
Appendix A Disaster Risk Management Documentation

TABLE OF CONTENTS

Table 1 – Risk Management Team.....	2
Table 2 – Establishment of the Risk Management Structure.....	3
Table 3 – Problem Definition and Establishment of Context.....	4
Table 4 – Identification and Description of Hazard (Flooding)	6
Table 5 – Identification and Description of Hazard (Storm Surge).....	6
Table 6 – Identification and Description of Community and Environment.....	7
Table 7 – Community Vulnerability Profile.....	9
Table 8 – Scale of Likelihood.....	10
Table 9 – Scale of Consequence.....	10
Table 10 – Scale of Risk.....	10
Table 11 – Risk Classification Matrix	11
Table 12 – Risk Register, Part A – Risk Description – Townsville.....	12
Table 13 – Risk Register, Part A – Risk Description – Townsville.....	13
Table 14 – Risk Register, Part A – Risk Description – Townsville.....	14
Table 15 – Risk Register, Part A – Risk Description – Townsville.....	15
Table 16 – Risk Register, Part A – Risk Description – Townsville.....	16
Table 17 – Risk Register, Part A – Risk Description – Magnetic Island.....	17
Table 18 – Risk Register, Part A – Risk Description – Magnetic Island.....	18
Table 19 – Risk Register, Part A – Risk Description – Pallarenda and Cungulla	19
Table 20 – Risk Register, Part A – Risk Description – Pallarenda and Cungulla	20
Table 21 – Risk Register, Part A – Risk Description – Other Components	21
Table 22 – Risk Register, Part A – Risk Description – Other Components	21
Table 23 – Risk Register, Part B – Risk Evaluation – Townsville	22
Table 24 – Risk Register, Part B – Risk Evaluation – Townsville (continued)	23
Table 25 – Risk Register, Part B – Risk Evaluation – Magnetic Island.....	24
Table 26 – Risk Register, Part B – Risk Evaluation – Pallarenda and Cungulla.....	25
Table 27 – Risk Register, Part B – Risk Evaluation – Other Components.....	25
Table 28 – Register of Prioritised Unacceptable Risks – Townsville (Flooding)	26
Table 29 – Register of Prioritised Unacceptable Risks – Townsville (Storm Surge)...	27
Table 30 – Register of Prioritised Unacceptable Risks – Magnetic Island (Flooding) ..	28
Table 31 – Register of Prioritised Unacceptable Risks – Magnetic Island (Storm Surge).....	29
Table 32 – Register of Prioritised Unacceptable Risks – Pallarenda and Cungulla....	30
Table 33 – Register of Prioritised Unacceptable Risks – Other Components.....	31
Table 34 – Identification and Evaluation of Treatment Options – Flood and Storm Surge	32
Table 35 – Treatment Strategy Development (Townsville).....	33
Table 36 – Treatment Strategy Development (Magnetic Island)	35
Table 37 – Treatment Strategy Development (Pallarenda & Cungulla)	36

Table 1 – Risk Management Team

Name	Position	Agency	Contact Details
Councillor Toni Kirkpatrick	Chair, Engineering Services Committee	Townsville City Council	Ph: 4772 5829 Fax: 4724 5176 Email: abk@townsville.qld.gov.au
Mr Brian Milanovic	Manager Engineering Services (Study Manager)	Townsville City Council	Ph: 4727 9358 Fax: 4727 9051 Email: bvm@townsville.qld.gov.au
Mr Bob Neunhoffer	Technical Services Engineer, Citiworks (Deputy Study Manager)	Townsville City Council	Ph: 4727 8468 Fax: 4727 8921 Email: rn1@townsville.qld.gov.au
Mr Ross Griffiths	Technical Coordinator, Citiworks	Townsville City Council	Ph: 4727 8440 Fax: 4727 8921 Email: rlg@townsville.qld.gov.au
Mr Allen Morris	Executive Officer - Townsville Thuringowa Counter Disaster Committee	Townsville City Council	Ph: 4727 9477 Fax: 4727 9051 Email: awm@townsville.qld.gov.au
Mr Mark Daniel	Manager Infrastructure Development	Townsville City Council	Ph: 4727 9413 Fax: 4727 9051 Email: mrd@townsville.qld.gov.au
Ms Paula Grant	Manager Policy and Planning, Planning and Development Services	Townsville City Council	Ph: 4727 9456 Fax: 4727 9052 Email: pyg@townsville.qld.gov.au
Ms Sandra Sherriff	Coordinator - Land Information Unit	Townsville City Council	Ph: 4727 9509 Fax: 4727 9504 Email: ss1@townsville.qld.gov.au
Mr Michael Fleming	District Manager Counter Disaster and Rescue Services	Department of Emergency Services	Ph: 4799 7114 Fax: 4771 4992 Email: mfleming@emergency.qld.gov.au
Senior Sergeant Steve Jenkins	Assistant to the Executive Officer - Disaster District Coordinator	Qld Police Service	Ph: 4759 9879 Fax: 4724 4339 Email: Jenkins.SteveF@police.qld.gov.au
Mr Mark Britton	Flood Study Consultant - Project Manager	Maunsell Australia	Ph: 4729 5500 Fax: 4729 5599 Email: mark.britton@maunsell.com.au

Table 2 – Establishment of the Risk Management Structure

<p>Physical and Time Boundaries of the Study</p> <p>The disaster risk management process will be applied to evaluation and treatment of risks associated within the defined study area. This area includes the Townsville floodplain (City, Fairfield, South Townsville, Mount Louisa, Sandfly Creek, and Annandale); Magnetic Island (Picnic Bay, Nelly Bay, Arcadia and Horseshoe Bay); Pallarenda and Cungulla.</p> <p>For the purposes of the risk analysis and evaluation process, the communities have been grouped as Townsville, Magnetic Island and coastal communities (Pallarenda and Cungulla). Phase 3 of the Study is to be completed by June 2002 to permit Council enough time to integrate this risk assessment into their application for further funding.</p>
<p>Communication and Consultation</p> <p>Throughout the course of the study, consultation was conducted with various groups and agencies including Queensland Police, Department of Emergency Services, State Emergency Services and the Bureau of Meteorology. In addition, a flooding questionnaire was delivered to various residents within the Townsville floodplain area to record anecdotal evidence and historical flood levels.</p>
<p>Terms of Reference, Goals and Objectives</p> <p>The specific aims of the risk management study include:</p> <ul style="list-style-type: none"> ▪ To assess the risk of flood inundation within the Study area ▪ To assess the risk of storm surge on coastal communities ▪ To determine the resulting flood hazards ▪ To assess community and infrastructure vulnerability <p>It is anticipated that the study will be incorporated into the existing Townsville/Thuringowa Counter Disaster Plan. Ongoing review of the study will allow the accuracy of the outcomes to be improved during future reviews.</p>
<p>Expected Outcomes</p> <p>In accordance with <i>Disaster Risk Management</i> (Zamecka and Buchanan, 1999) the study will provide:</p> <ul style="list-style-type: none"> ▪ Risk Evaluation Criteria ▪ Identification and Description of the hazard of flooding ▪ Identification and Description of Community and Environment ▪ Community Vulnerability Profiles ▪ Risk Register (Parts A and B) ▪ Identification and Evaluation of Treatment Options ▪ Treatment Strategy Development ▪ Risk Treatment Action and Monitoring Schedule <p>In addition to this, the study involves the assessment of storm surge on coastal communities, and will address the vulnerability of access to these areas (evacuation routes).</p>
<p>Extent and Comprehensiveness of the Risk Management Activities</p> <p>The Study will focus exclusively on the risks associated with flooding within the designated Townsville and Magnetic Island areas and the impact of storm surge on the coastal communities of Pallarenda and Magnetic Island.</p>
<p>Parameters and Sequence of Activities</p> <ul style="list-style-type: none"> ▪ Establish detailed management structures and processes. ▪ Review available information. ▪ Identify hazards. ▪ Describe the community and environment. ▪ Establish unacceptable risks and prioritise. ▪ Develop treatment options (where applicable).
<p>Other Issues</p> <p>The study will establish how uncertainties may be reduced in future reviews.</p>

Table 3 – Problem Definition and Establishment of Context

<p>Problem Definition</p> <p>Townsville City is located on the east coast of North Queensland and has a population of approximately 94739 persons (2001 Census). The Townsville region (which also includes the City of Thuringowa) is the largest regional centre in Queensland, and the primary administrative and industrial centre of North Queensland.</p> <p>The Study Area of Townsville comprises 12 sub-areas, the most significant of which is described as the Townsville Floodplain, incorporating the sub-areas of the City, South Townsville, Fairfield, Annandale, Mt Louisa and Sandfly Creek. The Study area also includes Magnetic Island (Picnic Bay, Nelly Bay, Arcadia and Horseshoe Bay), and the coastal communities of Pallarenda and Cungulla.</p> <p>The majority of natural disasters that have affected Townsville in the past have been related to cyclones and flooding. Notable examples of these are the recent flooding of January 1998 (ex-Tropical Cyclone Sid) and February 2000. The Townsville/Thuringowa Counter Disaster Plan recognises the risk of flooding, as well as storm surge and identifies the coastal communities of Pallarenda and Cungulla to be most at risk.</p> <p>Major transport infrastructure is comprised of the North Coast Railway line and the Bruce Highway, both of which run through the Townsville Study Area. A well-developed network of roads exists within the Study Area including access roads to the coastal communities listed above. In most cases, these roads are the only access in and out of the coastal communities.</p>
<p>Clients and Stakeholders</p> <p>Stakeholders include:</p> <ul style="list-style-type: none"> ▪ Townsville City Council ▪ Study Advisory Group ▪ Department of Emergency Services ▪ Residents of Townsville (within Study Area), Magnetic Island, Pallarenda and Cungulla ▪ Department of Main Roads ▪ Department of Transport ▪ Queensland Rail ▪ Department of Natural Resources & Mines ▪ Queensland Environmental Protection Agency ▪ Queensland Police ▪ Queensland Ambulance ▪ Queensland Fire and Rescue Authority
<p>Factors that Affect the Risk Management Process</p> <ul style="list-style-type: none"> ▪ Townsville City Council is committed to the principles of Disaster Risk Management. ▪ The Council's strategic direction recognises community safety and counter disaster obligations. ▪ Funding Agreement and Project Plan outlines aims, strategies and program for fulfilling funding obligations. ▪ Townsville City Council and the Council of Thuringowa have a joint Counter Disaster Plan (21 November 2001) that is periodically reviewed. ▪ The responsibilities of Council in regard to disaster management are prescribed in legislation, directives and policy documents. Those documents applicable to this study are listed below: <ul style="list-style-type: none"> a. Legislation <ul style="list-style-type: none"> ▪ Local Government Act 1993 ▪ Environment Protection Act 1994 ▪ Native Title (Queensland) Act 1993 ▪ Queensland Heritage Act 1992 ▪ State Counter Disaster Organisation Act 1975 ▪ Integrated Planning Act 1997 ▪ Coastal Protection and Management Act 1995 ▪ Water Resources Act 1989 ▪ Water Act 2000 ▪ Local Government Planning and Environmental Act ▪ Soil Conservation Act ▪ Environment Protection and Biodiversity Conservation Act 1999

<p>b. Guiding Principles</p> <ul style="list-style-type: none"> ▪ State Counter Disaster Plan ▪ Townsville/Thuringowa Counter Disaster Plan ▪ Disaster Risk Management (1999), Zamecka and Buchanan, Queensland Department of Emergency Services ▪ Floodplain Management in Australia, SCARM Report 73 (2000) – Best Practice Principles and Guidelines. ▪ Risk Management AS/NZS 4360:1999 ▪ Natural Disaster Financial Assistance Arrangements within Queensland 2001/2002 ▪ Queensland Urban Drainage Manual ▪ Natural Disaster Relief Arrangements, 2001 ▪ Regional Flood Mitigation Programme Guidelines, Department of Transport and Regional Services ▪ Economic Costs of Natural Disasters in Australia, Bureau of Transport and Regional Economics, Report 103 (2001) ▪ Benefits of Flood Mitigation in Australia, Bureau of Transport and Regional Economics, Report 106, (2002) ▪ The Community Awareness and Education in Emergency Management Good Practice Guide, Emergency Management Australia (2000) ▪ Australian Rainfall and Runoff, The Institution of Engineers, Australia (1998) <p>c. Government Departments</p> <ul style="list-style-type: none"> ▪ Department of Primary Industries – Fisheries ▪ Queensland Environmental Protection Agency ▪ Great Barrier Reef Marine Park Authority ▪ Department of Emergency Services ▪ Department of Natural Resources & Mines
<p>Applicable Federal, State and Local Disaster Arrangements</p>
<p>Townsville City Council has developed a Counter Disaster Plan (overview only) for various natural disasters, including flood, cyclones and storms, storm tides, earthquake/landslides, fire, and various accidents.</p>
<p>Political, Social and Economic Circumstances</p>
<p>Council is required to demonstrate flood mitigation options by developing an overall Disaster Risk Management Report and Disaster Mitigation Plan, to satisfy the requirements for continued eligibility for Natural Disaster Relief Arrangements. Politically it is unacceptable to do nothing about solving flooding problems currently faced by the residents of Townsville, particularly in those areas that are subject to frequent flooding. Townsville is vulnerable to flooding (including storm surge) as indicated by the historic flood events of January 1998 and February 2000, as well as Cyclone Althea, December 1971. The community is well aware of its vulnerability to flooding and is conscious that flooding is often as a result of inadequate local drainage infrastructure.</p>
<p>Other Issues</p>
<p>Due to the proximity of Townsville to Thuringowa, it is likely that during significant flood events, the impacts of flooding in Townsville will have follow-on effects in Thuringowa. The risk to the safety of the community and the risk of damage to public and private infrastructure as a result of storm surge is also a serious concern to Council.</p>

Table 4 – Identification and Description of Hazard (Flooding)

Hazard Name
Flooding
Hazard Description
<p>Flooding has been identified as the most significant hazard in the Study area. The vulnerability of Townsville to flooding was highlighted in the event of January 1998, when considerable inundation of property, damage to infrastructure and disruption to essential services occurred. The compensation paid by insurance companies to Townsville residents is reported to be approximately \$72 million.</p> <p>The actual disruption caused by flooding will depend on a number of factors including:</p> <ul style="list-style-type: none"> ▪ Total rainfall ▪ Intensity and duration of rainfall ▪ Geographical spread ▪ Antecedent weather conditions ▪ Ground cover ▪ Capacity of drainage systems and infrastructure ▪ Tidal influence ▪ Extent of impervious land (e.g. roofs, road surfaces) ▪ Depth of runoff (greater than 200 mm in private properties are considered a hazard) <p>The flood models developed as part of this study has looked at a range of flood events (up to 100 year ARI and PMF) for the Townsville floodplain and Magnetic Island. The risk assessment will look separately at the risks associated with a range of ARI events.</p>
Secondary Hazards
<p>A number of secondary hazards are a direct result of flooding and include landslides, particularly relevant to steep erosive slopes on Castle Hill, and public health issues associated with mosquito infestations (a result of ponding water) and the contamination of waterways with sewage due to the malfunction or overflow of sewage pump stations.</p>

Table 5 – Identification and Description of Hazard (Storm Surge)

Hazard Name
Storm surge and tidal inundation
Hazard Description
<p>For many coastal communities the threat of inundation from extreme tides is often greater than either river flooding or local runoff. This is case at Pallarenda and Cungulla and therefore the effect of storm surge and tides is considered the most significant hazard for these low-lying areas.</p> <p>The actual disruption caused by storm surge will depend on a number of factors including:</p> <ul style="list-style-type: none"> ▪ Severity of cyclone ▪ Landfall and direction of cyclone ▪ Resulting floodwater depth and velocity ▪ Rate of risk and recession of storm surge ▪ Duration ▪ Vulnerability of the community and the environment <p>The storm surge component of this study has looked at the impact of static 50 year ARI and 100 year ARI with wave setup, in addition to Cyclone Althea (1971) occurring coincident with a high tide, resulting in a peak water level of RL 4m. It should be noted that this component of work is preliminary only and provides a cursory look at the vulnerability of the community to storm surge and tidal inundation. Further detailed storm surge assessments are recommended.</p>
Secondary Hazards
<p>The aftermath of cyclones is usually classed as a rain depression and may add further complications should the rain continue and create flooding problems. Land degradation resulting from saline intrusion is also a potential secondary hazard of storm surge.</p>

Table 6 – Identification and Description of Community and Environment

Description of the Community
<p>Townsville City, located on the east coast of North Queensland, has a population of approximately 94739 persons (2001 Census). Approximately 3000 people reside on Magnetic Island.</p> <p>Townsville City has an unemployment rate of 8.8% and according to 2001 Census, approximately 16% of all families are living below the poverty line in the Townsville Region (i.e. including the City of Thuringowa).</p> <p>Demographic data indicates that high concentrations of older people live in the Townsville suburbs of Rowes Bay, Belgian Gardens (where a caravan park is located), Pallarenda, Mundingburra, Currajong, Magnetic Island and Pimlico. Aged care facilities are located in Rowes Bay, Belgian Gardens, Pallarenda and Mundingburra.</p>
Description of the Built Environment
<p>(i) Buildings</p> <ul style="list-style-type: none"> ▪ Townsville boasts a number of heritage-listed buildings scattered throughout the community, and large impressive buildings built during early settlement of Townsville are still being used today. ▪ The Strand Redevelopment has become the nucleus of recreational and social activity for the community. ▪ Recent years has seen the revival of residential accommodation in the inner city and expansion of new housing estates established in outer suburbs ▪ New development within the city continues with the redevelopment of old railway yards, the upgrading of defence facilities, and the expansion of mineral processing facilities.
<p>(ii) Engineering Lifelines</p> <ul style="list-style-type: none"> ▪ <i>Electricity</i> – Queensland's electricity market has recently been deregulated, with two peak load power stations and one recently constructed base load power station providing highly reliable power supply for Townsville. Communities within the Study Area are serviced by Ergon Energy, with overhead power provided to the coastal communities of Pallarenda and Cungulla. Power to Magnetic Island is via an underground service pipeline. ▪ <i>Telecommunications</i> – Telstra is the main supplier of telecommunication services. Telecommunications throughout the Townsville area (including Pallarenda) is reliable with fully diverse optical fibre routes meshed with all Australian capital cities and regional areas. Internet and email services are fully functional. Radio broadcast services are highly reliable. Magnetic Island has a reliable telecommunication network, as does Cungulla. ▪ <i>Water Supply</i> – The water supply to Townsville is reliable and sourced from Ross River Dam, Paluma Dam and Burdekin Falls Dam, provided by NQ Water, the bulk water provider for the region. Townsville City Council is responsible for the distribution of water throughout the Study Area, which includes Pallarenda and Magnetic Island. Residents at Cungulla operate rainwater tanks to supplement the water supply. ▪ <i>Waste Removal and Sewerage</i> – The Townsville floodplain area, as well as Pallarenda, have a reticulated sewerage system. Some areas of Magnetic Island are sewered however the majority are serviced by septic tanks. Septic tanks are also used throughout Cungulla. Townsville, Pallarenda, Magnetic Island and Cungulla have access to public waste disposal facilities, and Townsville City Council operates weekly waste removal services for Townsville, Magnetic Island and Pallarenda. ▪ <i>Transport Routes</i> – Major transport infrastructure is comprised of the Bruce Highway and the Northcoast Railway Line. Declared roads are under the financial responsibility of the Department of Main Roads. The Northcoast Railway Line is the responsibility of Queensland Rail. The road network throughout Townsville is comprehensive and offers alternative routes to critical facilities during emergency situations. When road closures do occur, the delay imposed is not thought to be extensive, with most routes expected to be open within 24hrs. A privately owned ferry service transports residents and tourists between Magnetic Island and the mainland. Cungulla is accessed from the Bruce Highway via the Aims Road.

(iii) Critical Facilities

Emergency Services

- The Department of Emergency Services, District Manager, Disaster Operations, Counter Disaster and Rescue Services for the region are based in Townsville.
- The City Councils of Townsville and Thuringowa Local Government Counter Disaster Committee has prepared "The Cities of Townsville/Thuringowa Counter Disaster Plan" for the local region and assists and advises the Chairperson and Executive Officer for the respective Councils in counter disaster operations.
- The State Emergency Services (SES) has a centre in Townsville.
- The Queensland Ambulance Service (QAS) has services in Townsville.
- Queensland Police has units based throughout the Study area, including Magnetic Island.
- The Fire Brigade has stations located in Townsville.
- There are designated evacuation centres within the Townsville area.

Health Services

- Townsville has the largest public facility of its type in the region, and is located in Douglas. Two other smaller privately owned hospitals are located in Pimlico and Hyde Park.

Airport

- An internationally accredited airport services Townsville, and is located within the Study Area (Garbutt).

Miscellaneous

- Defence facilities in the area (Army and RAAF) offer alternative emergency support capabilities.

Description of Natural Environment e.g. Topography

Townsville City is located in an area known as the Townsville Coastal Plains. This area is typically a narrow coastal plain bounded by mountain ranges, with areas of mangrove flats, old beach ridges, and estuarine and coastal freshwater wetlands. The inshore island community of Magnetic Island is also located within Townsville City.

The vast majority of Townsville City's population and infrastructure are located on the coastal plain of the Ross River, with the remainder located on the lower flanks of surrounding hills. The Ross River is dammed upstream of the city by the Ross River Dam (catchment area 750km²) which was constructed in the early 1970s for water supply and flood mitigation purposes. Other significant watercourses in the city include Louisa, Gordon, Stuart and Ross Creeks, and a drainage depression known as Mindham Park Drain (likely to be an old course of the Ross River). Mindham Park Drain and the Lakes and Woolcock Canal take the majority of Townsville's urban runoff.

Townsville City experiences a dry tropical climate. The City has an average rainfall of 1,143 mm per year, with the majority falling during summer. The area is also vulnerable to tropical cyclones, which form in summer and early autumn.

Description of Social Environment e.g. Community Safety Service Provision, Economics, Culture

Council has been proactive in addressing various risks associated with natural disaster events that threaten the safety of the Community by developing a Counter Disaster Plan. The purpose of the Plan is to minimise the effects of and coordinate the response to a disaster affecting the residents and communities of the Cities of Townsville and Thuringowa. Council has also established a "Townsville City Safe" project which, through partnership with the community and other organisations throughout the city work towards a safer environment for the residents of Townsville.

Townsville has a diverse economic base with no single dominating sector ensuring the economy is both stable and resilient to market fluctuations. The local economy receives major contributions from several core industries including manufacturing, public administration, defence forces, mineral refining, mining operations, tourism, education, research, and tertiary services.

The manufacturing and public administration sectors provide strong contributions to the economy with most businesses located in Townsville/Thuringowa serving as the commercial centre for the region. Public administration and defence also account for a large proportion of employment and can be attributed to the Lavarack Barracks Army Base in Townsville. The army base, the second largest facility of its kind in Australia, provides a steady demand for goods and services which further strengthens the economy. In recent years, mining has experienced the significant growth, reflecting the region's strong relationship with the mining industry.

The Townsville Civic Theatre is one of Australia's leading regional theatres which plays a central role within the community by presenting a wide variety of programmes featuring national and international artists, as well as providing a showcase for local talent. Townsville also boasts North Queensland's largest convention and entertainment venue that offers excellent meeting and exhibition facilities.

