



**Aboriginal Heritage Study:
Newcastle Local Government Area**

Newcastle City Council

Report

NSW Heritage Incentives Program
(HAP 2001 203)

2003012

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7 December 2005

Document Information

Date:	07/12/05 8:47 AM
Issue:	3
Recipients:	Jackie Arnold, Newcastle City Council
Copies:	1
Reviewed:	Alison Nightingale, Dr Val Attenbrow
Approved:	Alison Nightingale
Printed:	07/12/05 8:47 AM
Last Saved By:	Meaghan Russell
File Name and Path:	E:\AMBS-New\CONTRACT\2003-2004\2003012\Reporting\Final Reports\2003012_FINALRpt_Feb05.doc
Project Manager:	Alison Nightingale
Client Name:	Newcastle City Council
Name of Document:	Aboriginal Heritage Study: Newcastle Local Government Area (Report)

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Acknowledgments

AMBS wishes to acknowledge the assistance of the following people in this project:

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Executive Summary

Australian Museum Business Services (AMBS) was commissioned by Newcastle City Council in September 2003 to conduct an Aboriginal Heritage Study for the Newcastle local government area (LGA). The aim of the study was to provide a greater understanding of the Aboriginal heritage of the Newcastle area, and to develop a framework for the strategic conservation and management of Aboriginal cultural heritage.

Aboriginal cultural heritage refers to both the material evidence of Aboriginal occupation (archaeological sites), and intangible expressions of Aboriginal culture (social and cultural values). Archaeological evidence of Aboriginal occupation is a finite and irreplaceable resource, providing crucial information on past occupation in Australia and providing a link for modern communities to the past. Intangible expressions of culture link generations of Aboriginal people over time, and can include places of spiritual, traditional, historical or contemporary cultural significance. These locations do not need to contain material evidence.

To achieve the aims of the study, a desktop study was undertaken to investigate the archaeological and cultural values of the Newcastle LGA. Research targeted key issues, such as: environmental resources and characteristics; land use history and terrain integrity; and patterning in archaeological site distribution. Social values and cultural significance can only be determined by Aboriginal community members, so involvement of local Aboriginal stakeholders was integral to the study. Prior to AMBS' commission, Council consulted with local Aboriginal stakeholders to discuss the upcoming study, and its aims, approach and consultation framework. On this basis, a Reference Group was established for the study, with local Aboriginal stakeholders represented by members of the Awabakal, Mindaribba and Worimi Local Aboriginal Land Councils and Council's Guraki Committee. Council also consulted directly with local Aboriginal stakeholders through the Guraki Committee. This consultation process aimed for broader Aboriginal community awareness of the study, to be continued by Council following completion of the AMBS study.

The key results and recommendations of the study may be summarised as follows:

Environmental Resources and Characteristics: research was undertaken to investigate the environmental resources, characteristics and terrain integrity of the Newcastle LGA, as this information is crucial to the investigation of past Aboriginal land use and the analysis of archaeological site distribution. Research demonstrated that resources influencing Aboriginal occupation of the region – water, stone, flora and fauna – were found throughout all areas of the LGA. Areas where a wide range of available subsistence resources or stone materials occurred, such as the Hunter estuary delta, the Hexham Swamp, the Stockton Bight, and the Black Hill Spur were found to be key locations in Aboriginal occupation of the region.

History of Occupation and Landscape Modification: ethnohistorical records from the contact period were reviewed to summarise known information on the Aboriginal people, culture and material traditions of the Newcastle region of that time. This review refines our understanding of the Aboriginal cultural heritage values of the

Newcastle LGA, and also indicates the range of materials likely to be identified in surviving/extant archaeological sites. The history of colonial occupation of the region was also reviewed, to identify areas where archaeological materials may have been removed as part of industrial/residential development. This research found that although colonial settlement and land use is widespread in the region, the spatial and stratigraphic impact of that settlement is not adequately understood, and that areas with terrain integrity may be found throughout 'developed' landscape areas, including the City Centre.

Archaeological Knowledge of the Region: Site Distribution and Composition: previous archaeological investigations conducted throughout the Newcastle LGA were reviewed, to identify recorded patterning in archaeological site distribution and composition. Case studies were identified for detailed review, based on relevance of study area, investigation type and date completed. This review demonstrated that Aboriginal archaeological materials may occur in all landscape contexts within the Newcastle LGA. The density of sites varies between different landscape contexts, with sites more frequently identified in association with wetlands and watercourses within the Newcastle area. However, no landscape area within the Newcastle LGA should be considered archaeologically sterile unless determined so by an archaeological and/or cultural assessment.

Analysis of the Newcastle LGA: Landscape Model of Archaeological Sensitivity: analysis of the environmental and archaeological data was used to develop a landscape model of archaeological sensitivity for the Newcastle LGA. This model assesses the probability (low, moderate, high or very high) of archaeological materials occurring within specific landforms and environmental areas. This probability was determined on two primary criteria: known site patterning and terrain integrity. This sensitivity analysis provides a broad assessment of archaeological site distribution within the Newcastle LGA, on which Council can develop strategic conservation and management strategies for Aboriginal heritage. This is an important tool in heritage management, but the need for assessment of archaeological sensitivity to adequately identify individual site sensitivity during the development process is also stressed.

Cultural Sensitivity of the Newcastle LGA: places and objects within the landscape have significance to the contemporary Aboriginal community, and only Aboriginal community members can determine aspects of cultural significance. For this study, preliminary consultation was undertaken to discuss the social and cultural values of the Newcastle LGA, and statements made by community members on this issue are incorporated into the management strategy. However, further consultation will be required to address this issue, as no places or issues of significance were documented by the Aboriginal community during this study. This study stresses that further consultation is required to consolidate a partnership between Council and the local Aboriginal community.

Management Strategies to Conserve and Manage Aboriginal Cultural Heritage: the study aimed to develop a management framework for the identification, consideration and management of Aboriginal cultural heritage. The framework is to provide Council with a system of management principles, strategies and actions to manage the identified Aboriginal cultural heritage values of the Newcastle LGA. The following principles underlie the management framework.

1. Aboriginal cultural heritage is to be recognised as a finite and valuable resource of the Newcastle LGA.
2. Aboriginal community members are to be pivotal in the identification, assessment, and management of Aboriginal cultural heritage, as it is primarily Aboriginal people who should determine the significance of their heritage.
3. Places of Aboriginal cultural value within the Newcastle LGA are to be actively conserved and managed to retain those cultural values. Appropriate conservation actions will vary according to the level of significance.
4. Aboriginal cultural heritage is to be actively managed during the development process, to ensure appropriate conservation and impact mitigation outcomes are achieved.
5. Compliance with relevant statutory controls, specifically the *National Parks and Wildlife Act (1974)* and the *Environmental Planning and Assessment Act (1979)*, is to be required for all development and heritage programs.
6. Sustainable, ongoing management strategies for Aboriginal cultural heritage, that maximise involvement of Aboriginal stakeholders in heritage management, are to be implemented.
7. The importance of Aboriginal cultural heritage should be promoted within Council and the broader community, through heritage training for Council personnel and public interpretation programs.

A series of management strategies and actions have been developed by this study in accordance with the management principles outlined above. These strategies fall into the following categories: conservation; impact mitigation; Council and community awareness; research opportunities; and the implementation process. A major feature to all recommendations is the integral involvement of Aboriginal community groups in the heritage management process, spanning identification, assessment, conservation and impact mitigation.

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List of Acronyms and Abbreviations

TERM	DEFINITION
AHIMS	Aboriginal Heritage Information Management System
ALALC	Awabakal Local Aboriginal Land Council
AM	Australian Museum
AMBS	Australian Museum Business Services
BP	Before Present
DEC	Department of Environment and Conservation
DLA	Data Licensing Agreement
LGA	Local Government Area
MLALC	Mindaribba Local Aboriginal Land Council
NCC	Newcastle City Council
NPWS	National Parks and Wildlife Service
WLALC	Worimi Local Aboriginal Land Council

1 Introduction

Australian Museum Business Services (AMBS) was commissioned by Newcastle City Council in September 2003 to conduct an Aboriginal Heritage Study for the Newcastle local government area (LGA). The aim of the study is to provide a greater understanding of the Aboriginal heritage of the Newcastle area, and to develop a framework for the strategic conservation and management of Aboriginal cultural heritage.

Aboriginal cultural heritage refers to both the material evidence of Aboriginal occupation (eg. archaeological sites), and intangible expressions of Aboriginal culture (social and cultural values). Archaeological evidence of Aboriginal occupation is a finite and irreplaceable resource, providing crucial information on past occupation in Australia and providing a link for modern communities to the past. Intangible expressions of culture link generations of Aboriginal people over time, and can include places of spiritual, traditional, historical or contemporary cultural significance. These locations do not need to contain material evidence.

This study of Aboriginal cultural heritage is limited to the Newcastle LGA boundaries (see Figure 1). The LGA is generally bounded by Glenrock Lagoon in the south, the Black Hill Spur in the west, the Hunter River alignment to the north and the coastline to the east. The southern boundary extends from the Glenrock Lagoon to Hillsborough, before extending north west through Rankin Park, Glendale and Minmi. From Minmi, the LGA boundary continues north to Beresfield, before extending east to the Hunter River. The northern boundary follows the Hunter River alignment to the north of Kooragang Island and Fullerton Cove. At Fern Bay, the LGA boundary extends west and terminates at Stockton Beach.

This report outlines the aims, methods, results and recommendations of the Aboriginal Heritage Study, and is structured as follows:

Section 2 outlines the project aims and objectives, and the methods employed to achieve those aims. Key components of the research methodology discussed are environmental and land use history, archaeological context and site distribution patterning, and the assessment of archaeological sensitivity.

Section 3 documents the Aboriginal community consultation undertaken for the project, and outlines the participation of Aboriginal community members in the assessment of archaeological and cultural sensitivity across the LGA.

Section 4 describes the environmental characteristics and resources of the Newcastle LGA. Information targeted by this study include: evolution of the Newcastle LGA landscape; geological context and raw materials available; soil landscapes; and flora and fauna resources.

Section 5 outlines the Aboriginal and European colonial land use history of the Newcastle LGA. Landscape changes resulting from recent history are also discussed.

Section 6 reviews previous archaeological research conducted within the Newcastle LGA, to identify patterning in archaeological site distribution and composition. Particularly relevant past research is presented as case studies, to discuss the archaeological resources of the region.

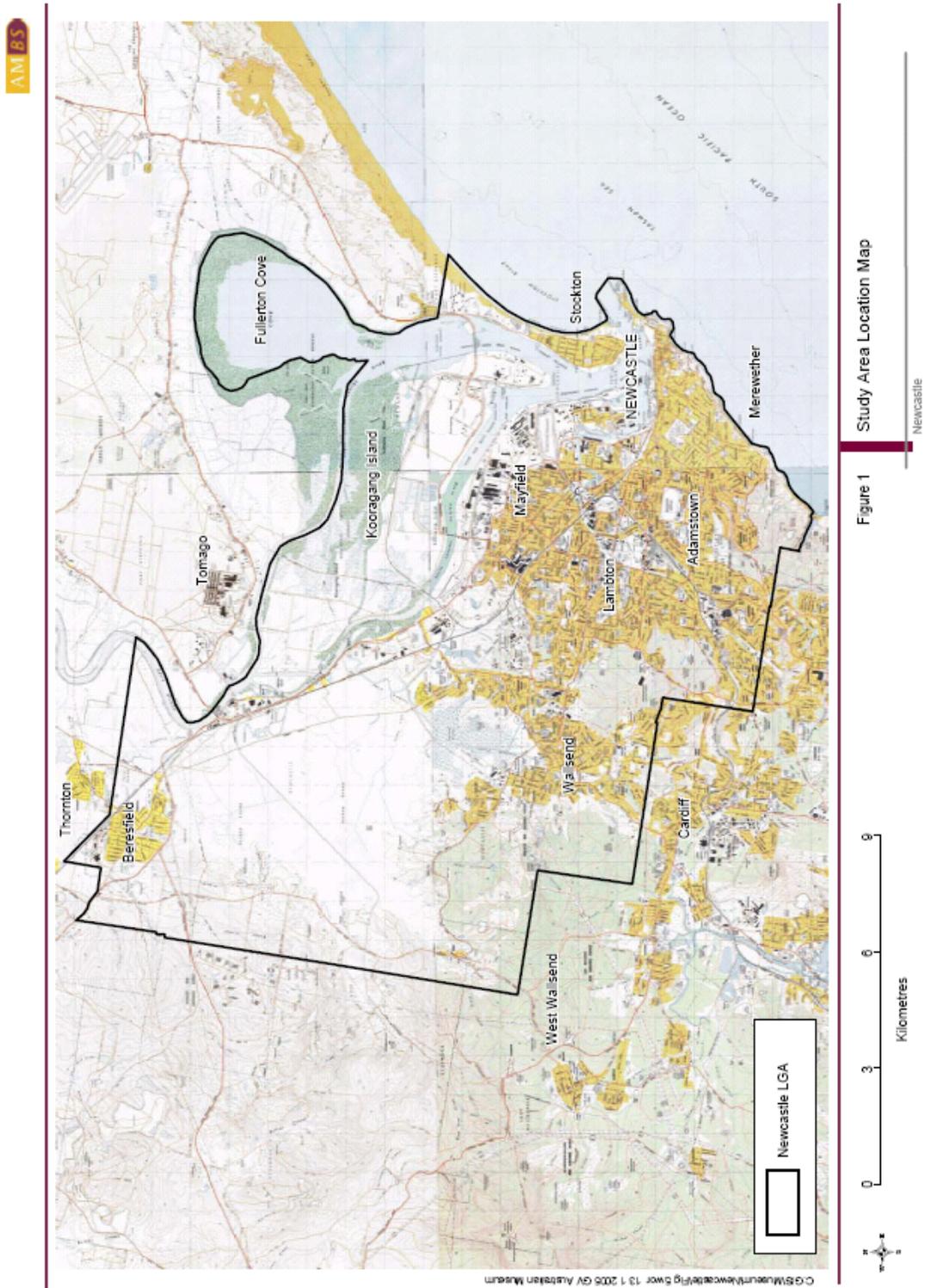
Section 7 presents a landscape model of archaeological sensitivity for the Newcastle LGA, based on the key environmental, land use and archaeological data presented in Sections 4, 5 and 6. This sensitivity analysis discusses the probability of archaeological materials occurring throughout the landscape of the Newcastle LGA. Specific places or areas of cultural sensitivity identified by the local Aboriginal community are added as a layer to the sensitivity mapping. This analysis forms the basis of the management strategies presented in Section 10.

Section 8 reviews the existing LEP zoning of the Newcastle LGA, and discusses the classification of each environmental area identified by the study. This review will identify how current and future land use may affect the Aboriginal cultural heritage of the Newcastle LGA.

Section 9 presents the relevant statutory controls affecting Aboriginal heritage in New South Wales, and discusses the implications for the management of archaeological sites and areas.

Section 10 outlines the management strategies developed by the study for the management of known sites and the management of archaeological potential and cultural sensitivity. A procedure for the consideration and management of Aboriginal archaeological/heritage issues during the Development Application process is a major component of the management recommendations formulated for Council.

Figure 1 : Study Area Location Map



2 Study Aims and Methods

2.1 Aims and Objectives

The broad aim of the study is to provide a greater understanding of the Aboriginal heritage of the Newcastle area, including both social / cultural values and the physical evidence of past occupation. At the outset of the project, the defined study objectives were to:

- consult with the local Aboriginal community to incorporate the views and values of the contemporary Aboriginal community and improve relations between Council and the local Aboriginal community;
- identify known Aboriginal heritage sites, places and landscapes for inclusion on an Aboriginal heritage database;
- provide an understanding of the known Aboriginal heritage of the study area including:
 - known Aboriginal archaeological sites, objects or places;
 - contemporary Aboriginal social and community values; and
 - documented historical values;
- provide a statement on the nature and significance of Aboriginal heritage, objects and places in the LGA;
- provide information to the Aboriginal community about heritage values and places in the study area for their own purposes;
- provide guidance for the effective management of Aboriginal heritage, including identified cultural values as well as the documented archaeological sites and heritage items;
- develop an appropriate database for storing and accessing the sites/place information, in consultation with the local Aboriginal community and Council;
- provide guidelines for the conservation of known Aboriginal heritage, objects and places of significance; and
- provide an information package that promotes use of the Aboriginal heritage database developed through this study.

Completion of the above would have resulted in: the creation of an inventory of known Aboriginal heritage objects, sites and places; development of recommendations for the management and use of the inventory; and production of a report on the recorded inventory.

However, during the course of the study, Council agreed not to obtain information on known sites in the Newcastle LGA from the Aboriginal Heritage Information Management System (AHIMS) held by the Department of Environment and Conservation (DEC)¹ as the Aboriginal community groups participating in the project

¹ Formerly the NSW National Parks and Wildlife Service.

had concerns regarding the use of the material by Council. Consequently, the Data License Agreement (DLA) application was withdrawn, and the project focus was revised.

Through discussions between Aboriginal community group members, Council representatives and AMBS archaeologists, the revised project objectives were defined as follows:

- consult with the local Aboriginal community to incorporate the social and cultural values of the Newcastle LGA into the study, and improve relations between Council and local Aboriginal community groups;
- provide an understanding of the Aboriginal heritage of the Newcastle LGA through the:
 - investigation of archaeological site distribution patterns throughout the study area;
 - development of a predictive landscape model of site distribution and archaeological sensitivity of the Newcastle LGA; and
 - integration of archaeological (scientific) and Aboriginal cultural values of the Newcastle area.
- provide a statement on the archaeological and cultural sensitivity of environmental areas within the Newcastle LGA;
- provide information to the Aboriginal community about archaeological sensitivity of the study area for their own purposes; and
- provide guidance to Council on the management and conservation of Aboriginal heritage, through the development of strategies for known sites and Aboriginal places, areas of archaeological sensitivity and cultural significance. Management strategies will also develop a written protocol for the consideration and management of Aboriginal archaeological issues during Development Applications submitted to Council.

The revised objectives of the Aboriginal Heritage Study place increased emphasis on a broader understanding of Aboriginal cultural heritage throughout the region rather than existing archaeological sites. It was considered that this, combined with Aboriginal community input on cultural values and sensitivity, will enable a greater understanding of Aboriginal archaeology and heritage values within the LGA. The development of a framework to conserve and manage Aboriginal cultural heritage, particularly during the development process, is emphasised by the revised aims and will provide Council with long term strategic objectives and procedures for Aboriginal cultural heritage management.

2.2 Project Methodology

This study is a desktop investigation of Aboriginal heritage of the Newcastle LGA, and is composed of the following elements:

- environmental research into the landscape characteristics, resources and processes of the area;

- land use history research into the colonial use of the region and the landscape changes since the contact period;
- archaeological review of previous studies, to identify known archaeological site distribution patterning within the local region. Presence of archaeological sites within discrete landscape contexts is identified, and along with knowledge of Aboriginal occupation and use of the landscape, is used to form the basis of a landscape model of archaeological sensitivity; and
- development of a landscape model of archaeological sensitivity incorporating results of environmental, land use and archaeological research. The model outlines broad areas of archaeological sensitivity based on site distribution patterns and terrain integrity. Places of social significance or areas of cultural sensitivity identified through consultation with the local Aboriginal community are included as a layer in the sensitivity mapping.

The methodology employed in carrying out the above tasks is outlined below.

2.2.1 Environmental and Land Use History Research

A review of available information on the environmental and land use history of the Newcastle LGA aimed to identify the environmental characteristics and resources of the study area, and document the natural processes and human actions impacting those characteristics and resources. This information is critical to the understanding of archaeological site distributions, specifically of the environmental influences on the deposition of archaeological materials, and the environmental and human influences on the survival of archaeological materials.

Information on the physical environment of the Newcastle LGA was obtained through published literature on the geology, soil and terrain characteristics of the region. Geological and geomorphological information on the region was obtained from a number of sources, including the Newcastle 1:250,000 Geological Series Sheet (S1 56-2) and studies by Roy and Thom (1981), Dean-Jones (1990), Roy, *et al.* (1995) and Roy and Boyd (1996). Information on terrain, soils and vegetation was obtained from the Newcastle Soil Landscape Series Sheet (9232), and published works by Waterhouse (1981), Matthei (1995), NSW National Parks and Wildlife Service (1997, 1998), Kooragang Wetland Rehabilitation Project (KWRP) Board (2003), Hunter Estuary Board (2003), and Wadsworth and Wadsworth (2004).

Information on land use history was obtained from a number of sources. Historical descriptions of colonial settlement of Newcastle and the Hunter were key sources, such as the studies by Goold (1981, 1985), Imashev (1983), Stewart (1983), Genders (1999), and May (2002). Available information on flora and fauna resources came from published studies such as those by Waterhouse (1981), NSW National Parks and Wildlife Service (1997, 1998) and Williams *et al.* (2000). Unpublished archaeological studies were also key sources of environmental and land use history, such as those by Dean-Jones (1990), Kuskie (1994), Kuskie and Kamminga (2000), and Umwelt (2000a, 2000b, 2002a, 2002b).

Mapping was an important element of the environmental research conducted, with geological, soil and geomorphological information mapped. Environmental areas defined by research on environmental characteristics and land use history were

mapped, and formed the basic analytical units for the assessment of archaeological sensitivity.

2.2.2 Archaeological Research

A review of the archaeological context of the Newcastle LGA was conducted for this study. Firstly, this process involved identifying archaeological reports relevant to the Newcastle LGA. This included archaeological investigations that have been conducted within the LGA boundaries and in the surrounding area where relevant. This process involved conducting a search of the reports registered with the AHIMS database at DEC. The titles of the reports listed with AHIMS were searched by key suburbs and places to identify reports from the Newcastle LGA and surrounds.

From this process, key reports were identified, summarised and the information placed into a table (Appendix B). These reports formed the basis of a discussion that focussed on early archaeological investigations in the area to provide insight into sites that have since been destroyed, and ideas that are still discussed in more recent archaeological investigations.

Due to the varying environmental characteristics within the LGA, further discussion of archaeological context involved dividing the LGA into four areas: swamp margins; Tomago Coastal Plain; Awaba Hills; and Lower Hunter Plain. This discussion involved summarising some of the identified archaeological evidence from the area, as well as a discussion of models for Aboriginal occupation of the area.

2.2.3 Landscape Model of Archaeological Sensitivity

The term archaeological sensitivity refers to the potential existence of Aboriginal cultural materials within an area that has not been archaeologically investigated. These may occur as surface and/or subsurface deposits. The analysis of archaeological sensitivity of the Newcastle LGA has been based on two primary criteria: (a) the probability of archaeological materials occurring within a specific landscape context (an analysis of site distribution patterns), and (b) the terrain integrity of varying landscape contexts throughout the Newcastle LGA. The methodology used to assess each criteria is outlined below. In using the environmental areas and landform units of the Newcastle LGA, an understanding of the likely occurrence of archaeological materials within discrete areas can be predicted.

Criteria 1: Archaeological Site Distribution Analysis

To assess the probability of archaeological materials occurring within the Newcastle study area, an understanding must be developed of archaeological site distribution within the region.

The location of known archaeological sites within the Newcastle LGA has not been identified by this study, as a Data License Agreement (DLA) for the full list of registered sites within the LGA on the AHIMS held by DEC was not obtained at the direction of the local Aboriginal communities. In lieu of this site-specific information, the study aimed to identify the landscape contexts where archaeological sites are known to occur by other means. This was done through the review of

previous archaeological investigations in the area, identified by a search of archaeological reports linked to the AHIMS at the outset of the study. Of the numerous studies identified within Newcastle LGA, certain studies were targeted for their relevance to the project, specifically recent studies that have examined the distribution of archaeological materials within the region. The distribution and relationship between surface and subsurface materials was also targeted. A range of studies conducted throughout all environmental areas of the Newcastle LGA were targeted, to ensure that varying patterns of archaeological distribution in varying landforms were identified.

Information collated from these studies formed the basis of the landscape model of archaeological site distribution, in identifying landscape contexts where surface and subsurface materials are known to occur.

Criteria 2: Terrain Integrity Analysis

Analysis of the terrain integrity of a landscape is crucial to the assessment of archaeological sensitivity, as changes in the landscape since deposition have the potential to remove and/or destroy archaeological materials. The colonial history of the Newcastle LGA is reviewed and discussed to identify areas where archaeological materials are likely to have survived. This form of terrain analysis can further refine our understanding of archaeological site distribution within the landscape, and identify areas of archaeological sensitivity.

Consideration of the above criteria formed the basis of the archaeological sensitivity rating for areas within the Newcastle LGA. The landscape model of archaeological sensitivity divided the entire Newcastle LGA area into the following four sensitivity ratings.

- **Low Archaeological Sensitivity:** Areas where archaeological materials are not likely to occur, as a result of removal or disturbance from natural process or land use history. Some indication of the natural soil profile or natural terrain may remain, but these landscape areas are not likely to contain surface and/or subsurface archaeological materials
- **Moderate Archaeological Sensitivity:** Areas where surface and/or subsurface archaeological materials may occur, and where areas of the natural soil profile or natural terrain remain
- **High Archaeological Sensitivity:** Areas known or likely to contain surface and/or subsurface archaeological materials. The natural soil profile or natural terrain is evident, and sites and artefacts are known to occur in similar landscape contexts. Site frequency and density are known to be higher in these landscape areas, as demonstrated by previous archaeological research.
- **Very High Archaeological Sensitivity:** Areas where previous archaeological investigations have identified a high frequency and/or density of archaeological materials. Areas of natural soil profile or natural terrain is evident, and the area is considered likely to contain additional archaeological materials at similar densities.

3 Aboriginal Community Consultation and Involvement

Involvement of local Aboriginal community stakeholders was a crucial element of the study, and was fundamental in the assessment process and development of a management framework for Aboriginal heritage.

Prior to AMBS' commission, Newcastle City Council consulted with local Aboriginal stakeholders to discuss the upcoming Aboriginal Heritage Study. Meetings were held with interested stakeholders to obtain Aboriginal community input on the project before it commenced, specifically how the process should be approached. The structure of consultation for the AMBS study was determined during this consultation phase, with a Reference Group model proposed and agreed to by Aboriginal community members, and consultation with Local Aboriginal Land Council's (and their sites' officers) seen as important.

At the outset of the project, Council established the Reference Group for the Aboriginal Heritage Study. Members of the Awabakal Local Aboriginal Land Council (ALALC), the Mindaribba Local Aboriginal Land Council (MLALC), the Worimi Local Aboriginal Land Council (WLALC), and Councils' Guraki Committee were invited to represent local Aboriginal stakeholders on the Reference Group. Regular meetings were held from February 2004 until July 2004, which provided a forum to discuss the progress of the study, current Aboriginal heritage management practices within the LGA, and what procedures and practices should be implemented to improve the current practices. The minutes for all Reference Group meetings are attached as Appendix A.

Although Reference Group meetings were the main focus of consultation, AMBS also met with individual LALC's throughout the project. AMBS personnel attended a number of monthly LALC meetings to present and discuss the study, and also met individually with key LALC members. These included attendance at ALALC monthly meetings on 2 March 2004 and 17 May 2004, where AMBS personnel were available to discuss the study with members for several hours. Monthly MLALC meetings on 1 March 2004 and 5 July 2004 were also attended, where AMBS personnel provided a short presentation on the study progress, and discuss the study with members. No WLALC meetings were held during this period, and in lieu of this, AMBS personnel met with key WLALC representatives Len Anderson (13 May 2004) and Steve Kilroy (17 May 2004, 6 July 2004).

To identify any additional Aboriginal community stakeholders in the region, AMBS conducted a Native Title Search in April 2004. No Aboriginal community groups or individuals had a claim registered in the Newcastle LGA. Despite this, AMBS are aware of a number of traditional owners groups and individuals in the general region, and consultation with these individuals was undertaken through the LALC structure and through Council's Guraki Committee. Reference Group members advised this was an appropriate consultation strategy, as traditional owner groups/individuals are affiliated with LALCs of the region. AMBS personnel therefore attended LALC meetings to ensure consultation with traditional owner groups/individuals.

Although consultation was undertaken to discuss places and issues of cultural sensitivity within the Newcastle LGA, no specific issues or places were documented by Aboriginal community stakeholders involved in the project. Further consultation will be required by Council to explore these issues and the appropriate management strategies for areas of cultural significance. Such consultation will also be required to build a partnership between Council and Aboriginal community stakeholders.

The draft Newcastle LGA Aboriginal Heritage Study was provided to the ALALC, the MLALC, the WLALC and the Guraki Committee on 27 May 2004. AMBS personnel met with key LALC and Guraki Committee members following draft report distribution to discuss the study, specifically to identify any additional issues that needed to be addressed by the study. To date, no written responses to the draft report have been received, and no additional issues or comments have been provided to AMBS during this consultation. Further consultation between Council and Aboriginal community groups will be required to discuss Aboriginal community responses to the study.

4 Environmental Context

Knowledge about the landscape characteristics and resources of a region is important to the investigation of past Aboriginal land use and the analysis of the potential distribution of archaeological sites and areas. Information about sources of stone materials, availability of water and available plant and animal foods, can be used to identify environmental factors that influenced Aboriginal site selection at the time of occupation. Information about the geomorphic evolution of a landscape can further identify the environmental factors influencing the chance of site preservation over time, and the environmental conditions producing site exposure in the modern landscape.

The Newcastle LGA is composed of five major physiographic areas: the Lower Hunter Plain; the Tomago Coastal Plain; the Awaba Hills; the East Maitland Hills; and the Sugarloaf Range. Within these major regions there are a number of discrete environmental areas, identified by their landscape characteristics and land use history. Within the Lower Hunter Plain, these include the Hunter estuary delta, floodplain and wetlands, and urban Newcastle. The Tomago Coastal Plain is defined by the Stockton Bight within the Newcastle LGA. Within the Awaba Hills, these include residential areas, industrial areas, nature reserves and open space. Within the East Maitland Hills, these include urban areas and open space. Only a small section of the Sugarloaf Range – Black Hill Spur – extends into the Newcastle LGA. The following discussion outlines the existing knowledge of the geology, geomorphology, landforms, soil landscapes, and flora and fauna of the region, with specific reference to the above environmental areas.

4.1 Geology and Geomorphic Evolution

The geological formation of the Newcastle area derives mostly from two major tectonic events: the Carboniferous-Permian Collision of the New England Fold Belt and the rifting apart of Australia and Lord Howe Island (Roy and Boyd 1996:57). The Carboniferous-Permian Collision generated mountains and a sediment source to the north of the Hunter Valley, and a basin to the south accumulating over six kilometres of Permian coal measures and marine shales as the basin filled in. The rifting apart of Australia and Lord Howe Island dates to the Cretaceous to Tertiary in age, and this event generated highlands along Australia's east coast.

The Newcastle Geological Series Sheet (SI 56-2) illustrates the geological units underlying the area. Table 1 lists each unit, its geographic extent and geological characteristics. The spatial organisation of these units is illustrated in Figure 2.

Figure 2: Geological Map of Newcastle LGA

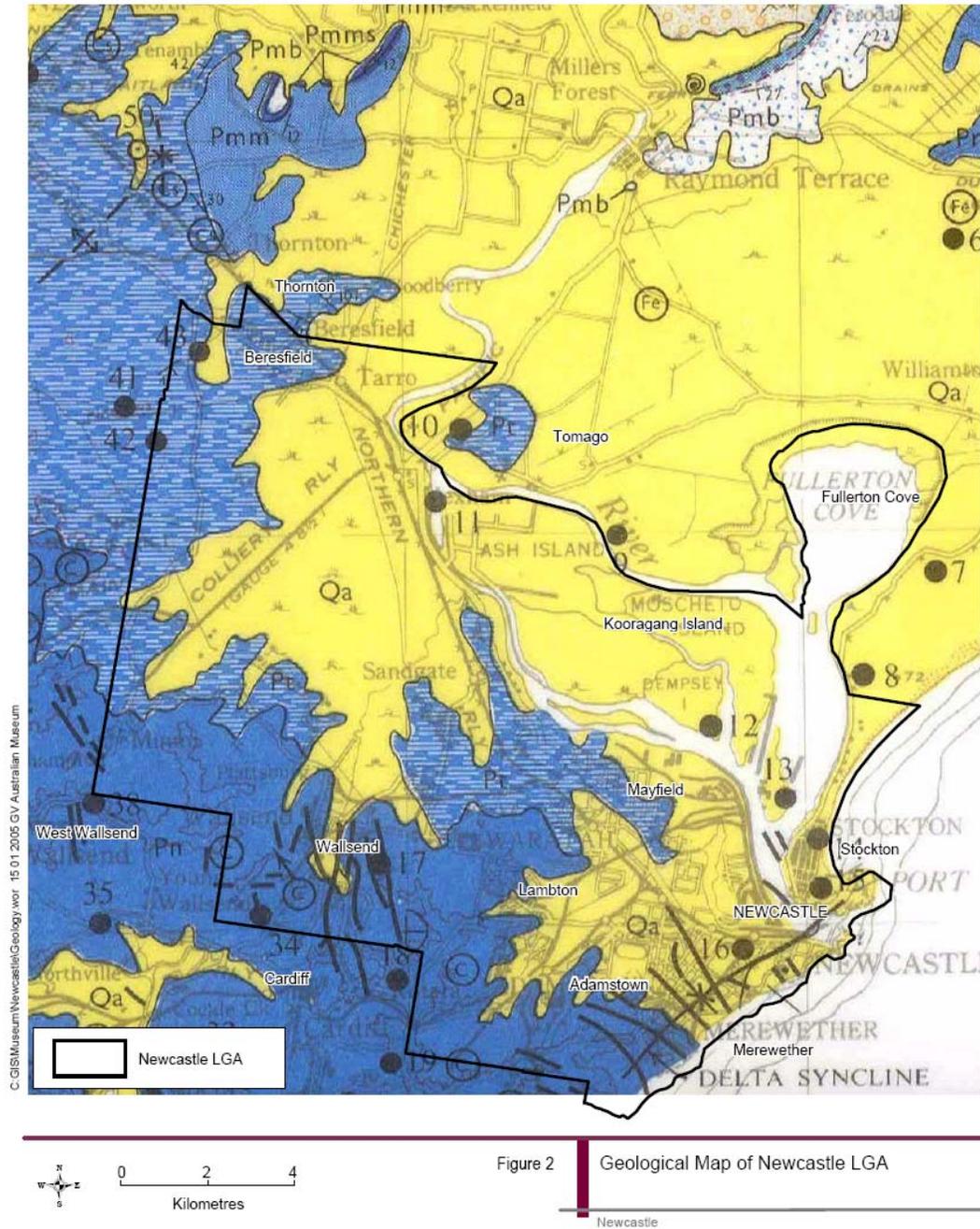


Figure 2 Geological Map of Newcastle LGA

Geological Unit	Location	Characteristics
Quaternary (Qa)	Defines the Hunter River corridor, coastal flats, Kooragang Island and Hexham Swamp. Also underlies much of Newcastle's urban centre, extending south to Merewether and west to Waratah.	Gravel, sand, silt, clay and "Waterloo Rock". Marine and freshwater deposits.
Newcastle Coal Measures (Pn)	Occurs to the south of Newcastle, extending west from Merewether to Adamstown, then slightly north to Waratah and west to Wallsend.	Permian in age. Composed of conglomerate, sandstone, tuff, shale and coal.
Tomago Coal Measures (Pt)	Occurs as two discrete areas. Area 1 is centred on Shortland, and extends from Waratah to Sandgate (parallel to the Hunter River). Area 2 occurs in the north east of the LGA, extending into Beresfield and partially into Leneghans Flat.	Permian in age. Composed of shale, mudstone, sandstone, tuff and coal.

The Newcastle Coal Measures comprise the youngest Permian Group, and are composed of conglomerate, sandstone, tuff, shale and coal. This basal formation is overlain by four subgroups (Matthei 1995:4):

- Waratah Sandstone – cross laminated grey-brown sandstone at the base;
- Lambton Subgroup – coal, sandstone, shale, minor conglomerate;
- Adamstown Subgroup – massive conglomerate, tuff, coal shale; and
- Moon Island Beach Subgroup – coal, tuff, conglomerate, sandstone, shale.

The Tomago Coal Measures are composed of shale, mudstone, sandstone, tuff and coal, and overlies Mulbring Siltstone, which is composed of shale, mudstone, claystone and thin sandstone. Within the Tomago Coal Measures Unit, three important outcrops of raw materials of the Tomago Coal Measures are located at Shortland, Tomago and Grahamstown Dam (Dean-Jones 1990:18). Unconsolidated Quaternary deposits define the present floodplains of the Hunter, Paterson and Williams Rivers. Terrace deposits, remnants of an extensive Pleistocene floodplain and delta, occur adjacent to bedrock on the Hunter Plain. The lower Hunter delta occupies a bedrock palaeovalley, which comprises floodplain alluvium and channel sands overlying estuarine mud (Matthei 1995:5).

Surface outcrops of raw materials are known to occur throughout these geological units. Of specific interest are fine-grained siliceous materials commonly used in the production of flaked artefacts. The Hunter River is a source of fine-grained siliceous stone, including silcrete and mudstone (tuff), available as cobbles derived from sources all along its length. Although much of this material is now buried, Kuskie and Kamminga (2000:182-184) report that such cobbles may have been available

from weathered outcrops of conglomerate in former river terraces and abandoned channels. The major stone materials known to occur within the Newcastle LGA are indurated mudstone or tuff and silcrete, with minor frequencies of quartz, fossilised wood, chert, porcellanite and local volcanics (Hughes 1984:77-79). The distribution of fine-grained siliceous raw materials within the region is summarised below.

