

STATEMENT OF ENVIRONMENTAL EFFECTS

APPENDICES

for

PROPOSED AQUACULTURE DEVELOPMENT & WATER SUPPLY WORKS

at

Lots 706,708,709,710 in DP 1000580; Lot 1 in DP 267742; and Lot 1 in DP 578962, No.355
Cudgen Road, Cudgen, NSW.

Crown Reserve 1001008; Council Lot 128 in DP 1039348 and Lot 32 in DP 847319; Council
Public Reserves of Marine Parade, Beach Street, Elrond Drive, Chinderah Road, Crescent
Street; and Un-named roads/pipeline.

Prepared for

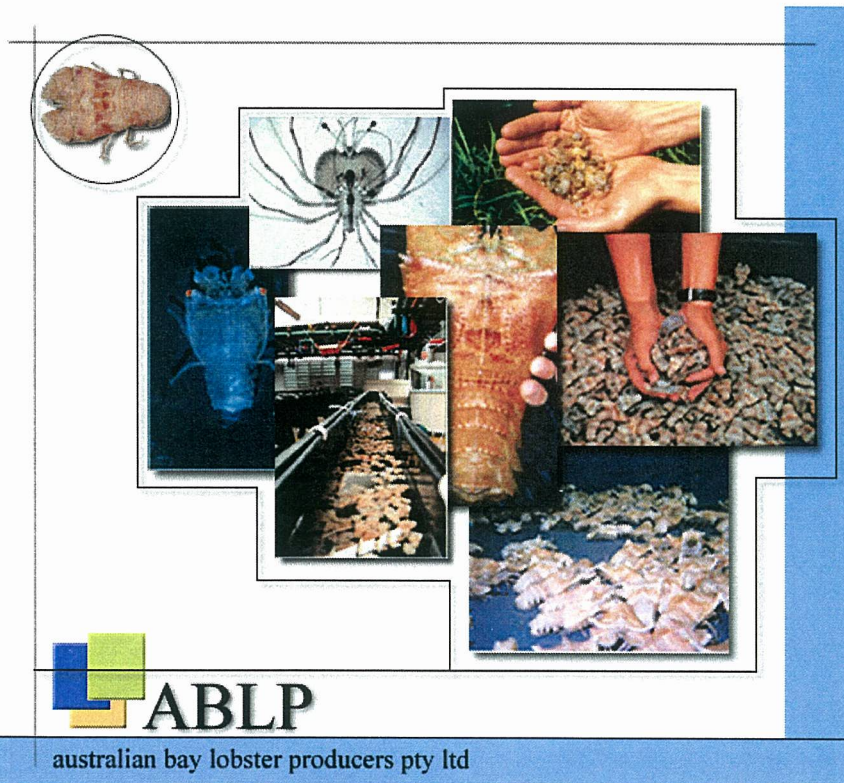
AUSTRALIAN BAY LOBSTER PRODUCERS

By

AUSTRALIAN FRESH RESEARCH & DEVELOPMENT CORPORATION PTY LTD

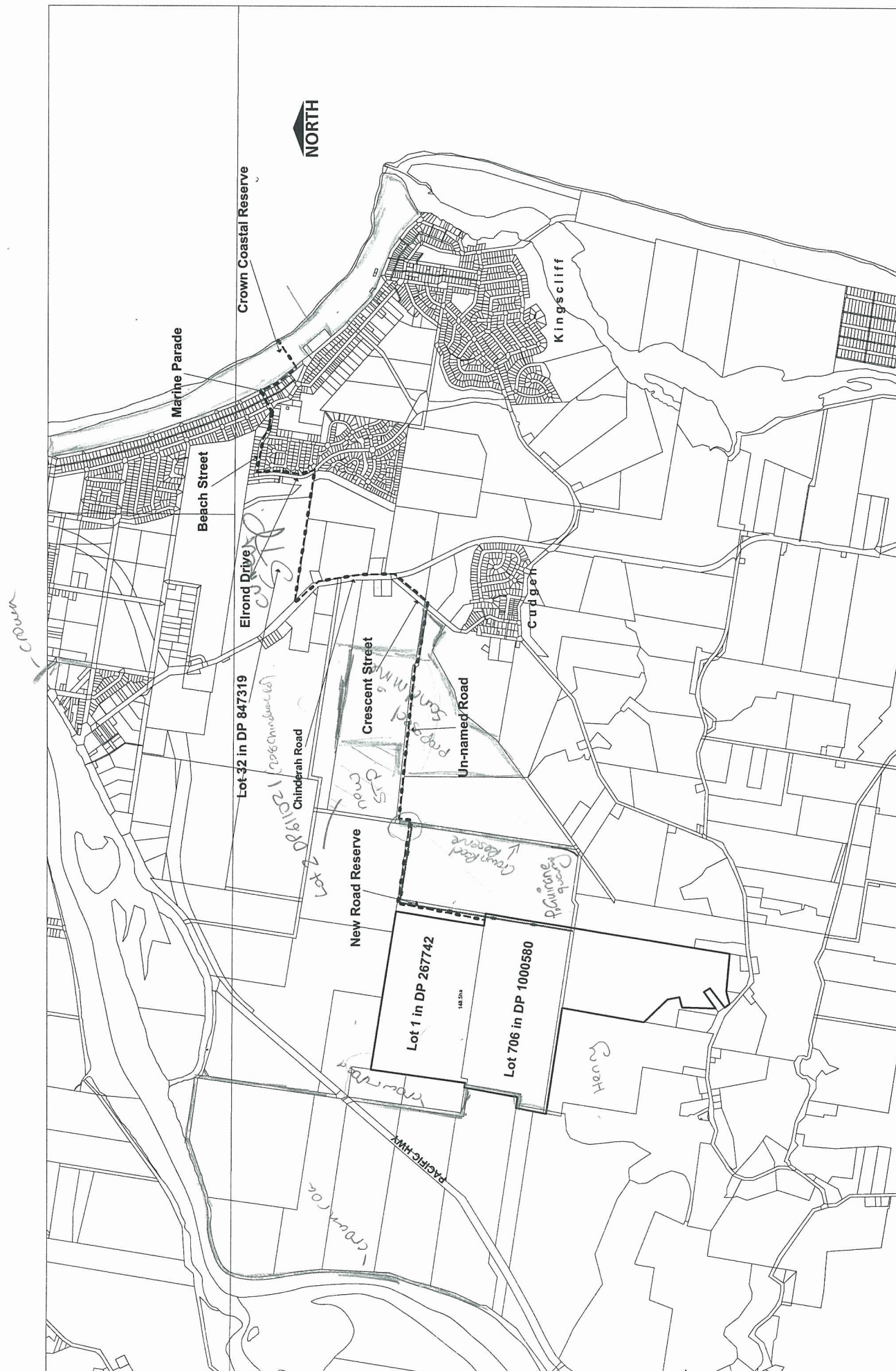
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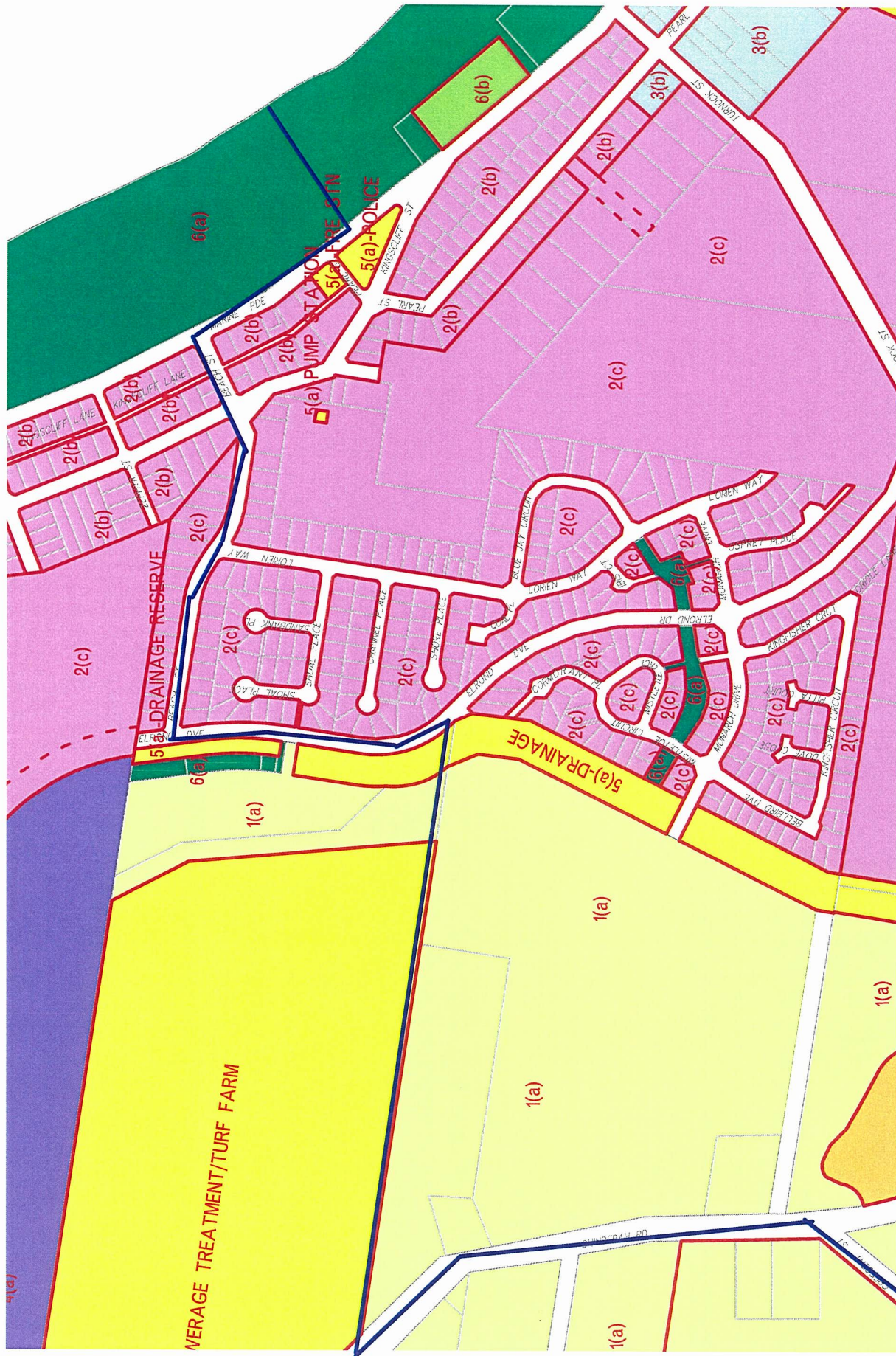
APPENDIX A

- GENERAL CADASTRAL - LAYOUT
- ZONING EXTRACT 1 - BEACH END
- ZONING EXTRACT 2 - SITE END
- DEPOSITED PLANS



GENERAL CADASTRAL LAYOUT - PROPOSED AQUACULTURE FACILITY

Date: September 2004



ZONING EXTRACT NO.1 - THE PROPOSED PIPELINE ROUTE

PLANIT CONSULTING PTY LTD



ZONING EXTRACT NO.2 - THE PROPOSED PIPELINE ROUTE

WARNING: DRIVING ON FOLLING WILL LEAD TO REJECTION

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- LOT 710
3955m²
- LOT 717
442.6m²
- LOT 719
2620m²
- LOT 720
2469m²

- LOTS 704, 709 & 714
LOT 1, DP78237
C.T. 1780237
- LOTS 705, 710 & 715
LOT 1, DP78145
AUTO-CON. 5146-3
- LOTS 706, 717
LOT 4, DP 616805
C.T. 4761605
- LOTS 707, 716
LOT 2, DP78145
AUTO-CON. 5146-3
- LOT 719 CROWN ROAD
LOT 720 CROWN ROAD

- (B) 1951887-RIGHT OF WAY 3.015 WIDE
- (C) 1951887-RIGHT OF CARRIAGEWAY 6.015
- (H) RIGHT OF CARRIAGEWAY 8.2 & 10 WIDE
& 148 DP 267742

Registered DP 10, 15, 19999

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24/1/19

Survey finished under Surveyor Act 1912

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LGA: TWEED SHIRE
Locality: CHINDERAH
Parish: CUDGEN
County: ROUS

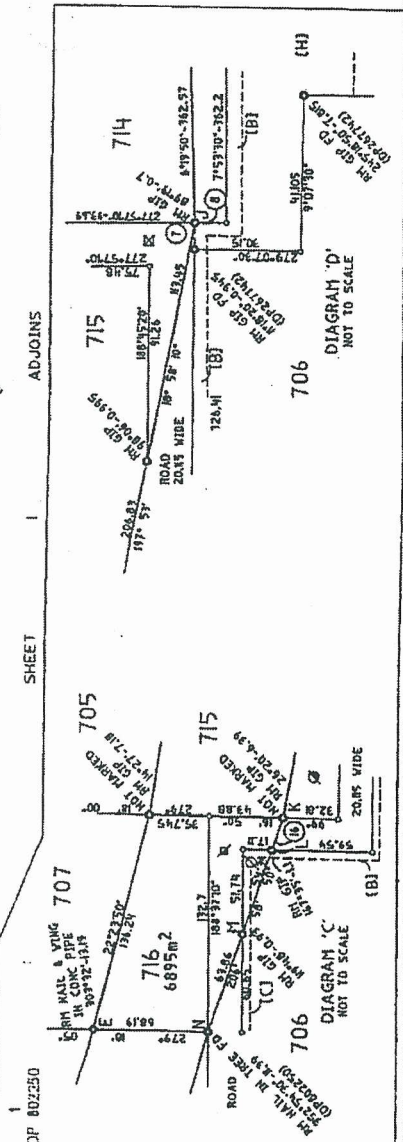
For use where space is insufficient to any parcel on Plan

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Plan Drawing only to appear in this space

CONNECTION PM8572 - 55MB4260 20951250 - 409841

LOTS 701 & 711
LOT 5, DP830653
C.T. 7/030659.

9101-708
4658m2

LOTS 702 & 712.
LOT 1, DP781275.
C.T. 178846.

LOT 718
2949m²

LOTS 703, 708 & 713.
LOT 1, DP781227
C.I. 1/78447

LOT 2

LOT 718, CROWN ROAD

61 - RIGHT OF WAY 30.45 WIDE HS&3013
 62 - RIGHT OF CARRIAGEWAY 8, 12 & 30
 63 - 141771 EASEMENT FOR TRAMWAY 10.06

719017d



SCHEDULE OF SHORT LINES	
1	18°52'25" -41.71
2	6°15'45" -9.96
3	18°57'22" -10.535
4	130°53'30" -15.25 BY SURVEY
5	130°53'30" -15.25 BY SURVEY
6	130°53'30" -10.23 BY SURVEY
7	9°06'30" -37.95

1. 33

ADJOINS

1331

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Reduction Ratio 1:3000

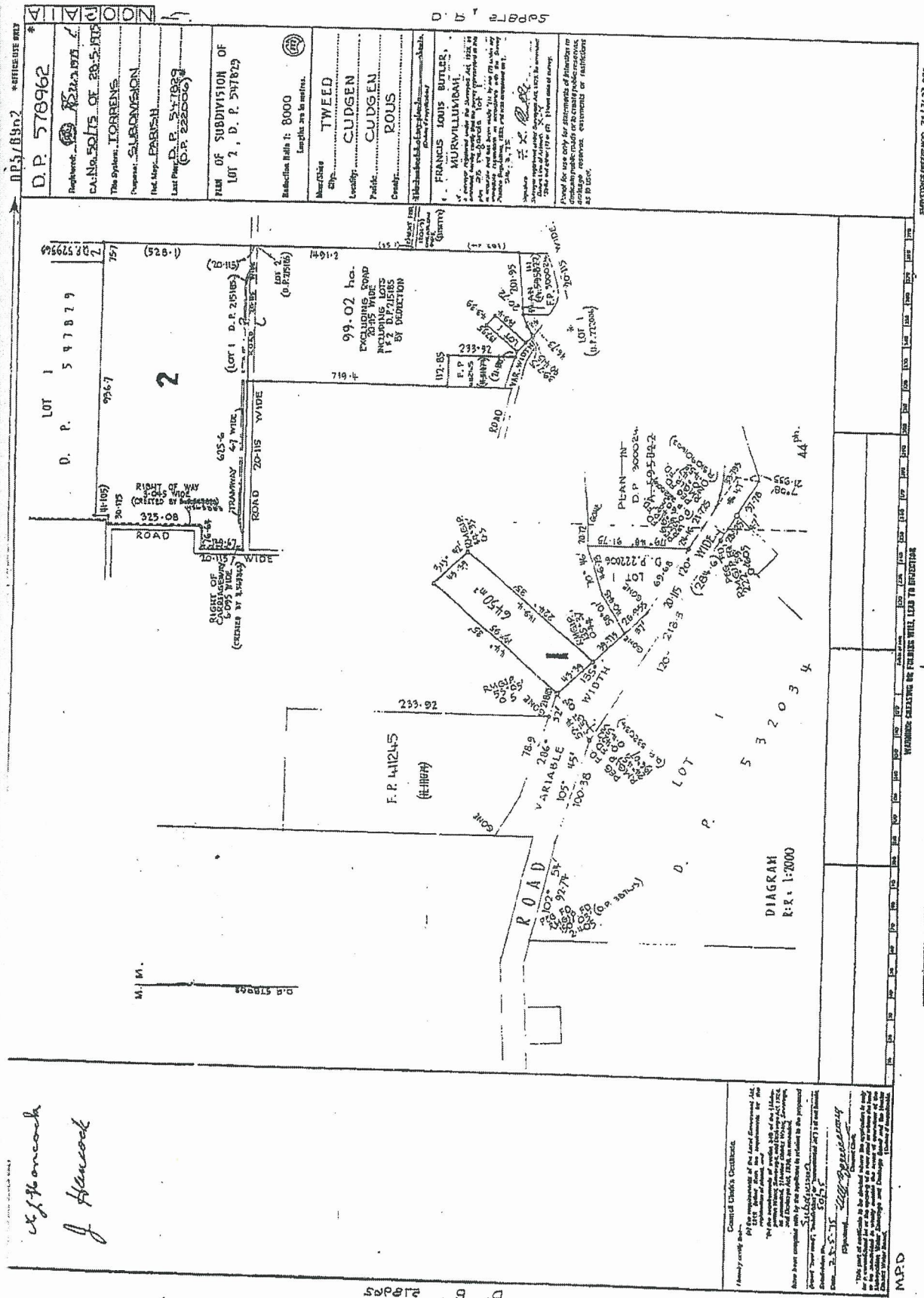
▲ SURVEYOR'S REFERENCE: CH29995 INCHES CKL15
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Downloaded from <http://ajph.org/> on November 10, 2014



W. J. Hancock
J. Hancock



547823

I, Jack Howard Hanson, Registrar General for New South Wales, certify that this register is a photograph made as a permanent record of a document in my custody this 21st day of September, 1975.

Jack Howard Hanson

M.P.D.

APPENDIX B

- PIPELINE ROUTE AND SITE PLAN



FIG 1: AERIAL ROUTE & SITE PLAN

Source: ABLP & JSC

Proposed Aquaculture Development & Water Supply Works.

Drawn: AMS

Plan No.

Date: Sept 2004

A. PO Box 1623 Kingscliff NSW 2487 P. 0266745001 F. 0266745003 E. info@plantconsulting.com.au



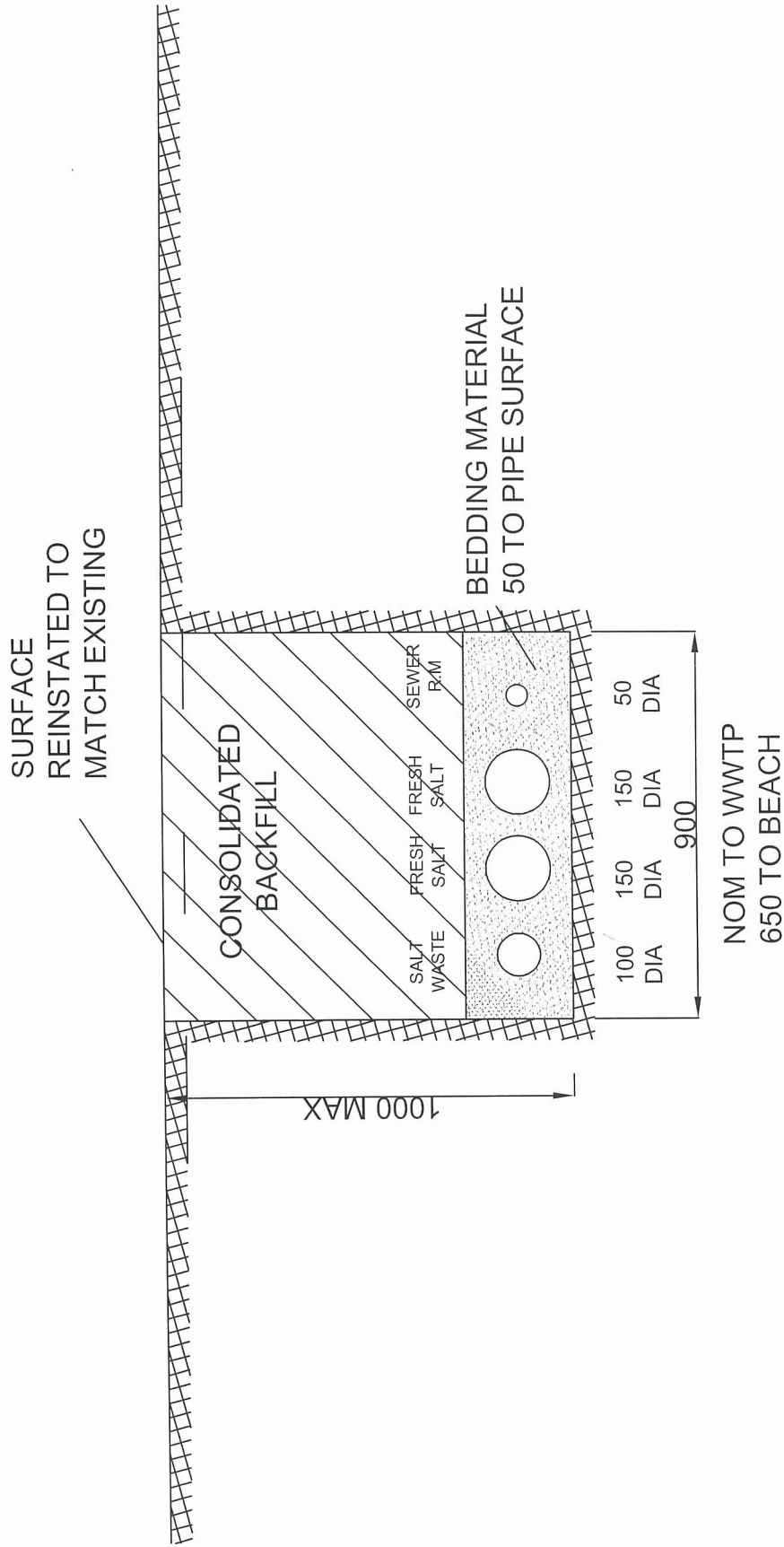
Site of Proposal



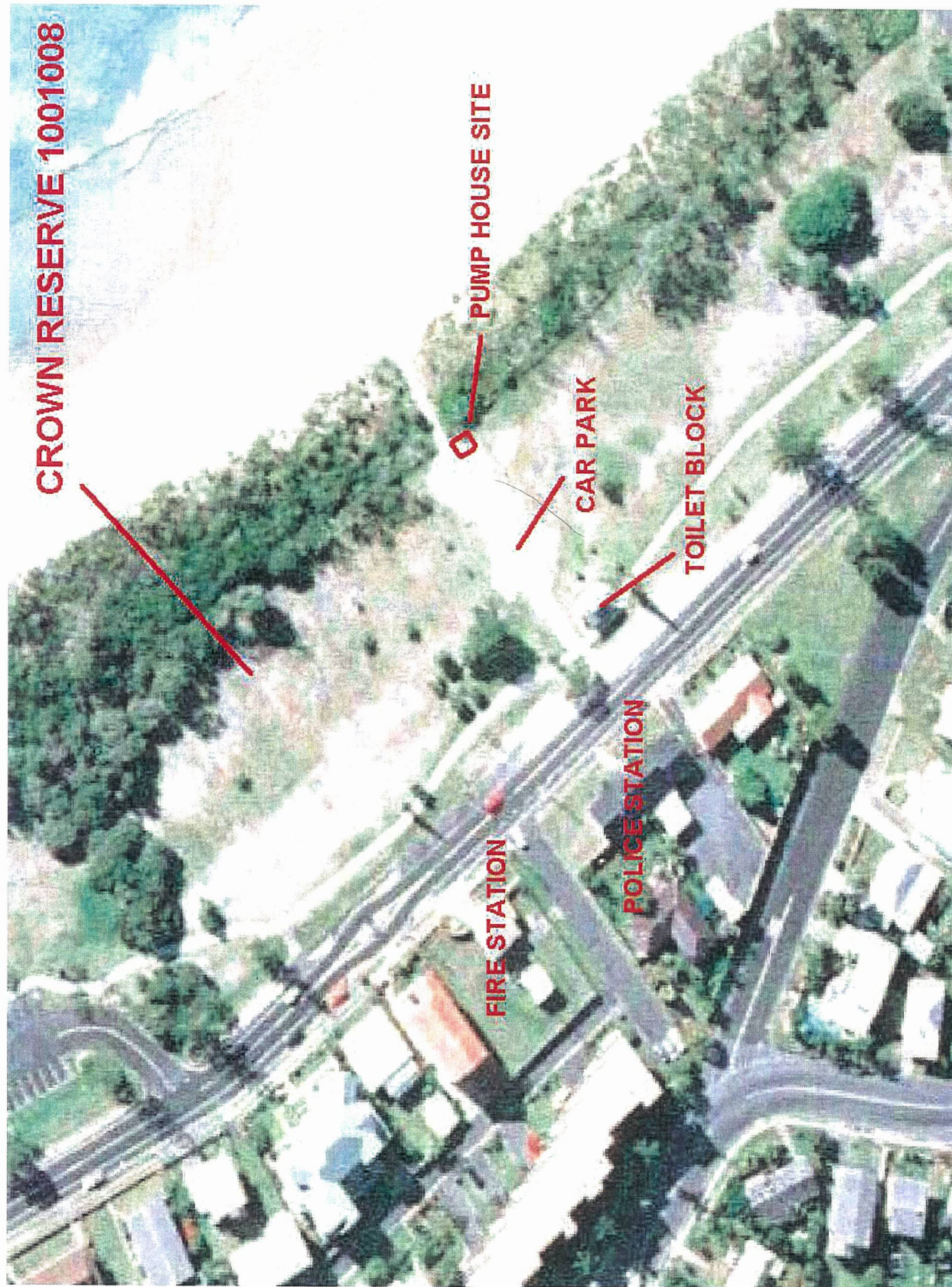
Pipeline Route

APPENDIX C

- PUMP HOUSE LAYOUT KINGSCLIFF BEACH
- PIPE TRENCHING STANDARDS
- AERIAL PHOTOGRAPH - INTAKE LOCATION

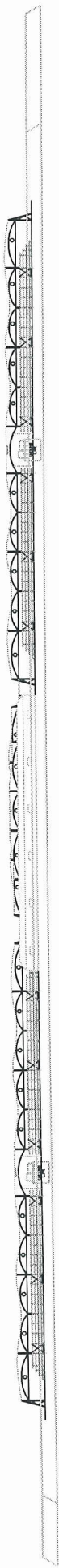


DAVID MCPHEE & ASSOCIATES ENGINEERS BRISBANE TEL/FAX 3202 6344	AUSTRALIAN BAY LOBSTER PRODUCERS Pty Ltd				PASSED		DATE	
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	DATE		7-10-84					
	TRACED							
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PIPE TRENCHING STANDARDS mm scale								DRAWING No