Table 7 – Community Vulnerability Profile

<p>Vulnerability of People</p> <p>The economic situation of many Study Area residents and businesses threatened by flooding is such that the resilience of the community would be impaired. Whilst there will be a small degree of community self-reliance it is anticipated that there will be a strong reliance on Council, Emergency Services and associated social support organisations. The small coastal communities are particularly vulnerable to storm surge. It should also be noted that it has been a significant amount of time since the last storm surge event (1971) and major flood (1998). Residents may have become complacent and new residents may not be aware of the risks of flooding and storm surge. This has the effect of reducing the preparedness of the community.</p>
<p>Vulnerability of Social Structures</p> <p>It is believed that social structures in Townsville are generally strong. James Cook University gives students wishing to gain tertiary education the opportunity to remain in Townsville whilst the defence forces attract young people/married couples to the city, resulting in an often vibrant and active community. Townsville offers excellent health and community services and facilities, education, cultural development, sporting and recreation facilities that underlies this strong sense of community well-being. The community response to major catastrophes has shown evidence of community spirit and the strong links between Council and community agencies.</p>
<p>Vulnerability of Buildings</p> <ul style="list-style-type: none"> ▪ Majority of houses built in the recognised flood zones do not have any special construction features that reduce damage caused by flooding. ▪ Typically older houses exist in flood prone areas. However, older homes in Townsville are typically highset, providing additional immunity to flooding. ▪ Recent years has seen extensive development on the slopes of Castle Hill. These slopes are highly erodable and during rainfall events significant amounts of silt is entrained within the runoff and cause local drainage systems to be blocked, resulting in the subsequent inundation of property.
<p>Vulnerability of Lifelines</p> <ul style="list-style-type: none"> ▪ <i>Electricity</i> – Power lines and telephone links are likely to fail due to high winds associated with cyclone events, and subsequent flooding. ▪ <i>Water Supply</i> – Reasonable reliability of water supply is expected to areas within Townsville during flood events. A 900mm water supply pipeline crosses the Ross River near the golf course. Approximately half the length of the pipeline was damaged in a flood and this portion of pipeline, when replaced, was buried under the river bed. There is potential for scouring of the river bed during severe flooding which may expose the pipeline. The remaining section of pipeline still exists above ground and there is potential for floating debris to collect behind this pipeline and cause failure. ▪ <i>Sewerage Systems</i> – Sewerage systems are unlikely to operate during flood events as pump stations shut-down when inundated with water. The sewerage system, if affected, is expected to be operable within hours. The Cleveland Bay Purification Plant is located on the lower Ross River floodplain, however, in the event of January 1998, the plant was isolated by not adversely affected. ▪ <i>Transport Routes</i> – The Bruce Highway and the Northcoast Railway are vulnerable to flooding inundation. Access routes into Cungulla and Pallarenda are vulnerable to storm surge and tidal inundation. Major evacuation routes within the city are also prone to inundation.
<p>Vulnerability of Critical Facilities</p> <p>The Townsville/Thuringowa Counter Disaster Plan designates Townsville City Council as the lead agency in flooding emergencies as well as cyclone and storm emergencies. The Council is supported by the SES, Queensland Police Service, Queensland Fire and Rescue Service, Ergon Energy, Telstra and Queensland Ambulance Service in emergency situations. Damage to critical facilities during flood events, including emergency service centres, the Disaster Coordination Centres, hospitals and evacuation centres, would hinder the ability of emergency services to respond in an emergency situation. The critical facilities to be utilised in flooding events are required to be safe from flooding but also to be structurally sound and able to withstand the winds associated with cyclones that often produce flooding.</p>
<p>Vulnerability of Local Economic Production and Employment</p> <p>Flooding is considered to impact on the economic viability, particularly in the short-term, of local businesses and residents of Townsville and Magnetic Island whilst the coastal communities of Pallarenda and Cungulla may experience some dislocation from regional centres for short periods of time.</p>

Table 8 – Scale of Likelihood

Likelihood		
Level	Descriptor	Description
A	Almost Certain	Up to 5 Year ARI <i>(the event is expected to occur)</i>
B	Likely	Up to 10 Year ARI <i>(the event will probably occur)</i>
C	Possibly	Up to 20 Year ARI <i>(the event should occur at some time)</i>
D	Unlikely	Up to 50 Year ARI <i>(the event could occur at some time)</i>
E	Rare	1998 Event (approximately 500 Year ARI) <i>(the event may occur only in exceptional circumstances)</i>

Table 9 – Scale of Consequence

Consequences		
Level	Descriptor	Description
1	Insignificant	Minimal property damage, no fatalities, no injuries, low financial loss, little disruption to the community, no measurable impact on environment
2	Minor	Inundation of a small number of properties, small number of injuries, no fatalities, first aid treatment required, some displacement of people (very short period of time eg 24hrs), some personal support required, some damage, some disruption (short period of time), small impact on environment with no lasting effects, some financial loss.
3	Moderate	Inundation of significant number of properties, substantial property damage, medical treatment required, no fatalities, some hospitalisation, displacement of people (very short period of time e.g. 24hrs), personal support satisfied through local arrangements, localised damage which is rectified by routine arrangements, normal community functioning with some inconvenience, some impact on environment with no long term effect or small impact on environment with long term effect, financial loss.
4	Major	Extensive injuries, fatalities, significant hospitalisation, large number displaced (more than 24hrs duration), external resources required for personal support, significant damage that required external resources, community only partially functioning, some services unavailable, some impact on environment with long term effects, significant financial loss, some financial assistance required.
5	Catastrophic	Large number of severe injuries, extended and large numbers requiring hospitalisation, general and widespread displacement for extended duration, significant fatalities, extensive personal support, extensive damage, community unable to function without significant support, significant impact on environment and/or permanent damage, huge financial loss – unable to function without significant support.

Table 10 – Scale of Risk

Risk		
Level	Descriptor	Description
E	Extreme risk	Immediate action required
H	High risk	Works identified and included in forward works programme
M	Moderate risk	Management responsibility must be specified
L	Low risk	Managed by routine procedures

Table 11 – Risk Classification Matrix

Likelihood	Consequences				
	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
A Almost Certain	M	H	H	E	E
B Likely	M	H	H	E	E
C Possibly	L	M	H	E	E
D Unlikely	L	L	M	H	E
E Rare	L	L	M	H	H

Legend: L: Low risk, M: Moderate Risk, H: High risk, E: Extreme risk.

Table 12 – Risk Register, Part A – Risk Description – Townsville

Hazard – Flooding (1 in 10 Year ARI Event)		
Vulnerable Elements	Risk	Consequence
People	A population of 183 is at risk of inundation by flooding in the following areas: <ul style="list-style-type: none"> ▪ Mt Louisa. ▪ Belgian Gardens, North Ward, Cranbrook, Mundingburra, Pimlico, Vincent. ▪ Wulguru, Cluden. 	<ul style="list-style-type: none"> ▪ People may be displaced from their homes for short period (eg 24hrs).
Buildings	52 residential buildings are at risk of inundation by flooding in the following areas: <ul style="list-style-type: none"> ▪ Mt Louisa. ▪ Belgian Gardens, North Ward, Cranbrook, Mundingburra, Pimlico, Vincent. ▪ Wulguru, Cluden. 	<ul style="list-style-type: none"> ▪ Buildings may suffer some damage (contents). ▪ Water, power and telecommunications are expected to operate adequately. ▪ Temporary loss of sewerage services. ▪ Some clean-up costs may be incurred by property owners.
Business	5 businesses are at risk of being affected by flooding in the following areas: <ul style="list-style-type: none"> ▪ Garbutt, West End. 	<ul style="list-style-type: none"> ▪ Businesses operate with some inconvenience. ▪ Temporary loss of sewerage. ▪ Some clean-up costs. ▪ Loss of power, communications and water supply unlikely.
Engineering Lifelines	Engineering lifelines (water, sewerage, power supply, communications) within the following areas may suffer damage by flooding (>300mm): <p><u>Pump Stations</u></p> <ul style="list-style-type: none"> ▪ City: near Mt St John STP. ▪ Fairfield: Abbot Street. ▪ Mt Louisa: Webb Drive. 	<ul style="list-style-type: none"> ▪ Negligible disruption to the community ▪ Sewerage may fail temporarily or surcharge.
Critical Facilities	Some critical facilities in the following areas are at risk from flooding: (>300mm) <ul style="list-style-type: none"> ▪ Mount Louisa: Evacuation centre at Bayswater Road. 	<ul style="list-style-type: none"> ▪ Some evacuation centres may be subject to inundation.

Table 13 – Risk Register, Part A – Risk Description – Townsville

Hazard – Flooding (1 in 50 Year ARI Event)		
Vulnerable Elements	Risk	Consequence
People	<p>A population of 573 is at risk of inundation by flooding, in the following additional areas:</p> <ul style="list-style-type: none"> ▪ Garbutt, West End, Hyde Park, Hermit Park, Mysterton, Currajong, Aitkenvale, Heatley. ▪ Railway Estate. 	<ul style="list-style-type: none"> ▪ People may be injured and require medical treatment. ▪ People may be displaced from their homes for short period (eg 24hrs). ▪ People may require local services. ▪ People may be able to work with some inconvenience.
Buildings	<p>Approximately 177 residential buildings are at risk of inundation by flooding, in the following additional areas:</p> <ul style="list-style-type: none"> ▪ Garbutt, West End, Hyde Park, Hermit Park, Mysterton, Currajong, Aitkenvale, Heatley. ▪ Railway Estate. 	<ul style="list-style-type: none"> ▪ Buildings may suffer some damage (contents). ▪ Temporary loss of power, telecommunications and sewerage. ▪ Property owners may incur some clean-up costs.
Business	<p>12 businesses are at risk of being affected by flooding, in the following additional areas:</p> <ul style="list-style-type: none"> ▪ Garbutt, Hyde Park, Hermit Park, Aitkenvale. ▪ Mt Louisa. ▪ Stuart. 	<ul style="list-style-type: none"> ▪ Businesses operate with some inconvenience. ▪ Temporary loss of power, telecommunications and sewerage. ▪ Some clean-up costs. ▪ Damage to caravan parks.
Engineering Lifelines	<p>Engineering lifelines (water, sewerage, power and communications) may suffer damage by flooding within the following additional areas (>300mm):</p> <p><u>Pump Stations</u></p> <ul style="list-style-type: none"> ▪ City: Hugh Street, Douglas Street/Lancaster Street, Sussex Street, Hugh Street/Chandler Street, Mariners Drive. ▪ Annandale: Marabou Drive. 	<ul style="list-style-type: none"> ▪ Sewerage, power and telecommunications may fail temporarily.
Critical Facilities	<p>Some critical facilities in the following additional areas are at risk from flooding (>300mm):</p> <p><u>Evacuation Areas</u></p> <ul style="list-style-type: none"> ▪ Fairfield: Area at Mervyn Crossman Drive flooded. ▪ City: Access to area at the showgrounds restricted at Kings Road and portion of area inundated. ▪ City: Access restricted to area at Fulham Road/Swanson Street intersection. ▪ Annandale: Access restricted to area on Yolanda Drive/Oleander Street and area inundated. 	<ul style="list-style-type: none"> ▪ Inconvenience to local goods distribution. ▪ Local clinics operate with some inconvenience. ▪ Hospital may operate with some inconvenience. ▪ Some delay in the response of emergency services (fire, police, ambulance) due to road access restrictions.

Table 14 – Risk Register, Part A – Risk Description – Townsville

Hazard – Flooding (1998 Flood Event – 1 in 500 Year ARI Event)		
Vulnerable Elements	Risk	Consequence
People	<p>A population of 3865 is at risk of inundation by flooding, in the following additional areas to those in Table 13:</p> <ul style="list-style-type: none"> ▪ Rowes Bay, Rosslea, Gulliver. ▪ Idalia, Oonoonba, Stuart. 	<ul style="list-style-type: none"> ▪ Injuries and fatalities. ▪ Evacuation and emergency accommodation and food. ▪ Post-traumatic stress. ▪ Recovery services and financial assistance required. ▪ Emergency services required. ▪ Temporary loss of jobs due to displacement and lack of access.
Buildings	<p>1185 residential buildings are at risk of inundation by flooding, in the following additional areas to those in Table 13:</p> <ul style="list-style-type: none"> ▪ Rowes Bay, Rosslea, Gulliver. ▪ Idalia, Oonoonba, Stuart. 	<ul style="list-style-type: none"> ▪ Buildings may suffer structural and/or contents damage. ▪ Temporary loss of power, telecommunications, and sewerage. ▪ Loss of government services. ▪ Property owners may incur cleanup costs. ▪ Damage to caravan parks and other community facilities.
Business	<p>310 businesses are at risk of being affected by flooding, in the following additional areas to those in Table 13:</p> <ul style="list-style-type: none"> ▪ Rowes Bay. 	<ul style="list-style-type: none"> ▪ Structure and stock damage. ▪ Temporary loss of power, telecommunications and sewerage. ▪ Looting may occur. ▪ Clean-up costs.
Engineering Lifelines	<p>Engineering lifelines will suffer damage by flooding (>300mm). Those lifelines most at risk include water supply and sewerage services, important transport routes and power.</p> <p><u>Sewerage</u> Western Suburb Outfall Main to CBPP at risk of damage due to debris in Ross River.</p> <p><u>Pump Stations</u></p> <ul style="list-style-type: none"> ▪ City: North Coast Railway/Mather Street, Catalyst Ct, Woolcock Street/Parkes Street, Lily Street, Leeds Street/Mooney Street, Fulham Road/Biggs Street, Anne Street/Alfred Street. ▪ Cluden: Bruce Highway (Stuart Caravan Park). ▪ South Townsville: Doorey Street. ▪ Fairfield: University Road 	<ul style="list-style-type: none"> ▪ Sewerage, power and telecommunications will likely fail. ▪ Roads will be closed. ▪ Essential services unable to be maintained – eg refrigeration of food. ▪ Health concerns due to contaminated water supply, spread of disease, especially if the major sewer that crosses the Ross River sustains damage. ▪ Inability to warn community, coordination of emergency services etc. ▪ Road access cut-off, structural damage to transport routes.
Critical Facilities	<p>Most critical facilities are at risk of damage due to flooding (depths > 300mm), in particular:</p> <p><u>Evacuation Areas</u></p> <ul style="list-style-type: none"> ▪ Fairfield: Access to evacuation centre on Mervyn Crossman Drive restricted (>300mm). ▪ Fairfield: Evacuation area on Oonoonba Rd flooded. ▪ Heatley: Evacuation area on Dalrymple Service road flooded. ▪ Annandale: Access to area at army barracks off University Rd restricted. 	<ul style="list-style-type: none"> ▪ Reduction in food and other critical goods storage and distribution capacity. ▪ Reduction in hospital capacity. ▪ Reduction in capacity of emergency services in both response and recovery stages.

Table 15 – Risk Register, Part A – Risk Description – Townsville

Hazard – Storm Surge & Tidal Inundation (Cyclone Althea)		
Vulnerable Elements	Risk	Consequence
People	A small population (440) is at risk from inundation, in Oonoonba, Hermit Park and South Townsville, Railway Estate.	<ul style="list-style-type: none"> ▪ No fatalities or injuries
Buildings	150 buildings are at risk of inundation by flooding, in Oonoonba, Hermit Park and South Townsville.	<ul style="list-style-type: none"> ▪ Minimal property damage ▪ No loss of power, telecommunications, water or sewerage services
Business	Businesses are at no apparent risk of inundation.	<ul style="list-style-type: none"> ▪ Minimal stock damage ▪ No loss of power, telecommunications, water or sewerage facilities
Engineering Lifelines	Engineering lifelines are at no apparent risk of damage by inundation.	<ul style="list-style-type: none"> ▪ Negligible disruption to the community ▪ No restrictions to access
Critical Facilities	Critical facilities are at no apparent risk from inundation.	<ul style="list-style-type: none"> ▪ Negligible impact on facilities

Note: Assessment based purely on impact of storm surge inundation. Significant damage will probably occur to moored vessels and to buildings as a result of wave and wind action (not assessed as part of this Study).

Table 16 – Risk Register, Part A – Risk Description – Townsville

Hazard – Storm Surge and Tidal Inundation (Cyclone Althea coincident with High Tide)		
Vulnerable Elements	Risk	Consequence
People	<p>A population of 7150 is at risk of inundation by inundation, in the following areas:</p> <ul style="list-style-type: none"> City: Belgian Gardens, North Ward, City, West End, Hyde Park, Hermit Park. South Townsville: South Townsville, Railway Estate. Fairfield: Oonoonba. 	<ul style="list-style-type: none"> Injuries and fatalities. Evacuation and emergency accommodation and food. Post-traumatic stress. Recovery services and financial assistance required. Emergency services required. Temporary loss of jobs due to displacement and lack of access. Theft and presence of looters.
Buildings	<p>2230 buildings are at risk of inundation, in the following areas:</p> <ul style="list-style-type: none"> City: Belgian Gardens, North Ward, City, West End, Hyde Park, Hermit Park. South Townsville: South Townsville, Railway Estate. Fairfield: Oonoonba. 	<ul style="list-style-type: none"> Buildings may suffer structural and/or contents damage. Temporary loss of power, telecommunications, water supply and sewerage. Loss of government services. Cleanup costs. Looting may occur. Property owners may incur cleanup costs. Damage to caravan parks and other community facilities.
Business	<p>160 businesses are at risk of being affected by inundation, in the following areas:</p> <ul style="list-style-type: none"> City: Belgian Gardens, City, Hyde Park, Hermit Park. South Townsville: South Townsville, Railway Estate. 	<ul style="list-style-type: none"> Structure and stock damage. Temporary loss of power, telecommunications, water supply and sewerage. Inability to service customers. Looting may occur. Clean-up costs.
Engineering Lifelines	<p>Some engineering lifelines may suffer damage by storm surge (>300mm). Those lifelines most at risk include important transport routes, and power.</p> <p><u>Transport Routes</u></p> <ul style="list-style-type: none"> Access to Cleveland Bay STP restricted. <p><u>Pump Stations</u></p> <ul style="list-style-type: none"> City: Cook Street, Howitt Street/The Strand, Mariners Drive/The Strand, Hanran Street, Lily Street. South Townsville: Perkins Street, Palmer Street, Sixth Street East (end), Sixth Street East/Fifth Avenue, Seventh Street, Ninth Street, Doorey Street, Railway Avenue/Queens Road, Sussex Street/Bayswater Road. 	<ul style="list-style-type: none"> Water, sewerage, power and telecommunications may fail. Roads will be closed. Essential services unable to be maintained – eg refrigeration of food. Health concerns due to contaminated water supply, spread of disease. Inability to warn community, coordination of emergency services etc. Road access cut-off, structural damage to transport routes. Coordination difficulties for emergency services personnel.
Critical Facilities	<p>Critical facilities are at risk from storm surge inundation (>300mm):</p> <ul style="list-style-type: none"> South Townsville: Fire Station inundated and access restricted. 	<ul style="list-style-type: none"> Reduction in food and other critical goods storage and distribution capacity. Reduction in hospital capacity. Reduction in capacity of emergency services in both response and recovery stages.

Note: Assessment based purely on impact of storm surge inundation. Significant damage will probably occur to moored vessels and to buildings as a result of wave and wind action (not assessed as part of this study).

Table 17 – Risk Register, Part A – Risk Description – Magnetic Island

Hazard – Flooding (1 in 50 Year ARI Event)		
Vulnerable Elements	Risk	Consequence
People	The population is at risk of inundation by flooding in the following areas: <ul style="list-style-type: none"> ▪ Picnic Bay (7) ▪ Nelly Bay (36) ▪ Arcadia (20) ▪ Horseshoe Bay (40) 	<ul style="list-style-type: none"> ▪ People may be injured and require medical treatment. ▪ People may be displaced from their homes for short period (eg 24hrs). ▪ People may require local services. ▪ People may be able to work with some inconvenience.
Buildings	Buildings are at risk of inundation by flooding in the following areas: <ul style="list-style-type: none"> ▪ Picnic Bay ▪ Nelly Bay ▪ Arcadia ▪ Horseshoe Bay 	<ul style="list-style-type: none"> ▪ Buildings may suffer some damage (contents). ▪ Temporary loss of power, telecommunications, water supply and sewerage. ▪ Some clean-up costs may be incurred by property owners.
Business	Businesses are at risk of being affected by flooding in the following areas: <ul style="list-style-type: none"> ▪ Picnic Bay ▪ Nelly Bay ▪ Arcadia ▪ Horseshoe 	<ul style="list-style-type: none"> ▪ Businesses operate with some inconvenience. ▪ Temporary loss of power, telecommunications, water supply and sewerage. ▪ Some clean-up costs.
Engineering Lifelines	Engineering lifelines (sewerage, power supply, communications) within the following areas may suffer damage by flooding: <ul style="list-style-type: none"> ▪ Picnic Bay ▪ Nelly Bay ▪ Arcadia ▪ Horseshoe Bay 	<ul style="list-style-type: none"> ▪ Sewerage, power and telecommunications may fail temporarily.
Critical Facilities	Some critical facilities are at risk from flooding	<ul style="list-style-type: none"> ▪ Inconvenience to local goods distribution. ▪ Local clinics operate with some inconvenience. ▪ Some delay in the response of emergency services (police) due to road access restrictions.

Table 18 – Risk Register, Part A – Risk Description – Magnetic Island

Hazard – Storm Surge & Tidal Inundation (1 in 50 Year ARI Event)		
Vulnerable Elements	Risk	Consequence
People	<p>The population is at risk of inundation by storm surge and tidal inundation in the following areas:</p> <ul style="list-style-type: none"> ▪ Nelly Bay (12) ▪ Horseshoe Bay (6) 	<ul style="list-style-type: none"> ▪ People may be injured and require medical treatment. ▪ People may be displaced from their homes for short period (eg 24hrs). ▪ People may require local services. ▪ People may be able to work with some inconvenience.
Buildings	<p>Buildings are at risk of storm surge and tidal inundation in the following areas:</p> <ul style="list-style-type: none"> ▪ Nelly Bay ▪ Horseshoe Bay 	<ul style="list-style-type: none"> ▪ Buildings may suffer some damage (contents). ▪ Temporary loss of power, telecommunications and sewerage. ▪ Some clean-up costs may be incurred by property owners
Business	<p>Businesses are at risk of being affected by storm surge and tidal inundation in the following areas:</p> <ul style="list-style-type: none"> ▪ Nelly Bay ▪ Horseshoe Bay 	<ul style="list-style-type: none"> ▪ Businesses operate with some inconvenience. ▪ Temporary loss of power, telecommunications and sewerage. ▪ Some clean-up costs.
Engineering Lifelines	<p>Engineering lifelines (sewerage, power supply, communications) within the following areas may suffer damage by storm surge and tidal inundation:</p> <ul style="list-style-type: none"> ▪ Nelly Bay ▪ Horseshoe Bay 	<ul style="list-style-type: none"> ▪ Sewerage, power and telecommunications may fail temporarily.
Critical Facilities	<p>Some critical facilities in the following areas are at risk from storm surge and tidal inundation</p>	<ul style="list-style-type: none"> ▪ Inconvenience to local goods distribution. ▪ Local clinics operate with some inconvenience. ▪ Some delay in the response of emergency services (police) due to road access restrictions

Table 19 – Risk Register, Part A – Risk Description – Pallarenda and Cungulla

Hazard – Storm Surge & Tidal Inundation (1 in 50 Year ARI Event)		
Vulnerable Elements	Risk	Consequence
People	The populations of Pallarenda (70) and Cungulla (100) are at risk of inundation by storm surge and tidal inundation	<ul style="list-style-type: none"> People may be displaced from their homes for short period (eg 24hrs).
Buildings	Buildings at Cungulla and Pallarenda are at risk of inundation by storm surge and tidal inundation	<ul style="list-style-type: none"> Buildings may suffer some damage (contents). Power and telecommunications are expected to operate adequately. Temporary loss of sewerage services (Cungulla). Some clean-up costs may be incurred by property owners.
Business	Businesses at Cungulla and Pallarenda are at risk of inundation by storm surge and tidal inundation	<ul style="list-style-type: none"> Businesses operate with some inconvenience. Temporary loss of sewerage (Cungulla). Loss of power and communications unlikely. Some clean-up costs.
Engineering Lifelines	Engineering lifelines may suffer damage by storm surge and tidal inundation. The pump station at the end of Cribb Street at Pallarenda is inundated.	<ul style="list-style-type: none"> Water and sewerage may temporarily fail (Cungulla). Health concerns due to contaminated water supply, spread of disease. Access may be restricted within local area at Cungulla.
Critical Facilities	Some critical facilities are at risk from storm surge and tidal inundation. The aged care facility at Pallarenda is subject to inundation at the property boundary.	<ul style="list-style-type: none"> Reduction in food and other critical goods storage and distribution capacity.