Raw Material	Surface Distribution
Indurated Mudstone or Tuff	Occurs in widespread seams throughout the Hunter Valley, and is occasionally exposed in drainage lines or in cliff faces, or occur as cobbles worked into river gravels (Kuskie and Kamminga 2000:182). Outcrops are known at Nobbys Head in Newcastle, and have been labelled as the Nobbys Tuff Member. Surface outcrops of silcrete and tuff occur at Somerset Park (Kuskie, 1994) and Weakleys Flat (Umwelt 2001).
Silcrete	Silcrete has been identified in both alluvial and terrestrial sources throughout the Hunter Valley, but the terrace gravels of the Hunter River have been identified as a major source of the material (Kuskie and Kamminga 2000:184). Other known sources have been identified at Thornton (Kuskie 1994), and at Holmwood Industrial Estate near Woods Gully (ERM 1996). Surface outcrops of silcrete and tuff occur at Somerset Park (Kuskie, 1994) and Weakleys Flat (Umwelt 2001).
Quartz	Pebbles are widely available within as alluvial cobbles and vein outcrops throughout the Hunter Valley (Hughes 1984:78).
Chalcedony	Occurs in alluvial gravel deposits, but not in high densities. This material is known to occur in the Black Hill and Woods Gully areas, as pebbles derived from weathering of conglomerate layers in bedrock (Kuskie and Kamminga 2000:186).
Quartzite	Pebbles occur in eroding conglomerates within the lower Hunter Valley, including the hills near the Black Hill and Woods Gully areas (Kuskie and Kamminga 2000:188).
Porcellanite	Is not reported to occur within the lower Hunter Valley, but is known to occur in the Merriwa Plateau, Liverpool Ranges and Barrington Tops (Kuskie and Kamminga 2000:188).

Other raw materials were also utilised in the past. Coarser materials such as sandstone outcrops for axe grinding or food production, and basalt or dolerite for the manufacture of ground edged axes and chisels (Umwelt 2001:2.4).

The distribution of bedrock geology exerts considerable influence over landscape evolution. Along the entire New South Wales coastline, Roy and Thom (1981) identify two bay barrier systems: the Outer Barrier of Holocene age and the Inner Barrier of late Pleistocene age. The Outer Barrier is one of the highest and most extensive transgressive dune fields of the eastern coast. The Inner Barrier only occurs in systems to the north of the Hunter River (Dean-Jones 1990:21). The Newcastle

Bight, which extends north from the Hunter River, is the southernmost coastal embayments that includes both an Inner Pleistocene Barrier and an Outer Holocene Barrier. An interbarrier depression separates the two barriers, and represents an area of former estuarine deposition and is now mostly in-filled with alluvial sediment. Figure 3 illustrates the organisation of the Inner and Outer Barriers in the Newcastle LGA area. Only a small portion of the Newcastle Bight is contained within the study area, being a mobile sand sheet (the Outer Barrier) of the Stockton Bight and Fullerton Cove. The Outer barrier was deposited at least 6,000 years ago, and has been relatively stable since that time (Dean-Jones 1990:10).

The Hunter River and associated alluvial valley is the dominant feature of the Newcastle LGA. The River is a barrier estuary formed by the deposition of sediments in swamps and flats lying between the Inner and Outer coastal barrier sands. The alluvial valley extends from Newcastle Harbour to Singleton, 55 kilometres north west of the coast. The valley is up to 100 metres deep, and is widest over the softer Tomago Coal Measures and marine subcrop, and narrowest across the Lochinvar Anticline west of Maitland (Roy and Boyd 1996:59). An analysis of the bedrock morphology of the valley by Ramage (1994, referenced in Roy and Boyd 1996) demonstrated that it is essentially a single feature from Newcastle to Port Stephens with three main tributaries. The tributary valleys branch north to join the Karuah valley, northwest up the main Hunter valley, and west under Kooragang Island to drain the Ironbark Creek catchment at the head of Hexham Swamp.

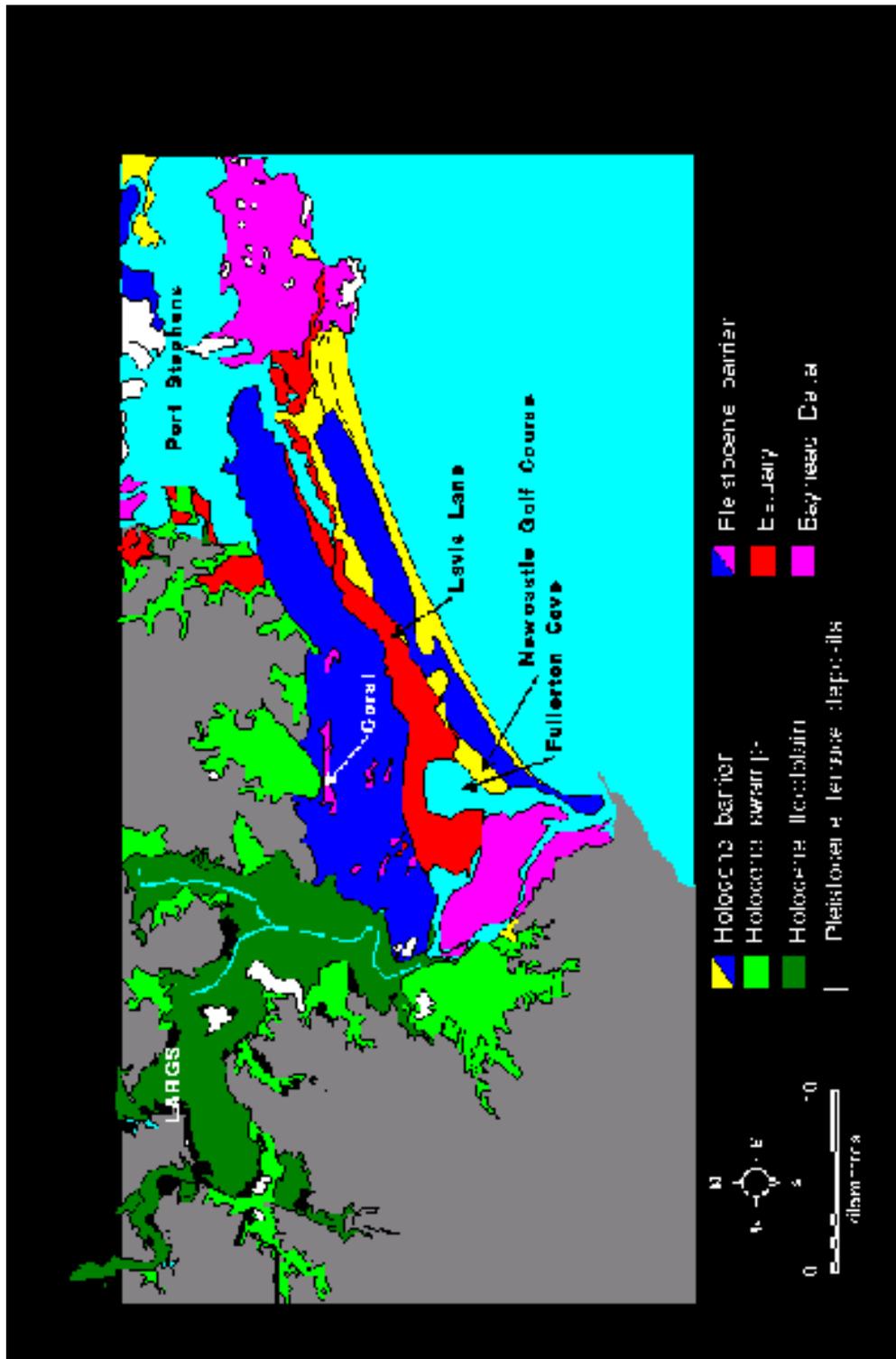
Roy *et al.* (1995) and Roy and Boyd (1996) have documented the evolution of the Hunter estuary. Sea level changes within the past 20,000 years have been summarised as follows (from Umwelt 2002a: 3.6):

- **20,000 years ago:** sea level was approximately 120 meters lower than present level;
- **17,000 to 10,000 years ago:** sea level rose rapidly;
- **10,000 to 6,500 years ago:** sea level continues to rise, but at much lower rate;
- **6,500 years ago to present:** sea level remains stable (Holocene standstill), although there is some evidence of slightly higher sea levels (1-2 metres only) in the early part of the standstill, between 4,100 and 3,200 BP.

The evolution of the Hunter estuary in response to these sea level changes has been classified in four chronostratigraphic stages. These stages and their evolution are outlined below.

- **Last Interglacial: 120,000 years ago**
It is estimated that the sea level was four to five metres higher than present, and that raised estuarine shell beds at Largs were deposited at this time. The inner coastal barrier formed at this time. Roy *et al.* (1995) consider that an extensive deltaic floodplain, similar to that of today, formed in the lower valley. Isolated remnants of Pleistocene terrace deposits that remain in the lower Hunter Valley indicate that the Pleistocene floodplain was up to ten metres higher than the Holocene floodplain.

Figure 3: Geomorphic Landscape



- **Last Glacial Maximum: 18,000 years ago**

As the sea level fell in the lead up to the last glacial maximum, coastal rivers such as the Hunter River gradually incised their valleys. Roy *et al* (1995) note that the last Glacial palaeovalley at Maitland is 20 metres below the surface, deepening to 50 metres below the coastline. At the height of the Glacial Maximum, the coastline was displaced approximately 25 kilometres to the east. During this time, much of the old Pleistocene floodplain around Maitland was eroded, with the sediment transported out beyond the Glacial coastline. These floodplain sediments must therefore have been part of the sediment swept landward across the continental shelf as the sea levels rose in earlier times.

- **Post glacial sea level rise and marine transgression: 18,000 to 6,500 years ago**

The post glacial transgression was characterised by repeated landward migration of sand bodies, possibly in the form of a series of short lived proto barriers. By the time the sea level stabilised at 6500 years ago, Hexham Swamp would have formed the shoreline of the estuary, reflected in the deposition of “beach” sediments around the swamp margins.

- **Holocene standstill: 6,500 years ago to present**

When sea level stabilised at its present level, a new stable sandy barrier formed to the east of the old Pleistocene barrier, and a new cycle of estuarine and deltaic sedimentation commenced in the lower Hunter Valley. Storm washover deposits were in the early stages of barrier formation. The Hunter estuary barrier is distinctive because of its high sediment supply and the multiple phases of dune transgression that were initiated between 5,000 and 500 years ago (continuing to the present). During the past 2,000 years, fluvial deposition of floodplain sediments dominated the estuary floodplain, with overbank alluvium being deposited as far downstream as Hexham. It is assumed that deposition of floodplain deposits in Hexham Swamp also accelerated during this time.

The infilling of the Hunter estuary has resulted from two processes: the build up of tidal delta marine sands in the lower estuary, and fluvial estuarine sedimentation in the upper estuary that has gradually been migrating seaward (Roy and Boyd 1996). The uplift generated by the Carboniferous-Permian Collision and the rifting apart of Australia and Lord Howe Island form the higher terrain areas surrounding the Hunter River alluvial basin. These high terrain areas are erosional landscapes, with sediment removed by wind and water erosion and deposited in lower terrain areas. This process has dominated the recent history of the Hunter basin, resulting in the infilling of the estuary with sediment within the past 4,000 years. Even at 6,500 years ago, the estuary would have been more like an open lake lying behind a barrier, with a narrow mouth that restricted tidal ranges (Umwelt 2002a:3.6). The contemporary Hunter estuary tidal delta has a maximum thickness of 20 metres and extends as far upstream as Hexham, 15 kilometres from the coastline. Fullerton Cove is the only part of the Hunter estuary continuing to accumulate estuarine mud, which are released back into the River as floods recede (Roy and Boyd 1996:59).

The creation of an extensive floodplain in the lower Hunter by this infilling process has involved significant local variations in the form of the landscape. Roy *et al*. (1995) identified numerous palaeo-channels across the floodplain surface, although their exact age is not known. These channels may be older features – relict delta

flood distributaries that formed as the estuarine basin was infilling – or they may be more recent features, reflecting channel switching after the floodplain formed.

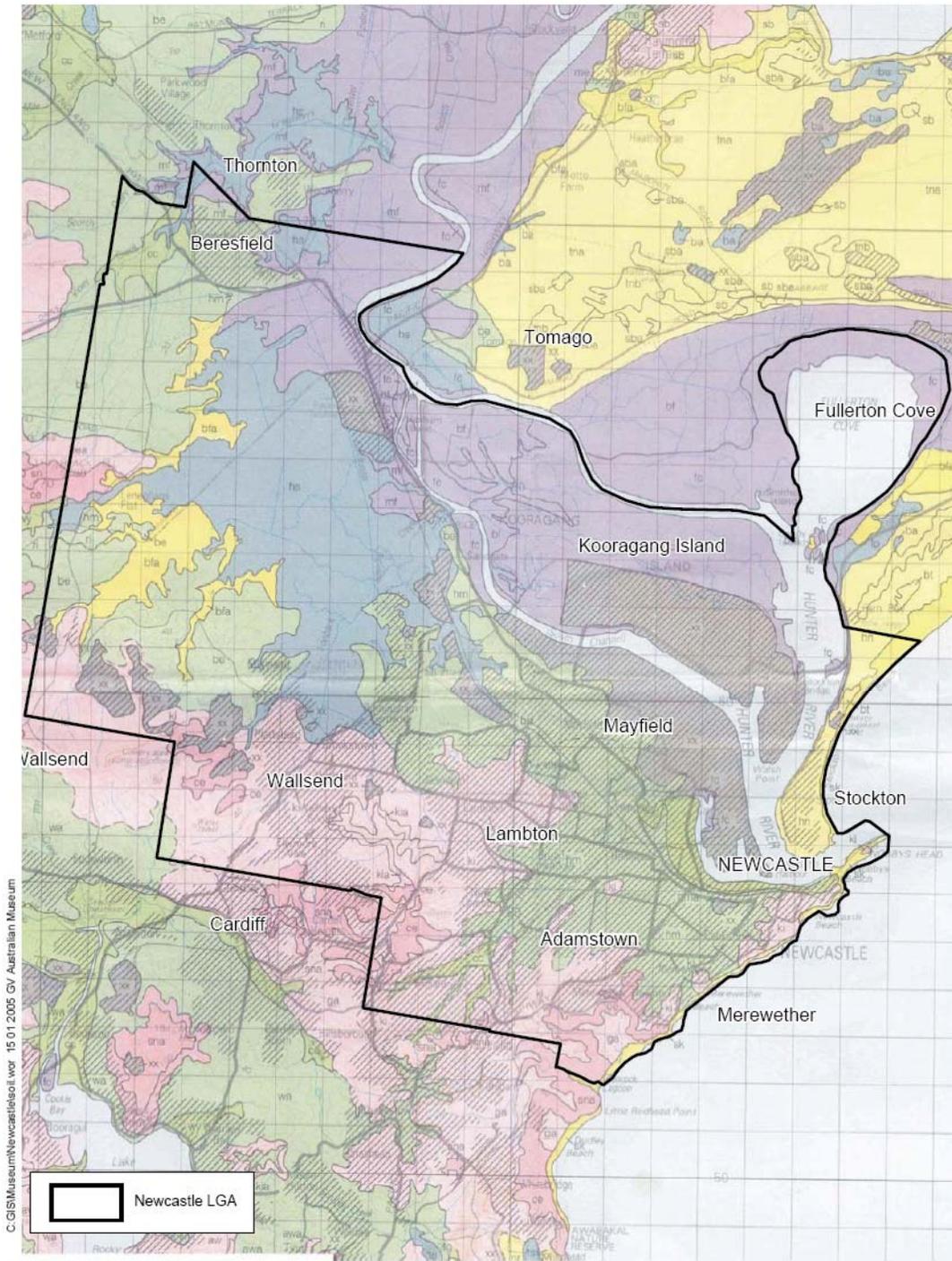
4.2 Soil Landscapes

The soil landscapes of the Newcastle LGA are illustrated on the Newcastle 1:100,000 Soil Landscape Series Sheet (9232). This Sheet depicts twenty distinct soil landscapes within the area (Figure 4), and for each outlines the characteristic soil profile and associated landforms. This information is summarised in Table 3.

All soil landscapes were classified by Matthei (1995:7-8) to be in soil landscape groupings. These are: residual, colluvial, erosional, alluvial, estuarine, beach, aeolian and swamp. The characteristics of each soil landscape grouping are briefly described below. Disturbed soil landscapes have not been described, as this can refer to varying landscape contexts extensively disturbed by human activity.

- **Residual Soil Landscapes:** are dominated by areas where soils have formed *in situ* from weathering of the parent rock. This process has presumably taken place over long time periods where the rate of soil formation has been greater than the rate of erosion. Residual soil landscapes typically have level to undulating topography. Stream channels are usually poorly defined. The five residual soil landscapes within the Newcastle LGA are the Beresfield, the Beresfield variant, the Hamilton, the Rivermead and the Warners Bay. All share common characteristics, with deep soil profiles (100-200 centimetres) that are commonly acidic, subject to some water and wind erosion, and associated with undulating landscape. These areas are generally suited to urban development, grazing and cultivation.
- **Colluvial Soil Landscapes:** are affected by mass movement. Soil parent material mostly consists of colluvial mass movement debris along with other landslide, mudflow and creep debris. These areas typically have moderately inclined to precipitous hillslopes and areas of commonplace mass movement. The three colluvial soil landscapes within the Newcastle LGA are the Cedar Hill, Stockrington and Stockrington variant. These soil landscapes have moderately deep soil profiles (60-200 centimetres) that are subject to mass movement hazard. The terrain consists of rolling to steep rises, which may be up to 40 per cent in gradient. These landscapes are not suited to urban development or cultivation, but can sustain grazing
- **Erosional Soil Landscapes:** have been principally sculpted by the erosive action of running water. Streams are well defined and are able to transfer sediment. Soil depth is usually shallow, and origin may be complex and variable. Terrain is commonly steep to undulating hills and may include tors, benches and areas of rock outcrop. Evidence of mass movement is rare. The three erosional soil landscapes within the Newcastle LGA are the Gateshead, the Killingworth and the Killingworth variant. All the above landscapes are subject to water erosion hazard and seasonal waterlogging, with the terrain ranging from undulating to steep (20 per cent gradient) slopes. This has resulted in shallower soil profiles than other areas, which vary from under 60 centimetres to 200 centimetres. These landscapes have moderate capabilities for urban development, cultivation and grazing.

Figure 4: Soil Landscapes of the Newcastle LGA



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Figure 4 Soil Landscapes of the Newcastle LGA

Newcastle

Landscape Grouping	Soil Profile	Soil Characteristics	Landform Characteristics	Capabilities and Limitations
Residual	Be: Beresfield	Moderately deep (<120cm), moderately well to imperfectly drained Yellow and Brown Podzolic soils. Brown Soloths occur on crests. Moderately deep (<120cm) Red Podzolic and Soloth soils occur on upper slopes. Brown and Yellow Soloths occur on sideslopes. Deep imperfectly drained Brown and Yellow Soloths occur on sideslopes. Deep imperfectly drained Yellow Podzolic and Soloth soils occur on lower slopes. Water erosion hazard. High run on localised to lower slopes. Highly acidic soils.	Undulating low hills and rises on Permian sediment in the East Maitland Hills region. Slope gradients 3-15%, local relief to 50m, elevation 20-50m. Partially cleared open forest.	Water erosion hazard. Acidic soils. Moderate limitations for urban development and cultivation. Low limitations for grazing.
	Bea: Beresfield Variant	As above, but steeper upper slopes 15-25%.	As above.	As above.
	Hm: Hamilton	Level to gently undulating well-drained plan on Quaternary deposits on the Hunter Plain region. Occasional low dunes occur. Slopes are <2%, elevation to 12m, local relief <1m. completely cleared.	Deep soils (>15cm), well drained weak Podzols with some deep (>100cm) well drained Brown Podzolic Soils on fans. Wind erosion hazard. Strong acidity.	Wind erosion hazard. Strong acidity. Seasonal waterlogging of fan deposits. Low limitations for urban development, cultivation and grazing.
	Ri: Rivermead	Moderately broad to extensive, level to gently undulating alluvial terraces in the Hunter Plain and Paterson Mountains region. May represent relict levee deposits. Slope 0-4%, elevation 5-20m, local relief 5-10m. Cleared tall open forest.	Deep (>200cm) well drained Yellow and Red Earths, and shallow to deep (<35 - >200cm) moderately well to imperfectly drained Brown Podzolic soils with some Chocolate soils and Brown Clays. Localised flood hazard and high run on. Seasonal waterlogging.	Localised flood hazard. Seasonal waterlogging. Imperfectly drained terraces. Moderate limitations for urban development, cultivation and grazing.

Landscape Grouping	Soil Profile	Soil Characteristics	Landform Characteristics	Capabilities and Limitations
Residual	Wa: Warners Bay	Undulating to rolling low hills and rises in the Awaba Hills. Local relief 30-80m, slope gradients 3-20%, elevation to 80m. Crests are broad, slopes are long and gentle and drainage lines are broad. Predominantly cleared tall open forest. Rock outcrop rare.	Moderately deep (100cm) to deep (>150cm) Podzolic soils. Poorly drained Structured Loams in drainage lines (>60cm). High water erosion hazard. Localised mass movement hazard. Strongly acidic soils. High run on.	High water erosion hazard. Mass movement hazard (localised). Seasonal waterlogging. Strongly acid soils. Moderate limitations for urban development and grazing. High limitations for cultivation.
Colluvial	Ce: Cedar Hill	Rolling to steep rises in the Awaba Hills and the Sugarloaf range. Local relief to 100m, elevation to 100m, slopes 15-40%. Cleared tall open forest. Drainage lines narrow and incised. Rock outcrop absent.	Moderately deep to deep (60-<200cm) well to imperfectly drained Brown and Yellow Podzolic soils. Black silty clay loam topsoil, pedal brown silty clay subsoil. High mass movement hazard on steep slopes. Acidic soils.	High mass movement hazard. Acid soils. High limitations for urban development and cultivation. Moderate for grazing.
	Sn: Stockrington	Steep rises, gradients 25-40% and benches have 15-20% slopes. Elevation to 160m, local relief to 180m. Uncleared tall open forest. Rock outcrop absent, but boulders may occur on lower slopes and benches.	Moderately deep (70-<300cm) rapidly drained Earthy Loams and Friable Loams on upper slopes. Deep (>200cm) well drained Red Podzolic and Soloth soils, brown and yellow Soloths on midslopes and benches. Active mass movement along steeper slopes.	Mass movement hazard. Rock fall hazard. Water erosion hazard. High limitations for urban capabilities and cultivation. Moderate capabilities for grazing.
	Sna: Stockrington Variant	As above, but side slopes with lower gradients (less than 20%).	As above.	As above, but moderate capabilities for cultivation and urban development.

Landscape Grouping	Soil Profile	Soil Characteristics	Landform Characteristics	Capabilities and Limitations
Erosional	Ga: Gateshead	Undulating to rolling rises in the Awaba Hills. Local relief to 100m. Slopes 5-15%. Elevation to 130m. Predominantly cleared woodland and open forest. Rock outcrop rare, less than 2%.	Moderately deep (100-200cm) soils, moderately well to imperfectly drained. Yellow Soloths and Podzolic soils on crests and sideslopes. Red Podzolic and Soloth soils on shale parent material. Water erosion hazard. Seasonal waterlogging on lower slopes. Acidic soils.	Seasonal waterlogging. Steep slopes. Water erosion hazard. Stoniness. Moderate limitations to urban development and grazing.
	Ki: Killingworth	Undulating to rolling hills and low hills of the Awaba Hills region. Elevation 50-160m, local relief 30-100m, slopes 3-20%. Predominantly uncleared tall open forest. Rock outcrop occurs occasionally in upper catchment areas.	Shallow (<60cm) to deep (<150cm) well to imperfectly drained soils. Brown-black pedal loam (A), hardsetting loamy sand to sandy clay loam (A ₂), pedal yellow-brown clay (B). Seasonal waterlogging. Strongly acidic.	Very strongly acidic soils. Water erosion hazard. Seasonal waterlogging. Moderate limitations to urban development and grazing.
	Kia: Killingworth Variant	As above, but rolling to steep hills, slopes less than 20%.	As above.	As above.
Alluvial	Cc: Cockle Creek	Narrow floodplains, alluvial fan deposits and broad delta deposits in the Awaba Hills. Some relict terrace and levee deposits, and point bar deposits. Slope gradients are 0-2%, elevation is <1-50m, local relief is <1m. Cleared open forest.	Deep, over 200cm, imperfectly to poorly drained yellow Soloths and Podzolic soils on floodplains. Moderately well to poorly drained yellow and grey Earths on delta and fan deposits. Water erosion hazard, flood hazard, acid infertile soils.	Flooding hazard. Waterlogging (localised deltas and floodplains). Very strong acidity. High to severe limitations for urban development. Moderate limitations for grazing and cultivation.

Landscape Grouping	Soil Profile	Soil Characteristics	Landform Characteristics	Capabilities and Limitations
Estuarine	Bf: Bobs Farm	Broad inter barrier estuarine flat on the Tomago coastal plain. Slope gradients <1%, elevation 1-3m, local relief <1m. Open woodland. Numerous drains excavated to assist with drainage.	Deep, over 300cm, very poorly drained Humic Gleys. Black pedal organic rich loam topsoil, grey plastic estuarine clay subsoil. Permanently high water tables, seasonal water logging, potential acid sulphate soils.	Flood hazard. Seasonal waterlogging. Potential acid sulphate soils. High limitations for urban development, low limitations for grazing and cultivation.
	Bfa: Bobs Farm Variant	As above, but also contains low remnant lake shore beach deposits. Up to 1m in relief, 15m wide and 200m in length.	As above.	As above.
	Fc: Fullerton Cove	Tidal flats and creeks in the tidal inlets and estuaries in the Lower Hunter Plain and Medowie Lowlands. Four shore parallel zones are recognised, each with different drainage pattern. Slope gradients <3%, elevation <3m, and local relief <3m. Mangrove scrub and salt marsh, some open forest.	Deep, over 100cm, very poorly drained Solonchaks. Black organic-rich peat (P ₁ horizon). Saturated saline organic mud, occurs below high tide (P ₂ horizon).	Flooding (tidal). Waterlogging. Wave erosion hazard. Potential acid sulphate soils. Severe limitations for urban development, grazing and cultivation.
	Mf: Millers Forest	Extensive alluvial plain on recent sediments in Hunter Plain region. Elevation 6-<3m, local relief <1m, slope gradients are <1m. Cleared tall open-forest.	Deep, over 150cm, imperfectly to poorly drained Prairie soils. Brownish black silty clay loam topsoil. Brown silty clay subsoil. Permanently high water tables, flood hazard.	Flood hazard. Permanently high watertables. Seasonal waterlogging. Potential acid sulphate soils. High limitations for urban development. Low limitations for grazing and cultivation.
Beach	Sk: Stockton Beach	Beaches and unstable dunes on the Tomago coastal plain up to 1km in width. Foredunes commonly 1-10m high, often shaped by human action. Unstable parabolic dunes behind foredune up to 28m high. Deep soils (>200cm). Morphologically dynamic landscape.	Deep, over 200cm, marine sands on beaches (well to poorly drained). Deep, over 200cm, aeolian sand on dunes (very well drained sands). Severe wave and wind erosion. High erodibility.	Wave and wind erosion hazard. Waterlogging on beach. Mass movement hazard. Severe limitations for grazing, cultivation and urban development.

Landscape Grouping	Soil Profile	Soil Characteristics	Landform Characteristics	Capabilities and Limitations
Aeolian	Bt: Boyces Track	Steep Quaternary sand dunes on the Tomago coastal plain. Two long walled ridges, parallel to shore line, form the major part of this system. Local relief 10-30m, slopes >25%, elevation 10-40m. Uncleared tall open forest. Stable dune system.	Deep (>300cm) well drained weak Podzols. Wind erosion hazard. Mass movement on steep slopes. Acidic soils.	Wind erosion hazard. Mass movement hazard. Non cohesive acid soils. High to severe limitations for urban development, cultivation and grazing.
	Hn: Hawks Nest	Low sandsheets and low transgressive dunes on the Tomago coastal plain. Local relief <3m, slope gradients <10%, elevation 3-12m. Dry scrubland, woodland and tall open forest. Stable sandsheets.	Deep soil profile, over 300cm. Well drained podzols on dunes. Deep (<200cm), poorly drained podzols on sandsheets. Potential acid sulphate soils.	Wind erosion hazard. Localised seasonal waterlogging. Non cohesive acid soils. High limitations for urban development, cultivation and grazing. Moderate limitations for urban development in sheltered areas.
Swamp	Hs: Hexham Swamp	Broad, swampy, estuarine backplains on the Hunter delta. Slopes <1%, local relief <2m, elevation to 2m. Sedgeland with open woodland on swamp margins. Deep tidal channels occur in Hexham Swamp. Permanent swamp watertable no more than 60cm below surface, rising during wet seasons.	Deep soil profile, over 200cm. Black pedal silty clay loam topsoil, brown-grey plastic clay subsoil. Areas of high run-on at swamp margins affected by considerable sheet erosion.	Flood hazard. Waterlogging. Potential acid sulphate soils. High limitations for urban development. Moderate limitations for cultivation and grazing.

- **Alluvial Soil Landscapes:** are formed by deposition along streams and rivers. Soil parent material is alluvium. Landscapes include floodplains and alluvial deposits. Typical landform elements include bars, backplains, levees, terraces, and prior and current stream channels. The only alluvial soil landscape within the Newcastle LGA is the Cockle Creek landscape. Deep (over 200 centimetres) soils define this landscape, and are found along floodplains, fan deposits and deltas. These terrain areas are level to very gently inclined, and are subject to flooding and waterlogging. This soil landscape has high to severe limitations for urban development, but low limitations for grazing and cultivation.
- **Estuarine Soil Landscapes:** occur where rivers and streams enter large bodies of water such as the sea. Channel flow is dissipated and also modified by wave or tidal action. Soils may be influenced by saline conditions, and terrain features include estuaries, deltas, tidal creeks and tidal flats. The four estuarine soil landscapes within the Newcastle LGA are the Bobs Farm, Bobs Farm variant, Millers Forest and Fullerton Cove. These landscapes are associated with the Tomago coastal plain estuarine flat and tidal flats and creeks of the lower Hunter estuary. The terrain is defined by extensive alluvial plain, inlets and estuaries. Deep (over 300 centimetres) soils are associated with this area, which is also subject to flood hazard and seasonal waterlogging. These areas are not suited to urban development, but low limitations for grazing and cultivation.
- **Beach Soil Landscapes:** have ground surfaces and soil parent material that has been deposited by wave action. Beach soil landscapes typically occur near sandy coast lines and near lake edges. Terrain elements include beaches, plains and foredunes. Within the Newcastle LGA, Stockton Beach is the only beach soil landscape. The landscape is characterised by unstable parabolic dunes up to one kilometre in width, which can be up to ten metres high. Dune sands are deep (over 200 centimetres) and subject to water and wind erosion and mass movement hazard. There are severe limitations for urban development, grazing and cultivation within these areas.
- **Aeolian Soil Landscapes:** have accumulated by deposition of sand-sized particles by wind action. Landscapes include dunefields, dunes, blowouts, sand sheets and lunettes. The two aeolian soil landscapes within the Newcastle LGA are Boyces Track and Hawks Nest. These landscapes are associated with Quaternary dunes and sandsheets on the Tomago coastal plain. These areas have a deep soil profile (over 300 centimetres), but are subject to wind erosion hazard and mass movement hazard. These areas have severe limitations for urban development, grazing and cultivation.
- **Swamp Soil Landscapes:** are dominated by ground surfaces and soils that are at least seasonally waterlogged. Soil parent material includes large amounts of accumulated decayed organic material. Watertables are frequently close to the surface. Landform elements may include swamps, relic ox-bows, abandoned channels, lagoons and swales. Hexham Swamp soil landscape is the only swamp soil landscape within the Newcastle LGA. This landscape is associated with the broad swampy backplain on the Hunter delta, including the deep tidal channels within the swamp. The soil profile throughout the area is deep, over 200 centimetres, and is subject to flooding and waterlogging. The area is not suited to urban development, but can sustain some grazing and cultivation.

The characteristics of soil landscapes, and each soil landscape grouping, can influence the survival of archaeological materials.

Aggrading landscapes, such as the residual and alluvial soil landscape groupings, are characterised by the retention of parent soil materials and deposition of transported soil materials. Should archaeological materials be deposited in an aggrading landscape area, they may be retained in that location as landscape processes add, and not detract, soil. Landscapes defined by soil movement, such as the colluvial, erosional and aeolian soil landscape groupings, are less likely to retain archaeological materials in their deposited location as the movement of sediment may result in artefactual movement.

The acidity of soils can also have a direct influence on the survival of archaeological materials, with organic materials broken down quickly in acidic soils. Most soils of the Newcastle LGA are acidic, and many areas have potential for acid sulphate buildup (NSW National Parks and Wildlife Service 1998:13). Soils of the Hunter estuary delta are less acidic, such as those found on Kooragang Island.

The soil landscapes of the Newcastle LGA have varying capabilities for land use and development. Areas that can sustain urban development are more likely to be used as residential or industrial areas. This often involves widespread impact to the natural landscape, through earthworks and construction associated with urbanisation. Although this process may not remove archaeological materials, urban areas have lower terrain integrity and are therefore not as likely to contain intact archaeological materials.

4.3 Landforms

The landscape of the Newcastle LGA has evolved to be composed of five major physiographic areas: the Lower Hunter Plain, the Tomago Coastal Plain, the Awaba Hills, the East Maitland Hills and the Sugarloaf Range (Matthei 1995:3). The arrangement of these environmental regions is illustrated in Figure 5.

The Lower Hunter Plain is primarily associated with the Hunter River, but also incorporates the floodplains of the Williams and Paterson Rivers. The Plain extends west from Newcastle Harbour to beyond Maitland, and as far as Paterson and Seaham in the north. The Plain extends up to 40 kilometres from the Hunter River (Hunter Estuary Board 2003), and defines much of the Newcastle LGA, including part of urban Newcastle. The Hunter River is the third largest coastal catchment in New South Wales, being over 22,000 kilometres square in area (Williams *et al.* 2000:5). The River channel is bounded by a wide floodplain that comprises overbank alluvium, deposited atop estuarine mud. The alluvial deposits are known to be eight metres thick at Maitland, tapering to 4 metres near Hexham (Umwelt 2002a:3.7).

At the time of contact, the Hunter delta was a complex of intersecting tidal channels, tidal flats and mangrove swamps. Modern Kooragang Island is located near the mouth of the Hunter River, between its north and south arms. The Island now covers an area of approximately 2,560 hectares (Genders 1999), although this has mostly been the product of reclamation. Swamps to the north of Kooragang Island are 800 hectares in size, and include estuarine swamp (mangrove and saltwort flats). Until the early 1900s, the Hunter River estuary where Kooragang Island now stands contained

several islands separated by narrow intertidal channels, but reclamation works throughout the twentieth century created a single land mass at this location (NSW National Parks and Wildlife Service 1998:4).

There are numerous wetland areas associated with the Hunter River floodplain between Newcastle and Maitland. The Newcastle City Council (2003b) recently estimated that wetlands form nearly twenty per cent of the Newcastle LGA, and described these wetlands as the most significant natural features of Newcastle. Wetlands are defined as " *areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres*" (Department of Environment and Heritage 2004). Within this broad definition, forty different wetland types are recognised, and these fall into three primary categories: (1) marine and coastal zone wetlands, (2) inland wetlands, and (3) human-made wetlands.

Hexham Swamp is the largest of the lower Hunter wetlands, being over 2400 hectares in area and representing almost half of the remaining swampland of the Hunter region. In 1990, approximately 900 hectares of the Swamp was dedicated as part of the Hexham Swamp Nature Reserve. As illustrated on Figure 5, the swamp is located in the north west of the Newcastle LGA and is bounded by Shortland, Hexham, Tarro, Minmi and Wallsend. The Hexham swamps are contiguous with important freshwater wetlands on freehold land to the west, near Minmi, the Shortland Wetland Centre to the east and in Newcastle Council's Wetlands Reserve below Newcastle University (NSW National Parks and Wildlife Service 1998:7).

Other key swamps in the area include Woodberry Swamp and Tarro Swamp. Woodberry Swamp is close to Hexham Swamp, and contains a wide variety of water birds. In addition to the swamps of the lower Hunter floodplain, there are several much smaller areas of freshwater wetland on the coastal strip between Port Stephens and the Lake Macquarie district. Many of these occur as swampy depressions or lagoons formed where drainage has been impeded by the formation of sand dunes parallel to the coast. Virtually all have been altered in shape, extent and appearance during the post-contact settlement of the area. In addition, new aquatic habitats have also been created by urban development, such as the shallow artificial lake constructed at Grahamstown near Raymond Terrace (Waterhouse 1981:23).

Only a small portion of the Tomago Coastal Plain occurs within the Newcastle LGA, being the Outer Barrier at Stockton Bight. The Stockton Bight is the northernmost portion of the Newcastle Bight, a geomorphic feature described in Section 4.1. The Stockton Bight is characterised by a low, stable Holocene dune sheet, and low sandy dunes and swales are the dominant landforms. Local relief in the area is less than three metres, and slope gradients are less than ten degrees. The area is generally well-drained apart from small and isolated swamps which occur in poorly drained swales. The native vegetation of the terrain is dry scrub land, woodland and tall open forest (Matthei 1995:205).