APPENDIX D

- **SITE LAYOUT, ELEVATIONS AND LANDSCAPING**
- **ABLP WATER FLOW PLAN**
- **PROCESSING BUILDING - ELEVATIONS**

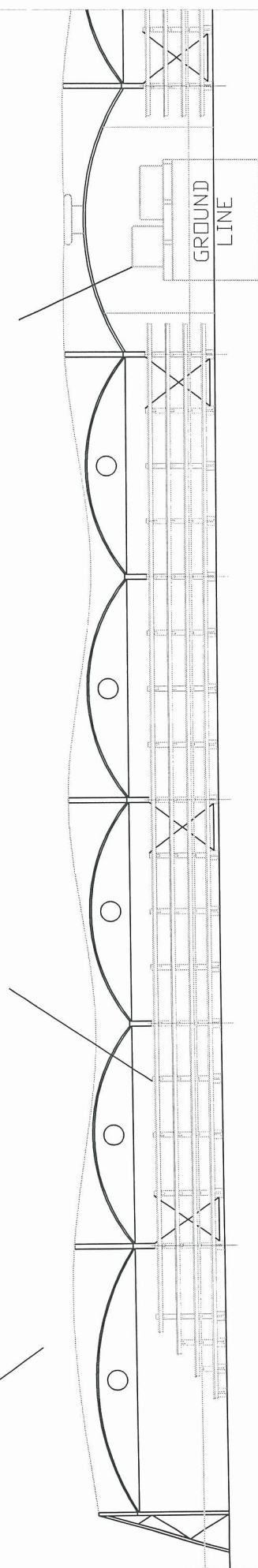


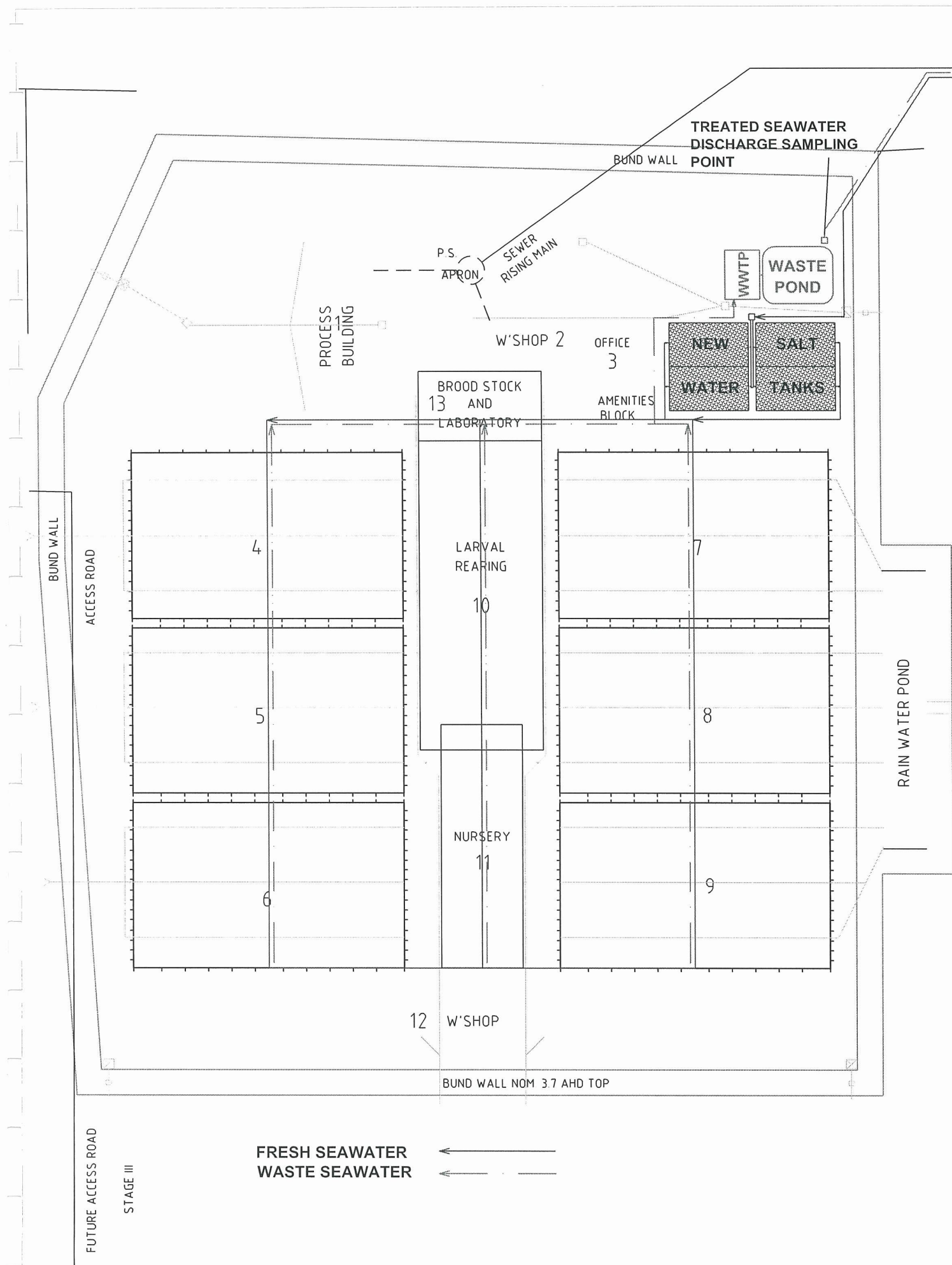
ABLP Southern Elevation

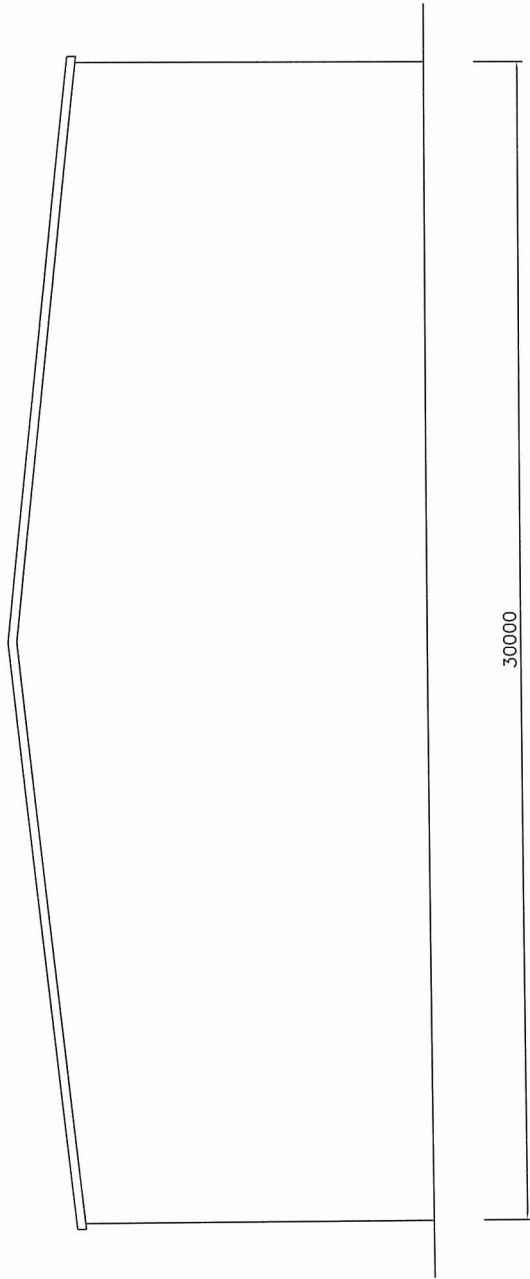
GREEN SHADECLOTH OVER

GROWOUT RACEWAYS

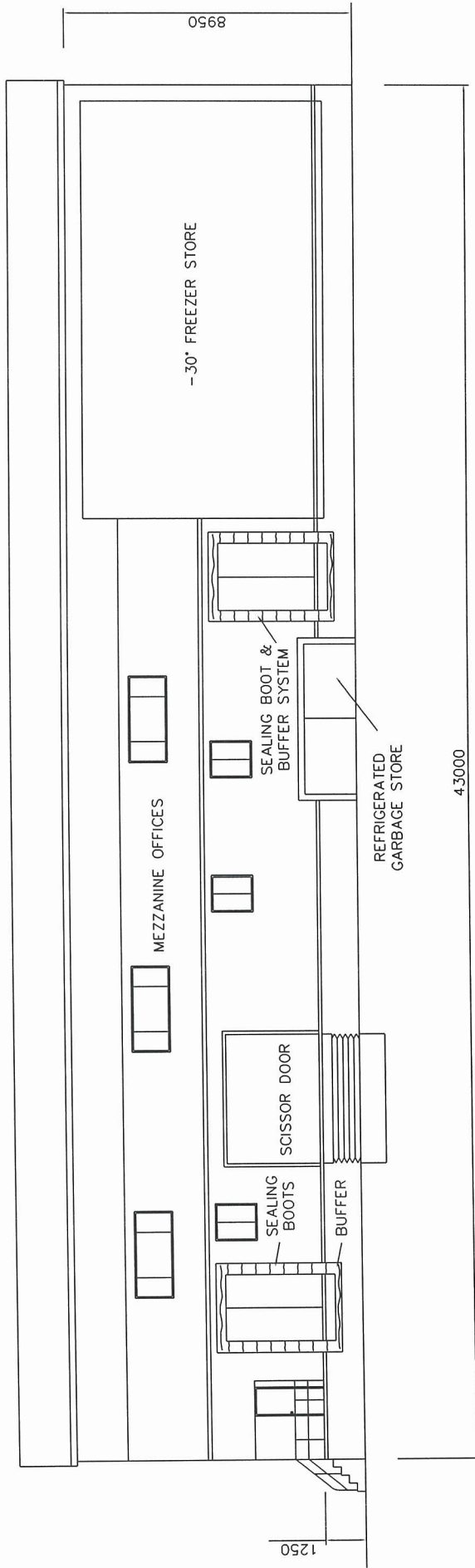
FILTRATION EQUIPMENT







END ELEVATION - PROCESS BUILDING



ELEVATION - PROCESS BUILDING
(DOCK SIDE)

APPENDIX E

- CULTURAL HERITAGE ASSESSMENT

DAVIES HERITAGE CONSULTANTS PTY LTD

PO Box 208, RED HILL, Qld 4059

ACN 079943678

**CULTURAL HERITAGE ASSESSMENT
OF
INDIGENOUS VALUES
OF TERRAIN TO BE IMPACTED
BY A PROPOSED
AQUACULTURE DEVELOPMENT
355 CUDGEN ROAD,
CUDGEN,
NORTH COAST NEW SOUTH WALES.**

**By
Susan Davies**

**For
David McPhee and Associates**

August, 2004

Report Reference JD187

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1.0 INTRODUCTION

This report presents the results of an assessment of Indigenous cultural heritage values of terrain to be potentially impacted by a proposed Aquaculture Development at 355 Cudgen Road, Cudgen, North Coast New South Wales (**Figure 1**). The Aquaculture Development includes Lot 1 on DP267762 and part of Lot 706 on DP215185 as well as the route of a proposed pipeline linking the development site with the Pacific Ocean (**Figure 2**).

Susan Davies (Davies Heritage Consultants Pty Ltd) and the Tweed Byron Local Aboriginal Land Council (LALC) undertook the assessment for David McPhee and Associates.

1.1 The Scope of the Study

The scope of the study was outlined by the Department of Environment and Conservation (Reference: GR2074 * GRF 9287):

1. The presence or absence of Aboriginal objects should be identified and the significance of the area to the local Aboriginal community must be determined. Accordingly, a search of the DEC Aboriginal Heritage Information Management System (AHIMS) should be made and the local Aboriginal community should also be consulted with regard to any Aboriginal heritage issues associated with the proposed development.
2. Aboriginal objects and places of significance to the aboriginal community are to be detailed on a plan. This plan should be at the same scale as the plan of the area subject to development to assist in the assessment of the impact of the proposal on the identified cultural components.
3. An assessment of the impact of the development on the identified cultural sites.
4. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on the identified cultural sites.
5. A contingency plan that details the measures to be taken in the event that archaeological sites are discovered during the course of operations must be prepared.



Figure 1. Location of Study Area in Northern New South Wales.



Figure 2. The Study Area

2.0 THE PROPOSED DEVELOPMENT

Australian Bay Lobster Producers propose to establish an aquaculture development on Lot 1 DP267762 and Part of Lot 706 on DP215185. Also included in the proposed development is a sea water intake pipeline which extends from the ocean at Kingscliff to the development site. The pipeline extends from Jack Bayliss Park to the development site via Marine Parade, Beach Street, Elrond Drive, Tweed Shire Treatment Plant, Chinderah Road, Crescent Street and west within the easement of a proposed new road connecting the to the Pacific Highway (**Figure 2**). The development site is around 70 hectares in extent and the pipeline route is approximately six kilometres long.

2.1 Development Methods

Both earthworks and drainage works are involved in the proposed development. Both activities will involve disturbance to both the ground surface and below ground surface portions of the soil profile.

2.1.1 Potential Impact of the Proposed Development

From the above outline of construction methods it is postulated that disturbance to both the ground surface and subsurface layers would occur as a result of this development.

Hence, both surface and sub-surface archaeological material, if they are present, could be under threat of impact from this proposed development activity.

3.0 CULTURAL HERITAGE MANAGEMENT

Cultural Heritage Management involves the recognition of culturally significant places through the processes of identification and assessment, and the subsequent making of recommendations regarding their future. The ideal outcome of such studies is the conservation of these places. Where this is not possible or practicable recommendations that lessen negative impacts (known as mitigation), are made. Strategies for mitigation can range from suggested alterations to proposed development plans so that a smaller amount of culturally significant fabric is destroyed, to recording places prior to their destruction so that some knowledge can be salvaged from the situation.

The identification process is often initiated from the results of research using the documentary record and the assessment process minimally requires a field survey of the relevant place, and generally community consultation. Recommendations as to the future of culturally significant places are usually guided by the philosophy of conservation practice outlined in the Burra Charter, and such recommendations must be implemented within a legal framework.

3.1 The Burra Charter

The Burra Charter (Australian ICOMOS 1999) guides the practice of cultural conservation in Australia. Within this Charter cultural significance is defined as meaning: *“aesthetic, historic, scientific, social or spiritual value for past, present or future generations”* (Article 1.2). Each of these values is defined in the attached Guidelines to the Burra Charter for Cultural Significance (Articles 2.2 to 2.5):

➤ **Aesthetic Value**

“Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and material of the fabric; the smells and sounds associated with the place and its use”.

➤ **Historic Value**

“Historic value encompasses the history of aesthetics, science and society, and therefore to a large extent underlies all of the terms set out in this section”.

➤ **Scientific Value**

“The scientific research value of a place will depend upon the importance of the data involved, on its rarity, quality or representativeness, and on the degree to which the place may contribute further substantial information”.

➤ **Social Value**

“Social value embraces the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a majority or minority group”.

The Guidelines also note that other categories of cultural significance may be developed as understanding of a particular place increases (Article 2.6). Article 5 of the Burra Charter promotes the position that: “Conservation of a place should identify and take into consideration all aspects of cultural and natural significance without unwarranted emphasis on any one value at the expense of others”.

3.2 Assessing Aboriginal Site Significance

Archaeology is primarily concerned with the interpretation of human history and cultural evolution through the study of material remains, discarded as a result of past human activities. This archaeological record is both fragile and non-renewable and any major disturbance of the environment such as landscape-altering development, poses a threat to this valuable cultural resource. The major cause of obliteration of much of the archaeological record (information upon which the prehistory of Australia can be constructed) is development by non-indigenous people during the past 216 years, with the impact by natural processes playing a minor role. Thus, that which remains is all the more valuable due to its scarcity.

The Aboriginal cultural record can generally be divided into two sections: physically identifiable object/s (archaeological sites) and object/s that are not physically identifiable (sites sacred or significant to Aboriginal people which can be unmodified features of the landscape) (Bowdler 1983:38). Archaeological sites can include stone artefact scatters, shell middens, axe-grinding grooves, quarries, scarred trees, ceremonial grounds, stone arrangements, burials and rockshelter sites (see Section 9.1). The assessment of the significance of these sites, both potential and realised, are fundamental to cultural heritage management planning (see Moratto and Kelly 1978). Significance can be assigned to particular sites/places, or to a grouping of sites/places within an area. In the latter case, the importance of a cultural heritage area or precinct may be greater than the sum of its individual sites/places. Put simply, cultural heritage significance is the value of cultural heritage sites/places to us and our society (Kerr 1990:3). The major, non-mutually exclusive criteria by which the significance of Aboriginal cultural heritage sites/places can be assessed internally are:

1. Social and political
2. Scientific
3. Historical
4. Educational and economic
5. Aesthetic

Each of these significance criteria can be assigned a relative value from low to very high and at a regional, state or national interest level. The following explanation of these criteria is taken from McNiven *et al.* 1994.

➤ Social and Political Significance

If a site/place has importance for a particular cultural or ethnic group, either a majority or minority group (Lennon 1992:4), for religious, mythological, spiritual, or other symbolic reasons - it has social significance (Johnson 1992; Moratto and Kelly 1978:10). Sites/places of social significance are usually important in maintaining a community's integrity and sense of place (Hall and McArthur 1993a:8; King *et al.* 1977:96). Bowdler (1983:26) recognises two kinds of sites that are significant to Aboriginal people; one relates to pre-contact times, the other to the period since colonisation. For most Aboriginal groups, Aboriginal archaeological sites (e.g. burials) and Aboriginal contact sites (e.g. missions) have strong social significance. In recent years, such associations have become increasingly politicised as Aboriginal people regain control of their ancestral lands and re-establish their sense of place following the devastating effects of non-indigenous invasion and colonisation (see Boyd and Ward 1993:112). Some of these sites/places may be recognisable due to landscape modification or material remains whereas others may consist of a noticeable but natural physical feature. Bowdler (1983:30) stresses that "identification of sacred sites and sites of significance to Aboriginal people is of necessity a matter for Aboriginal people.

No-one else can decide either the fact of significance or the degree of that significance to an Aboriginal community, except members of that community”.

➤ **Scientific Significance**

The scientific significance of sites/places represents their ability to furnish data on, and insight into, either past cultural activities (social, technological and ecological) and/or past natural/environmental conditions (see Bickford and Sullivan 1984; Moratto and Kelly 1978; Pearson 1984). For example, archaeological sites provide unique information on human activities, particularly everyday lifeways, which more often than not are not available in documentary sources. Such insights apply equally to literate and non-literate societies. Similarly, such insights may relate to questions of local culture history spanning tens or even thousands of years, and more general and theoretical questions relating to the evolution of cultural systems. Archaeological sites can also supply unique information on past climates and vegetation patterns (e.g. pollen grains) and past fauna (e.g. shell and bone remains).

The scientific significance of sites/places should be assessed according to “timely and specific research questions (research potential) on the one hand, and representativeness on the other” (Bowdler 1984:1). The focus of both research potential and representativeness can change over time. As research interests vary and archaeological methods and techniques change through time, criteria for assessing site significance are also re-evaluated. Consequently, the sample of site types conserved must be large enough to account for such changing variables. The concepts of “research potential” and “representativeness” are detailed below.

Research potential

A number of criteria may be employed to gauge the research potential of a site. These include site integrity, site structure and site content (Dancey 1981).

Site integrity is a property of the archaeological record concerned with the degree of preservation represented by a given deposit (site) (Dancey 1981:20). Both cultural and non-cultural processes affect site preservation. Examples of these processes are post-colonisation development and/or erosion. Sites least affected by such processes may contain significant information regarding the occupation of that site. Where disturbance is extensive there is a greater likelihood that information has been destroyed. Hence, the research potential of such disturbed sites is reduced.

Site structure refers to factors such as stratification, size and patterning of archaeological material within a site. As artefacts and soils accumulate at a given place the resulting deposit may attain a layered appearance. Where layering (stratification) occurs the bottom layer is generally older than the top layer. Thus, stratified sites offer the possibility of detecting changes in the cultural deposit through time. Larger sites may indicate major campsites that may have been occupied over generations, or intensively by larger groups. Internal site patterning may indicate distinctive activities undertaken at a site, or other preferences of site use or organisation.

Site content refers to the different types of archaeological materials which occur in a site. These may be both cultural and non-cultural. Cultural material may include artefacts and the waste material from artefact manufacture, discarded food remains, and charcoal (from hearths). Non-cultural material may include sediments and pollen, both of which may be analysed for information about the environment of the site at the time of its occupation.

Representativeness

Representativeness takes account of how common a particular type of site is (Bowdler 1984:2). That is, it allows sites to be evaluated with reference to the known archaeological record within the region of a particular site. As a rule, the more common a site type, the lower the significance of individual examples of such site types. Similarly, the older the site the greater its significance given that older sites tend to be rarer due to the vagaries of time and decay (Coutts and Fullagar 1982:61). However, an area exhibiting numerous similar (read common) sites can have considerable significance as it may provide a rare opportunity to investigate past land-use patterns. In this instance, the significance of the area is greater than the sum of its constituent sites (see Bowdler 1983:40). From a different perspective, representativeness also relates to maintaining the diversity of archaeological sites for future generations. This notion helps compensate for the biases inherent in academic research agendas that may ignore certain site types today but focus on these in the future (King *et al.* 1977:99). Sites may also be assessed to have scientific value if (based on current archaeological understanding of the area) they exhibit unique or rare qualities. The singular rarity or uniqueness of a site should be judged from a local, regional or national perspective.

➤ **Historical Significance**

A site or place has historical significance if it is associated with either significant person(s) or significant event(s). As Kerr (1990:10) notes, these “may include incidents relating to exploration, settlement foundation, Aboriginal-European contact, disaster, religious experience, literary fame, technological innovation and notable discovery”. However, historical significance may also include the ability of a site/place to be representative of cultural patterns from a particular historical period (Moratto and Kelly 1978:4). As a rule, the greater the degree of physical integrity of a site and its setting the greater its significance (Lennon 1992:4).

➤ **Educational and Economic Significance**

Cultural heritage sites/places can have important educational significance by providing opportunities for people to visually examine and better appreciate the nature of these sites for themselves. Such opportunities not only have important or indeed profound social consequences in terms of maintaining a community's identity, authenticity and sense of place (Lipe 1984:6), but also can have significant economic consequences in terms of cultural tourism (Hall and McArthur 1993b). From another perspective, economic significance of sites is increasingly becoming an issue of competing with alternative land-use activities (e.g. development). Although traditionally seen as mutually exclusive pursuits, cultural heritage preservation and economic development can work together. Best results occur when heritage issues are considered and accommodated for in the early stages of development planning (Rickard and Spearritt 1991).

➤ **Aesthetic Significance**

The aesthetic qualities of a site/place relate to the visual appeal, however subjective, of sites/places and their setting (Kerr 1990:10; also see Ramsay and Paraskevopoulos 1994).

3.3 Managing Significant Aboriginal Places

The Burra Charter has not always been found appropriate for places of significance to Aboriginal people. For this reason the '*Guidelines for the Protection, Management and Use of Aboriginal and Torres Strait Islander Cultural Heritage Places*' has been drafted

in a project by the Department of Communication and the Arts, managed for the Australian Heritage Commission and the Australian Institute of Aboriginal and Torres Strait Islander Studies, the Australian Nature Conservation Agency and Aboriginal and Torres Strait Islander Commission. It includes five points:

A. Aboriginal and Torres Strait Islander Involvement

1. Aboriginal or Torres Strait Islander people have the right to be involved in decisions affecting their cultural heritage, and in the on-going management of their cultural heritage. Aboriginal or Torres Strait Islander involvement in management must be continuous and at the level they consider appropriate.
2. Aboriginal or Torres Strait Islander people who have rights to speak for the place, and/or have interests in the place, should be identified and involved in decisions affecting that place. This will include wide and inclusive consultation, at the beginning of and throughout the process.
3. Decisions which have an effect at the local level need to have full local level involvement. Regional planning should accommodate local level input. Local level planning should be integrated with regional planning.

B. All Interest should be Considered

4. The concerns of all interest groups must be taken into account. Some places have cultural values for both Indigenous people and other groups in the community. All relevant groups should be consulted to allow agreement to be reached on the future of the place.

C. Cultural Significance

5. Cultural heritage place management must look after the cultural significance of a place. The 'cultural significance' of a place describes the value or importance the place has to a community and includes the 'social, aesthetic, historic, and research or scientific value of the place for present, past or future generations'. The term 'social value' includes spiritual values. The cultural significance of a place can change over time.

D. Process and Actions

6. Decisions about cultural heritage places should be made as a result of a conscious and logical planning process. This process, guided by and maintaining the cultural significance of the place, takes into account all the management issues affecting the place and identifies the objectives for the management of the place.
 - . actions affecting places need to be considered only after the cultural significance of the place has been established, and a statement of objectives has been agreed upon by the relevant Indigenous community or owners.
 - . physical intervention or other management actions should be taken to support cultural significance and should be the minimum required to achieve this aim. Actions which conserve cultural significance have top priority.

E. Making and Keeping Records

7. Records of places, records of decisions made about them and records of actions taken at heritage places should be made, kept, stored and accessed in a way which is appropriate to the place and meets the wishes of the community. Ownership of, storage and use of, and access to information should be openly agreed at the outset of a project with the people who own, provide or have rights to the information. Availability of information supports the cultural significance of the place.

3.4 Impact Assessment and Mitigation Strategies

Once the cultural record has been identified and its significance assessed, an important step in cultural heritage management studies is to predict the specific impacts on the cultural record that a particular proposal will generate. Negative impacts may need to be avoided or at least mitigated (lessened). Prediction of impacts calls upon an awareness of the various components of the cultural record in a particular area, as well as of the varying impacts that an activity may have on these components. Both human and natural processes impact upon the archaeological record. In considering development impacts, consideration must be given to the overall scope for potential impacts, beyond the construction stage to the operational stage.

➤ **Impact of Natural Processes**

Natural processes have always played a part in the disruption of the archaeological record. As soon as they have been discarded, artefacts undergo post-depositional processes that are integral to the nature of the cultural record, particularly the archaeological record, as we see it today. Such processes may include erosion, tree growth, weathering, and the impact of chemicals, tree roots or animals. On-going natural processes are not to be confused with impacts arising from any proposed development. However, some development can accelerate these natural processes (e.g. intensified erosion) and these are then considered associated impacts.

➤ **Impact of Cultural Processes**

Cumulatively, cultural activities (particularly since non-indigenous settlement) have led to often substantial though varying degrees of disturbance to the cultural record. The damage caused may be either direct (eg. through quarrying, ploughing or land clearing) or indirect (such as with changes to the erosion patterns of an area). The level of damage caused will also depend on a correlation between the site type and the kind of activity carried out. The degree of site survival in the study area will ultimately depend upon such factors, in addition to the general extent and intensity of historical disturbances. Prior cultural impacts are not considered part of any particular development proposal but the nature of prior impacts can affect the severity of potential impacts of proposed development. Where the record is relatively undisturbed, any new impacts will have a severe impact. Where the record has been disturbed, new impacts will correspondingly be of less severity.

➤ **Scope of Impacts**

Activities during active construction phases of development proposals are perhaps the most obvious source of impacts. However, impacts are not restricted to this stage. In particular, the changes in land use due to a development can bring about new threats to the cultural record. For instance, even though a place may not have been destroyed during a residential subdivision, the new concentration of people in the locality may lead to inadvertent or malicious damage of retained sites by new residents. Impacts may also relate to the cultural record outside of the study area. Where access roads or living camps need to be provided during the course of construction, this construction and also the influx of people into the area can generate impacts on parts of the cultural record.

So, in summary the potential impact of a particular development will vary according to a number of factors, amongst them being the inherent characteristics of a site type and the degree of previous site disturbances. The lesser the degree of disturbance in an area, the greater is the impact of new activities there.

➤ **Mitigation Options**

At times it will be recommended that proposed developments be modified to avoid impacts. Where this is not feasible, mitigative strategies may be employed. In the case of significant Aboriginal archaeological sites, a mitigation option would entail salvage work to recover the potential scientific knowledge of a site prior to its disturbance or destruction. Specific salvage mitigative work would depend upon the nature of the site and procedures can range from detailed recording, surface collection of artefacts to excavation of sites. Generally in assessing the need for mitigative measures, attention should be focused first upon areas of least disturbance and then progressively applied to other, increasingly disturbed locations (Hall and Lomax 1993). Additionally, any mitigative options must be formulated and operationalised in consultation and with the co-operation of the relevant Aboriginal community/s.