Table 20 – Risk Register, Part A – Risk Description – Pallarenda and Cungulla

Hazard – Storm Surge and Tidal Inundation (Cyclone Althea coincident with High Tide)		
Vulnerable Elements	Risk	Consequence
People	The populations of Pallarenda and Cungulla are at risk of inundation by storm surge and tidal inundation	<ul style="list-style-type: none"> ▪ Injuries and fatalities. ▪ Evacuation and emergency accommodation and food. ▪ Post-traumatic stress. ▪ Recovery services and financial assistance required. ▪ Temporary loss of jobs due to displacement and lack of access.
Buildings	Buildings are at risk of inundation by storm surge and tidal inundation	<ul style="list-style-type: none"> ▪ Buildings may suffer structural and/or contents damage. ▪ Temporary loss of power, telecommunications, water supply and sewerage. ▪ Cleanup costs. ▪ Property owners may incur clean-up costs.
Business	Businesses are at risk of inundation by storm surge and tidal inundation	<ul style="list-style-type: none"> ▪ Structure damages. ▪ Temporary loss of power, telecommunications, water supply and sewerage. ▪ Cleanup costs.
Engineering Lifelines	Engineering lifelines are at risk of inundation by storm surge and tidal inundation, particularly of main evacuation routes. There will also be damage to on-site septic systems, rain water tanks, power and telecommunications. The pump station along the Esplanade at Pallarenda is inundated.	<ul style="list-style-type: none"> ▪ Water, sewerage, power and telecommunications may fail. ▪ Roads will be closed. ▪ Health concerns due to contaminated water supply and inundation of septic tanks. ▪ Essential services unable to be maintained, e.g. refrigeration of food. ▪ Inability to warn community, coordination of emergency services. ▪ Road access cut-off, structural damage to transport links.
Critical Facilities	Some critical facilities are at risk from storm surge and tidal inundation. Further inundation of the Aged care facility at Pallarenda is evident.	<ul style="list-style-type: none"> ▪ Reduction in food and other critical goods storage and distribution capacity.

Table 21 – Risk Register, Part A – Risk Description – Other Components

Hazard – Flooding (1998 Flood Event)		
Vulnerable Elements	Risk	Consequence
Environment	<p>Ross River and various other creeks and floodplain environments throughout the Study Area may be adversely effected by flooding.</p> <p>Debris and sediment may be generated during the flooding.</p>	<ul style="list-style-type: none"> ▪ Pollution of water ways: spreading of disease, chemicals, fuels etc may be released in river. ▪ River bank scouring and erosion may occur, possible course change. ▪ Sediment transport and deposition. ▪ Loss of vegetation and habitat. ▪ Reduced drainage capacity due to debris and sediment loading.
Major Transportation Routes	<p>Major transport routes throughout the Study Area are at risk of flooding.</p> <p>The North Coast Railway Line is at risk of inundation by flooding.</p>	<ul style="list-style-type: none"> ▪ Structural damage. ▪ Major supply route cut off with indirect affects to neighbouring areas (Thuringowa). ▪ Major access routes cut off, causing difficulties for emergency services accessing the community. ▪ People travelling through the Study areas may be cut off, creating extra pressure on emergency services.

Table 22 – Risk Register, Part A – Risk Description – Other Components

Hazard – Storm Surge & Tidal Inundation (Cyclone Althea coincident with High Tide)		
Vulnerable Elements	Risk	Consequence
Environment	<p>Ross River, Ross Creek and various other creeks and floodplain environments throughout the Study Area may be adversely effected by storm surge and tidal inundation.</p>	<ul style="list-style-type: none"> ▪ Pollution of waterways: spreading of disease, chemicals, fuels etc may be released in creeks and rivers. ▪ Creek bank scouring and erosion may occur. ▪ Loss of vegetation and habitat through salt damage. ▪ Soil deterioration due to salt intrusion.
Major Transportation Routes	<p>Main accesses into Pallarenda and Cungulla are at risk of inundation by storm surge and tidal inundation.</p> <p>Main access routes are at risk of inundation by storm surge and tidal inundation.</p>	<ul style="list-style-type: none"> ▪ Structural damage. ▪ Major supply route cut off. ▪ Major access routes cut off, causing difficulties for emergency services accessing the community.

Table 23 – Risk Register, Part B – Risk Evaluation – Townsville

Hazard	Risk	Likelihood Rating	Consequence Rating	Risk Rating
Flooding (1 in 10 Year ARI Event)	Population at risk in City, Fairfield and Mt Louisa	Likely	Insignificant	Moderate
	Buildings flooded over floor level in City, Fairfield and Mt Louisa	Likely	Minor	High
	Businesses suffer loss/damage in City	Likely	Minor	High
	Engineering lifelines suffer damage	Likely	Insignificant	Moderate
	Critical facilities damaged/disrupted	Likely	Insignificant	Moderate
Flooding (1 in 50 Year ARI Event)	Population at risk in City, Fairfield, Mt Louisa, South Townsville and Annandale	Unlikely	Minor	Low
	Buildings flooded over floor level in City, Fairfield, Mt Louisa, South Townsville and Annandale	Unlikely	Moderate	Moderate
	Businesses suffer loss/damage in City, Mt Louisa and Fairfield	Unlikely	Moderate	Moderate
	Engineering lifelines suffer damage	Unlikely	Minor	Low
	Critical facilities damaged/disrupted	Unlikely	Moderate	Moderate
Flooding (1998 Flood Event)	Population at risk across most of Townsville area	Rare	Moderate	Moderate
	Buildings flooded over floor level across most of Townsville area	Rare	Moderate	Moderate
	Businesses suffer loss/damage	Rare	Moderate	Moderate
	Engineering lifelines suffer damage	Rare	Major	High
	Critical facilities damaged/disrupted	Rare	Moderate	Moderate

High Risks: Works identified and included in forward works programme

Table 24– Risk Register, Part B – Risk Evaluation – Townsville (continued)

Hazard	Risk	Likelihood Rating	Consequence Rating	Risk Rating
Storm Surge & Tidal Inundation (Cyclone Althea)	Small population at risk	Possibly	Minor	Moderate
		Possibly	Minor	Moderate
	Small number of buildings flooded over floor level	Possibly	Insignificant	Low
	Businesses suffer minimal loss/damage	Possibly	Insignificant	Low
	Engineering lifelines suffer minimal damage	Possibly	Insignificant	Low
Storm Surge & Tidal Inundation (Cyclone Althea coincident with High Tide)	Critical facilities not damaged/disrupted			
	Population at risk	Rare	Major	High
	Buildings flooded over floor level	Rare	Major	High
	Businesses suffer loss/damage	Rare	Moderate	High
	Engineering lifelines suffer damage	Rare	Moderate	Moderate
	Critical facilities damaged/disrupted	Rare	Moderate	Moderate

High Risks: Works identified and included in forward works programme

Table 25 – Risk Register, Part B – Risk Evaluation – Magnetic Island

Hazard	Risk	Likelihood Rating	Consequence Rating	Risk Rating
Flooding (1 in 50 Year ARI Event)	Population at risk	Unlikely	Moderate	Moderate
	Buildings flooded	Unlikely	Moderate	Moderate
	Businesses suffer loss/damage	Unlikely	Minor	Low
	Engineering lifelines suffer damage	Unlikely	Insignificant	Low
	Critical facilities damaged/disrupted	Unlikely	Minor	Low
Storm Surge & Tidal Inundation (1 in 50 Year ARI Event)	Population at risk	Unlikely	Minor	Low
	Buildings flooded	Unlikely	Minor	Low
	Businesses suffer loss/damage	Unlikely	Minor	Low
	Engineering lifelines suffer damage	Unlikely	Minor	Low
	Critical facilities damaged/disrupted	Unlikely	Minor	Low

Table 26 – Risk Register, Part B – Risk Evaluation – Pallarenda and Cungulla

Hazard	Risk	Likelihood Rating	Consequence Rating	Risk Rating
Storm Surge & Tidal Inundation (1 in 50 Year ARI Event)	Population at risk	Unlikely	Minor	Low
	Buildings flooded	Unlikely	Minor	Low
	Businesses suffer loss/damage	Unlikely	Minor	Low
	Engineering lifelines suffer damage	Unlikely	Minor	Low
	Critical facilities damaged/disrupted	Unlikely	Minor	Low
Storm Surge & Tidal Inundation (Cyclone Althea coincident with High Tide)	Population at risk	Rare	Moderate	Moderate
	Buildings flooded	Rare	Moderate	Moderate
	Businesses suffer loss/damage	Rare	Minor	Low
	Engineering lifelines suffer damage	Rare	Moderate	Moderate
	Critical facilities damaged/disrupted	Rare	Moderate	Moderate

Table 27 – Risk Register, Part B – Risk Evaluation – Other Components

Hazard	Risk	Likelihood Rating	Consequence Rating	Risk Rating
Flooding (1998 Flood Event)	Environmental damage to floodplain	Rare	Minor	Low
	Major transport routes cut off	Rare	Major	High
	Debris and sediment loading causes localised drainage issues	Possibly	Minor	Moderate
Storm Surge & Tidal Inundation (Cyclone Althea coincident with High Tide)	Environmental damage to floodplain	Rare	Moderate	Moderate
	Major transport routes cut off	Rare	Major	High

High Risks: Works identified and included in forward works programme

Table 28 – Register of Prioritised Unacceptable Risks – Townsville (Flooding)

Hazard	Risks	Risk Rating	Risk Evaluation	Assessment	Most Vulnerable Areas	Risk Priority
Flooding	Population at risk from over floor flooding: <ul style="list-style-type: none"> 183 in 10 Year ARI 573 in 50 Year ARI 3865 in January 1998 (500 year ARI) 	Moderate	Loss of life and serious injury in predictable events unacceptable. Large scale damage/displacement in extreme events like that experienced in 1998 is undesirable.	Unacceptable	City, Fairfield, Mount Louisa	2
	Residential buildings flooded over floor level: <ul style="list-style-type: none"> 52 in 10 Year ARI 177 in 50 Year ARI 1185 in January 1998 (500 year ARI) 	High	Damage to buildings is unavoidable in extreme events, where widespread loss of property and contents occurs. Damage to buildings or infrastructure for events less than 1 in 50 year AEP is unacceptable in existing areas.	Unacceptable	City, Fairfield, Mount Louisa	1
	Businesses suffer loss/damage from over floor inundation: <ul style="list-style-type: none"> 5 in 10 Year ARI 12 in 50 Year ARI 310 in January 1998 (500 year ARI) 	High	Major economic loss and long term effects on existing businesses is unacceptable for events less than the 1 in 10 year AEP. For larger events, it is accepted that economic loss is unavoidable.	Unavoidable	City	2
	Engineering lifelines suffer damage and disruption	High	Damage to engineering lifelines (water, sewerage, power, communications) for more than 24 hours is unacceptable.	Undesirable It is recognised that any loss will be for a short duration (less than 6 hours)	City	2
	Critical facilities damaged/disrupted	Moderate	Damage to critical facilities that makes them inoperable/unavailable at any time is unacceptable. New facilities should not be constructed in areas known to be flood prone.	Unacceptable	City, Annandale, Fairfield	1

Table 29 – Register of Prioritised Unacceptable Risks – Townsville (Storm Surge)

Hazard	Risks	Risk Rating	Risk Evaluation	Assessment	Most Vulnerable Areas	Risk Priority
Storm Surge and Tidal Inundation	Population at risk from over floor flooding: <ul style="list-style-type: none"> 440 in Cyclone Althea 7150 in extreme event 	High	Loss of life and serious injury in predictable events unacceptable. Large scale damage/displacement in extreme events like Cyclone Althea coincident with a high tide is undesirable.	Unacceptable	City, South Townsville, Fairfield	1
	Buildings flooded over floor level: <ul style="list-style-type: none"> 150 in Cyclone Althea 2230 in extreme event 	High	Damage to buildings is unavoidable in extreme events, where widespread loss of property and contents occurs. Damage to buildings or infrastructure for events less than 1 in 100 year AEP is unacceptable.	Undesirable	City, South Townsville, Fairfield	2
	Businesses suffer loss/damage from over floor inundation: <ul style="list-style-type: none"> 160 in extreme event 	High	Major economic loss and long term effects on existing businesses is unacceptable for events less than the 1 in 10 year AEP. For larger events, it is accepted that economic loss is unavoidable.	Unavoidable	City, South Townsville	3
	Engineering lifelines suffer damage and disruption	Moderate	Damage to engineering lifelines (water, sewerage, power, communications) for more than 24 hours is unacceptable.	Undesirable Unsealed access routes may remain untrafficable for extended period	Sandfly Creek (CBPP)	2
	Critical facilities damaged/disrupted	Moderate	Damage to critical facilities that makes them inoperable/unavailable at any time is unacceptable. New facilities should not be constructed in areas known to be flood prone.	Undesirable	South Townsville	2

Table 30 – Register of Prioritised Unacceptable Risks – Magnetic Island (Flooding)

Hazard	Risks	Risk Rating	Risk Evaluation	Assessment	Most Vulnerable Areas	Risk Priority
Flooding	Population at risk from over floor flooding: ▪ 103 in 50 Year ARI	Moderate	Loss of life and serious injury in predictable events unacceptable. Large scale damage/displacement in extreme events like that experienced in 1998 is undesirable.	Undesirable	Picnic Bay, Horseshoe Bay, Arcadia, Nelly Bay	2
	Buildings flooded over floor level.	Moderate	Damage to buildings is unavoidable in extreme events, where widespread loss of property and contents occurs. Damage to buildings or infrastructure for events less than 1 in 100 year AEP is unacceptable.	Unavoidable	Picnic Bay, Horseshoe Bay	2
	Businesses suffer loss/damage from over floor inundation.	Low	Major economic loss and long term effects on existing businesses is unacceptable for events less than the 1 in 10 year AEP. For larger events, it is accepted that economic loss is unavoidable.	Undesirable	Picnic Bay, Horseshoe Bay, Arcadia	3
	Engineering lifelines suffer damage and disruption	Low	Damage to engineering lifelines (water, sewerage, power, communications) for more than 24 hours is unacceptable.	Undesirable	Horseshoe Bay	3
	Critical facilities damaged/disrupted	Low	Damage to critical facilities that makes them inoperable/unavailable at any time is unacceptable. New facilities should not be constructed in areas known to be flood prone.	Undesirable	Nelly Bay	3

Table 31 – Register of Prioritised Unacceptable Risks – Magnetic Island (Storm Surge)

Hazard	Risks	Risk Rating	Risk Evaluation	Assessment	Most Vulnerable Areas	Risk Priority
Storm Surge and Tidal Inundation	Population at risk from over floor flooding: <ul style="list-style-type: none"> 18 in 50 Year ARI 80 in 100 Year ARI 	Low	Loss of life and serious injury in predictable events unacceptable. Large scale damage/displacement in extreme events like Cyclone Althea coincident with a high tide is undesirable.	Undesirable	Nelly Bay, Horseshoe Bay, Arcadia	3
	Buildings flooded over floor level: <ul style="list-style-type: none"> 6 in 50 Year ARI 27 in 100 Year ARI 	Low	Damage to buildings is unavoidable in extreme events, where widespread loss of property and contents occurs. Damage to buildings or infrastructure for events less than 1 in 100 year AEP is unacceptable.	Unavoidable	Nelly Bay, Horseshoe Bay, Arcadia	3
	Businesses suffer loss/damage from over floor inundation	Low	Major economic loss and long term effects on existing businesses is unacceptable for events less than the 1 in 10 year AEP. For larger events, it is accepted that economic loss is unavoidable.	Undesirable	Nelly Bay, Arcadia	3
	Engineering lifelines suffer damage and disruption	Low	Damage to engineering lifelines (water, sewerage, power, communications) for more than 24 hours is unacceptable.	Undesirable	Nelly Bay, Horseshoe Bay	3
	Critical facilities damaged/disrupted	Low	Damage to critical facilities that makes them inoperable/unavailable at any time is unacceptable. New facilities should not be constructed in areas known to be flood prone.	Undesirable	Picnic Bay, Nelly Bay	3

Table 32 – Register of Prioritised Unacceptable Risks – Pallarenda and Cungulla

Hazard	Risks	Risk Rating	Risk Evaluation	Assessment	Most Vulnerable Areas	Risk Priority
Storm Surge and Tidal Inundation	Population at risk from over floor flooding: Cungulla <ul style="list-style-type: none"> 100 in 50 Year ARI 140 in 100 Year ARI Pallarenda <ul style="list-style-type: none"> 70 in 50 Year ARI 170 in 100 Year ARI 	Moderate	Loss of life and serious injury in predictable events unacceptable. Large scale damage/displacement in extreme events like Cyclone Althea coincident with a high tide is undesirable.	Unacceptable	Pallarenda Aged care facility potentially isolated for short periods and subject to inundation	2
	Buildings flooded over floor level	Moderate	Damage to buildings is unavoidable in extreme events, where widespread loss of property and contents occurs. Damage to buildings or infrastructure for events less than 1 in 100 year AEP is unacceptable.	Unavoidable	Cungulla	3
	Businesses suffer loss/damage from over floor inundation	Low	Major economic loss and long term effects on existing businesses is unacceptable for events less than the 1 in 10 year AEP. For larger events, it is accepted that economic loss is unavoidable.	Undesirable	Pallarenda	3
	Engineering lifelines suffer damage and disruption	Moderate	Damage to engineering lifelines (water, sewerage, power, communications) for more than 24 hours is unacceptable.	Undesirable	Cungulla	2
	Critical facilities damaged/disrupted	Low	Damage to critical facilities that makes them inoperable/unavailable at any time is unacceptable. New facilities should not be constructed in areas known to be flood prone.	Undesirable	Pallarenda	2

Table 33 – Register of Prioritised Unacceptable Risks – Other Components

Hazard	Risks	Risk Rating	Risk Evaluation	Assessment	Most Vulnerable Areas	Risk Priority
Flooding	Environmental damage to floodplain	Low	Environmental damage through river bank erosion, loss of vegetation and habitat, possible river course change is unacceptable in frequent events. Some environmental damage in extreme events is unavoidable	Undesirable The flood event of 1998 produced no lasting environmental damage	Ross River floodplain, Louisa Creek, Ross Creek, Rowes Bay Canal	3
	Major transportation routes cut off	High	Damage/disruption to major transportation routes for more than 24 hours is unacceptable. It is unacceptable that frequent events (1 in 5 year AEP) result in individuals or communities being isolated for more than 6 hours. Reduced capacity for medical evacuation is unacceptable.	Unacceptable	Magnetic Island, Pallarenda, Cungulla, Cluden	1
	Debris and sediment reduce drainage efficiency	Moderate		Unacceptable	Mindham Park Drain, Castle Hill, Magnetic Island, Ross River	2
Storm Surge and Tidal Inundation	Environmental damage to floodplain and foreshore	Moderate	Environmental damage through foreshore erosion, loss of vegetation and habitat is unacceptable in frequent events. Some environmental damage in extreme events is unavoidable	Undesirable Recent cyclone events have resulted in significant foreshore erosion	Pallarenda, Rowes Bay, Strand, South Townsville	2
	Major transportation routes cut off	High	Damage/disruption to major transportation routes for more than 24 hours is unacceptable. It is unacceptable that frequent events (1 in 5 year AEP) result in individuals or communities being isolated for more than 6 hours. Reduced capacity for medical evacuation is unacceptable.	Unacceptable	Magnetic Island, Pallarenda, Cungulla, City, South Townsville, Fairfield	1

Table 34 – Identification and Evaluation of Treatment Options – Flood and Storm Surge

Risk	Risk Priority	Treatment Options				Treatment Evaluation
		Prevention/Mitigation	Preparedness	Response	Recovery	
Population at risk	Moderate To High	Structural measures to increase capacity of drainage systems, increase immunity of road crossings, or reduce frequency of flooding.	Implement a community awareness and education program aimed at preparedness, damage reduction and response resources.	Activate the Counter Disaster Plan, including designated Emergency Coordination Centre.	Assistance with clean up of residential and commercial property.	Townsville City Council consistently demonstrates commitment to disaster planning, including: - implementing lessons learnt from the event of January 1998 - development of draft town planning policies addressing flooding risk - funding major flood mitigation works in worst affected areas - developing brochures and advertising to raise awareness - collecting historical flood data and community input via questionnaire and public meetings. - undertaking design and investigation of mitigation works - expansion of flood warning network
Buildings flooded over floor level				Training and exercises for response and recovery teams.	Provision of temporary housing and shelter, financial assistance and emergency food supplies.	
Businesses suffer loss/damage		Utilise range of resources available to ensure that reliable and timely information is provided to the public (eg. Bureau of Meteorology, radio and television stations).	Counselling of emotionally affected people, particularly post-traumatic stress disorder.			
Engineering lifelines suffer damage		Improve the dissemination of flood warning advice to affected communities, and implement strategies to ensure efficient and targeted communication.	Coordination of evacuation procedures with Police, Fire, and SES personnel.	Public awareness programs to inform affected communities of where and when recovery assistance can be sought.		
Critical facilities damaged/disrupted		Upgrade the existing flood warning system, particularly in areas prone to flash flooding (most of the Study Area).	Resource logistical support as required to meet different situations (eg. military).	Review Counter Disaster Plan in light of recent experience.		
Environmental Damage		Assess potential for relocating or flood proofing critical facilities.	Minimise impact to transient population by implementing road and rail closures (in conjunction with Main Roads and QR) to limit population ingress to affected area.	Restoring lifelines and essential services, particularly to isolated communities.		
Debris and Sediment Loading		Review and update the Townsville / Thuringowa Counter Disaster Plan.				
Major Transport Routes Cut		Raise critical access roads or identify alternative routes.	Implement a regular maintenance program to minimise potential for debris and sediment build-up.			