The southern portion of the Newcastle LGA is defined by the Awaba Hills physiographic area. The Awaba Hills occur on the Newcastle Coal Measures to the south of the Hunter River, and much of the region is characterised by low rolling hills

and low hills. Elevation ranges from 50 to 160 metres above sea level, and local relief ranges between 30 to 100 metres. Slopes throughout the region range from three to 20 degrees. Variants to this landscape include areas of rolling to steep slopes, where hillslopes are over 20 degrees in gradient. Throughout the area, ridge crests are generally broad (250 metres wide), and hillslopes long (commonly over 500 metres). Drainage lines tend to be narrow (under three metres) and associated drainage plains are less than 500 metres in width. Short and steep slopes (over 20 degrees in gradient) often lead into drainage channels. Rock outcrops are known to occur in the region, most frequently in upper catchments of drainage lines (Matthei 1995:132). The Awaba Hills area extends to Newcastle's eastern coastline, which is dominated by steep escarpments, intermittent sandy beaches and rocky headlands. Part of this coastline has been reserved as Glenrock State Recreation Area.

The East Maitland Hills define the northwest corner of the Newcastle LGA, extending from Beresfield to the Black Hill Spur. The East Maitland Hills physiographic area borders the Hexham Swamp to the west, and is characterised by undulating low hills and rises. Local relief is 10 to 50 metres, and elevation is 20 to 50 metres. Slopes are generally three to 15 per cent in gradient, and sideslopes are long and gently inclined. Some very long footslopes (up to 2000 metres wide) are known to occur in the area. Drainage lines in the area are deeply incised and narrow (Matthei 1995:30). Within the East Maitland Hills, the Cockle Creek system extends north-south parallel to Hexham Swamp. This creek system is characterised by a moderately broad alluvial flat extending up to 1000 metres from the creek. Local relief is less than one metre across the flat, and elevation ranges from 1 – 50 metres. Some relict terrace, levee and point bar deposits are known to occur on lower Cockle Creek. Alluvial fan deposits occur in the upper reaches of the creek system, and can be up to 500 metres in width (Matthei 1995:167). Rock outcrop is absent throughout the area.

The Sugarloaf Range is positioned to the west of the Newcastle LGA, and only a small portion of the Range – the Black Hill Spur – extends into the LGA. Black Hill characterised by steep slopes, with a gradient of 15 to 40 per cent. Local relief is up to 100 metres, and elevation is 50 to 100 metres. Drainage lines are narrow and incised throughout the area, and terracettes are common (Matthei 1995:73). The northern slopes of the Black Hill Spur, facing Beresfield, share these characteristics but grade into undulating low hills and rises in the lower terrain areas. In these areas, slope gradient reduces to 3 to 15 per cent, and sideslopes can extend up to 750 metres in length (Matthei 1995:30). Rock outcrops are not known throughout the area, but boulders occur on lower slopes and benches.

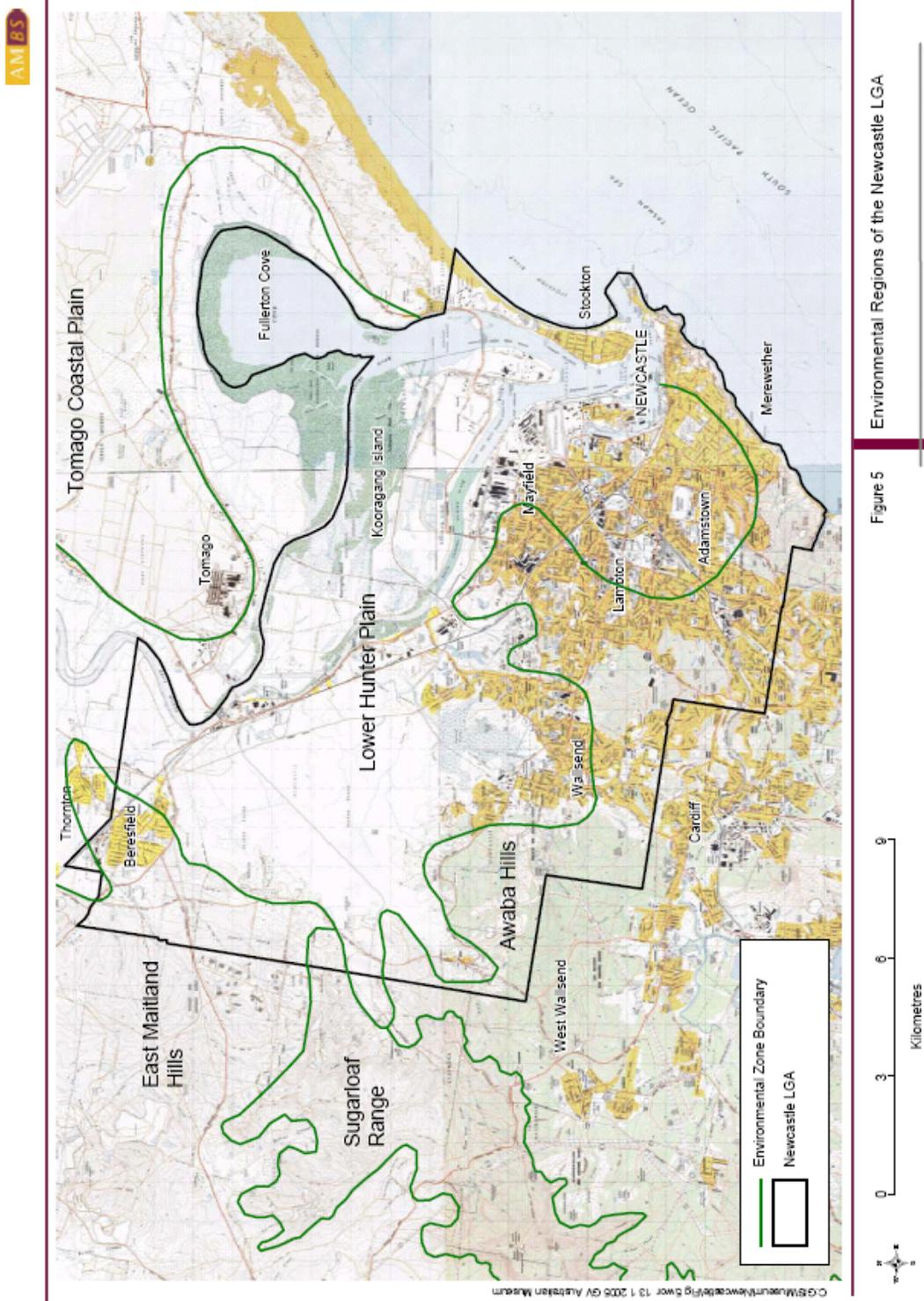


Figure 5 Environmental Regions of the Newcastle LGA

Figure 5: Environmental Regions of the Newcastle LGA

Flora and Fauna Resources

The varying landscapes of the Newcastle LGA are known to contain numerous flora and fauna resources. These abundant resources were used by Aboriginal people in the past, and influenced the deposition of archaeological materials within the landscape. The following discussion outlines the resources of the Newcastle LGA identified in the historical literature, and estimates the potential resources available to pre-contact Aboriginal people of the area. Little information is available for the flora and fauna of the area prior to contact, and extensive changes to the original habitats make it difficult to reconstruct with accuracy the vegetation communities and habitats that would have been available to past Aboriginal people.

A range of vegetation communities is associated with the Quaternary sands of the lower Hunter Valley alluvial plain. The vegetation at time of contact has been extensively cleared, but in upper reaches of the floodplain, remnants of tall open forest include *Allocasuarina cunninghamiana* (river oak) along river banks. In lower reaches where some saline influences occur, *Casuarina glauca* (swamp oak) dominates. Closer to the coastal zone, *Eucalyptus robusta* (swamp mahogany), *Melaleuca quinquenervia* (broad leaved paperbark) and occasional *Livistonia australis* (cabbage tree palm) occur. Narrow alluvial plains often support remnants of closed forest, including *Eucalyptus grandis* (flooded gum) and *Waterhousia floribunda* (weeping lillypilly) (Matthei 1995:6). In estuarine sediments, *Avicennia marina* (grey mangrove) and *Aegiceras corniculatum* (river mangrove) occur in areas of frequent tidal inundation. Saltmarshes containing *Juncus kraussii* (sea rush), *Bolboscoenus caldwellii* (coastal club-rush) and *Sarcocornia quinqueflora* (glasswort) occur in areas of extensive tidal inundation (Matthei 1995:6).

Along the coast, beaches are usually devoid of vegetation. In areas sheltered from sea spray, *Leptospermum laevigatum* (coastal tea tree), *Banksia intergrifolia* (coast banksia), *Acacia longifolia* var. *sophorae* (sydney golden wattle) occur, with *Pteridium esculentum* (bracken) and *Imperata cylindrica* (blady grass). On dunes and low beach ridges, uncleared open forest occurs. Dominant species are *Eucalyptus pilularis* (blackbutt), *Angophora costata* (smooth barked apple), *Eucalyptus gummifera* (red bloodwood), *Banksia serrata* (old man banksia) and a tall shrub understorey of *Leptospermum laevigatum* (coastal tea tree) (Matthei 1995:6).

Vegetation patterns of swamp lands in the Newcastle LGA, specifically Hexham Swamp, prior to contact are unknown as changes to the hydrology of the swamp have been significant and complex.

Until the twentieth century, it is understood that Hexham Swamp was covered by predominantly freshwater vegetation with saline communities restricted to creek margins (NSW National Parks and Wildlife Service 1998:18). Reeds and bullrushes form the dominant vegetation of the existing swamp, with the main species present being Common Reed (*Phragmites australis*), Fimbristlyis Reed (*Fimbristlyis ferruginea*), Tall Spike Rush (*Eleocharis sphacelata*) and Broad-leafed Cumbungi (*Typha orientalis*). These plants can grow over four metres high in the mud of the swamp (Waterhouse 1981:39). With the hydrology of the Hunter altered and the river increasingly saline from the 1950s, saline communities within the river expanded. The subsequent installation of the gates in Ironbark Creek in the 1970s restricted the

saline intrusion and resulted in the partial return to freshwater conditions (NSW National Parks and Wildlife Service 1998:19). In a 1970 survey, eleven of the fourteen coastal wetland types were identified at Hexham Swamp (Goodrick 1970). Since this time, a minimum of nine plant species have disappeared from the swamp, presumably as a result of hydrological changes within the swamp (NSW National Parks and Wildlife Service 1998:9). Work conducted in the swamp in the late 1970s (Briggs 1978) identified four primary vegetation types within Hexham Swamp:

- **saltmarsh and mangroves:** predominantly found in the south-east zone, dominated by grey mangrove, red samphire, saltwater couch and paspalum. Isolated stands of paperbarks and swamp casuarina occurred on higher ground;
- **reed community:** the central part of the swamp, dominated by *Fimbristylis ferruginea*, with minor areas of the common reed;
- **freshwater meadows and seasonal freshwater swamps:** the upper reaches of the swamp to the south west. This area contains the most diverse range of vegetation communities, dominated by cumbungi and other freshwater species; and
- **freshwater grassy swamps:** in the north-west part of the swamp, consisting of submerged aquatic plants, reeds, paspalum and other agricultural fodder plants. (NSW National Parks and Wildlife Service 1998:21).

The elevated ground surrounding wetlands throughout the area was once defined by coastal rainforests and forests. These forests have been progressively cleared, first for timber and then for agricultural use (Newcastle City Council 2003b). Post-contact settlement has also resulted in introduced plant species within the wetlands, with the Water Hyacinth (*Eichornia crassipes*) the most prominent introduced plant in freshwater swamp areas. This species is prevalent on the western side of Hexham Swamp, and can form dense mats (Waterhouse 1981:40).

The vegetation of Kooragang Island has also been altered during the historical period. Kooragang Island is currently covered with cattle pasture and estuarine wetlands supporting both saltmarsh plants and mangroves. Saltmarshes consist of a mixture of samphire (*Sarcocornia quinqueflora*), salt couch (*Sporobolus virginicus*), seablite (*Suaeda australis*) and streaked arrow grass (*Triglochin striata*), with the exotic spiny rush (*Juncus acutus*) and the native sea rush (*Juncus kraussii*) occurring near upland boundaries (Genders 1999).

The Awaba Hills region, occupying the southern portion of the Newcastle LGA, is dominated by open forest. *Eucalyptus maculata* (spotted gum), *Eucalyptus umbra* (bastard mahogany), *Eucalyptus punctata* (grey gum), *Eucalyptus paniculata* (grey ironbark), *Eucalyptus eugenioides* (thin-leaved stringy bark), and *Eucalyptus fibrosa* (broad-leaved ironbark) are the most common plant species observed. On exposed crests, *Angophora costata* (smooth-barked apple) and *Eucalyptus gummifera* (red bloodwood) occur, with occasional *Eucalyptus capitellata* (brown stringy bark) and *Eucalyptus haemastoma* (scribbly gum). In sheltered gullies, *Eucalyptus saligna* (sydney blue gum) and *Syncarpia glomulifera* (turpentine) occurs (Matthei 1995:5). Much vegetation within the area has been cleared for urban development, but the Glenrock State Recreation Area contains a large area of relatively undisturbed coastal vegetation (NSW National Parks and Wildlife Service 1997b:8).

As with flora resources, the fauna of the Newcastle LGA prior to contact can be estimated, but it is difficult to reconstruct available animal species due to changes in the landscape and eradication of animal habitats. The varying landscapes and vegetation communities would have provided a variety of animals.

Studies of the fauna of the Hunter estuary are limited. At present, it is known that the Hunter River contains about fifteen species of commercially important fish, crustacea and molluscs, including mullet, jewfish, prawn and oyster. Aquatic invertebrates such as worms, gastropods, molluscs and crustaceans are extremely abundant in Fullerton Cove. Further inland, various studies on Ironbark Creek demonstrated that the creek holds both marine and freshwater species (NSW National Parks and Wildlife Service 1998:23).

The wetlands of the region are rich in animal life and would have provided abundant resources for Aboriginal people, including estuarine fish, water birds, and a variety of lizards. Large wetlands such as Hexham Swamp support large populations and a greater diversity of native plants and animals than do small wetlands, and they provide essential habitat for specialised species that often depend on larger areas for survival (Pressey 1981). The tributary drainage lines and their associated catchments would also have provided habitat for a variety of mammals, including possum, wallaroo, kangaroo, swamp wallaby, swamp rat, sugar glider, squirrel glider and bandicoot (Umwelt 2002a:3.11-3.12).

Across Hexham Swamp a minimum of ten species of crab is known, the most common being the Red-fingered Marsh Crab and Semaphore Crab. Marine snails and shrimps are known, and numerous bird species are associated with these landscape areas. Larger wading birds include the royal spoonbill, great egret, white faced heron and sacred ibis are found here. When the paper barks and swamp mahoganies are in blossom, the large range of associated insects attract a variety of birds, such as scarlet honeyeaters and yellow thornbills. Marsupials also use the forests, such as squirrel gliders who feed on swamp mahoganies (Waterhouse 1981:38). Common fish species include bream, luderick and mullet, and at high tide, schools of small fish swim into the mangrove and saltmarsh areas looking for food and shelter (Newcastle City Council 2003b).

Kooragang Island is rich in swamp birds and fish (Waterhouse 1981:26). The Island is a particularly significant area for migratory waders and other waterbirds, and is host to birds in large numbers. In January 1995, 12,000 waterbirds were recorded at the location (NSW National Parks and Wildlife Service 1998:6). The Hunter estuary is also an important stopover for migratory birds en route to Victoria, such as the red knot, bar-tailed godwit. Kooragang Island is also host to a large and diverse frog population, with twelve frog species found on Kooragang Island including the endangered Green and Golden Bell Frog (Genders 1999).

There are few records of mammals within the Hexham Swamp and Kooragang Island nature reserves. Only three species of native mammal have been recorded on Kooragang Island: the water rat, the red fruit bat, and the grey headed fruit bat. Before the forest was cleared and introduced mammals became common, many native species would have been known in the area, such as possums, native rats and mice, bandicoots, microchiropteran bats and macropods. The estuarine areas of Kooragang

and Hexham are devoid of snakes, lizards and frogs, due probably to the presence of salt and its effect on their permeable skin (NSW National Parks and Wildlife Service 1998:25).

Australia has only two mammals adapted to living in freshwater: the platypus and the water rat. Both are widespread in the Hunter Region, and are found in swamps, lakes, rivers and creeks. The water rat is also found in wet heath areas and is known to venture into drier habitats. The black-tailed or swamp wallaby is at home in the swamp forest and adjacent wet meadows, but can be found in a variety of habitats, from mountains to coastal plains (Waterhouse 1981:44). A reptile that is quite common in the local swamps and creeks is the long necked tortoise (Waterhouse 1981:45).

There would have been changes in the available flora and fauna during the evolution of the lower Hunter landscape. In the early to mid Holocene, the most valued areas for resources that would support larger groups or more regular visits were probably the margins of the tributary drainage lines. In the later Holocene, the tributaries would have maintained these resources, but their relative resource value would have decreased as freshwater supplies extended to the swamp margins. The infilling of the Hunter River alluvial valley within the past 4000 years would also have resulted in significant variations in the form of the landscape, with associated changes in the presence of plant and animal habitats (Umwelt 2002a:3.7). These environmental changes would have been beneficial for Aboriginal occupants of the area, with a greater diversity of resources available within a smaller area. This would have impacted occupation and land use strategies, as discussed in Section 6.

5 Occupation and Land Use History

Knowledge of land use history in a particular area is an important element of archaeological assessments. Information about the nature and extent of land use across an area can indicate the potential distribution of archaeological materials. This section outlines the ethnohistorical records for the Newcastle area that provide information on some of the activities of the local Aboriginal people. This section then outlines a brief history of colonial occupation in the Newcastle area, providing information on the impacts of historical land use practices on the archaeological record.

5.1 Ethnohistorical Records of Aboriginal Life and Culture

There are a number of historical records that include observations and discussions of the Aboriginal inhabitants of the Newcastle region. In a lot of cases these observations are often supplemented or discussed in respect to the author's personal feelings towards Aboriginal people. Even so, these documents provide a useful insight into some of the activities, tools and clothing of the local Aboriginal people. They also serve as an insight into contemporary British views and ideas on Aboriginal society.

Observations were made by a variety of British people, including missionaries, military officers posted to Newcastle, and visitors to the area. Personal feelings and views on the Aboriginals varied amongst these people. Threlkeld, a missionary who spent a large amount of time with Aboriginal people at Lake Macquarie, made detailed and often the respectful comments and observations. Others reflected some of the much less respectful contemporary feelings of the British towards Aboriginals.

5.1.1 Subsistence Resources

Historical observations suggest that the Newcastle region provided a wide range and supply of food resources to the local Aboriginals. Aboriginals within the Newcastle area had access to a range of fresh water and marine resources from the Hunter River, the estuary towards the mouth of the Hunter River, and the South Pacific Ocean. Historical observations include many references to Aboriginal exploitation of these abundant resources.

Fish

Lieutenant Grant, of the Royal Navy, made an observation of the quantity of fish available in the Hunter River:

'fish were taken in great quantities, and of various kinds, particularly mullets, which were large and well flavoured. We caught also a species of jew fish, one of which weighed 56 pounds, and proved excellent eating. From the numbers of this fish, which escaped the seine, I am inclined to think there is great plenty in this river' (Grant 1803:159-160).

Another military officer in Newcastle, Lieutenant Coke, made a similar observation in 1827. He noted that 'we catch here eight or nine large fish called schnapper in an

hour – numbers of salmon, mullet – and we are obliged to kill four or five sharks there are so many here’ (Newcastle Morning Herald Supplement 1993:2).

Fishing Techniques

Various techniques were utilised by the Aboriginals to catch fish. The canoe was important, and was used for both line and spear fishing as well as for catching lobster. One observation, made by William Scott of Port Stephens in the mid 1800s, records that women used the hook and line and men used spears. However, one method of fishing he observed included both men and women:

‘The women would be on the lookout for the shining, shimmering mass of fish to come round some wooded headland, and when their shrill outcries told of the approach of the finny prey, the men would rush to the shore. Hissing into the water would hurtle the heavy spears....’ (Newcastle Morning Herald Supplement 1993).

Another technique included the use of a hand net, ‘forming a circle in shallow waters and enclosing the fish’ (Threlkeld in Gunson 1974:190). Threlkeld noted another method which he thought ‘most curious’:

‘planting sprigs of bushes in a zig-zag form across the streams, leaving an interval at the point of every angle where the men stand with their nets to catch what others frighten towards them by splashing in the water’ (Threlkeld in Gunson 1974:190).

Sea Mammals

A beached whale provided a large feast that was shared with Aboriginals from the surrounding area. Threlkeld observed that ‘a whale, cast on the shore, is quite a feast, and messengers are despatched to all the neighbouring tribes, who assemble and feast upon the monster of the deep so long as the treat lasts’ (Threlkeld in Gunson 1974:55). Aboriginals were also observed eating Porpoise. Threlkeld notes that ‘porpoises are never refused. We shot one or two, once, in the lake, and the blacks drew the dead fish on shore....’ (Threlkeld in Gunson 1974:55). Brayshaw (1987:77) suggests that, although Aboriginals ate porpoise when it was presented to them, there is no evidence that they actively pursued them.

Shellfish

Shellfish were also an important resource, illustrated by the large number of recorded shell midden sites in the Newcastle region including large oyster shell deposits in the Hunter estuary. The consumption of shellfish in the Newcastle region, is recorded in Threlkeld’s (Threlkeld in Gunson 1974) observations of cockle consumption at Lake Macquarie, and Grant (1803) also recorded fresh water mussel consumption further west along the Hunter River. Threlkeld’s descriptions of life at Lake Macquarie included:

‘Cockles were the every day fish on the lake, not because they were the favourite food, but, because they can be at all seasons, most easily obtained. These are roasted and eaten, squeezing them first in the hand to press out the superfluous

liquor contained within them, but they are a tough morsel' (Threlkeld in Gunson 1974:55)

Grant noted the availability of oysters and the large quantities of shells lining the shore:

'Here we found trees incrustated with oysters, and the shore covered to a great depth with oyster-shells, from which lime might be made on the spot...' (Grant 1803:155)

There has been a substantial impact on the shell middens in the Newcastle region, some were burnt in the early historical period for lime, whilst others were destroyed during the development process along the banks of the Hunter. Dyall (1971:155) suggests that 'prior to the establishment of heavy industry in Newcastle, shell middens extended all the way from Port Waratah to Sandgate along the riverfront'.

Further north at Port Stephens, William Scott noted that 'lobsters were caught by the women who, in the sea dived amongst the rocks for them' (Newcastle Morning Herald Supplement 1993). Similar observations were made by Lieutenant Coke (Newcastle Morning Herald Supplement 1993) in the Newcastle area and by Threlkeld at Lake Macquarie. Threlkeld noted that the acquisition of 'craw-fish involved 'choosing a calm day at sea, in one of their frail canoes, and dive along side of the rocks, and pull the fish out of the holes in the rock under the water' (Threlkeld in Gunson 1974:55). Threlkeld also noted the risk during this process of shark attack, although he notes that the Aboriginals did not succumb to attacks as often as he perceived based on the risks of their activities. He does mention one incident, however, when a canoe was upset and sunk and a shark killed one of the occupants.

Land Animals

Historical observations document the large number of land animals that the Aboriginals ate. These include land mammals such as kangaroos and bandicoots, and reptiles such as snakes and lizards. Threlkeld recorded that hunting techniques used to acquire bandicoots and kangaroos involved a group of Aboriginals surrounding or frightening these animals to particular spots where they were killed. Threlkeld went with a group of Aboriginals with waddies to hunt bandicoot and observed that:

'with the(ir) weapon of warfare they beat about every high grassy bushy place. The dogs hunting around likewise. The moment an animal appeared they threw their waddies at it and generally killed it at one blow. One man stood on the stump of a tree, and threw a spear with the greatest precision transfixing a Bandicoot to the ground....' (Threlkeld in Gunson 1974:54).

Threlkeld also observed a technique used to catch kangaroos. 'Kangaroos were often caught by being driven as a herd, using noise and smoke, into an ambush of spears' (Newcastle Morning Herald Supplement 1993). Snakes and lizards were also eaten, Threlkeld noted that 'large lizards are a favourite article of food' and 'snakes form another tit-bit, when roasted, for a certain description of Elders among the tribes' (Threlkeld in Gunson 1974:55).

Another creature that was eaten by Aboriginals and recorded in a number of records is 'cabra'. This creature has the appearance of a large maggot, and is found in 'grass tree stumps and inside pieces of wood immersed for any length of time in rivers and other bodies of water' (Newcastle Morning Herald Supplement 1993). Lieutenant Grant noted the 'cabra' and its taste:

'They are of a glutinous substance, and after being put on the fire, harden to the consistence of the spinal marrow of animals. When fire is not at hand the natives eat them raw...I tasted them on the recommendation of one of my men, and found them not unpalatable....' (Grant 1803:163).

Birds were an important part of subsistence. Threlkeld noted a large mutton bird colony on an island at the entrance to Lake Macquarie. 'The island, called Nirritibah, was raided for eggs and chicks once a year by the Aborigines' (Newcastle Morning Herald Supplement 1993).

5.1.2 Material Culture

A number of elements to the material culture of the local Aboriginal community were documented in historical records. There are a number of observations relating to the use of stone by Aboriginals. It is apparent that stone was one of a variety of materials, including wood and shell, used for implements and activities. Threlkeld notes that:

'The battle-spear is made...with the addition of pieces of sharp quartz stuck along the hard wood joint on one side so as to resemble the teeth of a saw' (Threlkeld in Gunson 1974:67).

Threlkeld further notes that these 'fragments of quartz' were replaced with bottle-glass, 'thus inflicting fearfully lacerated wounds with the deadly weapon, when thrown against their enemy' (Threlkeld in Gunson 1974:67). Threlkeld also noted introduced materials such as iron and glass were adopted for other uses, such as fish hooks (Threlkeld in Gunson 1974:54).

Lieutenant Grant recorded observing 'stone hatchets' and some of their uses. On one occasion an Aboriginal man had been invited onto the boat that Grant was on. One of Grant's superior officers, Colonel Patterson, gave the Aboriginal man a tomahawk. After the man had been returned to shore some of the ship's crew signalled to him to use the tomahawk, and Grant observed that:

'He readily understood them, and making a notch in the tree with his instrument, placed his foot into it, continuing the same practice; thus he very nimble ascended to the top, though the tree was of great thickness, and without branches that could assist him in the ascent to the height of forty feet' (Grant 1803:158).

Following this observation, Grant (1803:158) noted that 'The natives have hatchets of their own, formed with sharp stones, and which they used for the same purpose, and I have indeed remarked that many of the trees are notched'. This observation of notches on trees is supported by an item in the Australian Museum Aboriginal Ethnographic collection – a section of the trunk of a tree with a notch which came from Tickhole, Lake Macquarie LGA.

Observations indicate that trees and their products were used for a variety of other purposes by the local Aboriginals. These purposes included making canoes, tools and shelters from bark and wood and hunting fauna that lived in them. Threlkeld noted that when it rained ‘they will seek for shelter, or, raise up sheets of bark to cover them from the storm’ (Threlkeld in Gunson 1974:53). Threlkeld also described canoe manufacture. He noted that they were made ‘of the bark of a tree about 12 or 14 feet long, and from 3 to 4 feet in width’ (Threlkeld in Gunson 1974:54).

5.2 History of Colonial Occupation

The mouth of the Hunter River was first noted by Captain Cook who passed in May 1770 while sailing north. After the British settled in Port Jackson in 1788, fishermen were reported to visit the Hunter mouth area in 1796. It was not until 1797 that the British explored the Hunter delta in any detail. At that time, Lieutenant Shortland entered the bays and inlets of the delta in search of convicts who had escaped from Sydney (Newcastle City Council 2003a). During this trip, Shortland mapped the Hunter delta, and made the following comments on the location:

The entrance of this river is but shallow, and covered by a high rocky island lying right off it so as to leave a good passage round the north end of the island, between that and the shore. A reef connects, the south part of the island with the south shore of the entrance to the river. In this harbour are found a considerable quantity of very good coal, and lying so near the water side as to be conveniently shipped, which gives it, in this particular, a manifest advantage over that discovered to the southward. Some specimens of this coal were brought up in the boat. (Newcastle City Council 2003a).

Following this report of coal in the exposed cliff faces at Newcastle, coal was being shipped and transported to India and other overseas locations, via Sydney, by 1799. It is believed that coal was the stimulus for the first settlement of Newcastle, prompting Governor King to send troops to garrison an outpost at Newcastle in 1801. This settlement was established on the southern side of the Hunter River (known as Coal River until 1804) upstream of the sand hills where Watt and Bolton Streets are situated (Stewart 1983:11). Early mining operations continued only for a year, until reports of misconduct led to the withdrawal of convict miners and the associated military guard (Williams *et al.* 2000:7).

In 1804, a second penal settlement, initially known as “King’s Town”, was established at Newcastle and for the next two decades, Newcastle served as one of the principal penal settlements of New South Wales. The settlement initially numbered 61 convicts, which rose to 69 in 1811, 130 in 1812 and 792 in 1819 (May 2002). Convict labour was the basis of the early community, and was responsible for all early construction, although recalcitrant prisoners were confined at Nobbys Head. The first jetty of the settlement was constructed at the end of Watt Street, and the adjacent lagoon was utilised for harbour works. A breakwater was constructed between Nobby Island and the mainland in 1818 to restrict tidal flow to the main channel. Stone for these projects was sourced locally, from the riverside face of Beacon Hill (Stewart 1983:12).

Coal production was the primary industry of early Newcastle. For the first forty years of the settlement, convict workers extracted small quantities of coal from narrow shafts in the region (Shoebridge 1983:39). Mining operations did not increase until 1830, with the establishment of a mine at what is now the top of Brown Street (Stewart 1983:12). Over the next decade, production increased from 5,000 to 30,000 tons. Natural coal deposits of the Newcastle and Tomago Coal Measures around Wakefield, West Wallsend, Stockrington and Shamrock Hill were exploited, and other heavy minerals were also mined. These included rutile, zircon, ilmenite and monazite. Small areas of structural clay were also mined from the Swan Bay area for brick making (Matthei 1995:6).

Although coal was the primary industry, timber, lime and salt production were also important industries of early Newcastle. Timber was cleared from the rainforest and mangrove forests of the delta, and the complex of islands now known as Kooragang Island were an important source. Cedar was the most common timber cleared for shipment to Sydney during this time (Shoebridge 1983:39), and by 1801, a sawpit had been constructed on Kooragang Island (Williams *et al.* 2000:7). Huge quantities of oyster shells were burned to produce lime, and salt was also locally produced (KWRP 2003). It is likely that a source of shell was also the extensive shell middens that lined the banks of the Hunter River.

The diverse economic production of the early settlement dwindled in the 1820s, resulting from the reduction of timber and shell resources, and the expansion of agriculture and grazing along the alluvial flats of the Hunter River (KWRP 2003). Early agricultural activity was designed only to sustain the convict settlement, but as the Hunter Valley was opened to free settlers in the 1820s, settlement quickly extended along the fertile alluvial flats (Newcastle City Council 2003b). Among the earliest settlements in the region were the twenty or more farms established at Paterson's Plains (later Maitland), Green Hills (later Morpeth) and Hexham. Settlement at Hexham Swamp dates to 1828, following a survey by Henry Dangar of the location (Kuskie and Kamminga 2000:49). Early activity revolved around agriculture on peripheral but floodprone and relatively fertile soils, although dairying, cattle grazing and raising of horses were also conducted. By 1827, it is known that the region contained 25,000 horned cattle and 80,000 sheep (Hartley 1995).

These communities developed along the Hunter River, and became major centres of agricultural and pastoral activity, soon outstripping the production of coal from Newcastle. By 1825, it is reported that 200 tons of agricultural produce was being moved to Sydney each week from these river ports, compared with 50 tons of coal from the government mine at Newcastle (Stewart 1983:12). Production from these centres continued throughout the nineteenth century, with large quantities of wool, wheat, tallow, maize, tobacco, wine and timber shipped from Paterson, Clarencetown and Morpeth from the 1820s until the 1870s (Imashev 1983:29). During this time, vineyards, dairying and citrus orchards were also established in the lower Hunter Valley (Matthei 1995:1). The population of the Newcastle and Hunter grew rapidly throughout this period. In 1828, the population of the region (including Port Stephens) was 3,225. By 1833, this grew to 8,138, composed of 4,700 convicts and 3,438 free settlers. In the 1881 census, Newcastle alone recorded 8,986 people, with 1,160 recorded at Minmi and 1,059 at Wallsend (Hartley 1995).

With produce from the Hunter Valley being moved by ship, maritime building and repair services were established along the Hunter River from 1831. Important centres were established at Deptford, Clarencetown, Eagleton, Dockyard, Raymond Terrace and Wallalong (Imashev 1983:29). Newcastle's shipping facilities dated to the initial 1801 settlement, but these facilities likewise expanded in the 1830s reflecting the growth of the industry. During this time, a daily shipping service from Morpeth to Sydney via Newcastle was established. However, it was not until the 1870s that shipbuilding was focussed on the rapidly developing port of Newcastle. The move away from the River resulted from many factors, including the increased siltation of the River from clearance and erosion which made navigation difficult, and the advent of rail technology (Imashev 1983:30). The increased construction of transport infrastructure in Newcastle also reflected increased coal production, which transformed Newcastle into the largest coal exporting port in the Southern Hemisphere (May 2002).

The importance of shipping access to the Hunter delta during this time resulted in works being conducted within the harbour. Much of the existing shoreline has been modified by breakwaters, retaining walls and bank protection works. To prevent loss of wind to ships as they sailed behind Nobby, situated in proximity to the hazardous Oyster Bank, the outcrop was reduced from its original height of c.230 feet to the present 96 feet by 1855 (Stewart 1983:13). Following the large flood of 1857, dredging was undertaken within the Hunter River, presumably to reopen shipping channels. Works continued into the twentieth century, with drainage structures erected to control tidal flow in the late 1940s or early 1950s, and drainage structures and levee banks constructed around Kooragang Island. Seaham Weir was built across the lower portion of Williams River, and floodgates were put on Ironbark Creek (the main drainage channel for Hexham Swamp). The riverbank at Millers Forest, a section of the Hunter River, was dredged in 1969 as part of flood mitigation works. In 1970, headworks were installed at Ironbark Creek that reduced tidal range and water levels in Hexham Swamp (Williams *et al.* 2000:9-11).

Industrial development of the Newcastle harbour continued throughout the late nineteenth and twentieth centuries. In 1896, Broken Hill Proprietary Ltd (BHP) acquired 10 hectares of waterfront land at Port Waratah for smelters. The land available to BHP increased in the early 1900s as a result of the Newcastle Iron and Steel Works Act (1912), which increased the amount of land available for heavy industry (KWRP 2003). From the 1900s to the 1970s, a number of industries were established in the lower Hunter, including the Oak milk factory and the Hunter Water Corporation pipeline. In response, the Richmond-Pelaw Colliery Railway and the Great Northern Railway were established (NSW National Parks and Wildlife Service 1998:7).

The arrival of the Australian Agricultural Company in 1825 was an important event in Newcastle's history. The company developed extensive mining projects on the edge of the town, extracting 7,000 tons of coal in its first year of operations. For many years the Australian Agricultural Company had a monopoly in the Newcastle coal business. Most of the coal was sold within Australia, but occasionally to India, China and the Pacific Islands. By 1930 the Newcastle region was home to over 100,000 people. When the great depression hit, unemployment rose to over 30 per cent as steel production slowed and secondary manufacturing declined (Newcastle Tourism

2003). During the Second World War, BHP and Newcastle were critical to Australia's war effort. The Newcastle works produced specialised kinds of steel for weapons, aircraft and other military hardware. Newcastle's steel industry continued to grow through the 1950s and 1960s, but from the 1970s it went into a slow decline. In 1983, BHP announced that it would be closing its Newcastle steelworks. Under a plan worked out by the company, Unions and the Federal Government, the works eventually closed in 1999.

The complex of islands now known as Kooragang Island were a major focus of activity. With the exception of some shipbuilding infrastructure, no other major industry occurred on the island until after World War II (NSW National Parks and Wildlife Service 1998:4). In response to the War, the Newcastle Chamber of Manufacturers proposed a major industrial area for Kooragang Island be developed (NSW National Parks and Wildlife Service 1998:4). To enable this development, massive reclamation works commenced at the Island in the 1950s and 1960s (Umwelt 2002b:3.9). The creation of the Kooragang Island landmass was part of a NSW Public Works Department program supported by the Newcastle Harbour Improvements Act (1953). As part of this program, Platt's Channel was filled, connecting Spit Island to the mainland, and Walsh and Moscheto Islands were linked. In 1966, the channels around Dempsey Island were filled. By 1969, the term Kooragang Island was applied to the landmass that had originally been a complex of islands (Williams *et al.* 2000:10). At the completion of this program, the island area was approximately 20 per cent larger than illustrated on the 1801 naval chart and the number of islands had decreased from 21 to 6 (Williams *et al.* 2000:xi). In turn, the length of the shoreline has reduced from 154 to 121 kilometres.

