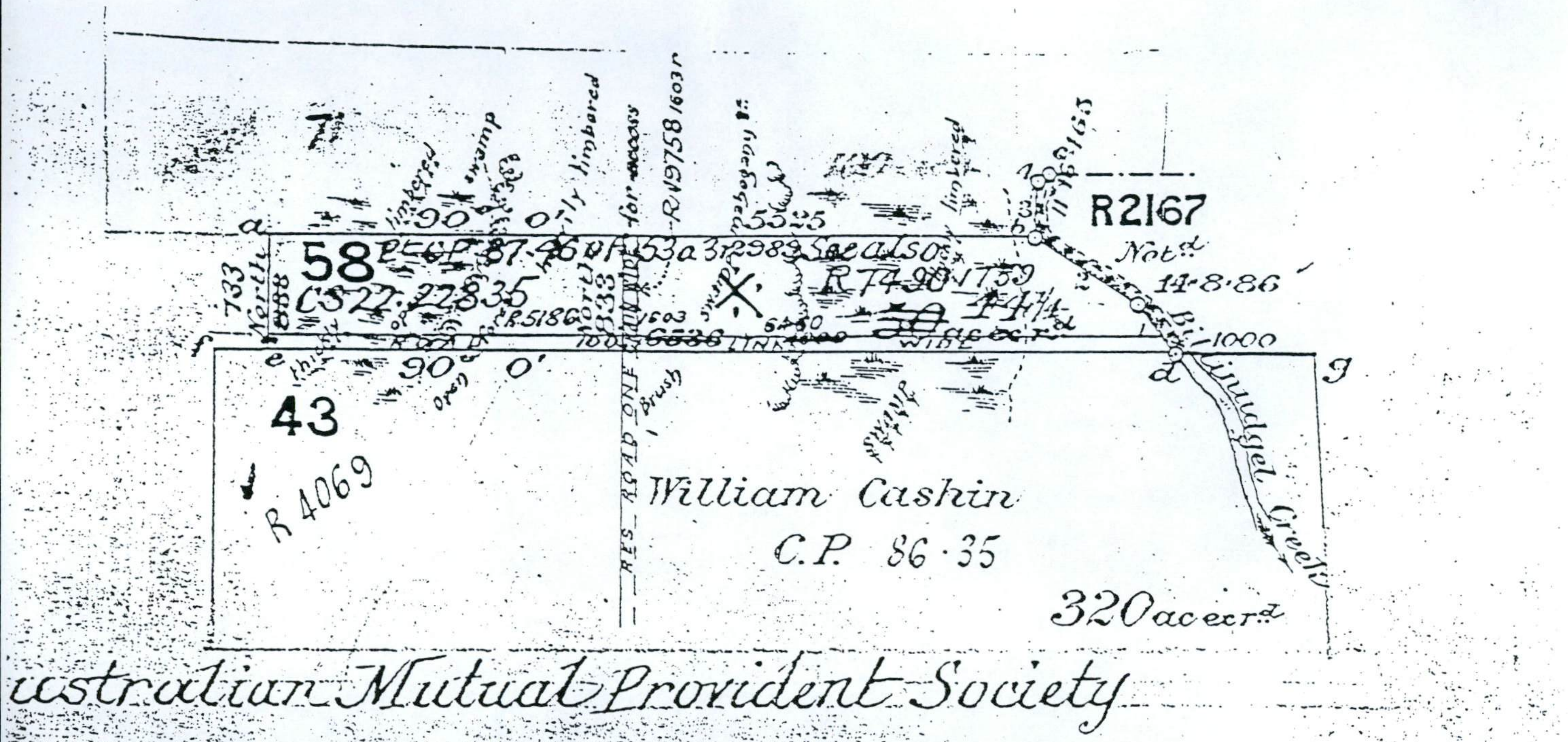
9.4.1 Major Wind Systems of Study Area

Three major wind systems can be identified which affect the Byron Bay-Hastings Point Region (Gentilli, 1971).

(1) *Travelling Anticyclones* – These move from West to East across the Australian continent with a periodicity of approximately 5 to 6 days, during which the winds radiating from the centre will swing through 360° at a given location. During the summer months the centre of these highs tend to cross the East Coast in the very South, through Tasmania giving a preponderance of S.E. winds in the Byron Bay region as the centre moves out into the Tasman Sea. In the winter months however the centre of the highs tends to cross the coast near the Queensland border. The region between two anticyclonic systems may represent unstable weather with associated cold fronts, warm fronts or rain;

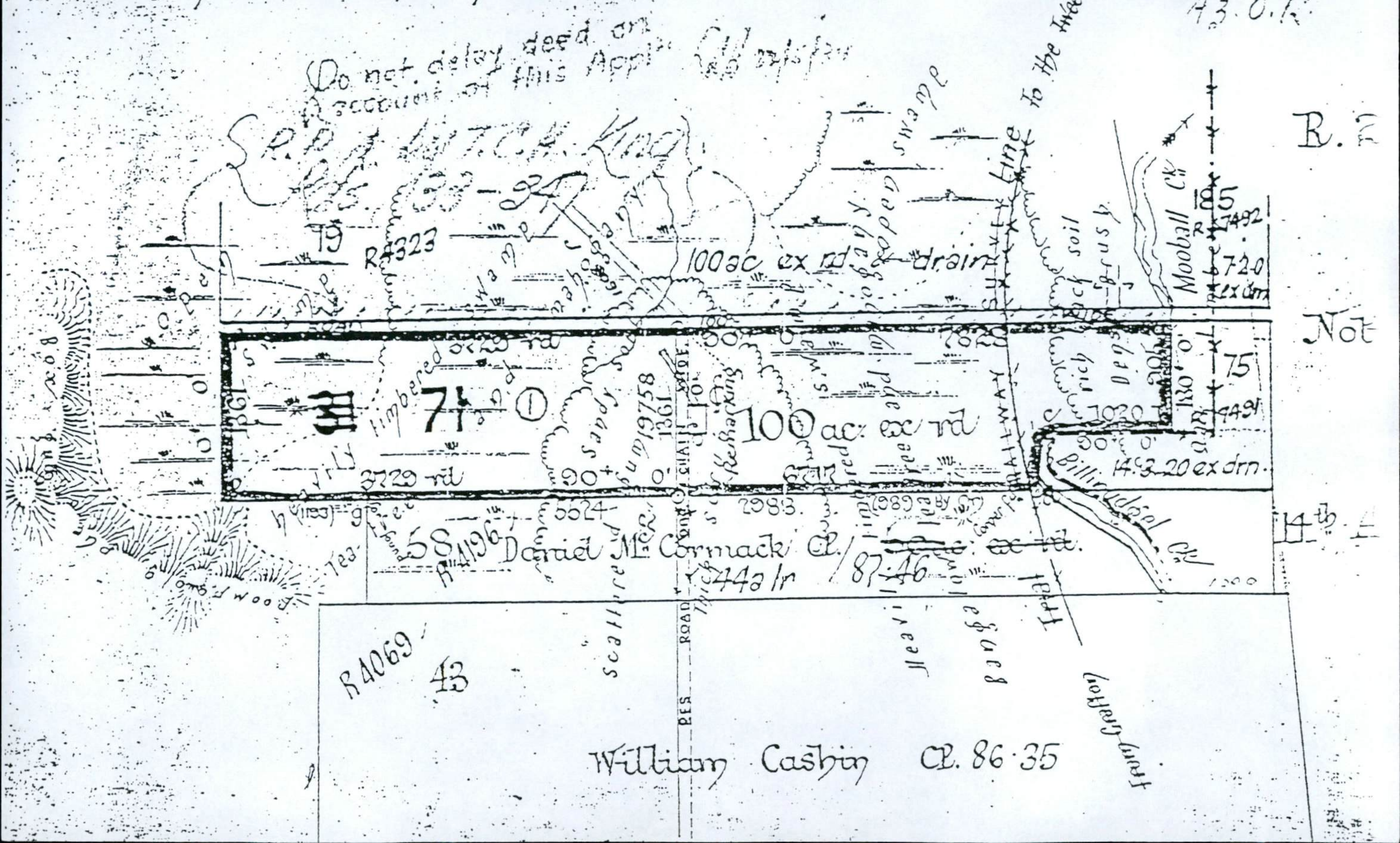
(2) *Land and Sea Breezes* – The differential heating and cooling of the land and

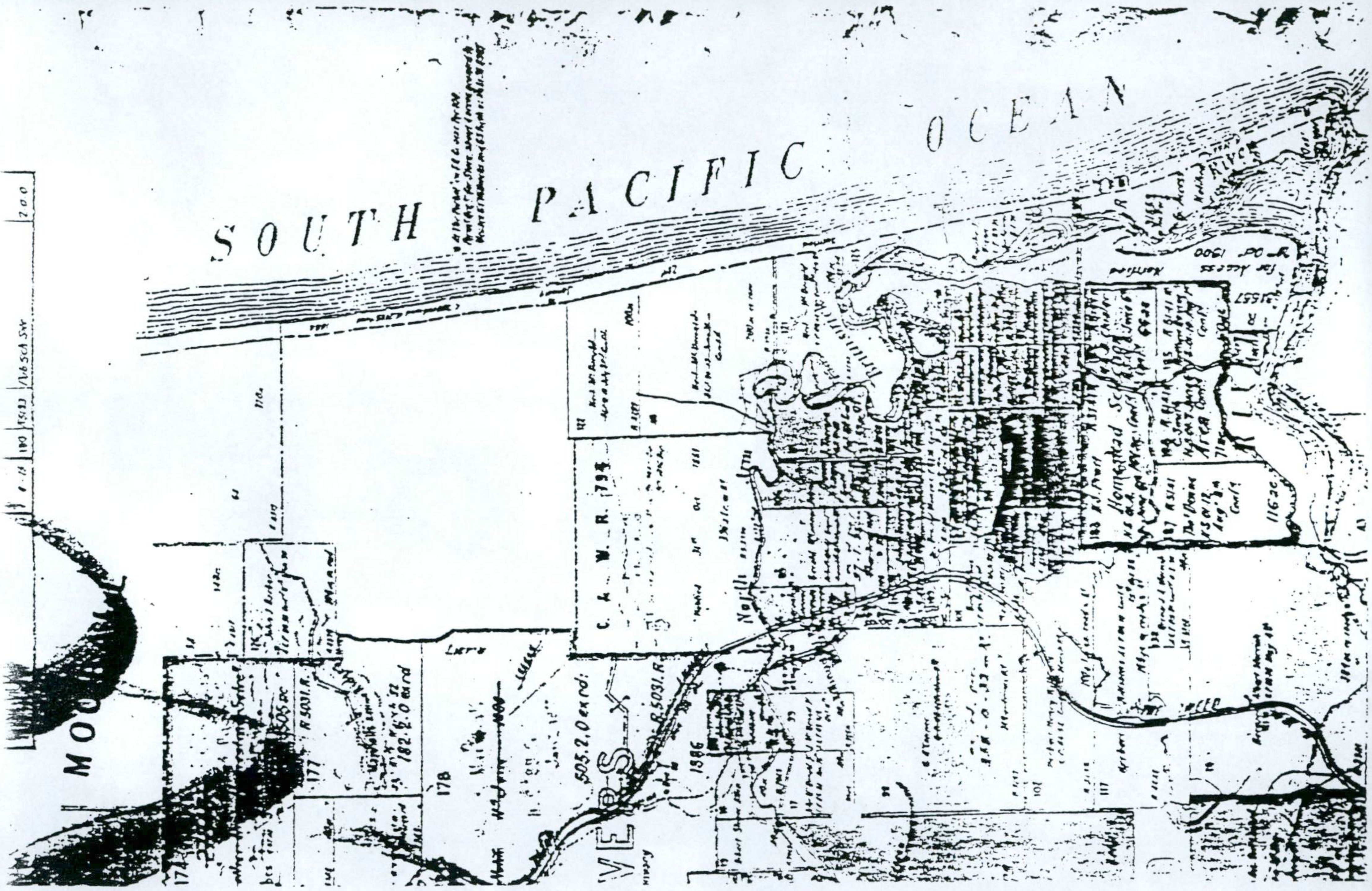

C.P. 86.35
43
brush jungle
2932
7932
5000
Large Swamp
with
James Charles Murnane
deep water
fair soil
320a. ex. rd.
CS10.12501
4000
2927
8282
5355
59
1002. ex. rd.
South Pacific



58
CS22 . 22835
R2167
14·8·86
43
R 4069
William Cashin
C.P. 86·35
320 ac ecrd
ustralian Mutual Provident Society
90 0'
1000
swamp

...P. 09·52 Gaz. 16th June. 15. Total Area. 114 ac. 3r. 20p.
of 114a 3r 20p. See also R7491 17- 3. John Charles McIn... sh the younger. Sale complete

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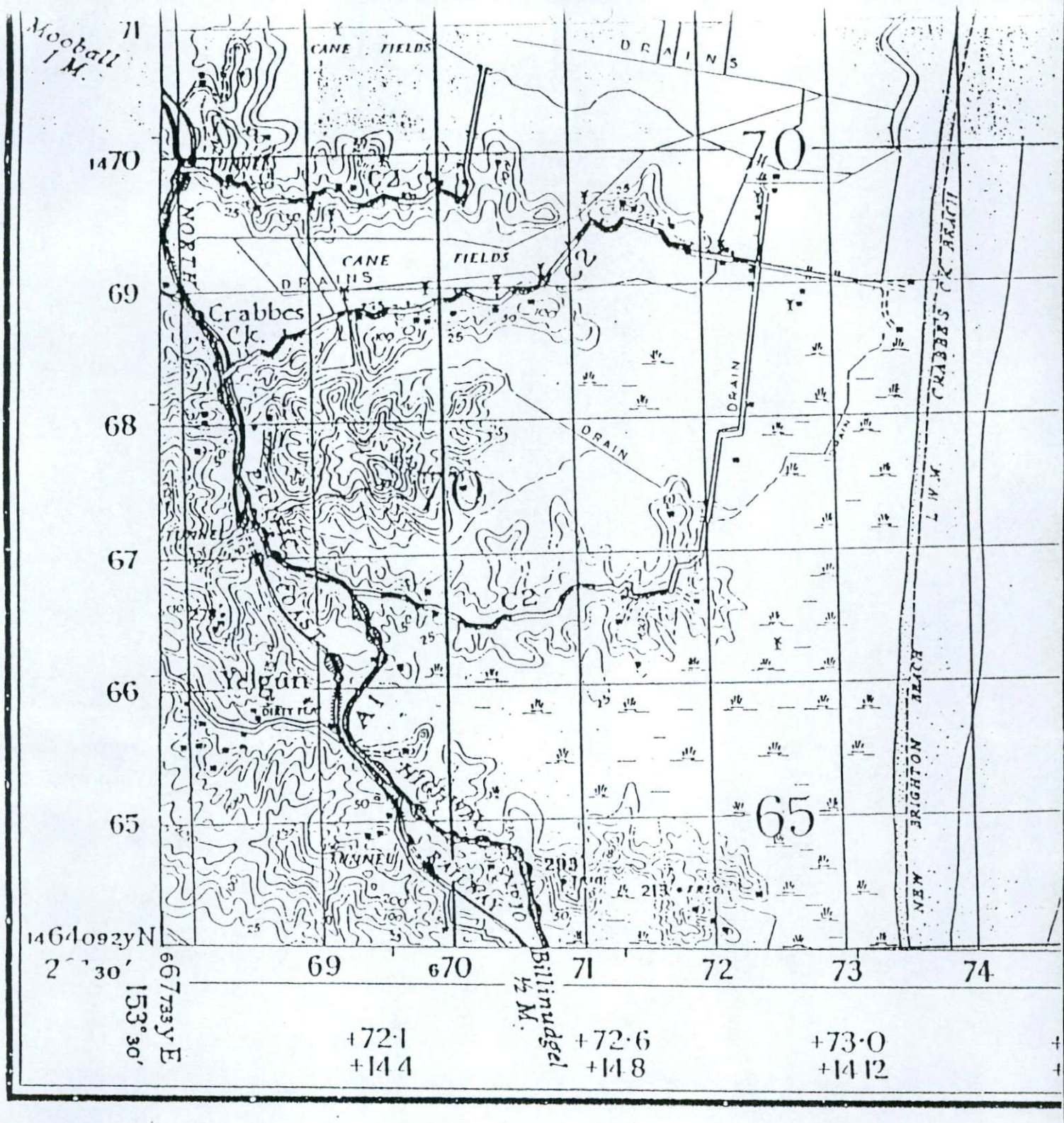


Prepared by Australian Section of Imperial General Staff

The framework of this Map depends entirely upon the First and Second Order Triangulation carried out by the 2nd Field Survey Coy., R.A.E.
Transverse Mercator Projection. Elevations in feet: Standard Datum, Sydney. Surveyed by 2nd Field Survey Coy., R.A.E., drawn in Department of Lands, New South Wales 1942.