Table 35 – Treatment Strategy Development (Townsville)

Ranking (Priority)	Endorsed Treatment	Responsible Agency	Complete Implementation Timeframe	Estimated Cost	Funding Source(s)
1 (H)	Continue to implement current Townsville West Flood Mitigation Project (Stage 1 and 2).	Townsville City Council	0 – 5 years	\$7.20 million	Council Budget, External Funding Sources
2 (H)	Develop town planning policy on flood and storm surge prone areas.	Townsville City Council	0 – 5 years	\$5000 (Time and Materials)	Council Budget
3 (H)	Upgrade existing flood warning system for Townsville.	Townsville City Council	0 – 5 years	\$25,000	Council Budget, External Funding Sources
4 (H)	Review and Update Counter Disaster Plan	Townsville City Council	0 – 5 years	\$5000 (Time and Materials)	Council Budget
5 (H)	Wandella Crescent/Cranbrook Park trunk drainage to Ross River	Townsville City Council	0 – 5 years	\$6.00 million	Council Budget, External Funding Sources
6 (H)	Killara Street Diversion to Ross River.	Townsville City Council	0 – 5 years	\$11.8 million	Council Budget, External Funding Sources
7 (M)	Widening of the primary drainage path in the area immediately downstream of Abbott Street – Gordon Creek	Townsville City Council	5 – 10 years	\$2.40 million	Council Budget, External Funding Sources
8 (M)	Widening the Woolcock Canal between Kings Road and Parkes Street, and culverts under Kings Road to match.	Townsville City Council	5 – 10 years	\$1.60 million	Council Budget, External Funding Sources
9 (H)	Relocate the exposed section of the western suburb outfall main that crosses the Ross River.	Citiwater	0 – 5 years	\$1.00 million	Council Budget, External Funding Sources
10 (H)	Raise section of Bruce Highway (between Abbott St and Stuart Drive).	Department of Main Roads and other agencies	0 – 5 years	\$0.10 million	State Government
11 (L)	Fraire Street (Hermit Park) Diversion to Ross River.	Townsville City Council	10 – 15 years	\$3.20 million	Council Budget, External Funding Sources
12 (M)	Construction of stormwater pump stations at Albany Road and Hindley Street.	Townsville City Council	5 – 10 years	\$1.8 million	Council Budget, External Funding Sources
13 (M)	Divert southern Dalrymple Road Drain under Bayswater Road to link up with the corresponding drain on the northern side of Bayswater Road.	Townsville City Council	5 – 10 years	\$0.15 million	Council Budget
14 (M)	Divert and upgrade Brampton Avenue pipe drainage system from Oliver Court to Fulham Road via Nathan Street.	Townsville City Council	5 – 10 years	\$3.50 million	Council Budget, External Funding Sources
15 (M)	Provide additional culvert capacity along Hopkins Street to reduce inundation around Hugh Street and Gill Park (Ambulance Station)	Townsville City Council	5 – 10 years	\$1.80 million	Council Budget
16 (M)	Upgrade drainage capacity at Lyndhurst Street / Barnet Street (Mount Louisa).	Townsville City Council	5 – 10 years	\$1.15 million	Council Budget, Developer Contribution.
17 (L)	Raise Boundary Street (Various Locations).	Townsville City Council	10 – 15 years	\$0.53 million.	Council Budget, External Funding Sources

Legend: H – High Priority, M – Medium Priority, L – Low Priority

Table 36 – Treatment Strategy Development (Townsville) (Contd)

Ranking (Priority)	Endorsed Treatment	Responsible Agency	Complete Implementation Timeframe	Estimated Cost	Funding Source(s)
18 (L)	Divert Buchanan Street / Davies Street drainage to Louisa Creek.	Townsville City Council	10 – 15 years	\$0.48 million	Council Budget, External Funding Sources
19 (M)	Upgrade drainage at Brooks Street/Tenth Avenue.	Townsville City Council	5 – 10 years	\$0.06 million	Council Budget
20 (M)	Upgrade pipe drainage system at Mitchell Street / Burke Street (North Ward).	Townsville City Council	5 – 10 years	\$0.50 million	Council Budget, External Funding Sources
21 (M)	Captains Creek (Rowes Bay Canal): Downstream of Old Common Road, the capacity of the Creek needs to be increased (particularly downstream of Evans Street).	Townsville City Council	5 – 10 years	\$1.75 million	Council Budget, External Funding Sources
22 (M)	Anne Street (Aitkenvale) Diversion to Ross River.	Townsville City Council	5 – 10 years	\$3.40 million	Council Budget, External Funding Sources
23 (M)	Upgrade diversion pump at Campbell Street/Queens Road intersection.	Townsville City Council	5 – 10 years	\$1.5 million	Council Budget, External Funding Sources
24 (M)	Channel clearing and widening of Gordon Creek to establish a defined flow path over a 1 km length.	Townsville City Council	5 – 10 years	\$2.00 million	Council Budget, External Funding Sources, Developer Contribution.
25 (M)	Upgrade drainage at Marshall Street/Primrose Street intersection.	Townsville City Council	5 – 10 years	\$0.90 million	Council Budget, External Funding Sources
26 (M)	Upgrading the access culvert to BP Service Station (Cluden).	Department of Main Roads / Developer	5 – 10 years	\$0.21 million	State Government
27 (L)	Upgrade capacity of the pipe drainage system along Fulham Road and Eckhoff Street.	Townsville City Council	10 – 15 years	\$3.20 million	Council Budget
28 (L)	Raise Kings Road (between Bayswater Road and Palmerston Street).	Townsville City Council	10 – 15 years	\$0.45 million	Council Budget
29 (L)	O'Dowd Street (Mundingburra) Diversion to Ross River.	Townsville City Council	10 – 15 years	\$0.40 million	Council Budget, External Funding Sources
30 (L)	Upgrade Water Street piped stormwater drain	Townsville City Council	10 – 15 years	\$0.38 million	Council Budget, External Sources
31 (L)	Buy out of flooded lot on the corner of O'Reilly / Brown Street	Townsville City Council	10 – 15 years	Subject to property valuation and negotiation	Council Budget
32 (M)	Divert Flow From Jurekey Street to Stuart Creek by Overland Flow Path	Townsville City Council	5 – 10 years	\$1.70 million	Council Budget, External Funding Sources

Legend: H – High Priority, M – Medium Priority, L – Low Priority

Table 37 – Treatment Strategy Development (Magnetic Island)

Ranking (Priority)	Endorsed Treatment	Responsible Agency	Complete Implementation Timeframe	Estimated Cost	Funding Source(s)
1 (H)	Establish two rainfall stations on Magnetic Island (Nelly Bay and Horseshoe Bay).	Townsville City Council	0 – 5 years	\$10,000	Council Budget, External Funding Sources
2 (M)	Upgrade culvert and drain along Apjohn Street (Horseshoe Bay).	Townsville City Council	5 – 10 years	\$0.50 million	Council Budget
3 (M)	Upgrade pipe drainage system at Picnic Bay (Picnic Street).	Townsville City Council	5 – 10 years	\$0.40 million	Council Budget
4 (L)	Upgrade overland flow path at Picnic Bay (Picnic Street to Hurst Street).	Townsville City Council	10 – 15 years	\$0.10 million	Council Budget
5 (L)	Upgrade drainage path at Nelly Bay (Sooning Street to Kelly Street).	Townsville City Council	10 – 15 years	\$0.15 million	Council Budget

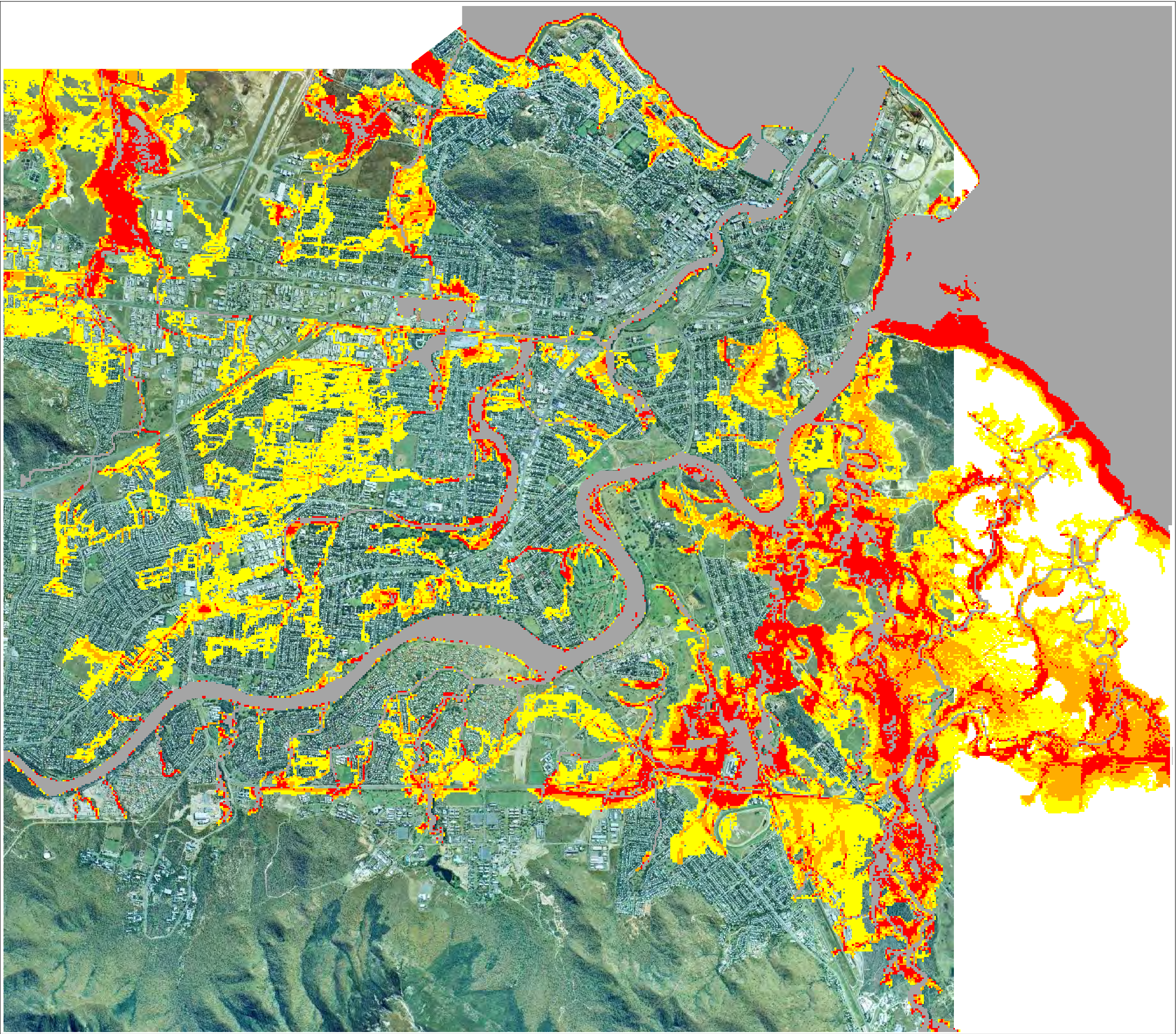
Legend: H – High Priority, M – Medium Priority, L – Low Priority

Table 38 – Treatment Strategy Development (Pallarenda & Cungulla)

Ranking (Priority)	Endorsed Treatment	Responsible Agency	Complete Implementation Timeframe	Estimated Cost	Funding Source(s)
1 (H)	Upgrade Heatley Parade (Evacuation Route from Pallarenda).	Townsville City Council	0 – 5 years	\$0.55 million	Council Budget, External Funding Sources
2 (H)	Install dedicated storm surge sirens at Pallarenda and Cungulla.	Townsville City Council	0 – 5 years	\$10,000	Council Budget, External Funding Sources
3 (M)	Upgrade Frank Randall Drive (Main Road at Cungulla).	Townsville City Council	5 – 10 years	\$0.20 million	Council Budget, External Funding Sources

Legend: H – High Priority, M – Medium Priority, L – Low Priority

Appendix B Hazard Maps



TOWNSVILLE
FLOOD HAZARD
20 YEAR ARI EVENT
(MIKE 21)

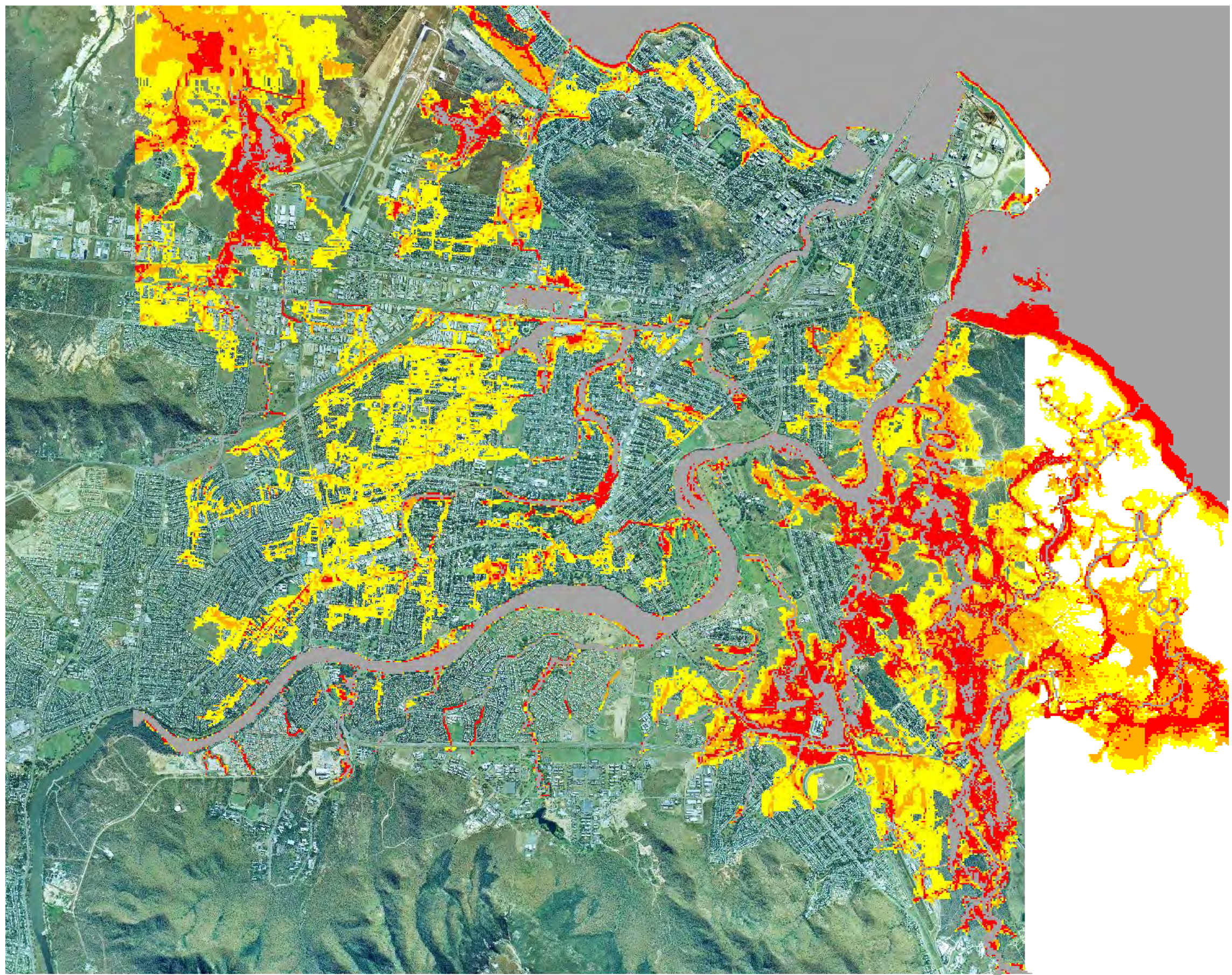
LEGEND
FLOOD HAZARD

- LOW
- MEDIUM
- HIGH
- EXTREME

NOT TO SCALE



TOWNSVILLE CITY COUNCIL



TOWNSVILLE
FLOOD HAZARD
50 YEAR ARI EVENT
(MIKE21)

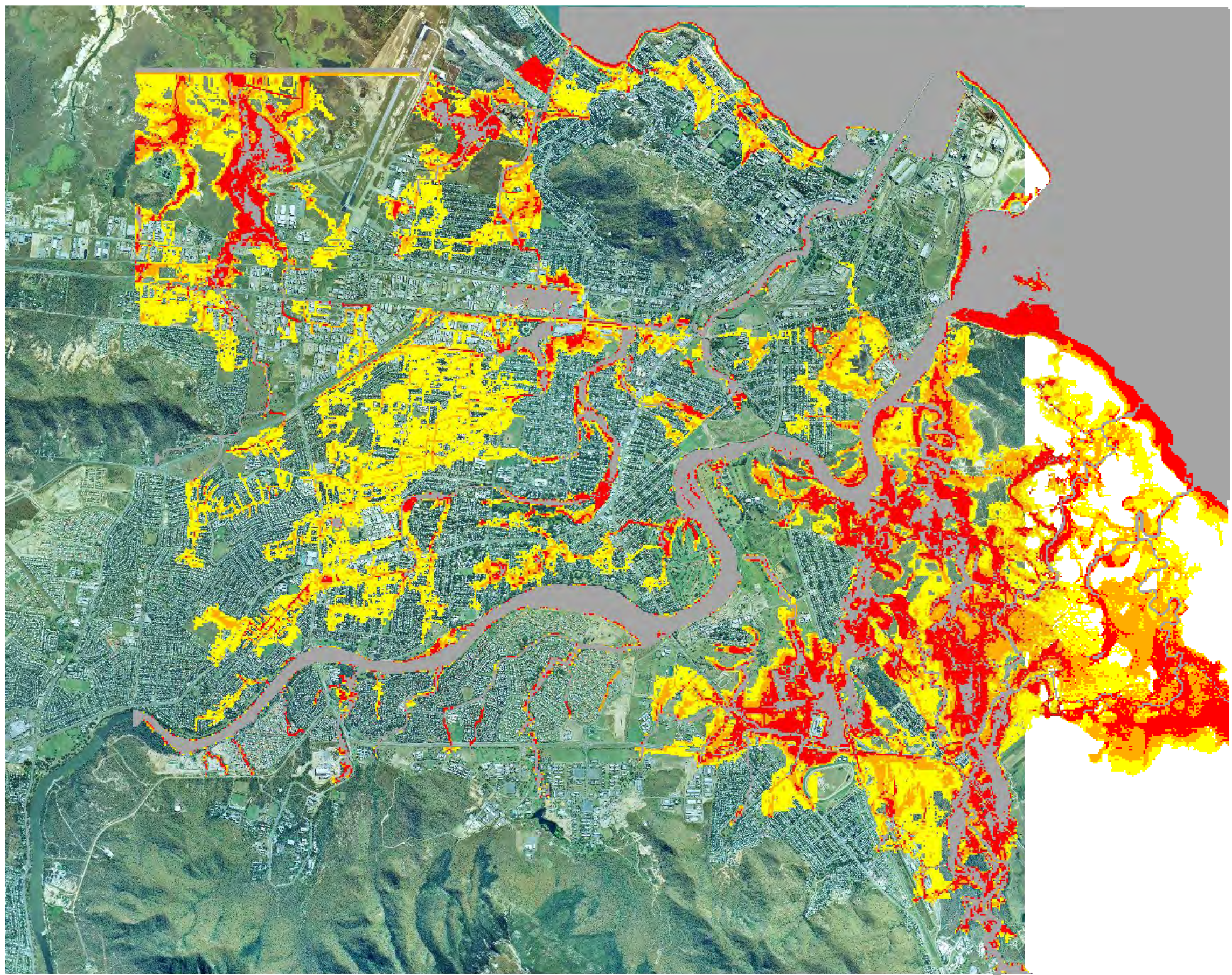
LEGEND
FLOOD HAZARD

- LOW
- MEDIUM
- HIGH
- EXTREME

NOT TO SCALE



TOWNSVILLE CITY COUNCIL

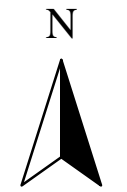


TOWNSVILLE
FLOOD HAZARD
100 YEAR ARI EVENT
(MIKE21)

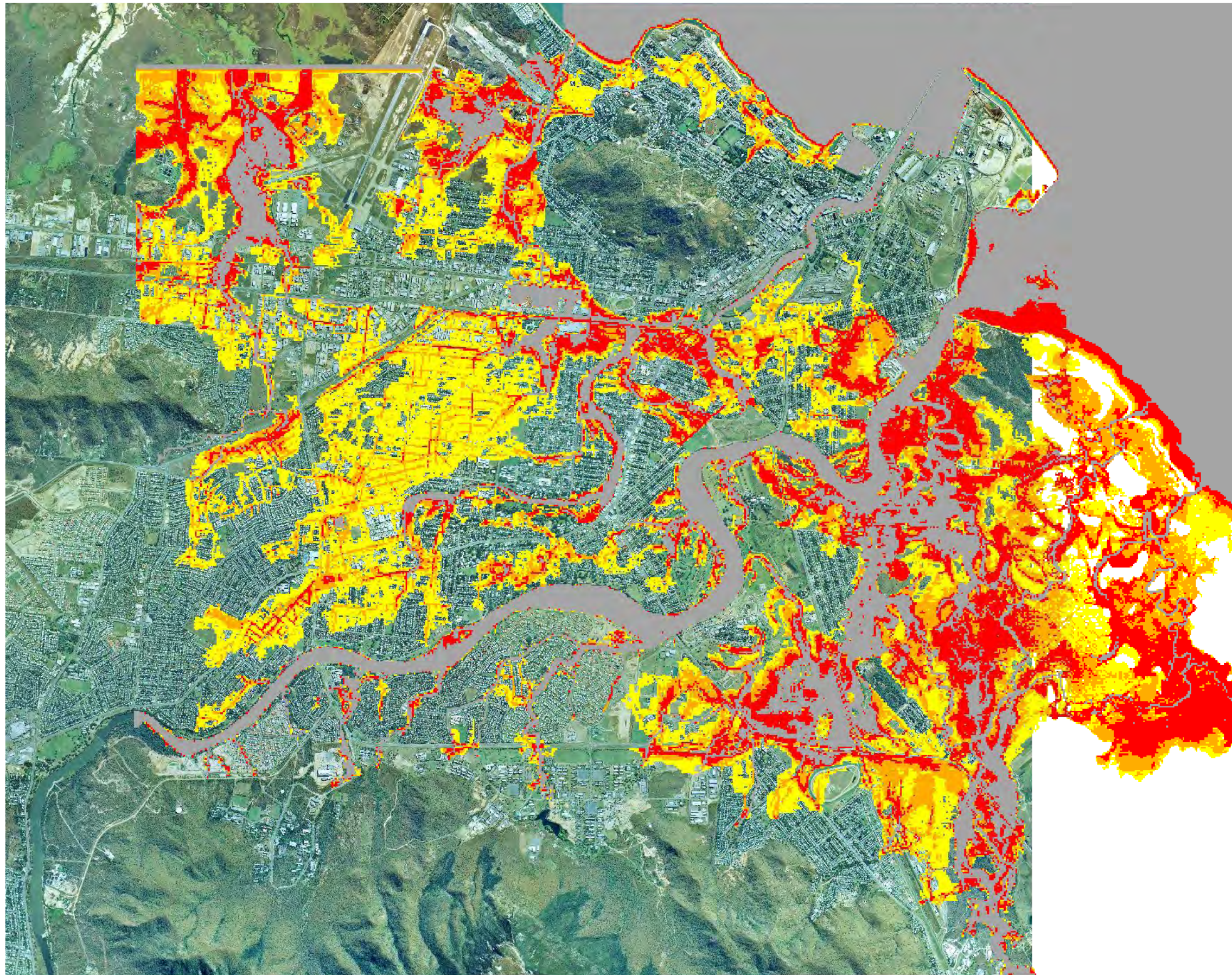
LEGEND
FLOOD HAZARD

- LOW
- MEDIUM
- HIGH
- EXTREME

NOT TO SCALE



TOWNSVILLE CITY COUNCIL



TOWNSVILLE FLOOD HAZARD 1998 FLOOD EVENT (MIKE21)