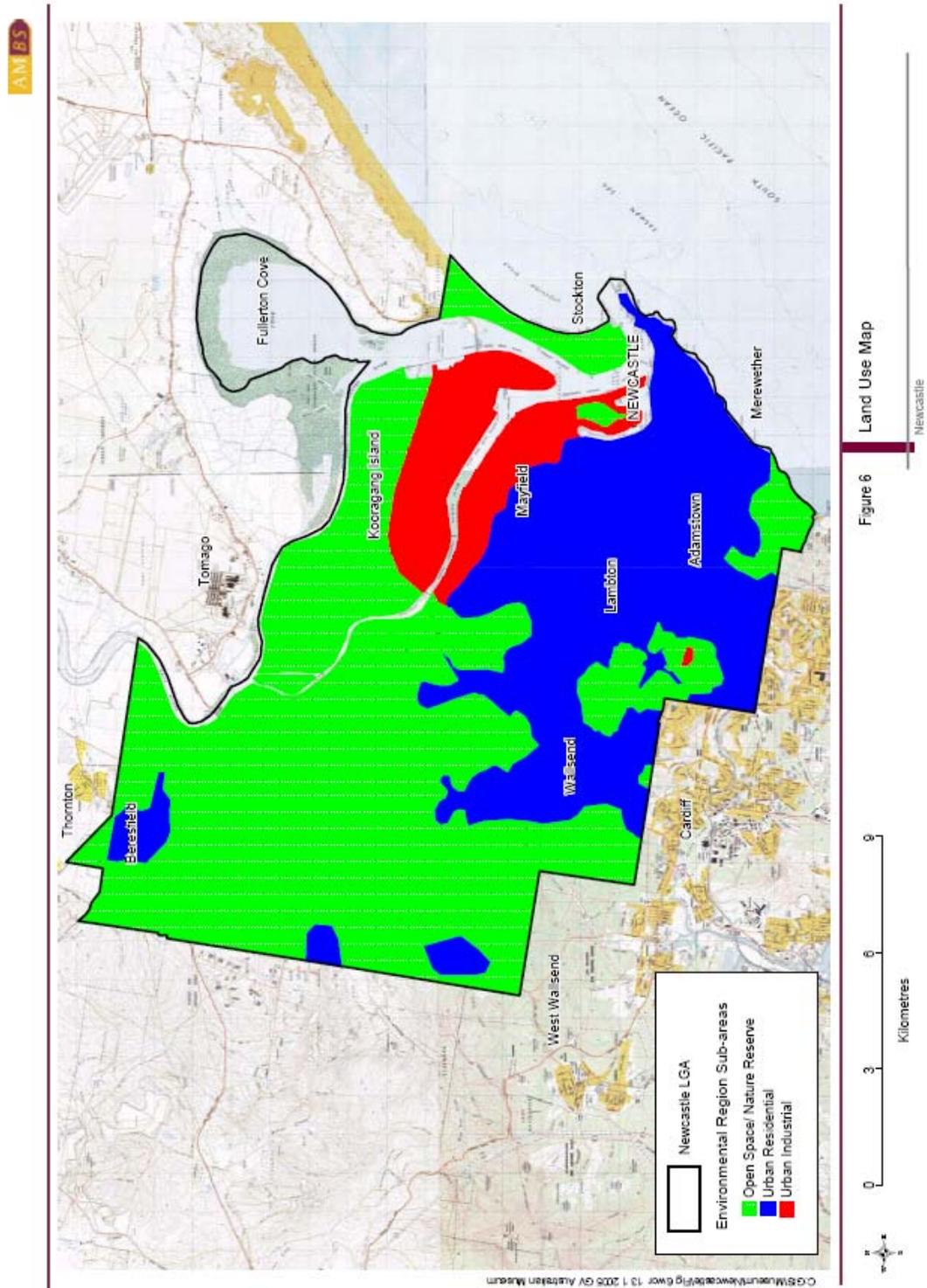
By the early 1970s, 27 per cent of Kooragang Island had been reclaimed for industrial purposes and there was growing community concern about the extent of the industrial reservation and air pollution. A 1972 Commission of Inquiry into Kooragang Island suggested that future engineering works be done in an ecologically sensitive way and that a large section of the island adjacent Fullerton Cove be preserved (KWRP 2003).

The urban centre of Newcastle as it currently exists is based on the original settlement, established on the sand hills of the Hunter River delta. Much of the area to the south of the River has been subject to a high level of urbanisation, focused on the major urban centres of the greater Newcastle area and Beresfield. At the start of the twenty-first century Newcastle has a population of over 250,000 (Newcastle Tourism 2003), is the second largest city in New South Wales, and the sixth largest in Australia.

5.3 Summary of Landscape Modification

The recent land use history of the Newcastle LGA, since the time of contact, has resulted in substantial landform modification. Modification has involved clearance of vegetation, earthworks and excavation, reclamation of estuarine areas, alteration of the hydrology of the Hunter River and surrounding wetlands, and widespread residential and industrial construction. Figure 6 illustrates the extent of landscape modification in the Newcastle LGA, identifying areas of industrial development, residential development and areas retained as open space. The impacts from development vary throughout the area according to its specific land use history, as discussed below.

Figure 6: Land Use Map



5.3.1 Vegetation Clearance

Early settlement of Newcastle was focussed on the Hunter River estuary delta. Much of the natural vegetation of the floodplain was cleared for the timber trade, to create farmland and to provide fuel for early industry. The impacts of this clearance include:

- by 1842, both banks of the Hunter River between Newcastle and Morpeth had been extensively cleared;
- clearance of wetland areas, prominent features of the alluvial plain, would have been accompanied by attempts to drain the wetland and improve access (Williams *et al.* 2000:9-13);
- infrastructure for timber cutting was also constructed in the region, such as the sawpit established on Kooragang Island in 1801 (Williams *et al.* 2000:7); and
- the impact of clearance throughout the lower Hunter Valley also affected natural erosion patterns and hydrology. Increased sediment movement in cleared areas resulted in the increased silting of the rivers, which in turn stimulated human action along the River through dredging (Imashev 1983:30).

5.3.2 Flooding Mitigation

Flooding of the Hunter River was perceived to be a major problem to early agriculture and pastoralism. Modifications to the River and surrounding plain is likely to date to early agricultural use, to control surface water (Williams *et al.* 2000:9). Controlling water movement of the Hunter estuary was an important feature of early industry, and this resulted in substantial landscape modification of the Hunter River foreshores. Works conducted included:

- a major dredging program in 1857, presumably to clear the navigation channels silted during the flood. Much of the dredging spoil was put on the shoals to the eastern end of Moscheto Island and within a few years enough material had been deposited to create a new dry land feature, subsequently named Walsh Island;
- construction of the Walsh Island training wall in 1898;
- construction of drainage structures in the late 1940s or early 1950s in the lower Hunter River channel. These included a levee bank constructed to the east of Waterpipe Road, and another to the east of Powerline Road;
- filling of Platt's Channel in the 1950s, effectively connecting Spit Island to the mainland;
- Walsh and Moscheto Islands were linked in the 1950s through filling;
- Seaham Weir was built across the lower portion of Williams River in the late 1960s and early 1970s;
- the riverbank at Millers Forest was dredged in 1969 as part of flood mitigation works; and
- floodgates constructed put on Ironbark Creek in 1970, the main drainage channel for Hexham Swamp.

5.3.3 Land Reclamation

Land reclamation has been extensive in the lower Hunter River estuary. Over 1,500 hectares of wetlands have been reclaimed to meet the demands of industry, agriculture, shipping and urban development (Newcastle City Council 2003b). Details of land reclamation across the Hunter River estuary include:

- in the early 1900s, portions of Moscheto Island were resumed for heavy industry and made available to BHP. Reclamation works of the eastern end of the island were halted in the 1930s as a result of the Great Depression (KWRP 2003);
- after the Second World War a new program of dredging and land filling began at Kooragang Island in order to create a single landmass out of the complex of islands at the location (KWRP 2003). By the early 1970s, 27 per cent of the existing Kooragang Island had been reclaimed (KWRP 2003);
- three hundred and forty four hectares (13 per cent) of open water was lost during this time. Much of the existing shoreline has been modified by breakwaters, retaining walls and bank protection works; and
- these works resulted in the extension of tidal flow further into the Hexham Swamp and threatened this highly valued freshwater area.

The first 100 years of historical activity at Kooragang Island were based on the progressive clearance of land for agricultural purposes and an increase in shipping facilities. Clearing would have been accompanied by attempts to drain the wetland and improve access to the complex of islands. With the emergence of industry on Kooragang Island, further land was reclaimed and levee banks were installed to reduce the extent of tidal inundation. During the latter part of the twentieth century, a massive investment was made in engineering structure on the island (Williams *et al.* 2000:13).

5.3.4 Further impacts of Industrial Development

The lower catchment of the Hunter River is a highly industrialised and urbanised complex, and the mouth of the river has been developed into one of Australia's most important ports. Changes to the wetlands of the lower Hunter Valley were discussed by Williams *et al.* (2000:xi). These changes include:

- between (1796 – 1895) the wetlands were impacted by agricultural and grazing, and to some extent, by shipping needs of the Newcastle colonists;
- extensive clearance was undertaken during the mid-late nineteenth century;
- between (1896 – 1989) industrial development, including the Great Northern Railway, the Richmond-Pelaw Colliery Railway, the Oak milk factory and the Hunter Water Corporation pipeline, have resulted in extensive earthworks and changes to the hydrology of the wetlands;
- concentration of wetland drainage through Ironbark Creek channel to the east, and the massive reclamation works at Kooragang Island, increased the salinity of the swamps (NSW National Parks and Wildlife Service 1998:7); and
- from the late 1980s, conservation of the wetlands has become increasingly promoted, and some rehabilitation works have since been conducted (Williams *et*

al. 2000:xi). In areas still used for grazing, the potential for regrowth is limited (Waterhouse 1981:37).

In addition to the swamps of the lower Hunter floodplain, there are several much smaller areas of freshwater wetland on the coastal strip between Port Stephens and the Lake Macquarie district. Many of these occur as swampy depressions or lagoons, and virtually all have been altered in shape, extent and appearance by farming, industry, transport, waste disposal and residential development. Many former wetlands along the coastal strip have been completely filled in to allow for urban development (Waterhouse 1981:23).

The full impact of landscape changes to the wetlands of the lower Hunter Valley is not adequately understood. The loss of animal habitats has had serious ecological implications, but the number of species lost to the area is not known due to lack of historical data for the Hunter River (Williams, Watford and Balashov 2000:xii). It is known that the number of birds, specifically freshwater species, utilising the swamps have decreased dramatically since the salt water intrusion of the 1950s (NSW National Parks and Wildlife Service 1998:9). In more recent times, the numbers of waterfowl have decreased (NSW National Parks and Wildlife Service 1998:9).

Industrial development has been mainly centred to the north of Newcastle, within the islands of the Hunter delta and to a lesser extent around Hexham (Matthei 1995:6). The rate of industrial development increased markedly during World War II, as Newcastle responded with increased production. There is continuing land development, which may give rise to increased soil erosion, water pollution and encroachment of feral animals and weeds affecting nature reserves in the area (NSW National Parks and Wildlife Service 1998:14). Impacts from industrial and residential activity have included:

- early landscape changes included the reduction in height of Nobbys, (Stewart 1983:13);
- before major underground mining operations were commenced, convict workers extract minor quantities from narrow shafts excavated throughout the area (Shoebridge 1983:39). Coal has been mined at Wakefield, West Wallsend and Shamrock Hill;
- small areas of clay have been mined from the Swan Bay area for brick making (Matthei 1995:6);
- lime production at Newcastle involved the burning of existing shell deposits in kilns to produce lime. It is likely that existing shell deposits included Aboriginal midden sites associated with the estuary;
- major urban centres of the area include the greater Newcastle area, Maitland, East Maitland and Beresfield (Matthei 1995:6); and
- clearance of vegetation, earthworks to create level surfaces for development, and modification of hydrology of the region. This has also involved stabilisation of the urban areas built on Quaternary sand deposits, including earthworks and introduced fill to create level surfaces.

6 Archaeological Literature Review

A body of previous archaeological work has been conducted within the Newcastle LGA. Studies have ranged from landscape surveys to salvage excavations, and with each study, our understanding of archaeological site distribution and composition patterns has increased. This section identifies previous archaeological research conducted within the Newcastle LGA, and provides detailed reviews of relevant case studies. The review targets key research issues, such as: the occurrence of known sites in the environmental regions and areas identified by this study; the nature of the archaeological record of the Newcastle LGA; and the varying distribution patterns for known archaeological site types. This review forms the basis of the landscape model of archaeological sensitivity presented in Section 7.

6.1 Previous Archaeological Research

Archaeological research within the Newcastle LGA first dates to the 1920s, when research scientists began examining sites in the region and collecting materials for analysis and display. As the nature of the development process changed in the 1970s and 1980s, heritage was increasingly incorporated into environmental impact studies and site-specific archaeological assessments were often required. Known archaeological studies conducted within the Newcastle LGA are discussed below, to identify research themes and key results of previous research undertaken.

6.1.1 Early Archaeological Research

Staff of the Australian Museum conducted early research in the Newcastle region. W.W. Thorpe, an ethnologist from the Australian Museum, documented a number of Aboriginal archaeological sites in the Newcastle area during the 1920s, as part of a typological analysis of stone artefacts. From his notes, it is apparent that prior to this heavy modification of the Hunter estuary delta, there were a number of substantial archaeological sites evidencing Aboriginal habitation and activities. For example, Thorpe (1928:241,243) states:

‘For miles along the bank of the south channel of the Hunter River west of the Broken Hill Proprietary’s works, the shore is largely composed of midden material. To break down and examine the contents of this area would entail enormous expense and considerable time. At intervals, however, aboriginal (sic) stone implements are revealed by tidal erosion, and other natural causes’.

Thorpe’s studies of the region (1926 and 1928) also refer to the early collection of archaeological materials by people in the Newcastle area. Two collectors described by Thorpe include Messrs C.W. Loch and D.F. Cooksey, both of Mayfield, who ‘possessed a remarkable series of these implements’ (Thorpe 1926:244). Thorpe examined a series of artefacts collected by Cooksey during an excavation in the Mayfield area, which included ‘scrapers’ in large quantities, waste flakes and cores, but a ‘remarkable absence’ of most of the specialised artefacts that collectors had obtained. Although such artefacts were recovered from excavation, Thorpe (1928:244) noted that the vast majority of artefacts were retrieved from surface contexts, as other local diggings failed to expose any archaeological materials.

David R. Moore of the Australian Museum continued research of the region in the 1970s, as part of studies of the Hunter Valley (Moore 1969, 1970 and 1981). Early research investigated the Upper Hunter Valley and Goulburn River Valley, and specifically targeted natural shelter formations on valley slopes. Moore did not consider the valley floor of high archaeological interest, due the destructive affects of both historical settlement and flooding of the Hunter and Goulburn Rivers:

‘Along the floor of the valley itself the severe flooding, already mentioned, has obliterated practically all traces of prehistoric and post-settlement Aboriginal occupation, but along the scarps and side valleys many interesting relics still survive’ (Moore 1970:29)

Moore’s work in the Upper Hunter included the excavation of three rock shelters and one open excavation. Although this work was conducted a fair distance from Newcastle, it provided the earliest dated contexts in the Hunter Valley and important information and comparisons of the recovered stone artefact assemblages. The main focus of contemporary archaeological investigations in the Upper Hunter is primarily open areas where land is being impacted by residential and industrial activities.

Following research in the Upper Hunter Valley, Moore planned to investigate the Lower Hunter Valley. Unfortunately, during preliminary assessment of the region, Moore (1981) came to the conclusion that the Lower Hunter Valley had been impacted too greatly by historical land use practices to provide adequate archaeological information:

‘...after extensive reconnaissance, it became clear that any occupation sites on the lower Hunter likely to contain in situ remains had been obliterated or destroyed by the intensive European use of the region’ (Moore 1981:388).

Moore (1981) provided references to this historical disturbance, including tree clearance and coal mining, and also witnessed the destruction of shell deposits on Ash Island:

‘At the time of the commencement of this survey some remnants of the formerly huge shell heaps on the swampy islands in the Hunter estuary still remained, but before it was possible to investigate them in any detail they were bulldozed out of existence for road-fill and factory development’ (Moore 1981:390).

Due to this conclusion that ‘the lower Hunter area seemed unlikely to provide any sites suitable for excavation’ (Moore 1981: 390) the survey was eventually re-located to the area of the Wollombi Valley, Mogo Creek and the lower Macdonald Valley. It is evident from other work conducted in the Lower Hunter that the archaeological record has *not* been totally destroyed or obliterated as Moore (1981) suggested.

Dyall (1971 and 1972) conducted a series of investigations in the Newcastle region that coincided with Moore’s work in the upper Hunter Valley. Dyall’s work presents research and field identification of Aboriginal occupation across the Newcastle, Hunter and Lake Macquarie region. A large amount of archaeological research has occurred since then, but Dyall’s work has been important in developing ideas on Aboriginal occupation, site types and site locations. A number of areas that Dyall investigated have since been destroyed or impacted by development.

Dyall (1971) presented a general discussion of the Aboriginal sites and habitation of the Newcastle area. He noted that the shell middens that had been documented in earlier references along the Hunter had been severely impacted by industrial activity. 'Prior to the establishment of heavy industry in Newcastle, shell middens extended all the way from Port Waratah to Sandgate and along the riverfront' (Dyall 1971:155). Dyall made extensive collections of surface artefacts from the Newcastle region, including Lake Macquarie and Port Stephens. Dyall (1971:157) noted that 'total collections (repeated to allow for the vagaries of wind and moisture conditions) do give a fair impression of the stone material the aborigines (sic) left at a site'. This material was deposited at the Australian Museum and is currently part of its Aboriginal archaeological collection.

6.1.2 Recent Archaeological Investigations

Since the 1980s, numerous archaeological studies have been conducted within the Newcastle LGA, primarily in advance of and in response to proposed development. These studies reflect the increased consideration of heritage impacts in the environmental impact assessment process.

To identify recent archaeological research conducted within the Newcastle LGA and surrounding area, a search of the Department of Environment and Conservation (DEC) Aboriginal Heritage Information Management System (AHIMS) was undertaken at the outset of the study. Search keywords were: Newcastle; Hexham; Kooragang; Blue Gum; Leneghans Flat; Beresfield; Walsh Point; Stockton; Nobbys; Merewether; Glenrock; Lambton; Wallsend; Shortland; Carrington; Adamstown; Minmi; Fullerton; Black Hill; Jewell's Swamp; Whitbridge; Gateshead; Charlestown; Cardiff; Redhead; Dudley; Fern Bay; Williamtown; Tomago. In addition, Newcastle City Council provided AMBS with a number of documents and archaeological reports that had been submitted to Council. All studies identified by the searches are listed in Appendix A, delineated into the broad environmental regions identified by this study.

As indicated in Appendix A, a substantial number of archaeological studies has been conducted within the Newcastle LGA, with 135 previous archaeological studies known. To identify major trends, the geographic areas investigated and the study type in each environmental area within the Newcastle LGA are tabulated in Table 4.

Table 4 : Analysis of Previous Archaeological Studies

Environmental Area	Geographic Area	Investigation Type					
		Sample Survey	Total Survey	Test Excavation	Salvage Excavation	Site Management	Other (unknown)
Lower Hunter Plain	Central Newcastle				2	2	2
	Kooragang	1	5				
	Hexham	1	2				
	Blue Gum		1	1	1		1
	Minmi	7	2	3			3
	Other		2	1			3
Tomago Coastal Plain	Stockton	1	1				2
	Fern Bay	3	2				1
Awaba Hills	Charlestown	2	2	1			
	Glenrock		4				
	Wallsend	8	3				1
	Other (Various)	7	4				4
East Maitland Hills	Beresfield	1	3	4			3
	Weakleys Flat		1	1			
Sugarloaf Range	Black Hill Spur	2	2	4	1	2	
Total		33 (30%)	34 (30%)	15 (14%)	4 (3.5%)	4 (3.5%)	20 (18%)

A brief analysis of the data presented in Table 4 has been conducted, although this analysis is limited to studies registered with the Department of Environment and Conservation, and the level of information supplied by the AHIMS report search results.

Table 4 indicates that some environmental and geographic areas within the Newcastle LGA have been subject to a greater number of studies than others in response to development activities. Of the 110 studies tabulated above, 35.8 per cent have been conducted within the Lower Hunter Plain, 33 per cent within the Awaba Hills, 11.95 per cent within the East Maitland Hills, 9.16 per cent within the Tomago Coastal Plain, and 10.09 per cent within the Sugarloaf Plain. Localities subject to greater

levels of research include Beresfield, Black Hill, Minmi, Charlestown and Wallsend, although assessments have been conducted throughout most areas of the region.

The method of archaeological investigation throughout the region has overwhelmingly consisted of archaeological survey (60 per cent) rather than archaeological excavation (18 per cent). Other methods of investigation, such as monitoring and management plans, totalled 4 per cent, and the investigation type for the remaining reports (18 per cent) was not nominated. Archaeological surveys consisted of sample surveys (30 per cent) and total surveys (30 per cent). Archaeological excavation programs consisted of test excavations (14 per cent) and salvage excavations (3.5 per cent).

Although most research has been conducted within the Lower Hunter Plain and the Awaba Hills – the largest geographic areas of the Newcastle LGA – there has been a disproportionate level of research within the East Maitland Hills and Sugarloaf Range areas considering their small size within the LGA. Increased research in these two environmental areas results from two major development projects: industrial development in Weakleys Flat (South Beresfield), and the F3 freeway extension extending across the Black Hill Spur. These developments stimulated a series of landscape surveys, test excavations and salvage excavations within the northeast portion of the Newcastle LGA.

The relatively large number of archaeological excavations within the region is important, as it has increased the current understanding of subsurface distribution of archaeological materials, and the relationship between surface and subsurface deposits. As archaeological surveys are so commonly limited by low surface visibility, excavation also provides a far more effective tool to understand surface distribution of archaeological materials (although limited to a small geographic area).

Table 4 demonstrates that archaeological excavation has been widely employed across the geographic areas of Newcastle, but has focussed on the Blue Gum, Minmi, Beresfield and Black Hill Spur areas. Although some other areas have been subject to test excavation, such as at Charlestown, these have been small-scale programs in comparison to the four areas mentioned above. This indicates that our current understanding of subsurface archaeological distribution in many areas of the Newcastle LGA is limited.

Due to the high numbers of previous investigations conducted within the Newcastle, reports to be reviewed as part of this study have been selected for their relevance based on the study area, investigation method and date of completion. On this basis, 17 studies were selected for detailed review, the key findings of which are summarised in Table 5.

Table 5: Summary of Selected Previous Archaeological Studies

Author / Date	Report Title / Study Area	Comments
Dyall (1971)	Aboriginal Occupation of the Newcastle Coastline.	Dyall conducted a survey and collection of Aboriginal artefacts across a large area of southern Newcastle. Material collected was deposited at the Australian Museum. In the field, Dyall observed a low density of stone artefacts across the spur lines and drainage channels, commonly chert. This was suggested to reflect short-term camping by small groups. Dyall argued that Aboriginal sites would be concentrated in proximity to the major subsistence resources of the area, specifically the coastline, Jewells Swamp and freshwater lagoons such as that at Glenrock Reserve. Away from coastal and lagoon areas, sites across the ridge and valley landforms are suggested as relating to short term occupation, associated with the procurement of specific resources and short term camps.
Dallas (1982)	An archaeological survey on Kooragang Island, Newcastle	This study area is located along the northern side of the existing rail corridor from the south arm of the Hunter River to approximately the centre of Kooragang Island. The study included the inspection of a proposed powerline corridor and railway marshalling yard next to the existing railway line. The northern and eastern portions of the study area are described in the report as consisting of natural flat mangrove swamp and wetlands, whilst the western section is disturbed by powerlines and pipeline installation and fill. It was predicted in the report that there is potential for Aboriginal sites and objects to occur in raised areas that have not been impacted by industrial land use. No Aboriginal sites or objects were identified during the survey, leading to the suggestion in the report that this was because the natural mangrove areas were low lying, and the remainder of the study area had been disturbed by industrial activity.
Koettig (1987b)	Preliminary Assessment of Aboriginal Archaeological Sites in the Proposed Sand Extraction Location at Nelson Bay Road	The study area for this archaeological assessment included a parcel of land adjacent to Fullerton Cove on the Holocene (Outer Barrier) of Stockton Bight. The survey resulted in the identification of 11 Aboriginal sites, consisting of shell and stone artefact scatters and one isolated stone artefact. These sites were all identified in association with tracks and in association with dune ridges. Shell material was noted as occurring between 10 and 20 cm below the contemporary ground surface. Stone artefacts were identified at 6 of the sites and it was observed that they generally occurred at low densities. Koettig surmised that the indications were that 'there is a continuous distribution of midden and stone artefacts across the dune crests in that area' (Page 19). The sites were noted as being relatively undisturbed, and the full extent of each site was not known due to vegetation coverage. In order to determine their significance and appropriate mitigation measures for the sites identified during the survey, recommendations included conducting a series of test excavations and comparison of the sites in the study area with those along the remainder of Stockton Bight.
Bairstow (1989)	Excavation report for Newcastle Lumber Yard	This excavation was located on the site of the former convict lumberyard in East Newcastle. The historical excavation uncovered remnants of convict built brick walls from the early Nineteenth Century. The site was assessed as having national significance, this high significance assessment was partly supported by the identification of Aboriginal objects during the excavation. It is apparent from the report that these Aboriginal objects were confined in 'one small section of the excavated area' (Page 18). The nature and composition of these objects are not described in the report.

Table 5: Summary of Selected Previous Archaeological Studies

Author / Date	Report Title / Study Area	Comments
Evans (1989)	Human Skeletal Remains, Salt Ash, Stockton Beach	Trail bike riders had identified skeletal remains in the foredunes behind Stockton Beach. The Raymond Terrace Police investigated the remains and contacted NPWS when it was identified as possibly being an Aboriginal burial. The burial had been exposed in a swale between dunes in the mobile dune field. Exposed archaeological material consisting of pipi shell was observed in the surrounding area. No archaeological material was observed in association with the skeletal remains. The arrangement of the remains suggested that it had been a fully extended burial, the remains were mostly intact, with minor disturbances observed and some of the smaller bones were absent. After analysis of the remains it was determined that they were from an adolescent or young adult female Aboriginal who had most likely lived on a traditional diet. The material was removed from its context due to concerns about disturbance from recreational activities and natural erosion from dune movement, as with another burial located in close proximity within the mobile dune field (Evans 1993). The Worimi LALC reburied the skeletal remains on a WLALC land holding.
Resource Planning (1992)	Fern Bay Sand Resource Potential Constraints and Strategy for Development	This archaeological survey and preliminary identification of constraints to sand mining covered a section of the Outer Barrier near Fern Bay from the active mobile sand dunes west across the stable transgressive dunes to Nelson Bay Road. Several Aboriginal sites, including middens and open artefact scatters were identified within the study area, including shell and stone artefacts exposed in the deflation basin. There was not a great deal of detail regarding the sites or their contexts, and large areas of sensitivity were identified based on the sites identified during the survey and the assumed potential of the surrounding context to reveal more archaeological material.
Evans (1993)	Salvage Report Aboriginal Burial, Boyces Track, Stockton Beach	Skeletal remains were identified in the mobile dune field, behind the foredune on Stockton Beach. The Nelson Bay Police Station contacted NPWS, and after an inspection by Evans (NPWS) the remains were confirmed as Aboriginal in origin. The skeletal remains were exposed in a swale and associated with the eastern face of a dune. The upper half of the torso was exposed, subsequent excavation of the remains uncovered the lower half beneath the sand. The remains were fully articulated, whilst the arrangement of the skeletal material suggested a fully extended burial. The surrounding context included a layer of humified sand, dark grey in colour with sections of tree trunks and roots, was observed eroding out of the face of the dune 'at the same level as the burial'. Analysis of the skeletal material suggested that they were most likely from a female on her late teens or early adulthood who had lived on a traditional diet. The skeletal material was removed because of the likelihood of further disturbance occurring from visitation by members of the public and natural erosion from dune movement, as with the burial identified at Salt Ash (Evans 1989). The Worimi LALC reburied the skeletal remains within WLALC holdings at Tanilba Bay, Port Stephens.

Table 5: Summary of Selected Previous Archaeological Studies

Author / Date	Report Title / Study Area	Comments
Hamm (1993)	An Archaeological Assessment of Optical Fibre Route from Stockton to Williamtown	This study involved an archaeological assessment and survey of a proposed optic fibre cable stretching from Stockton to Williamtown. The landforms covered by this study included the stable transgressive dunes of the Outer Barrier and closer to Williamtown estuarine deposits associated with the inter-barrier depression. The survey included walking most of the length of the proposed optic fibre route. The study area was generally described as vegetation with clearance and disturbance associated with tracks leading east across the Outer Barrier. One Aboriginal site was identified, consisting of shell and stone artefacts. This site was not assessed as scientifically significant, with the justification that sites further east and north of the study area having more potential to provide information on Aboriginal habitation of the area. No archaeological constraints were identified for the proposed installation of the optic fibre cable. The WLALC wished to monitor the installation of the cable along a specified 350 m stretch.
Bonhomme Craib & Associates and Rosen (1996)	An archaeological survey for Aboriginal sites at Tourle Street, Newcastle	The study area for this report was the BHP owned land on the southern side of the Hunter River south arm. A large section of this property consisted of an infilled channel and island that formerly existed in the Hunter River south arm. This island was called Spit Island, and the infilled channel was called Platt's Channel. Due to the fact that this island had been modified and buried with fill and the channel infilled, the current southern bank of the Hunter River south arm is highly disturbed and not in its natural context. The only area identified in the report with limited potential for the occurrence of Aboriginal sites was a hillslope in the southern section of the property that was formerly on the southern margin of Platt's Channel. This report highlights the specific impact of some of the large-scale industrial landscape modification that has occurred in the Newcastle region.
Effenberger (1996)	Aboriginal Assessment and Survey Spatial Sampling West Charlestown Bypass	This study involved a survey and subsurface investigation of the route proposed for the West Charlestown Bypass. The landform consisted of the ridges and drainage lines of the Awaba Hills. During the survey, 3 low density artefact scatters were identified, although previous investigations of the proposed route had not identified any Aboriginal sites. Subsurface testing program failed to identify additional archaeological materials in 64 test scrapes in varying landform contexts.
Kuskie (1997)	Aboriginal archaeological assessment of a property in Beresfield, Lower Hunter Valley	The study area measured approximately 130 hectares and was located on the western boundary of Hexham Swamp. The western portion of the study area consisted of low lying ridge lines and associated valleys. The eastern portion of the study area consisted of Hexham Swamp, a broad and flat landform. Survey of the study area identified twelve locations containing archaeological evidence, these consisting of seven stone artefact scatters and five isolated artefacts. One previously recorded open artefact scatter and one isolated artefact were also located within the study area. A majority of the artefacts were identified within 150 m of water sources, including wetlands or drainage depressions. It is suggested in the report that 'it can be argued that the entire landscape of the study area was probably used to differing extents and that the evidence located during the current survey is largely a function of surface visibility' (Page 55). Silcrete was the dominant raw material observed, with around a third consisting of volcanic tuff.

Table 5: Summary of Selected Previous Archaeological Studies

Author / Date	Report Title / Study Area	Comments
Higginbotham (1998)	Report on the Aboriginal relics located during archaeological test excavation of the Convict Lumberyard and Stockade, Newcastle	This study consisted of 13 test trenches excavated at the former Convict Lumberyard and Stockade site, Newcastle. This site had been excavated on previous occasions, the major aim had been to identify of historical relics and structures at the site. This further excavation was commissioned to assess the impact of a proposed park, interpretation and display centre on the site. A number of Aboriginal objects had been identified during the earlier excavations of the site, but these Aboriginal objects were not the primary focus of the excavations and were not analysed. Material recovered from this excavation that was suspected as Aboriginal, initially suspected as being 'railway ballast', was sent to AMBS for further identification and analysis. The majority of the material sent to AMBS was identified as Aboriginal in origin, mostly consisting of tuff stone artefacts. However, the context of this material was suspected as being either mixed with introduced gravel (possibly railway ballast), or even introduced with this gravel.
Silcox (1999)	Test Excavations for a Proposed Industrial Estate, Weakleys Flat, Beresfield	Test excavation of a proposed industrial area at Weakley's Estate, between Weakleys Flat Creek and Viney Creek. Ten backhoe trenches were excavated along two transects, excavated at 20 metre intervals. Trenches were 3m long, 50cm wide and 40-50cm deep. The transects extended 100 metres north from a known open camp site. 42 artefacts were recovered from 9 of the 10 trenches, with no more than 11 in one trench. A number of historical artefacts were recovered from the trenches, including glass fragments and gypsum. No evidence was identified for activity areas within the excavation area, such as a knapping floor. The results of the excavation were interpreted to indicate low-density archaeological evidence across the site, cinse disturbed by human actions.
Kuskie and Kamminga (2000)	Salvage of Aboriginal Archaeological Sites.... Black Hill, New South Wales	Salvage excavations along the route of the freeway alignment, to mitigate impact on two known archaeological sites (open camp sites) ranging 200-1000m from Hexham Swamp. Testing of a 94.25m ² area (plus five mechanical scrapes) recovered 37,585 artefacts, and a further 14,664 lithic fragments that may have been knapping debris. The mean density of artefacts excavated was 546.2 artefacts per m ² at the Black Hill site, and 209.5 artefacts per m ² at the Woods Gully site. The Woods Gully site also contained a stone-lined fireplace dating to 2,130±70 years BP.
Umwelt (2000)	Archaeological Assessment of a Proposed Mineral Sand Mine Stockton Bight	The study area for this investigation included a large section of Stockton Bight, stretching north from Fern Bay and incorporating the mobile sand sheet. This section of Stockton Bight is a Holocene Outer Barrier. Inland from the Outer Barrier is the Pleistocene Inner Barrier. The study involved establishing the impact and developing mitigation measures for proposed sand mining along this stretch of the Bight. Dean-Jones provided a comprehensive discussion of the geomorphology and site taphonomy in order to establish the nature of the archaeological record along the Outer Barrier. Dean-Jones outlined the periods of dune stability and instability that continue along the Outer Barrier. This process has resulted in several relict land surfaces from periods of dune stability. Sections of these relict land surfaces have been impacted by subsequent periods of dune instability that impacts on the preservation of these past land surfaces. The result of the investigation included a series of recommendations focussed on the conservation of the archaeological record.

Table 5: Summary of Selected Previous Archaeological Studies

Author / Date	Report Title / Study Area	Comments
Steele and Douglas (2001)	Aboriginal archaeological assessment of 700 Hunter Street, Newcastle	The study area was located in the Newcastle CBD, and has been subject to historical development including single storey industrial buildings. The Great Northern Railway runs along the northern boundary of the study area, with Hunter Street and the Cottage Creek culvert along its southern and western boundaries respectively. The topography consisted of very low-lying and undulating terrain, with relief approximately 1 m. The soil consisted of Quaternary alluvium, possibly associated with the original flow of Cottage Creek. Historical activities at the site included different phases of building construction and fill deposition. It was suggested in the report that beneath the identified layer of fill there was potential for relict topsoil and 'culturally modified deposits associated with the use of the place' (Page 20) before the layer of fill was introduced. No Aboriginal sites were identified because it was observed during the survey that no relict topsoil was exposed. Recommendations in the report included expansion of the historical archaeology test excavation to included testing of relict topsoil in an attempt to determine the extent of the deposit and whether it contained Aboriginal objects.
Douglas, Tuck and Steele (2001)	Archaeological test and salvage excavation at 700 Hunter Street, Newcastle	This excavation followed the historical and Aboriginal archaeological assessment conducted for the site. The test excavation identified a number of historical grave cuts and scattered human remains, as well as shell and a large number of Aboriginal stone artefacts. The report provided a brief overview of the Aboriginal objects that were identified during the test excavation. It was suggested that more in-depth analyses would take place at a later date. The preliminary figures that were provided in the report indicated that the recovered assemblage of stone was 'likely to include upwards of 4,000 flaked stone artefacts' (Page 12). The collection also included 2,939 whole and fragmentary shells and approximately 326 pieces of animal bone. The report suggested that based on the preliminary analyses and the location of the stone artefacts and shell across the site, that 'the excavated site evidence demonstrates the place was subject to repeated Aboriginal visitation and use in the past for a range of purposes including tool manufacture, maintenance and / or replacement, along with a range of other activities including food procurement, consumption and discard' (Page 13).
Umwelt (2002a)	Draft Newcastle coastline management study	This study provides an overview of Aboriginal and historical occupation of the Newcastle coastline. This study was part of an overall process to provide the Newcastle City Council (NCC) with a Coastline Management Plan. The study identified both through ethnohistorical records and previous archaeological investigations that the coastline has been and continues to be disturbed by historical land use practices. This analysis led to the suggestion that 'it is unlikely that any of the recorded sites along the Newcastle coastline are of scientific significance and are able to contribute to relevant archaeological questions' (Section 7.5). It was also noted that there are sections of the coastline that are important to the Aboriginal community for cultural and mythological reasons. Nobbys Headland was noted as being important in 'explaining the creation of the landscape and the people in it' (Section 7.2).