[illegible]
[illegible] Street
Sydney NSW 2000
GPO Box 47 Sydney
NSW 2001 Australia

RAIL ACCESS CORPORATION

Telephone 02 9224 3000
Facsimile 02 9224 3900

02-9224 3042

17 September 1996

Paterson Consulting Pty Limited
PO Box 596
Grafton NSW 2460

Attention: Mr K. W. Paterson

Dear Sir

Marshalls Creek Floodplain Management Plan

I refer to your letter of 19 July 1996 requesting a submission on the preparation of the above Management Plan. As requested, I have outlined below our organisation and its roles and responsibilities in relation to the flood mitigation strategies summarised in your newsletter.

The NSW Government has recently restructured the former State Rail Authority into independent entities to separately control rail infrastructure and train operations. The Rail Access Corporation (RAC) was established to own and manage rail infrastructure in NSW and provide open access to the rail system. The existing passenger and freight services are the responsibility of State Rail and Freight Rail Corporation respectively. In this context, RAC is responsible for the railway line and all fixed infrastructure through the study area.

RAC supports the development of a floodplain management plan and will assist where possible throughout the study process. In terms of the mitigation options outlined in the Community Newsletter, our principle concern is that any 'structural' options do not adversely impact on flooding of the railway line. In particular, any changes that influence the drainage pattern of Marshalls Creek catchment should include careful analysis of their effects on the railway bridges over the Creek.

The Casino to Murwillumbah Line is currently undergoing a bridge rehabilitation program which includes the timber bridges at Marshalls Creek and you may wish to contact the project coordinator of these works - Mr Peter Hanrahan, Division Engineer, Grafton on (066) 429 455 to discuss.

Yours sincerely

Alan Barham
Senior Asset Manager, Country North

APPENDIX E.4

PUBLIC NEWSLETTERS

MARSHALLS CREEK FLOODPLAIN MANAGEMENT PLAN
Community Newsletter No. 1, April 1996

1. Introduction

This community newsletter has been prepared by **Paterson Consultants**, Grafton who have been engaged by **Byron Shire Council** to prepare the **Marshalls Creek Floodplain Management Plan**.

The purpose of this newsletter is to inform the community on progress towards development of the plan, the possible outcomes and the need for community input.

2. Background

Marshalls Creek is the northern tributary of the Brunswick River. It joins the Brunswick River about 1.1 kilometres upstream of the Brunswick River entrance to the Pacific Ocean (at Brunswick Heads). The study area includes the catchments of Marshalls Creek, Yelgun Creek and Billinudgel Creek. In high river level conditions the three major creeks, Marshalls, Yelgun and Billinudgel (which drains towards Wooyung) can interconnect behind the coastal sand dunes.

Over the past 20 years, Marshalls Creek experienced major flooding in 1972, 1974, 1976, 1978, 1987 and 1995. Such flooding will continue to occur in the future, created by heavy catchment rainfalls, elevated ocean levels or a combination of both.

Flooding in New South Wales is erratic and our climate has periods of wetter and drier years. Large floods can occur frequently within a relatively short period of time and may be followed by periods of no flooding. Flooding is a random phenomena, that is, floods of any size can occur at virtually any time.

Various standard technical terms are used to describe the probability of flooding. In the Marshalls Creek Floodplain Management Study, probability of flooding is expressed as percentage (or chance) of occurring **in any one year.** A 1% probability (1% AEP) flood has a one percent chance of occurring **in any one year**. The probability does not represent the time between floods. The 1% probability event is used as a guide by many organisations in considering land use planning.

The 1987 flood on Marshalls Creek (the Mother's Day Flood) approached the 1% AEP flood at Billinudgel but was not as large further downstream.The study area is illustrated overleaf with the approximate extent of flooding for the 1% AEP flood. Considerable numbers of properties, residential, commercial and industrial buildings will be affected to differing degrees in a 1% AEP flood.

The approximate numbers of residences, commercial and industrial buildings identified as being flooded in the 1% AEP flood are:

- New Brighton: 58
- South Ocean Shores: 11
- South Golden Beach: 28
- Billinudgel: 15

Flooding causes financial losses to both individuals and the community and creates additional stress within the community. Flooding is a residual risk and needs to be addressed to reduce existing flood damage potential and to ensure new developments do not either suffer flood damage themselves or make flood conditions worse at other properties.

2. *Floodplain Management Process*

In the Marshalls Creek floodplain, the prime responsibility for land management and land use planning rests with Byron Shire Council. Byron Council operates within the legislative framework provided by the Government.

The NSW Government has an established Flood Policy which aims to reduce the impact of flooding and flood liability on individual owners and occupiers and to reduce private and public losses resulting from flooding. The Policy encourages works and measures to reduce flooding and flood liability in existing areas and, by application of effective planning controls, to contain the potential flood losses in new development areas.

The Flood Policy, outlined in the NSW Floodplain Development Manual, promotes sharing of the responsibility of flood liable land management between different levels of government with local planning being the responsibility of Local Government.

The Flood Policy outlines a 5 stage process towards execution of a floodplain management plan. These are:

1. Establish Floodplain Management Committee
   - ❑ to assist Council in development of a floodplain management plan.

2. Complete Flood Studies
   - ❑ to define nature and extent of problem.

3. Undertake Floodplain Management Studies
   - ❑ to formulate and assess management options.

4. Develop Floodplain Management Plan
   - ❑ to present details on how land is to be managed to achieve defined objectives as established by Council with community input.

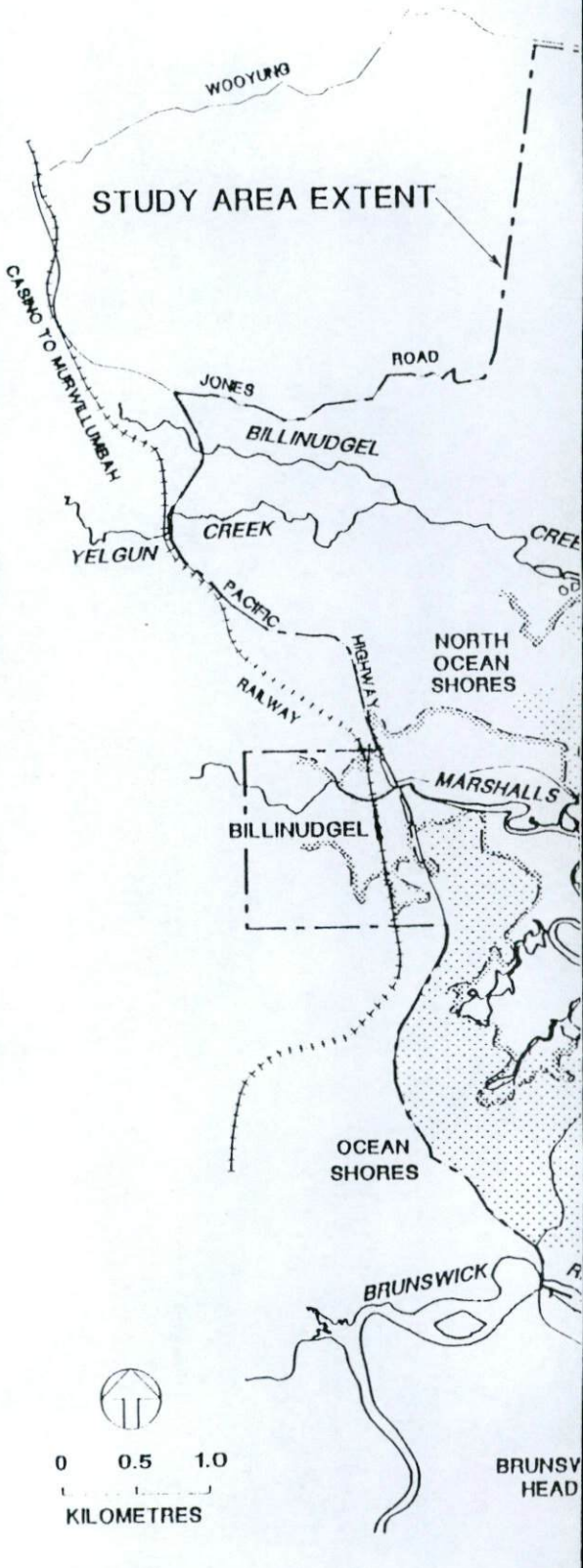
5. Implementation of Plan

Byron Shire Council has engaged **Paterson Consultants** of Grafton to complete the Floodplain Management Plan.

Paterson Consultants will be assisted by **Peter Cuming (Sustainable Futures** for planning, social and community consultation issues) and **Greg Clancy** (flora and fauna issues).

The objective of the Plan is to concentrate on the Marshalls Creek area while maintaining an awareness of wider catchment issues.

STUDY



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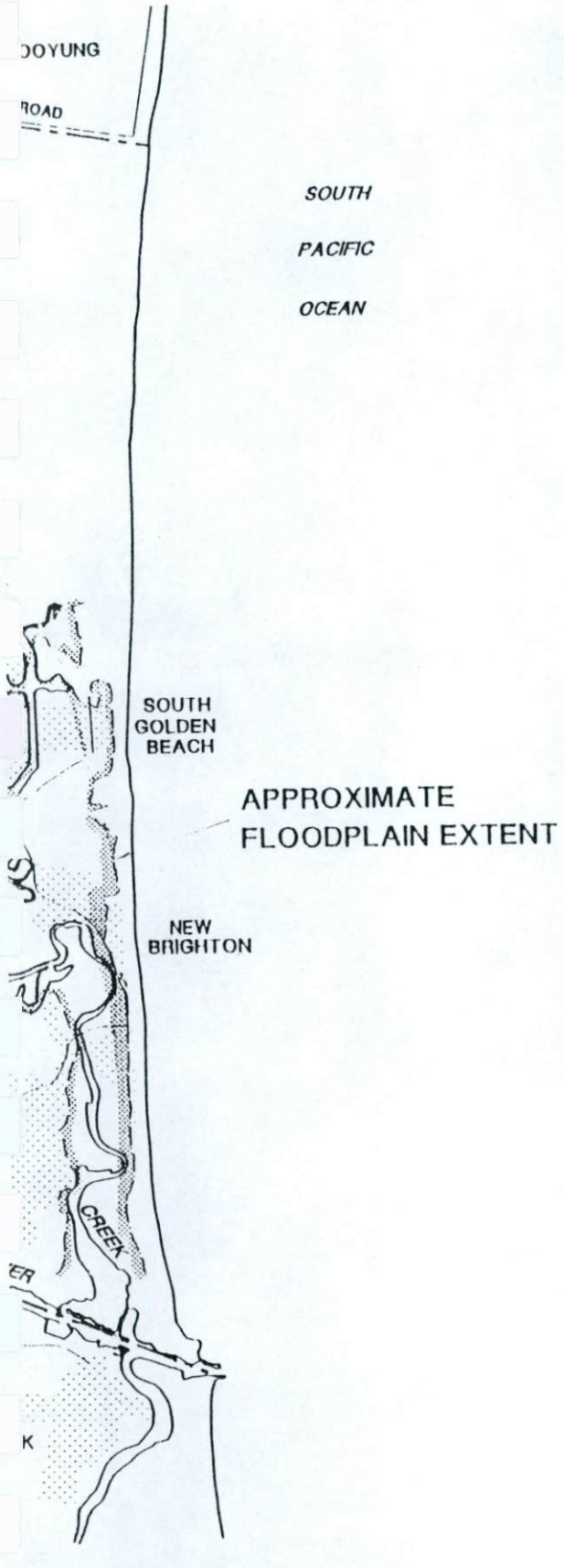


3. *Progress to Date*

- Byron Shire Council has had a Marshalls Creek Floodplain Management Committee in place since 1991.
- Council, together with NSW Department of Land and Water Conservation (formerly Public Works Department) has undertaken extensive investigations into flooding on Marshalls Creek and the Brunswick River.
- The investigations to date have developed over 45 alternative strategies for flood mitigation works or measures.
- The works and measures are described as:
  - structural ❑ they prevent land being flooded.
  - non-structural ❑ they change the way we use flood liable land.
- The suggested measures in Marshalls Creek have principally involved:
  - dredging of Marshalls Creek
  - additional ocean outlets
  - levees and filling
  - changes to road and railway bridges
- Council undertook a **Value Management Workshop** on 20 June 1995 with the objective of reviewing the 46 options investigated and sorting the alternatives to four or five viable options for further consideration.

  The options considered worth further investigation are :
  - widen the Orana Bridge.
  - dredge Marshalls Creek plus changes to training walls in Reading Bay.
  - create additional ocean outlets.
  - "quarantine development", that is, no further development on the floodplain.