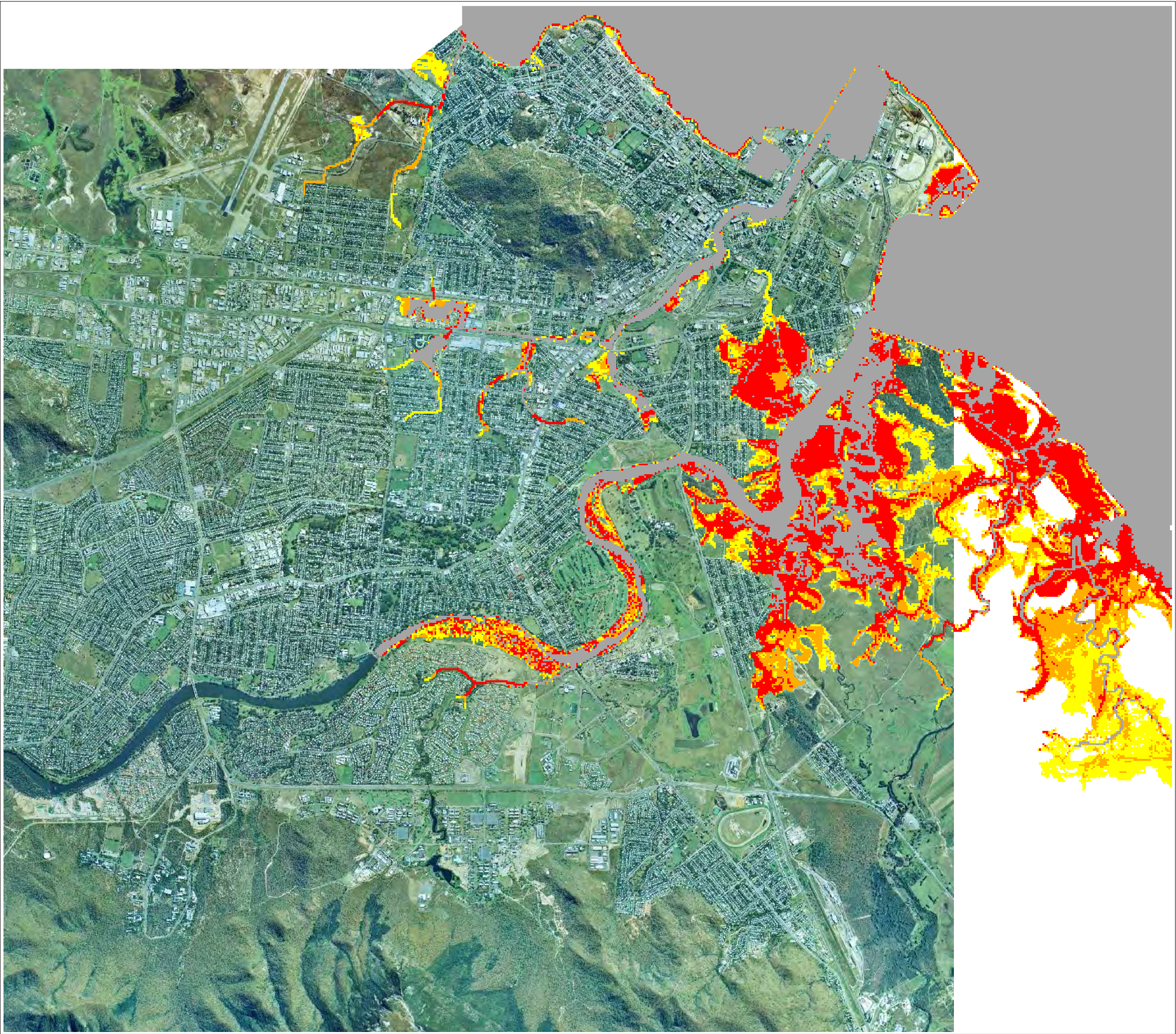
LEGEND FLOOD HAZARD



NOT TO SCALE



TOWNSVILLE CITY COUNCIL



TOWNSVILLE
STORM SURGE HAZARD
CYCLONE ALTHEA
DECEMBER 1971
(MIKE 21)

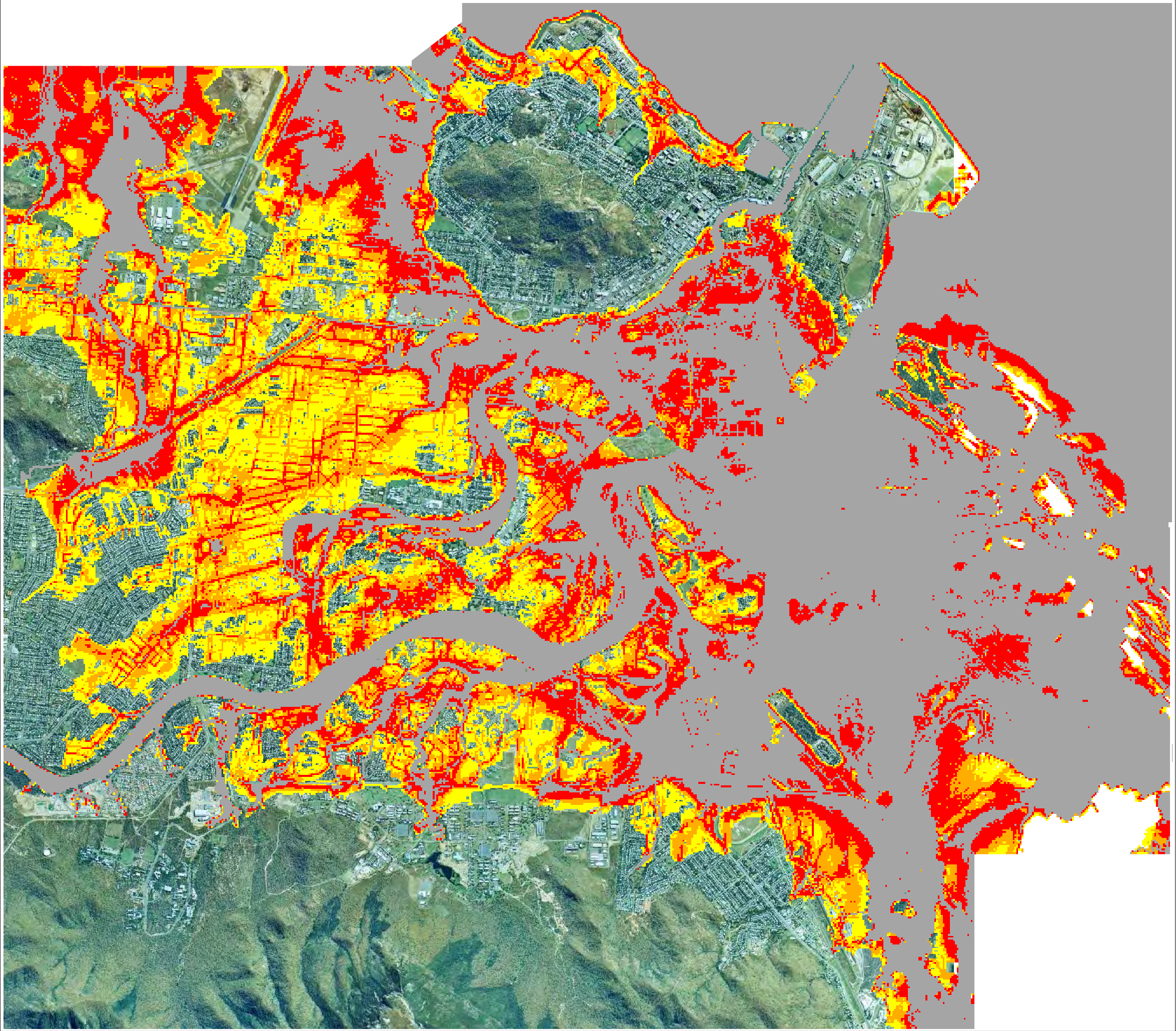
LEGEND
FLOOD HAZARD

- LOW
- MEDIUM
- HIGH
- EXTREME

NOT TO SCALE



TOWNSVILLE CITY COUNCIL



TOWNSVILLE
FLOOD HAZARD
PMF EVENT
(MIKE 21)

LEGEND
FLOOD HAZARD

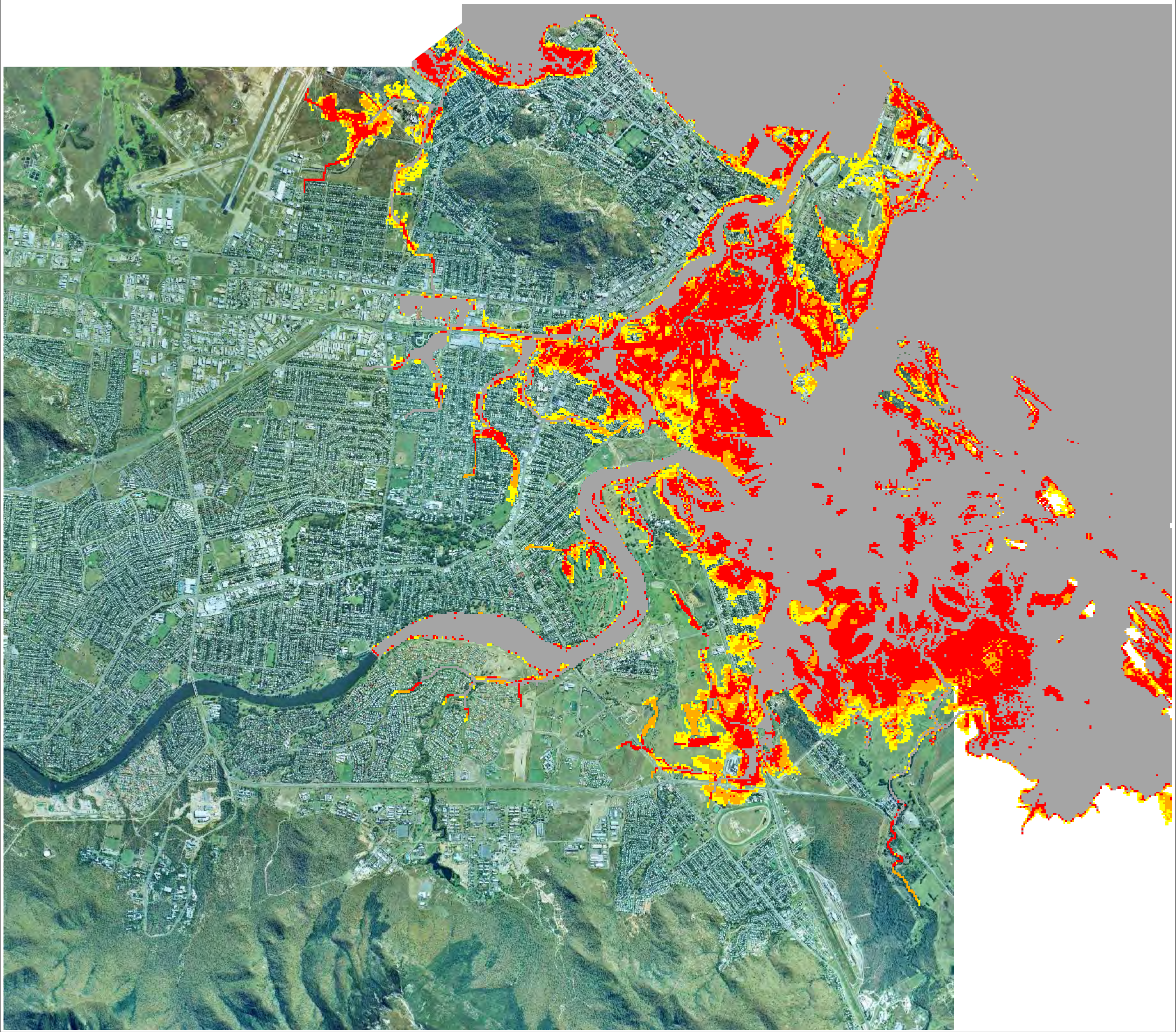
- LOW
- MEDIUM
- HIGH
- EXTREME

NOT TO SCALE

N



TOWNSVILLE CITY COUNCIL



TOWNSVILLE
STORM SURGE HAZARD
CYCLONE ALTHEA 1971-
PEAK COINCIDENT WITH
HIGH TIDE (MIKE 21)

LEGEND
FLOOD HAZARD

- LOW
- MEDIUM
- HIGH
- EXTREME

NOT TO SCALE



TOWNSVILLE CITY COUNCIL

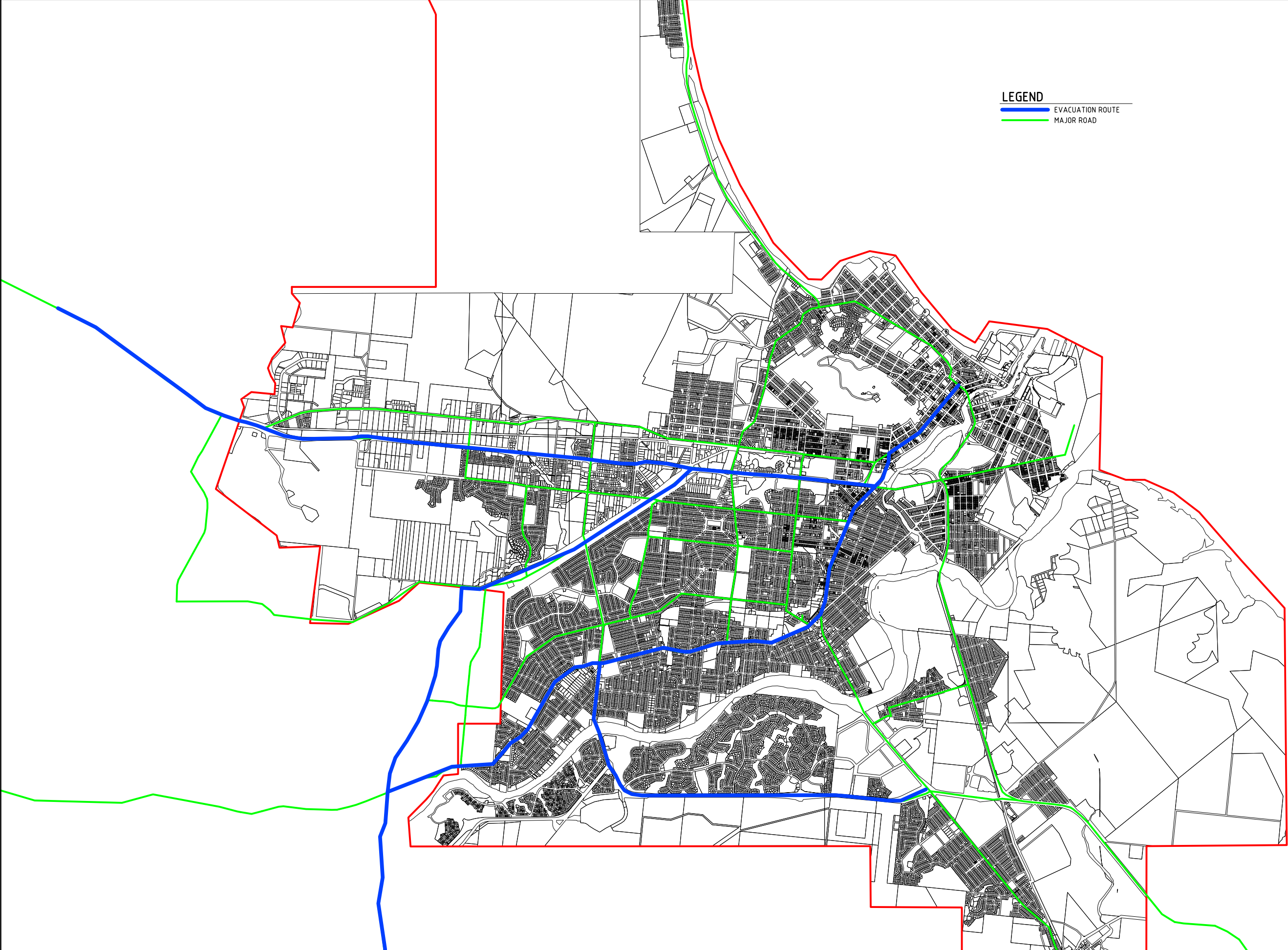
Appendix C Community Vulnerability Mapping

NOT TO BE USED
FOR CONSTRUCTION

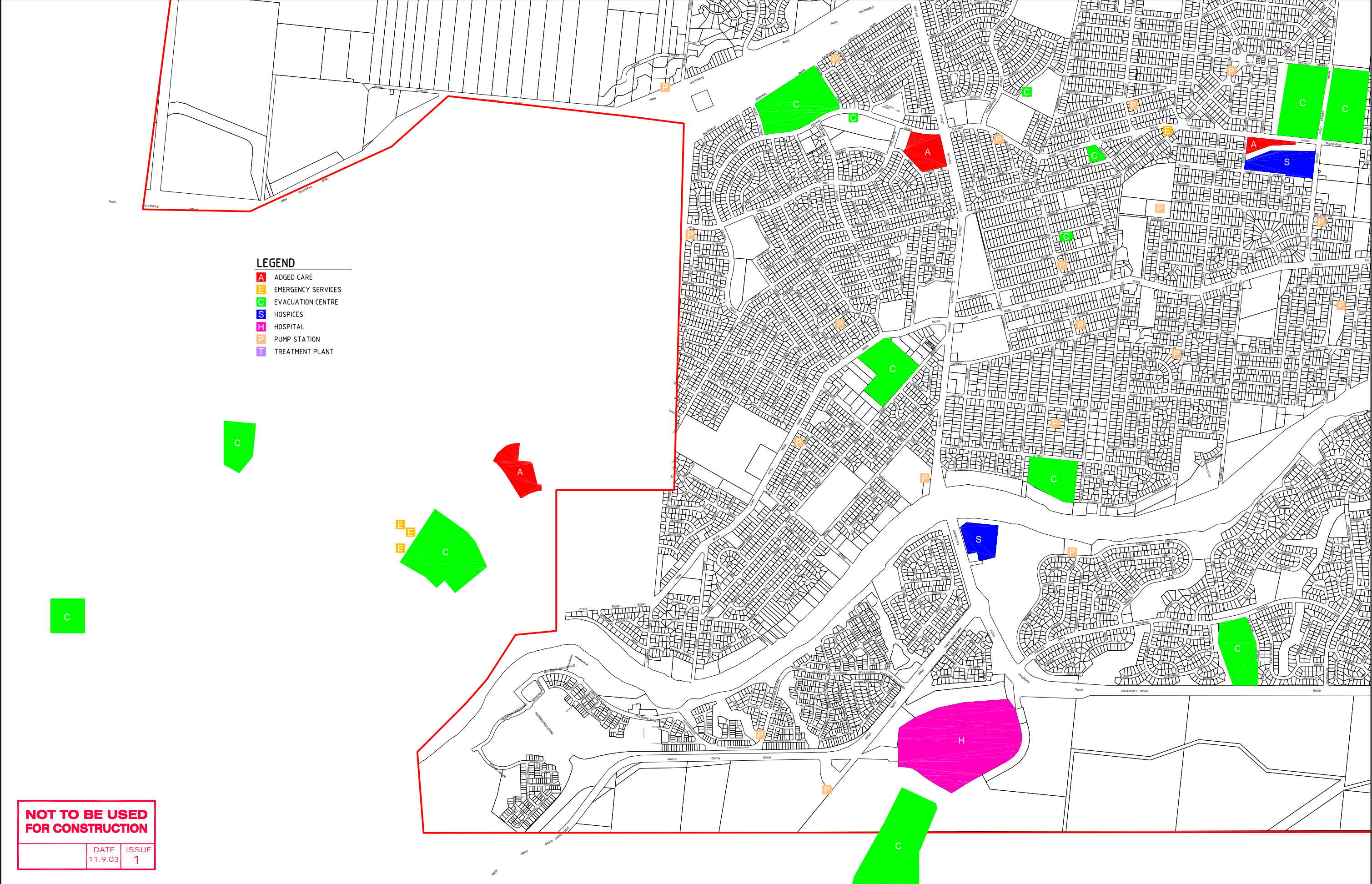
DATE	ISSUE
14.9.04	1

LEGEND

EVACUATION ROUTE
MAJOR ROAD



REVISIONS						Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services. Figured dimensions take preference over scaled. If in doubt, ask.		<p>SCALES</p> <p>0 300 1200m 1:30,000 (A1)</p> <p>Original Size A1</p>	<p>© COPYRIGHT</p> <p>This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company.</p> <p>THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001:1994</p>				<p>Maunsell</p> <p>Maunsell Australia Pty Ltd</p> <p>ABN 20 093 846 925</p> <p>Consulting Engineers, Planners, Environmental Scientists & Project Managers</p>	TOWNSVILLE CITY COUNCIL		
	TOWNSVILLE FLOOD STUDY								TOWNSVILLE FLOODPLAIN							
	EVACUATION ROUTES & MAJOR ROADS								CAD Ref: 80301202_02-CS01A.dwg							
	Date: 14 Sep 04 - 15:42								80301202/CS1 A							
No.	BY	DATE	DESCRIPTION			APPD			DESIGN	PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY: Brian Wright			
									DRAFTING	PSA	MFB	DATE	11.9.2003			



- LEGEND**
- A ADGED CARE
 - E EMERGENCY SERVICES
 - C EVACUATION CENTRE
 - S HOSPICES
 - H HOSPITAL
 - P PUMP STATION
 - T TREATMENT PLANT

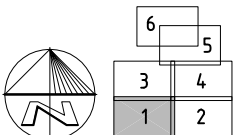
**NOT TO BE USED
FOR CONSTRUCTION**

DATE	ISSUE
11.9.03	1

No.	BY	DATE	DESCRIPTION	APPD

Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services.

Figured dimensions take preference over scaled. If in doubt, ask.



SCALES

0 100 400m 1:10,000 (A1)

Original Size A1

© COPYRIGHT

This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company.