Table 5: Summary of Selected Previous Archaeological Studies

Author / Date	Report Title / Study Area	Comments
Umwelt (2002b)	Excavation and Management of Cultural Heritage values in the Bluegum Vista Estate, Minmi Road	This study involved an excavation program over a site measuring 119 hectares. The report included a detailed discussion of previous archaeological investigations in the region, as well as a discussion of ethnohistorical and ethnographic records for the area. The excavation included 316 m ² of subsurface sampling investigations at 20 locations across the 21 terrain units identified within the study area. A total of 3,001 flaked stone artefacts were recovered from these subsurface investigations. In addition to this a large number of fragments of the same material as the stone artefacts were also recovered. The highest density of stone artefacts were recovered from, from highest density to lowest, a hillock / headland context, open spur crest context and sheltered spur crest context. A number of post discard processes were identified that had impacted on the stratigraphic context of the recovered artefacts. These included destruction from uncontrolled heat impacts, bioturbation, cultivation and other types of surface disturbance. Although the artefacts were not identified as occurring in a temporal context, and the majority of artefacts were unmodified flakes, diagnostic mid to late Holocene modified artefacts were identified. These modified artefacts included edge ground axe fragments and backed artefacts. The two main stone material types were tuff and silcrete. It was also suggested that 'the environmental information suggests that this area may have become more attractive for occupation in the latter part of the Holocene, with a greater diversity of habitats and more reliable access to fresh water in prograding tributary creek deltas' (Page 3).

6.2 Archaeological Case Studies

A number of previous archaeological studies were selected for detailed review and analysis. These were selected because each of the reports focuses on a separate environmental zone within the Newcastle LGA and cover the archaeological research themes that are discussed in this Heritage Study. These studies include:

- **Douglas, Tuck and Steele (2001):** who investigated an archaeological site in central Newcastle following exposure of materials during a historical excavation. The site was positioned in Quaternary sands of the Lower Hunter Plain;
- **Umwelt (2002b):** who investigated surface and subsurface patterns of distribution at Bluegum Vista, in advance of a residential release. The area investigated bordered Hexham Swamp (Lower Hunter Plain) to the south;
- **Koettig (1987b):** who conducted a landscape survey and assessment of Stockton Bight (Tomago Coastal Plain) in advance of sand mining activities;
- **Umwelt (2000):** who conducted a survey and assessment of a proposed sand mine at Stockton Bight (Tomago Coastal Plain);
- **Effenberger (1996):** who conducted a test excavation program within the Awaba Hills region in advance of the proposed Charlestown bypass. This study is one of the few conducted within this locality.
- **Silcox (1999):** whose conducted a test excavation program at Wealkeys Flat (East Maitland Hills) following a series of landscape surveys; and
- **Kuskie and Kamminga (2000):** whose salvage excavation program was the culmination of numerous archaeological studies at Black Hill (Sugarloaf Range).

These studies represent key investigations in the history of archaeological research within the LGA, and have contributed to our understanding of Aboriginal culture and heritage. Crucially, these studies also provide key information about varying archaeological patterns of distribution and composition throughout the environmental areas of the Newcastle region. Each study is discussed individually below.

6.2.1 *Douglas et al (2001): Hunter Street, Newcastle*

The site at 700 Hunter Street consisted of concrete slab floors and surrounding asphalt and concrete surfaces. The concrete slab floors had been the base of single storey industrial warehouses that had been demolished prior to the assessment. It had been identified in an earlier report (Doring and Doring 1991) that there was potentially a historical cemetery located beneath 700 Hunter Street. Therefore, Newcastle City Council had requested that a historical archaeological assessment of the site take place. The historical heritage assessment of the site was completed by Douglas and Wilson (2001), with the recommendation that an Aboriginal heritage assessment of the site be conducted.

One of the major aims of the Aboriginal heritage assessment was to initiate consultation with the Awabakal LALC in regards to the development project. The assessment also sought to identify whether Aboriginal people had been buried in the historical cemetery. In the findings of the report it is noted that 'it is unclear to date whether people of Aboriginal descent were buried in the historic cemetery' (Steele

and Douglas 2001:4). At the assessment stage, the nature of the surface beneath the current sealed bitumen and concrete surface was based on limited geo-technical investigations. The geo-technical data suggested that the underlying 'surface deposit comprises a shallow layer of re-deposited sand and clay with occasional (European) cultural artefact inclusions' (Steele and Douglas 2001:20). Due to this limited amount of available information, it is noted that the survival of remnant surface soil deposits 'is currently indeterminate' (Steele and Douglas 2001:11).

Due to the limited information available during the assessment stage as to the presence or absence of original topsoil beneath the current historically disturbed layer, it was recommended that the proposed historical test excavation program be amended to include test excavation if and where remnant topsoil is identified. The test excavation of 1 metre x 1 metre pits was arranged along sections where 'the base of excavation required for the hotel building would disturb deposits associated with use of the site prior to c.1920' (Douglas *et al.* 2001:3).

The test excavation and partial excavation of the site included excavation of an area of approximately 80 m². Material recovered from the excavation included approximately 5,734 pieces of stone, of which Douglas *et al.* (2001:12) suggest is 'likely to include upwards of 4,000 flaked stone artefacts that relate to the visitation and use of the land by Aboriginal people prior to the arrival of Europeans'. Along with the lithic material that was recovered during the excavations, 2,939 whole and fragmentary shells and approximately 326 pieces of animal bone were also recovered. This material, both lithic and faunal, was recovered from the grave fills and exhumation deposits, as well as the *in situ* topsoil between the grave cuts. The scale of lithic and faunal material led to the suggestion that:

'the place was subject to repeated Aboriginal visitation and use in the past for a range of purposes including tool manufacture, maintenance and/or replacement, along with a range of other activities including food procurement, consumption and discard' (Douglas *et al.* 2001:13).

From the results of the test excavation and partial salvage of the site and consultation with the Awabakal LALC, Douglas *et al.* suggested that the site had both High Scientific and High Cultural significance. Recommendations for the continuation of construction activities on the site included funding to analyse, document and interpret excavated archaeological material. It also recommended that the owner, with the Awabakal LALC, develop an interpretive display within the finished construction to recognise the prior Aboriginal occupation of the area and the significance of the site to the Aboriginal community.

6.2.2 Umwelt (2002b): Bluegum Vista Estate

The Bluegum Vista study area is located on the northern side of Minmi Road at Fletcher. This location is on the southern boundary of Hexham Swamp. Landcom were granted development consent for a 119 hectare parcel of land. The development consent required that Landcom provide written confirmation that they had satisfied the requirements of the NPW (1974) Act in relation to the presence of any Aboriginal sites within the proposed development area. The original development application for the site had been accompanied by an Aboriginal archaeological assessment that had been completed in 1993 (Curran 1993).

The assessment completed by Curran (1993) had not identified any Aboriginal sites and objects and recommended that there be no restraint to development across the site with a recommendation to re-survey the top of a drainage ridgeline after this section had been cleared for development. Umwelt (2002b:1.2) noted that due to a variety of factors these original recommendations 'were no longer considered appropriate'. They noted that:

'NPWS concerns about potential archaeological impacts associated with development around Hexham Swamp...have been raised by the results of several subsurface testing programs over the last five years, all of which have indicated considerable archaeological sensitivity for terrain units on the swamp margin' (Umwelt 2002b:1.2).

Umwelt (2002b:1.2) noted that the lack of surface evidence of Aboriginal occupation at the site as identified in the earlier assessment (Curran 1993) was a product of historical land use practices and contemporary ground cover.

To investigate the subsurface deposits of the study area, NPWS issued a Preliminary Research Permit (PRP) to Insite Heritage in 1999. Insite Heritage completed field investigation and a preliminary draft report (Bessant and Richardson 1999). However, Umwelt (2002b:1.3) noted that 'due to a number of contractual issues, the permit expired before the remainder of the fieldwork required...could be completed'. Following from this, Umwelt provided a new PRP application to NPWS in 2000 and continued on from Bessant and Richardson (1999) to assess and formulate management strategies for the Aboriginal cultural heritage of the site.

The Bluegum Vista Estate study area was characterised by crests and drainage lines that extend northward into Hexham Swamp. There were two main spur lines that extend northward into the Swamp. One major drainage line, Wentworth Creek, was on the western boundary of these spur lines, whilst Minmi Creek was on the eastern boundary. There were also several minor drainage lines that have formed along these spur lines. Umwelt (2002b:3.1) noted that these spur lines had 'low gradients and broad flat surfaces' with side slopes that have easterly and westerly aspects. The northern termination of the spur lines are characterised by 'outlooks to the north across the Hexham wetlands' (Umwelt 2002b:3.1).

Each of the three stages of archaeological excavation on the Bluegum Vista Estate (Bessant and Richardson 1999; Umwelt 2002b) covered varying degrees of the study area. Excavation conducted by Bessant and Richardson (1999) focussed on gentle spur crest terrain, and involved the excavation of a total area of 60 m² (Stage 1). The first stage of excavation conducted by Umwelt provided a sample across all terrain units (Stage 2A). The second stage (Stage 2B) of excavation conducted focussed on significant areas identified during Stage 2A.

One important factor in the excavation process was the size of the study area, the number of landform units and the lack of surface evidence to provide an indication of subsurface deposits across the study area. Through the excavation process, Umwelt (2002b) sought to achieve a fairly specific sampling area target. The proposed target of coverage for Stage 2A of excavation was equivalent to an effective surface survey coverage of 0.00025 per cent of the study area. In total, an area of approximately

316 m² was excavated during stages 1, 2A and 2B. A total of 3,001 stone artefacts were recovered, consisting of 675 from Stage 1, 1,919 from Stage 2A, and 407 from Stage 2B.

6.2.3 Koettig (1987b): Stockton Sand Mine

Koettig (1987b) undertook a landscape survey and assessment of a proposed sand mine immediately north of the Newcastle LGA boundary. This study area composed of stable, Late Holocene dune system, a landform that continues south into Stockton.

Total survey of the area was undertaken, although visibility was constrained by dense dune vegetation in areas. The survey identified eleven archaeological sites, being midden sites and open camp sites (isolated find) in the northern portion of the survey area. Sites included dense scatters of shell and stone artefacts, and were consistently located along dune ridges where the surface had been exposed by sand movement or human action (Koettig 1987b:13). Archaeological materials were observed occurring up to 20 centimetres beneath the surface. Shell materials were predominantly estuarine in origin, and were very fragmented as a result of human action. The stone artefacts recorded were predominantly indurated mudstone. The assemblage included flakes, flaked pieces and cores. One backed artefact and a large anvil cobble were identified among the assemblage. Although no evidence of human skeletal remains was known in the study area, burials were raised as an issue by the study as they are known to occur throughout the Bight in similar dune contexts.

Although analysis was limited due to visibility constraints, the study suggested that the distribution of exposed materials may represent a continuous distribution of midden and stone artefacts across the dune crests of the area. It was postulated that the materials may represent a relatively undisturbed midden site associated with stone artefacts (Koettig 1987b:22). Significance of the known materials could not be assessed as further information was required on the extent and composition of the site. The absence of exposed archaeological materials in the southern portion of the site was considered to reflect the lower level of human action and disturbance, and consequently lower visibility. It was also noted that archaeological materials could occur in subsurface contexts, as demonstrated in other areas of the Outer Barrier system (Koettig 1987b:19).

6.2.4 Umwelt (2000): Stockton Bight Sand Mine

Umwelt (2000) conducted an assessment of a proposed mineral sand mine at Stockton Bight, extending thirteen kilometres along the mobile dune field to the north of Fern Bay. Although the study area did not extend into the stable dune system of the Bight, which abuts the southwest boundary, the report discussed the nature of the archaeological resource of the area and the differing impacts of geomorphic history of stable and mobile dune environments.

At the time of the study, approximately 120 archaeological sites had been recorded within the mobile sand dunes of the Bight, and these included middens, open camp sites, scarred and carved trees, quarry, bora (ceremonial site), axe grinding groove and burials (Umwelt 2000:5.1). Approximately thirty of these sites were positioned in or near the area of assessment, all of which were located in proximity to the intersection of the deflation basin and the elevated dune field. The majority of all known sites

throughout the Bight are middens, some of which extend up to several hundred square metres, and contain shell, stone and bone materials. Umwelt (2000:3) noted that the suite of known archaeological sites of the Bight had previously been assessed to be archaeologically significant, and that Stockton Bight is itself considered to be of National natural and cultural heritage significance.

Following review of previous research and geomorphic history of the Bight, a series of predictions were outlined for the occurrence of archaeological sites within the mobile sand dunes of the Bight (Umwelt 2000:6.1-6.2). These included:

- evidence of Aboriginal occupation occurs within the A-horizon of former stable land surfaces;
- the occupation evidence is most commonly a thin layer of shell, bone and stone (1-3 shells thick), concentrated within an area of about 25m². This is the evidence of former camp sites, used one or more times by a family or larger group;
- this evidence has an equal probability of being located anywhere on the stable dune landform, from immediately behind the frontal dune to the landward margin of the dune field (same density across former land surfaces);
- large campsites were differentially located adjacent to semi-permanent wetlands in the dune field (ie, in former deflation basins, as isolated sources of freshwater);
- during periods of instability, evidence from former stable land surfaces would be buried, deflated, reburied, potentially multiple times, so that any artefacts and shell would be abraded;
- occupation evidence dating to periods of dune mobility would be diffusely scattered throughout the sand mass; and
- the archaeological evidence that is currently visible is a snapshot controlled by current dune morphology. It is not necessarily representative of the nature of Aboriginal activities in this landscape over time.

The impact of geomorphic dune movement was key in Umwelt's analysis of the Stockton Bight, and formed the basis of understanding the archaeological resource of the region. Within the actively transgressive dune system under assessment, archaeological materials were exposed in the windward face of blowouts, and most likely represented an archaeological deposit reworked several times. In addition to post-depositional movement, this reworking had the potential to destroy or damage the fragile evidence of Aboriginal occupation as materials such as shell and bone were repeatedly and intermittently exposed and abraded (2000:2).

However, the patterning of the known archaeological resource also suggested that these sites represent regular and persistent use of the diverse resources of the Bight in sheltered camping locations where fresh water was regularly available (Umwelt 2000:2)

In the stable dune system of Stockton Bight, which abutted the study area to the southwest. Umwelt (2000:2) noted that a small number of sites are known, the majority of which appear to be small middens and artefact scatters reflecting intermittent or opportunistic use by small groups. However, it was noted that increased ground cover hampers visibility within the stable dune system, so surface

exposures of archaeological materials may not accurately reflect the full resource. The presence of large, complex sites adjacent to wetlands of the interbarrier depression, between Fullerton Cover and Tillingerry Creek, were noted.

6.2.5 Effenberger (1996): Charlestown Bypass

Effenberger (1996) conducted a series of works for the proposed Charlestown bypass, between Bennetts Green and Adamstown Heights. This project followed earlier studies for the Charlestown bypass, including Brayshaw and Hanckel (DMR 1985) and Bickford (1980).

A landscape survey was conducted to identify any heritage – both Aboriginal and historical – constraints affecting the development. The bypass alignment was not subject to 100 per cent coverage, as the survey team aimed to identify general areas of landscape sensitivity for later testing. Three Aboriginal archaeological sites were identified during the survey, being:

- a low density scatter of artefacts located to the north of Myall Road. Within a one hundred metre square area, five artefacts were identified next to an artificial drainage line, and in a vehicle track between houses. Artefacts were produced from silcrete and chert;
- two artefacts (chert) next to an intermittent drainage line to the north of Hillsborough Road; and
- two artefacts (tuff) found along an access track. Conglomerate exposed along track, artefacts may have been exposed from erosion.

No other sites were identified within the bypass alignment, but searches of the NPWS Aboriginal sites register (present DEC AHIMS) demonstrated that other sites were known in the local area. Within the Newcastle LGA, two known sites were mapped in urban residential areas – an axe grinding groove site and an open camp site in Kotara Heights. Although the sites are not discussed in detail, the axe grinding groove is described as containing fifteen grooves in a flat sandstone platform in the upper reaches of a creek bed (Effenberger 1996:7). It is also noted that an isolated find (a silcrete core) was found in proximity to the bypass alignment in this area.

During the archaeological testing phase, 64 test scrapes were conducted in a range of geological and landform contexts, including shale upper slope, sandstone mid to lower slope, conglomerate alluvial flood plain, conglomerate mid to lower slope, coal saddle, sandstone lower slope and sandstone alluvial flat (Effenberger 1996:28). Test scrapes were placed to be comparable to landform area, with the exception being sandstone alluvial flat as it was close to wetland and considered to be of higher archaeological sensitivity. At each scrape location, care was taken to remove A and B Horizons separately, and all excavated materials were screened through a 20 and 5 millimetres nested mechanical sieves. No archaeological materials were identified by the testing program.

The study concluded that Aboriginal archaeology was not a constraint to the planned bypass. The three archaeological sites identified by the landscape survey were not assessed to be of archaeological significance, and the report also stated that the Aboriginal community did not consider the sites to be significant. The testing

program was used to predict the lack of archaeological sites throughout the remaining corridor (Effenberger 1996:35), and the bypass corridor as a whole was assessed to be of low archaeological significance.

6.2.6 Silcox (1999): Beresfield Industrial Estate

A series of archaeological investigations have been conducted in the Beresfield locality, in advance of a proposed industrial area at Weakley's Flat. These have included landscape surveys (ERM Mitchell McCotter 1995 and 1996, and Silcox 1998) and test excavation programs (Silcox 1999).

Previous studies in and surrounding the Weakleys Flat industrial estate area had demonstrated the presence of surface and subsurface archaeological materials. ERM Mitchell McCotter (1996) identified six archaeological sites on the lower hillslopes and flats associated with Viney Creek. However, further analysis was required to determine whether all lithic pieces were artefactual. Visibility throughout the area was recorded as low by all archaeological studies, and subsurface testing was considered necessary to adequately investigate the area.

Silcox (1999) conducted an archaeological test excavation program in advance of the industrial estate, to investigate the presence or absence of a subsurface deposit in the Weakleys Flat development area. This physical area had previously been assessed to have archaeological potential, and consisted of a low rise between Weakleys Flat Creek and Viney Creek.. The excavation program consisted of ten backhoe trenches along two parallel transects 40 metres apart, excavated at 20 metre intervals. Trenches were three metres in length, 50 centimetres in width, and 40-50 centimetres in depth. The transects extended 100 metres north from a known open camp site in the development area.

A total of 42 artefacts were recovered from nine of the ten backhoe trenches (Silcox 1999:18). Maximum artefact density was eleven artefacts from one trench. The majority of artefacts – 30 out of 42 – were silcrete, and displayed no evidence of retouch, use wear or diagnostic elements. A number of historical artefacts were recovered from the trenches, including glass fragments and gypsum. No evidence was identified for activity areas within the excavation area, such as a knapping floor.

The results of the excavation were interpreted to indicate low-density archaeological evidence across the site. The locality was assessed as disturbed by recent human actions, evidenced by the widespread distribution of historical materials across the site, although the impact of disturbance to the archaeological resource could not be assessed on existing data. Silcox (1999) further concluded that the location was not suitable for camping, as the soil was heavy and poorly drained. Occupation was considered more likely to be concentrated on better drained slopes and elevated landforms near the edges of swamp and creek margins, such as Weakleys Flat Creek or Viney Creek. Excavation results indicated that the rise between Weakleys and Vineys Creek systems does not appear to have been a favoured camp location (Silcox 1999:23).

Based on investigation results, the locality was considered to be of low archaeological significance and limited potential to contribute towards research questions. On this basis, the study recommended a Consent to Destroy permit for the known site within

the development area, to allow the proposed industrial estate to proceed. Further archaeological investigation was not considered necessary based on the limited potential and significance of the site.

6.2.7 Kuskie and Kamminga (2000): Black Hill

The Black Hill Spur has been subject to a number of archaeological investigations, primarily associated with the planned F3 freeway extension across the landform. Archaeological investigations in the area have included landscape surveys (Resource Planning 1992), archaeological monitoring programs (Effenberger 1995), and archaeological subsurface testing programs (Effenberger and Baker, 1996) and archaeological management plans (Kuskie 1999). Early studies at the site identified surface archaeological materials, subsurface archaeological materials, and at one site – Woods Gully – the highest artefact density identified in the Hunter Valley, with 1,854 artefacts recovered from one square metre (Effenberger and Baker, 1996).

Kuskie and Kamminga (2000) were commissioned to undertake salvage excavations along the route of the freeway alignment, to mitigate impact on two known archaeological sites (open camp sites). One site was centred on a first order drainage channel and adjacent lower (simple) slope, approximately 800-1000 metres from Hexham Swamp. The second site extended across a range of landforms: ridge crest, upper slope, simple slope, drainage depressions and low spurs. The site was approximately 200 metres from Hexham Swamp.

The excavation program consisted of initial testing (38.25 m²), open area excavations (56 m²), and five surface mechanical scrapes. The program identified a total of 37,585 artefacts, and a further 14,664 lithic fragments that did not have sufficient attributes to identify them as artefacts, but may have been debris from the knapping process. The mean density of artefacts excavated was 546.2 artefacts per square metre at the Black Hill site, and 209.5 artefacts per square metre at the Woods Gully site. Seven raw materials were identified in the excavated assemblage, with indurated tuff the primary material utilised (70.45 per cent).

At the Woods Gully site, Kuskie and Kamminga (2000:523-524) uncovered a stone-lined fireplace. An episode of occupation at this site was radiocarbon dated to 2,130±70 years BP. No Pleistocene materials or deposits were identified at the site.

An analysis of artefact distribution within the excavation area was conducted by Kuskie and Kamminga (2000:7). At the Black Hill site, artefact distribution indicated that human activity was focussed on the level ridge crest and gently inclined north-facing upper slope. At the Woods Gully site, human activity was focused in several areas with contrasting environmental conditions.

Kuskie and Kamminga (2000:186) also recorded outcrops of chalcedony and quartzite at Black Hills, which occurred as alluvial pebbles on the northern and eastern slopes, and were exposed from weathering conglomerate bedrock layers.

6.3 Research Themes

Previous archaeological studies have investigated a range of research themes. Three major themes of relevance to this study include variations in site types and assemblages, age of occupation, models of Aboriginal occupation, and post-depositional processes and site integrity. Each research theme is discussed below, with reference to the results of key archaeological studies conducted within the region. To provide the necessary context for research themes within the Newcastle LGA, studies conducted in surrounding regions such as the Hunter Valley and the Newcastle Bight are also discussed.

6.3.1 *Variations in Site Types and Distribution*

A number of site types are known to occur within the Newcastle LGA. These include open camp sites, middens, axe grinding grooves, scarred or carved trees, quarries, ceremonial sites, post-contact sites, and burials. This section defines the known site types of the study area, and discusses variations in site assemblages and distribution.

Open camp sites are mostly surface and associated subsurface scatters of stone artefacts, sometimes associated with fireplaces. They exist throughout all areas of the landscape, although larger and denser sites tend to be found on river banks and lower slopes facing watercourses, as well as ridgelines and other areas that offer movement routes. The spatial relationship of open camp sites, and the materials within open camp sites, has been subject to extensive research, particularly in the Central Lowlands of the Upper Hunter Valley. From research at Bulga, Koettig (1994:17) observed that open camp sites range from dense scatters of continuous artefacts extending over hundreds of square metres, to sites with widely spaced discrete archaeological resources. Although site and artefact frequency was observed to increase in proximity to watercourses, a common pattern observed throughout the region, Koettig demonstrated that this patterning was not evident along all watercourses. Numerous researchers have investigated the composition of open camp scatters within the Hunter region, to identify and explain patterning in artefact assemblages and stone technology. This body of work is extensive, and is not discussed as part of this study.

From review of previous research within the Newcastle LGA, it is clear that open camp sites are the most common site type known. Surface artefact scatters and isolated finds are known throughout all environmental areas of the Newcastle LGA, and similar deposits are commonly exposed during archaeological excavation programs. Dense concentrations of stone artefacts have been found within the LGA, such as at Hexham Swamp (Umwelt 2000, 2002b) and at the Black Hill Spur (Kuskie and Kamminga 2000).

Midden sites are defined as archaeological deposits in which shells are the dominant visible cultural items, which are principally the remains of past meals. Some midden sites contain a range of cultural material such as stone artefacts, animal bones, ochre, and charcoal. Human burials have also been found in many midden contexts. Middens are mainly located in close proximity to marine or estuarine shorelines, and shell composition reflects locally available resources (Attenbrow 2002:207). As shell deposits in marine or estuarine contexts may occur naturally, Dean-Jones (1990)

described a number of criteria to distinguish shell deposits of Aboriginal cultural origin. These include:

- midden deposits vary, and may reflect estuarine/freshwater/ocean foreshore shellfish species. Midden deposits may include shellfish species that do not occur naturally in the area;
- most commonly, shells are not articulated, but may be packed together. Midden shell deposits comprise shells of relatively uniform species and size, whereas swash or washover deposits contain shell of mixed species and a wide range of sizes;
- midden shell is generally not bored by predatory gastropods;
- midden shell exposures on the surface generally include bleached, weathered (or burnt) shell, rather than retaining the pinks and greys of live shells; and
- where flaked stone occurs with pipi shell, it provides additional evidence that the deposit is of cultural origin (although deposits may not be necessarily be contemporaneous). Middens may also contain animal and bird bone. Human bone has also been recorded from a small number of sites.

Midden sites are known to occur within the Newcastle LGA, in close proximity to the Newcastle coastline (representing exploitation of marine resources) and in close proximity to the Hunter River (representing exploitation of estuarine resources). Within the Stockton Bight, middens form the majority of known sites (Dean-Jones 2000:2). Historical accounts of the Hunter River delta during the early twentieth century describe large concentrations of shell along the Hunter River (Thorpe 1928: 241), and even in more recent times, researchers documented shell middens extending from Port Waratah to Sandgate along the Hunter River (Dyall 1971:155). Middens are also known to occur within the Glenrock Nature Reserve (NSW National Parks and Wildlife Service 1997b), demonstrating the occurrence of middens along the southern Awaba Hills coastline of the region.

Grinding grooves are grooves formed as a piece of stone, wood or bone was rubbed on a rock surface to manufacture an implement, specifically to shape an edge or point. Grooves are most commonly located on flat sandstone exposures close to a stream or rock hole. Grooves vary in size but are generally 30-40cm in length and elliptical in shape. Stone axes were ground into the softer stone allowing a working edge to be created or sharpened. Narrower grooves may have been used to work wooden spears or other thin implements (Attenbrow 2002:205). Grinding grooves are known to occur within the Newcastle LGA, with recorded examples in Kotara Heights and Fletcher. At Kotara Heights, a single grinding groove site contained fifteen grooves in a flat sandstone platform in the upper reaches of a creek bed (Effenberger 1996:7). At Fletcher, grinding grooves have been located to the south of Minmi Road (AMBS 1999) whilst none were identified in the Bluegum Vista Estate on the northern side of Minmi Road, an area characterised by well defined drainage channels and associated spurs. The recorded grinding grooves at Fletcher were positioned in a drainage channel on an outcrop of sandstone bedrock. Dean-Jones (1990:69) also noted the existence of an axe-grinding groove within the Stockton Bight landform, although she does not identify the precise location of the site.

Scarred or carved trees display scars where bark or wood was removed for cultural purposes, for example for constructing canoes, shelters, coolamons and shields. Distinctive scars are left from bark removal and can usually be differentiated from natural scars. Carved trees are more distinctive exhibiting patterns cut into the wood of a tree (Attenbrow 2002:204, 207). Scarred trees occur throughout the state, though carved trees occur principally in the eastern half of the state. Clearing and forestry practices have greatly reduced numbers of both scarred trees and carved trees. Scarred trees are known to occur within the Newcastle LGA, such as those recorded in the Stockton Bight (Dean-Jones 1990:69). Scarred and carved trees are unlikely to occur in areas cleared for development, or in areas of regrowth representing historical clearance, but may be known within areas of remnant vegetation such as National Parks or conservation areas.

Quarry sites usually occur wherever there are outcrops or other sources (eg. cobble and pebble beds) of siliceous or igneous rock. Stone material was used in creating stone tools that in turn were used to work wood and provide people with tools to assist in hunting and gathering activities. Many siliceous rocks easily flaked and made useful cutting and scraping tools, whereas igneous rock was preferred for edge-ground tools, particularly axes. Quarry sites may occur at surface outcrops of fine-grained siliceous materials within the Newcastle LGA, such as those identified within the Glenrock Nature Reserve (NSW National Parks and Wildlife Service 1997b:22). Quarries may also refer to places where the removal of ochre occurred from sources within the landscape (Attenbrow 2002:207)

Ceremonial sites were locations used for initiation ceremonies, marriages, tribal meetings and other important functions and are of great significance to Aboriginal people. Bora rings, which are one or more raised earth rings, were used for male initiation ceremonies (Attenbrow 2002:204). Review of previous research indicates that ceremonial sites are known to occur within the Newcastle LGA, such as the bora ground known within the Glenrock Reserve (NSW National Parks and Wildlife Service 1997b:22). A ceremonial ground is also known to occur within the Newcastle LGA at Stockton (Len Anderson, *pers. comm.*).

Post contact sites represent locations that were occupied or used by Aboriginal people after British colonists arrived in 1788, or are associated with events after that date. They may include places like reserves, missions, cemeteries, places of battles and massacres. They are often identified only by the presence of historical objects or through written or oral histories (Attenbrow 2002:207). Post-contact sites may occur in all regions and may represent a range of activities, rather than being associated with a particular environmental area or feature.

Burials are seen as part of continuing culture and tradition, as well of offering valuable archaeological information. The dead were sometimes cremated, sometimes placed in trees or rock ledges, and sometimes buried. Burials exist throughout New South Wales, and can be uncovered in construction work or become exposed through erosion (Attenbrow 2002:204). Burials in the Newcastle region are often associated with sand dune systems, with a number being exposed in deflation basins or by construction. Specifically, burials have been identified within the sand dunes of the Stockton Bight (Dean-Jones 1990:69), although their exact location is not identified by this study.

The above discussion has outlined known site type and composition as identified by previous research. Researchers have identified a number of biases within this data, such as:

- the geographic focus of archaeological investigations on development areas, rather than a research-focused assessment of the total landscape;
- the dominance of archaeological landscape survey as an assessment method, which is inherently limited by visibility issues; and
- the buried nature of the archaeological record, which is often only detected during archaeological survey in areas of exposure resulting from erosion or human disturbance.

6.3.2 Age of Occupation

Establishing the antiquity of Aboriginal occupation is a common research theme. The methods available to establish the age of occupation include direct dating of excavated deposits (radiocarbon dating, thermoluminescence dating), geomorphic analysis, and typological analysis.

Very few archaeological sites within the Lower Hunter region have been directly dated by radiocarbon or thermoluminescence dating, as there are limitations in applying this technology to open sites. Radiocarbon dating usually requires a sample of material containing carbon, such as charcoal, ash or shell. Dean-Jones and Mitchell (1993) noted that one of the main problems in applying this method to open sites is the associated between the dated sample and cultural materials may not be provable, unless the sample comprises an intact hearth. Application of thermoluminescence (TL) dating involves measurement of energy acquired by buried crystalline minerals, and is limited by bleaching of TL by exposure to sun and variations in ground water (Kuskie and Kamminga 2000:217).

Sites with known dates of occupation are of importance to this study, specifically the work conducted at Black Hill in the western portion of the Newcastle LGA. Salvage work conducted by Kuskie and Kamminga (2000:524) at the Woods Gully Site of the Black Hill Spur identified an intact stone-lined hearth at the locality. A charcoal sample from an excavated stone-lined fireplace was radiocarbon dated to 2,130+70 years. The calibrated date returned from this sample was BC 375 to 25 AD.

Dated archaeological sites from surrounding regions provide a context in which to assess age of occupation of the Lower Hunter area. Throughout the Hunter Valley, almost all dated archaeological sites are Holocene in age (Hagland and Rich 1995, Brayshaw 1994), although a number of sites have provided evidence of Pleistocene occupation. These include:

- **Tomago Coastal Plain (Moffats Swamp Dune):** the basal cultural level of this site was dated to 14,750+130 years BP. The calibrated date for the site equates to a median age of 15,376 cal BP (Baker 1994).
- **Central Lowlands, Hunter Valley (Glennies Creek Site):** a hearth feature was uncovered during a monitoring program at the site, and this was subsequently dated to >20,200 years BP (Koettig 1987a). The initial test excavations at the site

identified a soil deposit dating to 13,020±360 years BP, but no cultural materials were associated with this layer.

Analysis of geomorphic site conditions is a primary tool in the assessment of age of occupation. Most areas of the Hunter Valley, including the Lower Hunter region, are dominated by texture contrast soils that are widely considered to be less than 3,000 years in age (Dean-Jones and Mitchell 1993). These soils are formed by the lateral movement of sediment, and in such erosional contexts, archaeological evidence of earlier periods of occupation is likely to have been affected. However, in other areas of the region, texture contrast soils may be formed *in situ* as a pedogenetical entity, and in these areas, soils have the potential to be up to 30,000 years in age (Kuskie and Kamminga 2000:213).

Research conducted by Koettig (1987a) at Glennies Creek identified artefacts from the A horizon that had affinities with B horizon artefacts, but could be distinguished from them through technological characteristics and an assessment of weathering. General characteristics of B horizon artefacts include the dominance of volcanic rock instead of indurated mudstone (or tuff), a higher ratio of cores to flakes, and a general reduction in artefact density.

Substantially older dates may be found along the Newcastle Bight that extends from the Hunter River to the Port Stephens River, and which contains an Outer Barrier of Holocene age and an Inner Barrier of Pleistocene age.

Consideration of technological attributes of stone artefacts also provides an indication of the age of occupation, and is most beneficial in excavations where there is no chronological stratigraphy and datable material is very infrequent. Excavations throughout southeast Australia provide evidence for the appearance of backed artefacts during the Early Holocene period and their proliferation ca 3,000 BP (Hiscock and Attenbrow 2004). These artefacts have therefore been used as a distinguishing feature of Holocene occupation deposits, and on this basis, many sites are considered to be Holocene in age. However, it is likely that providing a specific date within the Holocene for a site, based only on the presence or absence of backed artefacts, is problematic.

On the basis of geomorphic context and technological analysis, the vast majority of known sites within the Lower Hunter region are considered to date to the Holocene period. Examples of sites dated in this way include an open camp site to the north of Hexham Swamp that has been assumed to be of an early-mid Holocene age, due to its position on an Early Holocene foredune (Kuskie and Kamminga 2000:213).

The general lack of older (Pleistocene) archaeological sites throughout the Hunter and Lower Hunter regions has been explained in several ways (Kuskie and Kamminga 2000:215):

- removal of older deposits during periods of severe erosion in the late Pleistocene or early Holocene period;
- burial of older deposits obscuring their detection;
- impacts of geomorphic processes that obscure or damage evidence;

- post-depositional processes obscuring or damaging evidence;
- sampling error during archaeological research, as few excavations have focussed on landscape areas likely to contain older, datable deposits; and
- the genuine lack of archaeological evidence dating to the Pleistocene, reflecting a lower density of Aboriginal occupation or favoured use of coastal landforms now under water.

6.3.3 Models of Aboriginal Occupation

Models of occupation seek to identify general patterns in the Aboriginal occupation and land use of a region based on the archaeological record. Although most research conducted within the region has been site-specific assessments in advance of development projects, the numerous studies completed contribute towards a broader understanding of the patterning of archaeological materials, and the associated patterning of Aboriginal occupation. Models of occupation developed for the broader region, encompassing the Upper/Central Hunter Valley, Lower Hunter Valley and Coastal Zone, range from general models of Aboriginal occupation and behaviour to models of occupation for specific localities. These models are outlined below, although it should be noted that only limited testing of the models has been undertaken, so they remain largely hypothetical.

6.3.3.1 General Model of Aboriginal Occupation

A large body of research has investigated patterns of hunter-gatherer occupation and strategies for survival, which can be used to provide basic principles for Aboriginal occupation and use of the landscape. One key model used by archaeologists in past research in the Hunter region was one developed by Foley (1981). This model is briefly summarised below to provide a broad context for the understanding of Aboriginal occupation of the region.

Foley's (1981) model assumes that human behaviour occurred continuously across the landscape, and settlements are points where higher frequency of activity occurred. This model draws heavily on ecological theories to discuss the relationship between population and subsistence resources, and defines the landscape as having core areas, seasonal ranges, annual ranges and lifetime ranges (1981:2). The implication of this theory for archaeological studies is that the archaeological record is assumed to be spatially continuous, but artefact density will vary according to the pattern of resource utilisation (Kuskie and Kamminga 2000:255). Foley (1981:5) outlines the variable archaeological characteristics of areas within the home range based on behavioural patterns, specifically:

- **home base:** primary focus for behaviour and discard. High artefact density;
- **home base periphery:** area adjacent to home base as focus for many activities and discard. Discard (loss) during transit, and as a function of extended living areas and peripheral working areas;
- **secondary home range foci:** beyond the home base and periphery discard relating to specific activities which occur at repeatedly visited points in the landscape (such as hunting and transitory camps);

- **occasional home range foci:** discard at points visited occasionally as part of subsistence activities (particularly hunting); and
- **extra home range loci:** discard beyond the routine home range boundary (particularly for raw material procurement, exchange or ceremonial activities).