  The criteria adopted to compare options and the weightings applied to these criteria were:
  - Environmental Impact: 18%
  - Community Acceptance: 11%
  - Flood Mitigation Effectiveness: 20%
  - External Impact Potential: 3% (Impact outside the study area)
  - Internal Impact Potential: 19% (Impact inside the study area)
  - Equity of Protection: 7% (Benefits and dis-benefits shared equally over the floodplain)
  - Affordability: 22%

The objective of the current study is to draw the four selected options into a Floodplain Management Plan that can be implemented by Council. The Plan might comprise of one of the options or a combination of options.

4. Community Involvement

Community consultation is an important part of the current process of developing a Floodplain Management Plan for Marshalls Creek.

Community information and dialogue is proposed by:

- Newsletter
- Public Meeting(s)
- Informal discussion with interested parties
- Public Exhibition of Draft Plan
- Formal Submission of Draft Plan

The first public meeting will be held at Ocean Shores School Hall on Wednesday 1st May at 5.30 pm.

5. Your Input

The study program allows for :

- Review of options, data collection, discussion, informal community inputs and review of options : Complete by end of May 1996
- Develop draft floodplain management plan : Complete by end of June 1996
- Public Exhibition of Draft Plan : Mid July to Mid August 1996
- Receipt of formal public submissions : August 1996

We look forward to your input as :

- ❑ comments or views which will be received before the end of May 1996.
- ❑ formal submission to the Public Exhibition of the Draft Plan.

Your input can be made to contacts as below :

Contact: Mr Peter Cuming
Sustainable Futures Planning & Design
195 River Street
MACLEAN
Tel: (066) 47 6463
Fax: (066) 47 6288

Contact: Bill Paterson or Ken Hegerty
Paterson Consultants Pty Ltd
60A Prince Street (or P O Box 596)
GRAFTON 2460
Tel: (066) 43 1588
Fax: (066) 42 7566
Email: patcon@nor.com.au

MARSHALLS CREEK FLOODPLAIN MANAGEMENT STUDY AND PLAN
Community Newsletter No. 2, July 1996

1. Introduction

This Community Newsletter has been prepared by Paterson Consultants, Grafton who are compiling a Floodplain Management Plan for Marshalls Creek on behalf of Byron Shire Council.

This newsletter is the second to be issued and seeks to inform the community of the progress and development of the FloodPlain Management Plan.

The first newsletter in April 1996 outlined a process of community consultation, study program and likely outcomes.

Byron Council has had a Floodplain Management Committee for Marshalls Creek since 1991. Extensive riverine hydraulics and mitigation options have been investigated. Council undertook a Value Management Workshop in June 1995 with nominated stakeholders, community and government representatives. The Workshop reviewed 46 options and identified 4 options which were considered to merit further investigation.

The options considered were :-

* Widen Orana Bridge
* Dredge Marshalls Creek and modify Readings Bay training walls
* Creation of additional ocean outlets.
* "quarantine development", that is no further development on the floodplain.

Paterson Consultants brief has involved drawing on the Value Management Workshop to develop a Floodplain Management Plan.

The responses to Community Newsletter No 1, the initial Public Meeting and the subsequent informal meetings have indicated that the best form of distribution of newsletters is through the informal channels established by the community consultation program. Accordingly, this newsletter has been forwarded through those channels.

2. Draft Aims and Objectives of the Plan

The Marshalls Creek Floodplain Management Plan has three broad objectives, which are:-

* The Plan seeks to reduce the impact of flooding and flood liability on individual owners and occupiers and to reduce private and public losses from flooding.

* The Plan seeks to reduce the impact of flooding on existing development areas by implementation of a series of flood mitigation lmeasures.

* The Plan seeks to reduce the potential for flood damage in and adjacent to new development areas by application of effective planning and development controls.

2. Plan Draft Aims and Objectives (Continued)

The Plan aims to achieve the objectives by :-

* Alerting the community (both existing and future) to the extent and hazard of flood liable land beside Marshalls Creek and its tributaries within the Plan's applicable area.

* Informing the community of Council and Government policies in relation to development and use of flood liable land.

* Definition of a flood standard to be used for planning purposes.

* Reduction of the risk to human life and damage to property caused by flooding through appropriate works and measures and development controls on flood prone lands

* Encouragement of development and uses for land which are compatible with the flood hazard at the site.

* Provide controls with regard to flooding such that new development projects can be treated consistently and on their merit.

* Provide mechanisms to support the community's response to flooding.

3. Progress to Date

3.1 Community Consultation

A Public Meeting was held on 1 May 1996 to discuss the Plan. Some 39 residents attended. A major issue from the Public Meeting was the community concern regarding the impact of further filling on the floodplain. Council has acted to prepare and exhibit a policy preventing further filling. After receipt of submissions, we anticipate that the policy will be adopted and applied.

The Public Meeting was advertised via Community Newsletter No. 1, of which some 4000 copies were distributed through the Marshalls Creek floodplain area.

The Public Meeting was followed by a series of informal meetings with community groups at New Brighton, South Golden Beach, North Ocean Shores, South Ocean Shores and CONOS. These meetings allowed identification of the community's shared values, shared concerns and preferred solutions which can be summarised as:

* The participants greatly valued the residential amenity of the area featuring the environmental quality and diversity of the area.

* There appears little support for widening of Orana Bridge given the cost and limited benefits.

3.1 Community Consultation (Continued)

* There was limited support for the large capital works envisaged at the Value Management Workshop on the basis of cost versus benefits in reduced flood levels.

* There is support for an opening through the dune system to release floodwater but the opening was seen as a natural opening rather than the engineered solution from the Value Management Workshop.

* There is support for dredging of Marshalls Creek with adjustments to the Readings Bay training walls providing these measures can reduce flood levels.

* Improvements to flooding were seen as flowing from:-
  - Empowerment of the community to handle floods
  - Making the environment less sensitive to floods
  - Making individual dwellings less flood prone.

* Community concern over the amount of filling in the floodplain was expressed as a need to limit further development in the floodplain. It was generally agreed that continued limited development was acceptable providing that the development did not worsen potential and actual flooding and other environmental constraints were rigorously addressed.

* There was support for greater emphasis on water quality improvements and changes to the development process to allow more control over disturbance of acid sulfate soils, silt and debris controls, drainage and development form.

Areas of conflict between the groups are principally in the relative importance placed on the shared values outlined above.

3.2 Formal Consultation

Requests for formal submissions have been sent to Government bodies, authorities and community groups. Eighteen responses have been received from the 54 requests dispatched. The responses have, on the whole, raised the issues of acid sulfate soils and the habitat values of the area. NSW Fisheries and NSW National Parks and Wildlife noted the diversity of the area and the need to fully address environmental impacts before proceeding with any works.

4.0 Work Program

4.1 Works Completed

Work has been completed in a number of areas. Reviews have been conducted on the hydraulic modelling to date, presentation of the hydraulic data in a more user-friendly format, review of the local environment, the local statutory planning requirements and coastal issues. The consultation process has been outlined above.

A number of technical issues have arisen which need to be addressed before proceeding to the Floodplain Management Plan. These issues cover:-

Ground survey.
The flood study work was based on ground survey undertaken some years ago. We have located only about one half of the original survey. This information is needed such that an accurate assessment can be made of flood hazard at individual locations.

House floor levels
Some difficulty has been experienced in obtaining house floor levels throughout the study area. House floor levels were taken some years ago and have taken time to locate. Cross-referencing of the house data-base against the garbage collection records suggests ground survey will be needed to confirm floor levels for another 300 properties in the floodplain area. The floor level data is required to identify the freeboard precisely available to each house, the magnitude of damage likely in floods and the benefits to be gained from the large scale structural works proposed in the Value Management Workshop.

The Bund
The Kalaroo Circuit Bund has been a divisive issue in the past and is the subject of a retro-fitting proposal, agreed between Byron Council and cane farmers at Wooyung. Some parts of the community have expressed concern at the proposal and have asked to review the data on which the agreement was based. There is a sound basis to delay the Floodplain Management Plan until the the Bundissue is resolved and base conditions confirmed.

4.2 Completion

Community Newsletter No 1 indicated that the Draft Plan would be on exhibition in mid July 1996. We now anticipate that exhibition will not occur until September 1996.

5. Contacts

Contact: Mr Peter Cuming or Jenny Donovan
Sustainable Futures Planning & Development
195 River Street
MACLEAN
Tel: (066) 45 3933
Fax: (066) 45 3922

Contact: Bill Paterson or Ken Hegerty
Paterson Consultants Pty Ltd

60A Prince Street
GRAFTON
Tel: (066) 43 1588
Fax: (066) 42 7566
Email: patcom@nor.com.au

APPENDIX E.5

INFORMAL MEETING REPORTS

Marshalls Creek, Floodplain Management Plan,

Report on public meeting no. 1, 1/5/95
held at Billinudgel Public School, Ocean Shores.

Prepared by Sustainable Futures
on behalf of Paterson Consultants, May 1996.

Introduction

This report has been prepared by Sustainable Futures who have been engaged by Paterson Consultants to undertake the community consultation for the above project, on behalf of Byron Shire Council.

The aim of the project is to prepare a plan for the management of the Marshalls Creek floodplain to mitigate the potential for flood damage.

The purpose of the meeting was to present to the public the four or five viable options that arose out of the Value Management Workshop undertaken on the 20 June 1995, explore the implications of those options and gain an understanding of the values and concerns of the local community in relation to the proposed plan. This report is divided into three parts which reflect three aims:

1) to summarise the conduct of the meeting,
2) to draw conclusions as to the general feeling of those in attendance and;
3) to identify the implications of incorporating those values and aspirations into the plan.

The Meeting

The meeting commenced at 5.30 pm and was attended by a maximum of 39 people. The number in attendance cannot be considered to represent the strength of feeling in the affected community because of the extremely inclement weather at the time, which has continued since and led to flooding in the catchment.

Bill Paterson, from Paterson Consultants, introduced the meeting and gave a brief overview of the process to date. Peter Cuming from Sustainable futures then outlined the team and the community participation process. P.C outlined the content of the meeting as being an exploration of the four or five options and their physical implications, a short break to allow people to study the options which were prepared by Paterson's and presented on boards at the meeting and an open discussion to consider the implications of these options. The meeting however departed from this structure by leaving out the break in order to give adequate opportunity for the participants to express their evident strength of feeling.

The five options discussed were:

Widening/lengthening(?) Orana bridge
Dredging the creek and changes to the training walls at Reading Bay
Additional ocean outlets
"Quarantine", or moratorium on development in the floodplain
A combination of the above.

Public Response

The participants came across as being both articulate and well informed. Some participants were much more vocal than others, however it is considered that no one person, or small group of people were allowed to dominate the proceedings.

In relation to organisation of the meeting, concern was expressed by two people about both the length of time of the meeting and the starting time, 6.30 or 7 pm was considered more appropriate to arrange tea/childcare.

The general mood was that the floodplain was presently poorly managed and that community feeling was little considered. This was expressed as a fundamental crisis of confidence with both the Council and the consultants that had previously been involved with this project. The community felt disenfranchised from the planning process. At a number of times participants (particularly Jim Mangleson) raised alleged incidences of submissions from within the community that had been ignored. The focus of this lack of faith seemed to be that the Council allowing continuing incremental infill within the floodplain especially given a floodplain management plan was not in place; and the apparent discrepancies on the data on which the computer modelling and conclusions were based. This was particularly evident in light of the anecdotal evidence that was presented by several members of the community.

Other concerns raised were:

The 1% AEP flood level and why it had changed in the preceding years, which also raised concerns about what it was likely to do in the future.

In relation to widening Orana bridge, the future of the bund and its affect on the hydrology of the area.

In relation to the additional ocean outlets option, the size of the required outlets.

In relation to the dredging option, the subsequent siltation of the channel and the implications of changes to the training wall.

In relation to the equity of the options, the participants felt that the values of future development and settlers was given greater consideration than the needs of the present population, who felt they were being sacrificed.

Generally there was concern at the way the agenda had been set, which further suggests a lack of confidence in the preceding stages of the process. There seemed strong support for levees at the meeting but this was not reflected in the options put before the community.

Another general concern was the perceived lack of standards in the consideration of development applications within the floodplain.

There was a strong sense that at the very least there should be a moratorium on future development within the floodplain until completion of the floodplain management plan, that greater emphasis should be placed on anecdotal evidence rather than on the computer models and that the strategy should be tailored for localised considerations.

Conclusions

There is an extremely pressing need to rebuild faith with the local community if their considerable resources of local knowledge and (potential) goodwill are to be harnessed. It appears likely that this will only be achieved when bridges are built between the Community and the Council. As agents for the Council, Sustainable Futures and Paterson Consultants both have a considerable role in demonstrating an openess to community concerns and a willingness to address those issues.

Achieving this responsiveness would seem to require the following:

* A clear explanation of the brief to the community, covering the areas the consultants can and cannot address in order that the community understands the parameters of what we can do, limiting the chances of falsely raised hopes, demonstrating confidence in the community and ensuring that subsequent stages are based on the correct understanding.

* A commitment to addressing localised issues, which will require individual meetings with the various component communities within the floodplain area.

* A commitment to understanding the broader social landscape. This will require that the consultants expressly seek to understand not only the problems to be addressed but also what is valued, not only for the resident community but also for those people that use the area for other purposes, for example those who use the shops, attend the school or just value that environment for its amenity value.

* A commitment to "openess"; that is, allowing the community to see what we are doing, through newsletters, meetings, etc. and providing an accessible contact point, in order to encourage a dialogue between community and consultants.

* A demonstration of our commitment to the community. This entails being adequately briefed about the background to the study and an explicit commitment to apportion weight to the values and anecdotal evidence of the local community.

The Next Steps

Establishing common ground between the community and the consultants (representing the Council) will require that the agenda for action reflects community aspirations and concerns.

As an immediate measure to demonstrate confidence in the local community and a commitment to their values, a moratorium on future development within the 1% AEP floodplain is suggested, at least as an interim measure until the finalisation of the management plan.

The commitment to address localised issues should be expressed through meetings held within the component communities. These meetings should seek not only to identify the localised social landscape and report any developments, but also draw on the consultant's skill to identify and communicate the social, environmental and economic implications of any ideas, not only for that community but also for others that share the Marshalls Creek area. In this way it is hoped that no one group would limit the possible options for another group at a subsequent meeting. In addition, this will help to engender a sense of social responsibility.

The commitment to understanding the social landscape can best be expressed by designing consultation to ensure that all points of input are structured to extract comparative information. Such a structure should be carefully considered to ensure it remains open and precedes any detailed consideration of the options, so as not to present a fait accompli or identify a social landscape which reflects hypothetical elements. In this way consultation can establish what people value about their surroundings, what people dislike and what are the characteristics of the area that define its character. Any subsequent decisions can then be considered in light of the findings of this assessment and conflicts between the social landscape and the individual solutions can be addressed; and the consultants skill brought to bear to resolve such conflicts. This will also enable technical solutions to be tailored to recognise and incorporate the social landscape, protecting valued elements and mitigating problems.