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001:1994

DESIGN	PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY: Brian Wright
DRAFTING	PSA	MFB	DATE	11.9.2003

Maunsell

Maunsell Australia Pty Ltd

ABN 20 093 846 925

Consulting Engineers, Planners,
Environmental Scientists & Project Managers

TOWNSVILLE CITY COUNCIL

TOWNSVILLE FLOOD STUDY

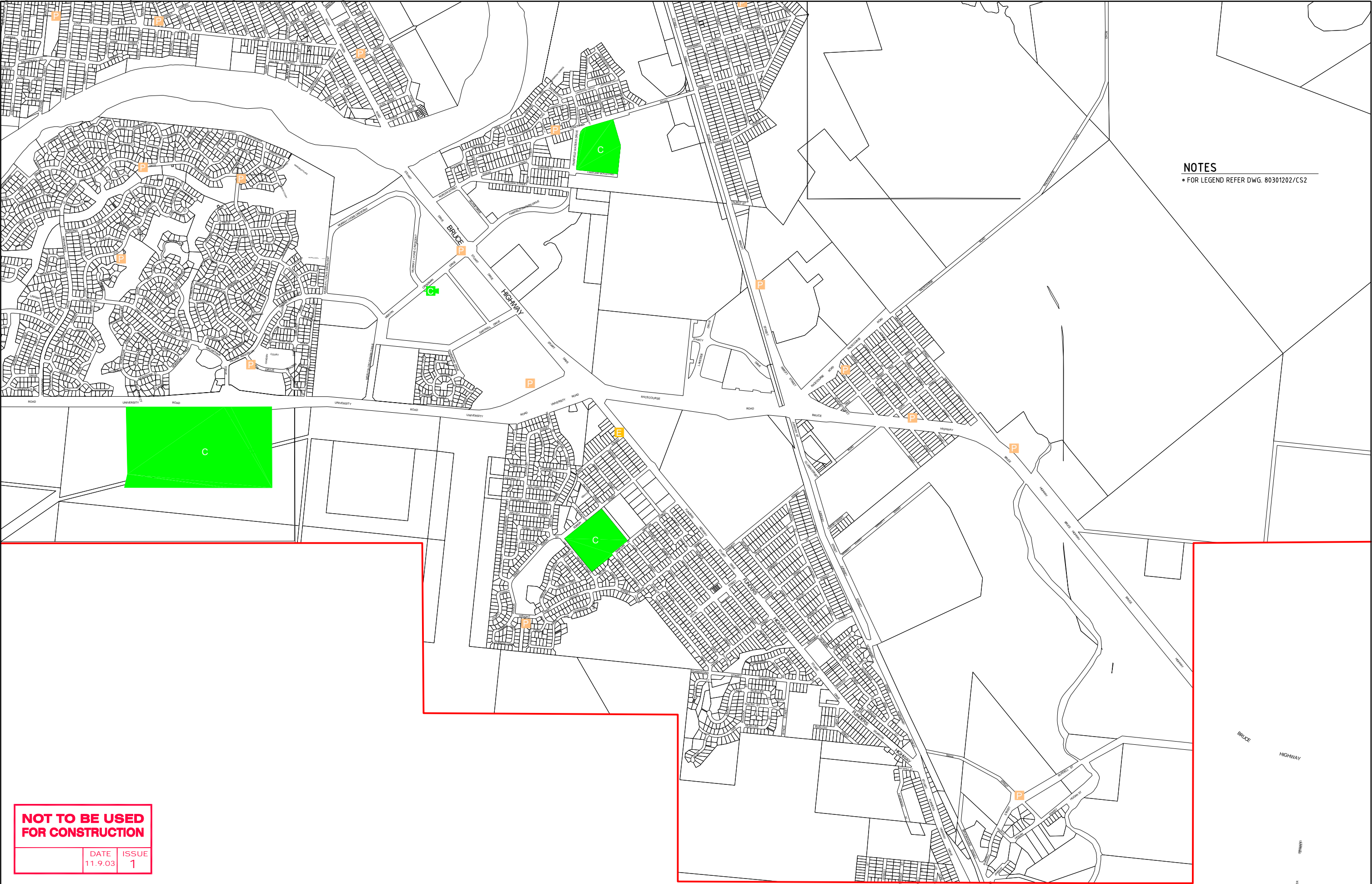
TOWNSVILLE FLOODPLAIN

COMMUNITY SERVICES

SHEET 1 OF 6

CAD Ref: 80301202_02-CS02.dwg Status: 11 Sep 03 - 11:18

80301202/CS2



NOTES
• FOR LEGEND REFER DWG. 80301202/CS2

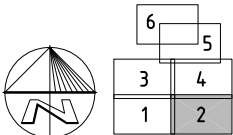
**NOT TO BE USED
FOR CONSTRUCTION**

DATE	ISSUE
11.9.03	1

REVISIONS	No.	BY	DATE	DESCRIPTION	APPD

Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services.

Figured dimensions take preference over scaled. If in doubt, ask.



SCALES

0 100 400m 1:10,000 (A1)

Original Size A1

© COPYRIGHT			
This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company.			
THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001:1994			
	PREPARED	CHECKED	PASSED
DESIGN			ORIGINAL DRAWING SIGNED BY : Brian Wright
DRAFTING	PSA	MFB	DATE 11.9.2003

Maunsell
Maunsell Australia Pty Ltd
ABN 20 093 846 925
Consulting Engineers, Planners,
Environmental Scientists & Project Managers

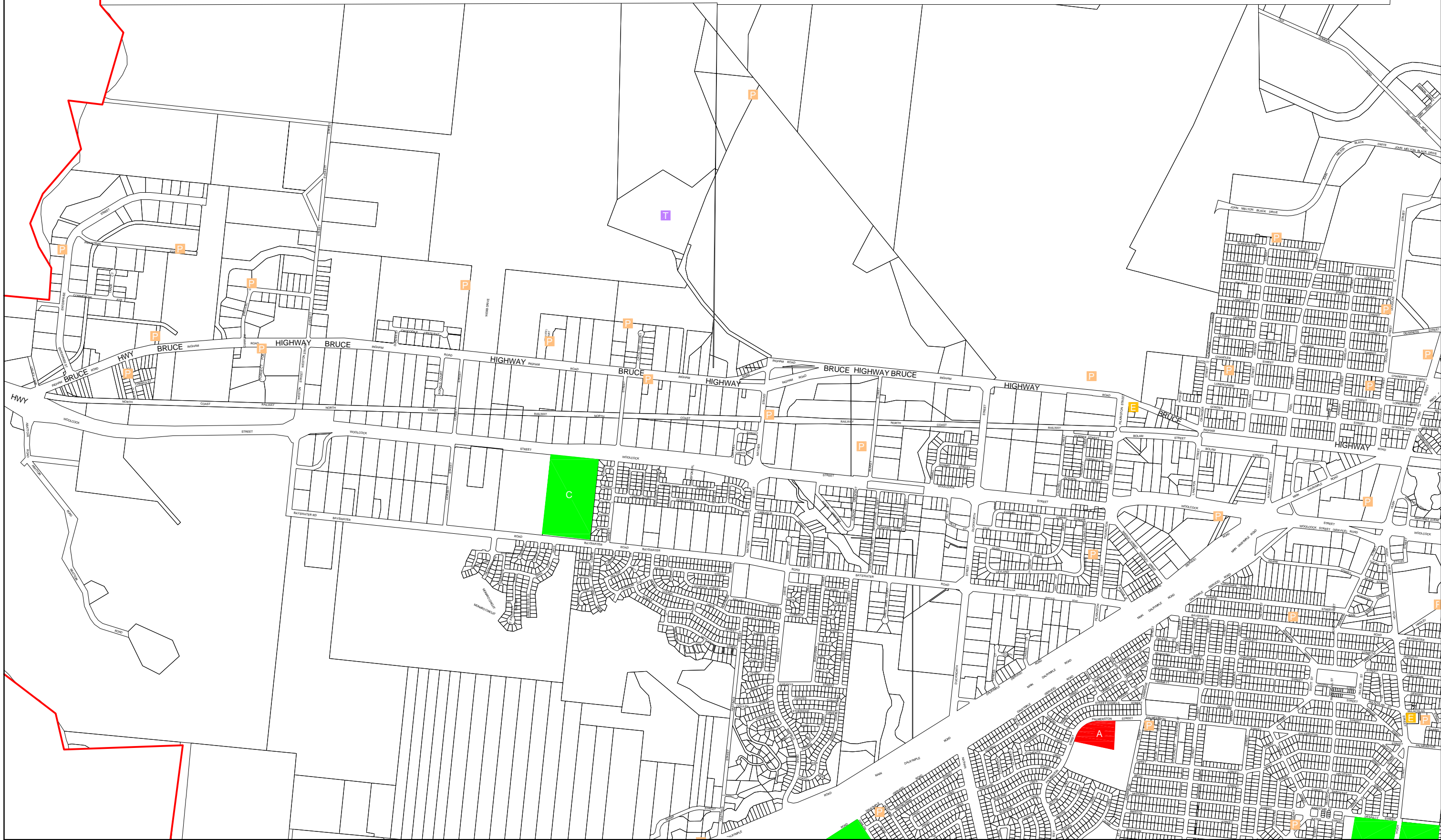
TOWNSVILLE CITY COUNCIL			
TOWNSVILLE FLOOD STUDY TOWNSVILLE FLOODPLAIN COMMUNITY SERVICES			
SHEET 2 OF 6			
CAD Ref: 80301202_02-CS03.dwg		Status:	
Date: 11 Sep 03 - 11:19		80301202/CS3	


NOT TO BE USED
FOR CONSTRUCTION

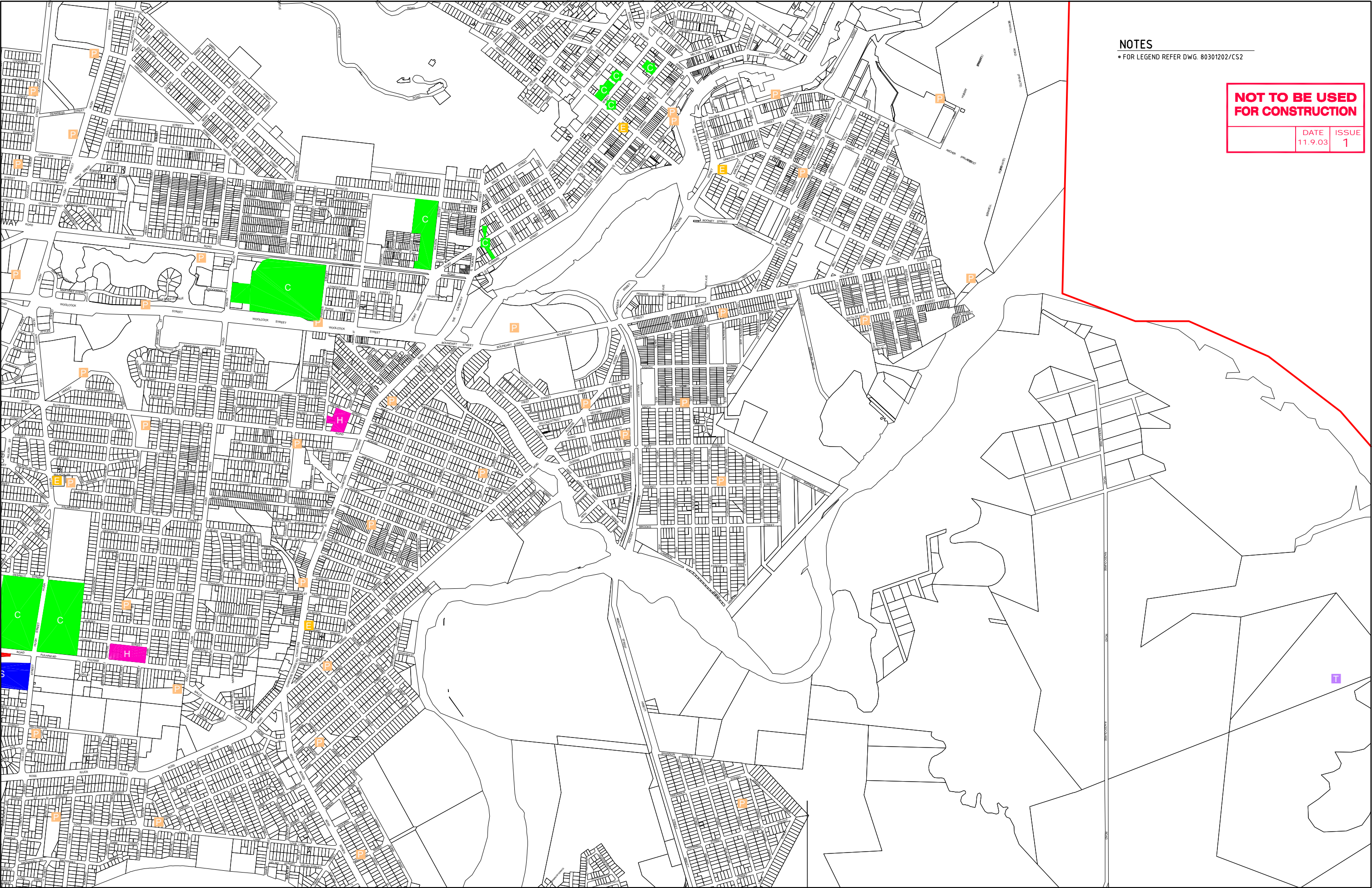
DATE	ISSUE
14.9.04	1

NOTES

• FOR LEGEND REFER DWG. 80301202/CS2



REVISIONS						Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services. Figured dimensions take preference over scaled. If in doubt, ask.		<table><tr><td>6</td><td>5</td></tr><tr><td>3</td><td>4</td></tr><tr><td>1</td><td>2</td></tr></table>	6	5	3	4	1	2	<p>SCALES</p> <p>0 100 400m 1:10,000 (A1)</p> <p>Original Size A1</p>	<p>© COPYRIGHT</p> <p>This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company.</p> <p>THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001:1994</p> <table><tr><td></td><td>PREPARED</td><td>CHECKED</td><td>PASSED</td><td>ORIGINAL DRAWING SIGNED BY : Brian Wright</td></tr><tr><td>DESIGN</td><td></td><td></td><td></td><td></td></tr><tr><td>DRAFTING</td><td>PSA</td><td>MFB</td><td>DATE</td><td>11.9.2003</td></tr></table>				PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY : Brian Wright	DESIGN					DRAFTING	PSA	MFB	DATE	11.9.2003	<p>Maunsell</p> <p>Maunsell Australia Pty Ltd</p> <p>ABN 20 093 846 925</p> <p>Consulting Engineers, Planners, Environmental Scientists & Project Managers</p>	<p>TOWNSVILLE CITY COUNCIL</p> <p>TOWNSVILLE FLOOD STUDY</p> <p>TOWNSVILLE FLOODPLAIN</p> <p>COMMUNITY SERVICES</p> <p>SHEET 3 OF 6</p> <p>CAD Ref: 80301202_02-CS04A.dwg Date: 14 Sep 04 - 15:44</p> <p>80301202/CS4</p> <p>A</p>		
	6	5																																			
	3	4																																			
	1	2																																			
	PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY : Brian Wright																																	
DESIGN																																					
DRAFTING	PSA	MFB	DATE	11.9.2003																																	
A	PSA	14.9.04	STUDY AREA BOUNDARY AMENDED	BPW																																	
No.	BY	DATE	DESCRIPTION	APPD																																	



NOTES
• FOR LEGEND REFER DWG. 80301202/CS2

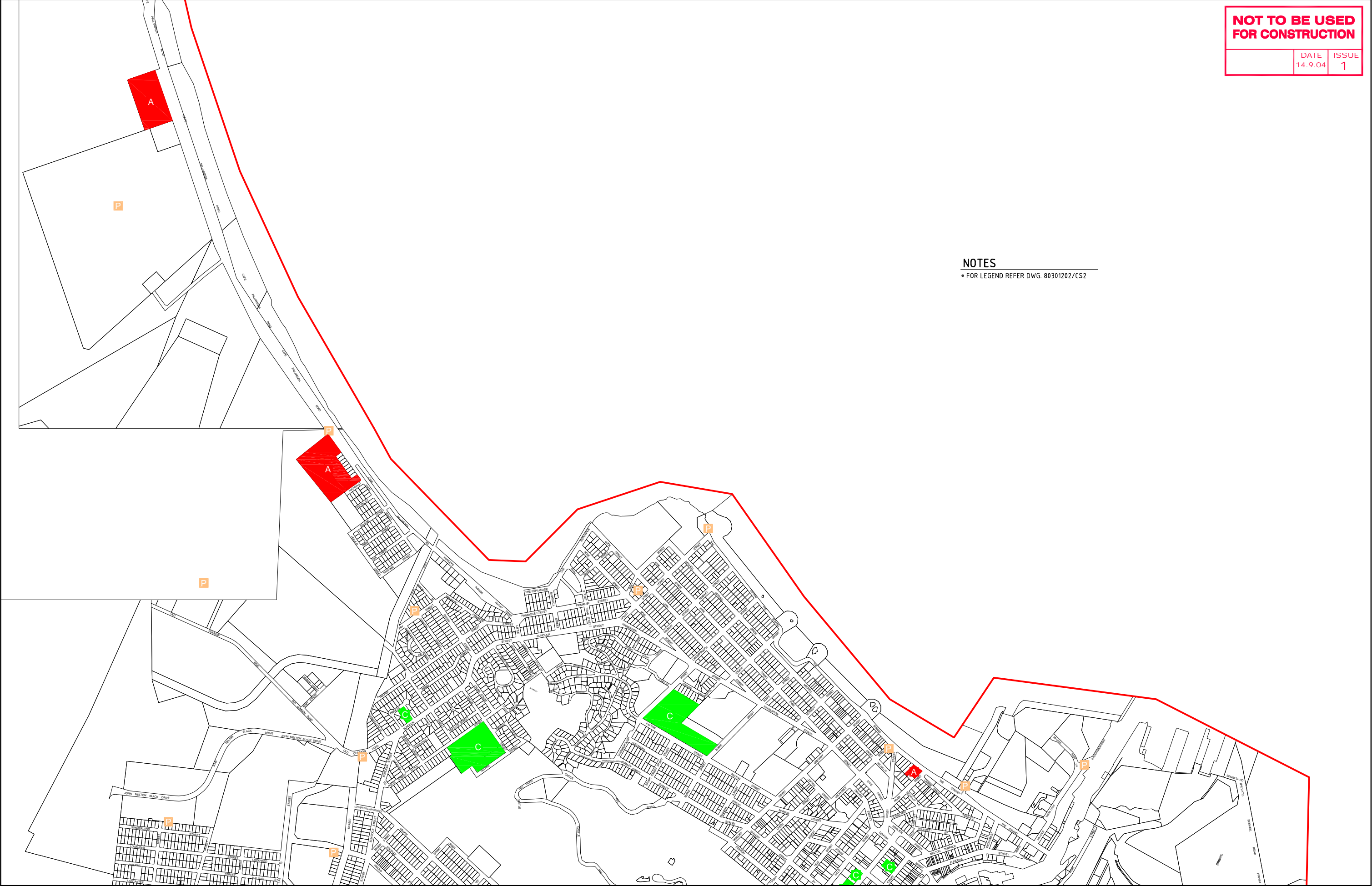
NOT TO BE USED
FOR CONSTRUCTION

DATE	ISSUE
11.9.03	1

REVISIONS					Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services. Figured dimensions take preference over scaled. If in doubt, ask.		<table><tr><td>6</td><td>5</td></tr><tr><td>3</td><td>4</td></tr><tr><td>1</td><td>2</td></tr></table>	6	5	3	4	1	2	SCALES 0 100 400m 1:10,000 (A1) Original Size A1	© COPYRIGHT This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company.			 Maunsell Australia Pty Ltd ABN 20 093 846 925 Consulting Engineers, Planners, Environmental Scientists & Project Managers	TOWNSVILLE CITY COUNCIL TOWNSVILLE FLOOD STUDY TOWNSVILLE FLOODPLAIN COMMUNITY SERVICES			SHEET 4 OF 6
	6	5																				
	3	4																				
	1	2																				
No.	BY	DATE	DESCRIPTION			APPD			DESIGN	PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY : Brian Wright	DATE	11.9.2003	CAD Ref: 80301202_02-CS05.dwg	Status:	80301202/CS5				
									DRAFTING	PSA	MFB					Date: 11 Sep 03 - 11:20						

NOTES

• FOR LEGEND REFER DWG. 80301202/CS2



REVISIONS

No.	BY	DATE	DESCRIPTION	APPD
A	PSA	14.9.04	STUDY AREA BOUNDARY AMENDED	BPW

Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services.

Figured dimensions take preference over scaled. If in doubt, ask.

0 100 400m 1:10,000 (A1)

Original Size A1

© COPYRIGHT

This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company.

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001-1994

	PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY:
DESIGN				Brian Wright
DRAFTING	PSA	MFB	DATE	11.9.2003

Maunsell

Maunsell Australia Pty Ltd

ABN 20 093 846 925

Consulting Engineers, Planners,
Environmental Scientists & Project Managers

TOWNSVILLE CITY COUNCIL

TOWNSVILLE FLOOD STUDY

TOWNSVILLE FLOODPLAIN

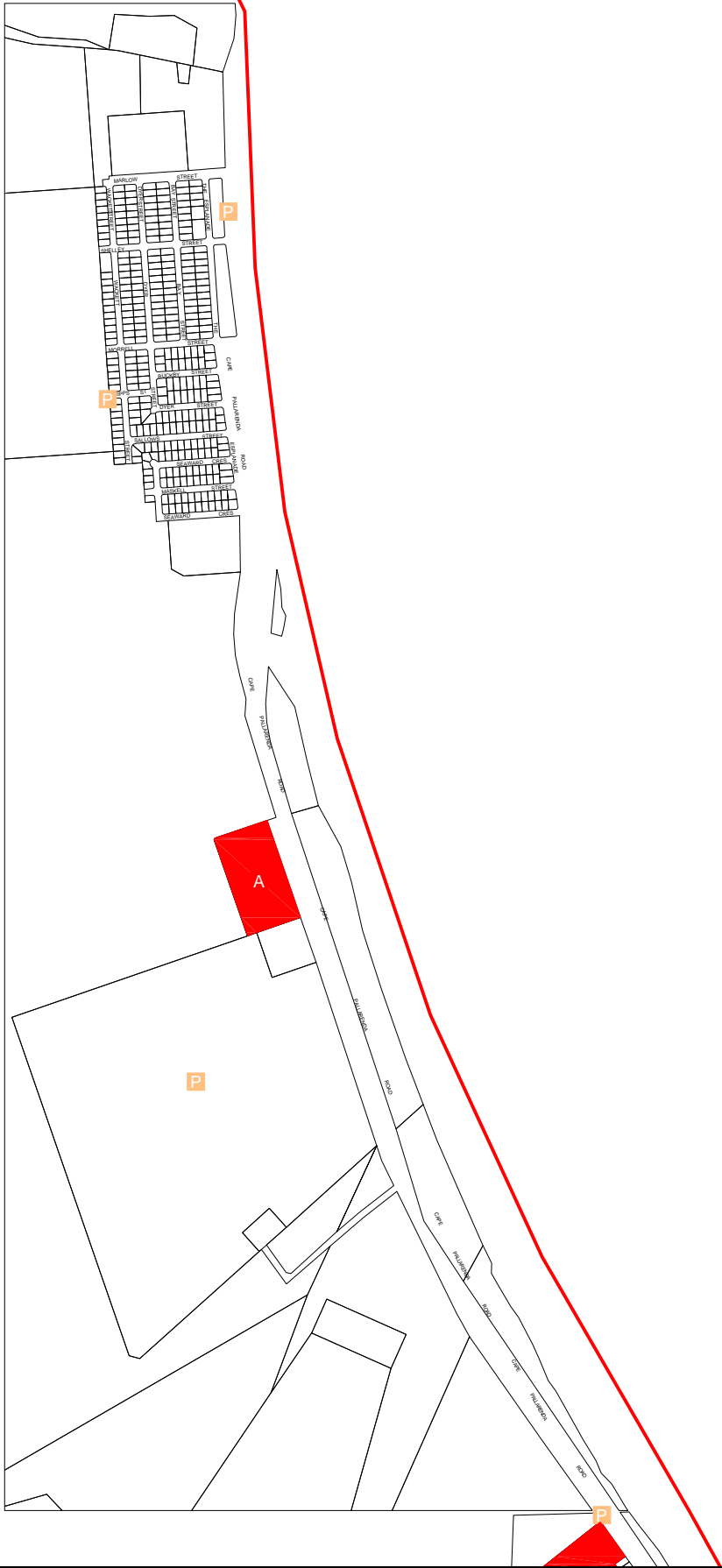
COMMUNITY SERVICES

SHEET 5 OF 6

CAD Ref: 80301202_02-CS06A.dwg
Date: 14 Sep 04 - 15:46
Status:

80301202/CS6

A



NOTES

• FOR LEGEND REFER DWG. 80301202/CS2



REVISIONS	No.	BY	DATE	DESCRIPTION	APPD

Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services.