Foley (1981:4-7) argues that behaviour and discard within the home range is influenced by the following five environmental factors:

- **topography:** in areas of low relief, home ranges will be larger, resources more evenly distributed, less chance of secondary home range development, and more chance of occasional discard;
- **productivity:** the availability of resources;
- **climate:** seasonal effects of climate change on resources and water supply;
- **habitat:** where habitats are irregular, artefact distribution may be clustered and discontinuous. On the boundaries between habitats (ecotones), there often occur areas of high resource potential, and consequent frequent activity and discard; and
- **diet and subsistence strategy:** effects of human behaviour.

Foley's model was used by Effenberger and Baker (1996) as a model of occupation for the Black Hill locality, to explain the assemblages identified at the Black Hill 2 and Woods Gully sites.

6.3.3.2 Wetlands and Wetland Margins

Wetlands form a major component of the landscape of the Newcastle LGA, occupying an estimated twenty per cent of the LGA at the time of contact (Newcastle City Council 2003b). Numerous archaeological investigations have been undertaken bordering wetland areas in response to development proposals, primarily along the margins of Hexham and Woodberry Swamps (Effenberger and Baker 1996), Kuskie and Kamminga 2000 and Umwelt 2002b). Investigations have included both landscape survey and archaeological excavation, so an understanding of the patterning of surface and subsurface materials (and the relationship between those deposits) has developed. This understanding has formed the basis of models of Aboriginal occupation and the patterning of the resultant archaeological resource.

Work conducted by Umwelt (2002b) at Bluegum Vista has provided substantial information on Aboriginal occupation associated with Hexham Swamp. The excavation program recovered a relatively high density of archaeological materials along the swamp margins. The patterning of archaeological materials indicated that sites on the swamp margins 'are large in aerial extent and have large and more complex artefact assemblages that generally reflect a wider range of stone knapping technologies than those in the riparian corridors (Umwelt 2002:2.2-2.3). It was further noted that evidence of Aboriginal habitation was 'heavily biased towards areas of lower slope associated with creek lines' around the swamp margins (2002:8.5). Umwelt (2002b:8.2) suggested the higher density of archaeological materials in lower slopes associated with wetland margins reflected the wider range of flora and fauna associated with this environment. It was argued that the increased level of subsistence resources provided benefits for Aboriginal occupation, in that the wider subsistence

base along the swamp margins may have supported larger Aboriginal groups for longer periods of time (2002b:8.2).

Archaeological investigations that have occurred away from the swamp margins have revealed a low density of artefacts (Everett 1996; Mills 1998). Umwelt (2002b) also identified a lower density of archaeological materials in landforms removed from the swamp margins. Sites were identified in association with waterways that flow into the swamp, and on gentle slopes and spur lines where there is an open aspect over the swamp. The distribution of these sites was associated with the use of riparian corridors, being waterways and lower slopes used to move to and from the swamp (2002:8.6). The availability of fresh water within the riparian corridors was an important resource affecting their use.

The suggestion that ridges or spur lines were used to travel across the landscape is not considered likely by Umwelt (2002b:8.6), who note that 'there is presently little evidence to suggest that spur lines and ridges were preferred pathways, though even if they were, it is unlikely that this would be archaeologically visible'. This is an interesting point in comparison to other areas in Australia, such as the Far South Coast of New South Wales (Byrne 1984) where ridges and spur lines are considered as landforms frequently utilised for travel across the landscape.

A study by Kuskie (1994) at Woodberry Swamp suggested that 'there is a clear trend for artefact density to increase closer to the wetlands' (1994:35). To confirm this pattern of site distribution, one excavation on the southern margin of Hexham Swamp at Bluegum Vista Estate tested each landform within the study area equally (Umwelt 2002b). This subsurface testing program confirmed the concentration of Aboriginal artefacts across gentle slopes and crest landforms that have open aspects across the swamp, 'and often in association with creeks that drain into swamps' (Umwelt 2002b:8.5). There is a clear trend from archaeological subsurface testing around the swamp margins that artefact numbers increase with proximity to the swampland.

From these findings, Aboriginal habitation and use of wetland areas within the Hunter region was based around the increased subsistence resources available in wetland margin zones, including the availability of fresh water, flora and fauna, influenced Aboriginal occupation, and it was a location that was either visited more frequently, for greater lengths of time or by large groups. Increased use of the area influenced the archaeological record, with greater densities of artefacts and a greater range of artefacts being discarded in these areas compared to areas away from the swamp. The greater range of artefact types and the range or nature of activities that occurred along the swamp margins differed to those carried out in other parts of the land.

6.3.3.3 Stockton Bight

A series of archaeological investigations within the Stockton Bight (Dean-Jones 1990; Evans 1989 and 1993; Hamm 1993; Koettig 1987b; Resource Planning 1992 and Umwelt 2000) have addressed the patterning of archaeological sites within the region, which is acknowledged to be of high archaeological sensitivity and significance.

The area of Stockton Bight that occurs within the Newcastle LGA, is part of the stable dune system of the Outer Bight. Koettig (1987b:5) noted that the Stockton Bight, especially the Fern Bay and Stockton localities, would have provided access to both

marine and estuarine subsistence resources. This area was an extremely rich resource zone, providing access to marine, estuarine and wetland resources in the immediate vicinity. In addition, the botanical resources of the Bight include numerous species known to have been valued by Aboriginal groups as food sources. In such a locality, the archaeological record of Aboriginal occupation is expected to contain physical evidence of a diverse economy (Umwelt 2000:4.10).

A number of archaeological sites are known to occur within the stable dune system of the Bight, the majority of which appear to be small, surface scatters of midden materials including shell, bone and stone artefacts. Site frequency and density appears to increase in associated with wetlands and their subsistence resource, with Umwelt (2000:2) noting that several large, complex archaeological sites are present adjacent to wetlands of the interbarrier depression, between Fullerton Cove and Tillingerry Creek.

Umwelt (2000:2) concluded that the small middens and artefact scatters associated with the stable dune system may reflect intermittent or opportunistic use by small groups. Although this conclusion is based on current knowledge of known sites, the dense vegetation covering stable dune surfaces may hamper archaeological assessments of the area and larger, more complex sites may be present, but in buried contexts.

6.3.3.4 Awaba Hills

An early archaeological investigation across the Awaba Hills was conducted by Dyall (1972), which formed the basis of an occupation model within the Awaba Hills region. Dyall hypothesised that Aboriginal sites would be concentrated in proximity to the major subsistence resources in the area, including the coastline, Jewells Swamp and freshwater lagoons such as at Gateshead. Away from these shoreline areas, sites across the ridge and valley landforms are suggested as relating to short term occupation, associated with the procurement of specific resources and short term camps (Dyall 1972). Archaeological sites recorded by Dyall away from the coastal zone consisted of low density collections of stone artefacts, such as chert flakes and cores, associated with spur lines and drainage channels. Dyall suggested that this material reflected a one-night stop by a small family group, or that some time was spent there making bark canoes or wooden implements from suitable trees (Dyall 1972:170).

Dyall's (1972) model of landscape distribution was later supported by an archaeological investigation in the Gateshead/Redhead area by Dallas and Navin (1990). This study demonstrated a concentration of archaeological materials along the coastline, Lake Macquarie, and some of the fresh water lagoons that occur in the area. Archaeological sites were known on hillslopes away from these resources, but not the frequencies or densities to suggest hillslope camps (1990:5). Dallas and Navin (1990:5) suggested seasonal shifts between the resources of the ocean shoreline to the resources of Lake Macquarie. Although evidence for the seasonal shifts was inconclusive, it was argued that the ocean shoreline would have provided resources during winter and the eastern side of Lake Macquarie was targeted in summer (Dallas and Navin 1990:5).

Results of previous studies (Dallas and Navin 1990; Dyall 1972) completed within the Awaba Hills region demonstrate that archaeological sites occur across all landscape contexts of the area (eg. crests drainage channels), but at a lower frequency and density than in other environmental areas, such as wetlands, wetland margins and Stockton Bight. Archaeological sites identified across the Awaba Hills include camp sites and grinding grooves in the southern suburbs of Newcastle, primarily in association with ridge lines and drainage channels. Site frequency and density increases along the coastal zone, as demonstrated by studies within Glenrock Nature Reserve. Within the Reserve, open-campsites, midden deposits, axe-grinding grooves, engravings, a chert quarry and a bora ground are known (NSW National Parks and Wildlife Service 1997b:22), and these sites have been found in association with drainage channels, spur lines and beach dunes. This increase in sites along the coastal zone, including lagoons, swamps, and further south, Lake Macquarie, may reflect use of a wider range of subsistence resources in these areas. Other resources available in the Awaba Hills area, especially along the ocean shoreline, are outcrops of lithic raw materials used for the production of stone artefacts.

6.3.4 Post-Depositional Processes and Site Integrity

A common theme in archaeological assessments throughout the region is the integrity of Aboriginal archaeological sites, and the natural processes and human actions affecting the site since deposition. Researchers need to address the influence of these factors in the post-depositional history of an archaeological site to adequately understand the contemporary archaeological record.

Natural processes such as sediment movement (erosion, deposition), bioturbation, weathering and dune movement are the primary natural processes that may affect archaeological sites in the Lower Hunter region. Sediment (soil) movement throughout the region is characterised by erosional landscapes (higher terrain areas) and aggrading landscapes (Hunter River delta, floodplain and wetlands). Soil movement downslope is facilitated by water and wind movement, causing finer sediment to be transported to lower terrain areas. Small stones of low density (<6 millimetres) can also be transported in this way. Sheetwash erosion is common throughout the Lower Hunter region, and is most notable in areas where recent land use practices have cleared vegetation or disturbed the ground surface. Dean-Jones (Resource Planning 1991:27-28) notes that sheetwash erosion is most common on footslopes and drainage lines that intersect low bedrock spurs. In these areas, lateral movement of sediment and the exposure of the subsoil is predicted.

Allen (1991) argues that it is unlikely that sheetwash erosion will cause a significant downslope movement of artefacts. The erosion process will wash sediment downslope leaving artefacts in high terrain areas exposed whilst burying artefacts in lower terrain contexts (Allen 1991). This means that artefacts in higher slope contexts would be more visible. Where sheetwash occurs in lower terrain contexts, such as footslopes and drainage lines, Dean-Jones (Resource Planning 1991b:27-28) argues that some lateral artefact movement would be expected, a process which may displace artefacts from their original contexts to deeper soil units.

Bioturbation refers to disturbance to the soil profile by plants and animals, and can result in the movement of soil by mixing and moulding. Dean-Jones and Mitchell (1993:43) identify an important effect of bioturbation on the soil profile, being the

development of stone layers between the A and B horizons of texture contrast soils. This results from a thickening of the topsoil, which buries stone fragments at a level where bioturbation agents usually cease operating (the base of the A horizon). This process may affect the stratification of open sites within the Lower Hunter region, but sites may still retain a high integrity.

Various forms of weathering may impact archaeological sites, including chemical, thermal and mechanical. Weathering affects materials in varying ways, and in particular, organic materials such as bone and shell will tend not to be preserved in acidic soils (Kuskie and Kamminga 2000:208). Chemical weathering can affect stone materials after deposition, such as unintentional heating and exfoliation.

Impacts to archaeological materials from dune movement have been addressed by Dean-Jones (1990) in a study of the Stockton Bight. The effects of mobile transgressive dunes on sites can be quite complex, and within short time periods, can affect the patterning of materials exposed and even bury recently recorded sites. Conversely, buried archaeological materials can be exposed by dune blowouts (Dean-Jones 1990:76). In areas such as the Fern Bay and Stockton localities, archaeological deposits may be associated with stable dune surfaces, and therefore retain a high level of site integrity. Areas of stable dune in this region can contain intact land surfaces that may date to the early Holocene.

Impacts of recent land use activities are commonly observed in archaeological site assessments. During the occupation of a site in the Prehistoric past, activities such as trampling, camp fires (thermally affecting artefacts), and re-use of discarded artefacts may affect the original distribution of materials in a campsite. Since contact, the impact of land use practices throughout the region has been substantial. Land use activities affect large areas, and include agricultural practices such as ploughing, pastoral practices such as grazing, tree clearance and urban development (residential, industrial, and transport infrastructure). These activities may have a range of impacts on archaeological sites, including the accelerated rates of erosion, artefact damage and breakage, and in extreme situations, the removal of the natural terrain and any archaeological materials within it (Kuskie and Kamminga 2000:209). The precise spatial and stratigraphic impact of land use activities varies, and although previous studies provide a comparative reference, the influence of human action needs to be assessed on a site-by-site basis.

7 Landscape Model of Archaeological Sensitivity

The environmental and archaeological data presented in Sections 4, 5 and 6 have been used to develop a landscape model of archaeological sensitivity for the Newcastle LGA. This model assesses the probability (low, moderate, high or very high) of archaeological materials occurring within landforms and environmental areas on the basis of known site patterning and terrain integrity.

This section discusses the archaeological sensitivity of each environmental area within the Newcastle LGA, being the Lower Hunter Plain, Tomago Coastal Plain, Awaba Hills, East Maitland Hills and the Sugarloaf Range. Within these regions, the sensitivity of various zones, including open space/nature reserves, urban residential and urban industrial, have been assessed. For each environmental area, the key environmental and archaeological data determining archaeological sensitivity is summarised and discussed.

7.1 Lower Hunter Plain

The Lower Hunter Plain extends up to 40 kilometres from the Hunter River, and is defined by Quaternary sands composed of over bank alluvium deposited atop estuarine mud. These sands have a maximum depth of twenty metres. Raw materials are known to occur in alluvial deposits throughout this area, such as indurated mudstone or tuff occurring as alluvial cobbles. The archaeological sensitivity of the Lower Hunter Plain is discussed below.

7.1.1 Open Space and Nature Reserves

The open space and nature reserves within the Lower Hunter Plain environmental zone consists of two main features, the Hunter estuary delta and floodplains and wetlands. The Hunter estuary delta extends from Nobbys Head within the Newcastle Harbour to Hexham Island in the west. At the time of historical settlement, the delta was a complex of intersecting tidal channels, tidal flats and mangrove swamps. These landforms were rich in flora and fauna, and provided a wide range of river, estuarine and marine resources. In general models of occupation, such as that outlined by Foley (1981), areas rich in subsistence resources are focal points of human activity within the landscape. Raw materials are known to occur in this landscape context. The Hunter River was an important source of cobbles of indurated mudstone or tuff, silcrete, and quartz and the Nobbys Tuff Member located at Nobbys Head in Newcastle harbour was also a bedrock source of tuff.

Previous archaeological investigations in the area have identified a number of known sites in the Hunter estuary delta, and the archaeological sensitivity of these landforms is recognised (see Section 6.3). The archaeological resources of the Hunter estuary delta reflect Aboriginal occupation and use of the area, specifically concentrated around its marine and estuarine resources.

The Hunter River floodplain extends from the western and northern boundaries of the Newcastle LGA to Wallsend in the south. Within this large, low lying area, there are a number of discrete wetlands, including Hexham Swamp, Tarro Swamp, the southern portion of Woodberry Swamp, Pambulay Swamp and numerous small freshwater wetland areas on the coastal strip between Port Stephens and Lake Macquarie. At the

time of contact, these wetlands formed nearly twenty per cent of the Newcastle LGA. Hexham Swamp is the largest swamp in the Lower Hunter Plain, being over 2400 hectares in area, and is a dominant geographical feature in the western section of the Newcastle LGA. The wetlands contain a variety of flora and fauna species, and would have provided substantial resources for Aboriginal occupation. Elevated areas above wetlands also provided abundant fauna resources.

Previous archaeological research of adjacent wetland areas within the Newcastle region has been high, primarily as these areas have been targeted for modern residential and industrial development. Recent archaeological research at Hexham Swamp by Umwelt (2002b) has been key in increasing our knowledge of the archaeological sensitivity of wetland landforms (see Section 6.2.2). Although recent land use has impacted wetland areas, and involved extensive reclamation works, many wetland areas remain relatively intact as they are zoned as National Parks, conservation zones or open space by the Newcastle City Council. Any areas of terrain integrity found in association with wetland areas would therefore be considered to be of high archaeological sensitivity.

The archaeological sensitivity of the Hunter estuary delta and the floodplains and wetlands of the Lower Hunter Plain has been assessed, as listed in Figure 7.

Physical Area	Sensitivity Rating
Hexham and Tarro Swamp boundaries	Very High
Northern portion of Kooragang Island, bounded to the south by the rail corridor	Moderate
Hexham Island	
Hexham Swamp	High
Tarro Swamp	
Southern limits of Woodberry Swamp and Pambulay Swamp	

7.1.2 Industrial Newcastle

Since contact, the Lower Hunter Plain, especially the Hunter delta, has been developed into one of Australia's most important ports. Reclamation was a major tool to create and stabilise the unstable sands of the delta, and this increased the landmass of the harbour by approximately twenty per cent. Extensive works were also undertaken to modify the layout of the harbour, with construction of breakwaters, retaining walls and bank protection works. Impacts to flora and fauna have also been extensive, with both banks of the estuary cleared by 1842.

The impact of landscape modification along the Hunter River has been severe, and in many areas, would have directly impacted archaeological sites. For example, Newcastle's early lime industry involved burning of existing shell deposits along the Hunter River to produce lime, and it is likely that existing shell deposits included

Aboriginal midden sites. In other areas of the estuary, archaeological materials are not likely to occur as a result of land use history, such as the reclaimed areas of Kooragang Island that were formed by dredging of the Hunter River. Despite the impacts of land use history, researchers have found archaeological materials along the southern side of the Hunter estuary delta, demonstrating that in areas of terrain integrity the potential for archaeological materials to remain is high.

Since historical settlement, the landscape of the wetlands across the Lower Hunter Plain have been altered in shape, extent and appearance by human action. Wetland fringes have been cleared for grazing animals and cultivation. Industrial development adjacent wetlands have involved reclamation works, and it is estimated that within the Newcastle LGA, over 1500 hectares of wetlands have been reclaimed. Earthworks associated with these developments have been extensive, and have resulted in changes to the hydrology of the wetlands.

The archaeological sensitivity of the Industrial area of Newcastle has been assessed, as presented in Table 7.

Physical Area	Sensitivity Rating
Southern portion of Kooragang Island, bounded to the north by the rail corridor	Low
Coal loading facility to west of Hexham	
Sewerage treatment plant to north-west of Birmingham Gardens	
Southern shore of the Hunter River, extending from Sandgate to Carrington	Moderate

7.1.3 Urban Newcastle

There are a number of urban areas within the Lower Hunter Plain; they include: central Newcastle, Islington, Hamilton, Merewether, Adamstown, Broadmeadow, Georgetown, Shortland, Birmingham Gardens, Brookstown, Wallsend, Plattsburg, Maryland and Minmi. These areas are in a shallow basin to the south of the Hunter River, defined by low, undulating Quaternary sands. Raw materials are known to occur in proximity to these areas, such as fine-grained siliceous cobbles occurring in the Hunter River, and the outcrop of Nobbys Tuff Member in the Newcastle Harbour. As with the Hunter estuary delta, the landforms of this area would have been rich in flora and fauna prior to contact, and would have provided access to a wide range of estuarine and marine resources, in addition to the resources of the Awaba Hills directly to the south. This Quaternary sand basin would have functioned to collect sediments from the Awaba Hills to the south, and archaeological materials deposited in the area may have been retained *in situ* under layers of alluvium. Prior to the historical period and landscape modification, these urban areas would have been of high archaeological sensitivity, due to their proximity to the Hunter River and its tributaries, and the occurrence of Aboriginal heritage deposits.

Few archaeological studies have been conducted within this environmental area, which forms the urban and commercial centre of Newcastle. This is primarily due to the early development of the centre in the nineteenth and early twentieth century, which predated requirements for archaeological studies during the development process. However, in recent years, a number of studies have demonstrated the presence of Aboriginal archaeological materials in the area. For example the study conducted by Douglas *et al* (2001) in Hunter Street, central Newcastle (See Section 6.2.1).

The archaeological sensitivity of the Newcastle's urban Quaternary areas has been assessed and listed in Table 8.

Physical Area	Sensitivity Rating
Urban area bounded by Georgetown, Adamstown, Merewether and Islington	Low
Urban area bounded by Birmingham Gardens, Wallsend and Maryland	
Semi-urban area centred on Shortland	Moderate
Minmi urban area	

7.2 Tomago Coastal Plain

The Stockton Bight is the only portion of the Tomago Coastal Plain extending into the Newcastle LGA. The Stockton Bight is the southernmost portion of the Newcastle Bight that extends between the Hunter and Port Stephens Rivers. The Stockton Bight is an Outer Barrier deposited in the Holocene, the majority of the Outer Barrier within the Newcastle LGA is a stabilised dune system. The vegetation associated with the dunes provides a range of flora resources and fauna habitats. The Bight also provides access to substantial estuarine and marine resources. Soils are deep within this area (over 200 centimetres) and fore dunes can be up to ten metres high in the northern portion of the Stockton Bight.

The Stockton Bight has previously been described to be of National natural and cultural heritage significance, and the archaeological sensitivity of the Stockton Bight landforms has been established by previous research (Koettig 1987b, Umwelt 2000). Over 120 archaeological sites are known to occur in the Stockton Bight, including middens, open camp sites, scarred and carved trees, quarry, bora (ceremonial site), axe grinding groove and burials (Umwelt 2000:5.1). Most known sites within the Stockton Bight have been identified within the mobile dune system to the north of Stockton, where archaeological materials have been exposed by dune action (in deflation basins and blowouts) or human actions. Archaeological sites recorded within the stable dune system of the Bight are predominantly small middens and artefact scatters. This material evidence of Aboriginal occupation has been interpreted to reflect intermittent or opportunistic use by small groups (Umwelt

2002:2). More information on the archaeology of Stockton Bight is presented in Section 6.2.

The archaeological sensitivity of the Stockton Bight is recognised to be high, although in areas, land use history may have impacted the archaeological resource of the area. Within Stockton, residential development has involved earthworks, excavation and construction. It is likely that some of this development may have impacted the archaeological resource of the stable dune system, but the exact spatial and stratigraphic impact of this disturbance is unknown. Where areas of terrain integrity remain within the southern portion of the Stockton Bight, there is a high potential for archaeological materials to remain. Due to the stability of this portion of the Stockton Bight dune system, archaeological sites of the area have the potential to remain *in situ* and be associated with former land surfaces.

The archaeological sensitivity of the Stockton Bight has been assessed and is listed in Table 9 and illustrated in Figure 9.

Physical Area	Sensitivity Rating
Stockton residential area	Moderate
Sewerage treatment plant to north of residential area	
Remaining area of Stockton Bight within the Newcastle LGA	High

7.3 Awaba Hills

The Awaba Hills region occupies the southern portion of the Newcastle LGA. The landscape of this area is characterised by undulating and low rolling hills leading into the Lower Hunter Plain. These hills are erosional landscapes, and provide a sediment source for the infilling of the Hunter estuary. Newcastle Coal Measures underlie this area, and outcrops of raw material such as tuff are known within Glenrock Nature Reserve. The natural vegetation of the region is dominated by open forest, although much has been cleared for urban development. Areas allocated as nature reserves and open space are found throughout this area.

Previous research within the Awaba Hills has not been extensive, and is predominantly surveys and assessments of small, individual development areas. Early research within the region was conducted by Dyall (1972), who identified archaeological sites at a low density along ridges and hillslopes of the area, interpreted to reflect short-term occupation periods. Archaeological site density increased in association with the coastline. This has been generally supported by later surveys of the region. Subsurface testing has been relatively limited, but a program was conducted by Effenberger (1996) as part of the Charlestown bypass, the testing program found no subsurface archaeological material (see Section 6.2.5)

Despite the apparent low density of archaeological sites within the region, previous research has demonstrated that a range of site types do occur within the Awaba Hills,

including open camp sites, middens, axe grinding grooves, quarries and ceremonial sites (NSW National Parks and Wildlife Service 1997b). These sites occur in all terrain contexts of the region. Research has also demonstrated that some landforms have a higher archaeological sensitivity within the region. These include lower hillslope contexts above the landforms of the Lower Hunter Plain. The northern margin of the Awaba Hills environmental area is therefore considered to be of high archaeologically sensitive, with a higher density of archaeological sites in these areas is likely to reflect the wider range of subsistence resources found in wetland margin areas. Other areas of archaeological sensitivity throughout the region include creek lines, which may include creek lines and associated flats (occupation sites), sandstone exposures within creek lines (axe grinding groove sites) of any locations associated with a raw material source (quarries). Site frequency and complexity is likely to increase in proximity to coastal landforms, such as demonstrated within the Glenrock Nature Reserve.

7.3.1 Urban Newcastle

There are a number of residential areas in the Awaba Hills area: central Newcastle, Cooks Hills, Merewether Beach, Merewether Heights, Kotara, New Lambton, Lambton, Mayfield, Jesmond, Elmore Vale and Wallsend South. The archaeological sensitivity of the Awaba Hills urban areas is listed in Table 10 and illustrated in Figure 9.

Physical Area	Sensitivity Rating
Urban area centred on Elmore Park and Rankin Park.	Low
Urban area bounded by Kotara, New Lambton, Jesmond and Mayfield.	
Lower hillslope corridor to south of Lower Hunter Plain. Extends through Wallsend South, Jesmond, Mayfield, Lambton, and Merewether (eastern and western Awaba Hills)	Moderate
Coastal corridor extending from Newcastle Beach to Merewether Beach.	

7.3.2 Industrial Areas

There are two discrete industrial areas within the Awaba Hills area: a colliery to the south-west of Minmi and a quarry to the west of New Lambton. Both areas have removed parts of the natural landscape to create the quarry or mine pits, and disturbed to the surrounding area through associated infrastructure and earthworks. It is likely that any archaeological materials within the excavated pits would have been removed. However, areas of natural terrain or soil profile may be found in the surrounding areas, as previous studies have identified archaeological materials in close proximity to mine and quarry sites. The archaeological sensitivity of the Awaba Hills industrial areas is listed in Table 11 and illustrated in Figure 9.

Physical Area	Sensitivity Rating
Quarry pit to north of Kotara	Low
Former mine pits in colliery area to the east of Minmi	

7.3.3 Nature Reserves and Open Space

There are a number of nature reserves and open space areas within the Awaba Hills area: the Glenrock Nature Reserve, Bluegum Hills Regional Park, and a number of unnamed open spaces in surrounding suburbs. Nature reserves and open spaces within the Awaba Hills area are considered to be archaeologically sensitive as they represent areas where landscape modification is less severe, and these areas often contain substantial tracts of natural landscape. If archaeological materials were deposited in the prehistoric past in these contexts, it is likely they would still be retained in the area. These areas also contain a sample of various landforms, and could therefore be of value to investigations of Aboriginal occupation throughout the landscape. Studies within Glenrock Nature Reserve and Blue Gum Hills Regional Park have identified archaeological sites (see Section 6), and assessed the locations to be of very high sensitivity.

The archaeological sensitivity of nature reserves and open spaces within the Awaba Hills region has been assessed and listed in Table 12 and illustrated in Figure 9.

Physical Area	Sensitivity Rating
Open space surrounding colliery area to the west of Minmi	Moderate
Open space to the west of Rankin Park	
Glenrock Nature Reserve	High
Blue Gum Hills Regional Park	

7.4 East Maitland Hills

The East Maitland Hills occurs to the west of Quaternary deposits at Beresfield, and only partially extends into the Newcastle LGA, extending into the Beresfield area. This area is very similar to the Awaba Hills, being characterised by undulating and low rolling hills above the Lower Hunter Plain, forming erosional landscapes with sediment removed by wind and water erosion and deposited in lower terrain areas. As it occurs within the Newcastle LGA, the East Maitland Hills environmental area is defined by low, undulating landforms above the Hexham and Woodberry Swamps. A number of major creek lines extend through this area, including Viney Creek and Weakleys Flat Creek, which are defined by broad alluvial flats extending up to 1000 metres from the creek lines. Some relict terrace, levee, point bar and alluvial fan deposits may occur along these creek systems (Matthei 1995:30).

Previous studies have demonstrated that archaeological sites occur within the East Maitland Hills region, with open camp sites the primary site type known. Sites occur in all East Maitland landforms found within the Newcastle LGA, including lower hillslopes and alluvial flats (ERM Mitchell McCotter 1995, Silcox 1999). Archaeological research within this region has predominantly focused on the relationship of the area to the Hexham Swamp, and the archaeological sensitivity of the creek line alluvial flats. Excavation was conducted by Silcox (1999) at Weakleys Flat (see Section 6.2.6). The excavation area also contained evidence of historical land use as well as pre-colonial Aboriginal occupation.

7.4.1 Urban Newcastle

Within the East Maitland Hills, Beresfield and Tarro form an urban area in the north-west of the Newcastle LGA. This area borders the floodplain of the Lower Hunter Plain, and is in close proximity to Hexham, Tarro and Woodberry Swamps. Previous research has demonstrated this landform area is of high archaeological sensitivity, due to the proximity to the subsistence resources of the wetlands. However, excavation and earthworks for industrial and residential development of these localities may have destroyed or disturbed archaeological sites. The spatial and stratigraphic impact of disturbance in the area is not adequately understood, and any areas of terrain integrity within this area may contain archaeological materials. The archaeological sensitivity of the East Maitland Hills urban areas is listed in Table 13 and illustrated in Figure 10.

Table 13: Archaeological Sensitivity of Urban Newcastle (East Maitland Hills)

Physical Area	Sensitivity Rating
Urban area including Beresfield and western Tarro	Moderate

7.4.2 Open Space

There is a large open space area within the East Maitland Hills to the south of Beresfield and Tarro, and north of the Black Hill Spur. This area is directly west of the Lower Hunter Plain, and is characterised by creek lines extending through low undulating hills. Viney Creek is the largest creek in the area, although numerous unnamed drainage lines feed into it. This raised terrain area would have provided access to estuarine resources along Viney Creek and in the adjacent swamp, as well as open aspects over the plain. Previous archaeological studies have demonstrated that material evidence of Aboriginal occupation is found in similar terrain contexts, with sites recorded in elevated lands above swamp margins (Umwelt 2002b), especially where also in association with riparian corridors. Since historical settlement, infrastructure has extended across this area, specifically John Renshaw Drive and the New England Highway. The remaining area has been cleared and is mostly used for pastoral grazing. Although parts of the landscape have been modified by this usage, much of the area is considered to have moderate to high terrain integrity.

The archaeological sensitivity of open space areas within the East Maitland Hills region has been assessed and is listed in Table 14 and illustrated in Figure 9.

Table 14: Archaeological Sensitivity of Open Space (East Maitland Hills)	
Physical Area	Sensitivity Rating
Open space to the west of Lower Hunter Plain, bounded to south by Black Hill Spur, and to the west and north by the Newcastle LGA boundary.	High
Lower hillslope corridor to west of Lower Hunter Plain. Extends from Black Hill Spur to Beresfield urban area.	Very High

7.5 Sugarloaf Range

Within the Newcastle LGA, the Black Hill Spur is the only portion of the Sugarloaf Range. The Black Hill Spur is the easternmost area of the Sugarloaf Range, and is characterised by rolling hills to steep rises with gradients of up to 40 per cent. The northern slopes of the Black Hill Spur, facing Beresfield, share these characteristics but grade into undulating low hills and rises in the lower terrain areas. Rock outcrops are not known throughout the area, but boulders occur on lower slopes and benches. Raw materials are known to occur in the area, with outcrops of chalcedony and quartzite identified at Black Hill.

Previous research along the Black Hills Spur has been extensive, with archaeological survey and excavation required in advance of the planned F3 freeway extension across the landform [Kuskie and Kamminga 2000 (See Section 6.2.7)]. The following assessment of archaeological sensitivity has been made of the Black Hill Spur, Table 15, and illustrated in Figure 11.

Table 15: Archaeological Sensitivity of the Black Hill Spur (Sugarloaf Range)	
Physical Area	Sensitivity Rating
Black Hill Spur within Newcastle LGA boundaries.	Very High