A questionnaire or door to door survey would assist in establishing the social landscape because of its inclusivity. However, given the considerable time and cost that this will require, it is considered that an approach which comprises of public meetings which are backed up with an accessible point of contact, such as a telephone "hotline" along with a review of any social profiles available of the catchment (e.g Council Section 94 Contribution Plan, ABS statistics) will represent the best way of identifying the social landscape within the available resources.

These initial actions will enable SUSTAINABLE FUTURES to assist Paterson's in establishing the broad principles of the flood management plan.

The possibility of supporting the plan with building and landscape design guidance, either advisory or for statutory adoption, for building/landscaping within the floodplain and adjacent to it should be considered as a matter of urgency.

Marshalls Creek, Floodplain Management Plan,

Report on public consultation meeting No. 2 with members of CONOS, held at Ocean Shores North on the 16th of May 1996,

Prepared by Sustainable Futures
on behalf of Paterson Consultants, May 1996.

Introduction

This report has been prepared by Sustainable Futures who have been engaged by Paterson Consultants to undertake the community consultation for the above project, on behalf of Byron Shire Council. The aim of the project is to prepare a plan for the management of the Marshalls Creek floodplain which mitigates the disruption, damage and potential costs to health and safety that are caused by floods and which retains the waterways as an ecological and social resource.

As part of our commitment to respecting community concerns and aspirations and our belief in the value of local knowledge in the planning and design process, this document reports back to the community our understanding of your worries and aspirations in relation to this project, as gained from the meetings held on the 16th and 17th of May, 1996.

The purpose of the meetings was to discuss the options that arose out of the Value Management Workshop undertaken on the 20th June 1995, in light of those community concerns. This report deals with the second meeting, held at Val and Stan Scanlon's house at 1.30 pm on the 16th of May. Val and Stan Scanlon are representatives of CONOS (Conservation of North Ocean Shore).

The Meeting

The meeting was attended by four people, two representatives of Conos and Cathy Billin and Jenny Donovan from Sustainable Futures. The strength of feeling and commitment of Val and Stan to the conservation of the area and concern at the plight of those affected by floods was evident from the start. There was a strong perception that environmental degradation the area had suffered was likely to get worse because of the amount of development in the pipeline, a problem which was considered likely to be compounded by the construction of the Billinudgel by-pass, which would both increase development pressure and cut an important nature conservation corridor which would then lose its integrity. There was a strong feeling that the nature reserve, north of Ocean Shores North (currently zoned 7k) was an extremely important ecological and archaeological resource, citing it as the habitat of 50 species of endangered flora and fauna and contained 22 registered archaeological sites, and was recognised as potentially having many more (Simpson Report, 1990).

There was a strong feeling that the modelling that had been done to predict the patterns of flooding was inaccurate and the hydrology of the area was poorly understood. In light of this, some of the assumptions behind the four options put to them were questioned. In particular regarding siltation and the direction of flow of Billinudgel Creek. The CONOS representatives expressed the belief that the agricultural practices further upstream had hastened the rate of run-off, had caused soil degradation on site and siltation and acid poisoning down stream which had been a major factor in the recent fish kills in the waterways. These problems were being exacerbated locally by incremental development in the flood plain. There was a perception that these factors had contributed to the unpredictable nature of flooding in the area and worsened the problems associated with them.

In relation to the Ocean outlet option, this measure evoked the strongest response. The heavily engineered solution presented to them was considered to be detrimental to the value of the nature reserve in ecological and archaeological terms. The participants cited the Simpson report (1990) as effectively eliminating that option at the time. They also questioned its value given the poorly

understood hydrology of the area. (Note: since the meeting, a low impact, more organic ocean outlet has been proposed, see report No. 4 in this section).

In relation to the other options, none were seen as offering a complete solution. The quarantine option however was the only one to receive support. There was a strong feeling that this would have to be supported by other measures, which could be described as a toolkit of measures that could be used to build a strategy for floodplain management. There was a consensus that these measures should have a substantial component of local input and should be tailored to localised conditions.

Recommendations

There was a general agreement that these localised solutions should include the following elements:

Education and consultation: The participants saw this as a two way process of assisting people to make decisions about the future of their environment and about how to cope with flooding without letting it become a major problem to them. This might include educating people when they purchase a property in the area of the implications of living in a floodplain, educating people how they can develop their property in such a way as to mitigate problems for them without worsening problems for other people affected by floods, educating people about landscaping with flood tolerant plants and use of permeable landscaping materials, encouraging an adequate understanding of flooding and assisting people to understand what they can do to handle flooding, for themselves and the wider community. The participants saw this as requiring some formal policy backing to ensure it was adequately resourced.

Management: The integrity of the Nature Reserve should be ensured in any proposed maintenance regime. In addition, management should ensure there is an adequate and well maintained drainage system, which might incorporate drainage swales instead of kerbs and gutters. Consideration should also be given to the compilation of a list of local tasks to be done in time of flood and a database of available resources held within the community during those times, when more traditional and official service providers, such as the Council and the SES might be overstretched. This element would need adequate safeguards to avoid being manipulated to sectional advantage and would, of course, need to be adequately resourced if it is to be effective.

Assessing development: Development should be considered in light of its environmental implications, of which a very important part is its effect on flooding. To this end a general quarantine was supported, given that further development would worsen the problems. However it was recognised that some development was inevitable. Where this was so, essential requirements would be for no-fill or disturbance of acid sulphate soils and conformance with the landscaping and servicing objectives mentioned above.

Flood damage mitigation measures: Where the measures described above would have only marginal value, the possibility of raising the house on poles or piers should be considered. For those properties where this cannot be done, because of slab construction, the possibility of buying back the land and demolishing the house should be considered where major flood impact has been identified. Depending upon the location of the site the land could be retained for public open space or redeveloped in a more appropriate manner.

Recognising the archaeological/spiritual value of the area: The participants felt strongly that the considerable historical and archaeological value of the area, and its spiritual significance should be protected and explored further.

Other capital measures: These were considered largely inappropriate and probably environmentally detrimental. Any re-consideration should be based on a more detailed and accurate study of their implications on the hydrology of the area, as the present assumptions were considered questionable.

Our Response.

The articulate nature of the community and their strength of feeling represents a potentially powerful resource of goodwill and local insight that could contribute greatly to the design, implementation and management of the plan. Utilising these resources can best be achieved by considering the following:

Implications for the Plan

The community represented at the meeting felt that the options under consideration should be re-assessed, with greater emphasis given to their potential environmental implications. The emphasis on large scale, capital intensive measures should be changed to more localised, community based measures in order to minimise the problems associated with flooding. The participants felt that the toolbox from which the management plan should be constructed should comprise the following elements:

Commission a survey of the Nature Reserve to establish its ecological and archaeological value.

Respect the spiritual value of the Nature Reserve, retain and enhance the viability of the Nature Reserve and its stock of biological and archaeological resources.

A quarantine on further development, particularly where fill is required.

Better information and education, to enable people to understand their environment and empower the local communities to make well-informed and considered choices about the future of their environment.

Changes to the Councils Development Application assessment practice to give greater emphasis on the developments' effects on flooding.

Better on-going management of infrastructure, to lessen the impact of floods when they do occur.

Provision for flood-proofing measures for the most severely affected properties.

The Next Steps

We are endeavouring to build on these findings, as well as those of the other meetings to establish the common ground shared by the communities, resolve differences and build a shared strategy for managing the flood plain that respects the qualities valued by the community, addresses the problems of concern to the community and empowers the community to maximise their say in the future of their shared environment. The common ground and areas of remaining substantial differences are outlined in the second part of this document.

Marshalls Creek, Floodplain Management Plan,

Report on public consultation meeting No.3 with members of
Ocean Shores Community Association,
held at Ocean Shores North on the 17th of May 1996.

Prepared by Sustainable Futures
on behalf of Paterson Consultants, May 1996.

Introduction

This report has been prepared by Sustainable Futures who have been engaged by Paterson Consultants to undertake the community consultation for the above project, on behalf of Byron Shire Council. The aim of the project is to prepare a plan for the management of the Marshalls Creek floodplain which mitigates the disruption, damage and potential costs to health and safety that are caused by floods and which retains the waterways' value as a social and ecological resource.

As part of our commitment to respecting community concerns and aspirations and our belief in the value of local knowledge in the planning and design process, this document reports back to the community our understanding of your worries and aspirations in relation to this project, as gained from the meetings held on the 16th and 17th of May, 1996.

The purpose of the meetings was to discuss the four options that arose out of the Value Management Workshop undertaken on the 20th June 1995, in light of those community concerns. This report deals with the third meeting, held at Stan Thompson's house at 10 am on the 17th May.

The Meeting

The meeting was attended by eleven people, eight representing Ocean Shores North residents from the Ocean Shores Community Association and Peter Cuming, Kathy Billin and Jenny Donovan from Sustainable Futures.

The high level of understanding and involvement with these issues and the strength of feeling of the participants was evident. There was a strong perception that the hydrology of the floodplain was very sensitive to the developments both in the floodplain and further upstream, and that many of the problems being faced now were worsened by further development. In particular it was believed that the infilling which has been a characteristic of much of the development has been generally detrimental and has contributed to the major component elements of the flood problems, being:

Flood levels and their unpredictability
Speed of rise and fall of flooding
Water quality problems
General environmental degradation
Inconvenience and financial loss.

There was a general feeling that the area was subject to considerable development pressure and that if development was to happen, it was felt all these problems would be worsened by the Council's D.A. assessment process which subjected development to specific requirements for compacted fill and hard surface drainage. There was also a feeling that the existing drainage system is poorly maintained. The in-filling of the ocean outlet that existed to the north of Ocean Shores North prior to 1974 was considered to have limited the ability of the floodplain to drain adequately. Other recognised problems included the silt that was being washed into the waterways, that Capricornia canal does not flush adequately and that the bund was restricting the flow of water through the system, all of which contribute to poor water quality, particularly immediately after flooding.

In relation to possible solutions, the participants suggested several innovative and creative ideas.

With regards to the suggested options it was felt that there was a pressing need that things should get no worse. This was perceived as requiring flood-proofing and flood mitigation measures. The two flood-proofing measures most strongly supported were either another ocean outlet as a safety valve to relieve excessive build-up of water, and/or dredging of the river channels to improve the efficiency of their profiles. The flood mitigation measure most widely supported was that development and redevelopment should be restricted to only "sensitive and healthy development" which was considered to be development which did not require fill or result in speed up of run-off from the site or the disturbance of acid sulphate soils. In addition to these measures, other suggestions included widening the span of New Brighton bridge rather than Orana bridge, as this was considered more effective; and replacing the bund with a bridge. In relation to the outlets there was a strong feeling that the assumptions of the options put before them were wrong and that an outlet could be achieved so easily as a natural narrow stream bed, similar to many beaches of the north coast. It was also felt that such an outlet would only replace an existing outlet that had existed there until 1974. In relation to the dredging option it was felt that the dredged material might be removed by pipe and be used for landscaping or if it was white sand, to build up either the dunes or the beaches. It was recognised that this was likely to require on going maintenance, without which likely increases in development pressures, which would result from the temporarily lowered flood levels, may lead to worsened long term problems. This led to the conclusion that such physical measures were inadequate in themselves and that any strategy should consist of several complementary measures which would limit the damage and disruption caused by flooding. In addition to the major capital measures and restrictions on future development, as described above, the participants recognised the importance of localised management and minor works measures. There was strong support that these measures should have a substantial component of local input and should be tailored to localised conditions. These measures were described as being pro-active and combining to form a toolkit of available measures.

Recommendations

There was a general agreement that this toolkit of solutions should include the following elements:

Capital measures: These were considered to be of central importance. As outlined above a northern outlet and/or dredging received the greatest support. Other minor works that achieved a great deal of support were for silt traps and gross pollutant traps at drain outlets and for a weir on the Billinudgel and Marshalls creek to incorporate silt and gross pollutant traps.

Education and consultation: The participants saw this as a process of assisting people to make decisions about the future of their environment and about how to cope with flooding without letting it become a problem to them. This might include educating people, when they purchase a property in the area, of the implications of living in a floodplain. Educating people how and in what way they can develop their property so as to mitigate problems for themselves without worsening problems for other people affected by floods. Educating people about landscaping with flood tolerant plants and use of permeable landscaping materials, encouraging an adequate understanding of flooding and assisting people to understand what they can do to handle flooding, for themselves and the wider community. The participants saw this as requiring adequate resources in order to be effective.

Management: There was strong support for a moratorium on development and developing the infrastructure and social structures for handling floods. This would include ensuring there is an adequate and well maintained drainage system, which might incorporate grassed drainage swales, where appropriate, instead of kerbs and gutters, the establishment of community based structures to handle problems associated with floods, when more traditional and official service providers, such as the Council and the SES might be overstretched. This component was seen as being dependant on adequate resources.

Assessing development: Development should be considered primarily in light of its effect on flooding. Development would be considered acceptable where it required no fill or disturbance of acid sulphate soils and did not greatly increase the amount of impermeable surfaces on the site. Modelling must include the cumulative effect of filling related to individual developments. The failure to consider this when assessing individual proposals is seen as a major fault.

Flood damage mitigation measures: There was a degree of support for either buying back or raising dwellings that were severely flood affected.

Our Response

The articulate nature of the participants and their evident strength of feeling represents a potentially powerful resource of goodwill and local insight that could contribute greatly to the design, implementation and management of the plan. Utilising these resources will require considering the following:

Implications for the Plan

The management plan should have two equal components, firstly a major capital flood-proofing element and secondly a substantial flood mitigation element. The first element is a "safety valve", to relieve pressure, the second element a way of ensuring the environmental problems associated with flooding are limited. The participants felt that the toolbox from which the management plan should be constructed should comprise the following elements.

The northern outlet option should be reconsidered in light of evidence of a purported pre-existing natural outlet, and the implications that this has on the assumptions about the economic and environmental costs of that option.

The option to widen Orana bridge should be amended to consider instead widening the span underneath New Brighton bridge.

The dredging option to be reconsidered in light of the potential value of the dredged material for the dunes.

Amending the quarantine option to state that development is not acceptable if it requires fill, substantial increase in the amount of impermeable surfaces or disturbs acid sulphate soil.

Changes in the Council's Development Application assessment practice to give greater emphasis on a development's effect on flooding.

Undertaking a program of minor capital works, such as silt and gross pollutant traps and the establishment of an effective drainage system.

Replace the bund on the Capricornia canal with a bridge.

Establishing maintenance policies to ensure drains and other infrastructure are adequate.