Figured dimensions take preference over scaled. If in doubt, ask.



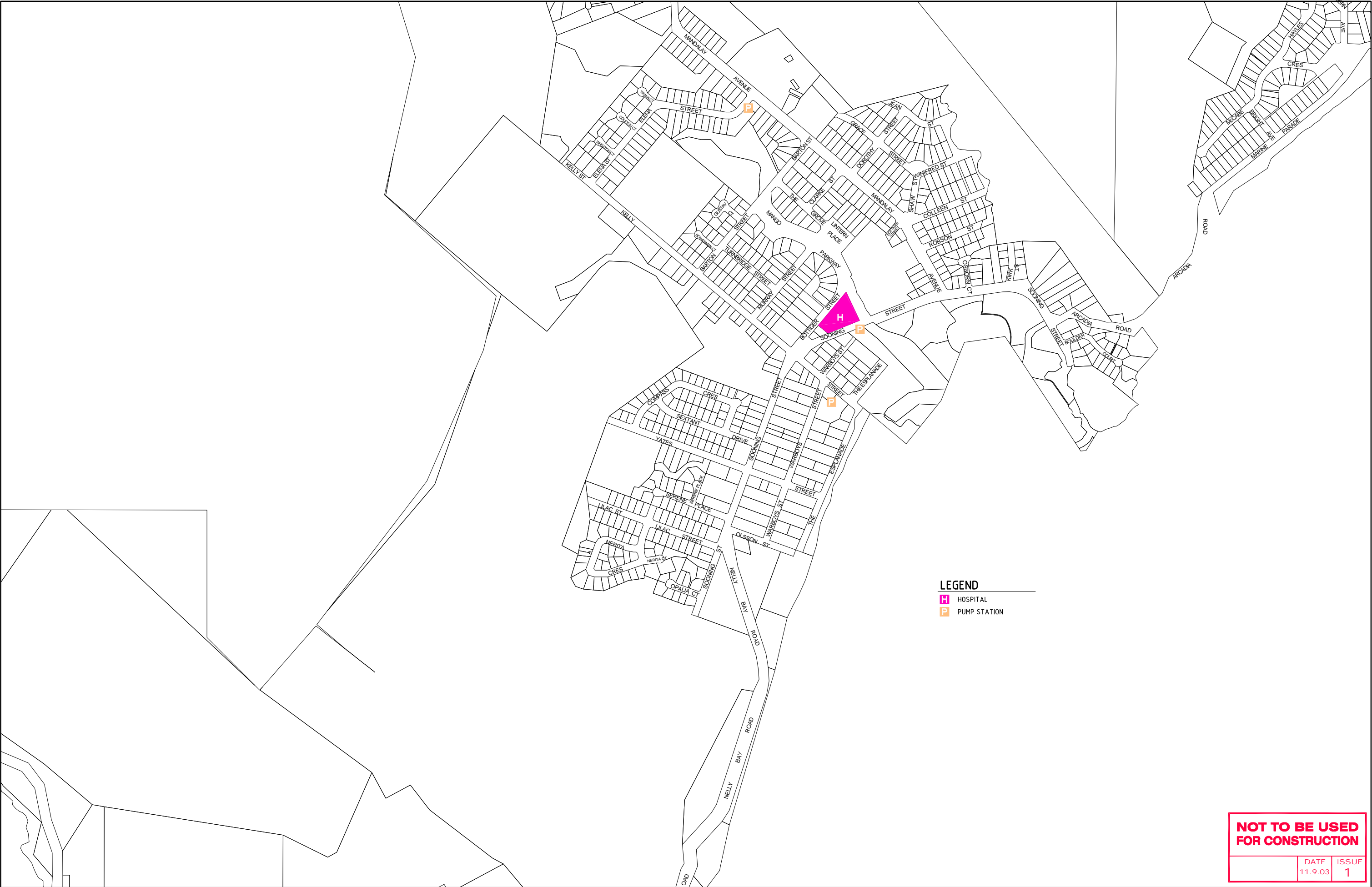
© COPYRIGHT				
This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company				
THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001:1994				
DESIGN	PREPARED	CHECKED	ORIGINAL DRAWING SIGNED BY : Brian Wright	
DRAFTING	PSA	MFB	DATE	11.9.2003



Maunsell Australia Pty Ltd
ABN 20 093 846 925

Consulting Engineers, Planners,
Environmental Scientists & Project Managers

TOWNSVILLE CITY COUNCIL			
TOWNSVILLE FLOOD STUDY MAGNETIC ISLAND COMMUNITY SERVICES - PICNIC BAY			
CAD Ref: 80301202_03-CS08.dwg		Status:	
Date: 11 Sep 03 - 11:34		80301202/CS8	



LEGEND

H HOSPITAL

P PUMP STATION

NOT TO BE USED
FOR CONSTRUCTION

DATE
11.9.03

ISSUE
1

REVISIONS

No.	BY	DATE	DESCRIPTION	APPD

Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services.

Figured dimensions take preference over scaled. If in doubt, ask.

SCALES

0 50 200m 15,000 (A1)

Original Size A1

© COPYRIGHT

This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company.

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001:1994

DESIGN	PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY :
				Brian Wright
DRAFTING	PSA	MFB	DATE	11.9.2003

Maunsell

Maunsell Australia Pty Ltd

ABN 20 093 846 925

Consulting Engineers, Planners,
Environmental Scientists & Project Managers

TOWNSVILLE CITY COUNCIL

TOWNSVILLE FLOOD STUDY

MAGNETIC ISLAND

COMMUNITY SERVICES - NELLY BAY

CAD Ref: 80301202_03-CS09.dwg
Date: 11 Sep 03 - 11:35

Status:

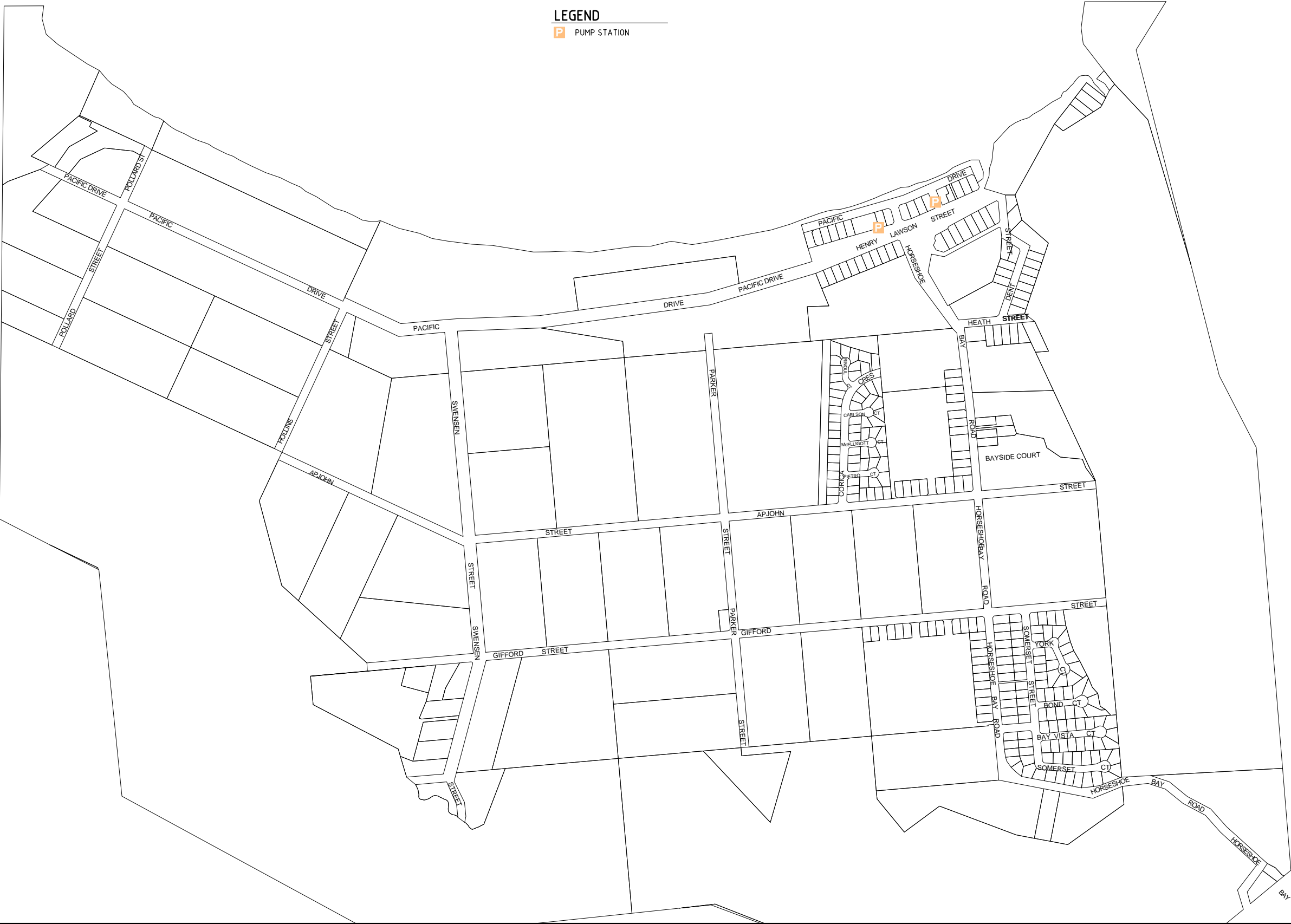
80301202/CS9

NOT TO BE USED
FOR CONSTRUCTION

DATE	ISSUE
11.9.03	1

LEGEND

 PUMP STATION



REVISIONS

No.	BY	DATE	DESCRIPTION	APPD

Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services.

Figured dimensions take preference over scaled. If in doubt, ask.



SCALES



Original Size A1

© COPYRIGHT

This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001:1994

DESIGN	PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY : Brian Wright
DRAFTING	PSA	MFB	DATE	11.9.2003

Maunsell
Maunsell Australia Pty Ltd
ABN 20 093 846 925

Consulting Engineers, Planners,
Environmental Scientists & Project Managers

TOWNSVILLE CITY COUNCIL

**TOWNSVILLE FLOOD STUDY
MAGNETIC ISLAND
COMMUNITY SERVICES - HORSESHOE BAY**

CAD Ref: 80301202_03-CS10.dwg
Date: 11 Sep 03 - 11:37

Status:

80301202/CS10

Appendix D Citiworks List of Preliminary Mitigation Areas



TOWNSVILLE FLOOD MITIGATION STUDY PRELIMINARY LIST OF MITIGATION WORK

PRIORITY 1

- Gordon Creek - Fairfield - Wulguru
 - Murray Sports Complex
 - Racecourse
- Ross Creek - Woolcock Street - Mindham Park - Killara Street
 - Lakes - Brampton Avenue
 - Including North and South rail yards
- Louisa Creek - Hammett Street
 - Eckhoff Street
 - Brampton Avenue
 - Buchanan Street, Davis Street
- Barryman Street Pumps + Other 2
- Clayton Street, Campbell Street Pump

PRIORITY 2

- Primrose Street, Marshall Street - North Ward – 'Seagulls'
- Margaret Street, Garrick Street (detention in Quarry)
- Mitchell Street behind Aquarius (Kennedy Street)
- Melrose Park, Douglas Street - Garbutt
- Lara Street, Isabella Court – Cranbrook
- Hugh Street adjacent to Gill Park – Hopkins Street Lakes 1

PRIORITY 3

- Boundary Street, Railway Estate - South Townsville
- Little Street, Heatley Parade, Bundock Street
- Chubb Street, Evans Street - Belgian Gardens
- Stagpole Street, William Street, Harold Street - West End
- Lyndhurst Street

PRIORITY 4

- Stuart Street, Stanley Street, Paxton Street
- Meenan Street, Garbutt
- Stuart Creek, Normandy Street
- Holroyd Street, Wulguru
- Howitt Street

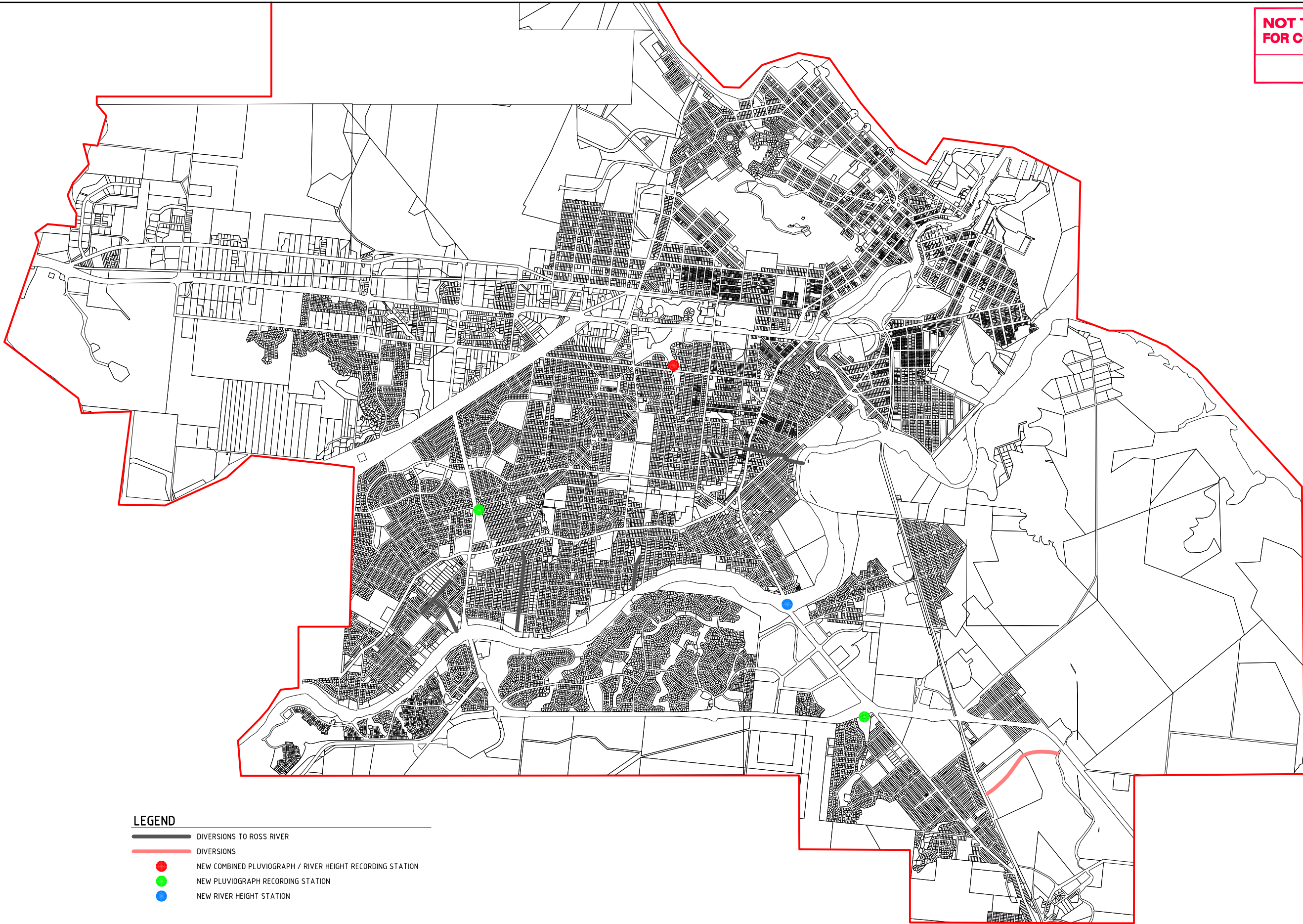
PRIORITY 5

- Stuart Drive
- Leichhardt Street, Eyre Street
- Brooks Street

Appendix E Mitigation / Treatment Option Mapping

NOT TO BE USED
FOR CONSTRUCTION

DATE	ISSUE
14.9.04	1



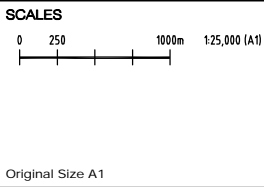
LEGEND

- DIVERSIONS TO ROSS RIVER
- DIVERSIONS
- NEW COMBINED PLUVIOGRAPH / RIVER HEIGHT RECORDING STATION
- NEW PLUVIOGRAPH RECORDING STATION
- NEW RIVER HEIGHT STATION

REVISIONS	No.	BY	DATE	DESCRIPTION	APPD
	B	PSA	14.9.04	STUDY AREA BOUNDARY AMENDED	BPW
	A	PSA	29.1.04	MINOR AMENDMENTS	BPW

Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services.

Figured dimensions take preference over scaled. If in doubt, ask.



© COPYRIGHT

This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company.

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001:1994

DESIGN	PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY: Brian Wright
DRAFTING	PSA	MFB	DATE	15.9.2003

Maunsell

Maunsell Australia Pty Ltd

ABN 20 093 846 925

Consulting Engineers, Planners,
Environmental Scientists & Project Managers

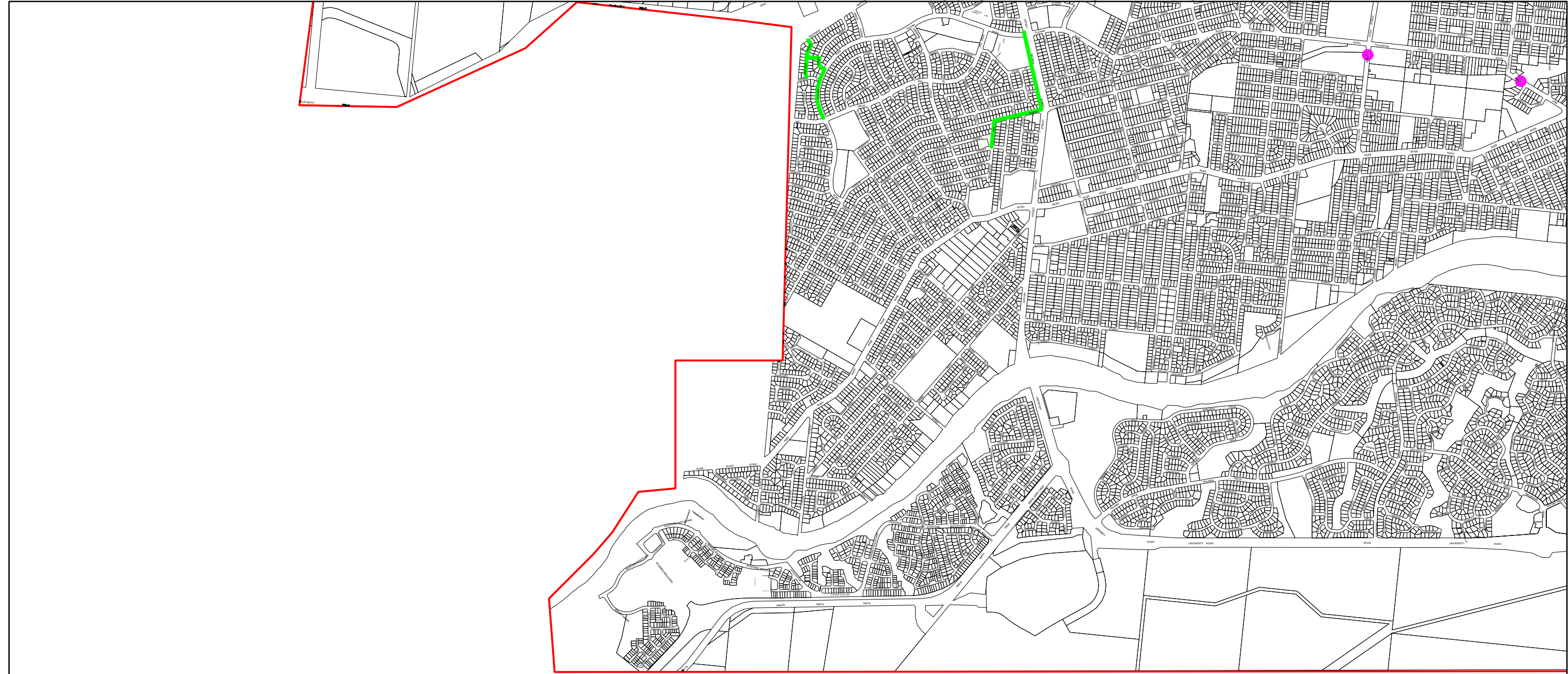
TOWNSVILLE CITY COUNCIL

TOWNSVILLE FLOOD STUDY

TOWNSVILLE FLOODPLAIN

FLOOD WARNING & DIVERSION OPTIONS

CAD Ref: 80301202_02-M001B.dwg	Status:	80301202/M01	B
Date: 14 Sep 04 - 15:49			



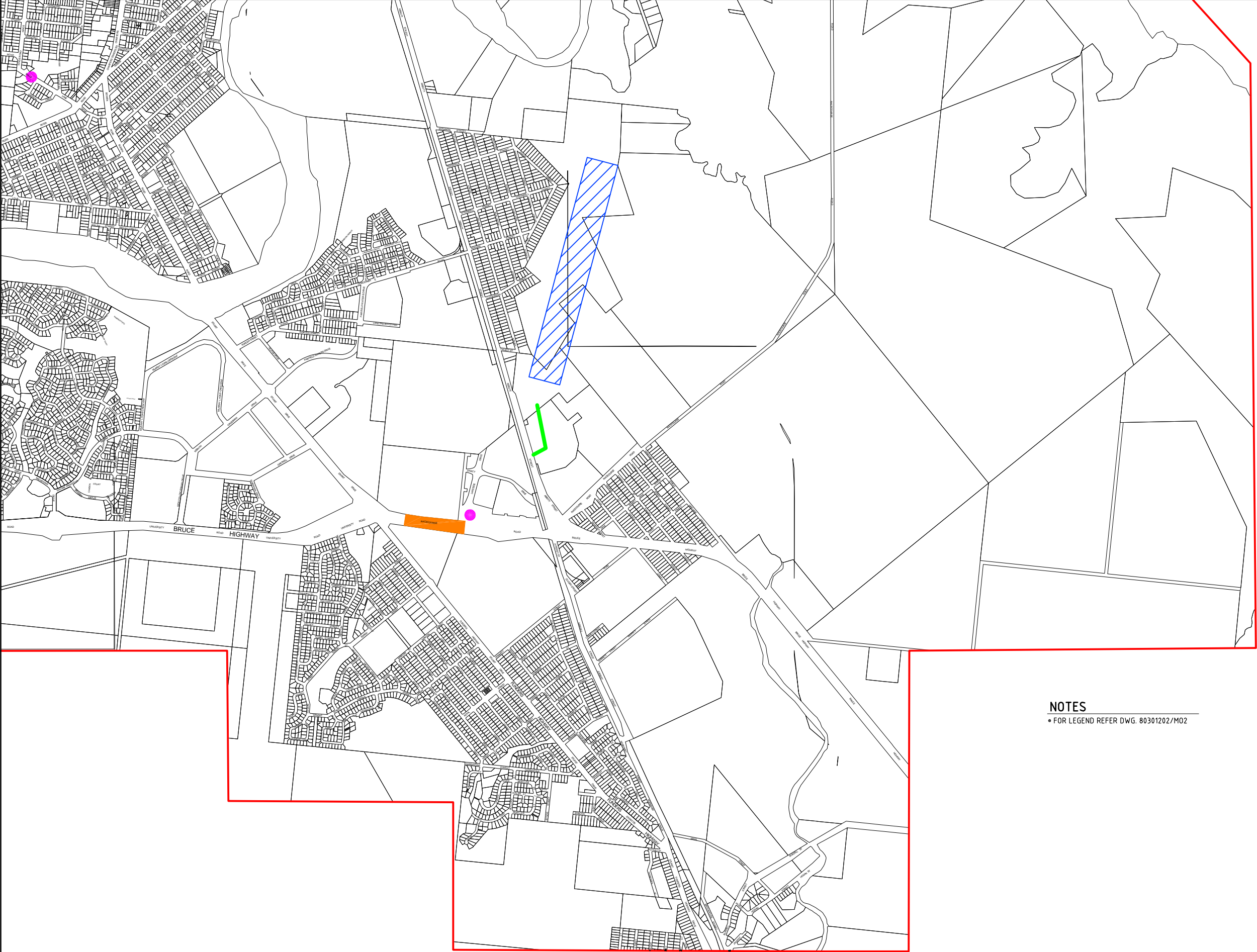
LEGEND

- UPGRADE DRAINAGE SYSTEM
- CHANNEL CLEARING / WIDENING
- ROAD RAISING
- UPGRADE CULVERT
- NEW CULVERT
- UPGRADE PUMP
- STORM SURGE SIREN

NOT TO BE USED
FOR CONSTRUCTION

DATE	ISSUE
15.9.03	1

REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
-----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--



NOTES
• FOR LEGEND REFER DWG. 80301202/M02

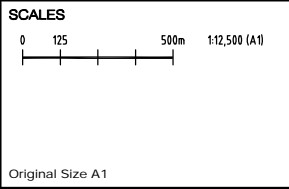
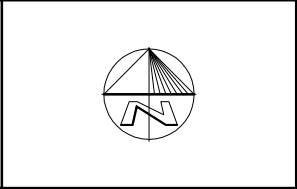
**NOT TO BE USED
FOR CONSTRUCTION**

DATE	ISSUE
05.1.04	2

REVISIONS					
No.	BY	DATE	DESCRIPTION	APPD	
A	PSA	29.1.04	MINOR AMENDMENTS	BPW	

Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services.