Detailed recording may be undertaken on immovable site types such as quarries and axe grinding grooves, as well as extensive sites. Surface collection of artefacts would

normally be recommended for relatively undisturbed sites, or in regions where there have been few other recorded sites. Relocation of scarred trees is another form of collection. Excavation would be warranted if there are indications of a depth to deposits, in particular if stratification were evident.

Although these salvage procedures go towards recovery of scientific information, they are nevertheless destructive of the site. Where the sites are strongly valued by the Aboriginal community, such destructive mitigative activities may not have the approval of the relevant community. In these cases in particular, avoidance of impacts is considered the base management option.

3.5 Legislative Protection

Culturally significant places in New South Wales are regulated by various pieces of legislation. The relevant provisions usually intend to prevent their unnecessary destruction. In making management recommendations about places, this legislative context must be borne in mind.

3.5.1 Federal Legislation

Relevant Federal legislation is the *Environment and Heritage Legislation Amendment Act (No. 1) 2003*, *Australian Heritage Council Act 2003*, *Australian Heritage Council (Consequential and Transitional Provisions) Act 2003* and the *Aboriginal and Torres Strait Islander Heritage Protection Act 1986*.

➤ ***Environment and Heritage Legislation Amendment Act (No. 1) 2003***

This Act amends the Environment Protection and Biodiversity Conservation Act 1999 to include 'national heritage' as a new matter of National Environmental Significance and protects listed places to the fullest extent under the Constitution. It also establishes the National Heritage List and the Commonwealth Heritage List.

➤ ***Australian Heritage Council Act 2003***

This Act establishes a new heritage advisory body to the Minister for the Environment and Heritage, The Australian Heritage Council, and retains the Register of the National Estate.

➤ ***Australian Heritage Council (Consequential and Transitional Provisions) Act 2003***

This act which repeals the *Australian Heritage Commission Act 1975-1990* amends various Acts as a consequence of this repeal and allows for the transition to the new heritage system.

➤ ***Aboriginal and Torres Strait Islander Heritage Protection Act 1986***

The purpose of this Act is to preserve and protect areas and objects of particular significance to Aboriginal Australians from injury or desecration. In particular, this legislation can provide protection for sacred sites. Any steps necessary for the protection of a threatened place are outlined in a gazetted Ministerial Declaration (Sections 9 and 10), and this can include the prevention of development. As well as providing protection to areas, it can also protect objects by Declaration, and in particular Aboriginal skeletal remains (Section 12). Heavy penalties may be levied in the case of contravention of provisions of a Declaration (Section 22).

Although a Federal Act, it can be invoked in a State if the State is unwilling or unable to provide protection for such sites or objects.

3.5.2 New South Wales Legislation

The three major pieces of legislation at the New South Wales state level for are the *National Parks and Wildlife Act, 1974*, the *Environmental Planning and Assessment Act, 1979* and the *Heritage Act 1977*.

➤ ***National Parks and Wildlife Act, 1974***

This Act protects Aboriginal Places and Relics, the former being sites of demonstrated mythological significance to Aboriginal people and Relics essentially the material remains of Aboriginal culture, including human remains. It is an offence under the Act to knowingly disturb or destroy Aboriginal places or relics without the consent of the Director of National Parks and Wildlife Service (NSW).

➤ ***Environmental Planning and Assessment Act, 1979***

In effect, this Act generates a broad spectrum of protection for Aboriginal sites by requiring that an Environmental Assessment, incorporating an assessment of anthropological and archaeological values be prepared for certain developments and activities. Any site located during such an assessment would be automatically protected under the above Act.

The Review of Environmental Factors (REF), incorporating this Cultural Heritage Assessment, has been prepared by the RTA in accordance with Part 5 of the *Environmental Planning and Assessment Act 1979*, and Clause 228 of the *Environmental Planning and Assessment Regulation 2000*. The purpose of the REF is to describe the Proposal, to document its likely impacts on the environment, including cultural heritage impacts, and to detail protective measures to be implemented.

➤ ***Heritage Act 1977***

The provisions of this Act protect places that have been entered onto registers kept by the Heritage Council (Section 22). One register contains information in relation to "items and land that are the subject of interim heritage orders; orders made under this Act; notices served under this Act; and heritage agreements entered into under this Act" (Section 22). The Heritage Council also keeps the State Heritage Register (Section 22). Items can only be listed on or removed from the State Heritage Register at the direction of the Minister (Section 31).

The *Heritage Act 1977* notes that both State and local heritage "significance, in relation to a place, building, work, relic, moveable object or precinct, means significance to the State in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item" (Section 4A).

4.0 INDIGENOUS CONSULTATION

As stated in Sub-section 1.1, consultation with the local Aboriginal community with regard to any Aboriginal heritage issues associated with the proposed development was a requirement of this study. The identification of the relevant LALC and/or Aboriginal community group is based on information generally obtained from:

- New South Wales Department of Environment and Conservation;
- Local Aboriginal Land Councils;
- National Native Title Tribunal; and
- Indigenous groups / organisations / individuals.

4.1 Native Title Claims

A search request was submitted to the National Native Title Tribunal for the area administered by the Tweed Shire Council. Although there are Native Title Claims within the Shire, none have been lodged over the area where the proposed development will be located.

4.2 Consultation Details

For this particular study the Tweed Byron LALC was consulted. Initial contact was made prior to the survey to inform the LALC of the study and to arrange a suitable survey date. The survey of the study area was undertaken with Mr Cyril Scott on the 27th August, 2004. The written response from the Tweed Byron LALC in relation to the survey results is discussed in Sections 12.2, 14.0 and 15.0 of this report and included in **Appendix 1**.

5.0 INDIGENOUS CULTURAL CONTEXT

This Section provides a brief outline of the language groups (Sub-section 5.1), social interactions (Sub-section 5.2), settlement patterns (Sub-section 5.3), economy (Sub-section 5.4), material cultural (Sub-section 5.5) and population density (Sub-section 5.6) of the Indigenous people whose traditional land did and still does cover the present study area. Post-contact history is briefly outlined in Sub-section 5.8.

5.1 Language Groups

Generally, the area encompassing the catchments of the Clarence, Richmond and Tweed Rivers is referred to as the Bundjalung speaking area (Crowley 1978). Bundjalung is lexically quite diverse and contains many named local dialects. It is, however, possible to recognise two major grouping of Bundjalung dialects, a coastal grouping and an inland grouping (see Crowley 1978:142; 1991:13). Crowley (1991:16) states that the “extent of this diversity suggests that perhaps both the coastal and inland areas of Bundjalung territory may have been occupied for longer than some of the coastal areas to the south, allowing a large number of local dialects to develop”.

5.2 Social Interactions

As is the case in Australia generally, inter-group social gatherings were a feature of Aboriginal life in this region. Coleman (1982) has reviewed the ethnohistorical literature and concluded that movements of large groups of people within the coastal region were made in order to attend social gatherings, rather than to mainly take up residence in another location. Byrne (1981) suggested that arrangements were made for inland groups to enter the territory of coastal groups for seasonal fish runs and ceremonial activities. One example of the extent of social interactions is the attendance by Indigenous people from the Tweed-Richmond region at Bunya gatherings which were held in the Blackall Ranges about 100km north of Brisbane. Such social gatherings facilitated trade and/or exchange between groups; for instance groups from the Tweed-Richmond-Clarence Rivers are reported as returning from Bunya gatherings with Brigalow spears.

5.3 Settlement Patterns

Site location patterns postulated by archaeologists (see Byrne 1985; Godwin 1987) indicate that the major river corridors along the northeastern coast served as a focus of activity in the region. According to Tindale (1974:127) “there was a local abundance of food (in the river basins) and the broken intervening country was such as to discourage travel” and “only about one half of the available area was used by the people of these tribes. The rest represented little-used belts separating more favourable locations”.

In contrast, Coleman (1978, 1982) and Belshaw (1978) suggested that coastal populations in northeast New South Wales were semi-sedentary, living in villages or base camps and being dependent on estuarine and littoral resources throughout the year. The huts within these villages were substantial. In 1882 in the Ballina area, Rous reported seeing huts 30 feet long and six feet high.

It has been postulated that movements of large groups of people appeared to parallel the coast. There is, however, considerable debate about the extent of movement between northern New South Wales coastal and inland Aboriginal groups. McBryde (1976) argued that there was large-scale relocation of people on a seasonal basis, with summers spent on the coast fishing and collecting shellfish and winters spent hunting in the hinterland. McBryde (1976:53) also suggested that this seasonal movement of populations was generally along the main rivers. This suggestion is supported by ethnohistorical records from the Clarence region which document population movement to the coast in spring for fishing, and of winters spent inland hunting (Byrne 1981). Nevertheless, Byrne (1981) suggested that arrangements were made for inland groups to enter the territory of coastal groups for seasonal fish runs and ceremonial activities.

5.4 Economy

The Aboriginal groups in this region lived in an environment where “they were able to exploit, within a comparatively small area, a coastal and estuarine or riverine environment, bordered by sub-tropical rainforest, swamps and lightly timbered country. This environmental diversity resulted in a very favourable food supply, which was plentiful, varied and dependable” (Sullivan 1978:104). Marine and freshwater fish and shellfish, reptiles, mammals, birds and plant food provided a diverse diet. For example, plant species included the rhizomes of bracken (*Pteridium esculentum*) and the roots of the Gynea Lily (*Doryanthes excelsa*), Milkmaids (*Burchardia umbellata*) and Yams (*Dioscorea transversa*).

The fruit of many species of plants were eaten including Fig (*Ficus* spp.), Native Guava (*Eupomatia laurina*), Pigeon Berry (*Monotoca elliptica*), Rough Tree Fern (*Cyathea australis*), Apple-berry (*Billardiera scandens*), Lance Leaf Geebung (*Persoonia lanceolata*), Lillipilli (*Acmena smithii*), wild grapes (*Vitis hyperglauca*) and wild cherries (*Excarpua cupressiformis*). The nuts of the Moreton Bay Chestnut (*Castanospermum australe*), Bush Nuts (*Macadamia ternifolia*) and Buyna (*Araucaria bidwillii*) were also eaten. Ainsworth (1987:43) notes that:

“A very appetising bread was made from a nut flour. These nuts grew on the coastal headlands, and in season when ripe were ground up between heavy stones. The pulp was then placed in running water for six weeks or so and the resultant paste when cooked made a very splendid bread. It resembles arrowroot in smell and was eagerly sought after by the whites when rations ran short.”

Animal species exploited included possum, koala, bandicoot, pademelon, wallaby, kangaroo, flying fox, turkey, snake, lizard, echidna and turtle. Birds, fish and many varieties of shellfish were also part of the diet. Shellfish species gathered included cockle (*Anadara trapezia*), club whelk (*Pyrazus ebeninus*), rock oyster (*Crassostrea commercialia*), mud oyster (*Ostrea angasi*), hairy mussel (*Trichomya hirsute*) and pipi (*Plebidonax deltoides*).

5.5 Material Culture

Material culture for the northeastern region of New South Wales is generally similar (see McBryde 1978). This similarity is manifested in the characteristic unbarbed spears and wooden shields (McBryde 1978:178). Sullivan (1978:107) notes that “no barbed, pronged, or bone or shell tipped spears were used for fishing in this area though they were quite common elsewhere on the east coast”. Other items included many artefacts

made of wood or bark obtained from various trees. For example, shields were made from the wood of the Ironbark or Mangrove (*Avicennia officinalis*) trees and tea tree bark (*Melaleuca quinquenervia*) was used for the construction of huts. The bark from the Kurrajong (*Brachychiton populneus*) was used to make cord for the manufacture of fishing lines and nets. Ainsworth (1987:43) describes the types of nets used:

“In catching fish they used what they called a “tow-row” – that is a finely meshed net attached to a stick of bamboo bent in the shape of a bow about eight feet across between the two ends. This gave a bag effect to the net and with a tow-row in each hand the blacks could surround the fish schools in narrow and shallow waters and catch them by the hundreds. The cordage of these nets, which were very strong and beautifully woven, was made from the inside fibre of the stinging tree and from the bark of the currajong. They used a similar net in hunting. This was made of the same fibre in long sections of four feet in width. These sections when joined together for the purposes of the chase would extend sometimes to a half-mile in length. Where game was plentiful in the forest or scrub the blacks would run the net after the manner of a fence in the shape of a semi-circle. Then the whole tribe with the dogs would beat up the neighbourhood for a mile or two and drive all game – everything – towards the open end of the enveloping net”

Cordage was also used for tying up the ends of canoes. Canoes were generally made from a sheet of stringy bark which was gathered and bound at the ends and had thwarts jammed across the centre to hold the bark apart.

Maintenance tools included stone adzes and chisels, abrasive stones, bone awls and sharpened shell knives and scrapers. Boomerangs, clubs, spearthrowers and hafted axes were also manufactured. Ground-edge stone axes were generally manufactured from river pebbles. These pebbles were ground into shape on sandstone boulders which were generally situated in the bed of a watercourse as water is necessary for the grinding process. Byrne (1985) states that there are no known axe quarries on the north coast (of New South Wales) and the distribution of axes made from stone from outside of the region indicates the extend of trade or exchange. Vines were used to assist in climbing trees to capture possums or collect honey. The vine was used to support the climber and, if necessary, an axe was used to cut footholds.

5.6 Population Density

The northern New South Wales coastal zone was one of the most densely settled before the non-indigenous invasion of their lands. The population density has been estimated at 1.5 people/km² (Brayshaw 1986). After Non-indigenous incursion into the region, the Aboriginal population was decimated by smallpox and other introduced diseases as well as through armed resistance to the takeover of their lands.

5.7 Implications for the Indigenous Archaeological Record

As Hall (1996:17) notes:

Given such a range of tasks and activities at a number of levels, it is obvious that people would have left traces pertaining to most of them over much of the landscape; and when the temporal dimension is added, there would be very few localities that would not have been visited in the past. However, when one considers the kinds of material used and their preservational qualities, only a few physical traces would be expected to

last the ravages of time...Thus, after hundreds of years, apart from localities which were most heavily used and which witnessed the accumulation of material in heaps (such as middens) only stone (in a form ranging from single artefacts to fish traps), some bone (including burials) and shell and fragments of charcoal (from cooking fires) remain distributed across the landscape.

In this article Hall (1996), however, did not address the possibility of sub-surface material. Also over time, items may be covered as a result of natural processes (see Sub-section 3.4); this is especially applicable in sandy or aggrading environments. Hence, items may not only be distributed across the landscape but also below the present ground surface.

5.8 Post-Contact History

It was with the invasion of pastoralists, who came to take the land and stay, rather than the non-indigenous explorers or early timber getters, that contact became more extensive. Subsequent to this scale of contact are associated changes in the archaeological record. In this case, the most obvious effect is a change in Aboriginal demographic patterns and as a result site distribution and frequency. Associated with the non-indigenous settlement are a number of other changes such as the cessation of seasonal movement and the establishment of fringe camps. Contact places (e.g. massacre sites, fringe camps, missions, reserves, etc.) can in themselves be considered by members of the Aboriginal community as sites and places of cultural heritage significance. The aim of this Sub-section is to provide both a social and cultural context to these changes.

The typical pattern of initial friendly contact, followed by Aboriginal population decline through open conflict and diseases, was repeated time and time again as the frontier spread across the continent (ATSIC 1990). As settlement spread beyond the government-established areas, random shootings and premeditated massacres of groups of women, children and men were undertaken by squatters in an effort to clear their selections of Aborigines. Sometimes Aboriginal waterholes were poisoned, or Aboriginal people given flour, sugar or damper mixed with arsenic.

Native Mounted Police operated in northern New South Wales from around the late 1840s. Consisting of armed, mounted Aboriginal troopers under the command of white officers, their mission was to reduce Aboriginal resistance to the intrusion and activities of the early non-indigenous settlers. This Force was used throughout the entire region to 'disperse' local Aborigines. 'Dispersal', a euphemistic term for murder, was an official Government policy for dealing with Aboriginal people (Cato 1982:4). Elder (1988:106) notes that "everyone on the frontier knew of the real brutality of the native police but the official records portrayed this band of licensed murderers as models of probity and conservatism". Elder (1988:106) quotes from a book on the native police:

A young 'sub', new in the force...used the word 'killed' instead of the official 'dispersed' in speaking of the unfortunate natives left *hors de combat* on the field. The report was returned to him for correction with a severe reprimand for his careless working...The 'sub' being rather a wag corrected his report so that the faulty portion now read as follows. 'We successfully surrounded the said party of aborigines and dispersed fifteen, the remainder, some half dozen, succeeded in escaping....

Rowley (1981:86) also notes that the use of the Native Police for 'dispersal' amounted in practice to 'shoot-on-sight' against groups thought to threaten settlers and stock.

Walker of the Native Police Force noted:

The blacks...were in a manner outlawed in their own country, being hunted from the river and creek frontages and thus deprived of means of lawfully obtaining food. Driven to desperation, they carried out a constant war of retaliation with the whites and lived solely on cattle...It is the hostile bearing of the settlers that causes the blacks to keep in such large numbers, for they cannot continue the assemblies customary to them for more than a few days on account of the want of food...They supply this want from the herds of the settlers...

At Shaws Bay, near Ballina, Haglund (1991) notes that a massacre occurred around 1853-54. Ainsworth (1987:45) states that between 200 and 300 Aboriginal people were camping on a "slope of the hill facing the valley reaching over towards Black Head". As a result of an attack by Native Mounted Police at least 30 and 40 people are believed to have been "killed outright and many who got away were badly wounded" (Ainsworth 1987:45).

As Aboriginal people were dispossessed of their land many became dependant fringe-dwellers around the new settlements. Some were employed as stockmen, domestic servants and shepherds. Within the study region, the Aborigines were of great assistance to the colonisers in mustering bullocks before fences were erected, finding cedar trees, cutting the undergrowth for them and also for clearing undergrowth and vines before a selection was cleared of its trees. They also assisted with hauling timber. Aborigines became skilful in breeding in horses and as police trackers and were often on the staff at police stations. The women often took on jobs with households. However, wages were not always given for this work (England and Walker 1976: 17, 46).

Other Aborigines were forced into government reserves or church missions, where they had to rely on non-indigenous people for handouts of food and clothing. In the 1870s churches again became interested in the welfare of the Aborigines and set up more missions. In 1882 the Aborigines Protection Board of New South Wales was formed and the first reserves were established. For almost the next 100 years - until the 1960s - Aborigines were increasingly institutionalised and their rights restricted by legislation (ATSIC 1990).

In 1909 the *New South Wales Aborigines Protection Act* was passed (ATSIC 1990). The Board established by this Act owned all the improvements on reserves, had the power to move Aboriginal people out of towns, appoint police as local guardians for reserves and to control all aspects of the lives of Aboriginal people living on reserves. Amendments to the Act in 1915 and 1918 allowed the Board to remove children from their parents for training, and to force "half-castes" to leave the reserves. These actions led to a considerable loss of traditional knowledge from being passed on between generations, and the break up of families. The practise of traditional lifestyles, including language and religion, were actively discouraged or prohibited. From the 1920s the official government policy changed from blanket 'protectionism' to forced assimilation for 'part-Aborigines' and in 1940 this assimilation policy was extended to all Aborigines. An implication of this policy was the eventual closure of all reserves. However, the Commonwealth policy of 'self-determination' for Aboriginal people was presented in 1972.

In 1983 the *Aboriginal Land Rights Act* was passed in New South Wales. This Act recognises that the State of New South Wales was traditionally owned and occupied by Aboriginal peoples and acknowledges the vital importance of land in Aboriginal culture. Under this Act, a system of Land Councils - at State, regional and local levels - were set

up. The Act provided for the annual payment of 7.5% of gross State Land Tax revenue in a fund until 1998. Half of this fund was set aside as capital to finance Aboriginal development in future years, with the balance meeting the costs of land council administration and land purchases.

Aboriginal culture in New South Wales is thus being revitalised. An important issue is the management and protection of Aboriginal sites and heritage items. Land Councils and other organisations (e.g. Aboriginal Corporations) provide advice to the National Parks and Wildlife Service, museums and consulting archaeologists on community wishes on these matters.

In the case of the northern coast of New South Wales, Byrne (1986) notes that many of the mission communities were able to maintain close links with their former lands. Many of the older initiated people kept alive the traditions associated with sacred places and the communities have maintained a unique attitude to the land which is possibly more spiritual than economic. The impact of non-indigenous settlement has been marked, but despite the assimilationist policies of past Governments, Indigenous people have not lost their Aboriginality. There is a demonstrable continuity of Aboriginal culture, and it has adapted rather than perished (see Godwin and Creamer 1984).

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As Aboriginal people were dispossessed of their land many became dependant fringe-dwellers around the new settlements. Some were employed as stockmen, domestic servants and shepherds. Within the study region, the Aborigines were of great assistance to the colonisers in mustering bullocks before fences were erected, finding cedar trees, cutting the undergrowth for them and also for clearing undergrowth and vines before a selection was cleared of its trees. They also assisted with hauling timber. Aborigines became skilful in breeding in horses and as police trackers and were often on the staff at police stations. The women often took on jobs with households. However, wages were not always given for this work (England and Walker 1976: 17, 46).

Other Aborigines were forced into government reserves or church missions, where they had to rely on non-indigenous people for handouts of food and clothing. In the 1870s churches again became interested in the welfare of the Aborigines and set up more missions. In 1882 the Aborigines Protection Board of New South Wales was formed and the first reserves were established. For almost the next 100 years - until the 1960s - Aborigines were increasingly institutionalised and their rights restricted by legislation (ATSIC 1990).

In 1909 the *New South Wales Aborigines Protection Act* was passed (ATSIC 1990). The Board established by this Act owned all the improvements on reserves, had the power to move Aboriginal people out of towns, appoint police as local guardians for reserves and to control all aspects of the lives of Aboriginal people living on reserves. Amendments to the Act in 1915 and 1918 allowed the Board to remove children from their parents for training, and to force "half-castes" to leave the reserves. These actions led to a considerable loss of traditional knowledge from being passed on between generations, and the break up of families. The practise of traditional lifestyles, including

language and religion, were actively discouraged or prohibited. From the 1920s the official government policy changed from blanket 'protectionism' to forced assimilation for 'part-Aborigines' and in 1940 this assimilation policy was extended to all Aborigines. An implication of this policy was the eventual closure of all reserves. However, the Commonwealth policy of 'self-determination' for Aboriginal people was presented in 1972.

In 1983 the *Aboriginal Land Rights Act* was passed in New South Wales. This Act recognises that the State of New South Wales was traditionally owned and occupied by Aboriginal peoples and acknowledges the vital importance of land in Aboriginal culture. Under this Act, a system of Land Councils - at State, regional and local levels - were set up. The Act provided for the annual payment of 7.5% of gross State Land Tax revenue in a fund until 1998. Half of this fund was set aside as capital to finance Aboriginal development in future years, with the balance meeting the costs of land council administration and land purchases.

Aboriginal culture in New South Wales is thus being revitalised. An important issue is the management and protection of Aboriginal sites and heritage items. Land Councils and other organisations (e.g. Aboriginal Corporations) provide advice to the National Parks and Wildlife Service, museums and consulting archaeologists on community wishes on these matters.

In the case of the northern coast of New South Wales, Byrne (1986) notes that many of the mission communities were able to maintain close links with their former lands. Many of the older initiated people kept alive the traditions associated with sacred places and the communities have maintained a unique attitude to the land which is possibly more spiritual than economic (also see Sub-section 8.2). The impact of non-indigenous settlement has been marked, but despite the assimilationist policies of past Governments, Indigenous people have not lost their Aboriginality. There is a demonstrable continuity of Aboriginal culture, and it has adapted rather than perished (see Godwin and Creamer 1984).

5.8.1 Implications for the Cultural and Archaeological Record

With the invasion of the area by non-indigenous people, the traditional lifeways of the local Aborigines were severely disrupted. Although some Aboriginal site types may have persisted into the post-invasion period (e.g. occupational camps), they generally ceased to be formed.

In the initial phase of this period non-traditional items were incorporated into subsistence activities. For example, steel axes replaced the traditional stone axe and glass and electricity insulators were sometimes flaked to obtain sharp cutting implements. Hence, the archaeological record may reflect the use of such non-traditional items.

6.0 INDIGENOUS ARCHAEOLOGICAL CONTEXT

The aim of this Section is to provide a general understanding regarding Indigenous archaeological site potential within the study area. The purpose of presenting this data is to provide background information so that sound predictions regarding the archaeological potential of the study area can be formulated. In Sub-section 6.1 an outline of the results of archaeological research for the broader study region is provided. Further Sub-sections review archaeological consultancies undertaken in the vicinity of the study area (Sub-section 6.2) and discuss previously recorded sites (Sub-section 6.3).

6.1 Northern New South Wales Archaeological Record

Although Aboriginal occupation of Australia is dated to around 60,000 years ago, the oldest dated site in the region (northern New South Wales/southern Queensland) dates to at least 22,000 years (Neal and Stock 1986). This site is located at Wallen Wallen Creek, North Stradbroke Island. There is also a relatively good archaeological record for the past 6,000 years.

Current theory holds that, as Pleistocene glacial ice melted and the seas rose, coastal people were forced to adjust to the changing landscape (Hall and Hiscock 1988). Seas reached their present levels sometime around 6,000 years ago. Through time regionally isolated settlement-subsistence systems and associated socio-political entities developed (McNiven 1991). Some groups fissioned and may have annexed territory from groups further west of the coast. By about 2,500 years ago, the region was populated by numerous named groups with diverging languages, similar to those recorded historically. These diverse groups were far from isolated entities and a great deal of social interaction (trade, marriage and other ceremonies) took place during the year. Thus, rather than taking the form of a patchwork quilt over the landscape, these different societies were more like a living interwoven mosaic due to extensive social ties through intermarriage and other socially-linking mechanisms.

This area of Australia has been the subject of much archaeological research, especially during the past decade (see Hall and Hiscock 1988). Archaeological excavations have revealed a long and interesting prehistory. For example, to the north of the Tweed River, excavation was carried out at Bushrangers Cave, an Aboriginal camping place located at the base of a high cliff in the McPherson Range at the headwaters of the Nerang River. Analysis of excavated material revealed that occupation of this campsite commenced sometime around 10,000 years ago (Hall 1986; Hall 1999). The remains of food animals found at this site do not change throughout this long span of occupation. These remains indicated not only that Aboriginal people using this site enjoyed a diet of wallaby, possum, turkey egg, fish and other animals but also that the local environment had remained quite similar for at least the last six millennia. It is noteworthy that Bushrangers Cave is located on the eastern side of a historically recorded Aboriginal pathway running from the coast to the mountains and river valleys to the west. It is thought that this pathway, which permitted travel and social interaction between the various clans of the region, has been in existence for thousands of years.

Excavations carried out at the Wombah midden on the Clarence River estuary (to the south of the study area) revealed that this site was occupied between 4,000 and 1,000 years ago. Analysis of the excavated material from the Wombah midden reveals an economy based almost totally on shellfish (McBryde 1982:33). At this midden only small quantities of fish bone were uncovered (McBryde 1982:34). McBryde (1976:52) suggested that, on the basis of the high percentage of shellfish (especially oyster), Wombah midden was probably occupied during the summer. Seelands rockshelter in the Clarence River Valley (near Grafton) was first occupied some 6,500 years ago (McBryde 1974). The faunal remains excavated from Seelands provide information about Aboriginal subsistence along the Clarence River. The bone remains indicate that forest mammals (rainforest and sclerophyll) such as wallaby, kangaroo, possum, bandicoot and “native cat” were the main component of the diet with fish, tortoise and freshwater molluscs making a minor contribution (Byrne 1985). As excavated material from this site (representing inland exploitation) reveals a subsistence pattern based on land mammals, the above analysis is therefore used to support the hypothesis of a seasonal occupation of coastal and hinterland sites. However, as marine shellfish are present at Seelands, the analysis can also be used to support Coleman’s (1978) hypothesis that the apparent contact between coastal and inland groups may be a result of trade and/or exchange. However, Coleman (1978) does concede that inland groups may have been invited by coastal groups to procure fish at certain times of the year.

In the 1890s Statham (1892:312) described middens along North and Chickiba Creeks. These middens were recorded by Ainsworth (1987) who noted that the middens were the result of Aboriginal gatherings specifically to exploit oyster beds on Chickiba Creek in late spring and summer. One mound measured 530m in length and was up to 4m in height (Statham 1892:312).