A commitment to keeping the community informed and consulted about developments.

The Next Steps

We are endeavouring to build on these findings, as well as those of the other meetings to establish the common ground shared by the communities, resolve differences and build a shared strategy for managing the flood plain that respects the qualities valued by the community, addresses the problems of concern to the community and empowers the community to maximise their say in the future of their shared environment. The common ground and areas of remaining substantial differences are outlined in the second part of this document.

Marshalls Creek, Flood Plain Management Plan,

Report on public consultation meeting No.4,
with members of Ocean Shores Community Association,
held at Ocean Shores Country Club on the 17th of May 1996.

Prepared by Sustainable Futures
on behalf of Paterson Consultants, May 1996.

Introduction

This report has been prepared by Sustainable Futures who have been engaged by Paterson Consultants to undertake the community consultation for the above project, on behalf of Byron Shire Council. The aim of the project is to prepare a plan for the management of the Marshalls Creek floodplain which mitigates the disruption, damage and potential costs to health and safety that are caused by floods and preserves it as an ecological and social resource.

As part of our commitment to respecting community concerns and aspirations and our belief in the value of local knowledge in the planning and design process, this document reports back to the community our understanding of your worries and aspirations in relation to this project, as gained from the meetings held on the 16th and 17th of May, 1996.

The purpose of the meetings was to discuss the four options that arose out of the Value Management Workshop undertaken on the 20th June 1995, in light of those community concerns. This report deals with the fourth meeting, held at the Ocean Shores Country Club on the 17th of May at 3 pm.

The Meeting

The meeting was attended by nineteen people, nine of whom indicated they came from Ocean Shores, two from Billinudgel, South Golden Beach and South Ocean Shores respectively and one person from New Brighton, in addition to Peter Cuming, Kathy Billin and Jenny Donovan from Sustainable Futures.

The participants were evidently well informed and displayed a high level of understanding and involvement with the flooding issues. There was a strong perception that the underlying trend was for worsening floods and the perceived inaction of the Council had caused considerable anxiety and frustration in the community. The main objective that the participants felt the plan should achieve was to "see the water flow more freely". Their initial perception of the hydrology of the area was that it had been slowed down by the retaining wall, the perceived silting of Marshalls Creek and Capricornia Canal and the blocking up of the northern ocean outlet, causing water to back up in times of flood. The group accepted that these problems were worsened by incremental development which had hastened run-off into the waterway and displaced waters, this was seen as development having dumped problems on the community. The participants expressed a strong desire for an overall solution that would address problems in their entirety.

In terms of preferred solutions, there was considerable support for measures which, in the participants' eyes, "pulled the plug" and freed up the ability of the waterways to flow. In relation to the options under consideration there was concern that the figures on which the options were based were flawed. There was a strong perception that the options should be reconsidered and that the Council's computer model was based on out-dated information and should be updated. Particular concern was voiced about the costings for a new ocean outlet. It was considered that the outlet would replace a purported pre-existing natural outlet, (for which photographic evidence was presented) and would not require the heavily engineered solution suggested in the option. There was also a degree of support for dredging Marshalls Creek and reducing the retaining wall height to let the water flow more freely out of the floodplain. The removal of dredged material by pipe and its potential use as landscaping material to repair the dunes or beach, for development of the Brunswick Heads by-pass by the RTA as appropriate, was also expressed as an advantage

of this option. In relation to the option of widening Orana bridge there was a considerable body of feeling that it would be more appropriate to widen the span of New Brighton bridge. The quarantine option gained considerable support, however, in the longer term the group felt it should be amended to allow "responsible development". This was expressed as development which did not worsen flooding problems elsewhere in the floodplain, in other words development which did not require any fill.

The group recognised that these structural measures were not in themselves adequate to address all the problems. In particular, it was believed that the Council's Development Application practices had contributed to the problems and so should be considered, particularly because they were seen as having required infill which displaced water and introduced a substantial element of impermeable surfaces, raising both levels and the speed of flooding. In addition the road layout of the floodplain worsened the problems associated with flooding by creating floodways and by causing ponding across roadways which result in limited access. The fact that the northern end of Bolemo drive is cut regularly by minor flooding should be addressed. Other important issues which were considered to be important elements of a plan were addressing the social upheaval caused by flooding and environmental problems associated with reductions in water quality, particularly after flooding.

Recommendations

There was strong feeling that the plan should reflect a commitment to the local community and that these issues should be resolved by measures which reflected community concerns and should be tailored to localised conditions. There was general support for the proposition that the strategy should comprise of a number of elements, both capital works, "the big picture", and management, "the little picture" in nature. There was a general agreement that this toolkit of solutions should include the following elements:

Capital measures: These were considered to be of central importance to "pulling the plug". As outlined earlier, a northern outlet and/or dredging of Marshalls Creek, or the reduction in the height of the training wall, received the greatest support. A northern outlet was seen as providing a safety valve which would dissipate water build up when it was most required. It was also suggested that the area of the level of the lake in the golf-course could be reduced prior to onset of flooding to offer greater storage capacity when flooding occurs. This would require the Country Club supporting this measure.

Consultation and education: The participants saw this as important to rebuild faith between the community and Council and was consequently a process of assisting people to make decisions about the future of their environment and demonstrating a commitment to the community. It was recognised that education was essential to ensure development was responsible, in other words it did not subject the occupants to future flood problems or worsen problems for other members of the community. In addition education could be used to encourage an adequate understanding of flooding and assist people as to what they can do to handle flooding, for themselves and the wider community. In relation to this project the participants felt strongly that the options should be presented more clearly, using maps that had more easily recognisable landmarks/elements and text which used more commonly understood or layman's language. The participants saw education as requiring adequate resources in order to be effective.

Management: There was considerable support for ensuring an adequate and well maintained drainage system, the establishment of strong community based structures to handle problems associated with floods, when more traditional and official service providers, such as the Council and the SES might be overstretched. These components were seen as being dependant on adequate resources.

Assessing development: Development should be considered primarily in light of its effect on flooding. Development would be considered acceptable where it required no fill, did not disturb acid sulphate soils and did not greatly increase the amount of impermeable surfaces on the site. Council should also adopt engineering practice to reflect modern principles, for example requiring grassed swales instead of concrete drains and wherever possible footings which did not adversely effect the permeability of the proposed dwelling site. Council should publish design guidelines which incorporated these ideas. The computer model used by the council to assess flooding was considered to require up-dating to build in all the incremental development that has occurred in recent years.

Our Response

The articulate nature of the participants and their evident strength of feeling represents a potentially powerful resource of goodwill and local insight that could contribute greatly to the design, implementation and management of the plan. Utilising these resources will require consideration of the following;

Implications for the Plan

The plan should have two main parts: a major capital flood-proofing element and a flood mitigation element. The participants felt that the toolbox of elements from which the plan should be constructed should comprise the following components:

Assumptions behind all the options should be reconsidered, with greater emphasis given to local knowledge and with less emphasis given to the computer model, which was considered to be flawed and based on out of date information.

Re-assess the Ocean outlet option in light of evidence that an organic, low impact outlet could be provided which would replace a pre-existing natural outlet that existed in that vicinity prior to 1974.

The quarantine option should be amended to incorporate a provision for limited development where it did not require fill, a substantial increase in impermeable surfaces, disturb acid sulphate soils or otherwise worsen the effects of flooding elsewhere.

The range of options considered should be broadened to consider other measures such as reducing the level of the lake prior to flooding.

The Council's Development Application assessment practices should be amended to incorporate the above and give greater emphasis to the effect of development on flooding.

The production of design guidance and consultation material in plain English and using clear maps and plans.

Commitment to greater consultation with the community.

Next Steps

We are endeavouring to build on these findings, and the findings of the other meetings to establish the common ground shared by the communities and build a shared strategy for managing the flood plain that respects the qualities valued by the community, addresses the problems of concern to the community and empowers the community to maximise their say in the future of their shared environment. The common ground and areas of remaining substantial differences are outlined in the second part of this document.

APPENDIX F

NEWSPAPER REPORTS

High Tide at Ballina.

BALLINA is well known to be in time of flood the dryest town on the river. This week, however, it has experienced, with a clear sky and no rain, the greatest submersion it has had for years. This has been brought about by the southern gale and heavy sea which has been running during the past few days, accompanied by a spring tide. For two or three days the tides have been much higher than usual, but Wednesday morning's tide eclipsed the lot. It covered the low-lying portions of each end of the town. Near North Creek Tattersall's Hotel was surrounded by one sheet of water that extended up Norton-st. as far as Mr. Jarrett's. The tide rushed with considerable force for hours over Norton and Martin-streets, between the School of Arts and the Post-office, and did much damage to the road. River-street was covered in several places, the end of it, in the neighbourhood of the Baths, forming a regular sea. The water was across the road in front of Webster's Arcade, and came right on the footpath under the verandah, leaving a considerable quantity of debris in the centre of the road. The sea also did some damage to the Southern Training Wall, settling down some of the stone and displacing the tram rails. It broke right over the bridge at the mouth of North Creek, which Mr. Denning is constructing, and sank his punt, fortunately in shallow water.—'R. R. TIMES.'

N. Star 7/1/1893 i

Wardell.

JANUARY 20.

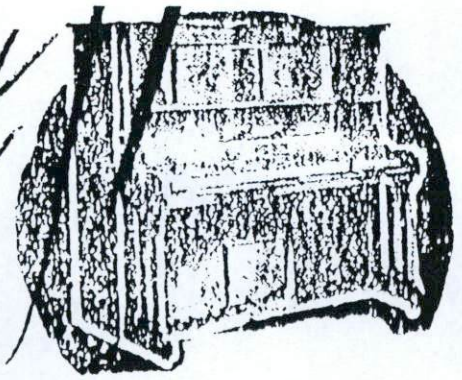
THE new year has set in very quietly with very few changes. The ferry and Ross and Alstonville mail contract has passed into other hands, but in fairness to the late contractors I may state that not into better, as much in their capacity have seldom been equalled both for courtesy and punctuality.

The late high tides have done considerable damage on the low lands, killing both cane and grass, washing the terrace down in places along the beach, the sea water actually flowing into the river at various places.

The abolition of the Rifle Reserves is not much appreciated here, as the Wardell Corps has been to great expense in procuring a good target, clearing a range, logging a footway over the swamps, erecting butts, and are now building a shed or pavilion, and after it has progressed so far instructions have been sent in for all arms to be returned to head quarters. Though Premier Dibbs thinks it a useless expenditure of money, and thinks to make a saving of £1,700, it is only a case of "in at the spigot and out at the bunghole," for what he will save here will only be paid away in other departments for something else, and the corps since the late Captain Henderson took command has been strong in members, containing some of the best shots on the Richmond, and has been pleasant recreation for its members on Saturdays and holidays. Surely the Government might easily have recouped this amount out of the salaries and pensions of the overpaid do-nothing Government officials without hurting them, and let our youths be instructed how to use a rifle.

N. Star 1/2/1893

wish
-day.



Victor Piano, £5 deposit.
Carl Ecke, £47/10/-.
Carl Wagner, £49/10/-.
London Piano, £18/10/-.

NIELSON'S
PIANO AND MUSIC SHOP,
LISMORE.
Shortly we shall be in our modern shop, Keen-street.

THE LISMORE DISTRICT BABE HOSPITAL.

WOMENS AUXILIARY.

The usual MONTHLY MEETING of the above Auxiliary will be held in St. Paul's Memorial Hall on THURSDAY, APRIL 2nd, at 3 p.m. Business general.

E. M. BAIRD, Hon. Sec.

M. PHILLIPS AND SON.

Sight Testing and Optical Service.

Consulting Optometrist,
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Accuracy, Quality, Style and Comfort assured.
LOWEST CHARGES.

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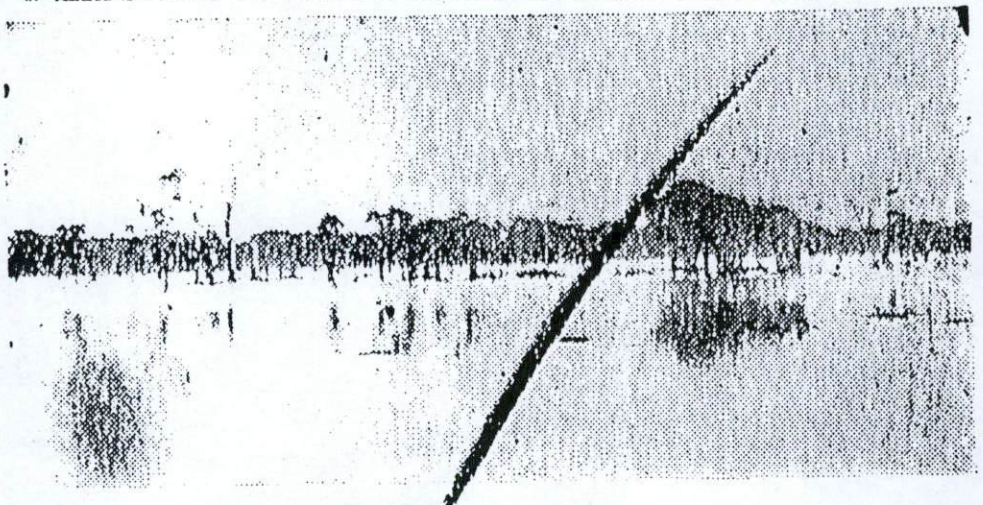


or the first time to the knowlege of residents of long standing the seas at Byron Bay last week were so heavy that waves broke over the closed mouth of Belongil Creek and flooded a large area of swamp and pasture land. Though the area previously has been flooded by rain, it is the first experience in 20 years of Mr. A. Brandschied, who has farming property in the vicinity, that salt water has inundated and killed pasture on his land. The flood-waters give the appearance of a small inland sea and it is likely to be several weeks before the water clears. The seawater also flooded the Pacific Highway shown above.

N. Star 30/3/36.

into operation for a short period this month while water was at spillway level in the dam. The level had now dropped to eight inches below the top of the weir and generation had again ceased.

Quoting comparative generation figures for the past two years Mr. Litchfield said the nett units supplied to the system in 1953 had shown an increase of 11.2 per cent.

He pointed out, however, that an increased generation of 900,000 units would have to be obtained in the current year to meet requirements. This was because of the cessation of feed back into the interconnected system.

Mr. Litchfield ... caused to damage had the apparatus by switchboard storms experienced violent ... the Christmas period ... that considerable dislocation of the supply system had resulted from storm damage to rural transformers.

Following discussion of a claim for damages by the owner of a cow which was electrocuted at the power ... last month it was ... to completely fence ... area.

... engineer said that the ... had apparently broken

WATER RESTRICTIONS LIFTED

... Tuesday night's meeting Mullumbimby Municipal Council lifted all restrictions ... the use of hoses.