Figure 7: Lower Hunter Plain sensitivity mapping

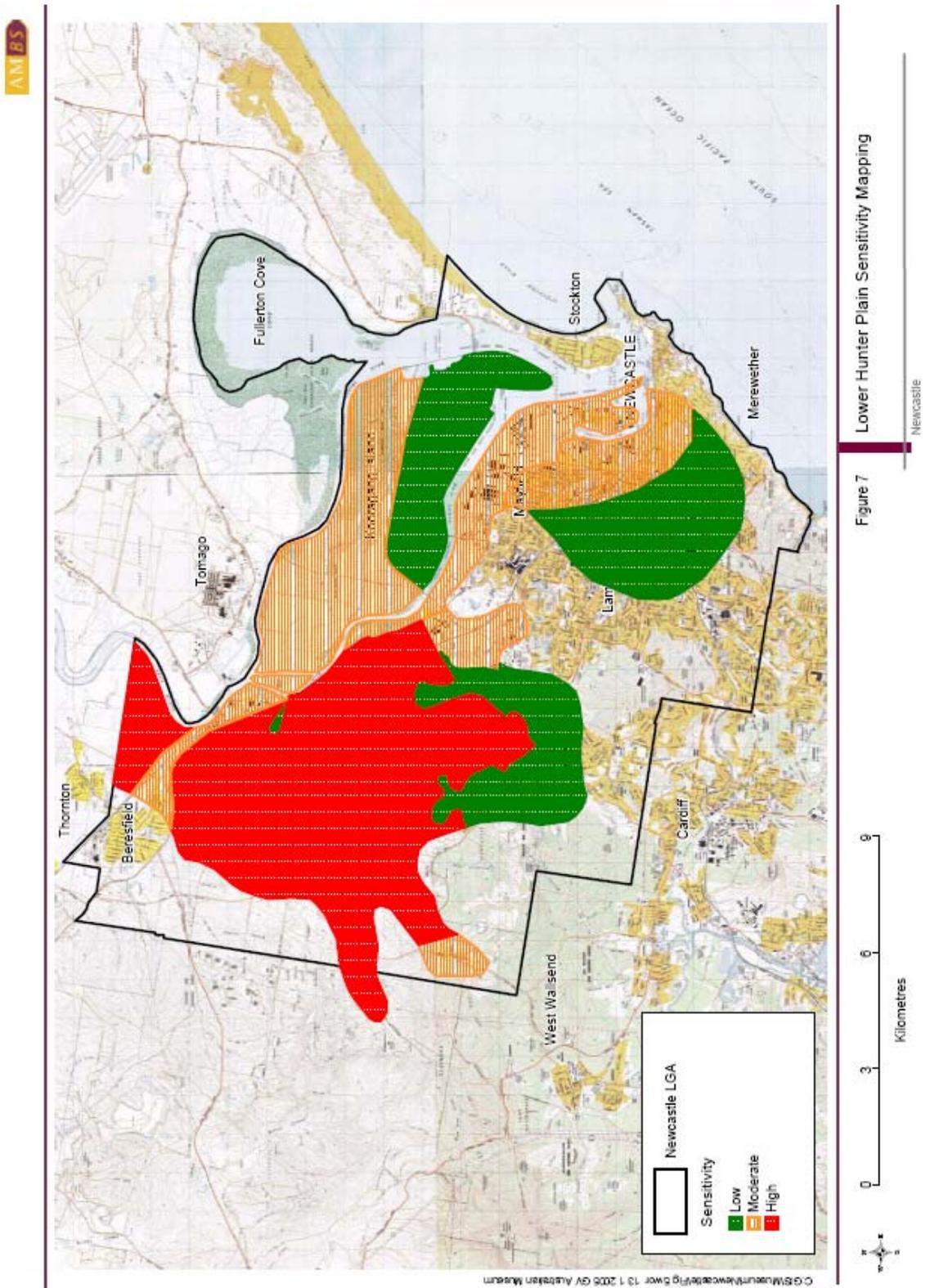


Figure 7 Lower Hunter Plain Sensitivity Mapping

Figure 8: Tomago Coastal Plain sensitivity mapping

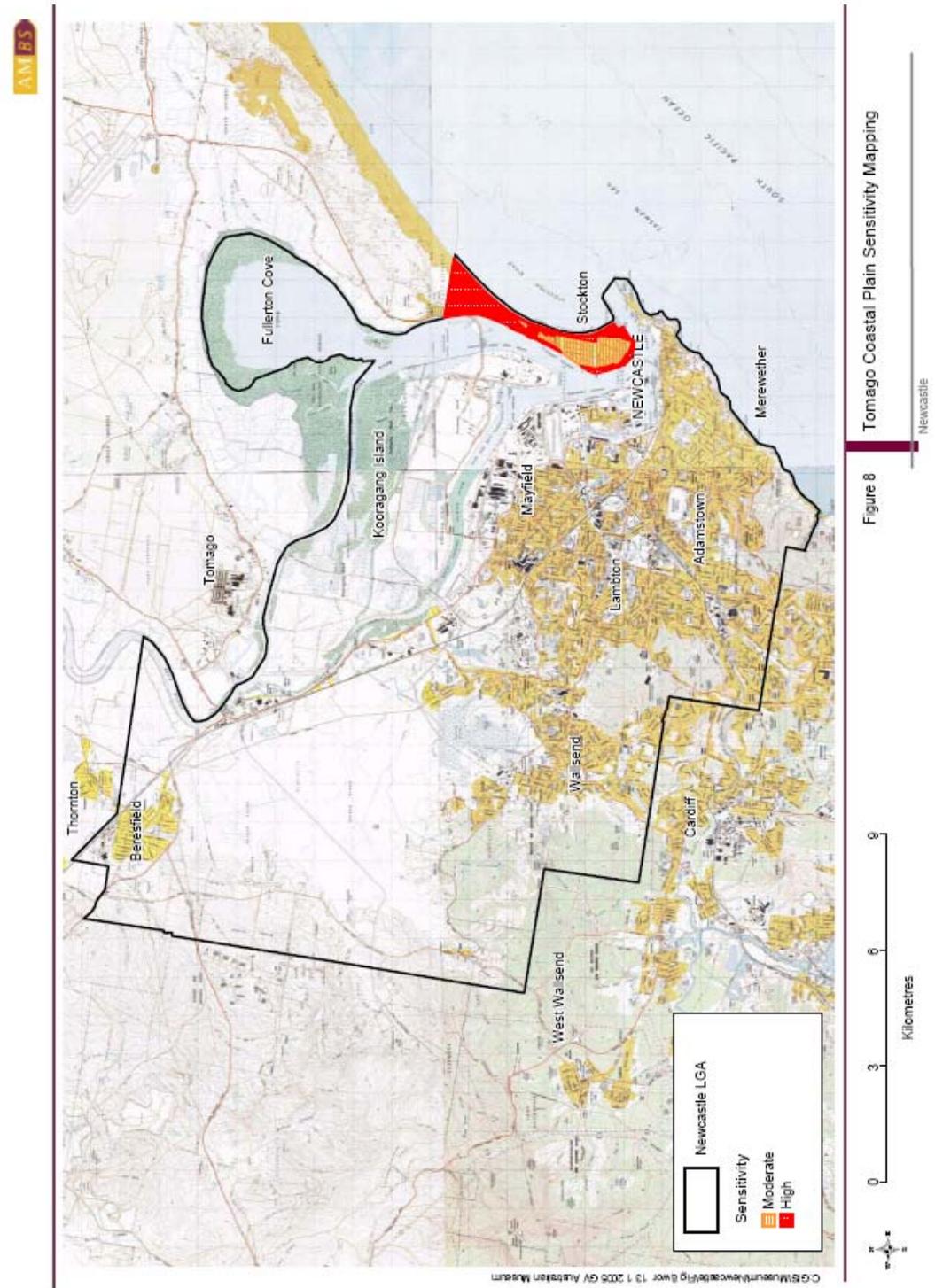


Figure 9: Awaba Hills sensitivity mapping

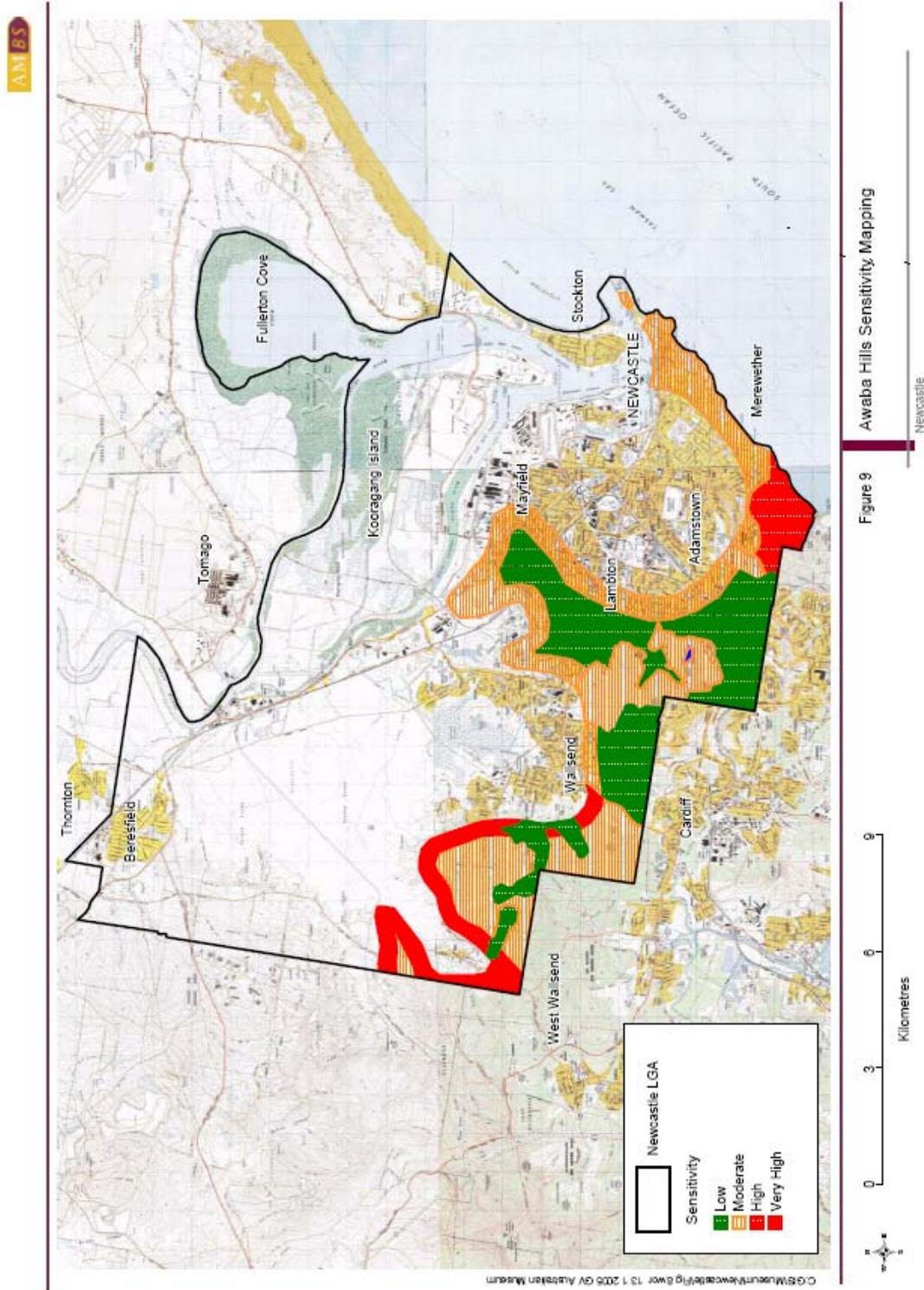


Figure 10: East Maitland Hills sensitivity mapping

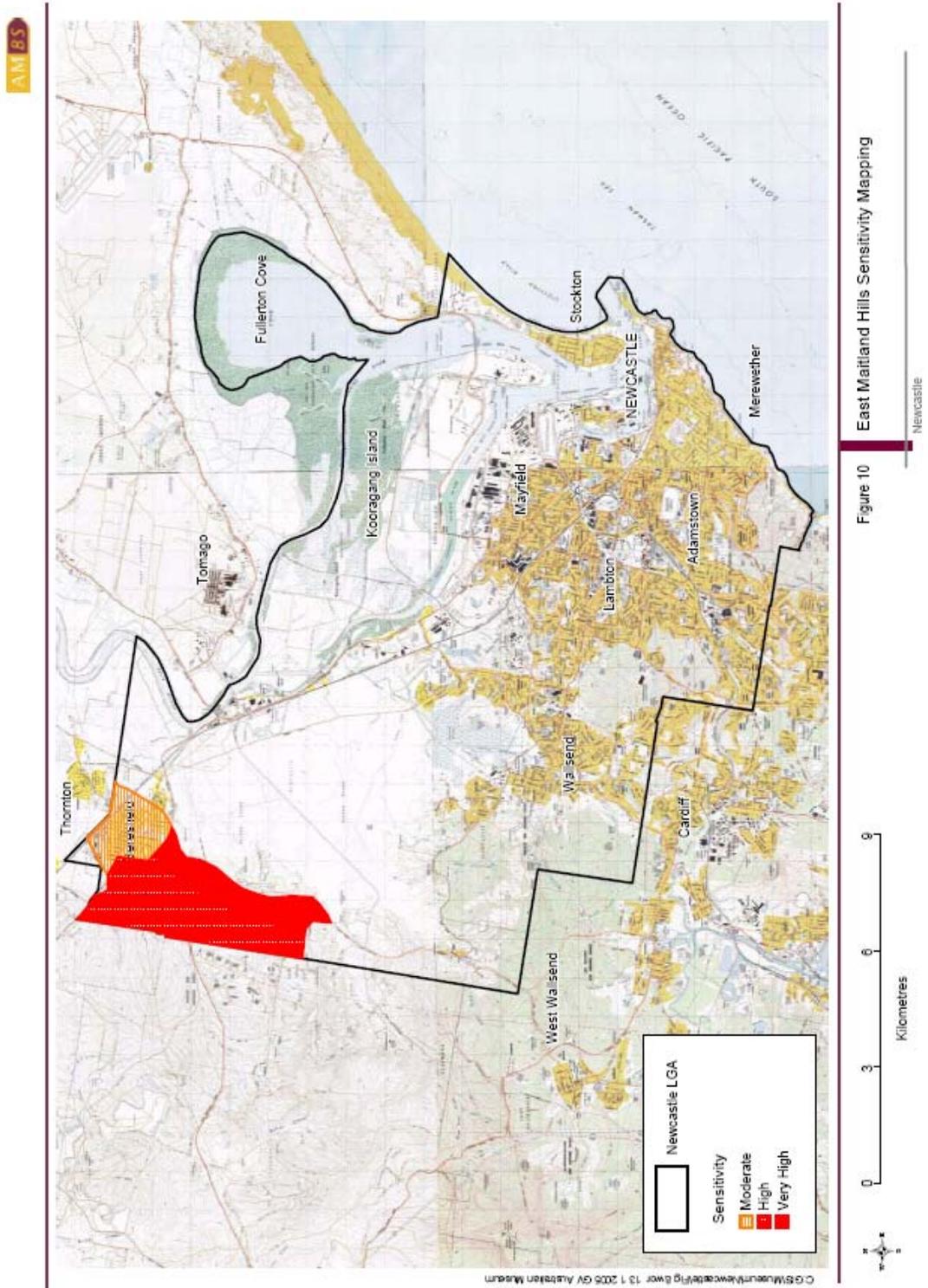
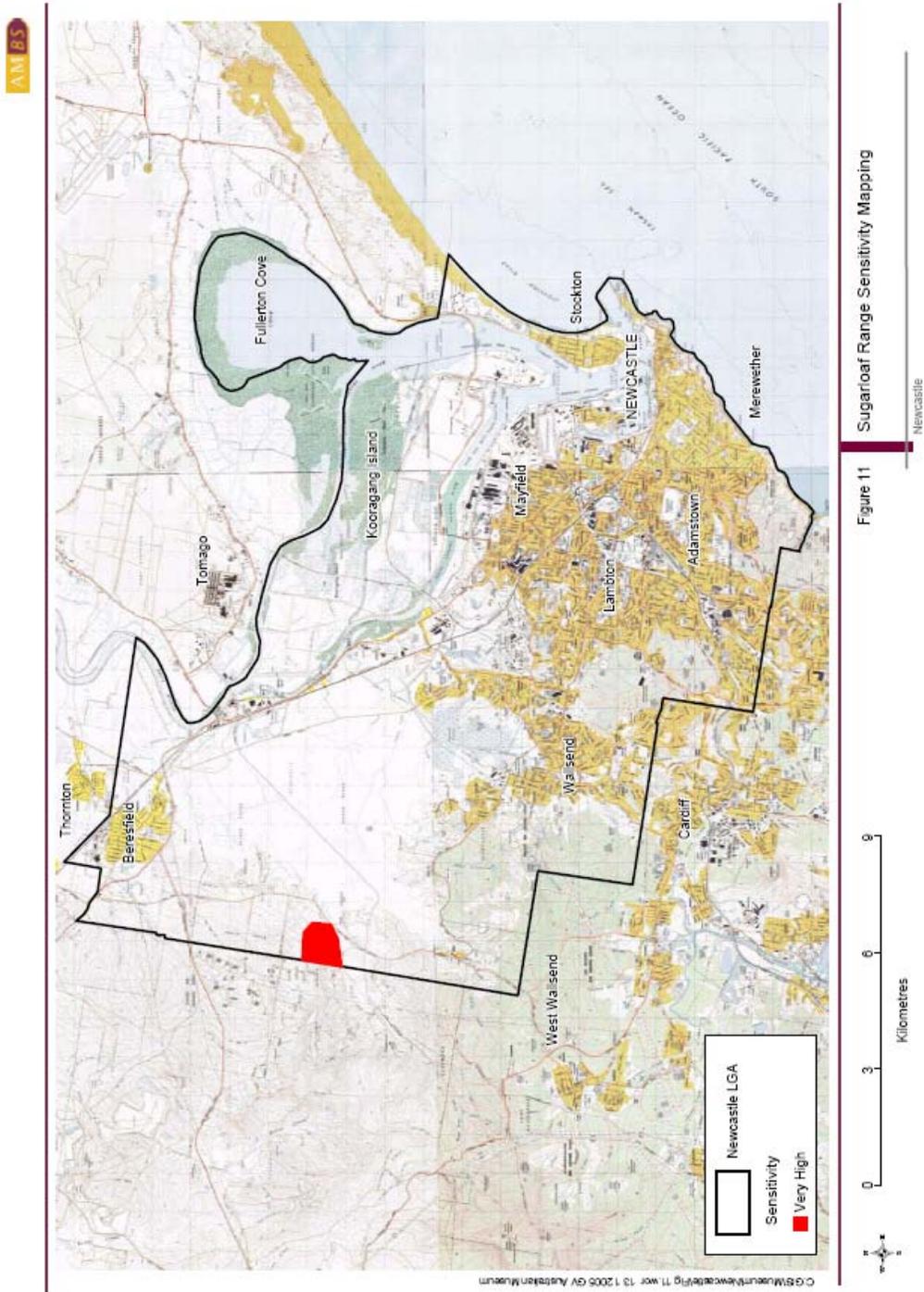


Figure 11: Sugarloaf Range sensitivity mapping



7.6 Summary

This study has identified that archaeological materials may occur in all landscape contexts within the Newcastle LGA. Although archaeological materials may occur in greater densities in specific landforms, no area within the Newcastle LGA should be considered to be archaeologically sterile unless demonstrated by an archaeological investigation. Absence of archaeological materials should be investigated and demonstrated as the spatial and stratigraphic disturbance from land use history is not adequately understood at this time.

Within the Newcastle LGA, however, there are a number of areas assessed to be of high and very high archaeological sensitivity. It is considered likely that these areas will contain higher frequencies and densities of archaeological materials, which may occur as surface and/or subsurface deposits. These areas include:

- Lower Hunter Plain: floodplain and wetland margins including Hexham Swamp, Tarro Swamp, Woodberry Swamp and Pambulay Swamp;
- Awaba Hills and East Maitland Hills: elevated terrain areas associated with wetlands of the region. Hexham Swamp wetlands are of particular archaeological sensitivity, as well as Glenrock Nature Reserve and Blue Gum Hills Regional Park;
- Sugarloaf Range: Black Hill spur; and
- Tomago Coastal Plain: Stockton Bight

This study has delineated all environmental areas within the Newcastle LGA to be of low, moderate or high archaeological sensitivity. The sensitivity ratings of all environmental areas, and where possible specific landforms within environmental areas is summarised below.

Table 16 : Summary of Archaeological Sensitivity

Environmental Area	Geographic Area	Physical Area	Archaeological Sensitivity Rating			
			Low	Moderate	High	Very High
Lower Hunter Plain	Hunter estuary delta and Floodplains and Wetlands	Hexham and Tarro Swamp Boundaries				●
		Northern Kooragang Island and Hexham Island		●		
		Hexham Island		●		
		Hexham Swamp			●	
		Tarro Swamp			●	
		Hexham, Tarro, Woodberry and Pambulay Swamp			●	
	Industrial Newcastle	Southern Kooragang Island	●			
		Coal loading facility to west of Hexham	●			
		Sewerage plant north-west of Birmingham Gardens	●			
		Southern estuary shore		●		

Table 16 : Summary of Archaeological Sensitivity

Environmental Area	Geographic Area	Physical Area	Archaeological Sensitivity Rating			
			Low	Moderate	High	Very High
Lower Hunter Plain	Urban Newcastle	Urban area bounded by Georgetown, Adamstown, Merewether and Islington	●			
		Urban area bounded by Birmingham Gardens, Wallsend and Maryland	●			
		Semi-urban area centred on Shortland		●		
		Minmi urban area		●		
Tomago Coastal Plain	Stockton Bight	Residential area & sewerage treatment plant		●		
		Remaining area in LGA			●	
Awaba Hills	Urban (Residential)	Urban area: Elernmore Park and Rankin Park	●			
		Urban area bounded by Kotara, New Lambton, Jesmond and Mayfield	●			
		Within Wallsend South, Jesmond, Mayfield, Lambton and Merewether (eastern and western Awaba Hills)		●		
		Coastal corridor between Newcastle Beach and Merewether Beach		●		

Table 16 : Summary of Archaeological Sensitivity

Environmental Area	Geographic Area	Physical Area	Archaeological Sensitivity Rating			
			Low	Moderate	High	Very High
Awaba Hills	Industrial Areas (Mine Pits)	All	●			
	Nature Reserves and Open Space	Open space around colliery to the west of Minmi		●		
		Open Space to the west of Rankin Park		●		
		Glenrock Nature Reserve			●	
		Blue Gum Hills Nature Reserve			●	
East Maitland Hills	Urban Newcastle	All		●		
	Open Space	Open Space to west of Lower Hunter Plain			●	
		Lower Hillslope corridor to west of Lower Hunter Plain				●
Sugarloaf Range	Black Hill Spur	All				●

8 Archaeological Sensitivity and Newcastle LEP Zones

Review of the zoning classification of the Newcastle LGA can identify the type and level of present and future development of each environmental area. When assessed against the archaeological sensitivity of each environmental area, potential Aboriginal heritage impacts can be identified. This understanding of potential impacts will enable the management strategies presented in Section 10 to be further refined.

8.1 LEP Zone Identification

The 2003 Newcastle Local Environment Plan (LEP) delineates the Newcastle LGA into a number of zones, and for each zone nominates the zone objectives, development that may be conducted (with or without consent), exempt development and prohibited development. The Newcastle LEP zoning classifications are:

- 1 (a) Rural Residential Zone;
- 2 (a) Residential Zone;
- 2 (b) Urban Core Zone;
- 3 (a) Local Centre Zone;
- 3 (b) District Centre Zone;
- 3 (c) City Centre Zone;
- 3 (d) Mixed Uses Zone;
- 4 (a) Urban Services Zone;
- 4 (b) Port and Industry Zone;
- 4 (c) Steel River Zone;
- 5 (a) Special Uses Zone;
- 5 (b) Special Uses Reservation Zone;
- 6 (a) Open Space and Recreation Zone;
- 7 (a) Conservation Zone;
- 7 (b) Environmental Protection Zone;
- 7 (c) Environmental Investigation Zone; and
- 8 (a) National Parks Zone.

The arrangement of the zoned areas is illustrated in the zoning map attached as Appendix B.

8.2 Environmental Area Analysis

The LEP zones present within each environmental area defined by this study are identified in Table 17 below, which lists them according to archaeological sensitivity ratings outlined in Section 7.

	Environmental Region	Physical Area	LEP Zones																	
			1(a)	2(a)	2(b)	3(a)	3(b)	3(c)	3(d)	4(a)	4(b)	4(c)	5(a)	5(b)	6(a)	7(a)	7(b)	7(c)	8(a)	
Low Archaeological Sensitivity	Lower Hunter Plain	Southern Kooragang Island																		
		Urban Newcastle		●	●	●	●		●	●			●		●	●				
		Coal loading facility and sewerage treatment plant									●									
	Awaba Hills	Urban Newcastle		●	●	●	●	●		●	●	●	●	●	●	●				
		Industrial areas (mine pits)												●					●	
	East Maitland Hills	Urban Newcastle		●	●	●				●				●	●	●	●			
		Road infrastructure in open space												●						
Moderate Archaeological Sensitivity	Lower Hunter Plain	Northern Kooragang Island and Hexham Island												●			●		●	
		Southern estuary shore						●		●	●	●			●					
	Tomago Coastal Plain		●	●	●															
	Awaba Hills	Lower hillslope corridor (eastern)		●										●	●		●	●	●	●
		Open space		●										●	●		●	●	●	●

Table 17: LEP Zoning of Areas of Archaeological Sensitivity

	Environmental Region	Physical Area	LEP Zones																	
			1(a)	2(a)	2(b)	3(a)	3(b)	3(c)	3(d)	4(a)	4(b)	4(c)	5(a)	5(b)	6(a)	7(a)	7(b)	7(c)	8(a)	
High Archaeological Sensitivity	Lower Hunter Plain	Floodplain and wetlands		●	●	●					●		●			●	●	●	●	
	Tomago Coastal Plain	Stockton open space													●					
	Awaba Hills	Glenrock Nature Reserve												●						●
		Blue Gum Hills												●						●
East Maitland Hills	Open space	●								●			●	●			●	●		
Very High Archaeological Sensitivity	Lower Hunter Plain	Hexham boundaries		●									●			●	●	●		
		Other swamp boundaries		●									●			●		●		
	Awaba Hills	Lower hillslope corridor (western)		●									●	●		●	●	●	●	
	East Maitland Hills	Lower hillslope corridor	●										●		●			●		
	Sugarloaf Range	Black Hill Spur	●										●					●		

The areas of low archaeological sensitivity include: southern Kooragang Island; urban Newcastle (Quaternary, Awaba Hills and East Maitland Hills regions), and specific areas of infrastructure (such as collieries, quarries, coal loading facility, sewerage treatment plant and road ways). Almost all zoning categories are found across these areas, excluding 1 (a) Rural Residential Zone; 7 (b) Environmental Protection Zone; and 7 (b) Environmental Protection Zone. Areas assessed to be of low sensitivity are not likely to contain archaeological materials, as landscape modification from human action has been high. However, these broader areas may contain some areas of terrain integrity, where the natural soil profile or natural terrain remains. Future development within these areas would need to consider potential heritage impacts, but it is unlikely that future land development in these areas would be constrained by Aboriginal cultural heritage.

The areas of moderate archaeological sensitivity include: northern Kooragang Island; Hexham Island; southern Hunter estuary shore; Stockton residential area; lower hillslope corridor (eastern); and open space within the Awaba Hills region. Areas assessed to be of moderate archaeological sensitivity may contain surface and/or subsurface archaeological materials, although materials are not likely to occur at high frequencies or densities. In these areas, there has been landscape modification but some areas of natural soil profile or natural terrain are known to remain. Almost all zoning categories are found across these areas, excluding 1 (a) Rural Residential Zone; 3 (b) District Centre Zone; and 3 (d) Mixed Uses Zone. Some areas of moderate archaeological sensitivity – such as northern Kooragang Island, the lower hillslope corridor and open space of the Awaba Hills region – are primarily zoned as open space or as National Park, being zoned 6(a), 7(a), 7(b), 7(c) and 8(a) under the LEP. The zoning emphasis on retaining these areas as open space will increase the likelihood of retaining archaeological deposits intact. However, any development application throughout the remaining areas of moderate sensitivity will need to consider potential Aboriginal heritage impacts.

The areas of high archaeological sensitivity include: floodplain and wetlands of the Lower Hunter Plain, open space of the Stockton Bight, Glenrock Nature Reserve and Blue Gums Hills within the Awaba Hills, and open space in the East Maitland Hills area. These areas are zoned as: 2 (a) Residential Zone; 2 (b) Urban Core Zone; 3 (a) Local Centre Zone; 4 (a) Urban Services Zone; 4 (b) Port and Industry Zone; 5 (a) Special Uses Zone; 6 (a) Open Space and Recreation Zone; 7 (a) Conservation Zone; 7 (b) Environmental Protection Zone; 7 (c) Environmental Investigation Zone; and 8 (a) National Parks Zone. As with areas of moderate sensitivity, there is an increased emphasis on open space and National Park land in these areas, specifically the open space areas and floodplain areas. Areas assessed to be of high archaeological sensitivity are known or likely to contain Aboriginal archaeological sites, as demonstrated by previous archaeological research. In these areas, natural soil profile or natural terrain is evident, and additional Aboriginal archaeological sites are likely to occur. Retention of National Park and open space lands for these areas is likely to retain the known and potential archaeological resource, and potential impacts from development would have to be considered for any Application.

The areas of very high archaeological sensitivity include elevated wetland boundaries throughout the Lower Hunter Plain, the lower hillslope corridor of the Awaba Hills,

East Maitland Hills and Sugarloaf Range, and the Black Hill Spur. These areas are considered to be of very high archaeological sensitivity as previous archaeological investigations have identified a high frequency and density of archaeological materials. Areas of natural soil profile or natural terrain is evident, and the areas are considered likely to contain additional archaeological materials at similar densities. These areas are zoned as follows:

- lower hillslope corridor of the Awaba Hills, East Maitland Hills and Sugarloaf Range: 2 (a) Residential Zone, 5 (a) Special Uses Zone, 5 (b) Special Uses Reservation Zone, 7 (a) Conservation Zone, 7 (b) Environmental Protection Zone, 7 (c) Environmental Investigation Zone and 8 (a) National Parks Zone; and
- Black Hill Spur: 1 (a) Rural Residential Zone, 5 (a) Special Uses Zone, and 7 (c) Environmental Investigation Zone.

A high portion of the lands assessed to be of very high archaeological sensitivity exist as open space, National Park, or are included in an environmental protection or investigation zone. These areas are generally of high terrain integrity, and this high integrity rating is an important element in the assessment of archaeological sensitivity. Although much of the area is retained as open space, future development could be proposed for areas zoned as residential or special use. Any Application made for these areas would require Aboriginal heritage works, and conservation outcomes should be incorporated into future land use planning.

9 Legislative Framework

All Aboriginal archaeological sites are protected by Commonwealth and State statutory controls, as detailed below. All controls need to be considered by Council when determining Development Applications and other heritage works, and the management strategies presented in Section 10 have been developed in accordance with the following statutory controls.

9.1 Commonwealth Legislation

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* is the principal Commonwealth legislation protecting Aboriginal heritage. This Act complements State legislation and is intended to be used only as a 'last resort' where state laws and processes prove to be ineffective. Under this Act the responsible Minister can make temporary or long-term declarations to protect areas and objects of significance under threat of injury or desecration. The Act also encourages heritage protection through mediated negotiation and agreement between land users, developers and Aboriginal people. On 17 December 1998 responsibility for administration of the *Heritage Protection Act* was transferred by Administrative Arrangement Orders from ATSIC to the Environment and Heritage portfolio and the Act is now administered by Environment Australia.

The Burra Charter (ICOMOS Australia 1999) also provides guidance for the conservation and management of places of cultural significance (cultural heritage places). The Charter was adopted by Australia ICOMOS (the Australian National Committee of ICOMOS) in 1979 with recent revisions adopted in 1999. The Charter sets a standard of practice for those who provide advice, make decisions about, or undertake works to places of cultural significance, including owners, managers and custodians.

9.2 State Legislation

The *National Parks and Wildlife Act (1974)* and the *Environmental Planning and Assessment Act (1979)* are the primary statutory controls protecting Aboriginal heritage within New South Wales. Both are discussed below.

National Parks and Wildlife Act (1974)

Under the provisions of the *National Parks and Wildlife Act 1974*, all Aboriginal Objects are protected regardless of their significance or land tenure. Aboriginal Objects are defined as "*any deposit, object or material evidence (not being a handicraft made for sale) relating to Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains*".

Aboriginal objects are therefore limited to physical evidence and may also be referred to as 'Aboriginal sites', 'relics' or 'cultural material'. Aboriginal objects can include pre-contact features such as scarred trees, middens and artefact scatters, as well as physical evidence of post-contact use of the area such as Aboriginal built fencing or stockyards, fringe camps.

The NPW Act also protects Aboriginal Places, which are defined as “*a place that is or was of special significance to Aboriginal culture. It may or may not contain Aboriginal objects*”. Aboriginal Places can only be declared by the Minister administering the NPW Act.

Under Section 91 of the Act, the Department of Environment and Conservation must be informed upon the identification of all Aboriginal Objects. Failure to do this within reasonable time is an offence under the Act.

Under Section 90 of the Act, it is an offence for a person to destroy, deface, damage or desecrate an Aboriginal Object or Aboriginal Place without the prior issue of a Heritage Impact Permit (formerly “Consent to Destroy”). The Act requires a person to take reasonable precautions and due diligence to avoid impacts on Aboriginal objects. Heritage Impact Permits may only be obtained from the Cultural Heritage Unit of the DEC. In considering whether to issue a Section 90 Heritage Impact Permit, DEC will take into account the:

- cultural and archaeological significance of the Aboriginal object(s) or Aboriginal place(s) subject to the proposed impacts;
- effect of the proposed impacts and the mitigation measures proposed;
- alternatives to the proposed impacts;
- conservation outcomes that will be achieved if impact is permitted; and
- outcomes of Aboriginal community consultation regarding the proposed impact and conservation outcomes.

The Act also provides for stop-work orders under Section 91AA if an action is likely to significantly affect an Aboriginal object or Aboriginal Place. The order may require that an action is to cease or that no action is carried out in the vicinity of the Aboriginal object or Aboriginal Place for a period of up to 40 days.

It is also an offence under Section 86 of the NPW Act to disturb or excavate land for the purpose of discovering an Aboriginal object, or to disturb or move an Aboriginal object on any land, without first obtaining a permit under Section 87 of the NPW Act. In issuing a permit under Section 87, DEC will take into account the:

- views of the Aboriginal community about the proposed activity;
- objectives and justification for the proposed activity;
- appropriateness of the methodology to achieve the objectives of the proposed activity; and
- knowledge, skills and experience of the nominated person(s) to adequately undertake the proposed activity.

Environmental Planning and Assessment Act (1979)

The *Environmental Planning and Assessment Act* (EP&A Act) requires that consideration be given to environmental impacts as part of the land use planning process. In NSW, environmental impacts include cultural heritage impacts. Part 3 of the Act relates to planning instruments including those at local and regional levels,

Part 4 of the Act controls development assessment processes and Part 5 of the Act refers to approvals by determining authorities.

Under Part 4 of the Act, approvals by State government agencies can be linked to the development consent process. Development applications that require specified approvals from State agencies are referred to as Integrated Development Approvals (IDA). The Department of Environment and Conservation is an approval body in the IDA process when a development will impact on an Aboriginal object or Aboriginal place, thereby requiring a Heritage Impact Permit pursuant to Section 90 of the NPW Act. Under the IDA process, applicants are required to provide the Department of Environment and Conservation with sufficient information to allow them to provide general terms of approval, prior to the granting of any development consent.

Part 4 also requires that in reaching a decision to grant development consent, a consent authority is to take into consideration the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality. This requires the consent authority to consider the impact on all Aboriginal heritage values, including natural resource uses or landscape features of spiritual importance, as well as the impact on Aboriginal objects and Aboriginal places.

Under the provisions of the EP&A Act, Local Environmental Plans (LEPs) or Regional Environmental Plans (REPs) can be made. Typically LEPs and REPs have provisions that protect items of environmental heritage. The 2003 Newcastle LEP outlines provisions for the conservation of environmental heritage in Part IV of Clause 27. This requires that a heritage assessment accompany development applications to carry out work on a heritage item or within a heritage conservation area, to determine potential impact on heritage significance. Clause 27 authorises Council to require the submission of a Conservation Management Plan (CMP) for development applications to carry out work on heritage items. Clause 31 deals specifically with development affecting places or sites of Aboriginal heritage significance, and is reproduced below in full.

Clause 31: Development affecting places or sites of Aboriginal heritage significance

Before granting consent for development that is likely to have an impact on a place of Aboriginal heritage significance or that will be carried out on an archaeological site of a relic that has Aboriginal heritage significance, the consent authority shall:

- (a) consider a heritage impact statement, which addresses the heritage impact of the proposed development, and
- (b) notify local Aboriginal communities and the Director-General of National Parks and Wildlife of the proposed development and take into consideration any comments received in response within 28 days from the date of notification.

10 Archaeological Management Framework

Management of the known and potential Aboriginal cultural heritage of the Newcastle LGA is crucial in future land use planning. Conservation strategies for Aboriginal objects, places and areas of archaeological or cultural sensitivity are necessary to retain this finite and valuable resource. Management of Aboriginal cultural heritage is also required in the development process to ensure identification of Aboriginal heritage issues, and incorporation of conservation outcomes into land use planning and development.

Developing a framework for identifying and managing Aboriginal cultural heritage values of the Newcastle LGA was a key objective of this study. This section presents the Aboriginal heritage management framework formulated by the study, which provides Council with an overview of the identified Aboriginal heritage values, and outlines a system of principles, strategies and actions to manage the identified Aboriginal heritage values of the Newcastle LGA.

10.1 Aboriginal Cultural Heritage Values of the Newcastle LGA

Aboriginal cultural heritage refers to both the material evidence of Aboriginal occupation (archaeological sites), and intangible expressions of Aboriginal culture (social and cultural values).

Archaeological evidence of Aboriginal occupation is a finite and irreplaceable resource, providing crucial information on past occupation in Australia and providing a link for modern communities to the past. This investigation identified that resources influencing Aboriginal occupation of the region – water, stone, flora and fauna – were found throughout all areas of the LGA. Areas where a wide range of subsistence resources or stone materials occurred, such as the Hunter estuary delta, the Hexham Swamp, the Stockton Bight, and the Black Hill Spur were found to be key locations in Aboriginal occupation of the region. Ethnographic references support the widespread use of the Newcastle LGA by Aboriginal groups, and also indicate the types of material culture to be expected in archaeological sites throughout the region. Despite landscape modification resulting from post-contact urban development, the spatial and stratigraphic impact of that settlement is not adequately understood, and archaeological materials may still be found throughout ‘developed’ landscape areas, including the City Centre.

Archaeological sites are known to occur in all landscape contexts within the Newcastle LGA, and include site types such as open camp sites, middens, axe-grinding grooves, engravings, quarries and bora grounds. The density of site occurrence varies between different landscape contexts, with sites more frequently identified in association with wetlands and watercourses within the Newcastle area. The analysis of archaeological sensitivity identified that additional archaeological sites may occur in all landforms within the region, and that no area should be considered to be archaeologically sterile unless demonstrated so by an archaeological and/or cultural assessment. The level of assessment required to make this determination can vary from consultation with Aboriginal community stakeholders only, to an archaeological investigation (survey, excavation).

Intangible expressions of culture link generations of Aboriginal people over time, and can include places of spiritual, traditional, historical or contemporary cultural significance. These locations do not need to contain material evidence. Areas of Aboriginal social/cultural significance within the Newcastle LGA can only be identified by the Aboriginal community, and throughout this project consultation was undertaken with the Awabakal, Worimi and Mindaribba Local Aboriginal Land Councils to discuss cultural values. No specific areas of cultural significance were documented during the preparation of this report, and further consultation will be required to establish places and issues of social and cultural significance, and how to manage those social and cultural values.

10.2 Management Principles

The following principles form the basis of the Aboriginal heritage management recommendations presented by this study, and address key issues regarding the recognition and management of Aboriginal heritage values.

1. Aboriginal cultural heritage is to be recognised as a finite and valuable resource of the Newcastle LGA.
2. Aboriginal community members are pivotal in the identification, assessment, and management of Aboriginal cultural heritage, as it is primarily Aboriginal people who are in a position to determine the significance of their heritage.
3. Places of Aboriginal cultural value, spanning archaeological sites and areas of social significance, within the Newcastle LGA are to be conserved and managed to retain those cultural values. Appropriate conservation actions will vary according to the level of significance.
4. Aboriginal cultural heritage is to be considered during the development process, to provide for appropriate conservation and impact mitigation outcomes.
5. Compliance with relevant statutory controls is required, specifically the *National Parks and Wildlife Act (1974)* and the *Environmental Planning and Assessment Act (1979)*.
6. Sustainable management strategies for Aboriginal cultural heritage should be implemented, that maximises involvement of the Aboriginal community.
7. The importance of Aboriginal cultural heritage should be promoted within Council through heritage training to raise cultural awareness, and within the broader community through public interpretation programs.

10.3 Management Strategies and Actions

A series of management strategies and actions are recommended by this study in accordance with the management principles outlined above. These fall into the following categories: conservation; impact mitigation; Council and community awareness; research opportunities; and the implementation process.

10.3.1 Conservation

The strategies and actions outlined below are recommended to conserve known Aboriginal archaeological sites, and areas of archaeological and/or cultural sensitivity, within the Newcastle LGA. These strategies recognise that future land use may conflict with conservation of all heritage sites and areas, but stress the incorporation of conservation outcomes into future development.

1. Conservation of Aboriginal heritage sites and areas is the preferred management strategy.
2. Maintenance of Aboriginal heritage sites, areas and objects is necessary to retain their cultural value. Council and Aboriginal community groups are therefore to work together to maintain and conserve known sites and areas.
3. Conservation of areas of high archaeological sensitivity, which are likely to contain *in situ* archaeological sites of significance, is to be considered by Council in future land use planning.
4. Strategic conservation of the Newcastle LGA landscape, to retain a representative sample of the archaeological resource of the region *in situ*, is to be considered by Council in future land use planning.
5. Recognition should be given to the coexistence of cultural (Aboriginal and historic) and natural values in the Newcastle LGA.
6. Promotion of opportunities for public interpretation programs, to enhance the understanding of Aboriginal heritage within the Newcastle LGA. Such programs are to be culturally appropriate, and should be developed in conjunction with Aboriginal community members.
7. Interpretation and/or use of Aboriginal heritage sites and areas is only appropriate where it has minimal impact on cultural heritage values.
8. Consultation with Aboriginal community members is to be continued to increase Council's understanding of areas of social/cultural value within the Newcastle LGA, and consider conservation of these areas in future land use planning.