Excavations on one of the middens at Chickiba Creek revealed that the midden was comprised mostly of oyster with other shellfish species present in smaller numbers. Stone artefacts, mammal and fish bones were also present (Bailey 1975). The estimated time frame for the midden is from 1720 ± 80 BP (Before Present) until around 1850. Bailey (1975) concluded that although shellfish was well represented in the middens as a dominant food consumed in the area, it was likely that shellfish represented only a small part of the overall diet (Bonhomme and Craib 1995). Bonhomme and Crab (1995) note that Bailey’s excavation also recovered artefacts manufactured from chalcedony. The closest source of this material is 70km to the north at Tweed Heads.

McBryde (1982) and Campbell (1982) undertook an investigation of archaeological sites at Schnapper Point, to the south of Lennox Head. The investigation included a survey of the area and a systematic collection of surface stone artefacts from a site eroding from a dune on Schnapper Point headland. Material collected included ground-edge artefacts, uniface pebble tools, scrapers, bipolar flakes, eloueras, burins and utilised flakes (McBryde 1982:61). Modified pebbles comprised around 16% of the assemblage. McBryde argued that the site was no older than 4000 years. Dates were obtained from nearby midden sites, which were believed to be associated with the stone artefact site; all were of the recent past. McBryde (1982) concluded that:

“...with the evidence from nearby occupation sites indicating recent use, and the artefact assemblage from the Schnapper Point site being compatible with this age, we may regard the headland area as one concerned with stone tool manufacture, dating to the recent past, and based on the exploitation of the natural resources offered by the Pleistocene pebble beach stratified in the dune system and from time to time exposed by severe wind erosion. The nearby

midden sites...may indicate the location of the camp sites of the groups who made use of these resources."

Further to the north, Appleton (1993) excavated an estuarine midden site at Sexton's Hill on the Tweed River. The midden was comprised predominantly of oyster although fish (mainly bream and snapper) and some macropod bone were also present. Thirty stone artefacts were recovered including bone points. The time span for the use of the site is probably from 4,700 BP to 4,200 BP (Appleton 1993).

Barz (1980) excavated National Parks and Wildlife Service (NSW) site number 04-6-0006 at Terranora (4kms south of Fingal). This shell midden, which overlies basalt bedrock, is one of two excavated middens on the Tweed and is the only undisturbed midden investigated in this area. The base of the midden has been dated to 605 years BP and analysis of the excavated material showed an apparent change from reliance on fish resources to a greater use of shellfish over time. However, the lack of comparable investigations preclude statements regarding the site's representativeness or importance (Dallas 1988).

In the 1960s Dr. Laila Haglund undertook the salvage excavation of the well-known Aboriginal burial ground at Broadbeach (Haglund 1976). Some 150 individuals were buried at this site. None of the remains dated prior to c. 1,200 years ago. From her analysis, Haglund (1976:87) suggested that "burial rites were apparently prolonged and complicated, consisting of many separate features which could be combined in different ways on different occasions". Given a fairly universal rule that cemeteries are an intra-rather than inter-community phenomenon (Pardoe 1988), the evidence suggests that Aboriginal groups in the region became established as separate socio-political entities within the past 1,500 years or so.

One of the most interesting features of the Bushrangers Cave evidence is that the deposition rate (i.e. the amount of material left at the site per each 100 years) of Aboriginal cultural items increases significantly after about 2,500 years ago (Hall 1986; Hiscock and Hall 1988; Mowatt 1989). This finding is consistent with results from other sites outside this local area and is interpreted as evidence of not only a general increase in Aboriginal population during the last few thousand years but also an increase in the number of named Aboriginal groups. It is postulated that the increase in the number of groups is due to their splitting into separate units and spreading further west from the coast to occupy less densely populated country (for details of this model refer to Hall and Hiscock 1988). On linguistic grounds it is possible that a split occurred within a larger Bundjalung group with new dialects forming through time to produce those of the modern communities. From the linguistic work of Crowley (1978) and Sharpe (1978), it would appear that the Bundjalung languages have spread from south to north, and that the latest spread may have been well within the past 2,000 years. This sort of explanation is consistent with evidence gathered about numerous Aboriginal societies during the past 200 years. For example, based on linguistic and archaeological evidence, it has been argued that the Gnugi people of Moreton Island, had begun to diverge from a larger group on Stradbroke Island by at least 500 (and possibly 1,000) years ago (see Bowen 1989; Hall and Hiscock 1988). This gradual process of fission eventually produced the numerous Aboriginal groups as well as the diverse (although related) set of languages and dialects in the region that were recorded by early non-indigenous people into this part of Australia.

6.2 Cultural Heritage Assessments in the Region of the Study Area

Numerous archaeological surveys have been conducted in the study region (e.g. Barker 1990; Barz 1980, 1982; Barz and Piper 1980; Bonhomme 1988; Border 1991, 1992; Dallas 1988; Davies 1991a, 1991b, 1992a, 1992b, 1992c, 1993, 1994, 1998; Hall 1980, 1990a, 1990b, 1991a, 1991b; Higgins 1990; Koettig 1988; Lilley 1981, 1982; Navin 1990; Piper 1983, 1990, 1994a, 1994b, 1997, 2000, 2001). A large number of these surveys, however, did not locate archaeological sites (e.g. Dallas 1988; Davies 1992a, 1992b; Hall 1980, 1990b, 1991b; Koettig 1988; Lilley 1981, 1982; Piper 1983, 1990). As a result of his survey of a proposed housing development at Cudgera Creek, Hastings Point, Lilley (1982b) suggests that poor ground surface visibility and large-scale disturbance are the main factors for a lack of archaeological sites in these areas (also see Hall 1990a, Lilley 1981 and Koettig 1988).

In 1990 Hall was involved in the assessment of Aboriginal sites at the Coolangatta airport. Hall (1990a) located two site complexes and “occasional stone artefacts and shellfish remains in isolated spots in the more elevated parts”. Due to visibility constraints in the swamp area bordering the Cobaki Broadwater, Hall (1990a) stated that “the evidence for Aboriginal occupation was restricted to the slightly higher ground surrounding the swamps”. Within the two site complexes, shellfish remains were located at varying densities with evidence suggesting that subsurface remains were also present. Stone artefacts were also located over the area. Hall (1990a) noted the common presence of “bevelled pounders”, large wedge-shaped artefacts that are found throughout the coastal zone between Cooloola and the Tweed River, that have been identified as tools used in the processing of the rhizome of the fern *Blechnum indicum* (Gillieson and Hall 1982; Higgins 1988).

In 1990 Hall completed a survey of the Cobaki Lakes Project. The Cobaki Lakes Project site was initially surveyed in 1981 by Lilley, but due to visibility constraints a second archaeological survey was undertaken by Hall (1990b). Despite the Cobaki Lakes Project site being situated just to the west of the site complexes located on the northern margin of Cobaki Broadwater, no archaeological remains were located. Hall (1990b) suggests that the negative results may be related to factors such as sand mining, ploughing and erosion. Poor ground surface visibility in the swamp areas also placed constraints on the survey.

Davies (1991a) surveyed the Telstra Optic Fibre Cable route between Anderson's Ridge and Banora Point and recorded shell middens in the dunes adjacent to Crabbes Creek Beach and a contact site on the banks of the Tweed River. The terrain adjacent to and behind the foredunes of Crabbes Creek Beach was also surveyed by Barz (1982) and Navin (1990).

Hall (1991a) and Davies (1992b) have undertaken surveys to the east of Chinderah. Both surveys were of low-lying coastal heath with a sand dune extending along the margin. This dune originated as a sand bar on a surface which dates some 220,000 BP. As a result of subsequent episodes of deposition and erosion some parts of this dune are Pleistocene (before 10,000 BP) while others are late Holocene (2,000 to 3,000 BP). Hall (1991a) located two low density sites on this dune and noted that the archaeological material at one of the sites was eroding from below the present surface suggesting that “more material may be present over a more extensive area”. Hall (1991a) stated that “given the considerable antiquity of the sand ridge...it is quite possible that similar materials exist undetected below its surface (especially along the top of the ridge)”, and noted that the lack of high density scatters (and other

archaeological remains) “may be more a function of poor ground surface visibility plus sand deposition over such remains than a reflection of absence”. Although the dune has high archaeological potential, no Aboriginal archaeological material was located during Davies’ (1992b) survey of the southern extent of the dune. Davies (1992b) suggested that factors contributing to the negative result included restrictions imposed by poor ground surface visibility, natural erosion and deposition as well as cultural factors such as sand removal and disturbance.

Hall (1991b) conducted an archaeological survey of the Chinderah Bypass road without locating archaeological material. An archaeological survey of a residential development area located on hilly terrain between Cudgera and Christies Creeks was undertaken by Collins (1993 - see Rich and Ahoy 1993). Four isolated finds and four low density stone artefact scatters (two of which were associated with shellfish fragments) were located. Of these only one stone artefact was located on low-lying terrain.

A quarry site was located near Cudgen Lake during an archaeological survey of the Cudgen Lake Nature Reserve Proposal. The site was found at the base of a small hill which extended down to the Lake (see Rich and Ahoy 1993).

During a survey conducted in 1980, Piper reported some 20 Indigenous archaeological sites in this general locality including 10 shell middens, four stone arrangements and six isolated occurrences of stone artefacts (Piper 1980). Piper (1976) has also located two sites on elevated terrain in the Tweed River floodplain. Both were low density artefact scatters located on elevated areas about two metres above the floodplain beyond the swamp and flood level (see Rich and Ahoy 1993).

Davies (1994) undertook an archaeological assessment of the Billinudgel to Chinderah bypass. The present study area is located to the immediate east of this bypass (now the Pacific Highway). Indigenous archaeological material was not located during this survey. Davies (1994) noted that the result may have been due to factors such as poor ground surface visibility and ground surface disturbance. As a result of this study, Davies (1998) identified three areas for further archaeological work. These areas included the crest of a spur line, the high bank of Cudgera Creek and the crest of a major ridge line. Archaeological test excavations were undertaken at these three locations without uncovering Indigenous cultural material.

GHD (n.d.) note that Wallin undertook a cultural heritage assessment of the augmentation of the existing Kingscliff WWTP. A section of the proposed sea water intake pipeline for the study which is the subject of this report is located adjacent to the WWTP. Although not explicitly stated, it would seem that Indigenous archaeological material was not located.

6.3 Recorded Indigenous Cultural Sites in the Vicinity of the Study Area

A search of the New South Wales National Parks and Wildlife Service’s Aboriginal Heritage Information Management System (AHIMS) has shown that six known Indigenous sites are currently recorded in the area. These sites are listed below in **Table 1**. Five of the sites are located to the north and north east, while site 4-2-0109 is located to the east of the present study area. None of the sites are under threat of impact from the proposed development.

Table 1. Recorded Sites in the Vicinity of the Study Area.

SITE NUMBER	SITE TYPE	INFORMATION
4-1-0021	Midden	Site Name: Chinderah. Features: earth mound, shell, artefacts.
4-2-0022	Open Camp Site	Site Name: Terranora 10. Features: artefacts
4-2-0023	Midden	Site Name: Terranora 11. Features: earth mound, shell, artefacts.
4-2-0035	Midden	Site Name: Chinderah. Features: earth mound, shell, artefacts .
4-2-0100	Non-Indigenous Burials	Site Name: Cudgen Burial Ground
4-2-0109	?	Site Name: Crescent St 1. Features: artefacts.

6.4 Summary of Archaeological Context

Although not a substantial amount of archaeological research or consultancies have been undertaken in proximity to the study area, it is considered that archaeological knowledge regarding possible site types and potential areas for site location can be proposed. Based substantially on the information contained within this Section with additional information from Section 9.2, it should be possible to propose a predictive model of site location (see Sub-section 9.3).

7.0 DESCRIPTION OF THE STUDY AREA

This Section of the report outlines the environment and natural resources of the study area (Sub-section 7.1). These are discussed in terms of their possible implications for the archaeological and cultural record. Following this discussion, and based on information contained in all the preceding sections of this report, a predictive model for the study area will be proposed (Sub-section 10.3.1).

7.1 Environment and Resource Background

The following sections outline the topography, geology, vegetation, and fauna patterns within the study area. These aspects of the environment are indicators for archaeologically sensitive areas. For example, the archaeological implications for these related factors include:

➤ **Topography**

This factor relates specifically to access and available camping locations.

➤ **Geology and Soils**

An understanding of the geology of the region provides information related to the types of lithic materials available for exploitation by Aboriginal people. Soils are derived from the underlying geology or from fluvial or alluvial processes which have the potential to conceal or expose sites. In areas where a deep soil profile is present the potential for stratified archaeological sites is greater. Soils can also influence vegetation patterns.

➤ **Vegetation**

The type of vegetation communities present in the region relate directly to the types of plant species available for exploitation and indirectly to the faunal species supported by the available plant species.

➤ **Fauna**

The type of faunal species present relates to various factors including vegetation type and water availability. Additionally, terrain types (e.g. open coast, estuarine, valleys, ranges, etc) also affect the presence/absence of particular species.

All these factors affected the types of exploitation strategies employed by Aboriginal people and hence the formation of the archaeological record. Additionally, these factors also affect the survival and present detectability of sites (see Sub-section 9.1).

7.1.1 Topography

The terrain within the study area is flat with elevations below 10 metres a.s.l. (above sea level). The southern boundary of Lot 1 DP267762 and Part of Lot 706 on DP215185 is marked by a drain. Numerous similar drains, built to reclaim the low-lying swampy terrain, have also been dug across the terrain in the vicinity of the study area. A low ridge with elevations to around 50 metres a.s.l. is present to the immediate south of the study area. The water pipeline also traverses low-lying terrain as well as a dune on the eastern side of Marine Parade (Jack Bayliss Park). This area has previously been sand mined (WBM 2001).

➤ **Archaeological Implications**

Based on available ethnographic data for the region and site location information in relation to recorded sites, low-lying flat terrain was not the preferred area for the placement of long term or consistently used camp sites. Dune areas adjacent to the ocean beach were a preferred area for such sites. Evidence of the use of the topography would be in the form of one or more of the potentially occurring archaeological site types (see Sub-section 8.1). Although not evident from the archaeological record, cultural factors may have also affected the placement of camps within the study area (see Sub-section 8.2).

7.1.2 Geology and Soils

The geology of the majority of the study area is comprised of Quaternary riverine deposits of gravels, alluvium, sand and clay. The dune area at the eastern end of the proposed pipeline route is comprised of Quaternary sands.

Soils in the study area are sands, silt and clays.

➤ **Archaeological Implications**

Lithic material suitable for the manufacture of stone artefacts would not have been available within the study area.

It is considered that generally soil profiles within the study area would be relatively deep. The areas where deep soil profiles are present, or where the surface is aggrading, have the potential to contain sub-surface and/or stratified archaeological deposits. Due to the regular deposition of sediments in these areas, however, detectability of such deposits is often constrained. Only a few site types are not affected by these processes (e.g. scarred trees).

7.1.3 Vegetation

Prior to extensive clearing, which came with non-indigenous settlement of the area, the low-lying marshy or swampy areas supported Paperbarks (*Melaleuca* sp.), tea Tree (*Leptospermum* sp.), Swamp Mahogany (*Eucalyptus robusta*) and Banksia (*Banksia* sp.) with a ground cover of reeds or coarse grasses. Due to a combination of processes, but particularly cultural, ground and vegetation disturbance has occurred. Specifically in relation to the study area, vegetation has been cleared, the terrain has been drained and used for sugar cane growing.

➤ **Archaeological Implications**

Vegetation types once present within the study area would have provided a variety of resources for exploitation (food and material culture items) (see Sub-sections 5.4 and 5.5). For example, fern species (especially *Blechnum indicum*) were heavily exploited by Aboriginal people (see Sub-section 6.2). The physical indicators of this exploitation strategy would be the presence of bevelled pounders. Additionally, the bark from tea-trees (*Melaleuca quinquenervia*) were used for material culture items (e.g. containers, roof sheeting; see Sub-section 5.5). Honey and fauna (e.g. possum) were also removed from trees. The physical indications of these activities are likely to be visible as scarred trees (e.g. container scars, footholds, etc.). The implications of vegetation clearance that has occurred is that this site type would now not be present within the study area. It should be stressed, however, that as a result of the significant modification to the

vegetation pattern since non-indigenous settlement, it is difficult to draw inferences between current patterns and past Indigenous use.

7.1.4 Fauna

As mentioned above (Sub-section 7.1), the appearance and distribution of fauna within an area relates to factors such as vegetation communities, water availability and terrain types. It is considered that prior to non-indigenous settlement the study area would have contained a diverse range of faunal species. Non-indigenous settlement and associated economic activities have disrupted the area's original faunal communities.

➤ Archaeological Implications

Numerous faunal species were utilised by Aboriginal people and indicators of this activity may be present in the form of bone and shellfish remains. Shellfish remains may occur as both surface and sub-surface (or stratified) deposits, whereas generally bone remains are most likely to occur within stratified archaeological deposits or in a sub-surface context.

7.1.5 Summary Implications

It is considered that, given the environment and resources available, the terrain within the study area would have been exploited by Aboriginal people. This exploitation would have related specifically to flora and faunal material. Given, however, the topography of the study area, it is unlikely that camp sites would have been located on such low-lying terrain.

8.0 THE POTENTIAL CULTURAL RECORD

Although Aboriginal people may have exploited all parts of the terrain present within the study area, their activities will only be reflected in the **archaeological** record if there are physical remains. However, many sites of significance to Aboriginal people do not contain such remains (cultural sites). In the following Sub-sections and based on information provided in the previous sections of this report, the most likely archaeological (Sub-section 8.1) and cultural (Sub-Section 8.2) site types that may be found within or immediately adjacent to the study area are discussed. The notion of Cultural Landscape is discussed in Sub-section 8.3.

8.1 Archaeological Site Types

There are potentially at least four archaeological site types that may be located within the study area:

➤ **Stone Artefact Scatters**

Stone Artefact Scatters are the remains of activity sites and contain evidence of Aboriginal activities such as the manufacture of stone artefacts. These sites may represent periods of variable duration and may reflect a variety of activities. Due to the resilient nature of stone material, Stone Artefact Scatters are also the most common archaeological site type.

Aboriginal people fractured fine-grained isotropic rocks to produce sharp cutting and scraping instruments. The raw material and form of stone tool artefacts can be quite varied, although fine-grained isotropic rocks, such as quartz, chert and silcrete, were preferred where sharp cutting and scraping edges were required. Crystalline volcanic rocks such as basalt, or pebbles of raw material such as argillite or greywacke, were flaked and then ground to form hatchet-heads for a variety of chopping and cutting tasks. The results of such activities as well as stone artefacts themselves, occur as scatters of modified stone (e.g. cores, flakes, flaked pieces, hammerstones, and anvils). Owing to site frequency and artefact density, Stone Artefact Scatters provide valuable information relating to past Aboriginal settlement and culture.

Stone Artefact Scatters often indicate the remains of occupational camp sites where other associated organic material has decayed, but they can also reflect the results of a specific activity (e.g. stone knapping site or food processing site). Sometimes Stone Artefact Scatters are recorded as Knapping Sites where only that specific activity is present. Knapping Sites and Stone Artefact Scatters, along with other site types such as hearths (fireplaces), shell middens, burials, shelters, etc., are often called Site Complexes.

Stone Artefact Scatters have been found in various locations, although the majority tend to be located on reasonably level ground. Higher density artefact scatters will generally be located closer to permanent water, whereas lower density and background scatters may be found some distance from permanent water.

Scatters of stone artefacts can be found in varying concentrations either in open terrain, or in rockshelter settings. The designation "site" is most commonly applied to high-density concentrations of archaeological material, whilst the surrounding intermittent, low-density material is referred to as "background scatter". This "background scatter" often occurs in the form of isolated artefacts. Researchers often assume that all

significant cultural information occurs within high-density concentrations of artefacts and areas of low artefact density or isolated items (background scatter) are of no value. A more accurate approach is to view the archaeological record as a more or less continuous artefact distribution of variable density across the landscape (see Dancey 1981; Dunnell and Dancey 1983:272; Dunnell 1992:34).

As stone artefact scatters and isolated artefacts have previously been recorded in the area (see Sub-sections 6.3), it is considered possible that this site type may be present within the study area.

➤ **Shell Middens**

In essence, Shell Middens are prehistoric food refuse heaps. They are deposits of shells of marine or freshwater molluscs that formed part of the Aboriginal diet. Midden sites can range considerably in size from large mounds to small, superficial scatters of shell. Middens may also contain the bones of terrestrial animals exploited for food as well as artefacts of stone, bone or shell (Bell 1986:28). These sites can occur close in inland lakes, swamps or rivers. Burials are sometimes located in middens (Bell 1986:30).

Shell middens have been recorded in the vicinity of the study area (see Sub-section 6.3). Given the relative close proximity of areas where shellfish species would have been available, there is a potential that this site type may be present within the study area. As the dune area at the eastern end of the proposed pipeline route has been subjected to sand mining activities, shell middens would not be present at this location.

➤ **Burials**

Burials are generally found close to areas where occupation was concentrated, though individual burials can occur almost anywhere. The majority of burials occur where soft sediments are available (e.g. alluvial flats adjacent to watercourses, sand dunes) and in caves or rock shelters (Bell 1986:30).

Although it is unlikely that this site type would be present within the study area, the potential the potential cannot be totally dismissed.

➤ **Contact and Post-Contact Period Sites**

Aboriginal settlement patterns and lifestyles changed significantly as non-indigenous people moved into local areas. Destruction of major portions of the natural landscape forced Aboriginal groups into a dependent relationship with the non-indigenous settlers. Locations where violent and non-violent contact occurred, fringe encampments which began to develop after contact and places of work (e.g. pastoral stations), are often remembered by Aboriginal people living today (Goulding 1993). Because of the close and personal historic contact Aborigines may have with these camps and locations, they regard them as significant and part of their history to be documented and, in some cases, preserved. While some of these sites still have visible remains, other sites often have no physical alterations to the landscape (e.g. massacre sites). Although there is often no documentation in relation to some of these sites, sometimes records do exist (e.g. station records, diaries, newspaper articles, etc.). Additionally, consultation with local and Indigenous informants assists in the identification of such sites.

8.2 Cultural Site Types

The following site types generally do not have physical indicators of their presence:

➤ **Mythological Sites and Places of Significance to Aboriginal People**

Mythological Sites usually involve no alteration to the natural landscape. As such they are archaeologically invisible and can only be identified with the aid of Aboriginal consultants. Such sites hold particular cultural significance to Aboriginal people.

Despite assumptions to the contrary, there exists a vital knowledge of 'sites of significance' amongst Aboriginal people. The Aboriginal Sites of Significance Survey conducted in New South Wales during the 1970s resulted in the recording of over 500 sites of Aboriginal significance. A large proportion of these were mythological or ceremonial sites (Godwin and Creamer 1984). A case study by Godwin and Creamer (1984) at Yamba, at the mouth of the Clarence River, yielded numerous places of significance to Aboriginal people which were classified under a number of categories as follows:

Good Food Places

These were places from which good supplies of fish, yams, birds' eggs, and so on, can be obtained.

Recent Camping Places

These consisted of two kinds of places. First were those associated with the location of Aboriginal missions and reserves in the area over the past 100 years. Second were those associated with getting away from town, and these often served as base camps for food-gathering activities.

Dangerous Places

These were identified as being where there had been a manifestation of a spirit, or where such manifestation might occur. Usually it involved a person being physically harassed by a spirit.

Mythological Sites

These were identified by the presence of a feature central to a myth or that is explained by a myth. Mountains, rocks, swamps, and other natural places may be mythological places.

Ancestral Camping Places

These were usually identified by spirit harassment.

Archaeologists generally cannot predict the presence of Cultural Sites. However, from background research and Aboriginal consultation the presence of such sites may be revealed.

8.3 Cultural Landscape

Although all the above mentioned site types are described in isolation of each other the pattern of distribution of such sites in the landscape should be viewed as providing information regarding the cultural landscape. That is, sites do not occur in isolation from other sites but are linked by various overlapping and interconnected relationships. Aboriginal people also managed the landscape in various ways (e.g. firing, deliberate plantings, fish traps, etc.) for resource utilisation. Thus, to Aboriginal people the landscape is part of the cultural heritage. As Ross (1996:9) notes:

Generally speaking, Aboriginal people view landscapes differently from non-Aboriginal people. To most Aboriginal people a landscape is an entity in its own right. And it is more than the land alone, as the concept incorporates relationships between place and people, both in a spiritual sense and from the perspective of the resources which the landscape supplies. Although different components of the landscape may be recognised and named, the whole is more than the sum of its parts.

9.0 PREDICTIVE MODELLING

This Section outlines the landscape archaeology approach employed in this study as well as archaeological site location predictions.

9.1 Landscape Archaeology Approach

One useful approach to generating predictive models for Aboriginal archaeological site location employs the notion of landscape archaeology (see Rossingnol and Wandsnider 1992). This approach follows the tenets of predictive modelling in hunter-gatherer archaeology whereby different environmental zones are seen to have provided distinctive sets of constraints on land-use patterns, particularly in terms of foraging behaviour and camp placement. Predictions are based on the known pattern of site distribution in similar land systems. The division into environmental zones relies on factors such as landforms, soils, vegetation, etc. These factors are assumed to have provided distinctive sets of constraints, which influenced prehistoric land use patterns in each zone. Hence, site types and their distribution should differ between zones. However, the detection of sites in each zone often depends on the following factors:

➤ **Ground surface Visibility**

This factor is determined by the nature and extent of the ground cover (e.g. vegetation).

➤ **Burial of Original Land Surfaces** (e.g. by aggrading flood alluvium or slope wash).

➤ **Exposure of Prior Land Surfaces** (e.g. surfaces eroded by water or wind erosion forming features such as gullies and sheet-eroded surfaces or washouts along vehicle tracks).

Exposure can also be enhanced by activities which disturb the ground surface (and at the same time disturb the site). Ploughing and logging are two examples of this form of disturbance. Research has demonstrated that ploughing / cultivation does not destroy artefacts but rather results in horizontal and / or vertical displacement, changes in the condition and preservation of artefact assemblages, changes in type frequencies and in the destruction or alteration of features and layers (see Boismier 1991:17). Horizontal displacement of artefact patterning is largely related to size, cultivation equipment type and slope. In general, studies have indicated that for all types of cultivation equipment, artefacts larger than 4 cm are moved the greatest horizontal distance, with artefacts smaller than 4 cm tending to be subjected to less horizontal displacement. Vertical displacement generally results in the segregation of artefacts by size. The results of vertical segregation is that artefacts greater than 4 cm tend to occur in higher proportions on the surface relative to the total plough zone artefact population. The most severe frequency changes occur among large artefact types, where the sorting action of plough implements causes them to be proportionally over-represented on the surface. Segregation effects on small artefacts result in them being either more evenly distributed throughout the plough zone or sorted to low levels within it. Both result in lower frequencies of small artefact types on the surface relative to the total plough zone population. Large artefact types have been shown by archaeological and experimental studies to be subjected to a greater amount of pattern disturbance and plough damage than smaller artefact types (Boismier 1991:18; also see Schofield 1991). That is, the patterning of large artefact types are more suitable for recognising plough-induced patterning with small artefact types being better indicators of archaeological patterning.

The depth of the cultivation zone is also relevant. Stratified archaeological deposits in alluvial areas have the potential to extend undisturbed below the disturbed cultivation zone (around 30 - 40cm).

Flooding episodes tend to disperse artefacts by size or weight. Rather than destroy a site (unless the site is immediately adjacent to a watercourse bank that erodes totally away) the artefacts can be dispersed over an area more extensive than the original location.

➤ **Site Obtrusiveness**

Some sites such as stone arrangements are easier to detect than (for example) sparse scatters of flaked stone artefacts, especially where the latter occur on well-vegetated surfaces.

➤ **Archaeological Visibility**

This factor relates to how observable archaeological material is on a given land surface. For example, stone artefacts will be easily observed on gravel free soils, where as on stony terrain these artefacts will be less easily detected.

9.2 Environmental Zones within the Study Area

Environmental Zones and their individual factors (e.g. topography, geology, soils, vegetation) have a direct relationship to land use patterns, and as a result Aboriginal site locations. These various factors will also influence site preservation (see Sub-section 7.1). In order to gain a better understanding of the relationship of land use patterns, Davies (1994) divided the terrain through which the Billinudgel to Chinderah Bypass was located into two different Land Zones: Hilly Terrain and Low-lying Terrain Zones. The division was based on a combination of factors including topography, geology, soils and vegetation. Each Zone incorporated a particular type of land form, irrespective of its particular placement within the region. The environmental characteristics of each Zone were then assessed in relation to assumed patterns of site distribution and land use within each Zone.