... water in the Wilson's Creek dam, which ... eight inches below the top of the weir early ... the week has regained normal level and all turbulence has disappeared.

This was stated this morning by the deputy town clerk, Mr. A. Gregory.

Mr. Gregory, however, warned that council would watch closely for any deterioration in the position. Consumers were asked to use caution and refrain from excessive use of hoses.

... juries caused when accidentally struck by a bicycle on the previous day, was returned by Byron Bay District Coroner Mr. S. Hackett following an inquest on Monday.

Evidence was given by Sergeant F. Worrall that inquiries made following Bell's death had revealed that the deceased had been struck by a cycle ridden by a youth, John Williams, in Jonson Street, Byron Bay.

John Williams, in evidence, said that he had been riding a cycle from the beach on January 4 when Bell stepped from the footpath behind a car.

The cycle was about two feet out from the car, witness said. Bell appeared to stagger and he (witness) tried to avoid a collision but could not.

Bell fell to the ground and appeared to strike his head on the bitumen, Williams said.

N. Farraway, taxi proprietor, of Byron Bay, said he was driving in Jonson Street on January 4 when he saw Bell step into the path of the cycle. He later saw Dr. Stitz examine the deceased and afterwards drove Bell home.

Dr. Allan James Stitz, of Byron Bay, said he had examined Bell after the accident but had found no visible sign of serious injury.

At 11 a.m. the next day, he was called to Bell's home. On arrival he found that Bell had been dead for a few minutes. Dr. Stitz said.

He conducted a post-mortem and found that death was due to a depressed fracture of the skull and severe clotting of blood over the right temple.

In returning his finding the Coroner said that Williams was in no way to blame for the accident.

properties in other parts of the town has remained unchanged.

This was reported to Mullumbimby Municipal Council on Tuesday night by the deputy town clerk, Mr. A. Gregory.

Mr. Gregory said that estimates of income and expenditure for 1954 were in process of preparation, but the work had been delayed owing to the receipt of the new valuations, which were immediately effective.

Council authorised expenditure for normal works and services until the estimates were completed and rates struck.

The unimproved capital value of land within the municipality has been increased on the new list from £150,743 to £234,338.

RATE MAY DROP

It is thought likely that the council will aim at revenue approximately equal to that of last year, which would mean a lower rate. The steep increase in Burringbar and Dalley Streets, however, indicates that ratepayers in these areas will receive higher rate accounts.

Some property owners have expressed dissatisfaction with the increase and in some cases appeals are likely.

STREET BINS

The council, after discussion, agreed to advise the Mullumbimby Chamber of Commerce that the erection of "be tidy" bins in Burringbar Street had been decided upon six months ago and would be carried out.

The chamber had requested the provision of similar types of bins to those used on city footpaths.

Ald. E. P. Starr said the need for bins was obvious.

"It is just one of those things discussed and never carried out," he added. "The greatest trouble will be to educate the people to use them when they are provided."

Ald. Starr reported that the site for the council's crusher had been almost completed. Work had been delayed for a time through shortage of staff.

"Council used £900 worth of screenings in tarring several streets recently," he said. "I believe that in 12 months we will save the cost of the crusher and the result will be good roads throughout the municipality. We can easily halve the cost of screenings."

It was decided to make a donation of £5/5/- to the Australian Life-saving Society to assist in financing a "water safety" campaign to be undertaken.

When a letter from the Coronation Gift Fund ad-

SURF RESCUE AT N. BRIGHTON

A 14-year-old girl is in Mullumbimby Hospital following her rescue by her father from the surf at New Brighton this morning.

She is Therese Mary Bannon, daughter of Mr. P. J. Bannon, of Kyogle.

With her father and another 14-year-old girl, Claire Latter, daughter of Mr. W. A. Latter, also of Kyogle, she was caught in a strong rip and carried to sea. Her father went to her aid, but twice lost his hold in the rough sea.

He managed to bring her to shallow water where both were in a state of collapse. They were assisted to the beach by two men.

Claire Latter was also in difficulties but managed to struggle into shallow water unaided. She was helped to the beach by her father.

Mullumbimby Ambulance attended and took Therese to Mullumbimby Hospital.

The two families had arrived for a holiday at New Brighton only this morning.

Erosion Opens New Vista at Brunswick

Erosion which has carried away much of the shoreline and numerous trees from the South Beach spit has opened up a new vista for residents and visitors at Brunswick Heads.

Many houses and flats formerly only within sound of the sea now have an ocean view through the wide opening rent by high tides at the river mouth.

In the past year about 100 yards of land has disappeared from the end of the spit and the river bank has been severely eroded, causing the collapse and complete disappearance of a lavatory originally many yards from the water's edge.

Recent high tides have eaten away more of the bank and have brought danger nearer to houses along the point.

High tides during the Christmas period, whipped up by a strong easterly swell, brought comparatively rough water into the river and for the first time in years a few waves broke over the stone wall on the town side.

The abnormal tides also caused flooding over much low-lying land along the river banks, and King's Creek. At least 100 acres of grazing land not previously affected are said to have been covered by salt water.

This also is attributed by some to the Brunswick erosion. It is claimed that the widening of the river mouth allowed a fuller flow, causing tidal waters in the river to rise at least five inches higher than usual.

Unsuccessful appeals for Government aid in halting the erosion were made last year by Byron Shire Council and Brunswick Heads Progress Association, and the damage was inspected by departmental engineers and certain recommendations made.

Further inspections have been made by Byron Shire engineer, Mr. E. R. Thompson, and it is likely that the matter will be discussed at next Tuesday's meeting of the council.

Star Advocate 15/1/54

23/2/54

Wiped Out

ntinued from Page 1)

sidents said yesterday several plantations, in- two whose owners vay, were almost wiped Growers of small crops e lower lands were also losers.

big landslide at Mul- bimby Creek carried a age and a large truck, property of Mr. G. uzis, down a hillside the adjoining pro- ty.

truck was almost to- crecked.

y other slides occurred e hillsides and bananas lat ed.

RUIN AT MAIN ARM

ries of devastation come from Main .

houses at Palmwoods orted to have been by the cyclone. They Cranney's Road.

use was evacuated by Parish and another by Staff when logs d a creek, causing it a new course through se.

road at the Top End en badly washed out bridge has disappeared ear the foot of the y Road.

me were also repair- s l yesterday and

Palmwoods road is im- .

Upper Main Arm 21.12 of rain were recorded urs on Friday and y.

was 18 inches over otbridge at Cherry's .

le news has come m Blindmouth, but known that land- and wind have havoc with plan- .

MAGE AT E POCKET

D nage to plantations e Pocket was also but damage to is reported to be

road at Billinudgel r of water yesterday. Saturday night water he bakery and but- p in the village. llar story of flatten-

Sea Break Through at New Brighton

At the height of the cyclone the sea broke over beach terraces in two places near New Brighton.

North of the township a breach occurred where carriers had carted away many tons of sand from the rear of the terrace.

Waves poured through and the water flowed around the back of the park and into the North Arm of the Brunswick River.

A huge gap still remains in the terrace which the sea still reaches at high tide.

At the "black hole," about half way between New Brighton and North Beach another breakthrough carried the sea into North Arm.

Here also an open gap remains which is filled at high tide.

In the township waves also broke over the terrace and flowed under some houses.

On the river side floodwaters entered some houses to a depth of five inches.

New Brighton was without power on Saturday and Sunday. The service had not been restored yesterday.

The road between New Brighton and the highway was also under water.

golf club house was partly unroofed.

The flood reached its peak on Saturday night, but the town was clear of water on Sunday morning.

AV. Au- Manager who is of all arrange- val tour.

holiday season am times would be av the public as a sh and for picnicker

If permitted it v the tent previously the committee.

(Lismore Ambulance mittee, which money for a new station at Mullumb

Sunday morning.

Brunswick Heads suffered most and major damage had to be repaired repeatedly. Total disconnection was finally made at 11.30 p.m. on Saturday because the maintenance of safe supply was impossible.

Damage was less severe at Mullumbimby.

Some rural areas affected could not be reached for service for three days.

The power station has operated 24 hours a day.

Fuel oil deliveries have been interrupted but supplies are expected before stocks are exhausted.

Biggest Flood at M'bimby

At Mullumbimby the floodwaters rose feet above the previous record.

Water entered several homes near the foreshores and at the eastern end of the town to a depth of several inches.

Police evacuated a family from a disused house on the flat near King's Creek bridge. The family had been living in a tent, but went into the house when the water rose.

Damage to property was negligible. The Mullumbimby

Yelgun, Mooball and Burringbar.

At each of those townships a house was unroofed.

Broken high tension wires at Mooball electrocuted and killed three cows, the pro-

LOC A

The May and Byron S jointly opene with the dest

The Mayor sa ing that the fu jointly administ decision had bee where it would but it could be personal losses, in surrounding be given highest

"Donations m the Council Chan is hoped the a and other publ tions will give th

Upper Crabbe's Ck. School to Celebrate First Anniversary

"Education Week" at Upper Crabbe's Creek School will be marked by the celebration on Wednesday, August 18, of the first anniversary of the school's official opening.

The day will be an "open day" when parents and friends will be invited to see the children at work under normal conditions and to inspect the school generally.

The celebration of Arbor Day (to-morrow) will be postponed to coincide with the anniversary, and trees will be planted in the grounds to replace those which have died out since the school was opened.

With the celebration will also be combined a prizegiving of books awarded on examination results.

A stall will be conducted to raise funds for the school. A fund for the school library is already in operation.

Parents and Citizens' Association president Mr Neil Duncan, and local school teacher Mr D. Freeman are confident of a big attendance of parents and friends.

A feature of the function will be the cutting of a cake decorated with one candle to mark the first birthday of the school.

SPEED LIMIT, BUT NO SIGNS

Although a speed limit of 30 miles per hour came into force at New Brighton when street lighting was installed, no signs indicating the restriction are to be erected there.

In a letter to Byron Shire Council the Police Traffic branch advised that as the speed limit was automatic the signs were not considered necessary.

A request for signs had been received from the New Brighton Progress Association.

A previous request from the association had been refused before the street lights were installed.

Levy for bridges at Crabbe's Ck

Members of Crabbe's Creek Progress Association have agreed to impose a levy on all produce marketed from a stipulated area to finance the construction of bridges at creek crossings.

The levy system will be similar to that used at Main Arm and The Pocket, but at Crabbe's Creek it will also apply to livestock.

Rates agreed to are as follows—

Bananas and tropical cases, 6d per case; tomato boxes, 3d per box; standard bean bags and sacks, 6d per bag or sack; peabags and sugarbags, 3d per bag; cream cans, 6d per can; bunch bananas, 3d per bunch; fat pigs and cattle, 3/6 per head; other pigs, cattle and calves 1/ per head.

The commencement date for the levy will be decided at a special meeting on August 19.

The proposal to raise money to be spent on the Crabbe's Creek road was discussed and approved by a recent meeting of Tweed Shire Council.

MORE MONEY FOR FLOOD DAMAGE

An additional grant of £188 has been made available to Byron Shire Council to repair flood damage to a culvert at Billinudgel.

The culvert is on the stock route and was inadvertently omitted from the original grant.

The new allocation brings the total for the shire to £2263 -50 per cent. of the estimated cost of repairs.

FOOTBALL BYE FOR A GRADE

Mooball A grade football team will have a bye on Sunday.

The B grade team will travel to Byron Bay to meet the home side. The match will be refereed by A. Walsh.

2-ALL HOCKEY DRAW

At Burringbar on Saturday Mooball and Burringbar Women's B grade hockey teams played a hard match to draw 2-all.

Burringbar saved the game when they scored the final goal right on full-time.

Scorers for Burringbar were N. Pollett and V. Ducat; for Mooball B. Rabjones and B. Plater.

The draw leaves the two teams still joint leaders on the B grade points table.

MOOBALL JOTTINGS

MR and Mrs Ron Burger, of Mooball are receiving congratulations on the birth of their new baby son.

Miss Betty Rabjones, formerly of Mooball, has taken up residence at Coolangatta.

Mr Jim Dillon, of Sydney, is holidaying with relatives at Mooball.

Sea Breaks Through at New Brighton

The sea has again breached the terrace about half a mile north of New Brighton township.

At high tide during the past week waves washed through an opening about 20 feet wide in the terrace and flowed into swampy land and over private property.

The local Progress Association discussed the matter at its monthly meeting on Sunday morning, when it was stated that an inspection of the break by Byron Shire engineer, Mr E. R. Thompson, was expected.

It is hoped that when a bulldozer is in the area it will be used to close the gap.

The opening was first made during the February cyclone, and was reopened about a month ago. Water also came over the terrace nearer to the town during the last cyclone.

OBJECTION TO BURNING

The Progress Association, at its meeting on Sunday took exception to a proposal to burn off scrub along the beach terrace north of the township.

Members took the view that the scrub presented no fire threat to private property and its burning might increase the possibility of further beach erosion.

It was decided to ask Byron Shire Council to revoke permission previously given to the captain of the local bushfire brigade to burn the scrub.

SHIRE ASKS FOR REPORT

At Wednesday's meeting of Byron Shire Council a letter from the Progress Association asking that the burning of the scrub should not be allowed was discussed.

The president, Cr E. W. Hatfield, said the matter was one for the bushfire brigade captain, who had authority to burn hazards. It was not for the council to interfere in the matter.

Questions on Brunswick Water Supply

Questions regarding the proposed Brunswick Heads water supply scheme were asked by members of Brunswick Heads Progress Association at their monthly meeting on Monday night.

The president, Mr C. G. Cooper, who had been absent from many meetings because of illness, was in the chair.

scheme would be available before the next meeting.

The council approved a draft agreement in connec-

Advocate

CIRCULATING IN MULLUMBIMBY · BYRON BAY · BANGALOW AND BRUNSWICK HEADS

Registered for Transmission by Post as a Newspaper. P.O. BOX 3. PHONE 26.

Volume No. 11. MULLUMBIMBY TUESDAY, JAN. 31, 1956. New Series No. 7.

Wilson's Creek To Have Bus Service

Wilson's Creek will have a school bus service as soon as the contractor, Mr Cliff Cumpstay, of Mullumbimby, obtains delivery of a suitable vehicle.

Meanwhile, Mr Cumpstay will continue to provide transport by taxi for as many children as possible.

This was revealed this morning by the president of Wilson's Creek Bus Committee, Mr F. H. Lee, of Huonbrook.

...ablishment of the bus service, which is expected to provide transport to Mullumbimby schools for more than 30 children, will be the culmination of a long hy campaign by Wilson's Creek residents. The beginning of the move dates back several years.

Mr Lee said that agreement upon conditions for the initial establishment of the service was reached last night at a conference between representatives of the Bus Committee, the secretary of Byron District Council of Parents and Citizens' Associations, Mr F. R. Tandy, and Mr Cumpstay.