Figured dimensions take preference over scaled. If in doubt, ask.



© COPYRIGHT

This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company.

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001:1994

	PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY : Brian Wright
DESIGN			DATE	15.9.2003
DRAFTING	PSA	MFB		

Maunsell

Maunsell Australia Pty Ltd

ABN 20 093 846 925

Consulting Engineers, Planners,
Environmental Scientists & Project Managers

TOWNSVILLE CITY COUNCIL

TOWNSVILLE FLOOD STUDY

TOWNSVILLE FLOODPLAIN

DRAINAGE UPGRADES – SOUTH EAST SECTOR

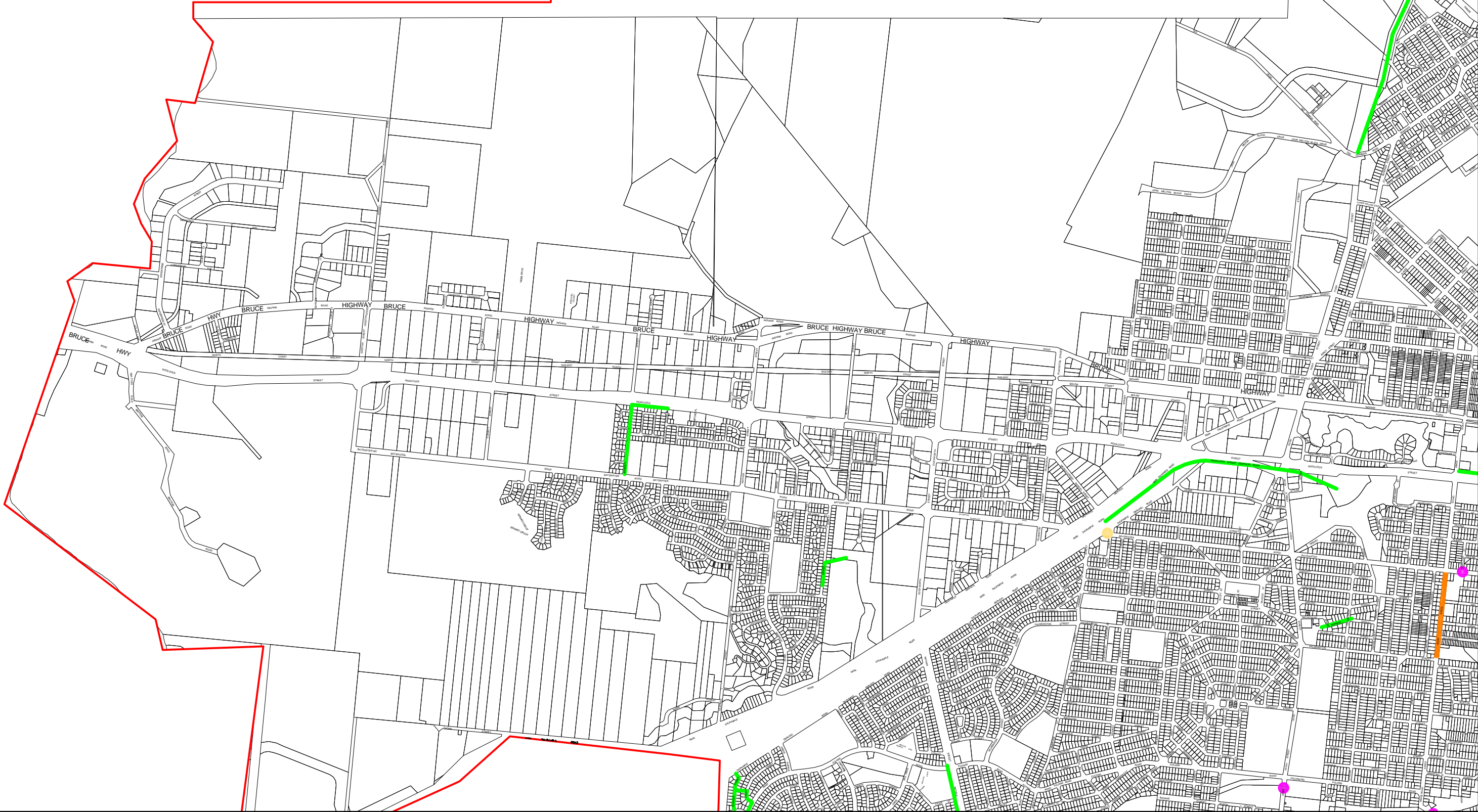
CAD Ref: 80301202_02-M003A.dwg	Status:	80301202/M03	A
Date: 29 Jan 04 - 12:52			

NOT TO BE USED
FOR CONSTRUCTION

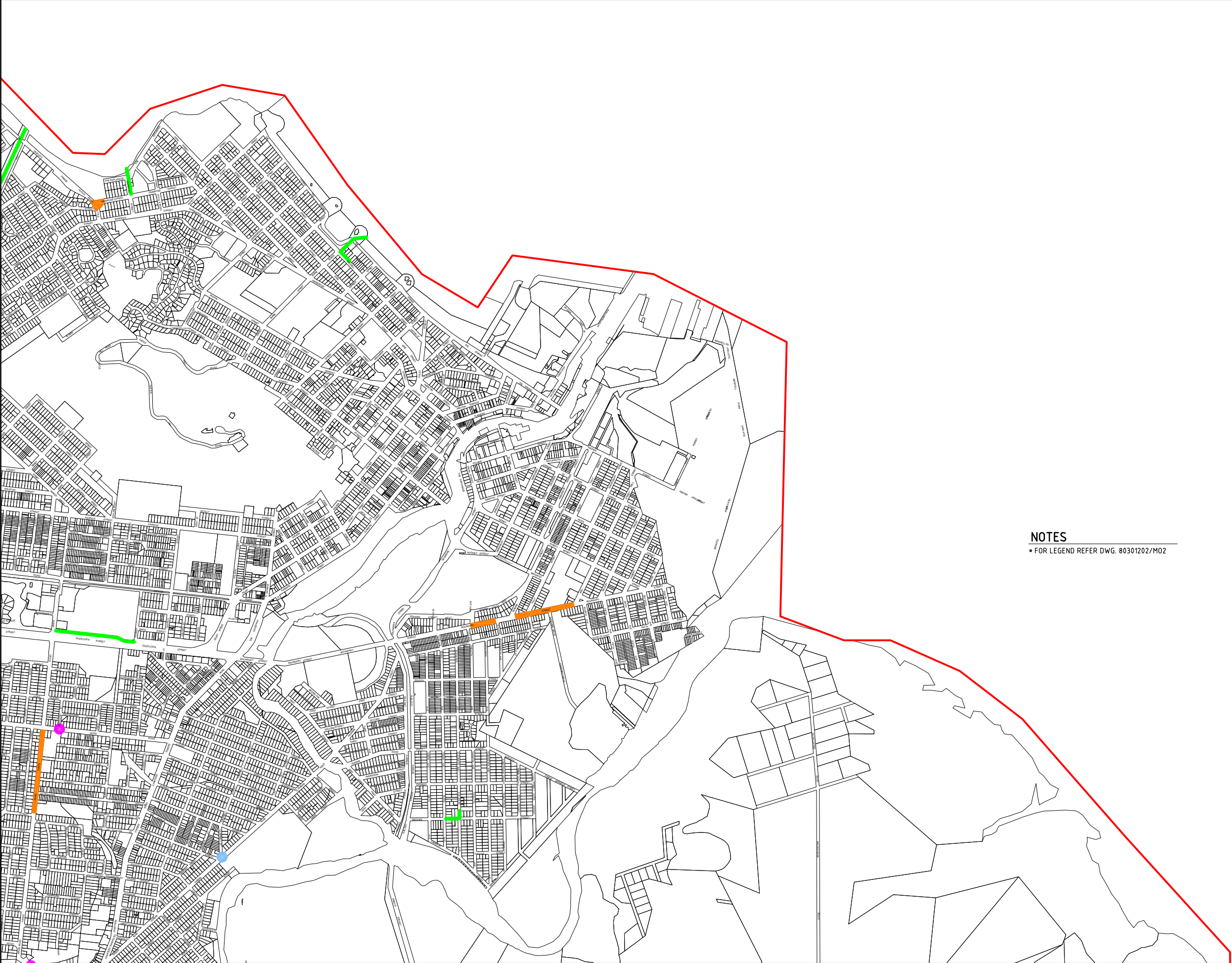
	DATE	ISSUE
	14.9.04	1

NOTES

• FOR LEGEND REFER DWG. 80301202/M02



REVISIONS						<p>Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services.</p> <p>Figured dimensions take preference over scaled. If in doubt, ask.</p>		<p>SCALES</p> <p>0 125 500m 1:12,500 (A1)</p> <p>Original Size A1</p>	<p>© COPYRIGHT</p> <p>This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company.</p> <p>THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001:1994</p> <table><tr><td></td><td>PREPARED</td><td>CHECKED</td><td>PASSED</td><td>ORIGINAL DRAWING SIGNED BY : Brian Wright</td></tr><tr><td>DESIGN</td><td></td><td></td><td></td><td></td></tr><tr><td>DRAFTING</td><td>PSA</td><td>MFB</td><td>DATE</td><td>15.9.2003</td></tr></table>				PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY : Brian Wright	DESIGN					DRAFTING	PSA	MFB	DATE	15.9.2003	<p>Maunsell</p> <p>Maunsell Australia Pty Ltd</p> <p>ABN 20 093 846 925</p> <p>Consulting Engineers, Planners, Environmental Scientists & Project Managers</p>	<p>TOWNSVILLE CITY COUNCIL</p> <p>TOWNSVILLE FLOOD STUDY</p> <p>TOWNSVILLE FLOODPLAIN</p> <p>DRAINAGE UPGRADES - NORTH WEST SECTOR</p> <table><tr><td>CAD Ref: 80301202_02-M004B.dwg</td><td>Status:</td><td>80301202/M04</td><td>B</td></tr><tr><td>Date: 14 Sep 04 - 15:50</td><td></td><td></td><td></td></tr></table>			CAD Ref: 80301202_02-M004B.dwg	Status:	80301202/M04	B	Date: 14 Sep 04 - 15:50			
		PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY : Brian Wright																																	
	DESIGN																																					
	DRAFTING	PSA	MFB	DATE	15.9.2003																																	
	CAD Ref: 80301202_02-M004B.dwg	Status:	80301202/M04	B																																		
Date: 14 Sep 04 - 15:50																																						
B	PSA	14.9.04	STUDY AREA BOUNDARY AMENDED	BPW																																		
A	PSA	29.1.04	MINOR AMENDMENTS	BPW																																		
No.	BY	DATE	DESCRIPTION	APPD																																		



NOTES
• FOR LEGEND REFER DWG. 80301202/M02

**NOT TO BE USED
FOR CONSTRUCTION**

DATE	ISSUE
15.9.03	1

REVISIONS						<p>Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services.</p> <p>Figured dimensions take preference over scaled. If in doubt, ask.</p>		<p>SCALES</p> <p>0 125 500m 1:12,500 (A1)</p> <p>Original Size A1</p>	<p>© COPYRIGHT</p> <p>This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company.</p>				<p>Maunsell</p> <p>Maunsell Australia Pty Ltd</p> <p>ABN 20 093 846 925</p> <p>Consulting Engineers, Planners, Environmental Scientists & Project Managers</p>	<p>TOWNSVILLE CITY COUNCIL</p>															
	<p>THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001:1994</p>								<p>TOWNSVILLE FLOOD STUDY</p> <p>TOWNSVILLE FLOODPLAIN</p> <p>DRAINAGE UPGRADES - NORTH EAST SECTOR</p>																				
	<table border="1"><tr><td>DESIGN</td><td>PREPARED</td><td>CHECKED</td><td>PASSED</td><td colspan="2">ORIGINAL DRAWING SIGNED BY : Brian Wright</td></tr><tr><td>DRAFTING</td><td>PSA</td><td>MFB</td><td>DATE</td><td colspan="2">15.9.2003</td></tr></table>				DESIGN				PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY : Brian Wright		DRAFTING	PSA	MFB	DATE	15.9.2003		<p>CAD Ref: 80301202_02-M005.dwg</p>		<p>Status:</p>		<p>80301202/M05</p>					
	DESIGN	PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY : Brian Wright																								
DRAFTING	PSA	MFB	DATE	15.9.2003																									
<table border="1"><tr><th>No.</th><th>BY</th><th>DATE</th><th>DESCRIPTION</th><th>APPD</th></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr></table>				No.	BY	DATE	DESCRIPTION	APPD																<p>Date: 15 Sep 03 - 16:48</p>		<p> </p>		<p> </p>	
No.	BY	DATE	DESCRIPTION	APPD																									



DATE	ISSUE
15.9.03	1

REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									</
-----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	----



LEGEND

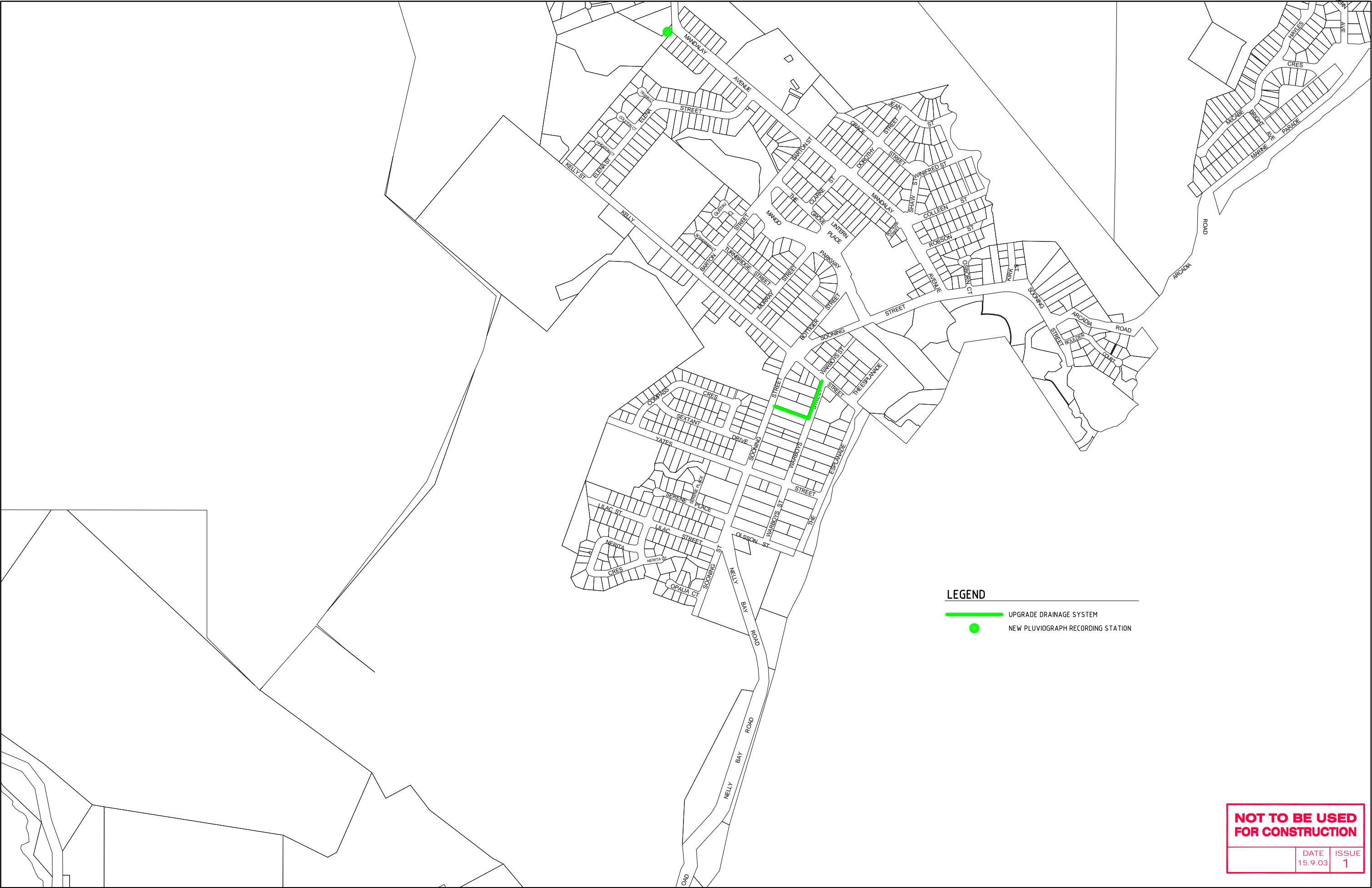
- UPGRADE DRAINAGE SYSTEM
- UPGRADE CULVERT
- UPGRADE RAIN GAUGE

NOT TO BE USED
FOR CONSTRUCTION


DATE	ISSUE
05.1.04	2


REVISIONS						<p>Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services.</p> <p>Figured dimensions take preference over scaled. If in doubt, ask.</p>		<p>SCALES</p> <p>0 25 100m 1:2,500 (A1)</p> <p>Original Size A1</p>	<p>© COPYRIGHT</p> <p>This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company.</p> <p>THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001:1994</p>	<table><tr><td></td><td>PREPARED</td><td>CHECKED</td><td>PASSED</td><td>ORIGINAL DRAWING SIGNED BY : Brian Wright</td></tr><tr><td>DESIGN</td><td></td><td></td><td>DATE</td><td>15.9.2003</td></tr><tr><td>DRAFTING</td><td>PSA</td><td>MFB</td><td></td><td></td></tr></table>		PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY : Brian Wright	DESIGN			DATE	15.9.2003	DRAFTING	PSA	MFB			<p>Maunsell Australia Pty Ltd</p> <p>ABN 20 093 846 925</p> <p>Consulting Engineers, Planners, Environmental Scientists & Project Managers</p>	TOWNSVILLE CITY COUNCIL		
		PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY : Brian Wright																								
	DESIGN			DATE	15.9.2003																								
	DRAFTING	PSA	MFB																										
TOWNSVILLE FLOOD STUDY																													
MAGNETIC ISLAND																													
PICNIC BAY DRAINAGE UPGRADES																													
CAD Ref: 80301202_03-M008A.dwg						Status:		80301202/M08		A																			
Date: 29 Jan 04 - 12:55																													

No.	BY	DATE	DESCRIPTION	APPD
A	PSA	29.1.04	MINOR AMENDMENTS	BPW




LEGEND

 UPGRADE DRAINAGE SYSTEM

 NEW PLUVIOGRAPH RECORDING STATION

NOT TO BE USED
FOR CONSTRUCTION

	DATE 15.9.03	ISSUE 1
--	-----------------	------------

REVISIONS						<p>Before commencing work, all controlling dimensions on the drawings must be verified on the site, particularly those relative to property alignments, other structures, and services.</p> <p>Figured dimensions take preference over scaled. If in doubt, ask.</p>		<p>SCALES</p> <p>0 50 200m 15,000 (A1)</p> <p>Original Size A1</p>	<p>© COPYRIGHT</p> <p>This drawing and design remains the property of Maunsell Australia Pty Ltd and may not be copied in any way without prior written approval from this company.</p> <p>THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE MAUNSELL AUSTRALIA QUALITY ASSURANCE SYSTEM CERTIFIED TO AS/NZS ISO 9001:1994</p>	<table><tr><td></td><td>PREPARED</td><td>CHECKED</td><td>PASSED</td><td>ORIGINAL DRAWING SIGNED BY : Brian Wright</td></tr><tr><td>DESIGN</td><td></td><td></td><td></td><td></td></tr><tr><td>DRAFTING</td><td>PSA</td><td>MFB</td><td>DATE</td><td>15.9.2003</td></tr></table>		PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY : Brian Wright	DESIGN					DRAFTING	PSA	MFB	DATE	15.9.2003	<p>Maunsell</p> <p>Maunsell Australia Pty Ltd</p> <p>ABN 20 093 846 925</p> <p>Consulting Engineers, Planners, Environmental Scientists & Project Managers</p>	TOWNSVILLE CITY COUNCIL		
		PREPARED	CHECKED	PASSED	ORIGINAL DRAWING SIGNED BY : Brian Wright																								
	DESIGN																												
	DRAFTING	PSA	MFB	DATE	15.9.2003																								
	TOWNSVILLE FLOOD STUDY																												
MAGNETIC ISLAND																													
NELLY BAY DRAINAGE UPGRADES																													
CAD Ref: 80301202_03-M009.dwg																													
Date: 15 Sep 03 - 16:55		Status:		80301202/M09																									