The environment of the present study area mirrors the environment of the Low-lying Terrain Zone as described by Davies (1994).

9.3 Predictive Modelling

A predictive model is defined as “hypotheses or sets of hypotheses which simplify complex observations whilst offering a largely accurate predictive framework for structuring these observations” (Sebastian and Judge 1988:1). Before discussing the Predictive Site Location Model for this study, some caution is offered regarding this approach to site location. Location modelling is based on the results of archaeological surveys in similar and adjacent regions. Therefore, restricted survey strategies based on such prior distributions may only tend to confirm an already biased pattern. The accuracy of predictive models is reliant upon the standards of data from which they are derived. Given the constraints under which the major body of data are often collected (i.e. through limited field surveys), the level of understanding required to achieve the sort of heuristic, higher level framework, defined above is rarely achieved. Due to the fact that these surveys usually examine non-probabilistic samples and are restricted by variables such as topography and ground surface visibility, it is unavoidable that certain

areas are not sampled. Therefore, although we may learn more about the nature of the record in certain areas of specific terrain, we learn little about the record that exists in areas that were under-represented in field surveys due to the constraints noted above. While techniques built into data collections such as testing of initial hypotheses and collection of independent data sets are avenues to address these problems, any study conducted with a low percentage sample coverage for a large area over a comparatively short time period will contain biases and inaccuracies which can become amplified when extrapolated. Thus, the identification of certain 'archaeologically sensitive' areas does not necessarily rule out the possibility that other areas also have archaeological potential. While recognising this in-built bias in the data base which provides the basis for predictive models of site location, they are employed for reasons of practicality.

9.3.1 Predictive Model for the Study Area

The archaeological predictive model of site location outlined by Davies (1994) in relation to the Low-lying Terrain Zone is considered applicable for the present study area. Note, as the sand dune at the eastern end of the proposed pipeline route has been subjected to sand mining activities, this area is not included in the predictive model outlined below.

➤ Low-lying Terrain Zone

This Zone consists of low-lying relatively flat terrain with elevations below 10 metres a.s.l. The Zone has been extensively cleared and has been subjected to varying levels of ground surface disturbance as a result of activities such as dairying and cultivation (especially sugar cane). Throughout this Zone a system of drains has been constructed to assist in water run-off. As this Zone is subject to inundation residential and commercial development is restricted in extent being generally located on the adjacent elevated terrain. The vegetation is generally thick pasture grasses, reeds or sugar cane.

This Zone is considered to have low archaeological potential. Although rich in resources, the nature of the topography (i.e. low-lying and subject to inundation) precludes suitable campsite locations. Site types that have been located in this zone include a scarred tree (Navin 1990), an isolated artefact (Collins (1993) and stone artefacts (see Sub-section 6.3). These site types most likely reflect exploitation of resources within this Zone.

It is predicted that the most likely **site type** to be located in this Zone would be Open Sites (mainly low density artefact scatters or isolated artefacts) and possibly middens (or shell scatters). Quaternary riverine deposits comprise the geology of this Zone. Such deposits do not generally contain fakeable material suitable for stone tool manufacture. Hence, it is unlikely that quarry sites would be present.

There are no apparent topographic features within the study area (e.g. creek banks, terraces, crests, etc.). Hence, there is not an obvious position within the study area for **site location**. There is, therefore the potential that predicted site types may be located anywhere within the study area but would most likely be present on slightly elevated terrain (if such were present within the study area).

This Zone is considered to be an aggrading land surface. Hence, site detectability in this Zone may be restricted. Also, poor ground surface visibility (thick pasture grasses,

reeds and mature sugar cane) and disturbance (cultivation, drain and road construction) place constraints on detecting archaeological sites.

10.0 SURVEY BACKGROUND

This Section of the report outlines the methodology of the field work phase of the study and includes Sub-sections outlining the survey aims (Sub-section 10.1) and site definition (Sub-section 10.2).

10.1 Survey Aims

The aim of the field survey was to locate and document Indigenous archaeological / cultural sites / items / places that may be present within the study area. Based on the results of the survey, predictive statements regarding the unknown portion of the archaeological record within the study area could be generated. Another aim was to record basic data on site form and content for all sites located so that significance assessment of sites could be undertaken and the appropriate recommendations for each site determined.

10.2 Site Definition

For this study, should archaeological material be located, the individual item would be taken as the basic unit of analysis and areas of higher density were regarded as only a part of the total pattern. As a result, isolated stone artefacts or sparse shell scatters would be given a separate location number. Hence, for this study, an archaeological site was defined as any location exhibiting physical evidence of past Aboriginal activity.

Discreteness of a site would be determined by defining a site as being spaced a distance of more than 25 metres from the nearest other location exhibiting evidence of past Aboriginal activity. If, however, a creek or gully separated cultural material less than 25 metres apart, then this would be regarded as two sites.

Areas of significance to the Indigenous people identified by the Tweed Byron LALC representative during the survey would also be given a site number.

10.3 Site Recording

The location of sites would be recorded with a Gamin GPSII Plus Gps Unit using WGS '84. All sites would be recorded using NPWS guidelines and NPWS Standard Site Recording Forms. Information recorded would include easting and northing of location, site type, site description, site area, environmental setting and condition of the site including any disturbance. For stone material, maximum density of stone artefacts scatters as well as raw material, artefact types and size of artefacts would also be recorded. Sites would be numbered sequentially as recorded.

11.0 THE FIELD SURVEY

This section of the report details the archaeological fieldwork conducted in the study area on the 27th August, 2004, by Susan Davies (Davies Heritage Consultants Pty Ltd), and Cyril Scott (Tweed Byron LALC).

11.1 Survey Method

The survey of the study area was conducted both on foot and from a slow moving vehicle. The area inspected on foot included transects through Lot 1 DP267762 and Part of Lot 706 on DP215185 as well as the pipeline route within the vicinity of the Kingscliff WWTP. As the remaining sections of the pipeline route were within formed road reserves, these were inspected from a slow moving vehicle. As the dune to the east of Marine Parade (Jack Bayliss Park) has been subjected to sand mining activities, this area was not surveyed.

11.2 Survey Constraints

The major constraint to the survey was ground disturbance. Most of the pipeline route is within formed road reserves and the terrain within Lot 1 DP267762 and Part of Lot 706 on DP215185 has been subjected to various ground disturbance activities including vegetation clearance, drain construction and sugar cane farming.

Ground surface exposure within Lot 1 DP267762 and Part of Lot 706 on DP215185 and along the proposed pipeline route was categorised as follows:

1. Poor ground surface exposure (0-10%) was a characteristic of the majority of the study area (**Plate 1** and **Plate 2**).
2. Medium ground surface exposure (11-70%) was restricted in extent and occurred in patches where ground cover was sparse (e.g. within recently harvested cane field).
3. Good ground surface exposure (71-100%) was generally absent within the study area.



Plate 1. Poor Ground Surface Exposure. View south of Lot 1 DP267762 and Part of Lot 706 on DP215185.



Plate 2. Poor Ground Surface Exposure. View east of pipeline route between Lot 1 DP267762 and Part of Lot 706 on DP215185 and Crescent Street.

11.3 Survey Coverage

Although the overall length of the proposed pipeline route is around six kilometres long only around two kilometres are outside of formed road reserves. The two kilometre section is covered with thick grasses and consequently areas of ground surface exposure were absent. Areas of exposure within Lot 1 DP267762 and Part of Lot 706 on DP215185 were also extremely limited. **Table 2** provides a general estimate of the percentage of area that was actually available for site detection within the study area.

Table 2. Estimated Percentage of Area Available for Site Detection

Size of Study Area (sq.m.)	Exposure %	Area of Exposure (sq.m.)	Average Visibility (%)	Area avail. for Site Detection (sq.m..)	% of area available for Site Detection
718,000	5	35,900	3	1,795	0.25

It is considered that all areas available for site detection were surveyed.

12.0 SURVEY RESULTS

It should be noted that the following results can not be taken as a comprehensive statement about all archaeological materials within the study area. Rather, they offer guidelines as to the archaeological sensitivity and potential of various locations within the study area from which informed cultural heritage management recommendations may be made.

12.1 Results in Relation to Indigenous Archaeological Sites

Although all areas available for site detection were surveyed, no Indigenous items or material were located within the study area during the survey.

12.2 Results in Relation to Cultural Sites / Places

During the survey the representative from the Tweed Byron LALC did not identify known traditional or contemporary cultural sites or places within the study area.

12.3 Discussion of Results

Results
Given the low archaeological potential of the study area, the result is not surprising. Hence, it is considered that the proposed predictive model of site location for the area has not been refuted.

It would seem that the terrain within the study area was not used for the placement of long term or consistently used camp sites. There is, nevertheless, a low potential that intermittent or short term camp sites were located within this area. Such sites would reflect movement through the area for resources. The uncovering of such material would be fortuitous due to the predicted low density nature of any such deposits.

13.0 IMPACT ASSESSEMENT

One of the objectives of this study is to assess the impact that proposed development activities would have on the cultural record within the study area. A number of points need to be raised with respect to this. First, both cultural and natural processes impact upon the cultural record and have done so ever since its formation. Second, as a resource the archaeological component of the record is entirely unrenowable and is therefore in need of careful management. Third, that such management calls upon an awareness of the various components of the cultural record in a particular area, as well as of the varying impacts that an activity may have on these components. To use an example from Smith (1993:91), logging may only disturb an artefact scatter but totally destroy a carved tree. In considering development impacts, consideration must be given to the overall scope for potential impacts, beyond the construction stage to the operational stage. Ultimately, however, it is possible that mitigation strategies may be implemented alongside such activities to lessen any (potential) damage caused.

13.1 Impact on the Cultural Record

The proposed development can impact on both the known and unknown components of the archaeological record. As archaeological material was not located within the study area, this discussion only addresses the unknown component.

13.1.1 Impact on the Unknown Indigenous Archaeological Record

Consideration needs to be given to the possibility that undetected archaeological material may be present in the study area. The unknown portion of the cultural record is perhaps the most vulnerable, as it is liable to inadvertent damage.

Given the ground surface disturbance within the study area (see Sub-sections 12.2) and the low archaeological potential of the terrain on which the proposed development will be located, it is considered that there is only a slight possibility that undetected surface archaeological material may be present.

This potential would relate mainly to low density artefact scatters or isolated stone artefacts (i.e. background scatter), representing intermittent or periodic use of the landscape.

The potential for stone artefacts to be present in a sub-surface context is also considered to be low for the study area and the uncovering of such material would be fortuitous. Nevertheless, the proposal would have the potential to impact upon any material that may be present.

14.0 MITIGATION STRATEGIES

The Sub-sections below pursues this topic with regards to the proposed development. Verbal comments regarding mitigation strategies from the Tweed Byron LALC representative present during the survey are taken into consideration as well as the report provided by the Tweed Byron LALC (see **Appendix 1**).

14.1 Mitigation and the Unknown Archaeological Record

Given the low potential for archaeological material to be present, a mitigative option for the proposed development would be for workers employed on the site during the construction of the aquaculture development on Lot 1 DP267762 and Part of Lot 706 on DP215185 and the installation of the sea water intake pipeline which extends from the ocean at Kingscliff to the development site to be made aware (via an Indigenous Cultural Heritage Induction) of the possibility of uncovering Indigenous items during vegetation removal, topsoil stripping and / or trench construction and be advised of the appropriate action that must be undertaken. That is, should any Indigenous items be uncovered, work in the immediate area should cease and such finds should immediately be reported to the Department of Environment and Conservation (NSW), Coffs Harbour and the Tweed Byron LALC.

Additionally, should the route of the proposed sea water intake pipeline as provided to Davies Heritage Consultants and shown in **Figure 3** be altered or should further pipelines be proposed, a cultural heritage survey of any changes or additions associated with the project must be undertaken by a qualified archaeologist and representative of the Tweed Byron LALC.

induction for workers ✓✓

15.0 MANAGEMENT RECOMMENDATIONS

The recommendations provided below are based on the following:

- background research as discussed in this report (see Sections 5.0 to 9.0);
- the results of the field survey (see Section 12.0);
- impact assessment (see Section 13.0);
- consultation with the Tweed Byron LALC; and
- legal requirements under the provisions of the *National Parks and Wildlife Service Act 1974* which states that “a person who, without first obtaining the consent of the Director General, knowingly destroys, defaces or damages, or knowingly causes or permits the destruction or defacement of or to, a relic or Aboriginal place is guilty of an offence against the Act”.

Hence, it is recommended that:

- **A cultural heritage survey of any development associated with the project outside of the development area as shown in Figure 3, must be undertaken by a qualified archaeologist and representative of the Tweed Byron LALC for the area where the additional development is located; and**
- **Should future activities associated with the proposed Aquaculture Development (including the sea water intake pipeline), uncover anything which may be interpreted as Aboriginal in origin, work in the vicinity of the find should cease immediately and the developer should inform the Department of Conservation (NSW), Coffs Harbour and the Tweed Byron Local Aboriginal Land Council as soon as possible for further discussion and negotiation. The provisions of the National Parks and Wildlife Act of 1974 state that it is illegal to damage, deface or destroy a relic without written permission of the Director of the Service. Those failing to report a discovery and those responsible for the damage or destruction occasioned by unauthorised removal or alteration to a site or to archaeological material may be prosecuted under the National Parks and Wildlife Act 1974, as amended.**

16.0 REFERENCES

- Ainsworth, J. 1987 **Reminiscences Ballina in the Early Days 1847-1922**. Apex 40: Ballina.
- Appleton, J. 1993 An archaeological investigation of a shell midden at Sextons Hill, South of Tweed Heads. Unpublished report to Ian Hill and Associates Pty Ltd.
- ATSIC 1990 Aboriginal People of New South Wales. AGPS: Canberra
- Australian ICOMOS 1999 The Burra Charter: The Australian ICOMOS Charter for Places of Cultural Significance 1999. Australian ICOMOS: Burwood.
- Bailey, G.N. 1975 The role of molluscs in coastal economies: the results of Midden analysis in Australia. *Journal of Archaeological Science* 2: 45-62.
- Barker, B. 1990 An archaeological assessment of the proposed development at Champagne Drive, Tweed Heads. Unpublished report to Cameron McNamara Pty Ltd, Brisbane.
- Barz, K. 1980 Report on Terranora Midden (Lillie Waters Estate). Unpublished report NSW National Parks and Wildlife Service.
- Barz, K. 1982 An archaeological survey for the proposed housing development at Ocean Shores and Billinudgel, NSW. Unpublished report for Holley Sharp and Skehan Pty Ltd.
- Barz, K. and Piper, A. 1980 An assessment of archaeological sites on Greenbank Island, Terranora Inlet, NSW. Unpublished report held by New South Wales National Parks and Wildlife Service.
- Bell, D. 1986 Aboriginal Sites in their Environmental Setting. In Ross, A. (ed.) *Planning for Aboriginal Site Management: A Handbook for Local Government Planners*. National Parks and Wildlife Service: Sydney.
- Belshaw, J. 1978 Population distribution and the pattern of seasonal movement in northern New South Wales. In McBryde, I. (ed.) *Records of Times Past*. Australian Institute of Aboriginal Studies: Canberra.
- Bickford, A. and Sullivan, S. 1984 Assessing the research significance of historic sites. In Sullivan, S. and Bowdler, S. (eds.) *Site Surveys and Significance Assessment in Australian Archaeology*. pp 19-26. Department of Prehistory, Research School of Pacific Studies, The Australian National University, Canberra.
- Boismier, W.A. 1991 The Role of Research Design in Surface Collection: an Example from Broom Hill, Braishfield, Hampshire. pp 11-25. In Schofield, A.J. (Ed.) **Interpreting Artefact Scatters: Contributions to Ploughzone Archaeology**. Oxbow Monograph 4. Oxbow: Oxford.
- Bonhomme, T. 1988 An archaeological survey of a proposed Heavy Mineral Extraction site at Newrybar Swamp north of Ballina, NSW. Unpublished report to R.W. Corkery and Co. Pty Ltd.

- Bonhomme, T. and Craib, J. 1995 An Archaeological Survey of the Teven Quarry, North West of Ballina, Northern NSW. Unpublished report prepared for Boral Resources (Country) Pty Ltd.
- Border, A. 1991 An archaeological assessment of the New South Wales Road and Traffic Authority's proposed Brunswick Heads Bypass and future development to 51.0 kms north of Ballina. Unpublished report to the New South Wales Road and Traffic Authority.
- Border, A. 1992 An archaeological assessment of the New South Wales Road and Traffic Authority's proposed second Option (Pink Corridor) for a Brunswick Heads Bypass. Unpublished report to the New South Wales road and Traffic Authority.
- Bowdler, S. 1983 Aboriginal Sites on Crown-timber Lands of New South Wales. Report to the Forestry Commission of New South Wales.
- Bowdler, S. 1984 Archaeological significance as a mutable quality. In Sullivan, S. and Bowdler, S. (eds.) Site Surveys and Significance Assessment in Australian Archaeology. Department of Prehistory, RSPacS, A.N.U.:Canberra.
- Bowen, G. 1989 A Model for Moreton Island Prehistory: Colonisation, settlement and subsistence. Unpublished Hons. Thesis, Department Anthropology and Sociology, University of Queensland: St Lucia.
- Boyd, W.E. and Ward G.K. 1993 Aboriginal heritage and visitor management. In Hall, C.M. and McArthur, S. (eds.) Heritage Management in New Zealand and Australia. pp 103-118. Oxford University Press: Auckland.
- Brayshaw, H. 1986 Aborigines of the Hunter Valley: a study of colonial records. Scone and Hunter Historical Society: Scone.
- Byrne, D. 1981 Archaeological survey of the Grafton-Lismore Transmission Line. Unpublished report for the Electricity Commission of NSW.
- Byrne, D., 1985 Archaeological sites in the Ulmarra Shire: a background for site management. Unpublished report held by the NSW National Parks and Wildlife Service.
- Byrne, D. 1986 Aboriginal archaeological sites in the Shire of Maclean: a heritage study. Unpublished report prepared for the Council of the Shire of Maclean.
- Campbell, V.M. 1982 Midden sites in the Evans Head District. In McBryde, I. 1982 Coast and Estuary: archaeological investigations on the north coast of New South Wales at Wombah and Schnapper Point. Pp 78-80. Australian Institute of Aboriginal Studies: Canberra.
- Cato, N. 1982 **The Noosa Story: A Study in Unplanned Development**. Jacaranda Press: Milton.
- Coleman, J. 1978 The analysis of vertebrate faunal remains from four shell middens in the Lower Macleay River district. Unpublished BA (Hons.) Thesis, University of New England: Armidale.

- Coleman, J. 1982 A new look at the north coast: fish traps and villages. In Bowdler, S. (ed.) Coastal Archaeology in Eastern Australia. Department of Prehistory, RSPacS, ANU: Canberra.
- Coutts, P.J.F. and Fullagar, R.L.K. 1982 A matter of significance. In Coutts, P.J.F. (ed.) Cultural Resource Management in Victoria 1979-1981. pp 55-84. Records of the Victorian Archaeological Survey, 13.
- Crowley, T. 1978 The Middle Clarence Dialects of Bandjalang. Research and Regional Studies 12. Australian Institute of Aboriginal Studies: Canberra.
- Crowley, T. 1991 Chipping at the past: a northern NSW perspective. Paper presented at the Archaeology and Linguistics: Understanding Ancient Australia Conference, Northern Territory University, Darwin.
- Dallas, M. 1988 Archaeological survey and preliminary Aboriginal community consultations on a proposed Hotel site at Fingal Head, NSW. Unpublished report to Ocean Blue Resorts Pty Ltd.
- Dancey, W.S. 1981 Archaeological Field Methods: An Introduction. Burgess Publishing: Minnesota.
- Davies, S.J. 1991a An archaeological assessment of the proposed Telecom Optic Fibre Cable Route between the Andersons Ridge Regenerator Station and Banora Point Telephone Exchange Northern Region, New South Wales. Unpublished report to Telecom Australia.
- Davies, S.J. 1991b An archaeological assessment of the proposed Telecom Optic Fibre Cable route between the Grafton Telephone Exchange and the Andersons Ridge Regenerator Station, New South Wales. Unpublished report to Telecom Australia.
- Davies, S.J. 1992a An archaeological assessment of the proposed Boyd Street Access Road to the Cobaki Lakes Project. Unpublished report to Calsonic Management Services.
- Davies, S.J. 1992b An archaeological assessment of Lot 482 DP 45974, Womin Bay, New South Wales. Unpublished report to the Tweed Shire Council.
- Davies, S.J. 1992c An archaeological assessment of Corridor G of the New South Wales Roads and Traffic Authority's Proposed Brunswick Heads Bypass. Unpublished report to the Roads and Traffic Authority of New South Wales.
- Davies, S.J. 1993 An archaeological assessment of a 300m section of the proposed Telecom inter exchange network Optic Fibre Cable Route between Murwillumbah and Uki, Northern Region, New South Wales. Unpublished report to Telecom Australia.
- Davies S.J. 1994 An archaeological assessment of the proposed New South Wales' Roads and Traffic Authority Proposed Motorway between Billinudgel and Chinderah, New South Wales. Unpublished report to Sinclair Knight.
- Davies, S.J. 1998 Results of Sub-surface testing: Yelgun to Chinderah Pacific Highway Deviation. Unpublished report to Sinclair Knight Merz.

- Dunnell, R.C. 1992 The Notion Site. In Rossignol, J. and Wandsnider, L. (eds.) Space, Time and Archaeological Landscapes. Plenum Press: New York.
- Dunnell, R.C. and Dancey, W.S. 1983 The Siteless Survey: a Regional Scale Data Collection Strategy. In Schiffer, M.B. (Ed.) Advances in Archaeological Method and Theory. Academic Press: New York.
- Elder, B. 1988 **Blood on the Wattle: Massacres and Maltreatment of Australian Aborigines since 1788.** National: Sydney.
- England, G. and Walker, R.A. 1976 The Coffs Harbour Story. The Central North Coast Newspaper Company Pty Ltd: Coffs Harbour.
- Gillieson, D.S. and Hall, H.J. 1982 Bevelling Bungwall Bashers: a use-wear study from Southeast Queensland. **Australian Archaeology** 14: 43-61.
- GHD n.d. Environmental Impact Statement for the Kingscliff Wastewater Treatment Plan: Preparation of an EIS for Kingscliff WWTP. Unpublished report by GHD.
- Godwin, L. 1987 An archaeological survey in the vicinity of Bonville Beach and Pine Creek. Unpublished report to Lockett and Montgomerie Pty Ltd.
- Godwin, L. and Creamer, H. 1984 Ethnography and Archaeology on the North Coast of New South Wales. Queensland Archaeological Research 1:103-116.
- Goulding, M. 1993 Identifying Aboriginal Historical Places in East Gippsland, Victoria. In Placing the Past: Identifying Aboriginal Historical Places in East Gippsland, Victoria. Australian Heritage Commission: Canberra. 1993 Technical Workshop Series No. 4, pp 3-21.
- Haglund, L. 1976 **An Archaeological Analysis of the Broadbeach Burial Ground.** University of Queensland Press: St. Lucia.
- Haglund, L. 1991 Angels Beach Development Area, Traditional and Contemporary Aboriginal Significance. Unpublished report for the Jali Local aboriginal Land Council and the Ballina Shire Council.
- Hall, C.M. and McArthur, S. 1993a Heritage Management: An introductory framework. In Hall, C.M. and McArthur, S. (eds.) Heritage Management in New Zealand and Australia. pp1-17. Oxford University Press: Auckland.
- Hall, C.M. and McArthur, S. 1993b The Marketing of Heritage. In Hall, C.M. and McArthur, S. (eds.) Heritage Management in New Zealand and Australia. pp 40-47. Oxford University Press: Auckland.
- Hall, H.J. 1980 An archaeological assessment of a shell midden on Fisherman's Island, Terranora Inlet, Tweed Heads, NSW. Unpublished report to Oceanics Australia Pty Ltd.
- Hall, H.J. 1986 Exploratory Excavation at Bushrangers Cave (Site LA:A11), a 6,000-year-old Campsite in Southeastern Queensland: Preliminary Results. **Australian Archaeology** 22: 88-102.
- Hall, H.J. 1990a An assessment of Aboriginal sites at the Coolangatta Airport. Unpublished report to Gutteridge Haskins and Davey.

- Hall, H.J. 1990b An archaeological assessment of a proposed development site at Cobaki, South Tweed Heads, NSW. Unpublished report to Prodap Services.
- Hall, H.J. 1991a An archaeological assessment of land at Wommin Bay, north of Kingscliff, New South Wales. Unpublished report to the Tweed Shire Council.
- Hall, H.J. 1991b An archaeological assessment of the proposed Chinderah Bypass Road, Chinderah, NSW. Unpublished report to Gutteridge Haskins and Davey.
- Hall, H.J. 1996 Cultural Heritage Assessment for the Beachmere DCP. Unpublished University of Queensland Archaeological Services Unit Report No 273 for Sinclair Knight Merz.
- Hall, H.J. 1999 The Impact of Sea Level Rise on the Archaeological Record of the Moreton Region, Southeast Queensland. In Hall, J. and McNiven, I.J. (Eds.) Australian Coastal Archaeology. Pp 169-184. ANH Publications, Department of Archaeology and Natural History, RSPAS, The Australian National University: Canberra.
- Hall, H.J. and Hiscock, P. 1988 The Moreton Region Archaeological Project (MRAP) - Stage II: An Outline of Objectives and Methods. Queensland Archaeological Research 5: 2-24.
- Hall, R. and Lomax K. 1993 An Archaeological Assessment of the Grafton Management Area. A report to the Forestry Commission of New South Wales.
- Higgins, S.J. 1990 An archaeological assessment of a proposed development at Elanora, Gold Coast, Queensland. Unpublished report to Winders, Barlow and Morrison.
- Hiscock, P. and Hall, H.J. 1988 Technological change at Bushranger's Cave (LA:A11), S.E. Queensland. Queensland Archaeological Research 5: 90-112.
- Johnson, C. 1992 What is social significance? A discussion Paper. Australian Heritage Commission, Technical Publications Series No. 3.
- Kerr, J.S. 1990 The conservation plan: a guide to the preparation of conservation plans for places of European cultural significance. National Trust: New South Wales.
- King, T.F., Hickman, P.P. and Berg, G. 1977 Anthropology in historic preservation: Caring for culture's clutter. Academic Press: New York.
- Koettig, M. 1988 Assessment of archaeological sites in the proposed tourist development site at Mobbs Bay, Ballina. NSW. Unpublished report held by the NSW National parks and Wildlife Service.
- Lennon, J. 1992 Our inheritance: historic places on public land in Victoria. Department of Conservation and Environment: Melbourne.
- Lilley, I. 1981 Cobaki Village archaeological assessment. Unpublished report to Cameron MacNamarra Pty Ltd., Brisbane.
- Lilley, I. 1982 Hastings Point: archaeological impact assessment. Unpublished report held by the NSW National Parks and Wildlife Service.