PAY LEVY

He said residents of Upper Wilson's Creek and Huonbrook had agreed to pay a levy of 1/ per family per day to meet the cost of the service above the amount of subsidy offered by the Department of Education.

The department had previously advised the committee that it was not prepared at present to pay full subsidy on a special school bus at the contract price.

Mr Lee said it was anticipated that the department would meet the full cost by subsidy in the next financial year and that the levy would cease after June 1 this year.

The committee has appealed to residents of the lower area of Wilson's Creek to assist in meeting the cost by contributing a levy of 6d per family per day.

Mr Lee pointed out that payment of such a levy would free parents of the need to pay children's fares on days when they are unavoidably absent from school.

The taxi service will begin next Monday.

Since its establishment, the Bus Committee has worked vigorously for the inauguration of the bus service, in conjunction with the continued efforts of Mr Tandy and other officials of Byron Council of P. and C. Associations and the Wilson's Creek P. and C. Association.

No Funds For Evening College

The Department of Education has no funds available for the establishment of an evening college at Mullumbimby High School.

Tentative organisation for a college, carried out by Mr E. C. Woods of the High School staff and a committee elected at a public meeting towards the end of last year, had revealed more than 100 prospective students for courses which would have been available at the proposed college.

These courses included manual trades, academical and film study groups.

In a letter from the department, Mr Woods has been advised of the lack of funds for the project.

The department stated that no new evening colleges were being established at present, and stressed the need for actual retrenchment in the department, with the possibility of discontinuing some colleges already operating.

Sydney A Grade Cricketer for M'by (1)

A cricketer who played the early part of this season with the Balmain (Sydney) A grade side has arrived at Mullumbimby and will join the Mullumbimby (1) team, according to club secretary Mr R. McDonald.

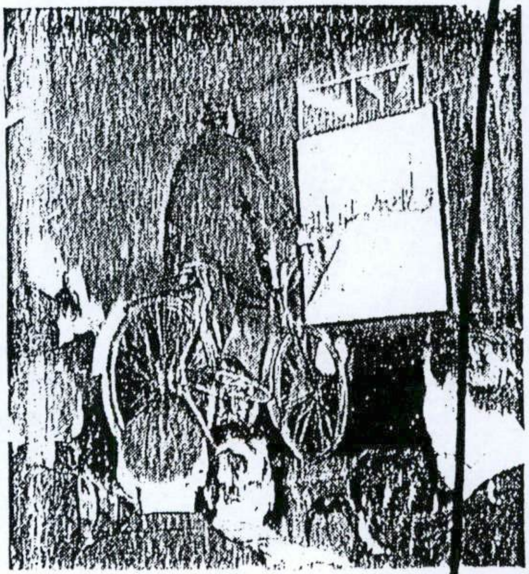
He is Des Cody, a teacher recently appointed to the Mullumbimby High School.

An opening batsman and left-hand bowler, Cody was regarded highly by the Balmain Club.

His presence in the Mullumbimby team should help to revive interest in local cricket.

Cody is also a golfer.

Road Safety Test



Under the watchful eyes of a British police sergeant, a cyclist at a recent schools' exhibition in London takes a road safety test on a special indoor machine. The set-up is designed to simulate normal traffic conditions. A moving film appears on the screen in front of the cyclist and his reactions to traffic, crossroads, and road signs are noted. Whatever ideas British schoolboys themselves may have about their future, such interest as space travel and television take second place to the realities of growing up and earning a living.

Surf Over Terrace at N. Brighton

High tides and big seas again took the surf over the beach terrace north of New Brighton township at the week end.

During the last few years breaches in the terrace have been comparatively frequent.

The latest break-through is only about a quarter of a mile from the township at a point where the sand dunes are practically devoid of cover. Waves broke over a fairly wide area of the terrace and flowed over low ground at the rear.

At a meeting of New Brighton Progress Association on Sunday morning it was decided to ask that Byron Shire Council's engineer should inspect the breach.

On a previous occasion a bulldozer was used to fill an opening caused by the surf.

WOMAN DIES AFTER NUDGEL CAR CRASH

BLOWOUT CAUSED CAPSIZE

One of two Murwillumbah women who were admitted to Tweed District Hospital on Sunday morning following a car accident on Pacific Highway, Billinudgel, died last night.

She was Mrs Annie Elizabeth Kuhler (69). She suffered head injuries, lacerated wounds to the left leg, arm and hand, and severe shock. It is understood that her condition was aggravated by a heart ailment.

The other woman, Mrs Florence Emily Lee, suffered lacerated wounds to the left leg and elbow, injuries to the back, and shock.

The driver of the car, John Frederick Lee, of Murwillumbah, husband of one of the injured women, escaped with a severe shaking.

The women were taken to Murwillumbah by an ambulance from the Brunswick Heads Sub-station.

The accident occurred when the left-hand rear tyre of the car blew out as the driver was overtaking another vehicle. The driver avoided collision with other vehicles on the highway, but the car got out of control and rolled over, coming to rest on its side.

Bodywork of the vehicle ... Thompson, suffered bruises to the right arm, and shock.

The man, Ronald Keith Homelech, a passenger in the other car, suffered abrasions to the forehead, a lacerated wound to the left thumb, and slight concussion.

The cars were being driven by Mrs Thompson and Ian Fulwood, of Brigalow (near Tamworth).

Both cars were extensively damaged. Murwillumbah District Ambulance attended.

River Rescue

A 14-year-old girl who got into difficulties in the water near the footbridge over South Arm, Brunswick Heads, on Sunday, was brought to the shore by a man who did not give his name.

He said that when he saw

Street Was on Private Land

Residents Fenced Off

Gaggin Street, which crossed private land at New Brighton has been fenced off by the owner, who is preparing the land for building.

The fencing has left residents who formerly used the ... day. It was decided to ask the Byron Shire Council to investigate

but had been prevented by bad weather conditions.

SEEK GRANT FOR PARK

The secretary, Mr G. Schweitzer, reported that application had been made for a Government grant to assist in the development of New

PRICE

Star Advocate

CIRCULATING IN MULLUMBIMBY · BYRON BAY · BANGALOW AND BRUNSWICK HEADS

P.O. BOX 3, PHONE 26.

Registered for Transmission by Post as a Newspaper.

Volume No. 14. MULLUMBIMBY, FRIDAY, JAN. 23, 1959. New Series No. 5.

Mullumbimby Sewerage High Priority, Department Says

...lumby sewerage scheme was on a high ...rage schemes, the Minister for Public ... Council through Mr S. T. Stephens, ... Tuesday ... council.

... that work ... would be ...nds were ...

...cated that ... within the ...

...BA

... the letter, ... said: "I ... the high ...k it might ... We will ...gging at ...

... that the ... to state ...

...Bus ... Is ...d For ... Ck.

... nt of Edu- ...ved of the ... n special ...ce between ...nd Wilson's ...

...ed by Mr ...sident of the ... Creek Bus ...

...d the bus ... far as Hecon- ...nd would be ... a milage ...

...ld be requir- ... difference ...ubsidy and ... the bus. ...ne had paid ...per day. Mr ...hew service ...

how high the priority was.

The town clerk, Mr L. J. Bourne, said the letter was in reply to an inquiry how high the priority was.

The Mayor, Ald. F. M. Uren, said the only way to find out was to go and see.

He suggested that the next time an alderman or council officer was in Sydney, he should interview the department.

The suggestion was adopted on the motion of Ald. E. Neath.

Council appointed Ald. Uren and Smith, Mr Bourne and the chief electrical engineer, Mr W. S. Litchfield, to attend the annual electricity conference at Newcastle from April 15 to 18.

A motion of sympathy with the relatives of the late Mr P. Guerin, Mrs Forbes and Mr W. Arnold was carried.

priority in the list of water Works has advised Mullum- M.L.A.

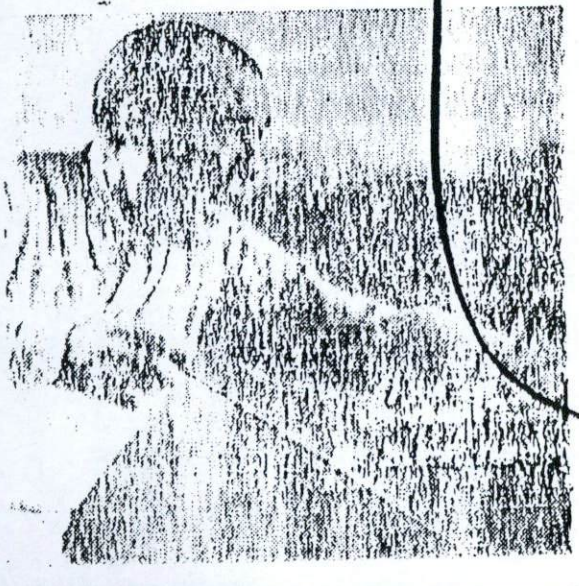
BANANA LOADINGS

Consignments of bananas from all centres to the southern markets for train 3A totalled 39,729 cases, comprising 23,123 from the northern section, 15,563 from the southern section and 236 from Queensland.

These figures represent an increase of 350 when compared with the corresponding train the previous week.

New South Wales consignments were forwarded to the following markets: Sydney 15,399, Melbourne 17,067, Adelaide 2561, Perth 1698, Newcastle 1803, and Albury 474.

Guest Conductor



ALFRED WALLENSTEIN, one of America's lead-

Cyclone Brought 9 Inches Of Rain

A total of 902 points of rain were registered at the Mullumbimby Post-office during this week's cyclone.

Greatest fall occurred during the 24 hours ended at 9 a.m. on Thursday, when 6.35 inches were recorded.

Other falls were: To 9 a.m. on Wednesday 188 points, Friday 139 points.

Total registration for the month to date is 1327 points.

Although the cyclone, which crossed the coast at Byron Bay on Wednesday night, brought gale force winds and heavy seas, no severe damage was caused.

Danger points along the coastline were closely watched and at Byron Bay rocks and sandbags were used to prevent damage.

Huge waves washed through the beach terrace near the Golden Beach site north of New Brighton and bulldozers were used to build up a wall against the encroachment.

At Brunswick Heads waves washed over the sandspit on the southern side of the river mouth and appeared likely to cut a deep opening through it.

The sea also cut deeply into the spit on the eastern side.

Reports from district centres indicate that damage to banana plantations was comparatively light.

Flooding of creeks cut several district roads.

New Toilet Block

Amended plans for the proposed toilet block for the Civic Memorial Hall have been submitted by the architects, the town clerk, Mr L. J. Bourne, told the

People' Garden Council

People of Byron Bay, ... Heads had been ...led up the ...surance rates, Cr A. Ribble- Council ...eeting on Tuesday

He said the people had been led to ... believe that fire insurance rates in the three towns would be lower After water was connected.

He was commenting on a letter from the Fire Insurance Underwriters' Association advising that 50 per cent. of the buildings in the business area of Byron Bay would have to be brick before the town could quality for reclassification.

It was stated that only 41.7 per cent. were brick

It was also stated that a four-inch water main served the area whereas a six-inch main was required.

The engineer, Mr H. Cook said there was a six-inch main along Jonson street from the factory to near the Ambulance Station

Fall Backw...

Property owners at Suffo... backwards" when they wer... to surface all streets in the... Byron Shire engineer, Mr ...

He was commenting on ... request made by the new... ly-formed Suffolk Park ... Progress Association.

The association requests ... included the preparation of ... an estimate for bitumen ... surfacing all streets, pro... vision of toilets for the ... park area, and action to ... have the park and lake ... dedicated as a public rec... reation reserve.

Mr J. Armstrong said the ... military service could be ... extended to the area when ... that was warranted, and ... the best means of provid... ing water supply would be ... by tanks until more de... velopment took place.

He said the provision of ... park toilets would be cost...

Vandals cause blackout in flood

Vandals shot and destroyed three insulators on an 11 kilovolt power line at Grafton, causing a large area to be blacked out for 23 hours during the height of the recent floods.

This was revealed yesterday in a report from the chief electrical engineer, Mr. L. W. Marchant, to the Northern Rivers County Council at its meetng in Grafton.

Mr. Matchant said the blackout was recorded at 6.30 p.m. on June 13 and the line re-energised at 4.30 p.m. the following day.

The delay in restoring power was due to the flood, he said.

He said workmen had found it difficult to check on the cause of the power failure and eventually found the site of the failure after examining the line in a floodboat.

The break was found in a lane between the Pacific Highway and Duncan's Wharf in Grafton. Three insulators had been badly damaged by rifle fire.

Mr. Marchant said the examination showed the damage had been caused only a relatively short time before the power failure, indicating it must have occurred while the flood was rising.

Should the damaged insulators have been in service more than a few hours, it would have been reasonable to expect the whole crossarm and pole would have been destroyed by fire caused by current leakage

Worst time

Mr. Marchant said the power failure had come at the worst possible time.

County council chairman, Cr. R. O'Neill, said there was no doubt such actions as these were "inexcusable and irresponsible."

Such vandalism could have caused loss of life.

Cr. J. F. Flaherty said, apart from the risk to the linesmen who had to repair the damage, the vandalism could easily have endangered members of the public.

Council adopted a motion from Cr. M. L. McNamara that circulars be distributed in quarterly electricity accounts to all consumers stating it was their duty to report such vandalism.

The motion also directed

Sea breaks into river; erosion at Brunswick

N. Star 27/6/67

Property owners along North Beach, on the northern side of the Brunswick River, have lost as much as 90 feet of their property as a result of heavy erosion caused by high seas whipped up by gale-force winds.

A section of the terrace along the front at North Beach has been completely eroded and at some places the sea is breaking across the road and into the north arm of the Brunswick River.

Serious erosion also has occurred on the beach front opposite the fitness camp at Lennox Head and along the surfing beach at Ballina.

At high tide the seas at North Beach are breaking through, flowing under many houses and holiday cabins.

The force of the water has demolished some car sheds which were in the back gardens of holiday homes.

Byron Shire Council workmen are working desperately to build a rock retaining wall along the ten chains of seafront where there had previously been a terrace.

The men are working in a northly direction and yesterday had only four chains of wall constructed.

Volunteer brigade

Property owners further up the beach, who are unprotected from the sea, have formed themselves into a voluntary brigade to try to save their land and keep the sea back.

The shire council provided sand bags for residents and they spent all day yesterday filling them with sand and placing them along the eroded beach front.

Council's engineer, Mr. I. Cook, said council workmen did not have enough time to build the sandbag wall.

He said they wanted to get the stone wall finished as soon as possible.

Mr. Cook said it was no good dumping the rock in a "slip-shod" manner at various sections along the beach front.

It was far better to start at one end and build a strong wall along the terrace.

Shire workmen have been working since last weekend to get the wall built.