10.3.2 Impact Mitigation

This Aboriginal Heritage Study identified that archaeological sites may occur in all landform contexts, and accordingly, any future activities or works may impact on Aboriginal heritage sites and areas. In recognition that not all sites/areas of Aboriginal heritage value can be conserved, impact mitigation strategies for managing Aboriginal heritage are outlined below.

1. Potential impacts to Aboriginal heritage sites and areas are to be identified and managed during the development process.

2. Council is to seek advice from Aboriginal community groups (and qualified archaeologists if necessary) regarding potential impacts to Aboriginal heritage sites and areas resulting from individual development proposals, including Council works. This specific advice will supplement the management principles and processes outlined in this Aboriginal Heritage Study for varying areas of archaeological sensitivity.
3. All impact mitigation works to be conducted in accordance with relevant statutory controls and professional guidelines.
4. Council review and update as necessary existing protocols for managing Aboriginal cultural heritage during the development process, specifically the *DA Guide* (Newcastle City Council 2002) and the *Draft Newcastle Development Control Plan* (Newcastle City Council 2004).
5. Where activities or works may impact Aboriginal heritage sites/areas, applicants are to consider potential Aboriginal heritage impacts. This would require an assessment by Aboriginal community groups, and qualified archaeologists where necessary, and may require individual Heritage Impact Assessments to be submitted with Development Applications.
6. Council is to consider guidance provided by the Department of Environment and Conservation - the statutory body for Aboriginal heritage - regarding impacts, and impact mitigation programs to known sites.
7. Incorporation of Aboriginal heritage conservation outcomes within the development process is to be promoted.
8. Consultation with Aboriginal community members is to be continued to increase Council's understanding of areas of social/cultural value within the Newcastle LGA, and determine appropriate impact mitigation strategies for those areas when impacted by activities or works.

10.3.3 Council and Community Awareness

The implementation of the Aboriginal heritage management framework presented by this study will require Council personnel to amend their existing work practices. As such, it is important that Council are made more aware of the Aboriginal heritage values of the Newcastle LGA, and the appropriate management of those values. Public interpretation programs will also increase broader community awareness and appreciation of the Aboriginal cultural values of the Newcastle LGA.

Strategies and actions for the promotion of Council and community awareness of Aboriginal heritage are listed below.

1. The value of Aboriginal heritage sites and areas is to be promoted within Council and the broader Newcastle community.
2. An Aboriginal Heritage Management training package is to be prepared and presented to relevant Council personnel (including Councillors) to increase

awareness of Aboriginal heritage issues and outline appropriate management strategies.

3. Opportunities for public interpretation programs should be actively promoted, in consultation with Aboriginal community groups, to enhance community understanding of the value of Aboriginal heritage sites and areas.

10.3.4 Research Opportunities

This Aboriginal Heritage Study represents the first major study of Aboriginal cultural heritage within the Newcastle LGA. Although a series of archaeological studies have been conducted within the region, they have primarily been commissioned in advance of development projects, and therefore have not aimed to strategically increase our knowledge of Aboriginal cultural heritage within the region. The following strategy is recommended for the future promotion of Council and community awareness of Aboriginal heritage are listed below.

1. Council is to actively seek funding for future Aboriginal heritage research within the Newcastle LGA, both material evidence of Aboriginal occupation (archaeological sites) and intangible expressions of Aboriginal culture (social/cultural values).
2. Aboriginal community groups are to be involved in all stages of future research, and provide key input on areas requiring future research and research strategies.

10.3.5 Implementation Process

Council should aim to adopt and implement the management framework presented by this study within three months of final report submission, and should aim to review the management system within twelve months from formal adoption. This review period is to involve consultation between Council and Aboriginal community stakeholders to identify areas of improvement, or aspects of the framework not adequately implemented. This review is crucial to the effective and ongoing application of the revised Aboriginal cultural heritage management framework.

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Appendix A: Aboriginal Community Consultation Documents

Appendix B: Register of Previous Archaeological Research

Previous Archaeological Research					
	Published Date	Author	Title	Study Type	AHIMS Report #
Lower Hunter Plain Environmental Area	1/1/1981	Brayshaw, H	Archaeological Survey of Proposed Site of Tomago Aluminium Smelter near Hexham	Total Survey	126
	12/1/1982	Mary Dallas Consulting Archaeologists	An Archaeological Survey on Kooragang Island, Newcastle, NSW	Total Survey	246
	5/1/1982	Brayshaw, H	Archaeological Survey at Maryland, near Wallsend	Sample Survey	125
	8/1/1986	Brayshaw, H	Archaeological Survey of the Two Proposed Coal Stockpile Sites at Hexham, NSW	Sample Survey	1001
	10/1/1992	Steele, N	Archaeological Survey, Interim Connection from the F# Freeway, Minmi to Beresfield, NSW	Total Survey	2410
	11/1/1992	Kuskie, P	A Preliminary Assessment of the Proposed Route of Optus Communication Fibre Optic Cable between Beresfield and Coffs Harbour, NSW	Reconnaissance	2426
	1/12/1994	Wilkinson, K	Archaeological Review of the Landcom Development Site 12115, Maryland, Newcastle	Synthetic Review	3149
	10/1/1995	Umwelt	Environmental Impact Statement, Heavy Mineral Sand Mining, "Fullerton" Project		3894
	1/8/1995	Mills, R	Archaeological Assessment of the Proposed Fletcher Subdivision South of Minmi Road, Wallsend	Sample Survey	3316
	1/2/1996	Bonhommie Craib and Associates, and Rosen, S	An Assessment of the Historical and Archaeological Values of BHP Land at Tourle St., Newcastle		98057
	1/1/1997	Everett, C	An Archaeological Survey of a Proposed Subdivision 12a Cardiff Road, Wallsend		4098
	9/1/1997	Umwelt	Archaeological Assessment Results of Test Pit Excavations at the "Fullerton" Site Newcastle Bight NSW		4160
	1/2/1997	McDonald, J	Archaeological Survey of the Maryland to Shortland Rising Main, Hexham Swamp	Total Survey	3765
	2/7/1997	Bonhomme, T	An Archaeological Survey for Aboriginal Sites at Tourle St., Newcastle, NSW		98058
	1/9/1998	Higginbotham, E	Report on the Aboriginal Relics Located During the Archaeological Test Excavation of the Convict Lumberyard and Stockade, Newcastle, NSW		4417
1/7/2001	Dominic Steele Archaeological Consulting	Archaeological Assessment Report – 700 Hunter Street Newcastle, NSW		97432	
1/9/2001	Dominic Steele Archaeological Consulting	ACCOR Ibis Hotel Site – 700 Hunter Street, Newcastle, NSW. Interim Report on Archaeological Test and Salvage Excavations at the Site	Excavation	97569	

Previous Archaeological Research					
Published Date		Author	Title	Study Type	AHIMS Report #
Lower Hunter Plain	1/10/2002	<i>Umwelt</i>	<i>“Fullerton” Project Annual Review: Implementation of the Aboriginal Heritage Management Plan Southern Extension Area</i>	<i>Management/Marketing</i>	98223
	1/10/2002	<i>Umwelt</i>	<i>“Fullerton” Project Aboriginal Heritage Management Plan Central Extension Area</i>	<i>Management/Marketing</i>	98224
	1/7/2003	<i>Mills, R</i>	<i>An Assessment of Indigenous Heritage Items Within the Proposed Northwest Residential Pty Ltd Development Area 290 and 302 Minmi Road, Fletcher near Newcastle</i>	<i>Investigation</i>	98834
Lower Hunter Plain and Awaba Hills Environmental Areas	5/1/1979	<i>Brayshaw, H</i>	<i>Archaeological Survey of the Route of the National Gas Pipeline between Sydney and Newcastle (Plumpton – Kooragang Island)</i>	<i>Total Survey</i>	134
	3/1/1982	<i>Bowdler, S, and Happ, G</i>	<i>An Archaeological Survey of a Proposed Transmission Line Route Between West Wallsend and Tomago, NSW</i>	<i>Total Survey</i>	414
	11/1/1994	<i>Mills, R, and Wilkinson, K</i>	<i>Archaeological Survey of Proposed Upgrade of the Shortland Wastewater Treatment Works</i>	<i>Total Survey</i>	3498
	12/1/1994	<i>Effenberger, S</i>	<i>Archaeological Survey Minmi Rd., Maryland NSW</i>	<i>Sample Survey</i>	3072
	1/6/1995	<i>Stuart, I</i>	<i>A Preliminary Survey of Lot 2, DO 844711 Near Minmi, Hunter Valley, NSW</i>	<i>Reconnaissance</i>	3364
	1/8/1995	<i>Mills, R</i>	<i>Archaeological Assessment of the Proposed Fletcher Subdivision South of Minmi Road, Wallsend</i>	<i>Sample Survey</i>	3316
	1/12/1996	<i>Everett, C</i>	<i>Sub-Surface Archaeological Testing at Lot 2 DP 844711 Near Minmi, Hunter Valley NSW</i>	<i>Excavation</i>	3831
	1/4/1998	<i>Central West Archaeological and Heritage Services</i>	<i>An Archaeological Survey of the Proposed Minmi Sewerage Rising Main between Shortland Sewerage Treatment Works and Minmi in the Hunter Valley</i>		4297
	1/4/1998	<i>Mills R</i>	<i>Am Assessment of Stone Material Recovered from Archaeological Test Excavation at Nikkinba Residential Subdivision, Wentworth Creek, Near Minmi in the Hunter Valley</i>	<i>Investigation</i>	98204
	1/5/1998	<i>Mills, R</i>	<i>Report on Sub-Surface Archaeological Testing Program at Nikkinba Ridge Minmi Road, Minmi</i>		4272
	1/9/2000	<i>Bessant, A</i>	<i>Blue Gum Hills: Stage One Test Excavation Interim Report: Preliminary Identification of Constraints</i>	<i>Excavation</i>	97612
	1/7/2003	<i>Mills Archaeological and Heritage Services Pty Ltd</i>	<i>An Assessment of Indigenous Heritage Items Within the Proposed Northwest Residential Pty Ltd Development Area 290 and 302 Minmi Road, Fletcher near Newcastle</i>	<i>Investigation</i>	98834

Previous Archaeological Research					
	Published Date	Author	Title	Study Type	AHIMS Report #
Awaba Hills Environmental Area	8/1/1972	<i>Dyall, L K</i>	<i>Aboriginal Occupation in the Dudley-Jewell's Swamp Area</i>	<i>Literature Survey</i>	303
	5/1/1981	<i>Lough, J C</i>	<i>Archaeological Survey of Freeway No. 3, Wallarah Creek to Wallsend</i>	<i>Total Survey</i>	543
	12/1/1981	<i>Bickford, A</i>	<i>An Archaeological Survey at Hillsborough, West of Newcastle</i>	<i>Total Survey</i>	78
	10/1/1981	<i>Brayshaw, H</i>	<i>Archaeological Survey of Wallsend Borehole Colliery Extension</i>	<i>Total Survey</i>	99
	6/1/1983	<i>Greer, S, and Brayshaw H</i>	<i>An Archaeological Survey of a Proposed Quarry Site Near Minmi, NSW</i>	<i>Total Survey</i>	351
	7/1/1983	<i>Brayshaw, H</i>	<i>Archaeological Survey at Rankin Park Hospital, Newcastle, NSW</i>	<i>Sample Survey</i>	114
	9/1/1984	<i>Brayshaw, H</i>	<i>State Highway No 23 – Archaeological Investigation at Lambton Heights, NSW</i>	<i>Literature Survey</i>	774
	3/1/1985	<i>Brayshaw, H</i>	<i>Archaeological Survey at Lambton, Newcastle, NSW</i>	<i>Sample Survey</i>	978
	3/1/1985	<i>Brayshaw, H</i>	<i>Archaeological Survey at Lambton, Newcastle, NSW</i>	<i>Sample Survey</i>	978
	10/1/1985	<i>Brayshaw, H</i>	<i>Archaeological Survey, State Highway No. 23 – West Charlestown Bypass</i>	<i>Total Survey</i>	941
	3/1/1986	<i>Brayshaw, H</i>	<i>Archaeological Survey – Proposed National Highway Wakefield to Minmi Road, West of Newcastle, NSW</i>	<i>Sample Survey</i>	1022
	4/1/1986	<i>Donlon, D, and Brayshaw, H</i>	<i>Archaeological Survey – F3 Freeway Proposed Link Road between Estelville to Wallsend, NSW</i>	<i>Sample Survey</i>	1221
	8/1/1986	<i>Brayshaw, H, Donlon, D, and Smith, L-J</i>	<i>Archaeological Survey – Proposed F3 Route between Wakefield and Minmi Road, West of Newcastle, NSW</i>	<i>Sample Survey</i>	607
	8/1/1988	<i>Mary Dallas Consulting Archaeologists</i>	<i>Archaeological Survey of the Proposed Minmi Sewerage Treatment Works Site at Minmi, NSW</i>	<i>Sample Survey</i>	1422
	10/1/1988	<i>Dean-Jones, P</i>	<i>Report of an Archaeological Survey of Two Potential Areas for Extension of Garbage Disposal Facilities at Redhead</i>	<i>Total Survey</i>	1507
	12/1/1990	<i>Mary Dallas Consulting Archaeologists Navin, K</i>	<i>Archaeological Survey of Development Sites on Crown Land at Bennetts Green, Gateshead and Redhead</i>	<i>Total Survey</i>	1944
3/1/1991	<i>Dean-Jones, P</i>	<i>Archaeological Survey of Lot 1, D.P. 42613 Cowlshaw Street, Redhead</i>	<i>Total Survey</i>	2064	
3/1/1991	<i>Dean-Jones, P</i>	<i>Preliminary Archaeological Assessment of Jennifer Street, Charlestown</i>		2068	

Previous Archaeological Research					
	Published Date	Author	Title	Study Type	AHIMS Report #
Awaba Hills Environmental Area	1/6/1992	<i>Barber, M</i>	<i>Archaeological Survey of the Proposed Dudley / Charlestown Sewerage Amplification Scheme, Glenrock SRA, Newcastle</i>	<i>Total Survey</i>	2334
	2/1/1993	<i>Steel, N</i>	<i>Archaeological Survey, Northlakes Urban Release Area, Edgeworth / Wallsend, NSW</i>	<i>Sample Survey</i>	2561
	6/1/1993	<i>Oakley, B</i>	<i>Archaeological Assessment for OPTUS Route Survey: West Wallsend to New Lambton</i>	<i>Sample Survey</i>	2667
	7/1/1993	<i>Ruig, J</i>	<i>An Archaeological Assessment of the Proposed Development at "The Park", Kallorea Rd, Redhead, NSW</i>	<i>Sample Survey</i>	2610
	5/1/1994	<i>Mills, R; Wilkinson, K</i>	<i>Archaeological Survey of Proposed Residential Development Site, Apollo Road, Charlestown</i>	<i>Total Survey</i>	2870
	3/1/1995	<i>Silcox, R</i>	<i>Archaeological Survey of Land Proposed for Rezoning, Garden Suburb, Newcastle, NSW (38-4-0343)</i>	<i>Total Survey</i>	3101
	1/4/1995	<i>Silcox, R</i>	<i>Archaeological Survey of a Proposed Extension to an Asbestos Disposal Area, Eraring Power Station, Newcastle, NSW</i>	<i>Sample Survey</i>	3166
	1/1/1996	<i>Effenberger, S</i>	<i>Archaeological Survey and Assessment, Construction of the West Wallsend Sewage Transportation Scheme</i>	<i>Sample Survey</i>	3464
	1/3/1996	<i>Mills, R</i>	<i>Archaeological Assessment of the Proposed Low Density Residential Subdivision North of Link Road, Wallsend</i>	<i>Sample Survey</i>	3556
	1/10/1996	<i>Effenberger, S</i>	<i>Aboriginal Assessment and Survey Spatial Sampling, West Charlestown Bypass</i>	<i>Sample Survey</i>	3836
	1/1/1997	<i>Everett, C</i>	<i>An Archaeological Survey of a Proposed Subdivision at 12a Cardiff Road, Wallsend</i>		4098
	3/1/1997	<i>Silcox, R</i>	<i>Archaeological Assessment for a Proposed Integrated Waste Management Facility, Gateshead</i>		4100
	26/3/1997	<i>Everett, C</i>	<i>An Archaeological Survey of the Proposed Windale Rising Main, Jewells Swamp, Jewells NSW</i>		3851
	1/4/1999	<i>Mills, R</i>	<i>An Aboriginal Heritage Study of a Proposed Northlakes Residential Development at Cameron Park, near Newcastle, NSW</i>	<i>Investigation</i>	4448
	1/5/2000	<i>Mills, R</i>	<i>Summery Report of the Indigenous Heritage Assessment of the Proposed Residential Development at Jubilee Road Elernmore Vale, Newcastle</i>	<i>Sample Survey</i>	97545
	1/7/2000	<i>Umwelt</i>	<i>Archaeological Survey of Proposed New Access Road to John Hunter Hospital, Newcastle</i>		97703
1/9/2000	<i>Brayshaw, H</i>	<i>Land at Link Road, Elernmore Vale, West of Newcastle, Archaeological Survey for Aboriginal Sites</i>		97766	

Previous Archaeological Research					
	Published Date	Author	Title	Study Type	AHIMS Report #
Awaba Hills Environmental Area	1/10/2000	Mills, R	<i>An Aboriginal Heritage Study of a Proposed Northlakes Residential Development at George Booth Drive Newcastle</i>		4708
	3/4/2001	Roberts, L	<i>Archaeological Assessment Lots 1 and 2, Lawson Road Macquarie Hills – Report to Harper Somers Pty Ltd Newcastle NSW</i>		98458
	23/8/2001	Roberts, L	<i>Archaeological Assessment Lot 3 Lawson Road Macquarie Hills – Report to Harper Somers Pty Ltd Newcastle NSW</i>		98459
	1/8/2002	Umwelt	<i>Archaeological Survey of Revised Route for the Proposed New Access Road to John Hunter Hospital, Newcastle, NSW</i>	Investigation	98207
	29/10/2002	AMBS	<i>Archaeological Assessment of Lot 101 DP 1037972 Bruncker Road, Adamstown, NSW</i>	Investigation	98300
	1/11/2002	ERM Thornton	<i>Intersection of Lookout Road and McCaffrey Drive, New Lambton: Indigenous Cultural Heritage Assessment</i>	Investigation	98304
	1/1/2003	Worth, S	<i>Archaeological Test Excavation over Land Proposed for a Residential Subdivision Development at Part Lot 101 DP 103797 Bruncker Road, Adamstown, NSW</i>		98543
Tomago Coastal Plain Environmental Area	2/1/1980	Sullivan, M.E.	<i>Stockton Bight: Investigation of Archaeological Site</i>	Investigation	703
	3/1/1982	Bowdler, S; Happ, G	<i>An Archaeological Survey of a Proposed Transmission Line Route Between West Wallsend and Tomago, NSW</i>	Total Survey	414
	12/1/1982	Brayshaw, H	<i>Archaeological Survey of Proposed Facility Extensions at Williamtown RAAF Base, North of Newcastle</i>	Sample Survey	127
	2/1/1987	Byrne, D	<i>Survey for Aboriginal Archaeological Sites along the route of a Proposed 132 kV Transmission Line at Newcastle Bight, NSW</i>	Total Survey	1246
	9/1/1987	Koettig, M	<i>Preliminary Assessment of Aboriginal Archaeological Sites in the Proposed Sand Extraction Location at Nelson Bay Road Newcastle Bight: DP 530095, NSW</i>	Management/ Marketing	1269
	12/1/1988	Smith, L-J	<i>Archaeological Survey of the Tomago to Karuah Section</i>	Total Survey	1339
	7/1/1990	Dean-Jones, P	<i>Newcastle Bight Aboriginal Sites Study</i>	Sample Survey	1845
	4/1/1992	Barber, M	<i>Fern Bay Sand Resource Potential Constraints and Strategy for Development; Archaeological Survey</i>	Sample Survey	2250
	9/1/1992	Dean-Jones, P	<i>Archaeological Survey at Fern Bay, Lot 4 DP 233358; Lot 22 DP 593626</i>	Total Survey	2479
	11/1/1992	Barber, M	<i>Investigation of Archaeological Site at ML 1070 and 1078, Moffats Dune, Newcastle Bight</i>		2411

Previous Archaeological Research					
	Published Date	Author	Title	Study Type	AHIMS Report #
Tomago Coastal Plain Environmental Area	1/1/1993	<i>Evans, S-L</i>	<i>Human Skeletal Remains Salt Ash, Stockton Beach</i>	<i>Special Investigation</i>	2677
	12/1/1993	<i>Giles Hamm Archaeology</i>	<i>An Archaeological Assessment of Optic Fibre Route from Stockton to Williamtown</i>	<i>Sample Survey</i>	2782
	1/1/1994	<i>Byrne, D</i>	<i>Archaeological Survey of the Route of the MR108 Nelsons Bay, Newcastle Bight</i>	<i>Sample Survey</i>	3129
	1/1/1994	<i>Curran, N</i>	<i>Archaeological Survey of Part of Lot 16, DP 258848 Fern Bay, NSW</i>	<i>Sample Survey</i>	2818
	1/1/1994	<i>Curran, N</i>	<i>Archaeological Survey of Part of Lot 16, DP 258848 Fern Bay, NSW</i>	<i>Sample Survey</i>	2958
	6/1/1994	<i>Crew, D</i>	<i>Archaeological Survey Lemon Tree Passage Rock Quarry, North of Newcastle, NSW</i>	<i>Total Survey</i>	3030
	7/1/1994	<i>Baker, N</i>	<i>Moffats Swamp Dune – A Story of Life in the Newcastle Bight 17,000 yrs Ago</i>	<i>Excavation</i>	3103
	1/6/1994	<i>Crew, D</i>	<i>Archaeological Survey Lemon Tree Passage Rock Quarry, North of Newcastle, NSW</i>	<i>Sample Survey</i>	3150
	1/6/1994	<i>Sullivan, M</i>	<i>Newcastle Bight Archaeological Management Plan</i>	<i>Management/Marketing</i>	3205
	1/6/1996	<i>Effenberger, S</i>	<i>Archaeological Monitoring Report, Mineral Sand Mining Lease, Tomago near Masonite Rd, Port Stephens</i>	<i>Other</i>	3572
	1/10/1997	<i>Brayshaw, H</i>	<i>Proposed Rezoning Application Cabbage Tree Road, Williamtown, NSW; Archaeological Survey for Aboriginal Sites</i>		97765
	11/1/1997	<i>Brayshaw, H</i>	<i>Proposed Rezoning Application, Cabbage Tree Road, Williamtown, NSW</i>	<i>Sample Survey</i>	4176
	9/1/1997	<i>Umwelt</i>	<i>Archaeological Assessment Results of Test Pit Excavations at the “Fullerton” Site Newcastle Bight NSW</i>		
	1/4/2000	<i>Umwelt</i>	<i>Mineral Deposits (Operations) Pty Ltd Archaeological Assessment of a Proposed Mineral Sandmine at Stockton Bight</i>		97841
	29/4/2002	<i>Myall Coast Archaeological Services</i>	<i>Archaeological Constraints Study ‘Bayway Village’, Nelson Bay Road, Fern Bay</i>	<i>Other</i>	98301
	1/12/2002	<i>Umwelt</i>	<i>Archaeological Survey for Aboriginal Sites at Duckhole Hill, Williamtown RAAF Base, NSW</i>	<i>Investigation</i>	98319
	1/2/2003	<i>ERM</i>	<i>Electricity Supply Upgrade from Tomago to Tomaree: Indigenous Cultural Heritage Assessment: Environment Statement</i>	<i>Investigation</i>	98386
1/2/2003	<i>ERM</i>	<i>Electricity Supply Access Road – Tomago to Salt Ash: Indigenous Cultural Heritage Assessment: Review of Environmental Factors</i>	<i>Investigation</i>	98387	

Previous Archaeological Research					
	Published Date	Author	Title	Study Type	AHIMS Report #
	1/8/2003	<i>Umwelt; McAdam, L</i>	<i>Aboriginal Archaeology Survey and Assessment of Part Lot 5, Stockton Rifle Range, Fern Bay</i>	<i>Investigation</i>	98719
East Maitland Hills	1/3/1995	<i>Silcox, R, and Ruig, J</i>	<i>Test Excavations on a Rural Residential Estate at Black Hill, Tarro, NSW</i>	<i>Excavation</i>	3152
	1/11/1995	<i>Effenberger, S</i>	<i>Archaeological Monitoring National Highway Interim Connections: Construction Between Stockrington Road and Beresfield, Cessnock LGA</i>	<i>Total Survey</i>	3311
	7/1/1996	<i>Peake, T</i>	<i>Flora, Fauna and Archaeology Survey for Lot 422 DP 791776 No 21A Forsythe Parade Black Hill NSW</i>		4139
	1/7/1996	<i>Curran, N</i>	<i>Archaeological Test Excavation, Proposed Holmwood Industrial Development, Beresfield South</i>	<i>Excavation</i>	3589
East Maitland Hills Environmental Area	11/1/1997	<i>Kuskie, P</i>	<i>An Aboriginal Archaeological Assessment of a Newcastle City Council Property at the Corner of Lenaghans Drive and John Renshaw Drive, Beresfield, Lowe</i>		4211
	1/7/1998	<i>Silcox, R</i>	<i>Archaeological Assessment for a Proposed Industrial Estate, Weakleys Drive, Beresfield, NSW</i>	<i>Sample Survey</i>	4320
	1/6/1998	<i>Silcox, R</i>	<i>Archaeological Assessment for a Proposed Industrial Estate, Weakleys Drive, Beresfield, NSW</i>	<i>Investigation</i>	4444
	1/7/1999	<i>Silcox, R</i>	<i>Test Excavations for a Proposed Industrial Estate, Weakleys Flat, Beresfield, NSW</i>	<i>Excavation</i>	4630
	1/7/1999	<i>Silcox, R</i>	<i>Test Excavations for a Proposed Industrial Estate, Weakleys Flat, Beresfield</i>		4647 97795
	1/9/2001	<i>Umwelt</i>	<i>Aboriginal Archaeological Assessment and Subsurface Investigation of the Proposed Freeway Industrial Estate at South Beresfield, NSW</i>	<i>Excavation</i>	97572
	1/3/2002	<i>Umwelt</i>	<i>Aboriginal Sites Management Plan, Year 2: Donaldson Open Cut Coal Mine, Beresfield Near Newcastle</i>	<i>Management/Marketing</i>	98225
	1/11/2002	<i>Umwelt</i>	<i>Aboriginal Sites Management Plan, Year 3: Donaldson Open Cut Coal Mine, Beresfield, near Newcastle</i>	<i>Site Management</i>	98780
	1/1/2003	<i>Umwelt</i>	<i>Report of a Supplementary Archaeological Study of the Mine Impact Area: Donaldson Open Cut Mine, Beresfield, near Newcastle</i>	<i>Investigation</i>	98344
	1/3/2003	<i>Worth, S</i>	<i>Aboriginal Heritage Assessment over Land Proposed for a Sub-Transmission Substation at Weakleys Drive, Beresfield, NSW</i>	<i>Investigation</i>	98724

Previous Archaeological Research					
	Published Date	Author	Title	Study Type	AHIMS Report #
Sugarloaf Range Environmental Area	11/1/1993	<i>Ruig, J</i>	<i>Report of an Archaeological Survey of the Proposed Extensions to the Black Hill Gravel Quarry, Black Hill, NSW</i>	<i>Total Survey</i>	2746
	3/1/1996	<i>Effenberger, S, and Baker, N</i>	<i>Archaeological Test Excavations and Significance Assessment F3 Freeway, Black Hill NSW</i>	<i>Excavation</i>	3496
	1/10/1998	<i>Silcox, R</i>	<i>Archaeological Assessment for Proposed Rezoning of Lot 1, DP 811514 Blackhill Road, Black Hill</i>	<i>Investigation</i>	4457
	1/10/1998	<i>Silcox, R</i>	<i>Archaeological Assessment for Proposed Rezoning of Lot 101, Lenaghans Drive, Black Hill</i>		97693
	1/11/1999	<i>Kuskie, P</i>	<i>Management Plan, Aboriginal Heritage Site at Woods Gully, along the F3 Freeway near Black Hill, Beresfield</i>	<i>Management/Marketing</i>	4642
	1/11/1999	<i>Kuskie, P</i>	<i>Aboriginal Heritage Site at Woods Gully, along the F3 Freeway near Black Hill, Beresfield</i>		97390
	1/1/2000	<i>Kamminga, J, and Kuskie, P</i>	<i>Salvage of Aboriginal Archaeological Sites in Relation to the F3 Freeway near Lenaghans Drive, Black Hill, New South Wales. Volume A: Report</i>		97844
	1/1/2000	<i>Kamminga, J, and Kuskie, P</i>	<i>Salvage of Aboriginal Archaeological Sites in Relation to the F3 Freeway, near Lenaghans Drive, Black Hill, NSW. Volume B: Figures, Tables, Plates and Appendices</i>		98018
	1/1/2000	<i>Kamminga, J, and Kuskie, P</i>	<i>Salvage of Aboriginal Archaeological Sites in Relation to the F3 Freeway, near Lenaghans Drive, Black Hill, NSW. Volume C: Lithic Item Databases</i>		98018
	1/1/2000	<i>Kamminga, J, and Kuskie, P</i>	<i>Salvage of Aboriginal Archaeological Sites in Relation to the F3 Freeway near Lenaghans Drive, Black Hill, NSW</i>		97845
	1/1/2000	<i>Kuskie, P</i>	<i>Salvage of Aboriginal Sites at Black Hill</i>		97646
	1/10/2002	<i>Kuskie, P</i>	<i>An Aboriginal Archaeological Assessment of Lot 2 DP 873320, Black Hill, Lower Hunter Valley, New South Wales</i>	<i>Investigation</i>	98227
All Areas	8/1/1982	<i>Bowdler, S; Gollan, K</i>	<i>An Archaeological Survey of a Proposed Transmission Line Route Between Tomago and Eraring via Newcastle, in the Lower Hunter Region of NSW</i>	<i>Total Survey</i>	90

Previous Archaeological Research					
Published Date		Author	Title	Study Type	AHIMS Report #
Area Unknown	12/1/1972	<i>Buchan, R.A.</i>	<i>Report on the Situation Regarding Aboriginal Relics and the Pipeline Route from Sydney to Newcastle</i>	<i>Synthetic Review</i>	<i>1303</i>
	3/1/1973	<i>Sim, I.M.</i>	<i>Archaeological Survey of the Natural Gas Pipeline Route Sydney to Newcastle: Progress Reports 1-4</i>	<i>Total Survey</i>	<i>659</i>
	8/4/1975	<i>Dyall, L.K.</i>	<i>Report on Aboriginal Sites near Newcastle</i>	<i>Investigation</i>	<i>315</i>
	1/1/1994	<i>Officer, K, and Navin, K</i>	<i>Preliminary Cultural Heritage Overview OPTUS Link from Sydney to Newcastle and Orange</i>	<i>Literature Survey</i>	<i>2862</i>

Appendix C: Glossary

TERM	DEFINITION
Archaeological Site	A location where physical evidence from past human activities and events survives in or on the land, ie, stone artefacts, shells, engraved images or grooves. Archaeologists classify sites according to their contents, form or function and sometimes location. Defining archaeological site boundaries may vary with the archaeological and geographic context.
Archaeological Sensitivity	The likelihood of archaeological materials occurring within a location. Sensitivity is assessed using current understanding of archaeological site distribution patterns in landscape areas, and terrain integrity of landscape areas.
Artefact	Any object or feature created or modified by humans. The term “stone artefacts” includes the pieces used as tools as well as waste product (debitage) from manufacture.
Axe Grinding Grooves	Grooves are located on flat rock exposures close to a stream or rock hole. They vary in size but are generally long (30-40cm in length) and elliptical in shape. Stone axes were ground into the softer stone allowing a working edge to be created or sharpened. Narrower grooves may have been used to work spears or other thin implements.
BP	“Before Present”. Term used with radiocarbon and radiometric dating of archaeological sites, meaning the number of years before present, or actually before 1950.
Burials	Burials are seen as part of continuing culture and tradition, as well of offering valuable archaeological information. The dead were sometimes cremated, sometimes placed in trees or rock ledges, and sometimes buried. Burials exist throughout New South Wales, and can be uncovered in construction work or become exposed through erosion.
Campsite	Locations at which people slept overnight and carried out a number of activities, including making equipment, and processing and eating of food. Also referred to as habitation or occupation sites. They are identified archaeologically by deposits containing cultural materials such as stone artefacts, shells, animal bones, etc. They occur in rockshelters as well as in open locations.
Carved and Scarred Trees	Tree bark was used for constructing canoes, shelters, coolamons and shields. Distinctive scars are left from bark removal and can usually be differentiated from natural scars. Carved trees are more distinctive exhibiting patterns cut into the bark or wood of a tree. Scarred trees can occur throughout the state, whilst carved trees are more restricted to the east coast, although clearing and forestry practices have greatly reduced numbers.

TERM	DEFINITION
Ceremonial Grounds	These sites were used for initiation ceremonies, marriages, tribal meetings and other important functions and are of great significance to Aboriginal people. Bora rings, which have one or more raised earth rings, were used for male initiation ceremonies.
Core	A piece of stone off which flakes have been intentionally struck in order to be used as stone tools. A core must have one or more negative or bulbar flake scars, being the concave surface left after a flake has been removed.
Deflation Basin	The low-lying area between the frontal dune and a transgressive dune field, where aeolian erosion has removed sand deposits down to the level of the water table.
Flake	A piece of stone detached from the core by striking. Flakes are identified by the presence of diagnostic features such as a striking platform, impact point, ringcrack, bulb of percussion and ventral surface. Broken flakes can also be identified through diagnostic features.
Heritage Assessment	A process to determine the nature and significance of heritage within an area, and can cover Aboriginal and Colonial History.
Holocene	A geological time-scale period lasting from 10,000 years ago to present. It is the last period in the Quaternary, which comprises the Pleistocene (glacial) and Holocene (post-glacial).
In Situ	Undisturbed. In the context of this report it refers to Archaeological materials in their original position.
Isolated Find	An item or object found in isolation, being a sufficient distance away from other archaeological materials that it is not considered part of another site.
Material Culture	The physical or material objects produced by a society. May include tools, shelter, clothing, canoes, weapons and rock art.
Midden	Archaeological deposits in which shells are the dominant visible cultural items, which are principally the remains of past meals. Some midden sites contain a range of cultural material such as shellfish, stone artefacts, fish and animal bones, ochre, and charcoal. Human burials have also been found in many midden contexts. Middens are mainly located in close proximity to marine or estuarine shorelines.
Motif	A form or figure which has a particular arrangement of components, and which is repeatedly drawn, painted or engraved.
Open Camp Sites	These sites are mostly surface and associated subsurface scatters of stone artefacts, sometimes associated with fireplaces. They exist throughout the landscape and are the most common site type. While found in all environmental contexts, larger and denser sites tend to be found on river banks and lower slopes facing

TERM	DEFINITION
	watercourses, as well as ridgelines and other areas that offer movement routes.
Pleistocene	A geological time-scale period. The last period of the Quaternary, lasting from about 2 million years ago to 10,000 years ago. This period is divided into the Early, Middle and Late Pleistocene.
Post-Contact Sites	Locations that were occupied or used by Aboriginal people after British colonists arrived in 1788, or are associated with events after that date. May include places like reserves, missions, cemeteries, places of battles and massacres. They are often identified only by the presence of European objects or through written or oral histories.
Quarry	Quarry sites usually occur wherever there are outcrops of other sources of siliceous or igneous rock. Stone material was used in creating stone tools that in turn were used to work wood and provide people with tools to assist in hunting and gathering activities. Siliceous rock is easily flaked and made useful cutting and scraping tools, where igneous rock was preferred for edge-ground tools, particularly axes.
Raw Material	Natural materials such as stone, bone, shell and plant materials from which items of material culture are made.
Rock Engravings	These sites usually occur where there is a suitable exposure of fairly flat rock or overhangs, usually sandstone. In the greater Sydney and southern Hunter Valley region the outlines of motifs were made by hitting the rock surface with a sharp stone to make small holes or pits. Sometimes the pits were joined to form a groove, by rubbing with a stone. People, animal shapes and tracks are common motifs, as well as non-figurative designs such as circles.
Rock Paintings	Aboriginal paintings are found on the ceilings and walls of rockshelters which occur wherever suitable rock surfaces and outcrops exist. Figures include humans, kangaroos, emus, echidnas, grid patterns, animal tracks, boomerangs, axes, hand stencils, hand stencils and other motifs. Paintings are made with white, red, yellow and black pigments. The motifs may be drawn, painted or stencilled, and charcoal drawings are common as well.
Rock Shelters with Archaeological Deposits	In outcrops of rock such as sandstone and granite, overhangs sometimes form creating useable shelters. Sediments from fires, roof fall, discarded stone tools and food remains form a deposit protected within the shelter.
Shell Midden	See Midden
Transgressive Dune	A dune that has moved landward by reworking and/or burying

TERM	DEFINITION
	older sand deposits. The dune trangresses over existing dune surfaces, or over bedrock surfaces.
Waste Products	Flakes and flaked pieces produced during the knapping process, and which appear to be unused due to absence of retouch and use wear. Also referred to asdebitage and debris.