- Lipe, W.D. 1984 Value and meaning in cultural resources. In Cleere, H. (ed.) Approaches to the archaeological heritage: A comparative study of world cultural resource management systems. Pp. 1-11. Cambridge University Press: Cambridge.
- McBryde, I. 1974 Aboriginal Prehistory in New England: An Archaeological Survey of Northeastern New South Wales. Sydney University Press: Sydney.
- McBryde, I. 1976 Subsistence patterns in New England Prehistory. Occasional Papers in Anthropology 6: 48-68.
- McBryde, I. 1978 Museum Collections from the Richmond River District. In McBryde, I. Records of Times Past. Australian Institute of Aboriginal Studies: Canberra.
- McBryde, I. 1982 Coast and Estuary: archaeological investigations on the north coast of New South Wales at Wombah and Schnapper Point. Australian Institute of Aboriginal Studies: Canberra.
- McNiven, I. 1991 Teewah Beach: New Evidence for Holocene Coastal Occupation in Southeast Queensland. Australian Archaeology 33:14-27.
- McNiven, I., Davies, S. and Lamb, L (eds.) 1994 Archaeological Survey of Blackdown Tableland, Central Qld: Sites, significance and management recommendations. Report to the Queensland Department of Environment and Heritage.
- Moratto, M.J. and Kelly, R.E. 1978 Optimising strategies for evaluating archaeological significance. Advances in Archaeological Method and Theory 1:1-30.
- Mowatt, F. 1989 Bushrangers Cave: a faunal analysis. Unpublished B.A. Hons. thesis, Department of Anthropology and Sociology, University of Queensland.
- Navin, K. 1990 An archaeological survey of North Ocean Shores Development area, NSW. Unpublished report to Bondcorp.
- Neal, R. and Stock, E. 1986 Pleistocene Occupation in the Southeast Queensland Coastal Region. Nature 323: 618-721.
- Pardoe, C. 1988 The cemetery as symbol. The distribution of prehistoric Aboriginal burial grounds in southeastern Australia. **Archaeology in Oceania** 23 (1): 1 - 16.
- Pearson, M. 1984 Assessing the significance of historical archaeological sites. In Sullivan, S. and Bowdler, S. (eds.) Site Surveys and Significance Assessment in Australian Archaeology. Pp 27-33. Department of Prehistory, Research School of Pacific Studies, The Australian National University, Canberra.
- Piper, A. 1983 An archaeological survey of crown land subject to application for development in the vicinity of Belongel Swamp, Byron Bay. An unpublished report held by NSW National Parks and Wildlife Service.
- Piper, A. 1990 An archaeological investigation and Aboriginal consultations on Aboriginal sites at Chinderah, NSW. Unpublished report to Dames and Moore Pty Ltd.

- Piper, A. 1994a An Archaeological Survey At Quirk's Quarry, Eviron Road, Cudgen Via Murwillumbah, NSW. Unpublished report held by New South Wales National Parks and Wildlife Service.
- Piper, A. 1994b An Archaeological Survey At Duranbah Sand Quarry, Cudgen, North Coast, NSW. Unpublished report held by New South Wales National Parks and Wildlife Service.
- Piper, A. 1997 An Archaeological Survey At Old Bogangar Road Realignment, Cudgen, North Coast, NSW. Unpublished report held by New South Wales National Parks and Wildlife Service.
- Piper, A. 2000 An Archaeological Assessment at Lot 2, Crescent St, Cudgen. Unpublished report held by New South Wales National Parks and Wildlife Service.
- Piper, A. 2001 An Archaeological Assessment At Cudgen Road, Cudgen. Unpublished report held by New South Wales National Parks and Wildlife Service.
- Ramsay, J. and Paraskevopoulos, J. (eds) 1994 More than meets the eye: Identifying and Assessing Aesthetic Value. Australian Heritage Commission 1993 Technical Workshop Series No. 7.
- Rich, E. and Ahoy, C. 1993 State Highway No. 10 – Billinudgel to Chinderah Corridor Options: Preliminary Report on Aboriginal Heritage. Unpublished report prepared for Sinclair Knight and Partners.
- Rickard, J. and Spearritt (eds) 1991 Packaging the past? Public histories. Melbourne University Press: Melbourne.
- Ross, A. 1996 Landscape as Heritage. In Smith, L. and Clarke, A. (eds.) Issues in Management Archaeology. Tempus 5. Anthropology Museum, The University of Queensland: St Lucia.
- Rossignol, J. And Wandsnider, L. (eds.) 1992 Time, Space and Archaeological Landscapes. Plenum: New York.
- Rowley, C.D. 1981 **A Matter of Justice**. Australian National University Press: Canberra.
- Schofield, A.J. (Ed.) **Interpreting Artefact Scatters: Contributions to Ploughzone Archaeology**. Oxbow Monograph 4. Oxbow: Oxford.
- Sebastian, L. and Judge, W.J. 1988 Predicting the Past: Correlation, Explanation and the use of Archaeological Models. In Judge, W.J. and Sebastian, L. (eds.) **Quantifying the Present and Predicting the Past: Theory, Method, and Application of Archaeological Predictive Modelling**. U.S. Department of the Interior, Bureau of Land Management: Denver.
- Sharpe, M.C. 1978 An Introduction to the Bundjalung Language and its Dialects. Reissued 1984 – Armidale college of Advanced Education.

- Smith, C. 1993 An Archaeological investigation of the Urbenville Management Area, northeastern New South Wales. Unpublished report prepared for the Forestry Commission of New South Wales.
- Statham, E.J. 1892 Observations on shell heaps and shell beds. *Journal of the Royal Society of New South Wales* 26: 304-314.
- Sullivan, S. 1978 Aboriginal diet and food gathering methods in the Richmond and Tweed River Valleys, as seen in early settler records. In McBryde, I. (ed.) *Records of Times Past*. Australian Institute of Aboriginal Studies: Canberra.
- Tindale, N.B. 1974 *Aboriginal Tribes of Australia*. University of California Press: Berkely.
- WBM 2001 Tweed Shire Coastline Hazard Definition Study, Final Report. Unpublished report prepared for the Tweed Shire Council.

17.0 APPENDICES

17.1 Appendix 1: Report from the Tweed Byron LALC



TWEED BYRON LOCAL ABORIGINAL LAND COUNCIL

P.O. Box 1410
Kingscliff, NSW 2487
Telephone: (02) 6674 3600
Fax: (02) 6674 3603
E-mail: tblelc@qldnet.au

Friday, 17 September 2004

FAXED

17 SEP 2004

Ms Sue Davies
Consultant Archaeologist
PO Box 208
Red Hill Qld 4059

Dear Sue,

Re: Aquaculture Development Site and Saltwater Intake Pipeline Route

On the 27th August 2004, I inspected the areas at and around Kingscliff / Cudgen for a proposed aquaculture development and saltwater intake pipeline. The aquaculture development site is flat land that has been drained for the purpose of sugar cane growing. The proposed pipeline route travels along most of the following road reserves: Marine Parade, Beach Street, Elrond Drive, Tweed Shire Council Sewage Plant, Chinderah Road and Crescent Street.

Recommendations

Because the pipeline route is on the road reserve and the development site is on land with little or no archaeological potential, the Tweed Byron Local Aboriginal Land Council has no concerns with this project.

If you have any further queries I can be contacted on (02) 66743 600.

Yours sincerely


CLARENCE PHILLIPS
CO-ORDINATOR

APPENDIX F

- TRAFFIC IMPACT ASSESSMENT APPENDIX N

TRAFFIC IMPACT STUDY

PROPOSED AQUACULTURE DEVELOPMENT

LOT 1 ON DP 267742, LOT 706 ON DP 1000580

PACIFIC HIGHWAY: CHINDERAH: TWEED SHIRE

TRAFFIC IMPACT STUDY

PROPOSED AQUACULTURE DEVELOPMENT

LOT 1 ON DP 267742, LOT 706 ON DP 1000580

PACIFIC HIGHWAY: CHINDERAH: TWEED SHIRE

Prepared for
Australian Bay Lobster
Producers Pty Ltd
by
Traffic Planning Services
(Qld) Pty Ltd
September, 2004

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TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE

1. INTRODUCTION

1.1 Scope

This report has been commissioned by David McPhee & Associates, Consulting Engineers on behalf of Australian Bay Lobster Producers Pty Ltd to assess the traffic impacts associated with a proposed aquaculture development to be situated on the eastern side of the Pacific Highway at the interchange with Tweed Valley Way at Chinderah in Tweed Shire, New South Wales; to form part of applications to Tweed Shire Council and the Roads & Traffic Authority (NSW).

This traffic report investigates the existing conditions at the Pacific Highway/Tweed Valley Way interchange, traffic generated by the proposed development and future traffic volumes. It then assesses the effects of this traffic on operating conditions at the Melaleuca Station access intersection with Tweed Valley Way and at the access road junction with the on-ramp and off-ramp loop on the eastern side of the interchange, following completion of the development, and makes recommendations for any improvements to cater appropriately for traffic generated by the proposal.

1.2 Executive Summary

The proposed aquaculture development is located approximately 11km south of Tweed Heads along the Pacific Highway at Chinderah. The development would be carried out in 3 stages with about 200 employees at full development.

Applications to Tweed Shire Council for approval to redevelop this site need to include a traffic report as part of the submissions.

Investigations have been carried out into the traffic volumes along Tweed Valley Way past Melaleuca Station access and the southbound on-ramp and off-ramp loop of the Pacific Highway on the eastern side of the interchange at the 15 year design horizon i.e. year 2019, and based on a conservatively high 4% per year growth rate. These include traffic generated by the proposed development as well as traffic generated by adjacent land i.e. sand mining operations by Tweed Turf & Sand and harvesting of sugar cane for the Condong Mill. Consideration has also been given to the proposed highway service centre at Melaleuca Station and the possible future road connection to Kingscliff; it has been determined that these proposals do not affect the proposed aquaculture development.

Analysis has indicated that the existing Tweed Valley Way/Melaleuca Station access intersection would cater for this traffic in a satisfactory manner, in particular the U-turn movement to return northbound along the Pacific Highway. The intersection of the local road with the southbound on-ramp and off-ramp loop on the eastern side of the interchange would need to be upgraded by providing a left turn deceleration lane and taper (with left turn island). This would be provided prior at the commencement of construction on-site.

The sugar cane pad between the local road and the Pacific Highway would need to be maintained or satisfactory alternative provisions made.

TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE

2. PROPOSED DEVELOPMENT

2.1 General

The site for the proposed aquaculture development is situated on land described as Lot. 1 on DP 267742 and Lot. 706 on DP 1000580 (part), Parish of Cudgen, County of Rous in New South Wales. It is located on the south-eastern corner of the Pacific Highway interchange with Tweed Valley Way at Chinderah, approximately 11km south of Tweed Heads.

The site has its frontage to the Pacific Highway which is a National Route (No. 1) and forms part of the national road network for motorists travelling from Brisbane to Sydney. The Tweed Valley Way (also known as Oaks Avenue) is a tourist drive (No. 40) for motorists travelling to Murwillumbah and other areas of northern New South Wales. It is proposed to gain access directly to the local road at the northern end of the site; this road then intersects the on-ramp and off-ramp loop on the eastern side of the interchange, providing ready access to the Pacific Highway and Tweed Valley Way. This local road will provide access to the proposed sewage treatment plant located some distance east of the site.

The location of the proposed development is shown in Figure 1 and Figure 2.

2.2 Off-Site Development

Currently, nearby land is sparsely developed and rural in nature with sugar cane growing along both sides of the Pacific Highway. Melaleuca Station is located in the south-west quadrant of the interchange between Tweed Valley Way and the Pacific Highway. Sand mining operations are carried out by Tweed Turf and Sand about 1km east of the site.

The general area development is shown in Figure 3.

2.3 On-Site Development

The on-site development proposed for the property is an aquaculture development. The site area is 148.5 hectares.

Provision is proposed to be made for car parking, service vehicles and open space such as landscaping, with access to the local road located to provide safe entry and exit to and from the site and in accordance with Council's requirements. Currently, access is proposed directly to the southern end of the existing local road to/from the loop on the eastern side of the interchange at the Pacific Highway.

TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE

TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE



FIGURE 1 – LOCATION OF SITE



TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE

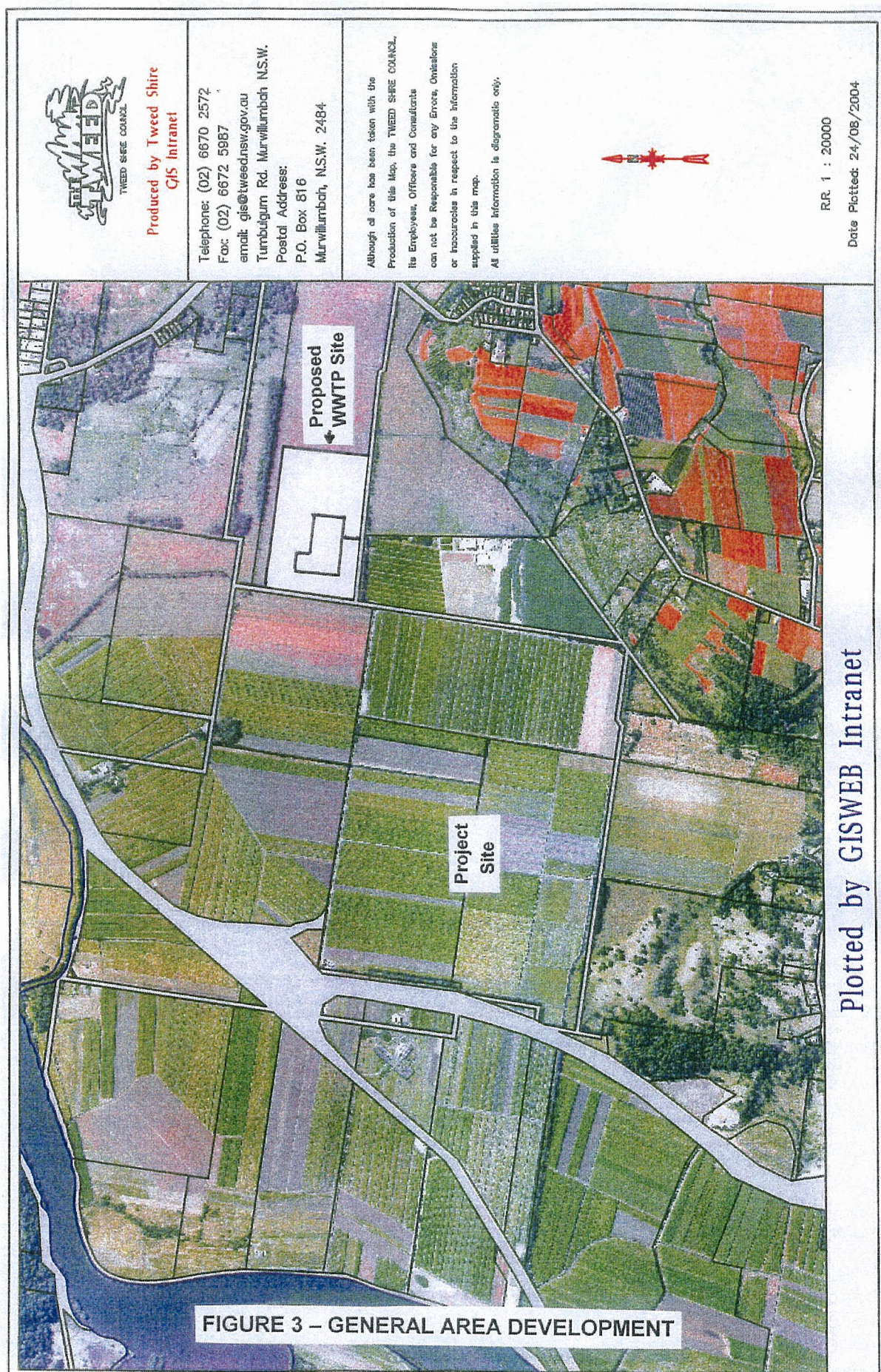


FIGURE 3 – GENERAL AREA DEVELOPMENT

**TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON
DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE**

3. AREA CONDITIONS

3.1 General

The Pacific Highway is a four-lane, median divided highway through the Tweed Valley Way interchange with a posted speed limit of 110km/h.

The Tweed Valley Way consists of a two-lane, median divided highway past the Melaleuca Station access with a posted speed limit of 80km/h southbound and 100km/h northbound. South of the Melaleuca Station access, the southbound carriageway has two lanes for traffic travelling towards Murwillumbah. The median is 11m wide at the Melaleuca Station access and provides a right turn bay for vehicles travelling north along Tweed Valley Way to store clear of through traffic while waiting to turn right to enter Melaleuca Station; it also provides a U-turn bay for vehicles from the north on the Pacific Highway to return northbound towards Tweed Heads.

On the eastern side of the overpass over the Pacific Highway, a right turn bay is provided from the on-ramp and off-ramp loop to the local road. It caters for traffic travelling northbound from the Tweed Valley Way and Pacific Highway off-ramp (i.e. Melaleuca Station direction) to the site. The speed limit on the loop and overpass is 80km/h with the loop curve signed at 75km/h in both directions.

The general intersection arrangements for the Melaleuca Station access with Tweed Valley Way and the local road/on-ramp and off-ramp loop are shown in Appendix C to this report.

3.2 Site Observations

Site inspections carried out on Tuesday, 24th August 2004 indicated traffic conditions were satisfactory. Vehicles appeared to be travelling at or slightly below the posted speed limits past the Melaleuca Station access on Tweed Valley Way and at about the 75km/h advisory speed along the on-ramp and off-ramp loop on the eastern side of the interchange. Vehicles experienced no difficulty carrying out U-turns to return northbound along Tweed Valley Way at the Melaleuca Station access. It is considered that motorists travelled through the interchange and approaches on Tweed Valley Way in a safe and orderly manner.

The lengths of the right turn bays and U-turn bay were measured:

- (i) Tweed Valley Way (at Melaleuca Station)
 - Right turn bay northbound into site
 - 75m lane with 30m taper;
 - U-turn to return northbound
 - 62m lane with 43m taper.

The left turn into the site is 72m lane with 13m taper.
- (ii) On-ramp and off-ramp loop (east side of interchange)
 - Right turn bay northbound into local road
 - 45m lane with 30m taper.

TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE

Sight distances for movements associated with the proposal to and from the Tweed Valley Way and the on-ramp and off-ramp loop on the eastern side of the interchange were:

- (i) Tweed Valley Way (at Melaleuca Station)
 - U-turn to return northbound – over 300m southwards.
- (ii) On-ramp and off-ramp loop (east side of interchange)
 - Right turn into local road - 220m northwards: this could be increased to over 330m with the removal of a fir tree in the landscaped area between the off-ramp and on-ramp
 - Right turn from local road- 330m northwards
- 165m southwards
 - Left turn from local road - 330m northwards
 - From vehicle on overpass to a vehicle stopped to turn right - 125m.

These sight distances conform to Austroads and are satisfactory.

3.3 Existing Traffic Volumes

Traffic surveys were carried out to determine the existing traffic volumes on the road network adjacent to the site. The surveys were carried out on Friday, Saturday and Sunday 20th – 22nd August and 3rd – 5th September 2004 by Australasian Traffic Surveys for this firm.

Automatic (tube) surveys were carried out on the southbound off-ramp and on-ramp on the eastern side of the interchange and for through movements on Tweed Valley Way for the 3 day period. To supplement this information, turning movement surveys were carried out for selected periods each day at the Melaleuca Station access during periods of higher flow. These periods were:

- (i) 8am – 12 noon and 3pm – 6pm Friday, 20th August 2004;
- (ii) 9am – 1pm Saturday, 21st August 2004;
- (iii) 11am – 4pm Sunday, 22 August 2004.

The summary sheets for the traffic surveys are included in Appendix A1, A2 and A3 to this report.

The highest volume (peak) flows along the Tweed Valley Way and on-ramp/off-ramp loop on the eastern side of the interchange are summarised in Table 1. These volumes have been determined from the total 3-day volumes for both directions along the Tweed Valley Way and on-ramp/off-ramp loop on the eastern side of the interchange and are considered to reflect normal traffic conditions and volumes at these locations.

**TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON
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**TABLE 1
TWEED VALLEY WAY & SOUTHBOUND ON/OFF RAMP: PEAK FLOWS**

Day	Tweed Valley Way			Times
	Northbound	Southbound	Total	
Friday	320 (464)	386 (456)	706 (920)	12-1pm 3-4pm
Saturday	348	401	749	12-1pm
Sunday	331	380	711	12-1pm

Day	Southbound On/Off Ramp			Times
	On-Ramp Southbound	Off-Ramp Southbound	Total	
Friday	13 (14)	365 (436)	378 (449)	12-1pm 3-4pm
Saturday	15	389	404	12-1pm
Sunday	18	352	370	12-1pm

The figures in brackets on Friday are the highest hourly volume flows. While it is unlikely that these volumes would coincide with the start/end of shift periods (see Section 4.1 of the report), they have been adopted as the existing peak hour flows. These volumes are shown in Figure 4.

**TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON
DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE**

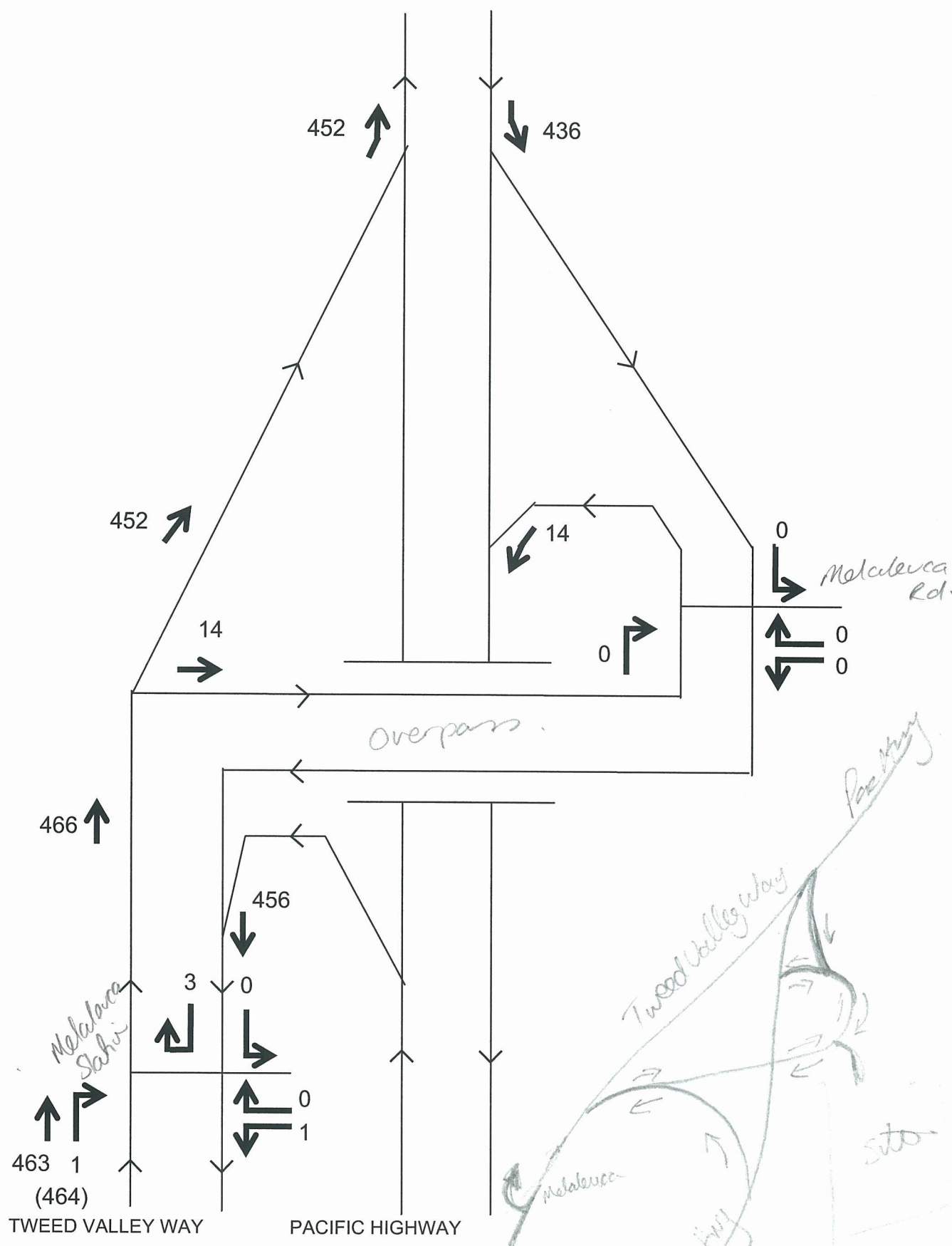


FIGURE 4 – EXISTING 2004 TRAFFIC VOLUMES

TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE

4. PROJECTED TRAFFIC

4.1 Site Traffic

from where to where - condⁿ 4 later stage

The development is proposed to be built in 3 stages with the first stage expected to be complete within 18 months and the full development within 5 years. The first stage would employ approximately 70 staff. This would increase to about 135 staff with the second stage, eventually providing approximately 200 staff at full development. It is understood that a bus service is proposed for employees to travel to and from the site following completion of the second stage of the project i.e. at the time staff members increase from 70 to 135.

The project is proposed to operate on a 24 hours per day, 7 days a week arrangement with 5 shifts per day. The start and finish times for the shifts would be discussed with staff. The workforce is diverse with a multitude of tasks, with the timing controlled by the nature of the animals and associated tasks i.e. feeding, cleaning, hatching and research work as well as plant maintenance and site maintenance, occurring at varying times through the day and night. As a result, it is difficult to precisely estimate traffic volumes at the start and ends of shifts. For analysis purposes, 3 shifts have been assumed with 180 staff as being a "worst-case" scenario for traffic generated by the proposal. This would result in about 20 staff starting each shift for Stage 1; increasing to about 60 staff for each shift at full development, assuming that all staff arrive in their own vehicle i.e. no bus service or ride-sharing arrangements.

but 200 are proposed.

20 staff @ each shift @ Stage 1

Staff starting a shift would enter the site prior to the end of the earlier shift. As a result, vehicles starting a shift would have entered the site before any vehicles leave the site at the end of the earlier shift.

The development would provide employment for residents of nearby communities. From discussions with Council officers, it is considered that 45 vehicles would approach the site from the north, 10 from the west (i.e. Murwillumbah) and 5 from the south before the start of a shift; with these vehicles returning to these areas after the end of their shift.

60 staff @ each shift @ S3

Vehicles other than employees' vehicles entering and leaving the site would be generally delivery vehicles (of the order 5-6 vehicles) on a daily basis, with occasional trips by salespersons and others to and from the site.

5-6 trucks per day

These additional trips would be low in number and spread throughout the day. To assess possible impacts on the road system at the start and end of shift, it is assumed that these trips would be 20% of employee trips (i.e. 12 trips) and travelling in the opposite direction to employee vehicles at the start/end of a shift.

It is considered that these site traffic generations, directional splits and distribution to the road network represent reasonable expectations for this type of development; and, as no allowance for a future bus service for employees or ride-sharing has been made and only 3 shifts have been assumed (instead of the likely 5 shifts in practice), is a "worst-case" scenario for traffic generated by the development.

TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE

The site traffic volumes are shown in Figure 5.

4.2 Adjacent Development Traffic

Following an on-site meeting with Mr M. Baldwin of RTA Grafton office on Tuesday, 24th August 2004 in relation to the project, discussions were held with Tweed Turf & Sand in relation to sand mining operations located about 1km east of the site, and New South Wales Sugar-Condong Mill (Condong Sugar Mill) in relation to harvesting of sugar cane on the eastern side of the Pacific Highway, to determine any likely additional traffic which may use the local road access to the on-ramp and off-ramp loop on the eastern side of the interchange.

(i) Sand Mining

Tweed Turf & Sand advised that the trucks associated with sand mining delivered sand to cement companies by travelling eastwards from the sandmining site to Tweed Coast Road then northwards along the Pacific Highway towards Tweed Heads. Trucks returned to the site along the same route.

No vehicles associated with sandmining operations at this location use the Pacific Highway/Tweed Valley Way interchange.

There is a possibility that tea tree harvesting may be considered at some future time. Traffic associated with this use would be approximately 6 trucks per day from 7am – 3pm (about 1 truck per hour), 5 days a week over a 3-4 week harvesting period.

(ii) Condong Sugar Mill

Cane harvesting is carried out 3 to 4 times during a season over 2 days maximum each time. This area can be harvested only every second year. Traffic generated by the harvesting is about 25-30 trucks in and 25-30 trucks out each 24 hour day. Average movements are about 2 trucks/hr each way (i.e. 1 truck each 30 minutes each way) during the day.

Normally, there would be about 15 movements in and 15 movements out between 6am and 6pm; with 10 movements in and 10 movements out between 6pm and 6am (i.e. 1 truck each way per hour at night).

The hardstand area at the 'bottom' end of the local road adjacent to the highway is used as a sugar cane pad for stacking of bins for sugar cane loading onto trucks. This area is an important sugar cane pad; if it was affected by the proposal, a new pad located close to the existing one would need to be provided.

The trucks carry the sugar cane to the Condong Mill for crushing etc (i.e. along Tweed Valley Way towards Murwillumbah. While these trucks would use the right turn bay on the eastern side of the overpass, they would not use the U-turn bay at the Melaleuca Station access.

**TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON
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(iii) *Summary*

It is considered that these developments would contribute about 3vph to the right turn bay on the eastern side of the overpass with 3vph turning left from the local road onto the loop on the eastern side of the interchange. These volumes are shown in Figure 5.

TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE

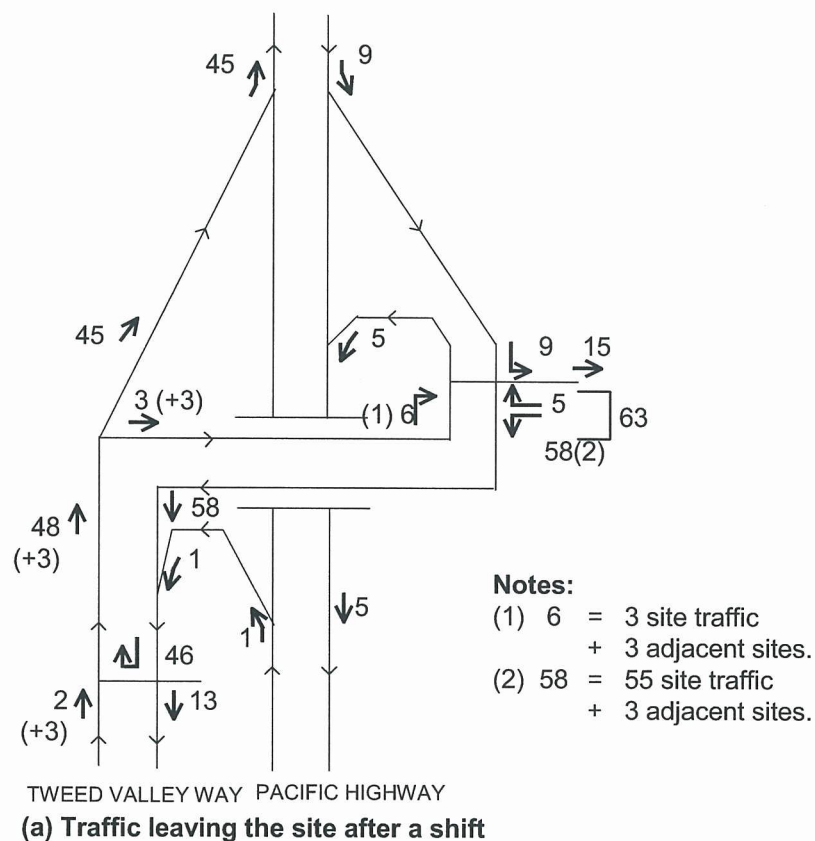
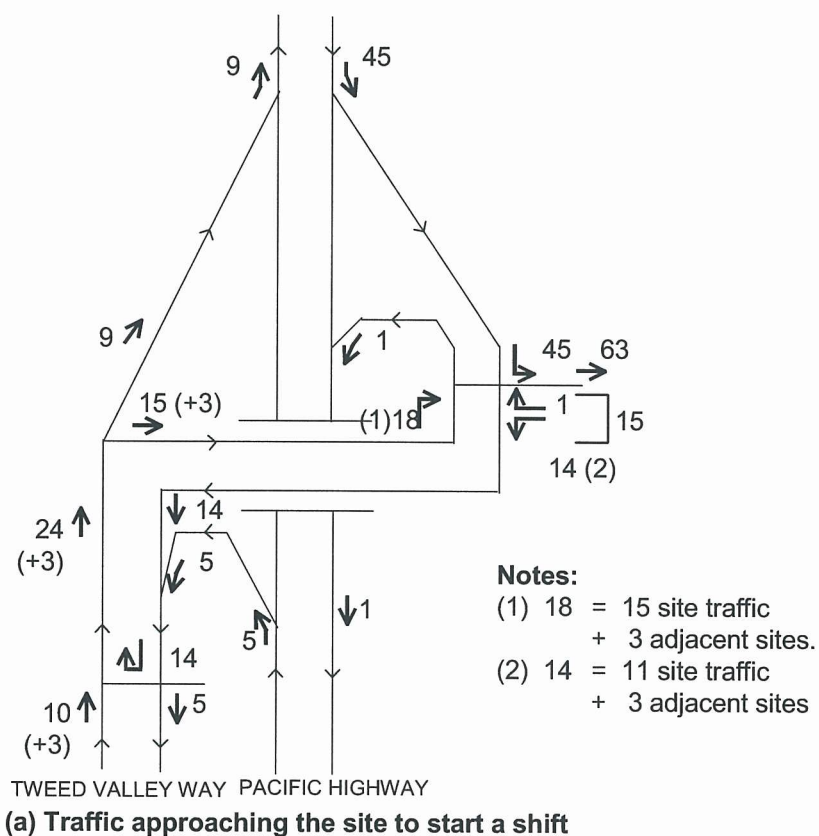


FIGURE 5 – SITE TRAFFIC AND ADJACENT SITES TRAFFIC DIAGRAM

TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE

4.3 Through Traffic

Traffic information has been obtained from the Roads & Traffic Authority (NSW) to determine a long term growth rate for traffic along this section of the Pacific Highway. This information indicated:

(i) Barneys Point Bridge – north side of Tweed River

- Year 1990 AADT 23,432
- Year 1998 AADT 32,642
- Year 2001 AADT 34,782.

This indicates a 2.2% per year growth rate for the 3 year period from 1998 to 2001; with a 3.7% per year long term growth rate for the 11 year period from 1990 to 2001.

(ii) South of Chinderah Road interchange

- Year 1998 AADT 14,416
- Year 2001 AADT 15,495.

This indicates a 2.5% per year growth rate.

Based on the above, a growth rate of 4% per year has been adopted for the 15 year design horizon for “through” volumes along Tweed Valley Way and the on-ramp and off-ramp loop on the eastern side of the interchange. This will result in “through” traffic volumes at year 2019 being approximately 80% higher than existing 2004 volumes. The year 2019 volumes without the development are shown in Figure 6.

4.4 Total Traffic

why 2019 when development expected to be functional by 2010

It is likely that the start/finish times of the 3 shifts of the day (e.g. at 6am, 2pm and 8pm) would not coincide with road peak times, except for possibly the 2pm shift.

However, to determine the impact of the proposed development on year 2019 design traffic volumes, the traffic generated by the site (Figure 5) is added to the 2019 design year base volumes (Figure 6). The resulting 2019 design year traffic volumes i.e. with the development, are shown in Figure 7.

TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE

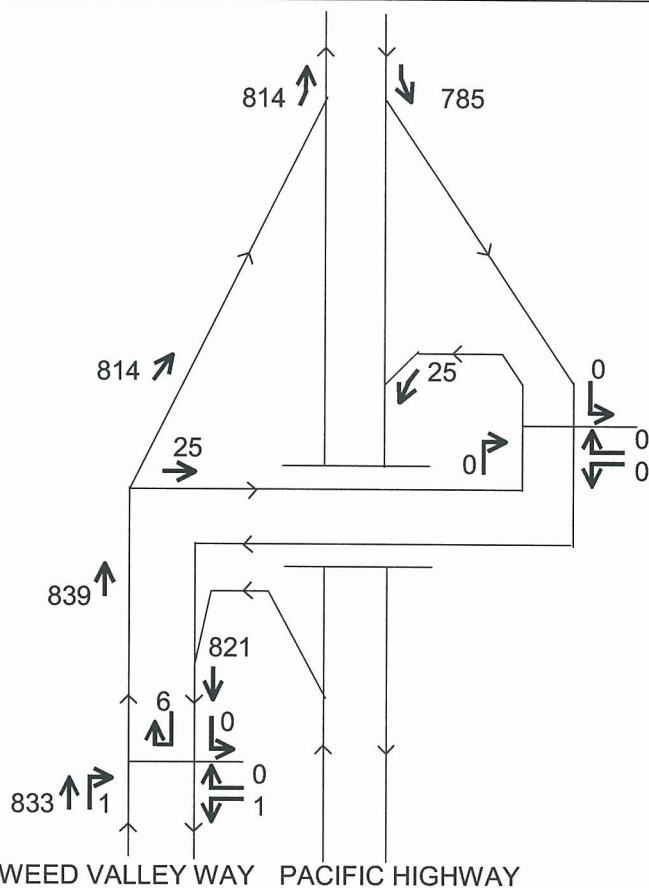


FIGURE 6 – 2019 BASE TRAFFIC VOLUMES (NO DEVELOPMENT)

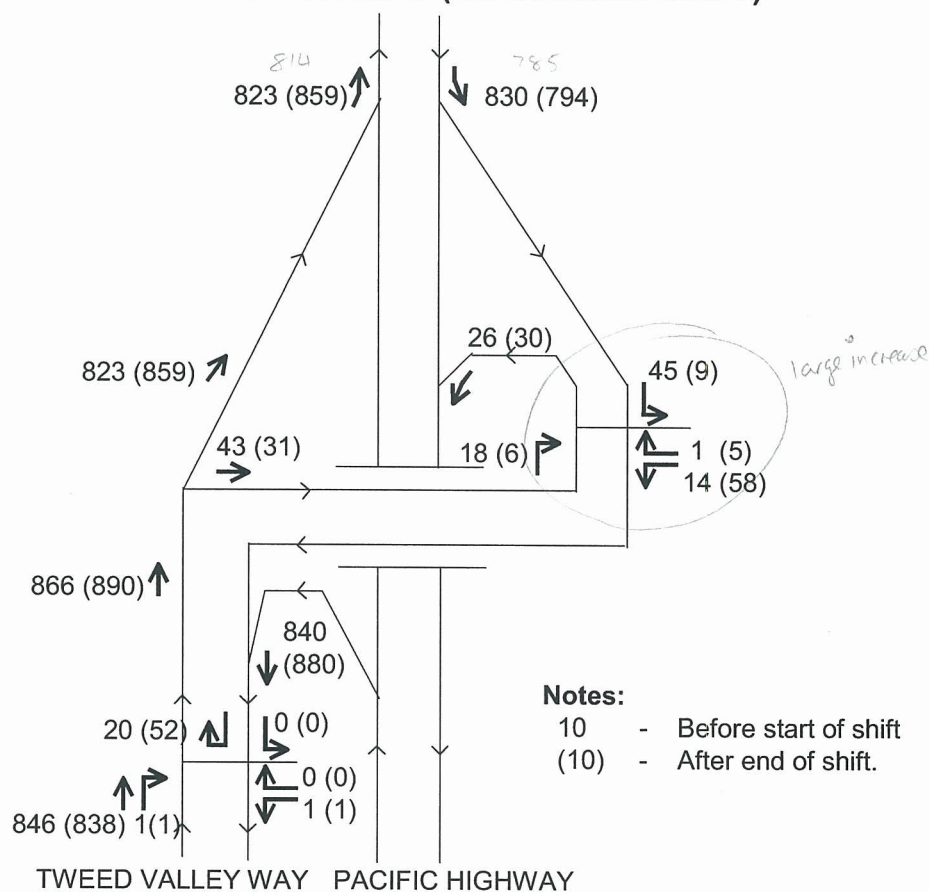


FIGURE 7 – 2019 DESIGN TRAFFIC VOLUMES (WITH DEVELOPMENT)

TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE

5. TRAFFIC ANALYSIS

5.1 Tweed Valley Way/Melaleuca Station Access Junction

From discussions with Tweed Shire Council, it is understood that access to the proposed highway service centre at Melaleuca Station would be located about 400-500m south of the existing access to Melaleuca Station along Tweed Valley Way. The U-turn provision at the existing access for motorists to return north along the Pacific Highway would also be relocated southwards to the new highway service centre access.

In view of this, the existing volumes turning into and out of Melaleuca Station access are used for analysis at year 2019. The 2019 design volumes from Figure 7 are shown below.

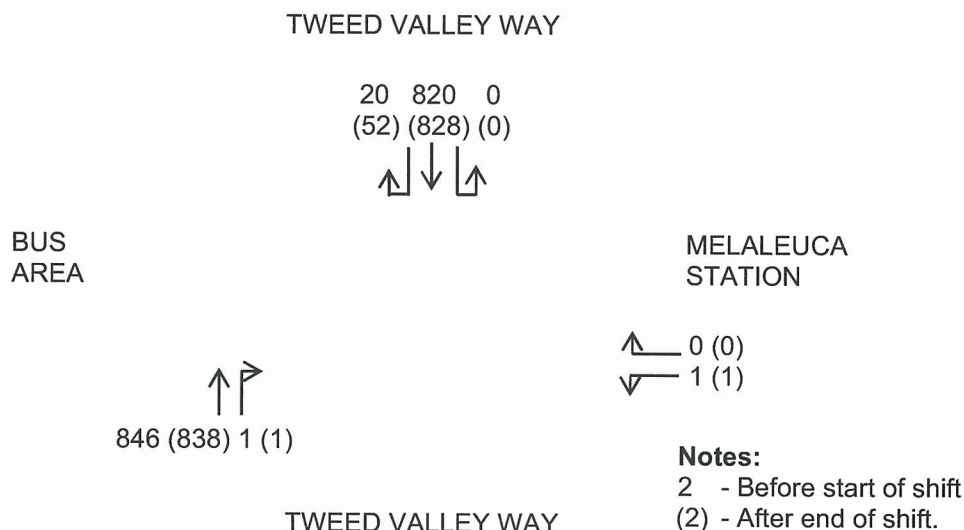


FIGURE 8 – 2019 DESIGN VOLUMES: MELALEUCA STATION ACCESS

Sidra analysis has been carried out to assess the impacts of the proposed aquaculture development on the U-turn at Melaleuca Station access. The intersection was analysed as a four-way intersection to allow assessment of the U-turn movement. Vehicles leaving Melaleuca Station and the bus area opposite use Austroads gap acceptance parameters i.e. acceptance gap (ta) = 5 seconds and follow-up headway (tf) = 3 seconds. This is considered appropriate as there is ample median width to store vehicles leaving these areas. Also, gap acceptance for U-turns has been adopted as 6 seconds.

Analysis has been carried out for the 'after end of shift' scenario as the U-turn volumes are substantially higher during this period. It is also assumed that the vehicles leaving at the end of a shift would do so over about a 20 minute period for analysis purposes. The results of the analysis are summarised in Table 2. Sidra output results are included in Appendix B to this report.

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DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE**

**TABLE 2 – INTERSECTION ANALYSIS SUMMARY
TWEED VALLEY WAY/MELALEUCA STATION ACCESS**

Performance Parameter	2019 Design Volumes with Aquaculture Development
Intersection	
- DOS	0.715
- Average delay (secs)	3.6
- Total vehicle delay (veh.h/hr)	2.04
- LOS	A
Tweed Valley Way	
- Right Turn (from south)	
• DOS	0.004
• queue length (m)	0.0
• average delay (secs)	20.6
• LOS	C
- U-turn (from north)	
• DOS	0.715
• queue length (m)	41.0
• average delay (secs)	38.0
• LOS	E

*what do it prior
to development*

Note: The average delay on the north approach is 6.0 seconds (LOS A).

Traffic operations at unsignalised intersections are generally considered satisfactory where the following criteria are met:

- (i) Degree of Saturation (DOS) – less than 0.80
- (ii) Average delay on approach – less than about 30 seconds.

Based on the above criteria and other relevant matters such as queue length, it is considered that the existing intersection arrangement would generally have satisfactory operating conditions and readily accommodate vehicle queues generated by the proposal. Also, the through volumes are based on a conservative (high) 4% per year growth rate.

5.2 On-Ramp and Off-ramp Loop/Local Road Access Junction

Discussions with Tweed Shire Council have indicated the possibility of a future connection to Kingscliff from the Pacific Highway/Tweed Valley Way interchange. It is understood that this concept has only been raised recently as a possible option to address ramp capacity needs at Chinderah interchange on the Pacific Highway about 2km north of the site, around year 2020. It was considered that provision of such a connection would require reconfiguration of the Pacific Highway/Tweed Valley Way interchange and that this would include accommodation of appropriate access to the aquaculture development at that time.

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In view of this, no provision is made in the analyses for likely volumes to be attracted to the route. The 2019 design volumes from Figure 7 are shown below.

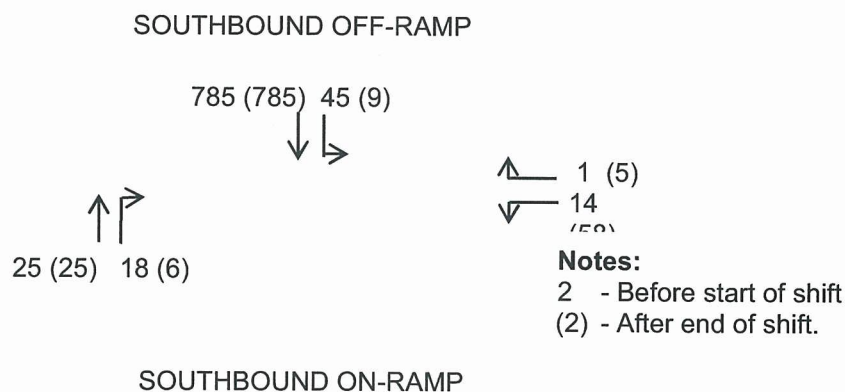


FIGURE 9 – 2019 DESIGN VOLUMES: LOCAL ROAD

Sidra analysis has been carried out to assess the impacts of the proposed development on the intersection, with a left turn deceleration lane and taper (with a left turn island) for the left turn from the southbound off-ramp into the local road. Vehicles leaving the local road access to enter the off-ramp and on-ramp loop use acceptance gap (t_a) = 6.5 secs (right turn) and 5.5 secs (left turn), with follow-up headway (t_f) = 3.5 secs and 3.0 secs respectively. These values are slightly higher than Austroads values and are considered appropriate, as most drivers would not store in the median to carry out the right turn.

Analysis has been carried out for both the 'before start of shift' and 'after end of shift' scenarios; over a 20 minute period, as most vehicles would enter and leave during this period for shifts. The results of the analysis are summarised in Table 3. Sidra output results are included in Appendix B to this report.

**TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON
DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE**

**TABLE 3 – INTERSECTION ANALYSIS SUMMARY
ON-RAMP AND OFF-RAMP LOOP/LOCAL ROAD ACCESS**

Performance Parameter	2019 Design Volumes with Aquaculture Development	
	Before Start of Shift	After End of Shift
Intersection		
- DOS	0.448	0.494
- Average delay (secs)	3.2	4.6
- Total vehicle delay (veh.h/hr)	1.03	1.47
- LOS	A	A
Off-ramp		
- Left Turn (from north)		
• DOS	0.104	0.021
• queue length (m)	3.0	1.0
• average delay (secs)	11.1	11.0
• LOS	B	B
On-ramp		
- Right turn (from south)		
• DOS	0.096	0.032
• queue length (m)	3.0	1.0
• average delay (secs)	16.4	16.1
• LOS	C	C
Local Road		
- Left turn		
• DOS	0.131	0.494
• queue length (m)	4.0	22.0
• average delay (secs)	19.1	21.7
• LOS	C	C
- Right turn		
• DOS	0.014	0.065
• queue length (m)	0.1	2.0
• average delay (secs)	24.4	22.3
• LOS	C	C

*what do
current LOS
(or 2019) w/out
development.*

It is considered that the existing intersection arrangement, upgraded to provide a left turn deceleration lane and taper (with a left turn island), would provide satisfactory operating conditions and accommodate vehicle queues generated by the proposal. It would also allow vehicles turning left from the off-ramp to reduce speed clear of 'through' traffic on the off-ramp and turn left safely into the local road.

Based on Austroads guidelines, it is considered that with a 3% upgrade (approximately) the length of the deceleration lane and taper would be about 100m plus provision for the left turn island. This would be the subject of detailed design and in accordance with RTA requirements.

TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE

5.3 Site Access

All vehicles will enter and leave the development via an access to the local road at the northern end of the site which intersects the on-ramp and off-ramp loop on the eastern side of the interchange. Vehicles may then travel north and south along the Pacific Highway to Tweed Heads or Ballina; or west along the Tweed Valley Way to Murwillumbah.

The access to the site is proposed to be located directly opposite the southern end of the local road stub on the eastern side of the interchange. This would be the subject of discussions with Council as plans for the development proceed.

5.4 Construction Traffic

Traffic associated with construction of the proposed development is not known at this stage of the proposal. It is considered that construction traffic would be less than traffic generated by the proposal when fully developed. Also it is understood that construction would be carried out from 6am to 6pm. The traffic volumes travelling along the roads at these times are substantially less than the year 2019 peak volumes used for analysis purposes (with volumes at time of construction (2005) about 50% of 2019 volumes).

*traffic volumes
unknown*

It is considered that the arrangements proposed to cater for traffic generated by the development would accommodate site construction traffic without difficulty. From a traffic operations and safety perspective, it is considered that the upgrading of the southbound on-ramp and off-ramp loop intersection with the local road i.e. the left turn lane upgrading, should be provided at the commencement of construction on-site.

6. FUTURE ROAD PLANNING

Discussions with Roads & Traffic Authority (NSW), Grafton have indicated that future planning along this section of the Pacific Highway would not require any land for future road purposes from the subject site. The proposal is able to be planned using setbacks and clearances from the existing property boundary; this would be consistent with current and future planning for this section of the Pacific Highway.

7. CONCLUSION

Investigations have been carried out into the traffic impacts associated with a proposed aquaculture development to be situated on the eastern side of the Pacific Highway/Tweed Valley Way interchange at Chinderah in Tweed Shire.

An analysis of traffic generated by the proposal has indicated that traffic impacts on the adjacent road network are minimal. The Tweed Valley Way/Melaleuca Station access intersection would cater for this traffic in a satisfactory manner, without any improvements to the intersection layout. The southbound on-ramp and off-ramp loop intersection with the local road on the eastern side of the interchange would need to

**TRAFFIC IMPACT STUDY: PROPOSED AQUACULTURE DEVELOPMENT AT LOT 1 ON
DP 267742, LOT 706 ON DP 1000580 PACIFIC HIGHWAY, CHINDERAH: TWEED SHIRE**

be upgraded to provide a separate left turn deceleration lane and taper approximately 100m in length (with left turn island) to cater for development traffic as proposed in this report.

These arrangements would accommodate construction traffic associated with the site. From a traffic operations and safety perspective, the left turn lane upgrading provisions should be installed at the commencement of construction on-site.

Access to the development is proposed directly from the southern side of the local road stub on the eastern side of the interchange. As the area between the local road and the Pacific Highway is currently used for stacking of bins associated with sugar cane harvesting, access would need to be clear of this area or an alternative hardstand area provided nearby.

Appendix A1

Vehicle Volume Summary Sheets Pacific Highway: Southbound On and Off Ramps

Site No.*1***Client** *Traffic Planning Services***Location***Pacific Highway On ramp***Direction***Southbound***Hourly Traffic Volume Summary**

Time (hour starting)	Friday 20/8/04	Saturday 21/8/04	Sunday 22/8/04	Total 3 day Volumes	Average Daily Volumes
00:00	0	1	1	2	1
01:00	1	2	0	3	1
02:00	1	3	0	4	1
03:00	1	0	2	3	1
04:00	1	3	1	5	2
05:00	5	0	1	6	2
06:00	10	4	0	14	5
07:00	14	6	5	25	8
08:00	11	7	5	23	8
09:00	9	7	11	27	9
10:00	9	14	14	37	12
11:00	13	9	11	33	11
12:00	13	15	18	46	15
13:00	9	9	11	29	10
14:00	17	16	13	46	15
15:00	14	15	14	43	14
16:00	15	13	10	38	13
17:00	7	9	4	20	7
18:00	4	5	5	14	5
19:00	9	3	3	15	5
20:00	5	2	6	13	4
21:00	1	2	2	5	2
22:00	1	2	2	5	2
23:00	1	2	1	4	1
Daily Total Traffic Volumes	171	149	140	460	153
Peak Hourly Traffic Volumes	17	16	18	51	17

Site No.

2

Client *Traffic Planning Services***Location***Pacific Highway off ramp***Direction***Southbound***Hourly Traffic Volume Summary**

Time (hour starting)	Friday 3/9/04	Saturday 4/9/04	Sunday 5/9/04	Total 3 day Volumes	Average Daily Volumes
00:00	13	39	33	85	28
01:00	10	17	27	54	18
02:00	5	15	15	35	12
03:00	18	13	12	43	14
04:00	13	23	13	49	16
05:00	52	33	21	106	35
06:00	206	131	59	396	132
07:00	313	179	84	576	192
08:00	309	201	149	659	220
09:00	354	253	236	843	281
10:00	329	340	322	991	330
11:00	358	341	407	1106	369
12:00	365	389	352	1106	369
13:00	303	356	288	947	316
14:00	369	344	334	1047	349
15:00	436	328	333	1097	366
16:00	460	311	342	1113	371
17:00	456	274	281	1011	337
18:00	298	182	126	606	202
19:00	159	123	101	383	128
20:00	145	112	118	375	125
21:00	108	101	68	277	92
22:00	86	84	56	226	75
23:00	74	62	23	159	53
Daily Total Traffic Volumes	5239	4251	3800	13290	4430
Peak Hourly Traffic Volumes	460	389	407	1256	419

Appendix A2
Vehicle Volume Summary Sheets
Tweed Valley Way: near
Melaleuca Station

Site No.

3

Client *Traffic Planning Services***Location***Tweed Valley Highway***Direction***Southbound***Hourly Traffic Volume Summary**

Time (hour starting)	Friday 3/9/04	Saturday 4/9/04	Sunday 5/9/04	Total 3 day Volumes	Average Daily Volumes
00:00	16	43	35	94	31
01:00	9	20	31	64	21
02:00	7	17	17	40	13
03:00	18	15	13	48	16
04:00	37	22	14	50	17
05:00	136	36	23	112	37
06:00	302	134	58	405	135
07:00	330	186	84	589	196
08:00	461	218	158	698	233
09:00	399	278	241	897	299
10:00	394	361	334	1045	348
11:00	340	353	427	1154	385
12:00	320	401	380	1167	389
13:00	375	379	318	1013	338
14:00	343	359	356	1095	365
15:00	464	342	355	1153	384
16:00	40	331	358	1160	387
17:00	327	292	294	1060	353
18:00	258	188	142	634	211
19:00	121	127	104	400	133
20:00	88	113	118	381	127
21:00	58	108	76	298	99
22:00	44	87	60	235	78
23:00	29	67	27	175	58
Daily Total Traffic Volumes	5467	4477	4023	13967	4656
Peak Hourly Traffic Volumes	474	401	427	1302	434

Site No.

4

Client *Traffic Planning Services***Location***Tweed Valley Highway***Direction***Northbound***Hourly Traffic Volume Summary**

Time (hour starting)	Friday 20/8/04	Saturday 21/8/04	Sunday 22/8/04	Total 3 day Volumes	Average Daily Volumes
00:00	16	23	20	59	20
01:00	9	12	6	27	9
02:00	7	12	16	35	12
03:00	18	11	9	38	13
04:00	37	24	14	75	25
05:00	136	67	40	243	81
06:00	302	122	66	490	163
07:00	330	183	80	593	198
08:00	461	259	165	885	295
09:00	399	369	292	1060	353
10:00	394	420	302	1116	372
11:00	340	404	353	1097	366
12:00	320	348	331	999	333
13:00	375	407	346	1128	376
14:00	343	309	367	1019	340
15:00	464	306	370	1140	380
16:00	40	270	361	1061	354
17:00	327	268	282	877	292
18:00	258	214	164	636	212
19:00	121	117	80	318	106
20:00	88	83	60	231	77
21:00	58	55	42	155	52
22:00	44	49	15	108	36
23:00	29	20	16	65	22
Daily Total Traffic Volumes	5306	4352	3797	13455	4485
Peak Hourly Traffic Volumes	464	420	370	1254	418

Site No.