A North Head property owner yesterday commended the shire for its prompt action in trying to check the spread of damage and the threat of homes, some of which are just hanging over the edge of the terrace.

Some of the property owners spent an anxious night last night as they waited for the effect of the next high tide in the early hours of this morning.

DEATH OF MR. ERN. MORGAN

One of Lismore's best known business and sporting personalities, Mr. Ernest Ralph Morgan, died suddenly at his home in Laurel Avenue last night.

Mr. Morgan, who was a director of the Lismore Base Hospital, had attended the monthly meeting of the board. He died soon after his return home.

He was a keen bowler and was a foundation member and former president of South Lismore Bowling Club.

He was one of the founders of De Luxe Motors in Lismore.

Guild function postponed

St John's East Lismore Church of England Guild's hoy morning, which was to have begun at 10 a.m. today, has been cancelled owing to the weather.

Moves to streingthen C.P. branch

CASINO. — Moves are being made to strengthen the Casino branch of the Country Party in view of the loss of the Casino electorate.

With the Casino subdivision's inclusion in the Clarence electorate, Country Party branches in this area will become part of the Clarence Electorate Council of the party.

With Casino at the northern end of the Clarence electorate, Country Party members feel it is imperative that there is a strong and vigorous branch of the party operating at Casino.

All members and supporters of the Country Party have been urged to attend the branch's annual meeting in the School of Arts tomorrow night.

The Member for Casino, Mr. Manyweathers has made a personal appeal to members and supporters to attend the meeting.

Motorist given a chance

Mr. Carruthers, S.M. said in Lismore Court of Petty Sessions yesterday he was going to give a motorist a chance.

"But in these cases you must remember you are only allowed one bite," he said.

Edward George Thacker 32, of Union Street, Lismore, was fined $100 when he pleaded guilty to having driven while under the influence of intoxicating liquor in Union Street, Lismore, on June 24.

Const. G. Williams said Thacker had been seen driving a car at 12.25 a.m. and on three occasions had veered to the incorrect side of the road.

Thacker admitted having a few middies of beer

Solicitor Mr. F. Herron

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out the Brunswick
llumbimby, Byron
nd all rural areas.
RY 9, 1972. No. 5

Sandbag Wall Saved Homes

Huge seas hammering the Far North Coast this week washed through homes at North Beach, Brunswick Heads.

The sea washed away fences and covered house yards and the roadway with heavy sand deposits.

Byron Shire Council workmen, assisted by about 50 members of the Ocean Shores staff and 50 other volunteers, built a 300ft. wall along the seafront to protect the properties.

The wall held out a new onslaught by the ocean at high tide at about 4.30 a.m. to-day.

An occasional wave lapped over the wall.

A short distance to the south of the wall the sea again crossed the beach into the North Arm of the river this morning.

At other district danger points the sea

+ gouged a deep gully into the beach just south of the Byron Bay Surf Clubhouse.

+ Washed out a channel almost to the front of the Brunswick Heads Surf Clubhouse at South Beach.

+ Washed over the road just south of New Brighton.

+Caused a minor breach in the Golden Beach terrace.

Byron Shire President Cr. R. B. James said an inspection along the North Beach this morning had shown the position well contained after a night long vigil.

He said the sea did not appear to have abated and to-morrow morning's tide could bring further dangers.

At Byron Bay yesterday about 50 tons of rock was tipped over the edge to fill the gap cut by the sea near the Surf Club-house.

The seas were so big at Byron Bay that they crashed over the beach and into Belongil Creek, causing an overflow which crossed the Byron Bay-Ewingsdale Road.

At Brunswick Heads residents had sandbags on the site showing the threat to the Surf Clubhouse become serious.

5000 SANDBAGS

Workmen at the North Beach danger spot stacked an estimated 5000 sand bags along the worst section of the break.

Residents boarded up windows and doors against the fury of the sea.

Farther north tons of rock were dumped over the edge of the eroded beach front to save the roadway between North Beach and New Brighton.

New Names For Local Rivers

New names have been proposed for the North and South Arms of the Brunswick River by the Brunswick Heads Progress Association.

The association will ask that the tributaries be renamed Simpson's River (North Arm) and Marshall River (South Arm).

The names were selected because of their association with early Brunswick history.

Mr Simpson was the first cedar boat pilot at Brunswick Heads (known in the early days as Simpsontown.

Mr Marshall was the proprietor of the first store at Brunswick Heads.

The names will be submitted to the Geographical Names Board through Byron Shire Council.

WOMEN'S BOWLS TITLE PLAY

Further matches in the Mullumbimby Women's Bowling Club championships were played last week with the following result's.

Singles: M. Philp 31 d L. Lee 22; J. Morgan 33 d F. McClymont 24.

Pairs: R. Bull, E. Wood 24 d N. Wiblen, L. Bopf 19; D. Usher, B. James 26 d F. McClymont, H. Lance 14.

BRUNSWICK HEADS

Last week saw the official resumption of the Women's Bowling Club for 1972.

The first monthly meeting was followed by trophy play.

Current queen of the green is president Norma Gerrard.

Trophy play: G. Allison, T. Hellyar, U. Godbee 35 (winners) v Lil Parker, N. Todd, B. Wakely 12; P. Hale, M. Larkin, F. Holm, V. O'Meara 29 v D. Wright, M. Pelchlatz, A. Sullivan, K. Brown 18; D. Henry, B. Carroll, N. Gaigard 29 v A. Ruiz, E. Flowers, R. Rolfe 18; S. Hardtuz, B. Boorman, F. Hazan 25 v D. Lansley, C.

REQUEST FOR TELEPHONE

Brunswick Heads Progress Association will renew its request for the provision of a public telephone at the intersection of Byron and Fingal Sts., at Brunswick Heads.

A similar request was previously rejected by the P.M.G. Department.

Association members said on Monday night that the increase in population of the western area of the town could now warrant the facility.

MULLUMBIMBY BOWLS DRAW AND TEAMS

Sunday, February 13, 10 a.m., handicap singles: G. Condle v H. Worker, G. Youngberry v C. O'Donnell, G. Allison v A. Vardy, A. Doyle v G. Lee, A. Cassidy v W. Hampson, P. Hanna v J. Mitchell, D. Gray v R. Pilgrim, B. Anderson v H. McIlwain, C. Doyle v S. Ruming, R. Hutley v C. Kline, L. Grob v N. Newell, F. Quinn v G. Stewart, N. Sweeney v A. Lance, E. Lindsay v N. Stewart, P. Taylor v S. Robinson.

Markers: J. Atkin, P. Moylan, C. Mules, A. Larsen, D. Henry, F. Peoples, A. West, T. Psallis, W. Bower, E. Bedford, E. Cole, J. Lawler, L. Evans, W. Carter.

No. 1 pennant team v Alstonville, at Lismore Heights (cars leave 12.30 p.m.): F. Quinn, C. Doyle, A. Doyle, T. Psallis, C. Condle, A. Larsen, V. Bassett, E. Bedford; J. Atkin, D. Henry, E. Cole, C. Mules; A. Lance, R. Oliver, S. Bellear, P. Taylor. Manager, E. Bedford. Cars, Bedford, Henry, Taylor Mules.

No. 3 pennant v Ballina at Mullumbimby: T. Estreich, S. Ruming, L. Grob, N. Newell N. Sawtell, A. Campbell, H. Middlecote, G. Stewart; L. Evans, A. Cassidy, D. Gray, G. Lee; B. Anderson, P. Moylan, R. Schneider, G. James. Manager, D. Gray; official umpire, J. Pearce.

Costs Force Rise In Electricity Charges

Electricity charges in the Mullumbimby and Byron Districts will be higher from January 1.

Appreciation

preciation for the work Mr J. J. Donaghy for Joint Electricity Comlee was expressed by chairman, Ald. R. B. nes, last night.
ld. James expressed the e that Mr Donaghy ld do well in his new tion with the Lismore Council, where he begin duty next nday.
r Donaghy has served years with Mullumby Municipal Council.

APPENDIX G

DREDGING "REFERENDUM"

BYRON SHIRE COUNCIL

INFORMATION PAPER FOR POLL TO BE CONDUCTED IN CONJUNCTION WITH LOCAL GOVERNMENT ELECTION - DREDGING OF THE BRUNSWICK RIVER -

A poll will be conducted in conjunction with the September 1995 Council election to gauge support for the dredging of the Brunswick River and its tributaries, Marshalls Creek and Simpsons Creek.

The question to be asked is:

> **"Do you support the dredging of the Brunswick River and its tributaries, Marshalls Creek and Simpsons Creek?"**

This paper has been prepared to provide information to assist electors in answering the poll question.

Preceding any proposal, a detailed environmental assessment would be undertaken in accordance with the Environmental Planning and Assessment Act, and would involve extensive community consultation.

Statutory provisions indicate that dredging would constitute Designated Development and, as such, would require the preparation of an environmental impact assessment. The preparation of the assessment would require the identification and investigation of many complex issues and would require consultation with several government agencies.

Parts of the river are affected by State Environmental Planning Policy No. 14 (Coastal Wetlands) and State Environmental Planning Policy No. 26 (Littoral Rainforests). The potential exists to impact on existing seagrasses, saltmarshes and other marine life, including fisheries and a commercial oyster lease. The location of buffers from these sensitive areas would need to be identified. The impact on the existing tidal regime and implications for the existing vegetation, including mangroves, would need to be investigated in detail. Such an assessment would also consider the extent and effect on the residential amenity caused by the activity. This would include such effects as the movement of trucks, earthmoving plant, dredging equipment and the visual impact of the work.

The proposal would require the preparation of an economic assessment to prove the viability of dredging. Items for consideration would include the cost of the proposed dredging, the possible markets for dredged materials, transport costs, sources of funding and other related benefits of the work, for example flood mitigation.

Possible benefits of dredging <u>may</u> be:

<u>Flood Mitigation</u>

- Improvement of channel hydraulics by increasing waterway area

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Ecological

- Improve tidal flushing of the river system
- Improvement of water quality in the river
- Removing siltation
- Provide sand for beach replenishment

Navigation

- Allow a navigable route from Brunswick Heads to Mullumbimby and along Marshalls and Simpsons Creeks
- Provide access for craft from Mullumbimby to the ocean

Recreation

- Improve access for boating
- Improve fishing opportunities
- Passive recreation - sailing, rowing, kayaks, leisurecraft

Tourism

- River tours
- Ecotourism
- Historical river trade

Commercial

- Sale of dredged materials, sand, gravel, filling
- Boating
- Oyster farming

The beneficial effects and impacts caused by any proposal would be fully investigated prior to any work being contemplated should the proposal receive community support.

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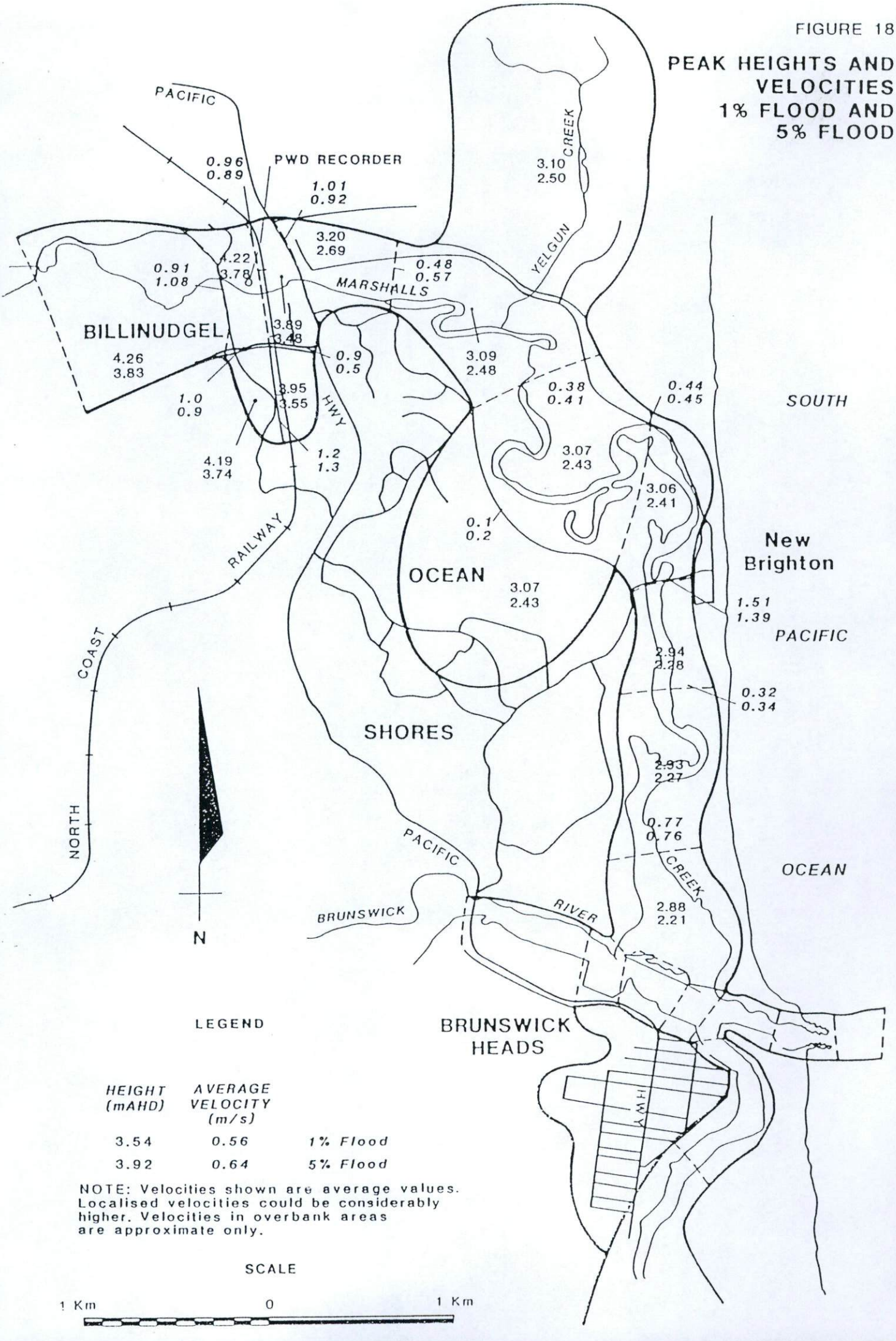
APPENDIX H

DESIGN FLOOD LEVELS
(Figure 18 of 1986 Flood Study)

FIGURE 18

PEAK HEIGHTS AND VELOCITIES 1% FLOOD AND 5% FLOOD



HEIGHT (mAHD)	AVERAGE VELOCITY (m/s)	
3.54	0.56	1% Flood
3.92	0.64	5% Flood

NOTE: Velocities shown are average values. Localised velocities could be considerably higher. Velocities in overbank areas are approximate only.

SCALE

1 Km 0 1 Km