5

Client *Traffic Planning Services***Location***Pacific Highway off ramp
between sites 2 & 3***Direction***Southbound***Hourly Traffic Volume Summary**

Time (hour starting)	Friday 3/9/04	Saturday 4/9/04	Sunday 5/9/04	Total 3 day Volumes	Average Daily Volumes
00:00	2	4	3	9	3
01:00	2	3	3	8	3
02:00	1	2	3	6	2
03:00	2	3	1	6	2
04:00	2	0	1	3	1
05:00	1	2	2	5	2
06:00	9	8	1	18	6
07:00	11	8	3	22	7
08:00	17	15	10	42	14
09:00	21	26	10	57	19
10:00	24	22	21	67	22
11:00	22	17	23	62	21
12:00	23	14	28	65	22
13:00	15	26	31	72	24
14:00	18	12	24	54	18
15:00	14	15	21	50	17
16:00	18	19	16	53	18
17:00	15	16	16	47	16
18:00	8	6	14	28	9
19:00	9	4	4	17	6
20:00	7	4	3	14	5
21:00	6	6	5	17	6
22:00	2	4	4	10	3
23:00	6	6	5	17	6
Daily Total Traffic Volumes	255	242	252	749	250

**Peak Hourly
Traffic Volumes**

24

26

31

81

27

APPENDIX A3

**Vehicle Volume Summary Sheets
Turning movements at Melaleuca
Station access with Tweed Valley
Way**

AUSTRALASIAN TRAFFIC SURVEYS

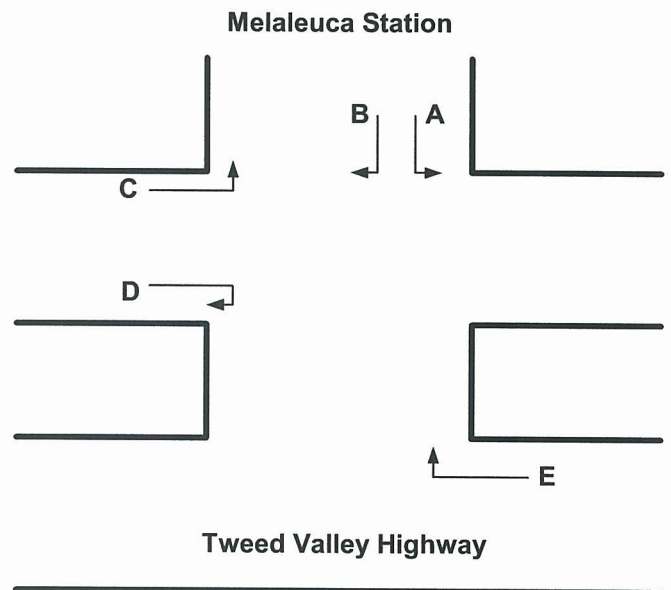
Site No.: 1 **Weather:** Fine

Location: Melaleuca Station, Chinderah

Day/Date: Sunday 22 August 2004

Sun Peak: Hour ending - 3:00 PM

Time Period	Movement Number				
	A	B	C	D	E
11:00 AM - 11:15 AM	0	0	0	1	1
11:15AM - 11:30AM	0	0	0	1	0
11:30 AM - 11:45 AM	0	0	0	2	0
11:45 AM - 12:00 PM	0	0	0	1	0
12:00 PM - 12:15 PM	0	1	1	0	0
12:15 PM - 12:30 PM	1	1	0	0	0
12:30 PM - 12:45 PM	0	0	1	0	0
12:45 PM - 1:00 PM	0	0	0	0	0
1:00 PM - 1:15 PM	0	0	0	0	0
1:15 PM - 1:30 PM	0	1	0	1	0
1:30 PM - 1:45 PM	0	0	0	0	0
1:45 PM - 2:00 PM	0	1	0	0	1
2:00 PM - 2:15 PM	0	0	1	0	0
2:15 PM - 2:30 PM	0	0	0	0	1
2:30 PM - 2:45 PM	2	1	1	2	0
2:45 PM - 3:00 PM	0	2	0	3	0
3:00 PM - 3:15 PM	0	0	1	0	0
3:15 PM - 3:30 PM	0	0	0	0	0
3:30 PM - 3:45 PM	0	0	0	0	0
3:45 PM - 4:00 PM	0	2	0	0	0
TOTALS	3	9	5	11	3
PEAK HOUR	2	3	2	5	1



AUSTRALASIAN TRAFFIC SURVEYS

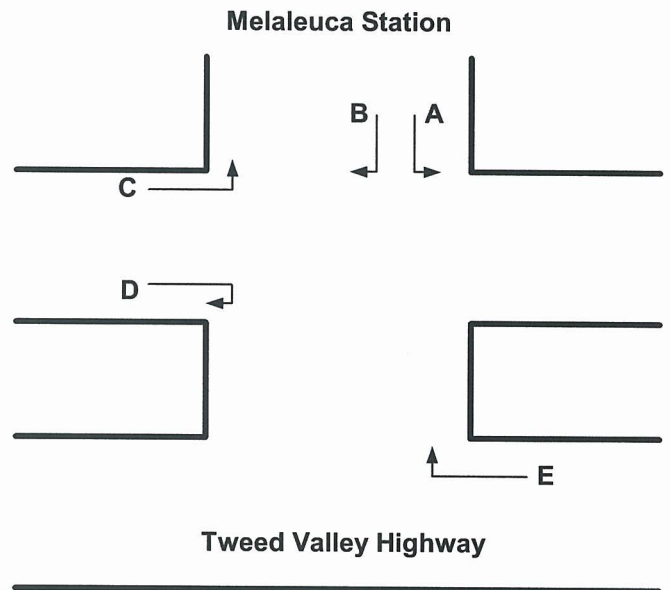
Site No.: 1 **Weather:** Fine

Location: Melaleuca Station, Chinderah

Day/Date: Saturday 21 August 2004

Sat Peak: Hour ending – 10:45 AM

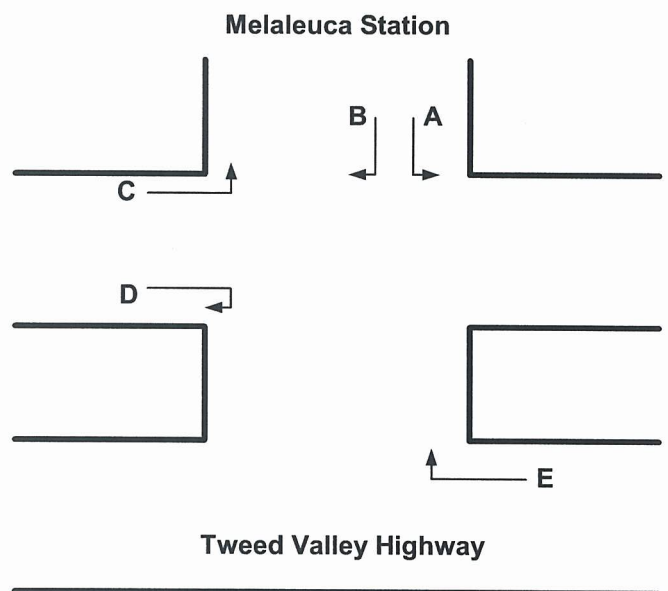
Time Period	Movement Number				
	A	B	C	D	E
9:00 AM - 9:15 AM	0	0	0	0	0
9:15 AM - 9:30 AM	0	0	0	3	0
9:30 AM - 9:45 AM	0	0	0	2	0
9:45 AM - 10:00 AM	0	0	3	0	0
10:00 AM - 10:15 AM	0	1	0	1	0
10:15 AM - 10:30 AM	1	0	4	0	0
10:30 AM - 10:45 AM	2	0	0	1	0
10:45 AM - 11:00 AM	0	1	1	0	0
11:00 AM - 11:15 AM	1	0	2	0	0
11:15 AM - 11:30 AM	0	1	1	0	0
11:30 AM - 11:45 AM	0	1	1	0	1
11:45 AM - 12:00 PM	0	2	1	0	1
12:00 PM - 12:15 PM	1	1	0	1	1
12:15 PM - 12:30 PM	0	0	0	0	0
12:30 PM - 12:45 PM	0	0	2	1	0
12:45 PM - 1:00 PM	0	0	0	0	0
TOTALS	5	7	15	9	3
PEAK HOUR	3	1	7	2	0



AUSTRALASIAN TRAFFIC SURVEYS

Site No.: 1 Weather: Fine
 Location: Melaleuca Station, Chinderah
 Day/Date: Friday 20 August 2004
 AM Peak: Hour ending – 9:45 AM
 PM Peak: Hour ending – 5:00 PM

Time Period	Movement Number				
	A	B	C	D	E
8:00 AM - 8:15 AM	1	0	0	0	0
8:15 AM - 8:30 AM	0	0	0	0	0
8:30 AM - 8:45 AM	0	0	0	0	0
8:45 AM - 9:00 AM	1	0	2	0	0
9:00 AM - 9:15 AM	0	0	1	0	0
9:15 AM - 9:30 AM	1	1	0	0	0
9:30 AM - 9:45 AM	0	1	2	3	0
9:45 AM - 10:00 AM	0	0	1	0	0
10:00 AM - 10:15 AM	0	0	1	0	0
10:15 AM - 10:30 AM	0	0	0	2	0
10:30 AM - 10:45 AM	0	0	0	0	0
10:45 AM - 11:00 AM	1	1	2	1	0
11:00 AM - 11:15 AM	1	1	0	0	0
11:15 AM - 11:30 AM	0	0	0	1	0
11:30 AM - 11:45 AM	0	0	1	0	0
11:45 AM - 12:00 PM	0	2	1	1	1
TOTALS	4	6	11	8	1
PEAK HOUR	2	2	5	3	0



Time Period	Movement Number				
	A	B	C	D	E
3:00 PM - 3:15 PM	0	0	0	2	0
3:15 PM - 3:30 PM	0	0	0	1	0
3:30 PM - 3:45 PM	0	0	0	0	0
3:45 PM - 4:00 PM	1	0	0	0	1
4:00 PM - 4:15 PM	0	0	0	0	0
4:15 PM - 4:30 PM	3	0	0	0	0
4:30 PM - 4:45 PM	0	3	2	0	0
4:45 PM - 5:00 PM	0	1	1	1	0
6:00 PM - 5:15 PM	0	0	0	0	0
5:16 PM - 5:30 PM	0	0	0	0	0
5:30 PM - 5:45 PM	0	0	0	0	0
5:45 PM - 6:00 PM	0	1	0	0	0
TOTALS	4	5	3	4	1
PEAK HOUR	3	4	3	1	0

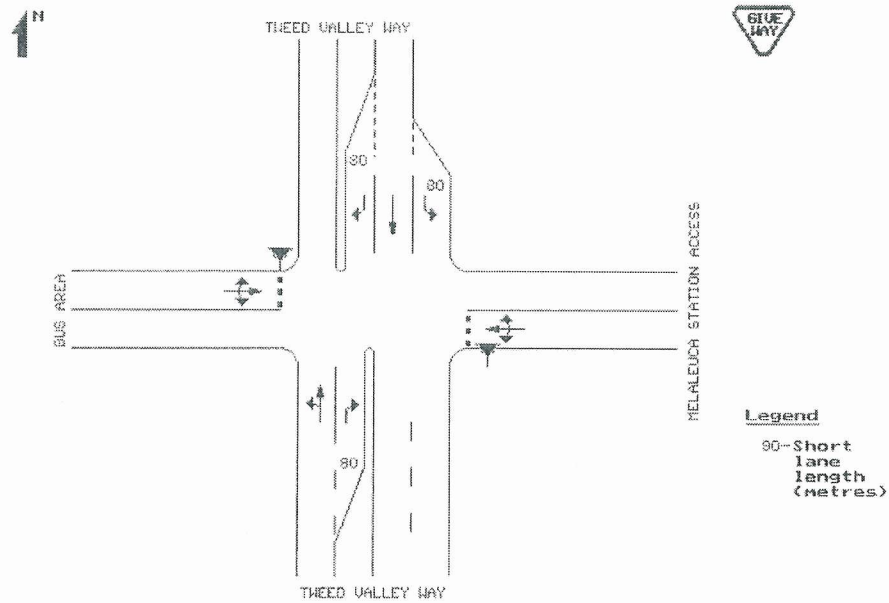
Appendix B
Summary of Sidra Results

TWEED VALLEY WAY / MELALEUCA STATION ACCESS : 2019 VOLUMES (WITH DEV) AFTER END OF SHIFT

User: 175

TRAFFIC PLANNING SERVICES (QLD) PTY LTD

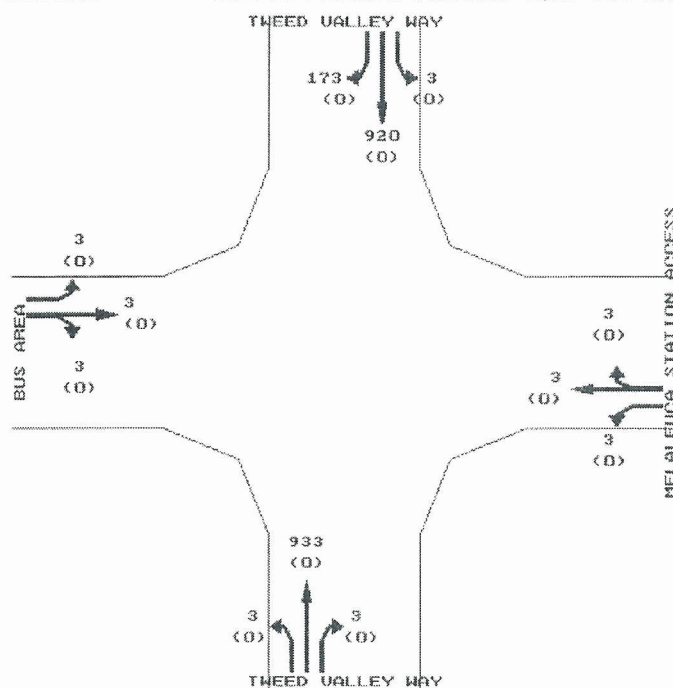
GEOMETRY



ARRB TR SIDGRA
File: TWMS19BS
Esc-Close Window

User:175

TRAFFIC PLANNING SERVICES (QLD) PTY LTD



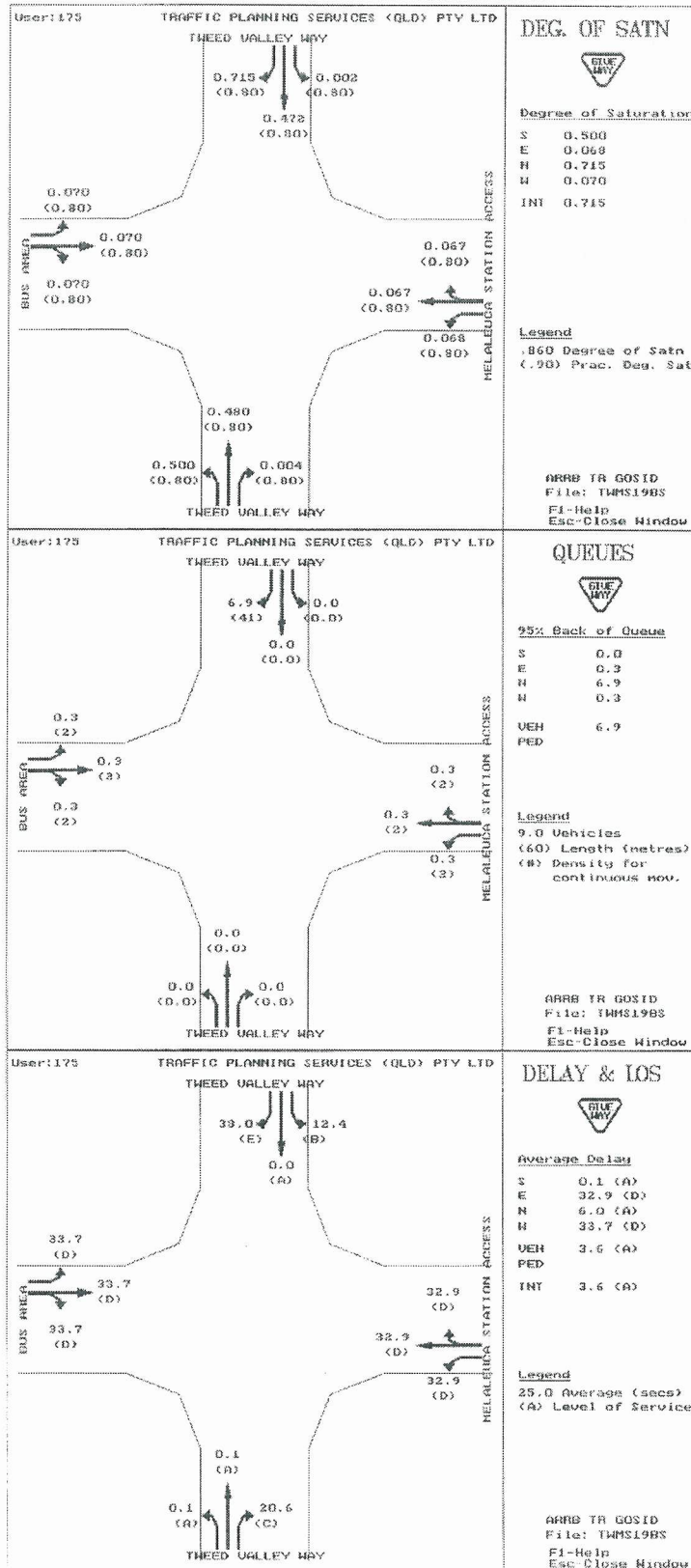
FLows per hour

Total Flow
S 939
E 9
N 1,096
W 9
VEH 2,053
PED

Legend
Vehicles
900 Light
(90) Heavy
Pedestrians

ARRB TR GOSID
File: TWMS19BS
F1-Help
Esc-Close Window

TWEED VALLEY WAY / MELALEUCA STATION ACCESS : 2019 VOLUMES (WITH DEV)
AFTER END OF SHIFT



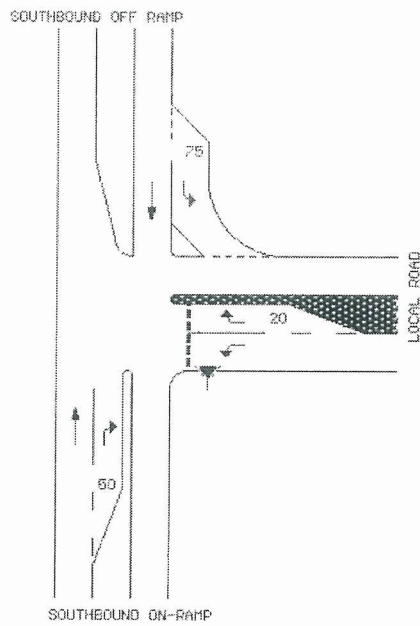
SOUTHB'ND ON-RAMP & OFF-RAMP LOOP / LOCAL ROAD : 2019 VOLUMES WITH DEV BEFORE START OF SHIFT

User: 175

TRAFFIC PLANNING SERVICES (QLD) PTY LTD

GEOMETRY

1^N



Legend

90-Short
lane
length
(metres)

ARRB TR SIDGRA
File: TIES19DS
Esc-Close Window

User: 175

TRAFFIC PLANNING SERVICES (QLD) PTY LTD

FLows per hour



Total Flow

S	90
E	50
N	1,023
VEH	1,163
PED	

Legend

Vehicles
900 Light
(90) Heavy

Pedestrians

ARRB TR GOSID
File: TIES19DS
F1-Help
Esc-Close Window

SOUTHBOUND OFF RAMP

150
(0)

873
(0)

3
(0)

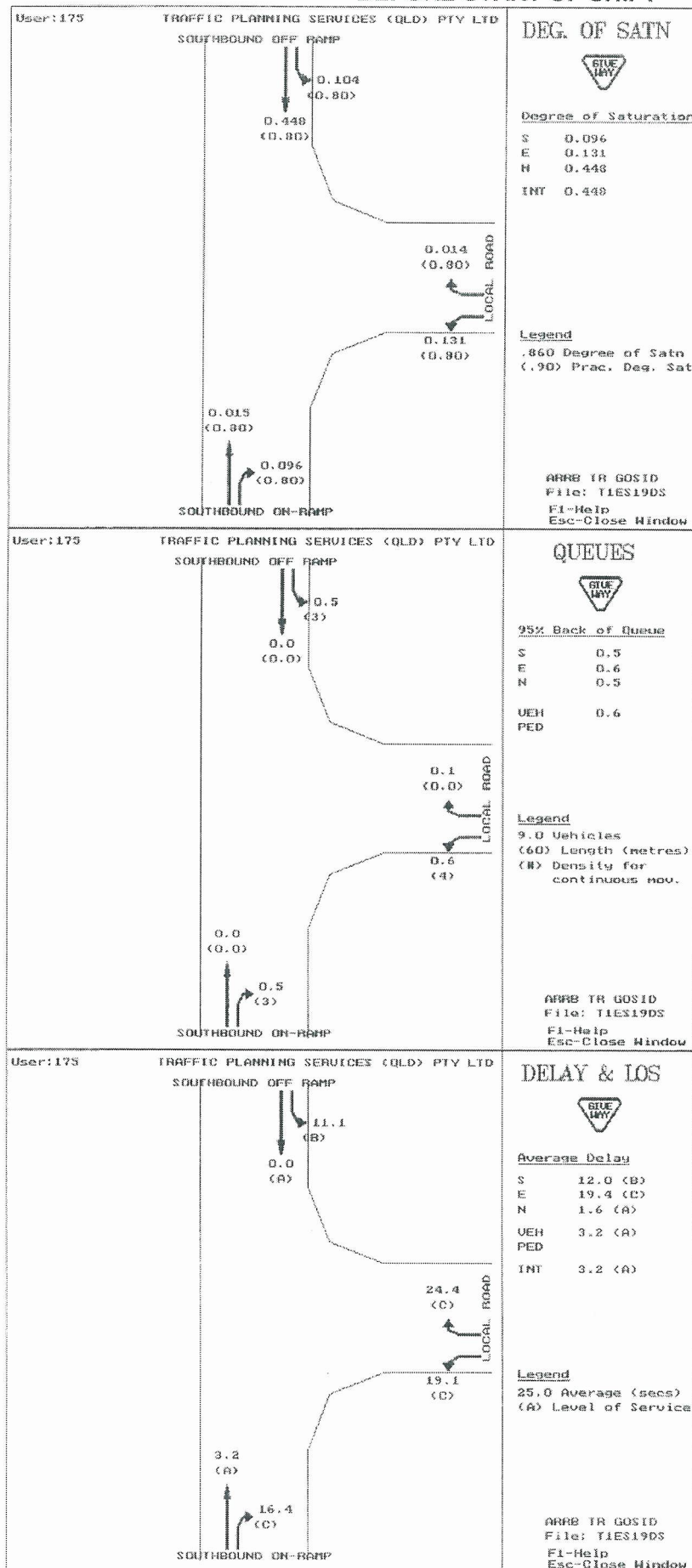
47
(0)

30
(0)

60
(0)

SOUTHBOUND ON-RAMP

SOUTHB'ND ON-RAMP & OFF-RAMP LOOP / LOCAL ROAD : 2019 VOLUMES WITH DEV BEFORE START OF SHIFT



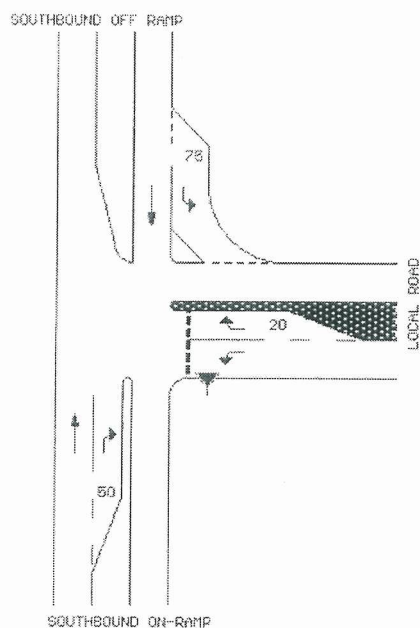
SOUTHB'ND ON-RAMP & OFF-RAMP LOOP / LOCAL ROAD : 2019 VOLUMES WITH DEV AFTER END OF SHIFT

User: 175

TRAFFIC PLANNING SERVICES (QLD) PTY LTD

GEOMETRY

1^N



Legend

80-Short
lane
length
(metres)

ARRB TR SIGRA

File: TIES198S

Esc-Close Window

User:175

TRAFFIC PLANNING SERVICES (QLD) PTY LTD

FLows per hour



Total Flow

S	50
E	210
N	903
VEH	1,163
PED	

Legend

Vehicles
900 Light
(90) Heavy
Pedestrians

ARRB TR GOSID
File: TIES198S

F1-Help
Esc-Close Window

SOUTHBOUND OFF RAMP

30
(0)

873
(0)

17
(0)

193
(0)

30
(0)

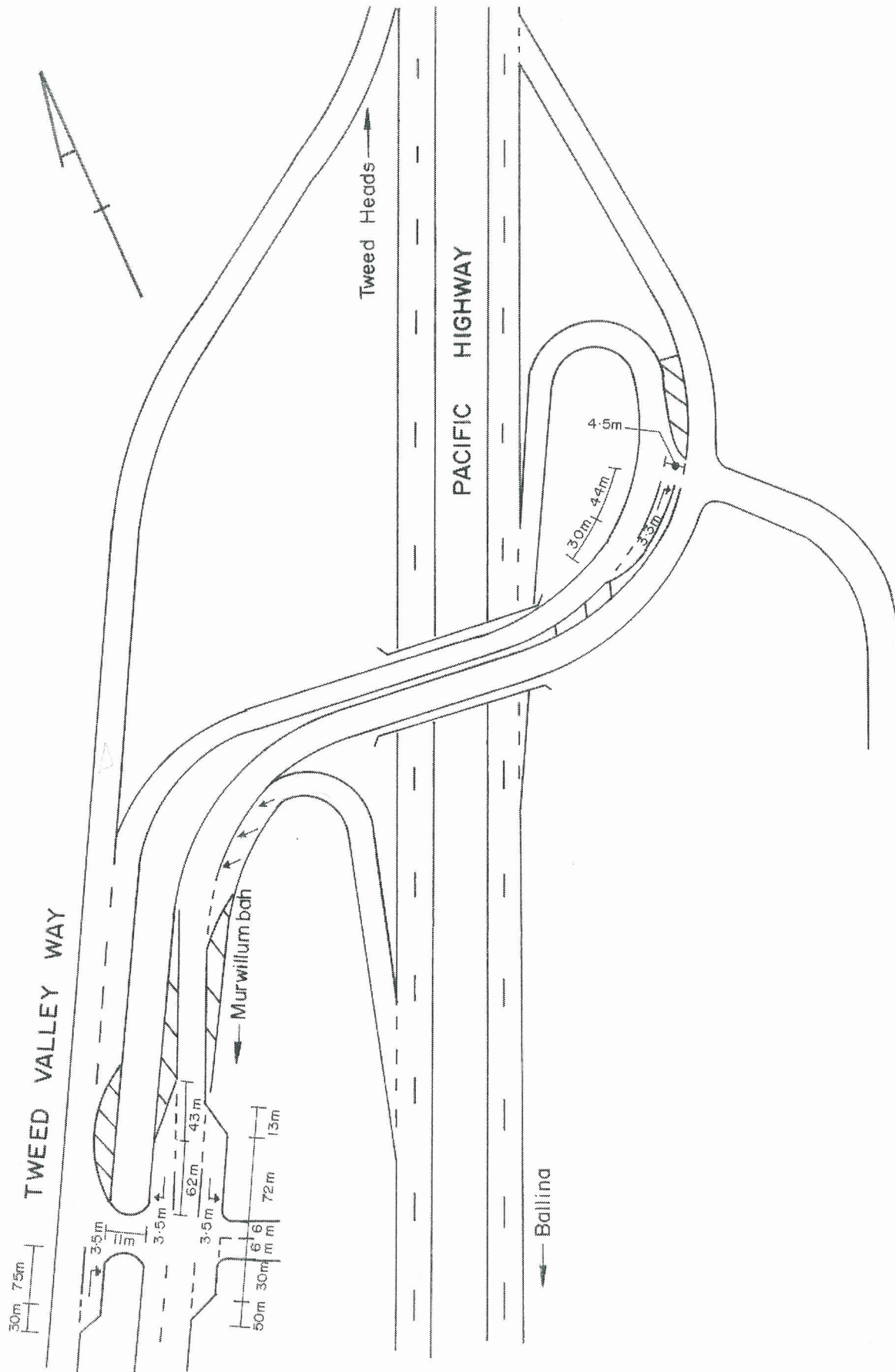
20
(0)

SOUTHBOUND ON-RAMP

LOCAL ROAD

APPENDIX C

General Intersection Arrangements



APPENDIX G

- NOISE ASSESSMENT